CAFB 97

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 27th FIGHTER WING (ACC)
CANNON AIR FORCE BASE, NEW MEXICO

30 SEP 1997

Lt Col Charles A. Hale
Deputy Commander, 27th Support Group
110 E Sextant Ave Suite 1098
Cannon AFB NM 88103-5323

Mr. Benito J. Garcia, Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
2044 Galisteo Street
PO Box 26110
Santa Fe NM 87502

ENTERED

Dear Mr. Garcia

As Deputy Commander for the 27th Support Group, I am forwarding this letter on behalf of Lt Col James A. Thomas III, the Support Group Commander.

Please find enclosed a statistical report prepared for groundwater monitoring at Landfill Five (SWMU #113) which took place over the course of the last year. We have sampled the wells at Landfill Five on a quarterly basis to get data for this report, and we will now revert to the twice yearly sampling agreed to by your office.

If you have any questions, please contact Mr. Sanford Hutsell of my environmental staff at (505) 784-6378.

Sincerely

CHARLES A. HALE, Lt Col, USAF
Deputy Commander, 27th Support Group

Attachment:
Statistical Report

cc:
NMED (C. Will)
NMED Groundwater Bureau (J. Jacobs)
Region 6 EPA (D. Neleigh)
HQ ACC CES/ESVW w/o Atch (M. Patterson)

Cannon Air Force Base, New Mexico

Statistical Analysis Report for Samples Collected August, December, 1996, March, and May 1997 from RCRA Ground-Water Monitoring Wells at Landfill 5

Prepared for

United States Air Force Air Combat Command
Cannon Air Force Base, New Mexico 88103

August 1997

Prepared by

U.S. Geological Survey, Water Resources Division
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SUMMARY OF STATISTICAL ANALYSIS

The U.S. Geological Survey (USGS), Water Resources Division and the U.S. Air Force Air Combat Command (ACC) have a memorandum of understanding that addresses the USGS assisting any ACC base in their hydrology or environmental programs. The USGS has agreed to assist Cannon Air Force Base (CAFB), an ACC base, in their Resource Conservation and Recovery Act (RCRA) ground-water sampling program. Cannon AFB is located in east-central New Mexico about 7 miles west of Clovis as shown on Figure 1. The ground-water sampling is at Landfill 5 on the southeast corner of the base as shown on Figure 2. The detection sampling is conducted semi-annually as part of the July 13, 1990 Compliance Agreement between CAFB and the New Mexico Environment Department (NMED). Ground water sampling is performed to evaluate whether a release of hazardous constituents has occurred from a regulated unit. The statistical procedures are used to determine whether baseline values or concentration limits have been exceeded in any of the monitoring wells during a sampling event.

This report presents the results of statistical testing of water-quality data for samples collected from four wells around Landfill 5 (figure 3), on August 1996, December 1996, March 1997, and May 1997. The statistical methods used to evaluate water-quality data at Landfill 5 (figure 4) are developed from Statistical Analysis of Ground-Water Monitoring data at RCRA Facilities (USEPA, 1992), and Parson Engineering Science, Inc. (1995). The statistical test procedures include parametric analysis of varience (ANOVA), nonparametiric ANOVA, and the Test of Proportions. The method to be used will be selected depending on data attributes. The SAS System (SAS Institute, Inc., 1988) was used to perform these statistical procedures. The detailed explanation of these statistical procedures is described in U.S. Environmental Protction Agency (USEPA, 1992), and Parson Engineering Science, Inc. (1995).

The monitoring wells sampled at Landfill 5 are downgradient wells I, L, M, and an upgradient well Q as shown on figure 3. These wells were sampled for the following Appendix-IX parameters: volatile organic compounds by method SW8260; semivolatile organic compounds by method SW8270; dioxins and furans by method SW8280; polynuclear aromatic hydrocarbons by method SW8310; pesticides and PCB's by method SW8080A; herbicides by method SW8150; general inorganics (cyanide by SW9012, sulfide by E376.2, total organic carbon (TOC) by SW9060, and total organic halogen as chloride (TOX) by SW9020); total metals (barium, beryllium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, vanadium, and zinc) by SW6010; total antimony by SW7041; total silver by

SW7761; total cadmium by SW7131; total arsenic by SW7060; total chromium by SW7191; total lead by SW7421; total mercury by SW7470; total selenium by SW7740; and total thallium by SW7841; and common ions (total calcium, total magnesium, and total sodium) by SW6010.

The data collected by Harding Lawson Associates (1996, 1997) for well Q on August and November 1996 were used in this statistical analysis for the August and Decembr 1996 sampling sets.

The parameters that have concentrations greater than reporting limits for environmental ground-water samples collected August 1996 through May 1997 from monitoring wells I, L, M, and Q at Landfill 5 are presented in tables 1 and 1a. Prior to the statistical testing, an attempt was made to check the seasonality by graphing concentration over time for parameters shown in table 1. Data is insufficient to judge seasonality. Therefore, the data were not adjusted for seasonality.

The statistical tests were performed on the detected parameters shown in table 1a except for fluorene, TOC, and copper (total) because these parameters were detected only one time and did not meet criteria to apply any statistical method for statistical evaluation. The data results of quality control samples such as field duplicate, trip blank, ambient blank, equipment blank, mtrix spike, matrix spike duplicate are not used in the statistical test.

The statistical test results of water-quality data for ground-water samples collected August 1996 through May 1997 from monitoring wells I, L, M, and Q at Landfill 5 are presented in table 2. The Test of Proportion procedure was performed on dichlorodifluoromethane, TOX, and selected total metals (arsenic, lead, manganese, nickel, selenium, and zinc). The Test of Proportions was performed at the five percent significance level to test the hypothesis that the proportion of compliance well samples where the analyte was detected exceeds the proportion of background well samples where the analyte was detected. A significant result is interpreted as evidence that there is a greater proportion of values above the reporting limit in the compliance wells than in the background well. The "Test of Proportion not applicable" was the result for dichlorodifluromethane, TOX, total arsenic and total lead. This means that these data did not meet the criteria to apply the Test of Proportion procedure for any statistical evaluation. A "no significant difference" was the result for total manganese, total nickel, and total selenium. This means that the compliance and background well data are similar and that there is no evidence of any compliance well having greater proportion of detected values than

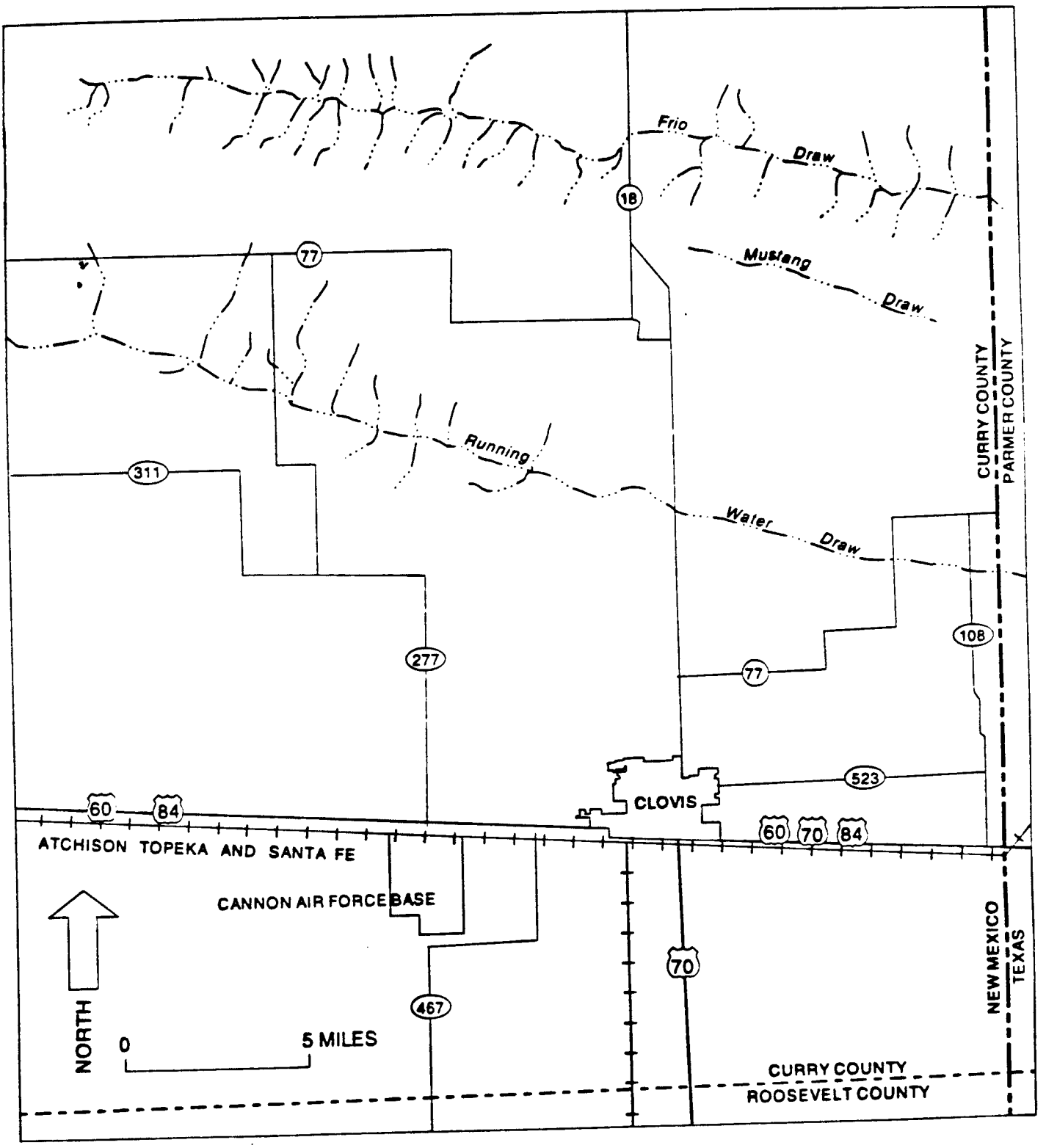
the background well. A "significant difference" was the result for total zinc. This result indicate that there is a greater proportion of detected values of zinc in the compliance wells than in the background well. The quality assurance and quality control (QA/QC) was performed for total zinc. Three out of six detected values for total zinc were reported with B qualifier from compliance wells (table 1a) which means that the values are questionable because low levels of zinc were also detected in the laboratory method blank. Therefore, the conclusion of a "significant difference" result for total zinc may not be valid due to the detection of zinc in the laboratory method blank. It should be noted that the concentration of total zinc ranged from 0.011mg/L in well I to 0.034 mg/L in well M (table 1a) which is much lower than the Environmental Protection Agency (EPA), Secondary Maximum Contaminant Level (SMCL) for drinking water standards for dissolved zinc of 5 mg/L.

The one-way, parametric ANOVA and the one-way, nonparametric ANOVA procedures (figure 4) were performed at the five percent significance level to test the hypothesis that samples from the compliance wells and the background well have sample means indicative of equal population means. A significant result is interpreted as evidence that at least one of the population means differs from the rest. The post-hoc pairwise comparison tests (Bonferroni multiple comparisons procedure) were then performed to determine which population means differed. The statistically significant detection limit (SSDL) was calculated for analytes that were tested using the one-way parametric ANOVA procedure. The SSDL is not meaningful for analytes that were tested using the one-way, nonparametric ANOVA procedure.

The one-way, parametric ANOVA procedure indicated a significant difference for total calcium, total magnesium, and total sodium (table 2). This means that at least one well shows different population mean than the rest of the wells. The pairwise comparison test results for total calcium indicate that the mean concentration of total calcium is greatest in the water from well M. The SSDL for total calcium is 59.16 mg/L. The mean concentration of total calcium for well M exceeded the SSDL. The pairwise comparison test results for total magnesium indicate that the mean concentration of total magnesium is greatest in water from wells L and M. The SSDL for total magnesium is 48.42 mg/L. The mean concentration of total magnesium for wells L and M exceeded the SSDL. The pairwise comparison test results for total sodium indicate that the mean concentration of total sodium is greatest in water from wells L and Q. The SSDL for total sodium is 45.33 mg/L. The mean concentration of total sodium for wells L and Q exceeded the SSDL. QA/QC was performed on total calcium, total

magnesium, and total sodium. The samples were not contaminated by the laboratory or field procedure in any way and the data were valid. The test results indicate the contribution of total calcium, total magnesium, and total sodium by Landfill 5.

The one-way, nonparametric ANOVA (Kruskal-Wallis test) procedure was performed on total barium, total chromium, total iron, and total vanadium (table 2). A "no significant difference" was the result for total chromium. This means that there is no evidence that the population means for total chromium differ among the wells tested. A "significant difference" was the result for total barium, total iron, and total vanadium. The pairwise comparison test resuts of total barium indicate that the mean concentration of total barium in water from wells L and M were significantly greater than the mean concentration of total barium in water from well Q. The concentration of total barium ranged from 0.027 in water from well Q to 0.054 mg/L in water from well M (table 1a). These values are much lower than the EPA, Maximum Contaminant Level (MCL) for drinking water standard of 2.0 mg/L dissolved barium. The pairwise comparison test results for total iron indicate that the mean concentration of total iron in water from well L is significantly greater than the mean concentration of total iron in water from wells I and Q. The concentration of total iron ranged from 0.054 mg/L in water from well Q to 1.7 mg/L in water from well L. The EPA, SMCL for drinking water standard for dissolved iron is 0.3 mg/L. A total iron value of 0.77 mg/L detected in water from well L was reported with B qualifier (table 1a) which means that the low level of total iron was also detected in the laboratory method blank. Therefore the conclusion that the mean concentration of total iron in water from well L is significantly greater than the mean concentration of total iron in water from wells I and Q may not be valid due to the detection of iron in the laboratory method blank. The pairwise comparison test results for total vanadium indicate that the mean concentration of total vanadium in water from well Q is significantly greater than the mean concentration of total vanadium in water from wells L and M. This result indicates that the source of total vanadium is not from Landfill 5. The concentration of total vanadium ranged from 0.014 mg/L in water from well M to 0.028 mg/L in water from well I.



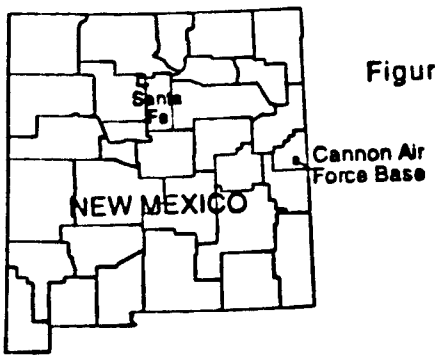


Figure 1.--Location of Cannon Air Force Base, New Mexico.

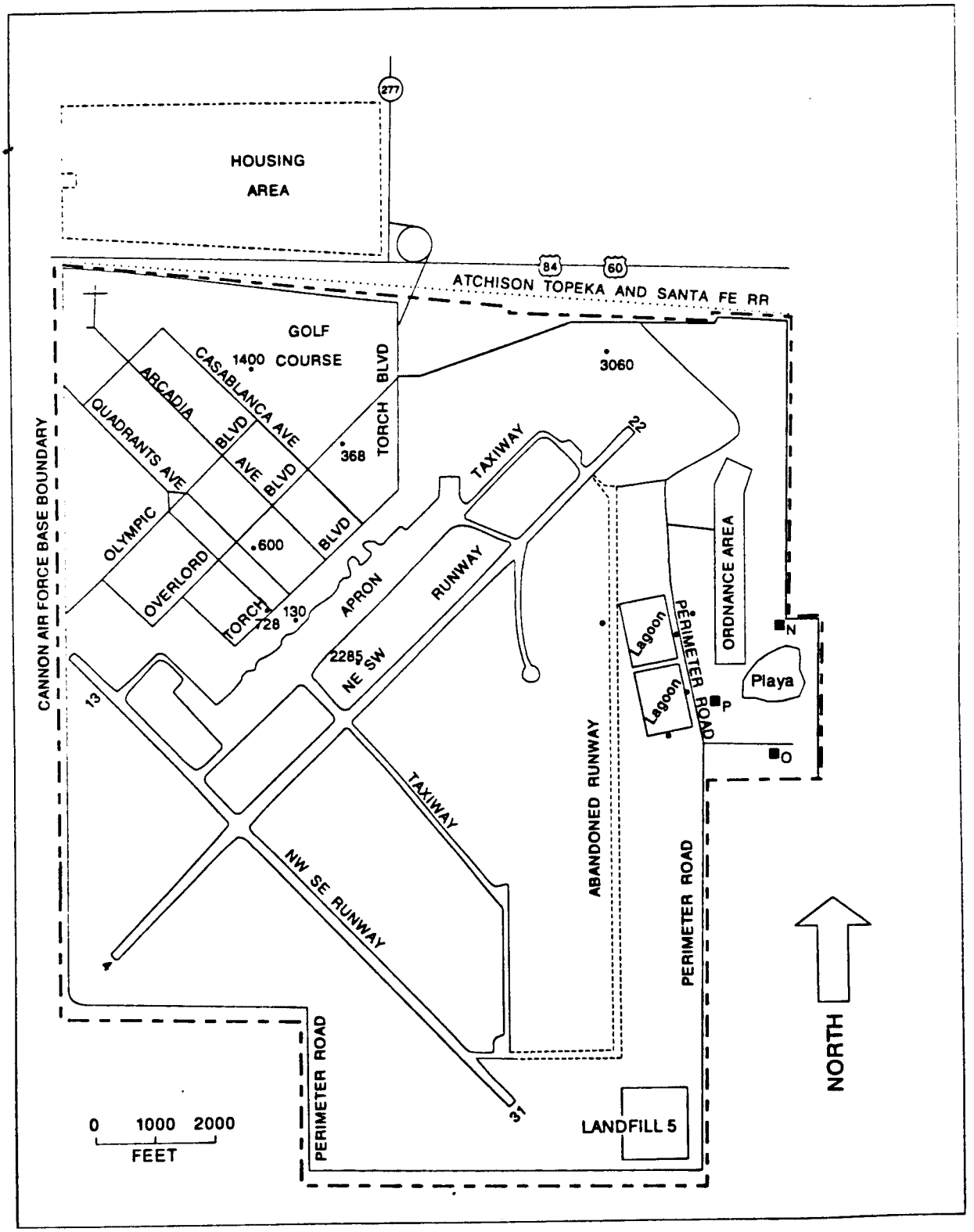


Figure 2.--Cannon Air Force Base and location of Landfill 5.

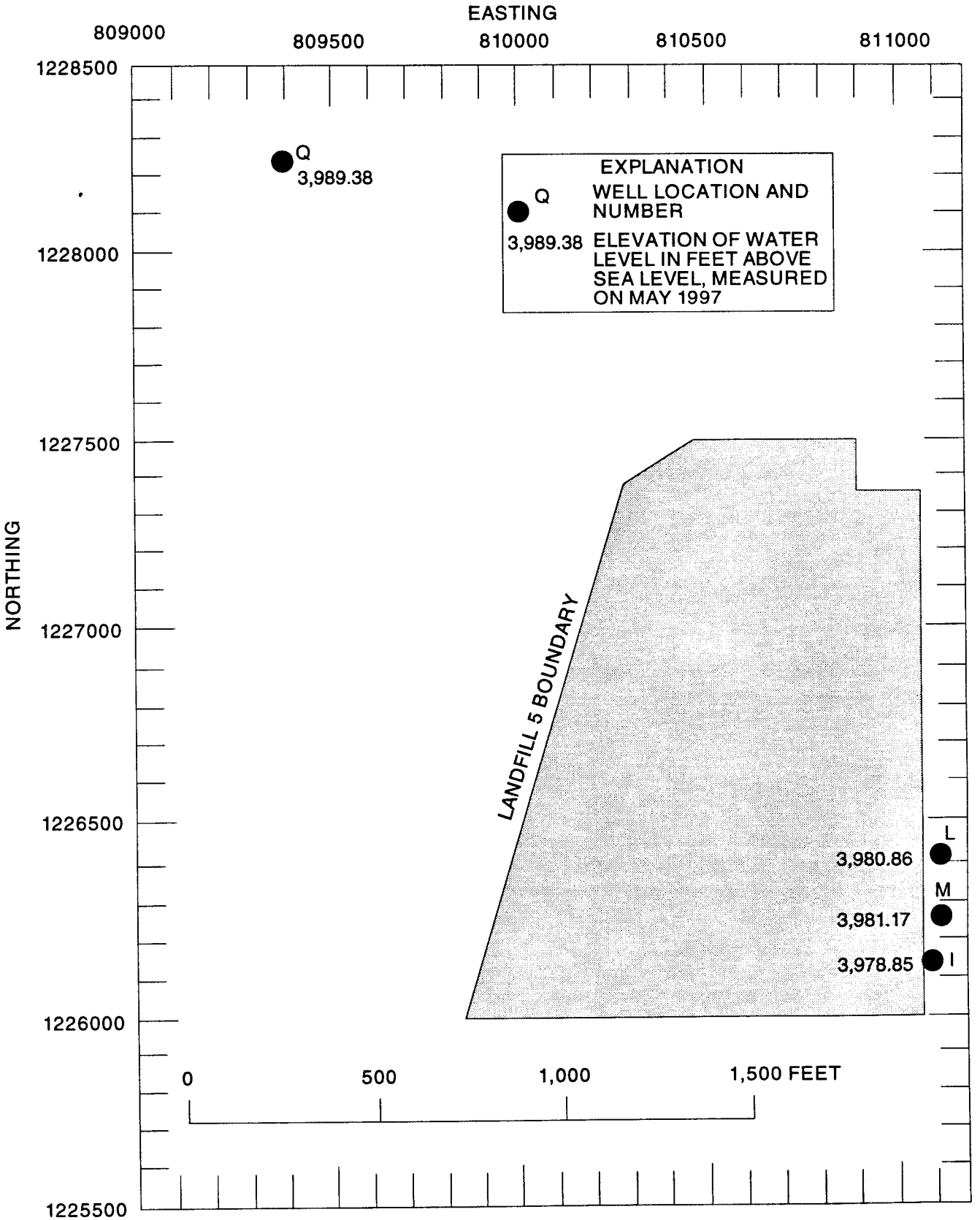


Figure 3.--Location of monitoring wells around Landfill 5.

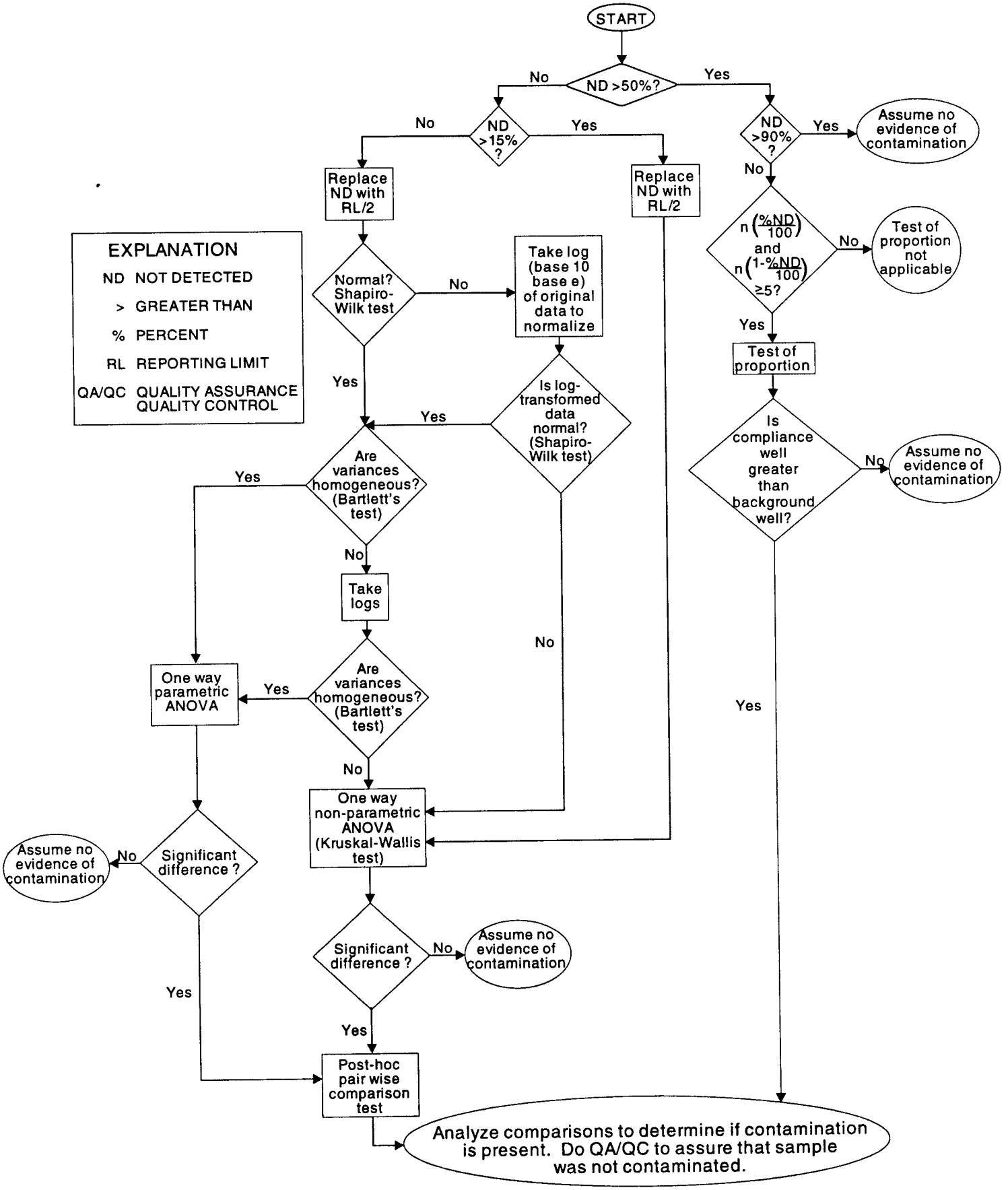


Figure 4.--Statistical methods used to evaluate water-quality data at Landfill 5.

Table 1.-- Parameters that have concentrations greater than reporting limits for environmental ground-water samples collected August 1996 through May 1997 from monitoring wells I, L, M, and Q at Landfill 5, Cannon Air Force Base, New Mexico

[µg/L, micrograms per liter; mg/L, milligrams per liter]

Parameter	Appendix IX method	Reporting unit	Reporting limits
Volatile organic compounnds:	SW5030/SW8260	µg/L	
Dichlorodifluoromethane			10
Polynuclear aromatic hydrocarbons:	SW3510/SW8310	µg/L	
Fluorene			0.19
Total organic carbon (TOC)	SW9060	mg/L	1.0
Total organic halogen as chloride (TOX)	SW9020	µg/L	0.01
Metals, total:		mg/L	
Arsenic	SW3020/SW7060		Varies
Barium	SW3005/SW6010		0.01
Chromium	SW3020/SW7191		Varies
Copper	SW3005/SW6010		Varies
Iron	SW3005/SW6010		Varies
Lead	SW3020/SW7421		0.001
Manganese	SW3005/SW6010		0.01
Nickel	SW3005/SW6010		0.04
Selenium	SW3020/SW7740		Varies
Vanadium	SW3005/SW6010		Varies
Zinc	SW3005/SW6010		Varies
Common ions, total:		mg/L	
Calcium	SW3005/SW6010		Varies
Magnesium	SW3005/SW6010		0.2
Sodium	SW3005/SW6010		5.0

Table 1a.-- Parameters that have concentrations greater than reporting limits for at least one environmental ground-water sample collected August 1996 through May 1997 from monitoring wells I, L, M, and Q at Landfill 5, Cannon Air Force Base, New Mexico

[µg/L, micrograms per liter; ND, not detected; B, compound is also detected in the method blank; mg/L, milligrams per liter; M, associated matrix spike or matrix-spike duplicate sample results did not meet the quality-control acceptance criteria; V, result is questionable because quality-acceptance criteria was not met; G, reporting limit raised due to the matrix of the sample; t, sample diluted due to the concentration of target compounds]

Parameter and units	Well I 8-21-96	Well L 8-21-96	Well M 8-21-96	Well Q 8-28-96	Well I 12-17-96	Well L 12-16-96	Well M 12-17-96	Well Q 11-19-96	Well I 3-5-97	Well L 3-5-97	Well M 3-4-97	Well Q 3-4-97	Well I 5-28-97	Well L 5-28-97	Well M 5-27-97	Well Q 5-27-97
Volatile organic compounnds:																
Dichlorodifluoromethane, µg/L	ND	ND	ND	ND	ND	ND	15.0	ND	ND	ND	ND	ND	ND	ND	13.0	ND
Polynuclear aromatic hydrocarbons:																
Fluorene, µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.25 B	ND	ND	ND	ND	ND
Total organic carbon, mg/L	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total organic halogen, µg/L	ND	ND	ND	0.012	ND	ND	ND	0.011	ND	ND	ND	ND	ND MV	ND MV	ND MV	ND MV
Metals, total, mg/L:																
Arsenic	ND G	ND	ND	0.0038	ND	ND	ND	0.004	0.0052	ND G	ND	ND	ND G	ND G	ND	0.0063
Barium	ND	ND	ND G	0.034	ND	ND	ND	0.027	0.034	0.051	0.054	0.032	0.029	0.049	0.051	0.028
Chromium	0.0087	0.25 t	0.045 G	ND	0.014 M	0.048GM	0.015 M	ND	0.0057M	ND M	ND M	ND M	ND	0.025	0.0053	ND
Copper	ND	ND	ND	ND	ND	ND	ND	0.012	ND	ND	ND	ND	ND	ND	ND	ND
Iron	0.055	1.7	0.53	ND	0.33	0.77 B	0.38	0.054	ND	0.13	0.12	0.11	ND	0.39	ND	ND
Lead	ND	ND	ND	0.002	ND	ND	ND	0.0022	ND G	ND	ND	ND G	ND G	ND G	ND G	ND G
Manganese	ND	0.015	0.024	ND	0.014	ND	0.013	ND	ND	ND	0.02	ND	ND	ND	ND	ND
Nickel	ND	0.19	0.23	ND	ND	0.076	0.13	0.025	ND	ND	0.14	ND	ND	ND	0.077	ND
Selenium	ND G	ND	ND G	0.0062	ND G	ND G	ND G	0.0057	ND G	0.0055	ND GM	0.0063M	0.0067M	0.0068M	ND GM	0.0053M
Vanadium	ND	ND	ND	0.023	ND	ND	ND	0.023	0.028	0.018	ND	0.022	0.025	0.018	0.014	0.026
Zinc	0.011 B	0.029 B	0.027 B	ND	ND	ND	0.016	ND	ND	ND	0.027	ND	ND	ND	0.034	ND
Common ions, total, mg/L:																
Calcium	54.8	51.7	62.3	44.7	51.8	52.8	63.0	41.9	51.7	53.1	78.2	43.1	51.5	58.1	74.8	44.1
Magnesium	48.3	46.3	51.1	38.1	43.3	47.3	50.7	37.0	46.0	49.2	54.5	38.7	44.1	52.3	52.2	38.3
Sodium	43.0	47.5	45.4	47.2	38.4	45.9	41.0	46.0	40.9	44.7	41.1	48.7	38.5	46.4	40.9	47.5

Table 2.--Results of statistical testing of water-quality data for ground-water samples collected August 1996 through May 1997 from monitoring wells I, L, M, and Q at Landfill 5, Cannon Air Force Base, New Mexico

Chemical parameter tested	Number of observations	0-15% of observations are non-detects YES	0-15% of observations are non-detects NO	16-50% of observations are non-detects YES	16-50% of observations are non-detects NO	51-89% of observations are non-detects YES	51-89% of observations are non-detects NO	90-100% of observations are non-detects YES	90-100% of observations are non-detects NO	Normal distribution? YES	Normal distribution? NO	Log values form a normal distribution? YES	Log values form a normal distribution? NO	Variances homogeneous? YES	Variances homogeneous? NO	Log value variances homogeneous? YES	Log value variances homogeneous? NO	1-way parametric ANOVA test results NOT SIGNIFICANT	1-way parametric ANOVA test results SIGNIFICANT	1-way non-parametric Kruskal-Wallis test results NOT SIGNIFICANT	1-way non-parametric Kruskal-Wallis test results SIGNIFICANT	Test of proportion results NOT SIGNIFICANT	Test of proportion results SIGNIFICANT	Pairwise comparison test results	Statistically significant detection limit (SSDL) (mg/L)
Dichlorodifluoromethane	16		X		X	X		X														Test not applicable			
Total organic halogen	16		X		X	X		X														Test not applicable			
Arsenic, total	16		X		X	X		X														Test not applicable			
Barium, total	16		X	X			X		X											X				L, M>Q	
Chromium, total	16		X	X			X		X												X				
Iron, total	16		X	X			X		X											X				L>I, Q	
Lead, total	16		X		X	X		X														Test not applicable			
Manganese, total	16		X		X	X		X															X		
Nickel, total	16		X		X	X		X															X		
Selenium, total	16		X		X	X		X															X		
Vanadium, total	16		X	X			X		X											X				Q>L, M	
Zinc, total	16		X		X	X		X														X			
Calcium, total	16	X			X		X		X	X		X			X	X		X						I, L, M>Q; M>I, L, Q	59.16
Magnesium, total	16	X			X		X		X	X				X				X						I, L, M>Q; M>I	48.42
Sodium, total	16	X			X		X		X	X				X				X						L, Q>M; L, Q>I;	45.33

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