Updated Final Technical Memorandum #2

SCV Demand Study Update: Land-Use Based Demand Forecast Analysis

To: Dirk Marks, Castaic Lake Water Agency

From: Lisa Maddaus, P.E., Maddaus Water Management (MWM), Inc.

Date: March 4, 2016

Reviewed by: Bill Maddaus, P.E., MWM and Anil Bamezai, WPR

1. INTRODUCTION

The purpose of the Demand Study Project (Project) is to update the projected demands for the four water retailer agencies (Retailers) in the Santa Clarita Valley (SCV) served by Castaic Lake Water Agency (CLWA). This technical memorandum presents the land use based demand forecasts prepared using a "bottom-up" approach based on Retailer provided information. The technical memorandum is updated from an earlier version issued in June 2015. This updated memorandum was necessary due to the revised information provided by Valencia Water Company (VWC) associated with revised development plans for Newhall Ranch, which altered their future demand forecast. This memorandum also incorporates the plumbing code updates due to a recent revision in September 2015, effective December 1, 2015, for the Title 20 Appliance Efficiency Standards adopted by the California Energy Commission. This technical memorandum now serves as the final land use based demand forecasts for each Retailer. It contains the best information currently available to support the Retailers and CLWA development of the Urban Water Management Plan in compliance with the 2015 Urban Water Management Plan Act to be completed and submitted to the Department of Water Resources by July 1, 2016.

The future growth accounted for in these forecasts is being confined to only existing service areas and anticipated by the Retailers. There is some development in the OVOV Plan that is left outside of these areas, and where appropriate some future potential development has been included in these demand projections. Overall, there can be seen a lower demand population projection associated with these land use based forecasts than historical estimated future buildout demand in in the 2010 UWMP.

In June 2015 the CLWA and the Retailers adopted the Water Use Efficiency Strategic Plan. For planning purposes a population based econometric model was selected (Phase I) as the more conservative strategy, given it has a lower population for 2020, meaning the per capita use is higher than it is under the projections provided herein. The forecasts in this memorandum are based on the planned land use development and deemed to be more accurate from 2021-2050 for the purposes of estimating buildout water demands.

The new buildout estimated total population is now approximately 421,500, using undeveloped parcels in the existing service CLWA service area such as West Side Communities, and proposed annexations such as Tapia Canyon, and Tesoro Del Valle. This includes potential future annexations to the NCWD service area that are already within the CLWA service area. Tapia and Tesoro will be served by NCWD. Similarly, the West Side Communities are located within the CLWA service area and are assumed to be annexed into the VWC service area. The nine West Side Communities consist of the five villages comprising Newhall Ranch (Landmark Village, Mission Village, Homestead Village South, Homestead Village North, and Potrero Village), three other future communities (Legacy Village, Entrada Village South, and Entrada Village North), and buildout of an ongoing development (Valencia Commerce Center).[1]

2. PURPOSE

The purpose of this Technical Memorandum #2 (TM-2) is to document and present the demand projections for the Santa Clarita Valley. TM-2 describes:

(1) Demand projection methodologies;
(2) Data inputs used in the analysis;
(3) Demand analysis results including updated CLWA retailer agency demand projections through buildout (2050); and
(4) Demand analysis results including recommended active conservation program implementation through buildout. Active conservation program measure design is presented as Program B in the 2015 SCV Water Use Efficiency Strategic Plan (WUE SP).

3. SUMMARY OF APPROACH

The project supported the development of demand forecasts that rely on econometric models to 2020, then extended forecast from 2021 to 2050 (assumed buildout) based on Retailer and/or CLWA supplied information. The land use based demand forecast was only conducted for three of the four Retailers: Newhall County Water District (NCWD), Santa Clarita Water Division (SCWD), and Valencia Water Company (VWC), given that Los Angeles County Water District 36 did not have sufficient information and is based on a population based demand forecast. A summary of the approach employed for each Retailer is provided below followed by more detailed description of methodology and findings.

For Newhall County Water District and Santa Clarita Water Division, the overall basis for this analysis was to build future demand forecasts using a "bottom-up" approach for land use based anticipated land development, which involved the following information:

[1] GSI Water Solutions, Inc. Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)," To: Corey Harpole and Steve Zimmer, Newhall Land and Farming Company; Ken Peterson and Matt Dickens, Valencia Water Company; and Dirk Marks, Castaic Lake Water Agency; Prepared by John Porcello and Cindy Ryals, March 2016.

- Estimated dwelling units proposed were provided by City of Santa Clarita and Los Angeles County data informed by general plans, specific plans, and past and remaining growth anticipated through GIS analysis
- Land use base GIS map shape files provided by the City of Santa Clarita and Los Angeles County planners for:
    - Base case (2004) used in the OVOV Study
    - 2012 recent update for transportation modeling
    - Buildout (2050) used in the OVOV Study
- Retailer provided GIS maps of service area boundaries overlaid on land use maps from the City and County
- Queries from GIS maps to determine dwelling units were multiplied by persons per household from the US Census appropriate to each Retailer's service area (that were previously present during the Population Assessment project analysis completed in June 2014)
- Billing data by customer category (single-family, multi-family, non-residential) previously provided for Water Use Efficiency Strategic Plan:
    - Base case (2004) for a water balance with setting demand factors
    - 2012 demands
- Climate and economic adjustment factors for normalizing demands in 2004 and 2012
- Future demand factors:
    - 2020 for planning for SB X7-7 (and period for economic recovery)
    - Buildout (OVOV Study)

For Valencia Water Company, the future demand hinges on the development of the nine adjoining communities that collectively comprise the West Side Communities in the Santa Clarita Valley in the VWC service area. The nine communities are five villages comprising the master planned Newhall Ranch (Landmark Village, Mission Village, Homestead Village South, Homestead Village North, and Potrero Village), three other future communities (Legacy Village, Entrada Village South, and Entrada Village North), and buildout of an ongoing development (Valencia Commerce Center). The growth projection was based on VWC providing a Technical Memorandum prepared by GSI Water Solutions, Inc. (GSI) in March 2016 (GSI, 2016). This technical memorandum provided the basis for the following:

- Dwelling unit counts by type of residential development
- People per household estimates based on recent documentation of occupancy rates in more recent home developments
- Non-residential acreage
- Dedicated irrigation acreage, predominately served by recycled water
- Demand factors for all new types of land use categories

The VWC, and CLWA directed MWM's work effort and carefully reviewed the basis for the land use based demand forecast presented in this memorandum.

Los Angeles County Water District 36 did not have detailed enough information (such as specific billing data by lot type) to derive demand factors. However, future demands in the LACWD 36 service area have been included in the overall total valley-wide demand forecast using the information presented in the Water Use Efficiency Strategic Plan (WUE SP) adopted in June 2015 by the CLWA.

The overall history of Project's collaborative approach includes the following phases:

- **Phase 1:** Demand Forecast Meeting was held on September 3, 2014. Retailer management, conservation and planning staff attended to facilitate Retailer understanding of and involvement in the development of the forecasting methodology and analysis. Following the September 2014 meeting, all four Retailers confirmed their conditional acceptance of the Phase 1 Modified Demand Forecasts for planning purposes for the WUE SP project. Retailers had an opportunity to review the demand modeling preliminary results and to ask questions and offer comments to CLWA by September 15th. General acceptance of the preliminary forecasts for planning purposes was necessary to create the versions of WUE SP DSS Models that allowed for a demand forecast to populate the conservation analysis section of the DSS Models and make further progress with conservation measures analysis.

- **Phase 2:** A follow-up meeting on Phase 2 Demand Forecast was held on March 5, 2015. CLWA and the MWM team worked to address comments through April in order to release an updated TM on June 9, 2015. In February 2016, VWC, with more accurate and newly available development information for their service area, partnered with MWM and restructured their projected demands based on West Side Communities development information developed by GSI. As part of this effort, recently adopted state plumbing codes were also incorporated into the analysis for all four Retailers. CLWA and the MWM team worked to incorporate the newly available development information and plumbing codes in order to release this updated TM. Retailers confirmed their acceptance of the Phase 2 Demand Forecasts for planning purposes for the 2015 UWMP.

4. DEMAND METHODOLOGY OVERVIEW

The demand projection for each Retailer combines the results of two different analytic models – the Econometric Model and the Least Cost Planning Decision Support System Model (DSS Model). The purpose of using these two models is to leverage the strengths of each to obtain the best forecast through the year 2050. This approach, described in this section, was reviewed with the Retailers at a meeting on June 19, 2014 and conducted in two phases that are described in the prior technical memorandum issued in June 9, 2015. The revised findings reviewed and approved by the Retailers is presented in this technical memorandum.

This project effort takes results from refined econometric models developed for CLWA's Retailers in the WUE SP to project demand out to 2020, transitioning to a land use based approach (in lieu of a population and employment-based approach) because such an approach can further improve upon assumptions about how future water usage patterns might be significantly different than they were in the past as the Santa Clarita Valley moves toward build-out.

The Econometric Model estimates the impact of economic conditions on water demand. The model can then be used to project, based upon historical patterns, the future rebound in demand associated with economic recovery, while taking into account other factors such as rate increases and weather. Since the Econometric Models are calibrated using historical data, their reliability depends on the historical relationship between water demand and its influencing factors remaining unchanged between the calibration and forecasting periods. Further into the future, changes in demographics, living patterns, housing stock and industrial structure can alter these historical relationships, which is why we do not use the Econometric Model for forecasting demand past 2020.

The DSS Model incorporates historical data provided by each Retailer to set up a water balance on a monthly time-step. Then the DSS Model can be used to forecast future demand (or to incorporate a previously developed forecast) as the basis for analyzing conservation measures aimed at achieving water savings to meet future gallons per capita per day (GPCD) targets. The DSS Model can accommodate data and assumptions reflecting how future service area and water use characteristics may differ from the past in each Retailer service area. To accommodate all of these considerations, Econometric Models are used to forecast baseline demand through 2020, and the DSS Model from 2021 through 2050.

The DSS Model also has a conservation component that quantifies savings from plumbing codes and from a user-selected menu of active conservation programs. This memorandum only includes the DSS Model's estimates of savings from plumbing codes so that each Retailer can evaluate its future water demand if it does not undertake any active conservation programs between now and the year 2050. Quantification of savings from active conservation programs use the same measures as presented in Program B list in the Water Use Efficiency Strategic Plan (WUE SP). However, the savings estimates are updated with the revision to the DSS Models associated with the plumbing code changes for all Retailers.

The demand analysis for each Retailer has three distinct parts (Figure 1):

(1) Historical View – Analysis of historical data between 1995 and 2013 (or a shorter window if a Retailer was unable to provide complete data going back to 1995). The purpose of this analysis is to identify the impacts of factors such as water rates, economic conditions and weather on water demands. Data analyzed include historical system production, water rates, weather (rainfall and reference ETo), population, unemployment rate, and other data as approved and verified by each Retailer. The source data of production and water rates that were provided by the Retailers were compiled into a single MS Excel workbook for each individual Retailer and verified by the Retailer staff prior to the modeling effort.

    As part of Phase 2, a historical land use assessment was conducted using land use data by Traffic Analysis Zones (TAZ) for years 2004 and 2012. The land use assessment was conducted by evaluating the land use types in each TAZ to determine what portion of the land use residing in that TAZ was located in each Retailer's service area. Furthermore, the 2014 CLWA Population Assessment provided 2010 Census-based estimates for residential dwelling units land use types. The Phase 2 analysis based on available information previously provided by, or confirmed by, each Retailer includes historical billing data or water use by large customers. Using historical billing data supported some limited validation of demand factors applied to future development by land use type. More information about this approach used for SWCD and NCWD as well as the source of land use data by TAZ and water demand factors can be found in Appendix D. More information about the approach used for the VWC can be found in Appendix E.

(2) Short-Term Future – Forecast of demands between 2014 through 2020 assuming normal weather, incorporating economic recovery predictions as well as water rate forecasts and population growth. Normal weather is defined as average reference ETo and rainfall between 1995 and 2006, corresponding roughly to the baseline that water utilities will choose for testing compliance with SB X7-7. The analysis incorporates the federal government's projection[2] that the US economy will return to its long-term growth path by 2020, reaching a national unemployment rate of 5.2%, or roughly the average of the US unemployment rate

[2] Congressional Budget Office: *Testimony - The Budget and Economic Outlook: Fiscal Years 2013 to 2023*
Douglas W. Elmendorf, Director Before the Committee on the Budget, United States Senate, February 12, 2013.
Bay Area Council Economic Institute, *Recession and Recovery: An Economic Reset*, April 2010.

between 1993 and 2000. The unemployment rate may differ across utilities at any given point in time. However, movements in this metric for any given utility over time parallels movement in the national unemployment rate quite well. To demonstrate this point, we have included Figure 2 comparing the unemployment rate over time in progressively higher jurisdictions starting with the City of Santa Clarita to the United States as a whole. Unemployment rates over time specific to each Retailer's service area are not available. Model testing suggested that the unemployment rate for Los Angeles County fit CLWA's water demand patterns marginally better than the unemployment rate for the City of Santa Clarita. This is not entirely surprising because economic conditions in CLWA's service area are substantially influenced by economic conditions in the broader region. Therefore, we are using Los Angeles County's unemployment rate for forecasting demand out to 2020. Water rates have been assumed to increase by 1.5% per year in real terms between 2013 and 2020. Population projections were developed as a separate component of this overall project, being anchored in the Census for the years 2000 and 2010, and the OVOV population forecast for 2050.

(3) Long-Term Future – Long-term water demand (2021-2050) was forecasted using the DSS Model, which estimates increases in each Retailer's demand by category. The land use based forecasting approach using build-out estimates for year 2050 from the One Vision One Valley Valley-Wide Traffic Study (OVOV) was substituted for this simple population and employment-based approach. For development in VWC's water service area, the most recently available land use development, demand factors, and projected demand data was provided by GSI Water Solutions for nine communities adjoining the VWC service area that collectively comprise the West Side Communities (GSI, 2016).

Figure 1. Demand Forecasting Methodology

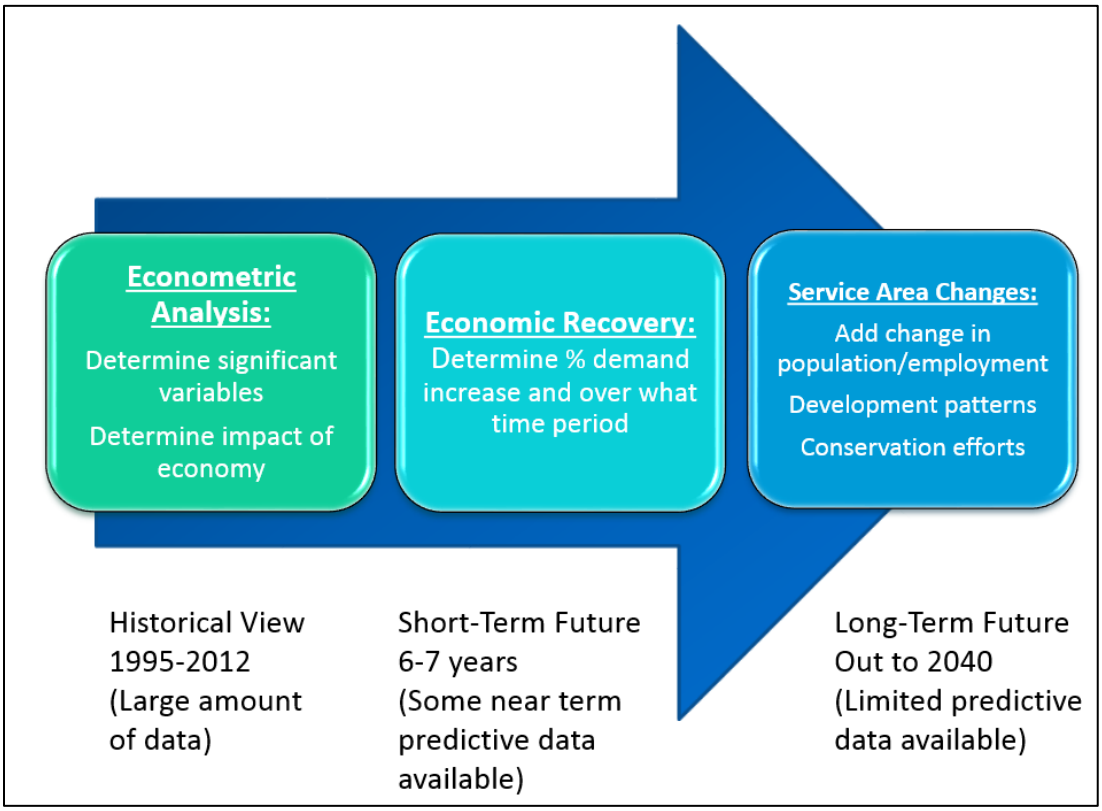
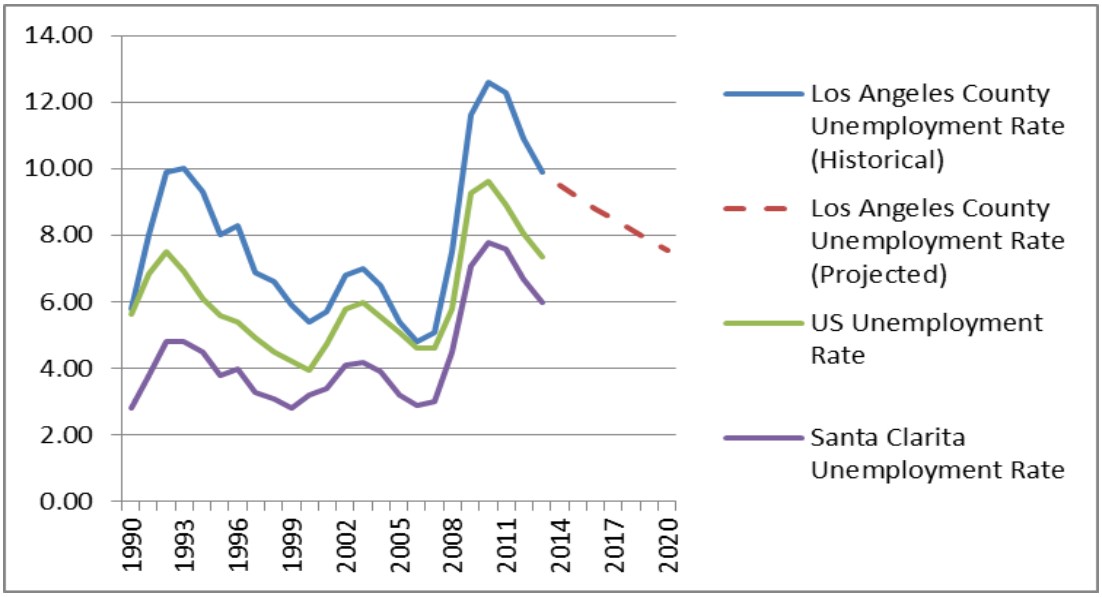


Figure 2. Unemployment Rate Comparisons



4.1 Econometric Analysis Methodology

This project uses Econometric Models to project short-term demand to the year 2020. This tool was incorporated into the demand analysis to estimate the relationship between water demand and factors that may be impacting it, such as price, economic conditions and weather. Relying on knowledge of past historical relationships and assuming that they continue in the short-run, this analysis provided insights into questions associated with demand, such as:

- At what rate will demand rebound as the unemployment rate falls reflecting the economy's return to its long-term growth path?
- How have price increases depressed demand?
- How has demand responded to weather?

An Econometric Model of water demand was constructed for each Retailer using up to 19 years of monthly production data (where available, data from 1995 through 2013 were used). Each Retailer's Econometric Model utilizes Retailer-specific data to depict retail water rates and population. These data were submitted and verified by each Retailer through the data collection process using a verification of a MS Excel data collection workbook. The model also included additional locally specific data provided by the MWM team. In Phase 1, temperature and rainfall data were used to capture the impact of weather on water demand. These data were obtained from the NOAA (National Oceanic and Atmospheric Administration) weather station located in Newhall, California. For Phase 2, however, the MWM team was able to obtain reference ETo and rainfall data made available by Department of Water Resources (DWR) through their PRISM weather modeling program. These are the weather data that both DWR and CUWCC recommend water suppliers use to weather-normalize their compliance year GPCD in 2015 and 2020. So there is every reason to favor PRISM over NOAA data. PRISM weather data are available with a high level of granularity. However, sensitivity analyses did not

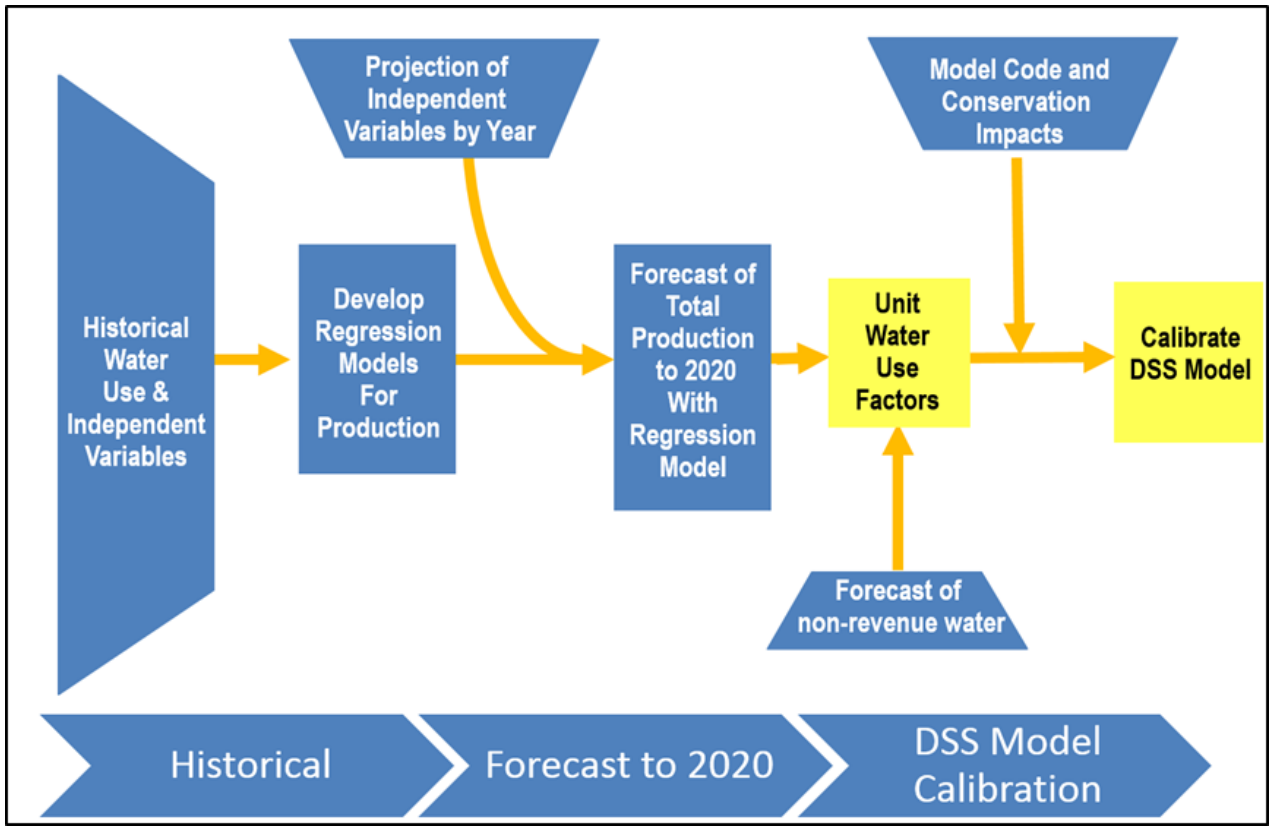
indicate that any of the four Retailers were sensitive to which PRISM grid was used to model weather impacts. Accordingly, the grid that includes Santa Clarita City Hall was used for all Retailers. Similarly, the Los Angeles County's unemployment rate was used to model economic conditions in each Retailer's service area as mentioned earlier.

After the Econometric Models were developed, they were then used to generate water demand forecasts out to the year 2020. The estimated model coefficient associated with each variable included in the models, such as rainfall corrected reference ETo, water rates and the unemployment rate, were also incorporated into the 4 Retailer DSS models.

A flow diagram for the overall modeling process with econometric models supporting the near turn 2014-2020 demand forecast is shown in Figure 3 and further described in Section 4.2 and Appendix C. All this information was reviewed and calibrated with the DSS Model. This process generated one complete model for each Retailer with data between 2013 and 2050.

For each Retailer, the econometric analysis estimated the relative impact of various factors on water demand. The Phase 1 Enhanced and more sophisticated Phase 2 results have been provided in Appendix A. For comparison purposes, the projected demands and population that were reported in CLWA's 2010 UWMP for each Retailer can be found in Appendix B. A more detailed description of the Econometric Modeling framework can be found in Appendix C.

Figure 3. SCV Demand Forecast Modeling Approach Flow Diagram



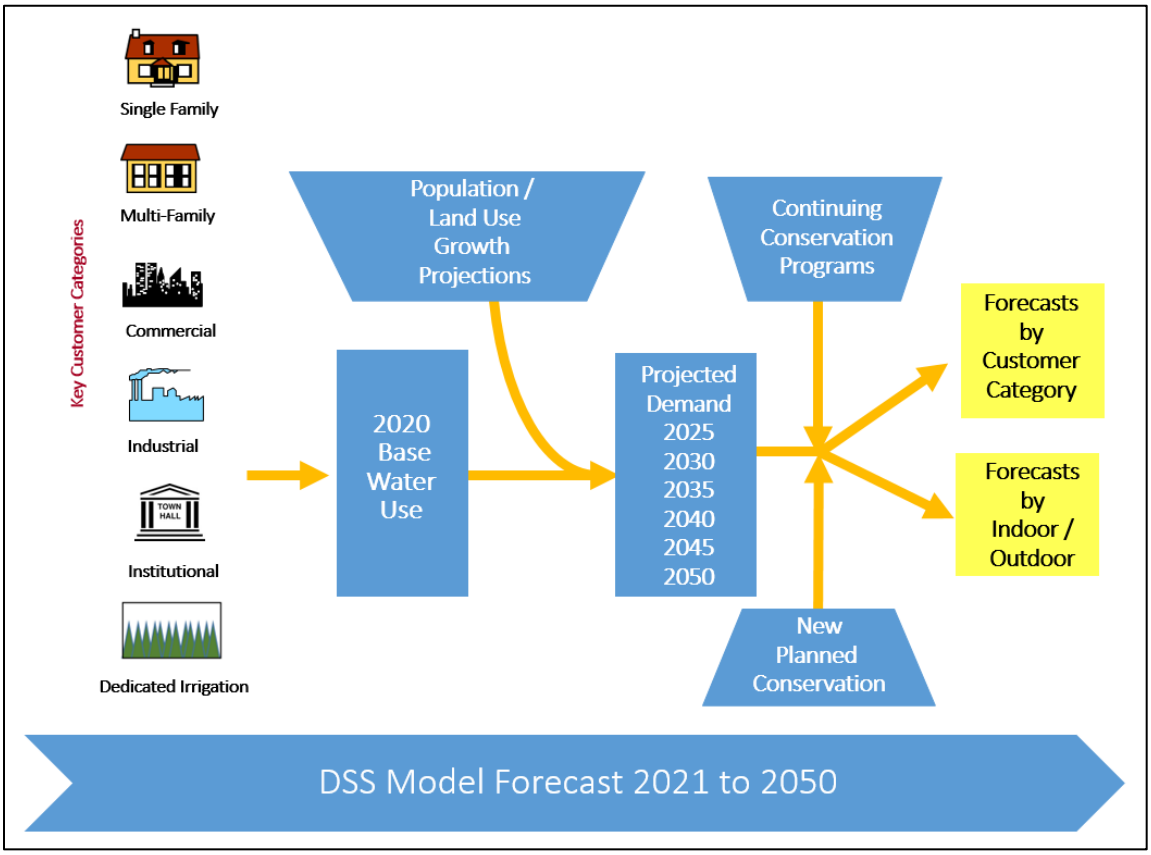
4.2 DSS Model Methodology

For the long-term projections (2021 through 2050), the DSS Model was used to generate demand forecasts for each Retailer. The DSS Model also includes a conservation component that quantifies savings from passive conservation (e.g. plumbing codes) and active conservation programs. The DSS Model's conservation component covers the entire forecast period, 2014-2050. Quantification of savings from active conservation programs is covered in the WUE SP. In this memorandum, only the DSS Model's estimates of savings from plumbing codes are provided so each Retailer can evaluate what its future "normal weather" demand would likely be if the Retailer did not undertake any active conservation programs between now and the year 2050.

4.2.1 Overview of the DSS Model

The DSS Model prepares long-range, water demand and conservation water savings projections. The model is an end-use model that breaks down total water production (i.e., water demand in the service area) into specific water end uses such as (e.g., toilets, faucets, or irrigation). This "bottom-up" approach allows for detailed criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes and conservation efforts. The purpose of using the end-use data is to enable a more accurate assessment of the impact of water efficiency programs on demand and to provide a rigorous and defensible modeling approach necessary for projects subject to regulatory or environmental review.

Figure 4. Retailer DSS Model Flow Diagram



As shown in Figure 4, the first step for forecasting water demands using the DSS Model was to gather customer category billing data from each Retailer. The next step was to calibrate the model by comparing water use data with available demographic data to characterize water usage for each customer category (single-family, multi-family, commercial, industrial and institutional) in terms of number of users per account and per capita water use. During the model calibration process, data were further analyzed to approximate the indoor/outdoor split by customer category. The indoor/outdoor water usage was further divided into typical end uses for each customer category. Published data on average per-capita indoor water use and average per-capita end use were combined with the number of water users to calibrate the volume of water allocated to specific end uses in each customer category. In other words, the DSS Model reflects social norms from end use studies on water use behavior (e.g., for flushes per person per day).

As part of the Phase 1 analysis, future population projections (originally derived from Retailer Master Plans then published in the 2010 UWMP and subsequently updated in the Population Assessment Project) were confirmed by each Retailer then incorporated into the DSS model. As part of Phase 2, future land use projections based on OVOV build-out estimates in year 2050 were incorporated into the DSS Model. These growth projections were used to develop projected demands for year 2021 through year 2050.

The conservation analysis portion of the Project was completed in April 2015 and updated in February 2016. As shown in Figure 3, the conservation measures analyzed were inputted into the DSS Model. These conservation measures are a combination of existing conservation measures and new conservation measures selected by a poll of the Retailers. Recommended active conservation program list of measures and designed parameters (e.g., unit costs and savings) is presented as Program B in the WUE SP. The only modification to the measures list was for VWC to not include landscape ordinance as a conservation measure, as demand factors appeared consistent with long-term performance anticipated from the local landscape ordinance for the Newhall Ranch development plans.

4.2.2 Future Population Data

Historical population from 1994 through 2010 was validated through the Population Assessment project in spring 2014. The population was then extended from 2010 through 2013 based on new account data using the same assumptions developed for the Population Assessment Project.

The land use based population estimates are founded on dwelling unit projection estimates from each Retailers' land use buildout projection with the people per household (PPH) estimates determined for each Retailer in the 2014 Population Assessment Technical Memorandum (lasted updated November 2014). In February 2016, VWC provided a revised projected land use population based on PPH estimates derived from average PPH for more recent developments including the communities of Bridgeport, North Park, and Stevenson Ranch (GSI, March 2016).

The land-use based population (Figure 6) is based on an assessment of future dwelling units based on schedule provided by Valencia Water Company, or where not available a linear extrapolation from 2012 count of dwelling units to buildout (as determined from the GIS query by Retailer service area boundary and land use type). For other service areas potential future development information was provided by CLWA based on recent NCWD Master Plans and historical information from the OVOV Plan such that additional future potential dwelling units between existing service area boundaries and known annexations were included in the analysis.

The population forecasts are presented in Table 1, Figure 5, and Figure 6. For reference, the 2010 Urban Water Management Plan (UWMP) population is also presented in Table 1 and Figure 6.

Table 1. Valley-Wide Population-Based Forecasts*

Valley-Wide Population Forecast Source	2015	2020	2025	2030	2035	2040	2045	2050
Land-Use Based	272,600	289,000	321,900	354,700	383,400	396,100	408,800	421,500
2010 UWMP	318,200	345,900	373,000	401,200	428,900	456,600	486,200	511,900

*Note: The 2010 UWMP population forecast is provided for comparison purposes only.

Figure 5. Valley-Wide Land-Use Based Population Forecasts

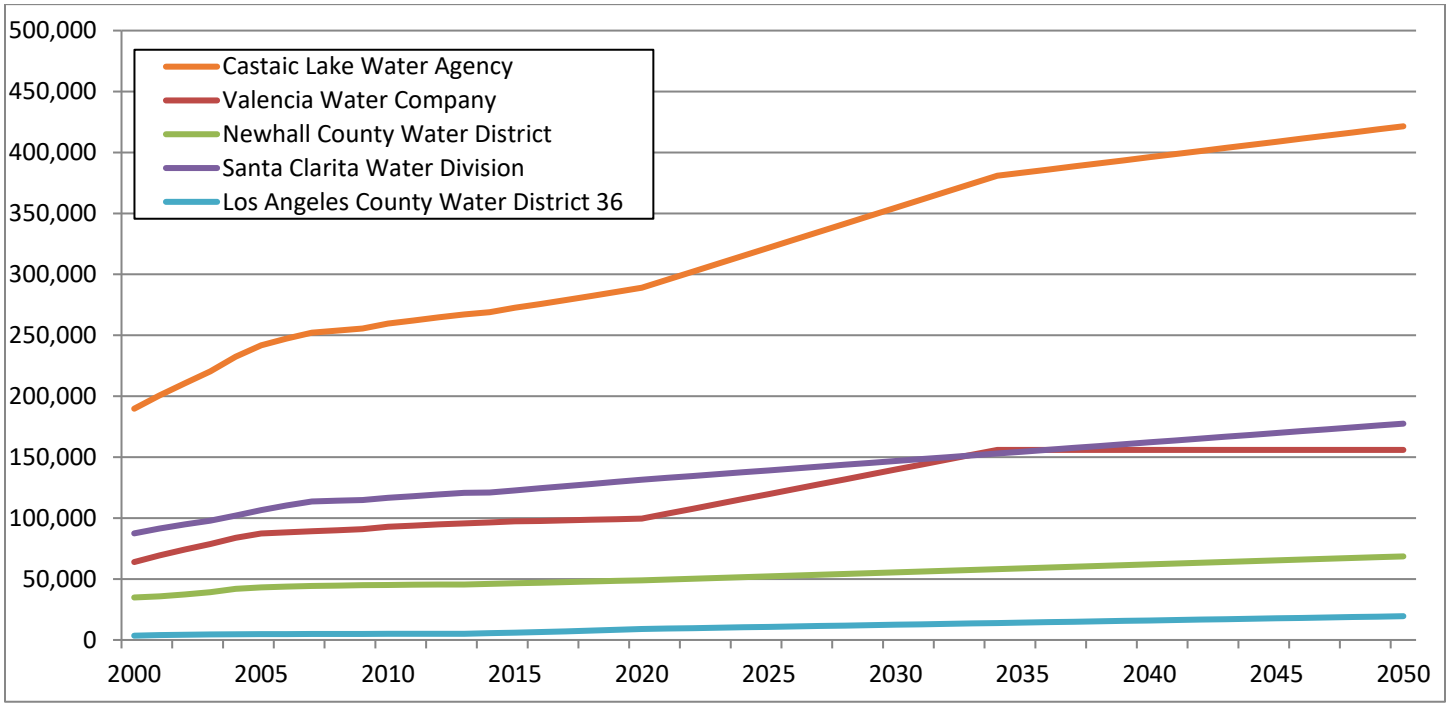
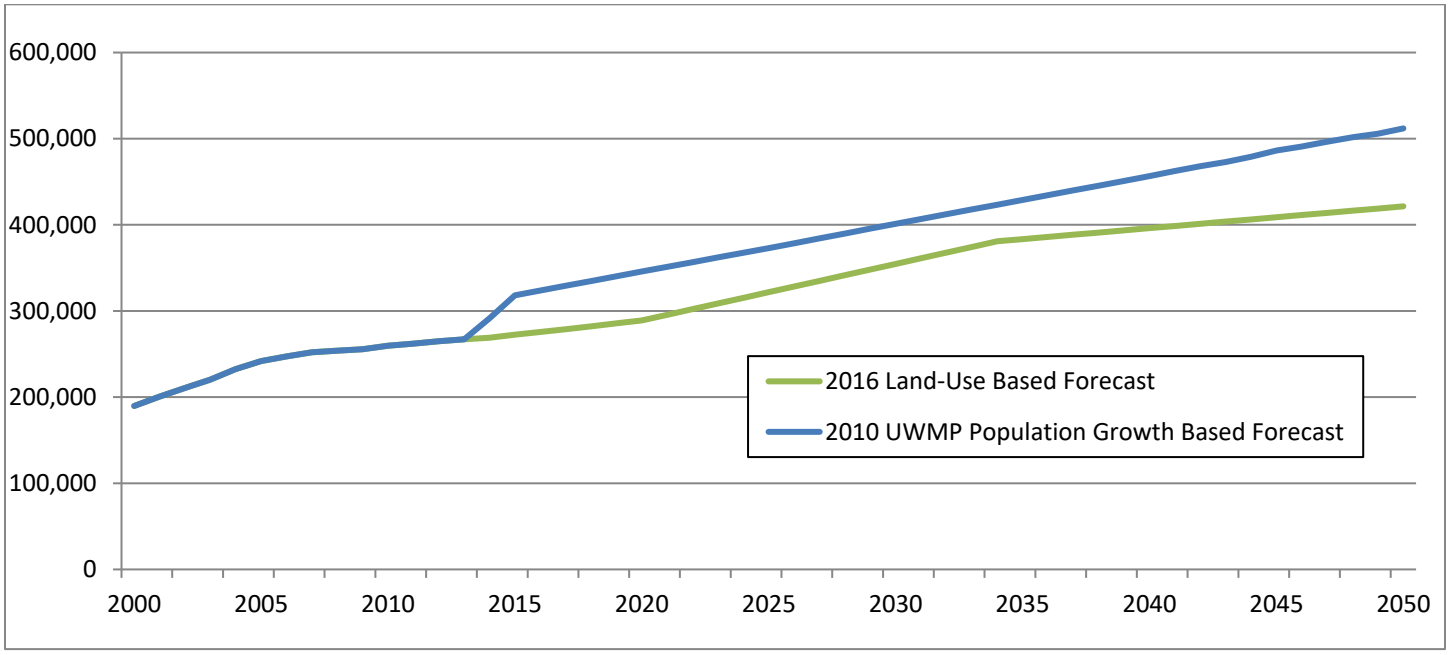


Figure 6. 2016 Land-Use Based Valley-Wide Population Forecast



4.2.3 Future Land Use Data

Future land use projections were based on build-out estimates from a combination of Retailer-approved development agreements and the OVOV study for VWC, NCWD and SCWD. LACWD land use was queried but a land use based demand forecast was not prepared due to data limitations. A diagram depicting the flow of work effort to prepare the land use analysis is presented in Figure 7.

Initial build-out estimates for land use types for each Retailer were determined using the GIS TAZ analysis presented in Section 3 and further explained in Appendix D. Three areas that are currently outside of Retailers' service area were added: West Side Communities for the VWC service area, and Tesoro Canyon and Tapia Canyon for NCWD. Nine adjoining communities collectively comprise the West Side Communities in the VWC service area. The nine communities are five villages comprising Newhall Ranch (Landmark Village, Mission Village, Homestead Village South, Homestead Village North, and Potrero Village), three other future communities (Legacy Village, Entrada Village South, and Entrada Village North), and buildout of an ongoing development (Valencia Commerce Center) (GSI, 2016).

For planning purposes, the residential land use types were consolidated and used average gallons per day per account for demand factors. This planning assumption was applied primarily due to the lack of enough detail on specific lot types. More specific details on the dwelling unit counts and land use values are provided in Appendix D and E for each Retailer, and an overall summary for all three Retailers is presented in Table 2.

A validation of the demand factors was prepared for 2004 and 2012 based on a review of GIS data, Retailer-provided billing data, and then the demand factors were applied to planned future development by land use type and projected development schedule. A summary of demand factors by Retailer is provided below and in Appendix D.

Figure 7. Flow Chart of Steps for Land Use Based Demand Projections

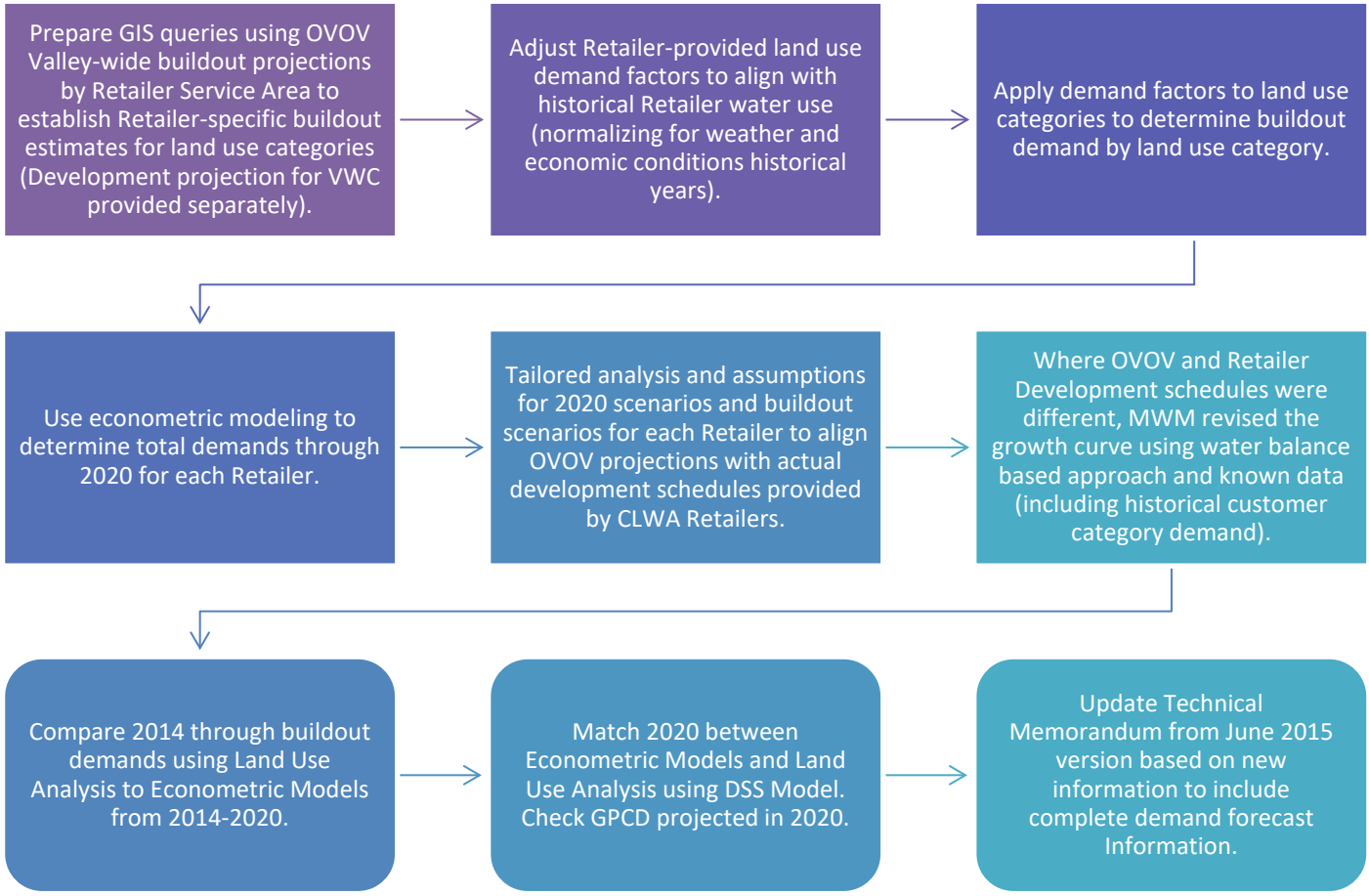


Table 2. Summary of Residential Land Use Type Data

Land Use Type	Units	2004	2012	2020	Build-out
Newhall County Water District[1]					
Single-Family	DU	7,618	8,606	9,011	14,249
Multi-Family	DU	4,870	4,984	5,696	7,147
Santa Clarita Water Division[2]					
Single-Family	DU	19,142	21,538	23,333	30,064
Multi-Family	DU	12,104	13,385	16,091	26,239
Valencia Water Company[3]					
Single-Family	DU	23,584	25,962	26,027	33,166
Multi-Family	DU	7,327	8,726	9,531	23,892

[1] Dwelling unit counts for Tesoro and Tapia Canyon Developments were provided by the County planners and assumed that they will develop by 2020. Additional development is based on OVOV projections aligned with NCWD and CLWA service area boundary using GIS analysis to build-out. All non-residential development is scaled as a percent increase based on OVOV projections as provided by the City of Santa Clarita and Los Angeles County Water District Planning Departments, and service area boundary shape files provided by NCWD and CLWA.
[2] All data presented is aligned with SCWD service area boundary using GIS analysis with OVOV database as provided by the City of Santa Clarita and Los Angeles County Water District Planning Departments, and shape files provided by SCWD.
[3] Dwelling unit counts are based on information provided in Attachment 3. Table A-2 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

NCWD and SCWD's projected land use by specific land use type can be found in Appendix D. VWC projected demands is presented in Appendix E. Individual Retailer's historical and projected land use can be found in the tables presented in Appendix D and E and includes the following for each Retailer. The following is a summary of the basis for the land use data sources:

- SF Land Use – based on historical population assessment DUs and added DUs by land use type as provided by Retailers, or if not provided used OVOV estimates
- MF Land Use – based on historical population assessment DUs and added DUs by land use type as provided by Retailers, or if not provided used OVOV estimates
- CII Land Use – based on GIS queries for growth with added irrigation or as provided by Retailers
- IRR – added in and assumed not to be double counted with other land use demand factors (given water balance based approach used in 2004 and 2012 as cross reference)
- Other – Utility (for all Retailers)
- Recycled Water – based on recycled water provided information by CLWA and Retailers

More explanation on the development of the Retailers' land use based demand projections is provided in Appendix D and Appendix E.

4.2.4 Future Demand Projections

Next, the Econometric Model and DSS Model were used to generate water demand projections for each Retailer. As previously described, the Econometric Model generated water demand projections for years 2014 to 2020 while the DSS Model generated water demand projections for years 2021 to 2050. Figure 8 presents a summary of the entire service area land use based demand projections through 2050.

The detailed Retailer specific land-use based demand projections for each Retailer through 2050 can be found in Appendix A in Tables A-1 through A-4 (and corresponding Figures A-1 through A-4) and include the following information for each Retailer:

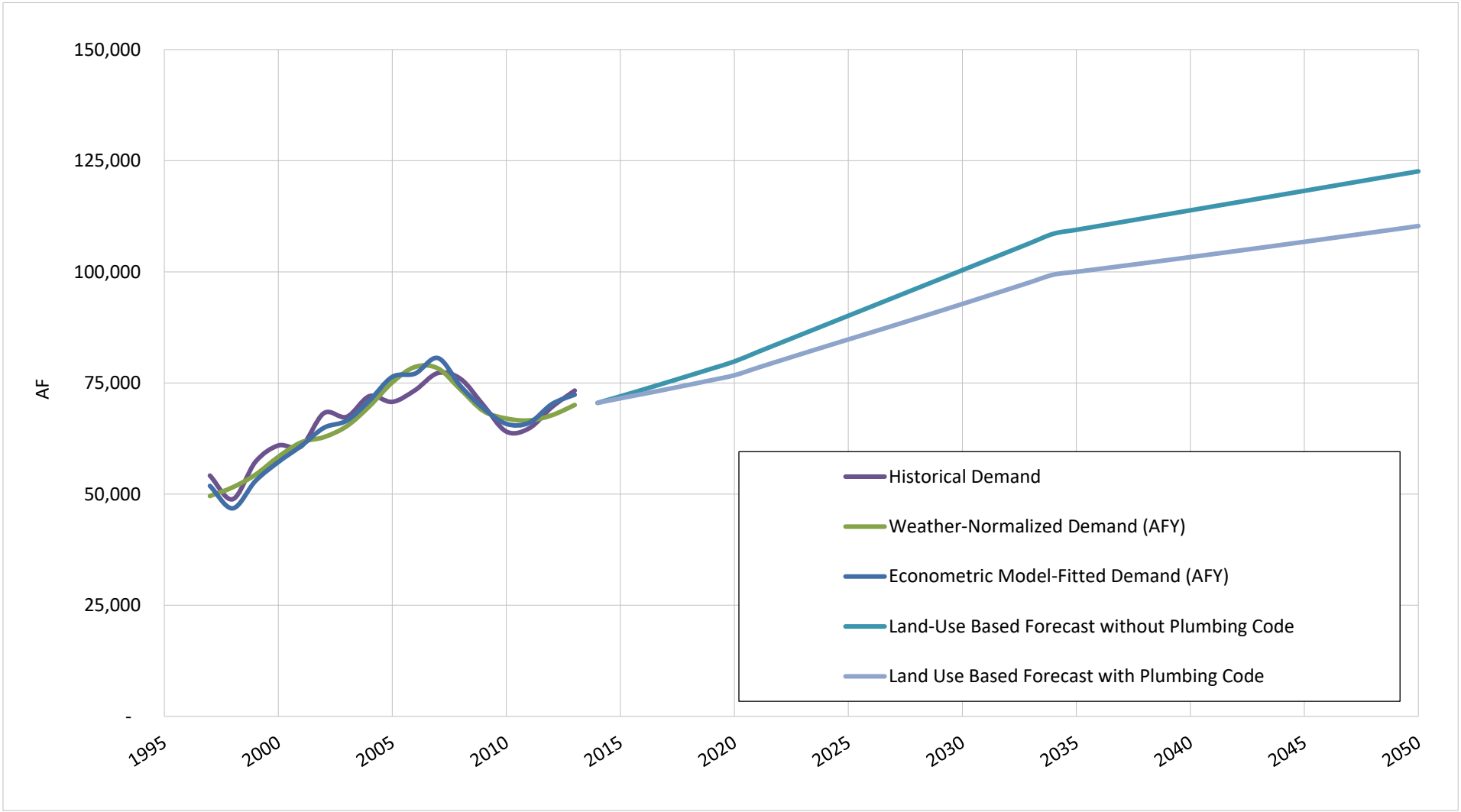
- *Projected Population* (Retailer-specific). Population provided for each Retailer based on land use dwelling unit projections using buildout estimates with the people per household (PPH) estimates determined for each Retailer in the 2014 Population Assessment Technical Memorandum. VWC projected land use population is based on PPH estimates derived from average SF attached, SF detached, and MF attached people per household based on more recently developed communities including Bridgeport, North Park, and Stevenson Ranch and presented in Attachment 3. Table A-2 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).
- *Projected Total Demand with No Plumbing Code Savings*. Water demands by each Retailer on five year increments that do not include the plumbing code
- *Projected Total Demand with Plumbing Code & Standards Savings*. Water demands by each Retailer in five year increments that nets out the effect of plumbing codes
- *Projected Total Demand with Active Conservation Program including Plumbing Code & Standards Savings*. Water demands by each Retailer in five year increments that nets out the effect of projected active conservation program implementation and plumbing codes. Recommended active conservation program measure design and water savings is presented as Program B in the WUE SP.

For comparative purposes, the 2010 Urban Water Management Plan (UWMP) population and demand projections for each Retailer through 2050 can be found in Appendix B in Tables B-1 through B-4 in five year increments.

Table 3. Valley-Wide Land-Use Based Population and Demand Projections

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Projected Population	272,600	289,000	321,900	354,700	383,400	396,100	408,800	421,500
Estimated Total Demand with No Plumbing Code Savings (AFY)	72,000	79,800	90,100	100,400	109,500	113,800	118,200	122,600
Estimated Total Demand With Plumbing Code Savings (AFY)	71,600	76,700	84,800	92,800	100,000	103,300	106,800	110,300
Estimated Total Demand With Active Conservation and Plumbing Code Savings (AFY)	69,100	69,000	74,600	80,800	86,100	88,500	91,000	94,000

Figure 8. Valley-Wide Land-Use Based Projected Demands to 2050 (AFY)



Individual Retailer's historical and projected water demands can be found in the graphs in Figure A-1 through A-4 and include the following curves:

- Actual Demand – This is historical demand as submitted in spring 2014 to MWM from each Retailer.
- Econometric Model-Fitted Demand – The Retailer Econometric Model results that try to match actual demand using the regression equation described in Appendix C.
- Weather Normalized Demand – Normalizes historical demand considering historical weather conditions.
- Estimated Demand - Assumes 1) normal weather, 2) economic recovery by 2020 as described previously, 3) price escalation projections of roughly 1.5% per year, 4) land use analysis land-use based population projections from land use buildout projection with the people per household (PPH) estimates determined for each Retailer in the 2014 Population Assessment, and 5) no plumbing code. Note VWC projected land-use based population is based on PPH estimates derived from more recently developed communities including Bridgeport, North Park, and Stevenson Ranch (GSI, 2016).
- Estimated Demand *with* Plumbing Code - Assumes 1) normal weather, 2) economic recovery by 2020 as described previously, 3) price escalation projections of roughly 1.5% per year, 4) land use analysis land-use derived population projections, and 5) plumbing code.
- Estimated Demand *with* Recommended Active Conservation Program Implementation and Plumbing Code - Assumes 1) normal weather, 2) economic recovery by 2020 as described previously, 3) price escalation projections of roughly 1.5% per year, 4) land use analysis land-use derived population projections, 5) active conservation program measure implementation as described as Program B in the WUE SP, and 6) plumbing code.

As presented in Appendix C, the Econometric Models quantify the relative impact of weather, price, and economic conditions on historical water demands.

5. CONCLUSIONS

The population and water demand forecasts contained in this memorandum reflect a significant refinement from those used in the 2010 UWMP. This reflects significant refined methodologies employed in this more current estimate. The previously developed demand forecast was a population-based forecast for the WUE SP. This effort takes results from refined econometric models developed for CLWA's Retailers to project demand out to 2020. In this case, a land use based approach was used (in lieu of a population and employment-based approach) because such an approach can further improve upon assumptions regarding how future development is planned and how water usage patterns might be significantly different than they were in the past as the Santa Clarita Valley approaches build-out. It is assumed that the Retailers will be basing future planning decisions on the forecasts presented in Figure 8, Table 3, and Appendix A.

Further analysis was conducted in the Water Use Efficiency Strategic Plan, where more background information about conservation program design and modeling results can be found. For reference, baseline GPCD, actual 2013 GPCD, and 2015 and 2020 GPCD targets are presented in Table 4. Also presented are projected 2020 GPCD with new growth and plumbing code savings taken into account, including active conservation.

Table 4. Retailer Baseline for Water Use Efficiency Strategic Plan (Phase I Enhanced) and Target GPCD

Retailer	GPCD Demand				Projected 2020 Demand		
	Baseline	2015 Target[2]	2020 Target[2]	Actual 2013	Without Plumbing Code	With Plumbing Code[3]	With Plumbing Code & Active Conservation
Los Angeles County Waterworks District 36[1]	235	212	188	227	250	242	227
Newhall County Water District	238	214	190	207	214	209	188
Santa Clarita Water Division	251	226	201	221	221	216	194
Valencia Water Company	335	301	268	295	307	301	264
Valley-wide[2]	280	252	225	246	252	247	220

[1] Los Angeles County Waterworks District 36 does not have 3,000 AF served or 3,000 connections, so SB X7-7 targets do not apply.
[2] Valley-wide 2015 and 2020 target GPCDs are based on a weighted average using projected 2020 populations for NCWD, SCWD, and VWC. Valley-wide target calculations do NOT include LACWD GPCD. Population projections and source references are presented in Section 4.3 of this document.
[3] Without active conservation includes estimated savings from the plumbing code only.

Projected 2020 demand (with plumbing code) values presented in the table above illustrate that additional active conservation programs are projected to be necessary to meet SB X7-7 GPCD targets.

APPENDIX A: DEMAND PROJECTIONS AND GPCD TARGETS – RETAILER SPECIFIC INFORMATION

This Appendix presents the land use based demand projections for each Retailer. Note that these forecasts have updated parameters with better data quality from the previous Technical Memorandum dated June 9, 2015 and draft memorandum from August 29, 2014. As compared to the previous Technical Memorandum dated June 9, 2015, the model has updated plumbing code savings estimates due to recent legislation enacted as a result of the recent drought. Both the 2015 CALGreen Building Code and the California Code of Regulations Title 20 Appliance Efficiency Regulations adopted by the California Energy Commission (CEC) on September 1, 2015 yielded more aggressive plumbing code savings, which has consequently affected the active conservation savings potential and savings estimates. Furthermore, for VWC, the land use development parameters provided were refined using better available data quality in relation to what was in the previous Technical Memorandum dated June 9, 2015.

OVOV based and land use based population projections are also presented by Retailer. For comparison purposes Appendix B presents the projected demands and population that were reported in CLWA's 2010 UWMP for each Retailer. In each Retailers case, the 2010 UWMP population estimates are higher than the land use based population estimates.

The land use based population is derived from planned dwelling units (Table 2, Appendix D and E) multiplied by the person per household from the US Census analysis prepared during the Population Assessment project. VWC projected land use population is based on PPH estimates derived from more recent developed communities including Bridgeport, North Park, and Stevenson (GSI, 2016). Where possible, conservative assumptions have been made related to the type of development (for example, more water intensive single-family demand factors were applied to future development in Newhall County Water District for future in-fill development not accounted for in Tapia and Tesoro Canyon developments). More refined land use specific plans that allowed for more specificity on the housing mix of future dwelling unit counts in terms of lot type and schedule for buildout would improve the analysis. Note the demand factors are averaged and validated in 2004 and 2012, which means that there is an inherent assumption that the housing mix in the future is assumed to be similar to the built environment in the existing service areas. It is assumed this added level of detail is either not available or not necessary to include at this time, given the land use based forecast will be revisited over time as the valley continues to build out.

Total demand projections presented in this Appendix account for the total projected water production in a service area water system, including non-revenue water, regardless of source. Source can be from CLWA surface water, groundwater or recycled water.

Both passive code and standards estimated water savings and active recommended conservation program implementation water savings are presented in this Appendix. Recommended active conservation program savings are based on Program B as presented in the Water Use Efficiency Strategic Plan.

Table A-1. Retailer Land-Use Based Demand Projections – Newhall County Water District

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Population (Land-Use Based)	46,500	49,000	52,200	55,500	58,800	62,000	65,300	68,500
Land-Use Based Total Demand with No Plumbing Code Savings (AFY)	10,400	11,900	13,200	14,400	15,600	16,800	18,000	19,200
Land-Use Based Total Demand With Plumbing Code Savings (AFY)	10,400	11,500	12,400	13,200	14,100	15,100	16,100	17,100
Land-Use Based Total Demand With Active Conservation Program and Plumbing Code Savings (AFY)	10,000	10,100	10,700	11,200	11,800	12,600	13,400	14,200

Notes:

1. The demands estimates account for additional development beyond what was found to be feasible within the existing service areas and approved annexations as of 2014. For planning purposes. CLWA is accounting for more future development beyond these planned annexations, mainly associated with additional development adjacent to NCWD and within the CLWA service area.
2. Total Demand accounts for the total projected water demand in a service area water system regardless of source. Source can be from CLWA surface water, groundwater or recycled water. Demands with and without plumbing code savings do not include planned active conservation savings estimates.
3. Updated demand forecasts were accepted as final by Mike Alvord, NCWD on March 2, 2016. More details on how the demands were prepared are presented in Appendix D.

Figure A-1. Retailer Land-Use Based Demand Projection – Newhall County Water District (AFY)

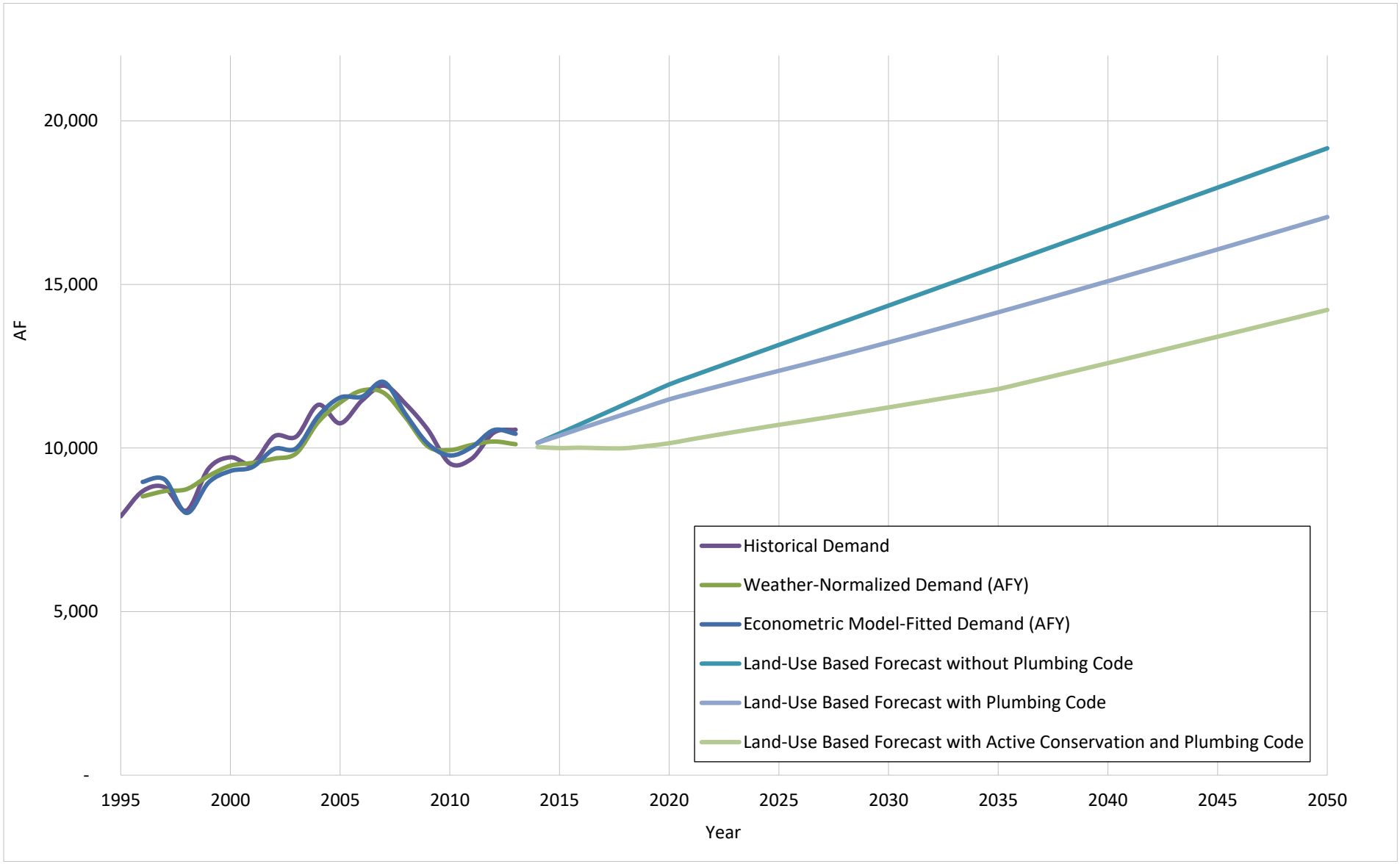


Table A-2. Retailer Land-Use Based Demand Projections – Santa Clarita Water Division

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Population (Land-Use Based)	122,700	131,500	139,200	146,800	154,500	162,200	169,800	177,500
Total Land-Use Based Demand with No Plumbing Code Savings (AFY)	29,000	32,500	35,200	37,900	40,600	43,300	46,000	48,700
Total Land-Use Based Demand With Plumbing Code Savings (AFY)	28,800	31,500	33,400	35,300	37,400	39,500	41,700	43,900
Total Land-Use Based Demand With Active Conservation Program and Plumbing Code Savings (AFY)	27,900	28,400	29,100	29,900	30,800	32,400	33,900	36,000

Notes:

1. The demands estimates account for additional development beyond what was found to be feasible within the existing service areas and approved annexations as of 2014.
2. Total Demand accounts for the total projected water demand in a service area water system regardless of source. Source can be from CLWA surface water, groundwater or recycled water. Demands with and without plumbing code savings do not include planned active conservation savings estimates.
3. Updated demand forecasts were accepted as final by Keith Abercrombie, SCWD on March 2, 2016. More details on how the demands were prepared are presented in Appendix D.

Figure A-2. Retailer Land-Use Based Demand Projection – Santa Clarita Water Division (AFY)

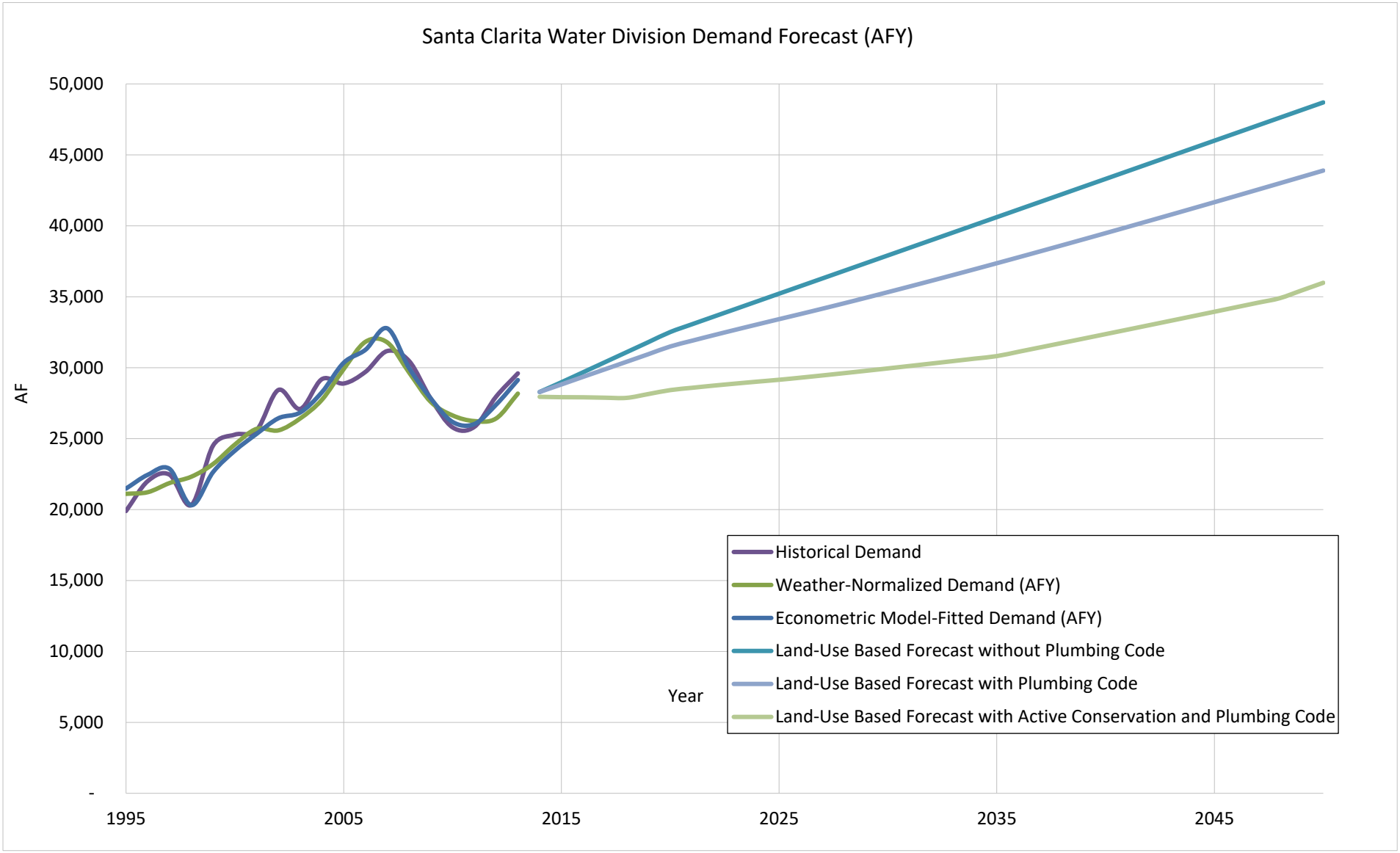


Table A-3. Retailer Land-Use Based Demand Projections – Valencia Water Company

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Population (Land-Use Based)	97,300	99,600	119,700	139,800	155,900	155,900	155,900	155,900
Total Land-Use Based Demand with No Plumbing Code Savings (AFY)	31,100	32,900	38,700	44,600	49,300	49,300	49,300	49,300
Total Land-Use Based Demand With Plumbing Code Savings (AFY)	30,900	31,300	36,100	40,900	44,800	44,600	44,400	44,300
Total Land-Use Based Demand With Active Conservation Program and Plumbing Code Savings (AFY)	29,700	28,100	32,100	36,600	40,000	39,600	39,300	39,000

Notes:

1. Past OVOV population and demands estimates are higher and assumed to be accounting for additional development beyond what was found to be feasible within the existing service areas and approved annexations as of 2014.
2. Total Demand accounts for the total projected water demand in a service area water system regardless of source. Source can be from CLWA surface water, groundwater or recycled water. Demands with and without plumbing code savings do not include planned active conservation savings estimates.
3. Updated demand forecasts were accepted as final by Ken Petersen on March 2, 2016. More details on how the demands were prepared are presented in Appendix E. Future population for 2017-2050 is provided in Table E-1.

Figure A-3. Land-Use Based Demand Projection – Valencia Water Company (AFY)

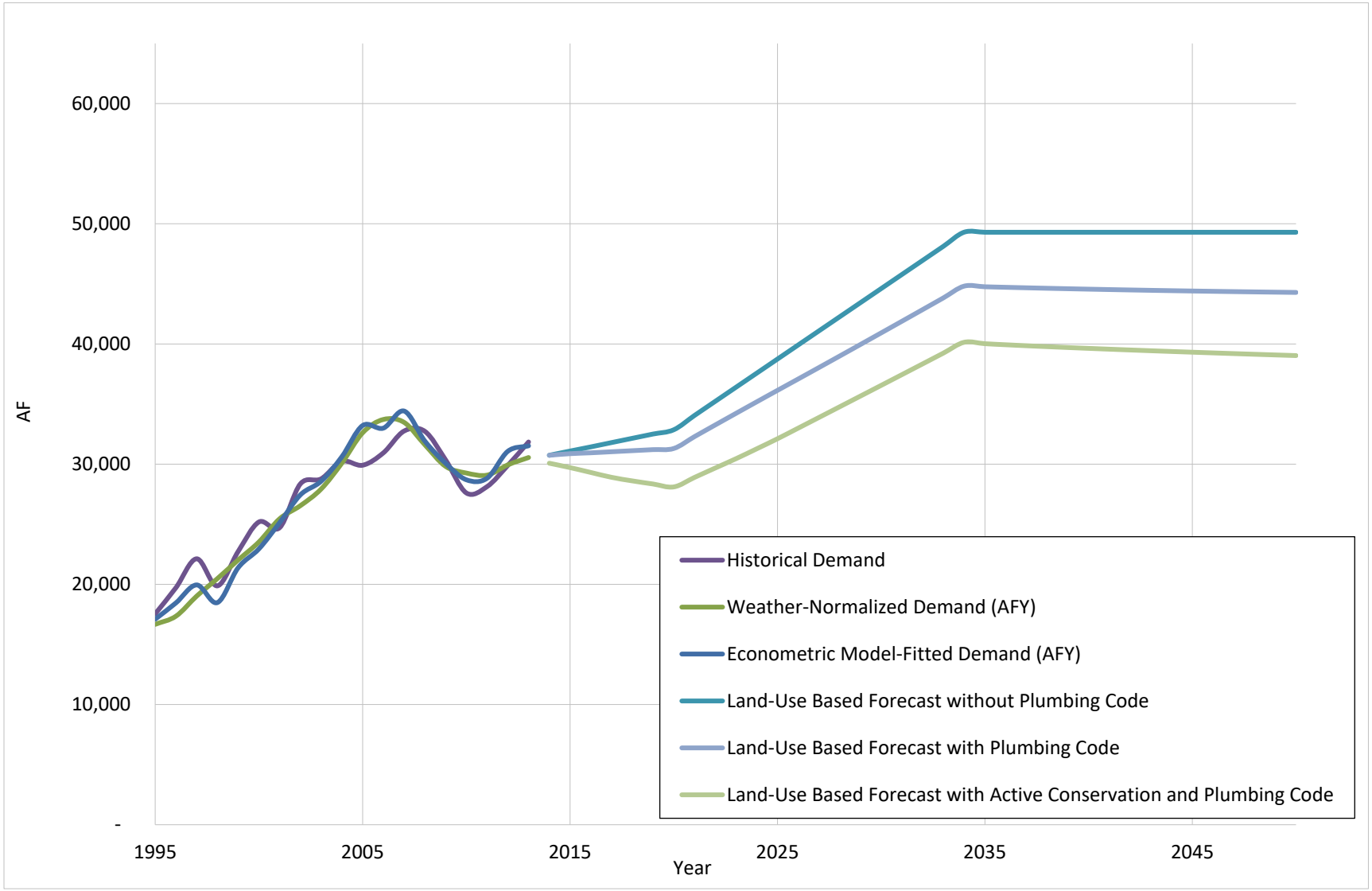


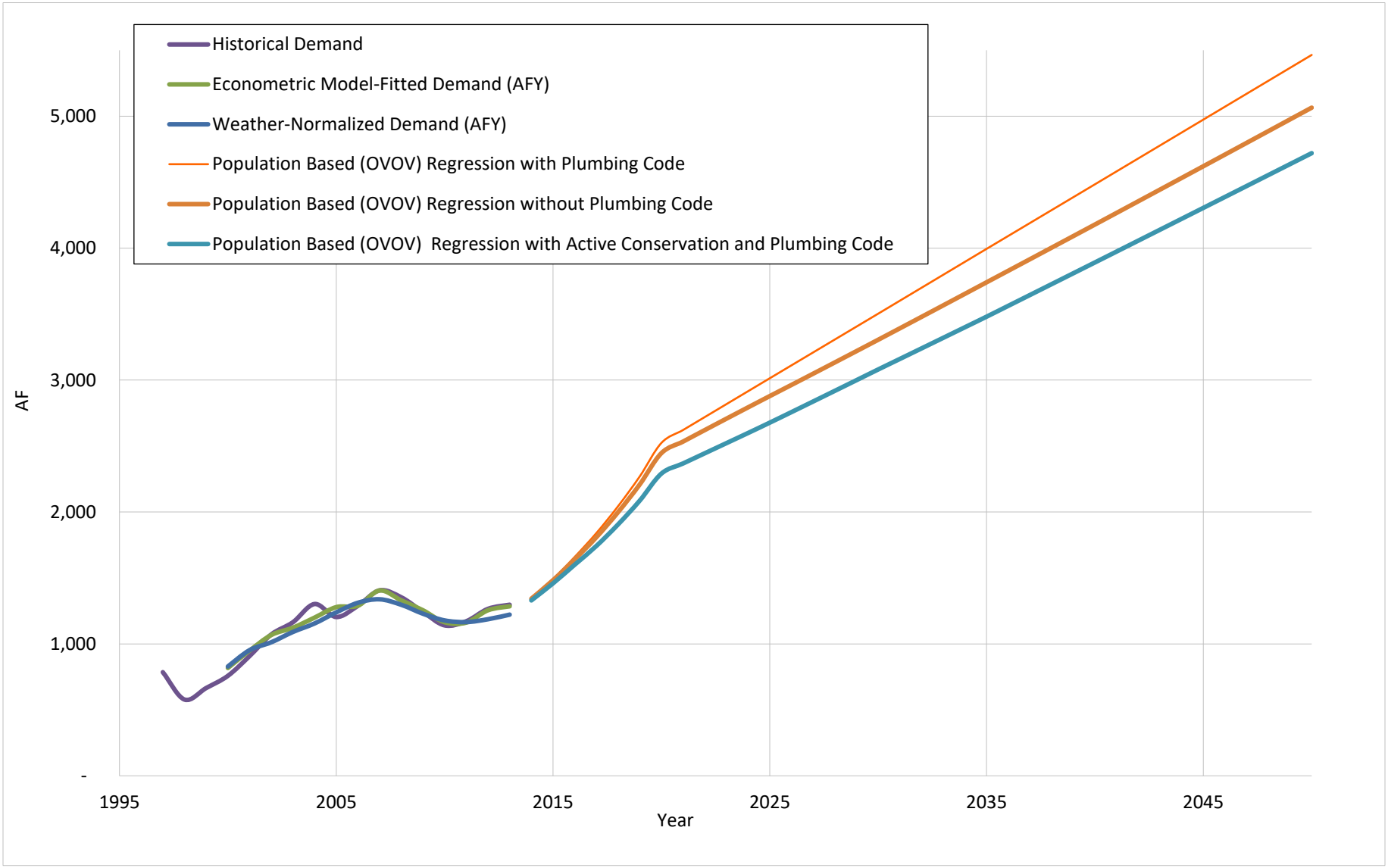
Table A-4. Population-Based Demand Projections – LA County Water District 36

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Population (OVOV Based)	6,000	9,000	10,800	12,500	14,300	16,000	17,800	19,500
Population-Based Total Demand with No Plumbing Code Savings (AFY)	1,500	2,500	3,000	3,500	4,000	4,500	5,000	5,500
Population-Based Total Demand With Plumbing Code Savings (AFY)	1,500	2,400	2,900	3,300	3,700	4,200	4,600	5,100
Population-Based Total Demand With Active Conservation Program and Plumbing Code Savings (AFY)	1,500	2,300	2,700	3,100	3,500	3,900	4,300	4,700

Notes:

1. Past OVOV population and demands estimates are higher and assumed to be accounting for additional development beyond what was found to be feasible within the existing service areas and approved annexations as of 2014.
2. Total Demand accounts for the total projected water demand in a service area water system regardless of source. Source can be from CLWA surface water, groundwater or recycled water. Demands with and without plumbing code savings do not include planned active conservation savings estimates.
3. Demand estimates were previously adopted as part of the WUE SP in June 2015.

Figure A-4. Retailer Demand Projection – LA County Water District 36 (AFY)



APPENDIX B PAST 2010 UWMP RETAILER DEMAND FORECAST AND POPULATION PROJECTIONS

For comparison purposes this appendix presents the projected demands and population that were reported in CLWA's 2010 UWMP for each Retailer. Phase 2 Retailer-specific demands can be found in Appendix A.

Table B-1. 2010 Urban Water Management Plan Demand Projections – Newhall County Water District

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand (AFY)	12,571	14,246	15,922	17,598	19,273	20,949	22,624	24,300
Population	49,933	54,559	58,612	63,824	68,450	73,079	78,715	82,341

Source: 2010 UWMP Demand without Conservation Table 2-2

Table B-2. 2010 Urban Water Management Plan Demand Projections – Santa Clarita Water Division

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand (AFY)	31,633	34,814	37,995	41,176	44,357	47,538	50,719	53,900
Population	133,868	143,544	153,220	162,896	172,572	182,248	192,924	201,600

Source: 2010 UWMP Demand without Conservation Table 2-2

Table B-3. 2010 Urban Water Management Plan Demand Projections – Valencia Water Company

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand (AFY)	34,107	37,235	40,362	43,490	46,617	49,746	52,872	56,000
Population	127,241	138,862	150,477	162,098	173,716	185,330	196,952	208,570

Source: 2010 UWMP Demand without Conservation Table 2-2. Total demand includes recycled water.

Table B-4. 2010 Urban Water Management Plan Demand Projections – LA County Water District 36

Demand Forecast	2015	2020	2025	2030	2035	2040	2045	2050
Total Demand (AFY)	1,759	2,189	2,619	3,048	3,478	3,908	4,339	4,768
Population	7,157	8,908	10,658	12,405	14,159	15,906	17,657	19,407

Source: 2010 UWMP Demand without Conservation Table 2-2.

APPENDIX C ECONOMETRIC MODEL DESCRIPTION

C.1 Introduction

In the past, CLWA has relied on projections of population and jobs to predict future baseline water demand. These estimates of baseline demand were then converted into estimates of net demand by subtracting likely savings from various plumbing codes and active conservation programs. While the simplicity of this methodology makes it appealing and easy to understand, econometric analysis of historical data (assuming historical relationships remain valid) can provide helpful information for answering questions such as:

- How much and at what rate will demand rebound as the economy expands?
- How much will future price increases continue to depress demand?
- How does demand respond to weather?

To address these questions, we have developed econometric demand models for each Retailer that aim to estimate the relationship between water demand and its key drivers such as price, economic conditions and weather. We have evaluated the following independent variables (Table C-1) for inclusion in the models and will evaluate a few more in Phase 2:

Table C-1. Independent Variables Evaluated for the Econometric Analysis

Variable Type	Variables	Units	Data Source	Comment
Weather	Precipitation	Inches per month	NOAA Weather Data	Phase 1
Weather	Avg Daily Max Air Temp	Fahrenheit	NOAA Weather Data	Phase 1
Weather	Reference ETo	Inches	Not available for all areas	Phase 2
Economy	# of Jobs	Jobs per capita	SCAG, LA County, City of Santa Clarita	Phase 2
Economy	Unemployment	Unemployment rate	CA EDD / BLS	Phase 1
Service Area Housing Mix	SF and MF Units	Dwelling units	DOF	Phase 2
Service Area Data	Rates	$/AF	Provided by Retailers	Phase 1
Service Area Data	Population	People	Census	Phase 1
Conservation	Conservation savings per year	Million gallons per day	CUWCC	Phase 2

Based on the Phase 1 analysis, the following best fit equation was developed:

$$Ln(monthly\ GPCD) = \alpha + \beta Trend + \theta Ln(unemployment\ rate) + \delta Ln(marginal\ price) + \vartheta Temperature\ Deviation + \vartheta Rainfall\ Deviation + \pi monthly\ indicators + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Eq.\ 1$$

Where,

- Monthly production is measured in gallons per capita per day (GPCD).
- α is a scaling constant. Trend is a variable that takes on a value of 0 in the first year, 1 in the second year, and so on.
- Unemployment rate is captured as an annual percent (for example, 7%).

- Marginal price for single-family customers, measured in dollars per hundred cubic feet
- Temperature deviation is measured in degrees Fahrenheit (average maximum daily temperature in a given month minus average for the same month between 1995 and 2012).
- Rainfall deviation is measured in total inches (total rainfall in a given month minus average total rainfall for same month between 1995 and 2012).
- Monthly indicators are binary 0-1 variables, taking on a value of 1 for a given month in question, 0 otherwise.
- ε denotes random statistical error.

Each variable on the right hand side of the equation (independent variable) is preceded by a coefficient (i.e. β, etc.)that measures the strength of the impact of an independent variable on monthly demand (the variable on the left hand side of the equation is also known as the dependent variable). A positive coefficient implies that increases in an independent variable will cause an increase in the dependent variable; a negative coefficient implies the opposite. The purpose of model development is both to select the elements of the equation, as well as to estimate each independent variable's coefficient. Continuous variables such as the marginal price and the unemployment rate are logarithmically transformed so that their respective coefficients can be given a proportional interpretation. So, for example, the coefficient on logarithmically transformed marginal price becomes the price elasticity, and so on. The trend variable captures changes in GPCD over time not accounted for by price, unemployment rate, or weather.

Our basic model specification (Eq. 1) includes several features. First, Retailer-specific production data are modeled at a monthly, not annual, level. The reason for estimating monthly level models is to allow for the impact of weather to vary by time of year. Prior research strongly indicates that abnormal reference ETo and abnormal rainfall do not have the same effect in January as, say, in May.[3] Working with monthly production data allows one to incorporate time-varying weather effects.

Second, rainfall corrected reference ETo enter the model as deviations from their respective monthly averages, capturing directly how demand reacts to weather as it deviates from average. Normal seasonality in monthly demand (that is, July demand being much higher than January demand) is captured by the monthly indicator variables.

In Phase 1, we used temperature and rainfall from the NOAA weather station located in Newhall, California to control for weather. In Phase 2 we used reference ETo and precipitation from Department of Water Resources' PRISM weather tool that are likely to be recommended by both DWR and CUWCC for the purpose of weather normalization of compliance year GPCD. Thus, there is every reason to favor PRISM over NOAA data.

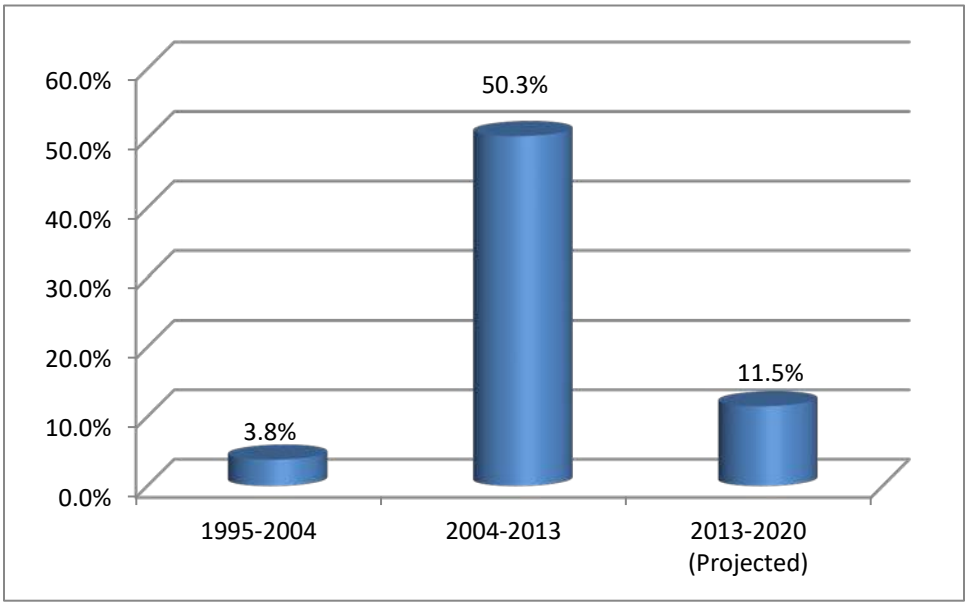
Third, economic conditions are captured by the unemployment rate obtained from the Bureau of Labor Statistics for Los Angeles County. We tested whether the city of Santa Clarita's unemployment rate predicts water use patterns better than a metric that reflects broader economic conditions, but it did not. In Phase 2, we have also evaluated whether changing proportion of single- and multi-family housing could be used to improve the models, but this metric did not show sufficient independent variation to merit inclusion in the final models.

Finally, our models also include a measure of the marginal price of water in real terms (that is, price deflated by the consumer price index published by the Bureau of Labor Statistics). We have used marginal price of water

[3] Bamezai, A., *GPCD Weather Normalization Methodology*, final report submitted to the California Urban Water Conservation Council, 2011.

faced by the average single-family customer in a Retailer to depict price variation over time. By and large, Commercial, Institutional, and Industrial (CII) and SFR price trends appear similar. Figure C-1 shows price escalation faced by single-family customers in the CLWA service area overall, calculated as a weighted average of each Retailer's price data.

Figure C-1. Valley-Wide Trends in the Single-Family Real Price of Water



C.2 Econometric Model Results

We developed models as shown in Equation 1 for each Retailer using their own unique data. To illustrate the method in general we also developed a monthly GPCD model for all CLWA Retailers combined. Results for this rolled-up valley-wide model are shown in Table C-2. This type of model is known as a time-series, cross-sectional model. This valley-wide model incorporates Retailer-level fixed effects, a correction for autocorrelation in the error term, and population weighting to account for different Retailer sizes. Autocorrelation refers to model error is successive months exhibiting a positive or negative correlation. Model estimation techniques that account for this correlation produce more accurate hypothesis tests. Retailer-specific fixed effects capture the impact of Retailer characteristics that do not vary much over time, such as average household income and lot size, leading to a much more robust model specification than one without these fixed effects. In other words, this model captures the impact on GPCD of income, lot size and other unobservable time-invariant differences across Retailers implicitly through these fixed effects.

In addition to the fixed effects, each Retailer is allowed to have its own time trend, if necessary, to capture the impact of service area dynamics that influence water use but are not fully captured either by price, unemployment rate or weather. Only in the case of WW36 did a positive time trend appear necessary, which matches anecdotal evidence suggesting that newer development in the area is more affluent than what has existed historically. The normal seasonality in water use is also allowed to vary across retailers as is the impact of weather deviations from normal. The differences across retailers are small, but in the interest of accuracy each is allowed to have their own unique seasonal pattern.

The estimated valley-wide model (Table C-2) has three columns, including one for the estimated coefficient, one for the likely band of error surrounding this coefficient (referred to as standard error), and one for the t-statistic. An independent variable's t-statistic is the ratio of the coefficient over its standard error. A t-statistic of 2 or greater indicates a statistically significant relationship between the dependent and independent variable; less than 2 indicates that the data are not able to conclusively demonstrate a relationship. The latter finding may reflect the lack of any relationship. Or, it may occur because of data errors or other problems, such as two or more independent variables being highly correlated with one another. The model's R-square is shown at the bottom, which is indicative of the explanatory power of a statistical model. It can vary between zero and a maximum of 1, with higher numbers indicating greater explanatory power.

Table C-2's coefficients have the following interpretations:

- A price elasticity of -0.154 indicates that a 10% real increase in the marginal price of water can be expected to reduce demand by 1.5%. Our valley-wide estimate of price elasticity compares well with the published literature on this topic.
- A 10% increase in the annual unemployment rate is likely to depress water demand by 1.7%, a statistically significant effect, and comparable to the effect of price. The weather coefficients are all significant and behave in expected ways.
- An extra inch of reference ETo per month (adjusted for rainfall) during the spring season increases monthly demand by roughly 15.8%, during the summer months by 8. 7%, and during the winter months by roughly 15.0%. Lower than average reference ETo would have the opposite effect.

The monthly indicator variables also exhibit the expected pattern with July and August exhibiting the largest coefficients, indicating that July and August demand is greatest during the year, reaching a minimum during February.

Figure C-2 shows how the model prediction compares with CLWA's valley-wide GPCD trend. The resulting R^2 value of 0.93 shows that there is a good fit between actual and predicted values. The models capture the downturn in demand experienced during the 2008-2011 period. The models suggest that a good chunk of the uptick in demand during 2012 and 2013 was weather related. Once this weather effect is removed it causes a downshift in projected normal-weather demand going forward. This normal weather baseline demand is expected to rise as the economy expands, but tempered by projected price increases (shown in Figure C-1) which have been factored into the forecast.

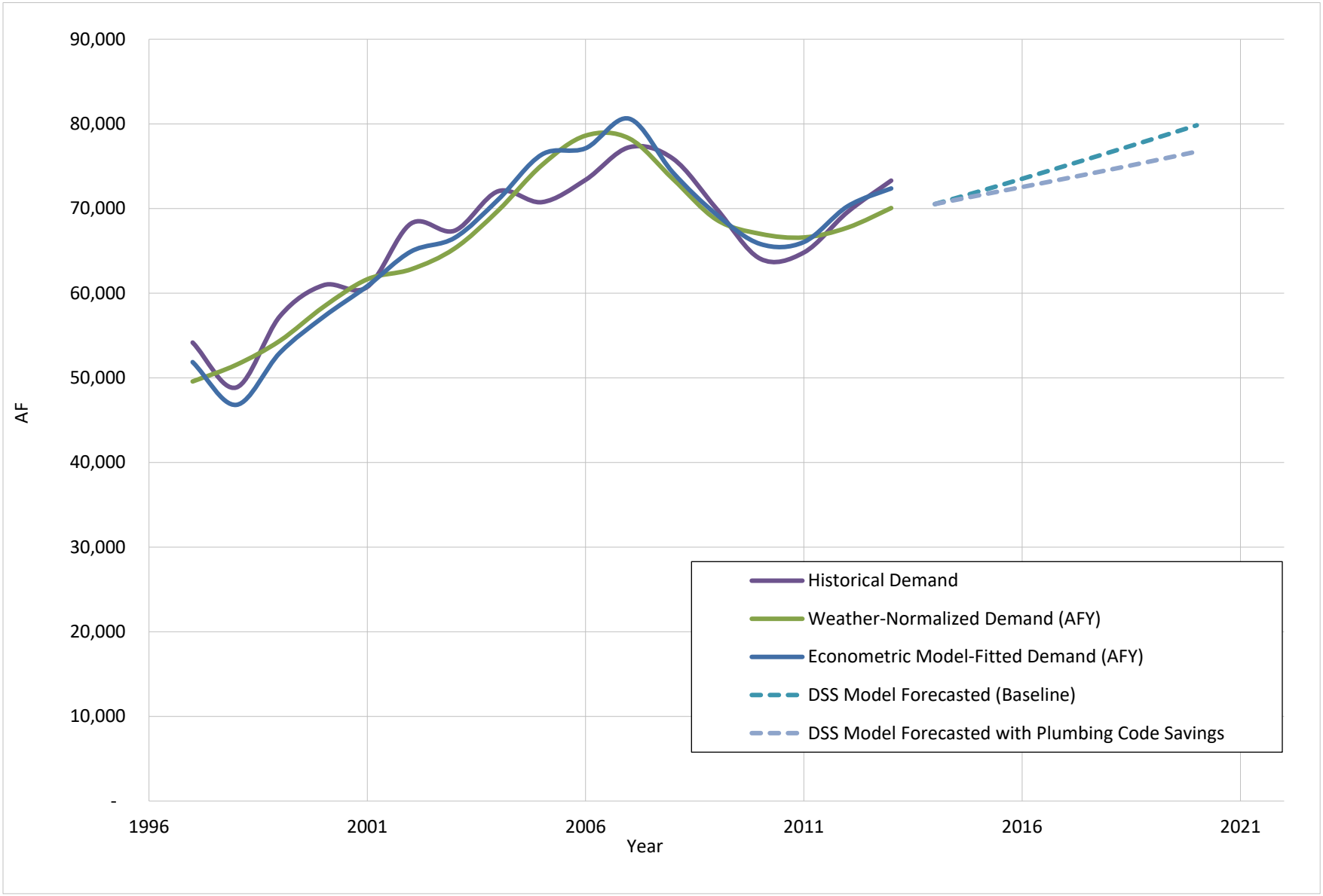
Table C-2. CLWA Valley-Wide Model Results

Dependent Variable: Ln (Monthly Baseline GPCD)

Independent Variable	Coefficient	Std. Error	t-statistic
Ln(Marginal Price)	-0.154	0.023	-6.7
Ln(Unemployment Rate)	-0.169	0.014	-12.4
Rainfall adj. Ref. ETo (Apr-Jun)	0.158	0.009	17.5
Rainfall adj. Ref. ETo (Jul-Oct)	0.087	0.010	8.4
Rainfall adj. Ref. ETo (Nov-Mar)	0.150	0.009	15.7
Jan Indicator	-0.082	0.020	-4.1
Feb	-0.145	0.023	-6.4
Mar	0.028	0.021	1.3
Apr	0.287	0.018	15.6
May	0.527	0.017	31.2
Jun	0.682	0.016	43.8
Jul	0.804	0.016	51.1
Aug	0.815	0.015	52.9
Sep	0.708	0.016	44.6
Oct	0.480	0.017	27.5
Nov	0.227	0.017	12.9
Constant	5.283	0.034	155.0
Retailer specific fixed effects	Included		
Retailer specific trend terms	Included		
Retailer interactions with monthly dummies	Included		
R-Square	0.93		

NOTE: The large number of coefficients associated with the Retailer fixed effects, Retailer trend terms and Retailer interactions with monthly dummies not shown for the sake of brevity.

Figure C-2. CLWA Valley-Wide Land Use Based Projection: Econometric Model Fit and Forecast



APPENDIX D - LAND USE DEMAND ANALYSIS METHODOLOGY FOR NCWD AND SCWD

This Appendix presents the land use demand analysis methodology steps, TAZ and land use background data, land use demand factors, and projected land use and land use based demand. Also presented is how a water balance was used as check on the basis of appropriate water demand factors using OVOV Study data prepared based on 2004 validated land uses aligned with Retailer water demand and account data.

D.1 Land Use Analysis Steps

As part of this project, the land use assessment was conducted using the following basic steps for the Newhall County Water District and Santa Clarita Water Division:

1. Prepared the GIS analysis using:
    a. Imported City and County provided GIS layers and traffic model level 59 land use categories for existing and planned build-out development,
    b. Imported CLWA and Retailer water service boundary maps,
    c. Appended new annexation and buildout boundary maps provided by NCWD and CLWA
    d. Developed a database of GIS exported data for land use in each service area boundary for 2004 (base year) and OVOV build-out.
2. Reviewed historical water use data to build a water balance for 2004 using retailer supplied billing data by generalized customer categories (SF, MF, Commercial, Industrial, Institutional, Irrigation, Other and Recycled Water).
3. Reviewed previously supplied dwelling unit counts from the Spring 2014 Population Assessment Project.
4. Reviewed historic documents with past demand factors (GSI 2008, 2010), including memorandums and overall boundary maps.
5. Discussed demand factors with CLWA, and received a memo dated November 25, 2014 with proposed demand factors.
6. Prepared weather normalized demand factors for 2004 and 2012 based on adjustment factors provided by Western Policy Research.
7. Adjusted demand factors to match water balance for 2004 based on GIS query of OVOV data.
8. Checked the percentage growth to 2012 based on an updated City of Santa Clarita provided model data (lesser quality than 2004 base year analysis by transportation modeling team).
9. Further tested and checked water balance with 2012 data.
10. Confirmed questions related to historical water use to finalize the water balances with adjusted demand factors.
    a. Residential demand factors are based on historical average gallons per day per account for each Retailer. This demand is only based on interior and exterior building use using per accounting historic billing data.
    b. Commercial demand factors are based on past demand factors provided by Retailers and adjusted to be weather normalized. This demand is only based on interior building use.
    c. Industrial demand is based on historical demand increased by percent future development by land use. This demand is only based on interior building use.
    d. Golf Course and Developed Park demand factors are based on average ETo aligned applied water requirement and 70% watering efficiency.

e. Future dedicated irrigation (recycled water) was used based on estimates provided by CLWA for availability of recycled water for Newhall Land Development and scaled by the residential development in individual villages. In the case of NCWD and SCWD the growth in irrigation was scaled to future residential growth.

11. Applied planned development for NCWD for future residential development according to an assumed Retailer schedules provided with development occurring between 2014 and 2020 or between 2021 and 2050. Linear interpolation was assumed to occur between 2014-2020 and 2021-2050.
12. Applied land use percentage increase growth by units provided (i.e., dwelling units, thousand square feet) between existing and build-out based on 2013 units growth to 2050 build-out units.

D.2 Processing TAZ and Land Use Data

This section presents the TAZ land use assessment methodology and the land use data by Retailer. The land use data by Traffic Analysis Zone (TAZ) is provided for years 2004, 2012 and build-out in 2050. The land use assessment was conducted by evaluating the land use types in each TAZ to determine what portion of the land use residing in that TAZ was located in each Retailer's service area. Furthermore, the 2014 CLWA Population Assessment provided 2010 Census-based estimates for residential land use types as a basis for comparison and methodology confirmation. Build-out was estimated from the One Vision One Valley Valley-Wide Traffic Study (OVOV). The analysis also included the development of demand factors for each land use type based on aligning with historical water use by land use type provided by or confirmed by the Retailers. In February 2016, VWC decided to pursue using better available development data using GSI's analysis of VWC's only projected development West Side Communities instead of the OVOV study approach.

TAZ Approach Methodology

A TAZ is the unit of geography most commonly used in transportation planning models. Though the size of a TAZ varies, typically a zone of less than 3,000 people is common. The spatial extent of zones varies, ranging from very large areas in undeveloped regions to zones as small as a city block or group of buildings in a central business district.

This project's Phase 2 GIS analysis was conducted by MWM sub-consultant Matt Pegler who coordinated with Retailer GIS specialists, water resources planners, City of Santa Clarita planners and Los Angeles County planners. The OVOV Study build-out land use data to cross reference with the analysis outcomes was provided by Jeff Ford, Water/Environmental Resources Planner at CLWA, and Fred Follstad, Associate Planner at the City of Santa Clarita, in June 2014. Initially, two principal GIS queries were conducted:

- 2004 OVOV-based data on the "built" environment
- Build-out (2050) OVOV-based "forecast" based on a build-ability review at the TAZ level for the Metropolitan Transportation Plan (MTP)

After review with Santa Clarita City Planner, Ian Pare, additional information, including updated GIS files for the TAZ layers with 2012 land use data, was provided in November 2014. According to the City and CLWA, these data contain all the existing development that was actually on the ground and generating traffic in 2012.

Like CLWA's 2010 Census-based 2014 Population Assessment, the Phase 2 Demand Analysis' TAZ assessment followed similar steps:

1. Each Retailer's service area Geographic Information System (GIS) maps were used for their service area boundaries. Retailer service area boundaries were validated as part of the Spring 2014 Population Assessment.
2. Retailer and CLWA service area maps were super-imposed onto TAZ maps to identify which TAZ's are included within CLWA's (and each Retailer's) service area, which TAZ's are excluded, and which TAZ's are bisected by the service area boundaries. This exercise was performed for each analysis year (2004, 2012 and 2050). This step includes applying the associate land use data for each TAZ that is either wholly within or bisected by the Retailer service area boundary or proposed future Retailer service area boundaries.
3. The next step involved dealing with the allocation of the land use types in the conflicted (bisected) blocks. This allocation is done by identifying the proportion of a TAZ that is within the service area and then using this proportion to split the TAZ-level land use type units into the portion that needs to be counted and the portion that falls outside the designated Retailer service area.
4. Once land use was determined and validated for the conflicted TAZ's, the final step was to add up the land use units in each Retailer's service area for each land use type by TAZ. Because the blocks are relatively small, the majority of the land use type units are located in non-conflicted TAZ's which can be summed easily. The remaining land use type units are located in conflicted blocks and are proportionally included.
5. An additional review was conducted of potential future development and some additional dwelling units were accounted for adjacent to NCWD service area boundaries. The GIS analysis uncovered an approximately 16% higher population planned to reside in outlying areas that is not currently planned for annexation.

The following three tables present the GIS logs of each year's analysis. These logs will allow CLWA and Retailer planners to reproduce this analysis.

Table D-1. Project Log for 2004 Land Use Unit Data

Description	Files, Databases Altered, Notes
Reformat 2004 Unit Type data to join to TAZ Shape file Note: TAZ Shape file contains 18 records that have no TAZ number but do contain other record data	OVOVData.xls Utilized a Macro written by Chris Matyas at MWM to reformat the data
Multiple Entries Found for TAZ 19, Zone 20. There was a duplicate record with unique values 775 and 1430. Until we can receive clarification on this issue we are combining the values	OVOVData.xls
Create a subset shape file of TAZ zones that touch the 2004 CLWA boundary	2004 TAZ Intersects.shp
Join OVOVData.xls to the TAZ shape file (Keep all Records)	
Added AREA_SQ_FT field to database and performed a geometry calculation to determine the Whole SQ_MI Area	2004 TAZ Intersects.shp
Discovered multiple records for same TAZ Zones	115 (2), 178 (2), 180 (4), 213 (3), 214 (3), 279 (2), 386 (2), 418 (2)
Removed multiple TAZ records Items with no area	2004 TAZ Intersects.shp 115, 178, 180, 213, 214, 279, 418
TAZ 386 has two unique boundaries and area values.	
Created union of data with the CLWA boundaries and TAZ zones	CLWA_TAZ_Union.shp
Added a NAREASQFT field and performed a geometric calculation of the TAZ areas split along service boundaries	CLWA_TAZ_Union.shp
Performed a calculation to determine the percentage of the original TAZ. [NAREASQFT]/[AREA_SQ_MI]*100	CLWA_TAZ_Union.shp
Exported The Table to a Comma-Delimited File	2004_TAZ_Unit_Types.csv
Formatted the Comma-Delimited File in Excel to remove unnecessary data	2004 CLWA TAZ Unit Types - Draft.xls

Table D-2. Project Log for 2012 Land Use Unit Data

Description	Files, Databases Altered, Notes
Reformat 2012 Unit Type data to join to TAZ Shape file	2012 LUI.xlsx Utilized a Macro written by Chris Matyas (MWM) to reformat the data
Join 2012 LUI.xlsx to the TAZ shape file (Keep all Records)	
Added AREA_SQ_FT field to database and performed a geometry calculation to determine the Whole SQ_MI Area	TAZ 2012 CLWA.shp
Created union of data with the CLWA boundaries and TAZ zones	CLWA_TAZ_2012_LU_union.shp
Added a NAREASQFT field and performed a geometric calculation of the TAZ areas split along service boundaries	CLWA_TAZ_2012_LU_union.shp
Performed a calculation to determine the percentage of the original TAZ. [NAREASQFT]/[AREA_SQ_MI]*100	CLWA_TAZ_2012_LU_union.shp
Exported The Table to a Comma-Delimited File	CLWA_LU_2012.csv
Formatted the Comma-Delimited File in Excel to remove unnecessary data	CLWA_LU_2012.csv

Table D-3. Project Log for OVOV Build-out Land Use Unit Data

Description	Files, Databases Altered, Notes
Reformat OVOV Unit Type data to join to TAZ Shapefile	OVOVData.xls
Combine annexed features and 2010 CLWA boundaries to create the OVOV CLWA boundaries	CLWA OVOV.shp Source files: 2010 CLWA Boundaries, Legacy Village, Tapia, Tesoro boundaries
Merge Tapia and Tesoro boundaries with NCWC boundary	CLWA OVOV.shp
Merge NCWD Buildout Boundary with NCWC boundary	CLWA OVOV_v2.shp
Create a subset shapefile of TAZ zones that touch the CLWA OVOV boundary	TAZ CLWA OVOV.shp
Join OVOVData.xls to the TAZ shapefile (Keep all Records)	
Added AREA_SQ_FT field to database and performed a geometry calculation to determine the Whole SQ_MI Area	TAZ CLWA OVOV.shp
Note: TAZ Shapefile contains 18 records that have no TAZ number but do contain other record data	
TAZ 386 has two unique boundaries and area values. Require clarification	
Created union of data with the CLWA boundaries and TAZ zones	OVOV_TAZ_CLWA_Union.shp
Added a NAREASQFT field and performed a geometric calculation of the TAZ areas split along service boundaries	OVOV_TAZ_CLWA_Union.shp
Performed a calculation to determine the percentage of the original TAZ. [NAREASQFT]/[AREA_SQ_MI]*100	OVOV_TAZ_CLWA_Union.shp
Exported The Table to a Comma Delimited File	OVOV_CLWA_TAZ_Unit_Types_-_Draft.csv
Formatted the Comma Delimited File in Excel to remove unnecessary data	OVOV_CLWA_TAZ_Unit_Types_-_Draft.csv

Land Use Types and Retailer Estimates

There are 42 types of land uses which include estimates of dwelling units (DU), total square footage (TSF), students (STU), acreage (AC), rooms, and seats by relevant land uses; for example, the number of seats per movie theater, number of students per school, and number of dwelling units in the category of single-family housing with 1-5 du/ac. A list of the types of unit codes included in the transportation model GIS Shape files provided by the City of Santa Clarita and County of Los Angeles is presented in the following table.

As part of this analysis, where necessary some land use categories were further consolidated to align with demand factors and water use data. Since the land use data was generated for transportation models, the land use types with special generator (SG) units are applicable only in transportation planning scenarios and not in water resources planning. Actual water use data were provided by CLWA and the Retailers for these SG land use types.

Table D-4. City of Santa Clarita and County of Los Angeles Transportation Model Land Use Types

Land Use Type	UNITS
Single-Family (<1 du/ac)	DU
Single-Family (1-5 du/ac)	DU
Single-Family (6-10 du/ac)	DU
Condominium/Townhouse	DU
Apartment	DU
Mobile Homes	DU
Senior (Active)	DU
Commercial Center (>30ac)	TSF
Commercial Center (10-30a)	TSF
Commercial Center (<10ac)	TSF
Commercial Shops	TSF
Hotel	ROOM
Sit-Down Restaurant	TSF
Fast Food Restaurant	TSF
Movie Theater	SEAT
Health Club	TSF
Car Dealership	TSF
Elementary/Middle School	STU
High School	STU

Land Use Type	UNITS
College	STU
Hospital	TSF
Library	TSF
Church	TSF
Day Care	STU
Industrial Park	TSF
Business Park	TSF
Manufacturing/Warehouse	TSF
Utilities	TSF
Regional Post Office	TSF
Commercial Office	TSF
High-Rise Office	TSF
Medical Office	TSF
Post Office	TSF
Golf Course	AC
Developed Park	AC
Undeveloped Park	AC
Wayside Honor Ranch[1]	AFY

[1] Wayside ranch has its own water supply.

Residential Land Uses

The number of dwelling units by land use type were separated by Retailer and combined into summary groupings that would allow for Retailer TAZ-based 2004 and 2012 data to be compared to and checked with other available data.

For example, single-family land use type units were totaled by Retailer and compared to the number of SF accounts in 2004 and 2012. The same was done for multi-family land use categories and accounts. The methodology and data from Phase 2 were further verified by comparing 2012 year SF and MF DU from the 2010 Census-based 2014 Population Assessment effort to 2012 TAZ land use values for SF and MF.

Table D-5. Land Use Units versus Number of Accounts – NCWD

Land Use Code and Type / Account Customer Category	Units	Population Assessment 2004 DU[1]	Population Assessment 2012 DU[1]	Projected Future 2020 DUs[2]	Projected Future Buildout DUs[2]
Single Family	DU	7,618	8,606	9,011	14,249
Multi-Family	DU	4,870	4,984	5,696	7,147

[1] SF based on historical accounts. MF based on 2014 Population Assessment DU results.

[2] SF projected units based on CLWA provided Tapia development information through 2020 and OVOV service area buildout estimates. MF values are based on CLWA provided Tesoro development information through 2020 OVOV service area buildout estimates.

Table D-6. Land Use Units versus Number of Accounts – SCWD

Land Use Code and Type / Account Customer Category	Units	Population Assessment 2004 DU[1]	Population Assessment 2012 DU[1]	Projected Future 2020 DUs[2]	Projected Future Buildout DUs[2]
Single Family	DU	19,142	21,538	23,333	30,064
Multi-Family	DU	12,104	13,385	16,091	26,239

[1] SF based on historical accounts. MF based on 2014 Population Assessment DU results.
[2] Projected DU's based on land use category OVOV service area buildout with linear interpolation from historical 2012 values.

Non-Residential Land Uses

Unit water demand factors provided by the Retailers were weather normalized for 2004 and 2012 and applied to 2004 and 2012 TAZ non-residential land use units. The demand factors were adjusted appropriately to create a water balance confirming that total 2004 and 2012 historical water use for non-residential accounts aligned with 2004 and 2012 water use calculated using TAZ non-residential land use 2004 and 2012 units.

Table D-7. Land Use Units – NCWD

Land Use Code and Type	Units	TAZ Analysis 2004 Data	TAZ Analysis 2012 Data	2020 Projection	Build-out Projection
Commercial Center (>30ac)	TSF	266	377	567	1,281
Commercial Center (10-30a)	TSF	389	359	514	1,098
Commercial Center (<10ac)	TSF	111	171	193	276
Commercial Shops	TSF	297	324	375	564
Hotel	ROOM	24	5	56	249
Sit-Down Restaurant	TSF	60	14	24	63
Fast Food Restaurant	TSF	-	4	4	4
Movie Theater	SEAT	-	-	-	-
Health Club	TSF	-	-	-	-
Car Dealership	TSF	-	-	-	-
Elementary/Middle School	STU	3,687	4,042	4,619	6,785
High School	STU	2,273	1,940	1,940	1,940
College	STU	1,479	765	1,035	2,051
Hospital	TSF	81	7	10	25
Library	TSF	17	17	21	34
Church	TSF	153	181	197	256
Day Care	STU	-	-	-	-
Industrial Park	TSF	179	152	1,356	5,870
Business Park	TSF	-	-	339	1,608
Manufacturing/Warehouse	TSF	83	68	82	135
Utilities	TSF	257	87	196	603
Regional Post Office	TSF	-	1	1	2
Commercial Office	TSF	137	62	97	227
High-Rise Office	TSF	-	-	-	-
Medical Office	TSF	-	20	20	20
Post Office	TSF	-	-	-	-
Golf Course	AC	77	0	7	34
Developed Park	AC	3	3	10	36
Undeveloped Park	AC	-	45	66	145

Table D-8. Land Use Units – SCWD

Land Use Code and Type	Units	TAZ Analysis 2004 Data	TAZ Analysis 2012 Data	2020 Projection	Build-out Projection
Commercial Center (>30ac)	TSF	130	564	818	1,773
Commercial Center (10-30a)	TSF	1,785	1,983	2,313	3,550
Commercial Center (<10ac)	TSF	973	1,053	1,120	1,371
Commercial Shops	TSF	509	607	667	896
Hotel	ROOM	0	0	92	436
Sit-Down Restaurant	TSF	15	12	31	101
Fast Food Restaurant	TSF	5	1	4	11
Movie Theater	SEAT	-	-	-	-
Health Club	TSF	-	-	-	-
Car Dealership	TSF	-	-	-	-
Elementary/Middle School	STU	14,955	14,411	16,025	22,077
High School	STU	7,017	5,510	6,179	8,686
College	STU	11	4,589	5,731	10,011
Hospital	TSF	15	-	-	-
Library	TSF	17	17	17	17
Church	TSF	99	167	194	294
Day Care	STU	-	-	-	-
Industrial Park	TSF	2,147	2,195	2,696	4,575
Business Park	TSF	383	154	677	2,640
Manufacturing/Warehouse	TSF	1,668	1,614	1,876	2,859
Utilities	TSF	122	97	108	151
Regional Post Office	TSF	-	-	-	-
Commercial Office	TSF	109	210	629	2,200
High-Rise Office	TSF	-	-	63	300
Medical Office	TSF	2	103	111	137
Post Office	TSF	-	-	-	-
Golf Course	AC	199	513	524	566
Developed Park	AC	159	156	269	694
Undeveloped Park	AC	-	-	-	-

Dedicated Irrigation

Golf Course and Developed Park 2004 and 2012 demand factors are based on 2004 and 2012 ETo-based applied water requirements with 100% watering efficiency (prior to conservation). The ETo applied water factor for 2004 was 6.04 ft/yr and 5.8 ft/yr for 2012. The Undeveloped Park demand factor was provided by the Retailers. Values were further weather normalized using factors presented in the following section.

Table D-9. Baseline Irrigation Demand (before conservation)

Land Use Type	Retailer-Provided GPD/AC	MWM Developed 2004 GPD/AC	MWM Developed 2012 GPD/AC
Golf Course	2,680	5,215	4,908
Developed Park	3,580	5,215	4,908
Undeveloped Park	200	194	190

D.3 Normalized Land Use Demand Factors

The Phase 2 analysis included the development of demand factors for each of the land use types shown in the previous table; these demand factors are based on historical water use. Land use demand factors were generated from historical billing data provided by Retailers for various land use and account types. Land use demand factors were tested in historical years 2004 and 2012 and normalized for weather and economic conditions in those years.

MWM worked with CLWA, Retailers and Los Angeles County/City land use and water planners. A critical step in was conducting more analysis demand factors by aligning billing data with water connections and current and future land use types to validate that usage patterns from the demand factors in the study were aligned with how water actually being used by these customer categories.

Western Policy Research provided the adjustment factors based on the econometric models for purpose of adjusting demand factors used in the water balances for years in years 2004 and 2012, where available land use and historical water billing data was available. These adjustment factors were taken as approximations and in some cases weight averaged to align with demand factors as necessary to make the water balances match as best as possible. These adjusted demand factors were then carried forward into analysis to develop the future demand projections.

Table D-10. Economic Adjustment Factors

		Correction Factor to GPCD in given year				
Year	LA County Unemployment Rate[1]	LACWD	NCWD	SCWD	VWC[2]	Average as percent
2004	6.5	0.976	0.971	0.978	0.977	**2.49%**
2012	10.9	1.062	1.076	1.057	1.060	**-6.37%**
Total Difference						**-8.86%**

[1]Normal LA County unemployment rate is assumed to be 7.55%, which is what LA County is expected to return to in 2020.
[2]Economic adjustment factors were NOT used in determining VWC's 2013-buildout demand. Demand from 2013 buildout is based on the West Side Communities demand analysis conducted by GSI in February 2016.

Table D-11. Weather Normalization Factors

Year	WN Factors by Customer Class in Key Calibration Years					WN factor for total production
	SF	MF	CII	IRR	Weighted Average (CII & IRR)	
VWC*						
2004	-3.13%	-2.52%	-0.67%	-5.24%	-3.23%	-1.73%
2012	-3.46%	-1.79%	-2.25%	-7.31%	-5.19%	-3.64%
NCWD						
2004	-3.07%	-1.93%	-3.12%	-5.51%	-4.30%	-1.65%
2012	-4.08%	-1.33%	-3.22%	-7.71%	-5.78%	-3.29%
SCWD						
2004	-3.07%	-1.93%	-3.12%	-5.51%	-4.70%	-1.89%
2012	-4.08%	-1.33%	-3.22%	-7.71%	-6.41%	-3.54%

*Weather normalization factors were NOT used in determining VWC's buildout demand. VWC demand by land use type at buildout is based GSI's Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

A thorough analysis of available data yielded a water balance assessment comparing 2012 historical consumption to 2012 calculated water use based on 2014 Population Assessment 2012 DUs, TAZ non-residential land use 2012 units multiplied by unit water demand factors. Phase 2 Retailer unit water demand factors in gallons per day per unit (GPD/Unit) are presented in the following tables.

Table D-12. Normalized Water Demand Factors

Land Type*	Units	NCWD (GPD/Unit)	SCWD (GPD/Unit)
Single Family (<1/DU/ac)	DU	593	557
Single Family (5-10 DU/ac)	DU	593	557
Single Family (6-10 DU/ac)	DU	593	557
Multi-Family (Condominiums)	DU	252	211
Multi-Family (Apartment, Mobile Homes, Senior (Active))	DU	252	211
Commercial Center (>30ac)	TSF	207	210
Commercial Center (10-30a)	TSF	207	210
Commercial Center (<10ac)	TSF	207	210
Commercial Shops	TSF	207	210
Hotel	ROOM	104	105
Sit-Down Restaurant	TSF	311	314
Fast Food Restaurant	TSF	207	210
Movie Theater	SEAT	5	5
Health Club	TSF	5	5
Car Dealership	TSF	207	210
Elementary/Middle School	STU	5	5
High School	STU	21	21
College	STU	21	21
Hospital	TSF	415	419
Library	TSF	104	105
Church	TSF	104	105
Day Care	STU	311	314
Industrial Park	TSF	259	262
Business Park	TSF	259	262
Manufacturing/Warehouse	TSF	259	262
Utilities	TSF	207	210
Regional Post Office	TSF	71	72
Commercial Office	TSF	207	210
High-Rise Office	TSF	207	210
Medical Office	TSF	207	210
Post Office	TSF	9	9
Golf Course	AC	5,365	5,649
Developed Park	AC	5,365	5,649
Undeveloped Park	AC	207	210

* Land use categories have actual annual water use provided to align calculated 2012 demands with historical 2012 consumption, refining the water balance.

D.4 Projected Land Use Based Demand

Land use units projection based on OVOV and/or developer build-out estimates and GIS analysis to isolate Retailer-specific values are presented in the following table. Water demands for each type, based on the demand factors introduced in the previous section, are also shown.

Table D-13. Projected Land Use Water Demand (AFY) – NCWD*

Land Use Code and Type	2020 Demand (AFY)	2050 Buildout Demand (AFY)	Comments
Single Family (<1/DU/ac, 5-10 DU/ac, 6-10 DU/ac)	5,984	9,462	Consolidated all SF land use categories and aligned with average use based on 2012 normalized demand factor
Multi-Family (Condo & Apartment, mobile home, senior)	1,605	2,014	Consolidated all SF land use categories and aligned with average use based on 2012 normalized demand factor
Commercial Center (>30ac)	132	297	
Commercial Center (10-30a)	119	255	
Commercial Center (<10ac)	45	64	
Commercial Shops	87	131	
Hotel	7	29	
Sit-Down Restaurant	8	22	
Fast Food Restaurant	1	1	
Movie Theater	-	-	
Health Club	-	-	
Car Dealership	-	-	
Elementary/Middle School	27	39	
High School	45	45	
College	24	48	
Hospital	5	12	
Library	2	4	
Church	23	30	
Day Care	-	-	
Industrial Park	393	393	
Business Park	98	467	
Manufacturing/Warehouse	24	39	
Utilities	45	140	
Regional Post Office	0	0	
Commercial Office	23	53	
High-Rise Office	-	-	
Medical Office	5	5	
Post Office	-	-	
Golf Course	-	-	
Developed Park	62	219	
Undeveloped Park	15	34	

* Table presents land use category demand only since Appendix D solely presents land-use based methodology. Two water using components of irrigation (approximately 4,200 AF) and non-revenue water (approximately 1,200 AF) are not included in the above table, but are included in total projected demand as presented in Appendix A are irrigation and non-revenue water.

Table D-14. Projected Land Use Water Demand (AFY) – SCWD*

Land Use Code and Type	2020 Demand (AFY)	2050 Buildout Demand (AFY)	Comments
Single Family (<1/DU/ac, 5-10 DU/ac, 6-10 DU/ac)	14,546	18,742	Consolidated all SF land use categories and aligned with average use based on 2012 normalized demand factor
Multi-Family (Condo & Apartment, mobile home, senior)	3,806	6,206	Consolidated all SF land use categories and aligned with average use based on 2012 normalized demand factor
Commercial Center (>30ac)	192	416	
Commercial Center (10-30a)	543	834	
Commercial Center (<10ac)	263	322	
Commercial Shops	157	210	
Hotel	11	51	
Sit-Down Restaurant	11	36	
Fast Food Restaurant	1	3	
Movie Theater	-	-	
Health Club	-	-	
Car Dealership	-	-	
Elementary/Middle School	94	130	
High School	145	204	
College	135	235	
Hospital	-	-	
Library	2	2	
Church	23	34	
Day Care	-	-	
Industrial Park	396	671	
Business Park	199	775	
Manufacturing/Warehouse	551	839	
Utilities	25	36	
Regional Post Office	-	-	
Commercial Office	148	517	
High-Rise Office	15	70	
Medical Office	26	32	
Post Office	-	-	
Golf Course	3,316	3,580	
Developed Park	1,704	4,389	
Undeveloped Park	-	-	

* Table presents land use category demand only since Appendix D solely presents land-use based methodology. Two water using components of irrigation (approximately 7,200 AF) and non-revenue water (approximately 3,800 AF) are not included in the above table, but are included in total projected demand as presented in Appendix A are irrigation and non-revenue water.

APPENDIX E - LAND USE DEMAND ANALYSIS METHODOLOGY FOR VWC

This Appendix E presents the land-use based demand projection approach for Valencia Water Company based on direction provided by VWC. In February 2016, VWC provided updated projected 2017-2034 land use development parameters per its anticipated West Side Communities Development residential units, non-residential acreage, demand factors, residential people per household, and demands were provided by land use type in the GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

Projected West Side Communities Development residential units by year 2020 and year 2034 (buildout) were provided in Table 2020 and Table 2034 in the "Estimated Residential Land Uses and Occupancy Rates for West Side Communities (9 Villages Combined)" updated February 13, 2016. The percentage of residential units constructed by year 2020 and after year 2020 was 4% and 96%, respectively. This residential development schedule was likewise applied uniformly to non-residential growth timing. (GSI, 2016)

VWC projected population is based on a people per household (PPH) estimate derived from average SF attached, SF detached, and MF attached people per household for more recently developed communities including: Bridgeport, North Park, and Stevenson Ranch in the "Single Family and Multi-Family Persons Per Household Assessment" based on 2010 US Census Block Data as shown in GSI March 2016 Updated Water Demand Projections for West Side Communities. These PPH estimates were applied to the projected West Side Communities residential units as is shown in the following Table E-1.

Table E-1. West Side Communities Residential Dwelling Units and Population

	Dwelling Units*			2017-2034 PPH*	Population		
	Near-term 2017-2020	Remaining 2017-2034	2017-2034 (Total)		Near-term 2017-2020	Remaining 2021-2034	2017-2034 (Total)
Single Family (<1 du/ac)	-	589	589	3.29	-	1,939	1,939
Single Family (1-5 du/ac)	65	3,199	3,199	3.29	214	10,531	10,531
Single Family (6-10 du/ac)	-	3,351	3,351	3.29	-	11,032	11,032
Total SF	**65**	**7,139**	**7,139**	**N/A**	**214**	**23,502**	**23,502**
Condominium /Townhouse	215	10,024	10,024	2.37	509	23,728	23,728
Apartment	590	4,337	4,337	2.10	1,241	9,120	9,120
Total MF	**805**	**14,361**	**14,361**	**N/A**	**1,750**	**32,848**	**32,848**
Total	**870**	**21,500**	**21,500**	**N/A**	**1,964**	**56,350**	**56,350**

* Source: Attachment 3. Table A-2. GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

The number of dwelling units by residential land use type were combined into summary groupings that would allow for VWC TAZ-based 2004 and 2012 data to be compared to and checked with projected West Side Communities development data. For example, single-family land use type units were totaled and compared to the number of SF accounts in 2004 and 2012. The same was done for multi-family land use categories and

accounts. The methodology and data from the land-use based analysis were further verified by comparing 2012 year SF and MF DU from the 2010 Census-based 2014 Population Assessment effort to 2012 TAZ land use values for SF and MF. Table E-2 presents the historical and projected number of SF and MF residential dwelling units in VWC's service area by taking the year 2012 number of dwelling units from the previous TAZ analysis explained earlier and adding the West Side Communities new development residential units as presented in the previous table.

Table E-2. Land Use Units versus Number of Accounts – VWC

Land Use Code and Type / Account Customer Category	Units	Population Assessment 2004 DU[1]	Population Assessment 2012 DU[1]	Projected Future 2020 DUs[2]	Projected Future Buildout DUs[2]
Single Family	DU	23,584	25,962	26,027	33,166
Multi-Family	DU	7,327	8,726	9,531	23,892

[1] As directed by VWC, SF based on historical accounts and MF based on 2014 DU results Population Assessment Memo (Maddaus, 2014).
[2] SF and MF values are based on data provided by VWC in Table 1 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

VWC West Side Communities unit water demand factors in gallons per day per dwelling unit (GPD/DU) are presented in the following table as provided in Table 2 of GSI March 2016 memo.

Table E-3. VWC West Side Communities Water Demand Factors

Land Use Type	GPD/DU*
Single Family (<1/DU/ac)	527
Single Family (5-10 DU/ac)	428
Single Family (6-10 DU/ac)	395
Multi-Family (Condominiums)	284
Multi-Family (Apartment, Mobile Homes, Senior (Active))	236

*Source: Table 2 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

Non-residential demands by land use type for the West Side Communities Development were aligned with GSI's Attachment 3. Table C-1 in their Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016

The following Table E-4 presents VWC projected West Side Communities Development at buildout by land use types, units, and projections as provided by GSI in the March 2016 "Updated Water Demand Projections for West Side Communities (Valencia, California)" Technical Memorandum.

Table E-4. West Side Communities Water Using Land Use Types and Acreage

Land Use Type	New VWC Development Acreage for Water Using Land Use Types between 2013 and Buildout*
Mixed-Use Commercial (Retail)	52
Commercial (Retail)	152
Mixed-Use Commercial (Office)	167
Business Park (Industrial)	246
Hotel/Spa	4
Sr. Assisted Living	11
Visitor Serving	37
Water Reclamation Plant	11
Fire Stations	13
Schools	118
Recreation Centers	54
Neighborhood Parks	119
Lake – Water	0.3
Arterial Highways Landscape Area	243
Irrigated Slopes, Wet Zones	1,004
O.S. LDZ, O.S. Trail LDZ, and SD&SS Easements	55

*Source: Attachment 3. Table A-1 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016). Buildout acreage for water using land use types only includes the entire footprint of the land use type area and NOT only the water using area.

Table E-5a presents projected VWC West Side Communities demand by land use type for the 2017-2020 and 2020-2034 time periods. Non-residential demands by land use type will align with GSI's Attachment 3, Table C-1 in their Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016).

Table E-5a. Projected New Land Use Water Demand (AFY) - VWC*

Land Use Type	VWC 2017-2020 West Side Communities Demands (AFY)	VWC 2021-Buildout West Side Communities Demands (AFY)	VWC 2017-Buildout West Side Communities Demands (AFY)
Single Family (<1/DU/ac)	-	350	350
Single Family (5-10 DU/ac)	30	1,530	1,560
Single Family (6-10 DU/ac)	-	1,480	1,480
Multi-Family (Condominiums)	70	3,190	3,260
Multi-Family (Apartment)	160	1,150	1,310
Subtotal Residential	**260**	**7,700**	**7,960**
Mixed-Use Commercial (Retail)	3	80	80
Commercial (Retail)	30	720	750
Mixed-Use Commercial (Office)	20	410	430
Business Park (Industrial)	50	1,160	1,210
Hotel/Spa	3	60	60
Sr. Assisted Living	5	120	130
Visitor Serving	3	60	60
Water Reclamation Plant	1	10	10
Fire Stations	2	50	50
Schools	8	200	210
Subtotal Nonresidential	**125**	**2,870**	**3,000**
Recreation Centers	8	210	220
Neighborhood Parks	19	460	480
Lake - Water	0.1	2	-
Landscape Area	180	4,350	4,530
Subtotal Recreation, Arterials, and Open Space	**200**	**5,020**	**5,220**
Total	**570**	**15,590**	**16,160**

* Source: Buildout demand based on Attachment 3. Table C-1 of GSI Technical Memorandum "Updated Water Demand Projections for West Side Communities (Valencia, California)" (GSI, 2016). VWC provided estimated distribution of 4% of new development is planned for before year 2020 with the remaining 96% planned for after 2020 through buildout year 2034.

West Side communities non-residential land use type demands were aligned with 2004 and 2012 land use categories as best as possible with the primary goal of aligning the land use types into the correct non-residential billing categories as presented in Table E-5b. The table presents historical and projected demand by VWC customer account categories. For VWC, all West Side Communities projected land use types falling into the "Recreation, Arterials, Open Space" non-residential subcategory was projected to use recycled water.

Table E-5b. Projected Customer Category Water Demand (AFY) - VWC*

Customer Category	Demand (AFY)				Comments
	2004	2012	2020	Buildout	
Single Family	13,800	14,300	14,400	17,700	Includes SF unit <1/DU/ac, 5-10 DU/ac, 6-10 DU/ac)
Multi-Family	1,300	1,600	1,800	6,100	Includes MF condominiums, townhouses, and apartments)
Commercial	4,100	4,800	5,100	6,500	Includes non-residential land use types
Industrial	1,600	1,600	1,700	2,700	Includes non-residential industrial land use types
Institutional	800	800	800	1,200	Includes non-residential institutional land use types
Irrigation	6,300	6,400	6,400	6,400	Irrigation total account type use did not change from year 2012 levels – as new irrigation demands are expected to be met by recycled water deliveries.
Other	100	40	40	50	Includes utility site demands.
Recycled	110	800	1,000	6,100	Includes all West Side Communities recreation, arterials, and open space demands.
Subtotal	**28,110**	**30,340**	**31,240**	**46,750**	
Non-Revenue Water	1,500	1,600	1,700	2,500	NRW is estimated to be approximately 5% based on VWC's AWWA Water Audit analysis 2011-2012.
Total	**29,610**	**31,940**	**32,940**	**49,250**	