

# Technical Memo

Date: Wednesday, July 05, 2017 Revised 8-30-17<sup>1</sup>

Project: Tract 53138 (Deerlake Ranch)

To: Eric Schlageter, Las Virgenes MWD

From: Dan Ellison, PE

Subject: Water Demand Estimate Study



This memorandum summarizes the results of HDR's analysis of the water demands projected for Tract 53138 (Deerlake Ranch). These estimated demands are intended to guide the sizing of water facilities to service this tract. Deerlake Ranch is a long-planned development at the extreme northern boundary of the Las Virgenes MWD (LVMWD) system, in the hills north of the San Fernando Valley. This development will receive water from the Twin Lakes Subsystem—part of the Las Virgenes MWD system.

As with other water demand estimates, this analysis is intended to be conservative—meaning it needs to be equal to or higher than the actual demands, otherwise fire flows and customer demands will not be met. For this particular case, a conservative estimate is particularly needed, since the existing Twin Lakes Pump Station and Tanks cannot be readily increased in capacity, should the estimates fall short. To avoid over-conservatism, a detailed estimate has been prepared, using the best available information.

## Overview - How Water Demands are Estimated

Water demands vary by the hour, the season, and the year. Weather plays a major factor. Hot-dry weather drives up irrigation demands, while conservation measures created by severe droughts can suppress demands. In the District's 2014 Master Plan, it was demonstrated that economic conditions also play a major role, with demands significantly depressed during economic recessions. Water system planning must factor in these many variables, with the goal of meeting the demands of the peak hour, on the maximum day, when the development is fully built-out and occupied.

Water demand estimates for residential developments are typically computed by combining estimates of average annual indoor and outdoor use, then applying peaking factors that account for variations in seasonal and daily demands. Because outdoor use dominates, maximum-day demands occur in the summer. Peak-hour demands generally occur around 7AM, when irrigation systems are operating while residents are also showering before work and school.

LVMWD recently adopted a rate structure based on individual "water budgets". Like rates at most California water utilities, the prices are tiered, with rates escalating as usage increases. The purpose is to encourage water conservation. In budget-based rates, different tiers are set

<sup>1</sup> Several small errors have been corrected. See highlighted text on p.10.

for each residential customer, based on the number of persons residing in the home, the landscaped area, and other factors. Budget goals are for efficient water use. The study which established these rates found that only 40 percent of customers were expected to conform to their budgets, and more than 40 percent were expected to exceed their budgets by at least 50 percent. A recent analysis of billing data from LVMWD showed that 27 percent of all customers were exceeding their budgets by 100 percent or more, with many consistently paying significant monetary penalties. A similar exceedance is found in the Twin Lakes zone. It is thus expected that many Deerlake Ranch customers will also exceed their water budget goals.

## Relevant Features of Deerlake Ranch

Demands at a typical Deerlake Ranch residence are expected to be somewhat higher than for the average LVMWD customer, for several reasons:

- The average lot size is relatively large (one-third acre).
- The tract is well inland, so is generally hotter and drier than many other areas of the District.
- New developments such as this also tend to have larger houses, and newer houses are also generally purchased by more affluent buyers.

Somewhat countering these factors, new developments are constructed with water-efficient appliances and plumbing fixtures, and frequently employ drought-tolerant landscaping. Similar relatively young developments nearby are LVMWD's Upper Twin Lakes Zone to the west and LADWP's Porter Ranch area to the east.

Water for the Deerlake Ranch development will be delivered through Metropolitan Water District's LV-3 Turnout and pumped through LVMWD's Twin Lakes Pump Station (PS). Twin Lakes Tanks 1 and 2 serve to moderate between pumping capacity and demands and also store water for emergencies and fire protection. During peak morning hours, water flows from these tanks, and during afternoons and evenings, storage is replenished. Twin Lakes PS also provides flows to the Upper Twin Lakes (UTL) system. Although the UTL system has its own tank, all its water must first be pumped by the Twin Lakes PS.

The Twin Lakes system is designed for pumping to occur 18 hours on peak days. By avoiding pumping during the afternoons, peak electricity rates are avoided. The difference between 18-hour and 24-hour operations also provides a buffer for emergencies and for refilling the tanks following a fire. The 18-hour pumping criterion also provides a small margin for error.

Table 1 shows the current capacities and current demands of the Twin Lakes facilities, based on the District's 2014 Water Master Plan.

**Table 1. 2014 Capacities and Demands on Twin Lakes System Facilities – 18-hour Pumping Criterion**

|                        | Capacity              | Required | Surplus |
|------------------------|-----------------------|----------|---------|
| Twin Lakes PS          | 1875 gpm <sup>2</sup> | 1533 gpm | 342 gpm |
| Twin Lakes Tanks 1 & 2 | 2.0 MG <sup>3</sup>   | 1.96 MG  | 0.04 MG |

## Indoor Water Use

Estimated indoor water use is based on: (1) the number of homes and other facilities, (2) the number of persons per household, and (3) estimated per capita indoor use.

- (1) Deerlake Ranch will consist of 314 single-family homes. Additionally a sheriff's substation and community center with swimming pool are planned.
- (2) The number of persons per household is conservatively taken as 3.0, based on the following data from the 2010 Census:

**Table 2. Population Data for Deerlake Ranch Area**

| Census Tract          | 9203.03                     | 1082.02              | 1082.01              |
|-----------------------|-----------------------------|----------------------|----------------------|
| Area                  | Twin Lakes / Deerlake Ranch | Western Porter Ranch | Eastern Porter Ranch |
| Population            | 1,446                       | 4,895                | 5,551                |
| Households            | 560                         | 1,826                | 1,848                |
| Persons per household | 2.6                         | 2.7                  | 3.0                  |

- (3) Per capita indoor use is conservatively taken as 80 gallons per capita per day (gpcd), based on the following data:

**Table 3. Per capita indoor water consumption**

| Reference                         | GPCD | Remarks  |
|-----------------------------------|------|--|
| LVMWD Water Budget Goal           | 55   | Based on State Water Conservation Act SBx7-7   |
| 2014 LVMWD Sanitation Master Plan | 90   | Based on influent to Tapia Water Recycling Facility of 240 to 280 gallons per day per ERU <sup>4</sup> |
| 2008 LVMWD Sanitation Master Plan | 95   | Based on influent to Tapia Water Recycling Facility of 247 gallons per day per ERU                     |

Over the last 20 years, indoor use has steadily decreased, as water-efficient toilets, washers, and other devices have been adopted. Deerlake Ranch homes will have modern, water-efficient plumbing fixtures and appliances, therefore water use should be less than 90 gallons per capita per day. However, consumption elsewhere shows that usage will be above the 55 gallons per day budget goal.

<sup>2</sup> Pump station capacity: 2500 gpm for 18 hours per day, is average of 1875 gpm

<sup>3</sup> Actual usable capacity is 1.87 MG, producing a ~0.1MG deficit.

<sup>4</sup> ERU = Equivalent residential unit; e.g., a house, apartment, or equivalent commercial / industrial property.

If indoor usage exceeds budget allocations in proportion to the overall budget exceedances, 80 GPCD would be expected.<sup>5</sup>

### Estimated Indoor Use

Using the figures above, estimated average annual indoor water use is as shown below.

**Table 4. Estimated Indoor Water Use**

| Customer Type       | Units | Persons per Unit | Daily Per Capita Use (gal) | Total (gallons/day) |
|---------------------|-------|------------------|----------------------------|---------------------|
| Houses              | 314   | 3.0              | 80                         | 75,000 <sup>6</sup> |
| Substation          | 1     | 2                | 30                         | 60                  |
| Recreation Center   | 1     | 5                | 50                         | 250                 |
| Total (rounded)     |       |                  |                            | 75,000              |
| <b>Total in gpm</b> |       |                  |                            | <b>52</b>           |

### Outdoor Water Use

Estimated outdoor water use is based on: (1) the types of land use, (2) the land areas irrigated, and (3) the estimated unit irrigation demands.

- (1) **Land Use.** The Deerlake Ranch development will be constructed in hilly terrain. Houses will sit on level pads, with varying amounts of backyard space. Frequently, the lots are very deep, extending into large sloped areas that are either natural or graded. Outside of the individually owned lots, common-area properties abut many of the roads or have terrace drains for conveyance of runoff. Many of these common areas will be graded, but some will be left in a natural state. All graded areas (both cut and fill) will have landscaping, which must be irrigated. Figure 1 (next page) illustrates some of the various conditions.
- (2) **Irrigated Areas:** The various land areas, based on an analysis of data provided by the developer, are summarized in Table 5 (next page). For this analysis, 75 percent of the level area of each lot is assumed to be irrigated, after subtracting the areas occupied by the house and driveway. The other 25 percent is assumed to be hardscaped (patio, walkways, etc.)
- (3) **Unit Demands.** Unit irrigation demands vary, depending on the types of plants, rainfall, the evapotranspiration rate (ET<sub>o</sub>) and the efficiency of water use. Various unit demands are shown in Table 6 (next page).

<sup>5</sup> Using budget exceedance figures, 80 gpcd is the overall result if: (1) 40% use 55 gpcd; (2) 27% use 2 x 55 gpcd, and (3) 33% use 1.5 x 55 gpcd.

<sup>6</sup> This compares to a water budget of 50,000 per day.

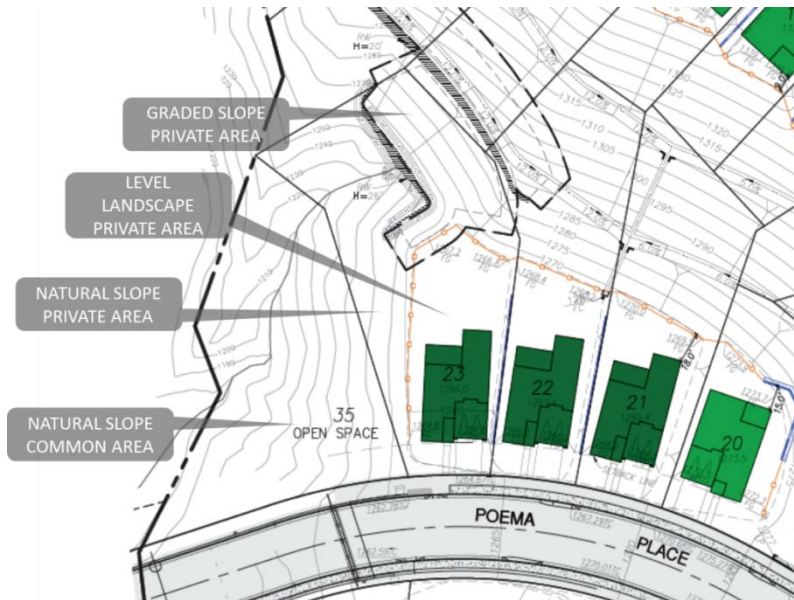


Figure 1. Illustration of various site conditions at Deerlake Ranch

Table 5. Calculated areas in Deer Lake Ranch

| Land Use                        | Areas (SF) | Remarks   |
|---------------------------------|------------|---|
| Level, landscaped private areas | 1,039,530  | $75\% \times ([\text{Pad area}] - [\text{std home footprint}]^7 - [\text{std driveway}]^8)$ |
| Sloped private areas            | 2,201,671  | $[\text{Gross lot size}] - [\text{pad area}]$   |
| Common landscaped areas         | 1,950,000  | From developer's 2016 landscaping plans   |
| Mini Park                       | 9,076      | From 2016 developer's landscaping plan  |
| Swimming Pool                   | ~3,000     | From developer's 2016 landscaping plans   |

Table 6. Various Unit Irrigation Demands

| Landscaping Type                    | Feet / Year | Remarks  |
|-------------------------------------|-------------|--|
| ETo <sup>9</sup> for Chatsworth, CA | 5           | Based on CIMIS Station 215, April 2016 - March 2017                                      |
| LVMWD Std Water Budget Goal         | 4           | 80% of ETo based on SBx7-7   |
| Parks                               | 3.5         | Based on analysis of 42 recycled water LVMWD accounts performed for the 2007 Master Plan |
| Golf Courses                        | 3.5         |  |
| Common area slopes                  | 2.6 – 2.8   |  |
| Medians/parkways                    | 5.5         |  |

<sup>7</sup> Standard home footprint = 2400 SF

<sup>8</sup> Standard driveway = 690 SF

<sup>9</sup> ETo for CIMIS Station 215 (Chatsworth), April 2016 - March 2017 is 60.09 inches

Both state law and local ordinances impose restrictions on what types of landscaping may be employed, including limits on the areas that may be planted in turf. As a new development, Deerlake Ranch must submit landscaping plans for plan check that comply with these requirements, but over time, individual property owners are not prevented from modifying the landscaping designs. It should be anticipated that many of the natural slope areas will eventually be planted and receive some amount of irrigation.

### Estimated Outdoor Use

As noted earlier, a majority of LVMWD customers do not meet their water budget goals, and a substantial portion exceed their goals by 100% or more (i.e., consumption is 2 times the goal or more). In designing water facilities for this development, it needs to be assumed that water budgets here will be also be exceeded. Taking these factors into consideration, conservative estimates of irrigation quantities are as shown below.

**Table 7. Estimated Outdoor Water Use**

| Land Use                        | Areas (SF) | Unit Demands      | Acre-Ft / Yr | Gallons/Day           |
|---------------------------------|------------|-------------------|--------------|-----------------------|
| Level, landscaped private areas | 1,039,530  | 5 <sup>10</sup>   | 119          | 107,000 <sup>11</sup> |
| Sloped private areas            | 2,201,671  | 1.3 <sup>12</sup> | 66           | 58,700                |
| Common landscaped areas         | 1,950,000  | 2.5 <sup>13</sup> | 112          | 100,000               |
| Mini Park                       | 9,076      | 4 <sup>14</sup>   | 1            | 750                   |
| Swimming Pool                   | 3,000      | 6                 | 0            | 350                   |
| TOTAL (rounded)                 |            |                   |              | 266,000               |
| <b>Total in gpm</b>             |            |                   |              | <b>185</b>            |

## Peaking Analysis

Figure 2 and Figure 3 show the general seasonal variations in demands for the Twin Lakes and Upper Twin Lakes zones. These graphs compare average monthly demands with average annual demands for the years 2010 through 2016, including pre-drought and drought conditions, and recession and post-recession periods. While the patterns are similar from year to year, variations in peak values are seen. No particular drivers for the variations are apparent: the peak values for 2010 and 2016 are very similar, although the weather and economic situations were different.

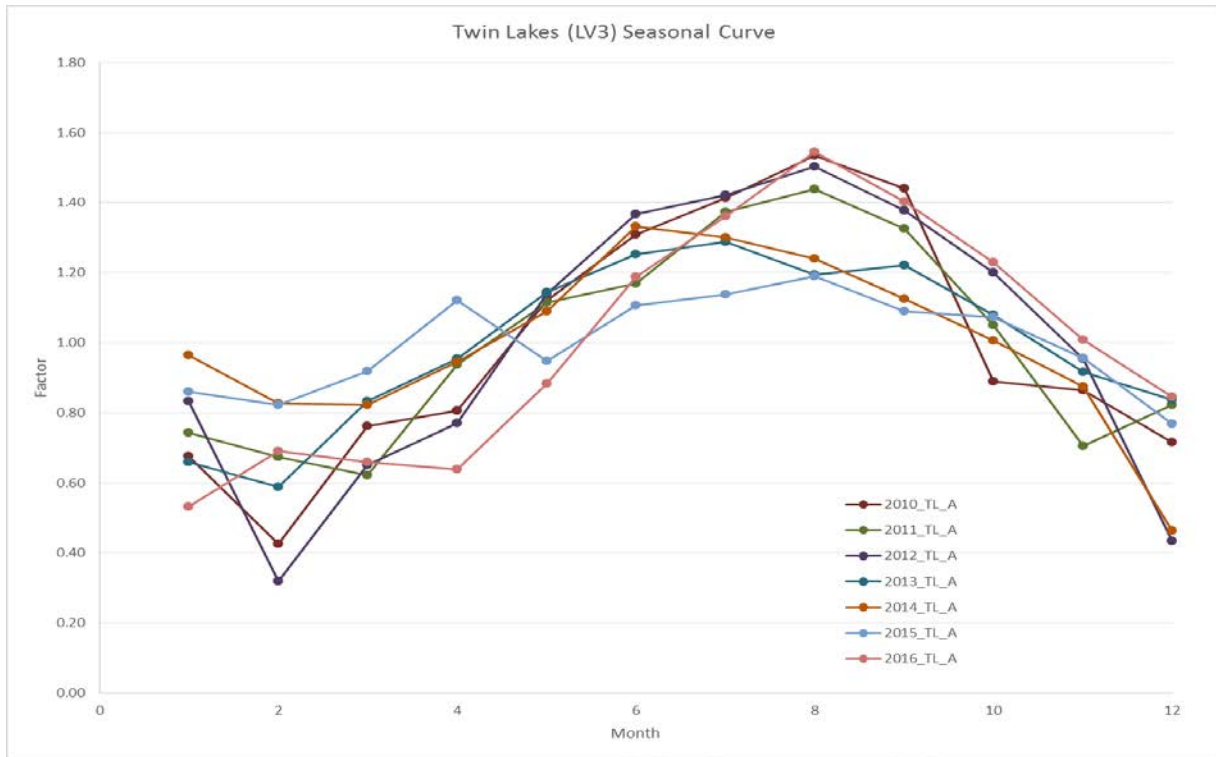
<sup>10</sup> Using budget exceedance figures, if (1) 40% use 4 ft (water budget); (2) 27% use 2 x 4 ft, and (3) 33% use 1.5 x 4 gpcd, the result is 5.7 feet. This has been rounded down to account for more drought-tolerant landscaping at Deerlake Ranch.

<sup>11</sup> This compares to an annual water budget of 85,000 gallons per day (80% of 5 feet, or 4 feet).

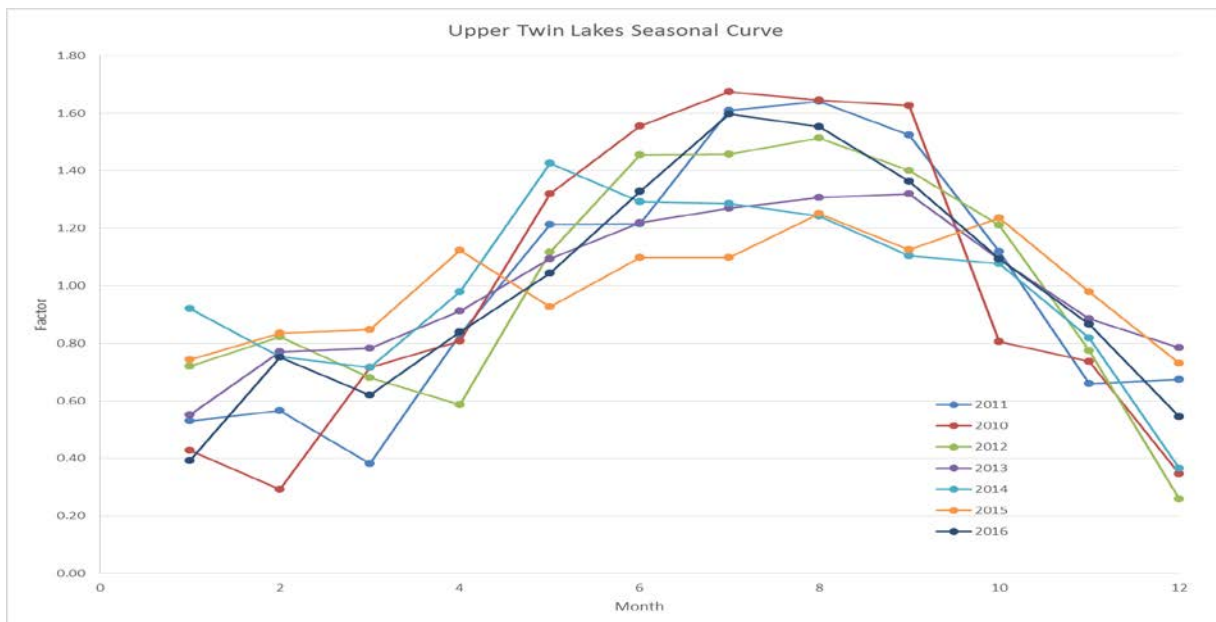
<sup>12</sup> Assumes 50% of these areas will eventually be landscaped and 2.6 feet of water will be applied per year.

<sup>13</sup> Based on 2.6-2.8 feet per year, from 2007 Master Plan, but factoring in more drought-tolerant plantings.

<sup>14</sup> 80% of ET<sub>o</sub>; assumes mostly turf.



**Figure 2. Seasonal Curve - Twin Lakes Subsystem**



**Figure 3. Seasonal Curve – Upper Twin Lakes Subsystem**

### Average Day Demand

Average day demand (ADD) is the volume of water consumed on the average day. For the Deerlake Ranch development, it is estimated to be the sum of the estimated indoor and outdoor usage as computed above.

$$\begin{aligned} \text{Deerlake Ranch ADD} &= \text{average indoor and outdoor use} \\ &= 52^{15} + 185^{16} = 240 \text{ gpm (rounded)} \end{aligned}$$

### Maximum Day Demand

For sizing of pumping and storage facilities, the maximum daily demand (MDD) is important. The MDD peaking factor (PF) is the ratio of the volume of water used on the maximum demand day to the ADD. Table 8 shows calculations of the MDD PF for the last seven years for both the Twin Lakes and Upper Twin Lakes zones.

**Table 8. Recent MDD, ADD, and MDD PF for Twin Lakes and Upper Twin Lakes Zones**

| YEAR   | Twin Lakes System |           |        | Upper Twin Lakes System |           |        |
|--------|-------------------|-----------|--------|-------------------------|-----------|--------|
|        | MDD (gpm)         | ADD (gpm) | MDD PF | MDD (gpm)               | ADD (gpm) | MDD PF |
| 2010   | 1187              | 321       | 3.7    | 196                     | 90        | 2.2    |
| 2011   | 855               | 341       | 2.5    | 377                     | 103       | 3.7    |
| 2012   | 1192              | 342       | 3.5    | 333                     | 109       | 3.1    |
| 2013   | 1052              | 382       | 2.8    | 399                     | 120       | 3.3    |
| 2014   | 891               | 366       | 2.4    | 353                     | 116       | 3.0    |
| 2015   | 783               | 304       | 2.6    | 229                     | 93        | 2.6    |
| 2016   | 783               | 337       | 2.3    | 237                     | 93        | 2.6    |
| DESIGN | 1200              | 400       | 3.7    | 400                     | 120       | 3.7    |

For its last two master plans, LVMWD has used a MDD PF of 3.2, based on calculations performed in 2007. For design of a new system, the MDD PF should be the highest that is reasonably expected to be experienced without a fire or other emergency. A MDD PF of 3.7 is therefore appropriate.

$$\text{Deerlake Ranch MDD} = \text{MDD PF} \times \text{ADD} = 3.7 \times 240 = 890 \text{ gpm}$$

### Peak Hour Demand

Similarly, the peak-hour demand (PHD) is important for the sizing of pipelines and other facilities that must handle instantaneous demands. The PHD is the maximum flow required on the peak hour of the maximum demand day. The PHD PF (as used in this analysis) is the ratio of this flow to the average flow for the year.

Table 9 shows calculations of the MDD PF for the last seven years for both Twin Lakes and Upper Twin Lakes pressure zones.

<sup>15</sup> From Table 4.

<sup>16</sup> From Table 7.

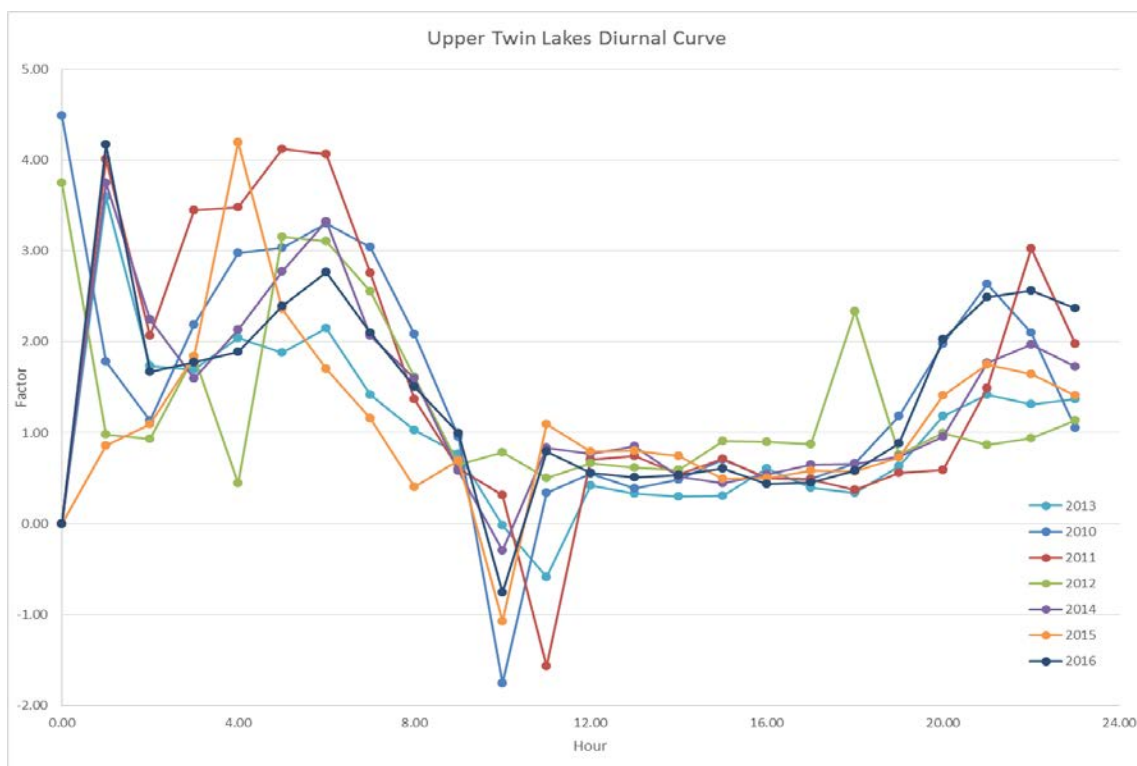


**Table 9. Recent PHD Peaking Factors for Twin Lakes and Upper Twin Lakes Zones**

| YEAR | Twin Lakes System | Upper Twin Lakes System |
|------|-------------------|-------------------------|
| 2010 | 2.6               | 4.5                     |
| 2011 | n/a               | 4.1                     |
| 2012 | 4.6               | 3.8                     |
| 2013 | n/a               | 3.7                     |
| 2014 | 4.8               | 3.8                     |
| 2015 | 3.6               | 4.2                     |
| 2016 | 4.7               | 4.2                     |

n/a = not available (poor data)

Figure 4 illustrates hourly peaking factors for Upper Twin Lakes, calculated from operational data (SCADA data) provided by the District. As expected, flows peak between 6AM and 7AM, and bottom out at mid-day. This figure also illustrates errors inherent in the calculations. The negative values are fictitious, produced when a tank level rise is recorded after the pump has shut down.



**Figure 4. Hourly peaking factors for the Upper Twin Lakes Subsystem**

For its last two master plans, LVMWD has used a PHD PF of 8.5, based on calculations performed in 2007.

For design of a new system, the MDD PF should be the highest that is reasonably expected to be experienced without a fire or other emergency. Therefore, a PHD PF of 5.0 is appropriate.

$$\text{Deerlake Ranch PHD} = \text{PHD PF} \times \text{ADD} = 5 \times 240 = 1200 \text{ gpm (rounded)}$$

## Summary of Results

Table 10 summarizes the estimated demands on the Twin Lake PS upon build-out of the Deerlake Ranch development.

**Table 10. Analysis of Twin Lakes Pressure Zone Maximum Day Demands**

|  | Flow rate (gpm) |
|--|-----------------|
| Existing Twin Lakes Zone MDD   | 1200            |
| Upper Twin Lake Zone MDD   | 400             |
| Allowance for Undeveloped Lots in TL and UTL zones                                   | 50              |
| Estimated Deerlake Ranch MDD   | 890             |
| Total Demand on Twin Lakes PS  | 2540            |
| Fire Flow (per Church of the Rocky Peak, record drawings, for 3 hours) <sup>17</sup> | 3750            |

Pumping and storage facilities will need to be adequately sized to meet the above demands. In addition, pipelines will need to be sized to meet peak-hour demands within the zone of 1200 gpm.

## Closure

Estimating water demands for Deerlake Ranch is inherently problematic since it involves predicting the future behavior of hundreds of future customers. Because these demands will be imposed on existing facilities, the ability to absorb these demands is very limited, so the estimates need to be both accurate and conservative.

Elsewhere in the LVMWD system, demands from new developments have exceeded estimates that were based on historical consumption data. In the cases of the Upper Twin Lakes and Upper Oaks systems, new pump stations serving these facilities were sized for demands that were less than what was ultimately experienced, but because these facilities had been designed for 9-hour pumping, they had significant capacity to absorb additional demands by extending operations for more than 9 hours. While the pumping time at Twin Lakes PS could be extended a little (from 18 hours to 24 hours), the added capacity is less substantial, and no margins for operational errors would exist.

\* \* \*

HDR appreciates the opportunity to provide this analysis. If there are any questions, please don't hesitate to contact Dan Ellison at 213.200.5152, [dan.ellison@HDRinc.com](mailto:dan.ellison@HDRinc.com).

<sup>17</sup> Fire flow is determined by the largest structure in the zone.