Don, please look over for any major problems. Thanks

57286.2
16-000666

WATER QUALITY AND FLOW CHARACTERISTICS OF PERENNIAL REACHES IN PAJARITO CANYON AND CAÑON DE VALLE, LOS ALAMOS NATIONAL LABORATORY

DRAFT

MICHAEL R. DALE

New Mexico Environment Department, DOE Oversight Bureau,

35 Rover Blvd., White Rock, NM 87544

Abstract -- From 1995 to 1997 field observations, flow measurements and water-quality sampling were conducted in Pajarito Canyon and Cañon de Valle along the western edge of the Los Alamos National Laboratory (LANL). The main objectives of this study were to assess water quality and determine if perennial conditions exist within the western reaches of these canyons. One surface-water sampling event occurred in early 1997, and data show that surface water in Pajarito Canyon appears to be free of any anthropogenic compounds; however, elevated levels of dissolved barium and manganese, nitrate as nitrogen and high explosive compounds were detected in Cañon de Valle surface water. Of these, dissolved barium and the high explosive compound RDX concentrations exceed ~~EPA's~~ LANL's screening action levels which is defined as: a specified contaminant level that if exceeded in a sample, requires further action. Discharge data collected in these reaches show that flow in both canyons is perennial and varies seasonally in response to precipitation. Perennial flow is supported by several springs which discharge from the upper Bandelier Tuff (Dale and Yanicak, 1996). Discharge rates ranged from 0.02 to 0.18 cfs in Cañon de Valle and 0.05 to 0.47 cfs in Pajarito Canyon.

Be more specific

Not sure this is correct

These SALs are based on EPA Region IX preliminary ri

3509

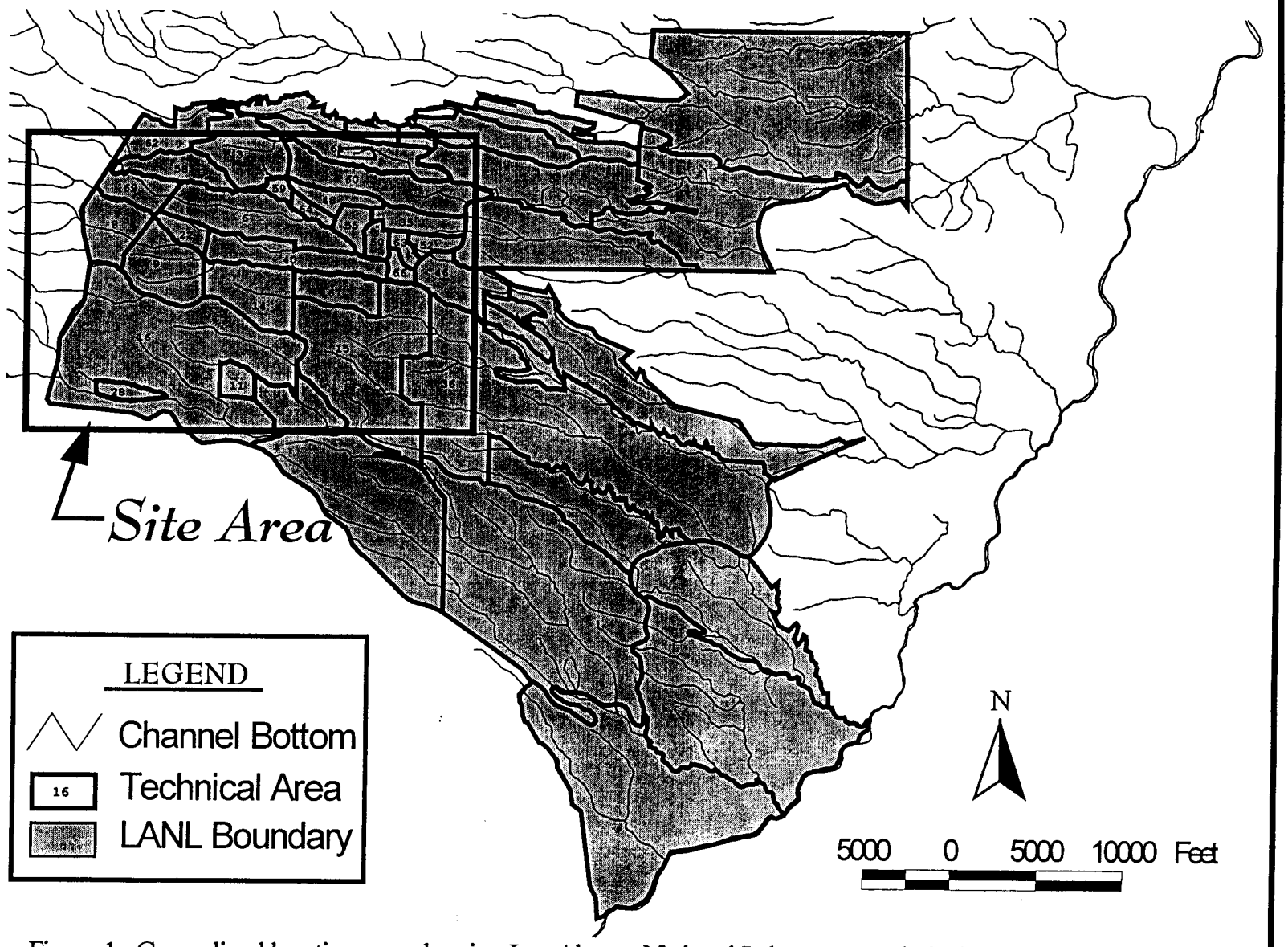


Figure 1. Generalized location map showing Los Alamos National Laboratory, technical areas, and site area.

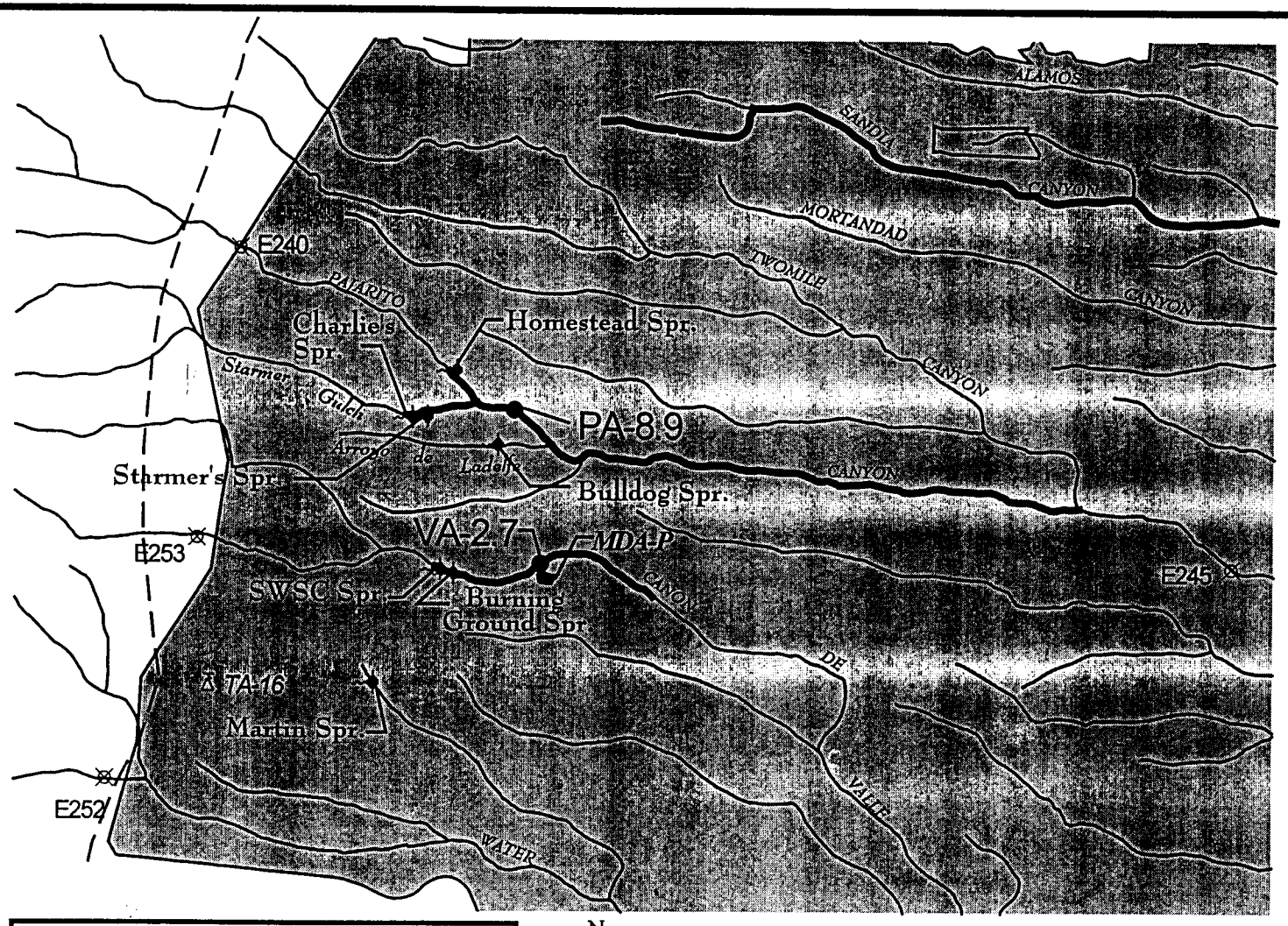
GENERAL SETTING OF THE STUDY AREA

The study area is located in the western portion of LANL, and is restricted to Pajarito Canyon and Cañon de Valle (Figure 1). This area is situated within the boundaries of several LANL TAs, specifically, TAs 9, 16 and 22. Within this area of the Laboratory, facility-operational areas are restricted to the mesa tops, and contain buildings, roads, utilities, storm-drains, active and inactive outfalls (e.g., NPDES Outfalls), waste-disposal areas, etc.

Vegetation in the study area and within this region of the Pajarito Plateau, varies from the mesa tops to the canyon bottoms. Mesa top vegetation is dominated by ponderosa pine, while the canyon bottoms contain more of a variety of flora including ponderosa pine, white fir, Douglas fir, Gambles Oak, and aspen.

Based on LANL's historical climatological data collected from 1961 through 1990, the average high and low temperatures in July were 27°C and 13°C respectively; the average high and low temperatures in January were 4° and -8°C respectively (Cross, 1996).

Precipitation data within the region have been continuously collected by LANL at TA-16 (Figure 2) from January 1, 1977 to the present (precipitation data for 1978 were not recorded). The average yearly rainfall from 1979 through 1997 was about 21 inches with August showing the most precipitation and January recording the least. Total rainfall amounts for 1994, 1995 and 1996, were 24.7, 23.3 and 24.0 inches respectively; with an average monthly rainfall of approximately 2 inches. As noted on Figure 3, an extremely dry period prevailed from October



LEGEND

- Rain Gage
- Flow Gage
- Sampling Location
- Springs
- Ephemeral
- Perennial
- Pajarito Fault Zone
- LANL Boundary

N

3000 0 3000 6000 Feet

Figure 2. Locations of springs, LANL gaging stations, and sampling and flow-measure stations.

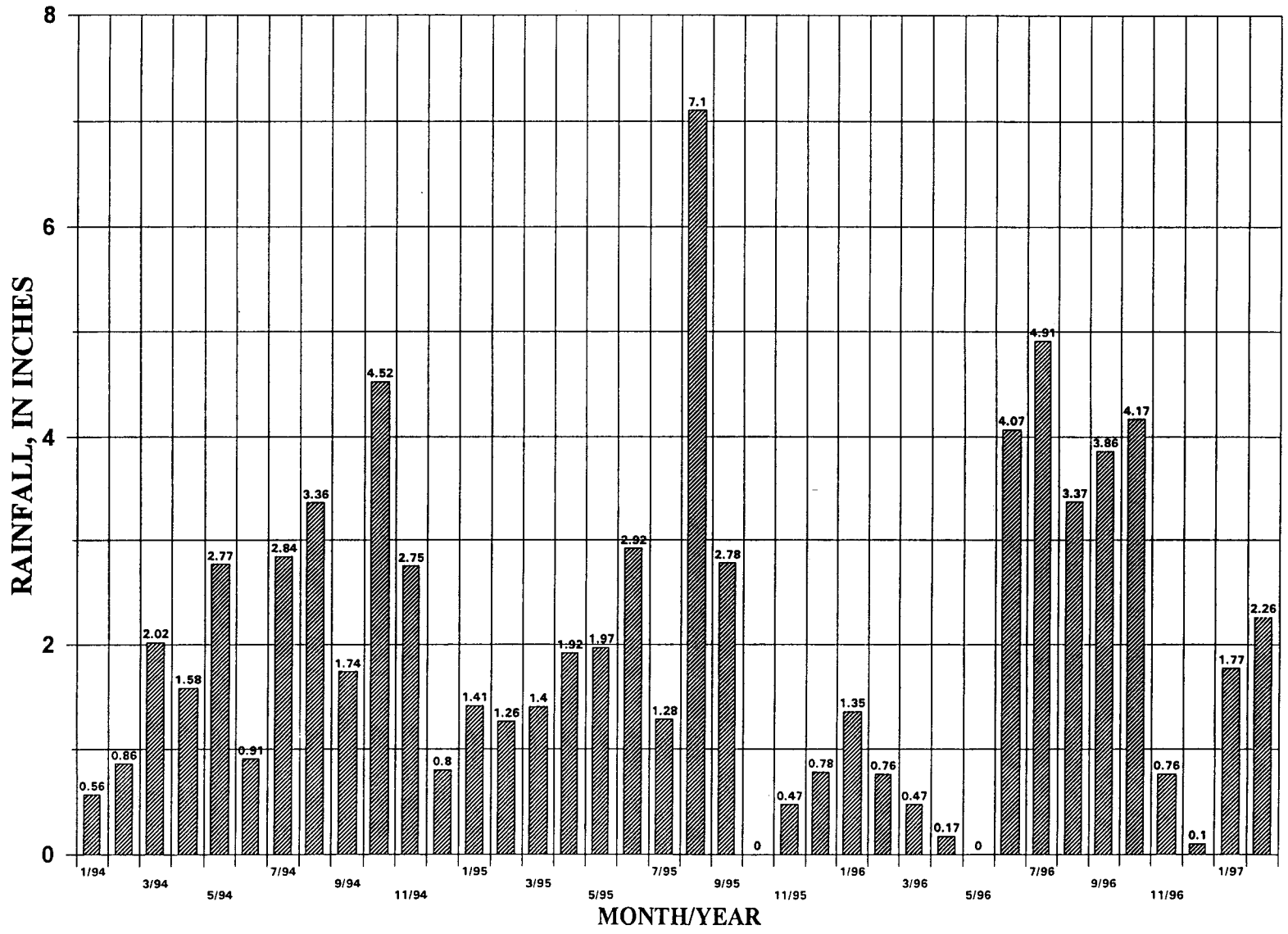


Figure 3. Monthly total precipitation for the study area from January, 1994 through February, 1997 (LANL Tech Area 16 Meteorological Station) (Source: LANL, ESH-17).

de los Valles to the Rio Grande. Cañon de Valle is a northern tributary to Water Canyon, whose headwaters begin at the Sierra de los Valles, and the watershed outlet is at the Rio Grande. Mesas between these basins rise to the west. Data-collection points in Pajarito Canyon and Cañon de Valle are located within the canyon bottom at approximate elevations of 7,360 ft and 7,350 ft respectively, and lie about 150 ft below the surrounding mesa tops. Active channel widths range from approximately 2 to 5 ft and depths range from approximately and 1 to 3 ft. Waterfalls are present in areas where resilient bedrock outcrops and/or areas where large boulders have dammed the active channel. Surface-water flow within these reaches is supplied by regional- and localized-snowmelt and storm-water runoff, and perennial and ephemeral springs which are located a short distance (≈0.5 mi) west or upstream of the study areas (Figure 2). Runoff contributions from canyon walls or hillsides are restricted to localized storm-water and snowmelt and anthropogenic sources such as facility outfalls. Continuous flow from the springs to the data-collection points was observed throughout the study period.

Note upstream outfalls & when 2600 outfall & stream plant shut down

Several springs supply flow in Pajarito Canyon which is observed normally west of the study area; it is not certain how far downstream of PA-8.9 this flow extends (Figure 2). However, several field excursions down the canyon showed that flow was continuous to at least the Twomile Canyon confluence. Flow at PA-8.9 is supplied mainly by perennial springs located in two small southern tributaries named Starmer Gulch and Arroyo De Ladelfe. Starmer's Spring, which is located in Starmer Gulch, supplies the bulk of flow observed at PA-8.9. Homestead Spring, located in Pajarito Canyon about 0.25 mi west of the Starmer Gulch confluence, supplies very little of the total flow observed in this reach. Ephemeral flow occurs upstream or west of the source-springs in Starmer Gulch and Pajarito Canyon. An additional

the Tshirege Member of the Bandelier Tuff (Qbt 3 and Qbt 4). It is assumed that Pajarito and Cañon de Valle contain a perched-alluvial aquifer which is recharged via surface-water and ground-water sources in the study area. The interconnection (e.g., return flow) between these possible perched aquifers and streamflow, and ground-water seepage beneath the alluvium are unknown.

FLOW MEASUREMENTS

Measurements of flow rate for ground water and surface water were determined by using the bucket-and-stop-watch method. Multiple measurements were made at each flow station in order to acquire a mean flow-rate value. All measurements were made during non-storm-water conditions.

You might want to get Dave's flow measurements for the springs as well.

Pajarito Canyon (PA-8.9)

Pajarito Canyon baseflow at the study area (PA-8.9) is assumed to be supplied predominantly by several perennial springs located west and upstream in Pajarito Canyon and Starmer Gulch (Figure 2). Estimated flow rates from these springs range from approximately 5 to 35 gpm. Other contributions to streamflow at this location may include interflow, underflow, throughflow, direct precipitation, etc. Streamflow loss between these springs and PA-8.9 was not calculated due to the lack of direct-discharge data for each spring. The exact distance flow extends downstream from PA-8.9 has not been determined; however, on July 22, 1994, continuous flow was observed from PA-8.9 to at least the Twomile Canyon confluence (Figure

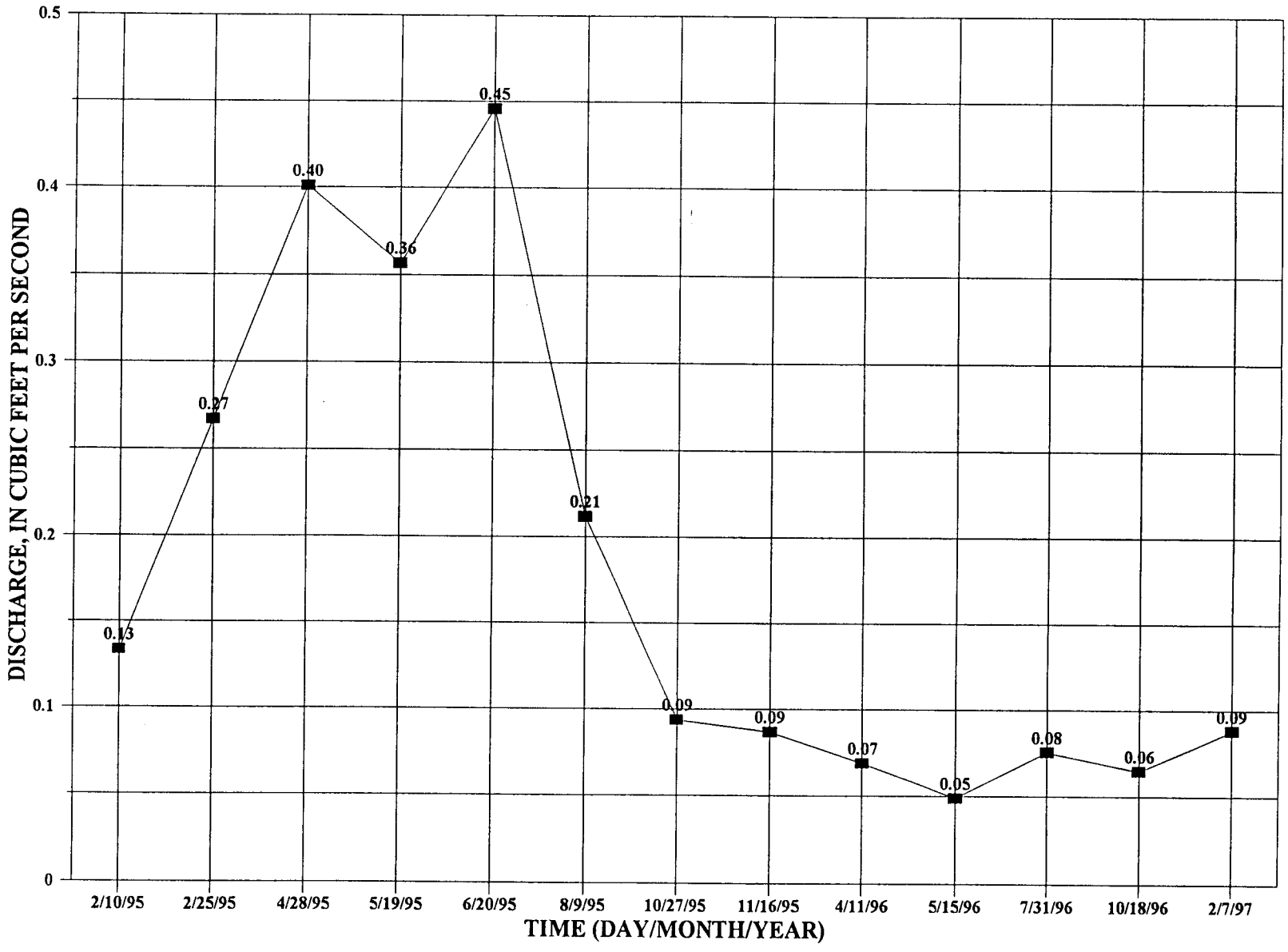


Figure 4. Hydrograph illustrating periodic-discharge measurements for Pajarito Canyon at PA-8.9.

surface-water contributions of this tributary to Pajarito Canyon was obviously not recorded at PA-8.9 due to its confluence being located east and downstream from PA-8.9. Flow is supplied by one major perennial spring (Bulldog Spring) which discharges at approximately 15 gpm (estimated). Flow from this tributary to Pajarito Canyon persisted throughout the study period.

Cañon de Valle (VA-2.7)

The majority of surface-water flow in Cañon de Valle at VA-2.7 is assumed to be supplied from Burning Ground and SWSC Springs, which are located west and upstream of VA-2.7 (Figure 2). On October 18, 1996, flow from Burning Ground and SWSC Springs was measured at 12.4 gpm (0.028 cfs) and 1.3 gpm (0.003 cfs) respectively. Streamflow at VA-2.7 was measured at 0.035 cfs approximately 20 minutes after the springs were measured, and the data show that the stream gained about 0.005 cfs between the springs and VA-2.7. During the past three years, we have observed that flow downstream from VA-2.7 normally extends eastward about 1.5 to 2.0 mi.

Including flow measurements here.

Flow-measurement data were collected at VA-2.7 utilizing a 24" diameter culvert which is located north and adjacent to Material Disposal Area P (MDA P) (Figure 2). Seventeen measurements were made from January 20, 1995, through February 7, 1997; flow varied from 0.02 cfs on May 24, 1996, to 0.18 cfs on May 5, 1995 (Figure 5). Using our data to suggest a baseflow of 0.02 cfs, the total volume of surface water passing VA-2.7 for one year would be approximately 14.5 acre-ft.

You might want to discuss apparent lack of correlation between stream flow to precipitation

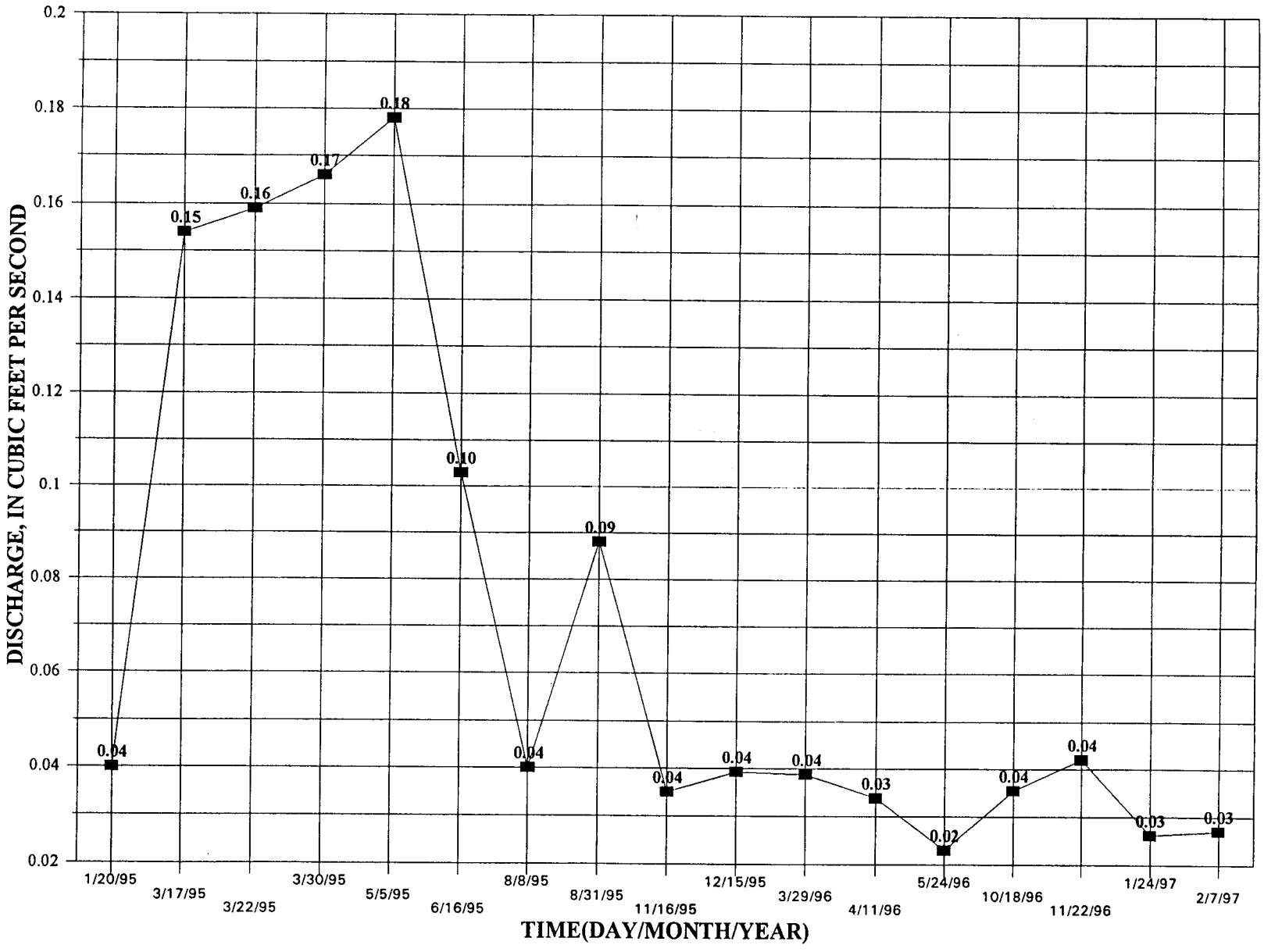


Figure 5. Hydrograph illustrating periodic-discharge measurements for Canon de Valle at VA-2.7.

All pH and temperature data were obtained using an Orion Model 290A ion-specific meter with an automatic-temperature-compensated electrode. Specific conductance and dissolved oxygen were measured using an Orion Model 124 meter and a YSI 51B respectively. Field equipment was calibrated according to manufacturer's specifications prior to use.

Pajarito Canyon (PA-8.9)

Pajarito Canyon surface-water samples were collected at PA-8.9 on February 7, 1997; a time at which total stream flow (0.09 cfs) was almost twice that of the assumed baseflow (0.049 cfs). The excess flow was probably the result of localized snowmelt runoff within the canyon bottom and/or along the canyon hillsides. At the time of sampling, flow above the source-springs was nonexistent. The field parameters pH, temperature, specific conductance and dissolved oxygen were measured at 7.09 S.U., 2.2°C, 230 uS/cm and 11.0 mg/L respectively. Turbidity was not measured in the field; however, laboratory analysis of total suspended solids were reported at less than 10 mg/L.

The water within this reach predominantly a calcium-sodium-bicarbonate type with dissolved solids at 180 mg/L. Major cations include calcium at 16 mg/L, magnesium at 5 mg/L, potassium at 4 mg/L and sodium at 25 mg/L. Bicarbonate (39 mg/L), chloride (48 mg/L) and sulfate (7 mg/L). Data for trace-metal concentration values were very limited because the majority of the results were below the method detection limits used by the laboratory; however, the following trace metals (dissolved) were detected: aluminum at 0.6 mg/L, iron at 0.3 mg/L and strontium at 0.12 mg/L. Total mercury and total recoverable selenium were not detected above the laboratory

Table 1. Summary of Inorganic results and Field Data for surface-water samples collected at PA-8.9 and VA-2.7, upper Pajarito Canyon and Canon de Valle, Los Alamos, New Mexico.

Station ID:			PA-8.9	VA-2.7
Sampling Date:			02/07/97	02/07/97
Analyte*	Analyte Method	F/T		
Ca	6010A	F	16	19
Mg	6010A	F	5	6
K	6010A	F	4	4
Na	6010A	F	25	22
Ag	6010A	F	<0.01	<0.01
Al	6010A	F	0.6	<0.2
As	6010A	F	<0.01	<0.01
B	6010A	F	<0.1	<0.1
Ba	6010A	F	<0.1	2.2
Be	6010A	F	<0.005	<0.005
Cd	6010A	F	<0.005	<0.005
Cr	6010A	F	<0.01	<0.01
Co	6010A	F	<0.01	<0.01
Cu	6010A	F	<0.01	<0.01
Fe	6010A	F	0.3	<0.1
Total Hg	7470	T	<0.0002	<0.0002
Li	6010A	F	<0.01	<0.01
Mn	6010A	F	<0.01	0.09
Mo	6010A	F	<0.01	<0.01
Ni	6010A	F	<0.02	<0.02
Pb	6010A	F	<0.003	<0.003
Sb	6010A	F	<0.02	<0.02
Total Recoverable Se	6010A	T	<0.005	<0.005
Si	6010A	F	19	21
Sn	6010A	F	<0.02	<0.02
Sr	6010A	F	0.12	0.13
Tl	6010A	F	<0.01	<0.01
V	6010A	F	<0.01	<0.01
Zn	6010A	F	<0.02	<0.02

Station ID:			PA-8.9	VA-2.7
Sampling Date:			02/07/97	02/07/97
Analyte*	Analyte Method	F/T		
Cl	300.0	NA	48	21
F	300.0	NA	<0.1	0.2
CO3	310.0	NA	<5	<5
HCO3	310.0	NA	39	77
TOTAL PHOSPHORUS AS P	365.2	NA	<0.05	0.08
SO4	300.0	NA	7	10
NITRATE + NITRITE as N	353.3	NA	0.55	1.0
TOTAL KJELDAHL NITROGEN AS N	351.2	NA	<2.5	<2.5
AMMONIA AS N	350.3	NA	<0.5	<0.5
GROSS ALPHA (pCi/L)	900.0/9310 Modified	F	<1.7	<1.8
GROSS BETA (pCi/L)	900.0/9310 Modified	F	4.0+/-2.2**	3.4+/-2.0**
TOTAL DISSOLVED SOLIDS (TDS)	160.1	NA	180	160
TOTAL SUSPENDED SOLIDS	160.2	NA	<10	<10
FIELD pH (Standard Unit)	NA	NA	7.09	7.21
FIELD SPECIFIC CONDUCTANCE (uS/cm)	NA	NA	230	215
FIELD TDS (ppm)	NA	NA	176	164
TEMPERATURE (degrees Celsius)	NA	NA	2.2	0.5
DISSOLVED OXYGEN	NA	NA	11.0	11.2

* - All results are in mg/L, except where noted.
** - Reported uncertainties are the Estimated Total Propagated Uncertainties (2 sigma).
NA - Not analyzed or not applicable.
T - Totals (non-filtered sample acidified prior to analysis).
F - Filtered (dissolved fraction < 0.45 micron).

Table 2. Volatile Organic Compound results for surface-water samples collected at PA-8.9 and VA-2.7, upper Pajarito Canyon and Canon de Valle, Los Alamos, New Mexico.

Station ID:	PA-8.9		VA-2.7	
Sampling Date:	02/07/97		02/07/97	
ANALYTE	Conc. (ug/L)	DL	Conc. (ug/L)	DL
ACETONE	ND	10	3 JB	10
ACETONITRILE (1)	ND	N/A	ND	N/A
ACROLEIN (1)	ND	N/A	ND	N/A
ACRYLONITRILE (1)	ND	N/A	ND	N/A
ALLYL CHLORIDE (1)	ND	N/A	ND	N/A
BENZENE	ND	5	ND	5
BROMODICHLOROMETHANE	ND	5	ND	5
BROMOFORM	ND	5	ND	5
BROMOMETHANE	ND	10	ND	10
2-BUTANONE (MEK)	ND	10	ND	10
CARBON DISULFIDE	ND	5	ND	5
CARBON TETRACHLORIDE	ND	5	ND	5
CHLOROBENZENE	ND	5	ND	5
CHLORODIBROMOMETHANE	ND	5	ND	5
CHLOROETHANE	ND	10	ND	10
CHLOROFORM	ND	5	ND	5
CHLOROMETHANE	ND	10	ND	10
CHLOROPRENE (1)	ND	N/A	ND	N/A
1,2-DIBROMOETHANE (EDB)	ND	5	ND	5
1,2-DIBROMO-3-CHLOROPROPANE	ND	5	ND	5
DIBROMOMETHANE	ND	5	ND	5
DICHLORODIFLUOROMETHANE	ND	5	ND	5
1,1-DICHLOROETHANE	ND	5	ND	5
1,2-DICHLOROETHANE (EDC)	ND	5	ND	5
1,1-DICHLOROETHENE	ND	5	ND	5
IODOMETHANE	ND	5	ND	5
ISOBUTYL ALCOHOL (1)	ND	N/A	ND	N/A
METHACRYLONITRILE (1)	ND	N/A	ND	N/A
METHYL METHACRYLATE (1)	ND	N/A	ND	N/A
4-METHYL-2-BUTANONE	ND	10	ND	10
PENTACHLOROETHANE (1)	ND	N/A	ND	N/A
PROPIONITRILE (1)	ND	N/A	ND	N/A
STYRENE	ND	5	ND	5
TRANS--1,2-DICHLOROETHENE	ND	5	ND	5
TRANS-1,4-DICHLORO-2-BUTENE (1)	ND	N/A	ND	N/A
1,2-DICHLOROPROPANE	ND	5	ND	5
CIS--1,3-DICHLOROPROPENE	ND	5	ND	5
TRANS--1,3-DICHLOROPROPENE	ND	5	ND	5
ETHYLBENZENE	ND	5	ND	5
ETHYL METHACRYLATE (1)	ND	N/A	ND	N/A
2-HEXANONE	ND	10	ND	10
METHYLENE CHLORIDE	ND	5	ND	5
1,1,1,2-TETRACHLOROETHANE	ND	5	ND	5
1,1,2,2-TETRACHLOROETHANE	ND	5	ND	5
TETRACHLOROETHENE	ND	5	ND	5
TOLUENE	ND	5	ND	5
1,1,1-TRICHLOROETHANE	ND	5	ND	5
1,1,2-TRICHLOROETHANE	ND	5	ND	5
1,2,3-TRICHLOROPROPANE	ND	5	ND	5
TRICHLOROETHENE	ND	5	ND	5
TRICHLOROFLUOROMETHANE	ND	5	ND	5
VINYL ACETATE	ND	5	ND	5
VINYL CHLORIDE	ND	10	ND	10
o-XYLENE	ND	5	ND	5
p- & m-XYLENE	ND	5	ND	5
TOTAL XYLENES	ND	5	ND	5

Method Used: 8260
ND - Not detected
DL - Method detection limit
B - Analyte found in Blank
J - Estimated value, analyte found below detection limit
(1)-Analyte searched for by ion and not quantitated
N/A - Not applicable

Table 3. High Explosive Compound results for surface-water samples collected at PA-8.9 and VA-2.7, upper Pajarito Canyon and Canon de Valle, Los Alamos, New Mexico.

Station ID:	PA-8.9		VA-2.7	
Sampling Date:	02/07/97		02/07/97	
ANALYTE	Conc. (ug/L)	DL	Conc. (ug/L)	DL
2-AMINO-4,6-DNT	ND	0.25	2.0	0.25
4-AMINO-2,6-DNT	ND	0.25	2.1	0.25
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	ND	1.0	8.2	1.0
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	ND	0.84	30	0.84
1,3,5-TRINITROBENZENE (1,3,5-TNB)	ND	0.26	ND	0.26
1,3-DINITROBENZENE (1,3-DNB)	ND	0.25	ND	0.25
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	ND	1.0	ND	1.0
NITROBENZENE (NB)	ND	1.0	ND	1.0
2,4,6-TRINITROTOLUENE (2,4,6-TNT)	ND	0.25	ND	0.25
2,4-DINITROTOLUENE(2,4-DNT) & 2,6-DINITROTOLUENE(2,6-DNT)	ND	0.25	ND	0.25
o-NITROTOLUENE (2-NT)	ND	1.0	ND	1.0
p-NITROTOLUENE (4-NT)	ND	1.0	ND	1.0
m-NITROTOLUENE (3-NT)	ND	1.0	ND	1.0

Method Used: Modified 8330
ND - Not detected
DL - Method detection limit

SUMMARY

Flow and water-qualtiy data obtained from field work performed during the study period show the following: 1) within the study areas located near the western boundary of LANL, perennial surface-water conditions exist in Pajarito Canyon and Cañon de Valle, both of which are located on DOE property, 2) streamflow specific to these two study-area reaches varies seasonally in response to precipitation, as demonstrated by lower discharge rates measured during the drought of 1995-96, and 3) water-quality data collected during the study period suggest that anthropogenic or manmade contaminants do exist in the study area location of Cañon de Valle but appear to be absent to the north in Pajarito Canyon. Contaminants of major concern identified in Cañon de Valle surface water are dissolved barium and RDX; both are present at levels which exceed EPA's (Region IX) screening action levels which is generally defined as: a specified contaminant level that if exceeded in a sample, requires further action.

In addition, we assume here that these water occurrences are vital to the local and regional ecological systems and that future users or inhabitants, perhaps even humans, may utilize these waters as well. These data may also support current and future assessments of ecological and human health risk at potential release sites located near or surrounding these canyon reaches. The protection and monitoring of these water resources are essential.

Shaull, D.A., Alexander, M.R., Reynolds, R.P. and McLean, C.T., 1996, Surface water data at Alamos National Laboratory: 1996 Water Year: Alamos National Laboratory, Report LA-13234-PR,53 p.