EMFAC Modeling Change Technical Memo

**SUBJECT:** GASOLINE SALES VOLATILITY (RVP)

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# SUMMARY

Beginning in 1996, State regulation (Title 13, California Code of Regulations §2262.4) requires that all gasoline sold in California meet low-volatility (less than 7.0 Reid vapor pressure (RVP)) requirements in the summer ozone months. The allowed volatility levels vary as to the start and end times in the year by county or air basin. Under the regulation, gasoline producers must begin producing and shipping compliant gasoline one month prior to the time at which all retail outlets must meet the specification.

The volatility of the gasoline fuel sold is stored in the EMFAC model as a function of time (calendar year), month of the year, and county. The current version of EMFAC does not accurately reflect the control periods for all areas except the South Coast Air Basin. To conform with this required specification, we have revised the control periods for a number of areas as shown in Table 1. This change affects only the annual-average inventory. Note that while the regulation allows for a one month extension in 2003 for the South Coast Air Basin and Ventura County, San Diego Air Basin, Mojave Desert Air Basin, and the Salton Sea Air Basin, we have not incorporated this one year exemption into the EMFAC Model as it only affects one month during that year and its impact on emissions is very small.

We have also changed the manner in which we calculated the winter-average RVP. Previously, we used the maximum RVP values found during the winter for use in calculating the winter-average day emissions before and after 1996. We are now changing this approach to use an average of the December, January, and February monthly RVP values.

Correcting the spring and fall values of RVP decreases the evaporative emissions (hydrocarbons) by 2.4 tpd out of a total of 287 tpd statewide in 2010, a 0.8% decrease. Using the winter-average RVP values instead of the maximum winter value lowers the winter-average day evaporative emission estimate by about 100 tpd to 975 tpd statewide for the year 1990, an approximately 9% decrease. For the year 2010, the effect on the winter-season average is a decrease of 46 tpd or 12%.

Table 1. RVP by air basin by month, 1996 onward

|  |  |
| --- | --- |
| Air Basin | Gasoline Vapor Pressure (RVP) psi |
|  |  | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Ann Avg | Win-ter Avg |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Great Basin Valleys | New | 10.3 | 9.1 | 8.1 | 7.5 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.8 | 9.5 | 10.7 | 8.08 | 10.0 |
|  | Old | 10.3 | 9.1 | 8.1 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 8.7 | 9.5 | 10.7 | 8.13 | 10.7 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lake County | New | 11.0 | 9.6 | 9.0 | 7.8 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 7.8 | 9.8 | 11.9 | 8.4 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 7.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 8.7 | 9.8 | 11.9 | 8.5 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lake Tahoe | New | 11.0 | 9.6 | 9.0 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 7.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mojave Desert | New | 10.3 | 9.1 | 8.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.2 | 10.7 | 7.8 | 10.0 |
|  | Old | 10.3 | 9.1 | 7.2 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.5 | 10.7 | 8.0 | 10.7 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mountain Counties | New | 11.0 | 9.6 | 9.0 | 7.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| North Central Coast | New | 11.0 | 9.6 | 9.0 | 7.8 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 7.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| North Coast | New | 11.0 | 9.6 | 9.0 | 7.8 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 7.8 | 9.8 | 11.9 | 8.4 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 7.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 8.7 | 9.8 | 11.9 | 8.5 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Northeast Plateau | New | 11.0 | 9.6 | 9.0 | 7.8 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 7.8 | 9.8 | 11.9 | 8.4 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 7.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 8.7 | 9.8 | 11.9 | 8.5 | 10.8 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sacramento Valley | New | 11.0 | 9.6 | 9.0 | 7.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Salton Sea | New | 10.3 | 9.1 | 8.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.2 | 10.7 | 7.8 | 10.0 |
|  | Old | 10.3 | 9.1 | 7.2 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.5 | 10.7 | 8.0 | 10.7 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| San Diego | New | 10.3 | 9.6 | 8.2 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.3 | 7.9 | 10.4 |
|  | Old | 10.3 | 9.6 | 7.2 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.3 | 8.1 | 11.3 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| San Francisco Bay | New | 11.0 | 9.6 | 9.0 | 7.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| San Joaquin Valley | New | 11.0 | 9.6 | 9.0 | 7.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.9 | 8.2 | 10.8 |
|  | Old | 11.0 | 9.6 | 9.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.9 | 8.4 | 11.9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| South Central Coast | New | 10.4 | 9.6 | 8.5 | 7.7 | 7.3 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.3 | 8.1 | 10.4 |
|  | Old | 10.4 | 9.6 | 8.5 | 7.7 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.3 | 8.3 | 11.3 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| South Central Coast | New | 10.4 | 9.6 | 7.7 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.3 | 11.3 | 7.9 | 10.4 |
| Ventura County | Old | 10.4 | 9.6 | 8.5 | 7.7 | 6.8 | 6.8 | 6.8 | 6.8 | 7.2 | 7.8 | 9.8 | 11.3 | 8.3 | 11.3 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| South Coast  | New | 10.4 | 7.6 | 7.2 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.7 | 11.1 | 7.7 | 9.7 |
|  | Old | 10.4 | 7.6 | 6.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 10.5 | 11.1 | 7.8 | 11.1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

# NEED FOR REVISION

SSD Fuels Section staff noted a problem wherein the assumed fuel RVP at the beginning and end of summer was higher than the low-volatility regulation required.

During the process of inspecting the monthly RVP values for each of the 75 years included in the EMFAC model, we noticed that the annual average and summer average values were often off by 0.1 to 0.2 psi. We also noted that the RVP value used for winter-average-day estimations was the largest over the winter months (same as the maximum of the year, always in December). There are no regulatory limitations on volatility for the winter months. The model values are based on refinery survey data. Since all the other averages were being recalculated, we decided it was opportune to correct and use the winter averages for the average winter day scenario.

**AFFECTED SOURCE CODE/VERSION**

RVPASSIGN.for (6/25/01) containing subroutine RVP\_INIT, a matrix of the values of Reid Vapor Pressure (in psi) of gasoline expected to be sold by month and calendar year for all the counties and sub-county areas in the state. The summer-average, winter-average, and annual-average RVP values for each year are also tabulated in the matrix.

## METHODOLOGY FOR REVISION

State fuels regulations limit the RVP during the summer months to 7 psi. This level was required beginning in 1996. Data from refiners in the South Coast region indicate that 6.8-psi volatility fuel is sold during the periods that require 7 psi. Therefore, 6.8 psi was inserted for the actual RVP during the times that require 7-psi-volatility fuel to be sold.

The regulations require the gasoline volatility at the refinery transfer points to transition to low-volatility values one month before the required start dates at the retail gas pumps. Our historical RVP data produced in the South Coast region was for product at the refinery. We assumed that the period or time delay before this fuel reached the retail gas pumps was approximately 2 weeks. Thus for the model we assumed that, during the spring transition month, the volatility at the gas pump was the average of the prior month’s actual reported and the future month’s target. During the fall transition, we assumed the gas-pump product-volatility was the average of the previous month’s (regulated) value and the next month’s reported, un-regulated value.

Changing the monthly RVP values changed the annual average figure, so this was corrected for the years 1996 to 2040.

In inspecting the RVP values we noticed that the maximum monthly RVP was used for the winter RVP value. The winter-average RVP value (average of December, January, and February values) was substituted for this value.

A summary of the before and after RVP numbers for the different air basins for 1996 onward is shown in Table 1.

The comparison is stored electronically in the spreadsheets rvpassign.xls and rvpassign2.xls. rvpassign2.xls shows what was changed between the June 2001 version of rvpassign and the April 2002 version, namely the winter average values. rvpassign.xls shows the comparison between the April 2002 version and the July 2002 version, namely the spring and fall transition values. No entry in the “after” (7/19/2002 or 3/21/2002) columns means the line is unchanged.

# INVENTORY EFFECTS

Changing the spring or end-of-summer RVP values to 6.8 from 7.2 or 7.8 psi has a small effect on the annual-average evaporative emissions, about 2.4 tpd in 2010, 0.8% of the onroad evaporative emissions. This change has no effect on the summer-average emission estimates, because the values for the months of June, July and August were not changed. Changing the winter-average basis RVP value downward from largest value to December-January-February average value has no effect on the annual-average evaporative emissions, has no effect on the December or January or February emissions estimates or results from the model, but lowers the average winter-day estimates by 46 tpd or 12%.

To determine these effects the changed monthly and average commercially available gasoline volatility (RVP) values were modified. Statewide sub-area runs were performed without the change and with the modified RVP values. The runs were done for 2010 on an annual basis, and for 1990 on an annual and winter-season basis. The results are shown side by side in Table 2 below. Table 2 shows the absolute emissions as well as the number of vehicles and the number of vehicle-miles traveled per day. These are shown so one can apportion a particular sub-area on the basis of population or VMT in comparison with the state. For example in Table 2, one can tell that it is a statewide basis because the number of vehicles is about three quarters of the state population. It also allows computation of per-mile emission rates to compare to state exhaust and evaporative standards. The exhaust emissions are shown also for comparison or context. One can see from the specific gram-per-mile numbers that, from 1990 to 2010, while the population of cars and the miles traveled has increased quite a bit, the per-mile exhaust and evaporative emissions are to be cut by a factor of five or six.

Lowering the estimate of winter-season gasoline sales volatility for the years 1965 through 1995 has no effect on the annual-average evaporative emissions for those years. This is because the annual averages are calculated from the results for the twelve individual months, which were not changed. The effect of changing the winter RVP from the maximum monthly to the average monthly for the average winter day (December through February) is a 98-tpd decrease of evaporative emissions for 1990 (an approximately 9% decrease).

Table 2. Effect of RVP Changes. (Statewide, on-road)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2010 Annual New RVP | 2010 Annual Old RVP | 1990 Annual New RVP | 1990 Annual Old RVP |
| # Vehicles | 27,670,000 | 19,379,500 |
| VMT, mi/d | 942,319,000 | 689,783,000 |
|  | tpd | g/mi | tpd | g/mi | tpd | g/mi | tpd | g/mi |
| Exhaust HC | 351.0 | 0.34 | 351.0 | 0.34 | 1486.5 | 1.96 | 1486.5 | 1.96 |
| Evap HC | 287.2 | 0.28 | 289.6 | 0.28 | 871.2 | 1.15 | 871.2 | 1.15 |
|  |  |  |  |  |  |  |  |  |
|  | 2010 Winter New RVP | 2010 Winter Old RVP | 1990 Winter New RVP | 1990 Winter Old RVP |
|  | tpd | g/mi | tpd | g/mi | tpd | g/mi | tpd | g/mi |
| Exhaust HC | 358.0 | 0.34 | 358.0 | 0.34 | 1519.5 | 2.00 | 1519.5 | 2.00 |
| Evap HC | 336.7 | 0.32 | 382.3 | 0.37 | 974.8 | 1.28 | 1073.0 | 1.41 |

Table 3 shows the effects of the RVP change in four sub-areas of the state for the year 2010 (annual average day). Values are given for the new, revised RVP values, the unchanged previous RVP values, and the decrease or difference.

Table 3 lists the absolute tons per day emissions and also lists the number of registered vehicles in the subareas and the vehicle-miles traveled (VMT) in vehicle-miles per day. These are interesting because they allow apportionment of importance in comparison with the statewide numbers. They also allow calculation of the per-mile specific emission rates. Table 3 also lists the amount of fuel used in the subareas and the per-vehicle fuel consumption and the per-gallon specific evaporative emission rates. This allows importance comparisons between off-road and on-road sources. For example, in Table 3 the average car uses about 600 gal/y of gasoline, and there is about 1 car per resident. Thus it would be expected that offroad gasoline usage will be insignificant in comparison with this. Also the specific evaporation rates of 12 to 14 lb/Mgal (pounds per thousand gallons) can be compared to the uncontrolled rate for 10-psi RVP gasoline of about 10 lb/Mgal, and the controlled (vapor-recovery) rate at gas stations and terminals of about 1 lb/Mgal.

The estimated change for the South Coast Air Basin is zero because the RVPs for South Coast were correct before the RVP change. The modeled response of the refineries’ gasoline-sales-RVP values in spring and fall to the 7.0-psi-RVP requirement was taken from actual data from South Coast refineries. The effect of this correction of the RVP values in the San Francisco Bay Air Basin (2010) is estimated to be 0.7 tpd decrease out of total evaporative emissions of 54 tpd, or 1.3%, two-thirds of which decrease is in running loss reductions.

Table 4 shows the effects of the change of the winter-season RVP basis from the largest (December) value to the December-January-February for four areas in 2010. The effect in the South Coast Air Basin is a 21 tpd decrease (15% of evaporative HC), about half in the running loss, and half in hot-soak.

Table 3. Result of RVP Change.

Annual average 2010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | South Coast Air Basin2010 | Santa Barbara County2010 | San Francisco Bay Air Basin2010 | Sacramento County2010 |
|  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  | Revised RVP version | Pre-vious RVP values | De-crease | Specific Emis-sions  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  |
| Vehicles | 10,646,000 |  | 332,784 |  | 5,624,280 |  | 1,049,190 |  |
| VMT | 356,437,000 mi/d | 12,221 mi/y | 10,736,000 mi/d | 11,775 mi/y | 175,757,000 mi/d | 11,406 mi/y | 35,533,000 mi/d | 12,361 mi/y |
|  | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi |
| Total Exh HC | 120.73 | 120.73 | 0 | 0.308 | 5.40 | 5.40 |  | 0.457 | 68.31 | 68.31 |  | 0.353 | 12.12 | 12.12 |  | 0.310 |
| Diurnal  | 12.10 | 12.10 | 0 | 0.031 | 0.31 | 0.31 |  | 0.026 | 5.22 | 5.28 | 0.06 | 0.027 | 1.35 | 1.37 | 0.02 | 0.034 |
| Hot Soak | 12.29 | 12.29 | 0 | 0.031 | 0.39 | 0.40 | 0.01 | 0.033 | 5.94 | 6.12 | 0.18 | 0.031 | 1.27 | 1.31 | 0.04 | 0.032 |
| Running  | 75.37 | 75.37 | 0 | 0.192 | 2.90 | 2.92 | 0.02 | 0.245 | 40.49 | 40.89 | 0.40 | 0.209 | 8.49 | 8.57 | 0.08 | 0.217 |
| Resting  | 6.38 | 6.38 | 0 | 0.016 | 0.16 | 0.16 |  | 0.014 | 2.48 | 2.50 | 0.02 | 0.013 | 0.53 | 0.53 |  | 0.014 |
| Total Evap HC | 106.14 | 106.14 | 0 | 0.270 | 3.76 | 3.79 | 0.03 | 0.318 | 54.13 | 54.79 | 0.66 | 0.280 | 11.64 | 11.78 | 0.14 | 0.297 |
| Specific Evap, Emissions |  |  |  | 12.0 lb/Mgal |  |  |  | 14.1 lb/Mgal |  |  |  | 13.2 lb/Mgal |  |  |  | 13.9 lb/Mgal |
| Gasoline usage | 17670.76 Mgal/d | 606 gal/y | 531.61 Mgal/d | 583 gal/y | 8181.75 Mgal/d | 531 gal/y | 1673.31 Mgal/d | 582 gal/y |
| Diesel usage | 3035.02 Mgal/d | 104 gal/y | 91.61 Mgal/d | 100 gal/y | 1484.36 Mgal/d | 96 gal/y  | 333.77 Mgal/d | 116 gal/y |

Table 4. Result of RVP Change.

Winter-season average 2010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | South Coast Air Basin Winter 2010 | Santa Barbara County Winter 2010 | San Francisco Bay Air Basin Winter 2010 | Sacramento CountyWinter 2010 |
|  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  | Revised RVP version | Pre-vious RVP values | De-crease | Specific Emis-sions  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  | Revised RVP version,  | Pre-vious RVP values, | De-crease | Specific Emis-sions  |
| Vehicles | 10,646,000 |  | 332,784 |  | 5,624,280 |  | 1,049,190 |  |
| VMT | 356,437,000 mi/d | 12,221 mi/y | 10,736,000 mi/d | 11,775 mi/y | 175,757,000 mi/d | 11,406 mi/y | 35,533,000 mi/d | 12,361 mi/y |
|  | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi | tpd | tpd | tpd | g/mi |
| Total Exh HC | 120.7 | 120.7 |  | 0.31 | 5.4 | 5.4 |  | 0.46 | 71.3 | 71.3 |  | 0.37 | 12.6 | 12.6 | 0.2 | 0.32 |
| Diurnal  | 12.4 | 14.4 | 2.0 | 0.03 | 0.4 | 0.4 |  | 0.03 | 4.0 | 4.3 | 0.3 | 0.02 | 0.7 | 0.8 | 0.1 | 0.02 |
| Hot Soak | 18.7 | 28.8 | 9.9 | 0.05 | 0.7 | 0.9 | 0.2 | 0.06 | 9.8 | 13.6 | 3.8 | 0.05 | 1.9 | 2.6 | 0.7 | 0.05 |
| Running  | 87.3 | 96.4 | 9.1 | 0.22 | 3.4 | 3.6 | 0.2 | 0.29 | 49.3 | 53.1 | 3.8 | 0.25 | 10.1 | 10.9 | 0.8 | 0.26 |
| Resting  | 5.8 | 6.1 | 0.3 | 0.01 | 0.2 | 0.2 |  | 0.01 | 1.7 | 1.7 |  | 0.01 | 0.3 | 0.3 |  | 0.01 |
| Total Evap HC | 124.3 | 145.6 | 21.3 | 0.32 | 4.6 | 5.1 | 0.5 | 0.39 | 64.8 | 72.7 | 7.9 | 0.33 | 13.0 | 14.6 | 1.6 | 0.33 |
| Specific Evap, Emissions |  |  |  | 14.4 lb/Mgal |  |  |  | 17.5 lb/Mgal |  |  |  | 16.0 lb/Mgal |  |  |  | 16.2 lb/Mgal |
| Gasoline usage | 17243.7 Mgal/d | 591 gal/y | 529.1 Mgal/d | 580 gal/y | 8071.0 Mgal/d | 524 gal/y | 1604.9 Mgal/d | 558 gal/y |
| Diesel usage | 3035.0 Mgal/d | 104 gal/y | 91.6 Mgal/d | 100 gal/y | 1484.4 Mgal/d | 96 gal/y | 333.8 Mgal/d | 116 gal/y |