NMED/DOE/AIP-96/5

Surface Water Quality Monitoring at Department of Energy Facilities in New Mexico

1992 -- 1993

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EXECUTIVE SUMMARY

The primary purpose of this report is to present data compiled by AIP staff during 1992 and 1993. Limited interpretation of data is presented in this report. Water and sediment samples collected at the DOE facilities were either replicate or split with samples that were collected by the operations and management contractor of the specific facility.

Statistical analysis, comparing 1992 NMED and Santa Fe Engineering (contractor for LANL) analytical results, indicate a high degree of similarity. With the exception of one stormwater sampling event (LA 4.1 - 930803), similar results were obtained when 1993 NMED and LANL results were compared. Differences in handling and storage, analytical techniques, and the fact that the samples were replicates not split samples, makes direct comparisons of this single sample's (LA 4.1 - 930803) analytical results difficult.

The authors recommend that the sampling, processing and analytical techniques used by both NMED and DOE or its contractors be standardized. The DOE Oversight Bureau has implemented a process for stormwater analysis that quantifies the concentration of contaminants both in the dissolved phase and the suspended sediment load. By incorporating flow measurements and inexpensive total suspended solids (TSS) analysis, an accurate estimate of contaminant transport as a result of stormwater runoff can be obtained. This data would be invaluable for the prioritization of clean-up, corrective action effectiveness, environmental risk assessment, total maximum daily load calculation and compliance demonstration.

The detection of radionuclides and heavy metals in the above stormwater sample addresses one of NMED's concerns. NMED is concerned that heavy metals, radionuclides, and some organics (e.g. PCBs) are adsorbed or bound to sediments and transported past DOE facility boundaries during spring snowmelt and summer storm events. Transport of radionuclides in summer run-off (Purtymun, 1974), distribution of radionuclides in channel sediments of canyon effluent areas (Purtymun 1966 and 1971, Hakonson 1976B, Miera 1976, Nyhan 1980), and transport of plutonium in snowmelt run-off (Purtymun, Peters & Maes 1990) has been well documented.

The authors feel that increased stormwater monitoring would be appropriate. Stormwater monitoring should be initiated in canyons which have received effluent discharges, are contaminated from other DOE facility operations and/or historically have discharged off DOE property. Contaminant transport studies should be initiated and mitigation measures may need to be considered to prevent the movement of contaminants beyond DOE facility boundaries.

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1.0 INTRODUCTION

In October 1990, an Agreement-in-Principle (AIP) was entered into between the U.S. Department of Energy (DOE) and the State of New Mexico for the purpose of supporting State oversight activities at DOE facilities in New Mexico. The New Mexico Environment Department (NMED) is the State's lead agency for the Agreement. The DOE has agreed to provide New Mexico with resources to support State activities in environmental oversight, monitoring, and to ensure compliance with applicable federal, state, and local laws at Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL) the Inhalation Toxicology Research Institute (ITRI) and the Waste Isolation Pilot Plant (WIPP), The Agreement is designed to assure the citizens of New Mexico that public health, safety, and the environment are being protected through existing programs.

2.0 PROGRAM ORGANIZATION

The Department of Energy Oversight Bureau, under the Water/Waste Management division of the New Mexico Environment Department, is tasked with assessing and monitoring DOE and DOE subcontractor compliance with state and federal environmental regulations. Additionally, staff members augment the current regulatory and environmental protection activities being conducted by NMED at the four DOE facilities. DOE Oversight Bureau personnel are located on-site at all DOE facilities and at a central office located in Santa Fe, NM. Figure 2.0.1 illustrates the organizational and hierarchical relationships of staff members working in the Agreement in Principal Program.

Other bureaus within the NMED work in coordination with DOE Oversight Bureau personnel in order to adequately address all environmental issues at the four DOE facilities. The Ground Water Protection and Remediation Bureau (GWPRB), Hazardous and Radioactive Materials Bureau (HRMB), and Surface Water Quality Bureau (SWQB), all have concerns with water quality. The GWPRB is concerned with any discharges that may infiltrate into the ground and have the potential to impact ground water. The HRMB is concerned with the discharge of any hazardous contaminant into the environment and also oversees the Resource Conservation and Recovery Act (RCRA) regulations at the facilities. The SWQB monitors surface water quality for impacts from discharges, stormwater runoff, snowmelt, and spills. The Air Quality Bureau and Air pollution Bureau are concerned with all air quality issues associated with the facilities. DOE Oversight Bureau personnel have established a monitoring program to gather and analyze data on the quality of waters in the lakes, rivers, springs, and streams that may be impacted by DOE facilities in New Mexico. This program enables NMED to assess DOE's compliance with applicable environmental laws and regulations at each facility. This report is a compilation of water-quality data collected in 1992 and 1993 by NMED/DOE Oversight Bureau personnel.

The following types of data and methods are included:

1. Collection and analysis of samples taken during snowmelt and stormwater runoff events at LANL.

2. Collection and analysis of samples taken from springs located in or near DOE facilities.

3. Collection and analysis of samples taken from National Pollutant Discharge Elimination System (NPDES) permitted outfalls at LANL.

4. Collection and identification of macroinvertebrates in springs and perennial reaches in streams surrounding and within LANL.

5. Collection and analysis of samples taken from SNL sanitary waste discharge.

6. Collection and analysis of samples taken from the WIPP waste-water effluent pond.

3.0 OBJECTIVES OF NMED/DOE OVERSIGHT AND MONITORING PROGRAM

The NMED/DOE Oversight and Monitoring Program is designed to meet the criteria of the AIP through the following objectives:

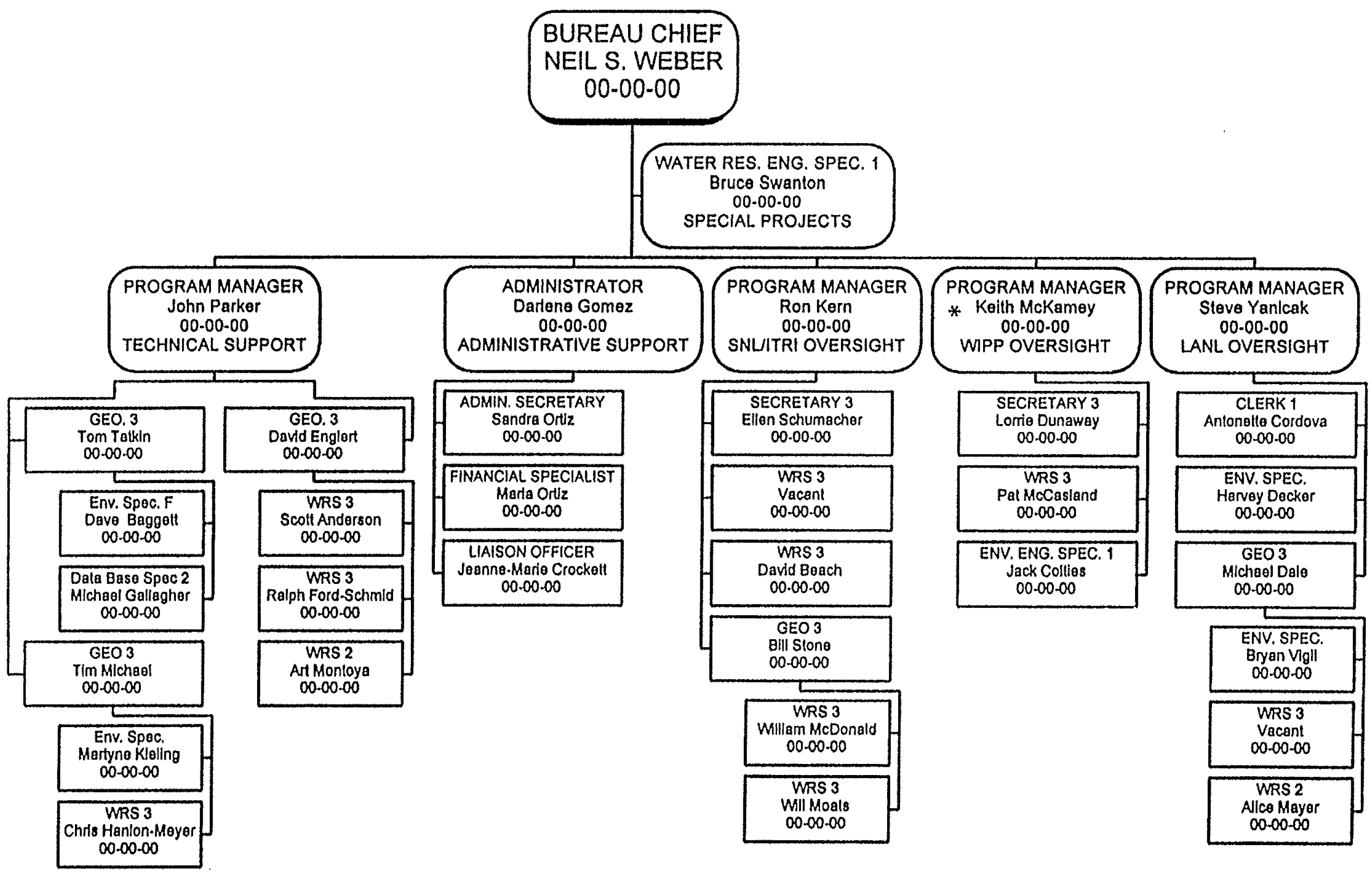
1) To assure DOE's compliance with applicable laws, including rules, regulations, and standards, such as NPDES permit requirements under the Federal Clean Water Act (CWA), New Mexico Water Quality Control Commission (WQCC) regulations and Water Quality Standards for Interstate and Intrastate Streams in New Mexico.

2) To monitor stormwater runoff for Constituents of Concern (COCs) from, Solid Waste Management Units (SWMUs), and from planned and unplanned releases for determination of the extent of contaminant impact to surface waters.

3) To obtain data representative of current conditions of the water, biological communities, and sediments.

4) To review DOE and DOE contractor generated data and reports.

Figure 2.0.1 DOE Oversight Bureau Organizational Chart



* As of September 30, 1996, the WIPP site office was closed.

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4.0 DATA COLLECTION METHODS

Water samples are collected by either grab sampling or through the use of automatic collection devices. The methods and equipment used to collect water and aquatic invertebrate samples are described in the following sections.

4.1 Water-Quality Monitoring Equipment

Flow Meter
Stormwater flows are measured with the ISCO 3200 series flow meter. The flow meter provides on-site hardware that measures flow rate, stores the data in a temporary memory, and controls the operation of the automated water-quality sampler. The flow meter can be accessed via cellular phone with any office computer by NMED staff in Santa Fe or White Rock, who in turn can control the monitoring equipment remotely. A schematic of this process is shown in Figure 4.1.1. The computer operator can communicate with the flow meter in real-time to determine the current monitoring status or can simply trigger the local memory to transmit stored data into the office computer.

Data transmitted to the computer are communicated through ISCO's FLOWLINK software. Monitoring results are then printed as a hydrograph or a summary. A sample graph is shown in Figure 4.1.2.

Two types of sensors are used for flow: an ultrasonic transducer and a pressure transducer. The ultrasonic transducer measures water depth by bouncing ultrasonic pulses off the surface of the water and measuring the time it takes for them to return. The flow meter converts the water level into a flow measurement and can be programmed to activate an automatic water-quality sampler.

The pressure transducer is commonly called the bubbler system. The bubbler system detects changes in the level of the stream by measuring the amount of air pressure required to force an air bubble through the end of a submerged tube. As flow increases in the channel, the rise of the water increases the amount of air pressure required to force the bubble from the tube. The flow meter converts the pressure output to a flow measurement and can be programmed to activate an automatic water-quality sampler.

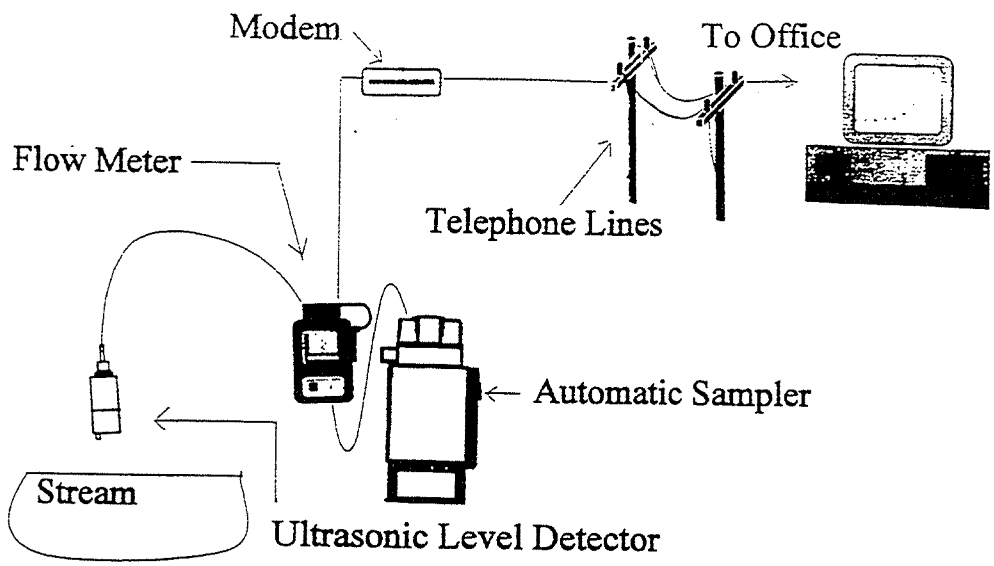


Figure 4.1.1 Schematic of Flow Monitoring and Sampling System

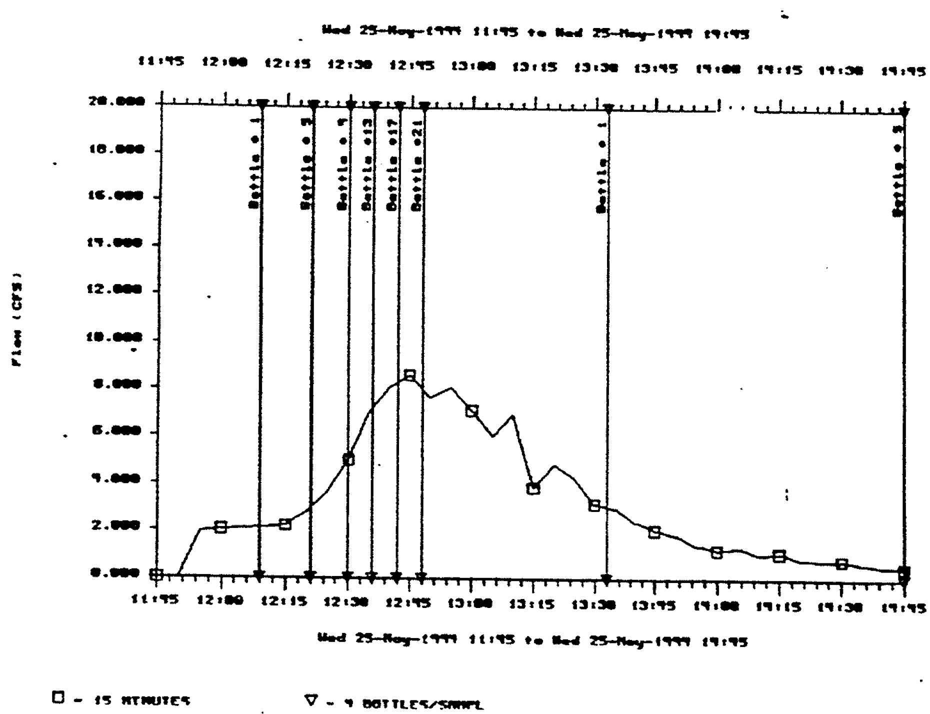


Figure 4.1.2 Typical Hydrograph

Water-Quality Samplers
The ISCO 3700 portable automatic sampler is used in the field to collect stormwater runoff. Water is collected through vinyl or Teflon tubing by a peristaltic pump and distributed to 24 individual one-liter polypropylene or glass bottles. The sampler can be programmed to take either sequential or composite samples. Samples are collected at either timed intervals or flow-paced intervals using flow-pulse inputs from the flow meter.

The flow meter and sampler are powered by a 12 VDC lead/acid battery. Voltage is maintained by a photovoltaic charging system (PVC).

Conductivity Meter
Conductivity is measured in the field using a Yellow Springs Instruments (YSI) model 33 S-C-T meter. Conductivity is a measure of the ability of water to conduct an electric current, thereby indirectly measuring the amount of total dissolved solids.

Dissolved-Oxygen Meter
Dissolved oxygen is measured in the field using the YSI model 58-B temperature compensating dissolved-oxygen meter.

pH Meter
The pH is measured in the field using an Orion model 290A ion-specific pH meter with an automatic temperature-compensated pH electrode.

4.2 Sampling Procedures

Water temperature, conductivity, dissolved oxygen, and pH are measured on-site using EPA approved (e.g. 40 CFR 136) methods. The field equipment is calibrated according to the manufacturer's and or method specifications prior to use. Grab water samples for analysis of ammonia, nitrate+nitrite, Kjeldahl nitrogen, phosphorus, major cations and anions, radionuclides, and metals are collected in clean, one-liter, single-use, polyethylene cubitainers.

Water samples collected by the automatic sampler are collected in acid-washed one-liter polypropylene or glass bottles. The collected water samples are then transferred to one-liter, single-use, polyethylene cubitainers. At the site, each container is thoroughly rinsed with a small amount of sample water, which is discarded, before the sample is placed in it. The samples are preserved as specified in 40 CFR Part 136, cooled on ice to 4° C, and transported in ice chests to an appropriate independent laboratory within the holding time specified for each sample analyte.

Sediment samples are collected using clean stainless steel or disposable plastic trowels. Sediment samples analyzed for metals are placed in clean, single-use, plastic whirl packs.

Sediments to be analyzed for organics or inorganics are placed in clean glass jars with Teflon lined lids.

4.3 Sample Preservation, Holding Times, Volumes

Analytical methods, detection limits, container type, sample preservation, and maximum holding times are detailed in Table 4.3.1.

Table 4.3.1 Methods, Detection Limits, Container Type, Preservation, and Maximum Holding Times for Major Measurement Parameters.

PARAMETER	METHOD	D. LIMIT	CONTAINER TYPE	PRESERVATION	MAX HOLDING TIME
Metals - Soils		uG/G			
Aluminum	200.7 ICP	5	4 oz. jar/glass	none	6 months
Arsenic	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Barium	200.8 ICP - MS	5	4 oz. jar/glass	none	6 months
Beryllium	200.7 ICP	5	4 oz. jar/glass	none	6 months
Boron	200.7 ICP	2	4 oz. jar/glass	none	6 months
Cadmium	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Calcium	200.7 ICP	2	4 oz. jar/glass	none	6 months
Chromium	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Cobalt	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Copper	200.8 ICP - MS	0.5	4 oz. jar/glass	none	6 months
Iron	200.7 ICP	0.5	4 oz. jar/glass	none	6 months
Lead	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Magnesium	200.7 ICP	2	4 oz. jar/glass	none	6 months
Manganese	200.7 ICP	2.5	4 oz. jar/glass	none	6 months
Mercury	245.1 Cold Vapor	0.25	4 oz. jar/glass	none	28 days
Molybdenum	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Nickel	200.7 ICP	2	4 oz. jar/glass	none	6 months
Selenium	270.2 Furnace AAS	0.1	4 oz. jar/glass	none	6 months
Silicon	200.7 ICP	2	4 oz. jar/glass	none	6 months
Silver	200.7 ICP	2	4 oz. jar/glass	none	6 months
Silver	200.8 ICP-MS	0.05	4 oz. jar/glass	none	6 months
Strontium	200.7 ICP	2	4 oz. jar/glass	none	6 months
Tin	200.7 ICP	5	4 oz. jar/glass	none	6 months
Uranium	200.8 ICP - MS	0.05	4 oz. jar/glass	none	6 months
Vanadium	200.7 ICP	5	4 oz. jar/glass	none	6 months
Zinc	200.8 ICP - MS	0.5	4 oz. jar/glass	none	6 months
Metals - Water		mG/L	1 liter plastic	5 ml HNO3	
Aluminum	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Arsenic	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months
Barium	200.8 ICP - MS	0.1	1 liter plastic	5 ml HNO3	6 months
Beryllium	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Boron	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Cadmium	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months
Calcium	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Chromium	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months
Cobalt	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months
Copper	200.8 ICP - MS	0.01	1 liter plastic	5 ml HNO3	6 months
Iron	200.7 ICP	0.01	1 liter plastic	5 ml HNO3	6 months
Lead	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Magnesium	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Manganese	200.7 ICP	0.05	1 liter plastic	5 ml HNO3	6 months
Mercury	245.1 Cold Vapor	0.0005	1 liter plastic	5 ml HNO3	28 days
Molybdenum	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months

Table 4.3.1 Methods, Detection Limits, Container Type, Preservation, and Maximum Holding Times for Major Measurement Parameters (Continued).

PARAMETER	METHOD	D. LIMIT	CONTAINER TYPE	PRESERVATION	MAXIMUM HOLDING TIME
Nickel	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Selenium	270.2 Furnace AAS	0.005	1 liter plastic	5 ml HNO3	6 months
Silicon	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Silver	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Silver	200.8 ICP-MS	0.001	1 liter plastic	5 ml HNO3	6 months
Strontium	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Tin	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Uranium	200.8 ICP - MS	0.001	1 liter plastic	5 ml HNO3	6 months
Vanadium	200.7 ICP	0.1	1 liter plastic	5 ml HNO3	6 months
Zinc	200.8 ICP - MS	0.01	1 liter plastic	5 ml HNO3	6 months
Organics					
SDWA VOC-I	EPA-502.2 Screen 774		4 oz. Glass w/ Teflon lined Septa	4 deg C	14 days
B/N/A Extractable	EPA - 8270 Screen 756		1 L Amber Glass jar	4 deg C	7 days to extraction 40 days after extraction
Nutrients					
Ammonia	EPA 350.1		1 Liter Plastic	2 ml H2SO4	28 days
Nitrate & Nitrite	EPA 353.2		1 Liter Plastic	2 ml H2SO4	28 days
Total Kjeldahl Nitrogen	EPA 351.2		1 Liter Plastic	2 ml H2SO4	28 days
Total Phosphate	EPA 365.4		1 Liter Plastic	2 ml H2SO4	28 days
Anion & Cations					
Alkalinity			1 Liter plastic	Ice to 4 deg C	14 days
Bicarbonate	EPA 310.1		1 Liter plastic	Ice to 4 deg C	14 days
BOD	EPA 405.1		1 Liter plastic	Ice to 4 deg C	48 hours
COD	HACH		1 Liter plastic	Ice to 4 deg C	28 days
Calcium	EPA 200.7		1 Liter plastic	Ice to 4 deg C	28 days
Carbonate	EPA 310.1		1 Liter plastic	Ice to 4 deg C	28 days
Chloride	EPA 300.0		1 Liter plastic	Ice to 4 deg C	28 days
Color Test	EPA 110.2		1 Liter plastic	Ice to 4 deg C	N/A
Conductivity	EPA 120.1		1 Liter plastic	Ice to 4 deg C	28 days
Cyanide	EPA 335.2		1 Liter plastic	Ice to 4 deg C	14 days
Fecal Coliform	EPA 922.1 C		1 Liter plastic	Ice to 4 deg C	6 hours
Fluoride	EPA 340.2		1 Liter plastic	Ice to 4 deg C	28 days
Hardness	EPA 200.7		1 Liter plastic	Ice to 4 deg C	28 days
Magnesium	EPA 200.7		1 Liter plastic	Ice to 4 deg C	28 days
PH	EPA 310.1		1 Liter plastic	Ice to 4 deg C	28 days
	& 150.1		N/A	N/A	Field
Potassium	EPA 200.7		1 Liter plastic	Ice to 4 deg C	28 days
	& NOVA		1 Liter plastic	Ice to 4 deg C	28 days
Sodium	EPA 200.7		1 Liter plastic	Ice to 4 deg C	28 days
	& NOVA		1 Liter plastic	Ice to 4 deg C	28 days
Sulfate	EPA 300.0		1 Liter plastic	Ice to 4 deg C	28 days
TDS	EPA 160.1		1 Liter plastic	Ice to 4 deg C	28 days
TSS	EPA 160.2		1 Liter plastic	Ice to 4 deg C	28 days
Turbidity	EPA 180.1		1 Liter plastic	Ice to 4 deg C	48 hours
Radiological					
Gross Alpha	EPA 900.0		1 Liter plastic	5 ml HNO3	6 months
Gross Beta	EPA 900.0		1 Liter plastic	5 ml HNO3	6 months
Gamma Scan	EPA 901.1		1 Liter plastic	5 ml HNO3	6 months
Plutonium 238/239	EPA 907.0		1 Liter plastic	5 ml HNO3	6 months
Tritium	EPA 906.0		1 Liter plastic	5 ml HNO3	6 months

4.4 Benthic Macroinvertebrate Sample Collection Methods

Benthic macroinvertebrate samples are collected qualitatively by the traveling kick-screen-method and quantitatively by using a circular sampler (Jacobi, 1978). Kick samples are collected using a 1 mm mesh "D" net. Riffles, containing gravel or rubble sized rock, generally represent the best habitat available and are the preferred sample sites. Riffles are sampled by agitating approximately one square meter of substrate upstream of the net (Figure 4.4.1). When a stream has no riffle habitat , pools are sampled by sweeping the net through the water and substrate. When sampling pools, all available habitats are sampled (e.g. undercut banks, root wads, aquatic vegetation). Samples are rinsed in the "D" net, dewatered on a no. 35 standard mesh screen and preserved with 70% ethanol. Samples are either sorted in their entirety or sub-sampled according to EPA's Rapid Bioassessment Protocol (Plafkin, et al. 1989).

Sub-sampling consists of evenly distributing the sample upon a screen that has been divided into 30 even sized cells. Cells are selected using a pseudo-random number generator or a roll of a die. All specimens within the selected cells are identified using appropriate taxonomic keys and enumerated (Merritt and Cummins 1984, and Pennak 1989). This process is repeated until at least 100 invertebrates are counted. A larger sub-sample may be used to increase the degree of resolution (e.g., 200, 300), depending upon available resources.

A habitat assessment is performed at each station according to EPA Rapid Bioassessment protocol (Plafkin, et al. 1989). Twelve habitat parameters are assessed and scored. The scores are weighted to emphasize the most biologically significant parameters. All parameters are evaluated for each station studied and scores increase as habitat quality increases. The ratings are totaled and compared to a site-specific control or regional reference station. A reference station is chosen to represent "best attainable" habitat conditions. The ratio between the score for the station and the score for the control or regional reference provides a comparability measure for each station (Plafkin, et al. 1989).

Metrics have been developed which allow the comparison of invertebrate data between the station of interest and a reference or control station. A comparison of habitat quality/availability, invertebrate populations, and water-quality parameters between the specific site and the reference station provides a measure of the biological condition of the site. A site can be evaluated as to whether it is reaching its biological potential or is limited due to degraded habitat, water quality, or both.

5.0 QUALITY ASSURANCE / QUALITY CONTROL

The Quality and Control office of the State Laboratory Division (SLD) is responsible for establishing the precision and accuracy of analytical procedures. Data for these quality control procedures are obtained by analyses of replicate, split, spiked, and blank samples. The following are quality control guidelines used by SLD:

(1) A QC-blank is run at the start of the run and every tenth sample.
(2) A low control is analyzed at the start of the run.
(3) A high control is analyzed at the start of the run.
(4) An external control is analyzed at the start of the run when available.
(5) Every tenth sample is run in duplicate.
(6) Every tenth sample is spiked in duplicate.
(7) A mid-level standard is analyzed every tenth sample.
(8) If the QC is off by as much as + or - 30% on a run, any samples with values > or = to the detection limit are re-analyzed.
(9) If the QC is better than or equal to + or - 20%, the run is accepted as is.

Figure 4.4.1 Benthic Macroinvertebrate Sampling in Los Alamos Canyon

5.1 Integrity of Data

Integrity of data is ensured by performing all analyses according to currently approved procedures (Table 4.3.1). Procedures are published in the latest editions of "Standard Methods for the Examination of Water and Wastewater," "Methods for Chemical Analysis of Water and Wastes," and other EPA-approved testing procedures found in the Code of Federal Regulations 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the CWA."

Duplicate samples for chemical and microbiological analyses are collected at the sampling site. The frequency for duplicate sampling is one sample in ten.

All samples are assigned a unique tracking number in the field that is recorded on the sample and the sample-analysis-request form. In addition, this number and all other pertinent information are recorded in the field technician's daily log book. The validity of all environmental measurements is ensured by strict adherence to the procedures given in the Quality Assurance Project Plan for Water Quality Management Programs (Anonymous, 1992).

Quality Assurance/Quality Control (QA/QC) involves equipment calibration, maintenance, and proper methods of sample collection and handling. All field measurement equipment is calibrated daily or before each use as outlined in the operating manual supplied with the equipment. All maintenance and calibration procedures are recorded in an equipment maintenance and calibration log book that is to be kept with each piece of equipment at all times.

5.2 Data Analysis

Analytical results are organized into spreadsheets and compared with applicable water quality standards or NPDES permit limits, (whichever is appropriate). Results from sample splits are compared with DOE obtained results to assure consistency in data analysis, evaluate the validity of DOE generated data and to determine if re-sampling is needed.

Three tests were applied to the data groups: Student's Matched Pair t-test, Wilcoxon Matched Pairs Signed-Rank[1] and Pearson's correlation. The Wilcoxon is a non-parametric test analogous to Student's Matched Pair t-test and is based largely on the proportion of positive and negative results when each member of one data group is subtracted from the paired member of the other data group. An equal or approximately equal proportion of pluses and minuses results when there is not a higher or lower trend in one or the other of

[1]Daniel, W.W., *Applied Non-Parametric Statistics*," PWS-Kent, 2nd edition (1990).

the data groups. The approach employed both parametric and non-parametric evaluations because with small groups of analytical data (which is by nature 'left truncated') it cannot be adequately determined whether or not the data is normally distributed and so it is uncertain whether a parametric test is appropriate.

The Pearson's correlation tests the 'linkage' of the data. For paired data, i.e., data collected at the same location and divided prior to analysis, the data can be said to be 'linked' if when one member of the pair is found to have a high concentration of the target analyte the other is also, or conversely, when one of the pairs is relatively low in concentration, so is the other. When the Pearson's correlation between groups of paired data is not significant then it may be suspected that the data represents the measurement of different chemical species; for example, that the preparation of the sample failed to free some chemically well-defined subspecies of the analyte. In this case the relationship of the concentrations of the analyte between sample pairs may not be consistent and the Pearson's correlation will be low.

6.0 LOS ALAMOS NATIONAL LABORATORY

6.1 Setting

The following setting description is an excerpt from the NMED report (Stone et al., 1993).

> "LANL is located west of the Rio Grande in Los Alamos County, approximately 40 km (25 mi) northwest of Santa Fe, New Mexico (Figure 6.1.1). Geologically, it sits on the Pajarito Plateau, an area of deeply dissected Quaternary-aged volcanic deposits and Tertiary fill of the Espanola Basin (Figure 6.1.2). The volcanics belong to the Bandelier Tuff, largely rhyolitic ash flows and pumice falls that were derived from the Valles Caldera in the Jemez Mountains to the west (Purtymun, 1984). The basin fill is represented by the Puye Conglomerate (fanglomerate, lake clays, basalt flows, ash, and river gravels) and the Tesuque Formation (mostly poorly consolidated sand and gravel). The average elevation of the plateau is approximately 7,000 feet above sea level."

Perennial, ephemeral, and intermittent streams flowing southeastward have dissected the plateau into a number of finger-like, narrow mesas separated by deep, narrow canyons, lying some 1,450 ft below the plateau (Figure 6.1.3.). From an elevation of approximately 1,890 meters (6,200 ft) at White Rock, the plateau ends in sheer cliffs, dropping to 1,646 meters (5,400 ft) at the Rio Grande (Cross, 1994). The major canyons that cut across the plateau are Guaje, Rendija, Barrancas, Bayo, Pueblo, Los Alamos, Sandia, Mortandad, Pajarito, Water, and Ancho. Springs between 7,900 and 8,900 ft on the flanks of the Sierra de Los Valles supply perennial base flow to the headwaters of Guaje, Los Alamos, Pajarito, and Water canyons (Abeele et al., 1981). Springs between 7,100 and 7,500 ft supply perennial base flow in Pajarito and Cañon de Valle canyons. Perennial flow is maintained in sections of Pueblo, Los Alamos, Sandia, and Mortandad canyons by the release of effluent from industrial-waste treatment plants, sewage plants, and cooling water from the power plant (Purtymun, 1975).

Figure 6.1.1 Regional Location of Los Alamos National Laboratory (LA - 12764 - ENV)

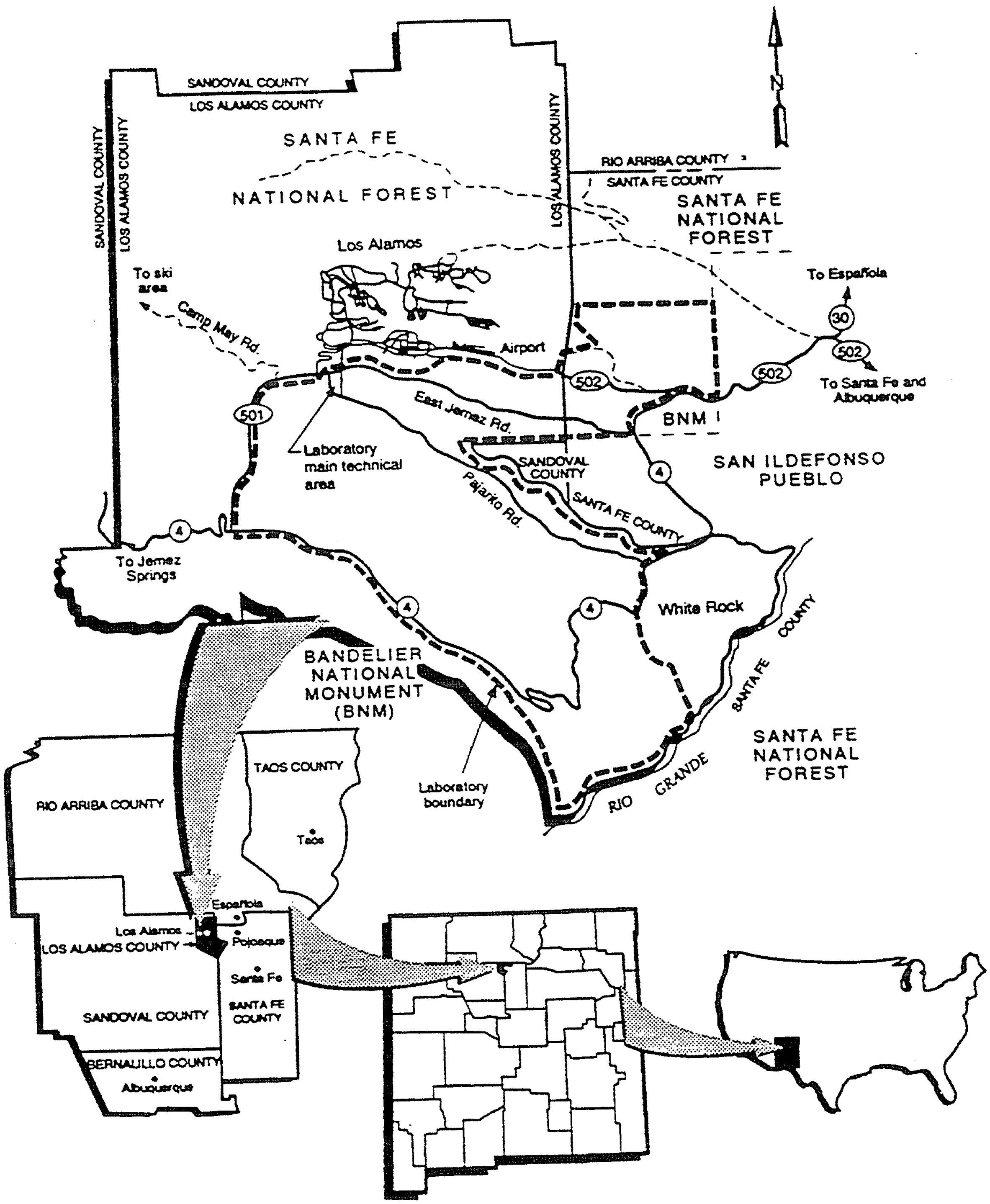


Figure 6.1.2 Generalized Hydrogeologic Model for LANL (from Hoffman and Lyncoln, 1992)

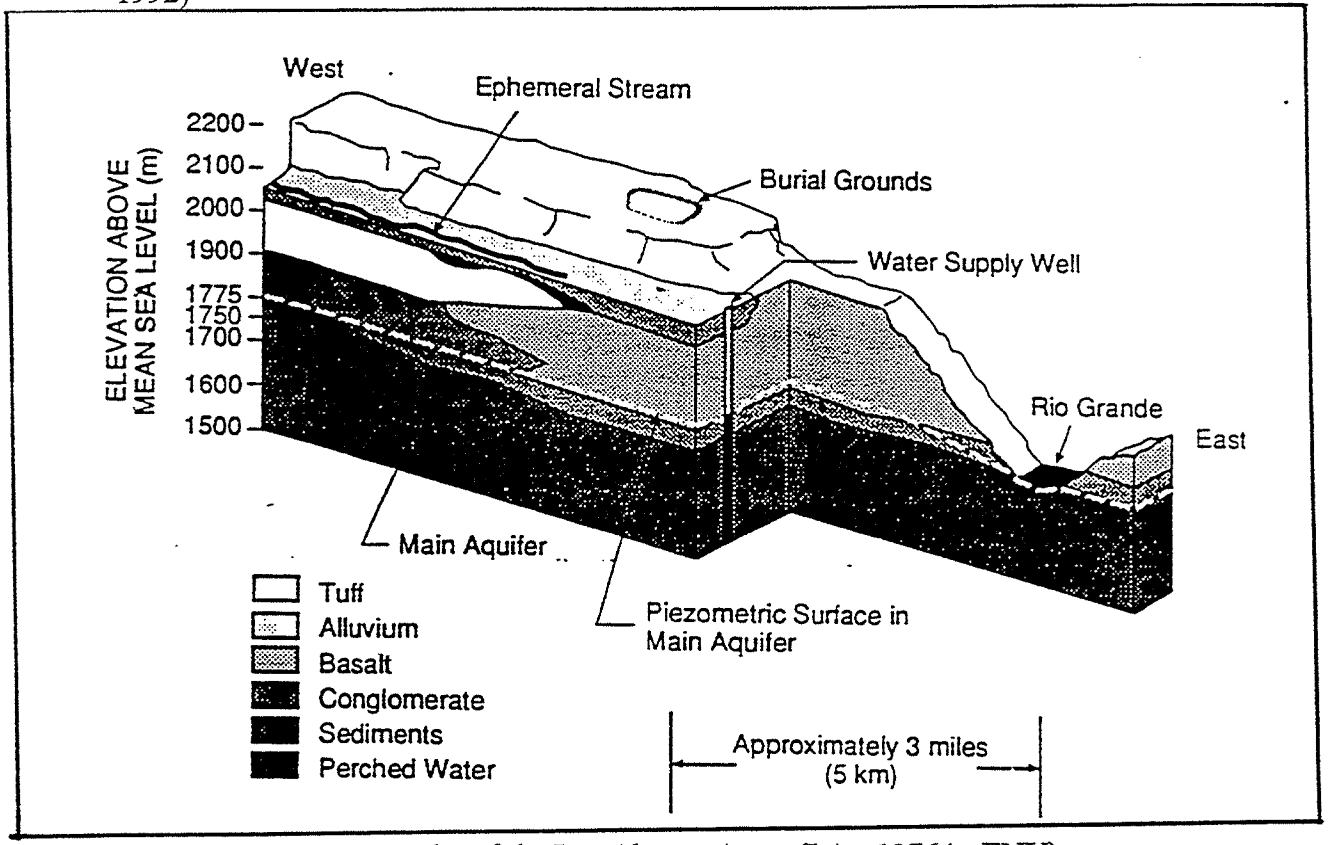
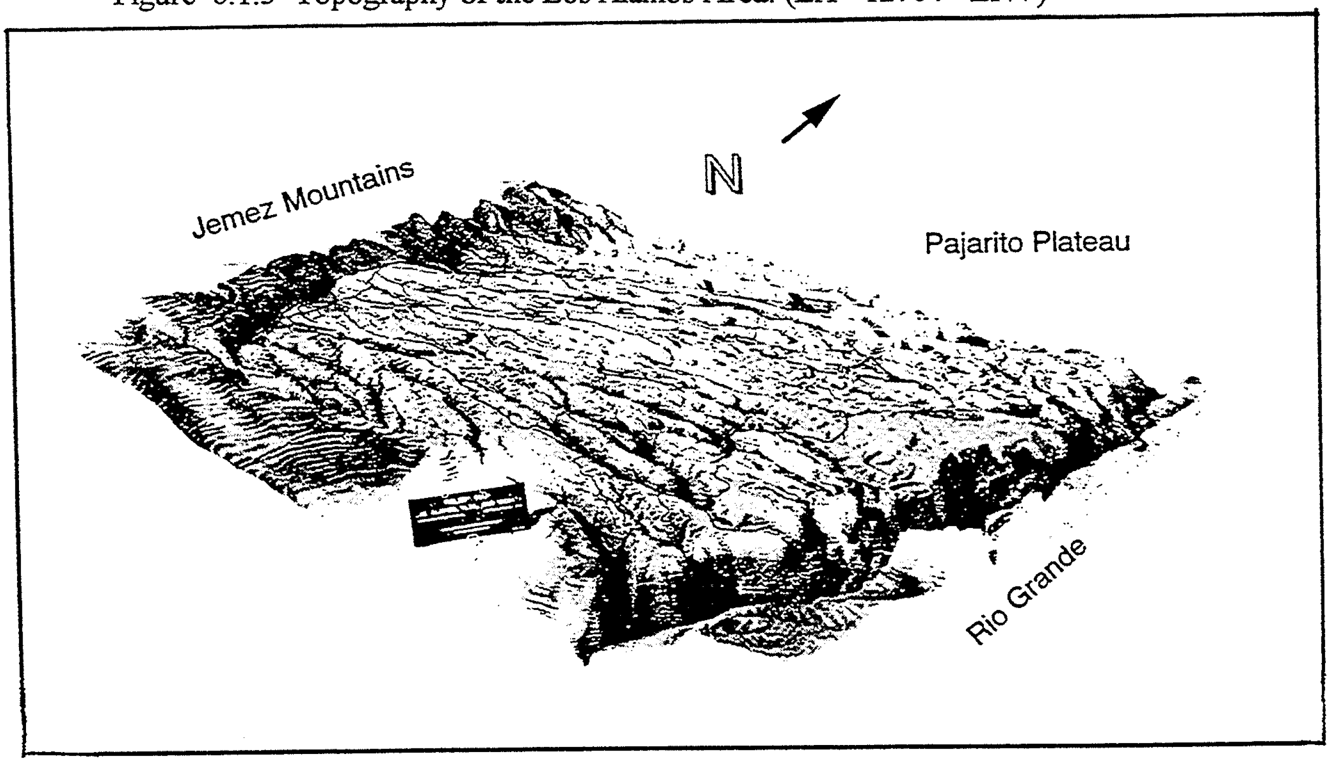


Figure 6.1.3 Topography of the Los Alamos Area. (LA - 12764 - ENV)



6.2 Description of Study Areas

The Laboratory discharges treated waste water into these canyons from approximately 128 NPDES discharges. Discharges include treated industrial waste, treated radioactive waste, and treated sanitary sewage. Outfalls and runoff from all sites are possible water sources for wildlife in the area. Throughout the history of the Laboratory, waste has been disposed of in many Solid Waste Management Units (SWMU). SWMUs are located both on the top of the mesa and in watercourses.

6.3 Site Selection / Sampling Stations

DOE Oversight Bureau staff members have concentrated their sampling efforts on streams that may have been impacted by discharges due to stormwater runoff and prior spill/discharge histories from Technical Areas (TA), and those streams having SWMUs located in their watershed. LANL has established annual sampling stations both on and off laboratory property.[2] In addition to these previously existing stations, DOE Oversight Bureau has established additional sampling stations for the monitoring of snowmelt runoff, stormwater runoff, and benthic macroinvertebrates. DOE Oversight Bureau personnel accompanied LANL personnel and split samples at established annual sampling stations. Springs and streams discharging into the Rio Grande in White Rock Canyon have been sampled for many years by the LANL staff and have been included in the NMED sampling plan (Figure 6.4.1). Due to budget limitations, DOE Oversight Bureau does not attempt to collect samples at all established stations, but selects some of each type, (springs, stormwater runoff, snowmelt) to sample each year.

A map depicting sampling locations is shown in Figure 6.2.1. Each station has been assigned a unique map designation. All sample stations in major canyons are designated by incorporating the first two letters of the canyon name and the distance in miles from them to the Rio Grande, as determined from USGS topographic maps (scale 1:24000). For tributaries to major canyons, the station designation is the first two letters of that canyon name and the distance from its junction with the main canyon. For example, station PA 9.0 is located in Pajarito Canyon, 9.0 mi upstream from the Rio Grande, at the confluence of Starmer Gulch and Pajarito Creek. A sample collected in Starmer Gulch, 16 meters above the confluence with Pajarito Creek, would be designated ST 0.01. A sample collected in Pajarito Creek, below the confluence of Starmer Gulch would be designated PA 9.0.

Tables 6.3.1, 6.3.2, 6.3.12, 6.3.13, 6.3.18, 6.4.1 and 6.4.6 provide detailed site locations and descriptions for all sample stations located on Figure 6.2.1.

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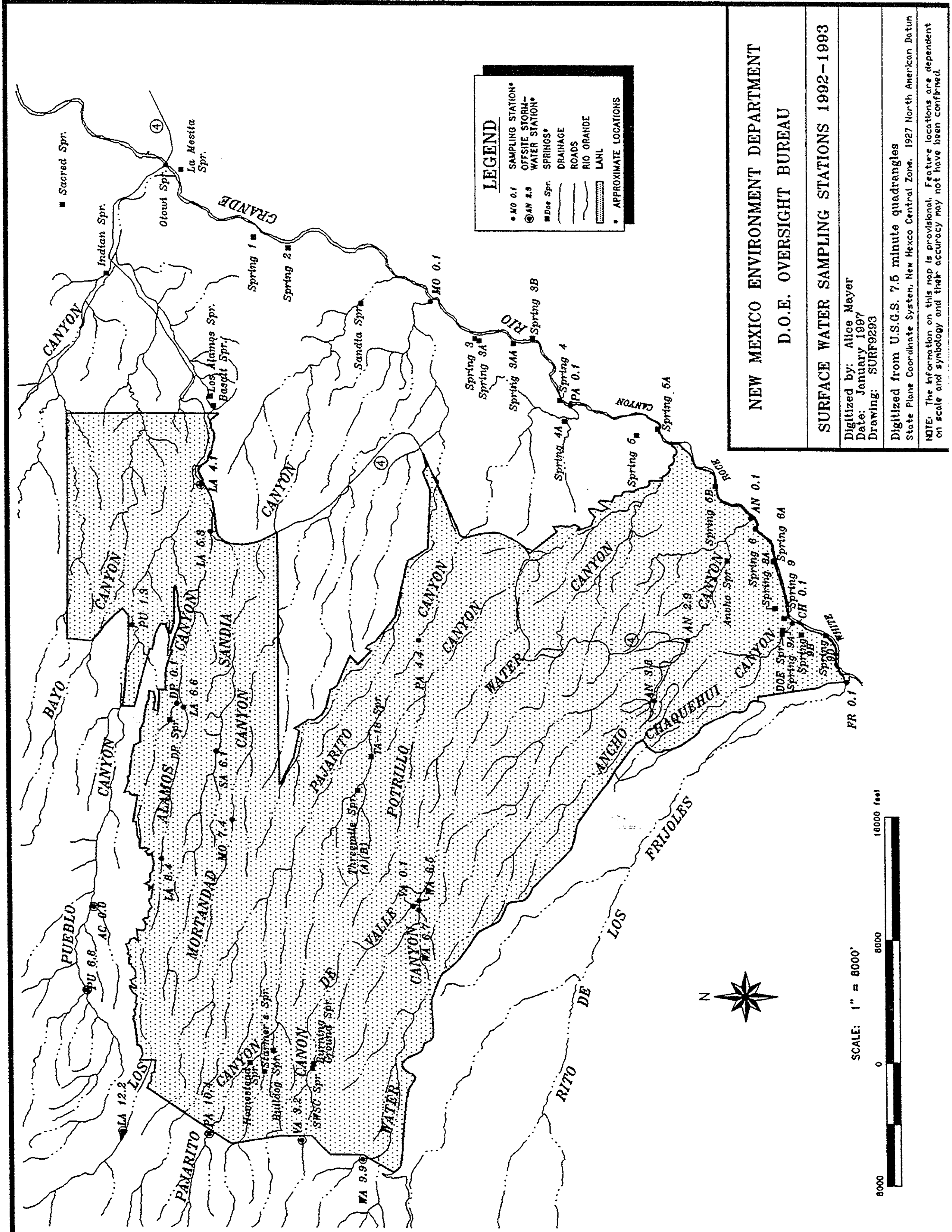
[2] LANL reports data in annual environmental reports.

Figure 6.2.1 LANL Surface Water Sampling Stations



6.3.1 Snowmelt Runoff Sampling - 1992

Snowmelt runoff samples were collected from 10 stations in 1992. Four background locations were established in upper Pajarito, Los Alamos, Water, and Valle canyons, west of Jemez Road, to determine the condition of surface waters prior to entering the Laboratory (Table 6.3.1). Four locations were at sites where snowmelt had flowed on DOE property but did not exit DOE property. Samples were taken upslope from where surface water infiltrated into the alluvium on DOE property. These locations were at Ancho Canyon below the meteorological tower at TA-49, Water Canyon above the confluence with Cañon de Valle, Cañon de Valle above the confluence with Water Canyon, and Sandia Canyon at the turnout below the TA-53 entrance (Table 6.3.2).

Two locations were at sites where snowmelt had flowed across DOE property some distance downstream from the sample site. These locations were at Pajarito Canyon at area G-1 and Los Alamos Canyon below a tributary from TA-53 outfall 09S sanitary lagoon discharge. Both locations were sampled prior to flowing off laboratory property. These samples represent snowmelt leaving DOE property (Table 6.3.2).

From May 5-7, 1992, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.3), total metals (Table 6.3.4), dissolved metals (Table 6.3.5), radiochemistry (Table 6.3.6 & 6.3.7), and volatile organic compounds (Table 6.3.8).

6.3.2 Snowmelt Runoff Sampling - 1993

Snowmelt runoff samples were collected from nine stations in 1993, four of which were background locations. The background water samples were collected in Water, Valle, Pajarito and Pueblo canyons (Table 6.3.1). Five additional water samples were collected and split with LANL in Pueblo, Acid, Water, Ancho, and Sandia canyons (Table 6.3.2).

From March 24 to June 28, 1993, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.9), total metals (Table 6.3.10), and dissolved metals (Table 6.3.11).

6.3.3 Stormwater Runoff Sampling - 1992

In 1992 the DOE Oversight Bureau was developing a program to monitor stormwater runoff at DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Due to the development of this program, stormwater events were not sampled during 1992.

6.3.4 Stormwater Runoff Sampling - 1993

Four stations were sampled during storm events at LANL in 1993. Two stations were sampled in Los Alamos Canyon: Los Alamos Canyon at the Otowi Well # 4 (Table 6.3.12), and Los Alamos Canyon, 500 yds. below State Road 4 (Table 6.3.13). Each was sampled once during separate storm events. DP canyon (at the former USGS gaging station) was sampled during six separate storm events and Pajarito canyon (below Area G-1) was sampled during one storm event (Table 6.3.12).

From July 15 to September 10, 1993, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.14), total metals (Table 6.3.15), radiochemistry (Tables 6.3.16 & 6.3.17).

6.3.5 Miscellaneous Surface Water Sampling - 1992

Mortandad Canyon was sampled at the USGS gaging station, (GS-1), below TA-50 outfall 051. This sample represents an accumulation of discharges from TA- 50 outfall 051, 03A outfall 160, 04A outfall 127, and 06A outfall 132. Although this was during the snowmelt runoff period, the majority of flow at this sampling site was due to effluent from TA- 50 outfall 051 (Table 6.3.18).

On May 7, 1992, samples were collected and analyzed for the following parameters: water chemistry (Table 6.3.19), total metals (Table 6.3.20), dissolved metals (Table 6.3.21), radiochemistry (Tables 6.3.22 & 6.3.23), and volatile organic compounds (Table 6.3.24).

6.3.6 Miscellaneous Surface Water Sampling - 1993

On January 30, 1993, a 3 gal/hr leak was detected in the primary coolant loop of the Omega West reactor that contaminated the ground-water under the reactor site. It was unknown how long the reactor coolant had been leaking. Tritium (H^3) was detected in the reactor building sump at a level of 109,000 pCi/L on January 30, 1993. This was attributed to ground water infiltration into the reactor building basement. This sump water had been routinely discharged into Los Alamos Canyon (from 1956 - 1993), though it was not an NPDES permitted discharge. This unpermitted point source discharge to a watercourse, Los Alamos Canyon, prompted NMED to sample the sump discharge on February 17, 1993.

Surface water samples were collected on September 3, 1993, at Los Alamos Reservoir spillway and Los Alamos Canyon near Otowi well # 4 to determine conditions above and below ongoing primary reactor coolant loop excavations at Omega West Reactor.

Samples were also collected and split with LANL from Sacred, Indian, La Mesita, and Basalt springs, and Mortandad Canyon at the gaging station from May 12 to July 19, 1993.

The above water samples were tested for the following parameters: water chemistry (Table 6.3.25), total metals (Table 6.3.26), and radiochemistry (Tables 6.3.27 & 6.3.28).

6.4 Springs of White Rock Canyon

NMED has collected samples from most of the springs that discharge into White Rock Canyon. Springs 1 and 2 have been sampled at the request of the San Ildefonso Pueblo. Spring 4A (Pajarito Spring) and Ancho Spring supply perennial surface-water flow to the Rio Grande via their respective canyons and are sampled annually. Other springs which discharge to the Rio Grande (after traveling for a short distance above ground) are sampled periodically to verify past and current sampling results documented in LANL's Annual Surveillance Reports (Table 6.4.1).

Samples collected during the September, 1992, and October, 1993, environmental surveillance trips were analyzed for water-chemistry parameters (Table 6.4.2 & 6.4.3). Sediment samples were collected at Spring 5 in 1992 and spring 4A in 1993. (Tables 6.4.4 & 6.4.5).

6.4.1 Streams of White Rock Canyon

The Pajarito Plateau, west of the Rio Grande, is drained by numerous canyons, five of which maintain intermittent or perennial flow to the Rio Grande in White Rock Canyon. Sanitary effluent from the county's domestic wastewater treatment plant in White Rock (NPDES permit No. NM0020133) forms a perennial flow (when not diverted for irrigation purposes at the White Rock ball fields) in lower Mortandad Canyon. Base flow in streams in Pajarito and Ancho Canyons is supplied by springs, and maintains perennial flow to the Rio Grande. Base flow in Frijoles Canyon is from a series of headwater springs located about 13 km (8 mi) west of the Rio Grande, which provide perennial flow to the Rio Grande. Flow in Chaquehui Canyon is from springs discharging from the Tesuque Formation. Due to infiltration and evapotranspiration, flow from Chaquehui Canyon does not reach the Rio Grande (Purtymun 1980), except during storm events.

Water, sediments, and stream macroinvertebrates were sampled from five tributaries of the Rio Grande and four stations along the Rio Grande during the annual White Rock Canyon environmental surveillance trips (Figure 6.4.1) (Table 6.4.6).

Water samples collected during September, 1992, and October, 1993, in White Rock

Canyon were analyzed for water-chemistry parameters (Table 6.4.2 & Table 6.4.3). Sediments collected during DOE Oversight Bureau annual White Rock Canyon environmental surveillance trips in 1992 and 1993 were analyzed for total metals (Table 6.4.4 & Table 6.4.5). Stream Macroinvertebrate sampling results are addressed in the following section.

6.5 Benthic Macroinvertebrate Sampling - 1992 & 1993

DOE Oversight Bureau staff performed a rapid bioassessment of Frijoles, Ancho, Chaquehui, Pajarito and Mortandad Canyons in 1992 and the resulting previously unpublished report (Hopkins, 1992) is included in Appendix A.

Stream macroinvertebrates were sampled in Frijoles, Ancho, Los Alamos, DP, Sandia, and Pajarito Canyons in 1993 and the samples were analyzed in their entirety. Sample locations are shown in Table 6.5.1. The organisms were identified by Dr. Gerald Z. Jacobi of New Mexico Highlands University. The species list developed from this sampling effort is included in Appendix B.

6.6 Applicable Water Quality Standards - LANL

Unclassified Canyon Watercourses

The canyon watercourses that receive the laboratory's NPDES permitted discharges and stormwater runoffs are tributaries to the Rio Grande. These watercourses are currently unclassified in the *Water Quality Standards for Interstate and Intrastate Streams in New Mexico* (WQS)[3]. Where no uses are designated through classification by the WQCC, the general standards of the WQS are applicable (WQS §1-102). Further WQS 3-101 lists "Standards Applicable to Attainable or Designated Uses Unless Otherwise Specified in Part 2" (emphasis added). LANL was questioned concerning its possible "attainable" uses when the laboratory's NPDES permit was last reviewed for reissuance by the EPA. A Settlement Agreement was reached between the NMED and the NPDES co-permittees University of California / Department of Energy, and was reviewed and approved by the WQCC[4]. This agreement temporarily resolved the issue until an independent study could be performed to ascertain the existing and attainable uses of the watercourses involved

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[3] As amended by the WQCC October 8, 1991 and effective November 12, 1991. Note the WQS were amended by the WQCC in October 1994 in accordance with triennial review requirements of Section 303 of the federal Clean Water Act. It is NMED SWQB's policy to compare ambient water quality data with the WQS in effect at the time of collection.

[4] April 20, 1993, Settlement Agreement resolving the co-permittee's appeal to the WQCC for review of the NMED's conditional certification of their NPDES permit NM0028355.

and classified standards could be proposed and reviewed by the WQCC. It was agreed that NPDES permit limits would be based upon the livestock and wildlife watering use, as set forth in WQS §3-101 and other applicable sections of the WQS (e.g., §1-102.G - Radioactivity). The WQS §3-101.K numeric standards for water quality necessary to sustain livestock and wildlife watering are listed in (Table 6.6.1):

Table 6.6.1 WQS §3-101.K Livestock and Wildlife Watering Use Standards

dissolved aluminum	5.0 mg/L	dissolved copper	0.5 mg/L
dissolved arsenic	0.02 mg/L	dissolved lead	0.1 mg/L
dissolved boron	5.0 mg/L	total mercury	0.01 mg/L
dissolved cadmium	0.05 mg/L	dissolved selenium	0.05 mg/L
dissolved chromium[5]	1.0 mg/L	dissolved vanadium	0.1 mg/L
dissolved cobalt	1.0 mg/L	dissolved zinc	25.0 mg/L
radium-226 + 228	30.0 pCi/L		

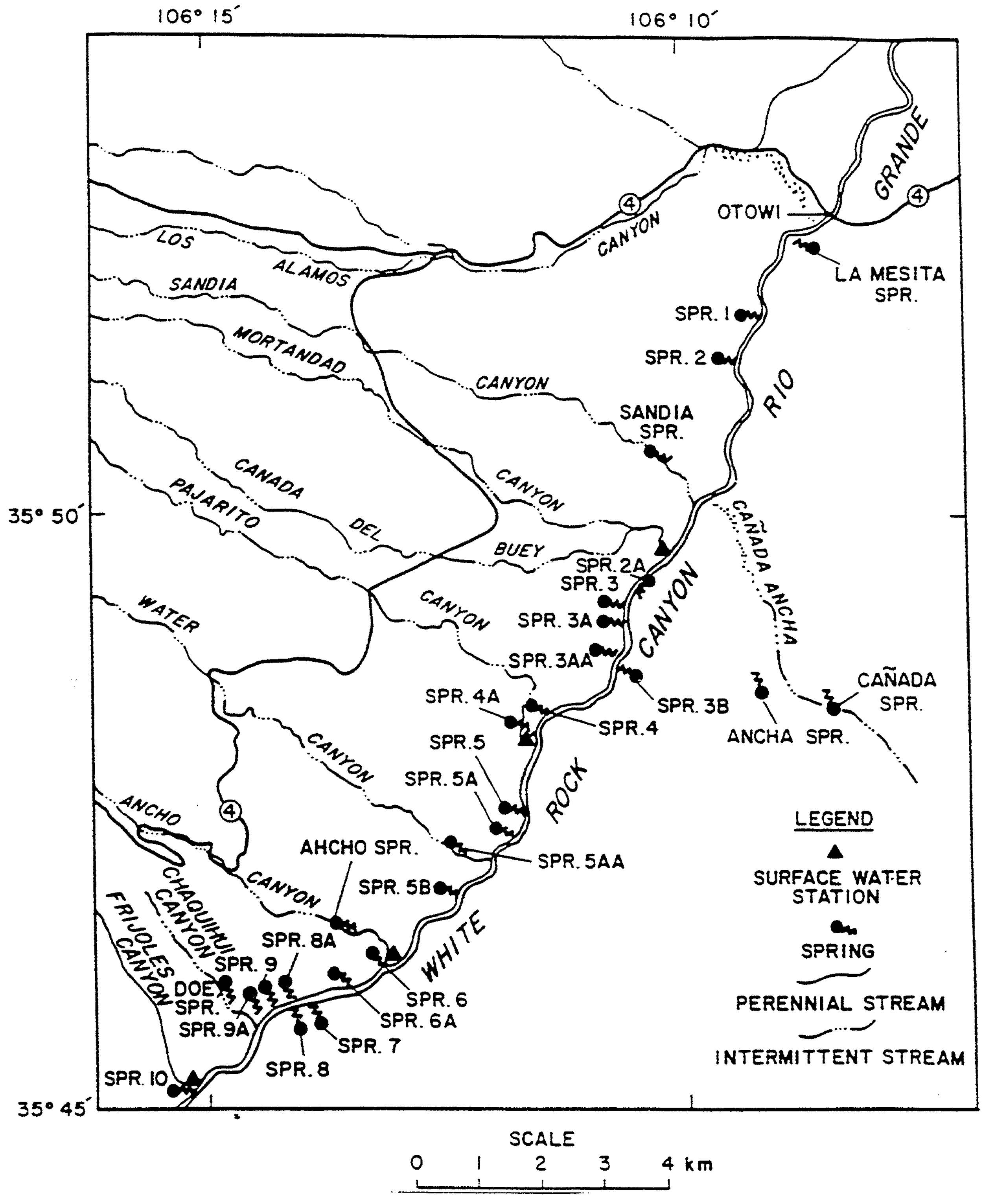
Regarding the radioactivity general standard WQS §1-102.G states:

"[t]he radioactivity of surface waters shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in Part 4 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989."

Classified Watercourses
The main stem of the Rio Grande from the headwaters of Cochiti Reservoir upstream to Taos Junction Bridge is classified in WQS §2-111 with the following designated uses: irrigation, livestock and wildlife watering, marginal coldwater fishery, secondary contact recreation, and warmwater fishery. Applicable water quality standards for this segment therefore include the narrative standards of the WQS Part I - General Standards, segment specific standards in WQS §2-211, and WQS §3-101 Standards Applicable to Attainable or Designated Uses Unless otherwise Specified in Part 2. Specifically the numeric standards of sections 3-101.D (irrigation), 3-101.F (marginal coldwater fishery), 3-101.J. (all fisheries), and 3-101.K (livestock and wildlife watering) are applicable. The WQS state that for waters with more than a single attainable use (e.g., segment 2-111) "the applicable criteria are those which will protect and sustain the most sensitive use" (§3-101 footnote 1, page 49).

[5] The criteria for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

Figure 6.4.1 Generalized Location of Streams and Springs in White Rock Canyon



6.7 Data Interpretation

Split sample data collected by NMED and Santa Fe Engineering (contractor for LANL) was statistically compared using three methods. The objective was to determine whether there was a statistically significant difference which might be attributable to methods of sample collection, methods of sample preservation or differences between analytical laboratories.

Results of Data Comparison

The statistical comparisons were made for calcium, magnesium, nitrate/nitrite, bicarbonate and total hardness. Neither parametric nor non-parametric evaluations indicated that there was a statistically significant difference between NMED and Santa Fe Engineering (SFE) data. The Pearson's correlation indicated that the data were significantly linked. NMED concludes that there is no difference between the groups of data which would indicate significant differences in method of sample collection, preservation or analysis. Furthermore, the significant Pearson correlation indicates that the same chemical species were being quantified by the two laboratories.

A comparison of 1993 NMED and LANL analytical results also showed the results are similar, except for one stormwater sampling event (LA 4.1 - 930803).

On August 3, 1993, the North Community precipitation monitoring site at LANL, recorded 1.12 inches of rainfall. DOE Oversight Bureau personnel were able to position themselves in Los Alamos Canyon, ahead of the first flush of stormwater, at the bridge on State Road 4 (sample station LA 4.1). Samples were collected during the first flush, as it passed onto Bandelier National Monument at Tsankawi Ruins. Replicate samples were collected for submittal to LANL. Samples submitted to SLD for analysis were acidified and stored on ice. DOE Oversight Bureau samples were analyzed for total metals (Table 6.3.15), for gross alpha/beta (Table 6.3.16), and by a gamma scan for activation and fission products (Table 6.3.17).

Upon receiving the radiological results from SLD, DOE Oversight Bureau notified LANL that its analysis showed elevated levels of gross alpha and beta emitters. The results obtained by LANL, though elevated, showed gross alpha and beta levels far below NMED's. LANL re-analyzed its samples, but DOE Oversight Bureau was not able to re-analyze its samples. LANL's results again were far below DOE Oversight Bureau's and nearer to background levels. Appendix C displays the comparisons of NMED and LANL data. DOE Oversight Bureau's total metal results indicated mercury (Hg) present above detection limits (yet below Livestock Watering Standards) while LANL did not detect any mercury.

DOE Oversight Bureau stormwater samples that were submitted for radiological analysis had nearly 0.2 inch of sediment in the bottom of the sampling container. This accumulation of sediment in the bottom of the Marinelli beaker during counting may have distorted the geometry and affected the quantification of the amount of activity present. It is probable that LANL filtered or decanted the water off the sediments prior to analysis, resulting in significantly lower counts in their gross alpha/beta analysis.

It is probable that concentrated nitric acid was mistakenly added to sample VA 3.2 on 920506 and then tested for nitrate + nitrite resulting in a high (1300 mg/L) analytical result.

It also appears that labels may have been switched on two snowmelt samples collected from Pajarito canyon in May of 1992.

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7.0 SANDIA NATIONAL LABORATORIES, NEW MEXICO

7.1 Setting

The following setting description is an excerpt from the NMED report (Stone, et al., 1993).

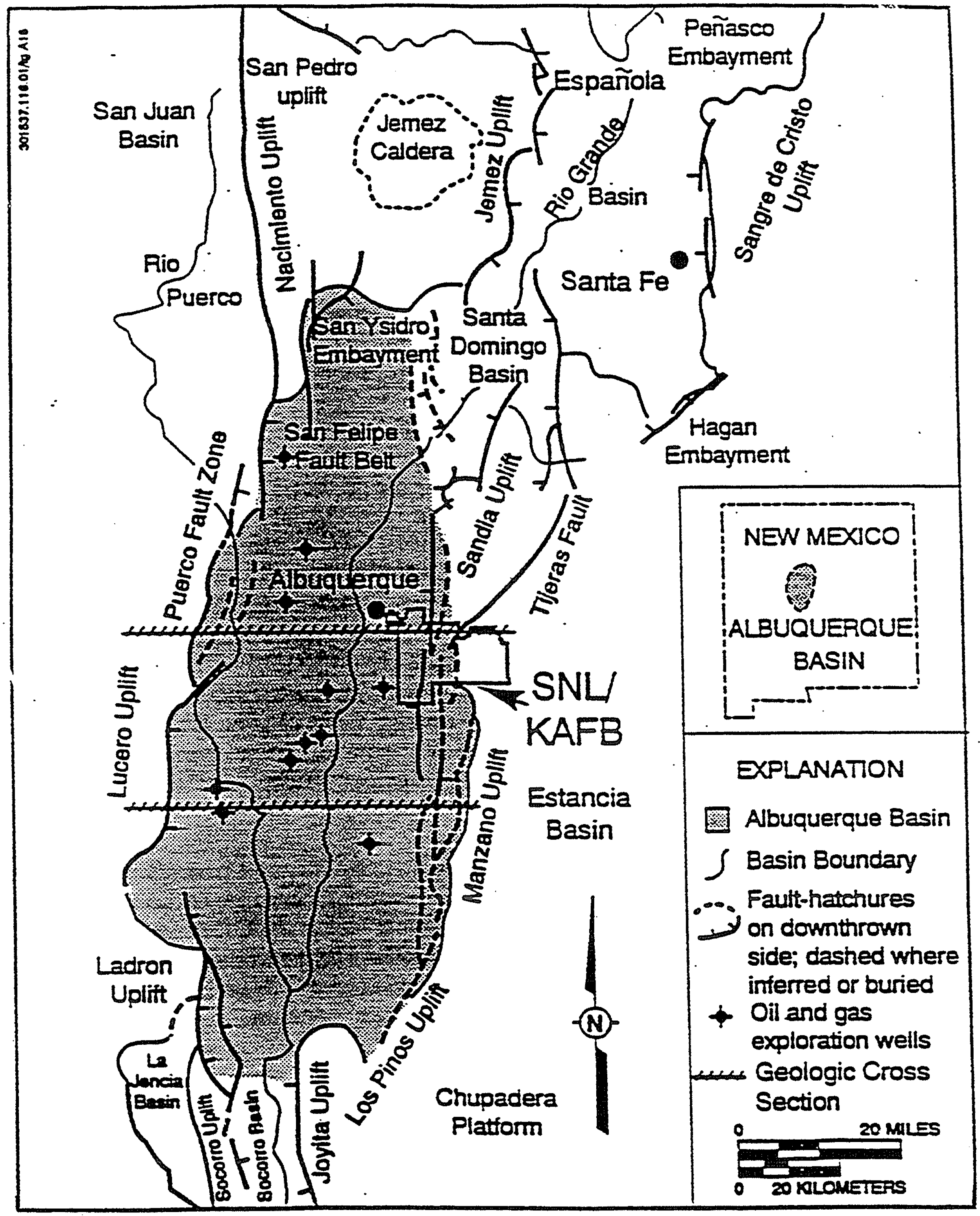
> "SNL/ITRI, NM is located on the Kirtland Air Force Base (KAFB) in the southeastern part of Albuquerque. KAFB is bound roughly by the Manzanito Mountains on the east, the Isleta Pueblo Indian Reservation on the south, Interstate 25 on the west and Central Avenue on the north (Figure 7.1.1). Geologically, the facility straddles the eastern edge of the Albuquerque Basin, one of numerous closed depressions making up the Rio Grande Rift. The Albuquerque Basin is a very complex geologic feature that is just now beginning to be understood through detailed studies like that of Hawley and Haase (1992). In general terms, however, Precambrian metamorphic rocks and Paleozoic sedimentary rocks of the mountains are separated from the thick sequence of mainly unconsolidated Tertiary/Quaternary alluvium in the basin (Santa Fe Group) by the Tijeras Fault Zone. SNL sits on the dissected bajada extending westward from the mountains.
>
> Elevations in the mountains are on the order of 10,000 ft, whereas those along the river are between 4,300 and 5,100 ft. The area is drained by ephemeral streams that flow westerly or southwesterly toward the Rio Grande. Tijeras Arroyo, Arroyo del Coyote and the so-called Travertine Hills Arroyo are the major drainage ways."

7.2 Description of Study Area

SNL/ITRI does not operate its own wastewater treatment facility. Most of the wastewater from SNL/ITRI is collected and delivered to the City of Albuquerque's sanitary-wastewater collection system, and is treated by the City's wastewater treatment plant (WWTP). The city discharges treated wastewater to the Rio Grande, pursuant to NPDES permit No. NM0022250.

SNL/ITRI conducts its own wastewater monitoring (Figure 7.2.1), to demonstrate compliance with the effluent limitations specified in the wastewater Discharge Permits (2069A-2, 2069D-3, 2069F-2, 2069G-2, 2069H-2, 2069I, and 2069K) issued to SNL by the city's pretreatment section. ITRI's wastewater Discharge Permit is 2178A. SNL/ITRI's wastewater self-monitoring consists of sample collection at permit-specified frequencies with continuous pH and flow monitoring at the eight stations.

Figure 7.1.1 Location and Geologic Setting of SNL/ITRI (from McCord, et al., 1993).



7.3 Site Selection / Sampling Stations

During 1992 and 1993 the DOE Oversight Bureau was developing and planning a storm water monitoring program to monitor storm-water runoff from DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Thus no stormwater events were sampled during 1992 or 1993.

In 1993 water samples were collected from the sanitary sewer system at two locations WW006 (2069-F) and WW008 (2069-I) (Figure 7.2.1). The samples collected were flow-proportioned, twenty-four-hour composites, which were split with SNL.

The above water samples were tested for the following parameters: water chemistry (Table 7.3.1), total metals (Table 7.3.2), and radiochemistry (Tables 7.3.3).

7.4 Applicable Water Quality Standards - SNL/ITRI

Unclassified Watercourses

Non-perennial watercourses (e.g., Tijeras Arroyo and its tributaries) are currently not classified in the WQS. Where no uses are designated through classification by the WQCC, the general standards of the WQS are applicable (WQS §1-102). Further WQS 3-101 lists "Standards Applicable to Attainable or Designated Uses Unless Otherwise Specified in Part 2" (emphasis added). The NMED's position, which has been reviewed by the New Mexico Water Quality Control Commission (WQCC), is that where water exists, it will, at a minimum, have an attainable use of livestock and wildlife watering and probably an attainable use of irrigation. The irrigation use is only excluded in cases such as hyper-saline playa lakes and locations where there is no arable land in the vicinity. Since the land in the vicinity is arable, the irrigation use needs to be considered. There are numeric water-quality criteria in the WQS for both these uses (§§3-101. K. and D. respectively).

According to WQS §3-101, for waters with more than a single attainable or designated use the applicable criteria are those which will protect and sustain the most sensitive use. The following standards apply to surface waters and surface-water drainages that may be affected by stormwater runoff, spills, or discharges. The numeric standards for water quality necessary to sustain the livestock and wildlife watering use and the irrigation use are compiled in Table 7.4.1.

Table 7.4.1 §§3-101. K. and D Standards for Livestock, Wildlife, and Irrigation Use

dissolved aluminum‡	5.0 mg/L	dissolved copper*	0.20 mg/L
dissolved arsenic†	0.02 mg/L	dissolved lead†	0.1 mg/L
dissolved boron*	0.75 mg/L	total mercury†	0.01 mg/L
dissolved cadmium*	0.01 mg/L	dissolved selenium†	0.05 mg/L
dissolved chromium*[6]	0.1 mg/L	dissolved vanadium‡	0.1 mg/L
dissolved cobalt*	0.05 mg/L	dissolved zinc*	2.0 mg/L
radium-226 + 228†	30.0 pCi/L		

‡ = standard is same for both uses.
† = where livestock and wildlife watering is the most sensitive use.
* = where irrigation is the most sensitive use.

Sanitary Wastewater Discharges
SNL is authorized to discharge wastewater to the City of Albuquerque sewer system, according to its wastewater discharge permit. The permit sets discharge limits and monitoring requirements on SNL. In addition, SNL is bound by other applicable sections of the WQS (e.g., §1-102.G - Radioactivity).

The radioactivity general standard (WQS §1-102.G) states:

[t]he radioactivity of surface waters shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in Part 4 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989.

Part 4-320 of the New Mexico Environmental Improvement Board Radiation Protection Regulations sets limits on waste disposal by release into sanitary sewerage systems.

For all water samples use Appendix A, Table 1, Column 2 of the New Mexico Environmental Improvement Board Radiation Protection Regulations, filed March 10, 1989.[7]

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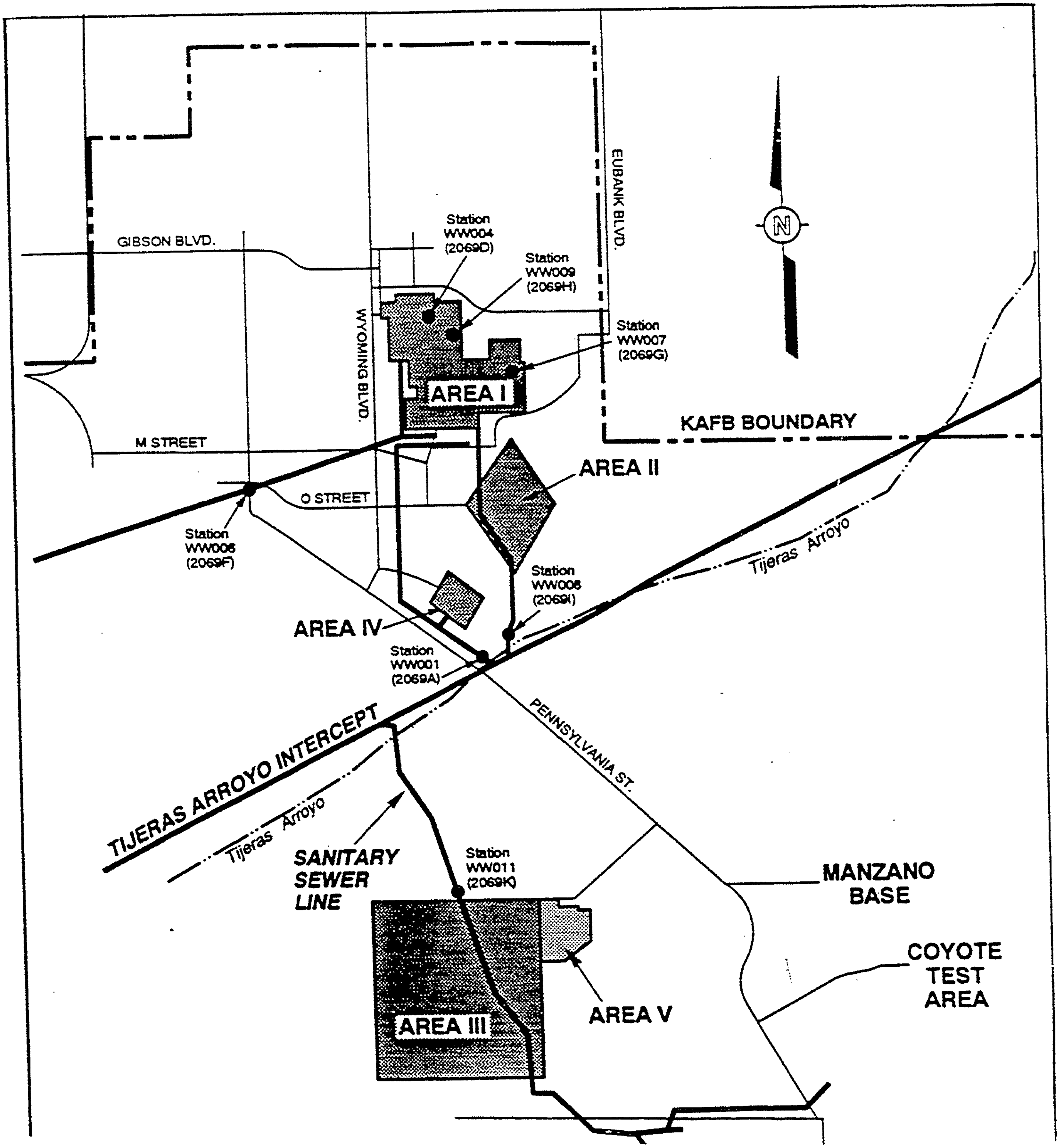
[6] Water Quality Standards for Interstate and Intrastate Streams in New Mexico, November 12, 1991. The criteria for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

[7] Values in the Radiation Protection Regulation's tables are typically expressed in units of microcuries per milliliter (μCi/ml). Results of radiological water quality samples taken as part of this study are typically expressed as picocuries per liter (pCi/L). In order to convert μCi/ml to pCi/L, multiply μCi/ml by 1×10^9 and change the denominator to liters.

Figure 7.2.1 Location of Wastewater Monitoring Stations at SNL (prepared by IT Corp. and provided by Adrian Jones, SNL).



7.5 Data Interpretation

A comparison of the analytical results obtained by NMED and SNL presents no significant differences.

8.0 INHALATION TOXICOLOGY RESEARCH INSTITUTE

8.1 Setting

The Inhalation Toxicology Research Institute is located on KAFB and its geologic and hydrologic setting is generally the same as given above for SNL (Figure 8.1.1).

8.2 Description of Study Area

ITRI no longer operates its own wastewater treatment facility. ITRI was connected into the City of Albuquerque Sanitary Sewer System and stopped using its sewage lagoons on May 21, 1992.

ITRI conducts its own wastewater monitoring to demonstrate compliance with the effluent limitations specified in the Wastewater Discharge Permit 2178A-2, issued to ITRI by the City's pretreatment section. ITRI's wastewater monitoring consists of sample collection at permit-specified frequencies along with continuous pH and flow monitoring.

8.3 Site Selection / Sampling Stations

In 1992, DOE Oversight Bureau staff was developing and planning a program to monitor stormwater runoff from DOE facilities. DOE Oversight Bureau procured automatic water quality samplers and flow meters during this time. Stormwater events were not sampled during 1992 or 1993 due to the development of the program and the commitment of resources at other DOE facilities. DOE Oversight Bureau intends to monitor stormwater runoff at ITRI during 1994 and 1995.

8.4 Applicable Water-Quality Standards

The same water-quality standards that apply to SNL apply to ITRI.

8.5 Data Interpretation

There were no sampling events in 1992 or 1993 at ITRI.

Figure 8.1.1 Location of the ITRI Facility.

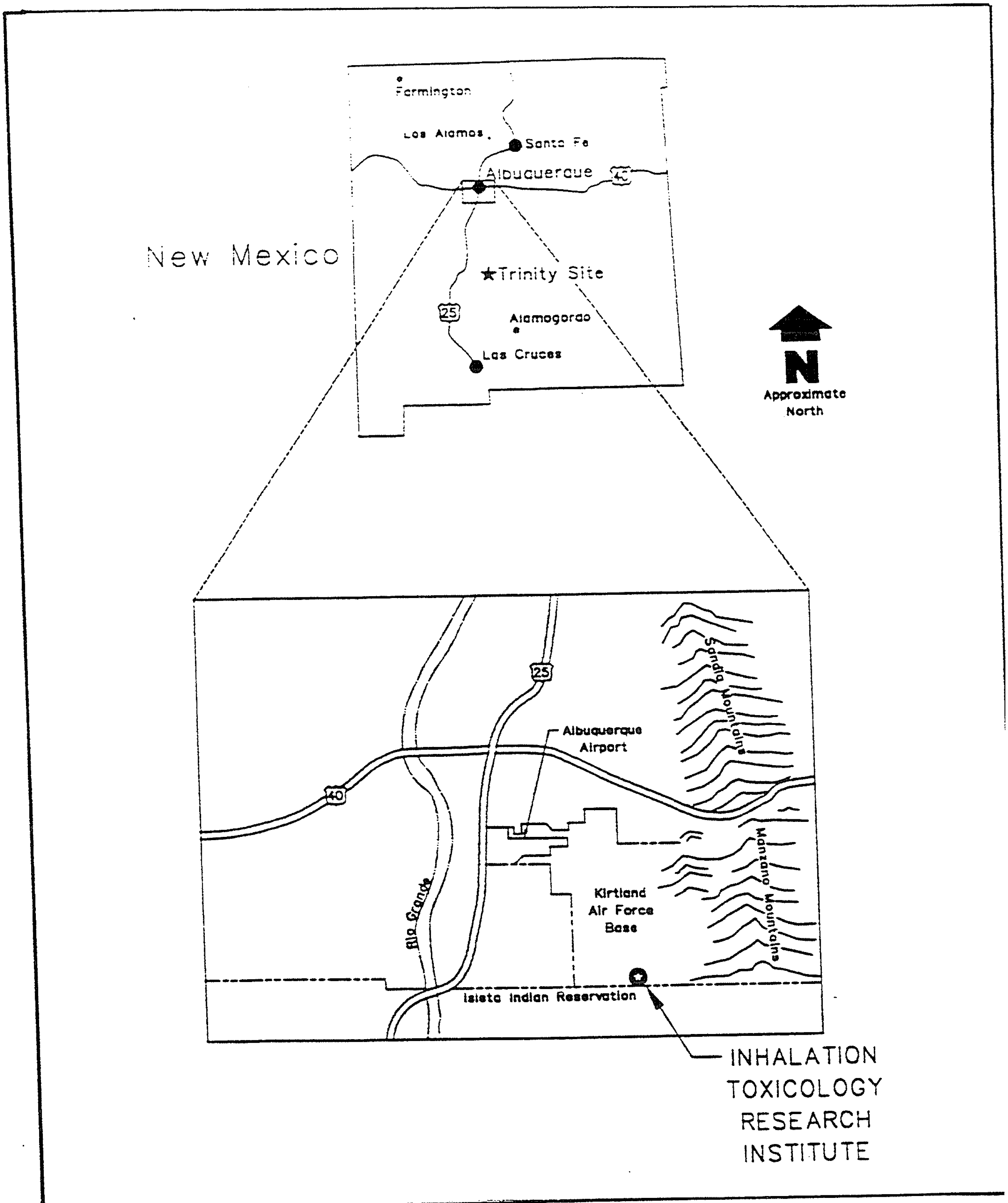
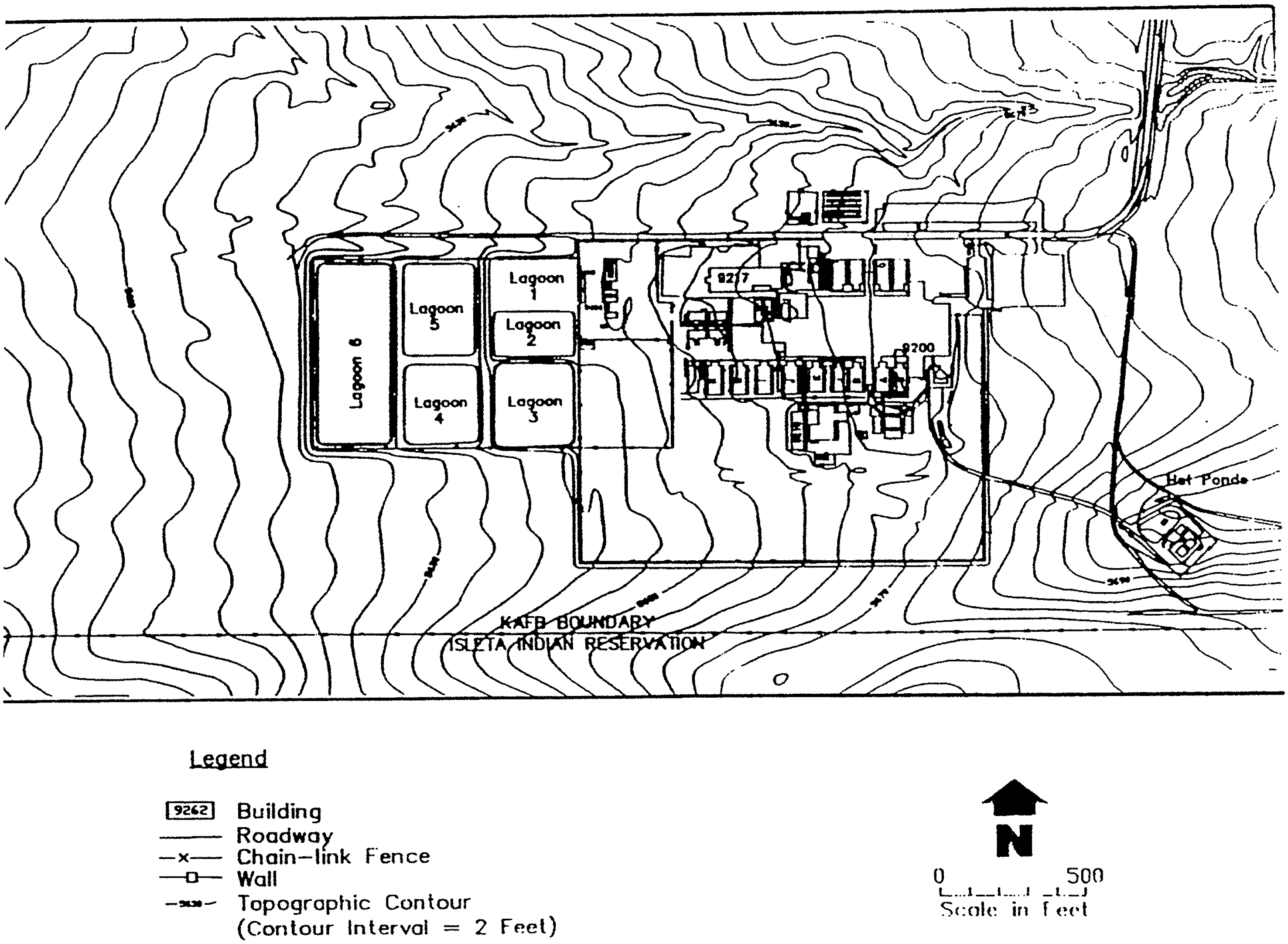


Figure 8.2.1 ITRI site map.



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9.0 WASTE ISOLATION PILOT PLANT

9.1 Setting

The following setting description is an excerpt from Stone, et al., 1993.

> "The Waste Isolation Pilot Plant (WIPP) is located on a karst plain approximately 26 miles east of Carlsbad, New Mexico (Figure 9.1.1). More specifically, it is in the area called "Los Medanos", on the gently sloping terrain rising eastward from the Pecos River to the Southern High Plains (Mercer, 1983). Geologically the site lies in the northern Delaware Basin, a late Paleozoic depression in which a sequence of various kinds of marine deposits accumulated (Figure 9.1.2). Of particular interest for the WIPP site is the Upper Permian or Ochoan Series of rocks. These include, in ascending order, the Castile Formation (anhydrite and halite), the Salado Formation (halite and potash), the Rustler Formation (anhydrite, dolostone, mudstone, halite) and Dewey Lake Red Beds (siltstone, claystone). Overlying the Permian rocks are nonmarine (dune, lake and stream) deposits of Quaternary age. The waste repository is being constructed in the lower halite member of the Salado Formation, at a depth of 2,150 ft below the surface (Chaturvedi and Rehfeldt, 1984).
>
> The region lies within the drainage of the Pecos River. However, owing to the blanket of permeable dune sand and the karst setting, integrated surface drainage features are largely nonexistent. For example, Nash Draw, a southeast-trending solution/collapse depression lying just west of the WIPP site and a major topographic feature of the region, has no external drainage (Mercer, 1983)."

9.2 Description of Study Area

The WIPP wastewater treatment system is a lagoon type system with zero discharge. The wastewater gravity flows to a splitter box where it can be directed to either or both of the primary settling basins. From the settling basins the flow goes to another splitter box where it can be directed to either or both of the polishing ponds. After the polishing ponds, chlorine is added by means of commercially available chlorination tablets placed in contact with the flow. After chlorination, the water is discharged to two evaporation basins. A schematic diagram of the wastewater treatment plant is given in Figure 9.2.

9.3 Site Selection / Sampling Station

The sanitary lagoons were selected for sampling in order to provide independent verification of water quality, and determine if the water complies with the Discharge Plan. Samples were also collected to determine background for radiological contaminants.

9.4 Applicable Water-Quality Standards

NMWQCC general standards apply to the WIPP site.

9.5 Data Interpretation

A comparison of analytical results obtained by NMED and Westinghouse showed no significant differences. While NMED's results indicate that there were measurable levels of Ra-226 present, the values were well below the permit limit.

Figure 9.1.1 Location of Geologic Setting of the WIPP Site (from Chaturvedi and Channell, 1995)

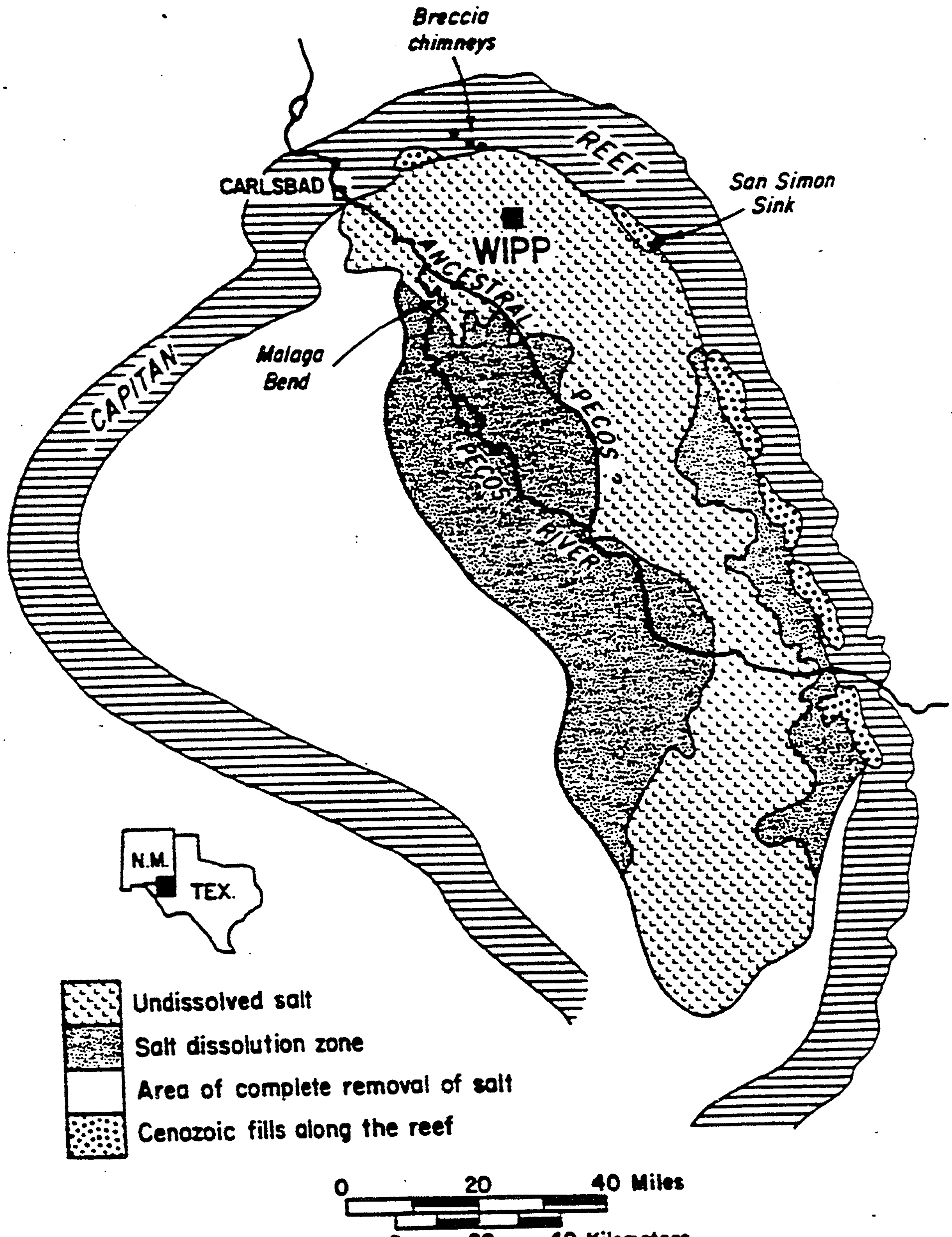


Figure 9.1.2 Generalized Stratiographic Column for the WIPP Site

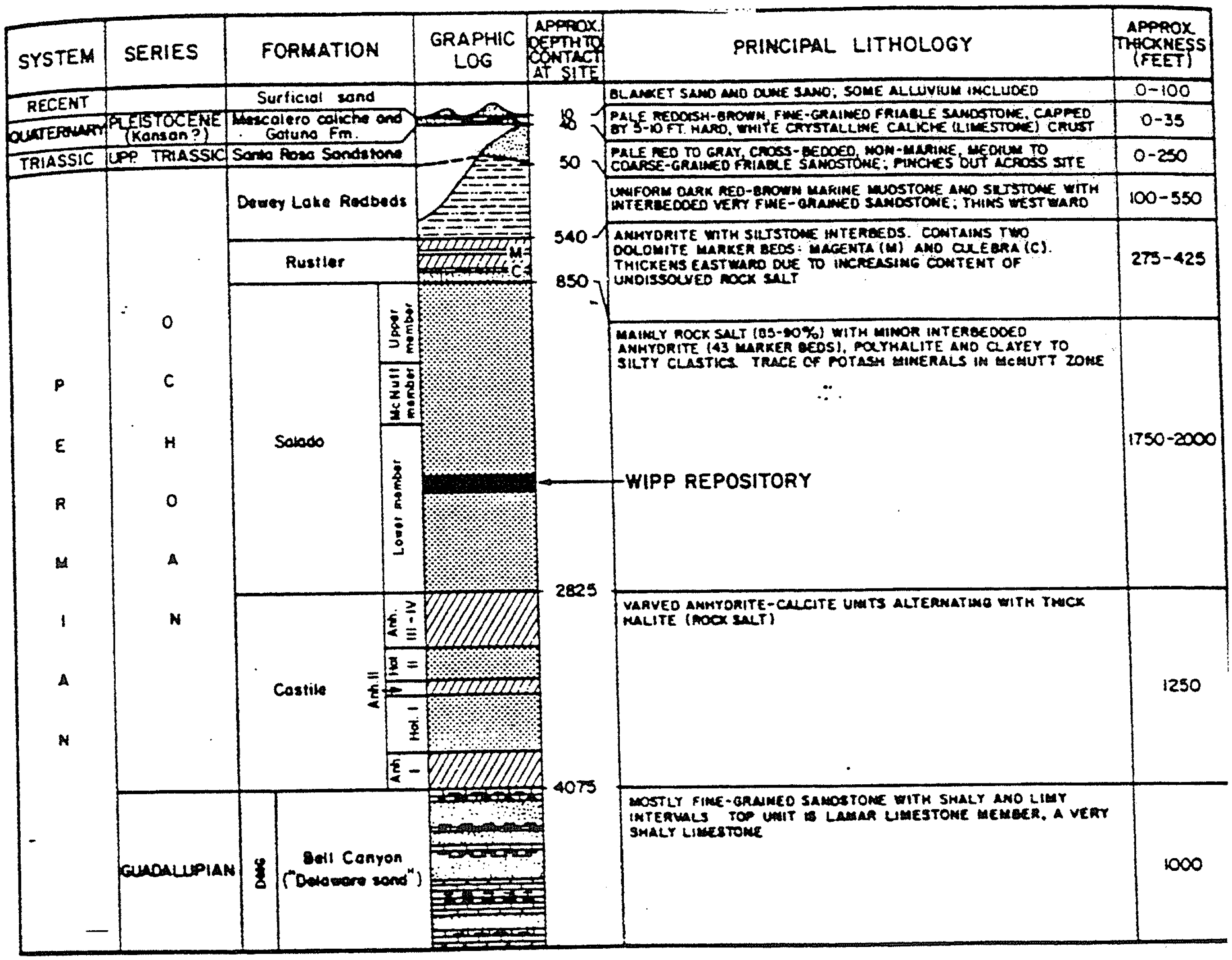
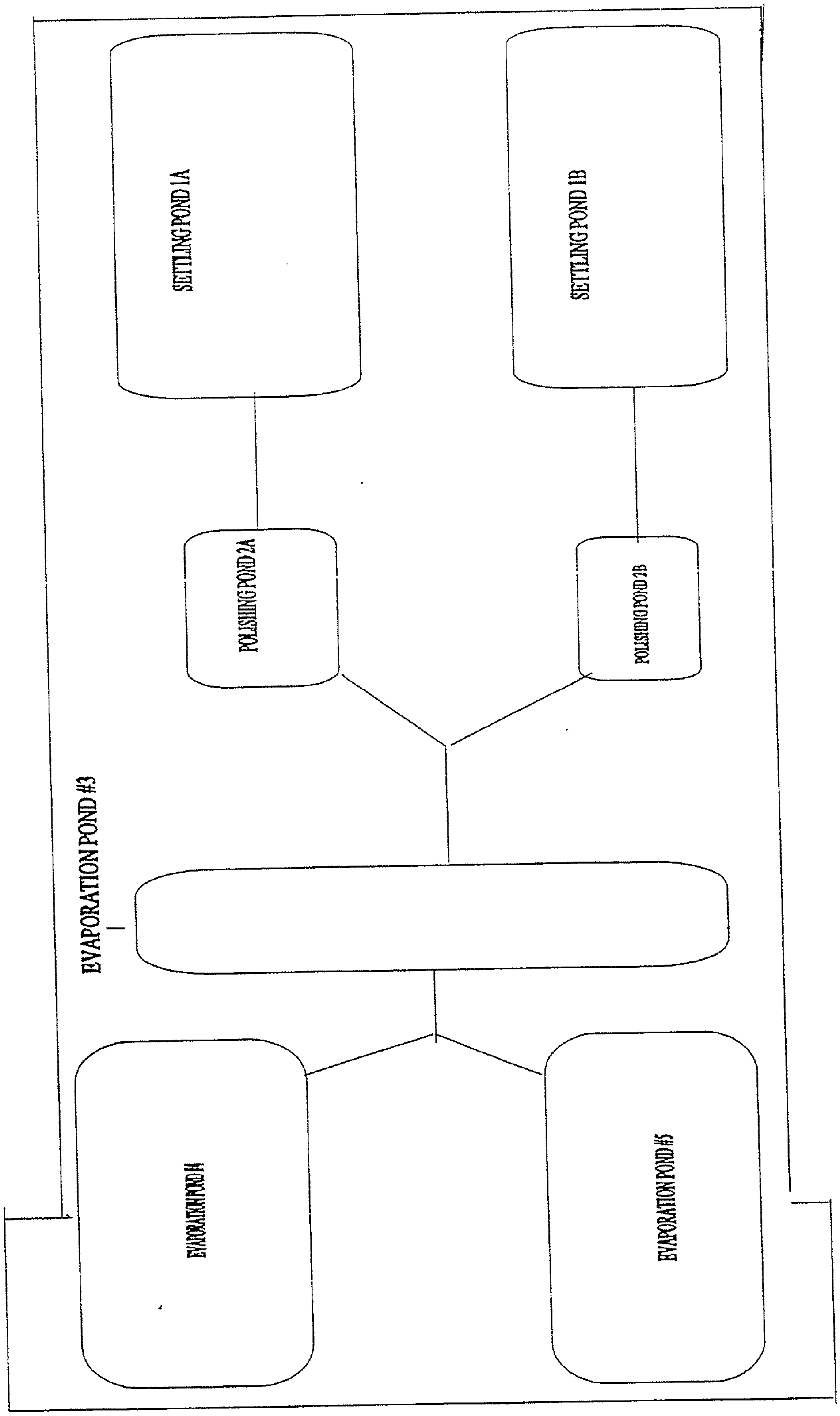


Figure 9.2 WIPP Sewage Facility Layout



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The mention of any manufacturer's name in this report does not constitute an endorsement of any kind by NMED.

10.0 TABLES

Table 6.3.1 Off-Site Snowmelt Runoff Stations - LANL - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
1992 Background			
Pajarito Canyon 50 yd. above W. Jemez Rd.	35 52 54.0	106 21 09.94	PA 10.4
Los Alamos Reservoir Spillway Discharge	35 53 00.1	106 21 11.74	LA 12.2
Water Canyon 100 yd. above W. Jemez Rd.	35 50 18.4	106 22 45.24	WA 9.9
Valle Canyon above W. Jemez Rd	35 51 08.8	106 21 50.6 4	VA 3.2
1993 Background			
Pueblo Canyon above Townsite	35 53 24	106 19 33	PU 6.6
Water Canyon 100 yd. above W. Jemez Rd.	35 50 18.4	106 22 45.24	WA 9.9
Pajarito Canyon 50 yd. above W. Jemez Rd.	35 52 54.0	106 21 09.94	PA 10.4
Valle Canyon above W. Jemez Rd.	35 51 08.8	106 21 50.6 4	VA 3.2

Table 6.3.2 On-Site Snow Melt Stations - LANL - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
1992 On-site Snowmelt Runoff Stations			
Los Alamos Canyon below TA-53	35 52 13	106 14 18	LA 5.3
Valle Canyon above Confluence with Water Canyon	35 49 50.9	106 18 15.9	VA 0.1
Water Canyon above Confluence w/ Canon de Valle	35 49 50.9	106 18 15.9	WA 6.7
Ancho Canyon below TA-49 @ Met Tower	35 48 33.3	106 17 05.4	AN 3.8
Pajarito Canyon @ G1	35 49 47.5	106 14 36.6	PA 4.4
Sandia Canyon 0.8 mi. E. of LANL TA-53 Entrance	35 51 59.1	106 16 10.1	SA 6.1
1993 On-site Snowmelt Runoff Stations			
Pueblo 3	35 52 44.6	106 13 52.2	PU 1.3
Beta Hole (below confluence of Water & Valle Canyons)	35 49 50.0	106 18 11.0	WA 6.7
Sandia Canyon 0.8 mi. E. of TA-53 Entrance	35 51 59.1	106 16 10.1	SA 6.1
Ancho Canyon @ hair pin turn on SR.4	35 47 30.3	106 15 64.2	AN 2.9
Acid Canyon Weir	35 53 26.6	106 18 34.5	AC0.0

Table 6.3.12 On-site Storm Water Sampling Stations - LANL - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
1992 On-site Stations			
None sampled in 1992			
1993 On-site Stations			
Los Alamos Reservoir Spillway Discharge (background)	35 53 00.1	106 21 11.74	LA 12.2
Los Alamos Canyon at Otowi Well No. 4	35 52 23	106 15 37	LA 6.6
DP Canyon at 60 deg. V-notch Weir	35 52 22	106 15 35	DP 0.1
Mortandad Canyon at Gage Station	35 51 54.8	106 17 41.5	MO 7.4
Pajarito Canyon @ G1	35 49 47.5	106 14 36.6 4	PA 4.4

Table 6.3.13 Off-site Stormwater Stations LANL - 1992 - 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
1993 Off-Site			
Los Alamos Canyon (East Side of State Rd. 4)	35 52 05	106 13 37	LA 4.1

Table 6.3.18 Other Surface Water Sampling Stations - LANL - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
1992			
Mortandad Canyon 300 yds. below LANL TA-50 Outfall 051 (above gage station)	35 51 54.8	106 17 41.54	MO 7.4
1993			
Mortandad Canyon 300 yds. below LANL TA-50 Outfall 051 (above gage station)	35 51 54.8	106 17 41.54	MO 7.4
Sacred Spring	35 53 35.01	106 8 57.80	Sacred Spr.
Indian Spring	35 53 4.39	106 9 47.66	Indian Spr.
La Mesita Spring	35 52 11	106 08 37	La Mesita Spr.
Basalt Spring	35 52 01	106 11 44	Basalt Spr.
Los Alamos Reservoir Spillway Discharge	35 53 00.1	106 21 11.74	LA 12.2
Los Alamos Canyon at Otowi Well No. 4	35 52 22	106 15 35	LA 6.6
TA-2 Basement Discharge (Unpermitted Discharge)	35 53 00.9	106 19 11.3	LA 8.4

Table 6.4.1 Sampling Stations -Springs of White Rock Canyon - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
Spring 1	35 51 31.35	106 09 23.66	Spring 1
Spring 2	35 51 16.43	106 09 31.16	Spring 2
Sandia Spring	35 50 28.42	106 10 21.38	Sandia Sir.
Spring 2A	35 49 22.87	106 10 27.98	Spring 2
Spring 3	35 49 10.02	106 10 42.04	Spring 3
Spring 3A	35 49 07.41	106 10 41.64	Spring 3A
Spring 3AA	35 48 45.18	106 10 44.44	Spring 3AA
Spring 3B	35 48 32.95	106 10 43.69	Spring 3B
Spring 4	35 48 13.93	106 11 48.37	Spring 4
Spring 4A	35 48 13.68	106 11 46.96	Spring 4A
Spring 5	35 47 21.05	106 11 48.06	Spring 5
Spring 5A	35 47 15.75	106 11 56.46	Spring 5A
Spring 5AA	35 47 21.28	106 12 47.69	Spring 5AA
Spring 5B	35 46 37.76	106 12 48.92	Spring 5B
Ancho Spring	35 46 55.58	106 13 54.46	Ancho Spring
Spring 6	35 46 11.61	106 13 15.17	Spring 6
Spring 6A	35 45 59.30	106 13 43.33	Spring 6A
Spring 7	35 45 52.28	106 14 01.75	Spring 7
Spring 8	35 45 51.29	106 14 09.03	Spring 8
Spring 8A	35 45 51.75	106 14 16.63	Spring 8A
Spring 8B	35 45 52.28	106 14 23.60	Spring 8B
Spring 9	35 45 49.86	106 14 21.28	Spring 9
Spring 9A	35 45 48.18	106 14 29.69	Spring 9A
DOE Spring	35 45 52.64	106 14 34.75	DOE Spring
Spring 10	35 44 58.87	106 15 26.95	Spring 10

Table 6.4.6 Sampling Stations and Streams of White Rock Canyon - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
Rio Grande At Otowi Bridge	35 52 51.5	106 08 58.3	Rio Grande at Otowi Bridge
Mortandad Stream above confluence with Rio Grande	35 49 44.4	106 10 19.0	MO 0.1
Pajarito Stream above confluence with Rio Grande	35 48 10.9	106 11 39.8	PA 0.1
Ancho Stream above confluence with Rio Grande	35 46 17.1	106 13 11.3	AN 0.1
Chaquehui above confluence with Rio Grande	35 45 49.3	106 14 32.0	CH 0.1
Frijoles above confluence with Rio Grande	35 45 15.5	106 15 19.4	FR 0.1
Cochiti Lake at Bland Canyon			Cochiti Lake at Bland Canyon
Cochiti Lake at the Tetilla Boat landing			Cochiti Lake at Boat landing
Cochiti Lake at the Dam Site	35 37 00.0	106 19 00.1	Cochiti Lake at Dam Site

Table 6.5.1 Invertebrate Sampling Stations - LANL - 1992 & 1993

STATION	LATITUDE	LONGITUDE	MAP DESIGNATION
Stations Sampled in 1992			
Mortandad Stream above confluence with Rio Grande	35 49 44.4	106 10 19.0	MO 0.1
Pajarito Stream above confluence with Rio Grande	35 48 10.9	106 11 39.8	PA 0.1
Chaquehui above confluence with Rio Grande	35 45 49.3	106 14 32.0	CH 0.1
Ancho Stream above confluence with Rio Grande	35 46 17.1	106 13 11.3	AN 0.1
Frijoles above confluence with Rio Grande	35 45 15.5	106 21 11.7	FR 0.1
Stations Sampled in 1993			
Los Alamos Canyon below Reservoir Spillway	35 53 00.1	106 21 11.7	LA 12.2
Los Alamos Canyon below TA 53	35 52 13	106 14 18	LA 5.3
Sandia Canyon below TA 53	35 51 59	106 16 10	SA 6.1
Ancho Stream above confluence with Rio Grande	35 46 17.1	106 13 11.3	AN 0.1
Pajarito Stream above confluence with Rio Grande	35 48 10.9	106 11 39.8	PA 0.1
DP Canyon	35 52 22	106 15 35	DP 0.1
Frijoles above confluence with Rio Grande	35 45 15.5	1106 21 11.7	FR 0.1

TABLE 6.3.3 Snowmelt Stations - Water Chemistry - LANL - 1992

	SNOWMELT STATIONS									
WATER CHEMISTRY	AN3.8 Dt: 920505 Tm: 0955	VA0.1 Dt: 920505 Tm: 1215	WA6.7 Dt: 920505 Tm: 1301	LA12.2 Dt: 920506 Tm: 0849	PA10.4 Dt: 920506 Tm: 0953	VA3.2 Dt: 920506 Tm: 1045	WA9.9 Dt: 920506 Tm: 1244	PA4.4 Dt: 920506 Tm: 1420	SA6.1 Dt: 920507 Tm: 1034	LA5.3 Dt: 920507 Tm: 1400
Water Temp. (C)	12.50	11.00	15.50	10.00	7.20	11.00	8.40	17.50	10.50	12.00
Field Conductivity (uhmo)	140.00	90.00	90.00	50.00	35.00	8.00	95.00	220.00	310.00	125.00
Dissolved Oxygen (mg/L)	3.00	5.80	6.00	6.40	7.20	7.20	5.60	6.50	8.15	8.20
Field pH (S.U.)	7.29	7.50	7.60	8.30	8.10	7.90	7.00	8.50	8.10	7.60
Nitrate+ite (mg/L)	0.04K	0.04K	0.09	0.10	0.18	1300.00	0.04K	0.04K	4.32	0.10
Ammonia (mg/L)	0.16	0.12Q	0.14Q	0.10K	0.10K	0.10	0.14	0.10KQ	0.10	0.10
Kjeldahl N (mg/L)	0.83	0.32Q	0.29Q	0.22Q	0.20Q	0.10KQ	0.39Q	0.21Q	0.71Q	0.27
Total Phos. (mg/L)	0.12	0.10Q	0.12Q	0.09Q	1.37Q	0.05Q	0.10Q	0.03Q	1.69Q	0.12
BOD (mg/L)	2.00	1.00K	1.00K	1.00K	1.00K	1.00KQ	1.00K	1.00K	1.00K	1.00K
COD (mg/L)	47.00	9.00	15.00	11.00	10.00	8.00	11.00	21.00	38.00	8.00
Cyanide (mg/L)	0.02K	0.02KQ	0.02K	0.02K	0.04K	0.04KQ	0.02K	0.04K	0.02K	0.02K
Ca (mg/L)	22.00	15.00	13.00	6.00	6.00	6.00	24.00	21.00	18.00	9.00
Mg (mg/L)	5.00	4.00	4.00	2.00	2.00	1.00	4.00	6.00	3.00	2.00
K (mg/L)	6.00	3.00	4.00	2.00	2.00	2.00	4.00	4.00	9.00	3.00
Na (mg/L)	13.00	13.00	20.00	5.00	3.00	3.00	13.00	22.00	82.00	19.00
Hardness (mg/L)	76.00	54.00	49.00	23.00	23.00	19.00	76.00	77.00	57.00	31.00
Alkalinity (mg/L)	89.10Q	49.10Q	38.40Q	21.20Q	26.10Q	20.90	38.4Q	78.6Q	90.20Q	35.8Q
Bicarbonate(mg/L)	109.00	59.80	46.90	25.80	31.90	25.50	46.90	95.90	94.60	43.70
Carbonate (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.20Q	0.00
Chloride (mg/L)	5.00KQ	5.00Q	24.00Q	7.80	5.00KQ	5.00KQ	19.00Q	30.1Q	37.70Q	25.40Q
Fluoride (mg/L)	0.18	0.27	0.18	0.10K	0.10K	0.10K	0.11	0.14	0.70	0.26
Sulfate (mg/L)	5.00KQ	6.10Q	7.60Q	7.60Q	7.10Q	6.20Q	10.20Q	8.1Q	87.40Q	7.90Q
Color Test (units)	50.00LQ	50.00L	50.00L	30.00Q	20.00Q	25.00Q	50.00LQ	5.00Q	25.00Q	30.00Q
Lab Conductivity (uS/cm)	194.00	129.00	178.00	77.00	71.00	60.00	153.00	263.00	557.00	173.00
Lab pH (S.U.)	7.74	7.63	7.28	7.28	7.42	7.35	7.78	8.07	8.72	7.53
TDS (mg/L)	175.00Q	184.00	204.00Q	68Q	68Q	88.00Q	196.00Q	152.00Q	358Q	156Q
TSS (mg/L)	12.00Q	8.00	4.00Q	15Q	35Q	3.00Q	8.00Q	5.00Q	39Q	12Q

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.4 Snowmelt Stations - Total Metals - LANL - 1992

TOTAL METALS (ug/L)	SNOWMELT STATIONS										
	AN3.8 Dt: 920505 Tm: 1025	VA0.1 Dt: 920505 Tm: 1253	WA6.7 Dt: 920505 Tm: 1316	LA12.2 Dt: 920506 Tm: 0851	PA10.4 Dt: 920506 Tm: 0944	VA3.2 Dt: 920506 Tm: 1043	WA9.9 Dt: 920506 Tm: 1238	PA4.4 Dt: 920506 Tm: 1430	PA4.4 * Dt: 920506 Tm: 1449	SA6.1 Dt: 920507 Tm: 1051	LA5.3 Dt: 920507 Tm: 1414
Al	700	6700	6500	3000	2600	1500	6400	100K	100Q	1000	3000
Ba	100K	800	110	100K	100K	100K	100K	100K	100KQ	100K	100K
Be	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	100K	100K
B	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	200	100K
Ca	21000	10000	13000	64000	6300	5300	11000	16000	14000Q	20000	10000
Co	5K	5K	5K	5K	5K	5K	5K	5K	50KQ	5K	5K
Cu	50K	50K	50K	50K	50K	50K	50K	50K	100KQ	50K	50K
Fe	2500	3300	2900	1100	900	500	2600	100	100KQ	700	1200
Mg	5100	3400	3900	2100	2400	1600	4000	5000	4700Q	3800	2700
Mn	400	50K	50K	50K	50K	50K	50K	50K	50KQ	50K	50K
Mo	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	200	100K
Ni	200	200	100K	100	100	200	200	100K	100KQ	100	100K
Si	2900	2900	3100	2600	2500	2600	3300	1600	1700Q	3800	2700
Ag	1K	1K	1K	1K	1K	1K	1K	1K	100KQ	1	1K
Sr	100	100K	100K	100K	100K	100K	100K	100	100Q	100K	100K
Sn	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	100K	100K
V	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	100K	100K
Zn	100K	100K	100K	100K	100K	100K	100K	100K	100KQ	100K	100K
U	5K	5K	5K	5K	5K	5K	5K	5K		5K	5K
As	5K	5K	5K	5K	5K	5K	5K	5K	5KQ	5K	5K
Cd	1K	1K	1K	1K	1K	1K	1K	1K	1KQ	1K	1K
Cr	5K	5K	5K	25	5K	5K	5K	5K	5KQ	15	5K
Pb	5K	5K	5K	5K	5K	5K	5K	6	5KQ	5K	5K
Hg	.5K	.5K	.5K	.5K	.5K	.5K	.5K	.5K	.5KQ	.5K	.5K
Se	5K	5K	5K	5K	5K	5K	5K	5K		5K	5K

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.5 Snowmelt Stations - Dissolved Metals - LANL - 1992

DISSOLVED METALS (ug/L)	SNOWMELT STATIONS									
	AN3.8 Dt: 920505 Tm: 1025	VA0.1 Dt: 920505 Tm: 1253	WA6.7 Dt: 920505 Tm: 1316	LA12.2 Dt: 920506 Tm: 0851	PA10.4 Dt: 920506 Tm: 0944	VA3.2 Dt: 920506 Tm: 1043	WA9.9 Dt: 920506 Tm: 1238	PA4.4 Dt: 920506 Tm: 1430	SA6.1 Dt: 920507 Tm: 1051	LA5.3 Dt: 920507 Tm: 1414
Al	100KQ	3300Q	2800Q	1700Q	1600Q	1300Q	4400Q	100KQ	100	1000
Ba	100KQ	100K	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100Q
Be	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
B	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
Ca	20000Q	10000Q	11000Q	6200Q	6200Q	5600Q	10000Q	21000Q	19000	10000
Co	5KQ	10K	5KQ	5KQ	5KQ	5KQ	5KQ	5KQ	10K	5KQ
Cu	50KQ	50K	50KQ	50KQ	50KQ	50KQ	50KQ	50KQ	50K	50K
Fe	700Q	1600Q	1300Q	600Q	500Q	500Q	1900Q	100KQ	200	400
Mg	4600Q	3100Q	3600Q	2100Q	2400Q	1700Q	4300Q	5600Q	3700	2700
Mn	310Q	50KQ	50KQ	50KQ	50KQ	50KQ	50KQ	50KQ	50K	50K
Mo	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	200	100K
Ni	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
Si	17000Q	24000Q	300Q	16000Q	18000Q	15000Q	500Q	12000Q	40000	19000
Ag	1KQ	1K	1KQ	1KQ	1KQ	1KQ	1K	1KQ	1K	1K
Sr	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
Sn	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
V	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
Zn	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100KQ	100K	100K
U	5KQ	5K	5K	5KQ	5KQ	5K	5K	5KQ	5K	5K
As	5KQ	5K	5KQ	5KQ	5KQ	5KQ	5KQ	5KQ	5K	5KQ
Cd	1KQ	1K	1KQ	1KQ	1KQ	1KQ	1KQ	1KQ	1K	1KQ
Cr	5KQ	5K	5KQ	15KQ	7KQ	18KQ	5KQ	5KQ	8	5KQ
Pb	5KQ	5K	5KQ	5KQ	5KQ	5KQ	5KQ	5KQ	5K	5K
Hg	.5KQ	.5K	.5K	.5KQ	.5KQ	.5K	.5K	.5KQ	.5K	.5K
Se	5KQ	5K	5KQ	5KQ	5KQ	5KQ	5K	5KQ	5K	5KQ

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.6 Snowmelt Stations - Radiochemistry - LANL - 1992 (Part I)

ANALYTE (pCi/L)	SNOWMELT STATIONS								
	AN3.8 Dt: 920505 Tm: 0955			VA0.1 Dt: 920505 Tm: 1254			WA6.7 Dt: 920505 Tm: 1328		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	0.30	0.30	0.40	0.70	0.20	0.40	1.20	0.40	0.60
Gross-alpha w/ U-nat ref	0.50	0.40	0.60	1.00	0.40	0.60	1.70	0.60	0.80
Gross-beta w/ Cs-137 ref	9.70	0.80	0.70	6.00	0.60	0.60	7.20	0.70	1.00
Gross-beta w/ Sr/Y-90 ref	9.70	0.70	0.70	6.00	0.60	0.70	7.30	0.70	1.00
U-238 Alpha Spec.	0.13	0.07		0.22	0.07		0.16	0.06	
U-234 Alpha Spec.	0.075	0.06		0.11	0.05		0.06	0.05	
Th-230 Alpha Spec.	-0.003	0.04		0.11	0.06		0.06	0.05	
Th-232 Alpha Spec.	0.026	0.013		0.09	0.06		0.1	0.06	
Am-241 Alpha Spec.	-0.01	0.013		0.06	0.025		0.031	0.02	
Pu-239 Alpha Spec	-0.005	0.006							
Pu-238 Alpha Spec.	-0.027	0.015							

ANALYTE (pCi/L)	SNOWMELT STATIONS								
	LA12.2 Dt: 920506 Tm: 0902			PA10.4 Dt: 920506 Tm: 1010			VA3.2 Dt: 920506 Tm: 1107		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	0.50	0.20	0.30	0.40	0.20	0.30	0.30	0.10	0.30
Gross-alpha w/ U-nat ref	0.60	0.20	0.40	0.60	0.20	0.30	0.40	0.20	0.30
Gross-beta w/ Cs-137 ref	3.00	0.30	0.50	3.20	0.30	0.50	2.60	0.30	0.50
Gross-beta w/ Sr/Y-90 ref	3.00	0.30	0.50	3.20	0.30	0.50	2.60	0.30	0.50
U-238 Alpha Spec.	0.11	0.05		0.15	0.06		0.11	0.06	
U-234 Alpha Spec.	0.07	0.05		0.06	0.04		0.04	0.04	
Th-230 Alpha Spec.	0.015	0.04		0	0.03		0.02	0.04	
Th-232 Alpha Spec.	0.041	0.015		0.032	0.014		0.029	0.013	
Am-241 Alpha Spec.	0.005	0.1		-0.004	0.007		0.033	0.02	
Pu-239 Alpha Spec	0	0.006		0.068	0.021		0.012	0.011	
Pu-238 Alpha Spec.	-0.019	0.013		-0.01	0.011		-0.002	0.012	

ANALYTE (pCi/L)	SNOWMELT STATIONS								
	WA9.9 Dt: 920506 Tm: 1306			PA4.4 Dt: 920506 Tm: 1450			PA4.4* Dt: 920506 Tm: 1450		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	1.70	0.30	0.40	0.40	0.30	0.40	0.30	0.20	0.40
Gross-alpha w/ U-nat ref	2.40	0.50	0.60	0.60	0.40	0.60	0.40	0.30	0.60
Gross-beta w/ Cs-137 ref	6.10	0.60	0.70	4.40	0.50	0.70	4.70	0.60	0.70
Gross-beta w/ Sr/Y-90 ref	6.10	0.60	0.70	4.40	0.50	0.70	4.80	0.60	0.70
U-238 Alpha Spec.	0.14	0.08		0.17	0.07		0.15	0.06	
U-234 Alpha Spec.	0.22	0.1		0.12	0.06		0.1	0.05	
Th-230 Alpha Spec.	0.05	0.04		-0.03	0.04		0	0.04	
Th-232 Alpha Spec.	0.11	0.03		0.005	0.006		0.017	0.015	
Am-241 Alpha Spec.	-0.004	0.01		0.002	0.007		0.06	0.03	
Pu-239 Alpha Spec	0	0.006		-0.003	0.005		0.06	0.04	
Pu-238 Alpha Spec.	-0.019	0.013		-0.015	0.012		0.025	0.04	

TABLE 6.3.6 Snowmelt Stations - Radiochemistry - LANL - 1992 (Part I)
(Continued From Previous Page)

ANALYTE (pCi/L)	SNOWMELT STATIONS					
	LA5.3 Dt: 920507 Tm: 000			SA6.1 Dt: 920507 Tm: 1052		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	0.60	0.30	0.40	0.60	0.40	0.90
Gross-alpha w/ U-nat ref	0.80	0.40	0.60	0.80	0.60	1.20
Gross-beta w/ Cs-137 ref	8.00	0.70	0.70	10.70	1.10	1.50
Gross-beta w/ Sr/Y-90 ref	8.10	0.70	0.70	10.70	1.10	1.50
U-238 Alpha Spec.	0.21	0.08		0.14	0.06	
U-234 Alpha Spec.	0.13	0.06		0.11	0.05	
Th-230 Alpha Spec.	0.005	0.04		0.02	0.04	
Th-232 Alpha Spec.	0.067	0.021		0.042	0.015	
Am-241 Alpha Spec.	0.046	0.019		0.009	0.01	
Pu-239 Alpha Spec	0.08	0.025		0.011	0.01	
Pu-238 Alpha Spec.	-0.011	0.011		-0.01	0.013	

TABLE 6.3.7 Snowmelt Stations - Radiochemistry - LANL - 1992 (Part II)

STATION	DATE	TIME	GAMA SPEC # of PEAKS	NUCLIDE	ENERGY keV	gamma/sec/L	pCi/L
AN3.8	920505	0955	0				
VA0.1	920505	1254	0				
WA6.7	920505	1328	0				
LA12.2	920506	0902	0				
PA10.4	920506	1010	1	K-40	1461.58	0.22 +- 0.22	56. +-55.
VA3.2	920506	1107	0				
WA9.9	920506	1306	0				
PA4.4	920506	1450	0				
PA4.4*	920506	1450	0				
SA6.1	920507	1052	0				
LA5.3	920507	000	0				

* = Replicate

TABLE 6.3.8 Snowmelt Stations - Volatile Organic Compounds - LANL - 1992

VOLATILE ORGANIC COMPOUNDS (ug/L)	SNOWMELT STATIONS										
	AN3.8 920505 0955	VA0.1 920505 1246	WA6.7 920505 1323	LA12.2 920506 0857	PA10.4 920506 1001	VA3.2 920506 1058	WA9.9 920506 1259	PA4.4 920506 1445	PA4.4 920506 1452	SA6.1 920507 1045	LA5.3 920507 1400
Acetone	U	U	U	U	U	U	U	U	U	U	
Benzene	U	U	U	U	U	U	U	U	U	U	
Bromobenzene	U	U	U	U	U	U	U	U	U	U	
Bromochloromethane (Chlorobromomethane)	U	U	U	U	U	U	U	U	U	U	
Bromodichloromethane	U	U	U	U	U	U	U	U	U	U	
Bromoform	U	U	U	U	U	U	U	U	U	U	
Bromomethane	U	U	U	U	U	U	U	U	U	U	
2-Butanone (MEK)	U	U	U	U	U	U	U	U	U	U	
n-Butylbenzene	U	U	U	U	U	U	U	U	U	U	
sec-Butylbenzene	U	U	U	U	U	U	U	U	U	U	
tert-Butylbenzene	U	U	U	U	U	U	U	U	U	U	
tert-Butyl methyl ether (MTBE)	U	U	U	U	U	U	U	U	U	U	
Carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	
Chlorobenzene	U	U	U	U	U	U	U	U	U	U	
Chloroethane	U	U	U	U	U	U	U	U	U	U	
Chloroform	U	U	U	U	U	U	U	U	U	U	
Chloromethane (Methyl Chloride)	U	U	U	U	U	U	U	U	U	U	
2-Chlorotoluene	U	U	U	U	U	U	U	U	U	U	
4-Chlorotoluene (1-Methyl-4Chlorobenzene)	U	U	U	U	U	U	U	U	U	U	
1,2-Dibromo-3-chloropropane	U	U	U	U	U	U	U	U	U	U	
Dibromochloromethane	U	U	U	U	U	U	U	U	U	U	
1,2-Dibromoethane	U	U	U	U	U	U	U	U	U	U	
Dibromomethane (Methylene Bromide)	U	U	U	U	U	U	U	U	U	U	
1,2-Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	
1,3-Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	
1,4-Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	
Dichlorodifluoromethane	U	U	U	U	U	U	U	U	U	U	
1,1-Dichloroethane	U	U	U	U	U	U	U	U	U	U	
1,2-Dichloroethane	U	U	U	U	U	U	U	U	U	U	
1,1-Dichloroethene	U	U	U	U	U	U	U	U	U	U	
cis-1,2-Dichloroethene	U	U	U	U	U	U	U	U	U	U	
trans-1,2-Dichloroethene	U	U	U	U	U	U	U	U	U	U	
1,2-Dichloropropane	U	U	U	U	U	U	U	U	U	U	
1,3-Dichloropropane	U	U	U	U	U	U	U	U	U	U	
2,2-Dichloropropane	U	U	U	U	U	U	U	U	U	U	
1,1-Dichloropropene	U	U	U	U	U	U	U	U	U	U	
cis-1,3-Dichloropropene	U	U	U	U	U	U	U	U	U	U	
trans-1,3-Dichloropropene	U	U	U	U	U	U	U	U	U	U	
Ethylbenzene	U	U	U	U	U	U	U	U	U	U	
Hexachlorobutadiene	U	U	U	U	U	U	U	U	U	U	
Isopropylbenzene	U	U	U	U	U	U	U	U	U	U	
(1-Methyl -) 4-Isopropyltoluene	U	U	U	U	U	U	U	U	U	U	
Methylene chloride	U	U	U	U	U	U	U	U	U	U	
Naphthalene	U	U	U	U	U	U	U	U	U	U	

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

TABLE 6.3.8 Snowmelt Stations - Volatile Organic Compounds - LANL - 1992
(Continued)

VOLATILE ORGANIC COMPOUNDS (ug/L)	SNOWMELT STATIONS									
	AN3.8 920505 0955	VA0.1 920505 1246	WA6.7 920505 1323	LA12.2 920506 0857	PA10.4 920506 1001	VA3.2 920506 1058	WA9.9 920506 1259	PA4.4 920506 1445	PA4.4 920506 1452	SA6.1 920507 1045	L 92 1
N-Propylbenzene	U	U	U	U	U	U	U	U	U	U	
Styrene	U	U	U	U	U	U	U	U	U	U	
1,1,1,2-Tetrachloroethane	U	U	U	U	U	U	U	U	U	U	
1,1,2,2-Tetrachloroethane	U	U	U	U	U	U	U	U	U	U	
Tetrachloroethylene	U	U	U	U	U	U	U	U	U	U	
Tetrahydrofuran (THF)	U	U	U	U	U	U	U	U	U	U	
Toluene	U	U	U	U	U	U	U	U	U	U	
1,2,3-Trichlorobenzene	U	U	U	U	U	U	U	U	U	U	
1,2,4-Trichlorobenzene	U	U	U	U	U	U	U	U	U	U	
1,1,1-Trichloroethane	U	U	U	U	U	U	U	U	U	U	
1,1,2-Trichloroethane	U	U	U	U	U	U	U	U	U	U	
Trichloroethylene	U	U	U	U	U	U	U	U	U	U	
Trichlorofluoromethane	U	U	U	U	U	U	U	U	U	U	
1,2,3-Trichloropropane	U	U	U	U	U	U	U	U	U	U	
1,2,4-Trimethylbenzene	U	U	U	U	U	U	U	U	U	U	
1,3,5-Trimethylbenzene	U	U	U	U	U	U	U	U	U	U	
Vinyl chloride	U	U	U	U	U	U	U	U	U	U	
o-Xylene	U	U	U	U	U	U	U	U	U	U	
p- & m- Xylene	U	U	U	U	U	U	U	U	U	U	
Acenaphthene	U	U	U	U	U	U	U	U	U	U	
Acenaphthylene	U	U	U	U	U	U	U	U	U	U	
Anthracene	U	U	U	U	U	U	U	U	U	U	
Benzoic acid	U	U	U	U	U	U	U	U	U	U	
Benzo (a) anthracene	U	U	U	U	U	U	U	U	U	U	
Benzo (b) fluoroanthene	U	U	U	U	U	U	U	U	U	U	
Benzo (k) fluoroanthene	U	U	U	U	U	U	U	U	U	U	
Benzo (g,h,i,) perylene	U	U	U	U	U	U	U	U	U	U	
Benzo -a-pyrene	U	U	U	U	U	U	U	U	U	U	
Benzyl alcohol	U	U	U	U	U	U	U	U	U	U	
Bis (2-chloroethoxy) methane	U	U	U	U	U	U	U	U	U	U	
Bis (2-chloroethyl) ether	U	U	U	U	U	U	U	U	U	U	
Bis (2-chloroisopropyl)ether	U	U	U	U	U	U	U	U	U	U	
Bis (2-ethylhexyl) phthalate	1.00 (J)	U	10.00 (B)	U	1.00 (J)	10.00	60.00	50.00	1.00 (J)	120.00	8
4-Bromophenylphenyl ether	U	U	U	U	U	U	U	U	U	U	
N-Butylbenzyl phthalate	U	U	U	U	U	U	U	U	U	4.00 (J)	
4-Chloroaniline (Benzenomine, 4 Chloro)	U	U	U	U	U	U	U	U	U	U	
2-Chloronaphthalene	U	U	U	U	U	U	U	U	U	U	
4-Chloro-3-methylphenol (Parachlorometa Cresol)	U	U	U	U	U	U	U	U	U	U	
2-Chlorophenol	U	U	U	U	U	U	U	U	U	U	
4-Chlorophenylphenyl ether	U	U	U	U	U	U	U	U	U	U	
Chrysene	U	U	U	U	U	U	U	U	U	U	

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

TABLE 6.3.8 Snowmelt Stations - Volatile Organic Compounds - LANL - 1992
(Continued)

VOLATILE ORGANIC COMPOUNDS (ug/L)	SNOWMELT STATIONS										
	AN3.8 920505 0955	VA0.1 920505 1246	WA6.7 920505 1323	LA12.2 920506 0857	PA10.4 920506 1001	VA3.2 920506 1058	WA9.9 920506 1259	PA4.4 920506 1445	PA4.4 920506 1452	SA6.1 920507 1045	LA5.3 920507 1400
Dibenz (a,h) anthracene (1,2,5,6-Dibenzanthracene)	U	U	U	U	U	U	U	U	U	U	U
Dibenzofuran	U	U	U	U	U	U	U	U	U	U	U
Di-n-butyl phthalate	1.00 (J)	2.00 (J,B)	1.00 (J,B)	U	U	U	U	U	U	U	U
1,2 -Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	U
1,3-Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	U
1,4-Dichlorobenzene	U	U	U	U	U	U	U	U	U	U	U
3,3'-Dichlorobenzidine	U	U	U	U	U	U	U	U	U	U	U
2,4-Dichlorophenol	U	U	U	U	U	U	U	U	U	U	U
Diethyl phthalate	U	U	1.00 (J,B)	U	U	U	U	U	U	U	U
2,4-Dimethylphenol	U	U	U	U	U	U	U	U	U	U	U
Dimethyl phthalate	U	U	U	U	U	U	U	U	U	U	U
4,6-Dinitro-2-methylphenol	U	U	U	U	U	U	U	U	U	U	U
2,4-Dinitrophenol	U	U	U	U	U	U	U	U	U	U	U
2,4-Dinitrotoluene	U	U	U	U	U	U	U	U	U	U	U
2,6-Dinitrotoluene	U	U	U	U	U	U	U	U	U	U	U
Di-n-octyl phthalate	U	1.00 (J, B)	U	U	U	U	U	U	U	60.00	U
Fluoranthene	U	U	U	U	U	U	U	U	U	U	U
Fluorene	U	U	U	U	U	U	U	U	U	U	U
Hexachlorobenzene	U	U	U	U	U	U	U	U	U	U	U
Hexachlorobutadiene	U	U	U	U	U	U	U	U	U	U	U
Hexachlorocyclopentadiene	U	U	U	U	U	U	U	U	U	U	U
Hexachlorethane	U	U	U	U	U	U	U	U	U	U	U
Indeno (1,2,3-cd) pyrene	U	U	U	U	U	U	U	U	U	U	U
Isophorone	U	U	U	U	U	U	U	U	U	U	U
2-Methylnaphthalene	U	U	U	U	U	U	U	U	U	U	U
2-Methylphenol (O-Cresol)	U	U	U	U	U	U	U	U	U	U	U
4-Methylphenol (P-Cresol)	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	U	U	U	U	U	U	U	U	U	U	U
2-Nitroaniline	U	U	U	U	U	U	U	U	U	U	U
3-Nitroaniline	U	U	U	U	U	U	U	U	U	U	U
4-Nitroaniline	U	U	U	U	U	U	U	U	U	U	U
Nitrobenzene	U	U	U	U	U	U	U	U	U	U	U
2-Nitrophenol	U	U	U	U	U	U	U	U	U	U	U
4-Nitrophenol	U	U	U	U	U	U	U	U	U	U	U
N-nitrosodiphenylamine	U	U	U	U	U	U	U	U	U	U	U
N-nitroso-di-n-propylamine	U	U	U	U	U	U	U	U	U	U	U
Pentachlorophenol (PCP)	U	U	U	U	U	U	U	U	U	U	U
Phenanthrene	U	U	U	U	U	U	U	U	U	U	U
Phenol (C6H5OH) - Single Compound	U	U	U	U	U	U	U	U	U	U	U
Pyrene	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trichlorobenzene	U	U	U	U	U	U	U	U	U	U	U
2,4,5-Trichlorophenol	U	U	U	U	U	U	U	U	U	U	U
2,4,6-Trichlorophenol	U	U	U	U	U	U	U	U	U	U	U

Legend:
B = Indicates compound was detected in the Lab Blank as well as in the sample.
J = Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
U = Indicates compound was analyzed for but not detected.

TABLE 6.3.9 Snowmelt Stations - Water Chemistry - LANL -1993

WATER CHEMISTRY	SNOWMELT STATIONS								
	PA10.4 930324 1145	AN2.9 930324 1321	VA3.2 930430 1103	PU6.6 930430 1142	WA9.9 930430 1023	PU1.3 930618 1156	AC0.0 930618 1031	WA6.5 930628 1008	SA6.1 930614 1029
Water Temp. (C)									
Field Conductivity (uhmo)									
Dissolved Oxygen (mg/L)									
Field pH (S.U.)									
Total Org. Carbon (mg/L)									
Nitrate+ite (mg/L)	0.05	0.04K	.04K	.04K	.04K	5.02	1.37	0.22	1.05
Ammonia (mg/L)	0.10K	0.10K	.10K	.10K	.10K	10.80	0.11	0.18	0.13
Kjeldahl N (mg/L)	0.38	0.68	0.27	0.87	0.40	15.60	1.21	0.96	0.80
Total Phos. (mg/L)	0.07	0.11	.10KQ	.10Q	.10KQ	5.60	0.50	0.20	2.50
BOD (mg/L)									
COD (mg/L)			19.00	64.00	17.00				
Ca (mg/L)	19.00	11.00	6.00	13.00	12.00	17.00	11.00	15.00	23.00
Mg (mg/L)	6.00	3.00	2.00	4.00	4.00	5.00	1.00	5.00	5.00
K (mg/L)	4.00	5.00	2.00	3.00	4.00	15.00	5.00	2.00	11.00
Na (mg/L)	21.00	8.00	3.00	9.00	13.00	66.00	76.00	21.00	124.00
Hardness (mg/L)	72.00	40.00	23.00	49.00	46.00				
Alkalinity (mg/L)	36.90	17.10	18.00	34.40	33.90				
Bicarbonate(mg/L)	45.00	23.20	22.20	41.90	41.30	112.00	68.00	69.00	177.00
Carbonate (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloride (mg/L)	38.80	5.00K	5.00K	5.00k	17.30	33.70	83.00	23.00	67.00
Fluoride (mg/L)	0.15	0.20	0.10K	0.12	0.12				
Sulfate (mg/L)	11.00	10.90	5.00K	11.70	8.10	26.00	12.00	8.00	104.00
Color Test (units)	50.00L	50.00L	25.00	50.00L	25.00				
Lab Conductivity (uS/cm)	240.00	97.00	54.00	128.00	158.00				
Lab pH (S.U.)	7.51	7.29	7.56	7.76	7.77				
TDS (mg/L)	198.00	256.00	77.00	274.00	182.00	388.00	272.00	210.00	520.00
Lab Turbidity (NTU)	27.00	60.00							
TSS (mg/L)	3.00K	3.00K	3.00	12.00	8.00				

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.10 Snowmelt Stations - Total Metals - LANL - 1993

TOTAL METALS (ug/L)	SNOWMELT STATIONS		
	VA3.2 Dt: 930430 Tm: 1105	PU6.6 Dt: 930430 Tm: 1145	WA9.9 Dt: 930430 Tm: 1024
Al	2500Q	1200Q	4800Q
Ba	100KQ	100KQ	100KQ
Be	100KQ	100KQ	100KQ
B	100KQ	100KQ	100KQ
Ca	5000Q	11000Q	11000Q
Co	50KQ	50KQ	50KQ
Cu	50KQ	50KQ	50KQ
Fe	1000Q	7400Q	2400Q
Mg	1600Q	4000Q	4000Q
Mn	50KQ	50KQ	50KQ
Mo	100KQ	100KQ	100KQ
Ni	100KQ	100KQ	100KQ
Si	1300Q	1600Q	200Q
Ag	100KQ	100KQ	100KQ
Sr	100KQ	100Q	100Q
Sn	100KQ	100KQ	100KQ
V	100KQ	100KQ	100KQ
Zn	50KQ	50KQ	50KQ
As	5KQ	5KQ	5KQ
Cd	1KQ	1KQ	1KQ
Cr	5KQ	12Q	5KQ
Pb	5KQ	13Q	5KQ
Hg	.5K	.5K	.5K
Se	5KQ	5KQ	5KQ

TABLE 6.3.11 Snowmelt Stations - Dissolved Metals - LANL - 1993

DISSOLVED METALS (ug/L)	SNOWMELT STATIONS		
	VA3.2 Dt: 930430 Tm: 1105	PU6.6 Dt: 930430 Tm: 1145	WA9.9 Dt: 930430 Tm: 1024
Al	1800Q	5400Q	3200Q
Ba	100KQ	100KQ	100KQ
Be	100KQ	100KQ	100KQ
B	100KQ	100KQ	100KQ
Ca	4900Q	11000Q	10000Q
Co	50KQ	50KQ	50KQ
Cu	50KQ	50KQ	50KQ
Fe	700Q	3600Q	1600Q
Mg	1500Q	3500Q	3800Q
Mn	50KQ	50KQ	50KQ
Mo	100KQ	100KQ	100KQ
Ni	100KQ	100KQ	100KQ
Si	1400Q	500Q	500Q
Ag	100KQ	100KQ	100KQ
Sr	100KQ	100Q	100Q
Sn	100KQ	100KQ	100KQ
V	100KQ	100KQ	100KQ
Zn	50KQ	60Q	50KQ
As	5KQ	5KQ	5KQ
Cd	1KQ	1KQ	1KQ
Cr	5KQ	5KQ	5KQ
Pb	5KQ	7Q	5KQ
Hg	.5K	.5K	.5K
Se	5KQ	5KQ	5KQ

TABLE 6.3.14 Stormwater Stations - Water Chemistry - LANL - 1993

	STORMWATER STATIONS	
WATER CHEMISTRY	PA4.4 Dt: 930910 Tm: 1335	LA6.6 Dt: 930830 Tm: 0900
Ca (mg/L)	22.00	15.00
Mg (mg/L)	6.00	2.00
K (mg/L)	5.00	4.00
Na (mg/L)	22.00	8.00
Hardness (mg/L)	80.00	46.00
Alkalinity (mg/L)	81.00	40.00
Bicarbonate(mg/L)	99.00	50.00
Carbonate (mg/L)	0.00	0.00
Chloride (mg/L)	29.00	6.00
Fluoride (mg/L)	0.18	0.10K
Sulfate (mg/L)	6.00	5.00
Color Test (units)	20.00	50.00L
Lab Conductivity (uS/cm)	278.00	127.00
Lab pH (S.U.)	8.13	7.47
TDS (mg/L)	186.00	134.00
Lab Turbidity (NTU)	4.10	
TSS (mg/L)	3.00K	840.00

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.15 Stormwater Stations - Total Metals - LANL - 1993

TOTAL METALS (ug/L)	STORMWATER STATIONS											
	DP0.1 Dt: 930715 Tm: 1531	LA4.1 Dt: 930803 Tm: 1740	DP0.1 Dt: 930806 Tm: 1824	DP0.1 Dt: 930806 Tm: 1840	DP0.1 Dt: 930807 Tm: 2114	DP0.1 Dt: 930807 Tm: 2115	DP0.1 Dt: 930813 Tm: 1830	DP0.1 Dt: 930813 Tm: 2230	DP0.1 Dt: 930813 Tm: 2250	DP0.1 Dt: 930813 Tm: 2300	LA6.6 Dt: 930830 Tm: 0900	PA4.4 Dt: 930910 Tm: 1335
Al	84000	300000	17000	9600	3200	85000	9100	4700	6600	7000	69000	300
Ba	900	2800	300	100	100K	2100	100K	100K	100K	100K	600	100K
Be	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K
B	100K	100	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K
Ca	43000	84000	22000	20000	17000	69000	12000	11000	11000	12000	27000	23000
Co	50K	90	50K	50K	50K	100	50K	50K	50K	50K	50K	50K
Cu	110Q	320	50K	50K	50K	120	50K	50K	50K	50K	70	50K
Fe	82000	273000	15000	6900	2100	110000	6300	2900	4400	4600	59000	200
Mg	14000	4600	3900	2700	1800	20000	2000	1400	1600	1700	11000	100K
Mn	3300	9180	890	230	50K	15000	170	50K	100	140	1700	6100
Mo	100K	100K	100K	100K	100K	1000K	100K	100K	100K	100K	100K	100K
Ni	100K	200	100K	100K	100K	100	100K	100K	100K	100K	100K	100K
Si	1100	2500	900	700	1000	600	800	900	700	1200	1700	400
Ag	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K
Sr	300	700	100	100	100K	500	100K	100K	100K	100K	200	200
Sn	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K	100K
V	100	300	100K	100	100K	200	100K	100K	100K	100K	100K	100K
Zn	940	260	200	70	50K	1700	60	50K	50K	60K	380	50K
As	9	13	5K	5K	5K	8	5K	5K	5K	5K	7	5K
Cd	4Q	1K	1K	1K	1K	8	1K	1K	1K	1K	1	1K
Cr	68	330	5K	7	5K	130	16	6	8	9	63	5K
Pb	400Q	1080	86	30	8	1500	25	11	17	19	190	5K
Hg	.5KQ	2.80	.5K	.5K	.5K	.5K	.5K	.5K	.5K	.5K	1	.5K
Se	5K	5K	5K	5K	5K	5K	5K	5K	5K	5K	5K	5K

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.16 Stormwater Stations - Radiochemistry - LANL - 1993 (Part I)

ANALYTE (pCi/L)	STORMWATER STATIONS								
	DP0.1 Dt: 930714 Tm: 1921			DP0.1 Dt: 930720 Tm: 1531			LA4.1 Dt: 930803 Tm: 1740		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	350.00	60.00	18.00	150.00	30.00	9.00	1000.00	150.00	50.00
Gross-alpha w/ U-nat ref	430.00	60.00	23.00	180.00	25.00	10.00	1480.00	150.00	80.00
Gross-beta w/ Cs-137 ref	760.00	60.00	33.00	390.00	35.00	15.00	1680.00	120.00	90.00
Gross-beta w/ Sr/Y-90 ref	750.00	50.00	32.00	390.00	35.00	15.00	1590.00	100.00	80.00

ANALYTE (pCi/L)	STORMWATER STATIONS								
	DP0.1 Dt: 930806 Tm: 1824			DP0.1 Dt: 930807 Tm: 2115			DP0.1 Dt: 930813 Tm: 1830		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	5.60	2.30	3.60	0.00	1.50	2.50	7.20	1.60	0.90
Gross-alpha w/ U-nat ref	5.60	2.20	3.60	0.00	1.50	2.50	8.70	1.70	1.10
Gross-beta w/ Cs-137 ref	119.00	9.00	6.40	92.00	6.00	5.00	82.00	6.00	1.60
Gross-beta w/ Sr/Y-90 ref	116.00	8.00	6.30	92.00	6.00	5.00	82.00	5.00	1.60

ANALYTE (pCi/L)	STORMWATER STATIONS								
	DP0.1 Dt: 930813 Tm: 2230			DP0.1 Dt: 930813 Tm: 2250			DP0.1 Dt: 930813 Tm: 2300		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	4.70	1.00	0.90	5.00	1.20	0.90	9.70	1.80	1.00
Gross-alpha w/ U-nat ref	5.60	1.00	1.10	5.90	1.20	1.10	12.90	1.80	1.40
Gross-beta w/ Cs-137 ref	81.00	6.00	1.60	74.00	5.00	1.60	84.00	6.00	1.60
Gross-beta w/ Sr/Y-90 ref	81.00	5.00	1.60	74.00	4.00	1.60	82.00	5.00	1.60

ANALYTE (pCi/L)	STORMWATER STATIONS					
	LA6.6 Dt: 930830 Tm: 0900			PA4.4 Dt: 930910 Tm: 1335		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	32.00	6.00	1.30	0.30	0.70	1.60
Gross-alpha w/ U-nat ref	54.00	7.00	2.20	0.30	0.70	1.60
Gross-beta w/ Cs-137 ref	48.00	4.00	2.40	6.30	1.80	3.40
Gross-beta w/ Sr/Y-90 ref	44.00	3.00	2.20	6.60	1.90	3.50

TABLE 6.3.17 Stormwater Stations - Radiochemistry - LANL - 1993

STORM WATER STATIONS	DATE	TIME	GAMA SPEC # of PEAKS	NUCLIDE	ENERGY keV	QUANTIFICATION	COMMENTS
DP0.1	930714	1921	3	Cs-137	661.9	170. +- 15 pCI/L	Confirmed
				K-40	1461.3	360. +- 150 pCI/L	Very Weak
				Pb-212	238.9	Not quantified 0.2 gps +- 60%	Very Weak
DP0.1	930720	1531	2	Cs-137	661.6	7. +- 5. pCI/L	Very Weak
				Cs-137	1460.7	21. +- 4. pCI/L	
LA4.1	930803	1740	9	Pb-212	239.1	Not quantified; 1.5 gps +- 10%	
				Pb-214	295.9	Not quantified; 0.6 gps +- 20%	
				Pb-214	352.5	Not quantified; 1.3 gps +- 10%	
				Be-7	478.4	230. +- 40. pCI/L	Atms Prd.
				Tl-208	584.2	Not quantified; 1.3 gps +- 15%	
				Bl-214	610	Not quantified; 0.9 gps +- 20%	
				Cs-137	662.5	140. +- 10. pCI/L	
				Ac-228	969.6	Not quantified; 1.1 gps +- 20%	
				K-40	1462.1	760. +- 80. pCI/L	
DP0.1	930806	1824	0				
DP0.1	930807	2115	0				
DP0.1	930813	1830	0				
DP0.1	930813	2230	0				
DP0.1	930813	2250	0				
DP0.1	930813	2300	1	Cs-137	661.6	7. +- 5. pCI/L	Very Weak
LA6.6	930830	0900	1	Cs-137	661.6	21. +- 4. pCI/L	
PA4.4	930910	1335	0				

TABLE 6.3.19 Surface Water Stations - Water Chemistry - LANL - 1992

WATER CHEMISTRY	SURFACE WATER STATION
	MO7.4 Dt: 920507 Tm: 0916
Water Temp. (C)	
Field Conductivity (uhmo)	
Dissolved Oxygen (mg/L)	
Field pH (S.U.)	
Nitrate+ite (mg/L)	144.00
Ammonia (mg/L)	1.10
Kjeldahl N (mg/L)	0.00Q
Total Phos. (mg/L)	0.13Q
BOD (mg/L)	1.00K
COD (mg/L)	15.00
Cyanide (mg/L)	0.03
Ca (mg/L)	79.00
Mg (mg/L)	3.00
K (mg/L)	45.00
Na (mg/L)	209.00
Hardness (mg/L)	210.00
Alkalinity (mg/L)	292.00Q
Bicarbonate(mg/L)	357.00
Carbonate (mg/L)	0.00
Chloride (mg/L)	67.10Q
Fluoride (mg/L)	1.44
Sulfate (mg/L)	51.20Q
Color Test (units)	5.00Q
Lab Conductivity (uS/cm)	1680.00
Lab pH (S.U.)	7.72
TDS (mg/L)	986.00Q
TSS (mg/L)	26.00Q

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.20
Surface Water Station -
Total Metals - LANL - 1992

TOTAL METALS (ug/L)	SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0917
Al	200
Ba	100K
Be	100K
B	300
Ca	160000
Co	5K
Cu	50K
Fe	100
Mg	3500
Mn	50K
Mo	300
Ni	100K
Si	14000
Ag	1K
Sr	200
Sn	100K
V	100K
Zn	100K
U	5K
As	5K
Cd	1K
Cr	5K
Pb	5K
Hg	.1K
Se	5K

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.21
Surface Water Station -
Dissolved Metals - LANL - 1992

DISSOLVED METALS (ug/L)	SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0917
Al	100KQ
Ba	200Q
Be	100KQ
B	300Q
Ca	160000Q
Co	5KQ
Cu	50KQ
Fe	100KQ
Mg	3800Q
Mn	50KQ
Mo	300Q
Ni	100KQ
Si	14000Q
Ag	1KQ
Sr	200Q
Sn	100KQ
V	100KQ
Zn	100KQ
U	5K
As	5KQ
Cd	1KQ
Cr	5KQ
Pb	5KQ
Hg	.5K
Se	5KQ

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.22 Surface Water Station - Radiochemistry - LANL - 1992 (Part I)

ANALYTE (pCi/L)	SURFACE WATER STATION MO7.4 Dt: 920507 Tm: 0933		
	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	9.20	2.10	2.00
Gross-alpha w/ U-nat ref	15.00	4.00	3.30
Gross-beta w/ Cs-137 ref	1210.00	70.00	3.00
Gross-beta w/ Sr/Y-90 ref	1190.00	60.00	3.00
U-238 Alpha Spec.	0.77	0.19	
U-234 Alpha Spec.	2.2	0.5	
Th-230 Alpha Spec.	-0.01	0.04	
Th-232 Alpha Spec.	0.01	0.008	
Am-241 Alpha Spec.	2.6	0.7	
Pu-239 Alpha Spec	2.3	0.6	
Pu-238 Alpha Spec.	0.6	0.15	

TABLE 6.3.23 Surface Water Station - Radiochemistry - LANL - 1992 (Part II)

STATION	DATE	TIME	GAMA SPEC # of PEAKS	NUCLIDE	ENERGY keV	gamma/sec/L	pCi/L
MO7.4	920507	933	3	Cs-137	662.24	5.0 +- 0.2	159. +- 7.
				Se-75	136.38	0.95 +- 0.10	46. +- 5.
				Se-74	264.88	1.04 +- 0.11	48. +- 6.

.E 6.3.24 Surface Water Station - Volatile Organic Compounds - LANL - 1992

SURFACE WATER STATION

M07.4

Dt: 920507

Tm: 0926

VOLATILE ORGANIC COMPOUNDS	(ug/L)	CONT'D VOLATILE ORGANIC COMPOUNDS	CONT'D (ug/L)	CONT'D VOLATILE ORGANIC COMPOUNDS	CONT'D (ug/L)
Acetone	U	Naphthalene	U	Dibenzofuran	U
Benzene	U	N-Propylbenzene	U	Di-n-butyl phthalate	U
Bromobenzene	U	Styrene	U	1,2 -Dichlorobenzene	U
Bromochloromethane (Chlorobromomethane)	U	1,1,1,2-Tetrachloroethane	U	1,3-Dichlorobenzene	U
Bromodichloromethane	U	1,1,2,2-Tetrachloroethane	U	1,4-Dichlorobenzene	U
Bromoform	U	Tetrachloroethylene	U	3,3'-Dichlorobenzidine	U
Bromomethane	U	Tetrahydrofuran (THF)	U	2,4-Dichlorophenol	U
2-Butanone (MEK)	U	Toluene	U	Diethyl phthalate	U
n-Butylbenzene	U	1,2,3-Trichlorobenzene	U	2,4-Dimethylphenol	U
sec-Butylbenzene	U	1,2,4-Trichlorobenzene	U	Dimethyl phthalate	U
tert-Butylbenzene	U	1,1,1-Trichloroethane	U	4,6-Dinitro-2-methylphenol	U
tert-Butyl methyl ether (MTBE)	U	1,1,2-Trichloroethane	U	2,4-Dinitrophenol	U
Carbon tetrachloride	U	Trichloroethylene	U	2,4-Dinitrotoluene	U
Chlorobenzene	U	Trichlorofluoromethane	U	2,6-Dinitrotoluene	U
Chloroethane	U	1,2,3-Trichloropropane	U	Di-n-octyl phthalate	U
Chloroform	U	1,2,4-Trimethylbenzene	U	Fluoranthene	U
Chloromethane (Methyl Chloride)	U	1,3,5-Trimethylbenzene	U	Fluorene	U
2-Chlorotoluene	U	Vinyl chloride	U	Hexachlorobenzene	U
4-Chlorotoluene (1-Methyl-4Chlorobenzene)	U	o-Xylene	U	Hexachlorobutadiene	U
1,2-Dibromo-3-chloropropane	U	p- & m- Xylene	U	Hexachlorocyclopentadiene	U
Dibromochloromethane	U	Acenaphthene	U	Hexachlorethane	U
1,2-Dibromoethane	U	Acenaphthylene	U	Indeno (1,2,3-cd) pyrene	U
Dibromomethane (Methylene Bromide)	U	Anthracene	U	Isophorone	U
1,2-Dichlorobenzene	U	Benzoic acid	U	2-Methylnaphthalene	U
1,3-Dichlorobenzene	U	Benzo (a) anthracene	U	2-Methylphenol (O-Cresol)	U
1,4-Dichlorobenzene	U	Benzo (b) fluoroanthene	U	4-Methylphenol (P-Cresol)	U
Dichlorodifluoromethane	U	Benzo (k) fluoroanthene	U	Naphthalene	U
1,1 -Dichloroethane	U	Benzo (g,h,i,) perylene	U	2-Nitroaniline	U
1,2-Dichloroethane	U	Benzo -a-pyrene	U	3-Nitroaniline	U
1,1 -Dichloroethene	U	Benzyl alcohol	U	4-Nitroaniline	U
cis-1 ,2-Dichloroethene	U	Bis (2-chloroethoxy) methane	U	Nitrobenzene	U
trans-1,2-Dichloroethene	U	Bis (2-chloroethyl) ether	U	2-Nitrophenol	U
1,2-Dichloropropane	U	Bis (2-chloroisopropyl)ether	U	4-Nitrophenol	U
1,3-Dichloropropane	U	Bis (2-ethylhexyl) phthalate	4.00 (J)	N-nitrosodiphenylamine	U
2,2-Dichloropropane	U	4-Bromophenylphenyl ether	U	N-nitroso-di-n-propylamine	U
1,1 -Dichloropropene	U	N-Butylbenzyl phthalate	1.00 (J)	Pentachlorophenol (PCP)	U
cis-1 ,3-Dichloropropene	U	4-Chloroaniline (Benzenomine, 4 Chloro)	U	Phenanthrene	U
trans-1,3-Dichloropropene	U	2-Chloronaphthalene	U	Phenol (C6H5OH) - Single Compound	U
Ethylbenzene	U	4-Chloro-3-methylphenol (Parachlorometa Cresol)	U	Pyrene	U
Hexachlorobutadiene	U	2-Chlorophenol	U	1,2,4-Trichlorobenzene	U
Isopropylbenzene	U	4-Chlorophenylphenyl ether	U	2,4,5-Trichlorophenol	U
(1-Methyl -) 4-Isopropyltoluene	U	Chrysene	U	2,4,6-Trichlorophenol	U
Methylene chloride	U	Dibenz (a,h) anthracene (1,2,5,6-Dibenzanthracene)	U		

egend:
= Indicates an estimated value for compounds detected and indentified but present at a concentration less than the quantitation limit
) = Indicates compound was analyzed for but not detected.

TABLE 6.3.25 Surface Water Stations - Water Chemistry - LANL - 1993

	SURFACE WATER STATIONS							
WATER CHEMISTRY	LA8.4 Dt: 930217 Tm: 1305	Sacred Spring Dt: 930512 Tm: 0325	Indian Spring Dt: 930512 Tm: 1235	La Mesita Spring Dt: 930615 Tm: 0948	Basalt Spring Dt: 930615 Tm: 1149	MO7.4 Dt: 930719 Tm: 1036	LA12.2 Dt: 930903 Tm: 1015	LA6.6 Dt: 930903 Tm: 1100
Water Temp. (C)								
Field Conductivity (uhmo)								
Dissolved Oxygen (mg/L)								
Field pH (S.U.)								
Total Org. Carbon (mg/L)	5.00K							
Nitrate+ite (mg/L)		0.14	0.81	3.04	1.36	.04K		
Ammonia (mg/L)		0.12	0.10K	0.10K	0.10K	0.01K		
Kjeldahl N (mg/L)		1.20	0.16	0.10K	0.30	0.27		
Total Phos. (mg/L)		0.10K	0.10K	0.10K	1.80	0.10KQ		
BOD (mg/L)	1.00K							
COD (mg/L)	5.00K							
Ca (mg/L)	49.00	23.00	36.00	35.00	32.00	35.00	8.00	14.00
Mg (mg/L)	10.00	1.00K	3.00	1.00K	8.00	3.00	3.00	3.00
K (mg/L)	21.00	4.00	3.00	4.00	6.00	9.00	3.00	4.00
Na (mg/L)	109.00	24.00	26.00	29.00	37.00	73.00	6.00	28.00
Hardness (mg/L)	164.00	57.00	102.00				32.00	47.00
Alkalinity (mg/L)	38.10	98.80	102.00				31.00	52.00
Bicarbonate(mg/L)	46.50	121.00	125.00	147.00	127.00	140.00	38.00	63.00
Carbonate (mg/L)	0.00	0.00	0.00	2.90	0.00	0.00	0.00	0.00
Chloride (mg/L)	244.00	5.00K	32.10	7.00	27.00	9.00	6.00	34.00
Fluoride (mg/L)	0.13					10.00	0.10K	0.19
Sulfate (mg/L)	14.30	6.90	7.30	14.00	22.00		5.00K	7.00
Color Test (units)	5.00						50.00L	25.00
Lab Conductivity (uS/cm)	901.00						98.00	239.00
Lab pH (S.U.)	7.51						7.66	8.10
TDS (mg/L)	596.00	172.00	222.00	194.00	280.00	370.00	114.00	184.00
Lab Turbidity (NTU)	0.06							
TSS (mg/L)	3.00K						14.00	9.00

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.

TABLE 6.3.26 Surface Water Stations - Total Metals - LANL - 1993

TOTAL METALS (ug/L)	SURFACE		WATER	STATIONS
	LA8.4 Dt: 930217 Tm: 1257	MO7.4 Dt: 930719 Tm: 1034	LA12.2 Dt: 930903 Tm: 1015	LA6.6 Dt: 930903 Tm: 1100
Al	100KQ	600Q	3200	2500
Ba	100Q	100KQ	100K	100K
Be	100KQ	100KQ	100K	100K
B	100KQ	100KQ	100K	100K
Ca	51000Q	2900Q	8100	14000
Co	50KQ	5KQ	50K	50K
Cu	100KQ	5KQ	50K	50K
Fe	100KQ	500Q	1200	1300
Mg	11000Q	2200Q	2800	3400
Mn	50KQ	50KQ	50K	50K
Mo	100KQ	100Q	100K	100K
Ni	100KQ	100KQ	100K	100K
Si	16000Q	700Q	1300	800
Ag	100KQ	10KQ	100K	100K
Sr	360Q	100KQ	100K	100K
Sn	100KQ	100KQ	100K	100K
V	100KQ	100KQ	100K	100K
Zn	100KQ	100KQ	50K	50K
U		5KQ		
As	1K	5KQ	5K	5K
Cd	1K	1KQ	1K	1K
Cr	1K	5KQ	5K	8
Pb	1K	5KQ	5K	5K
Hg	.5K	.5KQ	.5K	.5K
Se	5K	5KQ	5K	5K

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.3.27 Surface Water Stations - Radiochemistry - LANL - 1993 (Part I)

ANALYTE (pCi/L)	SURFACE WATER STATIONS											
	LA12.2 Dt: 930903 Tm: 1015			LA6.6 Dt: 930903 Tm: 1100			LA8.4 Dt: 930217 Tm: 1308			MO7.4 Dt: 930719 Tm: 1030		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	0.10	0.70	1.50	1.00	0.90	1.50	0.40	0.40	0.80	3.20	0.80	1.00
Gross-alpha w/ U-nat ref	0.10	0.60	1.40	1.00	0.90	1.50	0.70	0.60	1.30	4.30	1.00	1.30
Gross-beta w/ Cs-137 ref	7.30	2.20	3.30	7.40	2.20	3.30	7.00	0.90	1.30	135.00	9.00	1.70
Gross-beta w/ Sr/Y-90 ref	7.70	2.30	3.50	7.70	2.30	3.50	6.40	0.80	1.20	131.00	7.00	1.60
U-238 Alpha Spec.							1.26	0.21				
U-234 Alpha Spec.							0.54	0.10				
Th-230 Alpha Spec.							0.04	0.04				
Th-232 Alpha Spec.							0.00	0.03				
Ra-226 Non-SWDA							0.09	0.02	0.02			
Ra-228 Total							0.70	0.90				

TABLE 6.3.28 Surface Water Stations - Radiochemistry - LANL - 1993 (Part II)

STATION	DATE	TIME	GAMA SPEC # of PEAKS	NUCLIDE	ENERGY keV	QUANTIFICATION
MO7.4	930719	1030	7	Rb-83	520.3	190. +- 30. pCi/L
				Rb-83	529.5	190. +- 30. pCi/L
				Rb-83	552.5	190. +- 30. pCi/L
				Se-75	264.6	19. +- 5. pCi/L
				Se-75	136	19. +- 5. pCi/L
				Cs-137	661.6	25. +- 6. pCi/L
				Ann-Rad	511	
LA12.2	930903	1015	0			
LA6.6	930903	1100	0			
LA8.4	930217	1308	4	Pb-214*	295	Not quantified; 1.0 gps +- 9%
				Pb-214*	351	Not quantified; 2.0 gps +- 6%
				Bi-214*	609	Not quantified; 2.3 gps +- 8%
				Bi-214*	1121	Not quantified; 0.96 gps +- 16%

* Daughters of naturally occuring RA-226

TABLE 6.4.2 Raft Trip Stations - Springs and Streams of White Rock Canyon - Water Chemistry - LANL - 1992

	RAFT TRIP STATIONS (Springs & Streams)														
WATER CHEMISTRY	Rio Grande Otowi Bridge 920908 1025	Spring 1 920908 1216	Spring 2 920908 1220	Sandia Spring 920908 1445	MO 0.1 920908 1615	Spring 3A 920908 1655	Spring 4 920909 845	Spring 4A 920909 930	Spring 5 920909 1159	Ancho Spring 920909 1505	AN 0.1 920909	Spring 6A 920909 1703	DOE Spring 920910 1015	Spring 9 920910 800	FR0.1 920910 1205
Water Temp. (C)	17.50	19.00	23.00	19.70	18.00	18.00	16.50	18.00	18.90	21.00	18.00	21.60			19.80
Field Conductivity (uhmo)			253.00	255.00	410.00	160.00	175.00	115.00	159.00	130.00	147.00	110.00			100.00
Dissolved Oxygen (mg/L)	222.00			6.70			6.40		11.90			7.00			7.40
Field pH (S.U.)	7.65	6.96	8.40	6.98	7.90	6.90	7.15	7.67	8.73	7.30	8.74	7.47			8.50
Total Org. Carbon (mg/L)	5.00	2.00	4.00	2.00	16.00	2.00	2.00	1.00K	2.00	3.00		1.00K	2.00	3.00	3.00
Nitrate+ite (mg/L)	.04K	0.44	0.04K	0.12	8.15	0.84	1.35	0.96	0.23	0.49		0.44	0.10	0.23	0.04K
Ammonia (mg/L)	0.23	0.10K	0.20	0.10K	0.36	0.10K	0.10K	0.10K	0.11	0.30		0.10K	0.16	0.14	0.14
Kjeldahl N (mg/L)	0.40	0.10K	0.55	0.18	2.43	0.10K	0.10K	0.11	0.13	0.40		0.10K	0.28	0.16	0.18
Total Phos. (mg/L)	0.29	0.01	0.06	0.11	3.89	0.02	0.02	0.02	0.02	0.10		0.03	0.02	0.05	0.06
Ca (mg/L)	43.00	17.00	17.00	43.00	29.00	22.00	24.00	21.00	19.00	13.00		10.00	12.00	21.00	10.00
Mg (mg/L)	7.00	1.00	1.00k	3.00	8.00	2.00	4.00	4.00	5.00	3.00		3.00	3.00	5.00	3.00
K (mg/L)	3.00	2.00	2.00	3.00	16.00	3.00	4.00	3.00	2.00	4.00		4.00	2.00	2.00	2.00
Na (mg/L)	16.00	28.00	42.00	14.00	67.00	11.00	12.00	10.00	9.00	9.00		8.00	10.00	12.00	8.00
Hardness (mg/L)	136.00	47.00	42.00	120.00	103.00	61.00	76.00	69.00	68.00	45.00		37.00	42.00	73.00	37.00
Alkalinity (mg/L)	105.00	98.60	143.00	141.00	154.00	80.40	81.20	78.00	79.80	59.40		53.30	60.30	98.90	51.80
Bicarbonate(mg/L)	128.00	118.00	172.00	173.00	185.00	96.50	97.40	94.20	97.30	71.50		63.90	72.40	119.00	62.20
Carbonate (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Chloride (mg/L)	5.00K	5.00K	5.00k	5.00K	49.50	5.00K	5.80	5.00K	5.00K	5.00K		5.00K	5.00K	5.00K	5.00K
Fluoride (mg/L)	0.32	0.52	1.17	0.54	0.37	0.40	0.48	0.44	0.43	0.31		0.29	0.47	0.51	0.14
Sulfate (mg/L)	90.60	17.20	8.10	5.00K	33.30	5.00K	8.60	5.00K	5.00K	5.00K		5.00K	5.00K	5.00K	5.00K
Color Test (units)	15.00Q	5.00K	5.00Q	5.00K	40.00Q	5.00	5.00K	5.00K	5.00K	5.00K		5.00K	5.00K	10.00	10.00
Lab Conductivity (uS/cm)	343.00	221.00	304.00	281.00	623.00	191.00	216.00	193.00	187.00	132.00		124.00	132.00	204.00	124.00
Lab pH (S.U.)	8.06	8.14	8.30	8.29	7.96	8.22	8.09	8.19	8.25	7.78		8.05	8.12	7.92	8.06
TDS (mg/L)	228.00	106.00	206.00	202.00	476.00	154.00	174.00	174.00	170.00	153.00		144.00	144.00	192.00	130.00
Lab Turbidity (NTU)												4.00	6.00	5.00	7.00
TSS (mg/L)	50.00	8.00	13.00	21.00	15.00	3K	3.00	3.00K	4.00	34.00					

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.4.3 Raft Trip Stations - Springs and Streams of White Rock Canyon - Water Chemistry - LANL - 1993

	RAFT TRIP STATIONS (Springs & Streams)													
WATER CHEMISTRY	Spring 1 931012 1200	Spring 2 931012 1245	Sandia Spring 931012 1400	MO0.1 931012 1540	Spring 3 931012 1600	Spring 4 931012 1815	PA0.1 931013 0745	Spring 4A 931013 0900	Spring 5 931013 1130	AN0.1 931013 1400	Ancho Spring 931013 1452	Spring 8A 931014 0800	DOE Spring 931014 0915	FR0.1 931014 1200
Water Temp. (C)	15.60	15.60	16.20		18.80		21.00	21.00	14.00	20.40	19.00	11.00	11.40	15.40
Field Conductivity (uhmo)	256.00		317.00		195.00		80.30	80.30	166.00	125.00	115.00	90.00	130.00	93.00
Field pH (S.U.)	8.16		6.71		8.17		8.38	8.38	7.93	8.41	7.18	7.03	8.29	6.72
Nitrate+ite (mg/L)	1.00	0.10K	0.10K	9.50	0.90	0.30	0.90	1.00	0.40	0.10K	0.20	0.30	0.10K	0.10K
Ammonia (mg/L)	0.10K	0.10	0.10K	0.40	0.10K	0.20	0.10K	0.10K	0.70	0.10K	0.10K	0.10K	0.10K	0.10K
Kjeldahl N (mg/L)	9.00	6.50	0.10K	3.30	0.10	1.90	0.10K	0.10K	0.70	0.10	0.10K	0.10K	0.20	0.20
Total Phos. (mg/L)	2.50	1.60	0.09K	7.10	0.09K	0.30	0.09K	0.09K	0.09K	.09K	0.09K	0.09K	0.09K	0.09K
Ca (mg/L)	21.00	27.00	51.00	23.40	25.00	32.00	23.00	19.00	18.00	13.00	14.00	12.00	13.00	11.00
Mg (mg/L)	1.00	1.00	4.00	6.00	2.00	6.00	5.00	4.00	5.00	3.00	3.00	3.00	3.00	3.00
K (mg/L)	3.00	3.00	4.00	14.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00
Na (mg/L)	32.00	60.00	17.00	77.00	15.00	17.00	14.00	12.00	13.00	11.00	10.00	12.00	12.00	10.00
Hardness (mg/L)	57.00	72.00	144.00	82.00	11.00	105.00	78.00	64.00	66.00	45.00	47.00	42.00	45.00	40.00
Alkalinity (mg/L)	107.00	176.00	153.00	108.00	81.00	94.00	83.00	76.00	78.00	65.00	58.00	60.00	59.00	51.00
Bicarbonate(mg/L)	130.00	214.00	187.00	132.00	98.00	114.00	10.00	93.00	95.00	79.00	71.00	73.00	72.00	63.00
Carbonate (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00K	0.00	0.00	0.00	0.00
Chloride (mg/L)	5.00	5.00	5.00	46.00	5.00	9.00	6.00	6.00	6.00	5.00K	5.00K	5.00K	5.00K	5.00
Fluoride (mg/L)	0.53	1.16	0.53	0.98	0.42	0.46	0.43	0.43	0.39	0.36	0.34	0.36	0.45	0.17
Sulfate (mg/L)	7.00	9.00	5.00	29.00	6.00	10.00	8.00	7.00	6.00	5.00K	5.00K	5.00K	5.00K	5.00K
Color Test (units)	50.00L	50.00L	10.00	25.00	5.00	50.00L	0.00	5.00	15.00	5.00	5.00	15.00	5.00	10.00
Lab Conductivity (uS/cm)	238.00	362.00	308.00	553.00Q	192.00	232.00	199.00	187.00	180.00	142.00	134.00	134.00	134.00	116.00
Lab pH (S.U.)	7.79	7.95	8.25	7.60	8.16	8.17	8.13	8.04	7.98	8.54	7.87	8.06	7.94	7.98
TDS (mg/L)	188.00	292.00	224.00	420.00	168.00	170.00	178.00	184.00	192.00	168.00	170.00	158.00	160.00	162.00
TSS (mg/L)	335.00	790.00	15.00	54.00	7.00	295.00	4.00	8.00	51.00	5.00	4.00	5.00	10.00	4.00

Legend:
K = Actual value is known to be less than value given.
L = Actual value is known to be greater than value given.
Q = Sample held beyond normal holding time.
* = Replicate

TABLE 6.4.4 Sediment Stations - Raft Trip - LANL - 1992

SEDIMENT (mg/kg)	SEDIMENT STATIONS (1992 Raft Trip)				
	Spring 5 Date: 920909 Time: 1230	Rio Grande @ Otowi Bridge Date: 920908 Time: 0950	PA 0.1 Date: 920909 Time: 0000	Cochiti Lake Sed. @ Bland Canyon Date: 921007 Time: 0945	Cochiti Lake Sed. @ Dam Date: 921007 Time: 1015
Al	13850	4498Q	9750Q	26862Q	56904Q
Ba	416	111Q	200Q	448Q	335Q
Be	6.93K	0.12Q	6.25KQ	13.4KQ	16.8KQ
B	6.93K	0.12Q	6.25KQ	1.03Q	7.11Q
Ca	23546	13840Q	20000Q	31103Q	3561Q
Co	5.5	2.88Q	5.00Q	10Q	15.9Q
Cu	11.1	5.5Q	8.75Q	21Q	39.7Q
Fe	13850	7151Q	12500Q	20621Q	41213Q
Mg	6233	1961Q	4000Q	10552Q	15858Q
Mn	388	150Q	238Q	621Q	1213Q
Mo	6.93K	5.77KQ	6.25KQ	13.8KQ	16.75KQ
Ni	12.5	5.77KQ	8.75Q	21Q	33.1Q
Si	471	415Q	575Q	1448Q	1757Q
Ag	6.93K	5.77KQ	6.25KQ	13.8KQ	16.75KQ
Sr	194	40.4Q	87.5Q	238Q	167.7Q
Sn	6.93K	5.77K	6.25KQ	7.59Q	13.0Q
V	22.2	13.8Q	25Q	32Q	66.9Q
Zn	34.6	16.2Q	30Q	59Q	121Q
As	1.9	0.93Q	2.03Q	4.1Q	5.86Q
Cd	0.18	0.08Q	0.14Q	0.34Q	0.54Q
Cr	23	9.19Q	16.3Q	40.3Q	45.5Q
Pb	11.1	3.46Q	5.75Q	17.7Q	36.1Q
Hg	0.35K	0.29K	0.31K	0.86K	1.05K
Se	0.35K	0.29KQ	0.31KQ	0.86K	1.05KQ

TABLE 6.4.5 Sediment Stations - Raft Trip - LANL - 1993

SEDIMENT (mg/kg)	SEDIMENT STATIONS (1993 Raft Trip)		
	Spring 4A Date: 931013 Time: 0900	AN0.1 Date: 931013 Time: 1400	Ancho Spring Date: 931013 Time: 1455
Al	2955	1187	1620
Ba	41.6	10.88	18.87
Be	5.6K	5.49K	5.55K
B	5.6K	5.49K	5.55K
Ca	2719	307.7	665.93
Co	2.8	0.56	1.11
Cu	5.1	2.75K	2.89
Fe	8315	3340.66	3140.9
Mg	1629	329.67	621.5
Mn	93.26	105.49	66.59
Mo	5.6K	5.49K	5.55K
Ni	5.6K	5.49K	5.55K
Si	168.5		155.38
Ag	5.6K	5.49K	5.55K
Sr	12.4	5.49K	5.77
Sn	5.6K	5.49K	5.55K
V	16.9	5.49K	5.55K
Zn	16.9	10.77	10.99
As	0.28K	0.27K	0.28K
Cd	0.06K	0.05K	0.06K
Cr	15.7	0.75	1.44
Pb	5.4	2.09	1.44
Hg	.25K	0.27k	0.28K
Se	0.25K	0.27K	0.28K

TABLE 7.3.1 Waste Water Stations - Water Chemistry - SNL - 1993

WATER CHEMISTRY	WASTE WATER STATIONS	
	WW006 Dt: 931206 Tm: 0930	WW008 Dt: 931206 Tm: 0945
Water Temp. (C)		
Field Conductivity (uhmo)		
Dissolved Oxygen (mg/L)		
Field pH (S.U.)		
Total Org. Carbon (mg/L)		
Nitrate+ite (mg/L)	0.10K	0.60
Ammonia (mg/L)	18.50	4.60
Kjeldahl N (mg/L)	26.80	7.90
Total Phos. (mg/L)	5.40	0.80
Ca (mg/L)	36.00	44.00
Mg (mg/L)	6.00	8.00
K (mg/L)	19.00	7.00
Na (mg/L)	157.00	59.00
Hardness (mg/L)	115.00	142.00
Alkalinity (mg/L)	239.00	154.00
Bicarbonate(mg/L)	290.00	188.00
Carbonate (mg/L)	0.00	0.00
Chloride (mg/L)	155.00Q	35.00
Fluoride (mg/L)	0.62Q	1.45
Sulfate (mg/L)	72.00Q	107.00
Color Test (units)	50.00L	30.00
Lab Conductivity (uS/cm)	1075.00	566.00
Lab pH (S.U.)	7.80	7.54
TDS (mg/L)	640.00	394.00
Lab Turbidity (NTU)		
TSS (mg/L)	106.00	36.00

TABLE 7.3.2 Waste Water Stations - Total Metals - SNL - 1993

TOTAL METALS (ug/L)	WASTE WATER STATIONS	
	WW006 Dt: 931207 Tm: 0930	WW008 Dt: 931207 Tm: 0945
Al	1000	100K
Ba	100	100
Be	100K	100K
B	200	100K
Ca	46000	51000
Co	50K	50K
Cu	130	50K
Fe	2000	100
Mg	64000	7600
Mn	50K	50K
Mo	100K	100K
Ni	100K	100K
Si	NA	NA
Ag	100K	100K
Sr	300	400
Sn	100K	100K
V	100K	100K
Zn	110	50K
As	7	5K
Cd	1K	1K
Cr	16	5K
Pb	9	5K
Hg	.5K	.5K
Se	5K	5K

TABLE 7.3.3 Waste Water Stations - Radiochemistry - SNL - 1993

ANALYTE (pCi/L)	WASTE WATER STATIONS					
	WW006 Dt: 931207 Tm: 0930			WW008 Dt: 931207 Tm: 0945		
	Value	Sigma	D. Limit	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	5.80	2.5	3.5	2.7	0.8	1.1
Gross-alpha w/ U-nat ref	6.00	2.5	3.6	3.2	1	1.3
Gross-beta w/ Cs-137 ref	14.60	4.4	8	7.3	1.4	2.2
Gross-beta w/ Sr/Y-90 ref	14.60	4.3	8	7	1.3	2.1

TABLE 9.5.1 Waste Water Effluent Pond - Water Chemistry - WIPP - 1993

WATER CHEMISTRY	WW STATION SW Evap. Pond LWDF Dt: 930830 Tm: 0838
Ca (mg/L)	510.00
Mg (mg/L)	290.00
K (mg/L)	200.00
Na (mg/L)	990.00
Hardness (mg/L)	2470.00
Alkalinity (mg/L)	189.00
Bicarbonate(mg/L)	231.00
Carbonate (mg/L)	0.00
Chloride (mg/L)	1400.00
Fluoride (mg/L)	1.48
Sulfate (mg/L)	425.00
Color Test (units)	50.00L
Lab Conductivity (uS/cm)	5842.00
Lab pH (S.U.)	7.25
TDS (mg/L)	4000.00
TSS (mg/L)	290.00

TABLE 9.5.2 Waste Water Effluent Pond - Radiochemistry - WIPP - 1993

ANALYTE	WW STATION SW Evap. Pond, LWDF Dt: 930930 Tm: 0835		
(pCi/L)	Value	Sigma	D. Limit
Gross-alpha w/ Am-241 ref	13.00	5.00	7.00
Gross-alpha w/ U-nat ref	22.00	8.00	12.00
Gross-beta w/ Cs-137 ref	206.00	18.00	13.00
Gross-beta w/ Sr/Y-90 ref	189.00	14.00	12.00
Ra-226 Total	0.81	0.20	0.13
Ra-228 Total	-0.60	2.50	

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APPENDIX A

Rapid Bioassessment
of Five Rio Grande Tributaries
in White Rock Canyon, New Mexico

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Rapid Bioassessment of Five Rio Grande Tributaries in White Rock Canyon, New Mexico.

September 8 - 11, 1992

J. S. Hopkins

During the week of September 7-11, 1992, five tributary streams to the Rio Grande (Mortandad Canyon, Pajarito Canyon, Ancho Canyon, Chaquehui Canyon and Frijoles Canyon) (Fig. 1) were sampled using EPA's Rapid Bioassessment Protocols level II (RBA II). This methodology involves the comparison of the biological community with an evaluation of the available habitat to determine not only the quality of the benthic community but also the degree to which the habitat is utilized. This effort was undertaken to test the usefulness of the RBA II protocols on small, warmwater systems and to provide biological information to augment ongoing chemical and radiological surveys in this area.

The segment of the Rio Grande that receives the five systems in question is bisected by the flood-stage level of Cochiti Reservoir and so the tributary streams have been divided into two groups on the basis of habitat evaluations. Mortandad and Pajarito Canyons join the Rio Grande above the level flooded by Cochiti Reservoir and so scored much higher on the habitat assessment than did Ancho, Chaquehui or Frijoles Canyons (Table 1). Because of these habitat differences and the disparate scores they generated, Mortandad Canyon is compared to Pajarito Canyon and Frijoles Canyon serves as a reference for Ancho and Chaquehui Canyons.

Floodplain and riparian vegetative communities above the Cochiti flood pool are typical of Southern Rocky Mountain Ecoregion floodplains with Oneseed Juniper (*Juniperus monosperma*) dominating the uplands and Coyote Willow (*Salix exigua*) and Fremont Cottonwood (*Populus fremontii*) occupying the riparian areas with an often dense mix of other phreatophytic deciduous shrubs. Ancho, Chaquehui and Frijoles Canyons, which have been flooded periodically by Cochiti Reservoir, now pass through a very different type of landscape. Large woody plants such as Juniper and Cottonwood have been drowned to a height of forty to fifty feet above the current level of the Rio Grande and the floodplain has been buried to an often considerable depth by sediments deposited during high water events. While Ancho and Frijoles Canyons have cut down to the approximate levels of their original channels, Chaquehui Canyon no longer supports surface flow to the Rio Grande, if it ever did. The floodplain vegetation in this area is dominated by the skeletons of drowned juniper and a thin ground cover of *Kochia scoparia*. Living woody vegetation at the time of sampling was largely limited to isolated clumps of Current bushes (*Ribes* sp.) and Coyote Willow in the riparian area. Herbaceous vegetation in this area is limited to a usually sparse growth of forbes and grasses. The net effect of this recently flooded environment is increased sediment input to the streams in question as well as an increase in insolation and water temperature. Evidence of utilization of floodplain and riparian areas by cattle was found in all five canyons.At the time of this survey those areas of Frijoles and Chaquehui Canyons that supported forage were being grazed by a herd of at least ten, apparently stray, cattle. Because the only remaining forage in these canyons was located in wet riparian areas, grazing and loafing activities were concentrated along the streams.

Samples were collected using a 1 mm mesh 'D' net. Where flow permitted, riffles were sampled by agitating the substrate upstream of the net.Where flow was insufficient for this method, pools were sampled by sweeping the net through the water and substrate. All available habitats were sampled.Samples were rinsed in the 'D' net, dewatered on a no. 35 standard mesh screen and preserved with 70% ethanol. After further washing to remove preservative and residual turbidity, samples were floated in a gridded white enamel pan. Grid cells were selected using a pseudo-random number generator and sorted until approximately 100 organisms were sub-sampled. With the exception of Nematoda and Ostracoda, specimens were identified to the level of Family and enumerated. Only seven of the eight metrics normally used in RBA II could be utilized for the Ancho/Chaquehui/Frijoles group. As no scraper insects were found the scraper/filtering collector ratio could not be run. In addition to the eight metrics listed for RBA II, Percent Model Affinity, Shannon-Wiener Diversity and Winget and Mangum's CTQa were calculated (Table 2). A rough estimate of relative standing crop was developed by calculating the mean number of organisms per cell in the sorting tray. These data were not incorporated in the RBA II process. Rather, they were calculated for comparison to the RBA II results and as 'tie-breakers' should the assessment of any station not fall within clearly defined assessment limits.

Results of the RBA process show all stations to be 'Moderately Impaired' relative to their respective reference stations (Fig. 3). It should be noted that Pajarito Canyon, the reference station for Mortandad Canyon, is also 'Moderately Impaired' relative to the biological community at Frijoles Canyon. With the exception of a result of 'Partially Supporting' for Mortandad Canyon, habitat evaluations for all stations yielded results of at least marginally 'Supporting'. In that Pajarito Canyon scored 166 on the habitat assessment, 195% of Frijoles score of 85, it is possible that some as yet unidentified water quality effect is influencing community structure there. Frijoles Canyon produced the greatest number of high water quality dependent macroinvertebrates and was therefore used as the local reference for Ancho and Chaquehui Canyons. However, diversity at this station was low and community composition skewed due to the apparent absence of numerous taxa found at similar stations (Table 2). Whether or not this imbalance is related to the contamination of the Rito de los Frijoles by DDT and associated breakdown products as documented by the National Park Service and NMEID in 1988 and 1989 (M.R. Fletcher, N.P.S., Pers. Comm.) or is an artifact generated by the small number of cells sub-sampled during the sorting process (3) is not clear at this time. Note that the two stations with the lowest relative standing crop, Mortandad and Chaquehui, both produced greater numbers of taxa than their respective reference stations. Thus there is a direct correlation between the number of cells counted and the number of taxa found. This is an artifact that is amplified by differences between stations and further work on sub-sampling techniques is clearly required.

The greatest indication of water quality impairment found in these five streams is the generally high value developed by the Family Level Biotic Index (Hilsenhoff, 1988), which indicates communities tolerant to depressed dissolved oxygen levels. This condition is interpreted as an indication of organic nutrient loading.High nutrient loads are to be expected in Mortandad Canyon since flow is maintained in that system by effluent from the White Rock Waste Water Treatment Plant. Sources of nutrient enrichment in Pajarito, Ancho and Chaquehui Canyons are not readily apparent but sediment loading, groundwater inputs and cattle dung should be considered as well as non-contaminant related effects such as elevated water temperatures and site selection artifacts. One aspect of the benthic community in Mortandad Canyon, the near total lack of any filtering-collectors (Fig. 2), raises the possibility that toxic materials are being sorbed to suspended particulate material in that system. The filtering-collector trophic group strains fine particulates from the water column as a food source and can be eliminated if the fines are contaminated with toxic materials.

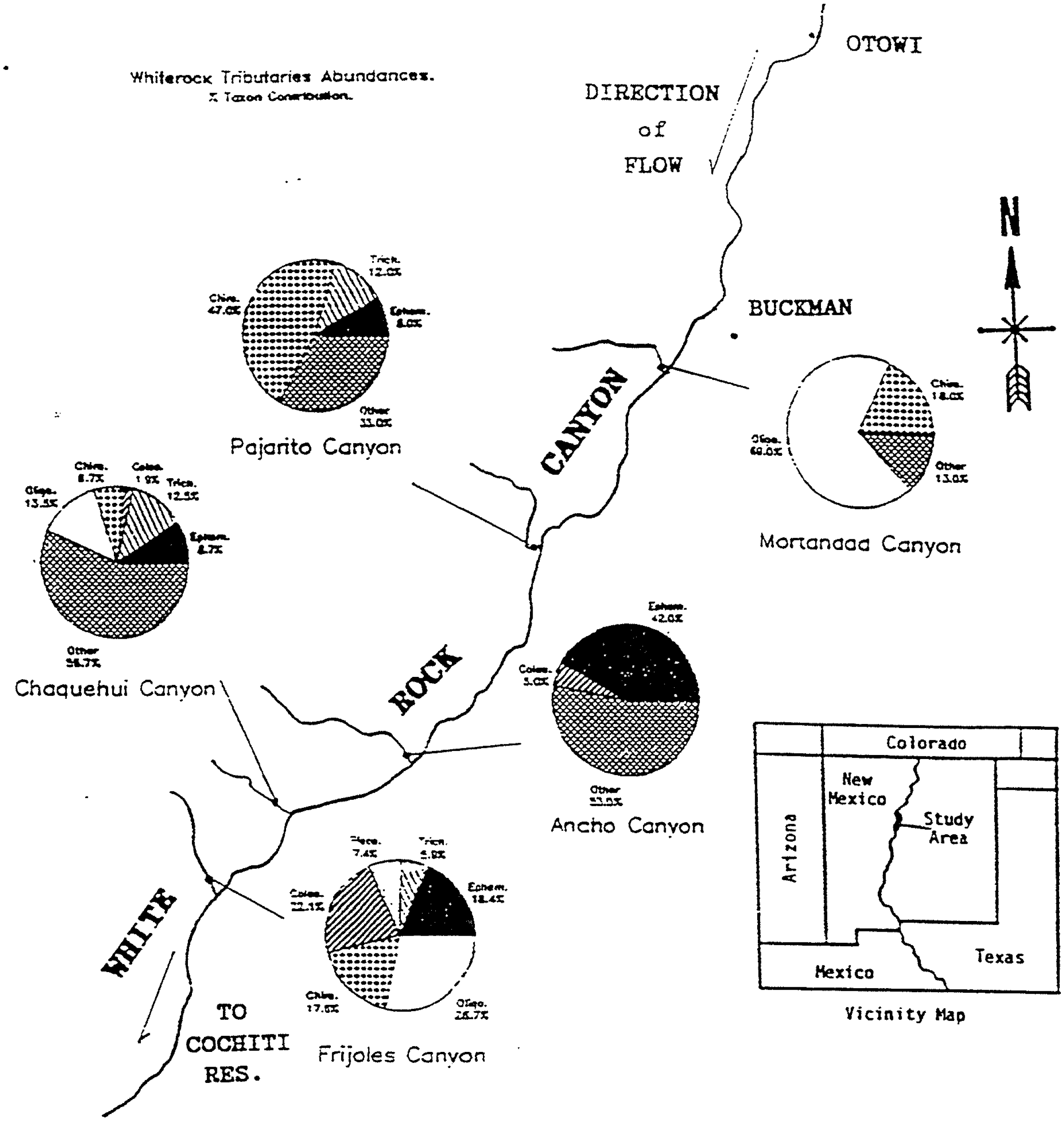
Flooding by Cochiti Reservoir has had a profound effect on habitat at the three lower stations. The combination of sandy soils and the removal of the sheltering effect of the Juniper forest has made the establishment of good ground cover difficult. Surface soils are, consequently, subject to erosion and stream banks remain unstable over much of the area. Above the Cochiti flood pool, Mortandad Canyon appears to be suffering the effects of a general destabilization of its channel. Ground cover has been disturbed over much of the valley floor and there is evidence of sediment deposition in the stream bed.

The Percent Model Affinity metric (PMA), as developed by Novak and Bode for use in New York State was run along side the RBA protocols for comparison. This metric, which requires identification of macroinvertebrates only to the level of Order, has been shown to correlate well with other metrics, notably Hilsenhoff's FBI. Results of this metric here parallel the results of the RBA II process closely and may offer an economical and truly rapid bio-assessment technique.

A number of concrete recommendations may be made on the basis of this survey. Nutrient analyses should be run on all five systems on an "above and below" basis ie, samples should be drawn as high as is practicable in the watershed as well as down on the Rio Grande floodplain. Additionally, all five systems, and especially the Rito de los Frijoles, should be sampled for DDT and associated decomposition products. The removal of cattle from federal land in White Rock Canyon would remove a major impediment to the re-establishment of riparian vegetation along tributary streams and the eventual stabilization of their banks. Damage to vegetative cover in some areas of Chaquehui and Frijoles Canyons caused by grazing and loafing activities was significant. It is apparent that sub-sampling methods for the RBA protocols need improvement over the method used here. One methodology that appears promising is to sort some percentage of cells in the tray. While there are drawbacks with this method as well, eg. some impacted stations may yield very low numbers, the bias engendered by unequal sampling effort would be minimized.

It is desirable but probably not practical at this time to conduct RBA II surveys on all five systems on an above and below basis to aid in separating watershed effects from base water quality effects. A program of this nature would be an invaluable aid in assessing the progress of any remediation efforts that might be undertaken on these streams.

Figure 1.



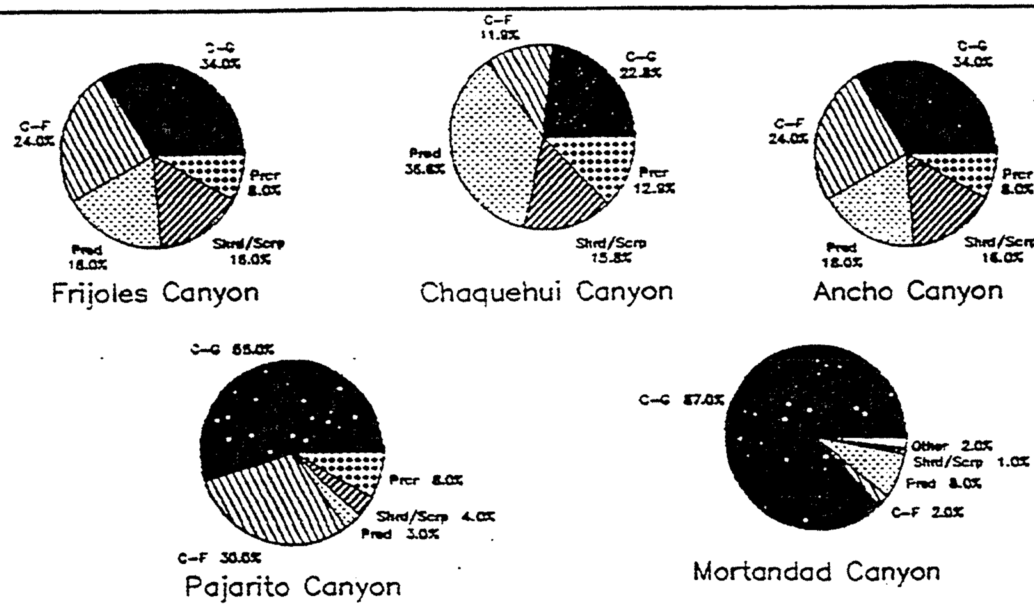


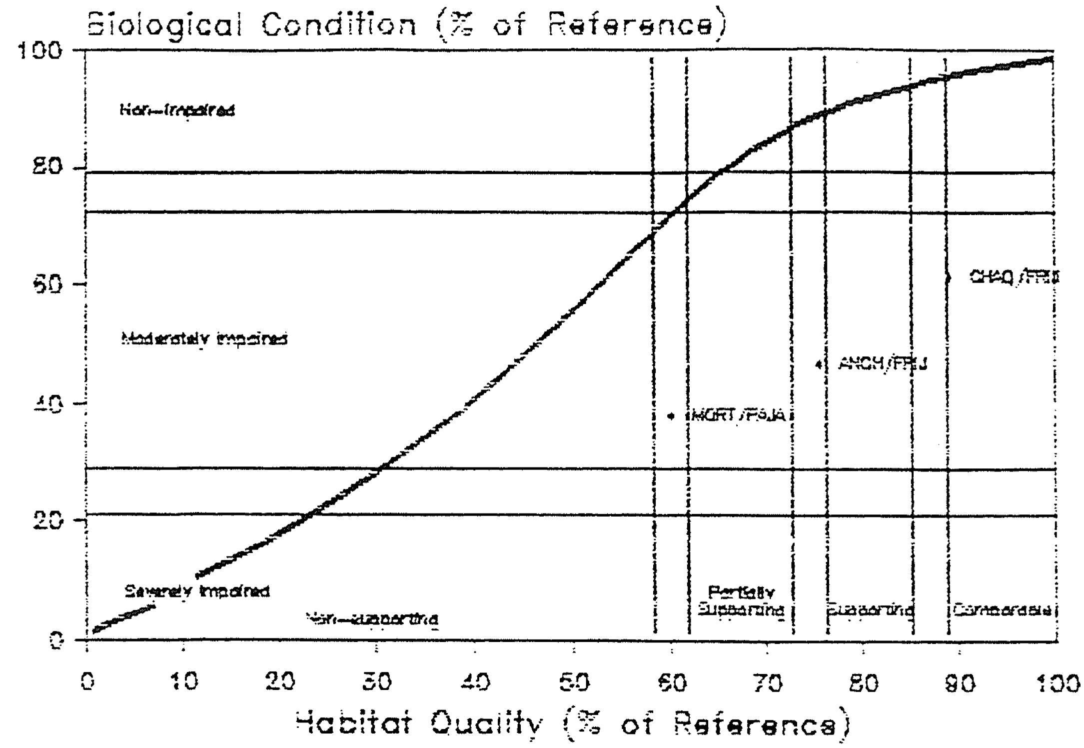
Figure 2.

Whiterock Tributaries % Trophic Groups:
Percent of population by trophic group.

C–G = gatherer, C–F = filterer, Pred = predator, Shrd/Scrp = shredder/scraper, Prcr = piercer, Other = nematodes

Figure 3. Bioassessment Summary: RBA II

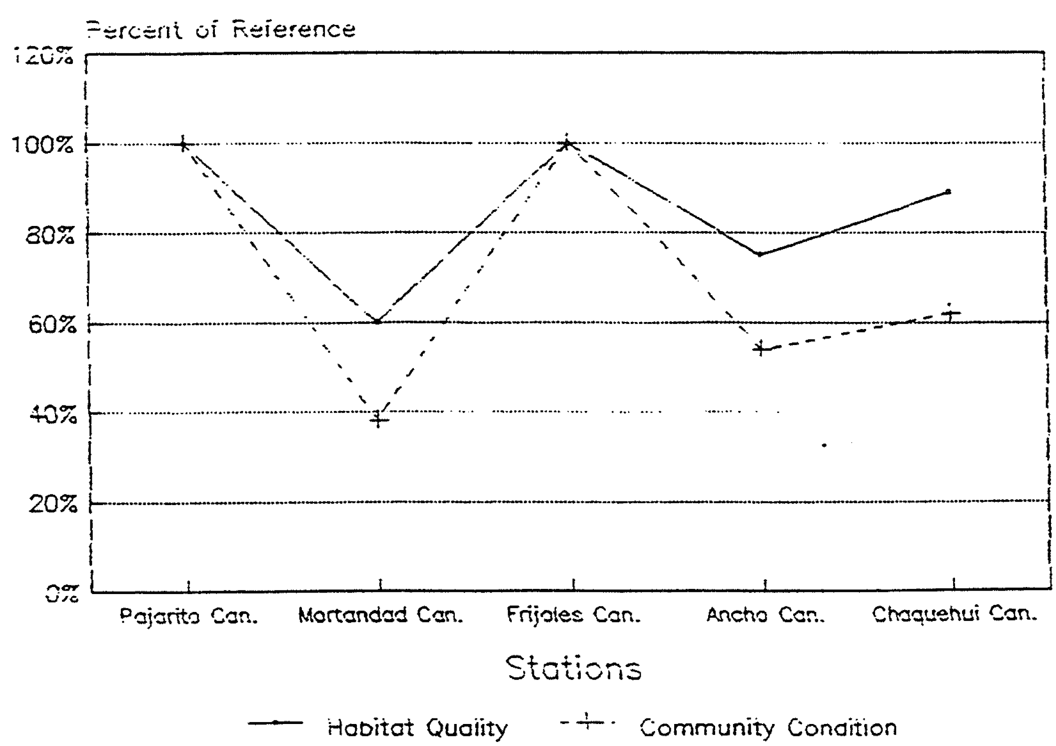
Biological Condition vs Habitat Quality



Reference stations assumed to be 100%.

White Rock Canyon Stations:

Habitat Quality vs Biological Condition



Values given are percent of reference.

Table 1. RAPID BIOASSESSMENT (PROTOCOL II) OF LOWER WHITE ROCK CANYON STATIONS, SEPTEMBER 8 - 11, 1992

METRIC	Station 2 Pajarito Canyon (Reference)	Station 1 Mortandad Canyon
Calculated Value		
Number of Taxa	9	11
Biotic Index		
FBI	6.56	7.82
Shredders/Total	0.11	0.09
EPT/(Chironomids + EPT)	0.80	0
% Dominant Taxa	47	69
EPT Index	4	0
Community Loss	-	0.64
Scrapers/(Scrapers + Collector-Filterers)	0.25	0
Percent of Reference		
Number of Taxa	100%	122%
Biotic Index		
FBI	100	84
Shredders/Total	100	82
EPT/(Chironomids + EPT)	100	0
% Dominant Taxa	100	146
EPT Index	100	0
Community Loss	-	0.64
Scrapers/(Scrapers + Collector-Filterers)	100	0
Score		
Number of Taxa	6	6
Biotic Index		
FBI	6	3
Shredders/Total	6	6
EPT/(Chironomids + EPT)	6	0
% Dominant Taxa	6	0
EPT Index	6	0
Community Loss	6	3
Scrapers/(Scrapers + Collector-Filterers)	6	0
Total	48	18
Biological Condition	100% reference	38% Moderately Impared
Habitat Condition	166	100 Partially Supporting 60 % of Reference

Table 1. (cont) RAPID BIOASSESSMENT (PROTOCOL II) OF LOWER WHITE ROCK CANYON STATIONS

METRIC	Station 5 Frijoles Canyon (Reference)	Station 4 Chaquehui Canyon	Station 3 Ancho Canyon
Calculated Value			
Number of Taxa	11	16	9
Biotic Index			
FBI	4.12	6.97	6.26
Shredders/Total	0.20	0.06	0.00
EPT/(Chironomids + EPT)	0.89	0.67	1.00
% Dominant Taxa	30	16	34
EPT Index	8	2	2
Community Loss	ref.	0.58	1.00
Percent of Reference			
Number of Taxa	100	145	82
Biotic Index			
FBI	100	59	66
Shredders/Total	100	30	0
EPT/(Chironomids + EPT)	100	75	112
% Dominant Taxa	30	16	34
EPT Index	100	25	25
Community Loss	ref	0.58	1.00
Score			
Number of Taxa	6	6	6
Biotic Index			
FBI	6	3	3
Shredders/Total	6	3	0
EPT/(Chironomids + EPT)	6	3	6
% Dominant Taxa	3	6	3
EPT Index	6	0	0
Community Loss	6	3	3
Total	39	24	21
Biological Condition	100% Reference	62% Moderately Impared	54% Moderately Impared
Habitat Condition	85 Reference	76 89% Comparable	64 75% Supporting

Table 2. TAXONOMIC LISTS FOR PAJARITO AND MORTADAD CANYONS, SEPTEMBER 8 - 11, 1992.

TAXON	Station 2 Pajarito Canyon (Reference)	Station 1 Mortandad Canyon
Lumbricidae	-	69
Nematoda	-	2
Ostracoda	-	1
Naucoridae	-	1
Ochteridae	-	1
Ceratopogonidae	1	2
Chironomidae	48	18
Culicidae	-	1
Dolichopodidae	2	-
Simuliidae	27	-
Tabanidae	-	2
Tipulidae	-	1
Pyralidae	4	-
Baetidae	8	-
Hydropsychidae	3	-
Philopotamidae	1	-
Hydroptilidae	8	-
Libellulidae	2	-
TOTAL	102	100

NON-RBA METRICS	Station 2 Pajarito Canyon (Reference) VALUE	Station 1 Mortandad Canyon
Shannon-Weiner Diversity	2.64	1.60
Hmax	3.17	3.46
E	0 .68	0.46
BCI/CTQa	102	107
No. cells picked	5	12
$\bar{X}$ no. per cell	20	8
Percent Model Affinity (PMA)	Ref.	31
PMA/Frijoles as reference	40	24

Table 2 (cont). TAXONOMIC LISTS FOR FRIJOLES, CHAQUEHUI AND ANCHO CANYONS,SEPTEMBER 8 - 11, 1992.

TAXON	Station 5 Frijoles Canyon (Reference)	Station 4 Chaquehui Canyon	Station 3 Ancho Canyon
Lumbricidae	3	12	-
Naididae	-	2	-
Nematoda	-	-	-
Ostracoda	-	5	20
Physidae	-	13	16
Notonectidae	-	3	-
Corixidae	-	1	1
Gerridae	-	7	-
Ceratopogonidae	-	3	-
Chironomidae	24	7	-
Ephydridae	-	1	-
Simuliidae	-	-	4
Tipulidae	-	4	-
Elmidae	30	-	-
Dytiscidae	-	2	5
Perlidae	3	-	-
Pteronarcidae	2	-	-
Nemouridae	2	-	-
Perlodidae	3	-	-
Baetidae	22	9	34
Tricorythidae	3	-	8
Hydroptilidae	1	13	-
Brachycentridae	7	-	-
Coenagrionidae	-	5	9
Libellulidae	-	17	-
TOTAL	100	104	100

NON-RBA METRICS VALUE	Station 5 Frijoles Canyon	Station 4 Chaquehui Canyon	Station 3 Ancho Canyon
S/W Diversity	2.66	3.61	2.64
Hmax	3.46	4.00	3.17
E	0.77	0 .90	0.83
BCI/CTQa	88	95	93
No. cells picked	3	10	3
X̄ no. per cell	33	10	33
% Model Affinity (PMA)	Ref	27	30
PMA/Pajarito as ref.	40	58	41

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APPENDIX B

1993 Invertebrate Taxa List

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1993 Invertebrate Taxa List

STATION	LA 5.3	AN 0.1	SA 6.1	DP 0.1	PA 0.1	FR 0.1	LA 12.2
DATE	21-Jun-93	13-Oct-93	21-Jun-93	21-Jun-93	13-Oct-93	14-Oct-93	21-Jun-93
TAXA							
PLECOPTERA - stoneflies							
Malenka sp.	57						466
Suwallia sp.	3						
Zapada cinctipes						4	12
Capniidae						1	
Pteronarcella badia						4	
Isoperla sp.						4	2
Hesperoperla pacifica						8	
EPHEMEROPTERA - mayflies							
Siphlonuridae		1					
Siphlonurus occidentalis	2						
Baetis tricaudatus	102	120	660	6	6	10	65
Nixe simplicoides	3						108
Tricorythodes sp.		5				2	
Paraleptophlebia sp.						1	9
Ephemerella inermis						7	
Ameletus sp.							2
Epeorus sp.							72
TRICHOPTERA - caddisflies							
Chimarra sp.		102			7		
Hydropsyche oslari		4				7	
Hydroptila sp		5			4		
Stactobiella sp.		3			1		
Hesperophylax sp.			10				3
Hydropsyche occidentalis					118		
Cheumatopsyche sp.					5		
Leucotrichia sp.					157		
Alisotrichia sp.					36		
Brachycentrus americanus						34	
Limnephilus sp.							1
Lepidostoma sp.							2
Wormaldia sp .					7		
DIPTERA - true flies							
Dicranota sp.	2		2				2
Simulidae				1			
Simulium sp.	362	339	1		32	23	14
Pagastia sp.	10						
Brillia sp.	1		1				6
Eukieffefiella sp.	7	10					2
Parametriocnemus sp.	4						
Tvetenia sp.	8		1			1	1
Chilifera sp.	1						
Limnophora sp.	5	3	1	1			
Thienimeniella sp.		1					

1993 Invertebrate Taxa List

STATION	LA 5.3	AN 0.1	SA 6.1	DP 0.1	PA 0.1	FR 0.1	LA 12.2
DATE	21-Jun-93	13-Oct-93	21-Jun-93	21-Jun-93	13-Oct-93	14-Oct-93	21-Jun-93
TAXA							
DIPTERA - true flies cont.							
Thienemannimyia sp.		2	3				
Cricotopus sp.		14			11	7	
Rheotanytarsus sp.		3			1	1	
Polypedilum sp.		6				2	
Pseudochironomus sp.		1					
Micropsectra sp.		1					
Stratiomyidae		1				8	
Tipula sp.				1			
Culiseta sp.				64			
Microtendipes sp.				3			
Corynoneura sp.					2		
Dixa sp.						3	3
Prosimulium sp.							5
ODONATA - damsel/dragonflies							
Libellulidae		11			10	1	
Hetaerina sp.		5			2		
Argia sp.		5			4		
HEMIPTERA - true bugs							
Gerris sp.	1			1		1	
Ambrysus mormon		3			1		
Veliidae		20			1		
Sigara sp.						1	
COLEOPTERA - beetles							
Agabus sp.	36	17	24	12			8
Deronectes sp.	2						
Optioservus sp.			3	5	2	1071	3
Zaitzevia parvula				1		2	11
Curculionidae				1			
Helichus sp.					1	2	1
Heterelmis sp.					18		
Microcylloepus sp.					6		
LEPIDOPTERA - moths							
Paragyractis kearfottalis					24	3	
AMPHIPODA - scuds							
Hyalella azteca					5		
ANNELIDA - segmented worms							
Lumbricidae	1		42			4	2
MOLLUSCA - snails/clams							
Phusella sp.		25					
Totals	607	707	748	96	461	1212	800
Total Taxa	18	25	11	11	24	26	23

APPENDIX C

Comparison of NMED & LANL data on (LA 4.1; 930803)

Comparison of NMED & LANL data on (LA 4.1; 930803)

TOTAL METALS	NMED - DOE Oversight Program	LANL EM - 8
	LA 4.1	LA 4.1; Sample Num. 93.15751
	930803	930803
TIME:	1740	1740
(ug/L)		
Al	300000	23,000
Ba	2800	1,400
Be	100K	13
B	100	10K
Ca	84000	NA
Co	90	45
Cu	320	90
Fe	273000	NA
Mg	4600	NA
Mn	9180	NA
Mo	100K	NA
Ni	200	50
Si	2500	NA
Ag	100K	10K
Sr	700	NA
Sn	100K	NA
U	NA	4
V	300	65
Zn	260	1,300
As	13	5.7
Cd	1K	6
Cr	330	22
Pb	1080	400
Hg	2.80	0.2K
Se	5K	2K

Legend: K= Actual value is known to be less than value given.

NMED - DOE Oversight
LA 4.1
DATE: 930803
TIME: 1740

LANL EM-8
LA 4.1
930803
1740
Sampling Num. 93.15751

ANALYTE (pCi/L)	Value	Sigma		ANALYTE (pCi/L)	Value	Sigma
Gross-alpha w/ Am-241 ref	1000.00	150.00	50.00	Gross-alpha w/ Am-241 ref	22.00	5.00
Gross-alpha w/ U-nat ref	1480.00	150.00	80.00	H-3	600.00	300.00
Gross-beta w/ Cs-137 ref	1680.00	120.00	90.00			
Gross-beta w/ Sr/Y-90 ref	1590.00	100.00	80.00	Gross-beta w/ Sr/Y-90 ref	93.00	9.00