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Rodriguez and Puig--GROUND-WATER QUALITY IN THE CAGUAS-JUNCOS VALLEY, PUERTO RICO, APRIL TO OCTOBER 1990--OFR 96-139

GROUND-WATER QUALITY IN THE CAGUAS-JUNCOS VALLEY, PUERTO RICO, APRIL TO OCTOBER 1990

U.S. GEOLOGICAL SURVEY
Open-File Report 96-139

Prepared in cooperation with the
PUERTO RICO AQUEDUCT AND SEWER AUTHORITY

Water samples from 19 wells were collected and analyzed for trace metals (table 3). Although barium was present in all samples, concentrations were far below the primary maximum contaminant level (MCL) (2,000 µg/L) and the Puerto Rico MCL (PRMCL) (1,000 mg/L) for drinking water (table 5). Water from wells located near the urban center of Juncos (32, 35, 36, and 41 through 44) had the highest concentrations of barium (140 to 290 µg/L). Cadmium was detected in samples from public-supply wells 19 and 36, and from wells 32, 41, and 46. However, cadmium concentrations were below the PRMCL (10 µg/L) and the maximum permissible concentration (5 mg/L) for a potable water source. Lead was detected in only 3 of 19 samples and all lead concentrations were below the PRMCL (50 µg/L) and the maximum permissible concentration (50 µg/L). Molybdenum was detected only in water from well 46 (an agricultural well); the molybdenum concentration of that sample was only 10 µg/L, the lower detection limit. Silver was detected in samples from four wells and the spring; all silver concentrations were far below the Federal and Commonwealth MCL's. Strontium was detected in all 19 samples. Vanadium was detected in six samples. Zinc was detected in 18 samples; all zinc concentrations were far below the SMCL for drinking water. Lithium, in low concentrations, was detected in 10 of 19 samples.

Volatile synthetic organic chemicals (VOC), widely used in industrial processes, were detected in water from wells 5, 9, 15, 29, and 46 (table 4). Chloroform was detected in water from four of these wells in concentrations ranging from 0.4 to 2.5 µg/L. Dichlorodifluoromethane (Freon 12) was detected in well 46 at a concentration of 3.6 µg/L. Concentrations of dichloroethylene and trichloroethylene (0.4 and 0.7 µg/L, respectively), below the drinking-water MCL, were detected in samples from one industrial well (well 5). Concentrations of benzene (5,800 µg/L), ethylbenzene (1,200 µg/L), toluene (12,000 µg/L), and xylene (15,000 µg/L), all of which exceeded the MCL, were detected in samples from well 9. VOC were not detected in samples collected from public-water supply wells.

The laboratory results were checked for accuracy using the cation-anion balance and the specific conductance-dissolved solids ratio analyses. In the cation-anion balance analysis, the sum of cations expressed in milliequivalents per liter should equal the sum of anions expressed in the same units. The difference between the sum of the cations and the sum of the anions should be less than 5 percent of the total anions and cations present. The sample from well 5 was the only one that exceeded the 5 percent limit.

The specific conductance-dissolved solids ratio for water of ordinary composition should be between 0.55 and 0.75 (Hem, 1989). All the samples had ratios within that range, except for the samples from well 10 and site 4, which had higher ratios. The higher ratio in these two sites may be caused by the high concentration of sulfate. Water with high sulfate concentrations may reach or even exceed the upper end (0.75) of the specific conductance-dissolved solids ratio (Hem, 1989).

Table 1. Information and ground-water field measurements from selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico

[µS/cm, microsiemens per centimeter at 25 °C; °C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; nd. not detected; --, information not available; na, not applicable]

Well number	Well name	Well identification number	Use of water	Well depth (in feet below land surface)	Screened interval (in feet below land surface)	Date of sampling	Specific conductance (µs/cm)	pH (units)	Temperature (°C)
1	Pozo Viejo AAA	181538066021300	public	116	79-100	08-27-90	485	7.4	26.5
2	CJ-TW 15	181539066014500	observation	70	25-70	08-08-90	554	7.0	26.0
3	Caguas Sugar	181511066005700	industrial	--	--	06-27-90	712	7.0	26.5
4	Caguitas Spring	181459066013600	none	na	na	06-29-90	2,350	7.3	31.0
5	Quality Elect.	181424066025400	industrial	81	51-81	09-10-90	3,480	7.0	27.0
6	CJ-TW 20	181446066013400	observation	37	25-35	07-11-90	924	7.9	29.5
7	CJ-TW 1	181445066011500	observation	32	26-30	08-07-90	3,200	6.6	29.0
8	Cartagena 2	181480066034500	agricultural	270	--	08-30-90	959	6.8	26.5
9	CJ-TW2	181422066015300	observation	45	39-43	09-11-90	--	--	--
10	CJ-TW 22	181412066020700	observation	52	25-50	08-02-90	468	6.7	27.0
11	CJ-TW 7	181406066004600	observation	76	51-71	08-09-90	934	7.0	28.0
12	CJ-TW 13	181351066013900	observation	73	20-70	08-06-90	444	6.5	27.0
13	CJ-TW 19A	181352066025300	observation	67	50-65	07-19-90	512	6.5	28.0
14	Gravero Navarro	181337066004100	industrial	--	--	04-19-90	1,020	7.6	27.0
15	R. Diez	181332066022100	commercial	80	--	07-30-90	322	6.3	28.5
16	CJ-TW 12	181318066032600	observation	70	45-65	08-08-90	368	6.4	30.0
17	CJ-TW 11	181311066022500	observation	110	66-96	07-23-90	253	6.9	28.0
18	E. Delgado	181046066024700	agricultural	--	--	08-02-90	471	7.7	26.0
19	Gurabo AAA 6	181548065592900	public	123	60-123	08-20-90	1,100	7.1	26.0
20	Gurabo AAA 7	181549065592100	public	160	54-136	05-01-90	586	7.1	26.0
21	CJ-TW 17	181511065592200	observation	45	20-40	07-10-90	536	7.4	28.0
22	CJ-TW 21A	181602065584400	observation	65	30-60	07-12-90	427	8.0	27.0
23	O. Dávila	181544065583200	domestic	--	--	04-26-90	942	7.2	27.0
24	CJ-TW 18	181540065580300	observation	65	40-60	07-18-90	577	7.2	27.0
25	P. Morales	181524065573900	industrial	40	--	08-23-90	769	7.0	27.0

Table 1. Information and ground-water field measurements from selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico--Continued

Well number	Well name	Well identification number	Use of water	Well depth (in feet below land surface)	Screened interval (in feet below land surface)	Date of sampling	Specific conductance (µs/cm)	pH (units)	Temperature (°C)
26	El Bambu AAA	181622065571500	public	300	40-300	08-22-90	585	7.4	27.0
27	Berríos 1	181504065571700	domestic	--	--	04-30-90	941	7.4	26.5
28	Don Sico AAA	181618065565900	public	300	40-300	08-22-90	884	7.4	26.0
29	C. Sánchez	181503065565600	agricultural	110	--	07-09-90	1,180	7.8	27.0
30	E. Mendoza 1	181518065561400	agricultural	110	--	06-28-90	450	7.2	26.0
31	CJ-TW 3A	181513065554600	observation	87	62-82	07-12-90	351	7.4	27.5
32	CJ-TW 4A	181501065555500	observation	34	23-33	07-16-90	299	6.3	28.0
33	CJ-TW 4B	181501065555501	observation	144	119-139	07-16-90	416	7.7	28.0
34	Z. Méndez 2	181514065661100	agricultural	250	--	08-01-90	715	7.5	27.0
35	Juncos AAA 1	181437065552200	public	140	40-140	04-23-90	447	6.7	26.5
36	Juncos AAA 2	181437065551900	public	320	120-320	07-31-90	760	6.8	27.0
37	Juncos AAA 7	181432065552000	public	90	50-90	07-31-90	377	6.9	26.5
38	Juncos AAA 5	181424065551400	public	85	27-85	04-23-90	617	7.0	26.5
39	Juncos AAA 3	181432065550500	public	88	40-88	07-30-90	647	7.0	27.0
40	Finca Batey	181453065545400	agricultural	--	--	08-27-90	374	6.9	27.0
41	CJ-TW 16A	181448065544200	observation	95	70-90	07-10-90	242	7.4	26.0
42	CJ-TW 16B	181448065544200	observation	60	30-50	07-17-90	220	6.3	26.5
43	CJ-TW 6	181415065545400	observation	102	67-87	08-06-90	1,130	7.5	27.5
44	CJ-TW 23	181330065540000	observation	50	34-49	07-17-90	739	6.9	28.0
45	E. Berríos 2	181402065523200	agricultural	--	--	08-23-90	469	7.0	27.0
46	Santa Ana 1	181315065523100	agricultural	120	--	04-30-90	761	7.2	26.0
47	Hermosura 2	181206065514400	agricultural	--	--	07-26-90	483	6.6	28.0
48	Robles Mendoza	181345065503200	agricultural	--	--	07-26-90	165	7.7	27.5
49	Hacienda Cuco 2	181220065502300	agricultural	--	--	04-26-90	841	7.1	27.0

Table 2. Major ions and nutrients in ground water at selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico

[mg/L, milligrams per liter; µg/L, micrograms per liter; --, data not available; <, less than the detection limit]

Well number	Well name	Date of sampling	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Chloride, dissolved (mg/L)	Flouoride, dissolved (mg/L)	Silica, dissolved (mg/L as SiO_2)
1	Pozo Viejo AAA	08-27-90	47	18	24	25	28	1.2	44
2	CJ-TW 15	08-08-90	52	21	28	14	44	.1	50
3	Caguas Sugar	06-27-90	65	15	61	83	51	<.1	37
4	Caguitas Spring	09-11-90	420	5	200	1,100	180	.1	24
5	Quality Elect.	09-10-90	48	36	31	70	53	1.4	68
6	CJ-TW 20	07-11-90	40	11	140	100	99	.3	69
7	CJ-TW 1	08-07-90	480	58	280	1,600	74	.4	54
8	Cartagena 2	08-30-90	88	51	36	92	78	.1	69
10	CJ-TW 22	08-02-90	47	19	20	30	29	.7	49
11	CJ-TW 7	08-09-90	100	12	84	69	23	.3	33
12	CJ-TW 13	08-06-90	28	15	36	17	37	.4	21
13	CJ-TW 19A	07-19-90	30	17	47	25	53	.1	77
14	Gravero Navarro	04-19-90	130	1	90	240	73	.2	32
15	R. Diez	07-30-90	13	10	35	6	37	.3	79
16	CJ-TW 12	08-08-90	26	15	28	49	13	<.1	63
17	CJ-TW 11	07-23-90	13	9	22	<1	18	<.1	68
18	E. Delgado	08-02-90	39	14	41	20	17	.8	47
19	Gurabo AAA 6	08-20-90	79	48	88	230	89	.3	54
20	Gurabo AAA 7	05-01-90	39	30	37	34	48	.1	53
21	CJ-TW 17	07-10-90	51	25	23	34	42	.2	63
22	CJ-TW 21A	07-12-90	43	13	24	27	30	<.1	57
23	O. Dávila	04-26-90	61	48	65	19	92	.3	45
24	CJ-TW 18	07-18-90	63	24	20	23	13	.2	47
25	P. Morales	08-23-90	53	44	53	26	61	.3	48
26	El Bambu AAA	08-22-90	57	19	39	38	36	.2	51

Table 2. Major ions and nutrients in ground water at selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico--Continued

Well number	Well name	Date of sampling	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Chloride, dissolved (mg/L)	Flouoride, dissolved (mg/L)	Silica, dissolved (mg/L as SiO_2
27	Berríos 1	04-30-90	80	46	47	59	67	<.1	38
28	Don Sico AAA	08-22-90	100	31	48	240	50	.2	45
29	C. Sánchez	07-09-90	87	53	91	51	110	.3	47
30	E. Mendoza 1	06-28-90	27	18	33	25	41	.1	51
31	CJ-TW 3A	07-12-90	22	13	28	13	39	.1	46
32	CJ-TW 4A	07-16-90	17	10	21	12	25	.1	48
33	CJ-TW 4B	07-16-90	41	8	34	13	24	.2	37
34	Z. Méndez 2	08-01-90	50	18	70	110	45	.7	32
35	Juncos AAA 1	04-23-90	39	15	30	18	29	.1	44
36	Juncos AAA 2	07-31-90	74	20	50	90	69	.2	49
37	Juncos AAA 7	07-31-90	32	15	23	27	25	.5	45
38	Juncos AAA 5	04-23-90	60	16	45	34	44	.1	47
39	Juncos AAA 3	07-30-90	69	16	45	50	47	.1	52
40	Finca Batey	08-27-90	16	9	43	30	19	1.1	59
41	CJ-TW 16A	07-10-90	12	8	20	3	22	<.1	48
42	CJ-TW 16B	07-17-90	12	7	18	11	21	<.1	36
43	CJ-TW 6	08-06-90	59	25	140	50	160	.5	39
44	CJ-TW 23	07-17-90	31	17	99	41	83	.4	51
45	E. Berrios 2	08-23-90	35	19	34	21	41	.2	50
46	Santa Ana 1	04-30-90	66	39	43	27	57	.2	70
47	Hermosura 2	07-26-90	26	11	56	20	48	.1	64
48	Robles Mendoza	07-26-90	13	4	9	14	19	<.1	16
49	Hacienda Cuco 2	04-26-90	65	34	62	59	69	.3	52

Table 2. Major ions and nutrients in ground water at selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico--Continued

Well number	Well name	Date of sampling	Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	Phosphorous, ortho, dissolved (mg/L as P)	Iron, dissolved (µg/L)	Manganese, dissolved (µg/L)	Dissolved solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Hardness total (mg/L as $CaCO_3$)
1	Pozo Viejo AAA	08-27-90	1.6	0.03	6	3	301	185	190
2	CJ-TW 15	08-08-90	1.2	.04	20	58	335	205	220
3	Caguas Sugar	06-27-90	<.1	.01	4,400	620	437	197	220
4	Caguitas Spring	06-29-90	<.1	<.01	47	89	1,950	34	1,100
5	Quality Elect.	09-10-90	3.8	.03	9	4	486	238	270
6	CJ-TW 20	07-11-90	<.1	.04	170	800	595	223	150
7	CJ-TW 1	08-07-90	<.1	<.01	2,520	6,200	2,650	147	1,400
8	Cartagena 2	08-30-90	9.1	.03	5	<1	588	288	430
10	CJ-TW 22	08-02-90	.6	.06	12	28	310	188	200
11	CJ-TW 7	08-09-90	.2	<.01	78	1,100	544	367	300
12	CJ-TW 13	08-06-90	3.1	.10	19	560	240	138	130
13	CJ-TW 19A	07-19-90	5.7	.11	29	23	319	114	140
14	Gravero Navarro	04-19-90	<.1	<.01	200	78	679	185	330
15	R. Diez	07-30-90	2.3	.07	41	12	238	95	74
16	CJ-TW 12	08-08-90	1.9	.08	45	510	260	107	130
17	CJ-TW 11	07-23-90	3.8	.06	180	910	--	89	70
18	E. Delgado	08-02-90	.1	.01	27	67	310	217	160
19	Gurabo AAA 6	08-20-90	.1	.07	9	130	750	264	400
20	Gurabo AAA 7	05-01-90	.2	.03	10	100	374	220	220
21	CJ-TW 17	07-10-90	1.1	.08	32	2,200	354	183	230
22	CJ-TW 21A	07-12-90	<.1	.03	130	300	283	147	160
23	O. Dávila	04-26-90	2.8	.02	180	500	542	348	350
24	CJ-TW 18	07-18-90	<.1	.02	12	750	359	277	260
25	P. Morales	08-23-90	.5	.02	6	4	472	310	310
26	El Bambu AAA	08-22-90	<.1	.01	110	110	374	220	220

Table 2. Major ions and nutrients in ground water at selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico--Continued

Well number	Well name	Date of sampling	Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	Phosphorous, ortho, dissolved (mg/L as P)	Iron, dissolved (µg/L)	Manganese, dissolved (µg/L)	Dissolved solids (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Hardness total (mg/L as $CaCO_3$)
27	Berríos 1	04-30-90	.7	<.01	1,200	150	548	349	390
28	Don Sico AAA	08-22-90	.1	<.01	80	110	623	179	380
29	C. Sánchez	07-09-90	2.6	.02	12	6	690	415	440
30	E. Mendoza 1	06-28-90	2.8	.02	47	2,100	273	125	140
31	CJ-TW 3A	07-12-90	4.5	.02	14	250	212	82	110
32	CJ-TW 4A	07-16-90	2.6	.01	5	570	183	81	84
33	CJ-TW 4B	07-16-90	1.0	.02	12	89	255	160	130
34	Z. Méndez 2	08-01-90	1.1	.01	4	4	445	195	200
35	Juncos AAA 1	04-23-90	.9	.03	12	870	277	162	160
36	Juncos AAA 2	07-31-90	.5	.03	120	800	479	202	270
37	Juncos AAA 7	07-31-90	.9	.02	7	110	249	134	140
38	Juncos AAA 5	04-23-90	.6	.04	88	160	367	198	220
39	Juncos AAA 3	07-30-90	.3	.02	10	44	413	220	240
40	Finca Batey	08-27-90	2.4	.08	7	4	252	121	78
41	CJ-TW 16A	07-10-90	4.4	.11	100	130	152	61	65
42	CJ-TW 16B	07-17-90	3.2	<.01	17	15	138	52	60
43	CJ-TW 6	08-06-90	.8	.03	40	480	653	294	250
44	CJ-TW 23	07-17-90	<.1	.03	130	870	458	223	150
45	E. Berríos 2	08-23-90	4.3	.02	<3	<1	285	139	170
46	Santa Ana 1	04-30-90	1.1	.04	5	2	488	308	330
47	Hermosura 2	07-26-90	2.3	.12	7	8	316	149	110
48	Robles Mendoza	07-26-90	.4	.03	40	11	91	25	49
49	Hacienda Cuco 2	04-26-90	2.4	.05	4	13	512	282	300

Table 3. Trace metals in ground water at selected wells and a spring within the Caguas-Juncos alluvial valley, east-central Puerto Rico

[µg/L, micrograms per liter; nd, not detected]

Well number	Well name	Date of sampling	Barium, dissolved (µg/L)	Cadmium dissolved (µg/L)	Lead, dissolved (µg/L)	Molybdenum, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Vanadium, dissolved (µg/L)	Zinc, dissolved (µg/L)	Lithium, dissolved (µg/L)
4	Caguitas Spring	06-29-90	15	nd	nd	nd	5	1,800	nd	nd	70
5	Quality Elect.	09-10-90	11	nd	nd	nd	nd	280	27	13	nd
7	CJ-TW 1	08-07-90	61	nd	nd	nd	nd	2,000	nd	36	63
14	Gravero Navarro	04-19-90	8	nd	nd	nd	1	580	nd	63	33
19	Gurabo AAA 6	08-20-90	9	1	10	nd	nd	220	9	8	nd
20	Gurabo AAA 7	05-01-90	24	nd	nd	nd	nd	520	16	14	6
32	CJ-TW 4A	07-16-90	170	1	10	nd	nd	120	nd	16	nd
33	CJ-TW 4B	07-16-90	60	nd	nd	nd	nd	220	7	5	nd
35	Juncos AAA 1	04-23-90	140	nd	nd	nd	nd	230	nd	14	5
36	Juncos AAA 2	07-31-90	160	1	nd	nd	1	410	nd	6	10
37	Juncos AAA 7	07-31-90	54	nd	nd	nd	1	190	nd	8	nd
38	Juncos AAA 5	04-23-90	81	nd	nd	nd	nd	280	nd	4	5
39	Juncos AAA 3	07-30-90	22	nd	nd	nd	nd	300	9	22	8
40	Finca Batey	08-27-90	84	nd	nd	nd	1	140	nd	120	nd
41	CJ-TW 16A	07-10-90	290	1	nd	nd	nd	92	nd	8	nd
42	CJ-TW 16B	07-17-90	260	nd	nd	nd	nd	61	nd	9	nd
43	CJ-TW 6	08-06-90	220	nd	nd	nd	nd	400	nd	15	6
44	CJ-TW 23	07-17-90	200	nd	nd	nd	nd	290	nd	11	nd
46	Santa Ana 1	04-30-90	3	2	20	10	2	240	60	16	10

Table 4. Volatile synthetic organic chemicals in ground water at selected wells within the Caguas-Juncos alluvial valley, east-central Puerto Rico

[mg/L, micrograms; nd, not detected]

Well number	Well name	Date of sampling	Chloro-form, total (µg/L)	Dichloro-difluoro-methane, total (µg/L)	Dichloro-ethylene, total (µg/L)	Trichloro-ethylene, total (µg/L)	Benzene, total (µg/L)	Ethyl-benzene, total (µg/L)	Toluene, total (µg/L)	Xylene, total (µg/L)
1	Pozo Viejo AAA	08-27-90	nd	nd	nd	nd	nd	nd	nd	nd
5	Quality Elect.	09-10-90	2.0	nd	0.4	0.7	nd	nd	nd	nd
7	CJ-TW 1	08-07-90	nd	nd	nd	nd	nd	nd	nd	nd
9	CJ-TW2	09-11-90	nd	nd	nd	nd	5,800	1,200	12,000	15,000
15	R. Diez	07-30-90	2.5	nd	nd	nd	nd	nd	nd	nd
17	CJ-TW 11	07-23-90	nd	nd	nd	nd	nd	nd	nd	nd
19	Gurabo AAA 6	05-01-90	nd	nd	nd	nd	nd	nd	nd	nd
20	Gurabo AAA 7	08-20-90	nd	nd	nd	nd	nd	nd	nd	nd
29	C. Sánchez	07-09-90	0.9	nd	nd	nd	nd	nd	nd	nd
32	CJ-TW 4A	07-16-90	nd	nd	nd	nd	nd	nd	nd	nd
35	Juncos AAA 1	04-23-90	nd	nd	nd	nd	nd	nd	nd	nd
36	Juncos AAA 2	07-31-90	nd	nd	nd	nd	nd	nd	nd	nd
37	Juncos AAA 7	07-30-90	nd	nd	nd	nd	nd	nd	nd	nd
38	Juncos AAA 5	04-23-90	nd	nd	nd	nd	nd	nd	nd	nd
40	Finca Batey	08-27-90	nd	nd	nd	nd	nd	nd	nd	nd
41	CJ-TW 16A	07-10-90	nd	nd	nd	nd	nd	nd	nd	nd
43	CJ-TW 6	08-06-90	nd	nd	nd	nd	nd	nd	nd	nd
44	CJ-TW 23	07-17-90	nd	nd	nd	nd	nd	nd	nd	nd
46	Santa Ana 1	04-30-90	0.4	3.6	nd	nd	nd	nd	nd	nd

Table 5. Water-quality regulations applicable to drinking water and potable water sources in Puerto Rico

[µg/L, micrograms per liter; mg/L, milligrams per liter; --, regulation not established]

	U.S. Environmental Protection Agency (1994)		Puerto Rico Department of Health (1989)	Puerto Rico Environmental Quality Board (1990)
Chemical	Drinking-water Maximum Contaminant Level (MCL)[1]	Drinking-Water Secondary Maximum Contaminant Level (SMCL)[2]	Drinking-Water Maximum Contaminant Level (PRMCL)[1]	Potable Water Source Maximum Permissible Concentration (MPC)[3]
Inorganics				
Sulfate (mg/L)	--	250	--	--
Chloride (mg/L)	--	250	--	--
Fluoride (mg/L)	4	2	--	--
Iron (µg/L)	--	300	--	--
Manganese (µg/L)	--	50	--	--
Dissolved solids (mg/L)	--	500	--	--
Barium (µg/L)	2,000	--	1,000	--
Cadmium (µg/L)	5	--	10	5
Lead (µg/L)	--	--	50	50
Silver (µg/L)	--	100	50	--
Zinc (µg/L)	--	5,000	--	--
Organics				
Dichloroethylene (µg/L)	7	--	7	7
Trichloroethylene (µg/L)	5	--	5	5
Benzene (µg/L)	5	--	5	5
Ethylbenzene (µg/L)	700	--	--	--
Tolune(µg/L)	1,000	--	--	--
Xylene (µg/L)	10,000	--	--	--

[1] Maximum contaminant level (MCL) - Enforceable, health based regulation.

[2] Secondary maximum contaminant level (SMCL) - Not enforceable, aesthically based regulation. At high concentrations health implications as well as aesthetic degradation may also exist. SMCL are not Federally enforceable but are intended as guidelines for the States.

[3] Maximum permissible concentration (MPC) - Enforceable, health based regulation for protection of water bodies used as potable water sources.

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U.S. GEOLOGICAL SURVEY

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San Juan, Puerto Rico
1996

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Denver, CO 80225

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CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNITS, AND ACRONYMS

Multiply	By	To obtain
	Flow	
million gallons per day	0.04381	cubic meter per second
	Length	
foot	0.3048	meter

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows
°F = 1.8 (°C) + 32

Abbreviated water-quality units and terms used in report:

micrograms per liter (µg/L)

milligrams per liter (mg/L)

microsiemens per centimeter at 25 °C (µS/cm)

Acronyms used in report:

Maximum contaminant limit (MCL)

Maximum permissible concentration (MPC)

Puerto Rico Aqueduct and Sewer Authority (PRASA)

Secondary maximum contaminant level (SMCL)

U.S. Geological Survey (USGS)

Volatile synthetic organic chemicals (VOC)

Ground-Water Quality in the Caguas-Juncos Valley, Puerto Rico, April to October 1990

By José M. Rodríguez *and* Juan C. Puig

ABSTRACT

Ground water from 48 wells and 1 spring in the Caguas-Juncos Valley was sampled and analyzed for major ions, nutrients, trace metals, and volatile synthetic organic chemicals from April to October 1990. This report presents the results of physical and chemical analyses made on these water samples.

Dissolved-solids concentrations exceeded 500 milligrams per liter in 28 percent of the samples. Concentrations of trace metals were below the maximum contaminant levels set by Federal and Commonwealth agencies. Volatile synthetic organic chemicals were detected in water from five wells, four of which were located in urban and industrial areas. Concentrations of benzene, ethylbenzene, toluene, and xylene detected in samples from one observation well exceeded the maximum contaminant levels set be Federal and Commonwealth agencies.

INTRODUCTION

The Caguas-Juncos Valley is an interior alluvial valley located within the Río Grande de Loíza drainage basin in east-central Puerto Rico (fig. 1). The valley is divided into two subareas: the Caguas Valley and the Gurabo-Juncos Valley. The population growth (from 167,000 in 1980 to 192,000 in 1990) in the municipalities of Caguas, Gurabo, and Juncos, located in the Caguas-Juncos Valley, has created an increased demand for potable water (U.S. Department of Commerce, 1982 and 1991). The public-water supply in the Caguas-Juncos Valley was 21 million gallons per day during 1986, of which 16 percent was derived from ground water (Puig and Rodríguez, 1993).

As part of a study to evaluate the potential for additional development of ground water in the Caguas-Juncos Valley, the U.S. Geological Survey (USGS), in cooperation with the Puerto Rico Aqueduct and Sewer Authority (PRASA) conducted a reconnaissance of ground-water quality from April to October 1990. A previous study conducted by the USGS on the ground-water quality at selected public-water supply wells throughout Puerto Rico (Senén Guzmán-Ríos, USGS, written commun., 1989) detected the presence of volatile synthetic organic chemicals (VOC) in ground water from a well located near Caguas. This report presents the results of a synoptic survey of the ground-water quality in the Caguas-Juncos Valley.

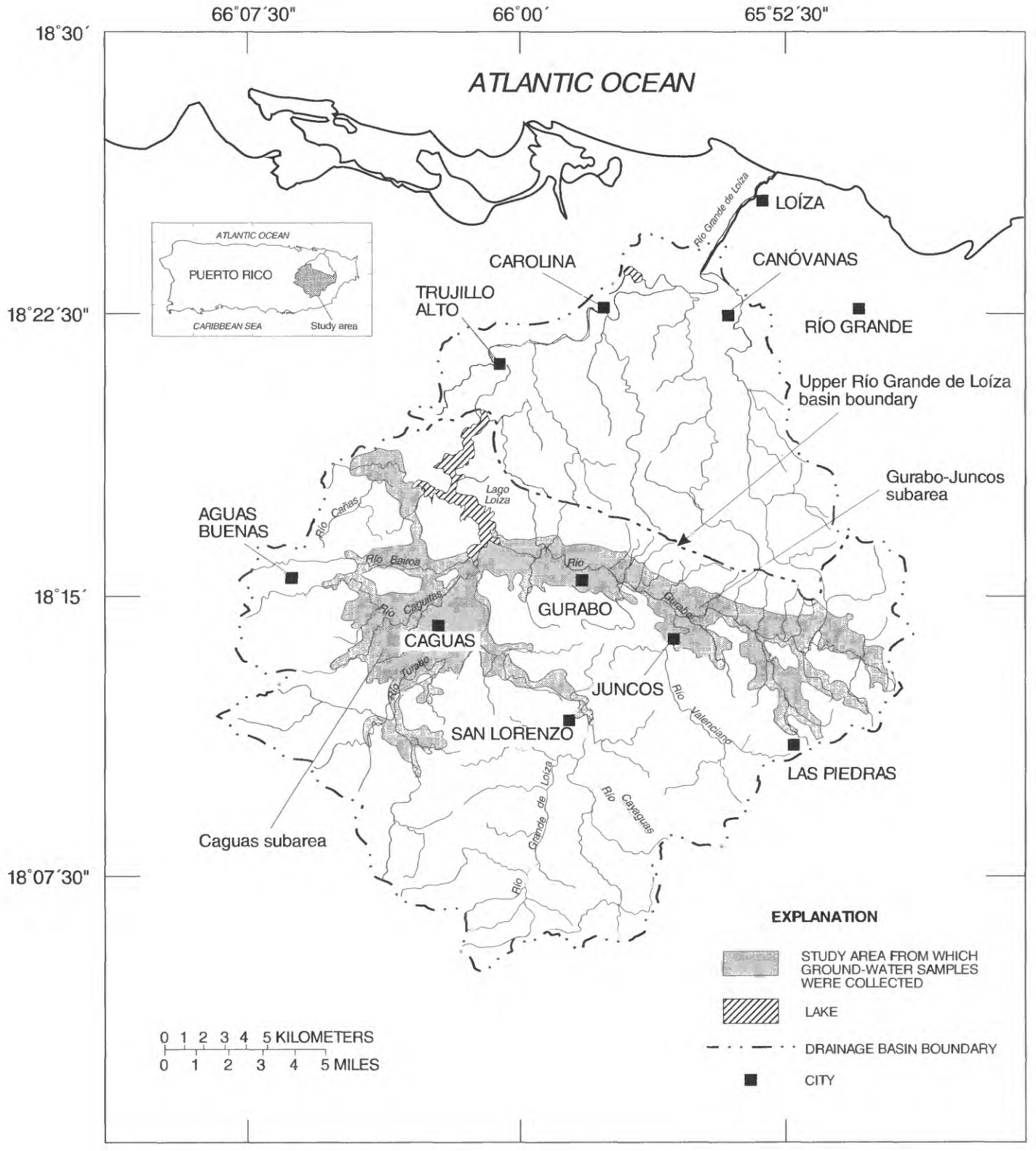

Figure 1. Location of the Caguas-Juncos alluvial valley in east-central Puerto Rico.

METHODS AND PROCEDURES

Ground-water samples were collected from 48 wells and 1 spring. Sampling techniques described by Brown and others (1970), Claassen (1982), and Wood (1976) were followed. Eighteen sampling sites were located in the Caguas Valley and 31 in the Gurabo-Juncos Valley (fig. 2). Ground-water samples from production wells were collected prior to chlorination and as close as possible to the well head. Samples from observation wells were collected after three times the volume of water in the well casing had been removed with a submersible pump. The same procedure was used to collect samples for VOC analysis, except that the pump was removed from the observation well and the water level was allowed to recover before the sample was collected. Samples for VOC analyses were collected with a bailer made of [1]Teflon™ which was lowered to the midpoint of the screened interval in the well.

Field measurements were made for temperature, specific conductance, pH, and alkalinity for each ground-water sample. Samples were processed and preserved in the field with standard USGS water-quality field techniques and sent to the USGS National Water-Quality Laboratory at Arvada, Colorado, for analysis. All samples (except samples from well 9) were analyzed for major ions and nutrients. Water samples collected from public-supply wells and wells located near landfills (active or inactive) and industrial sites, were also analyzed for trace metals, VOC, or both.

[1] Any use of trade, product, or firm names is for descriptive purposes only and does not implies endorsement by the U.S. Government.

RESULTS

Information on well location and construction, water use, and field measurements for temperature, specific conductance, pH, and alkalinity for all sample-collection wells in the study area is presented in table 1. Results of the laboratory analyses for major ions, trace metals, and VOC are summarized in tables 2 through 4. Water-quality data obtained from this study (tables 2 to 4) are compared with water-quality standards established by the Puerto Rico Environmental Board (1990), the Puerto Rico Department of Health (1989), and the U.S. Environmental Protection Agency (1994).

Calcium concentrations in ground-water samples collected from wells in the Caguas-Juncos alluvial valley ranged from 12 to 480 milligrams per liter (mg/L). Samples from wells in the Caguas subarea had the highest concentration of calcium. Sodium, chloride, sulfate, and dissolved-solids concentrations ranged from 9 to 280 mg/L; 13 to 180 mg/L; less than 1 to 1,600 mg/L; and 91 to 2,650 mg/L, respectively. Iron concentrations ranged from less than 3 to 4,400 µg/L and manganese concentrations from less than 1 to 6,200 µg/L.

Sulfate concentrations in water samples from well 7 and Caguitas Spring (site 4; table 2) exceeded the secondary drinking-water maximum contaminant level (SMCL) (250 mg/L; table 5). Dissolved-solids concentrations exceeded the SMCL (500 mg/L) in 13 (28 percent) of 47 samples (table 2). Iron concentrations in water from wells 3, 7, and 27 (table 2) exceeded the SMCL (300 µg/L). Manganese concentrations exceeded the SMCL (50 µg/L) in 31 of 48 samples. Values for hardness exceeded 180 mg/L in 27 of 48 samples. Water with hardness values above 180 mg/L is classified as "very hard" (Hem, 1989).

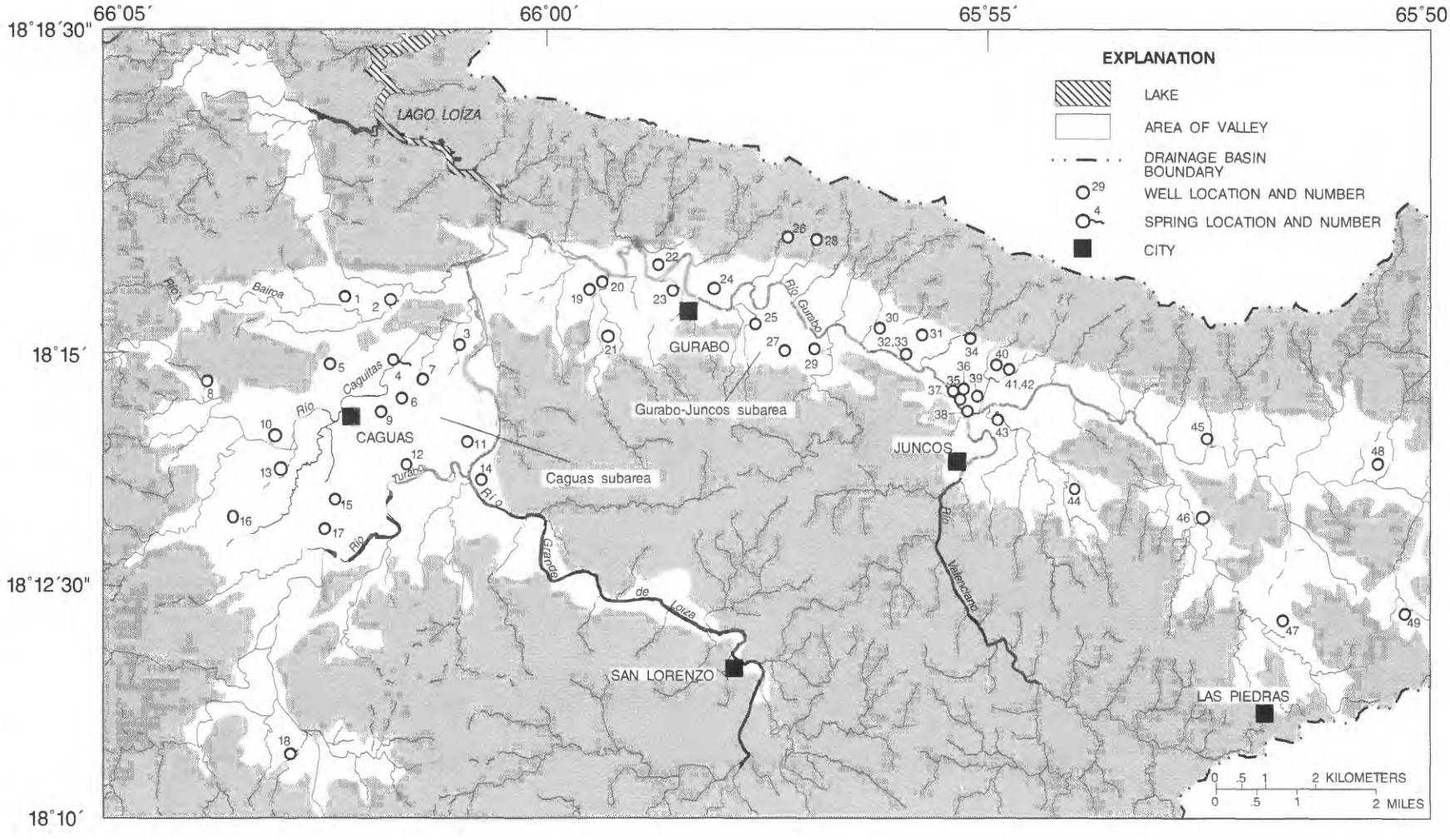

Figure 2. Location of sample-collection wells and spring in the Caguas-Juncos alluvial valley, east-central Puerto Rico.