

# **Results of the 2000 Water Quality Analysis at selected wells in the Westside Groundwater Basin**

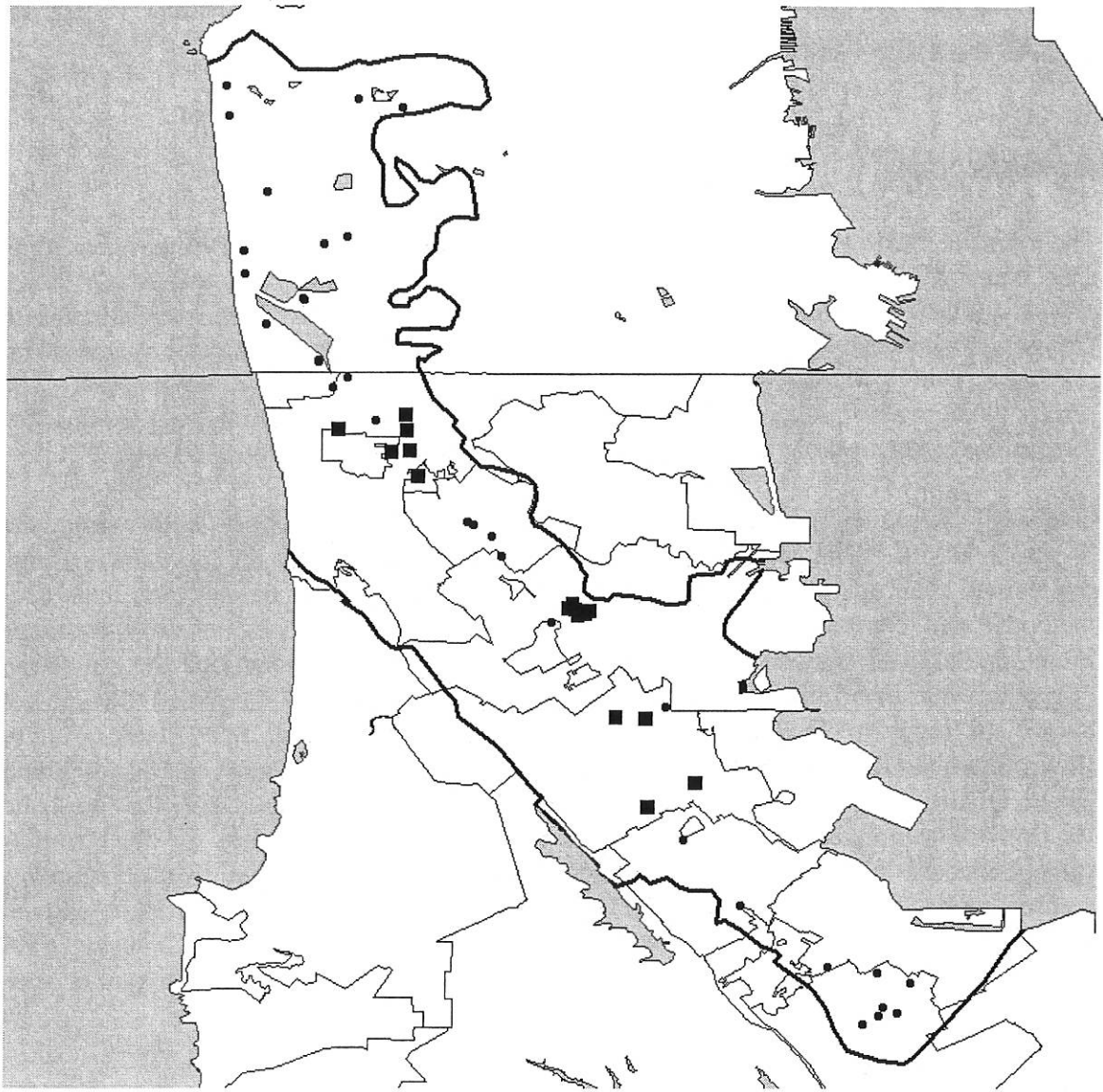
## ***Introduction:***

The Westside Basin Partners (Partners) consist of the San Francisco Water Department, Daly City Water & Waste Water Department, California Water Service, and San Bruno Public Works. The Partners have contracted with San Mateo County Environmental Health Division, to integrate groundwater data collection activities within the basin to provide a reliable repository for storage and distribution of basin-wide groundwater information. The results of the water quality analyses included herein are one of the first steps toward that integration of Basin-wide monitoring and data storage and distribution activities.

Ongoing water quality monitoring exists for municipal water supply wells within the Westside basin. Historically, individual water agencies within the partnership have maintained their own monitoring programs, including selection of analytes, analytical methods, and contract laboratories. The 1999 Bookman-Edmonston & Hydrofocus *Westside Basin Proposed Groundwater Management Plan* recommended the collection of groundwater data for areas where existing groundwater data collection activities do not exist. In order to facilitate the recommended data collection, San Mateo County Environmental Health Division, with concurrence from the San Francisco Bay Regional Water Quality Control Board (RWQCB), selected private water wells in the Westside Basin to be sampled to supplement existing groundwater quality data. Water samples were collected from the select private water wells and analyzed for constituents recommended in the *Westside Basin Proposed Groundwater Management Plan*, as well as for additional inorganic constituents, total coliform, cyanide and VOCs (using EPA Method 524.2). Results of the private well data, combined with water quality data provided by the individual water agencies, are presented in this report.

## ***Data Collection:***

By combining water quality data from local water agency wells and supplemental private wells, water quality data was available for 46 wells for the year 2000. Well locations are shown in Figure 1. Data sources and sampling methods for all wells are listed in Table 1.



- San Francisco Bay
- wells
  - WELLS SAMPLED BY SAN MATEO COUNTY ENVIRONMENTAL HEALTH SERVICES
  - WELLS ROUTINELY SAMPLED BY PARTNERS
- Pacific Ocean
- Westside Basin Boundary
- City Boundaries



Figure 1: Location of wells from which water samples were collected and analyzed in 2000.

<b>WELL NAME</b>	<b>data source</b>	<b>sampling location/method</b>
Arboretum 5	RWQCB/SMCoEHS	sampling port at the well head
Elk Glenn	RWQCB/SMCoEHS	sampling port at the well head
USGS South Mill D	RWQCB/SMCoEHS	bailer
USGS South Mill S	RWQCB/SMCoEHS	bailer
Windmill NE	RWQCB/SMCoEHS	sampling port at the well head
West Sunset Playground	RWQCB/SMCoEHS	bailer
Edgewood School	RWQCB/SMCoEHS	sampling port at the well head
LMMW1S	RWQCB/SMCoEHS	bailer
LMMW2S	RWQCB/SMCoEHS	bailer
LMMW2D	RWQCB/SMCoEHS	bailer
LMMW3S	RWQCB/SMCoEHS	bailer
LMMW3D	RWQCB/SMCoEHS	bailer
LMMW5S	RWQCB/SMCoEHS	bailer
LMMW6D	RWQCB/SMCoEHS	bailer
Zoo4	RWQCB/SMCoEHS	pipe outlet at water pond
San Francisco Golf Club 1	RWQCB/SMCoEHS	sampling port at the well head
Lake Merced Country Club	RWQCB/SMCoEHS	sampling from combined well system
Westlake 1	Daly City Water and Waste Water Department	sampling port at the well head
DC 10	Daly City Water and Waste Water Department	sampling port at the well head
Jefferson	Daly City Water and Waste Water Department	sampling port at the well head
Vale	Daly City Water and Waste Water Department	sampling port at the well head
DC 04	Daly City Water and Waste Water Department	sampling port at the well head
A St	Daly City Water and Waste Water Department	sampling port at the well head
Home of Peace	RWQCB/SMCoEHS	sampling port at the well head
Hills of Eternity	RWQCB/SMCoEHS	sampling port at the well head
Cypress Lawn Cemetery 2	RWQCB/SMCoEHS	pipe outlet at water pond
Holy Cross Cemetery 1	RWQCB/SMCoEHS	sampling port at the well head
California Golf Club 5	RWQCB/SMCoEHS	sampling port at the well head
SS 1-14	California Water Service	sampling port at the well head
SS 1-15	California Water Service	sampling port at the well head
SS 1-18	California Water Service	sampling port at the well head
SS 1-19	California Water Service	sampling port at the well head
Vince's Shellfish	RWQCB/SMCoEHS	sampling port at the well head
SB 15	San Bruno Public Works	sampling port at the well head
SB 16	San Bruno Public Works	sampling port at the well head
SB 17	San Bruno Public Works	sampling port at the well head
SB18	San Bruno Public Works	sampling port at the well head
Green Hills Country Club	RWQCB/SMCoEHS	sampling port at the well head
Pessagno	SMCoEHS (Emergency Water Supply)	sampling port at the well head
812 Irwin Dr	SMCoEHS (Emergency Water Supply)	sampling port at water tank
510 Eucalyptus	SMCoEHS (Emergency Water Supply)	sampling port at the well head
Burlingame Country Club 3	RWQCB/SMCoEHS	pipe outlet at water pond
25 New Place Rd	SMCoEHS (Emergency Water Supply)	sampling port at the well head
101 New Place Rd	SMCoEHS (Emergency Water Supply)	sampling port at the well head
1100 Jackling Dr	SMCoEHS (Emergency Water Supply)	sampling port at the well head
1700 Floribunda	SMCoEHS (Emergency Water Supply)	sampling port at the well head
Oceanside	RWQCB/SMCoEHS	bailer

RWQCB

Regional Water Quality Control Board

SMCoEHS

San Mateo County Environmental Health Services

Table 1: *Sampled wells and their sampling location or method.*

The majority of the samples considered in this evaluation were collected during May 2000 as part of a basin-wide water quality sampling project. Sampling of private wells not owned by the water agencies, and wells around Lake Merced and in the Sunset District owned by San Francisco Water Department, was funded by the Regional Water Quality Control Board. Samples were collected by San Mateo County Environmental Health Division and sent to Sequoia Analytical Laboratory for general minerals, nitrates, cyanide and VOC's (EPA method 524.2) analysis. In general, samples were collected from well head sampling ports. For wells without pumps or sampling ports samples are usually collected using 1L disposable bailers (3 ft long, 1.6 in diameter) without purging the well prior to sample collection. Samples were collected directly into 2 plain plastic 1L bottles with no preservatives, one 1L brown HDPE wide mouth nalgene bottle with 2 mL 1:1 sodium hydroxide and three 40-mL transparent glass VOAs with 0.5 mL 1:1 hydrochloric acid we. Samples were received by the contract laboratory the same day they were collected.

Seven wells were sampled as part of an emergency water supply study conducted by San Mateo County Environmental Health Services. The samples were collected by San Mateo County Environmental Health Division and sent to Sequoia Analytical for chemical analysis. The samples were collected from well head sampling ports located at the wells. Samples were collected directly into 2 plain plastic 1L bottles with no preservatives, one 1L brown HDPE wide mouth nalgene bottle with 2 mL 1:1 sodium hydroxide and three 40-mL transparent glass VOAs with 0.5 mL 1:1 hydrochloric. Samples were received by the contract laboratory the same day they were collected.

The remaining water quality data was provided by Daly City Water and Waste Water Department, California Water Service and San Bruno Public Works. California Water Service did not have year 2000 data available for all their active wells. Data for wells 1-20 and 1-21 will only be available in 2001 and 2002, respectively. Data provided by the water agencies included information on general minerals, cyanide, nitrates and VOCs covered by the EPA 524.2 method. Water agency analytical results are included in Appendix 1. Each water agency uses a different contract laboratory. Each laboratory has a slightly different list of analytes and varying reporting limits. Laboratory analytes and reporting limits are summarized in Table 2.

The anion and cation charge balance and calculated dissolved solids and specific conductance ratios have not been evaluated and should be considered in any error evaluation.



ANALYTE	UNITS	Sequoia Analytical		Daly City	Calwater	San Bruno
		DL	RL	DL	MDL	DL
Bicarbonate Alkalinity	mg/l	1.77	5.00		1.00	
Carbonate Alkalinity	mg/l	1.77	5.00		1.00	
Hydroxide Alkalinity	mg/l	1.77	5.00		1.00	
Total Alkalinity	mg/l	1.77	5.00		1.00	
Aluminum	mg/l				0.05	
Ammonia as N	mg/l	0.0196	0.100			
Antimony	mg/l				0.006	
Arsenic	mg/l				0.002	
Barium	mg/l				0.1	
Beryllium	mg/l				0.001	
Boron	mg/l	0.0500	0.100			
Bromide	mg/l	0.160	1.00			
Cadmium	mg/l				0.001	
Calcium	mg/l	0.200	0.500		1.00	
Chloride	mg/l	0.0670	10.0		1.00	
Chromium	mg/l				0.01	
Copper	mg/l	0.00500	0.0100	0.05	0.05	0.05
Cyanide (total)	mg/l	0.00200	0.0100	0.1		0.1
Fluoride	mg/l	0.0760	1.00	0.1	0.10	0.1
Hardness	mg/l	1.00	1.00	50	1.00	
Iron	mg/l	0.0100	0.0100	0.1	0.10	0.1
Lead	mg/l				0.005	
Magnesium	mg/l	0.0500	0.100		1.00	
Manganese	mg/l	0.00500	0.0100	0.02	0.02	0.03
Mercury	mg/l				0.001	
Methylene Blue Active Substances	mg/l	0.0179	0.0500			
Nickel	mg/l				0.006	
Nitrate as NO3	mg/l	0.217	1.00	2	2.00	2
Nitrite as N	mg/l				0.40	0.40
Nitrite as NO2	mg/l	0.130	1.00			0.40
pH	pH Units					
Orthophosphate as PO4	mg/l	0.301	1.00			
Phosphate-phosphorus	mg/l	0.160	0.330		0.07	
Potassium	mg/l	0.500	1.00		0.10	
Selenium	mg/l				0.005	
Silica (SiO2)	mg/l	0.430	0.430			
Silver	mg/l				0.01	
Specific Conductivity @ 25 C	umhos/cm	1.00	1.00		1.00	
Sodium	mg/l	0.200	0.500		1.00	
Sodium Absorption Ratio						
Sulfate as SO4	mg/l	1.09	5.00	0.5	0.5	0.5
Thallium					0.001	
Total Dissolved Solids	mg/l	3.60	10.0		0.0001*	
Zinc	mg/l	0.00500	0.0100	0.05	0.05	0.05
Color Apparent Filtered					1.00	
Langelier Index Source Temp.						
Odor Threshold at 60 C					1.00	
Temperature (Source)						
Turbidity (Lab)					0.05	
E. Coli	P/A		1.0			
Total Coliforms	P/A		1.0			
1,1,1,2-Tetrachloroethane	ug/l		0.500	0.5		
1,1,1-Trichloroethane	ug/l		0.500	0.5		
1,1,2,2-Tetrachloroethane	ug/l		0.500	0.5		
1,1,2-Trichloroethane	ug/l		0.500	0.5		
1,1-Dichloroethane	ug/l		0.500	0.5		
1,1-Dichloroethene	ug/l		0.500	0.5		

ANALYTE	UNITS	Sequoia Analytical		Daly City	Calwater	San Bruno
		DL	RL	DL	MDL	DL
1,1-Dichloropropene	ug/l		0.500	0.5		
1,2,3-Trichlorobenzene	ug/l		0.500			
1,2,3-Trichloropropane	ug/l		0.500	0.5		
1,2,4-Trichlorobenzene	ug/l		0.500	0.5		
1,2,4-Trimethylbenzene	ug/l		0.500	0.5		
1,2-Dibromo-3-chloropropane	ug/l		0.500			
1,2-Dichlorobenzene	ug/l		0.500	0.5		
1,2-Dichlorobenzene-d4	ug/l					
1,2-Dichloroethane	ug/l		0.500	0.5		
1,2-Dichloropropane	ug/l		0.500			
1,3,5-Trimethylbenzene	ug/l		0.500	0.5		
1,3-Dichlorobenzene	ug/l		0.500	0.5		
1,3-Dichloropropane	ug/l		0.500	1		
1,4-Dichlorobenzene	ug/l		0.500	0.5		
2,2-Dichloropropane	ug/l		0.500			
2-Chlorotoluene	ug/l		0.500			
4-BFB	ug/l					
4-Chlorotoluene	ug/l		0.500	0.5		
Benzene	ug/l		0.500	0.5		
Bromobenzene	ug/l		0.500	0.5		
Bromochloromethane	ug/l		0.500	0.5		
Bromodichloromethane	ug/l		0.500	0.5		
Bromoform	ug/l		0.500	0.5		0.5
Bromomethane	ug/l		0.500			
Carbon tetrachloride	ug/l		0.500	0.5		
Chlorobenzene	ug/l		0.500			
Chloroethane	ug/l		0.500	0.5		
Chloroform	ug/l		0.500	0.5		
Chloromethane	ug/l		0.500	0.5		
cis-1,2-Dichloroethene	ug/l		0.500			
cis-1,3-Dichloropropene	ug/l		0.500	0.5		
Dibromochloromethane	ug/l		0.500	0.5		
Dibromomethane	ug/l		0.500			
Dichlorodifluoromethane	ug/l		1.00	0.5		
Ethylbenzene	ug/l		0.500	0.5		
Hexachlorobutadiene	ug/l		0.500	0.5		
Isopropylbenzene	ug/l		0.500	0.5		
m,p-Xylene	ug/l		0.500	0.5		
Methyl ethyl ketone	ug/l		5.00			
Methyl isobutyl ketone	ug/l		5.00			
Methyl tert-butyl ether	ug/l		3.00	3		
Methylene chloride	ug/l		0.500			
n-Butylbenzene	ug/l		0.500			
n-Propylbenzene	ug/l		0.500	0.5		
Naphthalene	ug/l		0.500	0.5		
o-Xylene	ug/l		0.500			
p-Isopropyltoluene	ug/l		0.500	0.5		
sec-Butylbenzene	ug/l		0.500	0.5		
Styrene	ug/l		0.500	0.5		
tert-Butylbenzene	ug/l		0.500	0.5		
Tetrachloroethene	ug/l		0.500			
Toluene	ug/l		0.500			
Total 1,3-Dichloropropene	ug/l		0.500	0.5		
Total Trihalomethanes	ug/l		0.500	0.5		
Total Xylenes	ug/l		0.500	0.5		
trans-1,2-Dichloroethene	ug/l		0.500			
trans-1,3-Dichloropropene	ug/l		0.500			

ANALYTE	UNITS	Sequoia Analytical		Daly City	Calwater	San Bruno
		DL	RL	DL	MDL	DL
Trichloroethene	ug/l		0.500			
Trichlorofluoromethane	ug/l		5.00	5		
Trichlorotrifluoroethane	ug/l		10.0	10		
Vinyl chloride	ug/l		0.500	0.5		

\*  
DL filterable residue  
MDL detection limit (equivalent to PQL)  
RL method detection limit  
reporting limit

Table 2: Various analyzed constituents and the reported detection limits by the different water agencies.

Chemical results for all constituents addressed in the *Westside Basin Proposed Groundwater Management Plan* (Bookman-Edmonston & Hydrofocus, 1999) are included in Table 3. Maps and associated concentration contours included in this report were generated using ArcView version 3.2, with the ArcView Spatial Analyst version 2.0 extension. In using the ArcView software, groundwater elevations were interpolated between wells using Inverse Distance Weighted (IDW) interpolation. The IDW method weights closer data points greater than data points that are farther away. A specified number of points is used to determine the output value for each location. The number of neighboring points used for these interpolations was set to 12. The power parameter in the IDW interpolation controls the significance of the surrounding points upon the interpolated value. The software uses a barrier input line theme to break and limit the interpolation points. Based on known and inferred geologic and hydrogeologic features, the San Andreas Fault, Serra Fault, bedrock outcrops along the San Bruno Mountains, the Twin Peaks area, and a reported groundwater high in Burlingame, were defined as barrier themes in the interpolation. ArcView generated contour lines were adjusted slightly to correct for obvious edge effects along defined boundaries and where data was obviously limited. Concentration contours were drawn for all constituents mentioned in the *Westside Basin Proposed Groundwater Management Plan*, except for boron and bromide, for which insufficient data was available to allow a meaningful interpolation. For the wells screened in the shallow aquifer zone concentration contours were not generated because insufficient data was available to allow a meaningful interpolation. For the Golden Gate Park area the concentration contours may be in mistake since there is a possibility that the names of the USGS South Mill D and USGS South Mill S have been interchanged at the sampling time.

WELL_NAME	Br	B	Ca	Cl	Fe	Mg	NO3	Mn	K	Na	SO4	pH	S.C.	TDS	T.A.
Arboretum 5	ND	ND	29.80	31.80	ND	39	49	ND	1.39	26.80	36.80	7.08	531	352	171
Elk Glenn	ND	ND	30.40	38.40	ND	32.8	49.2	ND	ND	24.20	48.80	7.65	526	364	138
USGS South Mill D	0.78	5.00	16.60	89.10	2.96	17.0	0.93	0.13	6.04	165.00	44.60	7.84	1020	920	439
Windmill NE	ND	ND	29.50	41.70	ND	36.7	27.7	0.02	ND	32.80	41.90	7.30	548	342	175
West Sunset Playground	0.33	ND	6.64	20.20	1.15	6.6	ND	0.04	1.90	17.50	8.26	9.40	169	80	51
Edgewood School	ND	ND	41.90	28.40	1.36	2.35	33.8	0.09	4.97	24.20	32.30	7.37	410	240	108
LMMW2D	0.28	ND	21.10	39.10	0.04	6.24	3.04	ND	10.10	14.30	6.42	6.91	270	138	76
LMMW3D	0.61	ND	13.20	73.20	ND	ND	0.64	ND	8.10	27.70	9.90	11.40	640	260	99
LMMW6D	0.53	ND	18.30	27.80	ND	0.18	1.62	ND	13.30	13.80	6.11	11.30	408	122	70
Zoo4	0.39	ND	29.90	43.40	0.03	33.6	33.1	ND	2.33	42.00	37.70	7.71	386	312	157
San Francisco Golf Club 1	0.36	ND	17.80	49.70	ND	18.7	3.43	0.02	ND	30.50	8.66	8.05	350	208	89
Lake Merced Country Club	0.54	ND	35.90	54.30	ND	33.8	33.1	ND	3.16	24.90	35.50	7.91	535	304	150
Westlake 1	NA	NA	50.30	108.00	ND	47.1	31.6	ND	2.83	64.00	85.30	7.66	890	280	190
DC 10	NA	NA	20.50	50.50	ND	25.3	40.6	ND	1.48	35.50	27.80	8.12	474	262	113
Jefferson	NA	NA	21.10	55.80	ND	21.5	11.6	ND	1.71	32.40	10.90	8.10	427	240	119
Vale	NA	NA	24.50	65.70	ND	27.0	33.4	ND	2.68	37.80	25.80	8.14	619	286	122
DC 04	NA	NA	27.10	65.20	ND	32.5	61.0	ND	1.83	42.20	32.30	8.12	474	324	126
A St	NA	NA	24.80	71.90	ND	27.6	53.5	ND	2.19	37.80	20.60	8.10	540	280	113
Home of Peace	ND	ND	49.70	77.60	0.06	44.5	85.4	ND	1.15	51.80	49.30	7.67	674	522	195
Hills of Eternity	ND	ND	43.30	77.50	0.01	39.2	98.6	ND	1.38	48.00	42.40	7.75	623	530	161
Cypress Lawn Cemetery 2	ND	ND	34.10	69.10	0.08	34.2	46.9	ND	1.57	41.20	29.60	8.23	468	432	155
Holy Cross Cemetery 1	ND	ND	27.20	57.00	ND	28.1	41.3	ND	1.11	36.70	20.10	8.12	431	354	137
California Golf Club 5	0.62	ND	41.70	103.00	ND	41.2	6.34	0.09	3.67	60.50	63.70	7.81	701	446	190
SS 1-14	NA	NA	12.00	120.00	0.15	69.0	53.0	ND	3.0	83.00	98.00	7.55	1181	*634	297
SS 1-15	NA	NA	59.00	125.00	ND	57.0	28.0	0.02	3.2	75.00	70.00	7.43	1018	*572	255
SS 1-18	NA	NA	64.00	91.00	ND	50.0	69.0	ND	3.0	50.00	57.00	7.80	889	*605	207
SS 1-19	NA	NA	55.00	121.00	ND	56.0	31.0	ND	2.8	63.00	54.00	7.81	929	*531	213
Vince's Shellfish	0.50	ND	87.80	66.20	0.23	40.2	1.38	0.16	4.88	82.00	22.00	7.44	382	314	146
SB 15	NA	NA	81.00	98.00	0.1	19.5	8.5	0.3	3.4	53.00	75.00	6.90	750	412	168
SB 16	NA	NA	56.00	107.00	ND	35.0	ND	0.1	4.3	51.00	74.00	7.50	766	430	170
SB 17	NA	NA	34.00	66.00	ND	21.0	3.5	0.01	4.0	46.00	29.00	7.60	510	290	152
SB18	NA	NA	32.00	39.00	ND	18.0	5.8	0.1	4.1	36.00	20.00	7.70	470	250	130
Green Hills Country Club	ND	ND	59.70	101.00	0.12	38.2	16	ND	4.82	56.80	98.90	7.16	786	488	175
Pessagno	NA	NA	26.60	28.70	1.1	17	5.85	ND	ND	37.00	33.00	6.74	379	268	133
812 Irwin Dr	NA	NA	51.90	161.00	0.25	62.3	8.63	ND	ND	59.60	33.80	8.46	NA	490	NA
510 Eucalyptus	NA	NA	13.90	9.14	ND	3.73	3.89	ND	NA	11.10	14.50	8.93	129	NA	49
Burlingame Country Club 3	0.50	0.16	36.80	67.50	0.92	11.2	1.29	0.13	2.67	38.30	63.20	7.94	591	318	194
25 New Place Rd	NA	NA	13.90	9.40	ND	3.79	3.96	ND	NA	10.30	17.60	8.92	134	88	49
101 New place Rd	NA	NA	32.00	44.00	0.07	26.9	2.9	ND	ND	32.60	30.00	6.95	434	NA	173
1100 Jackling Dr	NA	NA	53.00	69.40	0.09	27.0	33.4	ND	NA	41.00	36.40	6.79	505	358	136
1700 Floribunda	NA	NA	9.40	4.91	0.03	2.4	0.67	ND	NA	9.60	8.79	9.10	83	620	31
Oceanside	0.46	ND	10.90	64.30	0.75	8.02	0.14	ND	67.80	134.00	0.79	9.35	338	250	139

S.C. Specific Conductivity  
T.A. Total Alkalinity  
\* Data collected in 1997

Table 3: Chemical results for all constituents addressed in the Westside Basin proposed groundwater management plan for wells screened in the deep aquifer zone. All values are reported in ppm. The values for USGS South Mill D may not be representative of that well but rather of USGS South Mill M or USGS South Mill S, which are not indicated in this table.

## ***Results:***

### **A) INORGANIC CHEMICAL CONSTITUENTS:**

#### **Boron:**

Boron was analyzed in samples collected by San Mateo County Environmental Health Services, California Water Service and San Bruno Public Works did not request the analysis for boron on submitted groundwater samples.

Only 2 of the analyzed wells detected boron, Burlingame Country Club 3, in Hillsborough (0.16 ppm) and USGS South Mill D (5.0 ppm). The concentration at the USGS South Windmill D is above agricultural water quality goals set at 0.75 ppm. The analytical results are shown in Figure 2.



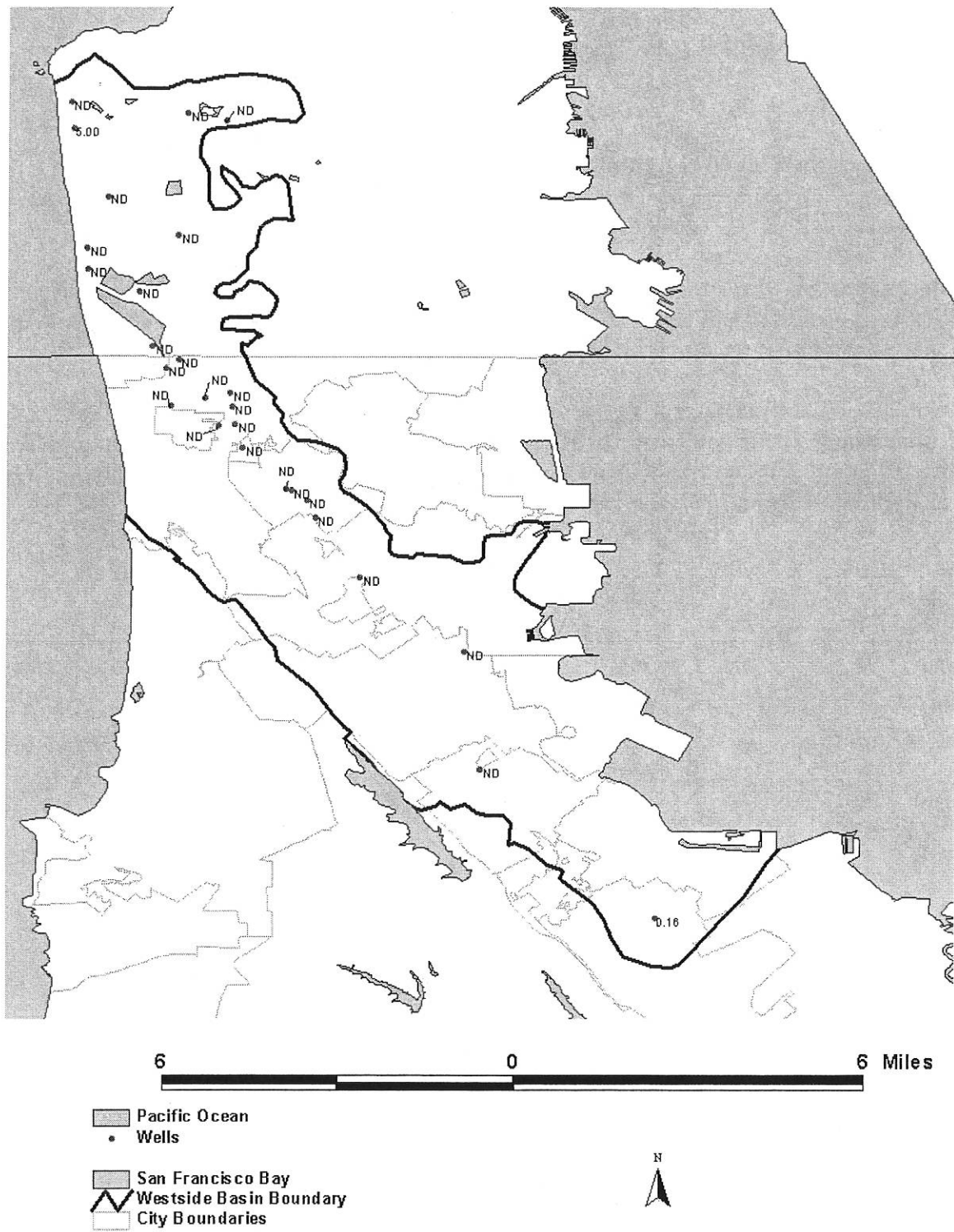


Figure 2: Boron concentrations for analyzed wells in the Westside Basin.

**Bromide:**

Bromide was analyzed in samples collected by San Mateo County Environmental Health Services, Daly City Water and Waste Water Department, California Water Service and San Bruno Public Works did not request the analysis for bromide on submitted groundwater samples.

For all analyzed wells the bromide concentration ranged from non-detect (ND) to 0.78 ppm. The analytical results are shown in Figure 3.

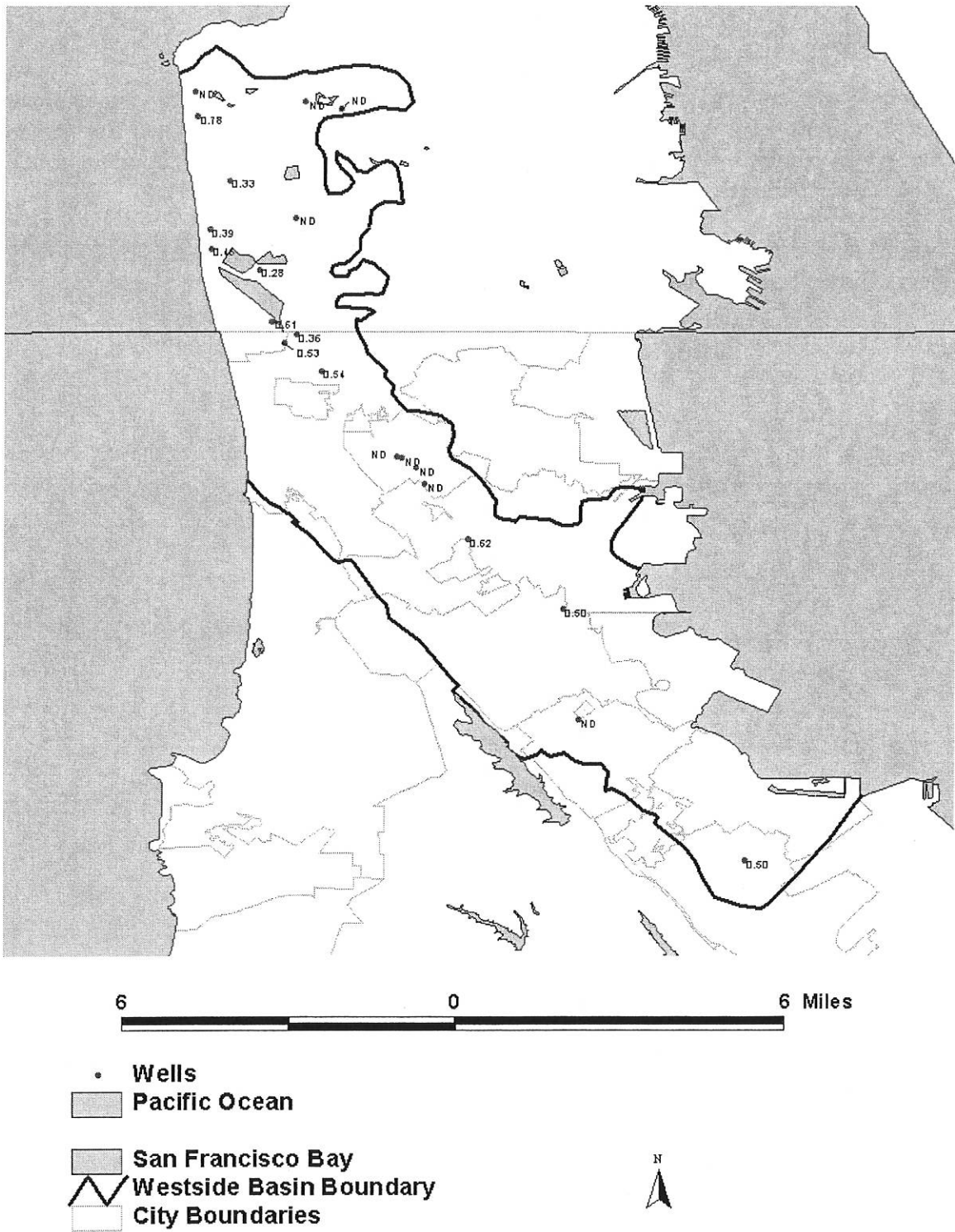


Figure 3: Bromide concentrations for analyzed wells in the Westside Basin.

**Calcium:**

Calcium data was available for all 46 wells. Reported concentrations ranged from 6.64 to 87.8 ppm. Highest concentrations were found in Vince's Shellfish well and San Bruno well 15. Lowest concentration was found in the West Sunset Playground well. Figure 4 shows the concentrations at each individual location and also the concentration contours.

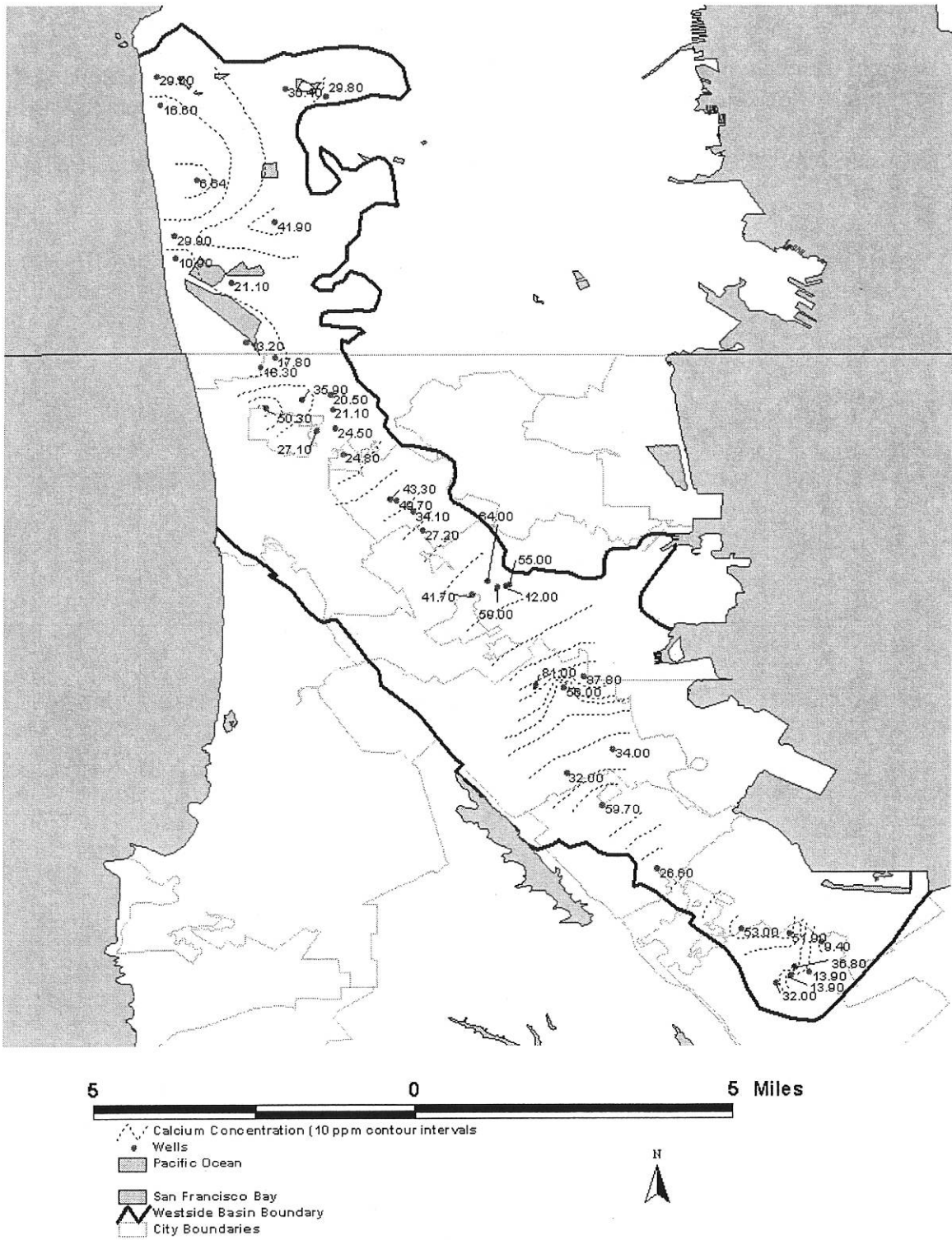
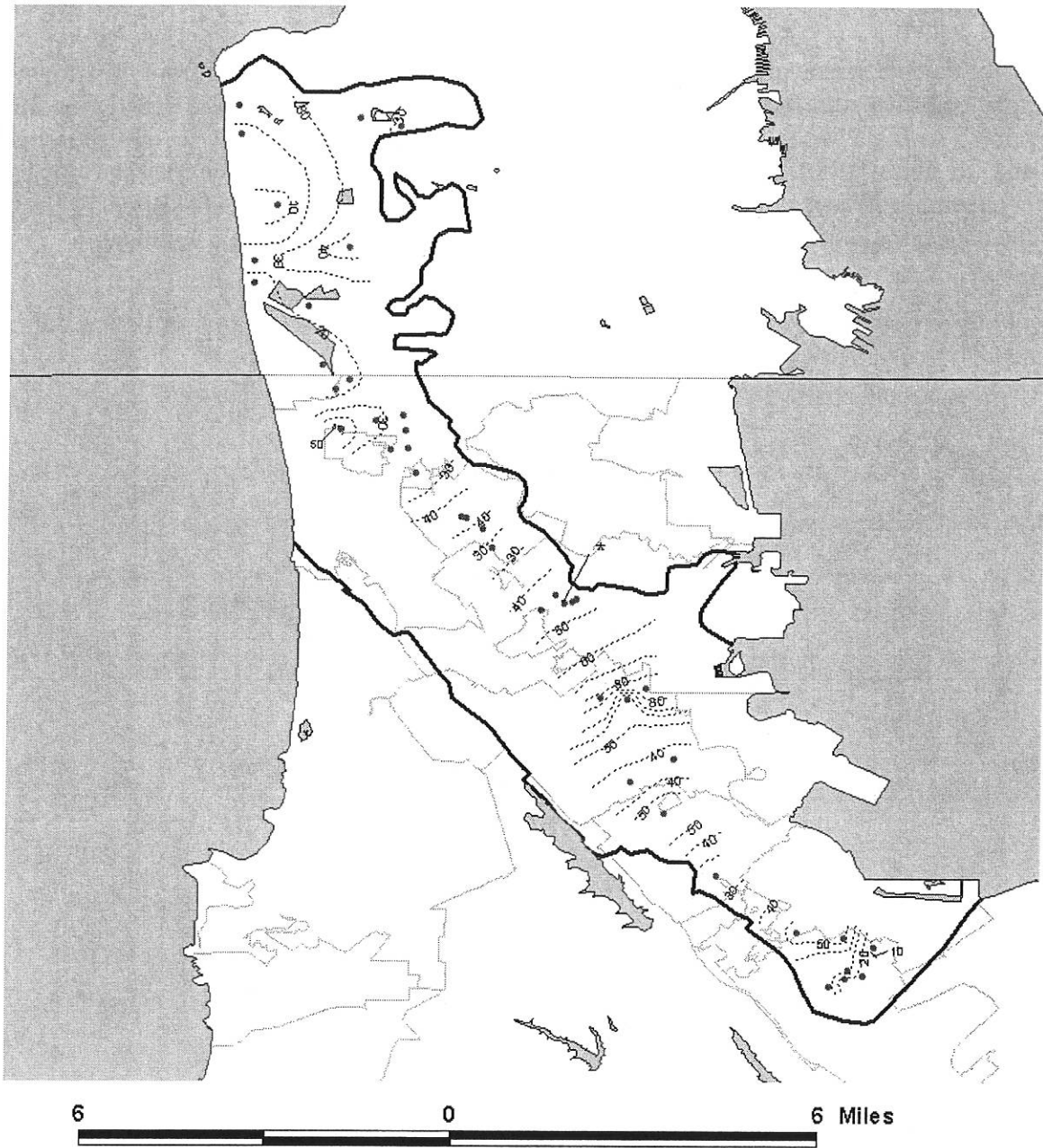


Figure 4a: Calcium concentrations for analyzed wells in the Westside Basin.





- Calcium Concentration (10 ppm contour intervals)
- Wells
- Pacific Ocean
- San Francisco Bay
- Westside Basin Boundary
- City Boundaries



\* For California Water Service wells the calcium concentration ranges from 12 to 64 ppm. A mean value of 47.5 ppm was used for the contour interpolation.

Figure 4b: Calcium concentration contours based on analyzed samples from wells in the Westside Basin.

**Chloride:**

Chloride data was available for all 46 wells. The concentrations ranged from 4.91 to 161 ppm and thus were below secondary Maximum Contamination Level \* (MCL) of 250 ppm. The highest concentrations were found in the well at 812 Irwin Dr, Hillsborough and in the California Water Service Wells in South San Francisco. The lowest concentration was found in the well at 1700 Floribunda, Hillsborough. Figure 5 shows the concentrations at each individual location and also the concentration contours.

For MCLs refer to California Department of Public Health or US EPA defined drinking water standards.

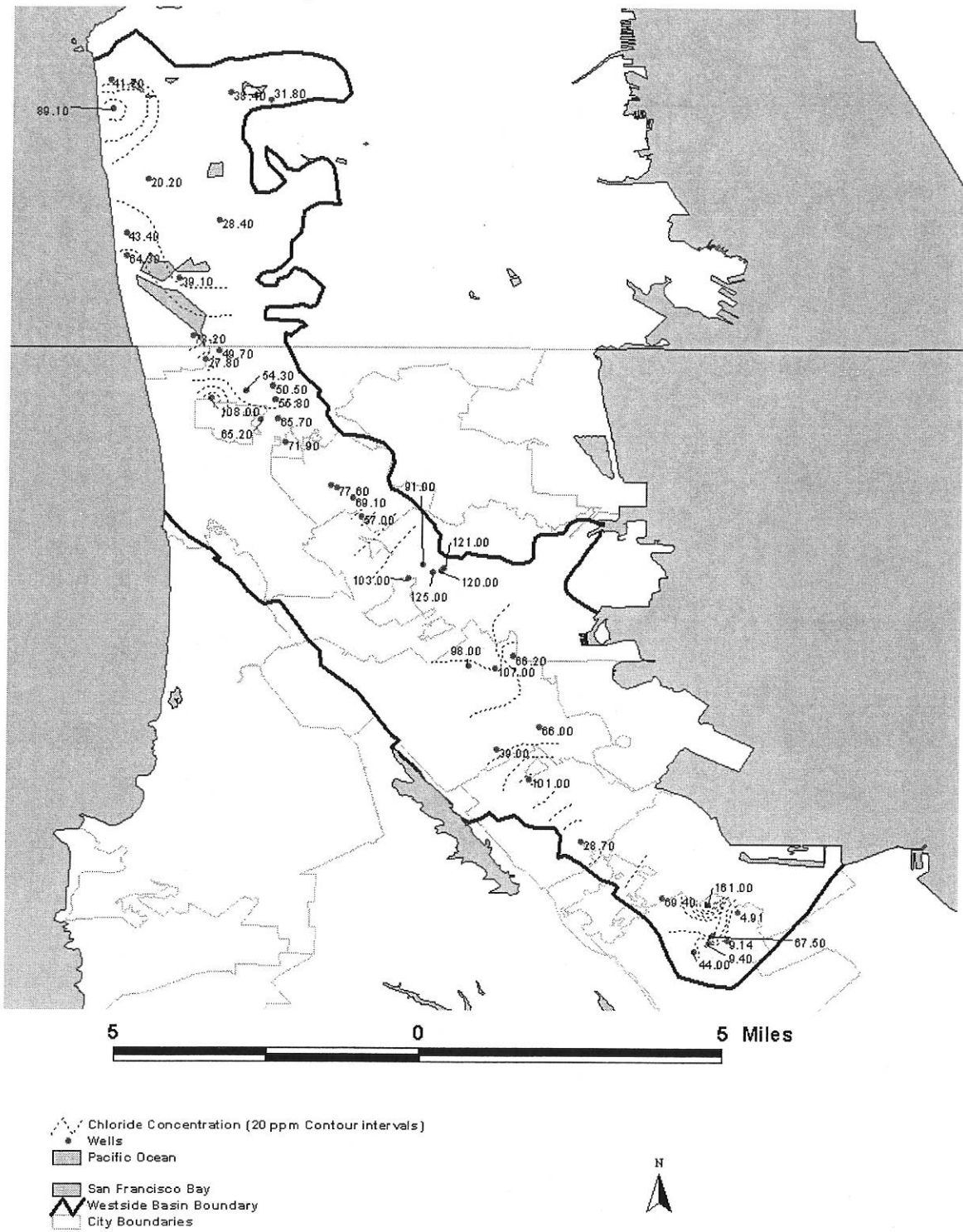


Figure 5a: Chloride concentrations for analyzed wells in the Westside Basin.

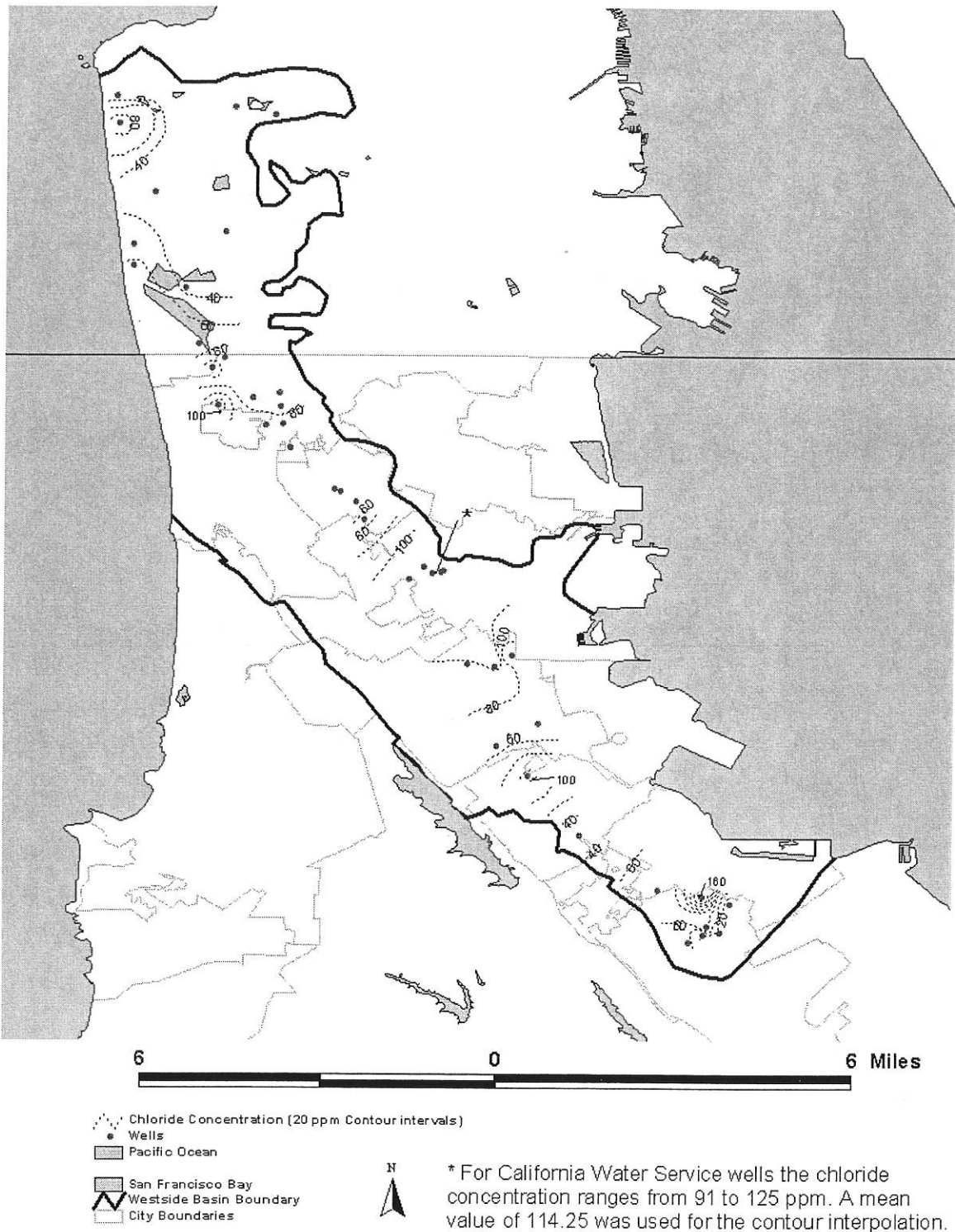


Figure 5b: Chloride concentration contours based on analyzed samples from wells in the Westside Basin.

**Iron:**

Iron data was available for all 46 wells. The concentrations ranged from ND to 2.96 ppm. Six wells had concentrations above the secondary MCL of 0.3 ppm. These wells are listed in Table 4. No iron was detected in any of the Daly City wells. Figure 6 shows the concentrations at each individual location and also the concentration contours.

WELL_NAME	Iron concentration (ppm)
USGS South Mill D	2.96
West Sunset Playground	1.15
Edgewood School	1.36
Pessagno	1.1
Burlingame Country Club 3	0.92
Oceanside	0.75

Table 4: *Wells with iron concentrations above secondary MCL in the Westside Basin. Value for USGS South Mill D may be of USGS South Mill M or USGS South Mill S.*



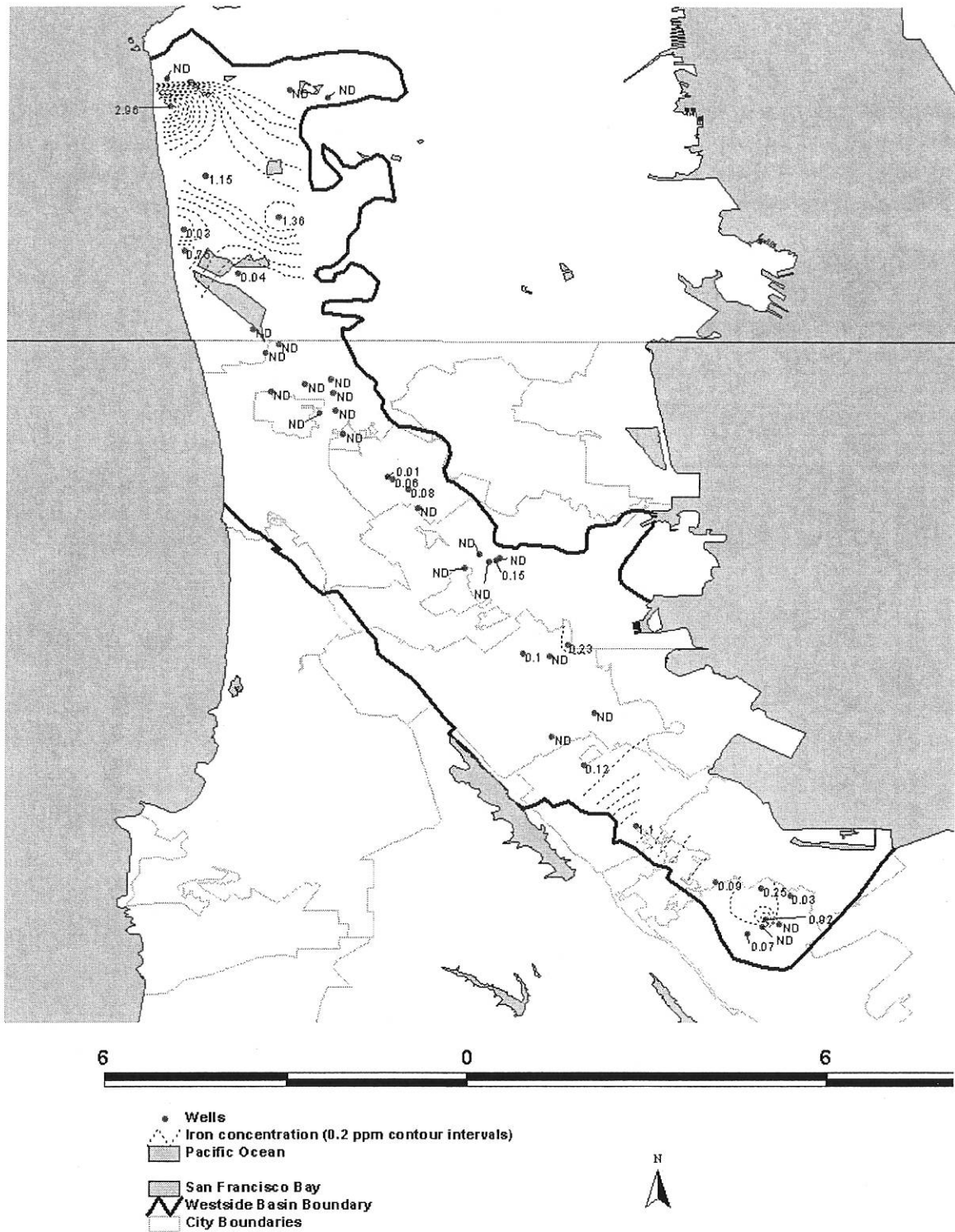


Figure 6a: Iron concentrations for analyzed wells in the Westside Basin.

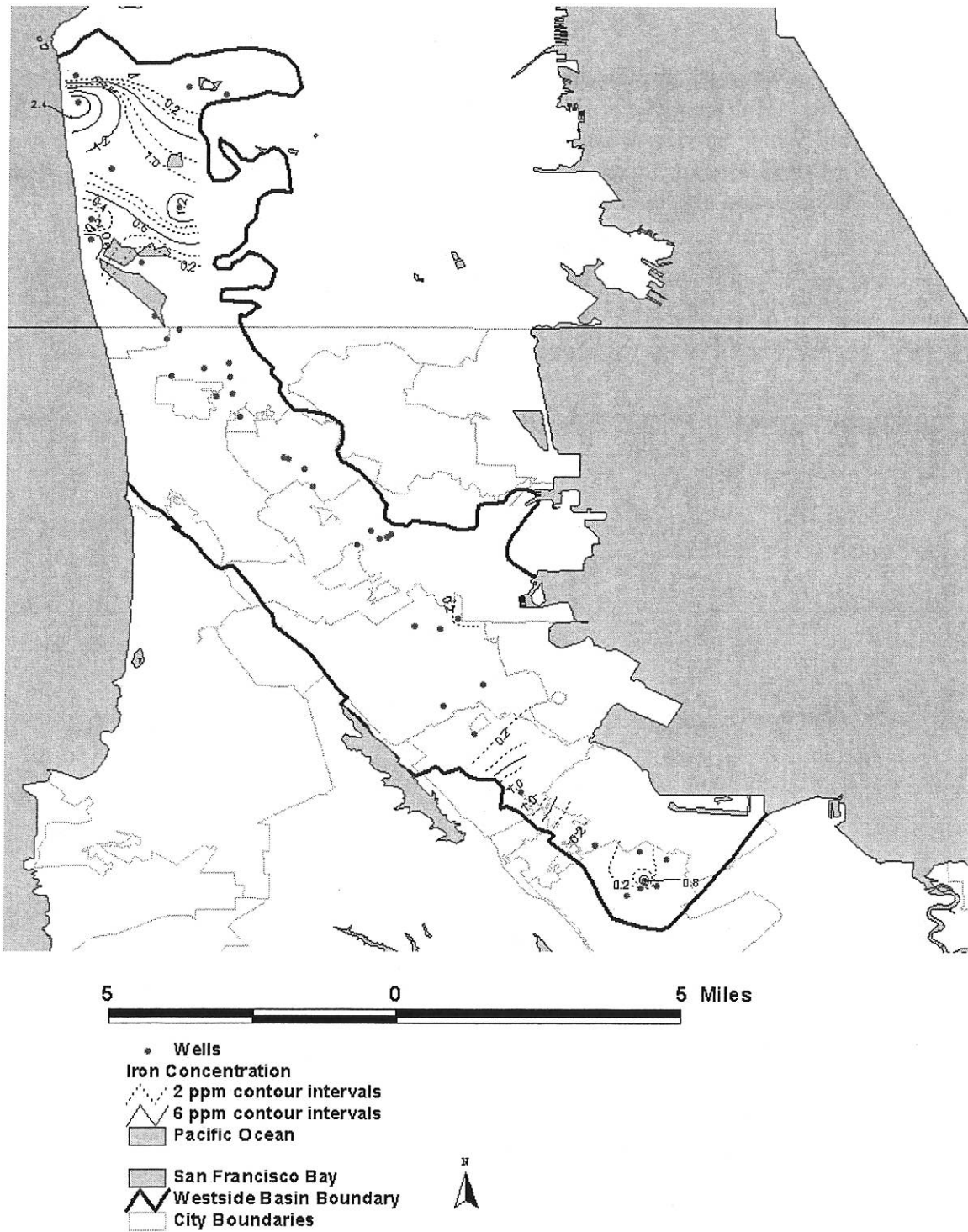


Figure 6b: *Iron concentration contours based on analyzed samples from wells in the Westside Basin.*

**Magnesium:**

Magnesium data was available for all 46 wells. The concentrations ranged from ND to 69 ppm. Highest concentrations were found in the well at 812 Irwin Dr, Hillsborough and in the California Water Service Wells in South San Francisco. Lowest concentration was found in LMMW3D, near Lake Merced. Figure 7 shows the concentrations at each individual location and also the concentration contours.

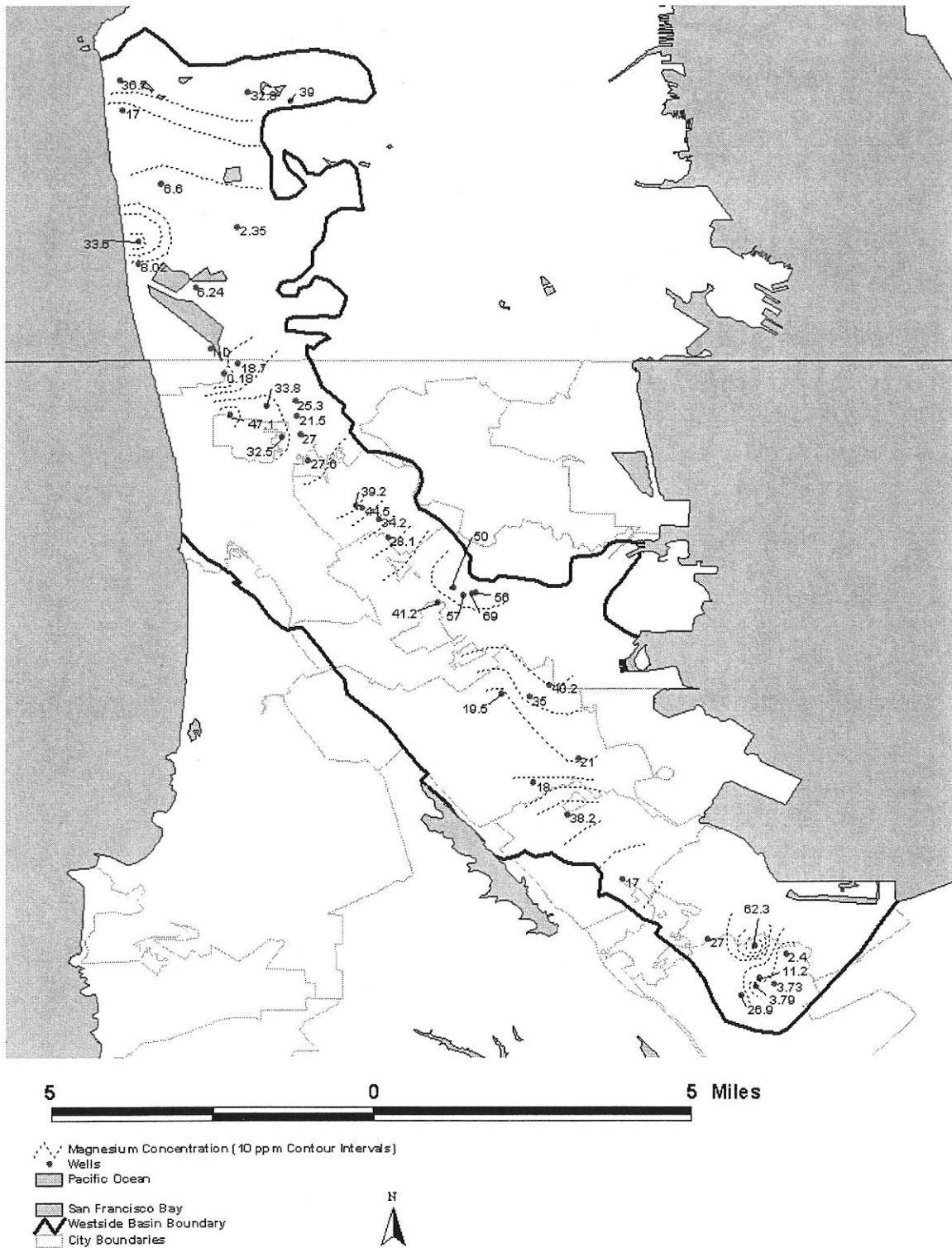


Figure 7a: Magnesium concentrations for analyzed wells in the Westside Basin.

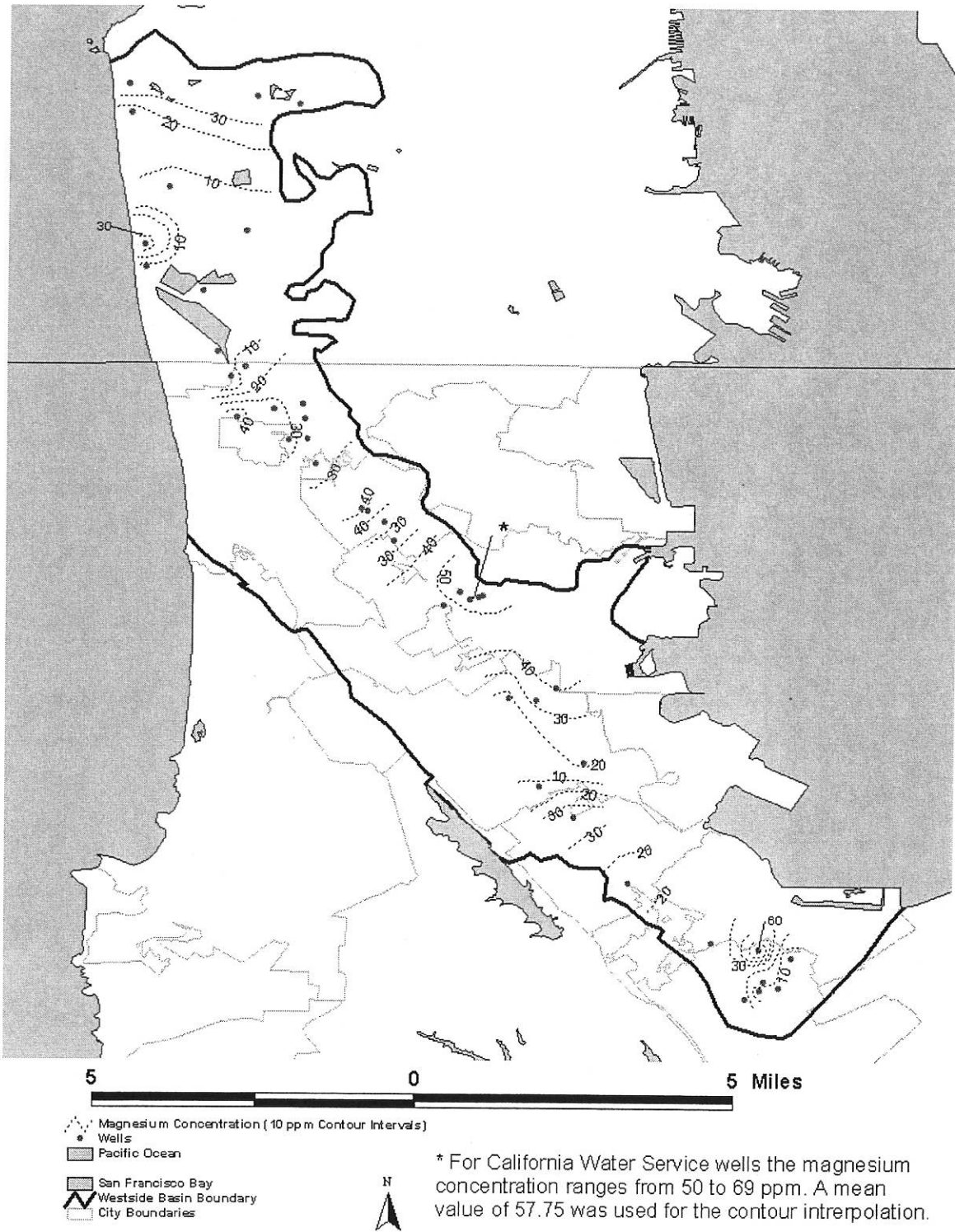


Figure 7b: Magnesium concentration contours based on analyzed samples from wells in the Westside Basin.



**Manganese:**

Magnesium data was available for all 46 wells. The concentrations ranged from ND to 0.30 ppm. Six wells had concentration above secondary MCL of 0.1 ppm. These wells are listed in Table 5. Except for the San Francisco Golf Club 1 well, no manganese was found in any analyzed well in Daly City and Colma. Figure 8 shows the concentrations at each individual location and also the concentration contours.

<b>Well Name</b>	<b>Manganese Concentration (ppm)</b>
USGS South Mill D	0.13
Vince's Shellfish	0.16
SB 15	0.30
SB 16	0.10
SB18	0.10
Burlingame Country Club 3	0.13

Table 5: *Wells with manganese concentrations above secondary MCL in the Westside Basin. Value for USGS South Mill D may be of USGS South Mill M or USGS South Mill S.*

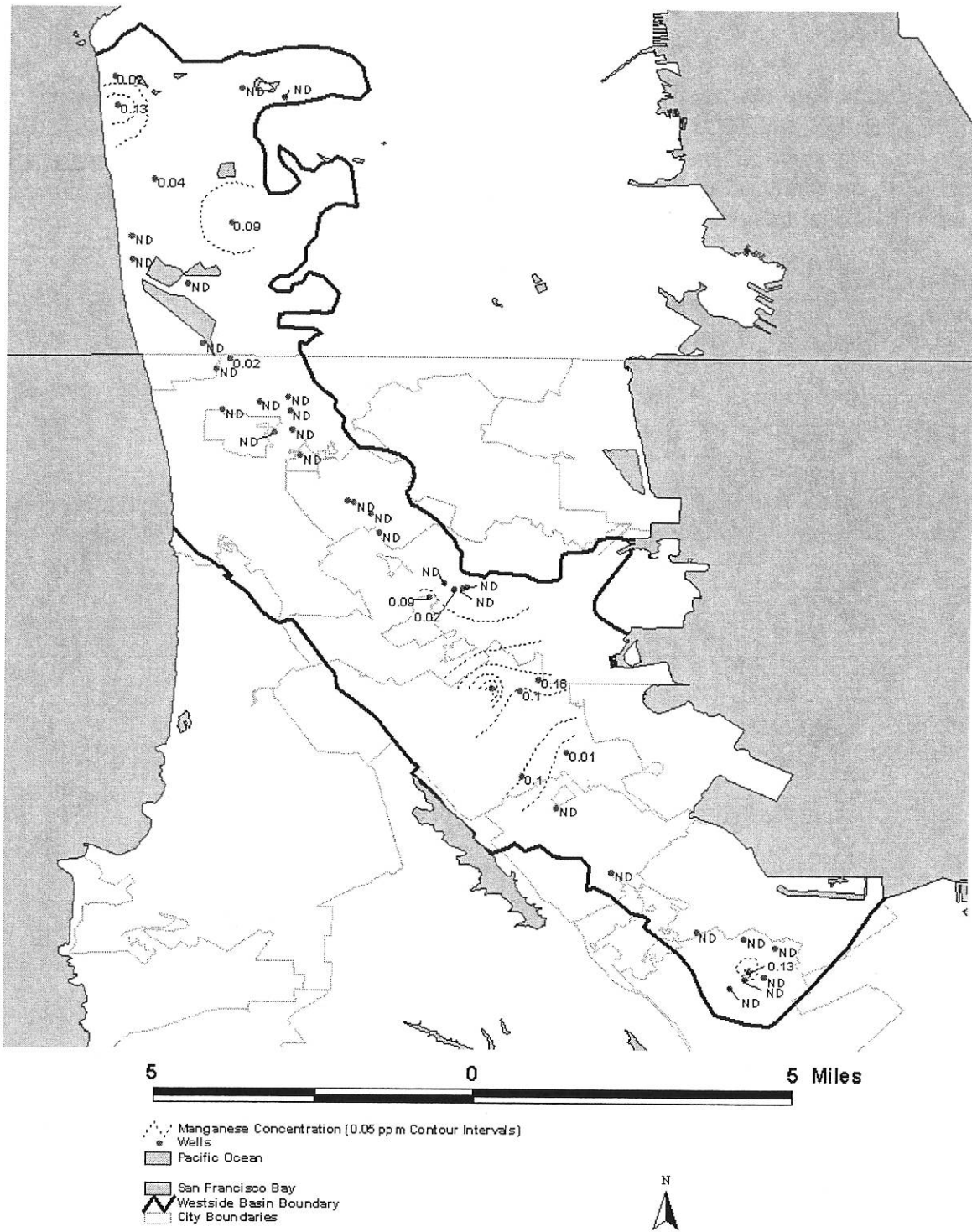


Figure 8a: Manganese concentrations for analyzed wells in the Westside Basin.

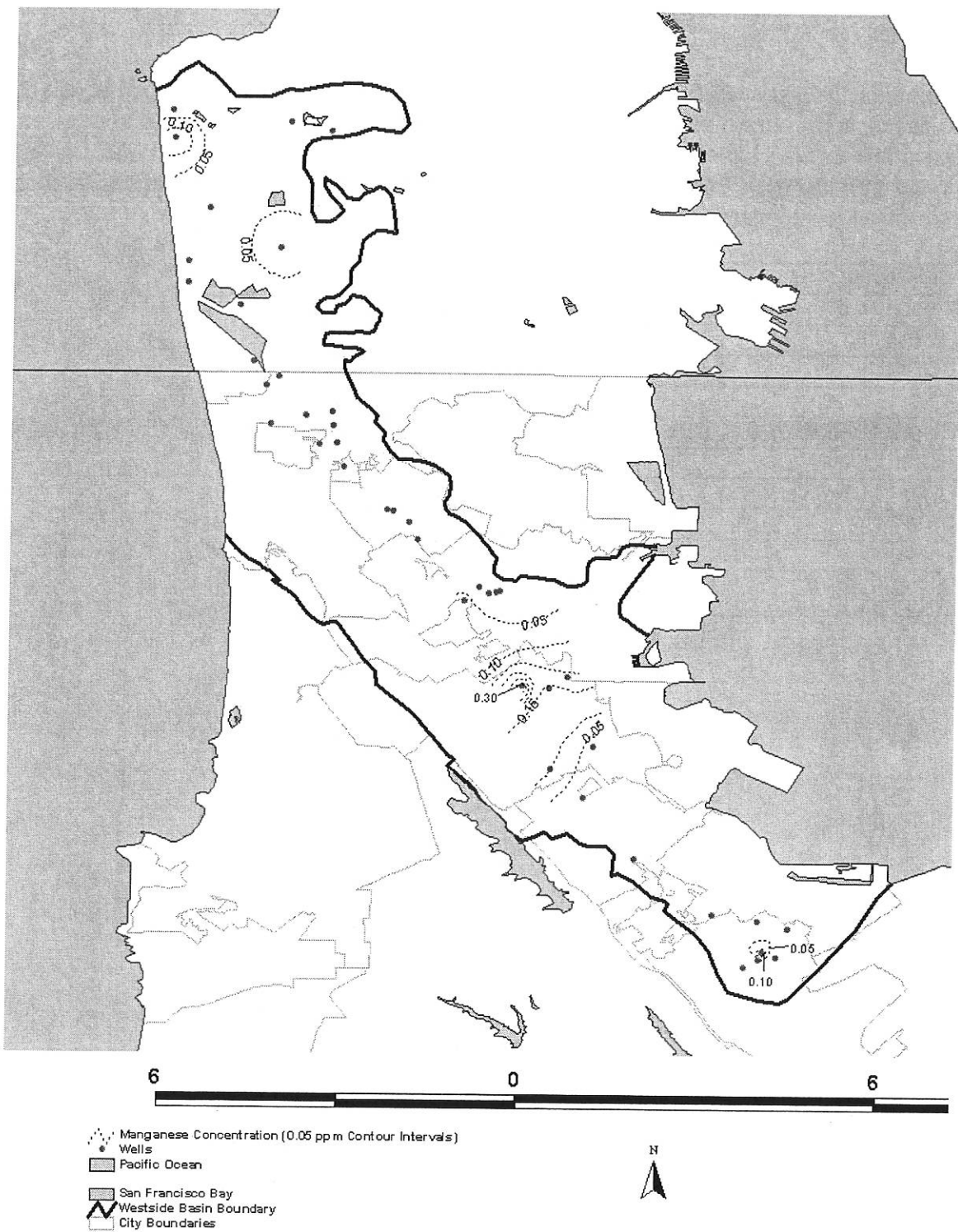


Figure 8b: Manganese concentration contours based on analyzed samples from wells in the Westside Basin.

**Nitrate:**

Nitrate (as NO<sub>3</sub>) data was available for all 46 wells. The concentrations ranged from ND to 98.60 ppm. Nine wells had concentration above MCL of 45 ppm. These wells are listed in Table 6. Highest concentrations were found in cemetery wells in Colma. Lowest concentrations were found in Hillsborough. Figure 9 shows the concentrations at each individual location and also the concentration contours.

<b>Well Name</b>	<b>Nitrate as NO3 Concentration (ppm)</b>
Arboretum 5	49.00
Elk Glenn	49.20
DC 04	61.00
A St	53.50
Home of Peace	85.40
Hills of Eternity	98.60
Cypress Lawn Cemetery 2	46.90
SS 1-14	53.00
SS 1-18	69.00

Table 6: *Wells with iron concentrations above MCL in the Westside Basin.*

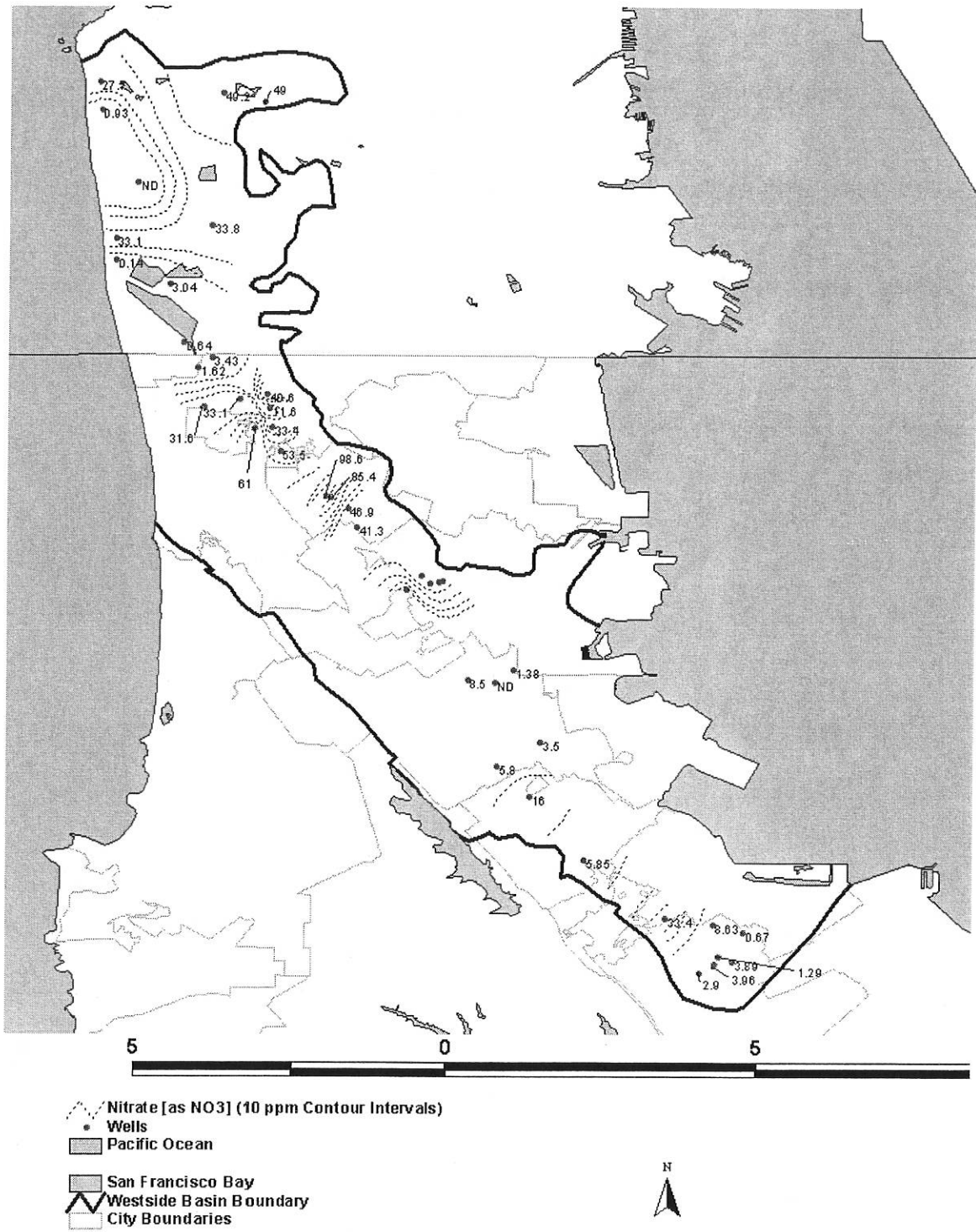


Figure 9a: Nitrate concentrations for analyzed wells in the Westside Basin.

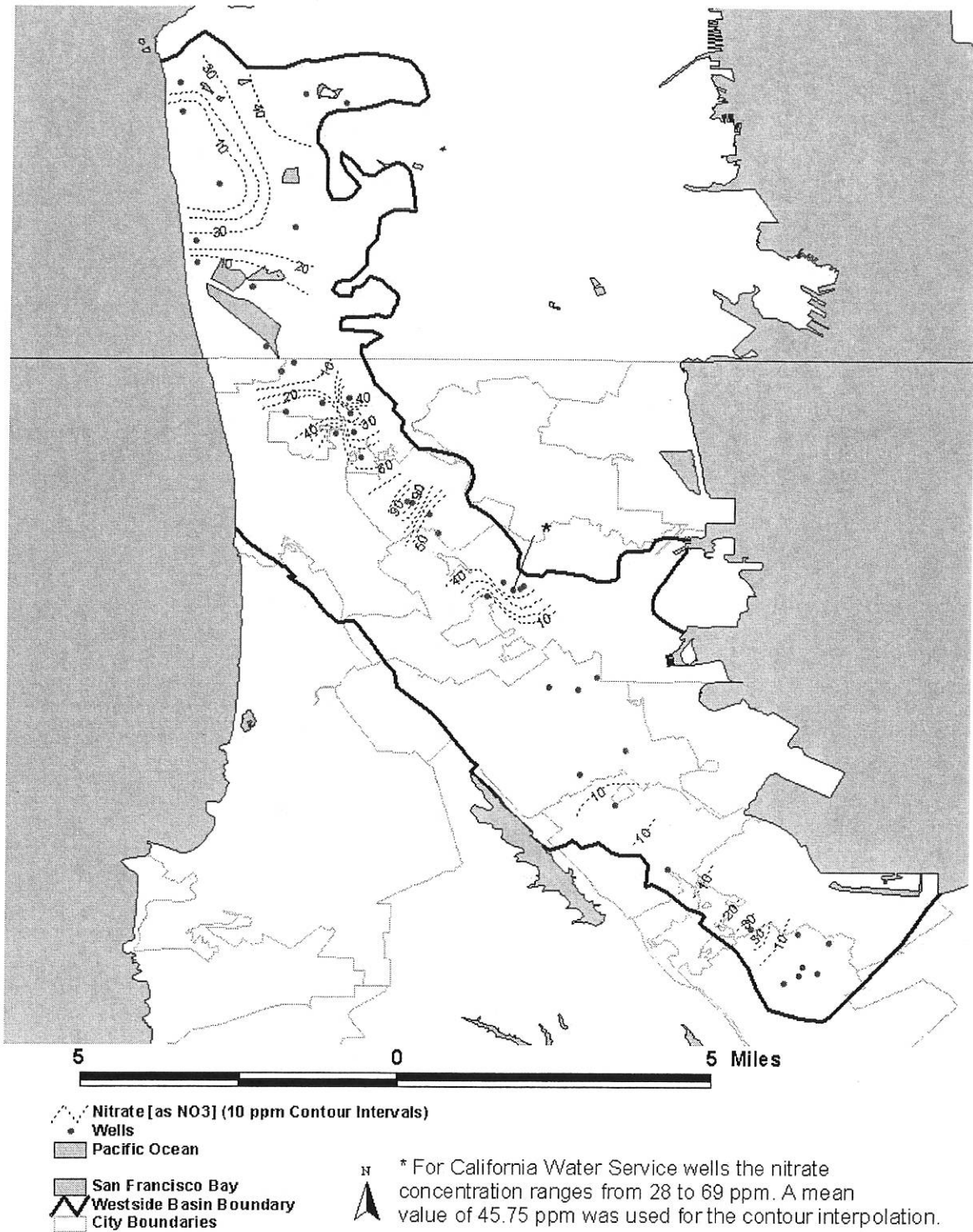


Figure 9b: Nitrate concentration contours based on analyzed samples from wells in the Westside Basin.



**pH:**

pH data was available for all 46 wells. Measured values ranged from 6.5 to 11.4. Seven wells showed a pH higher than 8.5. These wells are listed in Table 7. The highest values were found in LMMW3D and LMMW6D. Figure 10 shows the concentrations at each individual location and also the concentration contours.

<b>Well Name</b>	<b>pH</b>
West Sunset Playground	9.40
LMMW3D	11.40
LMMW6D	11.30
510 Eucalyptus	8.93
25 New Place Rd	8.92
1700 Floribunda	9.10
Oceanside	9.35

Table 7: *Wells with pH values above 8.5 in the Westside Basin.*

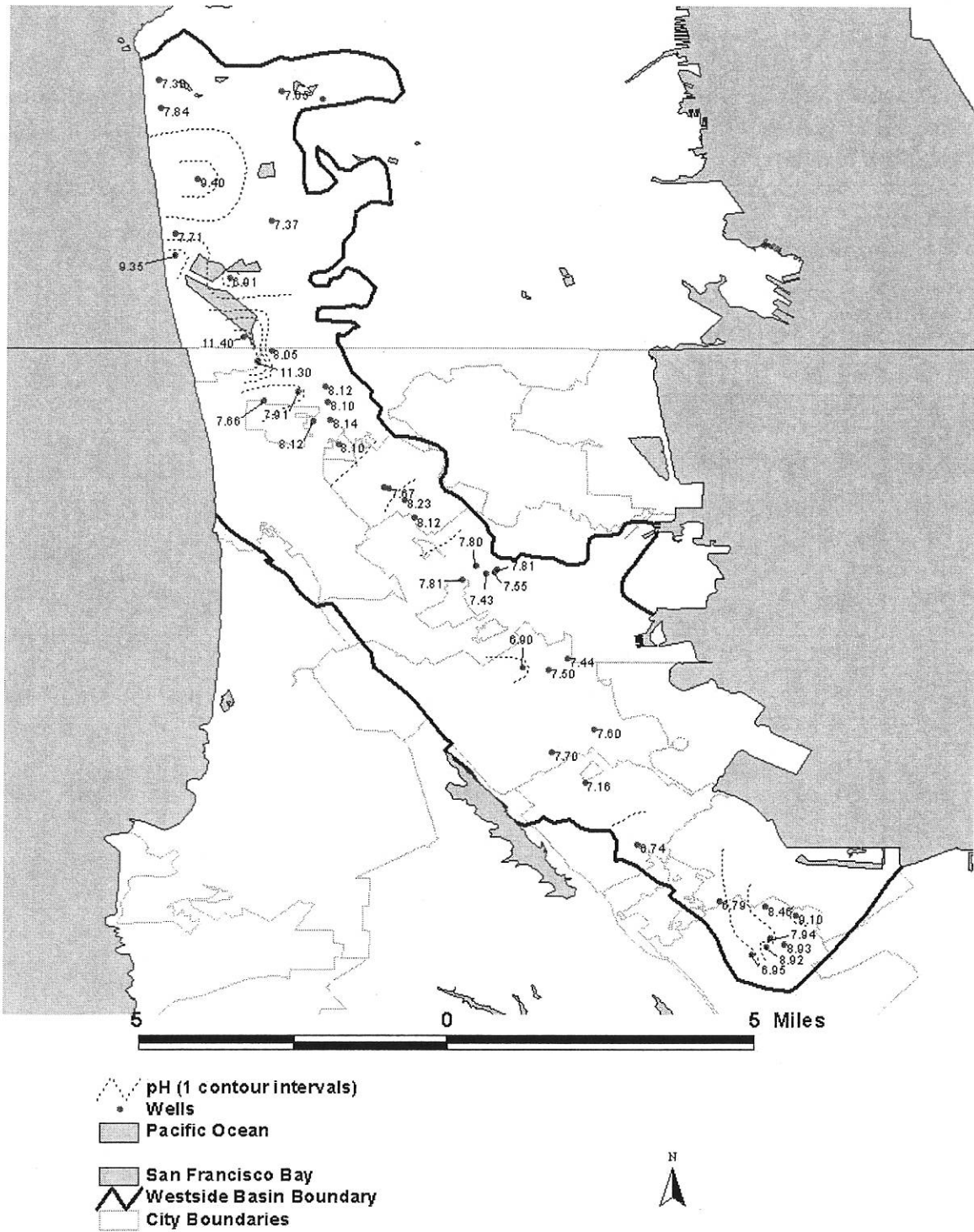


Figure 10a: pH values for analyzed wells in the Westside Basin.

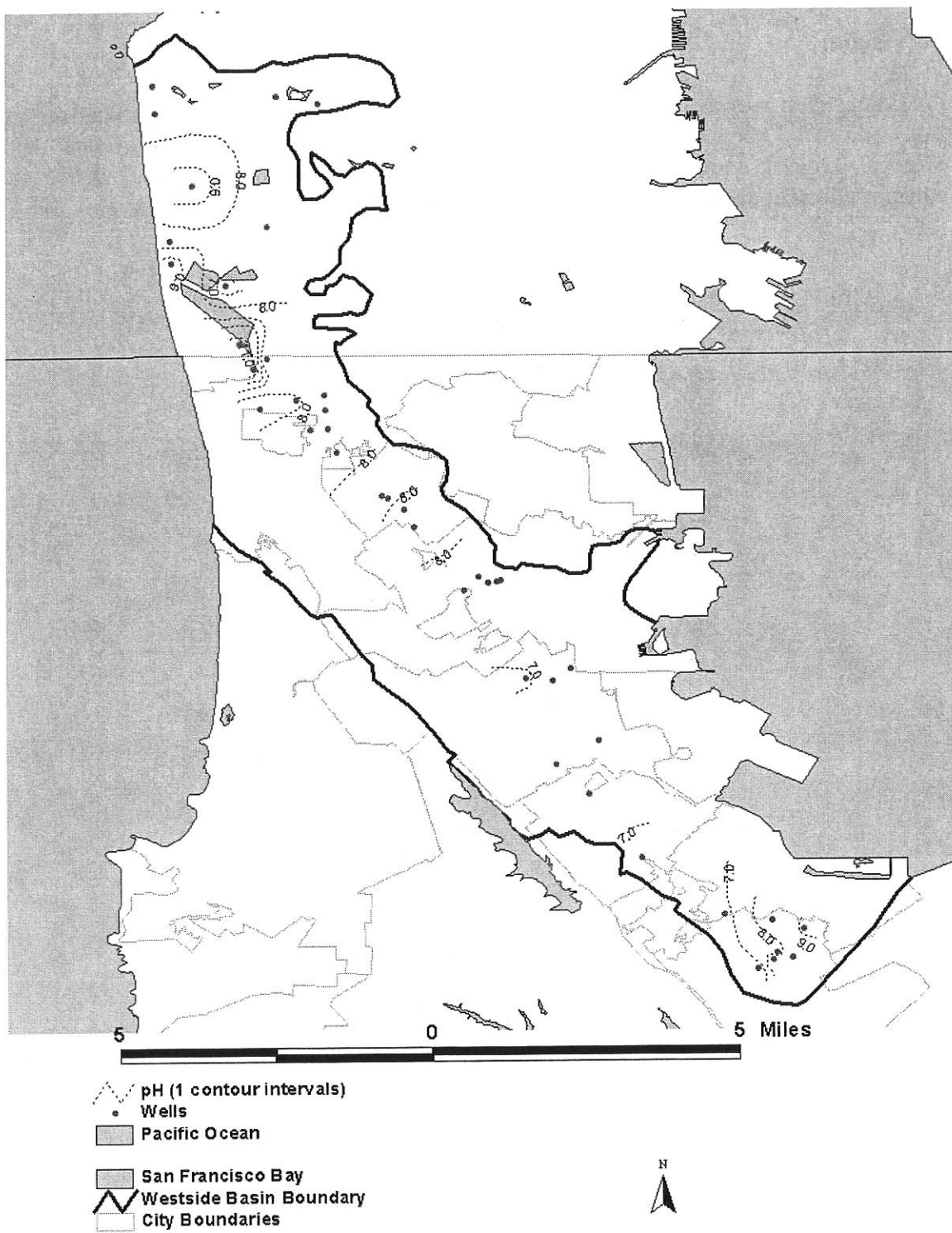


Figure 10b: *pH value contours based on analyzed samples from wells in the Westside Basin.*

**Potassium:**

Potassium data was available for 42 of the analyzed wells. The concentrations ranged from ND to 67.80 ppm. Highest concentrations were found in the wells around Lake Merced. Lowest concentrations were found in Hillsborough. Figure 11 shows the concentrations at each individual location and also the concentration contours.

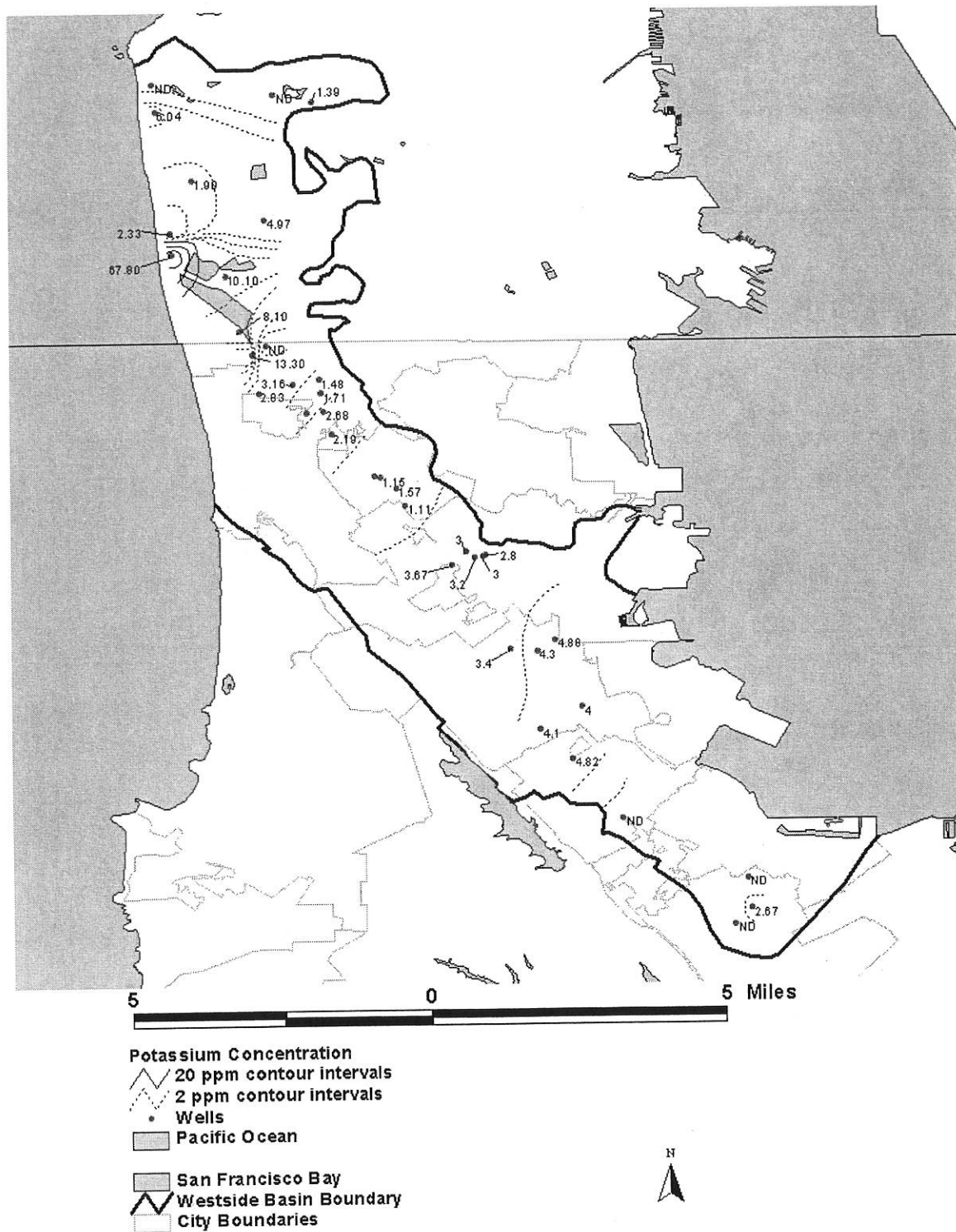


Figure 11a: Potassium concentrations for analyzed wells in the Westside Basin.

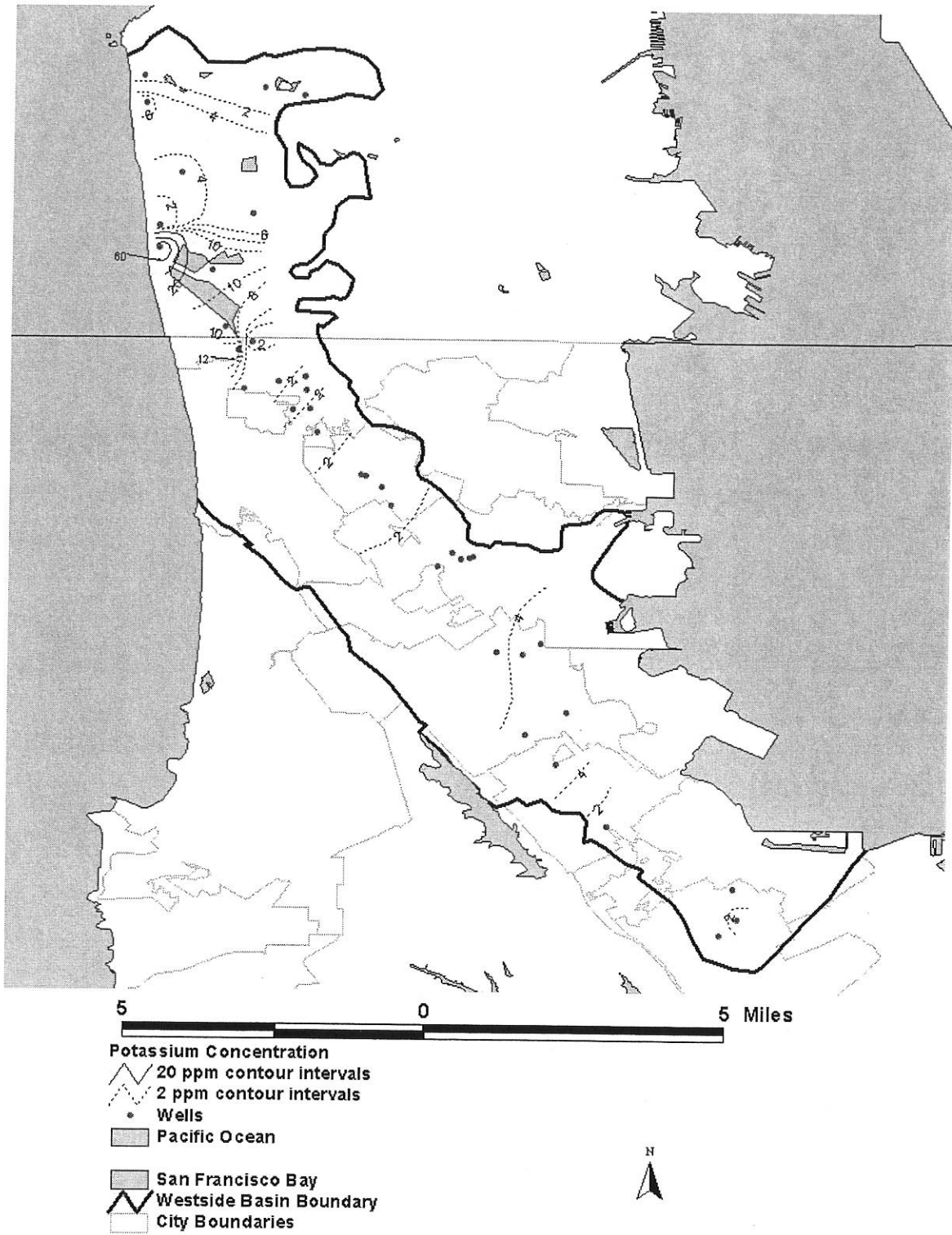


Figure 11b: Potassium concentration contours based on analyzed samples from wells in the Westside Basin.



**Sodium:**

Sodium data was available for all 46 wells. The concentrations ranged from 9.60 to 165 ppm. The highest concentrations were found in the USGS South Windmill D (165 ppm) and Oceanside (134 ppm) wells. Figure 12 shows the concentrations at each individual location and also the concentration contours.

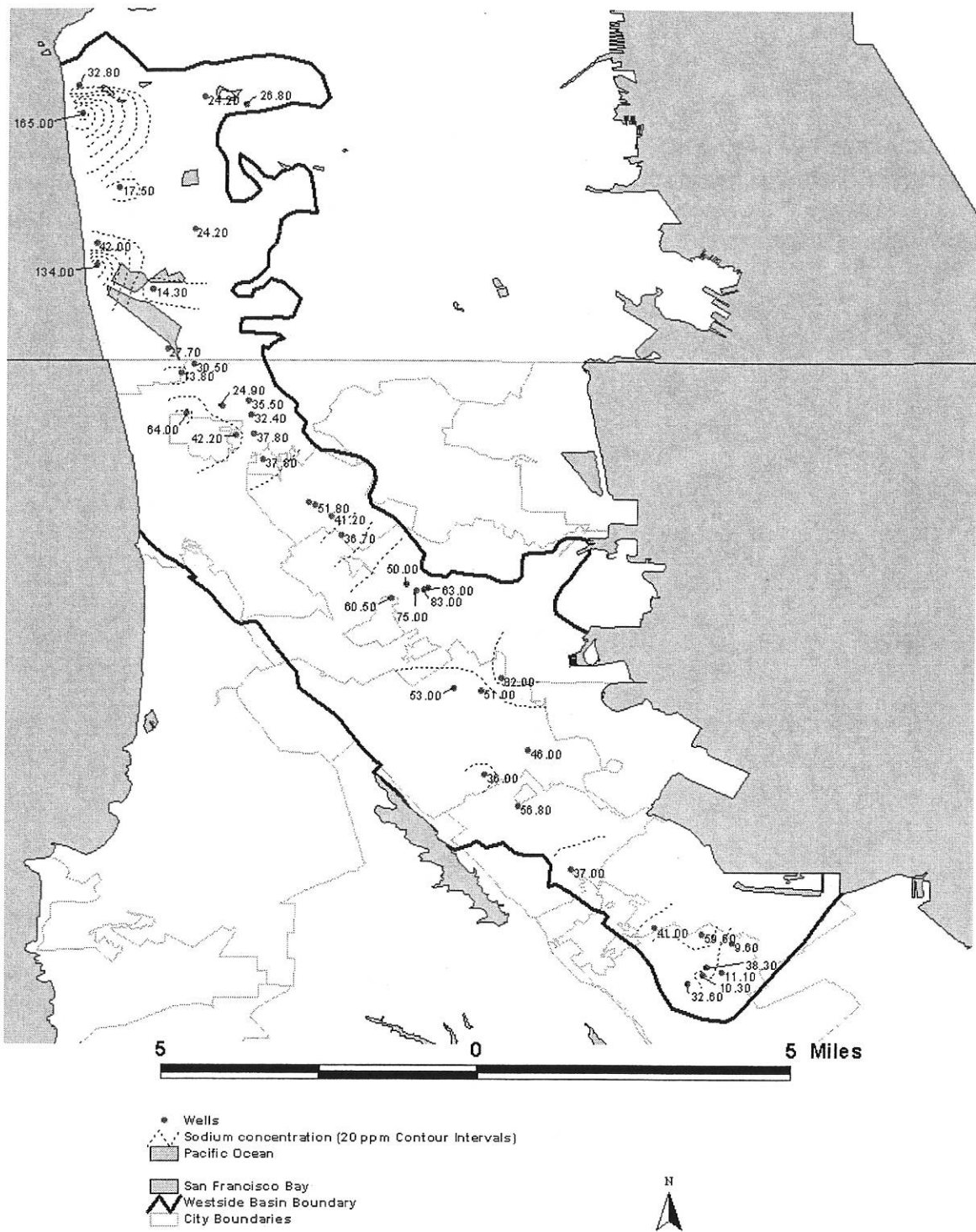


Figure 12a: Sodium concentrations for analyzed wells in the Westside Basin.

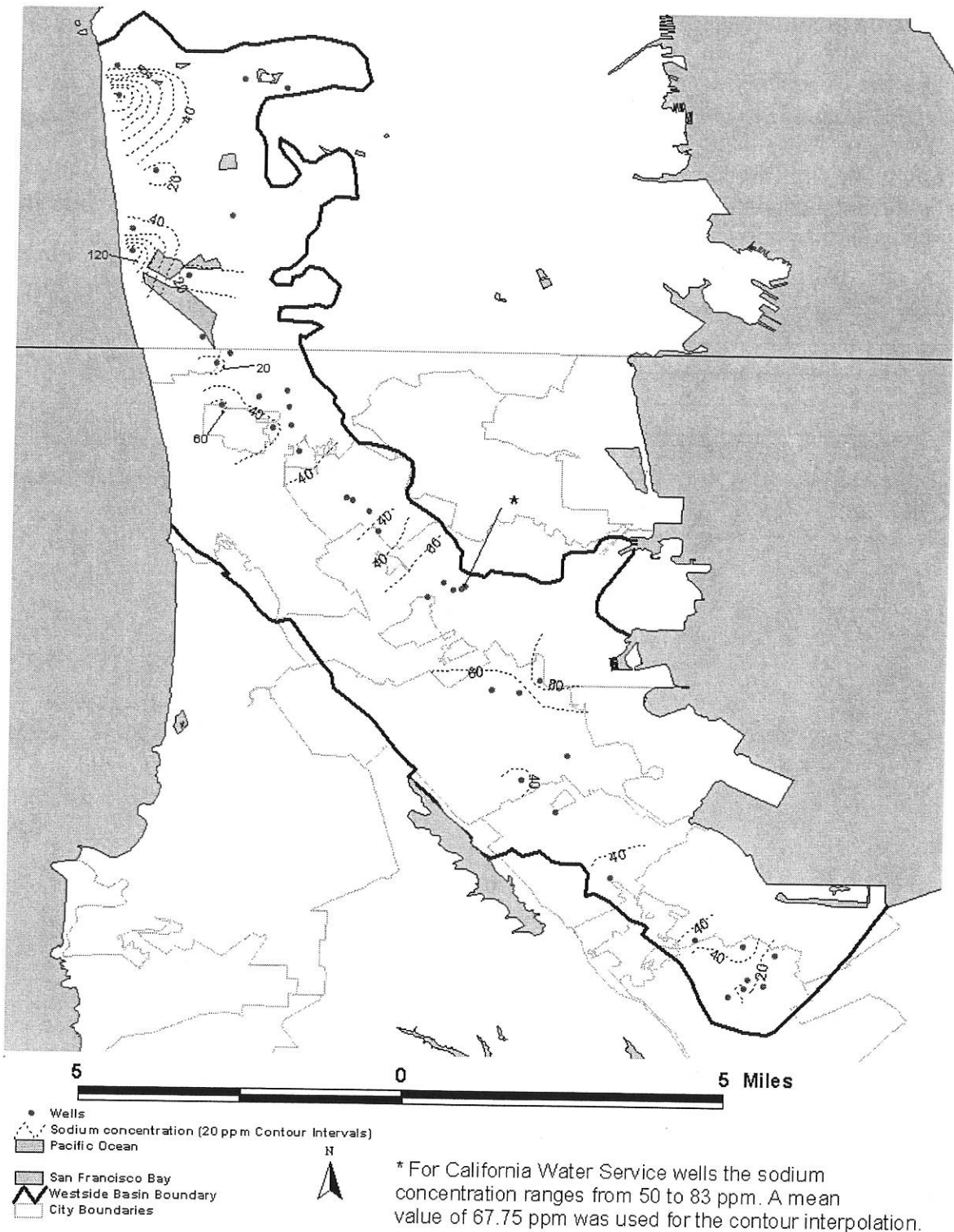


Figure 12b: Sodium concentration contours based on analyzed samples from wells in the Westside Basin.

### Specific Conductance:

Specific Conductance data was available for 45 of the analyzed wells. Measured values ranged from 83 to 1181 umhos/cm. Four wells had values above the secondary MCL of 900 ppm. These wells are listed in Table 8. Highest values were found in the USGS South Windmill well, in the Golden Gate Park and the California Water Service Wells in South San Francisco. Lowest values were found in Hillsborough. Figure 13 shows the values at each individual location and also the concentration contours.

Well Name	Specific Conductance (umhos/cm)
USGS South Mill D	1020
SS 1-14	1181
SS 1-15	1018
SS 1-19	929

Table 8: *Wells with specific conductance above secondary MCL in the Westside Basin. Value for USGS South Mill D may be of USGS South Mill M or USGS South Mill S.*

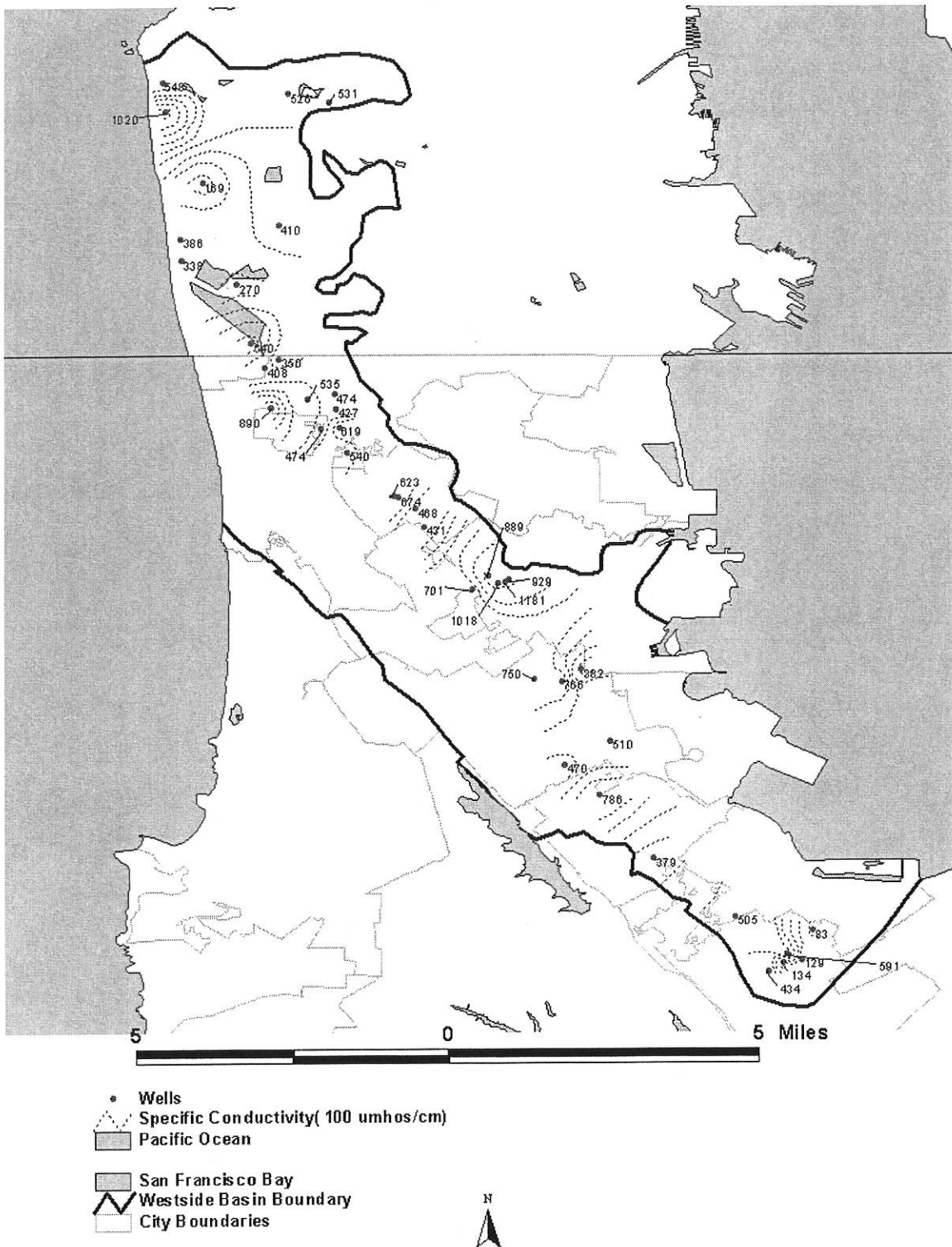


Figure 13a: Specific conductance values for analyzed wells in the Westside Basin.

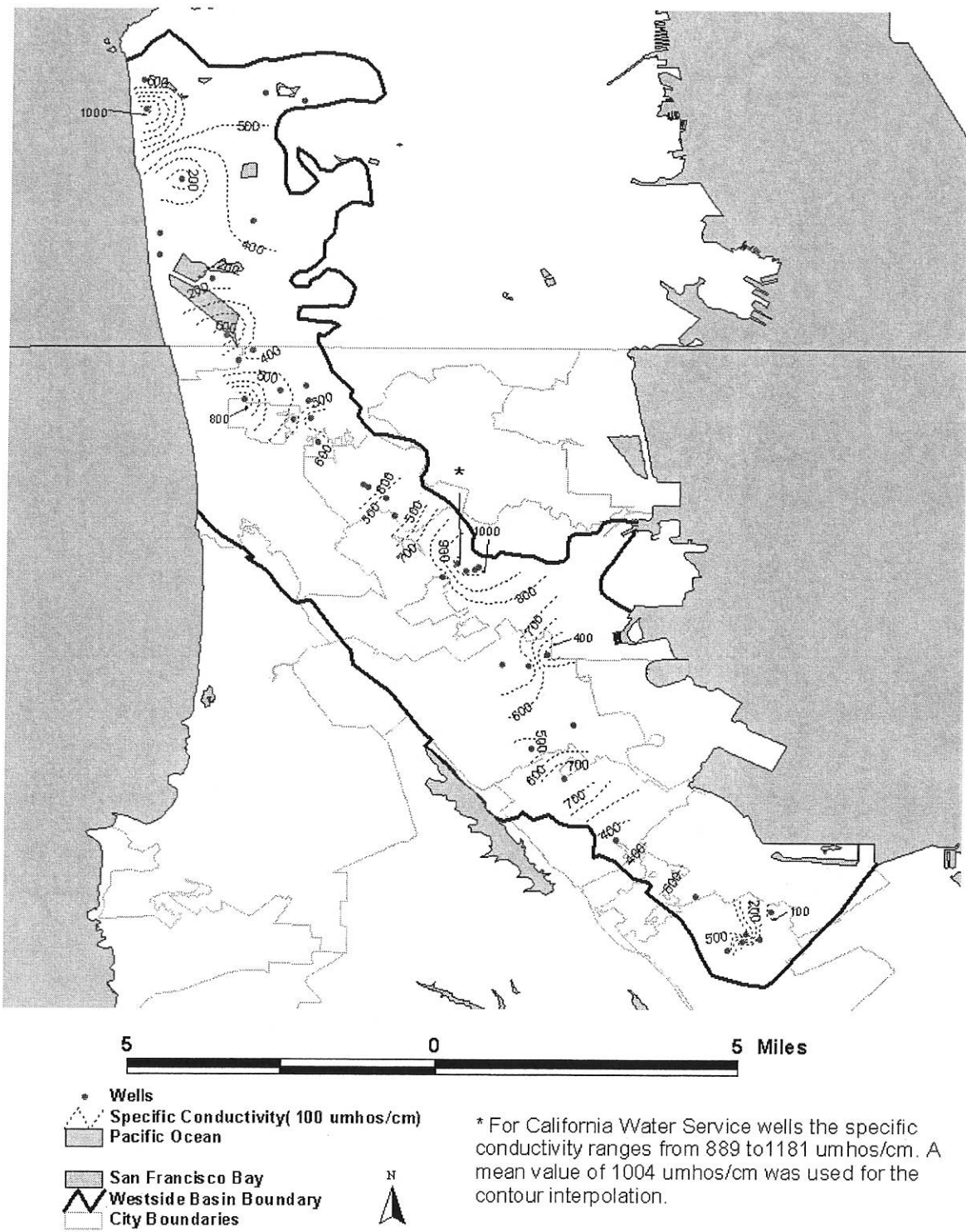


Figure 13b: *Specific conductance contours based on analyzed samples from wells in the Westside Basin.*



**Sulfate:**

Sulfate data was available for all 46 analyzed wells. Concentrations ranged from 0.79 to 98.90 ppm. All analyzed samples had concentrations under the secondary MCL of 250 ppm. Highest values were found in the Greenhills Country Club well, in Millbrae, in two of the California Water Service wells, in South San Francisco and in San Bruno Public works wells 15 and 16. Lowest concentrations were found in the wells around Lake Merced. Figure 14 shows the concentrations at each individual location and also the concentration contours.

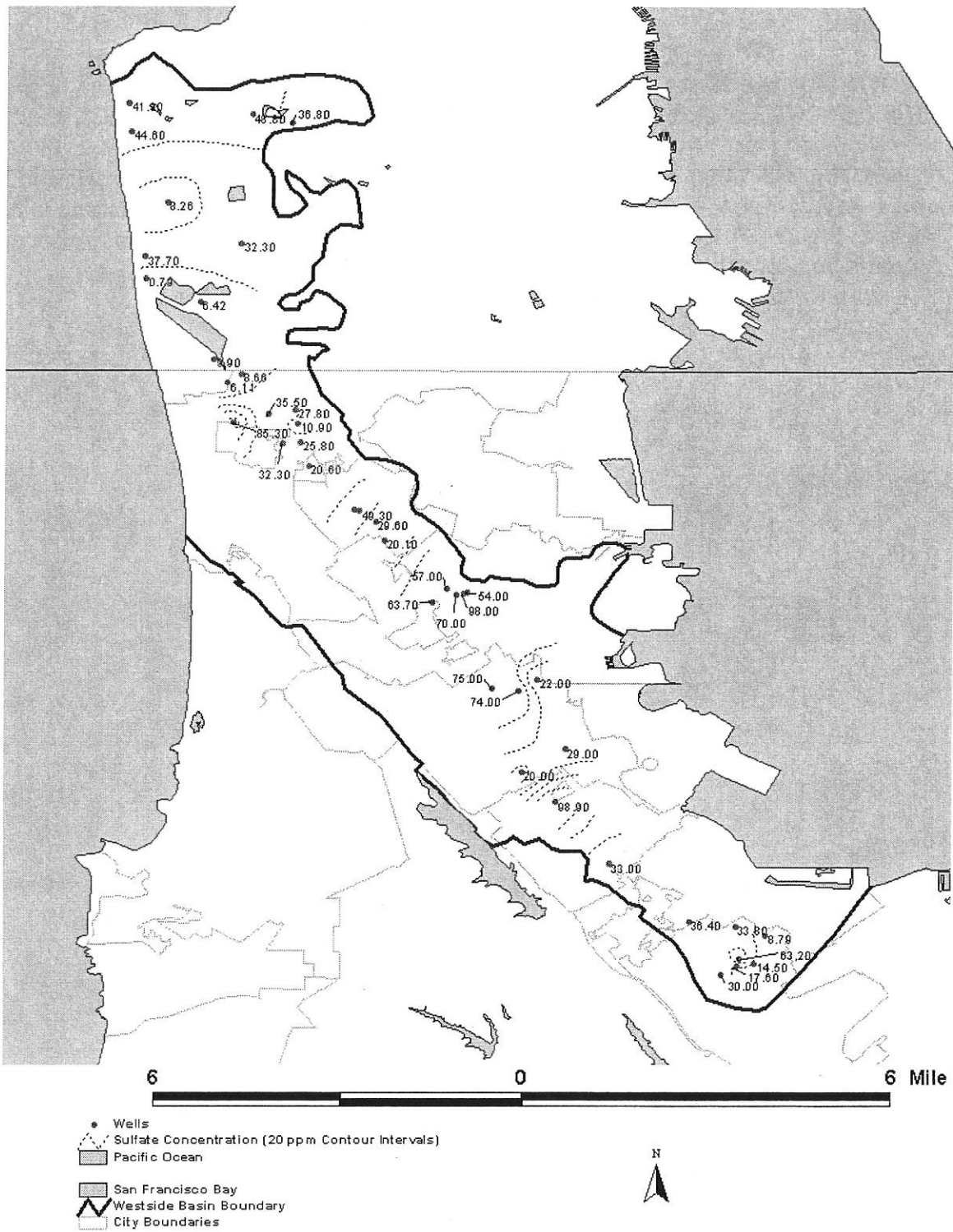


Figure 14a: Sulfate concentrations for analyzed wells in the Westside Basin.

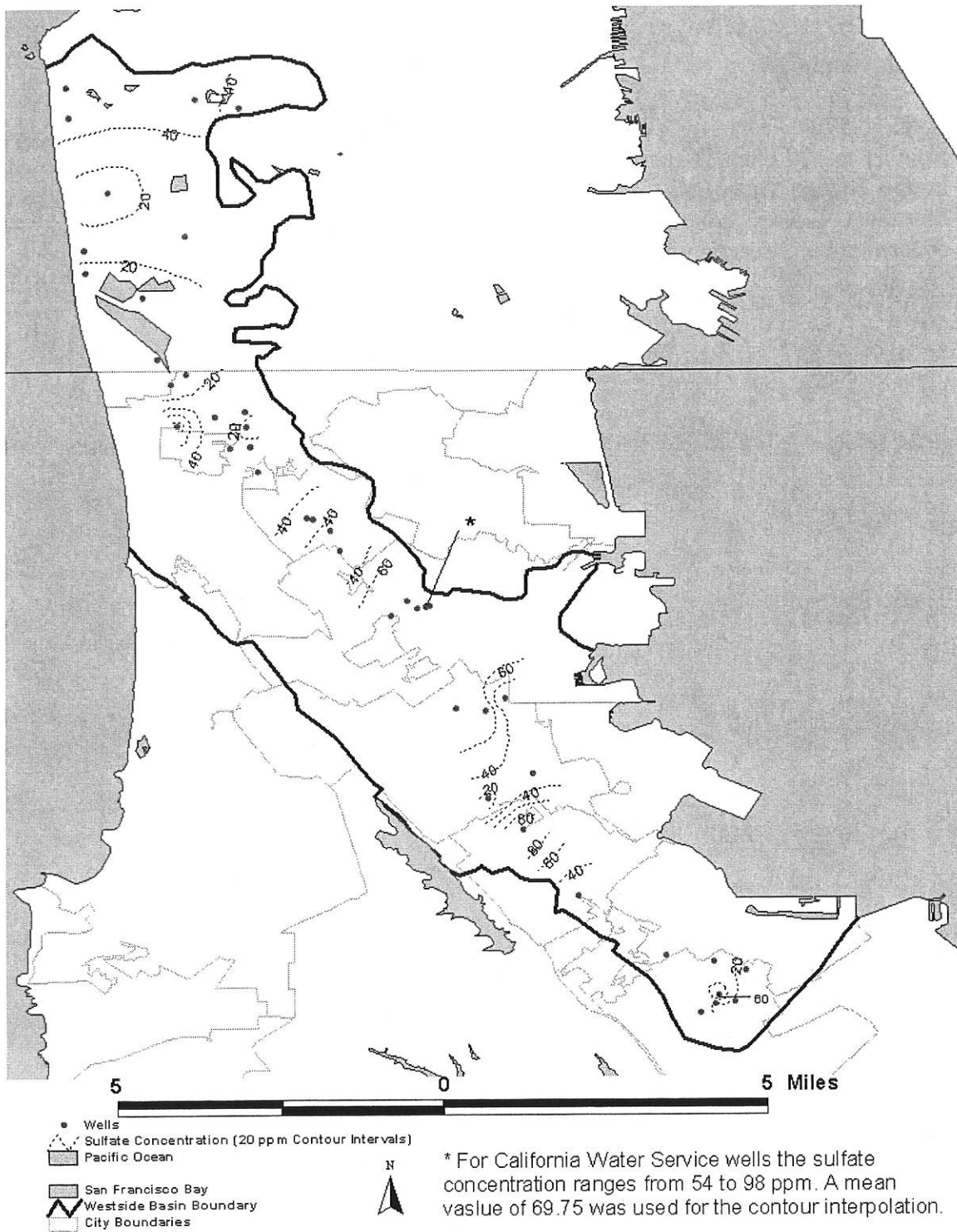


Figure 14b: Sulfate concentration contours based on analyzed samples from wells in the Westside Basin.

**Total Alkalinity:**

Total alkalinity data was available for 45 of the analyzed wells. Concentrations ranged from 31 to 439 ppm. Highest concentrations were found in USGS South Windmill well, in the Golden Gate Park, and in the California Water Service wells, in South San Francisco. Lowest concentrations were found in Hillsborough. Figure 15 shows the concentrations at each individual location and also the concentration contours.

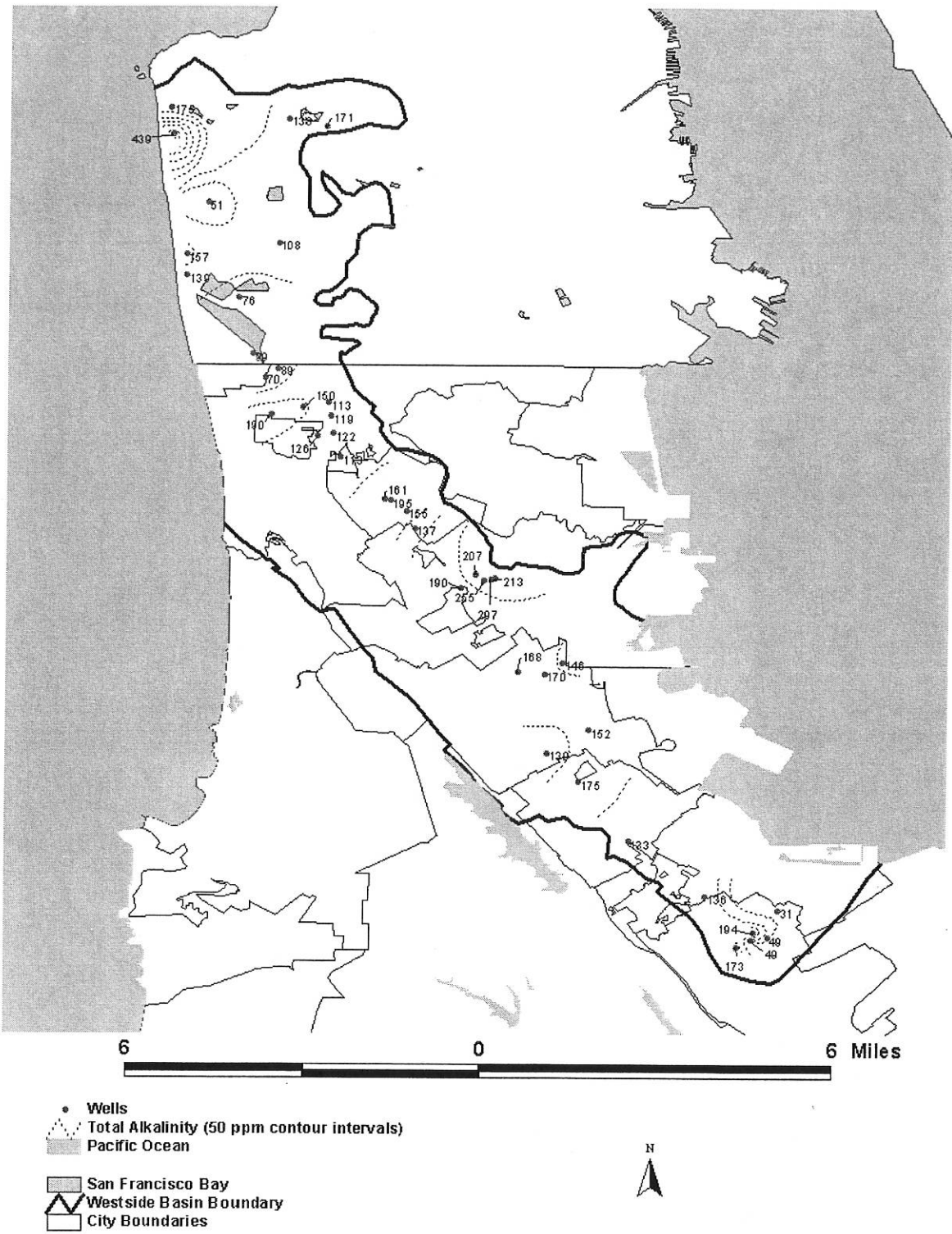


Figure 15a: Total alkalinity concentrations for analyzed wells in the Westside Basin.

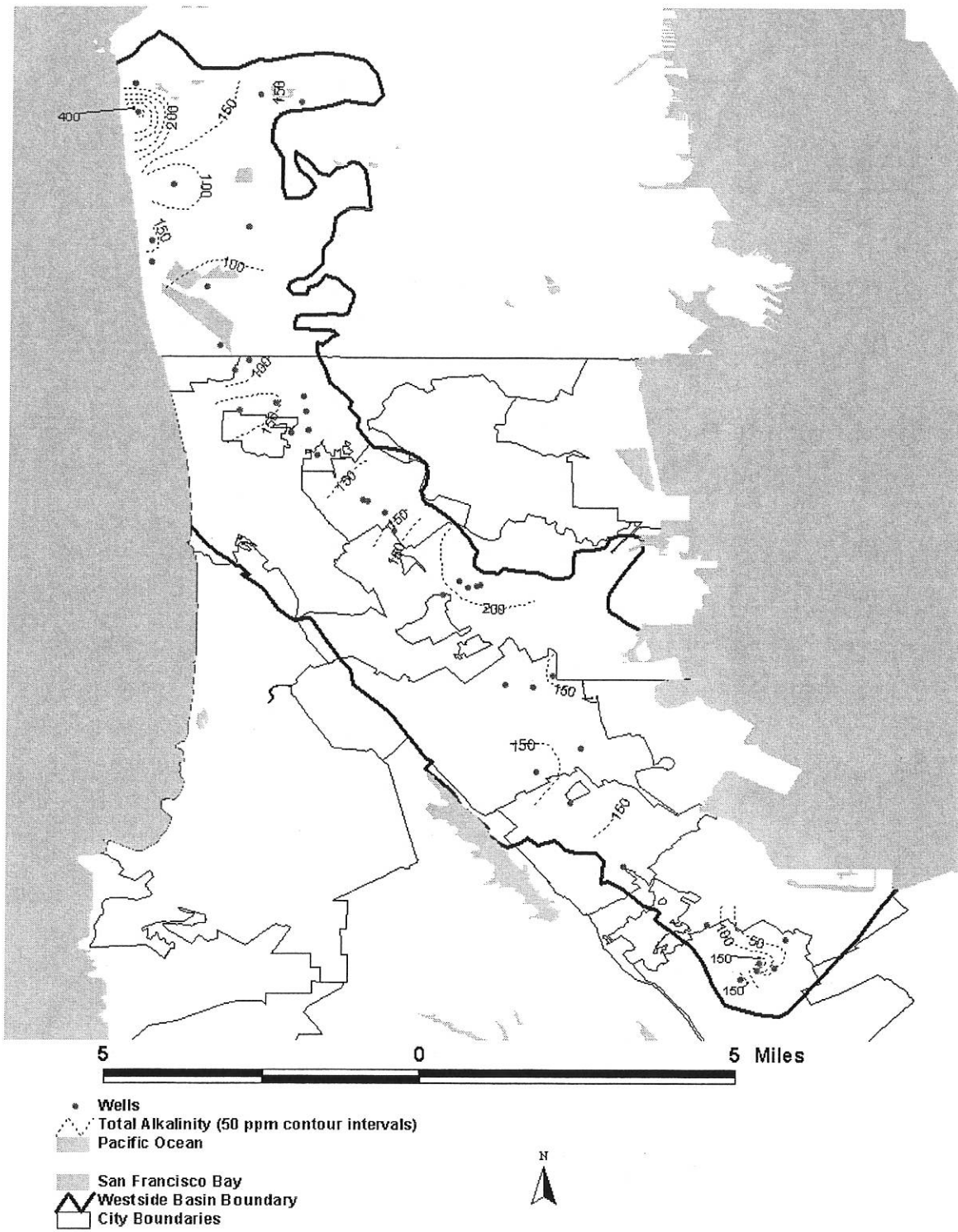


Figure 15b: Total alkalinity concentration contours based on analyzed samples from wells in the Westside Basin.



**Total Dissolved Solids (TDS):**

Total Dissolved Solids data was available for 44 of the analyzed wells. Concentrations ranged from 80 to 920 ppm. Eight wells showed concentrations above the secondary MCL of 500 ppm. These wells are shown in Table 9. Highest concentrations were found in USGS South Windmill well, in the Golden Gate Park, in the cemetery wells, in Colma, and in the California Water Service wells, in South San Francisco. Lowest concentrations were found in the West Sunset Playground and in the wells around Lake Merced. Figure 16 shows the concentrations at each individual location and also the concentration contours.

<b>Well Name</b>	<b>TDS (ppm)</b>
USGS South Mill D	920
Home of Peace	522
Hills of Eternity	530
SS 1-14	634
SS 1-15	572
SS 1-18	605
SS 1-19	531
1700 Floribunda	620

Table 9: *Wells with TDS above secondary MCL in the Westside Basin. Value for USGS South Mill D may be of USGS South Mill M or USGS South Mill S.*

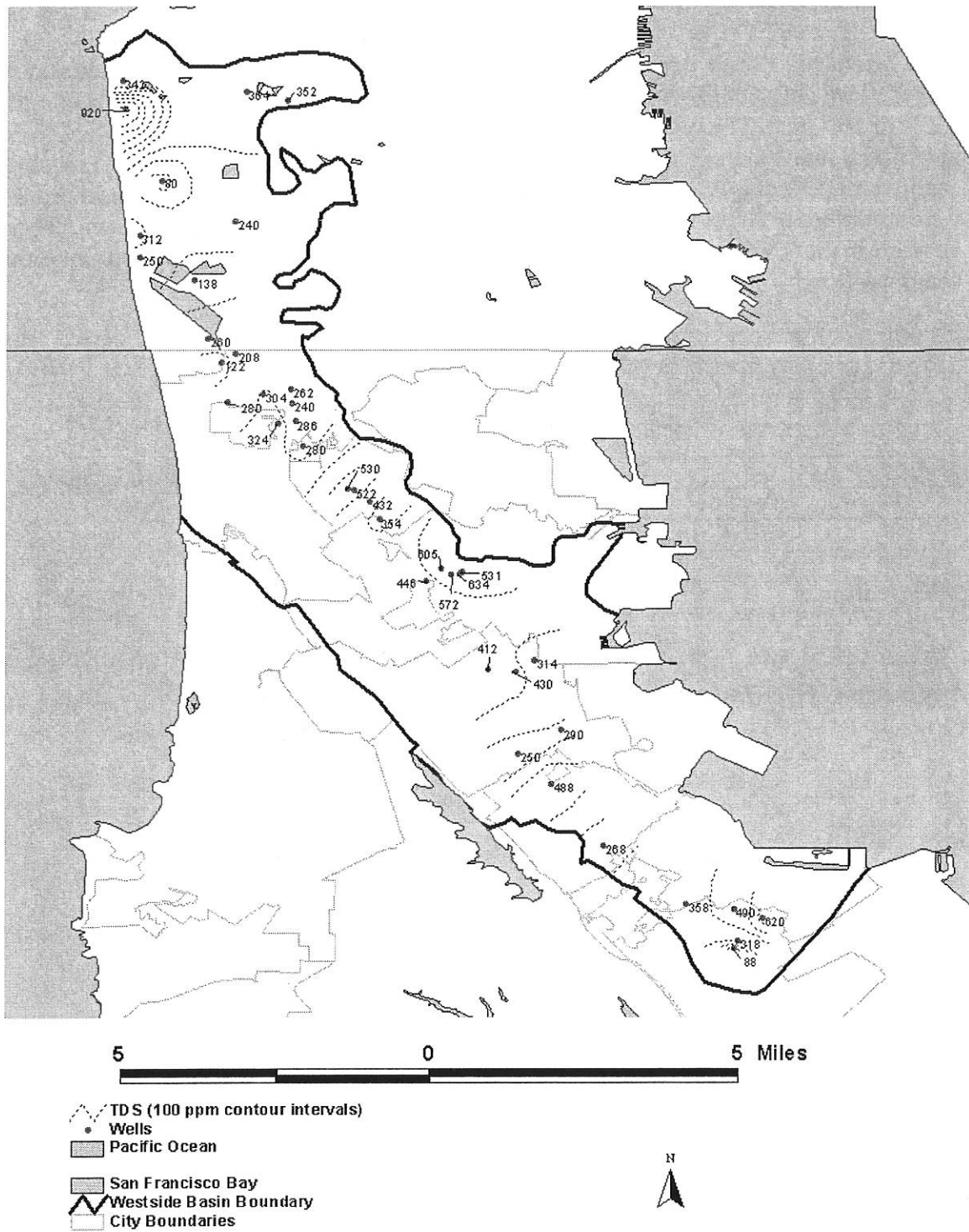


Figure 16a: TDS concentrations for analyzed wells in the Westside Basin.

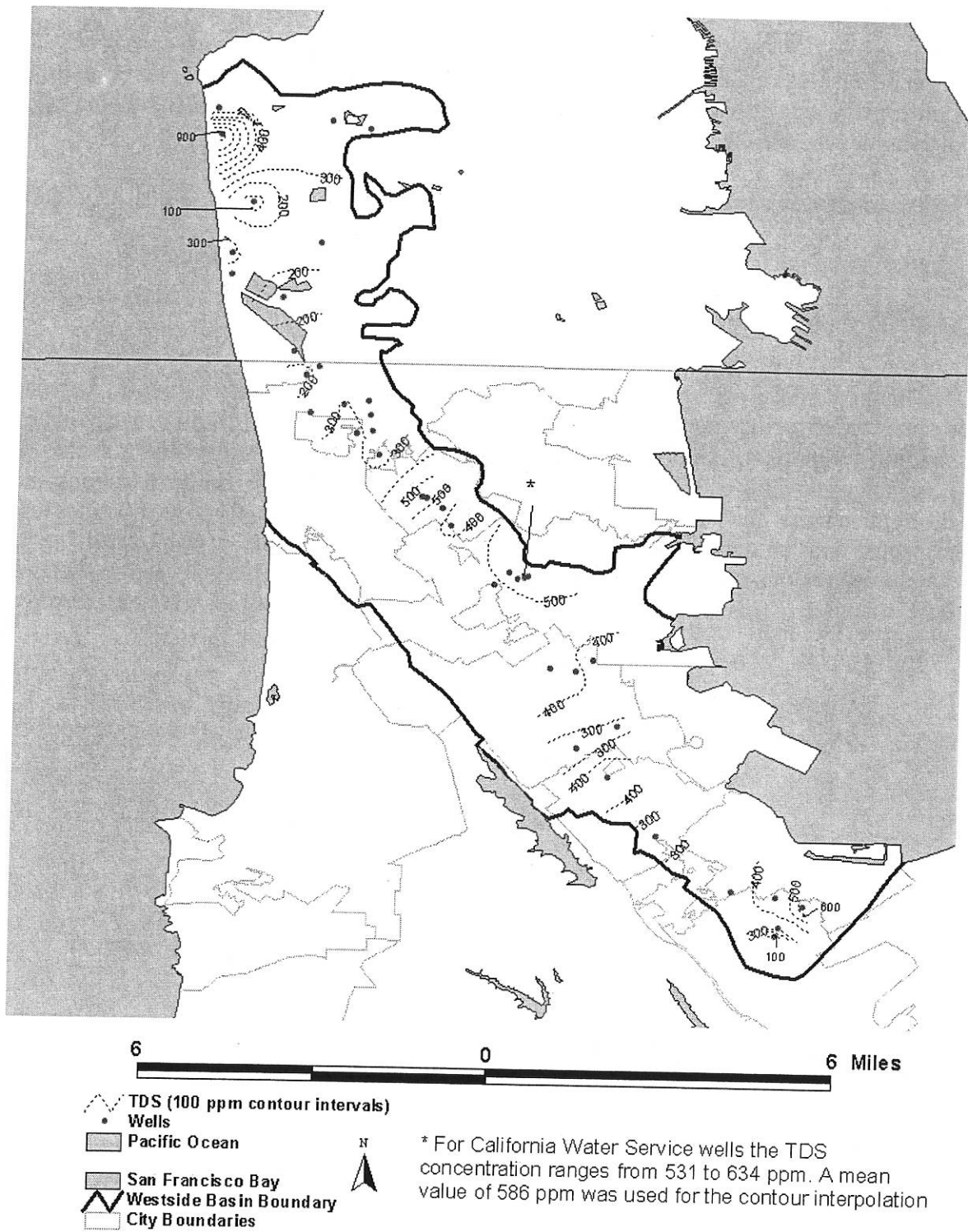


Figure 16b: TDS concentration contours based on analyzed samples from wells in the Westside Basin.



Figure 18 shows the piper diagram plots for 36 wells sampled in the Westside Basin. Table 10 shows the water quality type based on the major ions for these wells. Based on Fetter (1994), more than 50 % of these wells showed no dominant type. Almost 40% of these wells are bicarbonate waters and more than 10 % are sodium-potassium waters. In the Golden Gate Park 3 out of 4 wells were magnesium-bicarbonate waters. The wells with the sodium-potassium waters are located in the coastal area at the southern end of Lake Merced, at the southern end of the Fleishhacker Zoo and the southwestern end of the Golden Gate Park.

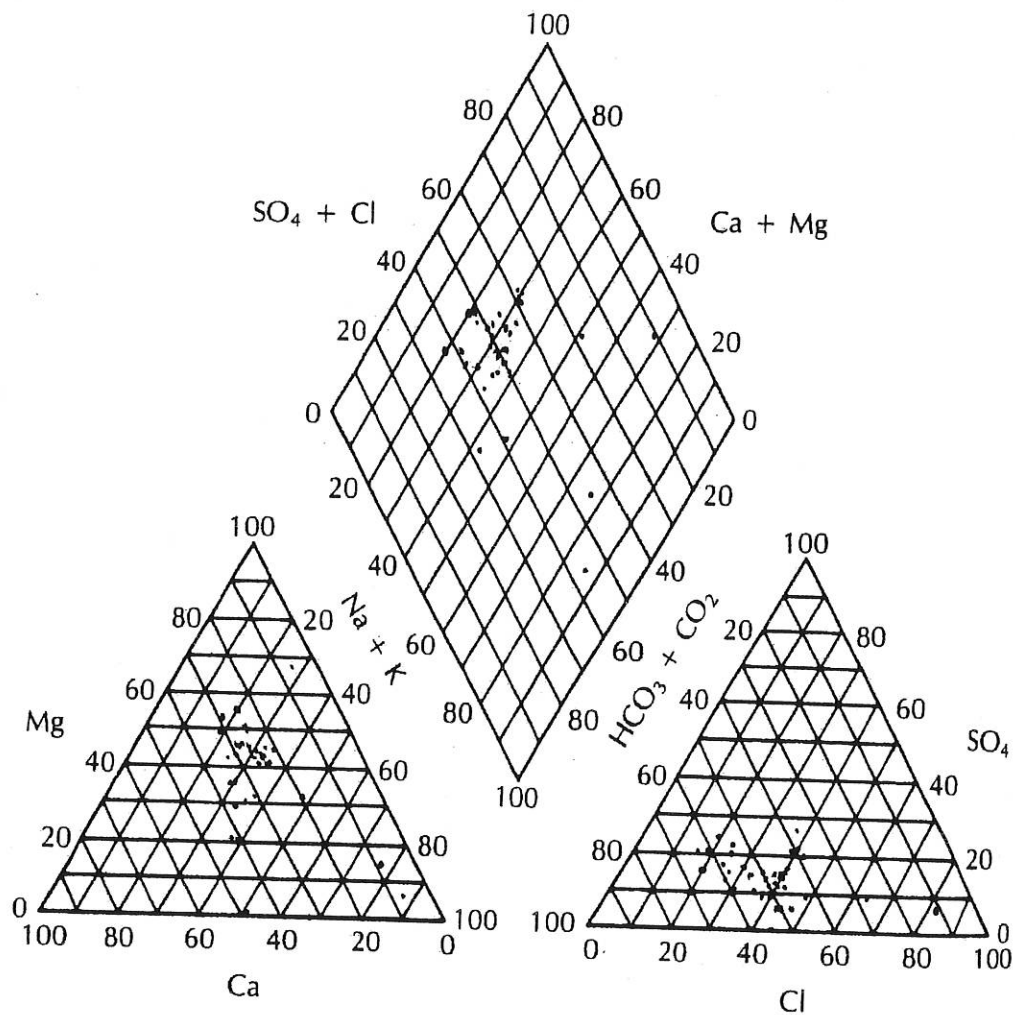


Figure 18: Piper diagram plot for 36 wells in the Westside Basin.

well	Ca	Mg	Na/K	Cl	HCO3	no dominant	type
Arboretum		X			X		magnesium-bicarbonate water
Elk Glenn		X			X		magnesium-bicarbonate water
USGS South Windmill			X				sodium-potassium water
NE Windmill		X			X		magnesium-bicarbonate water
West Sunset Playground					X		bicarbonate water
Edgewood School	X				X		calcium-bicarbonate water
LMMW3D			X	X			sodium-potassium-chloride water
LMMW2D						X	no dominant type
LMMW6D			X	X			sodium-potassium-chloride water
Zoo 4					X		bicarbonate water
Oceanside			X		X		sodium-potassium-bicarbonate water
San Francisco Golf Club 1						X	no dominant type
Westlake 1						X	no dominant type
Daly City 10						X	no dominant type
Jefferson					X		bicarbonate water
Lake Merced Country Club					X		bicarbonate water
Vale							no dominant type
Daly City 4							no dominant type
A St							no dominant type
Home of Peace						X	no dominant type
Hills of Eternity						X	no dominant type
Cypress Lawn Cemetery 2						X	no dominant type
Holy Cross Cemetery 1					X		bicarbonate water
California Golf Club 5						X	no dominant type
SS 1-14		X			X		magnesium-bicarbonate water
SS 1-15						X	no dominant type
SS 1-18					X		bicarbonate water
SS 1-19						X	no dominant type
Vince's Shellfish						X	no dominant type
San Bruno 15						X	no dominant type
San Bruno 16						X	no dominant type
San Bruno 17						X	no dominant type
San Bruno 18					X		bicarbonate water
Greenhills Country Club						X	no dominant type
Burlingame Country Club 3						X	no dominant type
25 New Place Rd					X		bicarbonate water

Table 10: Water quality type for 36 wells in the Westside Basin based on the hydrogeochemical classification by Fetter (1994). The values for USGS South Mill D may not be representative of that well but rather of USGS South Mill M or USGS South Mill S.

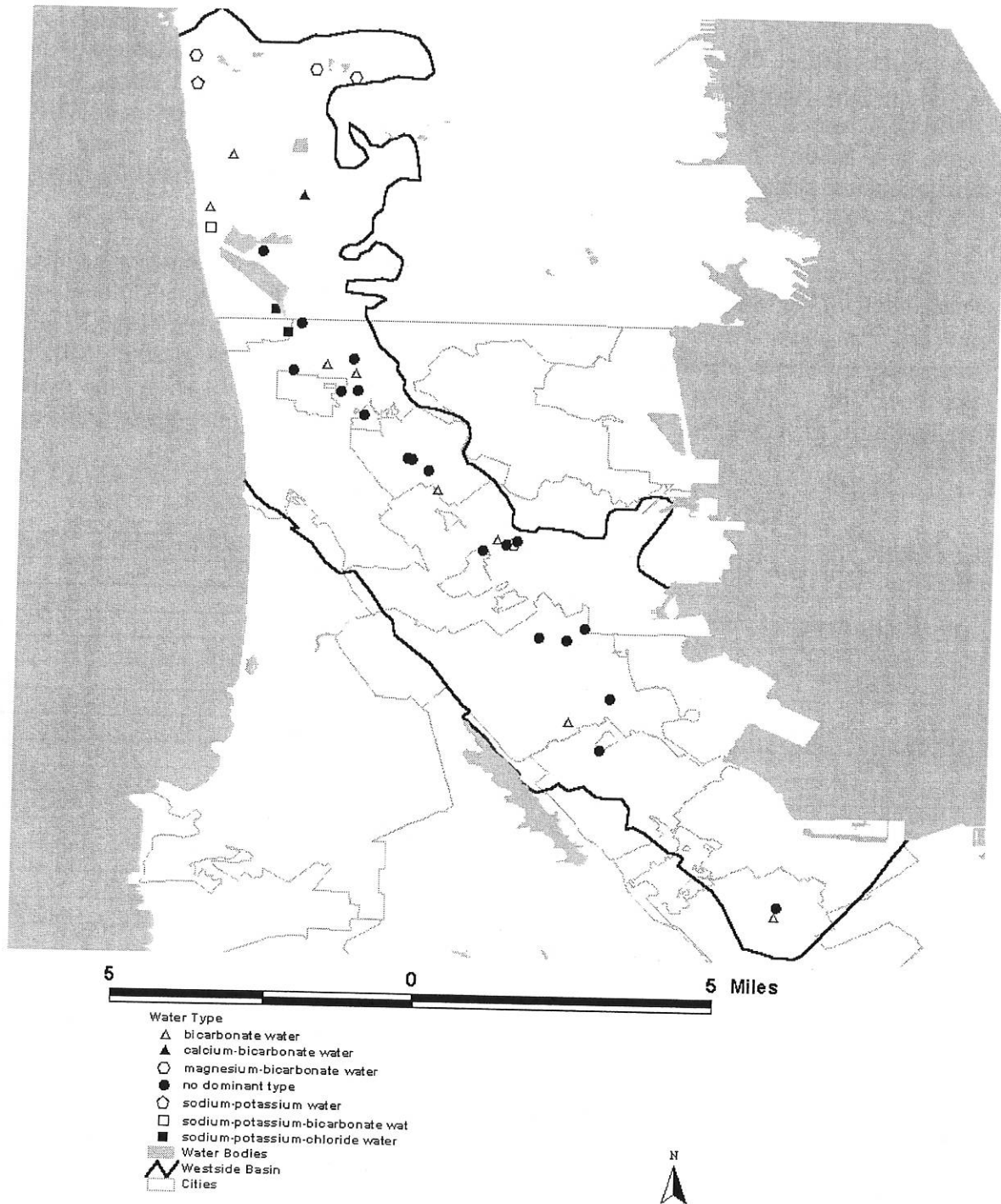


Figure 19: Location of the 36 wells used for the piper diagram and their determined hydrogeochemical classification for major ions, according to Fetter (1994).



**C) ORGANIC CHEMICAL CONSTITUENTS:**

The results of these constituents are shown in Appendix 1. The listed constituents are VOC's analyzed according to the EPA method 524.2. Daly City Water and Waste Water Department and San Bruno Public Works did not request the analysis for methylethyl ketone and methyl isobutyl ketone on submitted groundwater samples. These two constituents are part of the EPA method 524.2. California Water Service did not have the results for any of these inorganic constituents available.

Bromoform was found in the San Bruno 15 well. None of the other constituents were found in any of the municipal wells. Some irrigation wells in Hillsborough, Millbrae and San Francisco and one monitoring well in San Francisco had a hit for some of the VOCs. Concentrations above primary or secondary MCLs were found in USGS South Mill D (Benzene, Vinyl Chloride) and in the Arboretum 5 (MtBE). Table 13 shows the wells that had a hit for any of the VOCs and the concentration of the constituents found in them.

<b>WELL NAME</b>	<b>1,1-Dichloroethene</b>	<b>Benzene</b>	<b>Bromodichloromethane</b>	<b>Bromoform</b>
Arboretum 5	ND	ND	ND	ND
Elk Glenn	ND	ND	ND	ND
USGS South Mill D	1.44	27.6	ND	ND
Windmill NE	ND	ND	ND	ND
Edgewood School	ND	ND	ND	ND
SB 15	ND	ND	ND	0.87
Pessagno	ND	ND	ND	ND
510 Eucalyptus	ND	ND	5.77	ND
25 New Place Rd	ND	ND	6.29	ND
101 New Place Rd	ND	ND	5.66	1.38
1100 Jackling Dr	ND	ND	ND	ND
1700 Floribunda	ND	ND	5.13	ND

<b>WELL NAME</b>	<b>Chloroform</b>	<b>Dibromochloromethane</b>	<b>Ethylbenzene</b>	<b>Methyl ethyl ketone</b>
Arboretum 5	ND	ND	ND	ND
Elk Glenn	ND	ND	ND	ND
USGS South Mill D	ND	ND	1.95	ND
Windmill NE	0.516	ND	ND	ND
Edgewood School	0.54	ND	ND	744
SB 15	ND	ND	ND	ND
Pessagno	0.546	ND	ND	ND
510 Eucalyptus	74.7	ND	ND	ND
25 New Place Rd	78.6	ND	ND	ND
101 New Place Rd	40.6	1.07	ND	ND
1100 Jackling Dr	0.695	ND	ND	ND
1700 Floribunda	62.9	ND	ND	ND

WELL NAME	MtBE	Naphthalene	o-Xylene	Tetrachloroethene
Arboretum 5	290	ND	ND	7.53
Elk Glenn	ND	ND	ND	1.34
USGS South Mill D	ND	3.07	3.58	ND
Windmill NE	ND	ND	ND	ND
Edgewood School	ND	ND	ND	0.976
SB 15	ND	ND	ND	ND
Pessagno	ND	ND	ND	ND
510 Eucalyptus	ND	ND	ND	ND
25 New Place Rd	ND	ND	ND	ND
101 New Place Rd	ND	ND	ND	ND
1100 Jackling Dr	ND	ND	ND	ND
1700 Floribunda	ND	ND	ND	ND

WELL NAME	Toluene	Total Trihalomethanes	Total Xylenes	Vinyl chloride
Arboretum 5	ND	ND	ND	ND
Elk Glenn	ND	ND	ND	ND
USGS South Mill D	0.937	ND	3.86	0.797
Windmill NE	ND	0.516	ND	ND
Edgewood School	ND	0.54	ND	ND
SB 15	ND	ND	ND	ND
Pessagno	ND	0.546	ND	ND
510 Eucalyptus	ND	80.5	ND	ND
25 New Place Rd	ND	84.9	ND	ND
101 New Place Rd	ND	48.7	ND	ND
1100 Jackling Dr	ND	0.695	ND	ND
1700 Floribunda	ND	68	ND	ND

ND not detected

all values in ppb; bold values are above MCL

Table 13: *List of wells with VOCs in the water and their concentrations. All concentrations are in ppb. Value for USGS South Mill D may be of USGS South Mill M or USGS South Mill S.*

### ***Future Monitoring:***

The Partners have agreed to collect groundwater quality data on a regular basis for both municipal and non-municipal wells in the basin. Plotting of the collected data can assist in monitoring changes in water quality throughout the basin. A semiannual, basin-wide, water-sampling program should be implemented and all the performed analyses should follow the same standards with the same or similar method detection limits or practical quantitation limits.

At a minimum, groundwater should be analyzed for those constituents mentioned in the *Westside Basin Proposed Groundwater Management Plan* (Bookman-Edmonston & Hydrofocus, 1999). Both boron and bromide are constituents that the Management Plan recommends be analyzed. However, no data is collected currently for bromide by any of the Partners. Daly City Water and Waste Water Department is the only member of the Partners to collect boron data.

***Reference:***

*Fetter (1994): Applied Hydrogeology; Third Edition*