

4 Water Use Projections

SECTION 4

Water Use Projections

This chapter presents projections for future water use for both the 20-year planning period and full buildout within the urban growth boundary (UGB). Projection criteria and methodology are discussed.

Methodology for Water Use Projections

20-year Planning Period

The per capita approach, also known as the Single-Coefficient Method, was used for projecting demands within the 20-year planning period. This method estimates future water demand as a product of service area population and a constant per capita water use value developed from historical trends. Recent average and maximum day per capita water use values were presented in Chapter 3 Water Use History, page 3-4.

The criteria, assumptions, and data sources applied to the 20-year water use projections are enumerated below.

1. The *Linn County/Lebanon City Coordinated Population Forecast for the City of Lebanon* was made official in 1999 and was cited in the City of Lebanon's *Comprehensive Plan Update* (2004). In this population forecast, Lebanon's 1997 population was estimated at 12,190, and its annual average growth rate was estimated at 1.71 percent. To be consistent with the *Comprehensive Plan Update*, these population parameters were used to project population to the year 2050. The 2004 population estimate for the City of Lebanon (total city population, not the water service population) is 13,726.
2. The *Lebanon Urbanization Study* (2004) prepared by ECO Northwest and cited in the city's *Comprehensive Plan Update*, was used to determine household sizes (people/household) and household densities (households per gross acre) for multi-family and single family developments.
3. Multi-family dwellings (including duplexes, town homes, and apartments) will build out at a household size of 2.10 people per household.
4. Single family dwellings (including single family detached and manufactured homes) will build out at a household size of 2.60 people per household.
5. Mixed Density Residential zoning will build out at a household size of 2.38 people per household. This assumes that this zone will be developed with 55 percent single family dwellings at 2.60 people per household and 45 percent multi-family dwellings at 2.10 people per household ($0.55 \times 2.60 + 0.45 \times 2.10 = 2.38$).
6. Areas zoned "High Density Residential" are designated "Mixed Density Residential" or "Facility" in Lebanon's *Comprehensive Plan Update*. To be consistent with the *Comprehensive Plan*, buildout criteria for these areas were treated identically to the Mixed

Density Residential zone, with 2.38 people per household. Areas zoned High Density Residential are near buildout at this time, so this area does not contribute significantly to evaluation of service population growth.

7. Low Density Residential zoning will build out at a household size of 2.60 people per household. This assumes that 100 percent of Low Density housing will be single family.
8. Low Density Residential zoning will build out at a density of 4.84 single family dwelling units per gross acre.
9. Both High Density and Mixed Density Residential zones will build out at a density of 3.51 single family dwelling units per gross acre and a density of 2.85 multi-family dwelling units per gross acre. Summing these densities gives a composite build-out density of 6.37 dwelling units per gross acre.
10. The Mixed Use zone and land use designation allows all types of development including residential, commercial, and light industrial. For purposes of this analysis, the city assumes that, on average, the composition of developable land within this designation will be 50 percent Commercial, 25 percent Industrial, and 25 percent Mixed Density Residential. The residential component of this designation is therefore assumed to have a composite build-out density of 6.37 dwelling units per gross acre and a household size of 2.38 people per household.
11. Developed and developable land acreages for each of the comprehensive land use/zoning designations were calculated using GIS data layers compiled by ECO Northwest. The following data layers were used: 1) pressure zone overlay (produced by CH2M HILL), 2) City of Lebanon Zoning Map (County GIS), 3) City of Lebanon Comprehensive Plan Map (County GIS), and 4) City of Lebanon Land by Classification, Lebanon UGB Map (Map 2-2 as provided in the *Lebanon Urbanization Study*).
12. Zoning and land use designations were aggregated into the following broader land use categories: 1) all commercial zones/uses are aggregated into Commercial land use, 2) all industrial zones/uses are aggregated into Industrial land use, 3) Residential High Density (RH), 4) Residential Low Density (RL) (analogous to Single Family Residential land use designation), 5) Residential Mixed Density (RM) (analogous to Mixed Density Residential land use designation), and 6) Mixed Use (MU).
13. Service area population was determined by adding residential water customers outside the city limits (49 households in year 2004/2005 at an average RM zone density of 2.38 people per household equals 117 people) and subtracting those people within city limits who do not use city water (245 households at an average RM zone density of 2.38 people per household equals 583 people). This yields a 2004 service area population of 13,260 ($13,726 + 117 - 583 = 13,260$).
14. The estimate of 49 households using city water beyond the city boundaries is based on billing data provided by the City of Lebanon for $\frac{3}{4}$ -inch water meter residential accounts outside the city limits.
15. The estimate of 245 households within the city but without water service for the year 2004 is based on data found in the water billing summary reports for accounts identified as "280 WELL ON CITY SWR. "

Buildout Planning Period

Per capita water use may remain constant or it may vary over time. The per capita use may decline if the city implements an increased level of conservation. Conversely, an increase in the amount of industrial/commercial use compared to residential use would tend to increase the per capita coefficient because the per capita demands are based on total water use within the system divided by population.

Lebanon has a relatively large inventory of vacant industrial land that has received attention from a variety of industrial developers. Therefore, the ratio of industrial to residential water use is anticipated to increase as the city grows. To account for this anticipated shift, buildout demand projections include both a residential component and a commercial/industrial component. The projected buildout residential water use is based on buildout population and the residential per capita demands (ADD = 84 gpcd; MDD =148 gpcd) determined in Chapter 3.

Based on current commercial/industrial demand and the developed commercial and industrial land area, the demand factor for existing commercial and industrial properties is approximately 1,400 gpd per acre. Future development on vacant industrial and commercial land may result in higher demand. For planning, for example sizing sewer mains, the city uses a demand factor of 1,500 gpd per acre for commercial land development and 4,000 gpd per acre for industrial land development. Therefore, these factors along with the cities inventory of vacant commercial and industrial land areas were used to project potential future commercial and industrial water demand.

Population Forecast

The Linn County/Lebanon City Coordinated Population Forecast for the City of Lebanon, as described in the city's *Comprehensive Plan Update*, was used to develop population projections for the water master plan. As described in the Methodology for Water Use Projections section, the baseline service area population in 2004 was 13,260, and the annual population growth was estimated at 1.71 percent.

Exhibit 4-1 summarizes service area population projections. The water system service population is projected to increase from 13,487 in 2005 to 18,931 in 2025. This represents an increase of approximately 40 percent over the 20-year planning period. The 2050 service population is projected to equal 28,925.

EXHIBIT 4-1
Population Forecast

| Year | Lebanon Water Service Population |
|-------------|----------------------------------|
| 2004 | 13,260 |
| 2005 | 13,487 |
| 2006 | 13,717 |
| 2007 | 13,952 |
| 2008 | 14,191 |
| 2009 | 14,433 |

EXHIBIT 4-1
Population Forecast

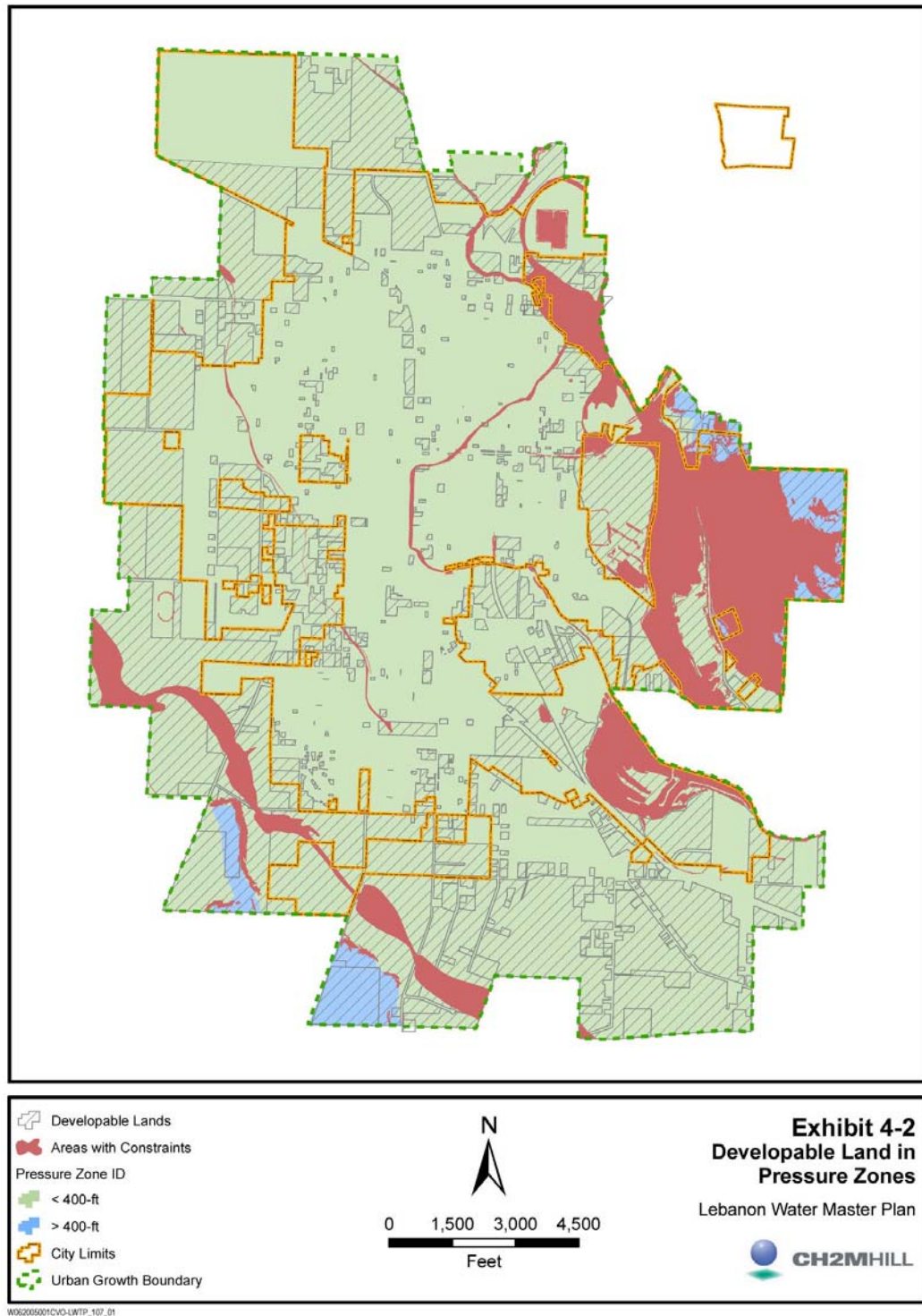
| Year | Lebanon Water Service Population |
|-------------|----------------------------------|
| 2010 | 14,680 |
| 2011 | 14,931 |
| 2012 | 15,186 |
| 2013 | 15,446 |
| 2014 | 15,710 |
| 2015 | 15,979 |
| 2016 | 16,252 |
| 2017 | 16,530 |
| 2018 | 16,813 |
| 2019 | 17,100 |
| 2020 | 17,392 |
| 2021 | 17,690 |
| 2022 | 17,992 |
| 2023 | 18,300 |
| 2024 | 18,613 |
| 2025 | 18,931 |

Exhibit 4-2 illustrates the expansion of the service area that will occur as the population grows to buildout within the UGB. Lebanon’s distribution system currently serves a single pressure zone, with all customers located at elevations below 400 feet. Exhibit 4-2 shows that developable lands include areas above 400 feet. Therefore, additional pressure zones will be required to ensure that customers receive water at acceptable pressures.

Developable Lands and Buildout Population

The buildout population was estimated by considering the amount and type of developable land located at elevations below and above 400 feet within the UGB, and current land use and planning assumptions. As shown in **Exhibit 4-3**, a buildout population growth within the UGB was generated by multiplying the appropriate projected population densities by developable residential land area. As indicated in Exhibit 4-3, 25,950 people will be added to the 2004 service area population of 13,260 to reach a build out population of 39,210. At a 1.71 percent annual growth rate, the city’s service area will reach the buildout population in year 2068.

Exhibit 4-4 illustrates the zoning and land use designations within the City of Lebanon and its UGB that were used to generate Exhibit 4-3. Areas that are not feasible for development, because of slope (greater than 30 percent), location within a riparian zone, or other factors, are not included in Exhibit 4-3. Exhibit 4-2 displays the developable areas. The determination of developable and non-developable lands was based solely on previous work prepared for the city by ECO Northwest.



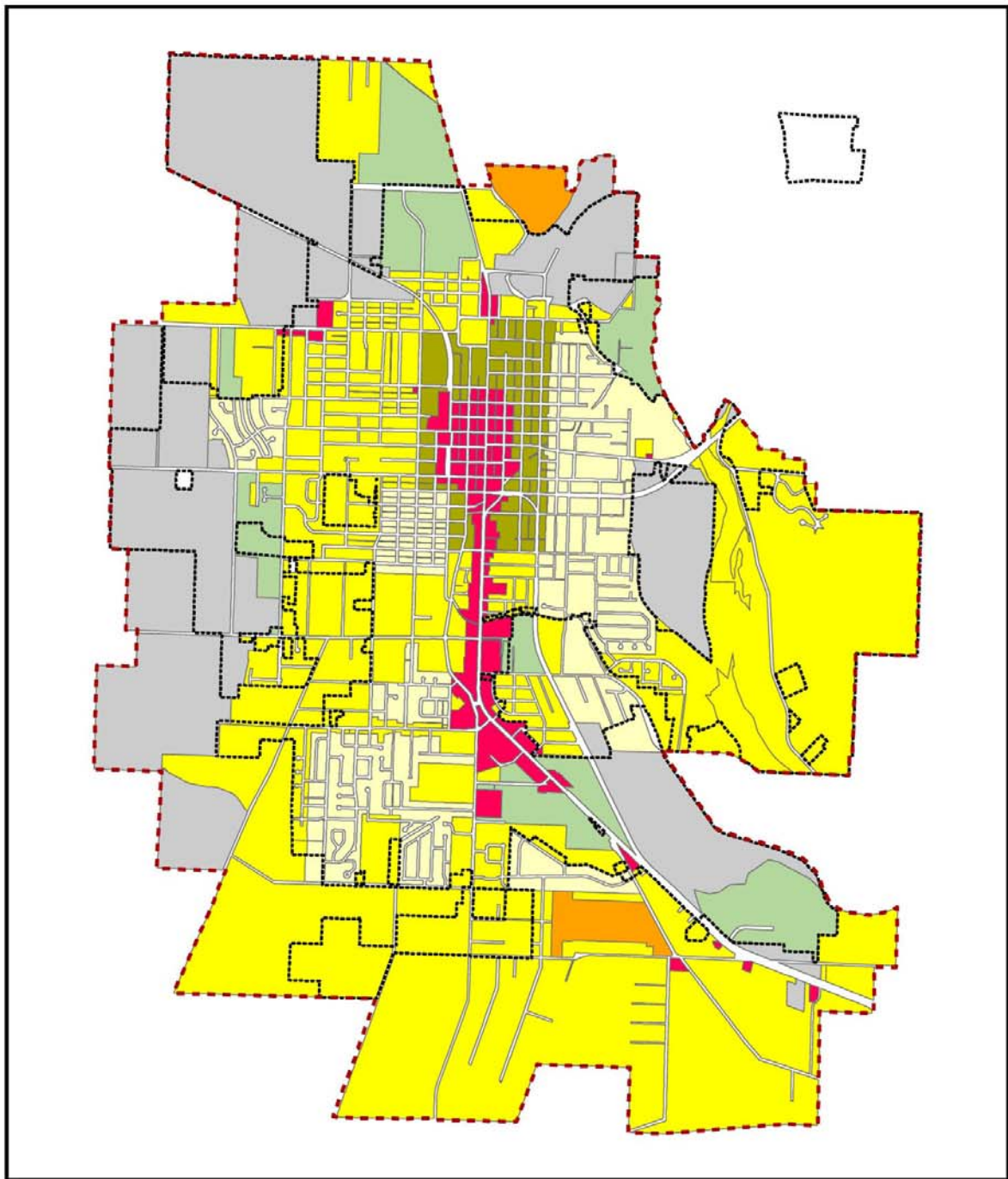
According to the *Lebanon Urbanization Study* (2004), the total area currently zoned commercial within the UGB is 159.2 acres, including 17.2 acres available for development. Likewise, the total area currently zoned either light or general industrial within the UGB is 1,553.8 acres, including 940.7 acres available for development.

EXHIBIT 4-3
 Potential Service Population Increase from 2005 to Buildout
Calculated by Land Use Type and by Pressure Zone

| Land Use Category | Vacant Developable Area within UGB ¹ (acres) | Partially Vacant Developable Area within UGB ¹ (acres) | Projected Density (units per gross acre) | Additional Households at Buildout within UGB | Household Size (persons per household) | Service Population Addition at Buildout w/in UGB ² |
|---|---|---|--|--|--|---|
| Existing Pressure Zone (<=400 feet elevation) | | | | | | |
| Commercial | 11.32 | 10.03 | NA | NA | NA | NA |
| Industrial | 886.03 | 282.25 | NA | NA | NA | NA |
| High Density Residential | 11.66 | 0.00 | 6.37 | 74 | 2.38 | 177 |
| Low Density Residential | 52.02 | 25.56 | 4.84 | 375 | 2.60 | 976 |
| Mixed Density Residential | 390.37 | 731.22 | 6.37 | 7,145 | 2.38 | 17,004 |
| Mixed Use | 264.70 | 42.03 | 6.37 | 488 | 2.38 | 1,163 |
| Subtotal | 1,616.11 | 1,091.09 | NA | 8,083 | NA | 19,320 |
| Future Additional Pressure Zone (>400 feet elevation) | | | | | | |
| Commercial | 0.00 | 0.00 | NA | NA | NA | NA |
| Industrial | 0.00 | 0.00 | NA | NA | NA | NA |
| High Density Residential | 0.00 | 0.00 | 6.37 | 0 | 2.38 | 0 |
| Low Density Residential | 0.00 | 0.00 | 4.84 | 0 | 2.60 | 0 |
| Mixed Density Residential | 282.21 | 155.12 | 6.37 | 2,786 | 2.38 | 6,630 |
| Mixed Use | 0.00 | 0.00 | 6.37 | 0 | 2.38 | 0 |
| Subtotal | 282.21 | 155.12 | NA | 2,786 | NA | 6,630 |
| TOTAL | 1,898 | 1,246 | | 10,869 | | 25,950 |

¹ Area includes constrained lands.

² This category lists additional population growth above the existing 2004 service population



Legend

- UGB
- City Limits
- Zoning/Comp Plan**
- Residential High Density
- Residential Mixed Density
- Residential Low Density/Single Family Residential
- Commercial
- Industrial
- Mixed Use
- Public Facility

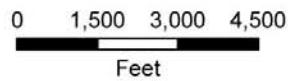


Exhibit 4-4
Zoning/Comp Plan Map
Lebanon Water Master Plan



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Projection Criteria

Exhibit 4-5 summarizes the criteria used for projecting demands. The population, ADD, and MDD for 2004 are used as the baseline for projecting future demands. The values shown for ADD and MDD are calculated using the trendlines developed in Chapter 3 Water Use History.

EXHIBIT 4-5
Demand Projection Criteria

| Criteria | Values |
|---|--------------------|
| 20-year planning period | |
| 2004 service population | 13,260 |
| Rate of population growth | 1.71 percent |
| 2004 ADD (trendline value) | 1.89 mgd |
| 2004 MDD (trendline value) | 3.32 mgd |
| 2004 PHD | 4.94 mgd |
| Overall per capita ADD | 143 gpcd |
| Overall per capita MDD | 250 gpcd |
| MDD weather allowance | 0.4 mgd |
| MDD industrial allowance | 2.0 mgd |
| Buildout | |
| Buildout population (est. 2068) | 39,210 |
| Residential/governmental per capita ADD | 84 gpcd |
| Residential/governmental per capita MDD | 148 gpcd |
| Existing commercial/industrial demand | 1,300 gpd per acre |
| Future commercial demand | 1,500 gpd per acre |
| Future industrial demand | 4,000 gpd per acre |

The MDD fluctuates from year to year, primarily related to summer weather conditions. Over the 12-year period from 1993 to 2004, the MDD has varied from the trend line by as much as 0.43-mgd. For planning purposes, an allowance of 0.4-mgd above the projected trendline is added to account for such variations.

A second allowance is added to the MDD to account for the potential of a new industrial or major commercial user locating in Lebanon. As shown in Exhibits 4-3 and 4-4, the city has developable industrial and commercial lands. Demand projections based on population growth do not directly account for future industrial or commercial use. Per capita projections assume that the ratio of commercial and industrial use to residential use remain constant. This ratio may change if a single industrial or major commercial customer that uses large quantities of water locates within the City of Lebanon service area.

A 2-mgd additional allowance to the MDD is shown to account for this potential future industrial/commercial demand. Based on the development of a 1.4-million-square-foot Lowe's Distribution Warehouse on a 204-acre parcel located in the northwestern area of the city and the additional industrial development that such development will attract or facilitate, city staff believes that it is appropriate to include a 2-mgd industrial allowance.

Demand Projections

20-year Planning Period

Exhibit 4-6 and **Exhibit 4-7** show ADD and MDD projections through 2025 using the constant per capita estimation method. The ADD is projected to increase from 1.9 mgd in 2005 to 2.7 mgd in 2025. A range is shown around the MDD projection in Exhibit 4-7 to illustrate the weather allowance of plus or minus 0.4-mgd. A curve showing the MDD plus 2.0 mgd industrial allowance is also shown.

EXHIBIT 4-6

Lebanon Demand Projections

| Year | Service Population | ADD (mgd) | MDD (mgd) | 3-Day MDD (mgd) | MDD - 0.4 mgd Weather Allowance (mgd) | MDD + 0.4 mgd Weather Allowance (mgd) | MDD + 2 mgd Industrial Allowance (mgd) |
|------|--------------------|-----------|-----------|-----------------|---------------------------------------|---------------------------------------|--|
| 2004 | 13,260 | 1.9 | 3.3 | 3.1 | 2.9 | 3.7 | 5.3 |
| 2005 | 13,487 | 1.9 | 3.4 | 3.1 | 3.0 | 3.8 | 5.4 |
| 2006 | 13,717 | 2.0 | 3.4 | 3.2 | 3.0 | 3.8 | 5.4 |
| 2007 | 13,952 | 2.0 | 3.5 | 3.2 | 3.1 | 3.9 | 5.5 |
| 2008 | 14,191 | 2.0 | 3.5 | 3.3 | 3.1 | 3.9 | 5.5 |
| 2009 | 14,433 | 2.1 | 3.6 | 3.4 | 3.2 | 4.0 | 5.6 |
| 2010 | 14,680 | 2.1 | 3.7 | 3.4 | 3.3 | 4.1 | 5.7 |
| 2011 | 14,931 | 2.1 | 3.7 | 3.5 | 3.3 | 4.1 | 5.7 |
| 2012 | 15,186 | 2.2 | 3.8 | 3.5 | 3.4 | 4.2 | 5.8 |
| 2013 | 15,446 | 2.2 | 3.9 | 3.6 | 3.5 | 4.3 | 5.9 |
| 2014 | 15,710 | 2.2 | 3.9 | 3.7 | 3.5 | 4.3 | 5.9 |
| 2015 | 15,979 | 2.3 | 4.0 | 3.7 | 3.6 | 4.4 | 6.0 |
| 2016 | 16,252 | 2.3 | 4.1 | 3.8 | 3.7 | 4.5 | 6.1 |
| 2017 | 16,530 | 2.4 | 4.1 | 3.8 | 3.7 | 4.5 | 6.1 |
| 2018 | 16,813 | 2.4 | 4.2 | 3.9 | 3.8 | 4.6 | 6.2 |
| 2019 | 17,100 | 2.4 | 4.3 | 4.0 | 3.9 | 4.7 | 6.3 |
| 2020 | 17,392 | 2.5 | 4.3 | 4.0 | 3.9 | 4.7 | 6.3 |

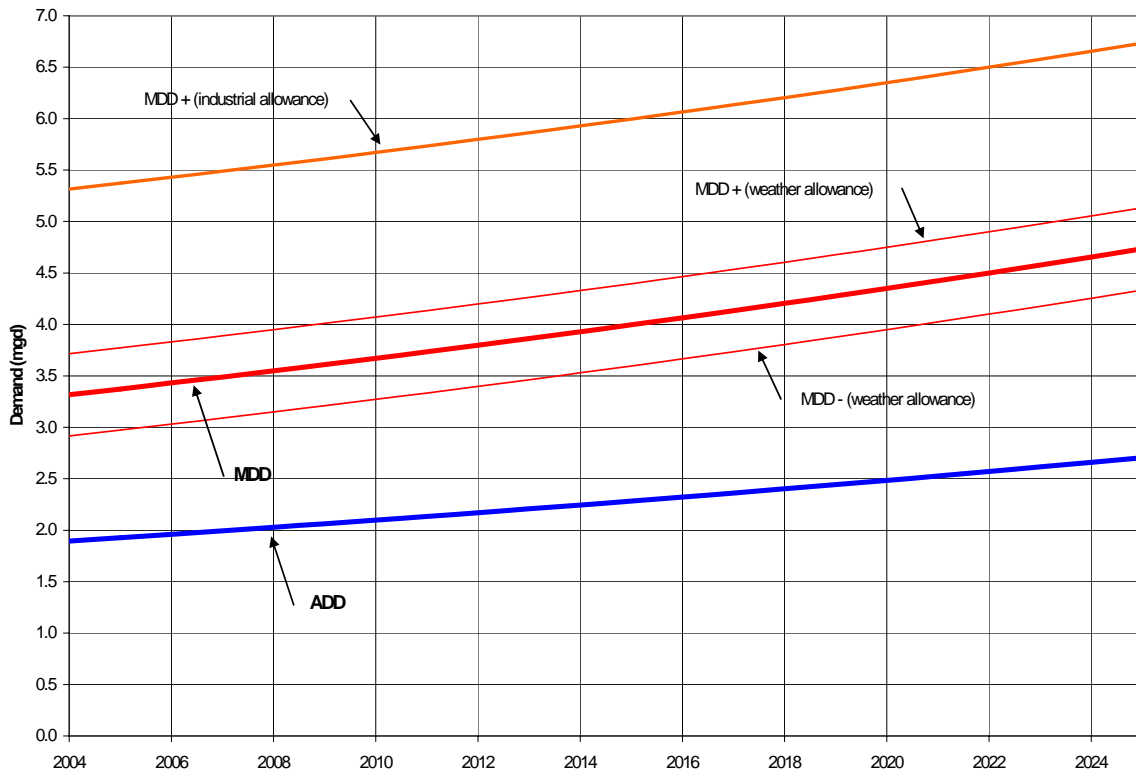
EXHIBIT 4-6

Lebanon Demand Projections

| Year | Service Population | ADD (mgd) | MDD (mgd) | 3-Day MDD (mgd) | MDD - 0.4 mgd Weather Allowance (mgd) | MDD + 0.4 mgd Weather Allowance (mgd) | MDD + 2 mgd Industrial Allowance (mgd) |
|------|--------------------|-----------|-----------|-----------------|---------------------------------------|---------------------------------------|--|
| 2021 | 17,690 | 2.5 | 4.4 | 4.1 | 4.0 | 4.8 | 6.4 |
| 2022 | 17,992 | 2.6 | 4.5 | 4.2 | 4.1 | 4.9 | 6.5 |
| 2023 | 18,300 | 2.6 | 4.6 | 4.3 | 4.2 | 5.0 | 6.6 |
| 2024 | 18,613 | 2.7 | 4.7 | 4.3 | 4.3 | 5.1 | 6.7 |
| 2025 | 18,931 | 2.7 | 4.7 | 4.4 | 4.3 | 5.1 | 6.7 |

EXHIBIT 4-7

Projected Maximum Day Demands



The MDD is projected to increase from 3.4 mgd in 2005 to 4.7 mgd in 2025. The weather allowance of 0.4-mgd suggests that the MDD in year 2005 may range from 3.0 to 3.8 mgd. For 2025, the projected range is 4.3 to 5.1 mgd. As described earlier, there is potential for new industrial and commercial development to increase these values by 2.0 mgd.

The MDD value is significant for planning because the water supply and treatment facilities are commonly designed to provide the MDD. For example, if the treatment plant is incapable of treating and delivering the MDD to the system, a net deficit will occur during a day of maximum demands. The city's distribution storage will decline following such an occurrence. If successive days occur that have demands equal to or near the MDD, the city would experience a water shortage.

Facilities are often designed to supply the 3-day MDD, which for Lebanon averages approximately 93 percent of the MDD. By definition, a MDD occurs only one day per year. The 3-day MDD provides an indication of the demands that are expected to occur on three successive days. However, if the 3-day MDD value is used for planning, it is recommended that the city add the weather allowance of 0.4-mgd. This ensures that there is not a shortfall during a year of hot and dry weather conditions.

Exhibit 4-6 indicates that for Lebanon, the MDD is essentially equal to the 3-day MDD plus weather allowance. For example, in 2005 the projected MDD equals 3.4 mgd, whereas the 3-day MDD plus the weather mgd allowance equals 3.5 mgd. For the year 2025, the single day MDD is projected to equal 4.7 mgd, whereas the 3-day MDD plus 0.4-mgd allowance equals 4.8 mgd.

Buildout

Buildout demands were estimated using the per capita method for residential and governmental water users, and a land area method for commercial and industrial customers. **Exhibit 4-8** summarizes buildout demand calculations.

EXHIBIT 4-8
Buildout Demand Estimate

| Customer Category | Developed Acres | Current ADD (mgd) | Vacant Acres | ADD from Development on Vacant Land (mgd) ¹ | Buildout ADD (mgd) ^{2,3} | Buildout MDD (mgd) ^{4,5} | Total Acres |
|-------------------|-----------------|-------------------|--------------|--|-----------------------------------|-----------------------------------|-------------|
| Residential | - | - | - | - | 3.3 | 5.8 | |
| Commercial | 142 | 0.18 | 17 | 0.03 | 0.2 | 0.4 | 159.2 |
| Industrial | 613 | 0.80 | 941 | 3.76 | 4.6 | 8.0 | 1553.8 |
| Totals | 755 | 0.98 | 958 | 3.79 | 8.1 | 14.2 | 1713 |

¹ From city production and billing data, the combined commercial and industrial ADD for developed land is approximately 1,300 gpd/ac.

² Residential/governmental ADD per capita = 84 gpcd

³ The ADD is assumed to be 1,500 gpd/ac for future commercial development and 4,000 gpd/ac for future industrial development.

⁴ Residential/governmental MDD per capita = 148 gpcd

⁵ MDD:ADD peaking factor = 1.76

Buildout ADD and MDD for residential and governmental customers were determined by multiplying the buildout population of 39,210 by ADD per capita of 84 gpcd and MDD per capita of 148 gpcd.

Existing commercial and industrial demand was assumed to remain constant. Potential future commercial and industrial demand was estimated by multiplying the vacant commercial land area within the UGB by a commercial ADD of 1,500 gpd per acre, and the vacant industrial land area by an industrial ADD of 4,000 gpd per acre. MDD was estimated from ADD values by multiplying by a MDD:ADD peaking factor of 1.76. Buildout ADD was estimated to be 8.1 mgd, and buildout MDD was estimated to be 14.2 mgd.