CHAPTER 6
Water Supply Reliability

Water Code §10631 (c)
(c) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(1) An average water year.
(2) A single dry water year.
(3) Multiple dry water years.

For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

6.1 RELIABILITY AND VULNERABILITY

As described in Chapter 3, the City relies on two primary sources of water supplies: wholesale Tuolumne River surface water deliveries from MID and local groundwater pumping. In general, the City’s and MID’s water supplies are most vulnerable to climatic variability and chemical contamination (due to natural and/or man-made constituents). Drought conditions can significantly reduce available surface water supplies. The reliability of the surface water supply is dependent on hydrologic variations and the ability to store and extract water from available storage reservoirs.

Precipitation, river flows and the incidental recharge of applied irrigation water are the primary sources of groundwater recharge to the groundwater basin. While drought conditions can reduce available groundwater supplies by reducing available recharge, this effect is less pronounced for groundwater than for surface water supplies, and is not expected to result in a reduction in pumping in dry years.

Rather, by using surface water in lieu of groundwater in normal years, the City will bank groundwater supplies for use in meeting dry year and peak period demands. The City’s future water supply planning incorporates sufficient future surface water supplies to allow the City to meet demands primarily through the use of surface water, allowing the in-lieu banking of groundwater for future use, thereby protecting the groundwater basin from overdraft and water quality degradation. The water supply, demand and shortfall estimates presented herein assume that the City will use surface water from MRWTP as its primary supply source for meeting demands north of the Tuolumne River, allowing the City to do in-lieu groundwater banking for future use in meeting demands in excess of available surface water supplies in dry years. For the City’s service area south of the Tuolumne River, groundwater will continue to serve as the source of supply. However, the City is evaluating participation in the RSWSP, which would provide additional supply reliability and allow the City to implement an in-lieu groundwater banking strategy in this portion of the City’s service area.

In contrast to surface supply reliability, reliability of local groundwater supplies is threatened by poor water quality. In the past, contamination from arsenic, uranium, perchloroethylene (PCE), trichloroethylene (TCE), dibromochloropropane (DBCP) and nitrate has resulted in the need for wellhead treatment to keep wells from being taken out of service. The City has developed a strategy to keep existing wells on-line and bring selected out of service wells back on-line through a combination of wellhead treatment, blending, and aggressive monitoring. As a result,
and as described further in Chapter 7, the City does not anticipate groundwater quality to threaten the City’s ability to pump and deliver groundwater supplies as needed to meet current and future demands.

Legal issues, including place of use and water rights issues, are also not anticipated to limit supply reliability for the City in future years. In certain situations, environmental factors can sometimes limit the reliability of surface water supplies, such as during a drought when dry year supply cutbacks are necessary to maintain the health of aquatic species and the environment in general. This issue is of particular concern for Delta water users, where dry year supplies can be greatly reduced to maintain adequate water supplies for environmental purposes. Although environmental issues to date have not been a limiting factor in available water supplies to the City, the regulatory process under FERC relicensing introduces potential uncertainties. Additionally, backup power and transmission/distribution system redundancies add reliability to the extraction, treatment and distribution of surface and groundwater supplies to existing and future customers.

Table 6-1 summarizes the factors contributing to vulnerability of the City and MID supplies.

<table>
<thead>
<tr>
<th>Name of Supply</th>
<th>Specific Source Name, if any</th>
<th>Limitation Quantification</th>
<th>Legal</th>
<th>Environmental</th>
<th>Water Quality</th>
<th>Climatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MID Wholesale Supply</td>
<td>Tuolumne River Diversions</td>
<td>None</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Groundwater(a)</td>
<td>Modesto, Turlock and Delta Mendota Subbasins</td>
<td>None</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

(a) Local groundwater is vulnerable to climate and water quality events. However, the City plans to maintain current groundwater supply availability through well monitoring for early detection, well rehabilitation, wellhead treatment, and blending.

### 6.2 PROJECTED WATER SUPPLIES

#### 6.2.1 City of Modesto Projected Water Supplies

The City/MID *Amended and Restated Treatment and Delivery Agreement* specifies a maximum delivery of 42 inches of water or the amount calculated as \((y/42)\) times 33,602 AFY, whichever is less (where \(y\) is the actual number of inches of water allocated by MID to agricultural water users for the irrigation season)\(^1\). Although the Agreement specifies a formula for water allocations during shortages, the reduction in supply is not determined until the time of the

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\(^1\) As described in the *Amended and Restated Treatment and Delivery Agreement*, upon completion of MRWTP Phase Two (anticipated in late 2012), the treated water quantity shall be changed from 33,602 AFY to 67,204 AFY.
shortage (Amended and Restated Treatment and Delivery Agreement, Section 17.2 Formula for Water Allocation).

The Amended and Restated Treatment and Delivery Agreement provides the opportunity for the City to purchase additional water from MID or to trade groundwater for agricultural use for treated surface water to achieve the full entitlement during drought years if such supplemental supplies are available. For example, in 1991, base supply was defined as 33 inches of the total 42-inch water allocation. MID made the remaining 9 inches available as an optional supply at a higher rate than base supply, resulting in a possible 100 percent allotment. If the remaining 9 inches had not been available, there would have been a surface water supply shortage.

For the purpose of estimating supply reductions during droughts, estimated MID delivery cutbacks were based on the 1991 condition. It was assumed that 1991 was the fifth year of a five-year drought (for the 1987 to 1992 drought as documented by the California Department of Water Resources), with equally proportioned shortages for the five years (or 9 inch reduction/5 years for a 1.8-inch effective reduction per year). Therefore, the MID delivery cutbacks experienced in each successive drought year would be as follows:

- First year cutback: 1.8/42 inches (4.3 percent)
- Second year cutback: 3.6/42 inches (8.6 percent)
- Third year cutback: 5.4/42 inches (12.9 percent)
- Fourth year cutback: 7.2/42 inches (17.1 percent)
- Fifth year cutback: 9/42 inches (21.4 percent)

It was assumed that, for a single dry year, MID delivery cutbacks would be equal to those experienced in 1991 (9/42 inches, or 21.4 percent).

In dry years, the City will supplement reduced surface water supplies with banked groundwater supplies, as necessary, to meet demands. Groundwater basin storage beneath the City is stable, and is not in any type of overdraft condition, as supported by stable long-term groundwater levels from wells located throughout the service area.

The basis for calculating projected demands and supply availability for each water year type are presented in Table 6-2.
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Water Supply Reliability

Table 6-2. Basis for City of Modesto & MID Water Year Data (DWR Table 27)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Base Year(s)</th>
<th>Assumed Water Supply Availability</th>
<th>Groundwater Pumping</th>
<th>Total Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average/Normal Year</td>
<td>1984(a)</td>
<td>Current MID supply of 33,602 AFY as described in Treatment and Delivery Agreement. MID supply will increase to 67,204 AFY with completion of MRWTP Phase Two.</td>
<td>Assumed to be equal to total demand minus MID deliveries north of the Tuolumne River.</td>
<td>Assumed to be equal to MID deliveries plus groundwater pumping</td>
</tr>
<tr>
<td>Single Dry Water Year</td>
<td>1991</td>
<td>Assumes 21.4 percent reduction in surface water supplies (equal to last year of multi-year drought)</td>
<td>Assumed to be equal to total demand minus MID deliveries north of the Tuolumne River.</td>
<td>Assumed to be equal to MID deliveries plus groundwater pumping</td>
</tr>
<tr>
<td>Multiple Dry Water Years</td>
<td>1987-1991</td>
<td>Assumes 4.3 percent reduction in surface and other water supplies per year (based on 1991 MID cutbacks of 9 inches spread equally over 5 years)</td>
<td>Assumed to be equal to total demand minus MID deliveries north of the Tuolumne River.</td>
<td>Assumed to be equal to MID deliveries plus groundwater pumping</td>
</tr>
</tbody>
</table>

(a) 1984 is representative of normal conditions for the area, based on the characterization of the year as an above normal year using the San Joaquin Valley Water Year Type Index. The index characterizes water year type based on the unimpaired flow at the following four locations: Stanislaus River below Goodwin Reservoir, Tuolumne River below La Grange, Merced River below Merced Falls, and San Joaquin River inflow to Millerton Lake. The unimpaired runoff for 1984 was 3.69 million AF. Above normal flow is characterized as flows greater than 3.1 MAF and less than 3.8 MAF.

Table 6-3 shows the historical supply reliability of the City’s supplies in the base years shown in Table 6-2. It should be noted that the City was not purchasing water supplies from MID in the base years shown (deliveries from MID to the City began in 1995 with the completion of the MRWTP); therefore, the quantities shown are based on what the available supplies would have been based on given hydrologic conditions.

Table 6-3. City of Modesto Historical Supply Reliability, AFY (DWR Table 28)

<table>
<thead>
<tr>
<th>Supply</th>
<th>Average/Normal Year</th>
<th>Single Dry Water Year</th>
<th>Multiple Dry Water Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>MID Supply—Urban Base Supply(a)</td>
<td>33,600</td>
<td>26,400</td>
<td>32,200</td>
</tr>
<tr>
<td>MID Supply—Total Urban Supply(b)</td>
<td>33,600</td>
<td>33,600</td>
<td>33,600</td>
</tr>
<tr>
<td>Groundwater(c)</td>
<td>53,500</td>
<td>53,500</td>
<td>53,500</td>
</tr>
<tr>
<td>Percent of Average/Normal Year</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

(a) Hypothetical supply available to the City if the MRWTP had been available in the base years shown. Phase 1 of the MRWTP was completed in 1995. Assumes only Phase 1 of the MRWTP was available.

(b) Assumes that optional supply would be made available by MID to the City, as was available from MID in 1991.

(c) Based on the estimated “operational yield” of the groundwater basin underlying the City’s service area.
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Water Supply Reliability

Based on the criteria described above, Table 6-4 shows the City’s minimum supply reliability for the next three years based on its current available supplies.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MID Supply via the MRWTP(a)</td>
<td>33,600</td>
<td>33,600(b)</td>
<td>33,600</td>
<td>67,200(c)</td>
</tr>
<tr>
<td>Local Groundwater(d)</td>
<td>53,500</td>
<td>53,500</td>
<td>53,500</td>
<td>53,500</td>
</tr>
<tr>
<td>Total</td>
<td>87,100</td>
<td>87,100</td>
<td>87,100</td>
<td>120,700</td>
</tr>
</tbody>
</table>

(a) MID may make additional water beyond base supply available to the City at an additional cost. The City may also deliver groundwater to MID’s irrigation canal system in exchange for an equal amount of raw surface water to be treated at the MRWTP during dry years in order to eliminate shortfall that would otherwise occur.

(b) Based on Total Urban Supply assumed to be available from MID (assumes optional supply will be available from MID).

(c) Assumes MRWTP Phase Two will be completed in late 2012.

(d) Based on the estimated “operational yield” of the groundwater basin underlying the City’s service area.

6.2.2 Modesto Irrigation District Projected Water Supplies

As described above, MID surface water supplies are subject to cutbacks based on climatic variability. However, as described above, even in 1991, MID was able to make optional supplies available to its irrigation customers resulting in a 100 percent allotment. It is anticipated that MID would continue to maintain this supply reliability in conjunction with the completion of MRWTP Phase Two.

6.3 WATER MANAGEMENT TOOLS AND OPTIONS TO MAXIMIZE RESOURCES AND MINIMIZE THE NEED TO IMPORT WATER FROM OTHER REGIONS

10620(f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

6.3.1 City of Modesto Management Tools and Options

The City’s current supply mix of local Tuolumne River water from MID and groundwater provides considerable flexibility in maximizing local resources. MID supply is treated at the MRWTP. The California Department of Public Health operating permit for the MRWTP does not allow treatment of supply other than from the Tuolumne River. Design of specific treatment methods at the plant are also based on the water chemistry of that local source.

The City currently maximizes the use of its surface water supply from MID in normal and wetter years. Currently, the City can receive 33,600 AFY from MID, increasing to 67,200 AFY, upon completion of MRWTP Phase Two, anticipated in late 2012. Use of this surface water supply gives the City the flexibility to preserve its groundwater supplies, through in-lieu banking.

The City is also pursuing participation in the Regional Surface Water Supply Project, which would provide local Tuolumne River water from TID in areas of south Modesto, south of the Tuolumne River.
To minimize the City’s vulnerability to groundwater quality issues, the City has also developed strategies to maintain and enhance its groundwater extraction capacity through a combination of well monitoring for early detection, well rehabilitation, wellhead treatment and blending.

With these available management tools, the City does not currently foresee a need to import water from other regions.

6.3.2 Modesto Irrigation District Management Tools and Options

MID is primarily an agricultural water supplier. Through its service agreements with agricultural users, MID has the ability to reduce deliveries in drought years when surface water supplies are reduced. MID also has more than 100 groundwater wells that it owns and maintains that are used to supplement surface water supplies during dry conditions when surface water supplies are limited. Groundwater wells are used for agricultural supply and are not used for drinking water purposes. MID does not currently foresee a need to import water from other regions.

6.4 POTENTIAL FUTURE WATER SUPPLY PROJECTS

6.4.1 City of Modesto Potential Future Water Supply Projects

As described in Chapter 3, the City is also evaluating potential participation in other surface water supply projects, including a potential future MRWTP Phase Three, which could result in additional treated water deliveries north of the Tuolumne River, as well as potential participation in the RSWSP, which would provide treated surface water using water supplied by Turlock Irrigation District to areas south of the Tuolumne River.

The City has engaged in very preliminary discussions with MID regarding the possibility of implementing a MRWTP Phase Three Expansion project, but at this time, this project is speculative. For the RSWSP, some project planning, environmental review and design have previously been completed. The RSWSP project is currently under review by a steering committee made up of elected city council representatives of the four cities potentially participating in the project (Modesto, Ceres, Hughson and Turlock). The steering committee is anticipated to make a recommendation on whether and how to proceed with the project sometime in late 2011. Since water sales agreements have not yet been negotiated for either project, projected start and completion dates and anticipated supplies are listed as ‘TBD,’ or ‘to be determined.’ These potential projects are summarized in Table 6-5.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Projected Start Date</th>
<th>Projected Completion Date</th>
<th>Potential Project Constraints</th>
<th>Normal Year Supply</th>
<th>Single Dry Year Supply</th>
<th>Multiple Dry Year Supply (Year 1)</th>
<th>Multiple Dry Year Supply (Year 2)</th>
<th>Multiple Dry Year Supply (Year 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRWTP Phase Three</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>RSWSP</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>
6.4.2 Modesto Irrigation District Potential Future Water Supply Projects

As shown in Table 6-6, the potential future MRWTP Phase Three may provide additional urban supplies in the future.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Projected Start Date</th>
<th>Projected Completion Date</th>
<th>Potential Project Constraints</th>
<th>Normal Year Supply</th>
<th>Single Dry Year Supply</th>
<th>Multiple Dry Year Supply (Year 1)</th>
<th>Multiple Dry Year Supply (Year 2)</th>
<th>Multiple Dry Year Supply (Year 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRWTP Phase Three</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

6.5 CLIMATE CHANGE

It should be noted that currently there are no specific requirements related to addressing the potential impacts of future climate change on water supplies or water supply reliability included in either the UWMP Act or the Water Conservation Act of 2009. However, within the next 20 years, DWR expects that water supplies, water demand, sea level rise, and the occurrence and severity of natural disasters will be affected by climate change as follows:

- **Water Demand:** Hotter days and nights, as well as a longer irrigation season, will increase landscaping and irrigation water needs, and power plants and industrial processes will have increased cooling water needs. Peak water demands may also be impacted.

- **Water Supply and Quality:** Reduced snowpack, shifting spring runoff to earlier in the year, increased potential for algal bloom, and increased potential for seawater intrusion—each has the potential to impact water supply, supply reliability and water quality.

- **Sea Level Rise:** It is expected that sea level will continue to rise, resulting in near shore ocean changes such as stronger storm surges, more forceful wave energy, and more extreme tides. This will also affect levee stability in low-lying areas and increase flooding.

- **Natural Disaster:** Natural disasters are expected to become more frequent as climate change brings increased climate variability, resulting in more extreme droughts and floods. This will challenge water supplier operations in several ways as wildfires are expected to become larger and hotter, droughts will become deeper and longer, and floods can become larger and more frequent.

California is addressing the causes and impacts of climate change in a number of different forums. The Global Warming Solutions Act of 2006 (AB 32) clearly identified climate change as a “serious threat to the economic well-being, public health, natural resources, and the environment of California”. The California Air Resources Board completed the Climate Change Scoping Plan (2008) to support implementation of AB 32 and the California Natural Resources...
Agency issued the Climate Change Adaptation Strategy (2009) to identify how California will adapt to expected climate changes.

Responding to climate change generally takes two forms: mitigation and adaptation. Mitigation is taking steps to reduce the contribution to the causes of climate change by reducing greenhouse gas (GHG) emissions. Adaptation is the process of responding to the effects of climate change by modifying systems and behaviors to function in a warmer climate.

In the water sector, climate change mitigation is generally achieved by reducing energy use, becoming more efficient with energy use, and/or substituting fossil fuel-based energy sources for renewable energy sources. Because water requires energy to move, treat, use, and discharge, water conservation results in energy conservation. As each water supplier implements DMM/BMPs and determines its water conservation targets, it can calculate the conserved energy and the GHGs not-emitted as a side benefit. Additionally, water suppliers may want to reconsider DMM/BMPs that conserve water if they do so at a significant increase in GHG emissions. Also, water suppliers can adapt to climate change through the diversification of its water supply portfolio, increased conjunctive use and introduction or expansion of recycled water use.

For the City, the implementation of its proposed overall water conservation program (described in Chapter 5), particularly the completion of the residential metering program, will help to reduce water demands, and also conserve energy as a result of decreased treatment, conveyance and pumping requirements. The City’s compliance with SBx7-7 and its interim and final per capita water use targets will also ensure continued water conservation and energy conservation in the future. The City’s increased use of surface water supplies from MID’s MRWTP Phase Two will help to further diversify the City’s water supplies and enhance the City’s water supply reliability to “adapt” to the changing hydrologic conditions associated with climate change.