

|        |     |     |      |
|--------|-----|-----|------|
| Map    | 9.2 | 9.3 | 9.4  |
| Legend | 9.5 | 9.6 | 9.7  |
|        | 9.8 | 9.9 | 9.10 |

**WATER SYSTEM DISTRIBUTION MAP**  
**FIG. 9.6**

SCALE 1"=50'  
CIVIL ENGINEERING

Field control provided by D.L. Collins and Associates, Inc. of Pasadena, CA  
 All elevations are in feet above mean sea level  
 All photographs obtained from 1968 photography  
 and corrected by the 1970 mapping

DESIGNED BY: HYDROLOGIC ENGINEERING  
 FROM PHOTOGRAPHS OBTAINED JULY 7, 1968



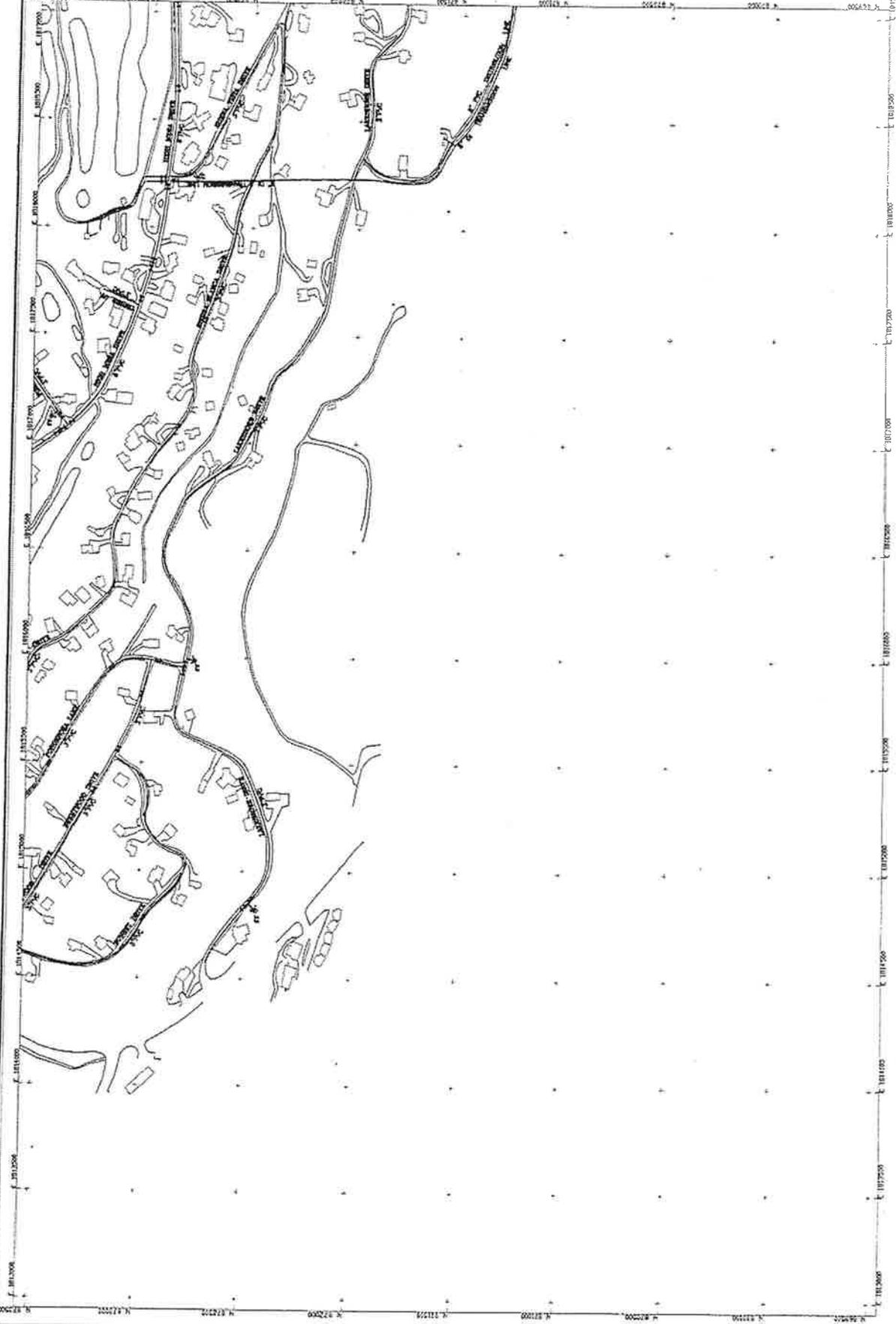




# WATER SYSTEM DISTRIBUTION MAP

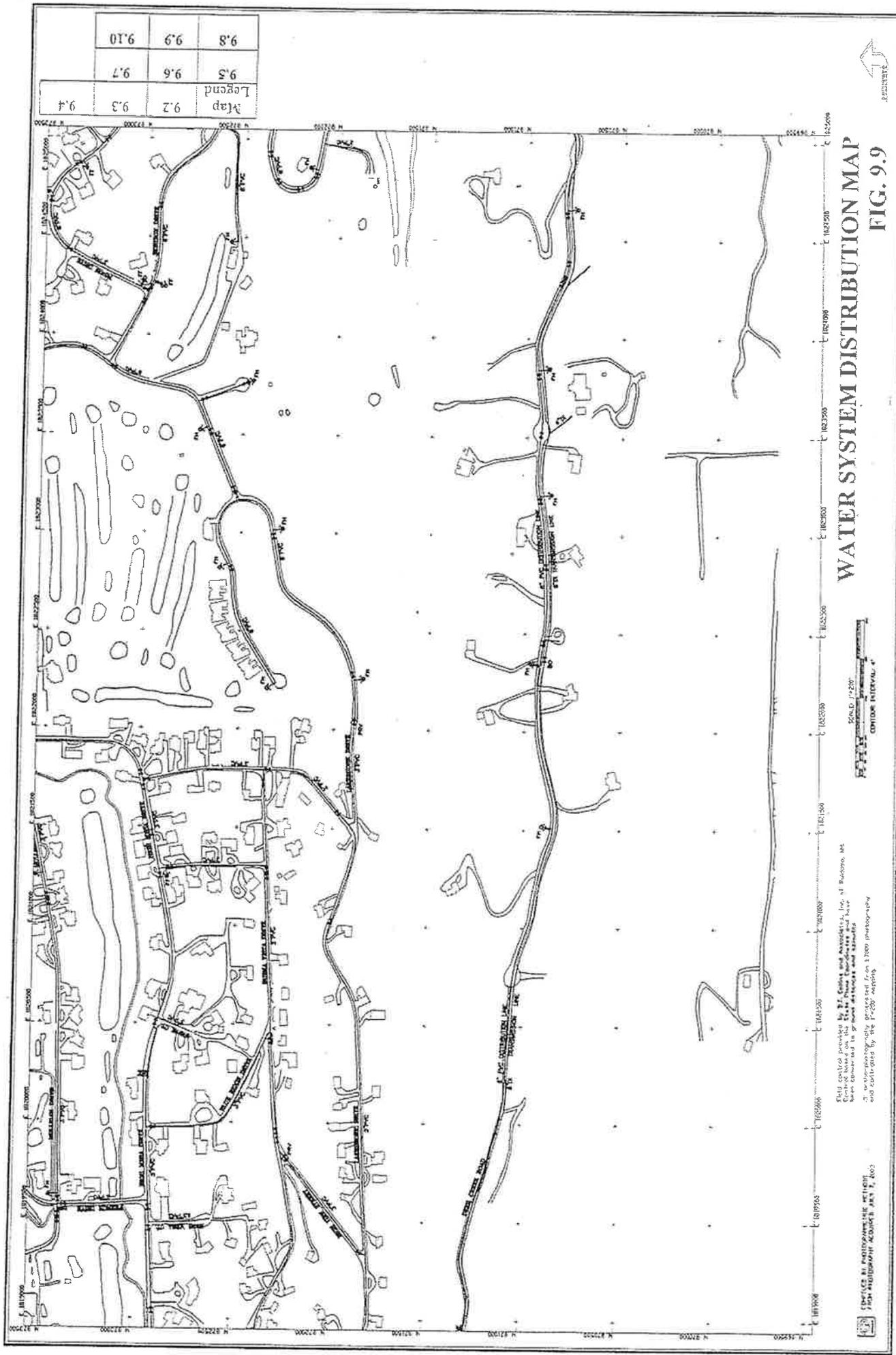
## FIG. 9.8

|        |     |     |      |
|--------|-----|-----|------|
| Map    | 9.2 | 9.3 | 9.4  |
| Legend | 9.5 | 9.6 | 9.7  |
|        | 9.8 | 9.9 | 9.10 |



Field control provided by Mr. Collins and Associates, Inc. of Adams, MA  
 Contour lines on the plan have been derived and have  
 been converted to ground surface and structure.  
 Aerial photography generated from 1968 photography  
 and contributed by the U.S. Army.

DESIGNED BY: PROFESSIONAL ENGINEER  
 JOHN W. HARRINGTON, P.E.  
 1000 WASHINGTON AVENUE, SUITE 100  
 WASHINGTON, D.C. 20004



|        |     |     |      |
|--------|-----|-----|------|
| Map    | 9.2 | 9.3 | 9.4  |
| Legend | 9.5 | 9.6 | 9.7  |
|        | 9.8 | 9.9 | 9.10 |

# WATER SYSTEM DISTRIBUTION MAP

## FIG. 9.9

Scale 1" = 200'  
Contour Interval 4'

Field sketches prepared by R. E. Smith and Associates, Inc., of Buffalo, N.Y.  
Control based on the State Plane Coordinate and State Plane  
have been converted to ground distances and bearings.  
2. water supply system prepared from 1:2000 photography  
and corrected by the F-200 system.

THIS MAP IS HEREBY MADE PUBLIC BY THE  
STATE ENGINEER OF CALIFORNIA, JAN. 17, 1965

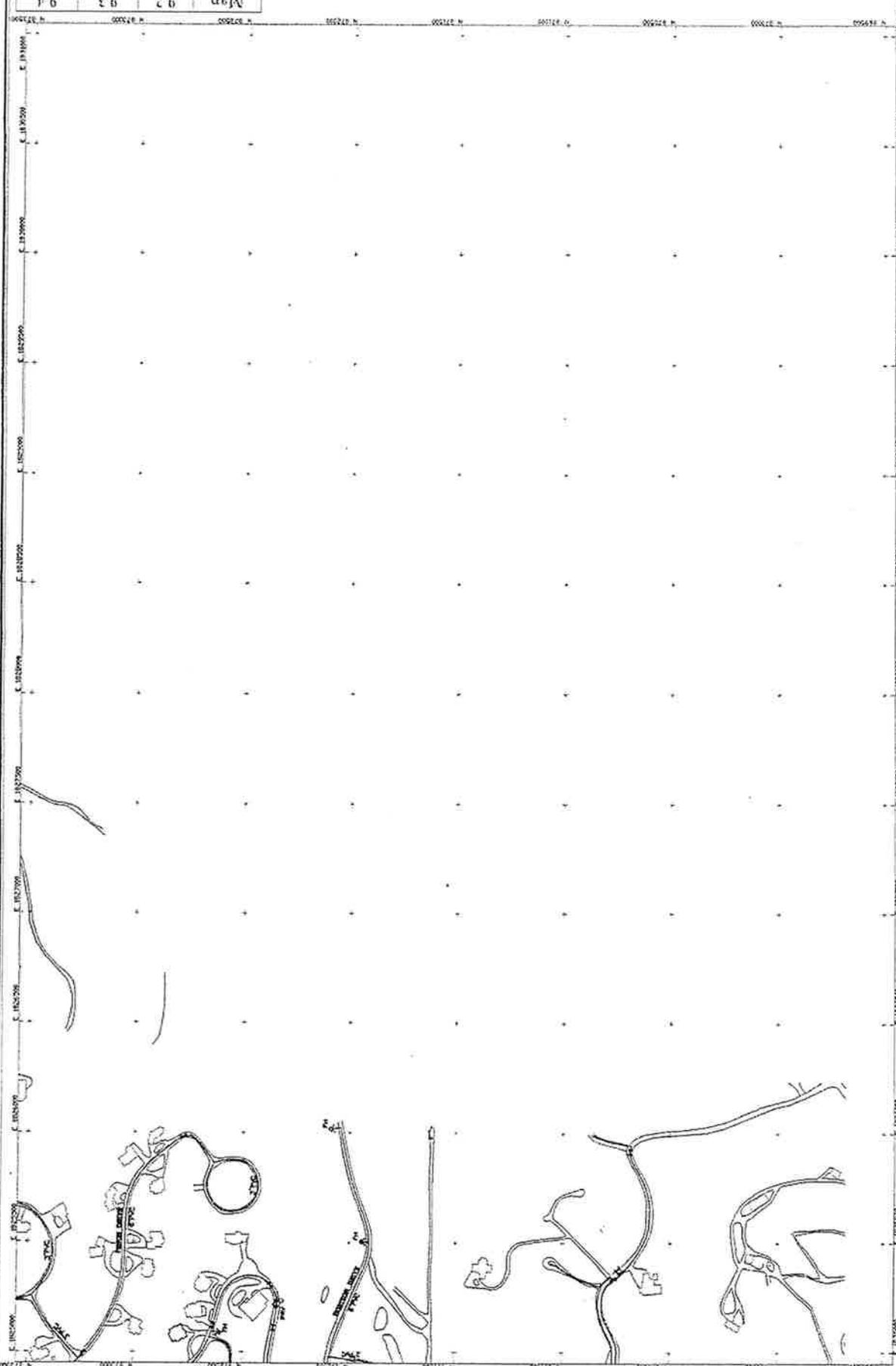


Professional Engineer Seal



# WATER SYSTEM DISTRIBUTION MAP

## FIG. 9.10



|        |     |     |      |
|--------|-----|-----|------|
| Map    | 9.2 | 9.3 | 9.4  |
|        | 9.5 | 9.6 | 9.7  |
| Legend | 9.8 | 9.9 | 9.10 |

SCALE: 1"=200'  
 1" = 200'  
 GRAPHIC INTERVAL: 4"

Field notes provided by St. Johns and Associates, Inc. of Madison, Wis.  
 Contour interval: 2.5 feet (topographic map)  
 All elevations are in feet above sea level.  
 and controlled by the 1:2500' contour.

DESIGNED BY: [Name]  
 FROM PHOTOGRAPHY: [Name]

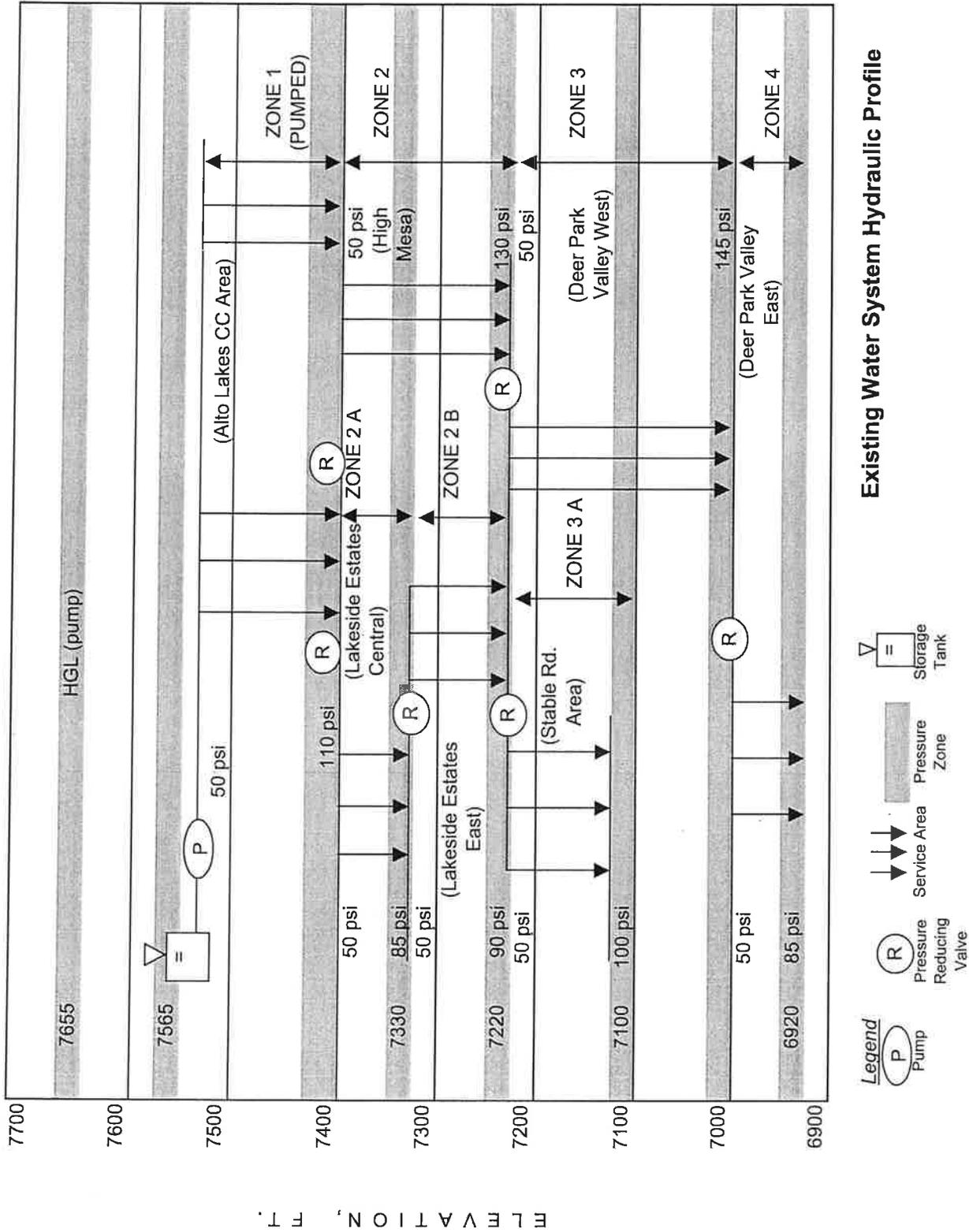
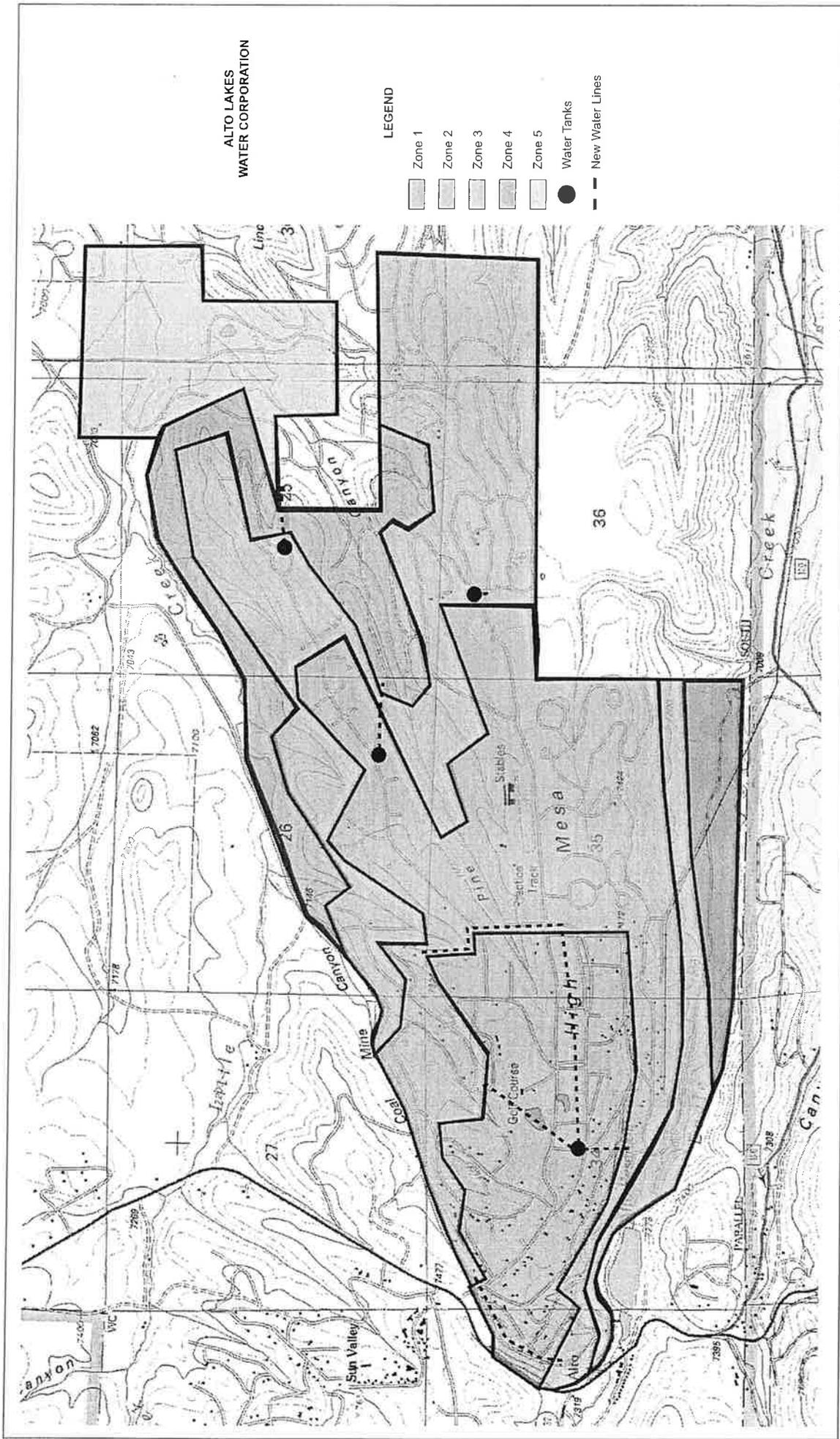


FIGURE 9.11



LIVINGSTON ASSOCIATES, P.C.

Figure 9.12: MODIFIED WATER SYSTEM PRESSURE ZONES

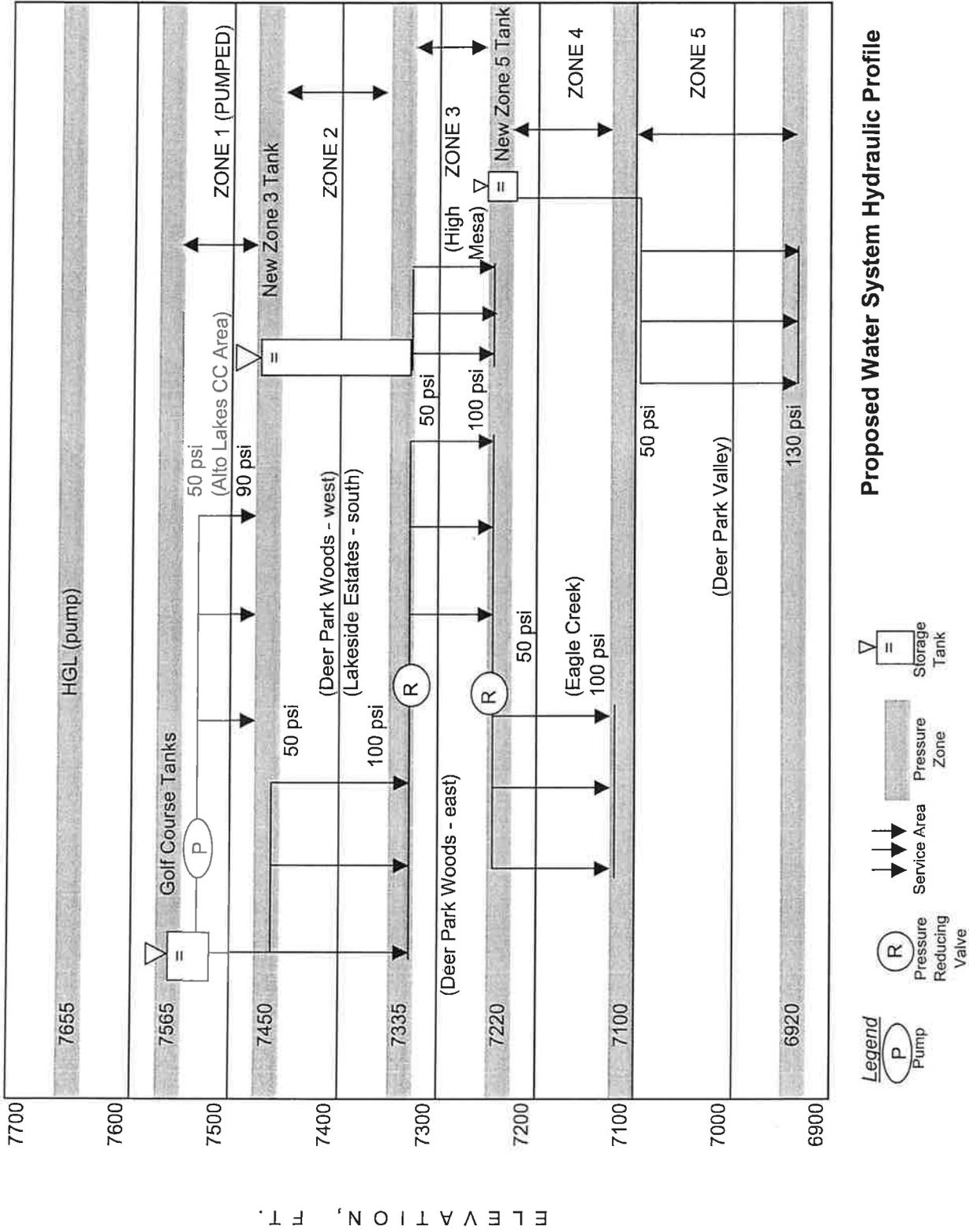


FIGURE 9.13

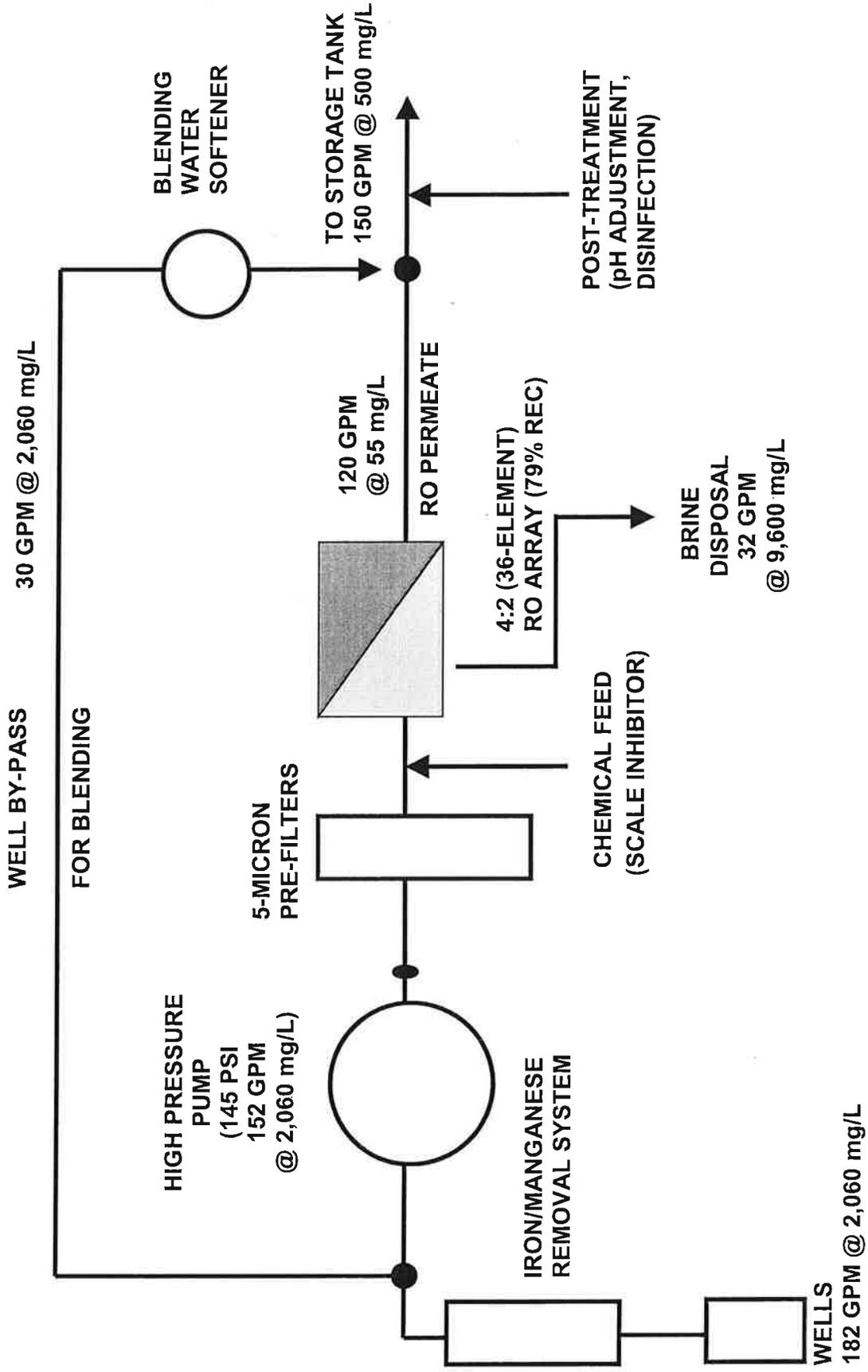


FIGURE 9.14 GENERAL RO SCHEMATIC

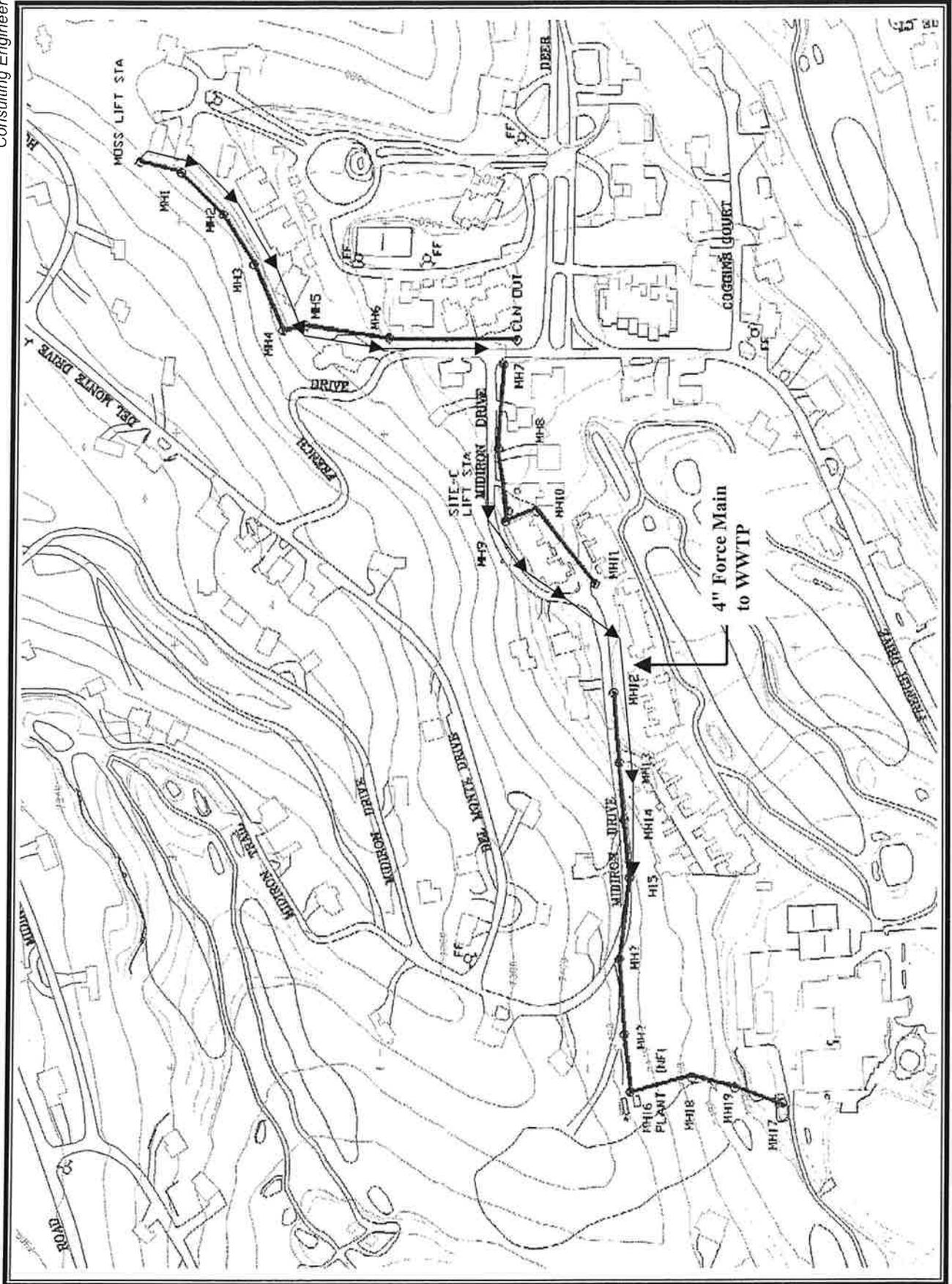


FIGURE 10.1

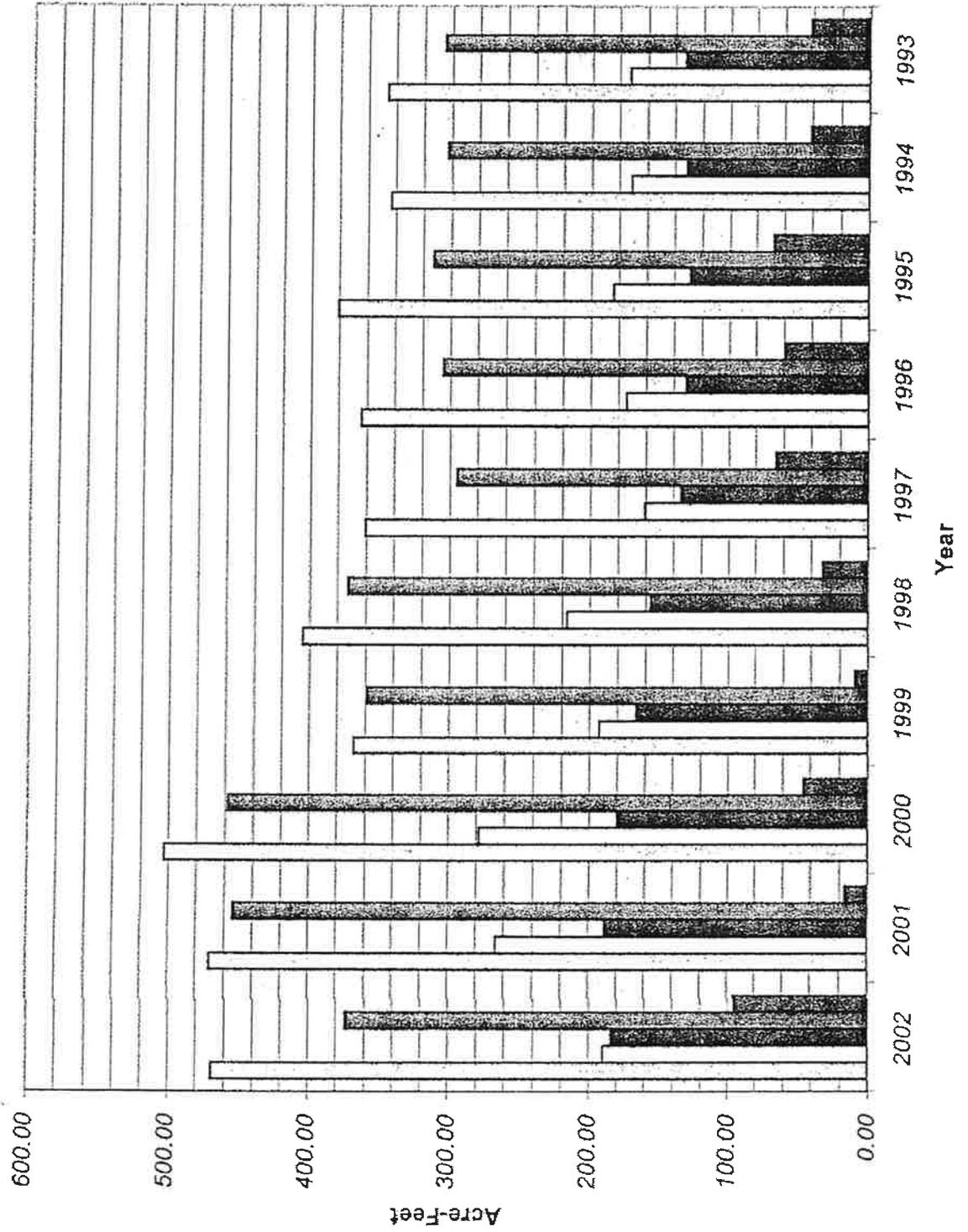
ALTO LAKES WATER CORPORATION SEWER SYSTEM



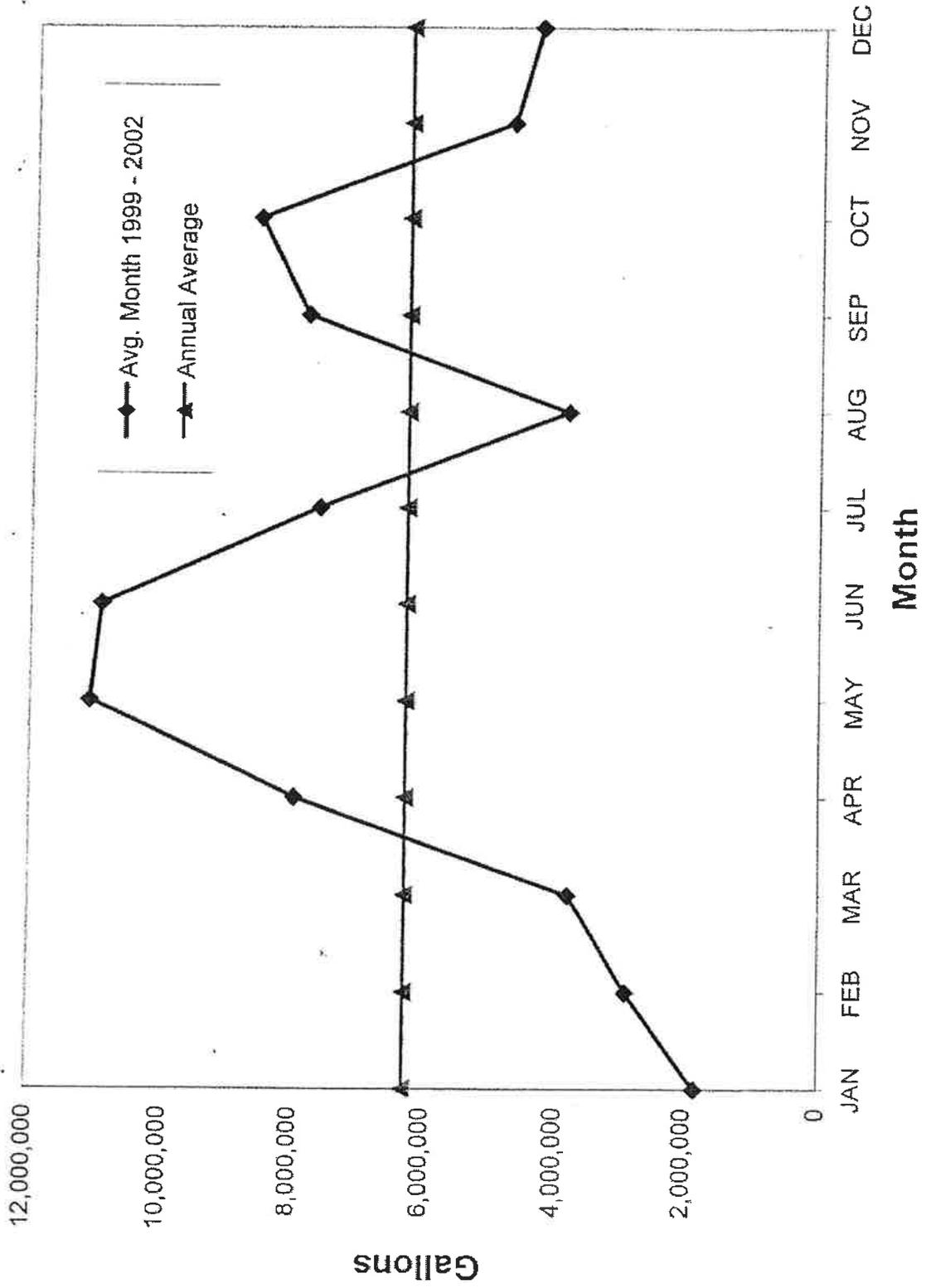
## **Appendix**

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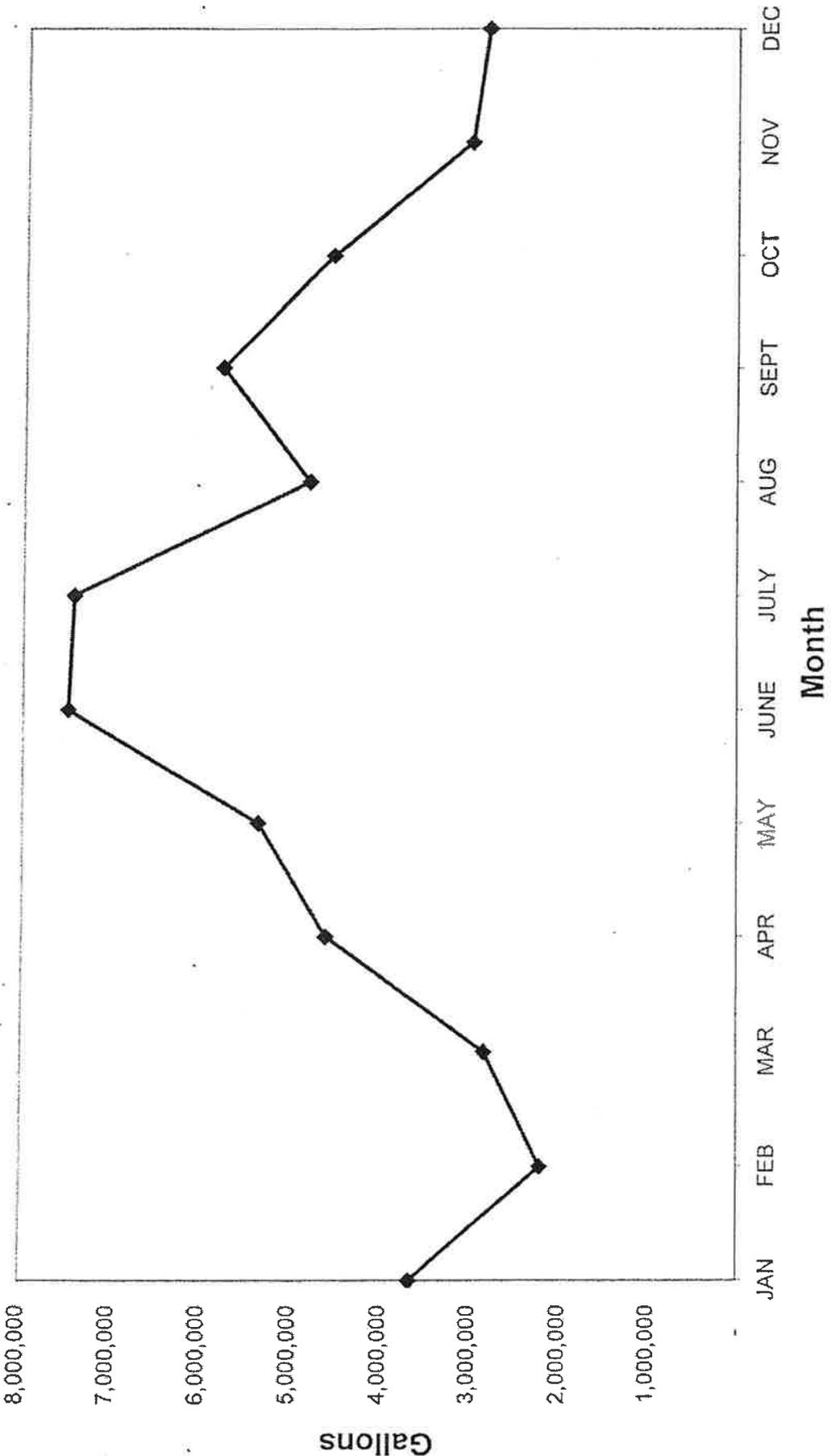
# Water Use (A-F) 1993-2002



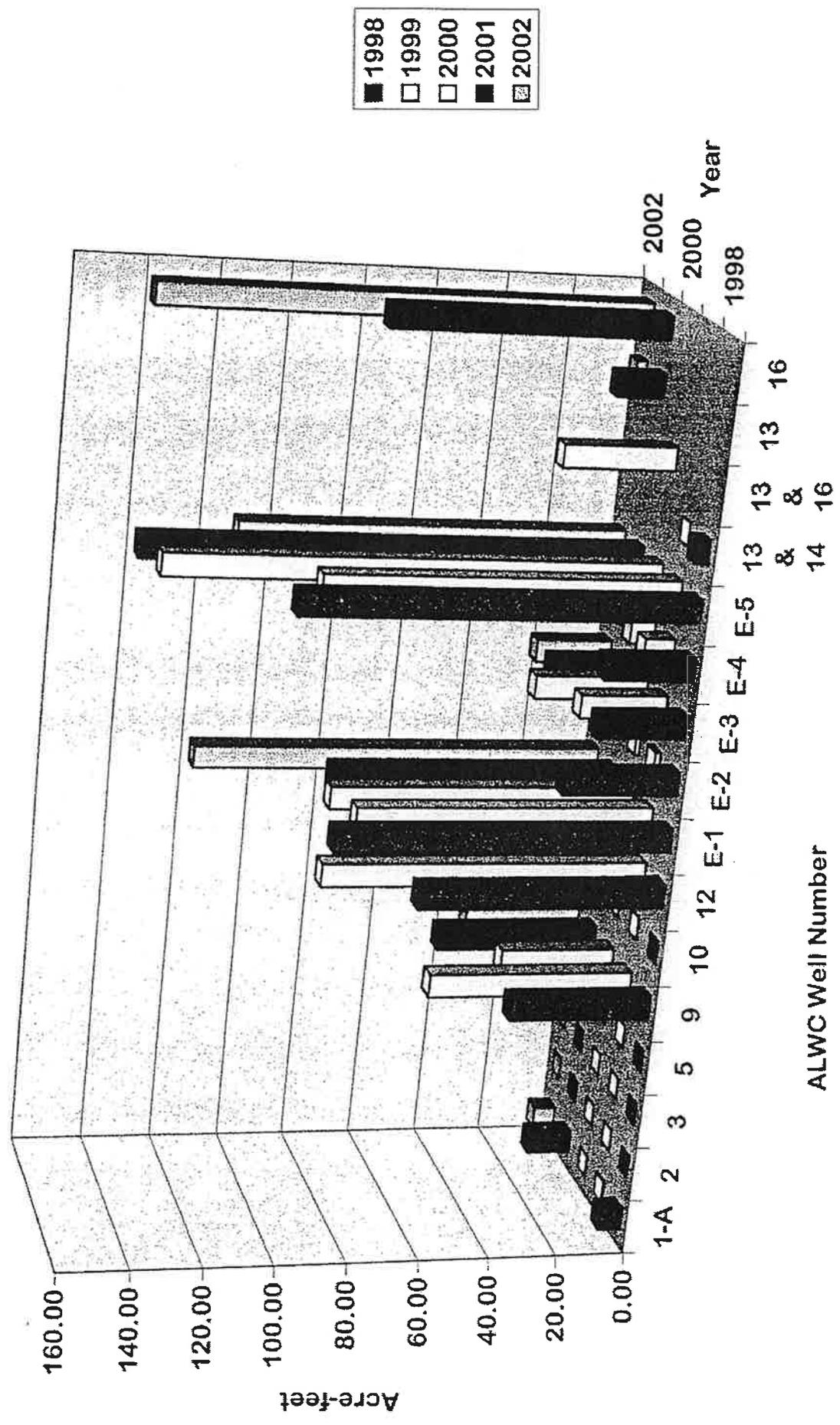
# Alto Lakes Golf Course Irrigation Avg. 1999 - 2002



# Alto Lakes Water Corp. Domestic Use Year 2002



# Well Production (Acre-ft) 1998-2002



Amount Sold During 2000

| Month  | Irrigation |           | Domestic (incl Comm) |           | Total       |           |
|--------|------------|-----------|----------------------|-----------|-------------|-----------|
|        | Gallons    | Acre-Feet | Gallons              | Acre-Feet | Gallons     | Acre-Feet |
| Jan    | 419,500    | 1.29      | 4,060,980            | 12.46     | 4,480,480   | 13.75     |
| Feb    | 7,363,400  | 22.60     | 2,709,550            | 8.32      | 10,072,950  | 30.91     |
| Mar    | 10,245,900 | 31.45     | 4,940,960            | 15.16     | 15,186,860  | 46.61     |
| Apr    | 9,766,700  | 29.97     | 2,901,630            | 8.91      | 12,668,330  | 38.88     |
| May    | 11,612,400 | 35.64     | 6,035,410            | 18.52     | 17,647,810  | 54.16     |
| Jun    | 10,776,500 | 33.07     | 7,130,440            | 21.88     | 17,906,940  | 54.96     |
| Jul    | 7,704,700  | 23.65     | 7,505,530            | 23.04     | 15,210,230  | 46.68     |
| Aug    | 5,434,700  | 16.68     | 6,096,100            | 18.71     | 11,530,800  | 35.39     |
| Sep    | 12,523,900 | 38.44     | 6,408,570            | 19.67     | 18,932,470  | 58.11     |
| Oct    | 9,258,400  | 28.41     | 5,504,460            | 16.89     | 14,762,860  | 45.31     |
| Nov    | 940,700    | 2.89      | 2,869,730            | 8.81      | 3,810,430   | 11.69     |
| Dec    | 4,550,700  | 13.97     | 2,448,090            | 7.51      | 6,998,790   | 21.48     |
| Totals | 90,597,500 | 278.05    | 58,611,450           | 179.88    | 149,208,950 | 457.94    |

Amount Sold During 2001

| Month  | Irrigation |           | Domestic (incl Comm) |           | Total       |           |
|--------|------------|-----------|----------------------|-----------|-------------|-----------|
|        | Gallons    | Acre-Feet | Gallons              | Acre-Feet | Gallons     | Acre-Feet |
| Jan    | 4,122,500  | 12.65     | 4,514,860            | 13.86     | 8,637,360   | 26.51     |
| Feb    | 1,034,800  | 3.18      | 2,389,970            | 7.34      | 3,424,770   | 10.51     |
| Mar    | 573,800    | 1.76      | 2,573,190            | 7.90      | 3,146,990   | 9.66      |
| Apr    | 9,990,700  | 30.66     | 4,154,070            | 12.75     | 14,144,770  | 43.41     |
| May    | 12,206,400 | 37.46     | 5,274,540            | 16.19     | 17,480,940  | 53.65     |
| Jun    | 15,500,000 | 47.57     | 7,891,930            | 24.22     | 23,391,930  | 71.79     |
| Jul    | 10,429,000 | 32.01     | 9,782,260            | 30.02     | 20,211,260  | 62.03     |
| Aug    | 4,356,400  | 13.37     | 6,063,140            | 18.61     | 10,419,540  | 31.98     |
| Sep    | 7,242,700  | 22.23     | 6,168,560            | 18.93     | 13,411,260  | 41.16     |
| Oct    | 7,738,800  | 23.75     | 5,504,830            | 16.89     | 13,243,630  | 40.65     |
| Nov    | 9,832,900  | 30.18     | 3,757,510            | 11.53     | 13,590,410  | 41.71     |
| Dec    | 3,501,700  | 10.75     | 3,285,650            | 10.08     | 6,787,350   | 20.83     |
| Totals | 86,529,700 | 265.57    | 61,360,510           | 188.32    | 147,890,210 | 453.89    |

Amount Sold During 2002

| Month  | Irrigation |           | Domestic (incl Comm) |           | Total       |           |
|--------|------------|-----------|----------------------|-----------|-------------|-----------|
|        | Gallons    | Acre-Feet | Gallons              | Acre-Feet | Gallons     | Acre-Feet |
| Jan    | 594,800    | 1.83      | 3,945,790            | 12.11     | 4,540,590   | 13.94     |
| Feb    | 822,500    | 2.52      | 2,439,940            | 7.49      | 3,262,440   | 10.01     |
| Mar    | 3,878,600  | 11.90     | 3,039,530            | 9.33      | 6,918,130   | 21.23     |
| Apr    | 9,612,500  | 29.50     | 5,063,560            | 15.54     | 14,676,060  | 45.04     |
| May    | 11,978,800 | 36.76     | 5,623,140            | 17.26     | 17,601,940  | 54.02     |
| Jun    | 5,343,890  | 16.40     | 8,237,820            | 25.28     | 13,581,710  | 41.68     |
| Jul    | 4,887,800  | 15.00     | 8,303,600            | 25.48     | 13,191,400  | 40.49     |
| Aug    | 3,547,700  | 10.89     | 5,435,050            | 16.68     | 8,982,750   | 27.57     |
| Sep    | 5,838,000  | 17.92     | 6,264,990            | 19.23     | 12,102,990  | 37.15     |
| Oct    | 7,505,100  | 23.03     | 5,092,410            | 15.63     | 12,597,510  | 38.66     |
| Nov    | 990,700    | 3.04      | 3,248,760            | 9.97      | 4,239,460   | 13.01     |
| Dec    | 6,774,200  | 20.79     | 3,204,700            | 9.84      | 9,978,900   | 30.63     |
| Totals | 61,774,590 | 189.59    | 59,899,290           | 183.84    | 121,673,880 | 373.43    |



Alto Lakes Water Corporation  
 Water and Wastewater Master Plan  
 Water Use by Residential Accounts  
 Categorized based on residence time

**Existing Conditions (based on 2002 data)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.45                | 395                        | 44                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.34                | 395                        | 67                       |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.21                | 395                        | 69                       |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 180                      | 1010          | 0.1786                | 1010            | 180                            |

**Existing Conditions (year 2004)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.34                | 395                        | 34                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.40                | 395                        | 79                       |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.26                | 395                        | 85                       |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 198                      | 1010          | 0.1959                | 1175            | 230                            |

**Future Condition (year 2008)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.28                | 395                        | 28                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.45                | 395                        | 89                       |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.27                | 395                        | 89                       |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 205                      | 1010          | 0.2030                | 1340            | 272                            |

**Future Condition (year 2012)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.22                | 395                        | 22                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.49                | 395                        | 97                       |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.29                | 395                        | 95                       |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 214                      | 1010          | 0.2115                | 1505            | 318                            |

**Future Condition (year 2016)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.18                | 395                        | 18                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.52                | 395                        | 103                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.30                | 395                        | 98                       |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 219                      | 1010          | 0.2167                | 1670            | 362                            |

**Future Condition (year 2020)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.15                | 395                        | 15                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.54                | 395                        | 107                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.31                | 395                        | 102                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 223                      | 1010          | 0.2209                | 1835            | 405                            |

**Future Condition (year 2024)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.11                | 395                        | 11                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.57                | 395                        | 113                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 228                      | 1010          | 0.2261                | 2000            | 452                            |

**Future Condition (year 2026)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.11                | 395                        | 11                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.57                | 395                        | 113                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 228                      | 1010          | 0.2261                | 2000            | 452                            |

**Future Condition (year 2028)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.10                | 395                        | 10                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.58                | 395                        | 115                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 229                      | 1010          | 0.2271                | 2000            | 454                            |

**Future Condition (year 2030)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.10                | 395                        | 10                       |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.58                | 395                        | 115                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 229                      | 1010          | 0.2271                | 2000            | 454                            |

**Future Condition (year 2032)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.09                | 395                        | 9                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.59                | 395                        | 117                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 230                      | 1010          | 0.2280                | 2000            | 456                            |

**Future Condition (year 2034)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.09                | 395                        | 9                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.59                | 395                        | 117                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 230                      | 1010          | 0.2280                | 2000            | 456                            |

**Future Condition (year 2036)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.08                | 395                        | 8                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.60                | 395                        | 119                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 231                      | 1010          | 0.2290                | 2000            | 458                            |

**Future Condition (year 2038)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.08                | 395                        | 8                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.60                | 395                        | 119                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 231                      | 1010          | 0.2290                | 2000            | 458                            |

**Future Condition (year 2040)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.07                | 395                        | 7                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.61                | 395                        | 120                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 232                      | 1010          | 0.2300                | 2000            | 460                            |

**Future Condition (year 2042)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.07                | 395                        | 7                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.61                | 395                        | 120                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 232                      | 1010          | 0.2300                | 2000            | 460                            |

**Future Condition (year 2044)**

| Category  | residence time (mos) | residence time (%) | percent of accounts | full-time equiv. use (afy) | weighted water use (afy) | Base Accounts | Use per Account (afy) | Actual Accounts | Total Domestic Water Use (afy) |
|-----------|----------------------|--------------------|---------------------|----------------------------|--------------------------|---------------|-----------------------|-----------------|--------------------------------|
| seasonal  | 3 mos                | 0.25               | 0.06                | 395                        | 6                        |               |                       |                 |                                |
| semi-perm | 6 mos                | 0.50               | 0.62                | 395                        | 122                      |               |                       |                 |                                |
| perm      | 10 mos               | 0.83               | 0.32                | 395                        | 105                      |               |                       |                 |                                |
| Totals    |                      |                    | 1.00                | 395                        | 233                      | 1010          | 0.2310                | 2000            | 462                            |

ALTO LAKES SEWER SYSTEM  
MANHOLE & LIFT STATION DATA

2/18/04

MANHOLES

DEPTH TO INVERTS

MH #

| MH #           | DIA. | DEPTH TO INVERTS |      |      |     |     |     |          |       | INVERT ELEV |       |        |        |        |  |  |  |
|----------------|------|------------------|------|------|-----|-----|-----|----------|-------|-------------|-------|--------|--------|--------|--|--|--|
|                |      | N                | S    | E    | W   | SE  | SW  | RIM ELEV | N     | S           | E     | W      | SE     | SW     |  |  |  |
| 1              | 4    | 6.0              | 5.8  | 5.0  | -   |     |     | 410.97   | 405.0 | 406.0       | 411.0 | 410.97 | 410.97 | 410.97 |  |  |  |
| 2              | 4    | 6.0              | 5.9  |      |     |     |     | 415.19   | 409.2 | 415.2       | 415.2 | 415.19 | 415.19 |        |  |  |  |
| 3              | 6    | 5.1              | 4.8  | 4.9  | -   | 1.2 |     | 418.88   | 413.8 | 414.0       | 418.9 | 417.68 | 418.88 |        |  |  |  |
| 4              | 4    |                  |      |      |     |     |     | 434.74   | 434.7 | 434.7       | 434.7 | 434.74 | 434.74 |        |  |  |  |
| 5              | 4    | 5.1              | 5.0  | 4.0  | -   |     |     | 447.28   | 442.2 | 443.3       | 447.3 | 447.28 | 447.28 |        |  |  |  |
| 6              | 4    | 5.3              | 5.2  | 5.2  | -   |     |     | 460.87   | 455.6 | 455.7       | 460.9 | 460.87 | 460.87 |        |  |  |  |
| 7              | 4    | 5.9              | 5.7  | 4.5  | 4.6 |     |     | 470.93   | 465.0 | 466.4       | 466.3 | 470.93 | 470.93 |        |  |  |  |
| 8              |      |                  |      |      |     |     |     |          |       |             |       |        |        |        |  |  |  |
| 9              | 4    | -                | 4.0  | 4.8  | -   | 5.2 |     | 468.71   | 468.7 | 468.7       | 468.7 | 468.71 | 468.71 |        |  |  |  |
| 10             | 4    | 8.9              | -    | -    | 8.6 |     |     | 475.17   | 466.3 | 475.2       | 466.6 | 475.17 | 475.17 |        |  |  |  |
|                |      |                  |      |      | 4.7 |     |     | 475.17   | -     | -           | 470.5 | -      | 475.17 |        |  |  |  |
| 11             | 4.0  |                  |      |      |     |     |     | 483.93   | 483.9 | 483.9       | 483.9 | 483.93 | 483.93 |        |  |  |  |
| 12             |      |                  |      |      |     |     |     | 481.45   | 481.5 | 481.5       | 481.5 | 481.45 | 481.45 |        |  |  |  |
| 13             | 4.0  | -                |      | 6.6  | 6.8 | -   | 5.6 | 473.06   | 473.1 | 466.5       | 466.3 | 473.1  | 467.5  |        |  |  |  |
| 14             |      |                  |      |      |     |     |     | 447.20   | 447.2 | 447.2       | 447.2 | 447.2  | 447.2  |        |  |  |  |
| 15             |      |                  |      |      |     |     |     | 436.36   | 436.4 | 436.4       | 436.4 | 436.4  | 436.4  |        |  |  |  |
| 16-Plant Inlet | SQ   | 2.6              | 2.55 | 2.55 | -   |     |     | 424.20   | 421.6 | 421.7       | 424.2 | 424.2  | 424.2  |        |  |  |  |
| 17             |      |                  |      |      |     |     |     | 513.03   | 513.0 | 513.0       | 513.0 | 513.0  | 513.0  |        |  |  |  |
| 18             | 4    | -                | -    | -    | -   |     |     | 486.31   | 486.3 | 486.3       | 486.3 | 486.3  | 486.3  |        |  |  |  |
| 19             | 4    | -                | -    | -    | -   |     |     | 501.28   | 501.3 | 501.3       | 501.3 | 501.3  | 501.3  |        |  |  |  |

LIFT STATIONS

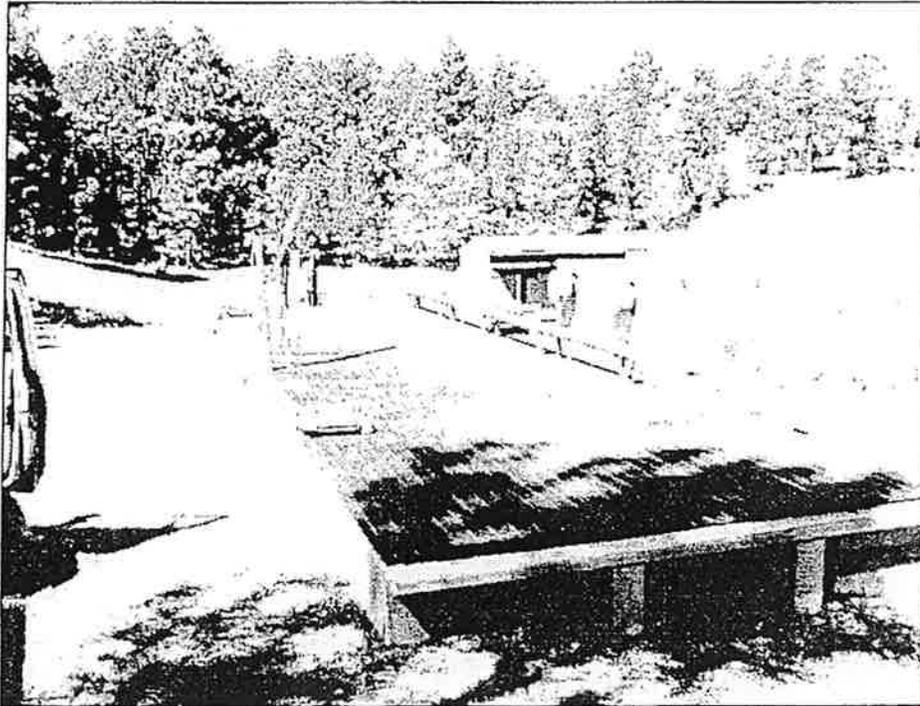
DEPTHS TO INVERTS

INVERT ELEV

|        | DIA | DEPTHS TO INVERTS |           |  | INVERT ELEV |           |  |
|--------|-----|-------------------|-----------|--|-------------|-----------|--|
|        |     | BOTTOM            | INFLU-ENT |  | BOTTOM      | INFLU-ENT |  |
| MOSS   | 6   | 10.2              | 5.6       |  | 380.1       | 384.7     |  |
| SITE C | 6   | 11.0              | 9.2       |  | 457.3       | 459.1     |  |

| MANHOLE #      | UTM COORDINATES 13 S<br>METERS |         | UTM COORDINATES 13 S<br>FEET |           |
|----------------|--------------------------------|---------|------------------------------|-----------|
|                | NORTHING                       | EASTING | NORTHING                     | EASTING   |
| PANEL POINT 20 | 3695004                        | 437978  | 12122680.0                   | 1436931.4 |
| MOSS           | 3696233                        | 438881  | 12126712.1                   | 1439894.0 |
| 1              | 3696180                        | 438855  | 12126538.2                   | 1439808.6 |
| 2              | 3696154                        | 438829  | 12126452.9                   | 1439723.3 |
| 3              | 3696149                        | 438804  | 12126436.5                   | 1439641.3 |
| 4              | 3696125                        | 438772  | 12126357.8                   | 1439536.3 |
| 5              | 3696106                        | 438762  | 12126295.4                   | 1439503.5 |
| 6              | 3696057                        | 438752  | 12126134.7                   | 1439470.7 |
| 7              | 3695969                        | 438740  | 12125846.0                   | 1439431.4 |
| 8              | 3695973                        | 438655  | 12125859.1                   | 1439152.5 |
| 9              | 3695965                        | 438635  | 12125832.9                   | 1439086.9 |
| SITE C         | 3696233                        | 438881  | 12126712.1                   | 1439894.0 |
| 10             | 3695943                        | 438628  | 12125760.7                   | 1439063.9 |
| 11             | 3695903                        | 438567  | 12125629.4                   | 1438863.8 |
| 12             | 3695892                        | 438480  | 12125593.4                   | 1438578.3 |
| 13             | 3695891                        | 438451  | 12125590.1                   | 1438483.2 |
| 14             | 3695878                        | 438399  | 12125547.4                   | 1438312.6 |
| 15             | 3695879                        | 438371  | 12125550.7                   | 1438220.7 |
| 16             |                                |         | 0.0                          | 0.0       |
| 17             | 3695775                        | 438240  | 12125209.5                   | 1437790.9 |
| 18             | 3695815                        | 438217  | 12125340.7                   | 1437715.5 |
| 19             | 3695815                        | 438241  | 12125340.7                   | 1437794.2 |

# Alto Lakes Wastewater Treatment Plant Operations Evaluation



Prepared by



November, 2003

# Introduction

WaterOps is a water and wastewater treatment operations consultant hired under a contract with Livingston Associates, P.C. to perform an operations and process performance evaluation of the Alto Lakes Water Corporation wastewater treatment plant (WWTP). Kit Roush, WaterOps owner and operations specialist, visited Alto lakes on September 18, 2003 to perform an onsite evaluation of the facility, interview the operators, and collect available laboratory data and permit information. This report is based on the information gathered during the onsite evaluation and describes the operation and condition of the wastewater treatment equipment and makes recommendations for operational changes and equipment repair or upgrade to comply with discharge permit requirements, improve effluent quality, and increase operations efficiency.

## System Description

### Facility

The Alto Lakes WWTP treats sewage from the Alto Lakes Resort community. The plant is located adjacent to the Country Club's driving range and consists of a single sequencing batch reactor (SBR) manufactured by ABJ Sanitaire. Because of its proximity to the driving range all tanks are covered with grating to prevent golf balls from entering the tanks. During WaterOps' morning tour of the facility the driving range was shut down but it was in operation when sampling was done that afternoon.

There is no screening process upstream of the SBR to remove trash, rags, or other large solids. There is also no grit removal process to remove sand, egg shells, coffee grounds, or other materials that settle quickly and are not readily biodegradable. Treated water, or effluent, from the plant is not disinfected and is discharged to a small chamber where it passes through a v-notch weir to one of three leach fields below the surface of the driving range. A ground water monitoring well has been installed near the leach field. Waste sludge from the SBR is held in an aerated tank, which is periodically pumped out by a septic pumping service.

The SBR uses a suspended growth biological process called activated sludge in which aeration is used to produce an environment favorable to naturally occurring bacteria that feed on the biodegradable material in sewage. This converts the suspended and dissolved pollutants to solids that are easily separated from the water by a settling process. There are many types of activated sludge WWTPs. In most of them, aeration occurs constantly in one tank, while settling is done in separate tanks known as clarifiers. In an SBR, both functions are performed in the same tank by sequencing the treatment processes to treat the wastewater in batches. The wastewater is aerated while the tank filled until the wastewater reaches a certain level or a set period of time has passed, then aeration is turned off and the solids settle to the bottom of the tank, leaving a layer of treated water at the top of the tank, which is decanted off. Some SBRs use a true "batch" process that requires two SBRs that receive sewage (influent) alternately. While one SBR is aerating and filling, the other is going through the settling and decanting processes. Other SBRs, like the one at Alto Lakes, operate on a timed cycle designed to receive flow constantly and require only one SBR. The ABJ Sanitaire SBRs go through five 288 minute treatment cycles per day. Each cycle consists of three stages, an aeration/mix stage of 168 minutes, a settling stage of 60 minutes, and a decant stage of 60 minutes.

The Alto Lakes SBR is equipped to accomplish denitrification. The SBR is aerated for a set period of time, increasing the dissolved oxygen (DO) concentration to above 1.5 mg/L. In the high DO conditions the bacteria convert ammonia ( $\text{NH}_3$ ) to nitrite ( $\text{NO}_2$ ) and then to nitrate ( $\text{NO}_3$ ) in the process

known as nitrification. Then the aeration is turned off and mixers in the SBR start automatically. Because the bacteria are still coming into contact with food they will continue to use oxygen until the DO drops into the anoxic range of less than 0.5 mg/L. Without the presence of free oxygen the bacteria enter the denitrification process by breaking down the  $\text{NO}_3$  for the oxygen and releasing the nitrogen as a gas.

## Discharge Permit

The effluent is discharged to the drinking range leach fields under a ground water discharge permit issued May 5, 2003 by the New Mexico Environment Department (NMED). The permit allows discharge of up to 30,000 gallons per day (gpd) with the following quality requirements: less than 10 milligrams per liter (mg/L) total nitrogen, which is the total of  $\text{NO}_2$ ,  $\text{NO}_3$ , and total Kjeldahl nitrogen (TKN), or organic nitrogen; less than 250 mg/L of chloride; and less than 1,000 mg/L total dissolved solids (TDS).

Samples taken from the WWTP effluent and from the monitoring well must be taken and tested for the parameters above on a quarterly basis. In addition to these parameters the monitoring well depth-to-water at the time of sampling must be reported.

In addition to the monitoring requirements, the permit requires submittal of a corrective action plan to identify the source(s) of high chloride and dissolved solids found in the WWTP effluent and monitoring well samples. The plan is to include characterization of TDS background levels in the community's water supply. The action plan was to be submitted within 180 days of the date the permit was issued. The permit also requires that the facility be fenced to prevent access by children and dogs, within 90 days of the issuance of the permit. There is another requirement that the monthly volume of treated wastewater discharged from the WWTP be measured by a V-notch weir totalizing device.

## Operations Evaluation

### Flow Monitoring

There is no flow recording or totalizing device at the WWTP. Flow to the facility is calculated by assuming that 80 percent of the drinking water used by the community ends up at the WWTP. Figure 1 shows the daily average flow for the year 2000 based on water use. It is WaterOps' opinion that the 80 percent is too high. The percentage of water produced that ends up at the WWTP varies significantly in most communities. For example, in the Town of Cochiti Lake, the flow to the WWTP averages 74 percent for November through February and 21 percent for May through August. The annual average is 34 percent.

Obviously the demographics and weather are different in Cochiti Lake than they are in Alto Lakes and water use patterns are going to be different.

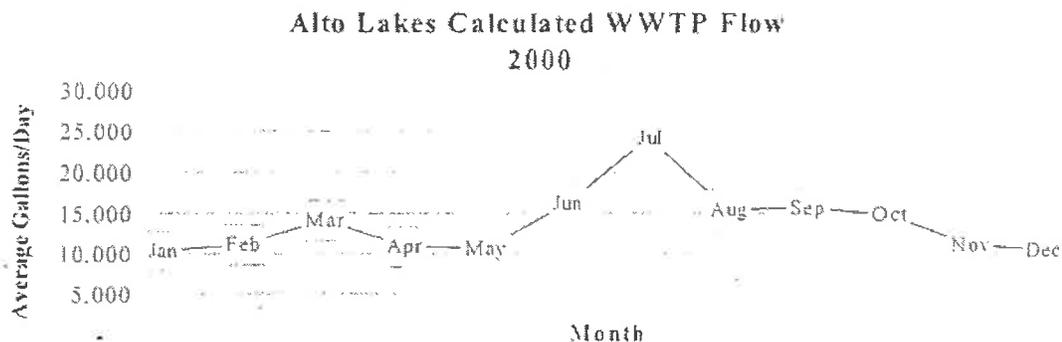


Figure 1 Flow to WWTP in 2000 calculated from water use.

However one would not expect such a big difference. One thing the chart in Figure 1 indicates is that the occupancy in July of 2000 was one and a half times that in June and August and over twice the occupancy in December and January.

## Laboratory Data and Effluent Quality

Because the WWTP operates under a groundwater discharge permit, the only analyses required by NMED are total nitrogen,  $\text{NO}_3$ , chloride, and TDS. Recent results for these parameters are listed in Table 1. Samples taken 5/7/03 and 7/15/03 were routine quarterly samples required by NMED. The 9/18/03 sample was taken by WaterOps as part of the operations evaluation. None of the results for chloride or TDS are in compliance with the permit requirements but do not necessarily reflect the performance of the treatment plant. The SBR process was not designed to remove either of these parameters.

The NMED ground water discharge permit does not require the two tests most widely used to gauge WWTP performance. These are biochemical oxygen demand (BOD) and total suspended solids (TSS). The BOD is the amount of oxygen that bacteria would use in converting pollutants in the wastewater to cell mass. Typical sewage influent to a WWTP has a BOD of about 200 mg/L. Most WWTPs will remove 90 to 98 percent of the BOD. Effluent discharged to rivers or streams generally must have a BOD below 15 to 30 mg/L. TSS are the solids that are suspended in the water; they do not float or settle. Generally, TSS concentration is similar to BOD in both influent and discharge requirements.

The BOD and TSS of the Alto Lakes WWTP influent samples taken 9/18/03 were higher than typical values, with a BOD of 494 mg/L and TSS of 380 mg/L. The results of the nitrogen analysis were high and unusual. Typical TKN values for residential sewage are 30 mg/L with about 65 percent as ammonia-nitrogen. The TKN of this sample was 70 mg/L with an ammonia concentration of 11.6 mg/L, which is only 15 percent of the total TKN. These values are more typical of restaurant sewage than residential sewage. Unfortunately, data for previous BOD and TSS testing was not available so it is not known if this is unusual for the Alto Lakes WWTP. The high TKN with the low ammonia value could indicate restaurant grease traps need to be installed or pumped more often. It should be considered that these results are from a one time grab sample taken during the afternoon when the influent flow is low and generally higher in BOD and TSS concentration. Also, the only place an influent sample was accessible was a box structure up stream of the plant that provided less than optimum sampling conditions.

In contrast, the effluent sampling went very well. The SBR discharges for about 50 minutes every 5 hours and we happened to be there about 30 minutes prior to it discharging. The results of the effluent tests were dramatically low with a BOD of less than 4 mg/L and TSS were not detectable (ND). The TKN was 0.8 with both ammonia and  $\text{NO}_2$  undetectable. The  $\text{NO}_3$  was 3.6 mg/l, bringing the total nitrogen (TKN +  $\text{NO}_3$ ) to 4.4 mg/L.

**Table 1**  
**Alto Lakes WWTP Test Results**

| Date      | Sample          | $\text{NO}_3$ mg/L | TKN mg/L | TDS mg/L | Chloride mg/L |
|-----------|-----------------|--------------------|----------|----------|---------------|
| 5/7/2003  | Effluent        | 3.1                | ND       | 3400     | 980           |
| 5/7/2003  | Monitoring well | 0.8                | ND       | 3300     | 1100          |
| 7/15/2003 | Effluent        | 6.7                | 2.0      | 3600     | 100           |
| 7/15/2003 | Monitoring well | 1.3                | ND       | 3100     | 990           |
| 9/18/2003 | Effluent        | 3.6                | 0.8      | 4780     | NR            |

ND = none detected    NR = not run

## **Process Control**

The job of the operator at a biological treatment plant is to maintain the proper environment for bacteria and other organisms. One of the most important factors of a proper environment is the balance between food and the bacteria population. This is done by "wasting" or removing a small amount of the bacteria population from the SBR. For the SBR at the Alto Lakes this is accomplished by setting the amount of time the waste pump transfers from the aeration tank to the sludge holding tank. The operator determines how long to run the pump by monitoring the depth of the settled sludge or "depth of blanket." If over several days, the blanket has risen higher than 5 feet, the pump run time is increased. As the blanket level decreases below 5 feet, the pump time is decreased. There is a DO meter available but DO readings are not taken on a regular schedule.

## **Facility Conclusions and Recommendations**

### **Facility Location**

The first conclusion WaterOps reached after observing the hundred or more golf balls laying within 20 feet of the plant is "somebody's going to get hurt." WaterOps understands that moving the plant may be a consideration in the future but if that happens, it's not likely to happen soon. WaterOps recommends that netting be installed over the plant to protect the operators and the equipment. No matter what the cost of the netting and installation, it will cost less and be less intrusive than moving the treatment plant. Until the netting is installed WaterOps recommends coordination between the operator's visits to the plant and operation of the driving range so that the driving range is not open when the operator is on site. Each of the five treatment cycles begins at the same time every day. Therefore, each treatment stage occurs at the same time every day. This allows the operator to time his routine visits to the plant as appropriate for the tasks he needs to perform. For example, to take the depth of blanket reading he would want to be at the plant when it is in the decant stage. When the operator must visit the plant while the driving range is open, some type of head protection is advisable.

### **No Preliminary Treatment**

Rags, sticks, plastic hygiene products, sand, rocks, coffee grounds, toys, and other objects that are flushed down the toilet and either sink or float and are not bio-degradable will accumulate in the SBR. Not having a screening device or grit removal ahead of the SBR allows a multitude of items into the SBR tank. Once in the tank the only ways out are with the effluent, with the waste, or manual removal. Sooner or later they will begin to inhibit the performance of the SBR. At that time it is very hard to remove material that has settled on the bottom of the tank without pumping out the entire tank.

Unfortunately, the equipment used to remove this nonbiodegradable material automatically is not inexpensive and would need to be inside an enclosure to avoid problems with freezing. While installation of this type of equipment would certainly avoid the necessity of a major project later and perhaps other more immediate problems, it would likely have a long pay-back period. However, Alto Lake may want to consider a manually cleaned bar screen or other device to at least catch the larger debris before it can enter the plant and plug the waste pump or cause other problems.

# Operations Evaluation Conclusions and Recommendations

## Install Flow Meter

Presently the flow to the plant is calculated by assuming that 80 percent of the water produced ends up at the WWTP. Based on WaterOps' experience in other communities these calculations indicate the flow is higher than it actually is. The difference between actual and calculated is much higher during the summer. During the winter months flow to the WWTP may be close to the 80 percent of water production but in summer WaterOps doubts that it is over 35 percent.

Regardless of the accuracy of the calculation, the ground water discharge permit requires Alto Lakes to use a v-notch weir and totalizing meter to measure the flow. A V-notch weir is already in place and could be used with a flow measuring and totalizing device to totalize the flow in compliance with the permit. There are several devices that will work with a V-notch weir but two are especially well suited for the Alto lake facility because of the ease of installation and setup. One device is an ultra-sonic transponder that uses sound waves to measure the height of the water passing through the V-notch. The transponder would need to be securely mounted in the discharge about a foot upstream of the weir and the meter would need to be mounted in a weather-proof box to the side of the tank or another nearby stationary object. The meter would also need a 120 volt power source. The other device is a pressure transducer designed to work with the same type of flow meter as the ultra-sonic transponder. Installation is easier with this type of transponder because it can be hung the below surface of the water using a piece of pipe as a stilling well or attached with a bracket. Either of these devices can be found for under \$2,000 including the totalizing meter.

## Facility Doesn't Remove TDS

The TDS and chlorides of the effluent and monitoring well are above the groundwater discharge permit requirements. However, because this treatment unit was not design to remove these substances and Livingston Associates is working with the community on this issue, WaterOps will not address it. The results of the effluent sample taken by WaterOps on 9/18/03 for BOD (4.0 mg/L), TSS (not detected), and total nitrogen (4.4 mg/L) were excellent. Our only recommendation regarding these samples is that BOD and TSS be added to the quarterly effluent testing and that the influent be tested for BOD, TSS and TKN. This will provide some background data for treatment plant loading that can be used if process problems occur as well as determining plant capacity.

## More Process Control Beneficial

As noted earlier in this report, only the depth of blanket test is used for process control at the Alto Lakes WWTP. However, the effluent BOD and TSS results indicate it is being used effectively. The only test result of concern is the 6.7 mg/L  $\text{NO}_3$  of the 7/15/2003 effluent sample. This result is of concern because it is both much higher than the other samples taken and when added to the 2.0 mg/L of TKN, it brings the total nitrogen count to 8.7, which is close to the maximum discharge requirement. It is possible that wastewater entered the plant with a TKN concentration that was so high the plant could not convert it all to  $\text{NO}_3$ , nor convert all the  $\text{NO}_3$  to nitrogen. However it is also possible that the DO in SBR was too high and the process was not in and anoxic state long enough to denitrify. It is for this reason that WaterOps recommends that at least once per week the DO in the SBR be monitored through at least one complete aeration and anoxic mix stage to confirm that the DO is above 1.5 mg/L for most of the aeration period and drops below 0.5 mg/L during the anoxic mix stage.