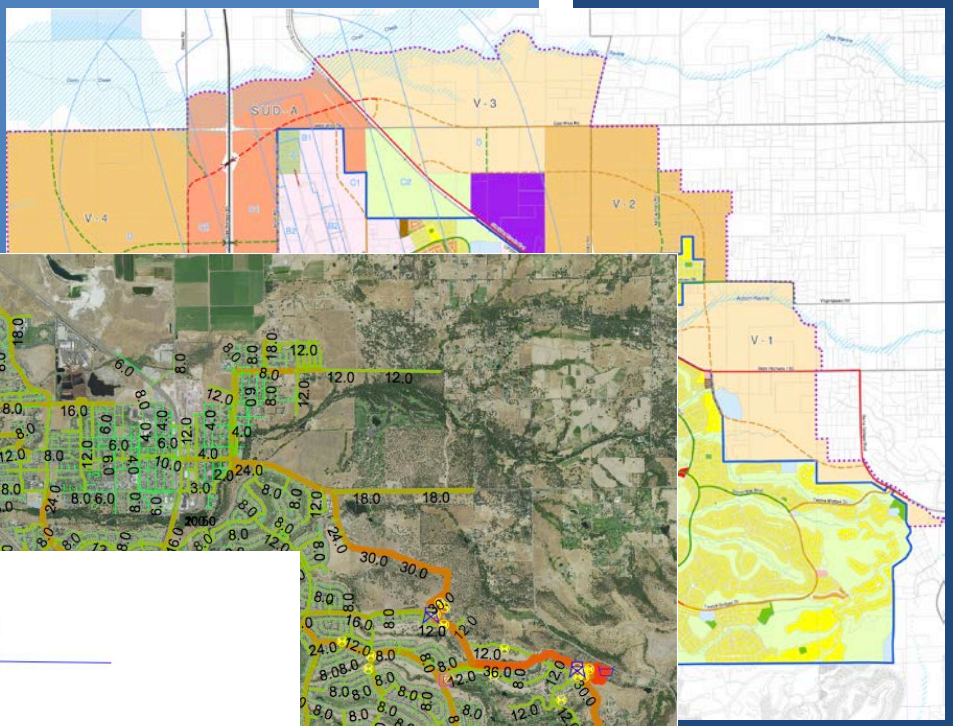
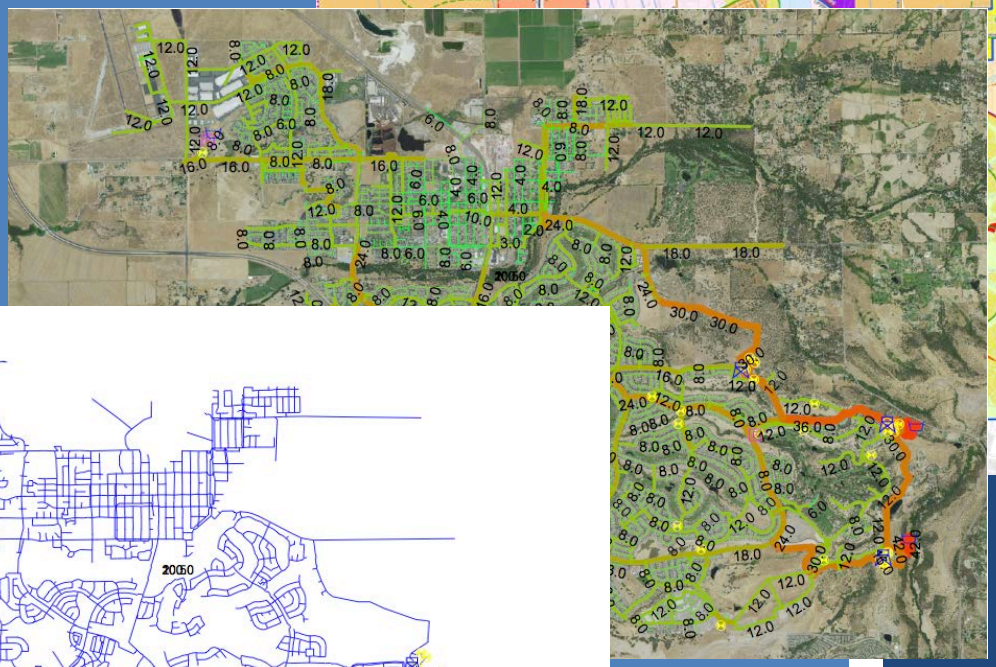
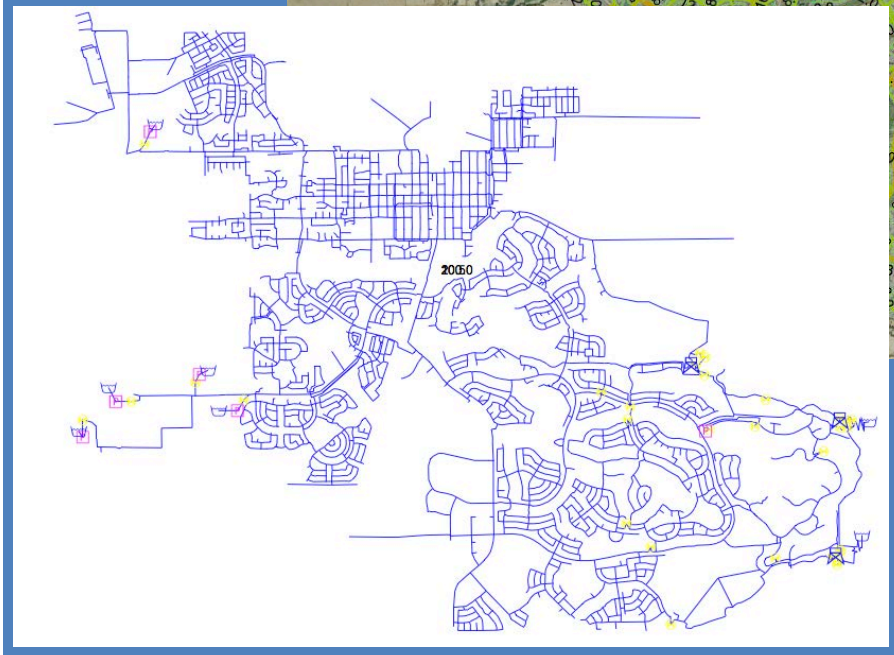
WATER MASTER PLAN 2017







Prepared for
City of Lincoln

Tully & Young
Comprehensive Water Planning

CITY OF LINCOLN, CALIFORNIA
INCORPORATED AUGUST 18, 1890

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This 2017 Water Master Plan has been prepared under the guidance

of a California Registered Civil Engineer



Tully & Young

Comprehensive Water Planning

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List of Acronyms

ACP	Asbestos Cement Pipe
ACWA	Association of California Water Agencies
ADD	Average Day Demand
adwd	Average dry weather demand
ADWF	Average Day Wastewater Flow
AWWA	American Water Works Association
BDCP	Bay Delta Conservation Plan
bgs	below ground surface
BMP	Best Management Practices
BO	Build out
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CIP	Capital Improvement Project
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
CWC	California Water Code
CWP	California Water Plan
D.A.	Development Agreement
DAF	Dissolved air flotation
DBPR	Disinfection By-Product Rule
DDW	Division of Drinking Water
DFW	Department of Fish and Wildlife
DMM	Demand Management Measures
DOF	Department of Finance
DSC	Delta Stewardship Council
DU	Dwelling Units
DWR	California Department of Water Resources
EIR	Environmental Impact Report
Eto	Evapotranspiration
FERC	Federal Energy Regulatory Commission
FRP	Facility Replacement Plan
fsp	Feet per second
GET	Groundwater Extraction Treatment
GIS	Geographic Information System
GMP	Groundwater Management Plan

GPCD	Gallons Per Capita Per Day
gpm	gallons per minute
GSA	Groundwater Sustainability Act
GSP	Groundwater Sustainability Plan
GSWC	Golden State Water Company
HDR	High Density Residential
IP	Cast iron pipe
IRWMP	Integrated Regional Water Management Plan
JPA	Joint powers authority
LAFCO	Local Agency Formation Commissions
LAR	Lower American River
LDR	Low Density Residential
LMS	Lincoln Meter Station
LU	Land Use
MAF	Million Acre Feet
MCL	Maximum Contaminant Level
MDD	Maximum day demand
MDR	Medium Density Residential
MFP	Middle Fork Project
MG	Million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MOU	Memorandum of Understanding
MWELO	Model Water Efficiency Landscape Ordinance
ND	non-detect
NDMA	N-Nitrosodimethylamine
NID	Nevada Irrigation District
NOP	Notice of Preparation
NPDES	National Pollution Discharge Elimination System
O&M	Operation and maintenance
OAL	Office of Administrative Law
PCWA	Placer County Water Agency
PFE	Public Facility Element
PG&E	Pacific Gas & Electric Company
PHD	Peak hour demand
PRSs	Pressure Reducing Stations
PRVs	Pressure Reducing Valves
PSA	Purveyor Specific Agreement
RWA	Regional Water Authority
RWQCB	Regional Water Quality Control Board
RWSP	Regional Water Supply Project
SACOG	Sacramento Area Council of Governments

SCADA	Supervisory Control and Data Acquisition
SCWA	Sacramento County Water Agency
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act
SMUD	Sacramento Municipal Utility District
SOI	Sphere of Influence
SSWD	Sacramento Suburban Water District
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
UIFR	Unimpaired Inflow to Folsom Reservoir
USBR	United States Bureau of Reclamation
UV	Ultraviolet
UWMP	Urban Water Management Plan
UWMPA	Urban Water Management Plan Act
WFA	Water Forum Agreement
WMP	Water Master Plan
WPCGMP	Western Placer County Groundwater Management Plan
WQCP	Bay Delta Water Quality Control Plan
WSCP	Water Shortage Contingency Plan
WSE	Water Supply Evaluation
WTP	Water Treatment Plant
WWTRF	Wastewater Treatment and Reclamation Facility

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Tully and Young, Inc. would like acknowledge all of the people who worked diligently to complete the City's 2017 Water Master Plan.

City Council for the City of Lincoln

Matthew Brower – City Manager

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EXECUTIVE SUMMARY

The City of Lincoln commissioned this Water Master Plan (WMP) in October of 2014 in order to analyze the City's water supply reliability and water management efforts. Accordingly, this WMP is a thorough assessment of the City's organizational structure, water demand, water supplies, water governance, and infrastructure. The WMP culminates in a set of recommended actions that advance the detailed analysis provided in the document. This Executive Summary captures the main themes from each WMP chapter and addresses central points that best explicate those themes.

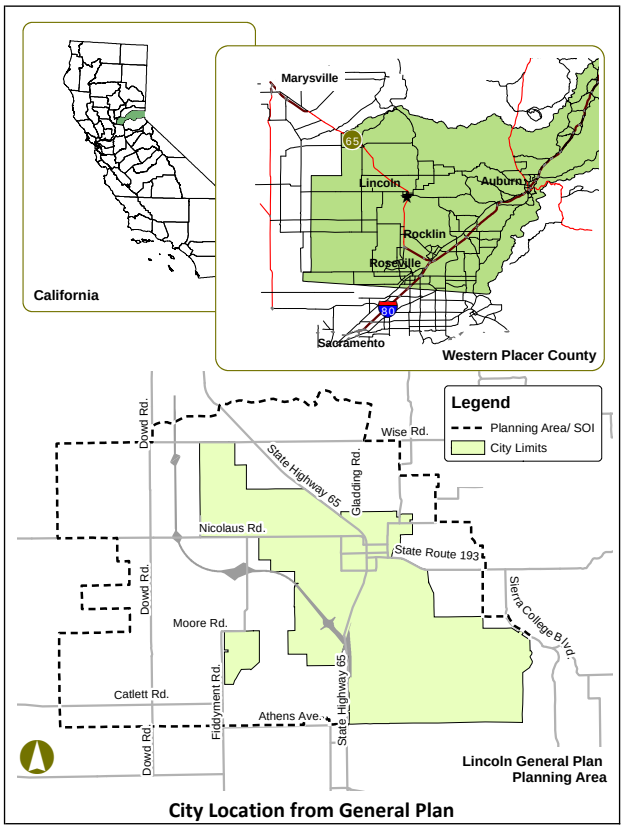
Chapter 1. Introduction and Historical Setting

Chapter 1 describes California's Water Framework and the City of Lincoln's historical setting. California's Water Framework is a broad overview of the major issues that affect water resources management that face all Californians. Specifically, large-scale issues like population growth, land conversion from agriculture to urban uses, climate change, and increased governance all affect water management at a macro-level. In other words, managing the City's water resources in the context these large-scale issues requires the City to track them and occasionally engage. For example, climate change impacts may alter water resource distribution throughout the State of California that could create significant water deficits in densely populated areas. Development of new water resources – like desalination – or reallocation of water resources from other existing users – through long-term conservation mandates in water surplus areas – may drive water policies over the course of the next millennium.

Continually monitoring California's Water Framework is of utmost importance to the City's long-term water management strategy. The following list summarizes the overarching issues that constitute California's Water Framework: population growth, agricultural to urban land conversion, trends in agricultural practices towards permanent crops, hydrologic variation, climate change, complicated water rights and entitlements, extensive water governance structures, expanding water competition, integrated land and water planning, mandated groundwater management, infrastructure investments, and copious planning documents. Within these categories, the City of Lincoln has local integration issues as well as regional, statewide, and even international issues that directly implicate its local water supply reliability.

The City's long history informs its growth patterns and water management. The City originated as a mining and agricultural town yet has transitioned into a suburban center. The conversion of agricultural lands to residential lands requires transitioning from

untreated sources of water to treated sources of water. This transition requires state-of-the-art infrastructure delivery systems to meet growing demands and comply with state and federal regulations. For instance, the City has transitioned its raw water canal deliveries and open-pond water treatment efforts into sophisticated treated water delivery systems that combine wholesale water purveyors' and the City's infrastructure systems. And although portions of the City's system still rely on 80-year old pipes, the ongoing water system conversion aligns with the City's 2008 General Plan objectives and continues a rigorous program of water system improvements. Maintaining these historical improvements, in light of California's Water Framework, requires continued diligence and strategic planning.

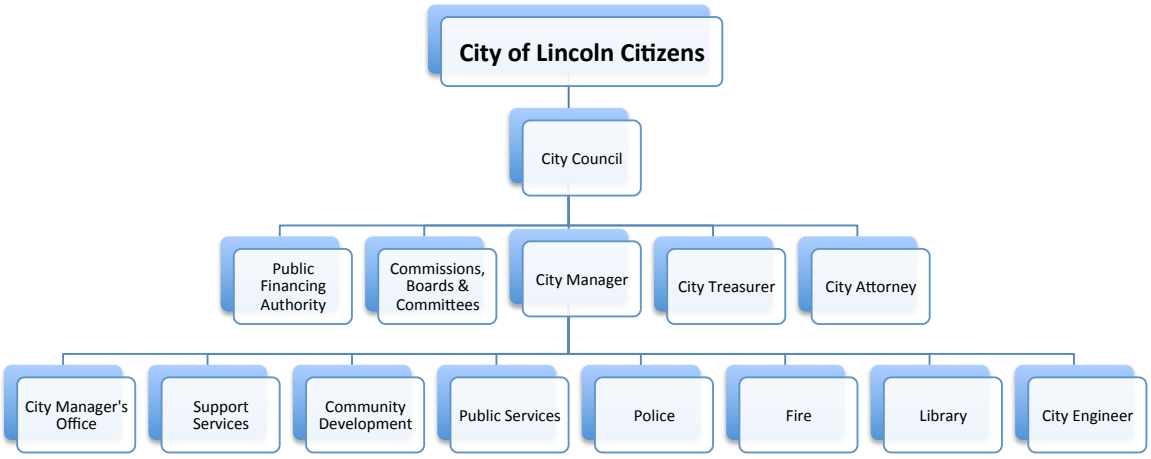


Chapter 2. City Planning and Policies

Chapter 2 describes the City's organizational structure, administrative responsibilities, and management practices as they relate to the City's potable water system. This chapter also examines the various planning documents that impact water supply planning and water management in the City of Lincoln. The City's governance combined with its planning documents constitute the organizational structure for the City's water supply reliability and water planning efforts.

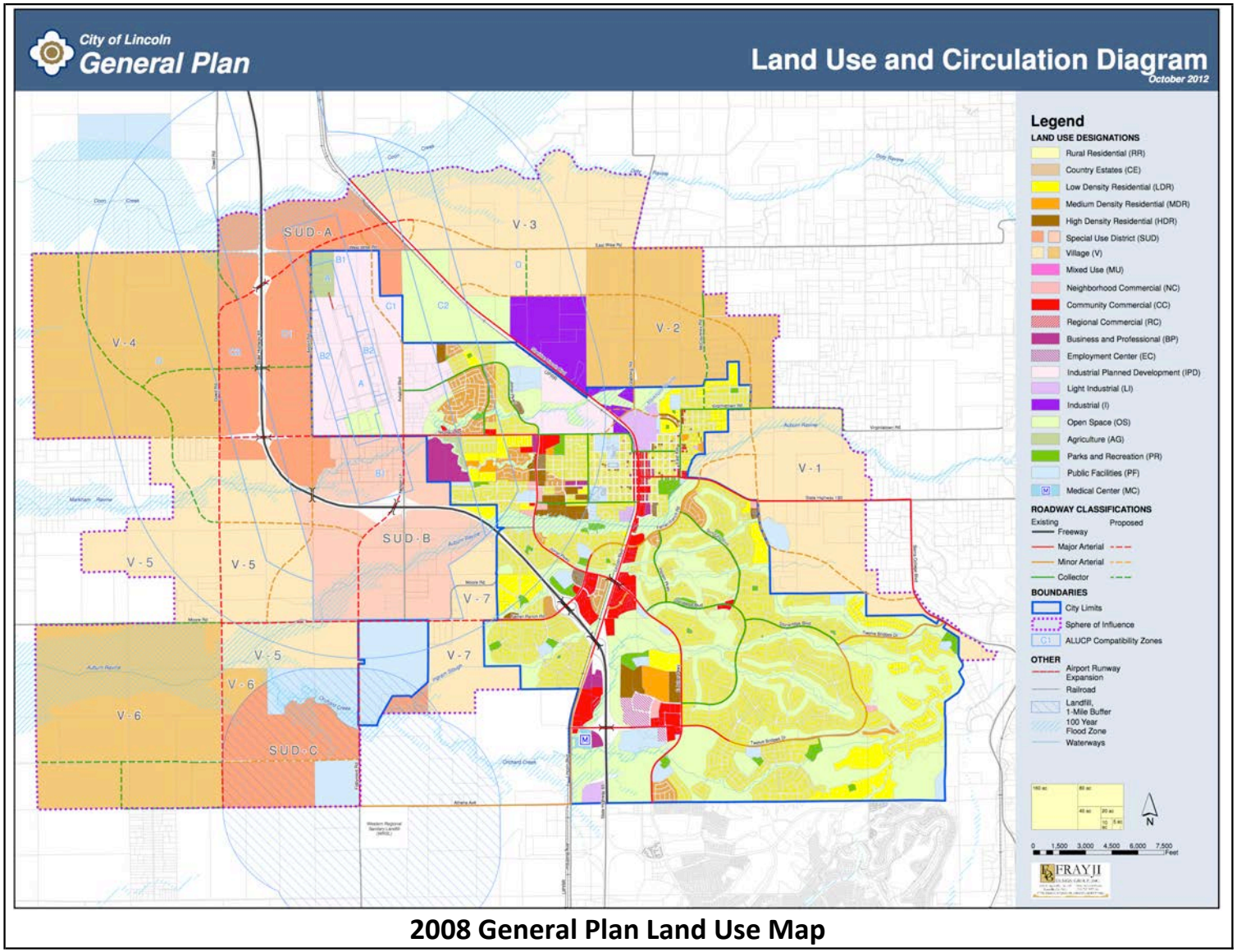
The City's organizational structure is derived from **Figure ES-1** shown below. Within this structure, all listed departments have some impact on the City's water planning and management with the exceptions of the Police and Library departments. The City Manager implements the City Council's water policies and provides guidance back to the City Council on potential policy actions that the Council should consider. The remaining departments implement the City Manager's directives as they are appropriately delegated.

Figure ES-1 – City of Lincoln Organizational Flow Chart



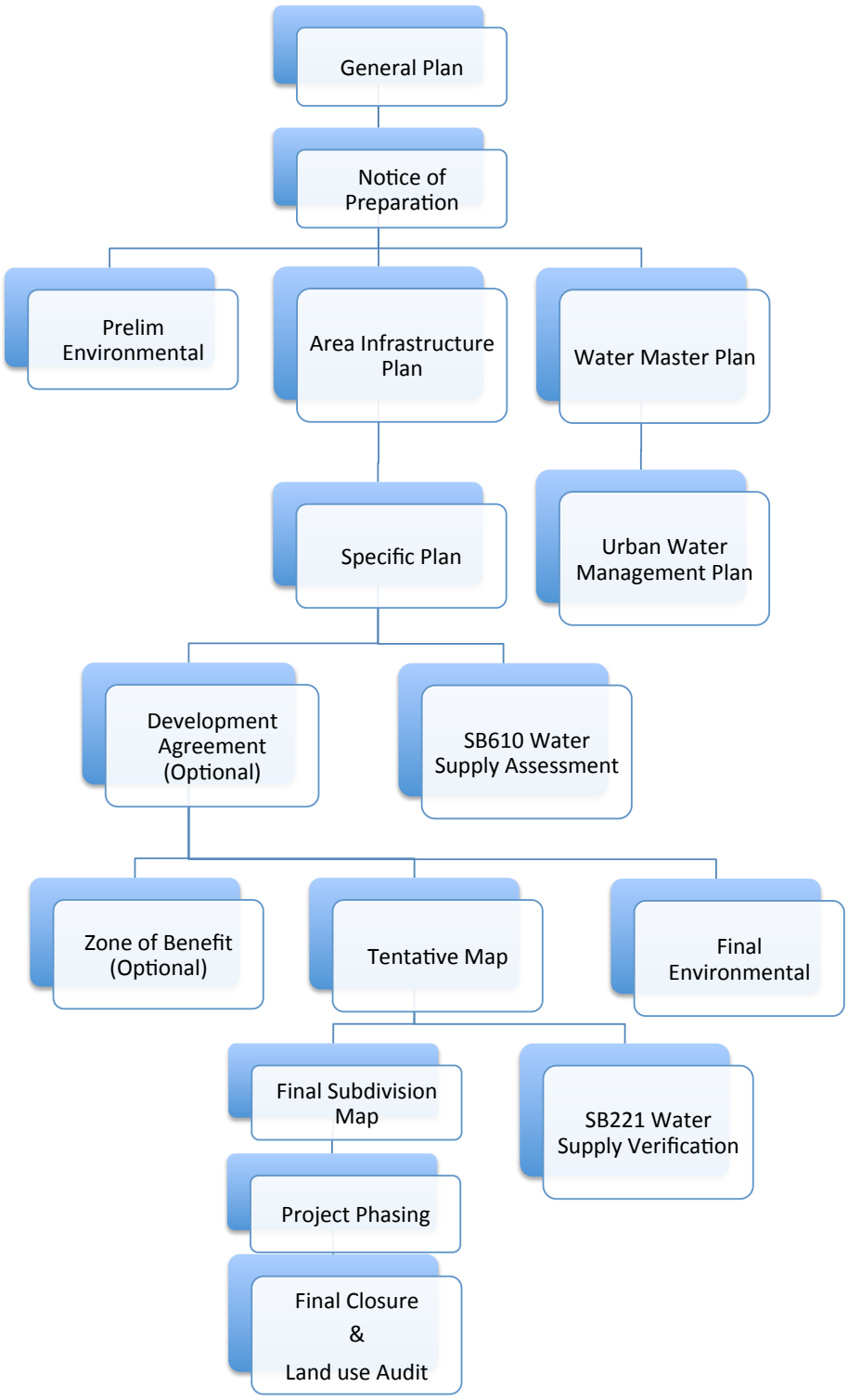
The majority of departments in the City of Lincoln have designated responsibilities that relate to water. In most cases, these responsibilities overlap with the responsibilities of other departments. For instance, the Support Services Department assesses end user water demands in order to derive customer billing for water usage. These end-user water demands are then aggregated and used by the Community Development Department in determining future demands associated with similar housing types planned for the new developments. The City Engineer also uses end-user demands to adequately size new infrastructure and repair existing infrastructure to meet customer needs. The Public Services Department uses end-user demands to ensure that water system is functioning properly to meet the daily needs of the City's customers. Last, the Support Services Department ensures that the funds are available to meet the future infrastructure needs derived from end-user demands and that revenues derived from customers as well as developers are adequate. Accordingly, the importance of continued integration and communication within the City's management structure on issues like assessing water demands has far reaching impacts to all aspects of the City's long-term water planning.

The land use and water supply planning documents required for successful long term planning are shown in **Figure ES-2** on page ES-5. Each of these documents has unique water planning requirements that are described in detail in **Chapter 2**.



2008 General Plan Land Use Map

Figure ES-2 – The City of Lincoln Water and Land Use Organization



The City's 2008 General Plan is the City's planning document that guides all other planning documents. The General Plan outlines the general growth policies and long-term land-use planning objectives of the City. As described in detail in **Chapter 2**, the General Plan elements – conservation, open space, public utilities, and water – as well as the Environmental Impact Report (EIR) required under the California Environmental Quality Act (CEQA) – developed the foundation for the City's water management objectives. As more information has become available through progressive City data collection, investigations, and planning, there have been more updates to the water management components in subsequent documents. For instance, the City's 2015 Urban Water Management Plan used two water meter studies that analyzed detailed meter data, to more accurately assess the City's current and future water demands. The information derived from these analyses is incorporated into the City's infrastructure planning through, among other things, this WMP, the SB 610 Water Supply Assessments, and Development Agreements. Thus, revising information originating from the 2008 General Plan as well as incorporating newly available information derived from the City's most recent analyses solidify the City's land-use and water planning objectives.

All of the planning documents shown in **Figure ES-2** require continuous synthesis in order to ensure that the planning assumptions and calculation methodologies remain congruent. And even where inconsistencies within the documents are identified, clear explanations that distinguish outdated findings with thoroughly reviewed new findings require a comprehensive understanding of the existing documentation. Importantly, precise analyses that integrate the numerous documents allow the large-scale infrastructure to be accurately determined and the financial water management components appropriately assessed.

Chapter 3. Water System Description

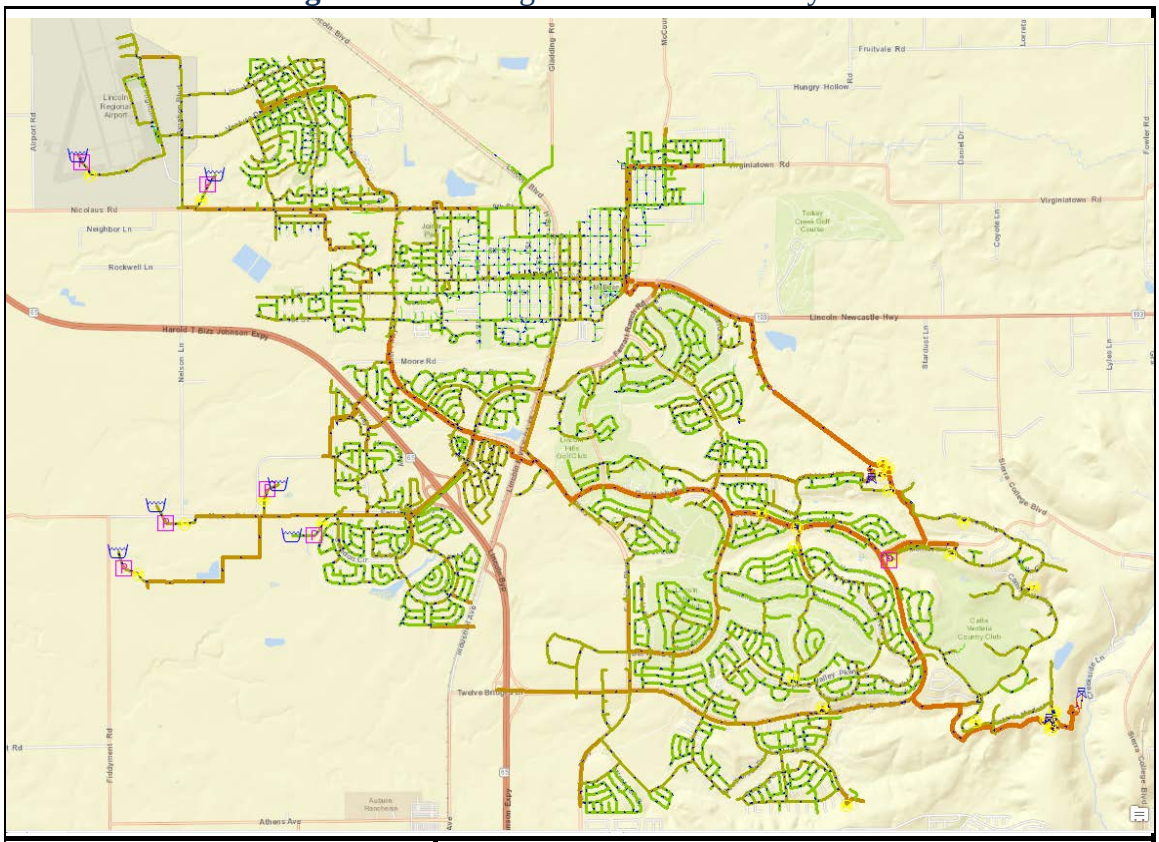
Chapter 3 provides a general overview of the wholesale agencies' water systems as well as the City of Lincoln's existing water system. In addition, this chapter provides a detailed assessment of specific attributes of the City's retail water system. Last, this chapter also serves as a reference guide for future water system engineers, staff, and managers, enabling those persons to identify and address planning and engineering issues in the City's water conveyance system. The size and complexity of the City's water system is described in relation to the City's Innovyze hydraulic water model that has been integrated with the City's Geographic Information System where applicable.

The City's wholesale water providers – Placer County Water Agency (PCWA) and Nevada Irrigation District (NID) – deliver potable water supplies derived from their water rights and contracts through PCWA's water system. The water supplies originate in the

Yuba/Bear River watershed as well as the American River watershed and are delivered to PCWA's Foothill Water Treatment Plant for transformation into potable water assets. From the Foothill Water Treatment Plant, potable water is delivered to the Lincoln Metering Station on the City's outer perimeter. At this location, wholesale water delivery from the PCWA system ends and the City's retail water system begins. Also at this location, the delivered water is further split into the "unregulated" and "regulated" supply systems as noted in the City-PCWA water supply contract (analyzed in **Chapter 5**). The regulated water moves into the City's lower elevation regions while the unregulated water remains in the upper system to serve the high elevation lots generally in the Catta Verdera development.

The City's retail water system is derived from two water sources – wholesale water delivered through PCWA's water system and groundwater derived from the City's wells. The City's system is essentially split into two sub-systems corresponding to the unregulated and regulated systems described above. **Figure ES-3** below depicts the City's retail water system.

Figure ES-3 – Diagram of Main Water System



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

The main infrastructure features of the City's retail water system include the following items: the 5 million gallon tank at Catta Verdera South, the 3 million gallon tank at Reservoir 1, the Catta Verdera Temporary Booster Pump Station, and the City's 5 active wells (Nicolaus, Westwood, Moore, Fiddyment, and Nelson). All of these facilities are described in detail in **Chapter 3**.

Additional infrastructure components are incorporated into the City's retail water system. These less prominent components include: City Meter at the 5 MG Tank, Altitude Valve and City Meter at the 3 MG Tank, 5 MG Tank and 3 MG Tank bypasses, 9 pressure reducing stations located closer to the eastern areas in the City, 5 pipeline crossings under Hwy 65, three Auburn Ravine pipeline crossings, and 7 Railroad Track pipeline crossings. The City also has 5 major transmission mains – 30-inch at the 5 MG Tank, 18-inch at Twelve Bridges Drive South, 20-inch at the 3 MG Tank near Oaktree Lane, 24-inch Twelve Bridges pipeline, and the 24-inch Oak Tree Lane pipeline. In addition, the City has an emergency backup intertie with PCWA's system on its southern border, a Del Webb backup meter, the Nicolaus Road and Q Street Altitude Valves, and the abandoned 1.5 MG Tank at the 3 MG Tank location. The City also manages 1,998 fire hydrants. Taken together with the smaller infrastructure depicted in **Figure ES-3**, the City has a robust and complex retail water delivery system.

Chapter 4. Water Demand Characteristics

Chapter 4 describes all aspects of the City's water demand. Understanding water demand characteristics is essential to enable the City of Lincoln to reliably forecast future customer water demands and then plan for and secure reliable water supplies. Further, securing water supplies that are based on the demand calculations requires the City to plan and budget for the necessary improvements to the delivery system infrastructure. **Chapter 4** characterizes the City's forecast water demands to build-out[1] and discusses the translation of that annual demand forecast into values important for infrastructure planning.

The City's annual water demand from 2010 to 2015 is depicted in **Table ES-1** below. As shown in that table, the City's water demand was highest in 2013 – the first year of the State's ongoing drought. As demand reduction mandates were issued by the State Water Resources Control Board, the City's annual demand lessened, as expected, to a 2015 low of 7,628 acre-feet.

[1] This information is consistent with the City's recently adopted 2015 Urban Water Management Plan (UWMP), but extends the demand forecast beyond 2040 to build-out. The UWMP limited the demand forecast to 2040.

Table ES-1 – Recent City Population and Annual Water Demand

Year	Population	Gross Water Use (af/yr)
2010	42,819	9,203
2011	43,142	9,481
2012	43,915	10,091
2013	44,336	10,858
2014	45,259	8,948
2015	45,837	7,628

For purposes of water reliability assessments and infrastructure planning in this WMP, the project team needed to estimate a demand based upon normalized conditions. The team utilized the meter data from 2011 and 2013 and calculated a normalized demand for the City of Lincoln for 2015 at 10,174 acre-feet. This demand calculation is representative of a static point in time for water demands on the City's water system. It is evident that this demand will change over time with changed conditions and this assumption is factored into the overall water demand analysis. The predicted future build-out annual demand is approximately 36,000 acre-feet of water.

The demand chapter also forecasts the City's future water demands based upon a detailed assessment of anticipated growth, water demand factors derived from the 2011 and 2015 meter studies, and the resulting incremental growth expected in the City over the next 50 years. Specifically, the City used the 2008 General Plan and subsequently adopted Specific Plans as well as satellite imagery to determine the overall growth in the City and its Sphere of Influence (SOI). The water demand factors were derived from actual meter data taken from the City's existing customers and superimposed upon landscape features that comply with conservation-based land-use planning laws. Last, the demand chapter analyzed the predicted growth rate for the City based upon the City's past growth waves, the State's growth projections, and Placer County's growth projections. Recognizing that this rate may fluctuate over time, the City Council concluded that an estimated 3% annual growth rate was appropriate for City planning purposes.

The annual demand projections can be translated into maximum day (Max Day) and peak hour (PH) demand estimates that allow for infrastructure sizing and planning as well as managing the City's wholesale water supply contract with PCWA. The City's retail water system must meet the Max Day water demand, the PH water demand during that Max Day, as well as any fire flow conditions that may result from an emergency during the PH flow. Infrastructure planning requires not only the ability to deliver the water

supplies from the potential sources to meet these demands, but also to ensure the safety and longevity of the City's water system in executing these deliveries.

The City's predicted build-out Max Day demand is 67 million gallons – meaning this volume of water must be able to move through the City's system during the highest use day when the City reaches build-out conditions. The City has decided that it will plan for approximately 57 MG during Max Day for its potable water system and allow the additional 10 MG to be derived from its non-potable system. As such, the City's demand forecasts for Max Day are derived from a 57 MG Max Day potable delivery where total annual potable water demands would approximate 30,000 acre-feet.

Chapter 5. Surface Water Supplies

Chapter 5 describes the City of Lincoln's existing and planned surface water assets through build-out of the City's current land-use projects as depicted in the 2008 General Plan and subsequent planning documents. The surface water supplies that are used within the City and its SOI are derived from two contract entitlements – the PCWA-City of Lincoln Water Supply Contract and the NID-City of Lincoln Temporary Water Service Contract. All of the water derived from these contracts is delivered through PCWA's treatment and conveyance system.

In 2012, the City entered into an updated water supply contract with PCWA for delivery of treated surface water.[2] The PCWA Contract entitles the City to a Maximum Delivery Entitlement of 18,501,424.5 gallons (~ 18.5 million gallons) of treated water supply.[3] The contract distinguishes between regulated and unregulated deliveries as follows:

- Maximum day Regulated Deliveries of 17,774,452 gallons per day; and
- Maximum day Unregulated Deliveries of 726,972.5 gallons per day.

Regulated water deliveries are those deliveries where the City uses its system operations to deliver water on a demand pattern for certain uses within the City. Specifically, the City uses its facilities to regulate pressure and accommodate peak demands. Unregulated water deliveries are those water deliveries that are provided to the City where PCWA uses its system operations to manage the water deliveries. PCWA's unregulated deliveries currently serve the City's "high elevation lots" generally in the Catta Verdera

[2] The Contract is titled: "Contract between Placer County Water Agency and the City of Lincoln for a Treated Water Supply" dated November 13, 2012. (Hereafter, "PCWA Contract").
[3] Article 5(b) PCWA Contract.

area.[4] The PCWA Contract also contains opportunities for the City to purchase additional supplies beyond the Maximum Delivery Entitlement identified in the contract.

The City's potable surface water assets come from two sources: PCWA and NID. These sources rely upon underlying water rights and contracts to make water available for use in the City of Lincoln. Specifically, the City receives potable water from PCWA's American River post-1914 appropriative water rights permits as well as its contract entitlement with Pacific Gas & Electric Company (PG&E). PCWA's Central Valley Project (CVP) contract entitlement is not yet available for PCWA's diversion and use. The City receives NID water from NID's pre-1914 appropriative water rights, post-1914 appropriative water rights, and its contract entitlement with PG&E. All water supplies derived from these sources are collectively managed in the City's retail system so as to comply with applicable law and best meet the City's demands in different year types, reduce delivery costs, manage water quality issues, and handle drought and emergency situations. As such, water deliveries from each identified source may fluctuate in any given year because of management decisions, regulatory constraints, and hydrological conditions.

Table ES-2 depicts PCWA's water supplies that are available to meet all of PCWA's demands in the future, including those of the City of Lincoln through the PCWA Contract. PCWA's post-1914 appropriative water rights permits from the American River have a priority date of 1958 – junior in priority to the Federal Central Valley Project water rights that fill Folsom Reservoir. These water rights are directly diverted from PCWA's American River diversion facility as well as diverted to storage into PCWA's storage system for metered deliveries into PCWA's system throughout a water year. These water rights were curtailed in 2014 and 2015 when the state issued its curtailment orders for all post-1914 appropriative water rights. PCWA's system deliveries derived from these water rights, however, were not impacted as the SWRCB issued corresponding conservation mandates to end users in the Placer County area.

Table ES-2 – PCWA Available Surface Supplies

Supply	Average/ Normal	Single Dry Year	Multiple Dry Water Years		
			Year 1	Year 2	Year 3
	af/yr	af/yr	af/yr	af/yr	af/yr
Pacific Gas & Electric	110,400	55,200	82,800	82,800	82,800
Middle Fork Project	120,000	80,400	120,000	120,000	120,000
Central Valley Project	32,000	16,000	24,000	24,000	24,000
Pre-1914	3,400	850	1,700	1,700	1,700
Total	265,800	152,450	228,500	228,500	228,500

[4] Article 5(c) PCWA Contract.

PCWA's two PG&E contract entitlements are derived from PG&E's water rights associated with the Drum-Spaulding project. Generally, these water rights have senior priorities and are based on pre-1914 appropriative water rights filings.[5] As shown in **Table ES-2**, PCWA anticipates a normal year PG&E contract entitlement supply availability of approximately 110,400 acre-feet.

The City and Nevada Irrigation District (NID) entered a temporary water supply contract for water deliveries to NID customers and developments that will be incorporated into the City's service area upon annexation. Through this agreement, NID provides additional surface water to the City for deliveries into the NID service area. The water contemplated in this agreement is provided by NID to PCWA for treatment and delivery to the City. Historically, NID has delivered through PCWA's system as much as 1,920 acre-feet of water to NID's service area within the City's boundaries. The actual amount of water that will be available to the City in the future, however, has not been finalized and the existing agreement has no clause expressly quantifying the available supply.

NID's water supplies consist of a variety of water rights and contracts that implicate the reliability of these supplies for current and future deliveries to the City. Specifically, NID has numerous pre-1914 appropriative water rights to waters in the Yuba River, Bear River and Deer Creek watersheds as well as post-1914 appropriative water rights to waters in the same watersheds. Collectively, these appropriative water rights allow for water diversions and collections to storage approximating 450,000 acre-feet of water each year. In addition to these rights, NID has a water supply contract with Pacific Gas & Electric Company for as much as 54,000 acre-feet of water in normal years. **Table ES-3** below depicts the collective water assets and storage rights of NID available for use in the entire NID service area.

Table ES-3 – NID Available Water Supplies

Supply	Average/ Normal	Single Dry	Multiple Dry Water Years		
			Year 1	Year 2	Year 3
	af/yr	af/yr	af/yr	af/yr	af/yr
Watershed Runoff	221,500	221,500	221,500	221,500	221,500
Carryover Storage	201,985	129,400	129,400	129,400	129,400
PG&E Contract	54,361	8,000	8,000	8,000	8,000
Total	477,846	358,900	358,900	358,900	358,900

The water derived from these sources constitutes the City's surface water supply portfolio and are described in more detail in **Chapter 5**. Each asset is derived from specific water rights, contracts, and planning arrangements that are subject to specific regulatory rules and contractual constraints. Some water assets that enter the City and its SOI are not

[5] A full analysis of PG&E's water rights is beyond the scope of this CWMP.

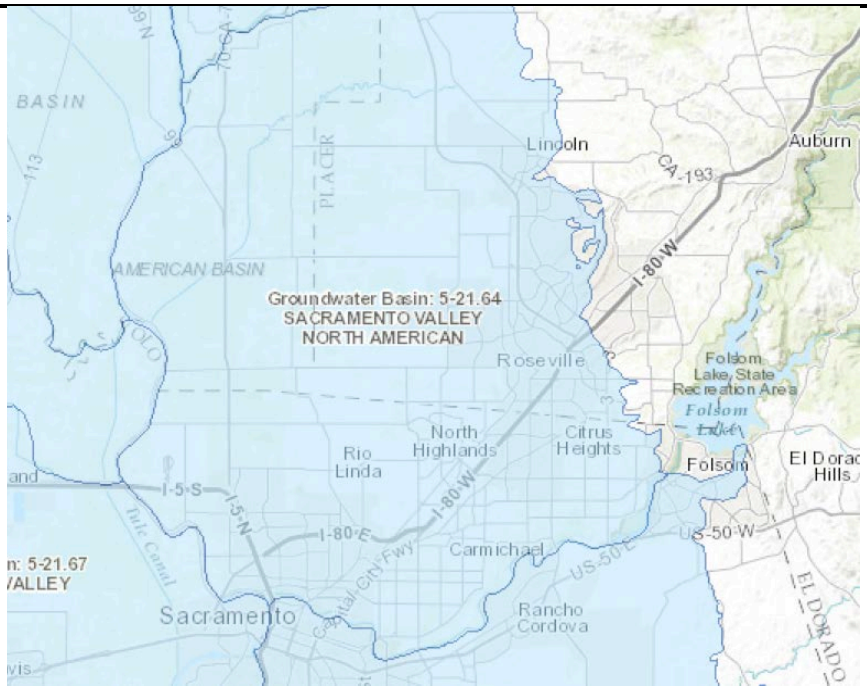
controlled by the City yet may influence the City's water management activities among the water assets that the City does control. Nevertheless, the diversity of surface water assets available to the City in its water supply portfolio as well as the volumes of water controlled by its wholesale providers, make the City of Lincoln's surface water supplies, in combination with the City's groundwater supplies (discussed in **Chapter 6**), available to meet its demands in normal years, a single-dry year, and multiple-dry years.

Chapter 6. Groundwater Technical Assessment

Chapter 6 provides a thorough assessment of the City's groundwater. Specifically, the chapter defines the North American Groundwater Sub-basin and its current groundwater conditions; explains the City's existing well system and groundwater rights; describes the governance structure and existing plans as related to the groundwater system; and assesses future governance issues, groundwater banking and long-term strategy objectives. The interaction of all four of these issues drive the City's long-term groundwater supply reliability.

The North American Groundwater Sub-basin (Sub-basin) is one of 18 sub-basins of the 7,900 square-mile Sacramento Groundwater Basin. The approximate total storage of the Sub-basin is 4.9 million acre-feet – about 5 times larger than the total storage of Folsom Reservoir. **Figure ES-4** shows the geographic extent of the Sub-basin.

Figure ES-4 – North American Groundwater Sub-basin



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Image Sources:
Sacramento Valley North American Basin
Bulletin 118, Basin 5-21.64

The Sub-basin's hydrogeological vertical profile includes geological deposits generally categorized in the following formations from oldest to youngest – Mehrten, Laguna, Turlock Lake (Riverbank), and Alluvial. The City generally utilizes groundwater derived from the Mehrten formation and pumps water from its 5 active wells located in and around the City limits. These wells include the Nicolaus, Westwood, Moore, Fiddyment, and Nelson wells. The locations of these wells are depicted in **Figure ES-5**.

Figure ES-5 – City of Lincoln Production Wells Map



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Image Sources:
Google Earth Pro

The City's historical groundwater pumping volumes since 2008 are depicted in **Table ES-4**. The City intends to utilize no more than 10 percent average annual groundwater in the future while maintaining the availability to utilize as much as 75 percent of its average day demand in case of an emergency. **Table ES-5** depicts the City's anticipated future groundwater pumping in 5-year increments.

Table ES-4 – Historical Groundwater Pumping

Acre Feet							
2008	2009	2010	2011	2012	2013	2014	2015
1,085	836	962	2,686	2,620	1,113	691	707

Table ES-5 – Future Groundwater Pumping

Acre-feet					
2020	2025	2030	2035	2040	BO
1,230	1,348	1,530	1,711	2,034	3,568

The City intends to use its groundwater supplies over a different pattern during the course of a year in order to manage peaking during the high water use months. Moreover, the City will use its overlying groundwater rights to potentially serve non-potable water

demands as well as its appropriative groundwater rights and stored groundwater supplies to meet its potable needs through its potable water distribution system.

Governance of the Sub-basin is subject to a number of existing governance agencies and private individuals as well as the newly forming authorities under the Sustainable Groundwater Management Act (SGMA). Currently, there are 5 groundwater management plans (GMP) that exist in the Sub-basin. They are: the Western Placer County GMP, South Sutter GMP, Sutter County GMP, Natomas Central Mutual Water Company GMP, and the Sacramento Groundwater Authority GMP. All of these GMP's have bearing on the overall management of the Sub-basin. The SGMA will require formal consultation among public and private groundwater interests in the Sub-basin in order to form one or more Groundwater Sustainability Agencies (GSA's) and Groundwater Sustainability Plans (GSP's). At this time, SGA has formed a GSA and is working to formulate its own GSP. Others, like the Western Placer County GMP group with the addition of Placer County, are looking to form a GSA before the July 2017 deadline.

Last the City's 2008 General Plan policies include the evaluation of groundwater recharge.[6] The City has been addressing its groundwater recharge efforts in the context of its increased usage of surface water resources and delivery of reclaimed water resources (in lieu of agricultural groundwater pumping). These efforts have resulted in groundwater elevation recovery in the City of Lincoln area whereas groundwater levels have dropped in areas closer to Sutter County with exacerbated groundwater use. As such, the City's groundwater management efforts require recognition and formalization – including potential development of groundwater banking protocols.

Chapter 7. Water Supply Reliability

Chapter 7 defines water supply reliability in the context of the City of Lincoln's water system and determines that the City's water supplies and delivery system are reliable. Water supply reliability is a synthesized assessment of water demand, water supply, and conveyance infrastructure. Isolating any of those components from the other components renders a water supply reliability assumption inadequate. As described in this chapter, the City's accurate demand calculations, integrated water supply system, and redundant delivery infrastructure combine to render a system with sufficient water supply volumes and conveyance capabilities to conclude that the City has reliable water supplies.

[6] 2008 General Plan Policy – PFS2.11 Groundwater Recharge.



City Well

The City has accurate water demand calculations. The Master Demand Spreadsheet Tool (MDST) synthesizes the City's current and future land use plans with state-of-the-art water demand accounting methodologies. Specifically, the MDST uses two recent meter studies (2011 and 2015) as well as thorough assessments of current and future regulatory schemes to assess the City's current demand and predict the City's future demands. These demands are analyzed to account for monthly City-wide demands as well as maximum day demands, peak hour demands, and fire flow demands that are critical for understanding the sizing of a water system. In short, the City's foundational demand calculations – as depicted in **Chapter 4** – are accurately represented and satisfy the first element of determining water supply reliability.

As described in **Chapter 5**, the City's numerous sources of water, including potable supplies from Placer County Water Agency, Nevada Irrigation District, and groundwater as well as its non-potable supplies from PCWA, NID, groundwater and reclaimed supplies, have numerous quantifiable benefits. In short, the City's multiple sources of supply reduce the risk that reliance on a single source of supply creates – that failure of that single source eviscerates supply reliability. Because of its diverse water supply portfolio as well as the volumes available in each component of the portfolio, the City is able to switch availability among all its water sources either to supplement potable supplies entering its water system or reduce demands so that available potable supplies may be used for essential purposes. In 2011, the City's major surface water supplies delivered through PCWA's system were vastly reduced due to a failure of the Bear River Canal. In this situation, the City was able to increase its groundwater delivered into its potable water system in order to offset the reduced volume of potable surface water available from PCWA. The ability to use alternative sources in a water supply portfolio based upon unpredictable conditions exemplifies water supply reliability.

Although the supply sources are reliable, the City's existing water supply portfolio requires additional steps with PCWA and NID in order to further secure potable surface water supply reliability in the future. These steps include improving contractual provisions with PCWA and NID as well as securing all water supply assets from the wholesalers to meet long-term development needs. The City must also aggressively engage with groundwater stakeholders in the SGMA processes in order to protect its long-term groundwater assets. Last, the City should further clarify its Master

Reclamation Permit and associated Waste Discharge Permit in order to ensure that current and future reclaimed water uses are preserved.

The third component in a water supply reliability assessment is infrastructure. The City's existing water system infrastructure meets the minimum thresholds for a reliability conclusion. Specifically, although the City has limited infrastructure redundancy in the event of an infrastructure problem, it does have contingency plans and emergency interties that allow it to handle infrastructure failures. As described in **Chapter 3**, the City uses water derived from the regulated flow ledger on the City-PCWA contract to pump water into portions of the Catta Verdera development. If the pump system failed, this portion of the Catta Verdera development would be without an adequate potable water delivery system. The City is taking actions to rectify this infrastructure limitation in order to mitigate this water supply reliability risk.

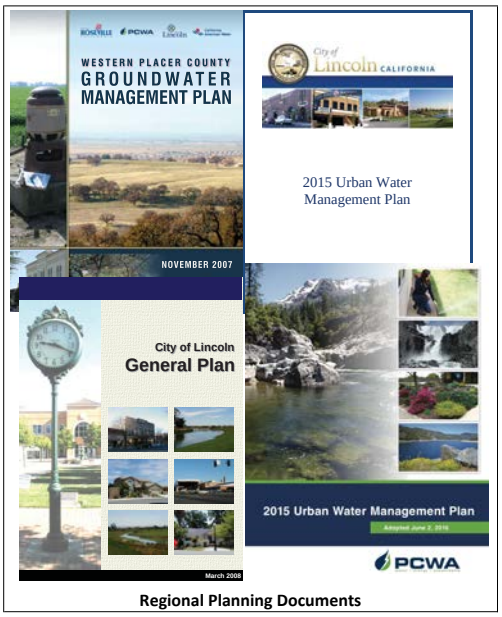
Similarly, the City receives its surface water supplies through a single source – Placer County Water Agency. The City is working with Nevada Irrigation District to develop a second potable water delivery system – the NID Regional Water Supply Project – that could delivery both NID water and PCWA water into the City's water system. Such redundancy in major system delivery systems will provide the City with adequate infrastructure redundancy as it approaches build-out conditions. In addition, augmenting groundwater pumping capacity – as is planned – in order to provide an additional infrastructure component in the case of catastrophic surface water outages is critical. All of these plans are moving forward as part of the City's long-term water supply reliability assessment.

Chapter 8. Strategic Water Issues

Chapter 8 of the Comprehensive Water Master Plan addresses the strategic water management issues facing the City of Lincoln in the context of the State's Water Framework as well as regional management issues. As described in this chapter, the issues facing the City vary in their complexity and geographic scope. In some cases, issues are entirely local and involve specific identifiable actions that are easily discerned. But in other instances, issues are complex with statewide and even global significance that require management actions aimed at mitigating the local risk.[7]

[7] Risk management as applied to water supply reliability was discussed in more detail in **Chapter 7**.

It is clear that the management of the City's water assets has become exponentially more complicated since the adoption of the 2008 General Plan. Indeed, the worsening four-year drought crisis has illuminated the lack of statewide water planning, highlighted the growing insurgency of federal and state regulatory agencies into local and regional issues, and underscored the City's water asset and water conveyance vulnerabilities.



Regional Planning Documents

A number of water management challenges are facing the City – both internally and externally. Critical to the management of the City's water assets is the continued diligence in perfecting the City groundwater rights, recycled water rights and surface water entitlements, as well as protecting the City's ability to provide a balanced water supply during wet and dry years to meet customer demands. In addition, the City must be prepared to control a dynamic assortment of issues that continue to evolve in light of the State's limited water resources. This control begins by forming an adaptive issue management structure that enables swift issue identification, clear issue prioritization, and effective issue engagement strategies.

As described in detail in **Chapter 8**, the City's regional and statewide issue tracking requires engagement in numerous water-related forums. Moreover, the City's issue tracking requires synthesis with the City's long-term water planning efforts in order to assure the appropriate issues are recognized and prioritized appropriately relative to preserving the City's water supply reliability.

The priority issues include leading the regional Sustainable Groundwater Management Act groundwater administration efforts in the North American Groundwater Sub-basin. This issue requires not only continually monitoring the Regional Water Authority (RWA), Sacramento Groundwater Authority (SGA), and Western Placer County GMP group's efforts, but also actively engaging in those forums to preserve the City's interests. Coalescing groundwater planning efforts among public and private interests across the entire North American Groundwater Sub-basin will require significant input of time and effort. Avoiding basin-wide adjudication should remain a high priority.

Other significant issues including the Bay-Delta Water Quality Control Plan Update and the California WaterFix continue to impact the City's surface water assets, and

potentially the City's reclaimed water assets. The City must continue to engage regional stakeholders and forums – including litigation forums – in order to preserve the surface water supplies in the region. For instance, in October of 2016, regional stakeholders covering the entire Sacramento Valley (including numerous stakeholders from the American River watershed) testified at the State Water Resources Control Board (SWRCB) hearings on the California WaterFix. Significant amounts of written and oral testimony were presented by regional stakeholders about the implications of the California WaterFix on surface water supplies. The City should monitor these actions closely as the outcome of this hearing will impact the surface water assets available to the City. In short, this example of an issue with statewide significance will impact the City's long-term water supply reliability. Simply relying upon external sources to inform the City of the issue's progress and resolution is insufficient to adequately integrate the WaterFix into the City's own supply reliability assessments.

Chapter 9. Water Model Presentation and Assumptions

The City of Lincoln has a long history of providing water to its residents – likely dating back before its incorporation in 1890. In providing water, the City became responsible for the development and upkeep of a water conveyance system. The City still manages and operates a potable water system with pieces of infrastructure that date back to at least 1929.[8] The existing water system contains pipes from every construction era since the City's formation all coalesced into a single conveyance arrangement. The pipe materials include: concrete, iron, steel, and PVC with the oldest redwood pipes having been fully removed. The City has continued to grow, expanding from a small town, to a City with over 45,000 residents. The miles of pipe, number of valves, pressure settings, and infrastructure locations all require maps, spreadsheets, and databases to monitor and service. Furthermore, the additions to the system must be carefully engineered to comply with the newest fire flow and design standards as well as tested and verified to keep the existing City water system in compliance with applicable law and regulations.

Since the 1970's, universities and private companies have been writing computer software to process engineering complexities in urban water systems. Computers are now capable enough to store all of a City's water system details and display the impacts of system changes in advance of problems arising. In the early 2000's, the City of Lincoln was tracking water system expansions and maintenance projects in a Geographic Information System (GIS) format and had developed a water system model. With the housing crisis of the late 2000's, the City's urban growth substantially slowed and the

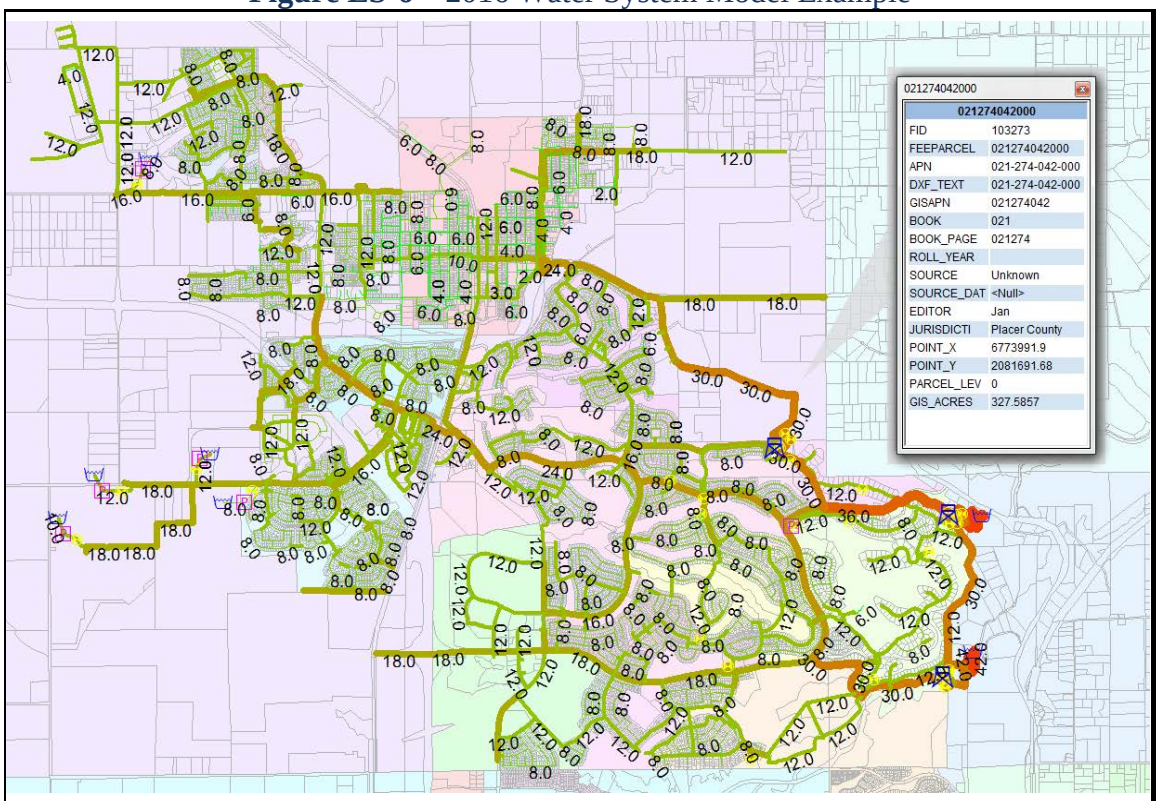
[8] 1929 is the oldest category of infrastructure cataloged in the City GIS system in 2009 by Ecologic. Much of the raw water systems controlled by the PCWA and NID date back to the gold rush days. As described in **Chapter 1**, these systems provided water to the City in its earliest years.

need for modeling additions to the water system stopped. Coupling the downturn with a lack of funding, the GIS database was mothballed. Fast-forward to the mid 2010's, and development has returned to the City as well as the need for an accurate, scalable, and robust water system model coupled with a comprehensive GIS database. The primary purpose of **Chapter 9** is to provide an overview of the City's updated model and explain its functional utility.

The City's previous water model was last updated in 2011 to derive some early infrastructure sizing and the connection estimates for the proposed Village 1 development. The current model displays pipe lengths, pipe materials, flow rates, GIS-related information, and system tracking into a single platform. With over 200 miles of pipe and nearly 3,000 pipe sections, there was a significant amount of work involved with updating the model representation of the City's constructed infrastructure and cross-checking infrastructure assumptions against the field maps to execute necessary corrections.

Figure ES-6 presents an example of the 2016 Water System Model. It is important to note that the model scaled in this example is depicts the larger infrastructure components throughout the City. The model has much more specific data – down to the street level – that is available for modeling assessment. For instance, exact pipe lengths, installation dates, and building materials can be entered into the modeling system. Minor corrections to the new model will be ongoing in the future as updated drawings are reviewed and analyzed. These corrections will have negligible impact on the overall results of the model and will not change the validity of the results drawn from the model.

Figure ES-6 – 2016 Water System Model Example



Tully & Young
Comprehensive Water Planning

Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

The City's water model incorporates all levels of detail related to the City's water system including: fire hydrants, pumps, tanks, pressure reducing valves (PRVs), wells, and other key infrastructure. The model also allows the City to assess flow rates, pressures, and other issues that may create infrastructure problems in the system. The model not only handles existing conditions but also allows the City to assess future major infrastructure projects that may also improve City water supply reliability. Accordingly, the City's water model is an important tool in analyzing the City of Lincoln's water supply reliability and water management system.

Chapter 10. Facility Replacement Program

Chapter 10 addresses the City of Lincoln's potable water supply projects identified as part of the Facility Replacement Program (FRP) based on water system infrastructure ages, materials, known conditions, and modeling results. The recommended FRP projects will assist the City in meeting build-out demand as well as current fire flow conditions. This chapter was developed in consultation with City Staff. Ongoing

projects and recommended projects are based upon conditions known as of August 2016. **Table ES-6** lists the City's FRP projects.

Table ES-6 – Facilities Replacement Program Projects

Project	Status	Timeframe
Larger 4" CIP Replacement	Underway	Completion within 5 years
C-Street Replacement	Underway	Completion within the year
East 9th Street	Near-term	Spring of 2017
East 5th Street	Near-term	Summer of 2017
LDS	Near-term	Completion in 2017
Summerplace	Near-term	Completion in 2017
Summerset - F Street	Near-term	Completion in 2017
Design Life Pipe Replacement	Long-term	15+ years
ACP Replacement	Long-term	15+ years
Older Rail Undercrossings	Long-term	15+ years
Fireflow Supply Issues	Underway	Ongoing

Chapter 11. Capital Improvement Program

Chapter 11 describes the potable water supply projects identified for Capitol Improvement Program (CIP) for the City of Lincoln based upon the City's build-out demand water modeling results, water supply portfolio, and water shortage planning. As the City of Lincoln's potable water system expands to meet additional needs, major infrastructure systems and pipelines will be constructed by affected developers in order for those developments to meet each development's fundamental project needs.

The City's existing infrastructure policies enable the City to pay for upsizing and expansion costs beyond those needed for an identified development. All developments contribute money to the City for the costs (as defined in the City's Impact Fees in the Master Fee Schedule) of the upsizing and expansion. If upsizing and expansion goes beyond the needs of an identified development (e.g. is slated to satisfy a City need), then the City would pay for the incremental component on its own. The projects listed in **Table ES-7** cover the CIP efforts that will be required for each major stage of City development within the City. **Table ES-8** identifies projects outside the City that the City will likely financially support. Many of these CIPs are categorized by an identified "Village" – the terminology associated with individual developments listed in the City's 2008 General Plan – in order to simplify the analysis and cost allocations.

Table ES-7 – Capital Improvement Program Projects Within City

Project	Status	Timeframe
Phase III Pipeline Connection and Metering Station	Underway	Completion by 2018
10 MG Tank and Pipeline at CV North	Underway	Completion within 5 years
Oak Tree Lane Replacement and Realignment	Near-term	Completion within 5 years
Village 1 Backbone Infrastructure	Near-term	Completion within 5 years
Village 5/SUD B Backbone Infrastructure	Near-term	Completion within 5 years
Village 7 Backbone Infrastructure	Near-term	Completion within 5 years
Airport Storage and Pump Station	Long-term	Completion as needed (10+ years)
Reservoir 1 Expansion	Long-term	Completion as needed (10+ years)
Village 2 Backbone Infrastructure	Long-term	15+ years
Village 3 Backbone Infrastructure	Long-term	15+ years
Village 4/SUD A Backbone Infrastructure	Long-term	15+ years
Village 6 Backbone Infrastructure	Long-term	15+ years
SUD C Backbone Infrastructure	Long-term	15+ years

Table ES-8 – Capital Improvement Program Projects Outside City

Project	Status	Timeframe
Phase III Pipeline	Underway	Completion by 2018
Bickford Pipeline	Underway	To be Completed as Necessary to Maintain Service
Ophir Water Treatment Plant	Underway	To be Completed as Necessary to Maintain Service
Sacramento River Diversion Project	Long-term	15+ years
NID Water Supply Project	Underway	To be Completed as Necessary to Maintain Service

Chapter 12. Water Management Recommendations

Chapter 12 summarizes the water management recommendations derived from the previous eleven chapters of the Comprehensive Water Master Plan that meet the City's long-term water management objectives. These fundamental objectives include protecting the City's water supply reliability, improving water planning and management, and constructing the necessary infrastructure to meet current and future demands. As described in **Chapter 1**, the ever-changing California Water Framework coupled with the City's rapid expansion necessitate continued diligence on water management issues in order to protect the City's water interests. Maintaining reliable long-term water supplies requires persistent efforts to stabilize the water asset acquisition, finance and build key infrastructure, create system flexibility to adapt to changed conditions, and stabilize internal water management efforts. Although the entire list of recommendations should be reviewed in that chapter, the priority recommendations are noted below:

- Monitor trends in integrated land and water planning, including new laws and regulations that further intertwine the two specialty fields.

- Create a specific land and water planning procedure that is applicable to all large and small development projects within the City. Cross-reference planning documents in the context of this planning procedure (e.g. assure consistency among documents).

- Regularly update the **Master Demand Spreadsheet Tool** in order to keep real-time demands and future demand predictions updated for project development and implementation.

- Investigate potential water use policies that can help manage peak hour and Max Day demands in a manner that can decrease pipeline sizing and other infrastructure expansion.

- Understand PCWA's long-term demand for its water assets throughout PCWA's service area. Assess growth rates and patterns to understand whether growth in PCWA's service area may impact the reliability of PCWA supplies delivered to the City.

- Support PCWA's decision to design and construct the Ophir Water Treatment Plant.

- Support NID's desire to design and construct the Regional Water Treatment Plant in order to create surface water supply reliability within the City of Lincoln as well as create redundant infrastructure systems capable of supporting the City in emergency outage conditions.

- Continue to develop and enhance the City's non-potable water supplies and develop associated uses for those supplies that relieve tension on the City's potable water system.

- Develop emergency groundwater management protocols and backup electrical and treatment systems to handle water supplies in case of a large-scale surface supply outage. Emergency protocols should include identification and installation of backup generators, automated water quality testing, and redundant system management.

- Preserve decision-making authority for the City on any governing body formed out of SGMA. The City's groundwater rights must be preserved through active City governance in a GSA.

- At a minimum, continue to actively engage in GSA formation and provide staff support to execute tasks and achieve governance outcomes – but consider leading efforts to ensure local control of important groundwater assets. Developing a political plan to work with regional entities to ensure local control of groundwater resources is paramount.

- Support PCWA in all aspects of its permit renewals on water right permits 18356 and 18358 so as to preserve the supplies available under those rights for uses in the City of Lincoln and its SOI as well as other areas in PCWA's service area.

- Develop and refine the City's conjunctive use efforts.

- Continue Facilities Replacement Program efforts with priority projects.

- Continue engagement in all regional water entities including RWA and WPCGMP group.

- Conduct normal year max day fire flow tests and re-calibrate the model to within 10% of the test calibration in the next normal water use year.

- Require developers through newly adopted policies to perform and submit development specific water modeling with defining parameters and product expectations.

- Undertake rigorous cost assessment of major potable water infrastructure projects – specifically, NID's Regional Water Supply Project and its associated infrastructure as well as PCWA's Ophir Water Treatment Plant project and its associated infrastructure.

- Develop a strategic assessment team that will organize CIP potable water projects and create processes to determine each project's utility. Utilize strategic assessment team to allocate costs for projects in coordination with City finance team.

CHAPTER 1. INTRODUCTION AND HISTORICAL SETTING

1.1 Purpose

Since October 2014, the City of Lincoln has been investigating its water assets, analyzing its technical and infrastructure needs, and preparing a synthesized water management plan. The purposes of this Water Master Plan (WMP) are to memorialize the findings associated with the City's efforts and outline a long-term plan that addresses the City's central water-related policies, strategic facility and infrastructure investments, and regional land and water expansion opportunities. The WMP captures relevant portions of these themes in each chapter while thoughtfully separating the priority actions from the secondary and tertiary ones. This WMP is designed to be a living document – a document that should be updated, at a minimum, every five years as conditions change in order to best serve the City's long-term development needs. The WMP organizes the City's strategic management planning and has practical application to the City's facilities replacement plans and land-based developmental needs. As such, the WMP provides a thorough platform to substantiate the City's water-related decision-making efforts while documenting their foundational underpinnings.

1.2 Document Organization

The Water Master Plan is organized into the following chapters to focus important topics and provide easy reference to relevant substantive materials:

Chapter 1 provides a framework of the water issues in the State of California as well as a history of the City and its water supply and infrastructure.

Chapter 2 describes the City of Lincoln's land and water planning organizational structure as well as the relevant documents that inform the City's water management.

Chapter 3 provides a full description of the City's existing water system as well as the planned future water system.

Chapter 4 details existing water demand characteristics and forecasts future water demand to meet the land-uses envisioned by the City's 2008 General Plan. It also establishes the necessary data for infrastructure sizing and placement.

Chapter 5 analyzes the City's water assets, including assets owned and controlled by the City's primary wholesale water purveyors – Placer County Water Agency and Nevada Irrigation District.

Chapter 6 assesses the City's groundwater assets and the regional issues associated with groundwater management.

Chapter 7 synthesizes the water supply and demands by demonstrating the reliability of water supplies through the City's build-out time horizon.

Chapter 8 presents the strategic water issues that impact the City's water assets and potential long-term water supply reliability, identifying the key political and regulatory forums that may require additional City engagement.

Chapter 9 details an overall assessment of the City's updated water infrastructure model, the key assumptions incorporated into the model, and important findings associated with the analysis of specific infrastructure representations.

Chapter 10 outlines the City's Facilities Replacement Plan that will inform the City's priorities for potable water infrastructure maintenance and replacement efforts.

Chapter 11 outlines the City's Capitol Improvement Plan that identifies the critical infrastructure needs to meet the City's long-term growth objectives envisioned by the 2008 General Plan

Chapter 12 provides the long-term water management plan and recommendations derived from the proceeding eleven chapters in order to organize the City's water management objectives.

1.3 California's Water Framework

As described in the eight water workshops presented to the City Council,[1] California's Water Framework (Framework) is a combination of variable hydrology, competition for limited water resources, as well as complex laws, policies and regulations. The Framework creates an evolving water system that lacks planning security – meaning that the City cannot rely on the existing Framework in order to protect its long-term interests. The Framework may change dramatically – and as seen in 2014 with the State's legislative incursion into local groundwater management. Accordingly, the City's long-term water plan must account for potential significant change.

California's Water Framework has numerous ongoing water issues. The bulleted list below outlines the primary issues confronting the City:

[1] Eight City Council workshops were held between October 2014 and December 2015.

- *California's Population*: The population in California is approaching 39 million and is projected to exceed 50 million by 2050. Water supplies will be needed to meet the needs of the state's growing population.

- *California Agriculture*: Farming and ranching occurs throughout 43 million acres of land in California. Irrigated agriculture is shifting from annual crops to permanent crops, requiring greater water supply certainty and reliability to maintain financial viability.

- *California's Hydrology*: Average annual runoff totals about 71 million acre-feet per year (MAF) with 56 MAF occurring north of Sacramento and 15 MAF occurring south of Sacramento. Nearly 30 MAF of the water from this runoff is consumed south of Sacramento, 15 MAF is used north of Sacramento and the remainder is dedicated to the environment, goes unused, or is lost.

- *Climate Change*: Measured changes in the form of precipitation (more rain and less snow), affecting the timing of runoff, indicate that the State's hydrological systems are changing. Changing hydrological systems will require modified storage and conveyance systems to meet expanding needs.

- *Water Rights and Entitlements*: California has numerous forms of water rights and entitlements that are unclear and often in conflict. The lack of clarity as related to the nuances and exceptions in the water allocation system adds uncertainty to the reliability of water supplies.

- *California's Water Governance*: Numerous state and federal agencies all regulate water or regulate issues that affect water assets. Moreover, thousands of special districts, joint powers authorities, and private companies regulate and affect water supplies. Often the objectives of these entities are misaligned.

- *Water Competition*: Water assets must be spread among many users, intensifying competition for water supplies. Endangered and threatened species, Delta water quality, municipal and industrial uses, agricultural uses, energy production, and habitat restoration all vie for same water resources.

- *Integrated Land and Water Planning*: Water is dictating modern land planning. Historically, land plans were approved and water supplies were delivered. Today, water supplies must be proven before land plans can be ratified.

- *Groundwater Management*: Groundwater management of California's 515 groundwater basins is now at the forefront of government attention and regulation. Long-term reductions in groundwater pumping are inevitable in areas of the state with chronically overdrafted groundwater basins. Stable basins may be more closely regulated to assure overdraft does not begin.

- *Infrastructure Investments*: Major infrastructure investments, like expanded treatment facilities or improved conveyance facilities, are complicated and require

large financial investments. These investments are often made when the return on those investments are derived over longer periods of time and tied to uncertain land-use and population expectations.

- *Planning Documents*: The sheer number of legally required land and water planning documents and the organization of those documents is often complicated, leading to opportunities for inconsistent data or policy representations. Each land or water planning document has legal significance, highlighting the critical need to draft documents that are internally and externally consistent, or that contain explanatory text to assure success in long-term project development and decision-making.

1.4 City of Lincoln's Historical Setting



5th Street Burge Hotel and IOOF Building 1905
Photo Curtousy Lincoln Native Sons

The City of Lincoln's current water supply reliability and water-related infrastructure is derived from its storied history. This section is dedicated to explaining a portion of that history as relevant to the overall Water Master Plan effort.

The City of Lincoln was established during a time of great change in the United States. California's Gold Rush had ended and the recalcitrant gold miners were establishing new settlements throughout the state while the fragile Union was on the brink of the Civil War. Although California was on the edge of the great confrontation, it held the keys to the natural resources wealth of the west. The area encompassing the current City of Lincoln contained mining and agricultural resources that were of great interest to the emerging society.

The original Lincoln town site was surveyed and recorded by Theodore Judah in the late 1850's in conjunction with the routing of the California Central Railroad through the area. The City is named from the second owner of the town site – Charles Lincoln Wilson, who sold the first town lots in 1859. In 1863, copper in mineable quantities was discovered creating a brief second mining boom in the area. The fledgling town relied on several sources of water in the area to meet the mining, agricultural and residential needs. Specifically, water was derived from natural watercourses, man-made ditches connecting the Sierra's to the foothills, shallow hand dug wells, and cisterns filled with precipitation from rooftops. After the Civil War, Lincoln became a hub for the burgeoning cattle and fruit production in the area. Cattle ranching in and around the City grew at an incredible pace and pasture land for grazing livestock greatly expanded.



Openland Grazing

In the 1870's, industrial opportunity came to the town in the form of the discovered coal and clay deposits around and underneath the town site, including areas under the current City Hall. These mined coal deposits were quickly exhausted as additional mining opportunities and industry arose. Gladding-McBean & Co. mined the clay resources from the ancient Ione Formation that emerged from the land surface on the edge of town. Since its inception in the 1870's, Gladding-McBean & Co. provided clay and terra cotta pipes for water and wastewater systems in the City.

The City of Lincoln incorporated in 1890 as a California General City. Additional mining opportunities arose as granite quarry operations were underway east of the City, similar to those in the Loomis Basin. The mining, industry, farming, and ranching caused the City's population to more than double from about 1,000 persons in the 1890's to about 2,400 people in 1950. The town's human and industrial growth required reliable water supplies.

In 1895, the City issued its first water bond. The South Yuba Ditch Company constructed an 11-inch riveted iron pipeline from the Caperton Canal to the unlined City Pond just downhill from the canal. The water supply then flowed by gravity to the City primarily to sell water for fire protection from hydrants served by a small network of iron pipes beneath City streets predominantly east of the railroad.



Pipes at Glagging McBean

Photo Courtesy lifeinlincoln.wordpress.com

The Caperton Canal was an uncovered man-made ditch running from the Sierras to the southeast through the heart of Placer County to meet the mining, urban and agricultural needs in the region. In 1924 a 14-inch pipeline of cast iron and riveted steel replaced the 11-inch line that connected the City to the Caperton Canal. The City also acquired a 5-acre site downhill of the Caperton Canal, later named "City Pond," and constructed the unlined impoundment. In the early 1950's, the 14-inch pipeline from the Caperton Canal was replaced with a 20-inch asbestos-cement transmission pipeline. Remnants of the 20-inch pipeline are still in service today. The open ditches and open ponds that were the sources of the City's potable water system soon gave way to enclosed pipes, better treatment systems, and confined storage as the City developed its relationship with regional wholesale water providers.

Since the creation of the Placer County Water Agency (PCWA) in the 1950's, Lincoln has received deliveries of both PCWA raw and treated surface water to meet City demands as well as raw and treated water derived from Nevada Irrigation District (NID) assets. Areas involved in agriculture in Placer County around the City limits have also been supplied raw surface water from PCWA and NID canal systems. As the City has expanded its boundaries and the corresponding need for treated water, the raw water deliveries to the previously agricultural areas have typically decreased.

In the 1970's two new 1.5 million gallon steel storage tanks replaced the City's open impoundment (City pond) off of the Caperton Canal, which had served the City since the turn of the 19th century. One tank was installed on the Reservoir 1 site. The second tank was located west of the Auburn Ravine at Highway 193 as a safety precaution against failure of the 20-inch transmission pipeline connecting the two tanks. Associated with these improvements was the construction of a 14-inch treated water pipeline by PCWA from PCWA's Sunset Water Treatment Plant at the end of the Caperton Canal at the Lincoln-Rocklin border to the City pond site. This new treated water line allowed the City to shut down, and later abandon, its chlorination facilities at the Reservoir 1 site.

In the 1980's, groundwater was introduced into the City's treated water system with the upgrading of a City-owned agricultural well into a municipal water supply (City Well No.2) just east of the airport. A second City production well (Well No. 4) was completed west of the airport in 1990. Water quality from both wells met the state's water quality standards and was commingled into the City's water system that derived surface supplies from PCWA.

The late 1990's saw an unprecedented boom in the City's population, increasing from about 7,500 to about 40,000 in less than 10 years. The City's infrastructure was expanded ahead of the growth to accommodate increases in water demand but still relied on remnants of an old system. In fact, the current historical assessment of the City's existing infrastructure that is incorporated into this CWMP has identified numerous pipes dating back to the 1920's. Nevertheless, the City completed significant surface water infrastructure systems and drilled additional wells to meet City demands.

Lincoln's current population of 45,800 is forecast to grow to 80,000 over the next few decades and expand beyond 130,000 at City build-out. The City's 2008 General Plan defines the City land use with a Sphere of Influence that provides growth limits based on land use densities and the anticipated infrastructure needed to serve the projected buildout population. From 1998 to 2008, the City water system was rapidly expanded to meet the new demands. Below is a listing of the more significant items that have been developed to accommodate the City's growth. All of these items are discussed in greater detail in other Chapters of this Water Master Plan.

- *PCWA Water Supply Agreement*. Renegotiating the City's Water Supply Agreement with PCWA for increased surface water deliveries and allow the expanding City limits to define the PCWA service area.

- *NID Water Supply Agreement*. Signing an MOU with NID and PCWA to allow NID water to be served in the NID service area within the City limits.

- *City Groundwater Analyses*. Completing the groundwater investigations into the volume and location of groundwater underlying the City, and the City's first groundwater management plan and identifying the groundwater underlying the City as a high quality, stabilized and valuable potable water supply.

- *Western Placer Groundwater Management Plan*. Signing an MOU with PCWA, City of Roseville and Cal-American Water Company forming the Western Placer County Groundwater Management Partnership (WPCGMP) for establishment of a regional groundwater management planning entity.

- *NID Regional Water Supply Project*. Signing agreements with NID to pursue the feasibility and construction of a Regional Water Supply Project to provide NID treated water directly to NID lands with the City.

- *Construction of Groundwater Wells*. Development of groundwater supplies within the City that meet State requirements for quality, with only disinfection, required for emergency and peak demand management purposes.

- *Completion of the Regional Wastewater Treatment and Reclamation Facility*. The WWTRF provides a tertiary treated recycled water product via ultra-violet radiation that was State-approved as the first recycled water permitted for direct application to fodder and rice crops. This permit and subsequent water rights expansion allows for recycled uses within the City.

- *PCWA Emergency Intertie*. Emergency intertie between the treated water systems of the City and PCWA-Rocklin.

- *PCWA Conveyance Facilities*. Signing agreements with PCWA for the City participation in the funding and construction of new PCWA transmission pipelines and new metering facilities to increase deliveries to the growing City and replace the undersized pipeline and metering station of the 1970's at the Reservoir 1 site.

- *Various Developer Agreements*. Signing of agreements with individual developers that (1) allowed combined funding of large one-time pipeline projects and (2) ceded the underlying groundwater supplies below the developments to the City.

Since 2008, the growth rate in the City has fallen back to fewer than 500 connections per year. This slower rate has been accommodated in the new water-related infrastructure, including use of treated surface water, disinfected groundwater, and raw surface water.

This infrastructure has been master-planned, built and effectively managed by the City for the influx population of over 30,000 people in a ten-year span.

CHAPTER 2. CITY PLANNING AND POLICIES

2.1 Introduction

This chapter of the Lincoln Water Master Plan (WMP) focuses on the City's organization, the paramount water planning aspects of the City's land use planning program, and the integration of City management with the water planning efforts. Accordingly, this section has the following format: 1) the organization, administration and management of the City as it pertains to Lincoln's water system; 2) the policies and planning documents guiding the City's understanding and implementation of water use and planning; and 3) the practical application of integrating the City organization with the development of planning documents and policies.

2.2 Water System Organization, Administration and Management

This section discusses the City's organization, administrative responsibilities, and management practices as they relate to the City's potable water system. The general assessment provided in this section is subject to refinement by City Staff in the context of changing management activities within the City. Accordingly, this section is organized as follows: City Council, City Management, and Specific Public Services.

2.2.1 Lincoln City Council

The City is a general law city with an elected five member City Council. The Lincoln City Council is elected based on an at-large, non-divisional approach to citizen representation. Council members are elected to four-year terms to oversee the City operations and to guide the future development of the City. Council-member terms are staggered so that a measure of continuity is maintained in the transition from one Council to the next. Election for three of the Council seats occurred in 2016, with the two remaining seats up for election two years later in 2018. This election is repeated similarly every two years. The City Council utilizes a mayoral rotation system to determine which Council members shall be chosen to serve as Mayor and Mayor Pro Tem. The City Council also serves as the Board of Directors for the City's Successor Agency to the Former Redevelopment Agency and the Lincoln Public Financing Authority.

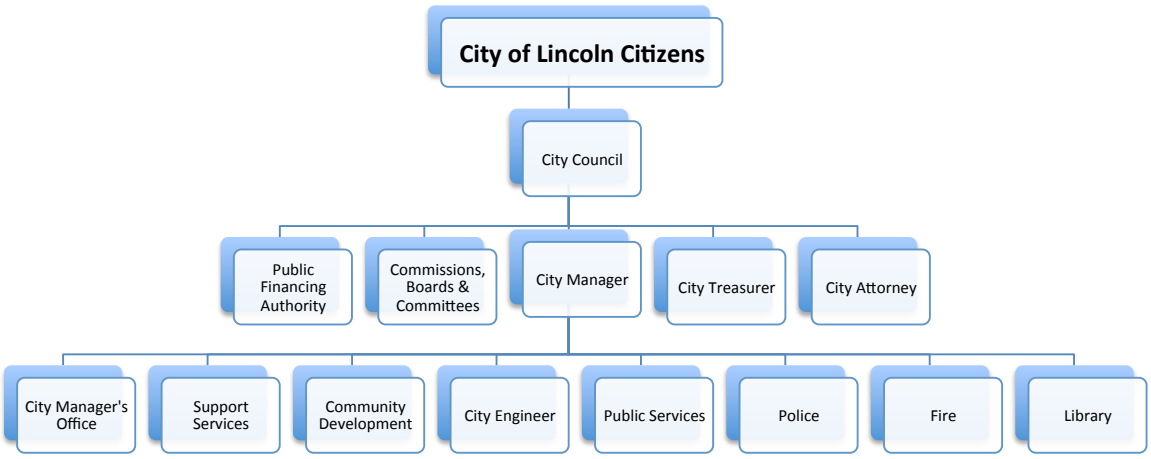
The City Council, with staff support, periodically reviews and prioritizes City activities and develops annual representation assignments including primary and alternate representatives and participants in various external forums. Relative to the City's potable water system these activities include, but are not limited to, representation with the Sacramento Regional Water Authority, Western Placer County Groundwater

Management Partnership, California League of Cities, as well as participation in regular meetings and special activities relating to regional water resources planning and policy issues.

2.2.2 City Management

The City staff is organized into seven (7) major departments reflecting the "full-service" activities of the City – all of which report directly to the City Manager. The departments include: City Manager's Office, Community Development, City Engineer, Public Services, Fire, Police, Lincoln Public Library, and Support Services. **Figure 2-1** diagrams the City's management structure. Departments primarily related to the City's water system include: City Manager's Office, Community Development, City Engineer, Public Services, Fire, and Support Services.

Figure 2-1 – City of Lincoln Organizational Flow Chart



The major responsibilities for the City's water system reside with the City Manager and his staff. Specifically, all City services are under the direction of the City Manager – including all aspects of water and wastewater. As the chief executive for the City, the City Manager balances the desired level of municipal services set by City Council policies and the available revenue to provide those services. Moreover, the City Manager is the key liaison between the City Council and the public. The City Manager is also responsible for representing the City in local, regional, and statewide venues for water resources planning that impact and influence City policy. The City Manager delegates these responsibilities to specific departments at his discretion.

2.2.2.1 City Manager's Office

With respect to City water system management, there are four distinct water systems serving the City. These systems are as follows: potable water, wastewater, recycled water and raw water. All four systems include pipe, ditch and storage systems that are impacted by other public agencies. For instance, as described in greater detail in **Chapter 5**, the City's potable water system is subject to the water management activities of its main surface water suppliers – Placer County Water Agency and Nevada Irrigation District. Although the discussion in this section focuses on the potable water system, the other three water management areas follow a similar regulatory path and require the City Manager's and his staff's regular attention.

The City Manager's Office provides leadership, general administrative direction, and policy implementation on behalf of the City's potable water issues. This department's staff, including the, City Clerk and Public Information Officer, work across all departments and disciplines within the City, providing consultation, direction and support. The City Clerk provides administrative services to all departments in the City. The Public Information Officer is charged with acquiring and distributing public information materials relevant to the City's function. All of these staff members are intimately involved in the City's potable water management efforts.

2.2.2.2 City Engineer

The City Engineer is charged with coordinating and synthesizing the City's infrastructure projects, including all projects related to the potable water system. This effort requires continued consultation with all other City Departments under the City Manager's supervision. The City Engineer's Department is responsible for the inspection and installation of water infrastructure systems. These efforts are harmonized with the Community Development Department in order to ensure the City's building efforts conform to State law, City Ordinances, and City Policies as well as the latest engineering standards. The City Engineer is also responsible for enforcing the City's standards and specifications for all construction and maintenance projects within the City through plan check and review as well as on-site inspections. The City Engineer's Department must also respond to fire flow and facility location requests, maintain City's base map, GPS and GIS database, determine cost estimates for developer generated fees, and update the City's construction standards and specifications on a regular basis.

2.2.2.3 Support Services

Support Services maintains the financial documentation for the City. Support Services organizes the Utility Billing for the City including: accounts receivable, accounts payable, and customer service. Support Services also oversees the City's general finance including: audit compliance, general ledger management, fixed assets management, financial reporting, and property inventory. Last, Support Services manages the City's

Information Technology efforts. In essence, Support Services provides key internal services to all departments, employees, and external customers. Related to water, Support Services is the vital unit charged with gathering meter data that informs the City's demand calculations as well as managing information technology relevant to water planning. These delegated administrative functions are designed to reduce overhead costs, increase efficiency, and provide effective customer service. The major responsibility areas in Support Services related to water are described below.

Accounting and Inventory

Accounting handles all aspects of the monthly, quarterly, and annual financial activity for the City, including water contracts and audit compliance. Inventory is responsible for monitoring, assessing and ordering of inventory, inventory paperwork, surplus materials and equipment, as well as audit and financial reporting compliance.

Billing and Collections

This aspect of Support Services produces and collects water bills for about 17,700 single-family residential connections, over 1,000 multi-family residential connections, and nearly 400 non-residential parcels. Support Services also produces and collects past due notices, 48-hour notices and shut off notices on a monthly basis. Staff also handles all liens, adjustments to accounts, customer service and Accounts Receivable audit compliance.

Customer Service

Customer Services annually receives requests for information (telephone and walk in) and dispatches over 4,000 service calls related to water and other issues. Staff also handles about 70,000 payments per year and customer correspondence.

Information Technology

Information Technology staff develops all information and communications technology requirements for the City. Staff maintains the City's computer network to include: hardware (servers, workstations, laptops), software, printers, telecommunications, monitoring and risk assessment, licensing, and maintenance for all City staff involved with the City's water system. Again, related to water system management, Support Services also has responsibility and authority for the Supervisory Control and Data Acquisition (SCADA) system and Geographic Information System (GIS) system (when activated). The City also anticipates that the Water Master Plan modeling efforts will be coordinated through this department.

2.2.2.4 Community Development

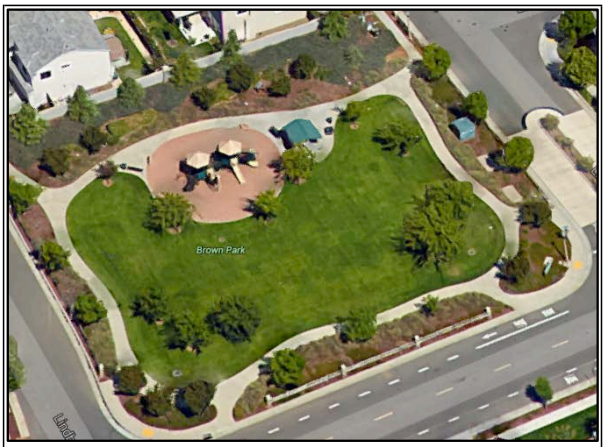
The Community Development Department, which houses the Planning and Building Divisions, Development Engineering, as well as Code Enforcement, is the key

department delegated leadership authority for development projects located in the City of Lincoln and its Sphere of Influence. The Department provides a broad array of community services to Lincoln residents and businesses. While all City departments are involved in at least some aspects of development, the Community Development Department receives and processes the actual development applications, which include Conditional Use Permits, Subdivision Mapping, Design Review, and Building Permits. Any development within the City of Lincoln must comply with the Lincoln General Plan and the Municipal Code, as well as state and federal law and regulations, described in more detail in **Section 2.3**.

The Community Development Department's Engineering Division is focused on project and program support of activities that are primarily in the public right-of-way and land use plan engineering. Such activities usually deal with public infrastructure such as roads, streets, bridges, and utilities and waterways. The Engineering staff review and approve all new residential development improvements for conformance to the City of Lincoln Improvement Standards and Design Criteria. Staff also review and impose "conditions of approval" for all new private development projects related to improvements within the public right-of-way. The Community Development Department directly coordinates efforts with the City Engineer and other departments.

2.2.2.5 Public Services

The Public Services Department provides and maintains public services for the City of Lincoln that improve the quality of life and ensure the health and safety of its residents. In the area of water, the Public Services Department is responsible for: potable water quality and delivery, wastewater and recycled water, and storm water, irrigation and maintenance of City parks, open space and landscape medians. The Public Services Department is subdivided into Environmental Utilities – that is responsible for potable water system operation and maintenance, and meter reading – as well as the Maintenance and Operations division.



Typical Neighborhood Park

Environmental Utilities

Environmental Utilities is responsible for sufficiently supplying instantaneous treated water demands to all services and maintain sufficient pressure for domestic and fire protection use. Public Services also provides continuous quality assurance and quality control of City potable water production activities and compliance

with Drinking Water Quality standards, regulatory reporting requirements, and maintaining a minimum system pressure.

Environmental Utilities, in 2013-the last year without drought considerations, provided approximately 9,700 acre-feet of treated water from PCWA and NID sources, and about 1,100 acre-feet of groundwater from City wells.[1] Environmental Utilities functions include preventive and corrective maintenance for all mechanical, electrical, chemical feed, and SCADA systems related to the water system.[2] The department responds to water quality issues and maintains water quality through distribution system-flushing and the City's Backflow Prevention program.



City Well

Environmental Utilities is responsible for compliance with federal and state water quality operations standards, including SWRCB-DDW and the EPA water quality testing programs such as: Total Coliform Rule, Title 22, Lead and Copper, Groundwater Rule, and the Disinfection By-Product Rule (DBPR). Water quality activities include:

- Bacteriological Testing: Bacteriological testing involves citywide sampling of the distribution system weekly.
- SWRCB-DDW/EPA Testing (Surface water and Groundwater): SWRCB-DDW/EPA requirements consist of surface water and groundwater testing for inorganic, secondary standards, general mineral, VOC, SOC, gross alpha, nitrate, nitrite, NDMA, and perchlorate in accordance with Title 22 of the California Code of Regulations. Distribution system testing under the Stage 2 DBPR is completed quarterly.
- Unregulated Contaminant Monitoring Rule UCMR-3: The EPA requires that all public water systems conduct assessment monitoring of unregulated contaminants every 5 years. The list of contaminants is provided by the EPA.
- National Pollution Discharge Elimination System (NPDES) Sampling: The City is required to maintain a Low Threat NPDES permit for all flushing and well pump to waste discharges to surface drainages within the City boundaries. Sampling is required once per quarter in order to maintain this permit.

[1] These numbers are rounded for explanatory purposes. **Chapter 4** details water usage in the City of Lincoln in 2013.
[2] Environmental Utilities must coordinate these efforts with the Information Technology component in the City Manager's Office.

- Flushing Program: In the City, there are many dead end mains that require periodic, high velocity flushing to reduce sedimentation and taste and odor complaints.

Environmental Utilities is also responsible for City well site maintenance and storage tank maintenance. The well maintenance for Well 2, Westwood, Moore Road, Fiddyment and Nelson is divided into the following categories: controls, chemical feed, and site maintenance. The storage tanks – Catta Verdera South (5 MG tank) and Reservoir 1 (3 MG tank) – maintenance is divided into the following categories: controls, site maintenance, inspection, and cleaning. Environmental Utilities is also responsible for the associated water sample stations, monitoring well maintenance, and pressure regulating station maintenance that includes maintaining controls, site maintenance, and inspection.

Last, Environmental Utilities provides the transmission and distribution functions that deliver adequate amounts of water for domestic and fire protection use to the City's customers. Operation and maintenance (O&M) functions include: service line repair, water main repair, valve repair, fire hydrant repair, meter repair, replacement and maintenance activities. Department-panned system maintenance functions include: meter installation, service line replacement, minimal water main replacement, mainline valve replacement, fire hydrant replacement and all labor and benefit cost associated with these functions. Environmental Utilities is responsible for providing 24-hour emergency service for replacements and repairs of water mains, fire hydrants, water services and valves. The Department is required to respond to Underground Service Alerts (dig requests) within the City boundary. Environmental Utilities annually tracks the work covering approximately 230 miles of active water main, 20,000 water meters, and 2,000 fire hydrants.

Environmental Utilities, in coordination with Information Technology, also leads the City's data management efforts for the potable water system. The data management functions occur using the automated Supervisory Control and Data Acquisition (SCADA) program that allows for unmanned operation of the water facilities and continuous monitoring and reporting of water production, system pressure, equipment operation times and many other performance parameters. The ongoing nature of data management systems requires continuous planning, rotation and upgrade of hardware and software as well as training for City personnel using the various programs necessary to operate the City's water system. There are well-established monitoring practices for tracking critical performance and scheduled replacement of key production and maintenance equipment. The City tracks performance and replacement schedules using spreadsheets.

Maintenance & Operations

The Maintenance & Operations Division is responsible for equipment owned and operated by City staff. This includes the service vehicles and most of the specialty equipment operated by the Environmental Utilities personnel on the City water system.

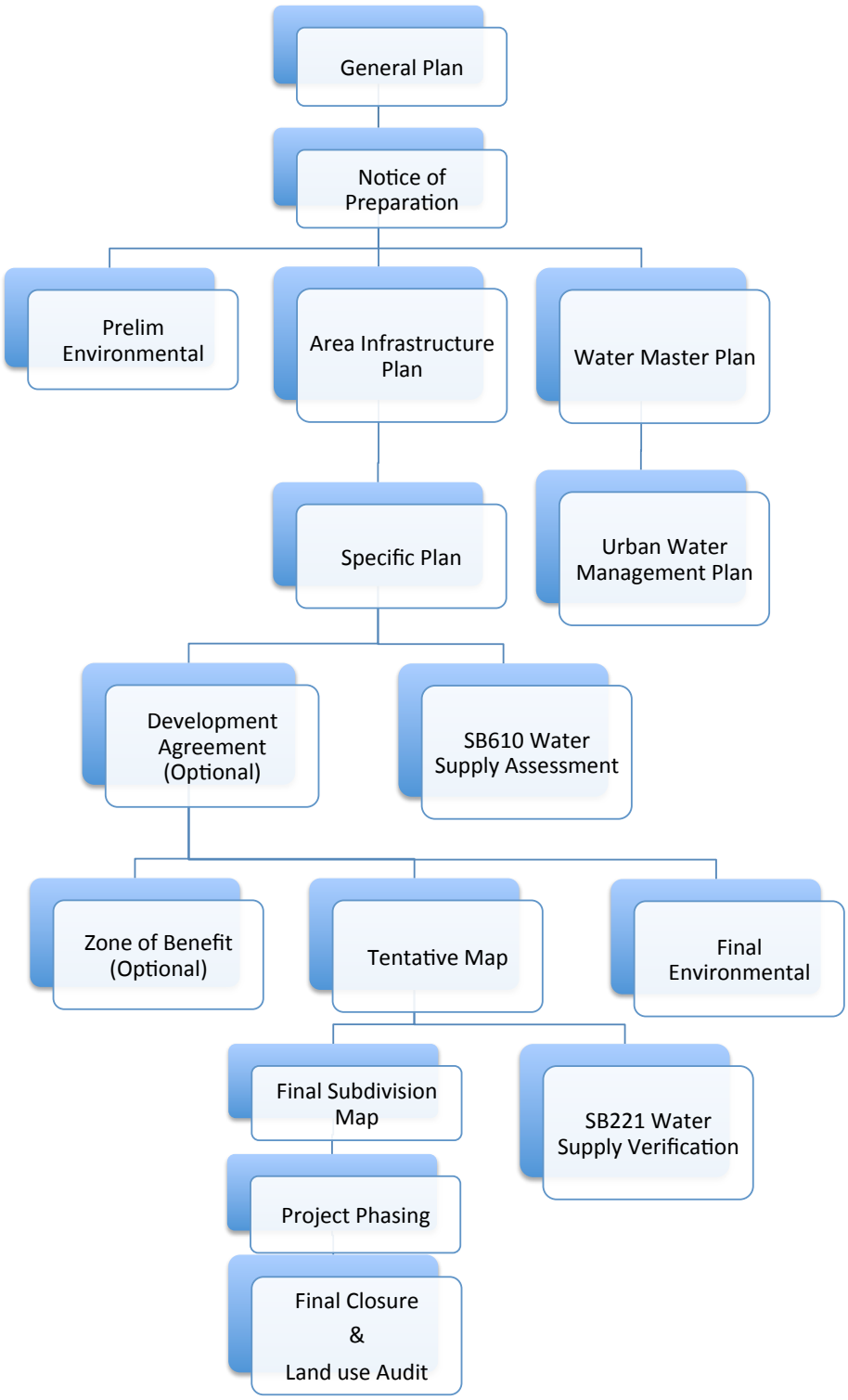
2.3 Planning and Policies

This section describes the various planning documents that impact water supply planning and water management in the City of Lincoln. The documents described in this section include: General Plan, Specific Plans, Water Master Plan, Urban Water Management Plan, SB 610 Water Supply Assessments, Developer Agreements, SB 221 Water Supply Verification, Low Threshold Project water analysis, Water Reclamation Plan, and California Environmental Quality Act (CEQA) analyses. All of these documents have some bearing on the land use and water planning in the City of Lincoln.

Figure 2-2 below shows the general relationship between the land use plans and water supply management plans in the City of Lincoln. Note the chart does not show a Reclamation Plan or a Low Threshold Project water analysis as those two water-planning documents supplement the land use and water planning flow chart depicted. Nevertheless, both of those planning tools are described in this document.

This section provides the City with (1) practical information about the relevant planning documents needed to inform the review and preparation of water reliability analyses as part of local planning processes (also see **Chapter 7**); and (2) a broad overview linking the City's organizational structure with the planning document requirements. The City will use this section to thoroughly integrate its water resources management issues with its land use planning processes. Last, the section identifies the assumptions that are used in the planning documents to develop the data and conclusions as well as an assessment of the typical scope and depth of the required elements.

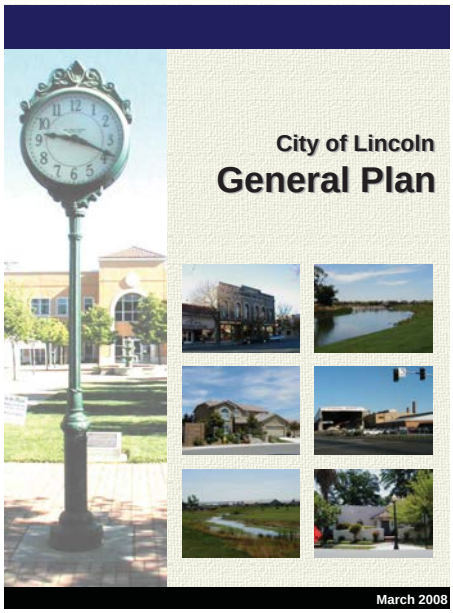
Figure 2-2 – Water and Land Use Organization within the City of Lincoln



2.4 General Plan

A General Plan is the blueprint for land use planning at the local government level. A General Plan is based on the regulatory requirements set forth in Government Codes sections 65300 et seq. A General Plan is a "project" and, as such, is subject to the requirements of the California Environmental Quality Act (CEQA) – a state law that requires assessment of hydrologic and water quality impacts in evaluating "a project." CEQA requirements are described throughout the body of this section.

The City of Lincoln is required to prepare a General Plan to ensure rational and orderly land use planning consistent with a community vision. A General Plan must contain a Land Use Element, which typically identifies the broad land use classifications and zoning designations on a land use map. Water resources management approaches are presented as sets of goals, policies and implementation strategies focusing primarily on conservation and preservation of the resource. Water resources are typically discussed in the context of the Conservation Element or Open Space Element, both of which are required. Some General Plans contain a standalone element on public utilities or water resources. The scope of the water resources discussion in the General Plan is driven by the principle of "Internal Consistency," meaning that the text and data must be consistent among all of the General Plan elements.



While water resources are often discussed within the General Plan elements themselves, the water supply and demand analysis is typically reserved for the assessment of hydrologic and water quality impacts under the California Environmental Quality Act (CEQA). The assessment of impacts under CEQA may be aided by an understanding of supplies and demands as presented in an Urban Water Management Plan (UWMP) or similar other supply and demand assessment that allows the entity preparing the Environmental Impact Report (EIR) to assess impacts to groundwater and surface water supplies, as well as impacts to drainage and water quality.

In simplified terms, the translation of the General Plan as a "project" into the Project Description for the environmental assessment serves as the basis for an analysis of the direct and reasonably foreseeable indirect environmental impacts of the General Plan. The CEQA Guidelines identify hydrologic and water quality factors to consider in determining whether a project might have a "substantial" impact upon hydrologic

resources, including groundwater aquifer depletion, supply expansion, supply sufficiency, and alteration in drainage or water quality. A General Plan should consider development of a Water Supply Evaluation in order to ensure that the most recent water information is included in the overall planning scheme. The City of Lincoln prepared a Water Constraints Analysis as part of its 2008 General Plan which has been the starting point for subsequent water analyses performed for the City.

A General Plan is the broadest land use planning document that a local government develops, and the environmental assessment that is developed for the General Plan may be utilized for a subsequent project to assess impacts. Development of comprehensive demand projections and supply conditions at this phase of planning can benefit subsequent phases of planning. In contrast, incomplete or incorrect analysis can cause problems for future supply and demand analyses contained in other planning documents. For instance, overestimating demands may lead to unnecessary expense in developing water sources or conveyance systems to customers. Moreover, often forgotten players in the land use and water supply planning framework are the Local Agency Formation Commissions (LAFCOs), which are tasked with considering water service efficiency when evaluating public services as part of annexation and Sphere of Influence (SOI) modification proceedings. This is important at the General Plan stage because General Plan updates often serve as the platforms for SOI expansion and service area annexations.

It is also important to recognize the intersecting areas of expertise contained in the General Plan and subsequent documents. For a General Plan to successfully convey a broad blueprint regarding the future of the City, it must successfully incorporate all possible factors and expertise into its planning. For example, to successfully include meaningful CEQA mitigations recommendations the City needs input from scientists to determine what the environmental impacts of a project may be; a financial analysis to incorporate cost considerations and prohibitions; and legal consultation verifying the legal requirements have been met. Synthesizing these elements is critical for successful plan completion.

General Plans should be updated every five years to reflect changed conditions within the City. Oftentimes, projected growth rates, projected growth patterns, and strategic infrastructure plans require revision as the pace of General Plan implementation changes. The City should consider updating its 2008 General Plan to reflect relevant changed conditions in the City.

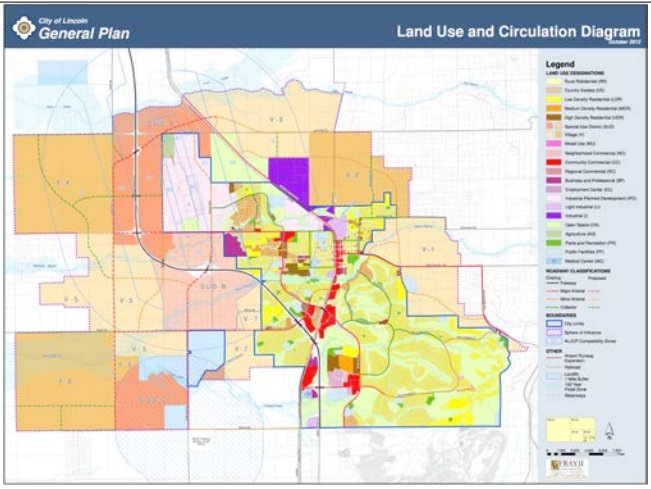
2.4.1 Conservation, Open Space, Public Utilities and Water Elements

General Plans are organized by elements, and must contain a specific section with policies regarding natural resources conservation and open space, and also should contain

policies regarding water resources. The Conservation Element should contain policies regarding the conservation, utilization and development of natural resources. The Conservation Element should also provide a venue for community members to develop land use policies to reconcile conflicting demands for scarce resources, through coordination with local water purveyors and evaluation of water supply and demand information. The Conservation Element is critical for developing the General Plan.

The Open Space Element is defined as "any parcel or area of land or water that is essentially unimproved and devoted to an open-space." The Open-Space Element seeks to preserve water resources important for habitat, agricultural purposes, and groundwater recharge purposes. The Open Space Element is often overlooked in assessing water assets and demands in General Plan water evaluations.

The Public Utilities and Water Element is not a specific requirement of a General Plan but is often developed as part of the General Plan. Surprisingly, there are no specific requirements regarding the contents or manner in which a General Plan should consider water resources. But the overriding principle of "internal consistency" (between and among the elements) guides the scope and depth of information that should be provided. Thus, handling impact of various required elements necessitates assessment of public utilities and water. For purposes of the water analysis, consistency with the land use element in the General Plan is critical. General Plans contain a Land Use Element that designates the proposed general distribution, general location, and extent of the uses of the land for all public and private classifications. The Land Use Element should also contain standards of population density and building intensity for the land use classifications. As mentioned above, the City of Lincoln prepared a Water Constraints Analysis as an appendix to its General Plan in 2008.



2008 General Plan Land Use Map

2.4.2 General Plan Timing

State law requires a City to prepare a General Plan upon incorporation and update the General Plan Housing Element at least every eight (8) years. General Plans require CEQA review and the CEQA process generally runs concurrently with the development of a General Plan. A Notice of Preparation (NOP) must be circulated for 30 days describing the draft General Plan. A draft Environmental Impact Report (EIR) must be circulated for a 30-60 day comment period before adoption. The lead agency must issue responses to written comments on

the draft EIR to the commenting party at least 10 days prior to certification of the EIR. Before adoption of the final EIR, the local jurisdiction must certify the EIR and make findings as to how significant environmental effects have been mitigated. Certification must take place within one year after deeming the initial project application complete.

2.4.3 General Plan Specific Provisions

The discussion of water resources in the Conservation Element, the Open Space Element, or a unique Water Resources or Public Utilities Element, incorporates a set of goals, policies, and implementation strategies. These goals, policies and strategies are typically conservation and preservation oriented, and based upon a broad understanding of a jurisdiction's current and future water resources issues. Examples of such goals, policies and strategies include:

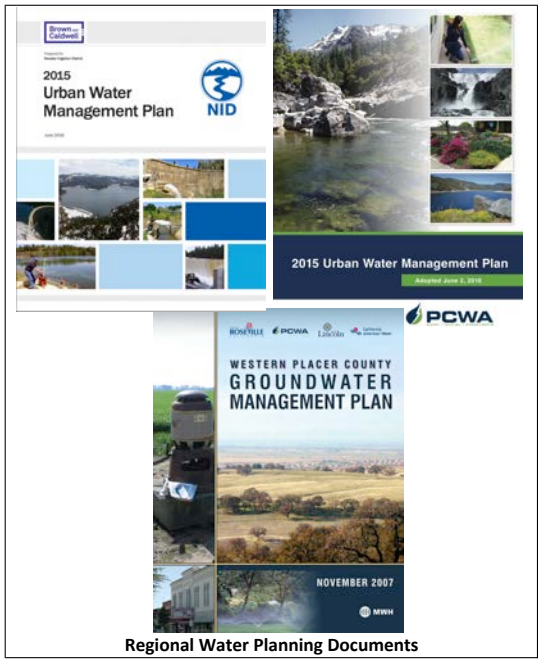
- Goal: To ensure that water supplies of sufficient quality and quantity will be available to serve the community needs, now and into the future.
- Policy: Protection of water resources and supply systems through sound system management.
- Implementation Measure: Maintenance of local water ordinances to protect the integrity of water supplies.
- Policy: The agency shall work to ensure continued reasonable alternate water supplies.
- Implementation Measure: The agency shall encourage water supply districts and companies in the county to identify and develop water supply sources, other than groundwater, where feasible.

A land use entity, prior to adoption of or a substantial amendment to a General Plan, is required to distribute the General Plan to "public water systems", serving 3,000 or more connections, for a 45-day review and comment period. This provision requires the public water system to provide the land use entity with the following information: (1) the most current UWMP; (2) a description of its water supply sources in wet, normal and dry years; (3) a description of the demands from all sources in the previous five years; (4) any proposed additional supplies; (5) a description of total current customers by category; (6) quantification of demand reduction associated with water use reduction measures in a water supplier's urban water management plan; and (7) any additional information that would allow for a determination of adequacy of existing and future supplies for the existing and projected demands.

Under the General Plan, the requirement that a public water system with more than 3,000 connections submit this information parallels the requirements contained in an UWMP. As such, this information should be readily available, unless the public water system just

reached the connection threshold or needs to update UWMP figures. While a discussion of water resources is valuable for various land use decisions that have an impact on watershed management and water quality, the primary purpose of this information is to consider whether demands are consistent with supplies and to address the potential water resource needs of a given jurisdiction.

While the coordination requirements of the General Plan process apply to the City and its relationships with PCWA and NID, the requirements to prepare a Conservation Element and an Open Space Element still remains with the City alone. Moreover, regardless of the number of connections that the City has, the requirement of internal consistency compels the City to consider water-planning elements. Specifically, under a General Plan adoption or General Plan amendment, land uses are certain to change and any discussion of water resources needs to accurately reflect the anticipated land use plans in a given jurisdiction. The City must account for water for human consumption through pipes or other constructed conveyances, including collection, treatment, storage, and distribution facilities, either under or not under the control of the operator of the system, which are used primarily in connection with the system. Thus, the City should not only be coordinating its General Plan with the regional UWMPs, but also making sure the General Plan aligns with its relevant Water Master Plan – the plan described below that generally assesses water infrastructure related issues. All of these items are critical considerations in the General Plan process.



Regional Water Planning Documents

2.4.4 Level of Specificity

The General Plan provides the broadest view of land use planning and water supply planning of all the documents discussed in this section. As shown, the General Plan elements qualitatively address water resources but the development of these qualitative principles requires substantive underlying analysis. Accordingly, the goals, policies and implementation strategies regarding water resources should be analyzed for internal consistency with the Land Use Element, including both qualitative and quantitative provisions. Because adoption of a substantial amendment to a General Plan requires an environmental assessment pursuant to CEQA, water resources are typically addressed in greater detail in an EIR and tier from relevant planning documents from regional purveyors (as available).

2.4.5 Relevance of LAFCO on General Plan Water Supply Planning

General Plan updates are often tied to the adoption or modification of a Sphere of Influence (SOI). An SOI represents the probable physical boundary and service area of a local agency or municipality as approved by the LAFCO. Within each county, LAFCO is responsible for approving SOI adoptions and modifications for each City and special district. LAFCOs consider amendments based upon the principles of logical and orderly development and coordination of local governmental services.

Among other elements, a LAFCO evaluates water service when considering whether an efficient SOI modification is possible. LAFCOs consider SOI boundaries based upon four factors: (1) present and planned land use; (2) present and probable need for public facilities; (3) present capacity and adequacy of public services (including water); and (4) social or economic communities of interest. In contemplation of an SOI modification, a LAFCO first considers a local entity's five, ten, and twenty-year growth projections and the associated land use changes. There should be a description of the present and probable need for public services concurrent with projected land uses. If the LAFCO processes alter land uses, then the water supply evaluation may need revision to maintain consistency. Generally, the water planning analyses contained in General Plans, General Plan EIRs, UWMPs or SB 610 WSAs will be satisfactory for LAFCO approvals.

For the City of Lincoln, multiple LAFCO issues are in play. Not only is the City's Sphere of Influence for its land use designations a LAFCO concern, but also the water supplies emanating from its wholesale water providers – Placer County Water Agency and Nevada Irrigation District. The wholesale entities' service areas are both within the City's existing boundaries and SOI. As such, coordinating the best mechanisms for water supply delivery from these entities is essential to satisfying not only the requirements of the General Plan, but also the LAFCO service boundary determinations for water supply availability. Furthermore, the City's water reclamation projects, raw water deliveries, private surface water rights in the City's SOI, and groundwater conditions should also be considered in the General Plan process. At this time, there are no considerations of changing the service area boundaries for PCWA and NID.

2.4.6 General Plan Summary

The General Plan presents a unique opportunity for the City, the public, and wholesale water agencies to mutually engage in the land and water planning process. The broad approach used in a General Plan typically allows for identification of policies regarding resource uses and impacts, as well as delineation of various responsibilities for meeting planning objectives. From a water planning perspective, a General Plan plays a significant role because it: (1) serves as an opportunity for public review of the hydrology

and water quality impacts associated with City growth; (2) may set the foundation for subsequent project-specific reviews that may attempt to utilize the General Plan and its supporting documents as the basis for subsequent decisions; (3) provides an opportunity for responsible agencies to participate in the planning process through providing detailed water information and reviewing the planning documents, including mitigation measures potentially adopted in an EIR.

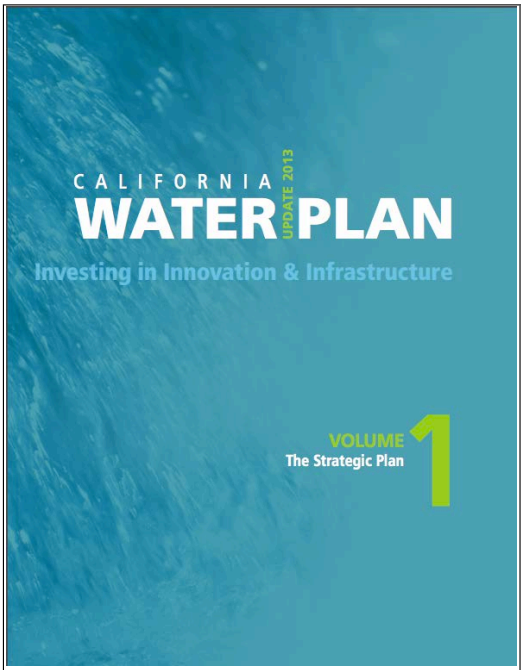
While a General Plan is a critical land use and water resource planning document, it is important to keep its limitations in mind, notably that it is infrequently updated because of the considerable staff time and financial resources involved in such an effort. This has the potential to lead to other problems related to water supply planning. Often, a developer will drive the project planning process and may hire a consultant to prepare an environmental assessment or SB 610 Water Supply Assessment for a project (discussed below). If the local jurisdiction does not institute quality control of the developer documents, consistency problems among project specific planning documents may emerge. Thus, the General Plan serves as the foundation for consistency determinations in the project specific documents, and it needs to remain relevant to local jurisdictional staff and decision makers.

2.5 Water Master Plan

Water Master Plans (WMP) are generated by water purveyors in California typically to (1) identify the water supply and water infrastructure assets available to their existing customers, (2) define the additional assets to meet current demands and future growth needs of existing and new customers, and (3) determine the assets that need to be upgraded or replaced over selected periods of time. In some cases, the WMP also presents the financial resources, funding sources and long-term investments necessary to continue efficient operations of the purveyor's water facilities. The WMP is a comprehensive document providing an overview and analysis of water supply, infrastructure, future supply and demand projections, and strategies for maintaining and expanding the purveyor's existing supplies and facilities.

2.5.1 California Water Plan

The California Water Plan (CWP) or Bulletin No. 3, State Water Resources Board, is defined by California Water Code Section 10004 to 10013 and summarized below. The CWP is updated every five years. The State of California (State) has a primary interest in the orderly and coordinated control, protection, conservation, development, and utilization of the water resources of the State by all individuals and entities. It is the policy of the State that the CWP is accepted as the master plan that guides the orderly and coordinated control, protection, conservation, development, management and efficient utilization of



California Water Plan

the water resources of the state. The California Water Plan utilizes information gleaned from individual purveyor Water Master Plans as well as Urban Water Management Plans in drawing its conclusions. Relevant portions of the California Water Plan include the assessment of groundwater resources and groundwater aquifer systems that are tied to Department of Water Resources Bulletin 118. Moreover, statistical assessments of drought frequency, climate change, and population growth are all components of the California Water Plan that can have direct bearing on the City's water planning efforts. The California Water Plan is used as a foundational document in assessing the California Water Framework (**Chapter 1**) and other statistical data used in this CWMP.

2.5.2 Purveyor Water Master Plans

Water Master Plans are the primary technical and engineering document that a water purveyor uses in developing, modifying, funding and operating their water systems. These documents generally provide information regarding the overall engineering structure of a water system as well as the delivery capabilities, ages of equipment and conveyance mechanisms, as well as proposed system improvements.

Complex water models provide the most useful modern tool in assessing water systems and addressing various safety and flow concerns. These modeling systems include mechanisms to delineate pipe diameters throughout the system, flow rates, capacity constraints, storage needs, and system deficits in water pressure and flow rate. Although the modeling systems are merely tools to address the system function and operations, the models are useful to allow quick assessment of problematic areas in the context of other available information.

The primary goal of a typical WMP is to first evaluate the existing system for water assets available, system age, system performance, regulatory compliance, and system expandability. Tools used to accomplish this include: purveyor records for operation, maintenance and revenue, field tests and computer modeling of the water infrastructure, regulatory or contractual requirements, and other available information provided by the water purveyor. Water asset review would include water rights, water permits, water supply contracts, groundwater development potential, recycled water use potential, demand reductions due to conservation efforts, and demand reductions related to building

code changes. This asset review is often deemphasized or overlooked completely in the WMP process resulting in very poor infrastructure recommendations and even building infrastructure that has little or no utility. For instance, depicting a groundwater supply as the well capacity, as is often done in a WMP, ignores the important nuances associated with the regulatory structure and hydrogeology of an groundwater basin that limit supply availability.

Review of water infrastructure includes: water production or delivery capacities, treatment facilities, storage facilities, flow and pressure regulating facilities, pumping facilities, pipelines and interconnections. Review of operations includes pressure zone needs, fire flow capacities, leakage and repair records, daily and hourly demand patterns for identifying factors, and infrastructure capacities and limitations in the modeling efforts for the existing system. Together these pieces help derive the total functionality of a water purveyors system with particular emphasis on the engineering components of the projects.

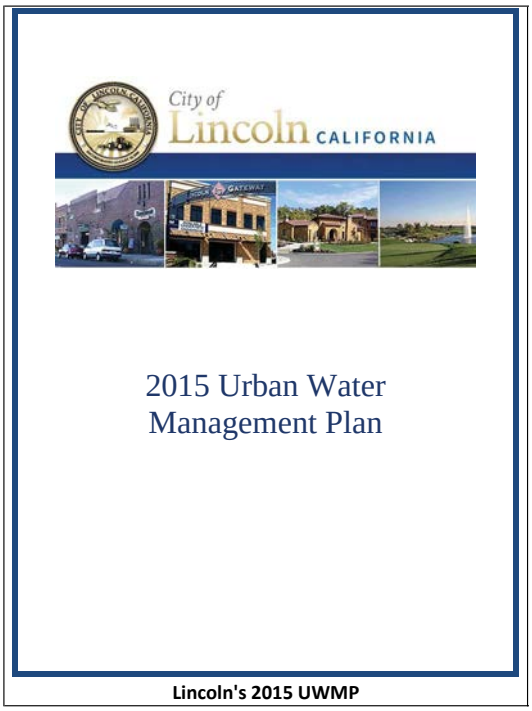
The WMP next identifies the potential growth based on General Plan population projections over a planning period (or updated projections), and recognized short-term and long-term development projects inserted into a planning horizon that can vary between 10 to 100 years. With the existing water infrastructure and water assets identified, the approved land uses with the purveyors service area determine the aggregate water demand and proposed infrastructure to serve the future development as well as continue to serve existing commitments. Variability in the future tends to produce multiple scenarios to evaluate impacts on the projected infrastructure and strain on the financing model. The water purveyor's Urban Water Management Plan should contain significant population and demand data needed for the future projections. The recommended infrastructure improvements are usually prioritized based on a combination of existing and pending service commitments. The resulting capital improvements program lists prioritized projects to be needed to meet current and future demands and identifies the capital funding annually required to provide those improvements. A financial plan and corresponding rate study would provide the funding requirements for the water system expansion.

Over the last decade, climate change impact analysis has entered into the environmental analysis of water-related projects in the State. This development has prompted water purveyors to identify not just their potable water sources, but also the non-potable water uses that can supplant potable water uses. The recent drought in California has made the public acutely aware of the need for water conservation and amenable to retrofitting water fixtures with those more water efficient.

The City has maintained a Water Master Plan providing a comprehensive plan and overview of all the elements impacting the City's current and future water needs and infrastructure. As shown in **Chapters 4** through **11**, this 2017 Water Master Plan, serves to update the City's previous stand alone water master plan, expands and synthesizes new information, and reflects changes that have occurred within the City and the SOI. The WMP assesses available water resources, additional or revised water-related projects and infrastructure, and changes within the regulatory and legal structures that impact water service to the City.

2.6 Urban Water Management Plan

The Urban Water Management Plan (UWMP) is the foundational water supply document for the City of Lincoln. While some water suppliers have historically viewed the UWMP as a "check-the-box" exercise, the quality of analytical detail is becoming more important as water supplies become scarcer and broader analyses are required to understand and disclose the reliability and sufficiency of the water supply. Though there is greater need for scrutiny and analysis, the Urban Water Management Planning Act (Act) recognizes the challenges associated with gathering data and recommends developing conclusions based upon information that is "reasonably available."



Lincoln's 2015 UWMP

The Act is intended to promote efficient use of urban water supplies, ensure water supply reliability in various hydrologic conditions, and provide a mechanism for long-term resource planning through the preparation of a UWMP. The Act is applicable to a publicly or privately owned water supplier serving water to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually.

Following approval of the UWMP by the public water supplier, the supplier must submit an UWMP to the California Department of Water Resources (DWR) every five years. The UWMP is the broadest, most comprehensive water supply and demand document that a public agency prepares. A well-prepared UWMP can be used as the basis for other analyses, including a supply and demand analysis within a General Plan, for a Senate Bill 610 Water Supply Assessment (SB 610 WSA), for a SB 221 Water Supply Verifications (SB 221 Verification), a water supply and demand analysis for a low-threshold project, or

as the technical basis for an environmental analysis required under the California Environmental Quality Act (CEQA). Thus, accurately preparing an UWMP and ensuring synthesis with previous water planning analyses can greatly reduce expenditures related to long-term water resources management and planning.

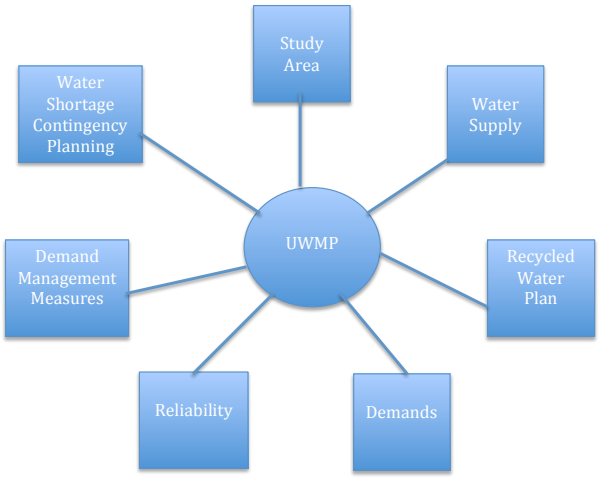
While DWR reviews the UWMP for consistency with the statutory requirements, it does not "reject" an UWMP filed by an urban water supplier. If a plan includes all of the required information, it is "complete." If a plan is not complete, DWR will request that the supplier improve its plan by addressing the provisions identified as "Not Addressed." The contents and analysis in a UWMP are tested when the UWMP is used as a reference in the preparation of an SB 610 WSA or SB 221 Verification because, at that point, projects become most publicly visible and the assumptions used within the UWMP may be tested. Moreover, those assumptions may again be challenged in the context of CEQA or other publicly available project assessment as those documents have legal significance.

Preparation of a UWMP requires a coordinated effort with other water purveyors in the region that may be affected by the planning efforts of the preparing entity. Thus, the preparing entity must notify such entities, make a draft copy of the UWMP available, and request comments regarding the content and recommendations prior to its formal adoption after a public hearing.

The UWMP requires completion of several elements intended to capture the balance between projected supplies and demands, and also to present both short-term and long-term demand management strategies, and alternative source development methods (including recycled water). While one of the primary objectives of a UWMP is assessment and disclosure of the supply and demand balance of a jurisdiction over a 20-year time horizon, a UWMP does not need to contain conclusions regarding the sufficiency of the water supply relative to projected demands. Nevertheless, the substantive elements of a UWMP do include data beyond that which is required in SB 610 WSAs and SB 221 Verifications, and even though a conclusion regarding sufficiency is not required, the elements of a UWMP should be carefully prepared with the understanding that the data will likely be used for sufficiency analyses at a later date.

The general elements included in the UWMP are illustrated in **Figure 2-3** and are discussed below.

Figure 2-3 – Components of UWMP



2.6.1 Study Area

The California Water Code requires preparation of a UWMP based upon the service area of the urban water purveyor. In some cases, the service area may overlap with the political boundary of a local government because the local government is the purveyor. There may be other cases in which the local government does not serve water to all areas within its jurisdiction, in which case it would not be required to include a discussion of the areas served by other water purveyors. On the other hand, a local jurisdiction may have an obligation, for health and safety purposes, to ensure availability of adequate supplies for those areas served by other purveyors in the case of a supply shortage or catastrophe and, therefore, may consider incorporating those obligations into its UWMP analysis.

The definition of the geographic Study Area is critical for analytical purposes because the land use based demand projections necessitate use of consistent total acreage figures. Subdivision of the Study Area into smaller segments may be appropriate for several reasons, including: (1) unique supply and demand considerations, such as provision of water to one area of the larger political jurisdiction by another water purveyor; (2) wholesale arrangements for certain portions of a jurisdiction that should be considered separately because the unique supply characteristics of the water purveyor may impact supply reliability; and (3) water right limitations associated with particular sources and uses of the purveyor's available water supplies.

To gain a broader understanding of future demand trends and provide justification for the unit demands developed as part of a UWMP, the UWMP must include a discussion of the

population projections for the study area. Population projections also assist in the evaluation of the potential savings that may be realized from implementation of the Demand Management Measures that are also required to be assessed in the UWMP. Thus, the juxtaposition of a land-use based demand assessment and a population-based demand assessment provides additional analytical rigor for these calculations.

2.6.2 Water Supplies

A UWMP requires a description of the supplies available to the urban water supplier over a 20-year planning horizon. The UWMP should describe the legal nature of each water supply, though it is not a requirement to include documentation supporting the supply in the UWMP itself.

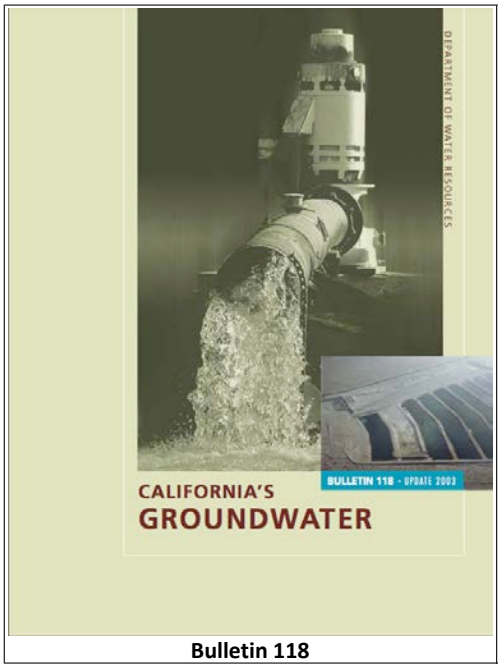
Surface Water: Based upon the Study Area delineations, surface water resources should be described consistent with water rights and contract entitlements, including the supply volume, point(s) of delivery and area served. The California Supreme Court's decision in the *Vineyard*[3] case highlights the importance of a "reasoned analysis of the circumstances affecting the likelihood of the water's availability." Thus, any documents that may be incorporated into an environmental analysis associated with CEQA, must address the key findings of this California Supreme Court decision. Speculative water supplies may be insufficient for purposes of meeting the *Vineyard* criteria. In the UWMP, the likelihood of a supply materializing does not have an impact on the conclusions in the document, but if these same supplies are going to be cited as potential sources in subsequent planning documents the disclosure of uncertainties becomes increasingly critical. This should probably compel a "reasoned analysis" in the UWMP because of its foundational nature.

Groundwater: Two of the primary issues related to a discussion of groundwater supplies are: (1) whether there is a reasonable and accurate description of the basin; and (2) whether the requirement to indicate whether the basin is in overdraft impacts future "sufficiency" determinations in subsequent water supply analyses. Generally, a UWMP requires a description of the groundwater basin consistent with the California Department of Water Resources Bulletin 118 summary. Whether the description of the basin is reasonable is in large part an intuitive hydrogeologic consideration. The goal to provide information regarding the basin from the urban water supplier pumps to serve demands in the Study Area. Clearly, this analysis can become quite complicated because the aquifer from which the urban water supplier pumps is not uniform across its range, contains cones of depression and hydrophobic lenses. Therefore, some uncertainty will almost always be present regarding the "basin" from which the urban water supplier pumps

[3] *Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* (2007) 40 Cal. 4th 412.

unless detailed studies of the basin have been conducted – and even if those analyses are complete some level of uncertainty will still exist.

An urban water supplier must determine whether DWR has projected the basin is or will become overdrafted if present management conditions continue, in the most current official departmental bulletin (i.e., Bulletin 118) that characterizes the condition of the groundwater basin . . . ." Bulletin 118-03 indicates that the Legislature did not provide direction or funding to undertake an overdraft analysis of the State's groundwater basins. Therefore, except for the 11 basins that Bulletin 118-03 recognizes as being in "critical overdraft," the scope of the analysis required under the statute is unclear. Nevertheless, this omission probably does not relieve the City from identifying overdraft conditions based on other available information. To help in this effort, Bulletin 118-03 does provide working definitions of "historical" and "projected" overdraft from which a good faith analysis of overdraft should be considered.



Bulletin 118

DWR Bulletin 118 defines "overdraft" as "the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions." DWR also defines "projected overdraft" as "an estimate of future water shortages based on an assumed management program within the basin, including projected supply and projected demand."

In 1978, DWR was directed by the legislature to develop a definition of "critical overdraft." As a result of public workshops and input from water managers, DWR developed a definition of critical overdraft that was utilized in DWR's Bulletin 118-80 as follows: "A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." Ultimately, DWR utilized this definition to identify 11 basins in "critical overdraft," and Bulletin 118-03 has retained this list.

The description of the basin, including "overdraft" considerations, is directly related to the methodology that an urban water supplier employs in an SB 610 WSA (described in **Section 2.10**) to determine whether there are "sufficient" groundwater supplies available because sufficiency is directly related to the available supplies and all other demands

relying upon the same supply source. Ultimately, the requirements for determining sufficiency of groundwater supplies may be the product of case law resulting from challenges to SB 610 WSAs. While this standard is relevant to SB 610 WSAs, the connection between a Water Supply Assessment and an UWMP may ultimately drive public water systems to prepare the UWMP consistent with this requirement.

2.6.3 Reliability

The Act requires a 20-year projection of water supply availability, as well as the availability of these supplies in normal, single-dry and multiple-dry years. The reliability analysis should be distinguished from the analysis of the nature of the water supplies themselves. Reliability analyses should be performed on those supplies that have been identified as available to serve demands. The interaction of hydrology and the identified water rights and entitlements is critical to assessing the reliability of supplies in different hydrologic year types. A few examples of reliability analyses include:

- *Historic Hydrologic Data*: Reliability is often assessed by analysis of historic supply conditions, with specific emphasis on the driest single and multiple dry-year periods. To perform this analysis, historic hydrologic data needs to be available over a sufficient time period to be able to select representative periods of time. Commonly, a multiple dry-year analysis entails consideration of supply conditions in three successively dry years. Based upon water supply conditions in the representative year(s), the City can estimate the quantity of water that might be available in these worst-case scenarios based upon the City's existing water rights.
- *Negotiated Agreements*: Reliability may also be assessed according to the details of a negotiated agreement that drive reductions in dry years based upon a unique formula such as reservoir inflow. For instance, specific provisions associated with drought conditions are described in the City's water agreement with PCWA. These conditions may drive reliability and should be reflected in the UWMP.
- *Groundwater*: Groundwater reliability presents a complicated issue because of the limited information available regarding groundwater supplies. Further detail regarding "sufficiency" of supplies is discussed in the evaluation of the SB 610 WSA in **Section 2.10**.

2.6.4 Demands

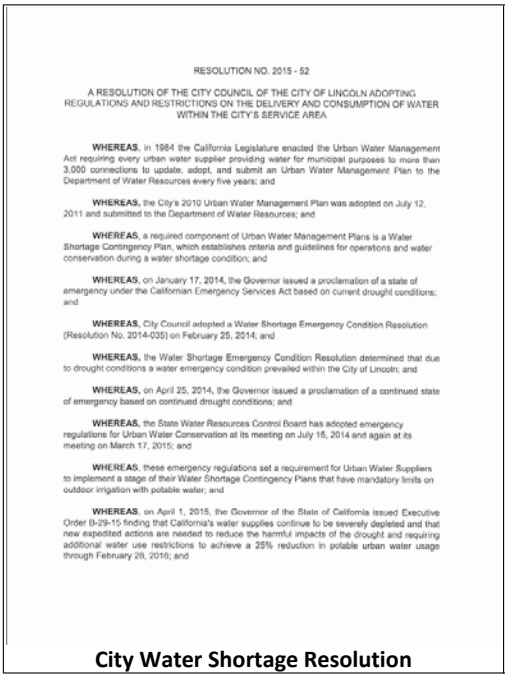
The Act also requires preparation of the past, current and projected demands by sector. Historic and current demands may be reported based upon available data, including water treatment plant production and end user meter data. A UWMP should also provide a detailed description of projected demands in five-year increments for a twenty-year period. The methodologies for developing these demand projections are described in detail in **Chapter 4** of this document.

As discussed previously, the importance of the demand assessment in light of future use for subsequent SB 610 WSAs and General Plans should be strongly considered to help avoid inconsistencies that could become problematic for subsequent land use planning decision documents.

2.6.5 Demand Management Measures

The Act requires that the urban water supplier describe long-term Demand Management Measures (DMMs). One of the primary objectives of this requirement is to ensure that urban water purveyors make a good-faith effort to use water efficiently prior to initiating water supply projects that may not be as cost-effective per unit of water. While reporting DMMs is a requirement for preparation of a UWMP, there are also incentives for maintaining a robust DMM program through membership in the California Urban Water Conservation Council (CUWCC). Preparation of, and reporting on, DMMs is critical to land use planning efforts because the DMMs are intended to make water "go further" per unit of land or for a population within a given jurisdiction. A detailed listing of required DMMs is available through the California Department of Water Resources.

2.6.6 Water Shortage Contingency Plan



RESOLUTION NO. 2015 - 52

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LINCOLN ADOPTING REGULATIONS AND RESTRICTIONS ON THE DELIVERY AND CONSUMPTION OF WATER WITHIN THE CITY'S SERVICE AREA

WHEREAS, in 1984 the California Legislature enacted the Urban Water Management Act requiring every urban water supplier providing water for municipal purposes to more than 3,000 connections to update, adopt, and submit an Urban Water Management Plan to the Department of Water Resources every five years; and

WHEREAS, the City's 2010 Urban Water Management Plan was adopted on July 12, 2011 and submitted to the Department of Water Resources; and

WHEREAS, a required component of Urban Water Management Plans is a Water Shortage Contingency Plan, which establishes criteria and guidelines for operations and water conservation during a water shortage condition; and

WHEREAS, on January 17, 2014, the Governor issued a proclamation of a state of emergency under the Californian Emergency Services Act based on current drought conditions; and

WHEREAS, City Council adopted a Water Shortage Emergency Condition Resolution (Resolution No. 2014-035) on February 25, 2014; and

WHEREAS, the Water Shortage Emergency Condition Resolution determined that due to drought conditions a water emergency condition prevailed within the City of Lincoln; and

WHEREAS, on April 25, 2014, the Governor issued a proclamation of a continued state of emergency based on continued drought conditions; and

WHEREAS, the State Water Resources Control Board has adopted emergency regulations for Urban Water Conservation at its meeting on July 15, 2014 and again at its meeting on March 17, 2015; and

WHEREAS, these emergency regulations set a requirement for Urban Water Suppliers to implement a stage of their Water Shortage Contingency Plans that have mandatory limits on outdoor irrigation with potable water; and

WHEREAS, on April 1, 2015, the Governor of the State of California issued Executive Order B-29-15 finding that California's water supplies continue to be severely depleted and that new expedited actions are needed to reduce the harmful impacts of the drought and requiring additional water use restrictions to achieve a 25% reduction in potable urban water usage through February 28, 2016; and

City Water Shortage Resolution

The Act requires an analysis water shortage contingency planning in conjunction with the UWMP. The Act also requires an urban water supplier to identify actions and plans for implementation of measures according to the plan in the case of water shortage. The water shortage contingency plan (WSCP) must consider stages of action up to a 50 percent reduction in supplies. Also, the urban water supplier must estimate available supplies, assuming a three-year dry period, consistent with the driest three-year period on record. The purveyor must consider mandatory prohibitions, penalties, methods for implementation (including resolutions or ordinances), and measurement approaches for determining whether conservation targets are being achieved. Also, the UWMP should contain an analysis of the costs to the agency resulting from shortages.

From the perspective of an UWMP, the biggest issue related to the applicability of a water shortage contingency plan is quantifying the water savings achieved from

temporary conservation actions. Because the goal is to achieve water savings sufficient to align demands with supplies, measurement becomes critical. By evaluating demands on an indoor/outdoor basis, it is possible to contemplate potential savings from various rationing activities designed to curtail outdoor uses, which are typically considered "discretionary."

The City of Lincoln has established a water shortage contingency plan as part of its 2015 UWMP which can be enacted under Municipal Code Section 13.04.600, which states "the city manager is authorized to enact, impose, implement, and modify water conservation restrictions in order to meet the state or local water conservation standards, and to declare the appropriate water conservation stage as provided in the City's water shortage contingency plan." This plan has been developed by the City in compliance with the State's requirements for water shortage contingency planning under the UWMP. The City's WSCP consists of four Stages of Action to address potential water supply reductions of up to 50 percent. Upon the declaration of a water shortage by the City Council, the appropriate stage can be implemented. The stages include voluntary and mandatory water demand management measures that may be implemented as appropriate to address the severity and anticipated duration of the water supply shortage. Stages of Action may be triggered by 1) current supply conditions, 2) future supply conditions, 3) regulatory actions, or a 4) loss of supply due to natural or human induced disasters.

In conjunction with the voluntary and mandatory conservation measures enacted through the stages of action, the City also maintains prohibitions on water waste. City of Lincoln Municipal Code Sections 13.04.400-13.04.440 outline specific water practices that are prohibited at all times within the City. However with the recent issuance of EO B-37-16, the City's water waste ordinance is no longer in compliance with State law. The EO outlines five specific activities that are now mandated as water use prohibitions. They are:

- Hosing off sidewalks, driveways and other hardscapes;
- Washing automobiles with hoses not equipped with a shut-off nozzle;
- Using non-recirculated water in a fountain or other decorative water feature;
- Watering lawns in a manner that causes runoff, or within 48 hours after measurable precipitation; and
- Irrigating ornamental turf on public street medians.

Lincoln's Municipal code Currently incorporates prohibitions against open hoses without a shut off nozzle. And although the rest of the new mandated prohibitions are addressed as demand reduction measures within the Water Shortage Contingency Plan, they are not contained within the Municipal Code as prohibitions. Therefore, the City should update Section 13.04.400 to incorporate these new prohibitions, as well as reassess the existing

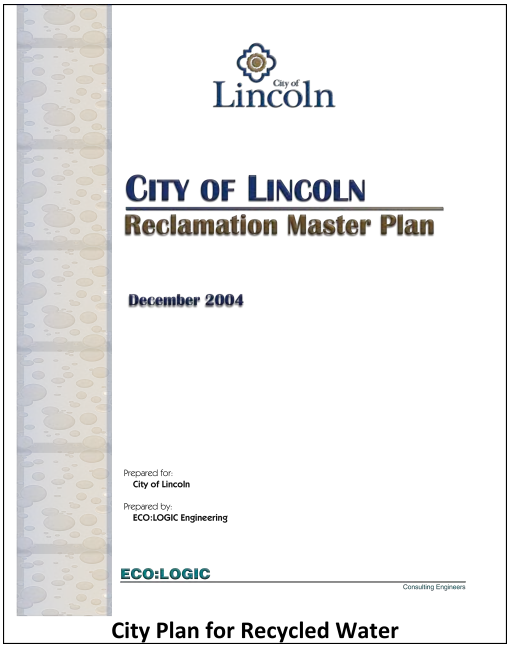
WSCP now that several demand management measures are permanent prohibitions to determine if additional actions or revisions to the plan should be made. While reviewing the WSCP, the City should also develop a more robust set of triggering events to identify when a shortage in water supply is occurring. This will help ensure that the WSCP is consistently applied and enable the City to monitor its potential for supply shortfalls closer.

Adequate Water Supply is required to be demonstrated by new developments before approval from the City is granted. This policy is in line with the State goals towards long term water planning and management.

It is important to note that in addition to the policies discussed in this Section, the City is also impacted by regional organizations and State plans which are discussed later in this document. These include RWA, IWGMP, and the future impacts of SGMA as it is implemented.

2.6.7 Recycled Water Plan

The UWMP Act requires consideration of recycled water opportunities, including capacity of wastewater collection systems, water quality of the wastewater and its suitability for various applications, and the potential demand within the urban water purveyor's jurisdiction for recycled water. There are a number of issues that emerge as part of this planning exercise, including: (1) the manner in which recycled water is classified in the supply and demand analyses; (2) the costs and benefits of developing recycled water infrastructure; and (3) the ability to ensure that the recycled water meets water quality discharge standards promulgated by the Regional Water Quality Control Board for various suburban and agricultural irrigation applications.



City Plan for Recycled Water

Many water supply and demand analyses classify recycled water as a source of supply, when recycled water opportunities may be better classified as demand reduction opportunities. Recycled water is originally part of an urban water purveyor's supplies, so it is not a new supply, but rather a way of reusing the original supply such that total demands may be reduced. Also, a water supply and demand analysis that projects recycled water will be a source of supply may be oversimplifying a highly complicated

process that requires acquisition of a water discharge permit from the Regional Water Quality Control Board, as well as potential agreements to distribute water to willing users.

Recycled water presents unique demand reduction opportunities that can be realized through application of such water for irrigation purposes. To realize these benefits, an urban water purveyor may have to make significant infrastructure investments. Even in California's Central Valley, where water resources are at a premium, retrofitting an existing water system to serve recycled water requires a significant economy of scale before such a venture may be beneficial. New developments present the most promising opportunity to install infrastructure for delivery of recycled water because the pipe can be installed underground alongside other utility infrastructure. In both cases, the economics of utilizing recycled resources for demand reduction is heavily dependent upon the scarcity of water and the cost of infrastructure.

The regulatory challenges associated with securing a permit to apply recycled water in public and semi-public landscaping and for crop irrigation should not be underestimated. The primary concern in the permits is protection of groundwater resources from degradation in water quality resulting from percolation of the applied recycled water. The Central Valley Regional Water Quality Control Board typically requires tertiary treatment of water prior to reuse of such water in landscaping and irrigation applications and the City of Lincoln meets those requirements. There may also be background and ongoing monitoring requirements to characterize the potential impacts that the recycled water operation is having on the groundwater.

2.6.8 UWMP Summary

UWMPs, though completed every five years, offer an essential opportunity for a water purveyor to provide consistent and comprehensive analysis of water supply and demand conditions that can be used for subsequent land use planning efforts. As a document required by the State, the UWMP must fit within the required parameters, but even with those parameters it provides the City with an opportunity to develop a robust planning and forecasting document examining current and future impacts on water supply and demand. This effort facilitates long-term water management planning to assist the City in determining if additional water supplies may be needed or if specific water supply infrastructure projects may be prudent for the City. Failure to pay attention to the reliance on UWMPs may create constraints for other planning efforts or require additional analysis and documentation to align and explain variances.

2.7 Specific Plan

A Specific Plan is a land-planning instrument that is used for the systematic implementation of the City's General Plan. Provisions within each Specific Plan require that it be consistent with the City's General Plan. Moreover, the Specific Plan enables City management and staff to synchronize land-planning analyses with water planning criteria in order to produce a thoroughly vetted planning document.

A Specific Plan may be as generic as setting forth broad policy concepts, or as detailed as providing direction to every facet of development. A Specific Plan may assess the type, location, and intensity of land uses as well as the design and capacity of infrastructure needed to serve those uses. It may also be the keystone document in understanding the financial components for assessing, designing, and building numerous public improvements – including water supply infrastructure. The Specific Plan must unify the General Plan with the other land planning and water planning documents in order to present a cohesive approach to a development project.

California Government Code Sections 65450 et seq. governs the particular details for development of Specific Plans. These sections define the context of a Specific Plan, describe the minimum content that must be contained in a Specific Plan, provide statutory support and mechanisms for the collection of fees, address additional environmental review procedures, and outline the protocols for adoption and implementation of Specific Plans. California law mandates that a Specific Plan shall include a text and diagrams that specify all of the following in detail:

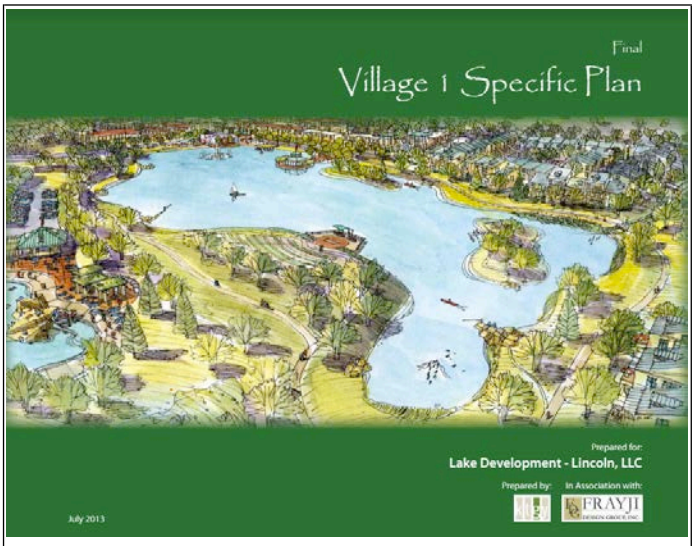
- The distribution, location and extent of the uses of land including open space, within the area covered by the plan.
- The proposed distribution, location and extent and intensity of major components of public and private transportation, sewage, water, drainage, solid waste disposal, energy and other essential facilities proposed to be located within the area covered by the plan.
- Standards and criteria by which development will proceed, and standards for the conservation and utilization of natural resources, where applicable.
- A program of implementation measures including regulations, programs, public works projects, and financing measures necessary to carry out paragraph (1), (2), and (3).

The Specific Plan must also include a statement of relationship of the Specific Plan with the General Plan. This nexus between planning documents is the key component of land planning laws. In addition to the required items, a Specific Plan may include optional contents to "address any other subjects which in the judgment of the planning agency are

necessary or desirable for the implementation of the General Plan." These discretionary items are the key aspects of the City's long-term planning efforts.

The governing statutes provide flexibility with regard to preparing additional components of a Specific Plan. This flexibility allows public agencies to generate standards for the creation of a wide range of projects or solutions to any type of land use issues. The City has incorporated the Code requirements into its guidelines and requirements for its Specific Plans as well as adopted additional local criteria.

A Village Specific Plan, as detailed in City Goal Land Use (LU) 15.1, or a Special Use District Specific Plan as detailed in City Goal LU-16, is required to be submitted to City Staff and approved by the City Council. The purpose of a Village Specific Plan is to ensure a mixed-use concept as envisioned in the General Plan. A mixed-use concept is a diverse mixture of residential and non-residential land uses. An approved Specific Plan and a General Plan Amendment is required prior to development of land within an area designated as a Village. A City-approved Village Specific Plan is also required before a Development Agreement (described in **Section 2.8**) with the City can be completed as described below. As part of a Village Specific Plan, a land use diagram is prepared that delineates the land uses and facilities to be developed within the Village. No remnant or unplanned areas will be created as final village boundaries may be modified. The City's objective in these criteria is to have whole, fully integrated land use plans that are compatible with the General Plan and the General Plan's supporting environmental compliance documents.



Example Specific Plan

A Specific Plan requires environmental review under the California Environmental Quality Act (CEQA) because it is a "project" as defined under applicable law. The environmental review, as detailed in later sections of this chapter, requires an Initial Study to determine preliminary environmental issues and an Environmental Impact Report (EIR) to detail environmental impacts of the project and mitigation measures associated with the project.

A Village Specific Plan must adhere to the water planning concepts defined in the General Plan and other planning documents. For instance, a General Plan may have

technical components related to water supply and water infrastructure, encompassing legal, financial, engineering, structural and political elements. Moreover, the City may have a Water Master Plan and an Urban Water Management Plan that may prescribe certain water management efforts needed in a Specific Plan. As an example, a Village Specific Plan may need to incorporate oversized water mains in its planning documents so that other subdivisions envisioned in the General Plan, that lie beyond the Specific Plan that is the subject of the identified Village, can receive municipal water service at a future time. This thorough integration of documents requires analysis and synthesis of each planning document that impacts the City's water management future. Failure to synthesize these items can create unnecessary expenses or infrastructure duplication that results in inefficiencies and monetary waste.

All Specific Plans prepared for a village-designated area must meet the State law requirements as outlined in the Government Code as well as the specific City of Lincoln policy provisions. The City of Lincoln has developed a four part specific plan implementation framework: Land Use Framework, Design Framework, Circulation Framework and the Infrastructure / Public Facilities Framework. Within each framework, the Specific Plan will provide the goals and policies that will guide future decisions on projects within the Specific Plan area. The frameworks will also include a detailed implementation plan that will identify responsibilities, financing requirements, as well as project phasing and timing.

2.7.1 Land Use Framework

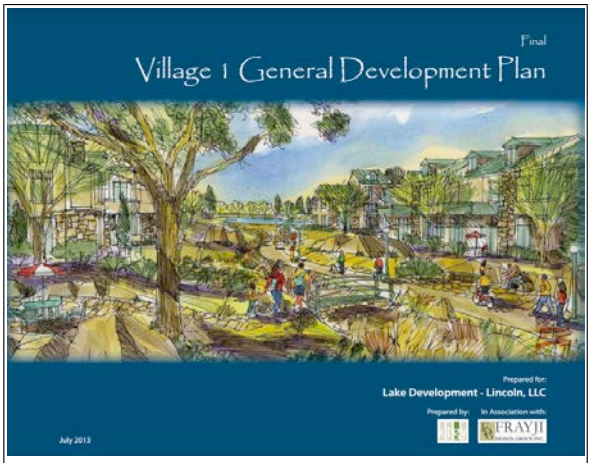
The Land Use Framework will include the proposed land use pattern, actual development densities in each neighborhood, and development phasing. The framework will also include specifics on development standards. The Specific Plan prepared will provide complete guidance on the land use provisions that will guide future development within the Planning Area. At a minimum, these provisions will address the following topics:

- **Land Use Classification.** A land use classification system that clearly identifies the uses that may be allowed in each area neighborhood. The Specific Plan will provide further details on development standards for each neighborhood. This classification system would use clear terminology to define and further describe allowable uses.
- **General Site Planning and Development Standards.** These standards will specify the requirements that would be applied to all development and land uses regardless of the applicable land use designation. These would address, as appropriate, site access requirements and entry statements; energy efficiency; fences, walls, soundwalls, hedges, buffers, and other screening; noise regulations; outdoor lighting standards; performance standards (e.g., air quality, glare, vibration, etc.), undergrounding of utilities; and other similar topics.

- **Development Standards.** Development standards for each land use designation (e.g., building forms, design objectives, land use objectives, height limitations, setback requirements, site coverage requirements, etc.) will be organized in tables and graphically illustrated wherever possible.
- **Housing Mix.** The Specific Plan will discuss the proposed mix of housing types within the village. A key to the housing component will be to incorporate a mix of housing types (as specified elsewhere in this section), and to provide phasing mechanisms that ensure the development of this housing mix in each phase of the project. For example, it may be undesirable to develop a village that leaves the majority of high-density development (VHDR designations) to the final phases in the plan.

2.7.2 Design Framework

The Design Framework provides detailed design guidelines that will be used as the Specific Plan is implemented / developed. The purpose of these guidelines will be to establish the expected level of design within the village while still maintaining project flexibility and innovation. The objective of this framework is not to dictate a specific design, but to establish design expectations.



Example Additional Development Planning

The design guidelines provided will be illustrated to help explain the intent and expectations. This part of the Specific Plan will also incorporate detailed landscaping standards, including specific requirements for preliminary and final landscape plan submittal and review.

The Design Framework will also provide guidance on the integration of the streetscape into the overall project design. The framework will define building type requirements of each neighborhood and define how buildings address the street and interact with public improvements and the public rights-of-way to define the overall character of the streetscape (e.g., new urbanism principles and smart growth concepts).

2.7.3 Circulation Framework

The Circulation Framework will include the proposed circulation network, system elements, design standards, and system phasing. This framework will address all components of the circulation system, including vehicular traffic, bicycles, pedestrian

movement, NEV's, and transit. This component will also address parking and loading standards if different from the standard City requirements.

2.7.4 The Infrastructure / Public Facilities Framework

The Infrastructure / Public Facilities Framework will cover infrastructure requirements (water, sewer, storm drainage, electricity, natural gas, and communications) as well as parkland, schools, and other public facilities. For infrastructure, the framework will address the proposed trunk infrastructure system improvements and system phasing necessary to support implementation of the land use plan.

Overall, the City ensures each village contains a mix of land use types. The four village components, Village Center, Village Center Neighborhood, Outer Village Neighborhoods and Transitional Neighborhoods, each include at least three different types of land use based on seven basic types of land use identified. The City requires the completion and approval of a Specific Plan for the entire Village Planning Area.

Prior to the approval of any Village Specific Plan, a Village Infrastructure Master Plan will be required that details the on-site infrastructure components necessary to serve the project. For water, this includes diagrams of all necessary infrastructure to serve both potable and non-potable water sources in the Village as well as necessary pipe alignments and sizes that may be needed to meet future development. These Village Infrastructure Master Plans display detailed design information within the village for infrastructure improvements, phasing, and financing. Initial environmental review by the City identifies information and technical studies required by CEQA and additional information as needed during the review process by the City. Community outreach program is provided describing how the community is informed about the project and how their concerns will be addressed. Formal public review and comment is solicited after the publication of the CEQA environmental document and the Specific Plan.

The Specific Plan is the first detailed step in implementing the policies and vision outlined in a General Plan. The City's Specific Plan guidelines require synthesizing the General Plan vision but also those policies adopted as part of the water management planning process – including a Water Master Plan, Urban Water Management Plan, and Reclamation Plan. The seamless synthesis of all of these documents allows for flawless environmental review analysis as well as significant streamlining of the land use planning processes.

2.8 Development Agreement

A Development Agreement (D.A.) is a voluntary contract between the City and a property owner, usually a Specific Plan project developer. The D.A. sets the standards

and conditions that govern the development of the property, such as project phasing related to dwellings and infrastructure, finance of infrastructure, development fees, and the term of the D.A.

The City of Lincoln Ordinances provide a framework for the City Council to enter into a D.A. Ordinance 18.84.070, titled “Findings required for council approval” states:

The council shall not approve the development agreement unless it finds that the agreement:

(1) Is consistent with the objectives, policies, general land uses and programs specified in the general plan and any applicable specific plan;

(2) Is compatible with the uses authorized in and the regulations prescribed for the land use zone(s) in which the real property is located;

(3) Is in conformity with public convenience, general welfare and good land use practices;

(4) Will not be detrimental to the health, safety and general welfare of persons residing in the immediate area nor be detrimental or injurious to property or persons in the general neighborhood or to the general welfare of the residents of the City as a whole;

(5) Will not adversely affect the orderly development of property or the preservation of property values;

(6) Is consistent with the provisions of Government Code sections 65864 through 65869.5.

The D.A. provides certainty to the developer that its project will be isolated from changes in the City’s zoning laws over the course of development. But the D.A. also contracts the developer to provide specifically outlined remunerations to the City. These remunerations may include infrastructure improvements, public open space designations, or monetary payments into various funding accounts, such as "in lieu" development fees, in exchange for contractual certainty.

Through the negotiation of a D.A. for a Village, the City and the developer will contractually agree to the specifics of a Village Specific Plan infrastructure design, construction phasing and funding. The D.A. will identify necessary project background and approval components, including: a City Council certified final Environmental Impact Report for the Village Specific Plan; project benefits and approved land use

entitlements; and City Council approval of Village consistency with the General Plan. A City D.A. generally contains the following article sections:

Article 1- General Provisions – term definitions and agreement details, notices.

Article 2 – Development of the Property – land uses, entitlements, PFE program, timing.

Article 3 – Developer Obligations – infrastructure improvements, financing.

Article 4 – City Obligations – PFE commitments, reimbursements, permits.

Article 5 – Annual Review – terms of D.A. and compliance.

Article 6 – Default, Termination and Enforcement and legal action related to each.

Article 7 – Defense and Indemnity/Hold Harmless.

Article 8 – Cooperation in the Event of Legal Challenge.

Article 9 – Miscellaneous Provisions – Agreement options, Attorney's fees, Obligation of Owners.

Article 10 – Provisions related to Lenders – obligations and rights.

Article 11 – Entire Agreement and Exhibits – Listing of pages and exhibits for D.A. [4]

New development is required to comply with the City's adopted Village Infrastructure Master Plan as well as other relevant planning documents adopted and followed by the City. Exhibits that are generally included in a D.A. may identify the Village boundaries, infrastructure improvements proposed both within and outside of the Village boundaries, as well as other components analyzed as part of the Specific Plan process. The new development will provide contributions towards existing and future improvements necessary to serve the development inside and outside of the Village boundaries. All of these components can be negotiated with City Management so long as they meet the general conditions provided in City Ordinances and State law.

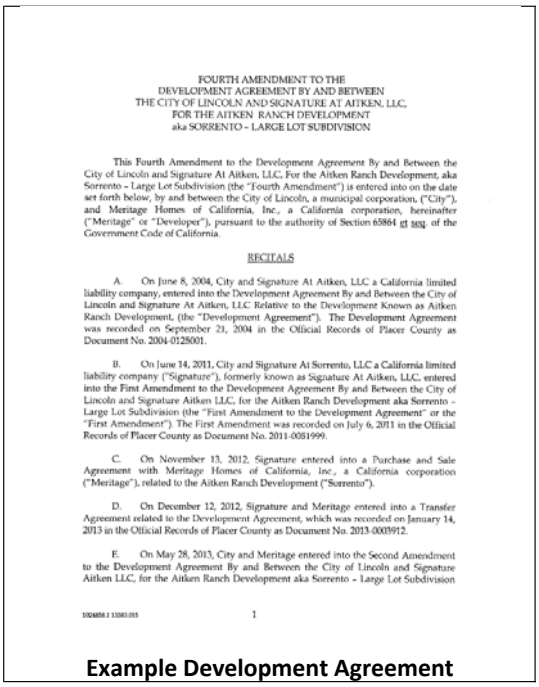
Included in the details of the Village D.A. will be the developer's recognition of the City's policy regarding foregoing or assigning of any and all water rights (i.e. - surface, groundwater, storage) within the proposed annexed areas of the development. The City's intent is to collect differing and diverse water rights available to the City from land

[4] The information here is based on the 2012 Lincoln 270 Amended D.A. and 2013 Village 7 D.A.

owned by the developer for any type of water supplies inherently delivered or granted to the land. These City-acquired water assets from the developer may be considered in offsetting purchased raw and potable water supplied to the City by PCWA and NID.

The Village D.A. shall also include the developer's recognition of the City's policy regarding the formula for determining the developer's obligation to fund infrastructure beyond the project's in-tract needs, including but not limited to off-site piping, storage and well requirements. As larger projects are needed to meet the City's expanding population, these provisions have become paramount.

The D.A. is to be processed, considered and executed in accordance with State law and City codes. The City holds a public hearing to deliberate on the merits of the proposed project and D.A. Finally, after assessing public comment and making the findings associated with Ordinance 18.84.070 described above, the City Council may approve or disapprove of a developer agreement as necessary. Even after approval, the D.A. can be amended through City Council action at its discretion.



FOURTH AMENDMENT TO THE
DEVELOPMENT AGREEMENT BY AND BETWEEN
THE CITY OF LINCOLN AND SIGNATURE AT AITKEN, LLC,
FOR THE AITKEN RANCH DEVELOPMENT
aka SORRENTO - LARGE LOT SUBDIVISION

This Fourth Amendment to the Development Agreement By and Between the City of Lincoln and Signature At Aitken, LLC, For the Aitken Ranch Development, aka Sorrento - Large Lot Subdivision (the "Fourth Amendment") is entered into on the date set forth below, by and between the City of Lincoln, a municipal corporation, ("City"), and Meritage Homes of California, Inc., a California corporation, hereinafter ("Meritage" or "Developer"), pursuant to the authority of Section 65864 et seq. of the Government Code of California.

RECITALS

A. On June 8, 2004, City and Signature At Aitken, LLC a California limited liability company, entered into the Development Agreement By and Between the City of Lincoln and Signature At Aitken, LLC Relative to the Development Known as Aitken Ranch Development, (the "Development Agreement"). The Development Agreement was recorded on September 21, 2004 in the Official Records of Placer County as Document No. 2004-0125001.

B. On June 14, 2011, City and Signature At Sorrento, LLC a California limited liability company ("Signature"), formerly known as Signature At Aitken, LLC, entered into the First Amendment to the Development Agreement By and Between the City of Lincoln and Signature Aitken LLC, for the Aitken Ranch Development aka Sorrento - Large Lot Subdivision (the "First Amendment to the Development Agreement" or the "First Amendment"). The First Amendment was recorded on July 6, 2011 in the Official Records of Placer County as Document No. 2011-0051999.

C. On November 13, 2012, Signature entered into a Purchase and Sale Agreement with Meritage Homes of California, Inc., a California corporation ("Meritage"), related to the Aitken Ranch Development ("Sorrento").

D. On December 12, 2012, Signature and Meritage entered into a Transfer Agreement related to the Development Agreement, which was recorded on January 14, 2013 in the Official Records of Placer County as Document No. 2013-0003912.

E. On May 28, 2013, City and Meritage entered into the Second Amendment to the Development Agreement By and Between the City of Lincoln and Signature Aitken LLC, for the Aitken Ranch Development aka Sorrento - Large Lot Subdivision

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Example Development Agreement

The planning commission, not less than once every 12 months from the effective date of the development agreement, reviews the D.A. between the City and an identified developer for compliance with its terms and conditions. The planning commission conducts a public hearing, at which time the party or parties to the D.A., other than the City, must demonstrate good-faith compliance with the terms of the D.A. If the Planning Commission determines that there has not been compliance in good faith with the terms and conditions of the agreement, the commission may include in its report a recommendation for the modification or termination of the D.A.

After approval of the D.A., the City and the developer have two additional documents to finalize to clarify their cooperative efforts for the development-related infrastructure improvements: Conditions of Approval and Memoranda of Understanding. The Conditions of Approval is one of the last City-generated documents for a developer's project before the permitting for construction is issued. The Conditions of Approval for developments with a signed D.A. rely on the D.A. for infrastructure-related requirements. This process is designed to avoid redundancy and potential conflicts with the D.A. If the

developer's project does not require a D.A., then the Conditions of Approval will contain specific items related to infrastructure requirements both internal and external to the proposed development.

A Memorandum of Understanding (MOU) between the City and a developer can be approved prior to the construction of Public Facility Element (PFE) related infrastructure that benefits the City but not necessarily the developer or his development. The developer would already be committed through a D.A. to construct the required infrastructure (water, sewer, drainage, streets and underground utilities) for a specific project. The City would indicate it has PFE-related projects not required to serve the developer's project but are required to be integrated into the developer's infrastructure design. The developer would agree to assist the City with the design and construction management of the PFE facilities. The developer would be funding the design and construction of the PFE projects to a specific agreed-upon amount. The City would be responsible for all costs exceeding the developers funding amount.

Taken in sequence, the General Plan, Specific Plan and the Developer Agreement make up the key aspects of the land use component of the planning process. The important aspect of these documents is that they must consider and actively address water-related planning and management issues that face the City. Such issues may include simply accessing additional water supply sources through purchases of water molecules to addressing infrastructure related issues by constructing oversized pipes, gather funds for large infrastructure improvements, or identifying future easements or transmissions that would benefit the City's potable and non-potable systems. Consideration of the political, legal, financial and structural implications of the D.A. are critical to ensure that the project will be successful. Furthermore, synthesis of planning documents is crucial for effective long-term planning.

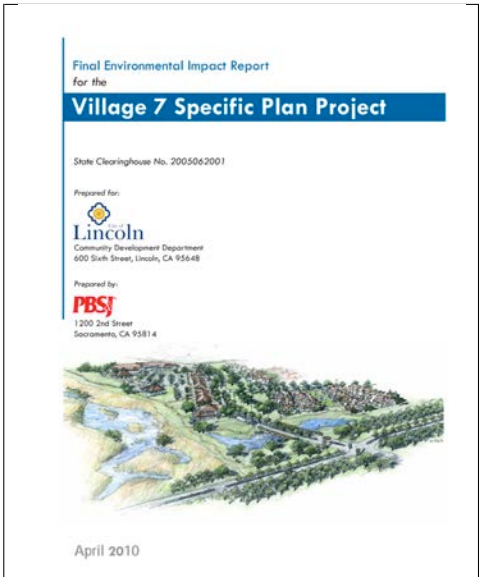
2.9 California Environmental Quality Act (CEQA)

Large-scale land use planning efforts generally require CEQA compliance. As described in **Section 2.4**, General Plan adoptions and updates are considered "projects" under CEQA, and thus require, at a minimum, an Initial Study of environmental impacts. If the Initial Study indicates that there are "significant" impacts, then the local entity needs to prepare an Environmental Impact Report (EIR). An EIR requires distribution of a Notice of Preparation to responsible agencies, which have 30 days to comment regarding the scope of the potential impacts. Upon receipt of all comments, the lead agency must complete a draft EIR. Generally, the assessment of hydrology and water quality is part of the Initial Study, and if there are direct, or reasonably foreseeable indirect impacts that are significant, the draft EIR.

Other water and land planning documents have a different nexus with CEQA. For instance, an SB 610 WSA – described in **Section 2.10** – is the primary water supply document that is used in determining environmental impacts associated with water in an EIR. In other projects, like low threshold projects, an EIR may be the only environmental analysis that considers water issues for an identified project. Accordingly, CEQA is an integral part of land use and water supply planning.

2.9.1 Initial Study and EIR Contents

The Project Description drives the scope of the water supply analysis and the associated environmental analysis that need to be considered in an Initial Study and draft EIR. A Project Description should include: (a) the precise location and boundaries of the proposed project, including its location from a regional perspective; (b) a purpose statement and clear set of objectives to help the lead agency develop a reasonable range of alternatives and a statement of overriding considerations; and (c) a general description of the project's technical, economic, and environmental characteristics. The intended uses of the EIR should also be included. The Project Description should detail the changed conditions that account for the potential environmental impacts associated with the direct physical and "reasonably foreseeable" indirect physical changes in the environment.



Example Environmental Impact Report

The California Supreme Court, in the *Vineyard* decision, emphasized the importance of the principle of "reasonable foreseeability" when considering the potential environmental impacts of obtaining a water supply for a project, and encourages presentation of the broadest extent of information possible to allow decision makers to understand the environmental benefits, impacts and costs of supplying water to a project. Consistent with the principle of "reasonable foreseeability," the *Vineyard* court further recommended that there not be any "ignoring or assuming" a solution of supplying water to a proposed development will manifest itself at a later stage in the development review process. The implication is that "reasonably foreseeable" physical changes may be less certain at the General Plan stage than at the Community or Specific Plan stage and therefore, the hydrologic analysis of the physical changes in the environment may be more general. Nevertheless, the analysis of reasonably foreseeable physical changes should be commensurate with the specificity of the activities presented in the land-use planning document. Thus, to the extent a land use activity is reasonably certain, and its

impacts can be contemplated, those impacts need to be evaluated at the earliest applicable stage in the land use planning process.

2.9.2 Hydrology Section

The Initial Study and draft EIR are intended to disclose the potential impacts of physical changes in the environment caused by a project. More specifically, the draft EIR provides further detail regarding those impacts deemed significant, and also includes mitigation measures and policy rationale for accepting certain environmental impacts. The CEQA Guidelines provide a list of relevant hydrologic and water quality factors to consider when preparing an Initial Study and draft EIR for a General Plan or other project subject to CEQA. The Guidelines include the following factors:

- *Groundwater*: Will there be a substantial depletion of groundwater supplies or interference with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?
- *Supply Expansion*: Will the project result in the need for new systems or a substantial expansion or alteration to the local or regional water supplies that would result in a physical impact to the environment?
- *Insufficient Supplies*: Will the project result in insufficient water supplies available to serve the project from existing entitlements and resources?
- *Drainage*: Will the project result in a substantial alteration of the existing drainage pattern of the site or area, including alteration of the course of a stream or river?
- *Water Quality*: Will there be a substantial alteration in surface or groundwater quality as a result of an alteration in drainage patterns?

These factors are broad, and leave room for a good faith reasoned analysis of the potential environmental impacts associated with utilizing or acquiring supplies and development of water demands. For example, when considering whether acquisition of sufficient water resources will cause a "substantial depletion" such that there would be a "lowering of the groundwater table level," the guidelines indicate that some lowering of the table might not be a significant impact over a certain period of time but would be considered a substantial impact if it persists over some longer average period of time. These impacts on the basin should be explained and to the extent they are significant, mitigation measures should be identified that would reduce the impact to "less than significant." Such a measure might include participation in the implementation of a regional groundwater management plan. Also, determination of whether a "substantial expansion of the local or regional supplies" may be considered a significant impact provides little indication of the "trigger" for such an impact. Most likely, any supply

expansion involving infrastructure development will ultimately trigger an environmental assessment, and the question of whether to prepare the assessment will depend whether the direct or reasonably foreseeable indirect impacts of an infrastructure project are certain. Additionally, analysis of whether a land use plan will result in "insufficient water supplies" presents issues similar to those that must be addressed in Senate Bill 610 Water Supply

Based upon the analysis of impacts, the lead agency must explain how significant environmental effects identified in the EIR will be mitigated or why mitigation measures are not feasible. The lead agency must certify that there will be no significant effects, or that the effects will be minimized and there is a compelling rationale as to why remaining affects are acceptable.

2.9.3 Water Supply Evaluation

One method for developing the information necessary to include in a Conservation, Open Space, Public Utilities, Water Resources Element or an environmental assessment of hydrology and water quality impacts is to prepare a Water Supply Evaluation (WSE). A WSE is most applicable to a jurisdiction that is newly incorporated or that has not reached the connection threshold for development of an UWMP. A WSE is not a statutory requirement, and, as such, there are no substantive requirements for a WSE. Nevertheless, given the previous discussion in this document regarding internal consistency, the need to assess whether water resource management measures will have a significant environmental impact, and the implications of EIR tiering, there may be value in developing a formal water supply and demand evaluation. In addition, a WSE can become a platform from which to prepare future SB 610 WSA compliant assessments or future UWMP updates. The potential components of a WSE are outlined below.

2.9.4 Contents

To effectively complete the environmental investigation so that it meets the objectives of the accompanying planning document, a WSE should contain the following elements:

- *Study Area*: The Study Area is the geographic boundary of the political jurisdiction preparing the WSE. Accurately defining the geographic study area is critical for analytical purposes because the land use based demand projections necessitate use of consistent total acreage figures.
- *Land Use Data*: The Study Area sets the boundaries for preparation of the land use data, including the land use classifications and relevant densities for all land area. A description of land use information should consider the development planning horizon of a Land Use Plan and any specifically referenced development proposals contained in a General Plan. While there may be value in considering a 20-year

demand projection consistent with requirements of a SB 610 WSA, consistency with the Land Use Element in a General Plan should be maintained.

- *Water Demands*: Based upon the land use data, unit water demand factors should be assigned to all land areas based upon the land use classifications. The unit water demands should be presented at the level of detail applicable to the General Plan and should incorporate any ordinances or policies contemplated in the General Plan that may affect unit water demand (i.e. conservation or landscape ordinances). If it is not possible to incorporate actual unit demands for indoor and outdoor uses based upon the nature of the land use at the early stages of the planning process, demands should be presented in aggregate per-acre of land area.
- *Water Supplies*: A WSE should include a description of a jurisdiction's current and future surface water supplies, including source and reliability. If applicable, a WSE should provide: (1) a description of the relevant groundwater subbasin based upon the current DWR Bulletin 118 description; (2) well hydrographs from available wells in an area that greatly exceeds the Study Area boundary; (3) groundwater contours and elevation trends for the same broader geographic area; and (4) supplier historic use, conveyance capacity, and projected use.
- *Dry-Year Supply Reliability*: If dry-year supply reliability projections have not been made in an applicable UWMP, development of reliability projections for a General Plan update are probably not necessary unless there are highly certain development proposals being contemplated, and there is a desire to prepare such analyses in a timely fashion.
- *Integration of Supplies and Demands*: A discussion of the relationship between supplies and demands will provide a basis for assessment of potential environmental impacts that might materialize with the expansion of existing supply infrastructure or acquisition of new supplies.
- *Conclusions*: With mitigation and overriding policy considerations in mind, develop conclusions related to integration results that will be useful in the contemplation of alternative scenarios under the General Plan.

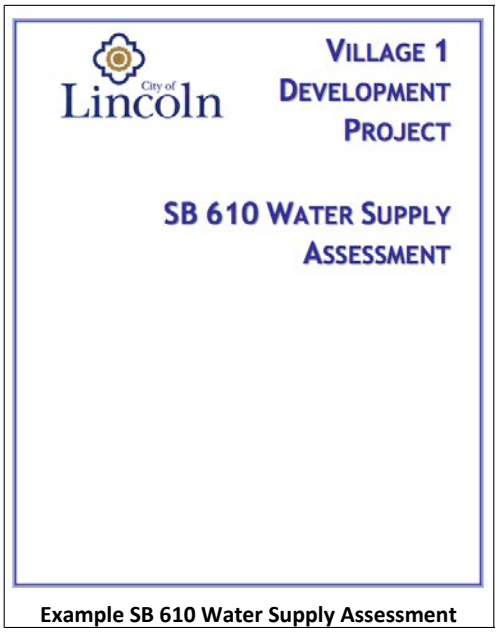
2.9.5 Project Alternatives

CEQA Guidelines § 15126.6 outlines the requirements for evaluating the environmental impacts of project alternatives, including the no-project alternative. A WSE is unique because there is more flexibility in the consideration of project alternatives under CEQA when there is not an overriding statutory requirement to generate specific information (such as the case with the SB 610 WSA). These scenarios might include land use designation changes in the existing jurisdictional boundaries, a proposal for various changes within a SOI, and even consideration of future land use modifications within a proposed SOI. Each of these footprints has an existing water demand and a potential future water demand consistent with the jurisdiction's proposed land use plans. To consider the environmental impacts of the "project," it is necessary to evaluate the

existing and future water demands and the associated hydrology and water quality impacts. Such an approach provides the lead agency with the information necessary to consider the environmental impacts of its immediate decision to approve land use changes under the proposed General Plan.

2.10 SB610 Water Supply Assessment

Enacted in 2001 (effective January 1, 2002), Senate Bill 610 Water Supply Assessment (SB 610 WSA) added section 21151.9 to the Public Resources Code requiring that any proposed "project," as defined in Water Code Section 10912, comply with Water Code section 10910, et seq. Commonly referred to as a "SB 610 Water Supply Assessment," Water Code section 10910 et seq. outlines the necessary information and analysis that must be included in an environmental impact report (EIR) to ensure that a proposed land development has a sufficient water supply to meet existing and planned water demands over a 20-year projection.



Example SB 610 Water Supply Assessment

The SB 610 WSA is the first of two development-specific water supply planning documents intended to closely link the demands of a set of proposed land uses contained in a proposed project with the water supplies available for that development. The standard for the certainty and reliability of water supplies sufficient to meet the demands of the proposed development is more exacting then that required for the Urban Water Management Plan (UWMP). Ultimately, because the SB 610 WSA is a source document for an EIR prepared for a proposed project pursuant to California Environmental Quality Act (CEQA), described earlier in this chapter, it must provide substantial evidence showing that sufficient water will be available to meet water demands for the water purveyor's existing and planned land uses over a 20-year planning horizon.

The relationship between CEQA and the SB 610 WSA drives the timing associated with preparation of an SB 610 WSA. The SB 610 WSA should be prepared concurrent with the EIR, such that the SB 610 WSA is utilized and referenced in the draft EIR. The SB 610 WSA should then be appended to the EIR that is certified by the local government agency approving the land use project. Thus, the SB 610 WSA is subject to the CEQA deadlines associated with issuance of a Notice of Preparation (NOP), a draft EIR and certification of a final EIR. The elements of a Water Supply Assessment are as follows:

- Initial considerations,
- Quantification of the proposed project's water demands,
- Description and documentation of water supplies,
- Sufficiency analysis.

2.10.1 Initial Considerations

The initial considerations require thorough vetting. First and foremost is to define the project and understand whether it is a project requiring an SB 610 WSA. Next, there should be a systematic assessment of any existing documentation related to the water supplies that will be utilized for the project. Both of these issues are described below.

2.10.1.1 Defining the Project

The initial question in conducting an SB 610 WSA is whether there is a "project" that is subject to the SB 610 WSA process. A "project" for SB 610 WSA compliance is different than the definition of a "project" subject to CEQA compliance as described elsewhere in this chapter. According to the SB 610 WSA requirements, a "project" is defined as any of the following:

- Residential development of more than 500 dwelling units;
- Shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space;
- Commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space;
- Hotel or motel, or both, having more than 500 rooms;
- Industrial, manufacturing, or processing plan, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area;
- Mixed-use project that includes one or more of the projects specified above;
- Project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.

If a public water system has fewer than 5,000 service connections, then "project" means any proposed residential, business, commercial, hotel or motel, or industrial development that would account for an increase of 10 percent or more in the number of the public water system's existing service connections, or a mixed-use project that would demand an amount of water equivalent to, or greater than, the amount of water required by residential development that would represent an increase of 10 percent or more in the number of the public water system's existing service connections.

Defining the project has important implications to the scope of the WSA analysis as well. For example, if the project will have a non-potable water component – i.e. "purple pipe"

– and the source of the non-potable supply from the public water system is a contaminated groundwater basin, then a full analysis of the groundwater basin will be required in the sufficiency analysis. If however, the project identifies a potable supply for the "potential" non-potable uses, then the sufficiency analysis may be more confined. Accordingly, the definition of the project not only triggers the Water Supply Assessment analysis but it also shapes the scope of the water supply analysis that will be required.

2.10.1.2 Existing Documentation

The SB 610 WSA may be most efficiently completed in cases where an UWMP has been prepared that incorporates the defined project into its analysis. This incorporation means that the level of detail of the demands and the documentation of supplies have been sufficiently detailed in accordance with the requirements of the SB 610 WSA.

In cases where all of the information required for the SB 610 WSA is not contained in the UWMP, then the SB 610 WSA may still reference the UWMP and then develop the necessary level of detail to satisfy the legal requirements. And, even if the UWMP exists and contains very little if any information relevant to the SB 610 WSA analysis, it should still be referenced in the report.

The more critical issue arises where the UWMP exists but the information contained in that document is outdated or contrary to the findings in the SB 610 WSA. In this instance, it is important that the SB 610 WSA explain any discrepancies in the information between the two documents. And, where the UWMP pre-existed the SB 610 WSA, the SB 610 WSA should explain the changed conditions or changes in calculation methodologies that lead to the discrepancies. If a discrepancy is so large as to effectively eviscerate the UWMP, then it may be worthwhile for the water supply provider that developed the UWMP to revise some findings through an amendment process.

Lastly, other water planning documents should be examined as well for consistency. An older SB 610 WSA or a Water Master Plan that has conflicting information than that provided in the more recent SB 610 WSA can create issues that may jeopardize the project's success. Specifically, where items such as demand factors (described briefly below and further detailed in **Chapter 4**) or supply reliability issues (described briefly below and further detailed in **Chapter 5**) are different in earlier water-related analyses than in the applicable SB 610 WSA, discrepancies must be explained.

2.10.2 Quantification of the Proposed Project's Demands

Water Code section 10910 requires that an SB 610 WSA quantify water demands associated with the proposed project. Water demand methodologies include both the land use and population- based methods coupled with verification actions. The nature of land

uses within the project should be well defined. Such characteristics as the actual number of each type of residential dwelling unit, acreages and square feet of commercial and office land uses, acreages of parks and acreages of roads should be known. Water demand projections for each land use type need to be made over a 20-year period in 5-year increments.

Although not specifically required in Section 10910, water demands associated with the proposed project should be estimated for normal, dry and multiple dry-year hydrologic years. Accounting for variations in water demands during dry periods is also a critically important component of the analysis as demands changed based upon changed climatic conditions. As described earlier, water demands generally increase in dry periods as outdoor irrigation may start earlier in the year or require more water.

2.10.3 Description and Documentation of Water Supplies

There are numerous forms of water supplies that may be applicable to a proposed project. Generally, the supplies are derived from surface water resources or groundwater resources. In other instances, the source water may be further defined in potable and non-potable water quality categories. The basics of the surface water and groundwater supplies for purposes of SB610 WSA compliance are described below.

2.10.3.1 Surface Water Supplies

The surface water analytical requirements for the SB 610 WSA are similar to those for the UWMP, which requires a description of quantities received in prior years, and an analysis of supplies under normal, dry, and multiple-dry year projections. In contrast to an UWMP, the SB 610 WSA also requires inclusion of documentation to establish and support "rights" associated with the stated water supplies. This may include copies of contracts, water right permits, licenses or other recordings that establish proof that the right exists as represented in the sufficiency analysis. Generally, an SB 610 WSA will require the following elements: (1) proof of "right" to a supply; (2) quantification of historic use of the identified supplies over the past five years; and (3) proof or intent to obtain supplies to meet the expected future demand.



PG&E Drum-Spaulding Project

Image Couteasy 2014 FERC EIS

2.10.3.2 Groundwater Supplies

Similar to the requirements of a UWMP, a SB 610 WSA must include, among other things, the following information if groundwater will be a source of supply for a proposed project:

- A description of any groundwater basin or basins from which the proposed basin will be supplied;
- Whether the groundwater basin or basins have been subject to any adjudication proceeding;
- Whether California Department of Water Resources (DWR) has identified the basin or basins as overdrafted in the most current bulletin; and
- Efforts being undertaken to eliminate the long-term overdraft condition.

If groundwater is a source of supply for the proposed project, the analysis must also include "[a]n analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project."



City Well

Two important issues have arisen regarding the question of groundwater sufficiency: (1) whether an SB 610 WSA must analyze existing and planned water use of all users overlying the relevant basin or basins; and (2) Whether there can be a finding of sufficient groundwater when the groundwater basin has been identified as overdrafted. Examining all demands within a basin for purposes of determining whether overdraft exists may be one way of satisfying the Water Code requirement to evaluate "sufficiency" in light of basin conditions. Alternatively, a finding of "sufficiency" may not require a quantification of recharge and pumping throughout the entire basin, but rather analysis of historic hydrograph records to determine how the aquifer has behaved over a series of years under various demand scenarios. Again, the SB 610 WSA requirements use "sufficiency" intentionally, because it is a broad term that provides discretion for groundwater pumpers in a region to exercise the basin within an acceptable range, understanding that in some years recharge will exceed pumping and in others pumping will exceed recharge.

One of the toughest challenges for those public water systems preparing SB 610 WSAs is going to be finding the point at which adequate information has been gathered and analyzed for purposes of making a reasoned conclusion regarding groundwater supply "sufficiency." Because the notion of "sufficiency" as applied to groundwater supplies is

relatively untested, and there is probably room for reasoned arguments regarding the scope and depth of information necessary to make a "sufficiency" determination, this element of SB 610 WSAs is likely to be contested. Whether broadly developed pumping data for those using groundwater throughout a basin is necessary to determine whether a basin is in overdraft may be in open question in some circumstances. In many arenas, given the nature of groundwater rights, which are generally highly unregulated, sufficiency may be achieved through analysis of historic groundwater levels and development of basin-wide management measures that reflect the nature of the nature of long-term hydrologic cycles and the opportunities for conjunctive use.

2.10.4 Sufficiency Analysis

The "sufficiency" determination is really the heart of the SB 610 WSA. Sufficiency is evaluated differently based upon whether the water source is groundwater or surface water. Because surface water supplies are generally more easily measured than groundwater, the potential issues associated with a determination of "insufficiency" related to these supplies are likely to be political or legal, though there may well be occasions in which it is technically infeasible to deliver adequate surface water to a proposed project. On the other hand, groundwater sufficiency determinations are more likely to consider primarily technical issues related to availability of water in the aquifer and the ability to measure the reliability of the water source.

An SB 610 WSA is required to determine whether the water supplier's total projected water supplies will be available during normal, dry and multiple dry water years over a 20-year period to meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing uses. This analysis is relatively straightforward as long as the water supplier's determination that sufficient water will be available is supported by substantial evidence. Once the water supplier determines whether sufficient water will be available, Water Code section 10911(c) requires that the land use jurisdiction ultimately responsible for the proposed project's approval make an independent determination as to whether sufficient water will still be available to meet demands for the proposed project in addition to demands of existing and planned land uses.

The California Water Code, however, does not define "sufficiency" for purposes of preparing a WSA. Therefore, it is left to the local jurisdiction to develop or ensure that the water purveyor develops substantial evidence such that a conclusion regarding sufficiency can be reasonably drawn. Intuitively, the determination of sufficiency is akin to an accounting process in which supplies are "insufficient" if projections anticipate that there will not be enough supply (down to the acre-foot) to satisfy demands in any of the normal, single-dry or multiple-dry year scenarios.

While Water Code § 10911 implies that projected supplies instantly become insufficient at some point along the spectrum of balancing supplies and demands, there is probably not a bright line for determining "sufficiency" such that a local jurisdiction can point to it and conclude that because supplies are projected to exceed demands by just a few acre feet that supplies are definitely sufficient to meet demands. Given the inherent uncertainty in the projection process, the smaller the projected margin between supplies and exceed demands, the more evidence a local jurisdiction needs to provide that it is capable of developing alternative supplies, including demand management measures, to offset the risk of insufficient supplies.

2.10.5 Finding of Insufficiency

The WSA contemplates that sufficient water supplies may not be developed at the time the WSA is prepared. In this case, the water supplier must include its "plans for acquiring additional water supplies, setting forth the measures that are being undertaken to acquire and develop those water supplies." The plans for developing water supplies should include information identifying:

- Costs and financing methods associated with developing the water supplies;
- Required permits, approvals and entitlements; and
- Estimated timeframes for developing the water supplies.

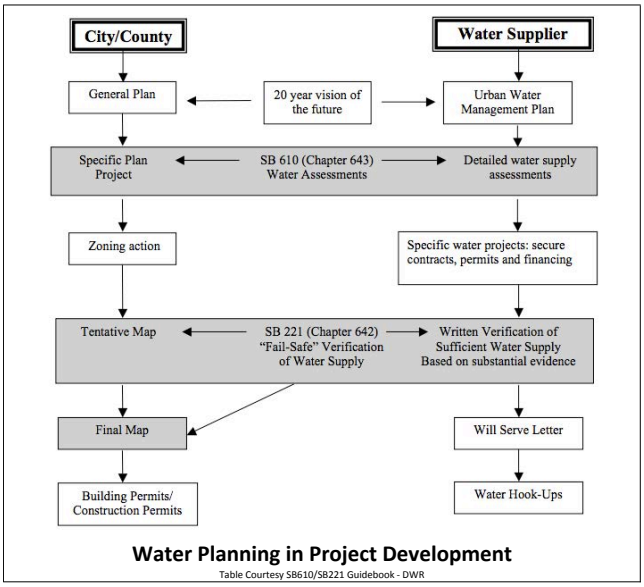
Although not expressly stated, the Water Code implies that plans for developing additional water supplies need to be narrowed to a few alternatives if not one identified source. A couple of issues emerge by requiring this approach, notably whether a jurisdiction may essentially accept the conclusion that there will be insufficient supplies for a "project" and yet approve the "project" if the water purveyor is able to develop adequate information regarding the acquisition of additional supplies. This issue highlights the relationship between the SB 610 WSA and the environmental assessment to which the SB 610 WSA is appended.

The California Supreme Court's *Vineyard* decision touches on some important themes that could drive the nature and scope of the relationship between the two documents. Specifically, *Vineyard* held that within an EIR, when evaluating the environmental impacts of supplying water to a project there must be certainty that the supplies evaluated will materialize, and are not speculative. Also, to the extent there is some uncertainty, *Vineyard* counsels that there should be discussion of alternatives and the environmental consequences of those alternatives. While *Vineyard* concerned the adequacy of an EIR (as opposed to an SB 610 WSA), these two holdings could have an impact on the scope of information that a land use agency seeks in an SB 610 WSA because of the need to evaluate the impacts of the water resources findings in the SB 610 WSA. Notably, at the

SB 610 WSA stage, a public water supplier should be focusing on a few highly likely sources. It is likely that the public water system will find additional pressure to specifically discuss the certainty associated with the "development of water supplies" consistent with the three bullet points above. The public water system will perhaps need to consider alternatives more carefully because of the requirement that the land use agency evaluate the environmental consequences of any identified alternative supplies.

2.10.6 Relationship to CEQA

Section 10911(b) of the California Water Code provides that the SB 610 WSA "shall" be included in the CEQA document. It is important to note that the requirements set forth for water supply and demand analyses in a SB 610 WSA cover a set of key elements that inform the broader CEQA analysis which should include consideration of hydrologic, water quality and any other impacts associated with the provision of supplying water to the proposed project. The same factors as those described in other sections of this subchapter may be utilized in this consideration of impacts including: (1) Substantial depletion of groundwater supplies; (2) Substantial expansion or alteration to the local or regional water supplies that would result in a physical impact to the environment; (3) Insufficient water supplies available to serve the project; (4) Substantial alteration of the existing drainage pattern; and (5) Substantial alteration in surface or groundwater quality as a result of an alteration in drainage patterns.



Water Planning in Project Development
Table Courtesy SB610/SB221 Guidebook - DWR

2.11 SB 221 Water Supply Verification

The purpose of the Senate Bill 221 Water Supply Verification (SB 221 Verification) is to "include as a condition in any tentative map that includes a subdivision a requirement that a sufficient water supply shall be available" to serve it. The requirement to prepare an SB 221 Water Supply Verification is triggered upon a local agency receiving a tentative map application for a proposed subdivision. A subdivision is defined as an addition of 500 or more dwelling units, or, if fewer than 5,000 connections exist, upon an increase of 10% or greater in the number of service connections. Upon receipt of a tentative map application, a local agency must send a copy of the application to any public water system that may provide water service to the identified lands. Upon receipt of the request

for verification, the public water system must provide the written verification of sufficient water supply to the local agency within 90 days. Also, the requirement that a tentative map comply with the California Environmental Quality Act (CEQA) is likely to be met by reference to earlier environmental analyses prepared as part of an area, specific, or community plan. If a tentative map application is submitted for a development project that does not meet the definition of "subdivision" as contained in Government Code 66455.3 then no SB 221 Verification is necessary.

Similar to a Senate Bill 610 Water Supply Assessment (SB 610 WSA), the heart of an SB221 Verification is the "sufficiency analysis" by the public water system. The SB 221 Verification defines "sufficient water supply" as the total water supplies available during normal, single-dry, and multiple-dry years within a 20-year projection that will meet the projected demand associated with the proposed subdivision, in addition to planned future uses, including, but not limited to, agricultural and industrial uses. To this end, a public water system is required to consider the following factors when determining whether a "sufficient water supply" exists: (1) the availability of water over a historical record of 20 years; (2) applicability of water shortage contingency plan; (3) sector reductions in water use pursuant to resolution or ordinance; (4) amount supplier could reasonably receive from another source. If supplies are not currently available, a "sufficiency" determination may rely upon: (a) written contracts; (b) capital outlay projects; (c) construction permits; (d) regulatory approvals.

The information required in the SB 221 Verification may be gained from the SB 610 WSA or other water supply planning documents. Reliance on these documents for the SB 221 Verification, however, requires that these alternative documents meet the verification criteria or a finding that conditions have not changed since the other documents were adopted. Accordingly, preparing documents that are consistent in analyses of water supply and demand conditions may prove helpful in completing the necessary SB 221 Verification analysis.

The written verification of sufficient water supply has some unique requirements beyond those required in an SB 610 WSA. These requirements are:

- The verification shall consider the reasonably foreseeable impacts of the proposed subdivision on the availability of water resources for agricultural and industrial users within the service area of the public water system; and
- If a subdivision will use groundwater, substantial evidence shall be presented regarding the landowner rights to groundwater for the subdivision.
- If the written verification indicates that water supplies will be insufficient, the local agency may make a finding that additional supplies "are, or will be made available prior to completion of the subdivision" that will satisfy the verification requirements.

2.11.1 Sufficiency Analysis

The SB 221 Verification requires a highly refined "sufficiency" analysis. At the tentative map stage, the land use planning entity will be expected to provide specific, parcel by parcel, land use information for a specific development, thus allowing a water analysis of indoor and outdoor uses for land use classifications and corresponding acreages.

If supplies are not currently available for the subdivision, along with agricultural and industrial demands, proof of permitted and/or licensed water rights; proof of contracts for water; as well as any other capital outlay proposals, permits and or regulatory approvals may be used as proof of future supply availability. In the case of a project that is planning to receive surface water supplies through a new diversion, permits and regulatory approvals associated with a project should be highlighted in the supply verification. In addition to a discussion of specific water supply availability and the status of the procedures necessary to secure additional supplies, the SB 221 Verification, as part of the "sufficiency analysis" must also include an evaluation of the following four elements:

- *Availability of water over a historical record of 20 years*: this requirement is intended to prove that recent demands for water have been met on a consistent basis. Though it will not prove that supplies will be available to meet future demands, it does provide evidence of the District's ability to meet historical demand on its system.
- *Applicability of water shortage contingency plan*: As required by Water Code 10632 (for an UWMP), the agency needs to develop a plan that helps achieve a reduction in demands assuming up to a 50% reduction in supplies. This requirement, as it applies to an SB 221 Verification, seeks assurances that the water shortage contingency plan is applicable to the subdivision contained in the tentative map as well as the other water uses throughout the land use jurisdiction's service area. Because a water shortage contingency plan entails specific voluntary and mandatory actions to be undertaken by specific sectors, including residential and commercial, there needs to be a direct connection between the actions, the sectors, and the ability to measure demand reductions.
- *Sector reductions in water use pursuant to resolution or ordinance*: Commonly, a water shortage contingency plan will establish water service sector priorities to evaluate the impacts of supply shortages and reductions in service to the respective uses within each sector. For example, many jurisdictions will develop a variation on the following three sectors:

    1. *Health and Safety*: All residential indoor and all non-residential sanitary uses, including the wastewater treatment plant.

2. *Business*: All usage related to commercial activity, which may include businesses with major outdoor usage, such as golf courses and agriculture.

3. *Outdoor Irrigation*: All residential outdoor uses, and various large landscape customers.

- *Other Sources*: Government Code § 66473.7(a)(2)(D) requires an estimate of the amount of water a supplier could *reasonably receive* from other sources, including recycling, conservation and transfers. In most cases, the recycling and conservation data will have been evaluated in either the Urban Water Management Plan or a SB 610 WSA, but to the extent this information needs to be updated, an estimate should be provided.

2.11.2 Agricultural and Industrial Users

The definition of "sufficient water supply" in Government Code § 66473.7(a)(2) provides that supply needs to be available for the subdivision, "… in addition to existing and planned future uses, including, but not limited to, agricultural and industrial uses." Furthermore, 66473.7(g) provides that the SB 221 Verification shall include reasonably foreseeable impacts of the proposed subdivision on the availability of water resources for agricultural and industrial users within the public water system's service area, and currently utilizing the same sources but not receiving water from the city/county. This requirement may be met if the impacts have been previously analyzed as part of an Environmental Impact Report (e.g., as part of a SB 610 WSA).

2.11.3 Proof of Rights to Groundwater

If a subdivision will use groundwater, substantial evidence shall be presented regarding landowner rights to groundwater for the subdivision. The analysis that may be required to demonstrate "rights" to groundwater is far from clear. Groundwater rights are generally categorized as either overlying or appropriative. Generally, water purveyors that provide water to developments hold appropriative rights to groundwater. Appropriative rights to groundwater exist only in the event that there is surplus water in the groundwater basin. Accordingly, a finding of surplus may be required before a water provider can make water available for the development. While this is a starting point for a domestic water purveyor to prove rights to groundwater, an affirmative finding of a right to groundwater based upon surplus groundwater conditions may be extremely difficult to make in light of the complicated nature of underground water systems and the difficulty in assessing availability of supplies. In this light, proving a right to groundwater as opposed to merely

the availability of groundwater, is a nuance that has yet to be fully developed as part of a SB 221 Verification efforts to date.

2.11.4 Future Water Supplies

Government Code 66473.7(b)(3) provides that even in the case the SB 221 Verification indicates that there is an insufficient supply**,** the local agency may make a finding on the record, that additional supplies will materialize that will satisfy requirements. This provision raises an interesting evidentiary issue outside of the SB 221 Verification because the tentative map condition of verifying sufficient water supply need not be based entirely upon the conclusions in the Water Supply SB 221 Verification. In other words, this action may require a water purveyor to commit to a future act or promise a future condition without essentially having the water supply available. Accordingly, if the "finding" of the water purveyor is incorrect and the water supplies cannot be secured, an SB 221 Verification may be made that may not have a verifiable water supply for the development with it.



Example Future Water Supply

2.12 Low Threshold of Projects

The requirements of the Senate Bill 610 Water Supply Assessment (SB 610 WSA) and the Senate Bill Water Supply Verification (SB 221 Verification) are intended to ensure that development proposals meeting specific criteria are fully analyzed from a water supply and demand perspective so that a land use entity may make an informed decision regarding the environmental impacts of a project based upon substantial evidence. Assuming a project does not meet the thresholds to trigger an SB 610 WSA or SB 221 Verification, it is nearly certain that a land use entity will need to prepare an environmental assessment and ultimately an Environmental Impact Report (EIR). A "low threshold" project would be one that is not 500 units or greater and does not increase the number of connections of a jurisdiction with fewer than 5,000 connections by 10% or more.

In a "low threshold" project, the water supply analysis will almost exclusively be contained in the environmental assessment required pursuant to California Environmental Quality Act (CEQA). The CEQA discussion later in this chapter outlines the requirements for utilizing CEQA in the water planning process. The CEQA EIR analysis

should be more detailed at successive planning stages. The EIR should contain more detailed analyses of water supplies and the associated uncertainties of the supplies materializing, as well as a detailed analysis of alternatives and their associated environmental impacts.

Also, important to the analysis of "low threshold" projects in a draft EIR are the following four factors: (1) whether known direct impacts to water resources are addressed and whether the conclusions are supported by substantial evidence presented in the draft EIR itself; (2) whether the draft EIR analyzes a range of reasonably foreseeable indirect physical changes that could have an impact on water resources; (3) if applicable, whether the draft EIR appropriately relies upon tiering from previously completed environmental documents; and (4) whether the range of alternative supplies seems reasonable, and depending upon the planning stage, whether a refined subset of highly likely supplies are rigorously analyzed for their impacts on hydrology and water quality resources.

In summary, even though a land use proposal does not trigger the requirement to prepare an SB 610 WSA or SB 221 Verification, the project still must satisfy the CEQA requirements to assess hydrology and water quality impacts.

2.13 Reclamation Plan

The City of Lincoln has constructed a state-of-the-art regional wastewater treatment and reclamation facility (WWTRF) for the purposes of treating and disposing of wastewater generated within the City's General Plan area and collected from Placer County areas to the east towards the City of Auburn (WWTRF is described in detail in **Chapter 5**). , effluent from the Lincoln WWTRF is of sufficient quality to allow unrestricted reuse, including the farming of salinity sensitive crops, i.e. - rice for human consumption. The State Water Resources Control Board (SWRCB), which is empowered to permit and regulate wastewater treatment and disposal facilities, has an established policy encouraging the recycling of effluent to the extent possible rather than discharging effluent to surface waters or disposing of effluent on land. This policy is set forth in the Sacramento River and San Joaquin River Basin Plan, 1998, adopted by the Central Valley Regional Water Quality Control Board (RWQCB).

In order to implement this policy locally, the City of Lincoln completed a 2003 study of the potential for reuse of effluent from its WWTRF. Agricultural properties located in the vicinity of the WWTRF that are suitable for irrigation with the reclaimed water have been identified in the report titled "City of Lincoln - Facilities Plan and Water Recycling Study", May 2003. The 2004 Reclamation Master Plan of December, 2004 is an update to the 2003 Facilities Plan, and identifies additional users within the City and in the

proximity of the WWTRF that express interest in the reclaimed water since the Facilities Plan was completed.

The 2004 Reclamation Master Plan has not been formally updated. However, the reclaimed water has since shifted from identifying disposal sites, four City-owned sites and a City-leased site, to negotiating reclaimed water delivery contracts. The eight categories of potential recycled (hereinafter referred to as reclaimed) water with the City's SOI is still valid. They are as follows:

- City-controlled agriculture;
- private agriculture;
- golf courses;
- Western Placer Waste Management Authority,
- industrial users;
- City parks and recreational areas;
- street landscaping; and
- highway landscaping.

California Water Code section 13550 states that "the use of potable domestic water for nonpotable uses…is a waste or an unreasonable use of the water within the meaning of Section 2 of Article X of the California Constitution if recycled water is available…." In the context of the City's long-term water planning, this law may have more implications to proposed land use plans than any other. The City's control over the WWTRF and the potential to deliver recycled water to non-potable uses may mean that sufficient infrastructure and delivery systems must be installed to address this mandate. As such, in addressing water supplies for all future land use planning issues, the City's Reclamation Plan should be consulted and integrated. The City's recycled water supplies are more fully described in **Chapter 5**.

CHAPTER 3. WATER SYSTEM DESCRIPTION

The purposes of this chapter are to (1) provide a general overview of the wholesale agencies water systems; (2) provide a general overview of the City of Lincoln's existing water system; and (3) provide a detailed assessment of specific components of the City's system. This chapter also serves as a reference guide for future water system engineers, staff, and managers so that those persons might more easily identify and address planning and engineering issues in the City's water conveyance system. The size and complexity of the City's water system is best understood through a GIS system integration tool – linking the City's water model with various geographical components – but this document serves as a substantive reference for the key system components outside a fully functioning GIS system.

3.1 Wholesale Water Facilities from PCWA and NID

The City of Lincoln takes its surface water deliveries through the Placer County Water Agency (PCWA) water system. As described in **Chapter 5** surface water supply, the City's water supplies that are delivered through the PCWA system include PCWA's surface water rights, Nevada Irrigation District's (NID) surface water rights, and Pacific Gas & Electric Company's (PG&E) water supplies that are contracted to both PCWA and NID. All of these surface water rights encompass the vast majority of the City's potable water supplies.[1]

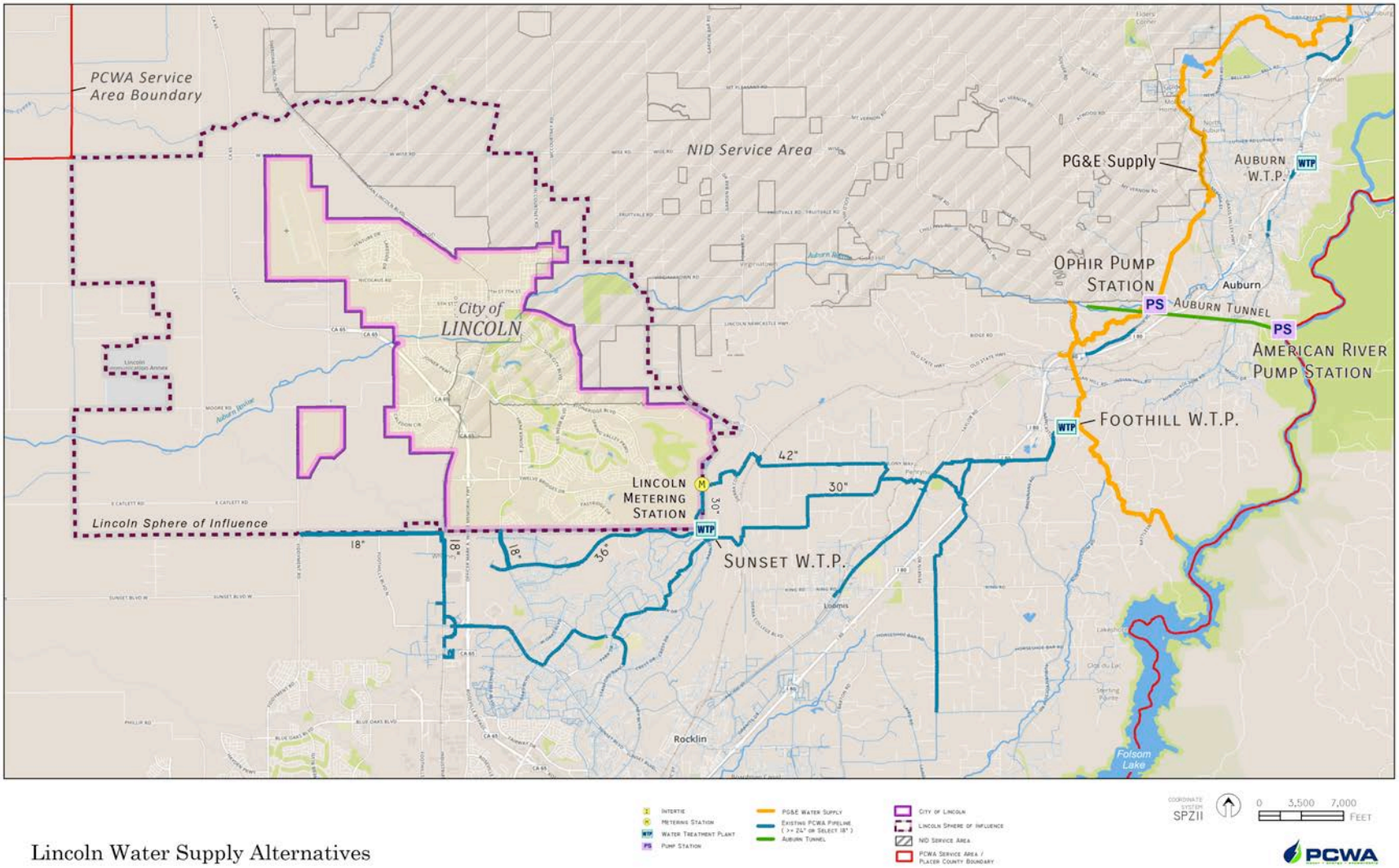
PCWA's water system starts in the Sierra Nevada mountain range. Diversions of raw water to feed the system are derived from water assets in both the American River watershed and Yuba-Bear Rivers watershed. On the American River side, raw water is diverted under PCWA's water rights from the American River at the American River Pump Station as well as PG&E water delivered through the PG&E South Canal. The diverted water is pumped up to the Auburn Tunnel and eventually flows to PCWA's Foothill Water Treatment Plant. Raw water originating in the Yuba-Bear system is derived from PG&E water supplies through PCWA and NID water rights and is delivered via the PG&E South Canal to the Foothill Water Treatment Plant (Foothill Plant).

Raw water is treated at the Foothill Plant and delivered, via gravity flow, through a series of potable water transmission pipes to the City of Lincoln. The treated water is received by the City of Lincoln at the Lincoln Metering Station. When the water passes through the Lincoln Metering Station, the wholesale water delivery from PCWA ends and the

[1] As noted in **Chapters 5** and **6**, the City also uses groundwater to augment its water supply portfolio.

City's retail water delivery system begins. As detailed in **Chapter 5**, the City receives both "regulated" and "unregulated" flow from the PCWA system for delivery to the City's retail customers. The unregulated flows move into the City's upper water system while the regulated flows move to the City's lower water system. **Figure 3-1** depicts the entire PCWA delivery system.

Figure 3-1 – PCWA Existing Transmission Facilities



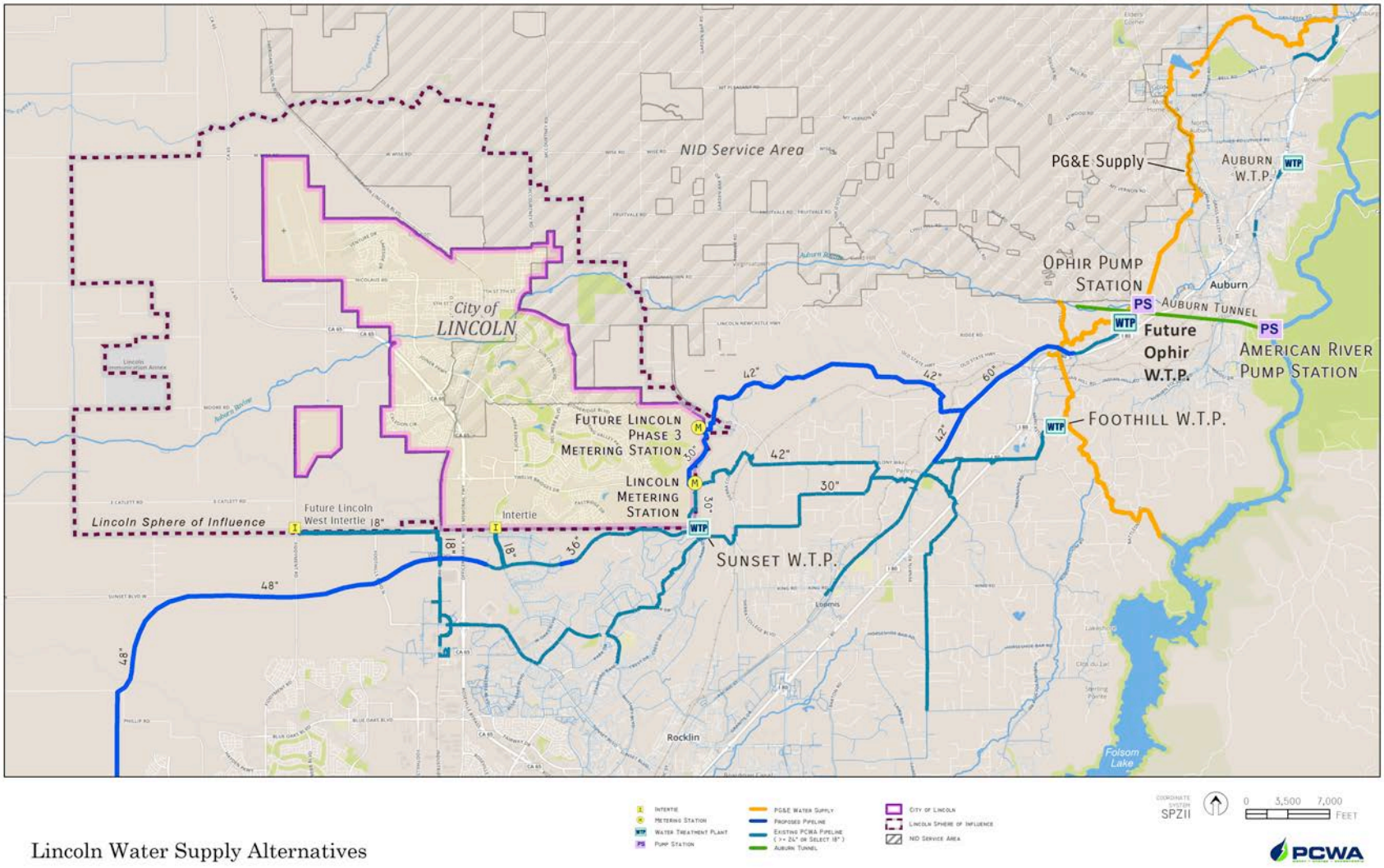
Lincoln Water Supply Alternatives

Both PCWA and NID plan to expand and upgrade their respective water systems in the future. In order to accommodate planned growth in Western Placer County, PCWA anticipates not only expanding treatment capacity at its existing treatment facilities (Foothill and Sunset) but also constructing a new water treatment plant and associated infrastructure. The Ophir Water Treatment Plant (Ophir Plant) is planned for construction at approximately the location where the Auburn Tunnel intersects the PG&E South Canal near Highway 80 off of Ophir Road. The Ophir Plant is planned for 30 million gallons per day (30 mgd) of treatment capacity, but can be expanded to 60 mgd. PCWA is working on a project partnership with several regional water purveyors including the City of Roseville, Cal-American Water Company, and the City of Lincoln to develop and finance the Ophir Plant.

PCWA also seeks to build additional infrastructure to deliver the treated water supplies to the City of Lincoln. This infrastructure includes large diameter pipes, like the Bickford Pipeline, flowing from the Ophir Treatment Plant to the City's borders. PCWA also plans to construct a new metering station as well as a connecting line to the existing metering station. Collectively, these system investments will greatly expand PCWA's water system. Total costs for this project were estimated in 2015 at $289.3 Million or approximately $9.6 million per million gallons of capacity.[2] PCWA's planned water infrastructure improvements are shown in **Figure 3-2**.

[2] This cost assessment was first presented to the City Council on August 21, 2015. PCWA is currently revising its cost estimates.

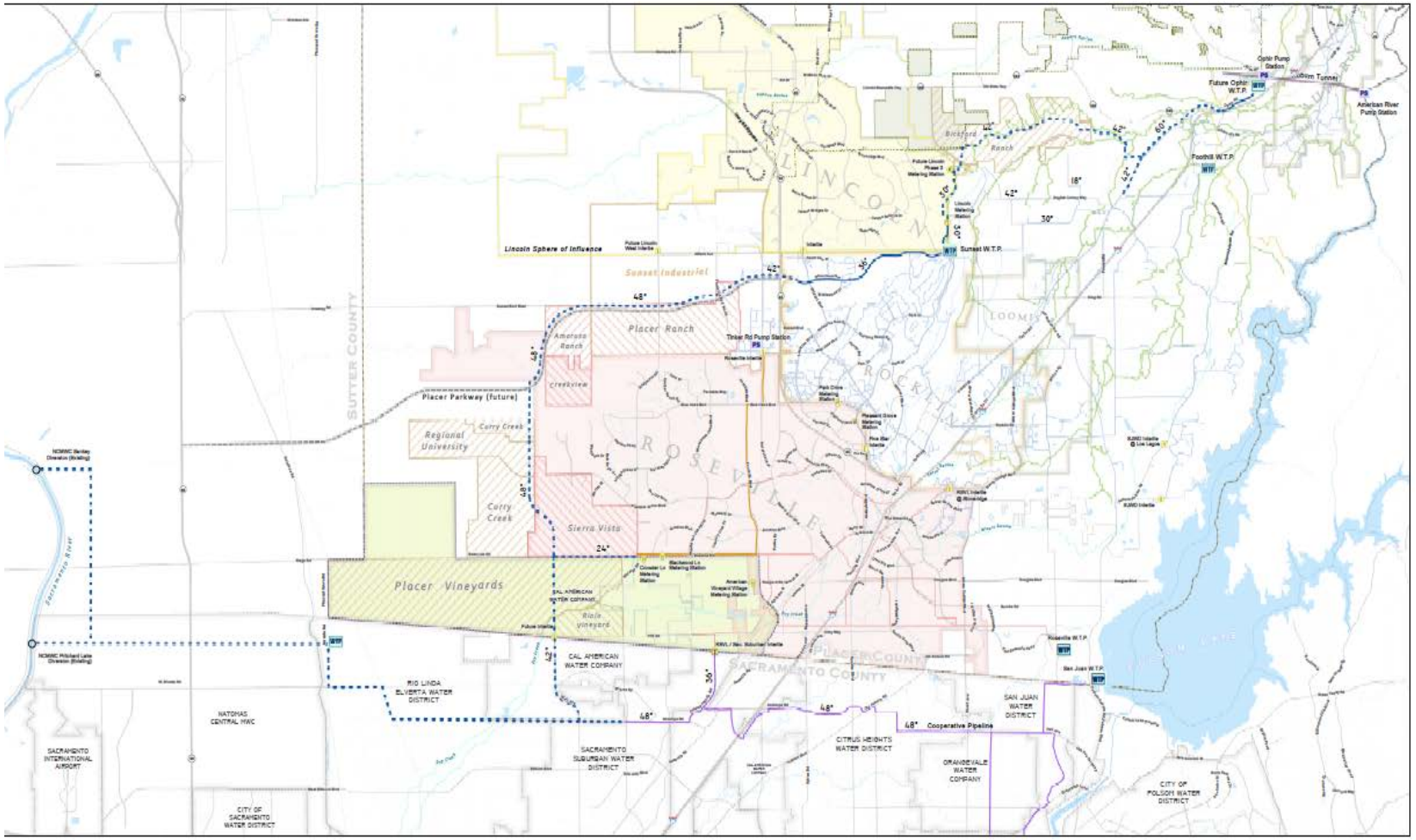
Figure 3-2 – PCWA Future Transmission Facilities



Lincoln Water Supply Alternatives

PCWA has also developed preliminary plans for additional water supplies derived from the Sacramento River. This project is known as the RiverArc Project (formerly Sacramento River Regional Water Supply Project). PCWA anticipates assigning a portion of its American River water rights and entitlements to the Sacramento River in order to divert those supplies for use in the most western areas of PCWA's service area. Specifically, PCWA is considering diverting water at two locations on the Sacramento River and delivering those supplies as far east as the westerly border of the City of Lincoln. **Figure 3-3** shows the preliminary outlay for the RiverArc Project.

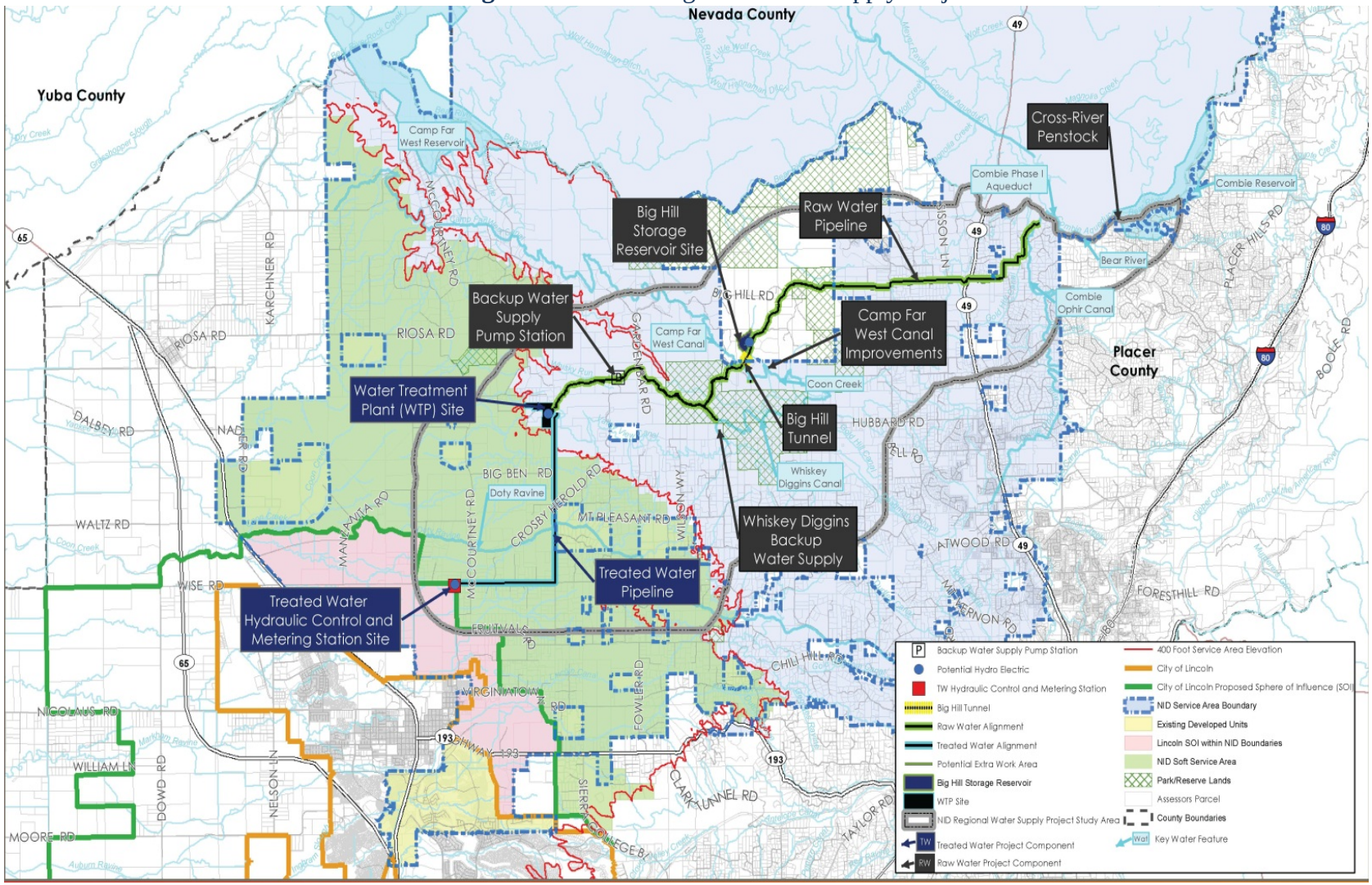
Figure 3-3 – Sacramento River Regional Water Supply Project



Nevada Irrigation District anticipates constructing its own water treatment facility in order to deliver NID treated water assets to the NID service area in and around the City of Lincoln. Presently, NID water assets are delivered to PCWA for eventual delivery into the City's water system at the Lincoln Metering Station. NID's water assets are accounted for based upon the measured demands in the NID service area within the City boundaries. NID anticipates building the Regional Water Supply Project (RWSP) to take raw water from the Yuba-Bear Rivers Watershed and NID facilities in both Placer and Nevada Counties and deliver that water to urban areas contained within NID's boundary. NID's service area includes those areas within NID's service area that are also incorporated into the City of Lincoln and its Sphere of Influence.

The RWSP is planned to commence construction within 5 to 10 years and will be located inside the NID service area west of the District's major reservoirs. The RWSP is currently sized at 40 million gallons of capacity and would serve both NID's "soft service area" – urban areas other than the City in NID's service area boundary – as well as the City of Lincoln. The first phase of the project would deliver approximately 10 mgd of treated water capacity. Up to Twenty-five million gallons of the 40 mgd are earmarked for the City of Lincoln. Additional facilities are also planned for development as part of the project – including a raw water pipeline that would deliver water from Combie Reservoir and Combie Aqueduct to the water treatment plant as well as a treated water pipeline that would deliver treated water to a metering station at the north end of the City of Lincoln. The total cost of the project is estimated at $265.7 Million or $6.60 Million per mgd. **Figure 3-4** shows the major components of NID's RWSP project.

Figure 3-4 – NID Regional Water Supply Project

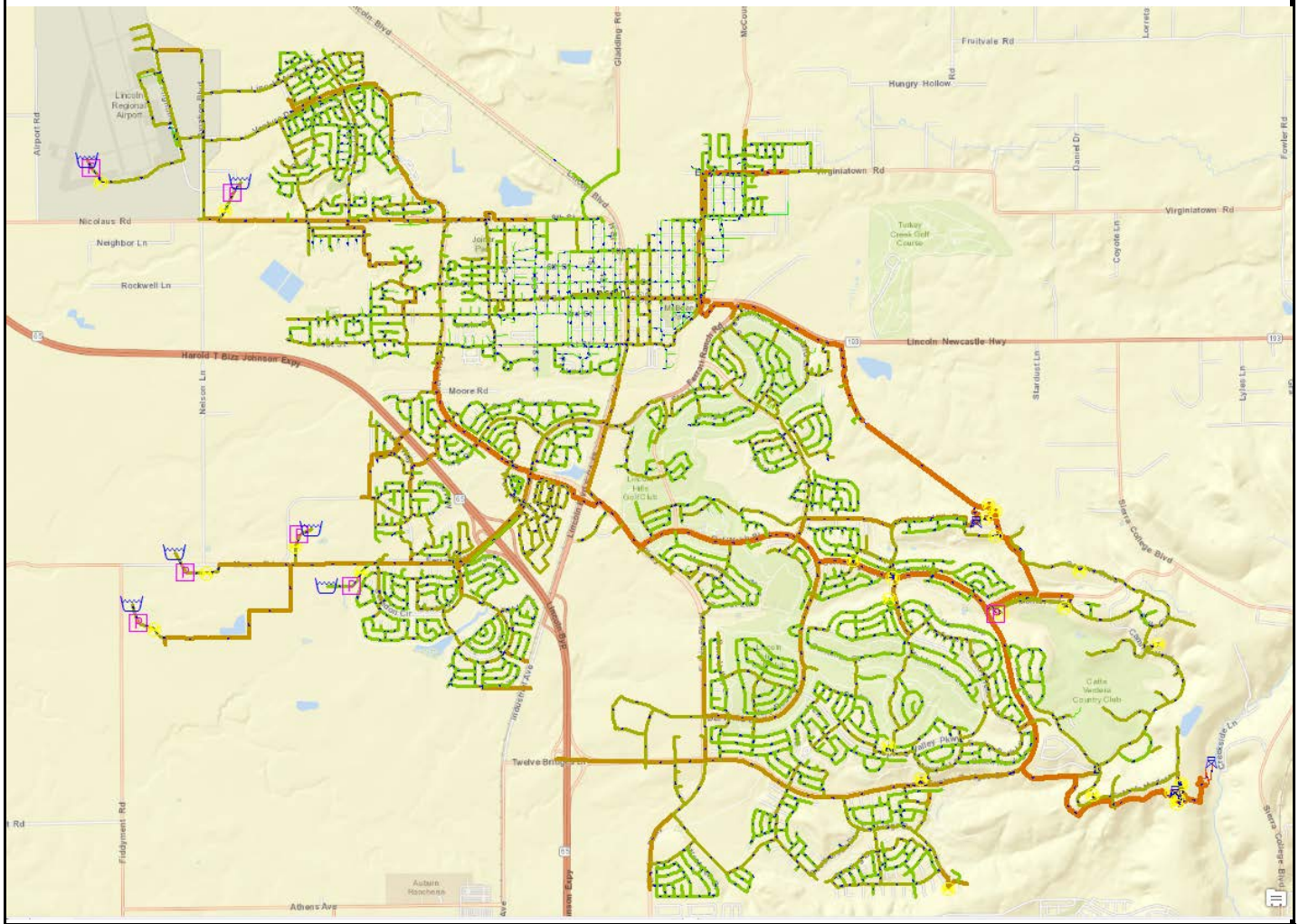


As described in **Chapter 4**, the City's anticipates needing approximately 67 million gallons per day (mgd) of water capacity and an annual total of approximately 37,000 acre-feet of water. Approximately 57 mgd of capacity will be needed to meet potable demands while the remaining 10 mgd of capacity will be needed to meet non-potable demands which may be derived from separate non-potable systems (raw water or recycled water). The potable supplies will be derived from PCWA's facilities, NID's facilities, and groundwater. The City's current water model – which is detailed in **Chapter 9** – has infrastructure components built into the model that allow for a combination of water supply alternatives that will meet both long-term demand and emergency conditions.

3.2 City of Lincoln's Current Retail Water Distribution System

This section describes the City's current retail water distribution system. This system is derived from two main potable water sources – wholesale water delivered at the Lincoln Metering Station and groundwater derived from the City of Lincoln's groundwater system. These water assets are delivered through an infrastructure system that transverses the entire City boundary. **Figure 3-5** shows a map depicting the City's water infrastructure.

Figure 3-5 – Diagram of Main Water System



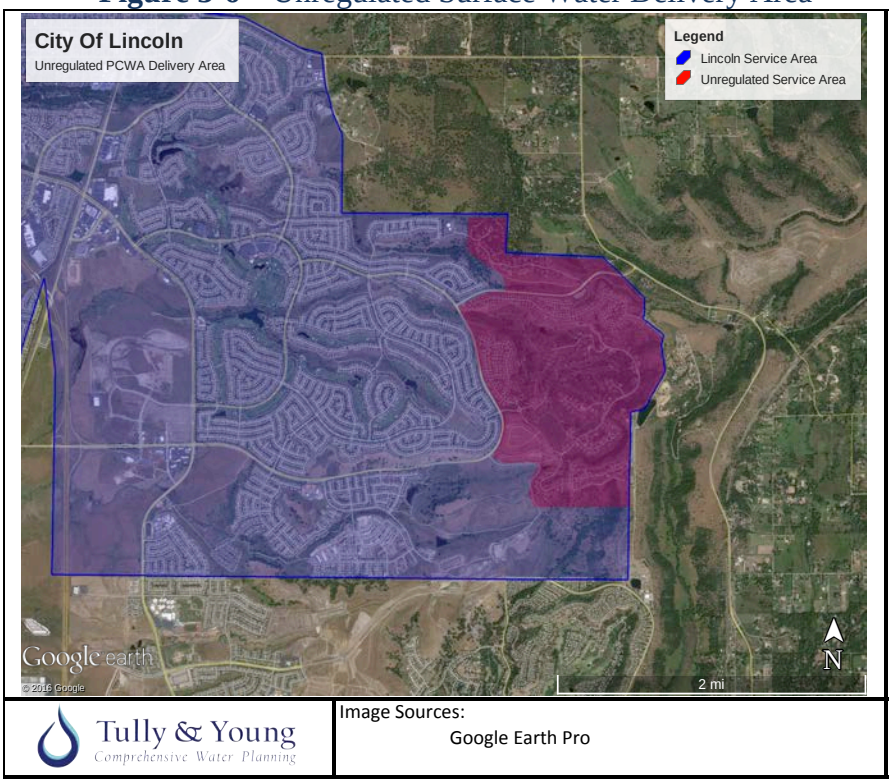
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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

As shown in **Figure 3-5**, the City's infrastructure is depicted down to the individual street level. This level of detail is further refined with data input recognizing the physical details of each pipe in the system (diameter and length) as well as the age of each pipe in the system.[3] The information related to the water system model in terms of pipe diameter, length, and ages is more fully developed in **Chapter 9**.

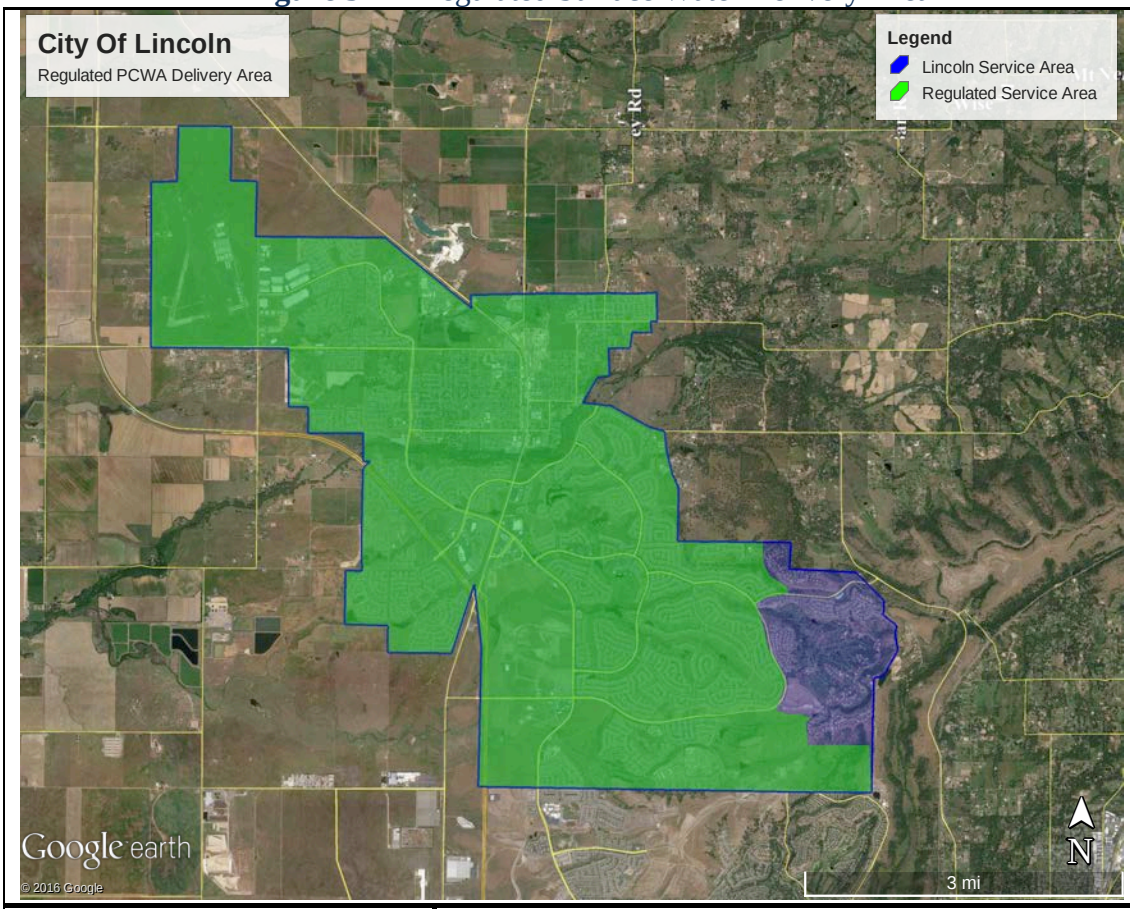
The City's system is further split into essentially two sub-systems. The first system is that area located in the eastern part of the City that receives unregulated water deliveries that are managed by Placer County Water Agency. This area is commonly referred to as the Catta Verdera area. In that area, PCWA uses its treatment and delivery system to deliver the flows of water in order to meet system demands. The second system is the remaining area served by regulated deliveries derived from PCWA water that the City "regulates" in order to make water available to its customers. In some places in the City, the two systems overlap as described in more detail in the pages below. **Figure 3-6** and **Figure 3-7** depict maps of the unregulated and regulated areas in the City of Lincoln.

Figure 3-6 – Unregulated Surface Water Delivery Area



[3] The system depiction is based upon the best available information. In some instances, the ages of the pipes in the system are unknown.

Figure 3-7 – Regulated Surface Water Delivery Area



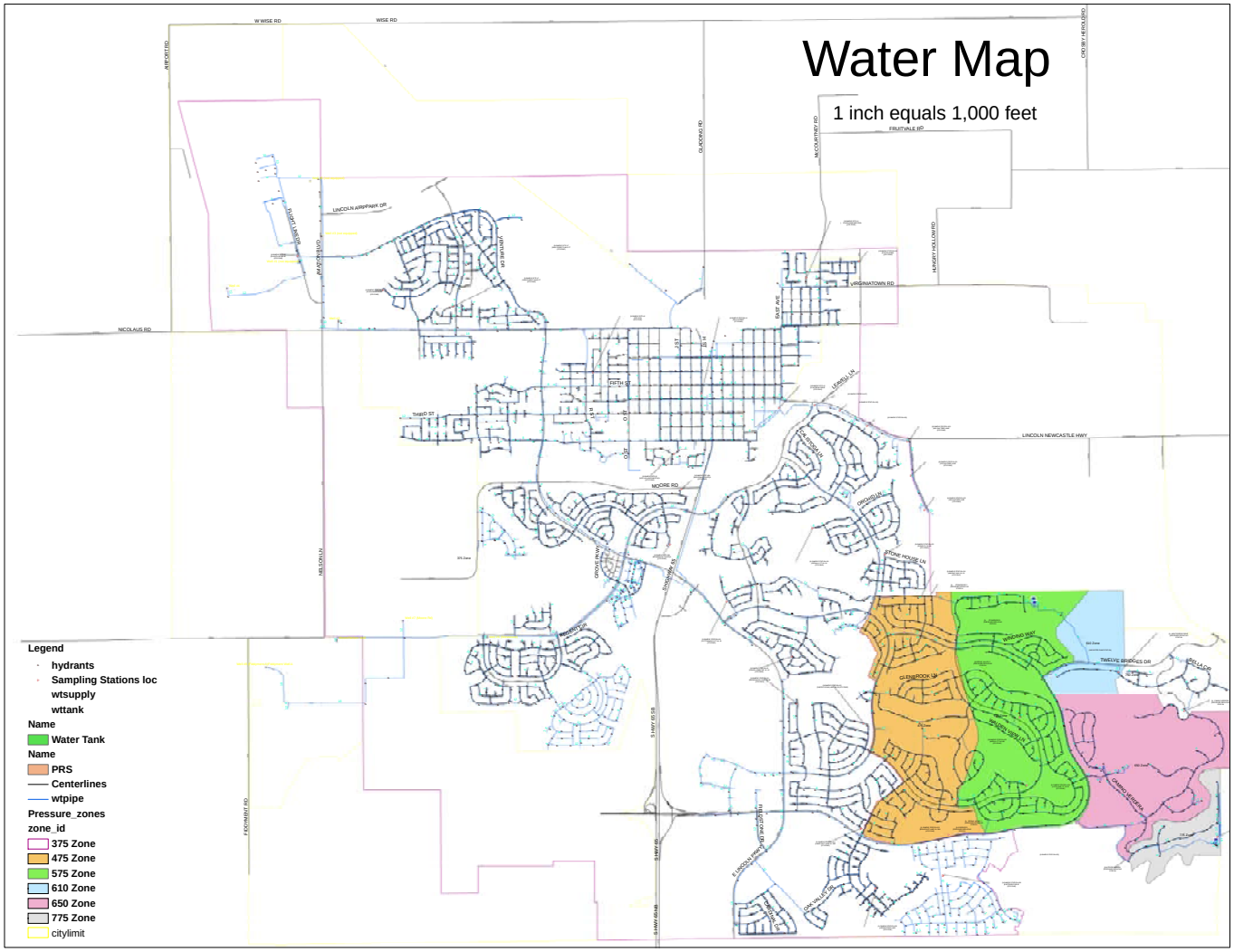
Tully & Young
Comprehensive Water Planning

Image Sources:
Google Earth Pro

3.2.1 Pressure Zones

The City of Lincoln's unregulated and regulated systems can also be divided into areas that are defined by pressure zones. The map depicting the City's Pressure Zones is shown below in **Figure 3-8**.

Figure 3-8 – Pressure Zone Map



3.2.2 System Supply Infrastructure

This section provides detail on the various major components of the City's water system that allow the City to deliver water to meet end user demands as well as fire safety conditions. As described in **Section 3.1** above, the surface water delivered to the City's system is delivered by PCWA to the Lincoln Metering Station (See **Figure 3-2**). At this location, the City takes control of the water and delivers the water to the City's residential, commercial, industrial, and recreational retail customers.

3.2.2.1 Lincoln Metering Station at Reservoir #2

The Lincoln Metering Station (LMS) is a facility that is owned and operated by Placer County Water Agency. The LMS is located adjacent to the 5 MG City Tank at Catta Verdera South (Reservoir #2 site). **Figure 3-9** below shows the LMS.

Figure 3-9 – Lincoln Metering Station



The LMS splits the water received by PCWA to serve the unregulated side as well as the regulated side. A 16-inch diameter pipe leads from the unregulated side to serve Catta Verdera. A 30-inch diameter pipe leads from the regulated side to serve the lower part of the City's system. The Metering Station also includes pressure reduction valves. In 2015 PCWA installed a small hydrogeneration facility at the LMS to take advantage of the excess pressure delivered to the site which then must be reduced in order to meet the City's delivery pressure criteria for the unregulated service.

3.2.2.2 5 MG Tank – Catta Verdera South (Reservoir #2)

The Catta Verdera south 5 million gallon (MG) concrete, gravity water storage tank was installed on City property in 2004. The water supplied to this tank comes through PCWA's LMS. The purpose of this tank is to assist the City in managing pressures and flows in the City's water system during peak demand periods. At an elevation of 565 feet the tank is capable of supplying operational pressures from 40 psi to 130 psi to the City's regulated system. All water metered and delivered via PCWA's LMS for the City's regulated system passes through this tank under normal operating conditions. Flows delivered through the regulated meter are at a set flow rate. Water flows from the LMS into a 30-inch transmission pipeline and is measured by PCWA at the metering station. **Figure 3-10** depicts the City's 5 MG Tank.

Figure 3-10 – 5 Million Gallon South Tank



3.2.2.3 MG Tank – Reservoir 1

The 3 million gallon (MG) steel water storage tank was installed at the City's old Reservoir 1 site in 2003. The tank is supplied water through gravity flow. At an elevation of 366.1 feet, the tank is capable of supplying operational pressures, 40 psi to 130 psi, to the majority of the regulated system in the City including the lower portions of the Del Webb and Twelve Bridges developments. The 3 MG tank is supplied from the 5 MG Catta Verdera South tank through a combination of 12-inch, 16-inch, 20-inch and 36-inch pipelines. An altitude valve controls the flow rate from the 30-inch under pressure from the 5 MG Catta Verdera South tank, into the 3 MG tank to maintain a preset water level and to prevent overflow,. Flow out of the 3 MG tank into the 16-inch and 20-inch pipelines is measured by 16-inch and 20-inch mag flow meters owned by the City. **Figure 3-11** depicts the City's 3 MG tank.

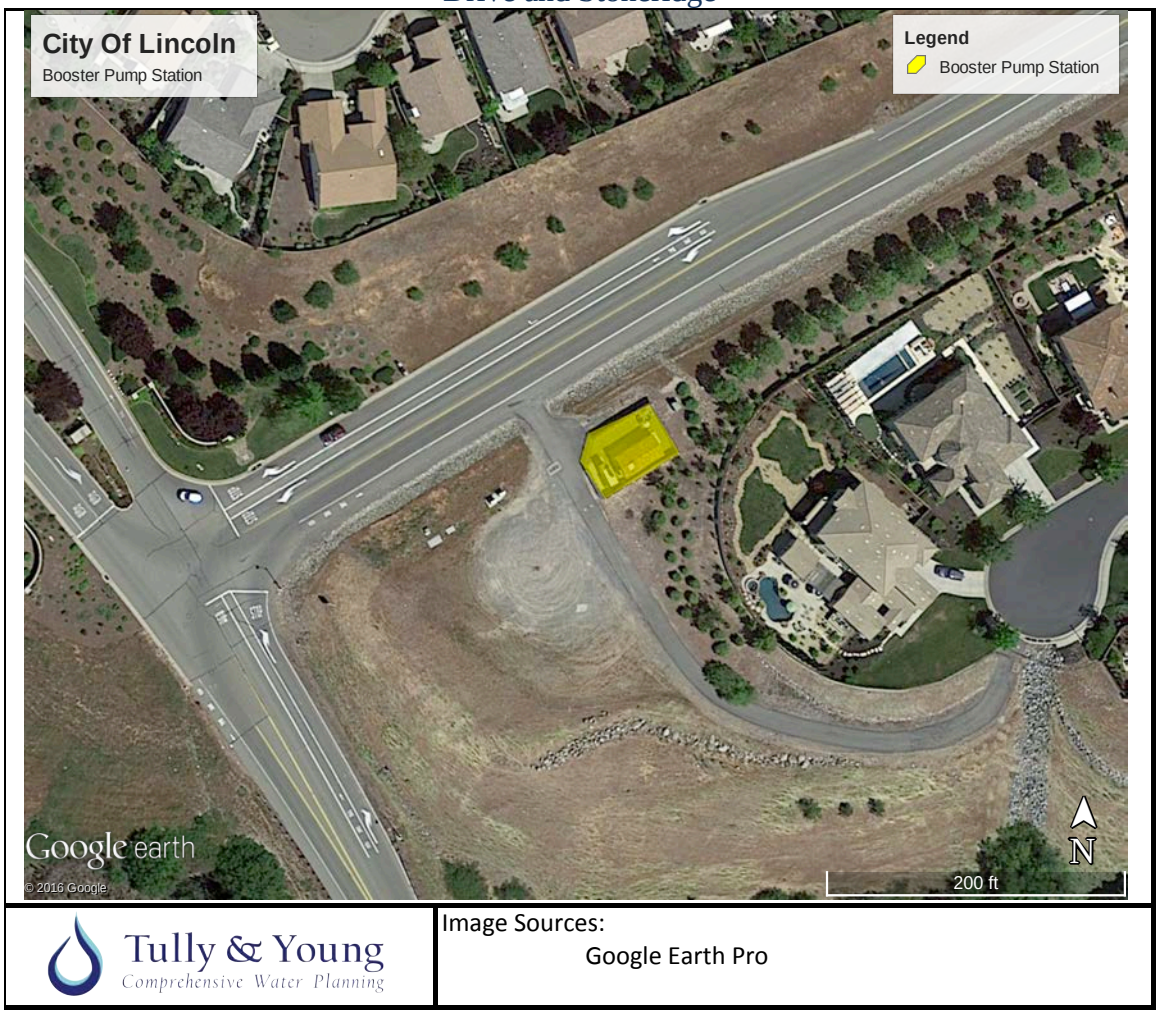
Figure 3-11 – 3 Million Gallon Tank



3.2.2.4 Catta Verdera Temporary Booster Pump Station (Booster Pump Station)

The Booster Pump Station was constructed to accommodate City service to high elevation lots in the Catta Verdera Development that could not be served from the existing unregulated service from the PCWA Lincoln Metering Station. The Booster Pump Station was considered temporary as it would be needed until the PCWA Phase 3 - 30 inch pipeline and new metering station could be built to serve the City through the eastern side of the Catta Verdera development. The Booster Pump Station is supplied water from the 5 MG Catta Verdera South Tank at elevation 565 feet via a 24-inch pipeline and is boosted by one to three pumps, depending on demand, to a service elevation of 750 feet. The Booster Pump Station will be placed in standby mode when the new 30-inch line and the PCWA metering station are completed in the Catta Verdera North area. **Figure 3-12** shows the Catta Verdera Temporary Booster Pump Station.

Figure 3-12 – Booster Pump Station @Intersection of Twelve Bridges Drive and Stoneridge



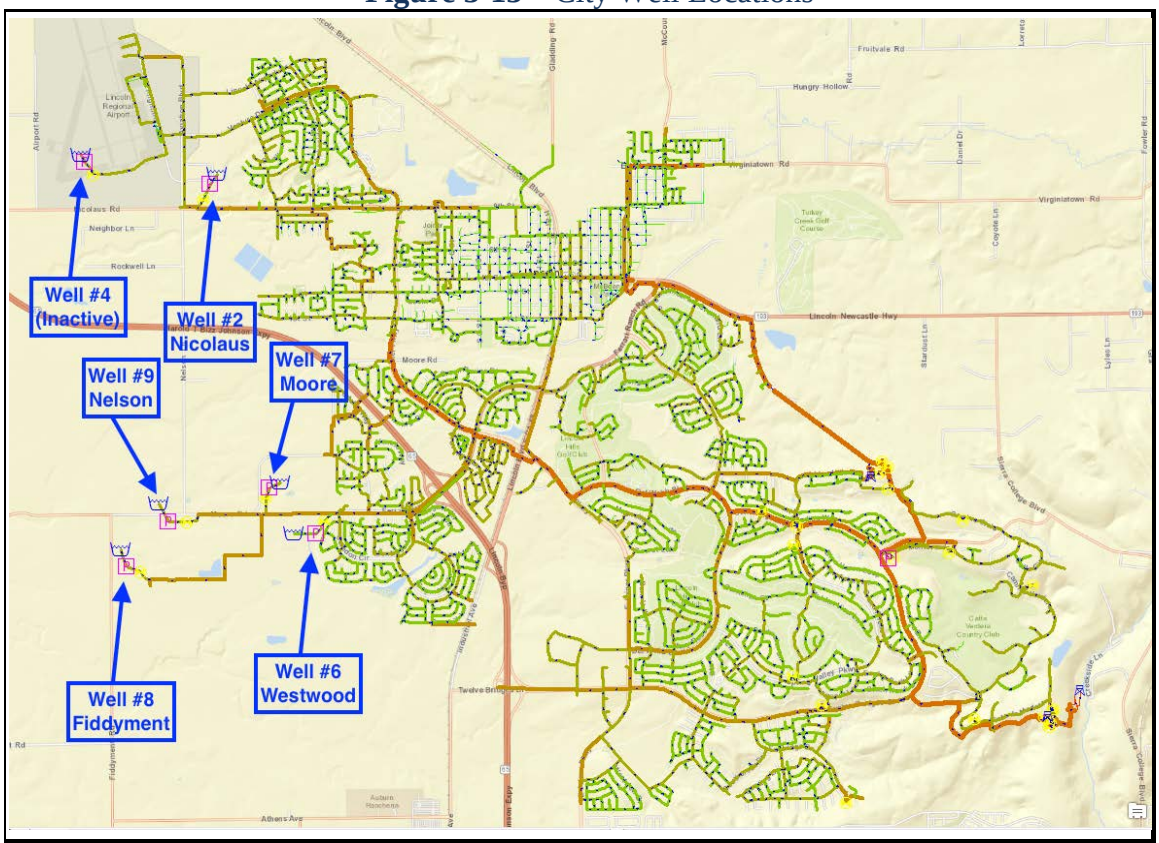
3.2.2.5 City Wells

The City of Lincoln currently operates 5 wells as shown on the Well Map in **Figure 3-13** below. The total production is limited to about 10% of annual City demand but wells are operated primarily in the summer to help balance water pressures and peak demands. The wells are generally located on the western side of the City in the more productive groundwater aquifer. **Table 3-1** summarizes the well characteristics. **Chapter 6** of the Water Master Plan provides additional information on individual wells, the North Basin Aquifer, and the regional governance of groundwater.

Table 3-1 – City of Lincoln's Active Groundwater Wells

Well Name	Max Production	Year Built/ Upgraded	Status
Well No. 2 – Nicolaus Rd	900	1984/90/15	Operational
Well No. 6 – Westwood	1,000	2000	Operational
Well No. 7 – Moore Rd	1,000	2002	Operational
Well No. 8 – Fiddyment	1,400	2004	Operational
Well No. 9 – Nelson	1,500	2005/2014	Operational
Subtotal	**5,800**		
Well #4	n/a	1999	Inactive
Well #5	n/a	1999	Inactive

Figure 3-13 – City Well Locations



Currently, the City wells are operated during high use periods to maintain pressures within the City. Well usage is generally rotated among the wells with one or more wells left in reserve to meet potential backup needs. The operations staff chooses which wells to operate who maintain working knowledge of the current well system conditions. Wells must be taken offline for inspection and repairs regularly. Conservative long-term planning of well production for the system provides the basis for assessing water volumes in this WMP.

3.3 Additional Important Water Infrastructure

This section details other important water infrastructure features of the City water system that are crucial for operation, backup, or management of the water system. This section contains diameters of vital pipes as well as locations of specific infrastructure pieces. Additional existing system infrastructure components in need of replacement or undersized for optimal system operations are also detailed in this section.

3.3.1 City Meter out of 5 MG Tank

The purpose of the 16-inch City meter on the discharge side of the 5 Million Gallon South Tank described in **Section 3.2.2.2** is primarily to quantify the peak outflows and verify metered daily flows as recorded by PCWA into the tank. The 16-inch diameter meter is too small to adequately record the current peak demands as the meter's registering capacity is periodically exceeded during peak seasonal demands. However, the meter feeds the 30-inch pipeline into the City. The 30-inch pipeline is the only supply line to the majority of the City, and thus cannot be taken out of service for meter replacement until the new PCWA Metering Station is in service to the City. The new metering station is incorporated into the Phase III 30-inch pipeline and metering station that is currently being developed by PCWA.

3.3.2 Altitude Valve, City Meter out at 3 MG Tank

The altitude valve into the 3 MG tank at altitude 366 feet (described in **Section 3.2.2.3**) is on the 30-inch pipeline that is supplied from the 5 MG South Tank, located at elevation 565 feet, that operates at a higher pressure. The altitude valve is necessary to reduce line pressure into the 32 foot high gravity tank to about 30 feet of head at elevation 395 feet. The City meters on the 16-inch and 20-inch pipelines exiting the 3 MG Tank are designed to summarize and record daily peak flows out of the tank.

3.3.3 5 MG and 3 MG Tank Bypasses

Both the 5 MG storage tank and the 3 MG storage tank contain a bypass system and related control system. The 5 MG has a bypass line that relies upon adequate pressure reduction and flow control from the adjoining PCWA valves. The bypass allows for isolating the 5 MG tank for maintenance purposes. The 3 MG has a bypass line that includes control valves for isolating the 3 MG tank for maintenance. Both of these bypass systems require regular upkeep in order to allow for tank maintenance at both locations.

3.3.4 Pressure Reducing Stations (PRSs)

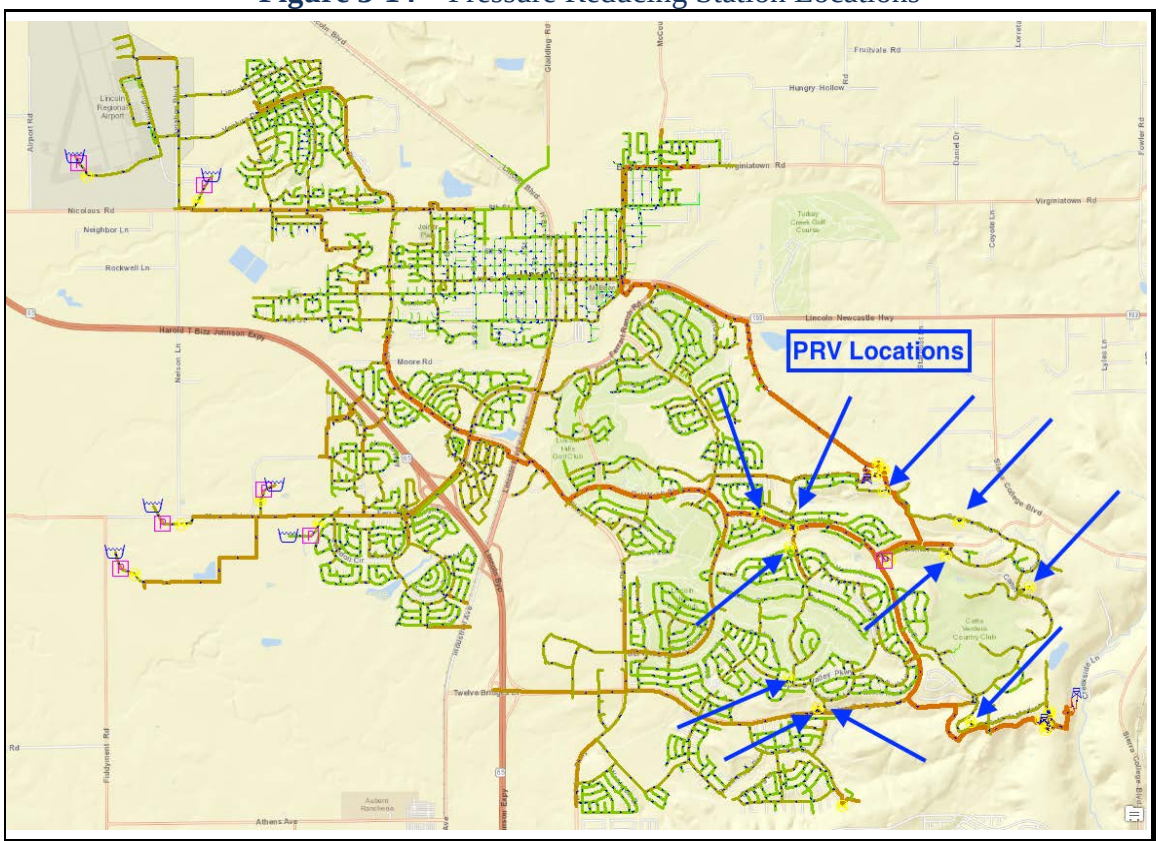
The City's potable water system includes nine pressure-reducing stations. **Table 3-2** lists these 9 stations and **Figure 3-14** shows their locations. The purpose of the below-grade, concrete vault stations is to adjust the system operating pressures in various pressure zones in the regulated system in the City to between 40 psi and 130 psi. The current operating PRSs were installed in 1997 during the period when the City was experiencing rapid urbanized growth. The typical PRS shown in **Figure 3-15** includes the following major, generic components: full diameter, manually operated valved bypass of the PRS based on the size of the pipe main associated with the PRS; a high flow pressure reducing

control valve with associated piping connected to the pipe main and sized to pass to estimated maximum flow available from the upstream reach of pipe main; a smaller pressure reducing valve for lower flows, i.e. night time, for more efficient pressure control in that flow range; telemetry (SCADA) elements that allow monitoring and remote control of the downstream discharge pressure leaving the PRS and corresponding flow through the PRS.

Table 3-2 – City's Pressure Reducing Stations

PRS Name	Location	System	Current Setting
Stoneridge	Stoneridge Drive	Regulated	Some PRV Settings May Change Seasonally See Operations Staff for Current Settings
Spring Valley #1	North	Regulated	
Spring Valley #2	South	Regulated	
Wildomar	Wildomar Drive	Regulated	
12 Bridges	12 Bridges Drive	Regulated	
CVIL 13	Vista De Madera	Unregulated	
CVIL 17	Camino Verdera	Unregulated	
CVIL 18	Monteverde	Unregulated	
CVIL 19	Camino Cielo	Unregulated	

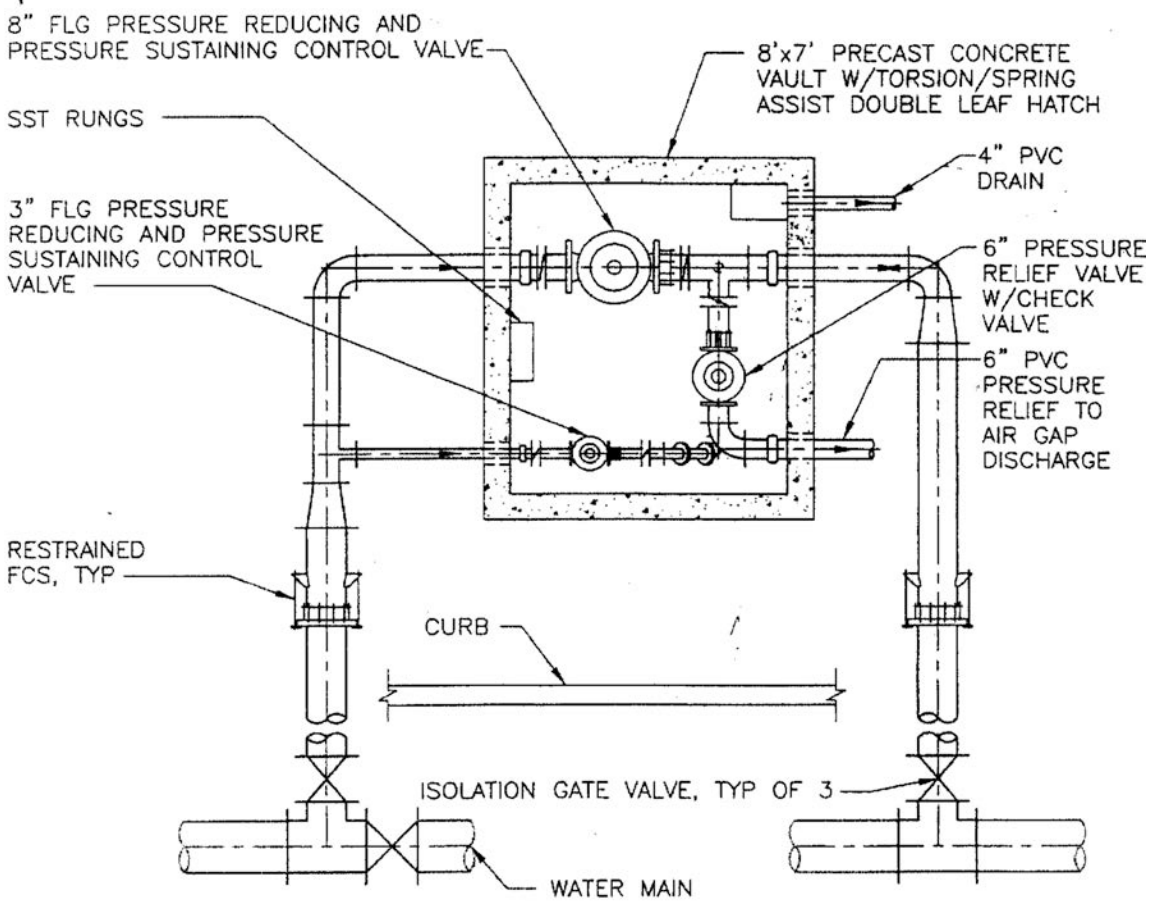
Figure 3-14 – Pressure Reducing Station Locations



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Figure 3-15 – Pressure Reducing Station Diagram



3.3.5 Highway Crossings

The City of Lincoln currently has 6 water infrastructure pipelines planned to cross Highway 65. Of the 6 pipelines, only 4 have been built and are operating. The 4 in use were built as part of the Lincoln Crossing and Three D developments. A 16-inch water line was built and installed with the Twelve Bridges Drive Overpass but is not being used at this time. The recently completed Nicolaus Overpass was completed with utility easements and conduits in the Nicolaus Overpass bridge but Cal-Trans shows the conduits as only being 14-inches in diameter. The 14-inch sizing of this conduit may limit the utility of this crossing in the future. Outside of the diameter limits in the Nicolaus Overpass crossing yet to be used, the age and materials used in the existing crossings should provide long-term reliable service. **Table 3-3** shows the details of the Highway 65 pipe crossings.

Table 3-3 – Highway 65 Pipeline Crossings

Location	Diameter	Material	Year Installed
Ferrari Ranch	16”	PVC	2000
Ferrari Ranch	18”	PVC	2000
Three D North	18”	PVC	2005
Three D South	16”	PVC	2005
12 Bridges Drive	16” Reported		
Nicolaus Overpass	14” Conduit	Not Installed	Not Installed

Figure 3-16 shows the locations of the Highway 65 pipe crossings described above. Each crossing is located in an area where there is a physical structure (bridge) associated with traffic management.

Figure 3-16 – Highway 65 Pipeline Crossing Locations



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS

3.3.6 Auburn Ravine Crossings

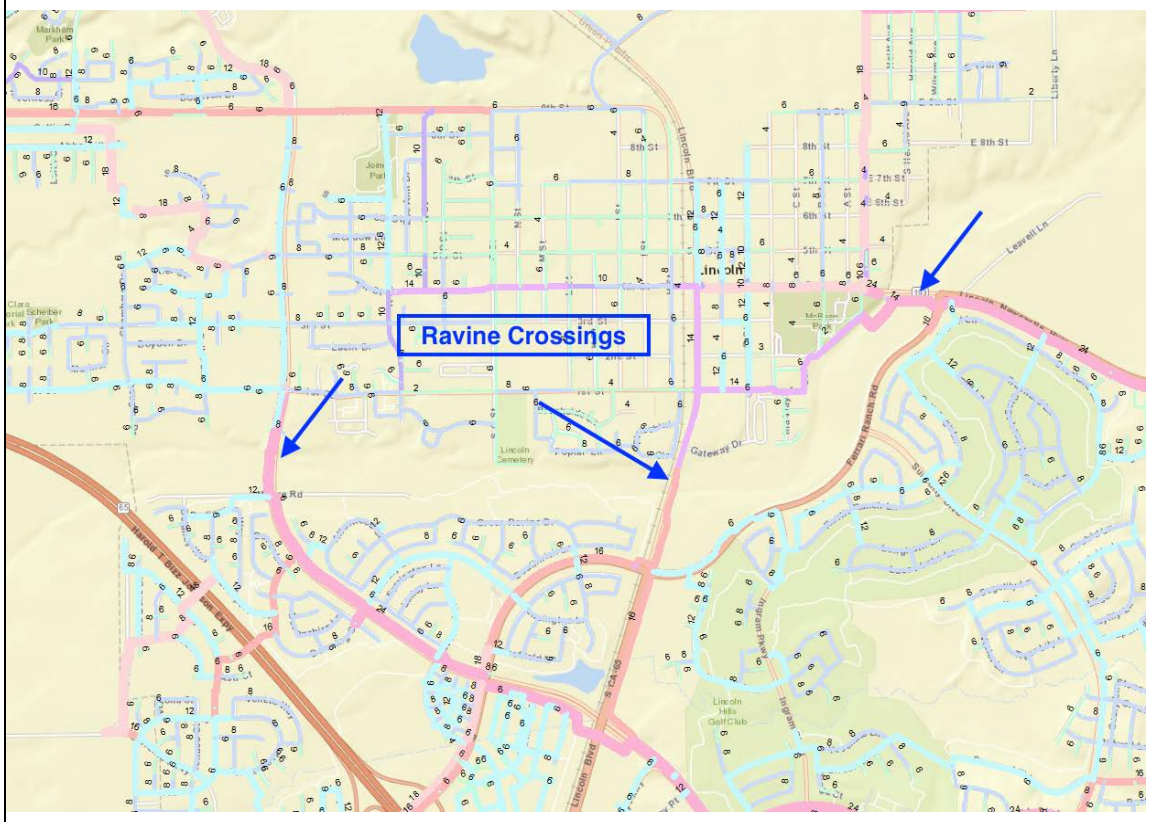
The City of Lincoln currently has 3 pipelines that cross Auburn Ravine. Like the Highway 65 crossings, the Auburn Ravine possesses significant technical and financial difficulties when traversing with water utilities. The three pipelines that cross Auburn Ravine are the Joiner Parkway pipeline, the Lincoln Boulevard pipeline, and the McBean Park Drive pipeline. The age of these pipelines and the materials used in constructing these pipelines should provide long-term reliable service for the City of Lincoln's water system. Furthermore, as Village 1 is constructed, the City will have another Auburn Ravine pipeline crossing at extension of Oak Tree Lane capable of providing redundant service to the existing downtown areas. **Table 3-4** shows the details of the Auburn Ravine pipeline crossings.

Table 3-4 – Auburn Ravine Pipeline Crossings

Location	Diameter	Material	Year Installed	Method of Crossing
Joiner Parkway	24"	DIP	2002	Bridge Hung
Lincoln Blvd	16"	PVC	1998	Buried
McBean Park Dr.	24"	PVC	2003	Buried

Figure 3-17 shows the locations of the Auburn Ravine Pipeline Crossings

Figure 3-17 – Auburn Ravine Pipeline Crossing Locations



3.3.7 Railroad Track Crossings

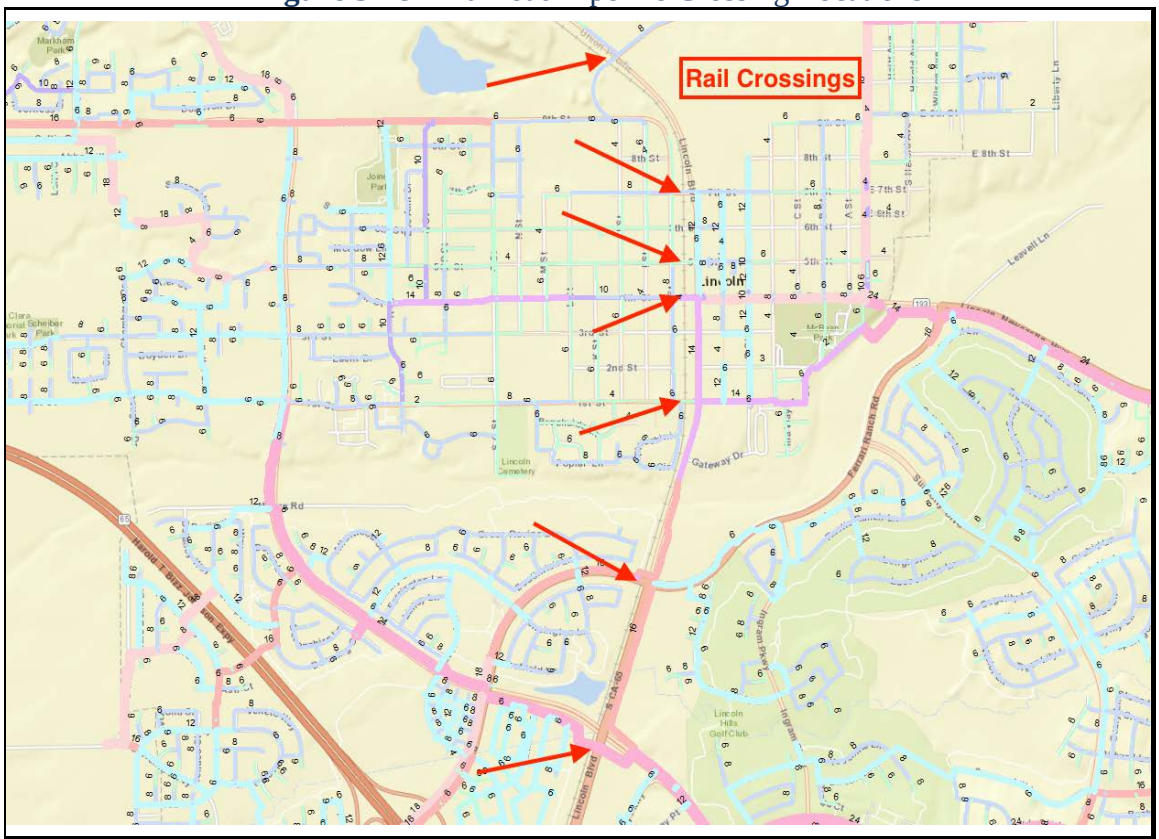
The City of Lincoln currently has 7 pipelines that cross the Railroad Tracks. Similar to highway crossings, the railroad crossings present significant technical and financial difficulties when trying to traverse with water utilities. These seven railroad crossings also cross the old Highway 65 (Lincoln Blvd.) that bisects the middle of downtown Lincoln. With the completion of the Highway 65 bypass, water utility crossings on Lincoln Blvd. have become less burdensome. Nevertheless, these railroad crossings represent a significant deficiency in the City infrastructure. Specifically, many of the crossings are undersized to handle the legally required fireflows and several are very old. Only 3 of the crossings are less than 50 years old and larger than 12-inches in diameter. **Table 3-5** shows details of the railroad pipeline crossings.

Table 3-5 – Railroad Pipeline Crossings

Location	Diameter	Material	Year
Gladding & 9th	8”	ACP	1960
7th	8”	ACP	1959
5th	6”	CIP	1929
4th	14”	DIP	1994
1st	6”	CIP	1929
Ferrari Ranch	16”	PVC	2000
Joiner Parkway	24”	PVC	2006

Figure 3-18 shows the locations of the Railroad Pipeline Crossings. As expected, the undersized and aging pipeline are associated with the older parts of the City of Lincoln – pre-dating more stringent modern water system standards.

Figure 3-18 – Railroad Pipeline Crossing Locations



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

3.3.8 Transmission Main – 30-inch at Reservoir 2

The 30-inch water transmission line out of the Reservoir 2 tank was built shortly after the tank was constructed. The 30-inch line delivers water down the hill to the main transmission loop on Twelve Bridges Drive. This 30-inch water line is slightly undersized for the amount of flow that it transmits during a peak hour in the middle of the summer. The City is currently planning on redundant transmission mains in its water system in order to accommodate future growth while avoiding the option to upsize or duplicate this water line. Water velocities in this line have been shown to be controllable in all stages of future growth, including final build-out. However, this 30-inch line will regularly be near operational limits during peak use periods during the height of the summer water demand. City staff is advised to monitor the condition of this pipeline due to the high operational stresses it sees and current lack of redundancy. Augmenting the City's water delivery system to reduce pressures in this pipeline is a priority future action. **Figure 3-19** shows the location of the 30-inch transmission main.

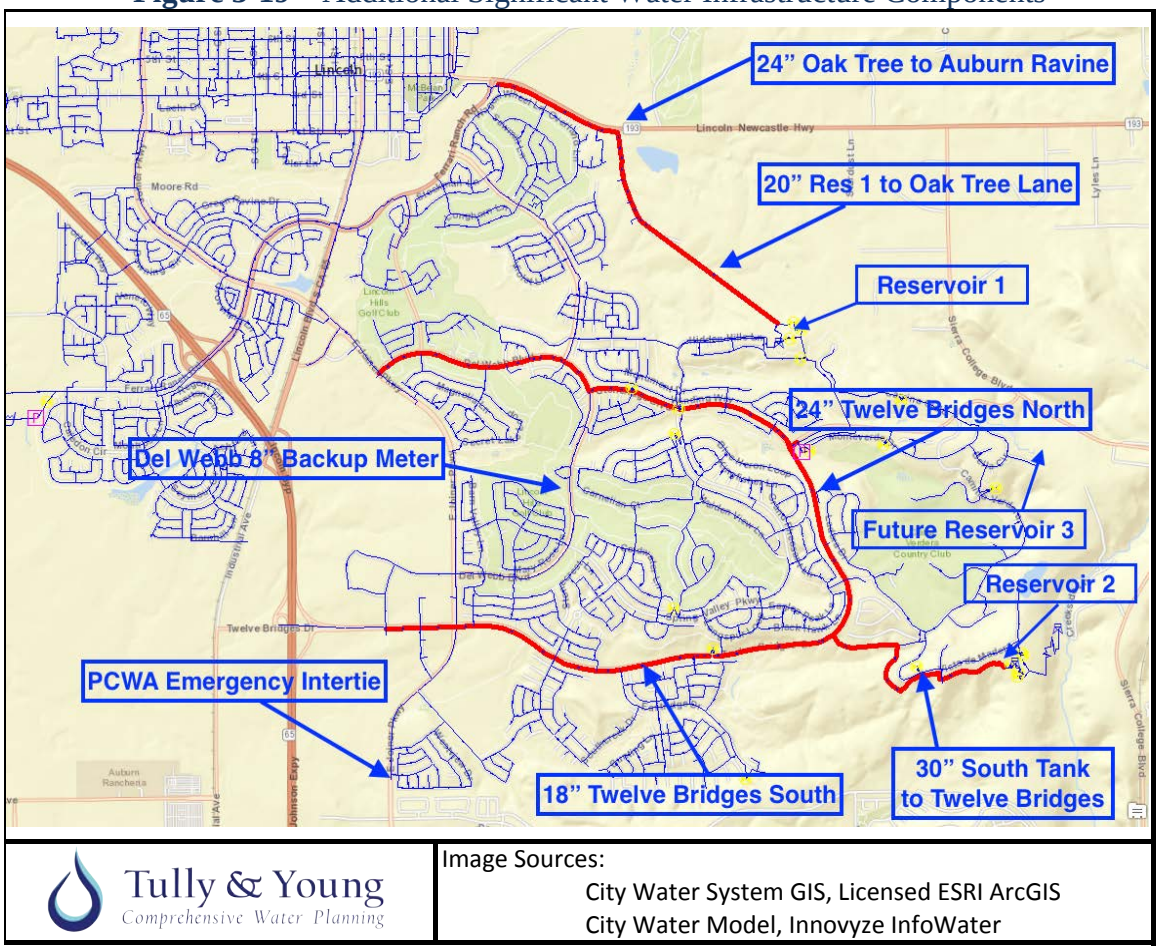
3.3.9 Transmission Main – 18-inch Twelve Bridges Drive South

The 18-inch transmission main that runs from the intersection of the 30-inch Reservoir 2 South tank transmission main to highway 65 along Twelve Bridges Drive was built in 2001. This 18-inch transmission line is adequately sized for current water system operation as well as planned future City growth. Some sections of the transmission main, where there is no parallel flow through the neighborhood systems, will have high velocities during peak flows as the City approaches build-out. The sections of line that do not have parallel lines may need to be upsized in order to best meet the water transmission and fire safety needs. Improving the entire line by increasing the capacity would likely be constrained by the capacity to cross Highway 65. **Figure 3-19** below shows the location of the 18-inch Transmission Main.

3.3.10 Transmission Main – 20-inch Reservoir 1 3 MG tank to Oaktree Lane

The 20-inch Reservoir 1 Transmission Main runs down the hill from the Reservoir 1 site at the 3 MG Tank to Highway 193. This 20-inch line is one of the older components of the City's water system dating back to the City's own open reservoir treatment (See **Chapter 1**). The 20-inch pipe is known to be in a degraded condition and the easement in place limits the City's ability to perform repairs. This 20-inch transmission line will be up-sized and replaced in the near future as part of the Village 1 development. Current infrastructure plans will have this pipeline re-routed to allow for development grading and placement on a wider, and less-conditioned, easement. **Figure 3-19** shows the location of the 20-inch Reservoir 1 Transmission Main.

Figure 3-19 – Additional Significant Water Infrastructure Components



3.3.11 Transmission Main – 24-inch Twelve Bridges

The 24-inch Twelve Bridges Drive transmission main runs from the existing 30-inch transmission main north along Twelve Bridges Drive, continues onto Stoneridge Drive, and then turns north on Del Web Boulevard to Joiner Parkway. This 24-inch line is currently of adequate size but will see high velocities when the City completes the Reservoir 3 10MG tank project at Catta Verdera North. Following completion of the Reservoir 3 tank, a 36-inch pipeline will run down a different portion of Twelve Bridges Drive and meet the existing 24-inch pipeline at the Twelve Bridges and Stoneridge intersection. The extra pressure and flow supplied by this 36-inch pipeline will require pressure reduction valve to limit the velocities in the latter part of this main. The City should upsize or parallel this line any time a section needs repair or maintenance. **Figure 3-19** above shows the location of the 24-inch Twelve Bridges Transmission Main.

3.3.12 Transmission Main – 24-inch Oaktree Lane

The 24-inch Oaktree Lane Transmission Main was built in 2003 and connects to the old 20-inch Transmission Main from Reservoir 1 at the south end of Oak Tree Lane. This 24-inch Transmission Main runs north to 193 and then west to the McBean Park Drive Bridge at Auburn Ravine. This line is currently adequately sized will need to be paralleled with an 18-inch line at some time in the future before build-out. **Figure 3-19** above shows the location of the 24-inch Oaktree Lane Transmission Main.

3.3.13 PCWA Emergency Intertie

The City of Lincoln maintains an emergency intertie with PCWA's treated water system. This 18-inch intertie is located on East Lincoln Parkway at the southern edge of the City Limits. This intertie could receive treated water delivered from the Sunset Treatment Plant and into the City. This emergency intertie has not been used. **Figure 3-19** above shows the location of the PCWA Emergency Intertie.

3.3.14 Del Webb Backup Meter

The City of Lincoln, per the Developer Agreement with the Del Webb Corporation and its successors-in-interest, maintains an 8-inch water meter connected to the City's potable water system. This water meter would allow potable water to discharge into a drainage way, under emergency conditions, to help maintain water flows through the wetlands and golf course areas of the Del Webb development. The 8-inch meter installation is manually operated and has not been in use since its installation. If this meter were turned on and water discharged into the wetlands area, the City's overall water demands would greatly increase and it could jeopardize the City's ability to meet its gallons per capita per day (GPCD) targets as required by law. Further evaluation of the Del Webb Backup Meter is warranted.[4] The location of the Del Webb Backup Meter is shown in **Figure 3-19** above.

3.4 Older City Infrastructure

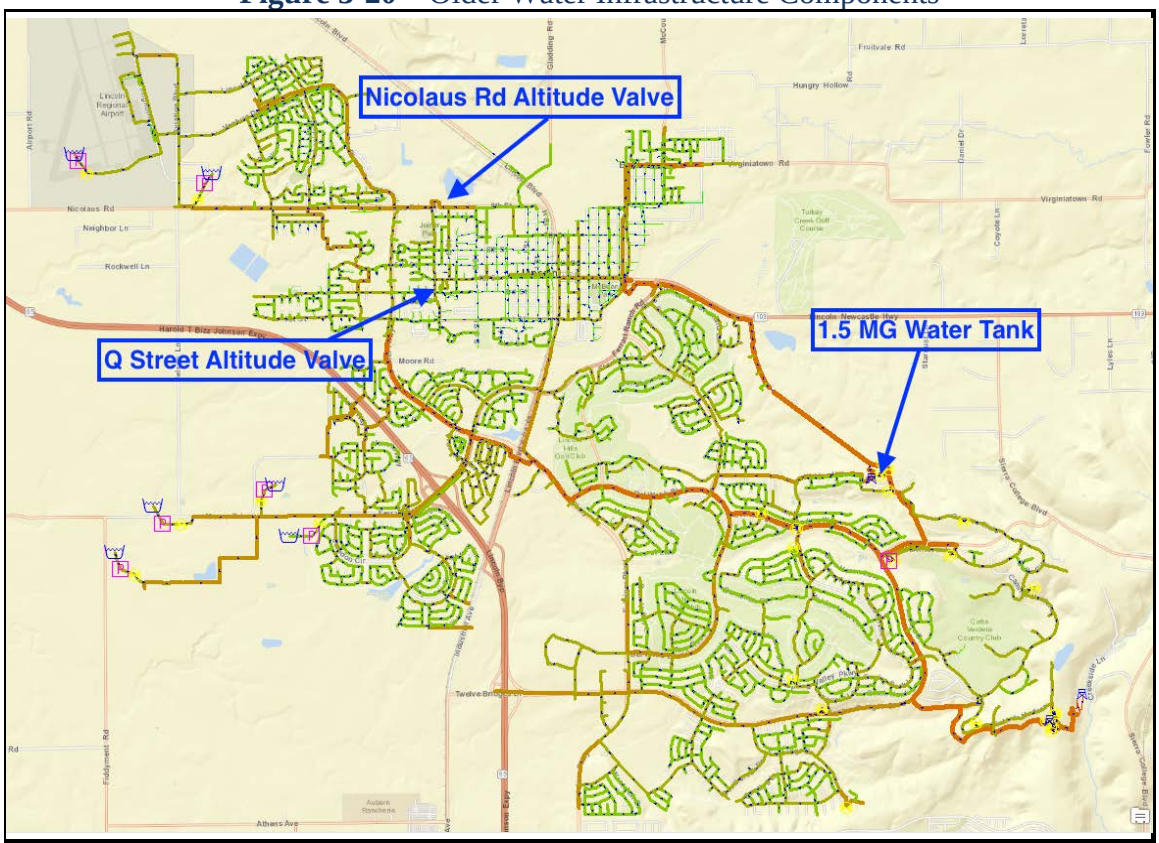
The City of Lincoln has a number of older infrastructure items in its water system that implicate long-term reliability as further developed in **Chapter 7**. Although the replacement schedule for these items is more fully discussed in **Chapter 10**, this section identifies the main time-worn components. These components include altitude valves, transmission mains, and a water tank.

[4] This potential water service to Del Webb is also discussed in both **Chapters 5** and **7** of this CWMP.

3.4.1 Nicolaus Road and Q Street Altitude Valves

The City has two older altitude valves. The first altitude valve is located near Log Deck in Nicolaus road. This non-operational, bypassed altitude valve is a remnant of the pressure reduction system that used to separate the PCWA surface water supplied area from other areas in the City. Specifically, it historically separated the PCWA delivery area from the airport area. In 2002, with the installation of the 24-inch pipeline from the Del Webb development, looping into the southwestern portion of the City north of the Auburn Ravine via Joiner Parkway, the altitude valve installation became obsolete. The second altitude valve that is obsolete is located near Q and 4th Streets. This altitude valve also became obsolete upon the installation of the 24-inch pipeline from the Del Webb development. These two altitude valves are shown in **Figure 3-20**.

Figure 3-20 – Older Water Infrastructure Components



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

3.4.2 1.5 MG Water Tank

The existing 1.5 MG steel gravity storage tank at the Reservoir 1 site was used in the City's older water infrastructure and distribution system. The 1.5 MG tank was operated successfully until the 3 MG replacement tank was completed (this tank is more fully described in **Section 3.2.2.3**). At that time, the 1.5 MG tank was taken off-line and dewatered due to concern related to its structural integrity. Specifically, damage was caused to the tank from seismic activity and corrosion. The tank will not be returned to potable water service and should be removed in the future.

3.5 Fire Hydrants

The City of Lincoln has 1998 fire hydrants mapped in GIS and additional fire hydrants that have not yet been mapped in that system. **Figure 3-21** shows the location of all fire hydrants mapped in the City's GIS database. Due to fire code changes, newer developments have more hydrants spaced closer together. The fire hydrants and their associated installation dates are listed in **Table 3-6** below. The fire hydrants listed have installation times dating back to 1929. However, many of these older hydrants have been replaced yet those replacements have not been updated in the GIS database.

Figure 3-21 – City of Lincoln Fire Hydrant Locations

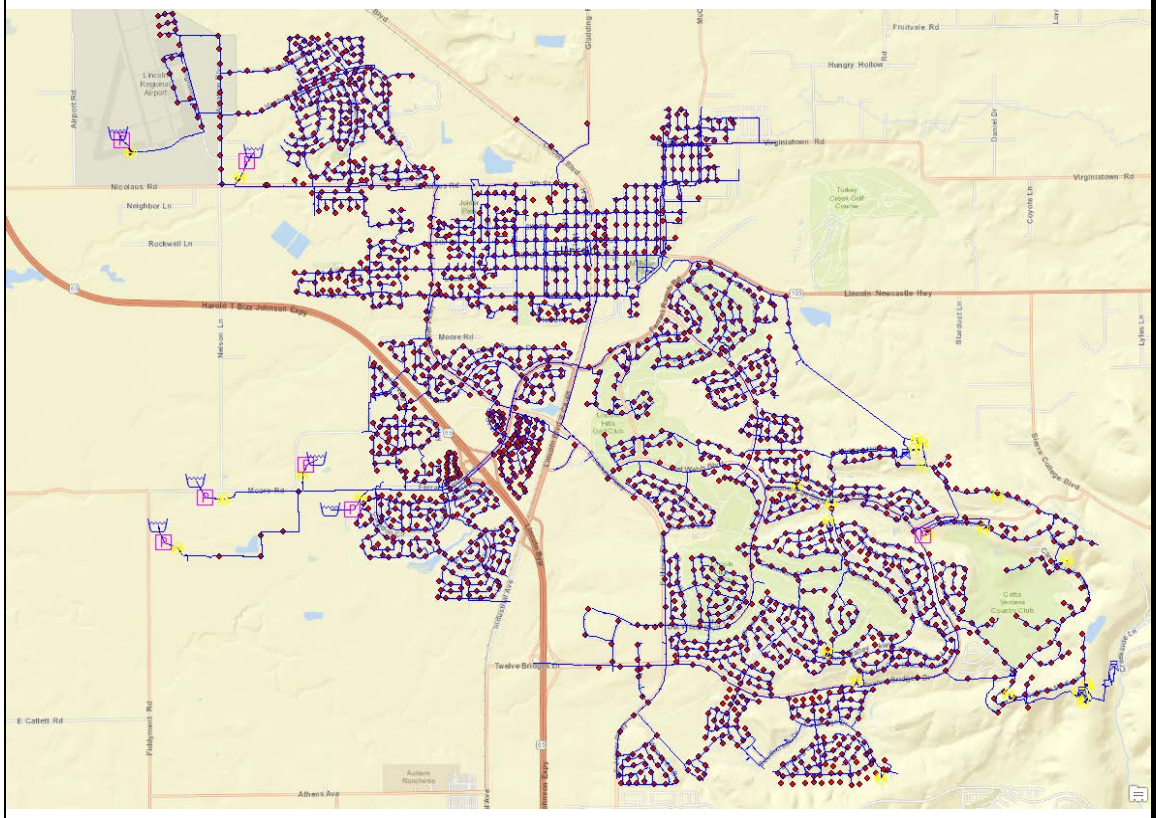


Table 3-6 – Fire Hydrants and Installation Dates

Year Installed	Count
__-1929	43
1930-1959	48
1960-1979	70
1980-1989	122
1990-1999	353
2000-2009	1362
Total	**1998**

CHAPTER 4. WATER DEMAND CHARACTERISTICS

Understanding water demand characteristics is essential to enable the City of Lincoln to reliably forecast future customer water demands and then plan for and secure reliable water supplies. Further, securing water supplies that is based on the demand calculations requires the City to plan and budget for the necessary improvements to the delivery system infrastructure. This section characterizes the City's forecast water demands to build-out[1] and discusses the translation of that annual demand forecast into values important for infrastructure planning. This chapter is organized as follows:

- *Existing Customer Demand and Characteristics* – This section presents customer demands from the past several years, characteristics that affect these existing demands, and a discussion of likely reduction in demands due to on-going water use efficiency efforts.
- *Future Demand Forecasts* – This section describes the detailed assessment of anticipated growth, likely demand factors, and the resulting expected incremental expansion in demand over the next 50 years.
- *Relationship Between Demand Forecasts and Infrastructure Planning* – This section describes how annual demand relates to infrastructure sizing and planning, current water supply contract language, and the impacts of recent and expected conservation on previous planning and infrastructure investments.
- *Recommendations* – This subsection provides recommended actions that will continue to inform the City during on-going and future master planning efforts.

4.1 Existing Customer Demand and Characteristics

Over the past several years, the City has served about 10,000 acre-feet per year (af/yr) on average to a population of over 45,000 through approximately 17,700 single-family residential connections, over a thousand multi-family units, and over 500 non-residential parcels. As shown in **Table 4-1**, the City's "gross water use" – defined as the water entering the distribution system to meet the demands of its customers – has dropped significantly in 2014 and 2015 compared to 2012 and 2013 even with a slight increase in the population. This drop, however, is fully attributable to the significant drought that began in 2013, causing concerns throughout California that resulted in the Governor mandating all water purveyors meet prescribed conservation targets. The City was tasked with meeting a 32 percent conservation goal between June 2015

[1] This information is consistent with the City's recently adopted 2015 Urban Water Management Plan (UWMP), but extends the demand forecast beyond 2040 to buildout. The UWMP limited the demand forecast to 2040.

and February 2016. Through December 2015, the City successfully achieved a 33.3 percent cumulative savings (compared to 2013 conditions – which was the State's baseline).[2]

Table 4-1 – Recent City Population and Annual Water Demand

Year	Population	Gross Water Use (af/yr)
2010	42,819	9,203
2011	43,142	9,481
2012	43,915	10,091
2013	44,336	10,858
2014	45,259	8,948
2015	45,837	7,628

Because of the annual variance driven by external forces, a representative existing demand for the City was established as 10,174 acre-feet per year (see **Table 4-2**). As explained below, the derivation of this representative value is intended to provide the City with an understanding of "current" conditions so it can assess how the future demand of those existing customers may change over time – a value that is added to the forecast demands of future customers (explained in the next section).

Table 4-2 – Representative "Existing" Customer Demand

Land-class	Representative Unit Counts	Current Demand Factors (af/account)	Representative Demand (af/yr)
Multi-Family	1,873	0.30	562
Single Family	16,486	0.46	7,584
Commercial	247	0.99	245
Industrial	7	2.15	15
Public	23	2.57	59
Parks/Landscapes	186	3.73	694
		Subtotal	9,158
		System Loss (at 10%)	1,017
		Total	10,174

The "representative unit counts" for the residential customers in **Table 4-2** were derived from the Department of Finance (DOF) population and housing data as of January 1, 2015. Specifically, the "single family" classification includes only single family, detached units. All single family

[2] Based on report from the SWRCB available at: http://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2016feb/suppliercompliance_020216.pdf.

attached, small condos, apartments and mobile homes are combined under the "multi-family" class. This readily available DOF data groups together different home-types, home ages, lot densities, and occupancy rates, resulting in the need for a representative unit demand factor that also blends these factors to also be used. Using findings from the City's meter studies (discussed in **Section 4.2**), a single demand factor was developed that was consistent with the meter study findings, yet allowed the total estimated water demand to fall within the range of recent water use as shown in **Table 4-1**. The chosen representative demand factor for each land-use class is presented as "current demand factors" in **Table 4-2**. For the two residential land-use classes, the current demand factors use the highest value for each class from those determined during the meter studies for each similar class (e.g. the meter studies reflected at least three separate demand factors to represent different future lot densities, the highest of these was used to reflect the current single family use factor).

The City also recognizes that the existing customer demand factors are not static and are expected to lessen over the next few decades as existing customers continue to use water more efficiently. Existing customers' future unit demand factors are assumed to change mostly from demand drivers such as general homeowner fixture replacements and upgrades, increased awareness and management by homeowners of landscape irrigation scheduling, the City's conservation awareness and incentive programs, and other factors affecting a general increased awareness of water conservation. The future unit demand factors for existing customers reflect a reduction from the current value in **Table 4-2**, but are still within the range of factors determined during the City's meter studies.

4.2 Future Demand Forecasts

This section provides the detailed basis for incremental demand forecasts that form the foundation for securing water supplies and constructing necessary delivery infrastructure. The key factors driving the forecasts include: (a) land-use based demand factors, (b) characteristics of anticipated growth, and (c) system losses. This section is organized to provide the details for each of these factors.

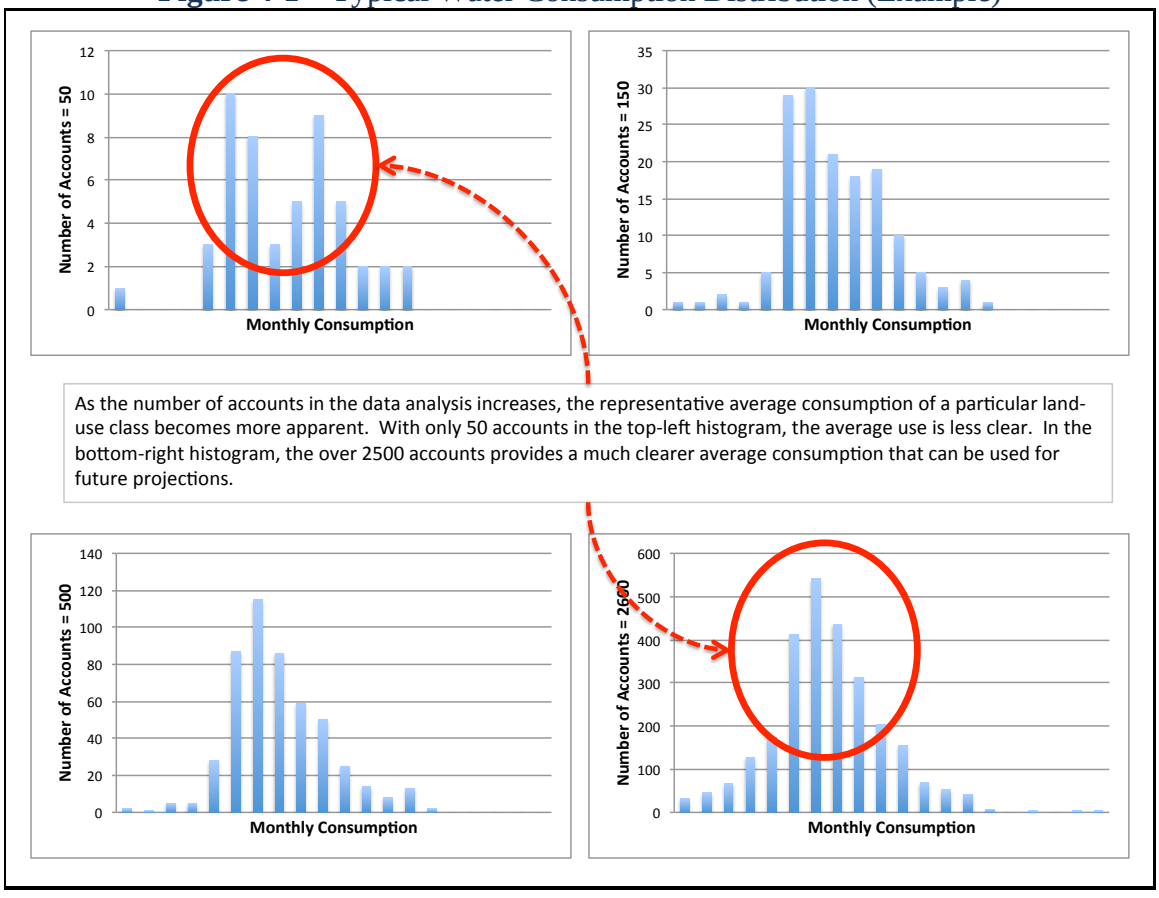
4.2.1 Land-use Based Demand Factors

A demand factor represents a generalized rate of annual water use by a customer. A demand factor is often differentiated by the customer type or land classification (e.g. a single family residential home versus a commercial building). Using demand factors that are uniquely distinguished for current and future customers allows for projections of future water demand to be based on current customer use and trends, as well as being representative of future homes and buildings that must adhere to new, more stringent, water efficiency standards.

Development of usable existing and future demand factors is based on the availability of existing customer water meter data and other readily available factors. Often, this customer meter data has only recently become available and easily manageable for these purposes (water meters were legally mandated in the early 90s). The City is fortunate to be completely metered, providing a useful data source for demand factor development.

As more fully discussed in the next subsection, the large number of individual meters with fairly extensive historic data provided the opportunity to assess enough specific customer types to provide a high level of confidence in the resulting demand factors. As represented in **Figure 4-1**, having a larger number of data points for a particular customer type improves the resulting representative monthly demand. This improvement is due to the diminished effect of outliers on the resulting average and median use – allowing better use patterns to emerge that provide a sound basis for determining demand factors.

Figure 4-1 – Typical Water Consumption Distribution (Example)



4.2.1.1 City's Legacy Demand Factors

During preparation of the City's 2010 UWMP, it was apparent that the City already preceded most other urban suppliers in its use of land-use based demand factors. Up to that point, the City's demand factors, however, were derived from customer use data from the 1990's, before

the development of statewide efficient plumbing codes. Moreover, at that time, the City was less than 20 percent of its current size. Thus, the old factors were based on limited meter data, general representations of land use through the use of engineering estimates, and industry standard flow rates. Though better than many methods and data sources, these early demand factors had been losing accuracy with the City's rapid expansion as they tended to overestimate the annual demand of the majority of newer City customers. Due to new plumbing codes and changes in development types, which generally included larger houses on smaller lots, both indoor and outdoor average demands had been dropping. With over 80 percent of the development in the City occurring since 1993, when efficient plumbing codes were first established, the majority of the houses in the City were using less water than anticipated using the 1990's data. These older demand calculations were used for projecting buildout demand in the City's 2008 General Plan. While significantly more accurate than a simple use-per-person basis using population projections, the limited use of the more recent (at the time) meter data meant projections contained many assumptions that exaggerated actual water use by the City's customers.

4.2.1.2 Analysis using 2010 Residential Data

In early 2011, the City undertook a refined analysis of its residential customer use data to develop more appropriate demand factors for use in the 2010 UWMP update (which was being drafted in early 2011). Using a more extensive data set as well as finer discretion between types of residential customers (e.g. older versus new homes, smaller versus larger lots), the City generally found residential demand factors were lower than previous values used by the City. This new study (hereafter the "2011 Meter Study") also found a variance in demand factors based upon the age of structures, the development style (e.g. lot and house size), as well as definitive downward trending of indoor water use most likely attributed to new plumbing code regulations and the availability of water efficient fixtures and appliances.

4.2.1.3 Updated Analysis using 2013 Customer Data

To inform the 2015 UWMP and this WMP, additional residential data was reviewed and assessed. In addition, non-residential meter data was more fully analyzed (hereafter the "2015 Meter Study"). With drought conditions affecting customer water use in 2014 and 2015, water meter data from 2013 was obtained as it best represented "normal" water use for purposes of improving upon the 2011 Meter Study results. Though a comprehensive GIS database was still unavailable, complete access to the 2013 billing database provided ample data for a wide array of customer types. The 2015 Meter Study focused on refining or verifying the residential demand factors derived in the 2011 Meter Study with the availability of more data points for residential users, and developed more accurate numbers for the commercial, industrial, and public land uses.

4.2.1.4 Representative Demand Factors for Current Customers Use

Using the results from the 2011 Meter Study and those additions refined by the 2015 Meter Study, the following demand factors by land-use classification form the basis for use in demand forecasting.

Residential Country Estates

Country Estates are defined as very low density residential lots at approximately 1.0-2.9 dwelling units per acre (DU/Acre), generally inclusive of large, upscale homes. The demand factor from the 2008 General Plan assumed 1.22 acre-feet (AF) per DU per year. This prior demand factor was inclusive of a 15% loss factor, which would make the pre-loss demand factor about 1.06 acre-feet per dwelling unit per year (AF/DU/Yr). The 2011 Meter Study analyzed about 130 homes in the Catta Verdera development (representing about 15% of the total dwelling units in this category). To account for vacant homes due to the economy, all minimal use customers were excluded from the sample. The 2011 Meter Study determined a demand factor of 0.85 AF/DU/Yr. The 2015 Meter Study revisited this land classification for over 80 homes, resulting in a minimal increase to 0.86 AF/DU/Yr.

Low Density Residential

The Low Density Residential (LDR) category includes houses with densities ranging from 3.0-5.9 DU/Acre. The demand factor from the 2008 General Plan assumed 0.61 AF/DU/Yr, inclusive of a 15% loss factor – resulting in a representative customer demand factor of 0.53 AF/DU/Yr.

This unit type represents the majority of the City's residences, with a large variability in the ages of the structures. The older homes are located on the numbered and lettered streets surrounding the original downtown. By inspection of satellite imagery, these homes typically had minimal landscaping compared to the newer construction that began in earnest in the 1990's. These more recent residences were categorized as post-1993 homes and reflect efficient plumbing standards and tract-style developments where groups of homes are typically built almost simultaneously. The post-1993 homes typically have full property landscaping, but the residence itself commonly occupies more of the lot as compared to older homes in this class. The difference in these categories was confirmed during the 2011 Meter Study, identifying the post-1993 construction having higher peak summer demands while older homes had higher winter-only flows (reflecting indoor use).

The data sample for the 2011 Meter Study represented about 460 of the older homes and 550 of the post-1993 homes. These categories produced two different demand factors which were weighted to generate an average for this existing land class. This sample is estimated to represent just over 10% of the total number of homes in this land class. The results from the 2011 Meter Study indicated a demand factor of 0.46 AF/DU/Yr.

The 2015 Meter Study included data for over 600 homes from various locations throughout the City. The 2015 Meter Study showed a variance of less than 1% from the results of the 2011 Meter Study, but greater variance by neighborhood. The average demand factor was maintained at 0.46 AF/DU/YR. Because of the neighborhood variance, a future meter study that incorporates GIS technology to easily differentiate variables would be helpful to further define subcategories at this housing density and help refine future demand estimates.

Medium Density Residential

The Medium Density Residential (MDR) category includes houses with densities ranging from 6.0-12.9 DU/Acre. The demand factor from the 2008 General Plan assumed 0.52 AF/DU/Yr, which was inclusive of a 15% loss factor – resulting in a factor of 0.45 AF/DU/Yr.

This unit type of property represents duplexes and other larger attached, or small lot detached housing – as is often associated with new development proposals. This unit class is found primarily on the west side of the City, but is expected to be a large part of future development in the City's designated growth areas. Medium density housing is a newer portion of modern development and, as a result, the majority of these unit types are new and not subject to great variability in the ages of the structures. Due to the relatively small number of these structures the sample size was limited to 55 units for the 2011 Meter Study. The results from the 2011 Meter study indicated a demand factor of 0.29 AF/DU/Yr.



Residential Demand Analysis Example

The 2015 Meter Study analyzed data from 434 meters in this land use category and found no change from the findings of the prior study.

A few of the City's proposed developments also use this designation, but represent larger lots and non-age restricted housing (many of the units analyzed in the meter studies include houses with the Del Webb and other age-restricted communities). This caused the need to establish development-specific demand factors. As an example, Village 5's MDR identifies larger lots than existing MDR, but fell between major land use categories. A Village 5-specific demand factor was calculated using standard indoor demands, coupled with outdoor estimates for lots at the upper end of the MDR density range. The result was a Village 5-specific demand factor for MDR of 0.39 AF/DU/Yr.

High Density Residential

The High Density Residential (HDR) category includes houses with densities ranging from 13.0-25.0 DU/Acre. The demand factor from the 2008 General Plan assumed 0.29 AF/DU/Yr, inclusive of a 15% loss factor – resulting in a demand factor of 0.25 AF/DU/Yr. This type of property is typically associated with apartments and townhomes. This unit class is found primarily on the west side of the City but is also part of designated land classes in future development expected within growth areas. High Density housing is generally a newer portion of the City's development and as a result, the majority of these unit types are relatively new, built after the introduction of plumbing codes, and not subject to great variability in the ages of the structures. The 2011 Meter Study sample size was limited to about 150 units. The result of the 2011 Meter Study indicated a demand factor of 0.22 AF/DU/Yr.

The 2015 Meter Study used data from 200 meters in this land use category. The newer data resulted in a slight revision to a demand factor of 0.21 AF/DU/Yr.

Commercial, Office, Business, and Professional Land Uses

This land-use class can have significant variances when assessed individually, limiting the usefulness of individual meter analysis. However, grouping the set of commercial operations that may share a parcel area (e.g. share a parking lot) provides for averaging the water use of different types of commercial operations – resulting in a more functional demand factor for use in forecasting. Distinct demand classes saw significant decreases in projected demands. Most of the analysis for this land-use class was completed in the 2015 Meter Study. For comparative purposes, the 2008 General Plan used a demand factor of 2.8 AF/AC/Yr for this generalized land-use class.

For the 2015 Meter Study, businesses were grouped together for analysis resulting in a much more realistic projection of future demands for the following three sub-classifications:

Village Commercial/Retail Commercial Land Use Demand Factor

This subclass includes shopping centers, larger format retailers, hotels/motels, banks, and restaurants, meant to serve the City's residents. The 2015 Meter Study resulted in a demand factor of 0.99 AF/AC/Yr – significantly lower than the assumptions used in the 2008 General Plan.

Office/Commercial Land Use Demand Factors

This subclass includes fitness centers, financial institutions, restaurants, other business services, and other appropriate supporting businesses meant to serve as freeway accessible moderately intensive employment.

The 2015 Meter Study resulted in a demand factor of 0.99 AF/AC/Yr – significantly lower than the assumptions used in the 2008 General Plan.

Business and Professional Land Use Demand Factors

This subclass includes medical offices, clinics, and professional business office space.

The 2015 Meter Study resulted in a demand factor of 1.22 AF/AC/Yr – still lower than the assumptions used in the 2008 General Plan. This subclass is higher primarily due to the inclusion of medical facilities in the meter study.

Public Land Uses

This land use category is comprised of municipal land (City buildings and grounds), parks, and schools. The demand factor from the 2008 General Plan assumes 5.82 AF/AC/Yr, inclusive of a 15% loss factor – resulting in a pre-loss demand factor of 5.06 AF/AC/Yr. The 2015 Meter Study separated available customer use data and analyzed the following subclasses:

Schools

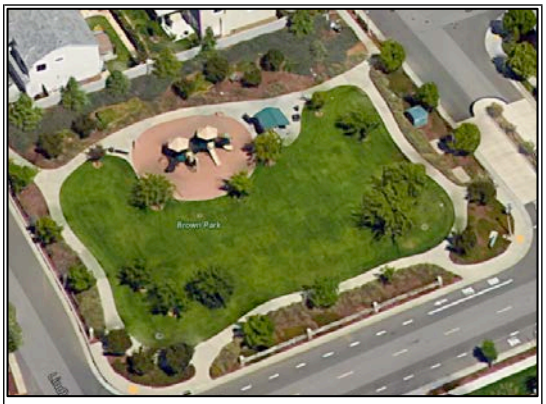
A school-specific demand factor was developed during the 2011 Meter Study – estimated at 2.57 AF/AC/Yr. But, due to the limited or non-existing billing information, the value was simply estimated by measuring lot size percentages in GIS and applying general demand factors. However, the 2015 Meter Study did analyze use data and confirmed the prior representative demand factor.

Public/Quasi-Public

This land use class is anticipated to include water demands from safety facilities such as fire stations, utilities, local government offices and facilities, community centers, and other similar uses. Due to the lack of billing information available for the 2011 Meter Study, the previous demand was estimated by measuring lot size percentages in GIS an applying general demand factors, with a resulting demand factor of 2.80 AF/AC/Yr. The 2015 Meter Study confirmed these demand factors.

Parks and Linear Parks

The 2011 Meter Study identified a demand factor of 3.55 AF/AC/Yr for typical neighborhood and community parks. However, many of the new developments also include “linear parks” that have differing proportions of non-irrigated areas (e.g. hardscape) than compared to neighborhood and community parks. The 2015 Meter Study determined these linear parks should have a demand factor of 3.73 AF/AC/Yr.[3]



Typical Neighborhood Park

[3] Linear Park Acreages were found to be limited to landscape areas more than typical parks that included other areas in total acreages including parking areas and other hardscapes.

Other Miscellaneous Uses

Recently proposed projects within the City have additional miscellaneous land uses including right of way landscaping, and various designations of open space (e.g. agricultural preserve, wildlife preserve, or common). These newer land-use classifications have not previously been assessed to understand specific demand factors. These uses have minimal impacts to the overall projected water use due to their limited water needs, and/or because they are temporary in nature. The following provides guidance used for demand forecasting.

Open Space

Open Space is often either planted with native landscaping or is left in its natural, undisturbed state. Either way, this designation does not require water over the long-term.

However, when native landscaping is planted, some water is necessary for plant-establishment. This demand may last for a few years after planting, after which the plants rely on natural precipitation. Establishment water, when necessary, uses a conservative demand factor of 3.73 AF/AC/Yr. Establishment irrigation is only anticipated to occur for less than 5 years.

Right-of-Ways

The 2011 Meter Study analyzed the demands for median landscaping and derived a demand factor that reflects the majority of this class is hardscaped (e.g. roadways), resulting in a minimal demand factor of 0.19 AF/AC/Yr for the entire right-of-way area (e.g. inclusive of the roadways, sidewalks, etc.).



Right-of-way Landscaping Example

High Water Use Industrial

High water using industrial customers, such as Gladding-McBean and Sierra Pacific Industries, use large quantities of potable City water, but also take up large areas within the City. These specific high-water users are reflected in demand forecasts based on their individual meter data records, so unit-based demand factors are not applicable.

4.2.1.5 Summary of Demand Factors

This section summarizes the demand factors developed from the 2011 Meter Study and 2015 Meter Study as applicable to forecasting the City's water demand.

These demand factors should not be considered static, as a variety of factors will continue to influence future land-use class-based demand factors. Demand factors should be analyzed about every 5 years. Given some of the lasting impacts of the recent drought on individual use and water use habits, many of these demand factors will likely be adjusted further downward.

Additionally, trend tracking of the City's demand factors over time will provide a useful tool in updating and refining future water system analysis.

These demand factors represent the most current and complete analysis available for the City and reflect factors used to forecast demands presented in the 2015 UWMP.

Residential demand factors are presented in **Table 4-3** and non-residential demand factors are in **Table 4-4**.

Table 4-3 – City of Lincoln Residential Annual Demand Factors

Residential Demand Category	Average Density (du/ac)	Indoor Factor	Outdoor Factor	Total Demand Factor (af/du)
Country Estate	2.0	0.19	0.67	0.86
Low Density	5.0	0.19	0.27	0.46
Medium Density (Village 5)	7.0	0.18	0.21	0.39
Medium Density	9.0	0.18	0.11	0.29
High Density	21.0	0.17	0.04	0.21

Table 4-4 – City of Lincoln Non-Residential Annual Demand Factors

Land Use	Demand Factor	Unit
Village Commercial	0.99	af/ac
Commercial	0.99	af/ac
Office/Commercial	0.99	af/ac
Business and Professional	1.22	af/ac
Elementary Schools	2.57	af/ac
Middle School	2.57	af/ac
High School	2.57	af/ac
Public/Quasi-Public	2.80	af/ac
Parks	3.55	af/ac
Linear Park	3.73	af/ac
Open Space (establishment only)	3.73	af/ac
Right of Ways	0.19	af/ac

4.2.1.6 Influencing Future Demand Factors

There are several factors that affect the development of future unit water demand that will be used by the City for future evaluations and updates to demand forecasts. These range from state mandates to changes in the types of housing products being offered, to simple changes in customer behavior. While the demand factors presented in **Table 4-3** and **Table 4-4** are likely conservative in that they do not reflect theoretical reductions from many evolving factors, they

provide the City with a level of certainty for near and mid-term demand forecasts. Characteristics of the most important factors are described below.

Water Conservation Objectives

On November 10, 2009, Governor Schwarzenegger signed SBX7-7, which required each urban water supplier to reduce its per-capita water use by 2020, with a statewide goal of achieving a 20-percent reduction by 2020.[4] The City has established a 2020 Target GPCD in response to this requirement and its current use (see **Table 4-1**) nearly meets this target already.[5] In May 2016, Governor Brown issued an executive order (EO B-37-16) that, among other things, directed the State Water Resources Control Board (Board) to build upon the 20 percent reduction goal.[6] The Board is currently evaluating methods to achieve this directive, with new conservation targets potentially in place by 2020.

Indoor Infrastructure Requirements

In January 2010, the California Building Standards Commission adopted the statewide mandatory Green Building Standards Code (hereafter the "CAL Green Code") that requires the installation of water-efficient indoor infrastructure for all new projects beginning after January 1, 2011. The Cal Green Code was revised in 2013 with the revisions taking effect on January 1, 2014; however these revisions do not have substantial implications to the water use already contemplated by the 2010 Cal Green Code.[7] The CAL Green Code applies to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure.

All new developments must satisfy the indoor water use standards directed by the CAL Green Code, which essentially require new buildings and structures to reduce overall potable water use by 20 percent. Expected future customers will satisfy the standards through the use of appliances and fixtures such as high-efficiency toilets, faucet aerators, on-demand water heaters, or other fixtures as well as Energy Star and California Energy Commission-approved appliances.

California Model Water Efficient Landscape Ordinance

The Water Conservation in Landscaping Act was enacted in 2006, requiring the Department of Water Resources to update the Model Water Efficient Landscape Ordinance (MWELO).[8] In 2009, the Office of Administrative Law (OAL) approved the updated MWELO, which required a

[4] California Water Code § 10608.20.
[5] See the City's 2015 UWMP, Chapter 4, for further details.
[6] https://www.gov.ca.gov/news.php?id=19408
[7] "The 2010 CAL Green Code was evaluated for updates during the 2012 Triennial Code Adoption Cycle . HCD evaluated stakeholder input, changes in technology, implementation of sustainable building goals in California, and changes in statutory requirements. As such, the scope of the CAL Green Code was increased to include both low-rise and high-residential structures, additions and alterations." *Guide to the 2013 California Green Building Standards Code (Residential)*, California Department of Housing and Community Development, 2013.
[8] Gov. Code §§ 65591-65599.

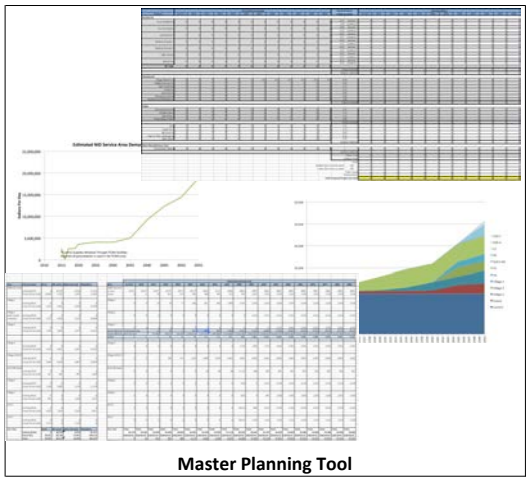
retail water supplier or a county to adopt the provisions of the MWELO by January 1, 2010, or enact its own provisions equal to or more restrictive than the MWELO provisions.[9]

In response to the Governor's executive order dated April 1, 2015, (EO B-29-15), DWR updated the MWELO again and the California Water Commission approved the revised MWELO on July 15, 2015. The changes include a reduction to 55 percent for the maximum amount of water that may be applied to a landscape for residential projects, which reduces the landscape area that can be planted with high water use plants, such as turf. The MWELO applies to new construction with a landscape area greater than 500 square feet (the prior MWELO applied to landscapes greater than 2,500 sf).[10] For residential projects, the coverage of high water use plants is reduced to 25 percent of the landscaped area (down from 33 percent).

It is difficult to predict the ultimate impact of the MWELO requirements on future water demand. While the requirement is for development of a landscape design plan that uses plants and features that are estimated to use no more than 55 percent of ETo, some recognition must be made for the inherent tendency to overwater even with irrigation controllers installed, piecemeal changes in landscape design, reductions in irrigation efficiency through product use, and limited resources for enforcement in the absence of dedicated irrigation meters.

4.2.2 Characteristics of Anticipated Growth

The City is in a unique position to couple the significant amount of land-use data with land-use based demand factors to develop a useful representation of expected demand over time. Land use information from the 2008 General Plan, various development Specific Plans or tentative map applications, and existing approved projects (yet to be built) provide a picture of anticipated rates of growth, types of expected growth and locations of that growth. This data supports forecasts of annual demand, but also becomes invaluable to integrate with the City's water infrastructure model to more practically anticipate delivery system improvements and potential limitations.


Master Planning Tool

To facilitate this effort, a comprehensive set of tables were constructed in a "living" Excel workbook (hereafter titled the "Master Planning Tool"). The Master Planning Tool includes an extensive number of individual tables developed to represent the various

[9] California Code of Regulations (CCR), Tit. 23, Div. 2, Ch. 27, Sec. 492.4. The MWELO provides the local agency discretion to calculate the landscape water budget assuming a portion of landscape demand is met by precipitation, which would further reduce the outdoor water budget.
[10] CCR Tit. 23, Div. 2, Ch. 27, Sec. 490.1.

land use data as understood by the City at any given point in time. The Master Planning Tool is meant to be a dynamic Excel workbook to allow the City to routinely update land use or water use information and re-evaluate forecast demand quantities and timing. Specifically, the Master Planning Tool represents the following land-use sources, listed by increasing level of certainty and/or detail regarding land-use plans:

2008 General Plan

The future projects accounted for in this subset of tables are derived from the 2050 General Plan adopted in 2008. The 2008 General Plan presents a number of Villages to be built in the City's Sphere of Influence (SOI) and provides a vision of housing densities and proportions of each density. These future areas with only the General Plan vision used to prepare a demand estimate represent the least developed City projects and furthest out time wise. Many of these projects are not anticipated to begin construction for more than 20 years. More information about the water model is discussed in **Chapter 9**, the Model Presentation and Assumptions Chapter.

Specific Plans

Several of the villages in the 2008 General Plan have prepared, or are preparing, specific plans that detail development plans. These projects have general housing counts for various housing types as well as acreages for non-residential demand types. These projects are generally anticipated to begin construction in the next decade and will buildout as housing demand allows.

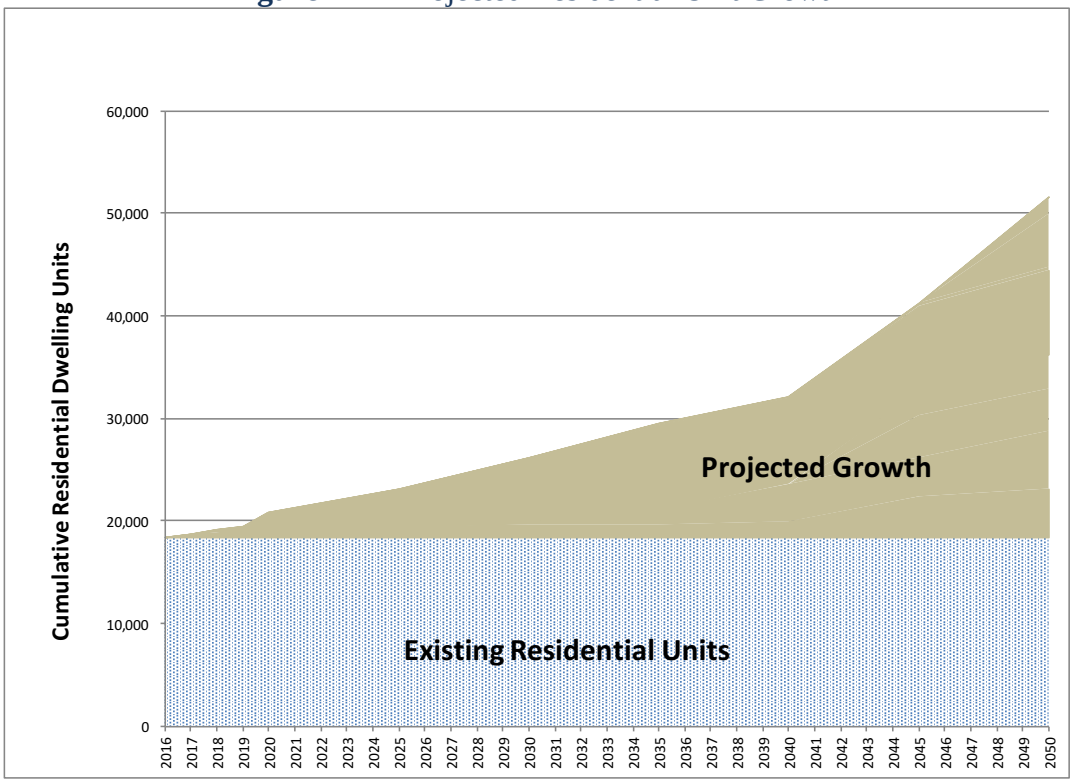
Pending or Already Approved (but not fully built) Tentative Maps

These projects typically have an adopted specific plan with tentative maps and are sold to home builders or are already in the early phases of construction. These project types have the most detail available with specific lot counts, specific non-residential acreages, landscape designs, and specific project elements.

For each category, the Master Planning Tool includes individual tables that identify anticipated residential and non-residential land use counts (e.g. dwelling units or acres), and calculates demands at various time intervals, using the growth defined by each project's representative development timeline. The counts are adjusted so as to match a standard growth rate to buildout expected by the City. A summary table sums the forecasted water demands and housing counts by 5 year intervals. Because each development-specific table within the Master Planning Tool has a unique set of residential and non-residential land-use classes, a summary of all the residential and non-residential unit counts over time is not practical. Rather, as demonstrated by **Figure 4-2**, the growth anticipated by the City mimics roughly a 3 percent annual growth in residential units. The growth in residential units associated with each development was adjusted in a manner that resulted in approximating this rate – with limit regard to which type of

residential class was being adjusted (e.g. the adjustments were made to all residential classifications from Country Estates to High Density).

Figure 4-2 – Projected Residential Unit Growth



4.2.3 Distribution System Losses

The demand factors presented earlier in this chapter represent the demand for water at each customer location. To fully represent the demand, distribution system losses must also be included. Often, these losses represent water that is lost due to system leaks, fire protection, construction water, unauthorized connections and inaccurate meters. Essentially, this is the water that is delivered to the City's main storage tanks or pumped by City wells that does not make it to the customer – either as a real loss or an apparent loss (e.g. such as may result when a customer meter under reports actual use). In most instances, the predominant source of distribution system losses is from leaks that inevitably exist throughout the many miles of pipes and service saddles.

As documented in the 2015 UWMP, the City calculated the distribution system loss for 2015 using methodology developed by the American Water Works Association (AWWA). The City calculated a loss equal to 11.8 percent of the water supplied into the distribution system. However due to the mandated conservation in 2015, this number is slightly higher than losses the

City has estimated in prior years (e.g. due to the lower overall use, but the system maintaining the same pressures, leaked volumes become a greater percentage of the total).

For purposes of estimating future demand from new connections, the distribution system loss is assumed to be 10 percent to reflect on-going City programs to address meter inaccuracies, find and fix identified system leaks, and normalize the mandated conservation requirements imposed in 2015.[11]

4.2.4 Demand Forecast Summary

Multiplying the projected land-use information detailed in the Master Planning Tool by the anticipated land-use based demand factors for the various projected development-specific land uses provides the City a functional forecast of annual water demand for many decades into the future. Notably, the further in the future the forecast, the less certain the projection. However, the City is most interested in the near and mid-term forecasts as they directly related to infrastructure planning (as discussed in the next section). **Table 4-5** summarizes the anticipated annual demand to build-out.

Note, however, that because the Master Planning Tool is very detailed to reflect development-specific land-use details, it does not create a summary by land-use class – only a summary of total demand. Thus, although the total demand projections in **Table 4-5** accurately reflect the Master Planning Tool, the breakdown by the listed land-use classes is an estimated representation. In other words, although the 2040 estimated demand of 20,336 acre-feet is from the Master Planning Tool, the representation of "single family" of 13,718 acre-feet may not exactly the single family demand if all of the unique single-family classes for each development-specific table were added together. The Master Planning Tool should be referred to for detail demand estimates.

As presented in the table, based upon the current configuration of growth and understanding of future land-use plans, the City anticipates needing about 36,000 acre-feet at build-out. For purposes of distribution infrastructure planning, this equates to approximately 32 million gallons per day on average (e.g. the ADD is 32 MGD).

[11] For purposes of estimating this quantity when viewed from the customer meter looking back to the "beginning" of the water supply distribution system, a slightly higher value is multiplied by the customer demands, then added to those demands to reflect a total projected demand.

Table 4-5 – Projected Annual Water Demand

Land-class		Forecast Demand (af/yr)					
		2020	2025	2030	2035	2040	Build-out
Multi-Family	Existing	562	538	515	492	468	468
	Future	82	242	421	642	853	1939
	Subtotal	644	780	936	1,133	1,321	2,407
Single Family	Existing	7,584	7,130	6,677	6,223	5,770	5,770
	Future	1,159	2,291	3,817	5,575	7,948	18077
	Subtotal	8,743	9,421	10,493	11,799	13,718	23,847
Commercial	Existing	245	245	245	245	245	245
	Future	129	271	491	568	905	2059
	Subtotal	373	515	736	813	1,150	2,304
Industrial	Existing	15	15	15	15	15	15
	Future	2	2	2	2	382	868
	Subtotal	17	17	17	17	397	883
Public	Existing	59	59	59	59	59	59
	Future	60	79	159	159	176	401
	Subtotal	119	138	218	218	235	460
Parks/ Landscape	Existing	694	694	694	694	694	694
	Future	472	566	673	729	789	1795
	Subtotal	1,166	1,260	1,367	1,423	1,483	2,489
Subtotal		11,063	12,132	13,768	15,404	18,305	32,391
Unaccounted water (at 10%)		1,228	1,347	1,528	1,710	2,032	3,595
Total		12,291	13,478	15,296	17,113	20,336	35,986

4.3 Relationship Between Demand Forecasts and Infrastructure Planning

The forecast annual demand detailed in the prior section is the foundation for determining when, where, and how distribution system infrastructure must be improved to meet the expected growing water needs of the City. The projected annual demand, however, must be modified in order to understand the potential infrastructure needs, such as pipe sizes, pumping capacities, well production rates, and treatment plant capacities. The annual demand needs to be translated to anticipated peak demands during the expected maximum days and peak hours of customer needs. Ultimately, it is these apex values that guide source water capacity requirements and infrastructure sizing.

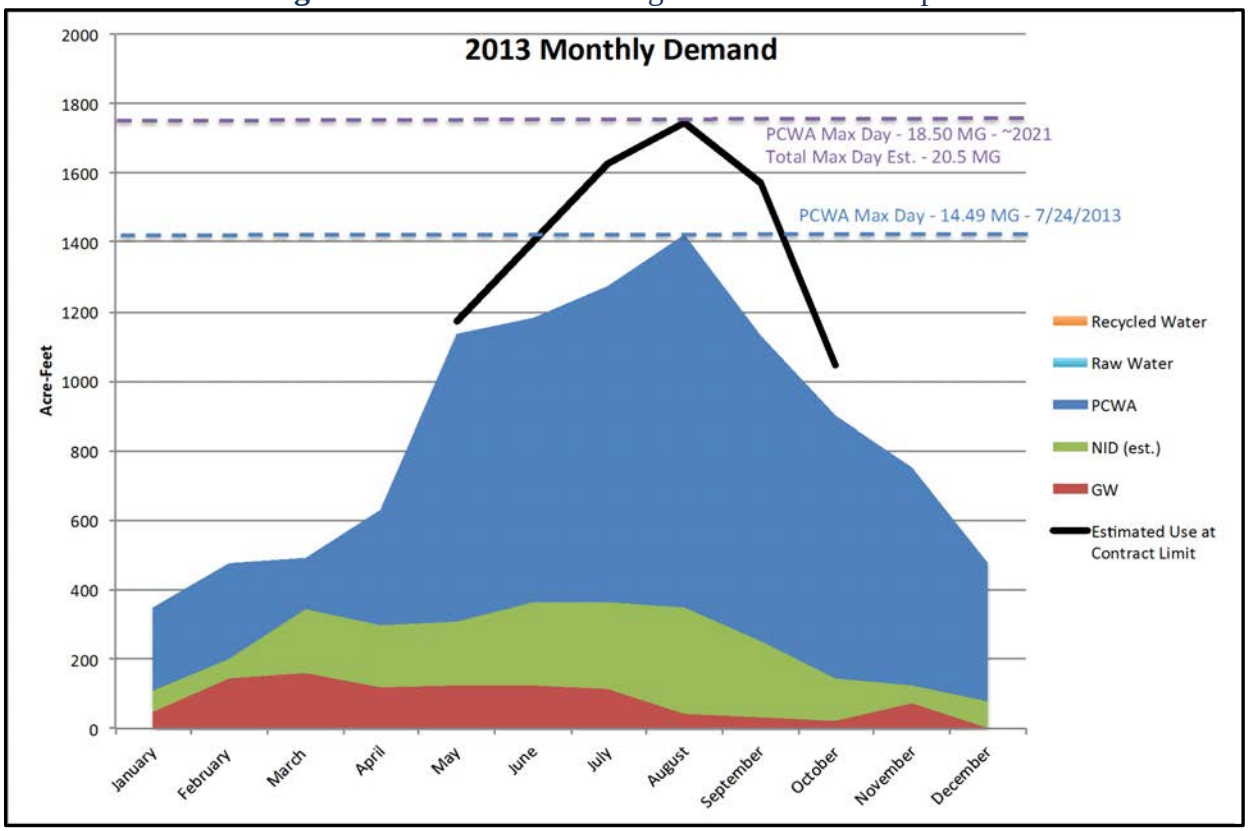
4.3.1 Annual Demands

As described in the prior section, demands are expected to grow annually until projected buildout conditions are reached around 2060.

If the typical annual demand or a single family home is evaluated on a monthly demand basis, it becomes evident that winter water use is lower than summer water use. This observation is intuitive because indoor water use is fairly constant year round but irrigation generally occurs

only during the dry, summer months. This pattern, normalized using data from many water meters, generates a curve that is flat in the winter, gradually ascends in the spring, peaks in the summer and again descends in the fall. The flat winter period generally represents the residential indoor demand, which remains nearly consistent throughout the entire year while the peak period represents the irrigation demands that generally start around March or April, peak in July and August, then taper off by September and October. **Figure 4-3** represents the peaking phenomenon. Besides reflecting the varied use by the City of its different supply sources, **Figure 4-3** demonstrates the significant difference between average monthly indoor demands seen in January, February and December, and the peak significant increase in monthly demand to meet added irrigation demands over the summer. The Average Day Demand (ADD) reflects the average of these lower winter demands and higher summer demands.

Figure 4-3 – Seasonal Peaking of Lincoln Consumption



4.3.2 Estimating Maximum Daily Demand

The ADD provides a useful value for purposes of securing water supplies (e.g. annual use of surface supplies, groundwater resources, and recycled water). But, for purposes of infrastructure sizing and design, an estimate of the potential maximum demand for any given day during the year is needed (commonly referred to as "Max Day" demand, or "MDD"). Most customer water meter data is only recorded monthly, so understanding the MDD requires evaluation of meters

that record water flowing into the distribution system (from production wells and from PCWA's metering station) in combination with customer meter data. The Max Day will typically occur during the highest water use month during the hottest time of the year (e.g. July or August for the City). Therefore, data from system meters as well as customer meters for July and August were analyzed to determine the average day demand during the peak month. Further assessment of the daily data records for system inflow meters allows a comparison of average day during the peak month to peak day. For the City, the Max Day was about 10 percent greater than the average day during the peak month.

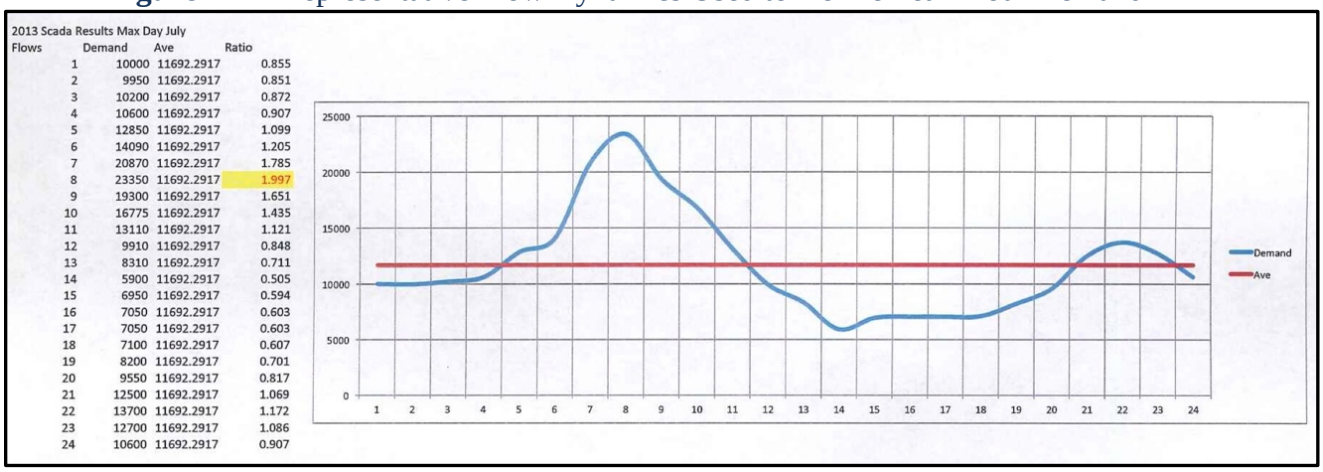
Historically, the City has used a value of 2.5 times its ADD to determine its Max Day demand. Based upon evaluation of system inflow meters and customer demands during the peak month, it appears that the City's Max Day multiplier may now be overstating the Max Day demand. This is likely due to continued improvements in irrigation management and changes in landscape plantings that require less water overall – lowering the peak demand. For the future homes, the new MWELO (discussed previously) further limits landscape plant types, likely further influencing the relation between ADD and Max Day.

For purposes of infrastructure planning, the City is adopting a Max Day demand of 67 MGD. This value reflects a multiplier between 2.0 to 2.2 – a range of between 64 and 70 MGD. It is important to note, however, that this Max Day reflects the potential build-out condition when the City anticipates serving about 36,000 acre-feet annually. Since that is projected to occur several decades from now, the Max Day estimate will continue to be refined as the water planning efforts are regularly updated.

4.3.3 Estimating Peak Hour Demand

Similar to translating ADD to generate a Max Day estimate, daily demands can be used to understand peak hour demands. Unlike the bell curve that represents the monthly variance of annual demand, hourly use is more sinusoidal with two distinct peaks and valleys. The typical hourly curve is different by user class, but given the preponderance of residential use in the City, a curve using system inflow data will likely represent typical residential daily use patterns. Using the inflow and well production meters beginning at midnight demonstrates a curve that starts about average usage, peaks in the morning, dips mid-day to below average, then peaks again in the evening.

Figure 4-4 – Representative Flow Dynamics Used to Define Peak Hour Demand



2013 Scada Results Max Day July

Flows	Demand	Ave	Ratio
1	10000	11692.2917	0.855
2	9950	11692.2917	0.851
3	10200	11692.2917	0.872
4	10600	11692.2917	0.907
5	12850	11692.2917	1.099
6	14090	11692.2917	1.205
7	20870	11692.2917	1.785
8	23350	11692.2917	1.997
9	19300	11692.2917	1.651
10	16775	11692.2917	1.435
11	13110	11692.2917	1.121
12	9910	11692.2917	0.848
13	8310	11692.2917	0.711
14	5900	11692.2917	0.505
15	6950	11692.2917	0.594
16	7050	11692.2917	0.603
17	7050	11692.2917	0.603
18	7100	11692.2917	0.607
19	8200	11692.2917	0.701
20	9550	11692.2917	0.817
21	12500	11692.2917	1.069
22	13700	11692.2917	1.172
23	12700	11692.2917	1.086
24	10600	11692.2917	0.907

The shape of this curve is explainable with a typical nuclear family routine in a day. The curve starts sloping upwards in the early morning as people shower, irrigation systems are often run and other morning activities are occurring. Mid-day use is low as most people are at work, and irrigation typically is not occurring due to being inefficient (and strongly discouraged). The evening peak represents residents returning home doing laundry, dishes, and bathing. In reality a number of factors impact water use and the timing thereof and the delay in tank releases and wells operations means there may be some shifting of the peaks than what the meters show (since these are not reflecting actual customer meters).

Commercial and industrial demands would typically be more constant and either continuous or limited to standard business hours.

The curve shape from the City is expected because the majority of water use is residential and driven by typical residential use patterns. A number of studies have found similar curves in residential driven service areas.[12] The City's policies, such as limits on watering times or on days of the week, can affect the resulting curve without changing the total daily demand – potentially flattening or increasing the hourly variance from average.

Similar to how an average line can be drawn across the representative monthly bell curve to understand the peaking factor between ADD and Max Day, a similar peaking factor can be derived for understanding peak hour demands. This peak hour factor is an important input to infrastructure design.

4.3.4 Historic Trends in City Planning Demands

Shortly after completion of the 2008 General Plan, the City assessed its projected demands and developed anticipated Max Day and Peak Hour requirements based on data available at that time.

[12] Residential End Uses of Water, AWWA 1999

A Max Day demand of 118 MGD was determined. This determination would drive significant investments in infrastructure and supply contracts – including potentially calling for larger pipes (up-sizing) or building many miles of new pipe parallel to existing infrastructure to accommodate the high peaks.

As presented in the previous sections, the new projection of annual demand and resulting Max Day needs has shrunk significantly. This is mostly due to the improved data used to establish unit demand factors, coupled with improved land-use information and on-going conservation standards.

The new Max Day design value established by this WMP effort is 67 MGD – almost half the value projected as part of the 2008 General Plan efforts. This reduction will result in significant savings in terms of water supply contracts, treatment plant facilities, and conveyance infrastructure.

The significance of this drop highlights the importance of ongoing demand trend tracking. Forecasting future demand is only as good as the quality of the data used, which is highly reliant on the City's on-going data management and analysis protocols. It is critical that the City continue to periodically re-assess demand factors, land-use understandings, and peaking factor relationships to assure infrastructure requirements are appropriately being planned and installed.

4.4 Recommendations

As part of its on-going data management and analysis protocols, this Comprehensive Water Master Plan recommends that the City:

- Complete a comprehensive customer meter study every 5 years to evaluate any necessary refinements to land-use based demand factors.
- Track addresses of residential and commercial water use audits and rebate programs and analyze before and after conditions to assess the benefits of audits (including non-audited customers can help evaluate the benefits of the audit compared to naturally occurring changes in water use).
- Increase the information and functionality of the existing City SCADA system to obtain more data points to further improve pressure and flow management.
- Calibrate system meters and replace undersized system meters.
- Install additional meters on main transmission lines in key areas of the system to enable improved understanding of customer water use dynamics.

- Expand support for PCWA and NID raw water supplies to offset potable demands. Use of raw water will reduce the demands on the City's potable water infrastructure and reduce Max Day and peak hour demands.

- Expand use of recycled water to also reduce the demand on the City's potable water infrastructure.

- Investigate potential water use policies that can help manage peak hour and Max Day demands in a manner that can decrease pipeline sizing and other infrastructure expansion.

CHAPTER 5. SURFACE WATER SUPPLIES

5.1 Introduction

This chapter describes the City of Lincoln's existing and planned surface water assets through build out of the City's current projects. The water supplies that are used within the City and its Sphere of Influence (SOI) are derived from PCWA, NID, groundwater and recycled water. All water supplies derived from these sources are managed in order to best meet the City's demands in different year types, reduce delivery costs, manage water quality issues, and handle drought and emergency situations. As such, water deliveries from each identified source may fluctuate in any given year because of management decisions, regulatory constraints, and hydrological conditions.

The water derived from these sources constitutes the City's surface water supply portfolio and are described in more detail in the subsections below. Each asset is derived from specific water rights, contracts, and planning arrangements that are subject to specific regulatory rules and contractual constraints. Some water assets that enter the City and its SOI are not controlled by the City yet may influence the City's water management activities among the water assets that the City does control. Nevertheless, the diversity of surface water assets available to the City in its water supply portfolio as well as the volumes of water controlled by its wholesale providers, make the City of Lincoln's surface water supplies, in combination with the City's groundwater supplies (discussed in **Chapter 6**), available to meet its demands in normal years, a single-dry year, and multiple-dry years.

5.2 Historical Potable Water Supplies

The City's potable water supplies have historically included water supplies that are treated and delivered through PCWA's treatment and conveyance system. Today, the surface water that is treated and delivered to the City consists of PCWA surface water rights and entitlements as well as Nevada Irrigation District (NID) water rights and entitlements. Under current contractual and operational conditions, PCWA's and NID's wholesale water assets are commingled in PCWA's treatment and conveyance system before they are delivered to the City. The City also uses groundwater during periods where treated surface water through PCWA's system is reduced as well as to manage seasonal summer maximum day and peak hour water demands. **Table 5-1** shows the City's annual surface water and groundwater potable water supply volumes that are used to meet the City's treated water demands.

Table 5-1 – City of Lincoln Historic Water Supplies

Supply (AF)			
Year	Ground Water	Surface Water	Total Supply
2006	623	8,753	9,376
2007	924	9,396	10,320
2008	1,085	9,443	10,528
2009	836	9,326	10,162
2010	962	8,253	9,215
2011	2,686	6,795	9,481
2012	2,620	7,471	10,091
2013	1,113	9,745	10,858
2014	691	8,257	8,948
2015	707	6,922	7,629

The City generally only purchases and delivers water that is required to meet the City's customers' demands on a daily basis. **Chapter 6** provides a comprehensive overview of the City's groundwater assets. Although the City may have the capability to access and use additional supplies from its various water sources, its operational relationships with its wholesale providers as well as its groundwater management foster a tempered approach – where the City acquires only those water assets that the City needs to meet its demands.

5.3 Existing Water Supplies and Entitlements

There are five primary surface water contracts and entitlements (collectively, "water supplies") that are used within the City's existing service area and SOI. All five of these water supplies are used to meet the water demands for the City's residents. And, in several areas within the City and its SOI, the water supplies can be interchanged for deliveries to certain water users. The water supplies are:

- PCWA contract entitlement
- NID contract entitlement
- PCWA raw water entitlements
- NID raw water entitlements
- Recycled water rights

Each of these water supplies are subject to a unique set of conditions based upon their underlying water rights, the regulatory environment, the contractual limitations, and the City's ability to access and deliver the supplies to meet targeted end-user needs. Within

this structural framework, the City manages its water assets to meet its customer's needs. Importantly, the structural framework morphs and changes requiring the City's water managers to adjust water asset management and system operations.[1]

5.3.1 PCWA Treated Water Supply Contract

In 2012, the City entered into an updated water supply contract with PCWA for delivery of treated surface water.[2] The PCWA Contract entitles the City to a Maximum Delivery Entitlement of 18,501,424.5 gallons (or 18.5 million gallons) of treated water supply.[3] The contract distinguishes between regulated and unregulated deliveries as follows:

- Maximum day Regulated Deliveries of **17,774,452** gallons per day; and
- Maximum day Unregulated Deliveries of **726,972.5** gallons per day.

Regulated water deliveries are those deliveries where water is delivered at a set (regulated) flow rate from PCWA and the City uses its storage infrastructure to deliver water on a demand pattern for certain uses within the City. Specifically, the City uses its storage facilities to compensate for variances in demand over the course of a day/week to accommodate peak demands. Unregulated water deliveries are those water deliveries that are made to the City where PCWA uses its system storage to manage the water deliveries and maintain pressures. Supplies from PCWA in this zone are available "on demand" to meet customers' instantaneous needs without first entering City owned storage infrastructure. PCWA's unregulated deliveries currently serve the City's "high elevation lots" generally in the Catta Verdera area.[4] The PCWA Contract also contains opportunities for the City to purchase additional supplies beyond the Maximum Delivery Entitlement identified in the contract.

The City's PCWA Contract provisions require PCWA to deliver water up to the max day delivery amount to the City for use in the City's service area. The contract contemplates delivery of water supplies derived from PCWA's water rights and entitlements as the basis for the supplies coming to the City. Water from PCWA is treated at PCWA's Foothill Water Treatment Plant and is then delivered to the City. The PCWA Contract has a term of 20 years and a right of renewal for successive 20-year periods.

The maximum day water supply delivered to the City from PCWA's system is measured at the Lincoln Metering Station. In 2013, the most recent year without mandatory

[1] The City is investigating additional water assets that may be included in its water supply portfolio.
[2] The Contract is titled: "Contract between Placer County Water Agency and the City of Lincoln for a Treated Water Supply" dated November 13, 2012. (Hereafter, "PCWA Contract").
[3] Article 5(b) PCWA Contract.
[4] Article 5(c) PCWA Contract.

drought reductions, the City's max day regulated use under the contract was 13,944,160 gallons and the maximum day unregulated water use was 605,716 gallons.[5] This delivery included water derived from NID's water assets – which is described in more detail below.[6] The maximum day measurement – is just that – the single day in the calendar year when the City uses the most water as measured at the Lincoln Metering Station. As such, the max day water use can be modified depending upon which sources of water are used during specific times of the year and managing the timing of peak demand on the City's system.

In 2015, PCWA indicated that the City's remaining unused peak flow capacity under its contract was approximately 3.8 million gallons on the regulated side and 0.12 mgd on the unregulated side.[7] PCWA estimated this amount based upon 2013 demand figures – the last normal water year where demand reductions were not mandated by the State of California. The PCWA Letter indicates that PCWA has additional future treatment and delivery capacity of approximately 3.86 million gallons per day (mgd) of unallocated capacity at its Foothill Water Treatment Plant and Sunset Water Treatment Plant.[8] The recent treated water supply quantities delivered by PCWA to the City are shown in **Table 5-2**.

Table 5-2 – Historic PCWA Treated Water Supplies Delivered to the City of Lincoln

Year	Supply (AF)
2006	6,940
2007	7,736
2008	7,779
2009	7,724
2010	6,772
2011	5,672
2012	6,173
2013	7,825
2014	6,617
2015	5,425

5.3.2 PCWA Water Rights

Importantly, the City's treated water supplies contemplated in the PCWA Contract for delivery to the City are grounded in PCWA's water rights and contracts. In other words,

[5] Letter to Matthew Brower from Brent Smith dated March 1, 2016 at page 2. (Hereafter, "PCWA Letter").
[6] PCWA Letter at page 1.
[7] PCWA Letter at page 2.
[8] PCWA Letter at page 2.

the reliability of water supply delivery to the City is grounded in the underlying water rights and contracts held by PCWA.

PCWA's surface water supplies consist of water from the North Fork American River and its tributaries – including water stored in its Middle Fork Project (MFP) – under water right Permits 13856 and 13858; Central Valley Project (CVP) project supply under CVP Contract 14-060200-5082A from the American River; and water purchased from Pacific Gas & Electric Company (PG&E) from the Yuba and Bear Rivers under two contracts: the 1982 Zone 3 Contract Purchase Agreement and the February 27, 2015 Water Supply Agreement. PCWA uses a limited amount of surface water from small creeks under its pre-1914 appropriative water rights.

5.3.2.1 Permits 13856 and 13858

PCWA's Permits 13856 and 13858 are post-1914 appropriative water rights subject to State Water Resources Control Board (SWRCB) jurisdiction. Post-1914 water rights are those water rights created after the formation of the SWRCB (in 1914) and are regulated by the SWRCB as an administrative body within California's Executive Branch. California's SWRCB-governed water rights system consists of a three step water right staged process – application, permit and license stages. PCWA's water rights are in the permit stage, meaning that PCWA has not yet put the water supplies it applied for under its applications and was granted to use under its permits to full beneficial use.[9] PCWA is engaged in a "permit renewal process" whereby it is working with SWRCB to extend the time limitations placed upon it to fully utilize the water.

Permits 13856 and 13858 have diversion priority dates of April 7, 1958 and April 8, 1958, respectively. These priority dates are generally junior in priority to many other water rights on the American River system and are junior in priority to the Central Valley Project (CVP) water rights that constitute the Folsom Reservoir diversions to serve CVP customers throughout California. PCWA diverts water under these rights to its Middle Fork Project storage reservoirs for use throughout the year. In 2014 and 2015, two of the driest years on record, PCWA's water rights were curtailed from direct diversion or diversion to storage through SWRCB orders.

PCWA may use water under its permitted water rights in western Placer County, as well as portions of northern Sacramento County, including San Juan Water District, Sacramento Suburban Water District, and Rio Linda/Elverta Community Water District service areas. PCWA's wholesale customers include the City of Roseville, San Juan Water District, and the Sacramento Suburban Water District. PCWA has signed an agreement with the United States Bureau of Reclamation (Reclamation) limiting its

[9] In addition to Permits 13856 and 13858, PCWA also possesses permits 13855, 20754, and 13857. However 13855 and 13857 report cumulative shared water used for power and recreation activities in 2015.

diversions under PCWA's permitted rights to 120,000 af/yr off of the American River for use within the current PCWA place of use.

The Water Forum Agreement (WFA) may reduce the water available under these Permits in certain years. The WFA requires PCWA to release up to 47,000 acre-feet of additional water in drier years through reoperation of MFP reservoirs (27,000 acre-feet for PCWA and 20,000 acre-feet for the City of Roseville) to replace water diverted above the WFA 1995 baseline volumes.[10] When projected March through November Unimpaired Inflow to Folsom Reservoir (UIFR) is between 950,000 acre-feet and 400,000 acre-feet, the amount of these additional water releases is linearly interpolated between 0 acre-feet and 47,000 acre-feet. When projected March through November UIFR is less than 400,000 acre-feet, it is considered a "conference year" where Water Forum participants meet to determine how best to manage the available water, recognizing that there may not be sufficient water to meet both deliveries and environmental release requirements specified in the agreement. Both 2014 and 2015 were "conference years" under the WFA.

Several additions to PCWA's diversion and conveyance infrastructure will need to be made in order to acquire all of PCWA's MFP water supplies under its Permits. The American River Pump Station will need to be expanded and Ophir Water Treatment Plant would need to be built. Assuming that these items move forward, watershed modeling indicates that Middle Fork Project water supplies could be reduced by as little 33 percent in dry years based on PCWA's water storage capabilities. Thus, PCWA anticipates the reliable dry year supply under Permits 13856 and 13858 to be 80,400 af/yr.

5.3.2.2 Permits 13855, 20754, and 13857

PCWA holds the rights to permits 13855, 20754, and 13857, in addition to Permits 13858 and 13856 discussed above. Based on the 2015 progress reports submitted to the State, 2,852 af/yr was reported for Permit 20754 and 138,494 af/yr was reported for Permit 13855. It should be noted that no water use was reported under Permit 13875, since Permit 13855 reported water use is representative of the cumulative water used for both Permit 13855 and 13857. Permit 13855 is the only permit with a diversion storage (up to 65,604 af/yr) and has recreation listed as a beneficial use in addition to power which is the only beneficial use listed for both Permit 13857 and Permit 20754. Furthermore, Permit 20754 supplements PCWA's License 12644 through direct diversion through the Hell Hole Power Plant for up to 17,640 af/yr. Combined, under these two rights, PCWA is able to divert 40 cfs year around up to 29,140 af/yr.

[10] PCWA's baseline volume is 8,500 af/yr. The City of Roseville's baseline volume is 19,800 af/yr.

5.3.2.3 Central Valley Project Contract

PCWA has a Central Valley Project (CVP) water contract with the United States Bureau of Reclamation (Reclamation) for delivery of up to 35,000 af/yr for Municipal and Industrial purposes, including groundwater recharge programs that are consistent with applicable State law. The term of the CVP contract, Amendatory Contract 14-060200-5082A, was through 2011, but included a long-term renewal provision. The contract has been extended through three two-year interim renewal contracts since 2011 until a long-term renewal contract can be implemented by Reclamation. The long-term renewal is pending resolution of issues regarding environmental documentation associated with the CVP. The current interim contract is good through February 28, 2018. [11]

PCWA's point of diversion for CVP water is Folsom Dam, but the contract could also include the potential for other diversions, including the Sacramento River, if the Contracting Officer agrees to the points of diversion. PCWA does not currently own or control facilities that are capable of conveying CVP water from Folsom Dam or the Sacramento River to the PCWA service area. As such, the availability of the water supply is currently affected by physical limitations. PCWA is engaged in negotiations with the City of Roseville and other regional entities to potentially utilize existing facilities to divert and deliver PCWA's CVP project water supplies. The CVP contract identifies only a portion of PCWA's Zone 1 service area as the area available for water deliveries from CVP Project supplies.

Article 3(b) of the CVP contract indicates that of the 35,000 af/yr identified in the contract, the amount of water that would likely be delivered in normal years is 32,000 acre-feet.[12] Reclamation reserves the right to apportion the available CVP water supply between PCWA and other CVP water contractors under Reclamation's Municipal and Industrial Water Shortage Policy (M&I WSP). The M&I WSP generally defines water service terms and conditions under drought conditions. The M&I WSP is valid through 2030. Generally, reductions in M&I deliveries should not exceed 25 percent, unless conditions are severe. In 2015, M&I WSP allocations on the American River watershed were 25 percent of the historical use – meaning 25 percent of the last three normal years average use adjusted for identified variables.

PCWA anticipates that in dry years its CVP Project Supply would be reduced by approximately 50 percent. Accordingly, the dry year supply is approximately 16,000 acre-feet per year.

[11] Contract No. 14-06-200-5082A-IR3 dated March 1, 2016.
[12] Contract No. 14-06-200-5082A-IR3.

5.3.2.4 PCWA Pacific Gas & Electric Contracts

PCWA has two water supply contracts with PG&E that provide opportunity to purchase up to 125,400 af/yr for irrigation and domestic purposes. For practical purposes, the delivered supply has historically peaked at 110,400 af/yr. The underlying rights for the PG&E supply are PG&E's pre-1914 appropriative rights to water in the Yuba and Bear Rivers, which were established prior to the time that PG&E developed hydroelectric facilities throughout the Yuba and Bear River watersheds.



PG&E Drum-Spaulding Project

Image Couteasy 2014 FERC EIS

The water supply that PCWA purchases from PG&E is used to meet both treated and raw water demands within PCWA's Western Water System. In 1968, PCWA purchased PG&E's lower Placer Water System, including its distribution canals and treated water systems as well as rights to delivery of 100,400 af/yr of water from PG&E's Drum-Spaulding Project to serve PCWA customers in the Western Water System area. This supply generally serves PCWA customers in Western Placer County.[13]

PCWA and PG&E entered a new Water Supply Agreement on February 29, 2015. In Article II of the Agreement, PG&E will continue to deliver 100,400 acre-feet of water to PCWA from the Drum-Spaulding Project. PCWA will purchase this water during a water contract year from (Oct 1 to Sept 30 of the following year). PCWA is also entitled to purchase additional water if made available by PG&E. In the Agreement, however, PG&E:

- Grants PCWA and NID right of first refusal for surplus water[14]
- Has no obligation to deliver water of a particular quality[15]
- Takes no responsibility for defects in its water rights[16]

[13] The demarcation for Western Placer County is the service area line separating PCWA's Zone 3 from Zone 1 customers seen in PCWA's 2015 UWMP.
[14] 2015 Water Supply Agreement, Article II, paragraph 2.3.
[15] 2015 Water Supply Agreement, Article II, paragraph 2.4.
[16] 2015 Water Supply Agreement, Article III, paragraph 3.4(c).

- May suspend deliveries in case of "any stoppage and/or impairment in the flow of water except to the extent such stoppage and/or impairment results from a breach of…under this Agreement."[17]

The 2015 Water Supply Agreement terminates upon "the expiration date of the New FERC License…."[18]

The Drum-Spaulding Project consists of 29 reservoirs, 6 major water conduits, 12 powerhouses as well as other water infrastructure, power, and recreation related facilities. In 2014, the Drum-Spaulding Project was divided into three distinct projects for purposes of Federal Energy Regulatory Commission (FERC): Upper Drum-Spaulding, Lower Drum, and Deer Creek hydroelectric projects.[19] Although the systems are currently operating on annual FERC license renewals, when the final FERC licenses are issued they will have a term between 30 and 50 years.

The Upper Drum-Spaulding, Lower Drum, and Deer Creek hydroelectric projects are FERC licensed facilities and are subject to the terms and conditions of the three FERC Licenses affecting their operations. In concert with the terms of these licenses, PG&E provides wholesale water to PCWA for consumptive uses in PCWA's service area. While federal law allows for FERC to adopt permit conditions that mandate minimum flows, reservoir levels or set temperature limitations related to operation of a hydroelectric facility, these provisions should not affect the appropriation and distribution of water for consumptive purposes at this time.[20] Future conditions in the FERC License renewal process could impact deliveries for consumptive purposes.

In 1982, PCWA purchased the remainder of PG&E's Upper Placer Water System.[21] In the PG&E and PCWA Purchase Agreement, PG&E agreed to deliver as much as 25,000 acre-feet per year from PG&E's Drum Spaulding Project as part of the Upper Placer Water System conveyance.[22] PCWA typically acquires 10,000 acre-feet during normal years. PCWA generally delivers water under this Agreement to customers in its Zone 3 service area – outside the boundaries of the City of Lincoln or its sphere of influence.

PG&E's pre-1914 water rights and supplies delivered through its system under these water rights are highly reliable during normal, single-dry, and multiple-dry year periods. Between 1987 and 1992, when the State of California experienced a 5-year drought,

[17] 2015 Water Supply Agreement, Article IX, paragraph 9.1.
[18] 2015 Water Supply Agreement, Article I, paragraph 1.2.
[19] NID's Yuba-Bear hydroelectric project is also incorporated into the Final FERC EIS.
[20] 16 U.S.C. § 821.
[21] Purchase Agreement between Pacific Gas and Electric Company and Placer County Water Agency dated November 17, 1982 (hereafter "PG&E and PCWA Purchase Agreement").
[22] PG&E and PCWA Purchase Agreement at Exhibit A.

PCWA had a full Yuba/Bear river supply each year. In the 2015 water year, one of the driest years in California's history, PG&E delivered 76,119 acre-feet of water to PCWA – 68.9 percent of the 110,400 acre-feet that PCWA anticipates each year. This reduction represents significant supply reliability as compared to other sources of water in California in 2015 where supplies were reduced to a much greater extent (even zero in some cases). Nevertheless, for conservative long-term planning purposes, PCWA anticipates that it will experience a 50 percent reduction in its PG&E supply in single dry years and a 25 percent reduction in multiple dry years equating to 55,200 acre-feet and 82,808 acre-feet respectively.[23]

5.3.2.5 PCWA Pre-1914 Appropriative Water Rights

PCWA also possesses four pre-1914 appropriative water rights for diversion of water from various small creeks and their tributaries in western Placer County. These rights are generally for agricultural purposes – including stockwatering and irrigation. In 2014, the combined diversion for all four water rights approximated 2,500 acre-feet. These water supplies are not used in PCWA's treated water system. It is unclear whether they are used in PCWA's raw water conveyance through the Caperton Canal

5.3.2.6 PCWA Water Supply Summary

PCWA anticipates that it will have approximately 252,000 acre-feet of surface water available in normal years and approximately 146,000 acre-feet of surface water available in dry years for its wholesale, retail, and raw water deliveries. **Table 5-3** below depicts PCWA's available supplies for the City of Lincoln.

Table 5-3 – PCWA Available Surface Supplies[24]

Supply	Average/ Normal	Single Dry Year	Multiple Dry Water Years		
			Year 1	Year 2	Year 3
	af/yr	af/yr	af/yr	af/yr	af/yr
Pacific Gas & Electric	110,400	55,200	82,800	82,800	82,800
Middle Fork Project	120,000	80,400	120,000	120,000	120,000
Central Valley Project	32,000	16,000	24,000	24,000	24,000
Pre-1914	3,400	850	1,700	1,700	1,700
Total	265,800	152,450	228,500	228,500	228,500

At build-out, the City anticipates relying upon as much as 37,000 acre-feet per year of water from PCWA as part of its water supply portfolio necessary to meet its municipal and industrial demands. Although the City's contract with PCWA does not guarantee

[23] These numbers represent the combined PCWA PG&E contract supplies taken from the 2015 UWMP. The same reduction percentages as applied to the Zone 1 supplies only. These numbers are shown in **Table 5-3**.

[24] As described in Section 5.3.2, availability of CVP supply requires necessary diversion and conveyance infrastructure to be built. And full diversion of the MFP requires additional conveyance capacity at the American River Pump Station as well as construction of Ophir Water Treatment Plant.

that this amount will be available, PCWA's 2015 UWMP as well as its MFP Permit renewal efforts indicate that the quantity desired by the City will be available at build-out of the City's general plan area as defined by the Adopted 2008 General Plan Update.

5.3.3 NID Surface Water Contract and PCWA Delivery Contract

NID supplies irrigation, wholesale, and retail water to Nevada County and Placer County customers. Agricultural water use accounts for nearly 90 percent of the total demand on NID water supply. The remaining water supplied to Placer County residential customers by NID is primarily delivered directly through PCWA's system to single-family residential accounts. NID's mountain watersheds cover 70,000 acres and include the upper portions of the Middle Yuba River above Milton Diversion, Canyon Creek above Bowman Reservoir, and Deer Creek.

The City and Nevada Irrigation District (NID) entered a temporary water supply contract for water deliveries to NID customers and developments that will be incorporated into the City's service area upon annexation. Through this agreement, NID provides additional surface water to the City for deliveries into the NID service area. The water contemplated in this agreement is provided by NID to PCWA for treatment and delivery to the City.

The amount of water available to the City from NID at build out is quantified as approximately 12,000 acre-feet based on the City's long-term demand estimates. Historically, NID has delivered through PCWA's system as much as 1,920 acre-feet of water to NID's service area within the City's boundaries. The actual amount of water that will be available to the City in the future, however, has not been finalized and the existing agreement has no clause expressly quantifying the available supply.[25]

Nevertheless, NID's 2015 UWMP posits that water shortages to its overall water supply would only occur in the driest of years. In 2015, the driest year in California's history, NID experienced no water shortages. All reductions in deliveries to end-users were mandated by SWRCB regulations requiring reductions in consumptive use. However, in the event that shortages were to occur, NID would equally reduce water supplies between its domestic water customers and the City.

[25] Paragraph 6 of the NID-Lincoln contract states: "Raw water delivered by NID under this agreement is subject to scheduled and unscheduled outages. It will be PCWA and/or Lincoln's responsibility to provide an alternate treated water supply during such outages so that deliveries to Lincoln's customers by NID will not be disrupted." Paragraph 10 of the contract states: "This agreement is intended to be a temporary agreement to be in effect until such time as NID constructs a treatment plant and other facilities sufficient to enable NID to supply treated water to Lincoln for those customers within Lincoln that are also within NID's boundary."

In September 2004, the City, PCWA and the Nevada Irrigation District (NID) entered into temporary raw water sales agreement pursuant to which NID supplied raw water to PCWA treatment facilities for delivery within the City's water service area. **Table 5-4** below summarizes NID water deliveries into the City's service area from 2008 until present. The delivery mechanism for these supplies has been PCWA's treatment and delivery systems.

Table 5-4 – Historic NID Water Supplies Delivered to the City of Lincoln[26]

Year	Supply (AF)
2008	1,664
2009	1,602
2010	1,481
2011	1,123
2012	1,298
2013	1,920
2014	1,640
2015	1,497

The City and NID are jointly planning a regional water treatment plant that would serve NID water and potentially PCWA water to various areas in Lincoln and Lincoln's SOI. This proposed facility could deliver approximately 17,500 acre-feet of water per year. The City negotiated a Water Facilities/Planning Phase agreement with NID in 2007 to establish a conceptual framework for the design and construction of a new $265.7 million water treatment facility.[27] The preferred location for the new plant is near NID's Valley View site located northeast of the City, as identified in the *Lincoln Area Water Treatment Plant Planning and Site Study* (2005). The proposed treatment facility would allow NID to serve treated water within the NID service area to customers in the Lincoln SOI rather than wheeling that water through PCWA's system.

NID is currently working on completing the planning, design studies, environmental review, and engineering details necessary to better define the project and its alternatives. In 2005, NID had planned to start operating the plant by 2015 but the economic downturn slowed growth. NID expects the planning, design, engineering, environmental review, and permitting to take many years. However, in the interim, the existing agreement to route NID water through PCWA treatment facilities for delivery to the City will serve as the mechanism for NID to provide water to its service area within the City.

[26] Historic NID water supplies delivered to the City of Lincoln include 10 percent above metered amounts to account for delivery losses. Actual water use in the NID service area within the City and SOI has been higher than total NID water deliveries through the PCWA system because of other NID raw water deliveries to those locations. NID water shortages are anticipated to be made up through the use of well water.

[27] This can be found on the City of Lincoln's website.

5.3.4 NID Water Supplies

NID's water supplies consist of a variety of water rights and contracts that implicate the reliability of these supplies for current and future deliveries to the City. Specifically, NID has numerous pre-1914 appropriative water rights to waters in the Yuba River, Bear River and Deer Creek watersheds as well as post-1914 appropriative water rights to waters in the same watersheds. Collectively, these appropriative water rights allow for water diversions and collections to storage approximating 450,000 acre-feet of water each year. In addition to these rights, NID has a water supply contract with Pacific Gas & Electric Company for as much as 54,000 acre-feet of water as well as riparian rights that can be used for riparian purposes.[28] All of the relevant assets are described in more detail below.

5.3.4.1 NID Watershed Runoff Supplies

Nevada Irrigation District holds 25 pre-1914 appropriative water rights (pre-1914 rights) to the waters of the Yuba River, Bear River and Deer Creek watersheds.[29] Pre-1914 appropriative water rights are not subject to the jurisdiction of the State Water Resources Control Board (SWRCB). In other words, SWRCB does not have the authority to determine where the pre-1914 rights are diverted, how they are used, or where they are used so long as those uses (or changes to those uses) do not injure other legal users of water. Moreover, the senior nature of these water rights under California's water rights system makes them extraordinarily valuable. Specifically, water rights junior in priority to NID Pre-1914 rights on these watersheds (all post-1914 appropriative rights) must be curtailed before a single pre-1914 water right is curtailed. The water rights senior status makes them highly reliable during drought conditions.

NID also holds 28 post-1914 appropriative water rights to the waters of the Yuba River, Bear River, and Deer Creek watersheds. Post-1914 appropriative water rights are subject to SWRCB jurisdiction. The rights generally identify a point of diversion, purpose(s) of use, and place of use in order to assure other users about the availability of their water supplies. Changes in the use of these water assets are not permitted without SWRCB's consent.

Some of NID's pre-1914 and post-1914 appropriative water right assets are for power production purposes. This non-consumptive use of water essentially allows for the diversion and storage of water so that releases can be made for power generation

[28] This document will not assess the NID's riparian water rights as those water rights cannot be diverted to storage nor can they be used on lands within the City's service area. Although they are an important component of NID's water supply portfolio, they are not particularly relevant for assessing supply reliability to NID's deliveries to the City.

[29] NID's 2015 UWMP says that NID has 25 pre-14 rights but there are only 22 Statement of Diversion and Use filings with the SWRCB.

purposes through surface water reservoirs. Reviewing the filings submitted to the State, NID has 25 pre-14 rights, licenses and permits that list power generation as one of the beneficial uses. Of those 25, eight licenses exclusively list power as the beneficial use for an overall total volume of 112,787 AFY in 2015. Additionally, power is the only beneficial use for five of NID's permits for an overall total of 203,821AFY and one pre-1914 right which had no water reported.[30] The rest of NID's water reports to the State list a variety of beneficial uses including domestic, irrigation, industrial, municipal and recreation. The total volume of reported under all rights that included consumptive uses was 254,444 AFY. Non-consumptive water rights are relevant to this analysis only in that they determine the amount of water that can be held in storage and released for consumptive purposes within and outside of NID's service area.

Collectively, NID refers to all of its appropriative water rights as "watershed runoff."[31] Watershed runoff is NID's primary water supply. The amount of watershed runoff depends on the annual snowpack and the rate of snowmelt. In 2015, the total runoff available to NID was 77,378 acre-feet while in wet years watershed runoff has neared 470,000 acre-feet. Average runoff is approximately 221,500 acre-feet per year.

5.3.4.2 NID Carryover Storage

NID operates a system of surface water storage reservoirs directly related to its appropriative water rights. The nine reservoirs, with a combined storage capacity of 279,985 acre-feet include: Jackson Meadows, Bowman, Jackson Lake, Sawmill, Faucherie, French, Rollins, Scotts Flat, and Combie. **Table 5-5** shows the reservoirs and their storage capacity.

Table 5-5 – Water Supply Reservoirs

Reservoir	Capacity, ac-ft
Jackson Meadows	69,205
Bowman	68,510
Jackson Lake	1,330
Sawmill	3,030
Faucherie	3,980
French	13,840
Rollins	65,988
Scotts Flat	48,547
Combie	5,555
Total Capacity	279,985

[30] A summary table of PCWA's and NID's rights, reported beneficial uses, and total volume reported based on 2015 progress reports filed with the State is available upon request.
[31] Nevada Irrigation District 2015 Urban Water Management Plan.

NID holds its total carryover storage in its reservoir system to not less than 78,000 acre-feet annually. NID's carryover storage average is 129,400 acre-feet per year.

5.3.4.3 NID Pacific Gas & Electric Contract

NID and PG&E have water supplies that commingle in the context of both entities power production systems in the Yuba-Bear River watershed. PG&E has agreed to supply NID as much as 54,361 acre-feet of water per year from its water rights water in the Yuba-Bear system. This supply, however, is underutilized because there are significant conveyance restrictions in the delivery system. Specifically, conveyance restrictions reduce the available supply to approximately 8,000 acre-feet per year.

5.3.4.4 NID Water Supply Summary

NID anticipates that it will have approximately 477,000 acre-feet of water available in normal years and approximately 359,000 acre-feet available in dry years for its wholesale, retail, and raw water deliveries. **Table 5-6** below shows NID's normal year, single dry year, and multiple dry year supply reliability forecast.

Table 5-6 – NID Available Water Supplies

Supply	Average/ Normal	Single Dry	Multiple Dry Water Years		
			Year 1	Year 2	Year 3
	af/yr	af/yr	af/yr	af/yr	af/yr
Watershed Runoff	221,500	221,500	221,500	221,500	221,500
Carryover Storage	201,985	129,400	129,400	129,400	129,400
PG&E Contract	54,361	8,000	8,000	8,000	8,000
Total	477,846	358,900	358,900	358,900	358,900

5.3.5 PCWA Raw Water

The City receives PCWA raw water for irrigation purposes through the Caperton Canal. This delivery manifests through a raw water contract paid for by the City of Lincoln. The PCWA raw water offsets potential potable water use within the City of Lincoln. PCWA raw water is utilized for irrigation purposes in addition to the Del Webb Golf Course and maintaining wetlands, for areas within the City and its Sphere of Influence.

5.3.6 NID Raw Water

Areas within the City and its Sphere of Influence receive NID raw water for irrigation purposes. This includes Turkey Creek Golf Course area as well as Lincoln Crossing. The City does not control the water deliveries and payment obligations. The raw water offsets potential potable water use within the City of Lincoln.

5.4 Recycled Water

The City of Lincoln has been utilizing recycled water since Lincoln's Wastewater Treatment and Reclamation Facility (WWTRF) became operational in 2004. To provide a complete picture of the City's recycled water program and assets this section will: (1) describe the basic policy framework for recycled water in California; (2) describe the City's water treatment facility and reclaimed water delivery plans; (3) assess the City's water reclamation and discharge permits; and (4) provide the basis for securing water rights to the treated water produced from the City's water system.

5.4.1 Recycled Water Policy Framework

Water recycling is widely recognized in California as a critical component in supplementing the state's existing surface water and underground water supplies. Recycled water use is mandated under the state's applicable statutory and constitutional requirements, as well as certain state policies designed to promote and facilitate water recycling projects to the maximum extent feasible. Specifically, the California Constitution requires that the waters of the state be put to beneficial use to the maximum extent feasible. Thus, although the actions required to produce recycled water are not mandated under law, they are strongly encouraged and incentivized. However, the water derived from water recycling efforts, once produced, should be put to beneficial use and in some cases, *must* be put to beneficial use.

California's Water Recycling Law encourages water recycling and mandates use of recycled water under certain conditions. Water Code section 13510 states:

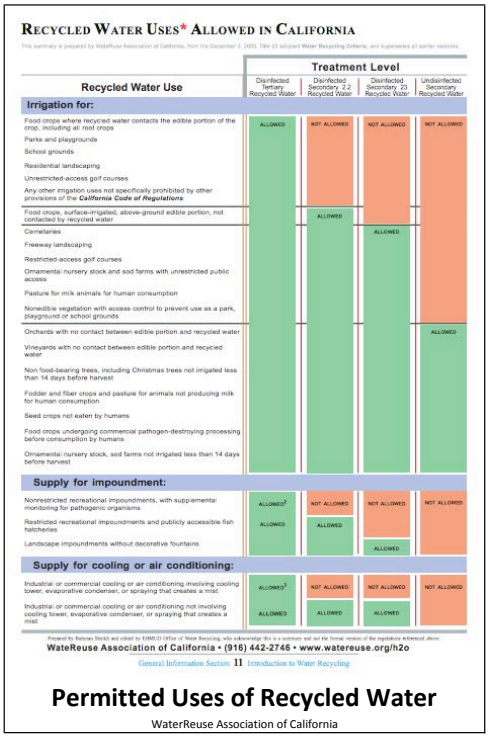
> It is hereby declared that the people of the state have a primary interest in the development of facilities to recycle water containing waste to supplement existing surface and underground water supplies to assist in meeting the future water requirements of the state.

The legislature and the state regulatory agencies provide funding to develop water reclamation and recycling facilities in support of this policy. The City of Lincoln has received funding from the State of California to develop its water reclamation and recycling facilities.

Not only has the State Legislature enacted policies encouraging the creation of water recycling facilities, it has also enacted statutes mandating the use of recycled water where certain conditions are met. This mandate is based on the fundamental tenets of beneficial, reasonable use in California water law. For instance, Water Code section 13550(a) states:

> The Legislature hereby finds and declares that the use of potable domestic water for nonpotable uses, including, but not limited to, cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses, is a waste or an unreasonable use of the water within the meaning of Section 2 of Article X of the California Constitution if recycled water is available….

The Legislature clarified its mandate by creating exceptions. For instance, recycled water need not be used in lieu of potable water if it is not of "adequate quality," is costly, "detrimental to public health," or will harm other water rights users or fish and wildlife. Neither the mandate nor these exceptions have been legally challenged in any venue. But the potential to require recycled water use – especially in light of state water bond and grant programs that could help alleviate financial burdens – will likely arise in the future as exceptions may be politically expedient to dismiss.



Permitted Uses of Recycled Water
WaterReuse Association of California

These legislative commitments in the Water Code that mandate recycled water use were also developed for land use planning efforts affecting land use planning agencies, like the City of Lincoln. For instance, Government Code section 65602(e) says:

> The Legislature finds and declares all of the following: (e) The use of potable domestic water for landscaped areas is considered a waste or unreasonable use of water within the meaning of Section 2 of Article X of the California Constitution if recycled water is available that meets the conditions described in Section 13550 of the Water Code.

This mandate is part of the key land use planning laws contained in the Government Code. Thus, the emphasis on water recycling is concurrently aimed at land use planning agencies and as rapidly growing as those addressed to water planning agencies. As another example, mandates for installation of recycled water delivery systems ("Purple Pipe") is now required under the California Government Code as a component of the specific plan land planning process. Essentially, the California Legislature has mandated that reclaimed water be used in lieu of potable water – to the extent feasible – and it is requiring the installation of infrastructure in land use developments so that use of recycled water becomes inevitable.

In furtherance of these Legislative policy declarations, local land use agencies must adopt ordinances designating areas where recycled water is determined to be available within the next ten years and how it will be used. If recycled water is available in the City, Government Code Section 65605 requires that the City adopt and enforce a recycled water ordinance. The ordinance shall include to following provisions:

> (1) State that it is the policy of the local agency that recycled water determined to be available pursuant to Section 13550 of the Water Code shall be used for nonpotable uses within the designated recycled water use area set forth by the local agency when the local agency determines that there is not an alternative higher or better use for the recycled water, its use is economically justified, and its use is financially and technically feasible for projects under consideration by the local agency.
>
> (2) Designate the areas within the boundaries of the local agency that can or may in the future use recycled water, including, but not limited to, existing urban areas in lieu of potable water.
>
> (3) Establish general rules and regulations governing the use and distribution of recycled water in accordance with applicable laws and regulations.
>
> (4) Establish that the use of the recycled water is determined to be available pursuant to Section 13550 of the Water Code in new industrial, commercial, or residential subdivisions located within the designated recycled water use areas for which a tentative map or parcel map is required pursuant to Section 66426. These provisions shall require a separate plumbing system to serve nonpotable uses in the common areas of the subdivision, including, but not limited to, golf courses, parks, greenbelts, landscaped streets, and landscaped medians. The separate plumbing system to serve nonpotable uses shall be independent of the plumbing system provided to serve domestic, residential, and other potable water uses in the subdivision.
>
> (5) Require that recycled water service shall not commence within the designated recycled water use area in any service area of a private utility, as defined in Section 1502 of the Public Utilities Code, or to any service area of a public agency retail water supplier that is not a local agency, as defined in subdivision (b) of Section 65603, except in accordance with a written agreement between the recycled water producer and the private utility or public agency retail water supplier that shall be made available in

a timely manner by the recycled water producer to the local agency adopting the ordinance pursuant to this article.

In summary, properties located within the designated recycled water service area are required to use recycled water in lieu of potable water if recycled water is determined to be available pursuant to section 13550 of the Water Code, unless they qualify for a limited exception. In addition, new industrial, commercial or residential subdivisions located within the designated area are required to provide separate recycled water plumbing systems to serve their onsite irrigation needs to meet the objectives of the City's ordinance. These legislative and regulatory trends will undoubtedly require more recycled water use that will necessitate more recycled water investment and infrastructure.

5.4.2 Lincoln's Recycled Water System

The City of Lincoln owns and operates the Wastewater Treatment and Reclamation Facility (WWTRF) south west of the City, located in Sections 29 and 30, T11N, R6E, MDB&M. The WWTRF was designed to process and treat domestic sewerage to Title 22 compliant "disinfected tertiary recycled water" (nearly unrestricted re-use) standards. Title 22 of the California Code of Regulations defines the quality standards for recycled water and its uses. The WWTRF operates under a Master Reclamation Permit from the California Regional Water Quality Control Board – Central Valley Region (RWCQB) under Order R5-2005-0040-01 and a Waste Discharge Permit under Order R5-2014-0007 (NPDES No. CA0084476). Both of these permits are relevant to the City's long-term management and use of its recycled water assets. The City's use of its recycled water assets is also governed by a water right order (WR0066) issued by the State Water Resources Control Board (SWRCB) in 2013. These documents are discussed in later sections of this chapter.


Recycled Water Line Crossing Auburn Ravine

The WWTRF began operation in 2004 and discharges wastewater to Auburn Ravine Creek. Auburn Ravine Creek is classified as "a water of the United States" subject to Clean Water Act jurisdiction because the Creek is tributary to the Sacramento River. Auburn Ravine flows into the East Side Canal and then the Natomas Cross Canal, which finally discharges to the Lower Sacramento River. The WWTRF has been master planned to achieve up to 12 million gallons per day (mgd) average dry weather flow

(adwf) capacity and will be incrementally expanded at approximately 2.1 million gallons per day (MGD) intervals. Final capacity of the WWTRF could be as much as 25 MGD dependent on the wastewater treatment technology used at the plant.

The City provides sewerage service for the City of Lincoln serving a population of approximately 43,000. The current design ADWF capacity of the WWTRF is 5.9 MGD. The City recently completed a WWTRF expansion and upgrade to increase the design ADWF from 4.2 MGD up to 5.9 MGD to accommodate regionalization with the Placer County Sewer Maintenance District 1 (SMD#1) Wastewater Treatment Plant. The City's Master Permit (described in later sections) allows for an increase in the permitted ADWF up to 8.4 MGD (or some smaller increase) to accommodate growth within the City's service area and additional regionalization projects.

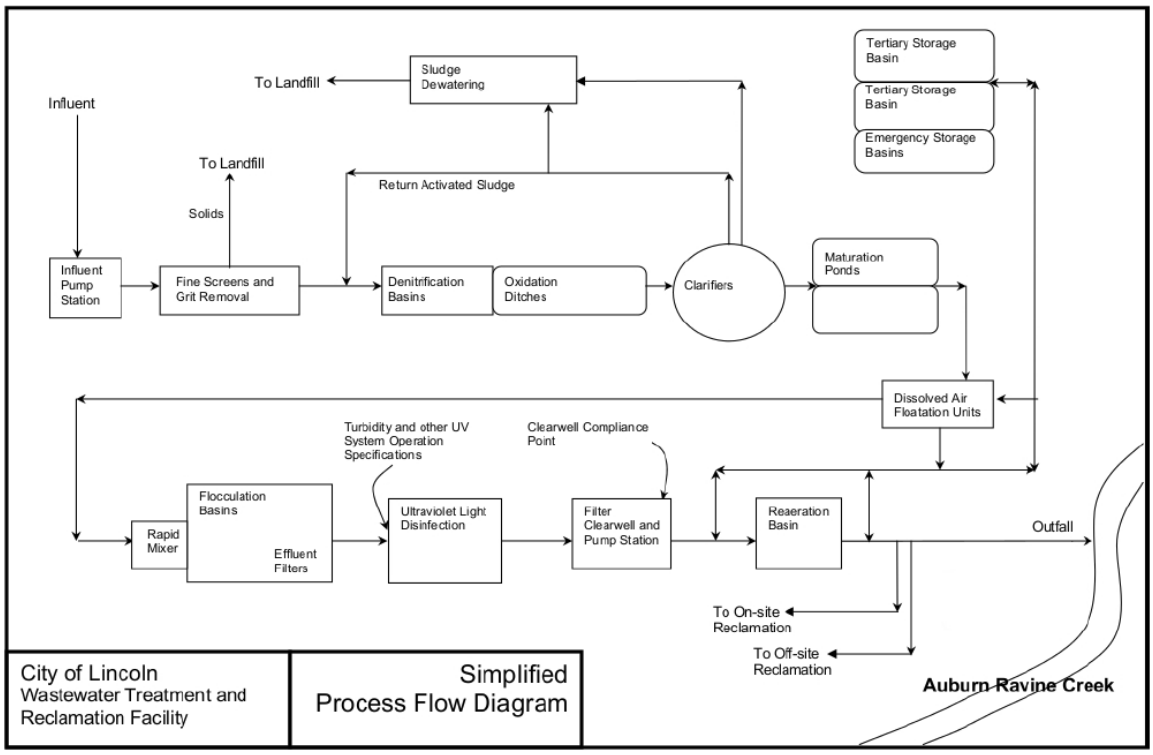
Historically, all wastewater treated by the Lincoln WWTRF has originated from the residential, municipal, industrial, and commercial water users within the City of Lincoln. Recently, inflow from other areas in Placer County were included in the influent and treatment at the WWTRF. The primary sources of the future flows to the WWTRF will continue to be residential, municipal, industrial and commercial water users both within and outside the City. The WWTRF does not receive stormwater or combined sewer flows from the City's collection system.

Raw sewerage flows by gravity to the influent pump station from the sewer collection system. An influent pump station with a hydraulic capacity of 39.5 MGD lifts the raw sewerage to a sufficient height in the plant headwork's to flow the rest of the way through the treatment process by gravity.

The treatment system at the WWTRF produces "disinfected tertiary recycled water" – the highest wastewater treatment level under Title 22. The produced water is available for all non-potable uses including irrigation of public access areas like parks. The treatment process consists of solids screening, oxidation ditches with anoxic zones, secondary clarification, maturation ponds, dissolved air flotation (DAF), coagulation, flocculation, sand filtration, and ultraviolet light (UV) disinfection. Downstream of the UV disinfection process, the flow passes through a clear well and the reaeration basin and into the effluent pump station. From the effluent pump station, the plant effluent can be pumped to Auburn Ravine Creek or to the storage basins. The WWTRF includes a lined emergency storage basin and two tertiary storage basins. The WWTRF has over 20 days of storage in an 86 million gallon emergency storage basin as required by long-term storage provisions in Title 22, Section 60431(b). The tertiary storage basins have a total volume of 190 million gallons that is available if there is a problem with the recycled water system or other discharge issues. **Figure 5-1** provides a flow schematic of the WWTRF.

The tertiary treated recycled water is either discharged to Auburn Ravine Creek at discharge point just downstream of the Moore Road creek crossing, or to on-site and off-site reclamation areas. The City has the ability to divert tertiary treated effluent to the tertiary storage basins to store recycled water, store final effluent during downstream flood events, and to store effluent that does not meet regulatory permit requirements (e.g., receiving water temperature limits). Since the WWTRF is able to temporarily store tertiary treated effluent and discharge for delivery or discharge at a later date, there are times when no discharge to surface water at the Auburn Ravine Creek discharge point is occurring and there are times when the discharge to surface water at the discharge point on Auburn Ravine Creek is higher than the regulated flow capacity of the WWTRF (e.g., flow is being discharged directly from the treatment process and stored, treated effluent is being discharged from the tertiary storage basins). The City's outfall at the Auburn Ravine Creek discharge point possesses a maximum hydraulic capacity of 13 MGD.

Figure 5-1 – City of Lincoln Wastewater Treatment and Reclamation Facility Flow Process



Health related water quality requirements for recycled water are defined in Title 22. Title 22 also defines the allowable uses of recycled water based on the level of treatment provided by the wastewater treatment process. The effluent produced by the Lincoln WWTRF is being oxidized, coagulated, clarified, filtered, and disinfected to 2.2 mpn/100

ml conforming to Title 22 unrestricted reuse criteria. According to Title 22, such effluent can be used for all available non-potable uses, including:

- Irrigation of food crops, including all edible root crops, where the recycled water comes into contact with edible portion of the crop.
- Irrigation of parks and playgrounds.
- Irrigation of schoolyards.
- Irrigation of residential landscaping and unrestricted access golf courses.
- And as a source of water supply for non-restricted recreational impoundments.[32]
- Under sections 60306 through 60307 of Title 22, recycled water of lesser quality can be used for the following:
- Irrigation of food crops, including crops with edible portion produced above groundwater and not contacted by the recycled water.
- Irrigation of cemeteries, freeway landscaping, restricted access golf courses, ornamental nursery stock and sod farms, pastures for animals producing milk for human consumption, and nonedible vegetation with controlled access.
- Irrigation of orchards, vineyards, non-food-bearing trees, fodder and fiber crops for non-milk producing animals, seed crops not eaten by humans, food crops that undergo commercial pathogen-destroying processing, ornamental nursery stock, and farms with limited public access.
- As a source of water supply for restricted recreational impoundments and publicly accessible impoundments at fish hatcheries.
- As a source of water supply for landscape impoundments without decorative fountains.
- Cooling and other purposes.
- Title 22 places a number of restrictions on use of the tertiary oxidized wastewater to protect other water users from potential harmful issues. These restrictions include:
- No irrigation with recycled water shall take place within 50 feet of any domestic water supply well, unless conditions specified in Section 60310 of Title 22 are met.
- No impoundment of tertiary recycled water shall occur within 100 feet of any domestic water supply well.

[32] Irrigation of Title 22 unrestricted reuse water (disinfected tertiary) may by spray irrigation for all beneficial uses.

- All areas where recycled water is used shall be properly signed to alert the public regarding the use of recycled water.
- Any irrigation recycled water runoff shall be confined to the recycled water use area, unless the runoff does not pose a public health threat and is authorized by the regulatory agency.
- No connections shall be made between recycled water system and potable water system, except as defined in Title 17, Section 7604.
- Hose bibs are not allowed in portions of the recycled water piping system that is accessible to the general public.
- The producer of the recycled water shall prepare an Engineering Report to cover production, distribution and reuse of recycled water. The Engineering Report shall identify the means of compliance with Title 22 regulation and "any other features specified by the regulatory agency," e.g., RWQCB permit requirements. The Engineering Report is also required to provide "a contingency plan which will assure that no untreated or inadequately treated wastewater will be delivered to the use area."

Since the 2004 startup of the WWTRF, the City has provided tertiary treated reclaimed water to agricultural demands on adjacent and neighboring lands. About 400 acres are currently provided with recycled water from the WWTRF facility. The 2012 assessment estimated a potential current annual demand for the 400 acres of 1,676 af/yr. Treated effluent not provided to the current agricultural operations is discharged to Auburn Ravine, in compliance with the City's NPDES permit.

As an example of things to come, an expansion of the WWTRF to 6.3 MGD Average Day Wastewater Flow (ADWF) would be able to generate a recycled water supply of about 7,000 af/yr. While this is more than the total demand for all planned City and surrounding area recycled water uses (about 6,800 af/year as identified in the City's Recycled Water Master Plan), the demand timing for different identified uses might mean there are deficient supplies in the peak demand summer months and surplus supplies in the winter months. The anticipated recycled water uses within the City has been projected to account for as much as 6,822 acre-feet per year of the anticipated build-out water demand. Thus, during some months, potable or raw water would be necessary to make up the difference between the identified recycled water demand and the available recycled water supply. To generate as much as 7,000 af/yr in treated wastewater, total treated water demand would need to be about 14,000 af/yr, assuming 50 percent of treated water demand results in wastewater influent flows. The City's wastewater permits and Order WW0066, described more fully below, place limitations on the usability of all water produced at the treatment facility.

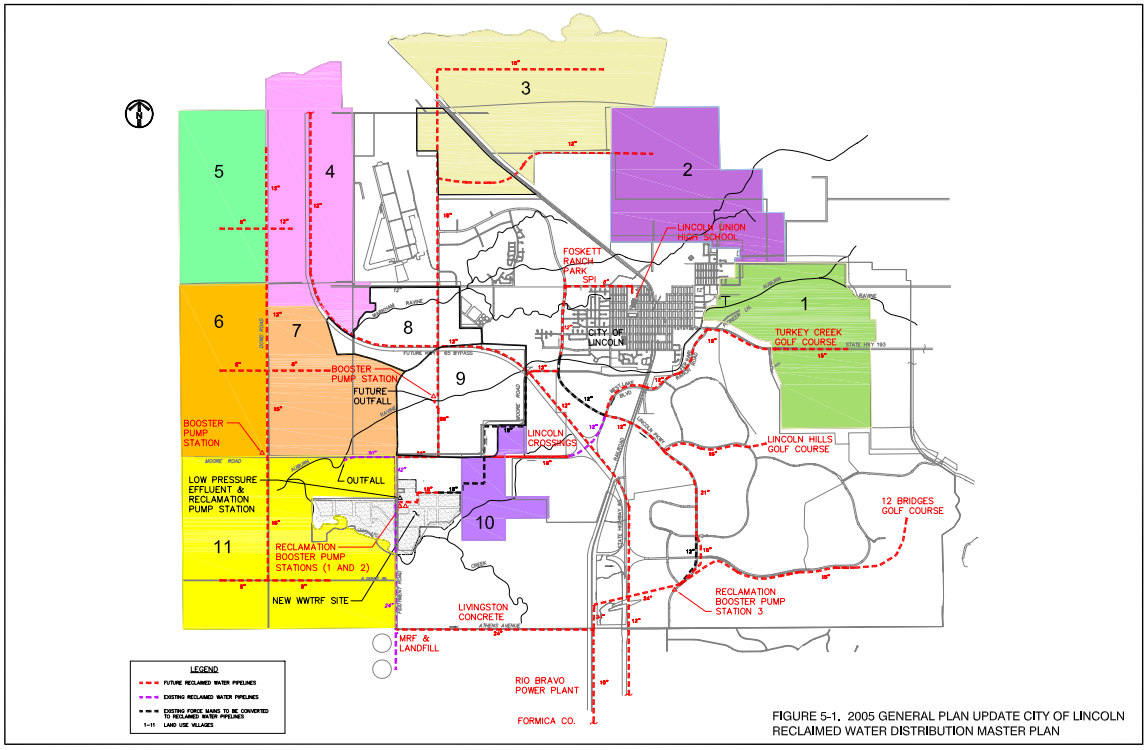
In 2003 and 2004 the City completed studies regarding the use of tertiary treated, reclaimed water in and around the City as provided from its WWTRF. The City has also implemented design standards for the construction of recycled water systems using "purple pipe" and "purple hydrants."

Once produced at the WWTRF, the recycled water is conveyed from the reclamation booster pump station for agricultural irrigation on property owned by Placer County (WPWMA property) to the south via a 24-inch force main running parallel to Fiddyment Road and ending at Athens Road. The reclamation booster station has been designed to allow for expansion to convey additional recycled water from the WWTRF to the areas within the City of Lincoln. A pipeline project completed by the City in 2015 will allow delivery of recycled water to at least four off-site locations along Nicolaus Road that are currently using potable water and to the "purple pipe" irrigation system of the Lincoln Crossing development currently using raw water.

The City has entered into two contracts for reclaimed water deliveries with Auburn Ravine Ranch and with Machado Ranch. The terms and conditions of these contracts are not the subject of this analysis but essentially allow the users to claim a substantial portion of the water assets for use in their areas.

Figure 5-2 below depicts the planned extent of the City's Recycled Water Infrastructure. This figure is taken from the City's 2008 General Plan illustrates the City's proposed recycled "purple" pipeline main infrastructure network with selected prospective customers at the time. As noted below, and in subsequent sections of this analysis, some of the areas depicted in the map are beyond the place of use of the current water right associated with the City's recycled water and some areas lack economic feasibility to deliver water where other sources of water may be available.

Figure 5-2 – City of Lincoln's Recycled Water Infrastructure



5.4.3 City Water Reclamation and Discharge Permits

In California, recycled water use permits are granted by the State Water Resources Control Board and its nine Regional Water Quality Control Boards (RWQCB). The California Department of Public Health (CDPH) reviews and establishes water recycling criteria and regulations. CDPH has been subsumed into SWRCB per the 2014 water legislation package. The RWQCB issues permits for water reclamation and wastewater discharges.

The City of Lincoln has two separate wastewater related permits. The first is the Master Reclamation Permit (Order No. R5-2005-0040-01 and amended Order No. R5-2012-0052) which governs recycled water distribution within and around the City of Lincoln and the second is the City's NPDES Permit (Order R5-2014-0007, NPDES No. CA0084476) that governs discharges of water to Auburn Ravine Creek ("Auburn Ravine"). Both of these permits are relevant to the City's long-term management and use of its recycled water assets. The City's use of its recycled water assets is also governed by a water right order (WR0066) issued by the State Water Resources Control Board (SWRCB) in 2013.

5.4.3.1 Master Reclamation Permit

The City's Master Reclamation Permit (Master Permit) is the primary document granting the City the authority to utilize its recycled water assets within the City and surrounding areas. Originally issued in 2005, the Master Permit identifies the treatment requirements, treatment methodologies, system operations, reclaimed water uses (subject to the Engineer's Report), and regulatory requirements for complying with the Permit terms.

The treatment requirements and methodologies were described in previous sections of this chapter. However, the treatment requirements must be maintained to achieve the tertiary level of treatment under Title 22 in order to deliver water for the applicable uses described in those regulations and fully incorporated into the Master Permit. The City has, however, planned for potential contingencies in the operations of its facilities by addressing how it might manage secondary levels of treated effluent in the event of system failures.

The use of reclaimed water is not only governed by the type of treatment and the allowable regulatory structure, but also by the places of use of the water asset and issues assessed in the Engineer's report. As noted below, the place of use for reclaimed water incorporates nearly all of the City and its Sphere of Influence as well as areas beyond the City and SOI boundaries. The issue remains, however, how much analysis must be completed in the context of providing service to each identified location. The current Engineer's Report indicates that the analyzed places of use include only small areas in and around the WWTRF. Three specific locations are called out in the Engineer's report: a two acre parcel connected to the WWTRF, a 96 acre parcel at Antonio Mountain Ranch, and a 115 acre parcel at Warm Springs.[33] All three parcels utilize the water for spray or flood irrigation. The City, however, may be delivering water to areas beyond that area through the above-identified contracts and reporting water uses associated with those deliveries. Accordingly, water reclamation deliveries under the Master Permit deserve further investigation.

The regulatory requirements in the Master Permit include very specific items for specific types of water application as well as general requirements applicable to all forms of application. For instance, rice irrigation is permitted in the Order so long as:

- The discharge from the WWTF to the irrigation area is in full compliance with the California Toxics Rule, National Toxics Rule, Basin Plan Water Quality Objectives and the NPDES permit for that facility;
- The irrigated rice areas are in full compliance with the Regional Board's Irrigated Land Regulatory Program;

[33] City of Lincoln Production, Distribution and Use of Recycled Water Engineering Report (2003) at p. 25.

- The irrigation of rice does not exacerbate vector control problems or cause a nuisance; and
- The reclaimed water is treated to a tertiary level and adequately disinfected.

Moreover, "excessive irrigation" or "irrigation that results in excessive runoff" is prohibited. "Overspray" must be minimized and spray irrigation is prohibited if "wind velocities exceed 30 mph." And an application of water within 50 feet of any domestic well is also prohibited. All of these specific criteria must be complied with in the delivery and use of water for irrigated rice.

General regulatory requirements apply to all uses identified in the Permit. For instance, the City must "continue groundwater monitoring" and comply with its reporting schedule in the "Monitoring Reporting Program" (which is part of the Master Permit). Moreover, the discharges of water "requires the discharge to not degrade groundwater quality." And, importantly, the order prohibits the "co-mingling of recycled water with stormwater in the regional control basin."[34]

All applications of recycled water for identified uses within the City must comply with the specific regulatory criteria identified for that type of use in both the Master Permit as well as the Title 22 Regulations (where those regulations are more stringent than the terms of the Permit). It is incumbent upon the discharger, in this case the City of Lincoln, to comply with the terms of the Master Permit in all circumstances.

5.4.3.2 NPDES Permit

The City's NPDES Permit issued by the RWQCB determines the recycled water discharge requirements from the WWTRP into waters of the United States. Specifically, this permit outlines the waste discharge requirements for the City of Lincoln in discharging water to Auburn Ravine Creek – the only direct discharge point allowed for the City's recycled water assets. The Permit does not define any specific distinction between discharge and use, as the permit language exclusively focuses on discharge. This Permit rescinded Order R5-2008-0156 making the 2014 Order the primary compliance item for discharges to Auburn Ravine. WW0066, described below, is also applicable to the terms of this Permit.



City of Lincoln WWTP Treated Effluent Outfall

[34] Lincoln Master Permit Order No. R5-2005-0040-01 at p.5.

Indirect discharges of recycled water that return to natural water bodies – both surface water and groundwater – after application for other uses, like irrigation, are governed by the City's Master Permit described above. The Master Permit governs these uses through the Basin Plan and general regulatory compliance issues – like groundwater monitoring stations and regulatory restrictions on the application of recycled water through irrigation. Purposeful discharges of reclaimed water from irrigated lands or through direct discharge to a point other than the one identified in the permit may be in violation of both regulatory constructs.

This temporary permit that expires on February 1, 2019, complies with the Clean Water Act as implemented by the State of California through California Water Code section 13260. The primary responsibility for compliance with this order lies with the discharger – the City of Lincoln. The City has contracted its responsibility for operations of the facilities to Stantec Consulting Services, Inc. As described above, Stantec runs the day-to-day operations of the project and provides infrastructure operations and regulatory compliance with both orders.

Like the Master Permit, the NPDES Permit essentially requires treatment of water to a tertiary level of treatment before discharge into Auburn Ravine. The NPDES Permit outlines a number of specific criteria that must be adhered to before the water may be discharged. Moreover, the NPDES is subject to the RWQCB anti-degradation policy for discharge of waters. This policy is contained in SWRCB Resolution 68-16 as well as Federal regulation 40 CFR 131.12. Specifically, the "release of waste…shall not cause the underlying groundwater to contain waste constituents in concentrations greater than background water quality or water quality objectives, whichever is greater." Last, the NPDES prohibits commingling of "pollutant-free wastewater" with the actual wastewater. As defined in the NPDES Permit, pollutant free wastewater is: "rainfall, groundwater, cooling waters, and condensates that are essentially free of pollutants."

The NPDES Permit also requires the City to have contingency plans in case the facility has operational problems or there are other issues that may affect the treatment and discharge of reclaimed water. And the City must comply with Monitoring and Reporting Requirements and special conditions that are applicable exclusively to the City.

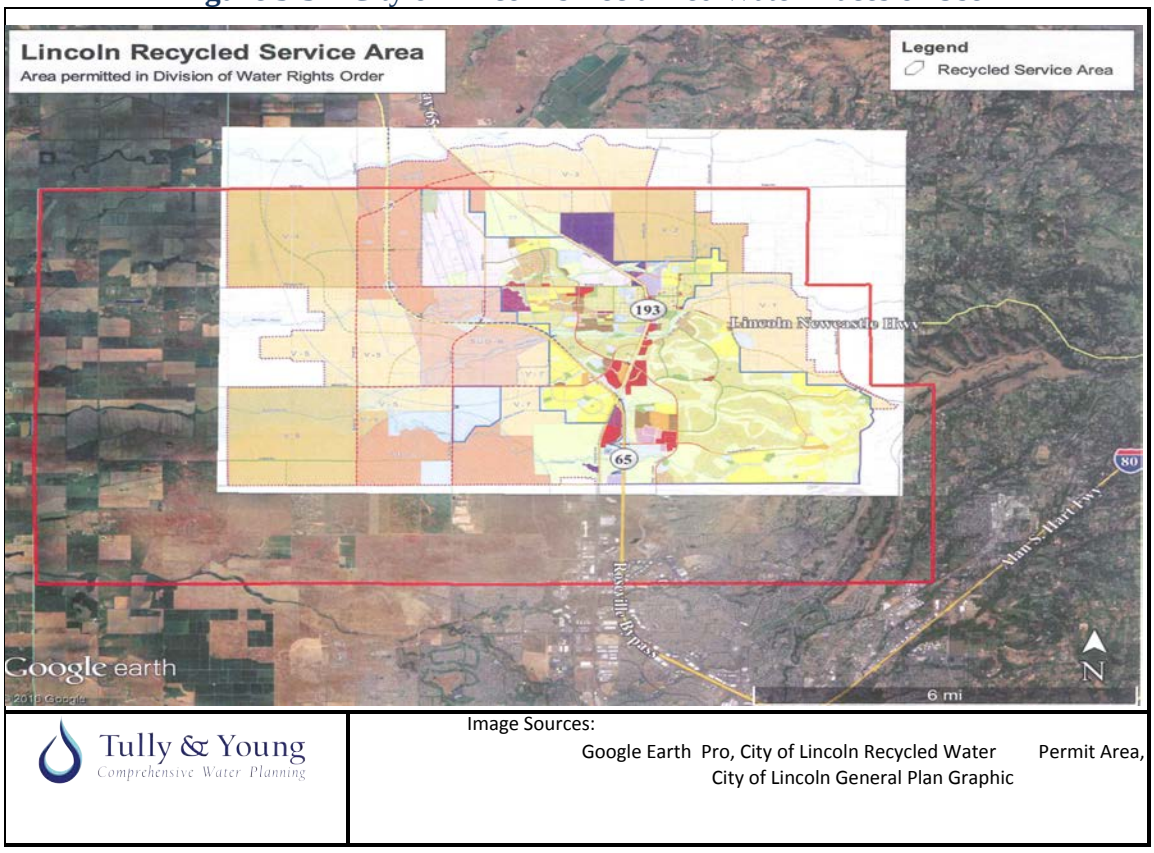
The City must also "establish interagency agreements" with other users that may convey waste streams to the WWTRF. The interagency agreements must contain "requirements for implementation of an industrial pretreatment program that meets the minimum requirements of this permit." The City must submit the interagency agreements for new connections to the RWQCB 30 days prior to connection to the WWTRF system. Last, the City is covered under Order 2006-0003-DWQ for operation of its wastewater collection system and must comply with that Order as modified in the future.

5.4.3.3 WW0066

WW0066 resulted in an Order Approving Change in Purpose of Use and Place of Use of reclaimed water in the City of Lincoln. A copy of this order can be found in **Appendix B**. WW0066 cites the City's Master Reclamation Permit as well as its *former* Waste Discharge Requirements Order No. R5-2008-0156. This Order was rescinded by the City's now Order R5-2014-0007. It is unclear if the requirements in WW0066 are applicable to Order R5-2014-0007 or not.

The Order greatly expanded the Place of Use of reclaimed water in the City. Specifically, the Order created an authorized place of use that incorporates all of the existing City, a majority of the City's Sphere of Influence, and a large area of land that is beyond the City's General Plan boundaries. A map depicting the authorized Place of Use is shown in **Figure 5-3** below.

Figure 5-3 – City of Lincoln's Reclaimed Water Places of Use



Tully & Young
Comprehensive Water Planning

Image Sources:
Google Earth Pro, City of Lincoln Recycled Water Permit Area, City of Lincoln General Plan Graphic

The Order requires the City to coordinate ("discuss and confer") with PG&E, NID, PCWA and SSWD in the management of Auburn Ravine. The Order further requires the City to maximize the treated effluent discharge into Auburn Ravine from "October 1 through November 30 and March 1 through April 15" each year.

The Order declares that the treated wastewater may be used for "irrigation and industrial purposes" and may be used for these purposes from January 1 to December 31 of each year. However, it clarifies that "no water shall be used under this wastewater change petition until petitioner has filed a report of waste discharge with the Regional Board… and the Regional Board…has prescribed waste discharge requirements or has indicated that waste discharge requirements are not required." The City has filed a report with the Regional Board since the issuance of the Order, allowing the City to utilize its treated wastewater. Discharges to groundwater may be permitted if certain conditions are met. A report on the waste discharge under this permit has been filed with the Regional Board, allowing the treated wastewater to be used for irrigation and industrial purposes.

5.4.4 Recycled Water Rights

Rights to recycled water or rights to water foregone when recycled water is used should be pursued by the City. There are numerous forms of water rights that the City may wish to utilize to secure its reclaimed water assets for use in its service area or for export to areas that can access water from Auburn Ravine or any waters that Auburn Ravine is tributary to. The four primary mechanisms for the City of Lincoln to secure water rights are related to:

- Foreign Water
- Salvaged and Developed Water
- Water Code Section 1211 petition process; and
- Water Code Section 1212 instream dedication process

As a preliminary matter, the City's ability to gain water rights to reclaimed and recycled water generated at the WWTRF requires assessing compliance with Water Code section 1210. Water Code section 1210 states:

> The owner of a waste water treatment plant operated for the purpose of treating wastes from a sanitary sewer system shall hold the exclusive right to the treated waste water as against anyone who has supplied the water discharged into the waste water collection and treatment system, including a person using water under a water service contract, unless otherwise provided by agreement.

In other words, if no agreement exists between the provider and the recycled water producer expressly retaining the water provided for the provider's use, then the water belongs exclusively to the owner of the waste water treatment plant.

The City's 2012 water supply contract with PCWA, titled "Contract Between Placer County Water Agency and City of Lincoln For A Treated Water Supply," is informative on the issues of whether an agreement exists preserving PCWA water at the City's WWTRF. Article 22 of the contract provides that without the prior written consent of PCWA, the City may not sell or dispose of PCWA water, for use outside the City's limits. The contract further states though that PCWA may not unreasonably withhold consent, and its refusal may only be based on the lack of water or capacity in PCWA facilities or PCWA's intention to provide service to the area outside the City's sphere of influence. This provision is intended to address the sale of treated and potable water delivered to the City from PCWA under the terms of this agreement rather than reclaimed water. The City has not provided any information that would indicate that PCWA claims recycled water that is derived from treated water sold to the City of Lincoln.

The City also receives potable water derived from Nevada Irrigation District. These water assets are provided to the City through a temporary water sales contract. The supplies are delivered to the City through a wheeling agreement entered into between PCWA and NID. Nothing in those agreements indicates that NID intended to reserve rights to water supplied to the City of Lincoln.

5.4.4.1 Foreign Water

Foreign water is water that is brought into an area from a different watershed. The unique geography of the City of Lincoln shows that it is neither a part of the American River Watershed nor part of the Yuba/Bear River watershed because waters that flow through its landscape are not tributary to either of those two bigger water systems. Specifically, Auburn Ravine, Markham Ravine, and Coon Creek all originate in the foothills to the east of the City and derive their natural water supplies from overland flow and surface water runoff in small watersheds. The City's surface water supplies are derived from the American River and Yuba/Bear River watersheds – both of which lie beyond the watersheds that lie within the City's place of use. Accordingly, because the surface water components of the City's recycled water assets originate outside the watershed surrounding the City, they are accorded protection under California Water Law as foreign water rights.

The City's surface water supplies are also considered "foreign water" because they are "foreign in time" as compared to water that flows through a system as part of the natural flow. Specifically, the water delivered to the City from PCWA and NID is derived from stored water in the American River and Yuba/Bear watershed systems. Stored water is water that would not otherwise be present in a system but for the reservoirs that hold the water from running down the system. Thus, the modified timing of the release of the water creates an additional foreign water component in water delivered to the City.

Foreign water rights afford the City with an absolute right to manipulate and re-use the water regardless of the impact on downstream water right holders. An "absolute right" means that the City is able to utilize the water regardless of any usage by any other water users that derive benefit from the imported water. In other words, no other legal user of water may claim a right to the use of foreign waters against the importer of those foreign waters so long as the foreign waters are put to reasonable and beneficial use. Those rights extend to the discharge of water as well. The City may cease discharging water and use the discharged water for any purposes even if a downstream user has developed a dependence on the discharged water supply being present.

Currently, over 90 percent of the City's delivered water supplies are derived from surface water sources that are imported into the City. The amount of water that flows through the wastewater system is thus assumed to be the same percentage – meaning 90 percent of the wastewater effluent discharged into the City's sewer system is considered wastewater derived from imported surface water sources.

In addition, the City derives the remaining 10 percent of its water supplies from groundwater. This groundwater supply, and the policies behind it, is discussed in greater detail in **Chapter 6.** The SWRCB has previously concluded that "return flow of groundwater should be treated as foreign water if the groundwater does not naturally flow into the watercourse and is only present because it was extracted from the ground." Recent hydrogeological analyses, described subsequently in **Chapter 6**, indicate that the groundwater resources extracted by the City are separated from Auburn Ravine and Markham Ravine through hydrogeological barriers. Some groundwater used by the City may be derived from Coon Creek which appears to be hydrologically connected but as a recharge system only (the stream is not a "gaining stream" – meaning groundwater does not feed the stream's natural flow. As such, groundwater is considered legally distinct from surface water, and thus, no downstream appropriator or riparian user of surface waters can claim a right to the recycled water discharges that are derived from groundwater extractions. So long as the water is used for reasonable, beneficial purposes, the City has the exclusive rights to its treated wastewater derived from groundwater extractions.

In summary, the City's surface and groundwater resources appear to all be foreign water sources subject to the rules applicable to foreign water rights under California Water Law. Foreign water rights accord the water right holder substantial deference in how it uses and manipulates its foreign water assets both for uses within its service area and in areas where it may wish to export supplies. By claiming foreign water rights as the basis for the City's ownership to its water supplies, the City will maintain the most flexibility over that water to protect those water rights for current and future uses.

5.4.4.2 Salvaged and Developed Waters

Salvaged and developed waters are an area of California Water Law that is not well developed in the recycled water arena. Salvaged water is defined as water that is "saved" or "restored" to the supply within a particular area by artificial means. Developed Waters are "not present in the area until they are brought there by means of artificial devices."

Reclaiming and recycling water is a process that produces a usable product out of an unusable product. Surface water is consumed by end users in the City of Lincoln. These users eat, drink, wash, irrigate, and otherwise use water in a number of different ways. This consumption eventually finds its way to the City's sewer system. In other words, raw sewage and other wastewater that has been consumed by people is captured in the City's sewer system. Normally raw sewage is not useful for any purpose normally associated with usable water sources. Raw sewage must be treated with specific industrial processes that require the expense of time, money and energy. These industrial processes create a new product out of a formally unusable one.

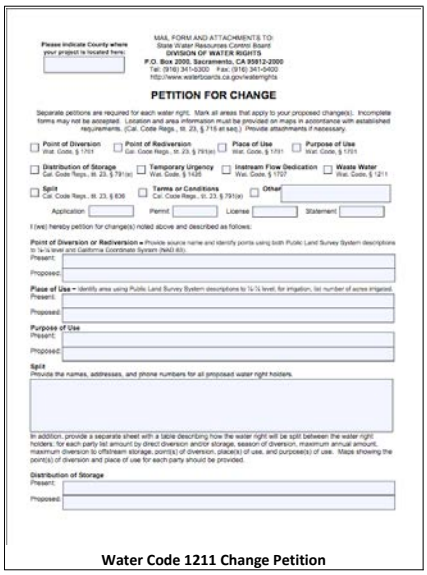
Under the definition of "salvaged", reclaimed water assets are "saved" and "restored" through industrial processes that take an unusable product, raw sewage, and make a usable product, tertiary treated reclaimed water. This reclamation of water by its own definition indicates that the act of reclaiming does not infringe on rights of others because the usable resource did not exist before the treatment process was undertaken. In other words, the act of reclamation created a new water asset.

Similarly, under the definition of "developed", reclaimed water assets were brought to the location by artificial devices and methods. Sewer systems collected the raw sewage and delivered that sewage to the treatment facility. The reclaimed water was never present in the area until the reclaimed water process created the water from the raw sewage. In other words, the treatment processes again created a new resource that can be used for identified purposes.

Both developed and salvaged water rights are accorded substantial protection under California Water Law. Specifically, the person who by his own efforts makes such waters available is entitled to use them, so long as he is not infringing on the prior rights of others. It would be difficult for any other legal user of water to claim reliance or injury on a source of water that is essentially consumed as it is converted into sewage. The development of a usable water source from unusable sewage is the key to understanding the water rights principles of developed and salvaged water.

5.4.4.3 Water Code Section 1211

Water Code section 1211 provides another mechanism for securing a water right. This statutory section allows a recycled water asset producer to secure the ability to deliver that water to a point of discharge, defined place of use, and for a new purpose of use. In developing this water right, a recycled water producer may petition the SWRCB for this modification. In order to petition the SWRCB, the recycled water producer would likely need to already possess a Reclamation Permit for discharges to recycled water uses or an NPDES Permit for discharges to water bodies. The RWQCB regulates wastewater discharges but does not possess full authority to regulate all uses available for recycled water.



PETITION FOR CHANGE

Water Code 1211 Change Petition

Water Code section 1211 reads:

(a) Prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, the owner of any wastewater treatment plant shall obtain approval of the board for that change. The board shall review the changes pursuant to the provisions of Chapter 10 (commencing with Section 1700) of Part 2 of Division 2.

(b) Subdivision (a) does not apply to changes in the discharge or use of treated wastewater that do not result in decreasing the flow in any portion of a watercourse.

The exception listed in paragraph (b) indicates that where water has not been discharged to a watercourse, SWRCB approval is not required for a change in items listed in paragraph (a). Moreover, it is unclear whether the decrease in flow is attributed to "natural flow" or "any flow" in a water system. If it is natural flow, then any water imported into the watershed does not require compliance with section 1211. But if "flow" means "any flow" then waters that originate in the watershed may qualify as well as water originally discharged and then reduced. The legislative intent behind these provisions requires further analysis.

The City already uses a portion of its treated wastewater to irrigate crops within the City limits. If the City wished instead to transfer that water to alternative uses it would not need to obtain SWRCB approval under Section 1211 because its change in the use of

treated wastewater would not result in a decreased flow in the Creek. However, the change in use of the wastewater must comply with the requirements of its Master Reclamation Permit.

5.4.4.4 Water Code Section 1212

Water Code section 1212 affords the City another mechanism to assert control over its water assets. Under this section of the Water Code, a recycled water producer need only state its intent to reserve the water asset to protect the asset against other users. Section 1212 states:

> The board shall not grant any permit or license to any person other than the treated waste water producer for the appropriation of treated waste water where the producer has introduced such water into the watercourse with the prior stated intention of maintaining or enhancing fishery, wildlife, recreational, or other instream beneficial uses. Holders of existing rights may not use or claim such water.

The question arises as to what the Legislature meant by "prior stated intention." There is no judicial interpretation of this issue. From a practical perspective, it seems evident that a formal public agency resolution or other formal public act would suffice to show the intent to commit the water to an instream beneficial purpose. Developing the discharger's intent to protect instream sources generally protects the water asset from other legal users.

But a second issue arises in utilizing this statutory section if the discharger decides to alter the recycled water discharge to the natural water body. It is possible that the instream beneficial use that received the water from the discharging agency may be dependent on that source of water for survival or other purpose (recreation). It is unclear whether a permanent right vests in that dependent user or whether the discharger has the ability to retract that water asset in the future. Again, this legal provision has not been tested.

5.4.4.5 Abdication of Water Rights

The City's fundamental position should be that the sewage it delivers to the WWTRF is derived from foreign water sources and that the water in that facility is salvaged and developed water because it is unusable in any form without the City's industrial efforts and monetary expenditures. As such, the City possesses a complete water right to the water assets produced at the WWTRF.

However, because the recycled water is essentially treated and then discharged to lands and waters in the United States, it is subject to the waste discharge requirements

established under the Clean Water Act and subsequent California Water Law. As such, the discharge of this water to any land or water source requires Master Reclamation Permit and NPDES Permit compliance, respectively. Thus, although the water right belongs to the City, the use and application disposal of that water is subject to the jurisdiction of the RWQCB.

The City also possesses the ability to abdicate its water rights to conditions set upon it by the SWRCB in obtaining permits. For instance, in WW0066, the City agreed to discharge water to Auburn Ravine during certain times of year in exchange for the expansion in the place of use. The City may not have needed to obtain this approval from the SWRCB since the water was derived from foreign water sources as well as developed and salvaged through expensive water reclamation processes. Thus, the City may have abdicated a portion of its water asset by agreeing to terms of the Order. The City certainly has the ability to contract away its water rights but it should be hesitant to do so. The mandated discharges to Auburn Ravine under WW0066 may be permanent as fisheries, recreation, and other instream uses may depend on that water and coordination with regional agencies in maintaining Auburn Ravine is required

5.4.4.6 Moving Recycled Water to Alternate Locations

The City's recycled water right may be moved to alternative locations beyond the City boundary through delivery in natural watercourses. In other words, the foreign, developed and salvaged water supplies may have utility and value to places that are removed from the City and its Sphere of Influence. Water Code section 7075 is the key provision applied to transport of water in natural water bodies. That section states:

> Water which has been appropriated may be turned into the channel of another stream, mingled with its water, and then reclaimed; but in reclaiming it the water already appropriated by another shall not be diminished.

Accordingly, the City may reclaim water that is foreign, discharge that water into the stream system, and redivert the water at a point downstream of the discharge. The City must account for the water it discharges and that is later diverted downstream and adjust the amount of water available for conveyance, evaporation and other wheeling losses. The City's existing NPDES Permit does not prevent nor expressly authorize rediversion of the foreign water at downstream locations.

Again, although this action is applicable to all water rights, recycled and reclaimed water may have more restrictions because of its regulated status as wastewater. However, so long as the discharge is permitted under the NPDES Permit, the extraction of the water at a lower point in a stream system should not be problematic so long as: (a) the City has

not abdicated its right to the water in some way; (b) it accounts for water losses in delivery of water to the new destination; and (c) there is adequate authority to divert the water from the stream channel at a new location. The characterization of the City's water as foreign, developed, and salvaged water makes all of these opportunities more likely. Full utilization of these opportunities will require coordination in the timing of the diversion as it relates to downstream users.

CHAPTER 6. GROUNDWATER TECHNICAL ASSESSMENT

6.1 Introduction

The purposes of this chapter are to (1) define the North American Subbasin and its current groundwater conditions; (2) explain the City's existing well system and groundwater rights; (3) describe the governance structure and existing plans as related to the groundwater system; and (4) assess future governance issues, groundwater banking and long-term strategy objectives.

6.2 Groundwater Basin Description

The City of Lincoln is located in the northeastern part of California's Central Valley, bordering the foothills of the Sierra Nevada Mountain Range. The Central Valley Groundwater Basin, geotechnically named the Great Valley Geomorphic Province, is a large structural depression underlain and bounded on the east by the gently westward-dipping Sierra Nevada and on the west by the complexly folded and faulted Coast Ranges. The surrounding mountains are generally composed of non-water bearing rocks, while the Central Valley is filled with water-bearing sediments accumulating from the Valley's formation and depositional activity derived from the surrounding mountains. Most of the surface water within the Central Valley originates in rivers and streams that descend from the surrounding mountains and uplands.

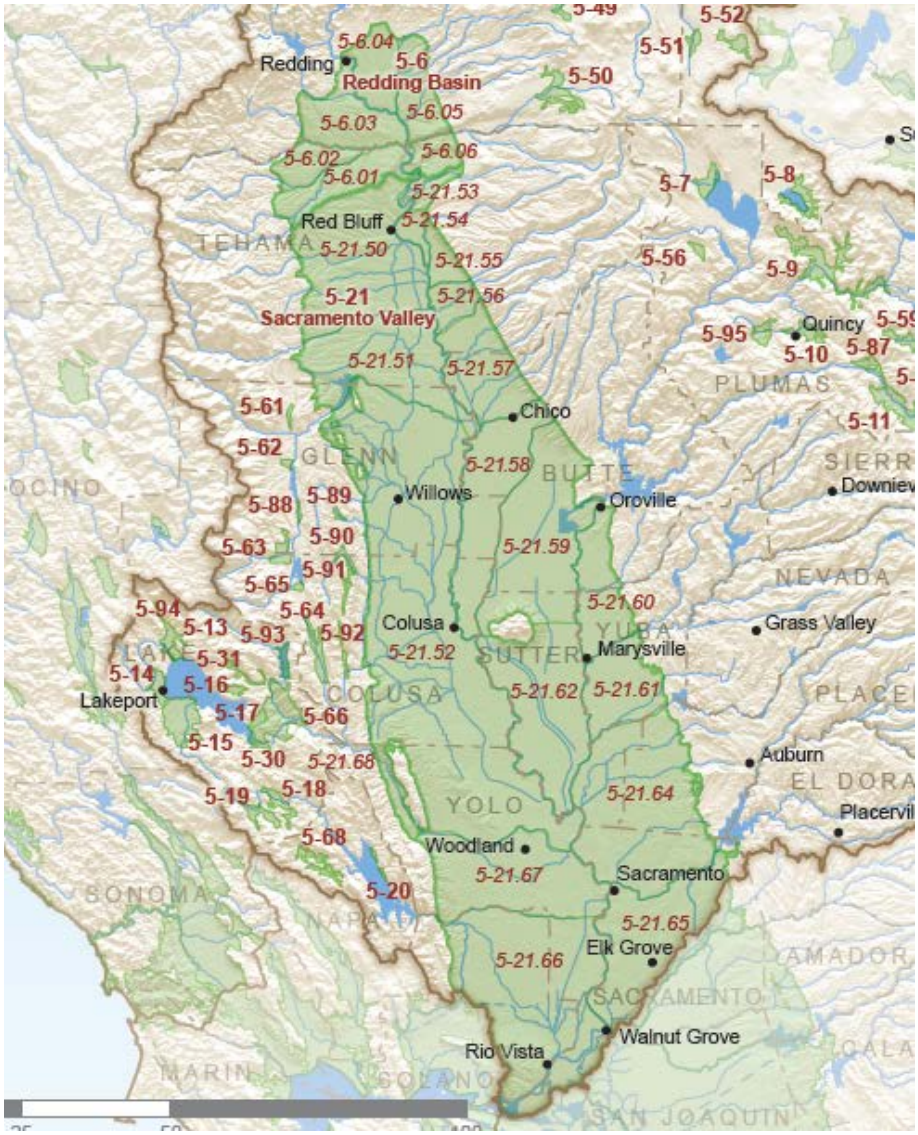
The large sediment accumulation in the Central Valley began in a marine environment over 60 million years ago, during the Cretaceous period. These marine sediments compose the Sacramento Valley's lower layers and are saturated with predominantly brackish or saline water. As late as 6.7 million years ago, volcanic eruptions in the Sierra Nevada deposited pyroclastic rocks, lava flows, and mudflows down the mountain range's western slopes. These volcanic rocks were eroded and deposited in marine and continental environments within the Central Valley. The Sacramento Valley area was almost fully formed about 3.4 million years ago with fluvial – river and stream – processes dominating the sedimentary deposition landscape since then. These younger volcanogenic and fluvial sediments are the key depositionary materials that constitute the Sacramento Valley's freshwater aquifer system.

The Central Valley Groundwater Basin is an important resource, estimated to contain approximately 114 million acre-feet of water under approximately 15,500 square miles of land surface.[1] Several fresh water aquifers are present beneath the Basin ranging in depth from near the soil surface to 3,000 feet below ground. The Sacramento Valley Groundwater

[1] Sacramento Valley Groundwater Basin, Hydrologic Region Sacramento River, DWR Bulletin 118, p. 1-5.

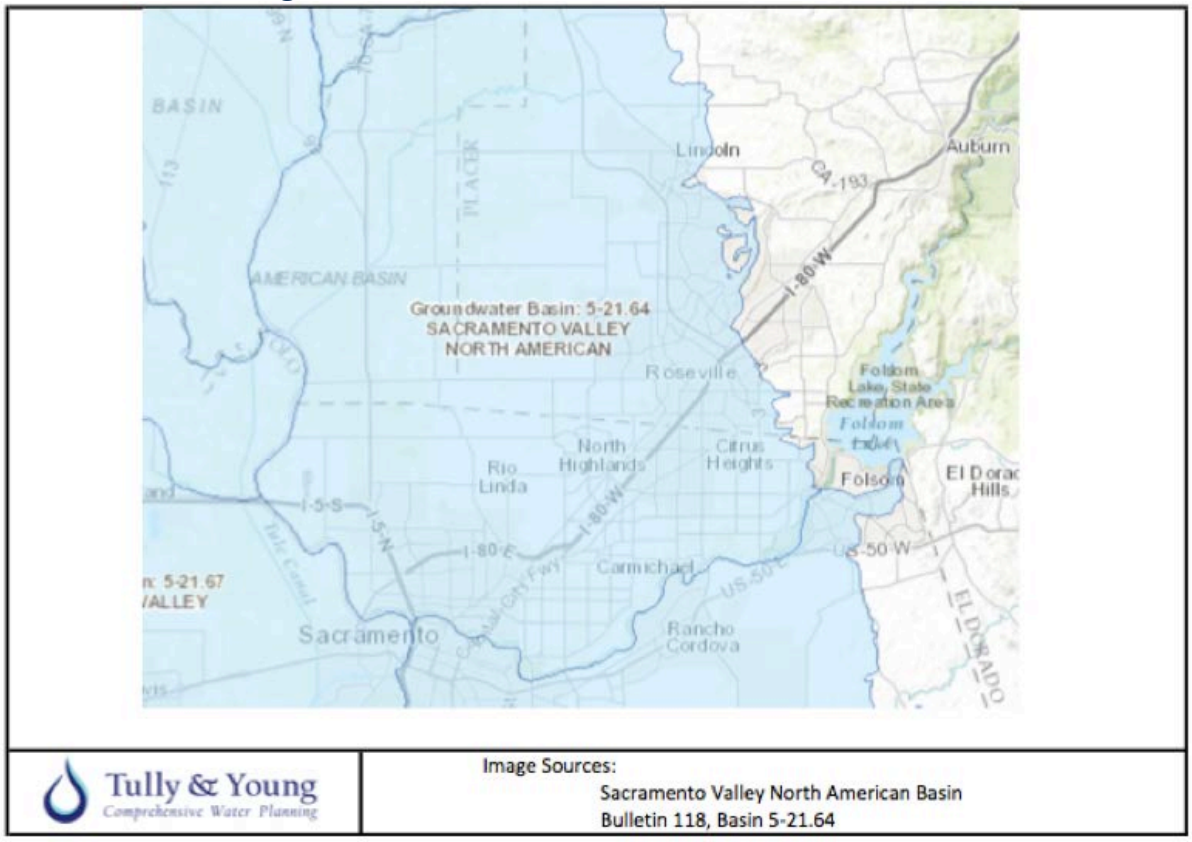
Basin is one of the several large categorical areas that makes up the Central Valley Groundwater Basin. The Sacramento Valley Groundwater Basin covers nearly 7,900 square miles. The Sacramento Valley Groundwater Basin is comprised of numerous sub-basins with hydrogeological and political delineations. The Sacramento Valley comprises the northern one-third of the Central Valley. **Figure 6-1** depicts the Sacramento Valley and its groundwater basins.

Figure 6-1 – Sacramento Valley Groundwater Basins[2]



[2] Bulletin 118, Sacramento River Hydrologic Map found at http://www.water.ca.gov/groundwater /bulletin118/ maps/SR.pdf.

Figure 6-2 – North American Groundwater Subbasin[3]



The North American Groundwater Subbasin ("Subbasin" – **Figure 6-2**, above) is one of 18 subbasins that comprise the Sacramento Valley Groundwater Basin. The Subbasin lies within portions of Sutter, Placer, and Sacramento Counties. The Subbasin is identified by the California Department of Water Resources (DWR) in Bulletin 118-2003 as Basin No. 5-21.64.[4] The approximate total storage of the North American Subbasin is 4.9 million acre-feet of water, across a surface land area of approximately 351,000 acres. This Subbasin is the primary groundwater zone of the City's concern.

The Subbasin is delimited by the Bear River on the north, the Feather River and the Sacramento River on the west, the American River on the south, and the Sierra Nevada foothills on the east. The eastern boundary, characterized by low rolling dissected uplands, represents the approximate edge of the alluvial basin – a boundary where percolating recharge from the Sierra Nevada generally ceases. Beyond this eastern border, some fractured rock groundwater systems may recharge the Subbasin but percolation directly to the basin is generally absent. The northern, western, and southern portions are flood basins for the Bear, Feather, Sacramento and American rivers, interspersed with several small tributary

[3] City of Lincoln Groundwater Management Plan, 2003, p. 16.
[4] Bulletin 118 Sacramento Valley Groundwater Basin North American Subbasin, p.1-6.

streams. These major boundaries – all the major perennial rivers – represent partial groundwater divides, where at shallow depths there is little groundwater flow from the aquifer system on one side of the river to the aquifer system on the other side. At greater depths, however, there is groundwater flow across these hydrogeological boundaries.

The general direction of drainage – land surface slope – is west-southwest. Naturally occurring subsurface groundwater movement generally follows this drainage direction, except where isolated lenses or barrier layers impede water movement through the soil profile. The base of freshwater deepens moving westward from about 400 feet below sea level near the Sierra Nevada foothills to over 1200 feet at the axis of the valley (approximately the location of the Sacramento River).

The City of Lincoln's current boundary is located wholly within the North American Subbasin. The City is lies approximately two miles to the west of the demarcated hydrogeological boundary at the Sierra Nevada foothills. Lincoln's Sphere of Influence (SOI) is mostly located within the North American Groundwater Subbasin. But the SOI's eastern expanse, as described in the Lincoln 2008 General Plan, extends beyond the water-bearing sediments of the Subbasin into the western reaches of the Sierra Nevada foothills. As described in subsequent sections of this analysis, the City's location and future SOI boundary coupled with the region's diverse hydrogeology, require further investigation before the City undertakes future groundwater development and management actions.

6.2.1 North American Subbasin Hydrogeology

The hydrogeologic units of the North American Subbasin can be grouped into two aquifer units in the City of Lincoln area. The upper aquifer includes the saturated Laguna Formation and younger unconfined sediments consisting of generally thin and laterally discontinuous sands and gravels separated by thick sequences of clay strata. The lower aquifer consists of Mehrten Formation continental deposits, including a significant amount of fine-grained materials. These two systems constitute the major water producing aquifers in the City of Lincoln area. Both systems are composed of lenses of sand, silt, and clay, inter-bedded with coarse-grained stream channel deposits that store water.

Groundwater aquifers can be confined, semi-confined, or unconfined. A fully confined aquifer is generally bounded by impervious layers on all sides and has no direct connection with an overlying aquifer or soil surface. A semi-confined aquifer is bounded by confining strata but is partially connected to an overlying aquifer or soil surface. An unconfined aquifer has direct interaction with the soil surface.

The fresh water bearing deposits of the North American Groundwater Subbasin in and around the City of Lincoln are divided into two broad aquifer systems with lithologic and hydrologic differences. The division between the two systems is not clearly demarcated

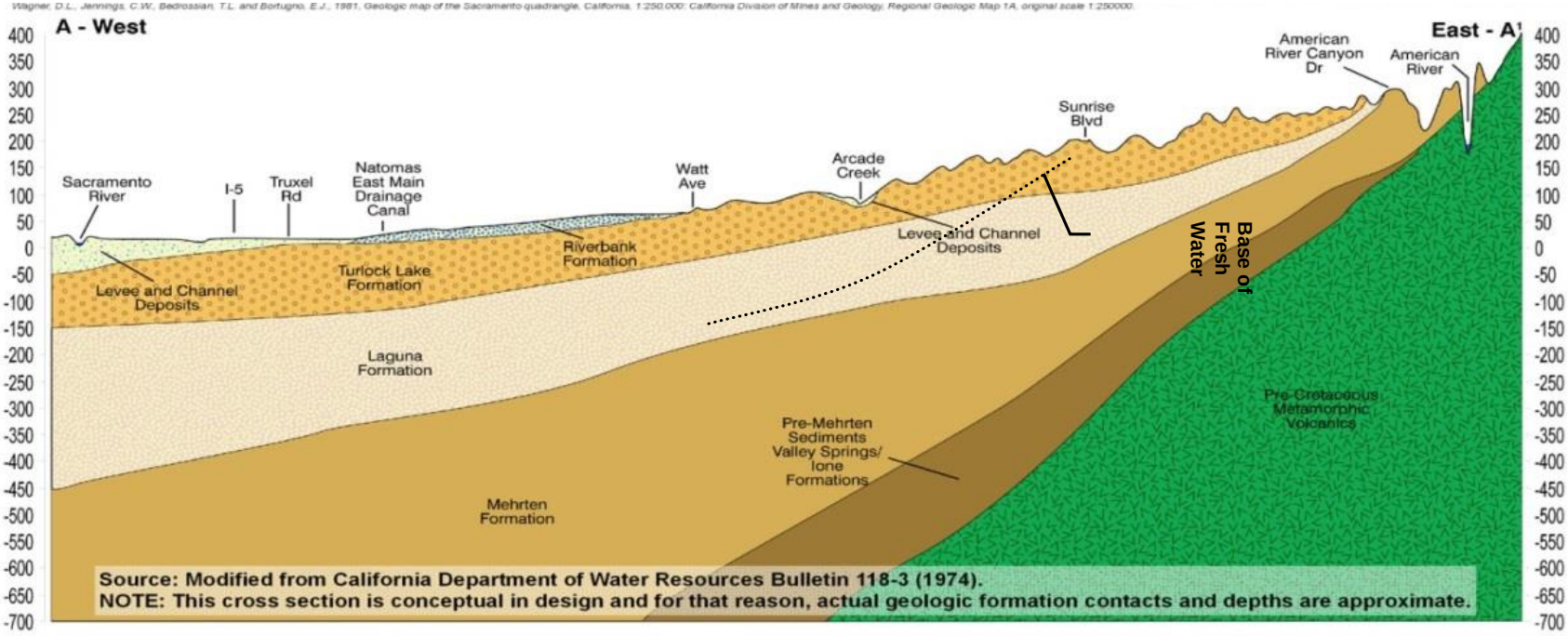
because the subsurface geology and groundwater conditions have not been fully mapped. The aquifer systems themselves are quite variable – the aquifer thickness, the horizontal and vertical extent of individual geologic layers, and the presence of semi-confining layers, dividing lenses, and physical anomalies all vary throughout the two systems hydrogeological profile.

6.2.2 Upper Unconfined and Semi-Confined Aquifer System

The upper unconfined and semi-confined aquifer system lies directly below the land surface and is composed of alluvium deposits. The system varies in thickness from as much as 300 feet in the western part of the Lincoln SOI to essentially zero feet in the eastern part where the aquifers end in the Sierra Nevada foothills. The aquifer system contains generally thin sands and gravels that are laterally discontinuous, separated by low permeability clay and silt. Aquifer conditions are known to be unconfined and semi-confined based on the direct response of groundwater levels to imposed stresses, like aggressive pumping. Throughout much of the Lincoln area, however, except near creeks and ravines, a low permeability clay soil or "hardpan" layer exists near the soil surface that restricts vertical water flow and deep percolation into the aquifer. This less permeable geological horizon may act as an upper semi-confining layer to the aquifer in some places.

From youngest to oldest, the three hydrogeologic units that comprise the upper aquifer system include Holocene alluvium ("Alluvium"), the Pleistocene Riverbank Formation ("Riverbank Formation"), and the Pliocene-Pleistocene Laguna Formation ("Laguna Formation"). All of these hydrogeological units are described below. **Figure 6-3** depicts a cross-section of the groundwater basin formations.

Figure 6-3 – Groundwater Basin Cross-Section[5]



[5] Sacramento Groundwater Authority Groundwater Management Plan (2014), p. 28.

6.2.2.1 Alluvium

The youngest alluvium consists of unweathered gravel, sand, and silt deposited by present-day water flow through creeks and drainages. These deposits are primarily located along the surface streams in the area and spread out based upon the historical flood plain of the surface system. The Alluvium's depositional thickness and areal coverage is not significant because of the limited hydrology of the local surface water systems. Accordingly, the Alluvium does not yield appreciable quantities of groundwater.

6.2.2.2 Riverbank and Turlock Lake Formations

These two formations overlie the Laguna Formation and have been laid down along the American River lower watershed. These formations are geologically young (Pleistocene) and largely unconsolidated. Formation sediments are primarily derived from decomposed granite and metamorphic rock of the western Sierra.[6] The Riverbank Formation contains a heterogeneous mixture of silt, sand, gravel, and clay – exhibiting extreme grain size variability over short lateral and vertical distances. The Riverbank Formation overlies the Turlock Lake Formation yet is interspersed with it in areas. The Riverbank Formation often is differentiated into two members:

- Upper Member – an unconsolidated, dark brown to reddish-colored alluvium deposit composed of gravels, sands and silt with minor amounts of clay.
- Lower Member – a semi-consolidated, red-colored alluvium deposit composed of gravels, sands and siltstone that represent remnants of dissected alluvial fans.

The Riverbank Formation deposits are widespread throughout western Placer and northern Sacramento counties along foothills and often considered an important aggregate resource. The deposits thickness varies, with a maximum thickness of 50 to 75 feet. The formation is moderately permeable overall, with highly permeable coarse-grained zones. Where saturated, these deposits can yield appreciable quantities of groundwater.

6.2.2.3 Laguna Formation

The Laguna Formation geologic unit is composed of a heterogeneous mixture of tan and brown interbedded alluvial sand, silt, and clay, with some gravel lenses – deposited by ancestral rivers and streams that drained the Sierra Nevada. The formation generally increases in thickness toward the west and has a maximum thickness of about 200 feet. In certain portions of Placer and Sacramento Counties, the Laguna Formation is similar in depth, thickness and composition to the overlying Riverbank Formation – but generally it is more fine-grained than the other overlying formations. Where this unit is saturated,

[6] Sacramento Groundwater Authority Groundwater Management Plan, 2008 at p. 9.

appreciable quantities of groundwater can be produced, although most wells within the unit have low to moderate yields.

6.2.3 Lower Semi-Confined Aquifer System

The Lower Semi-Confined aquifer system occurs below the upper unconfined and semi-confined aquifer system, and is composed of clastic deposits of volcanic origin that vary in thickness from greater than 200 feet in the western part of the area to less than 10 feet in the eastern part. These deposits are known as the Mehrten Formation. The semi-confining layer dividing the upper and lower aquifer systems consists of a clay layer and a hard, consolidated volcanic tuff-breccia layer.

Aquifer conditions in this lower system appear to be at least partially confined based on the limited response of groundwater levels to imposed stresses at shallow depths. The base of the lower aquifer system is defined by the base of the fresh water-bearing zone or the top of the regional geologic basement complex of the Sierra Nevada foothills, the former in the western part of the Lincoln area and the latter in the eastern part. The lower system also contains significant amounts of low permeability clay and silt, but the coarse zones, although laterally discontinuous, appear to be somewhat thicker than those of the upper aquifer system.

6.2.3.1 Mehrten Formation

The Mehrten Formation is composed of a sequence of fragmental volcanic rocks that overlie marine and brackish water sediments. The formation consists of two distinct units:

- A sedimentary unit containing fluvial deposits composed of gray to black well-sorted sands with associated lenses of stream gravels containing cobbles and boulders, interbedded with blue to brown silts and clays.
- A dense, hard gray andesitic tuff-breccia formed by the solidification of ash mudflows emanating from volcanic eruptions to the east.

The sand and gravel beds within the sedimentary unit, which are individually 5 to over 20 feet thick, are highly permeable and saturated with primarily fresh water. Consequently, the sedimentary unit of the Mehrten Formation is recognized as an important aquifer in much of the Sacramento Valley, producing significant fresh groundwater supplies throughout much of the Placer, Sutter, and Sacramento County regions.

6.2.3.2 Ione Formation

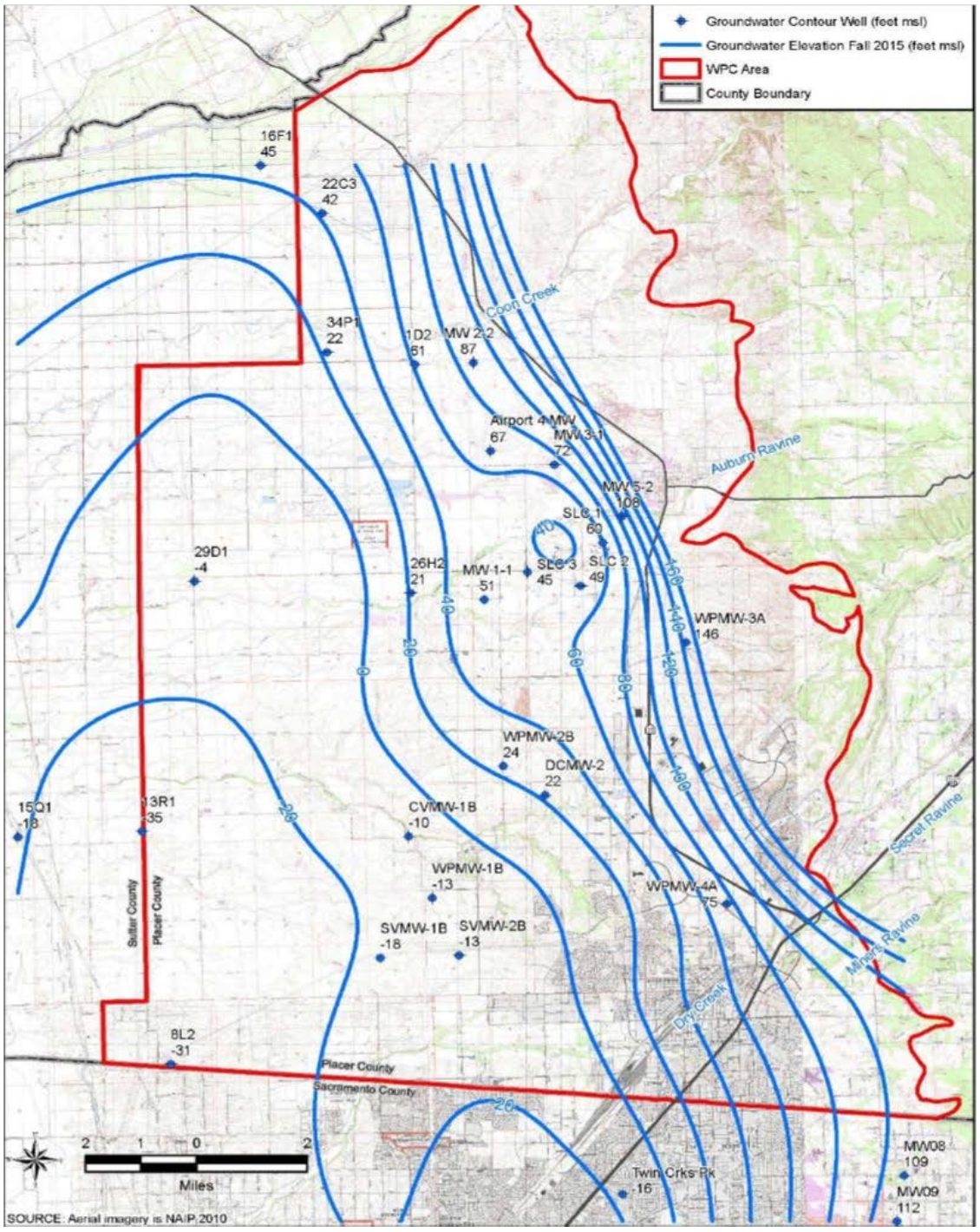
The Ione Formation lies below the Mehrten Formation. This hydrogeological unit contains marine deposits consisting of white to light yellow colored conglomerate, sandstone, and claystone. The Ione is recognized as the light colored clay visible in the Gladding-McBean quarry north of Lincoln. As the depth of the Ione Formation increases it has been recognized

that water quality in this formation becomes degrades becoming more brackish and eventually saline. The Ione Formation has not been used extensively for groundwater production due to its generally low water yield and mostly poor water quality.

6.2.4 Groundwater Movement

Groundwater levels and flow direction in the Lincoln area have remained relatively stable since 1950. The regional groundwater flow direction is west-southwest, approximately parallel to Coon Creek in the northern part of the Lincoln area and southwesterly through most of the Lincoln Sphere of Influence. The sedimentary section comprising the aquifer systems dips to the west-southwest as well, at about five degrees or less – suggesting the unstressed groundwater flow direction is parallel to the slope of geologic bedding. Below in **Figure 6-4** is an historical groundwater contour map indicating the direction of groundwater flow.

Figure 6-4 – Groundwater Contour Map



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Image Sources:
GEI- Western Placer County Groundwater Level Summary

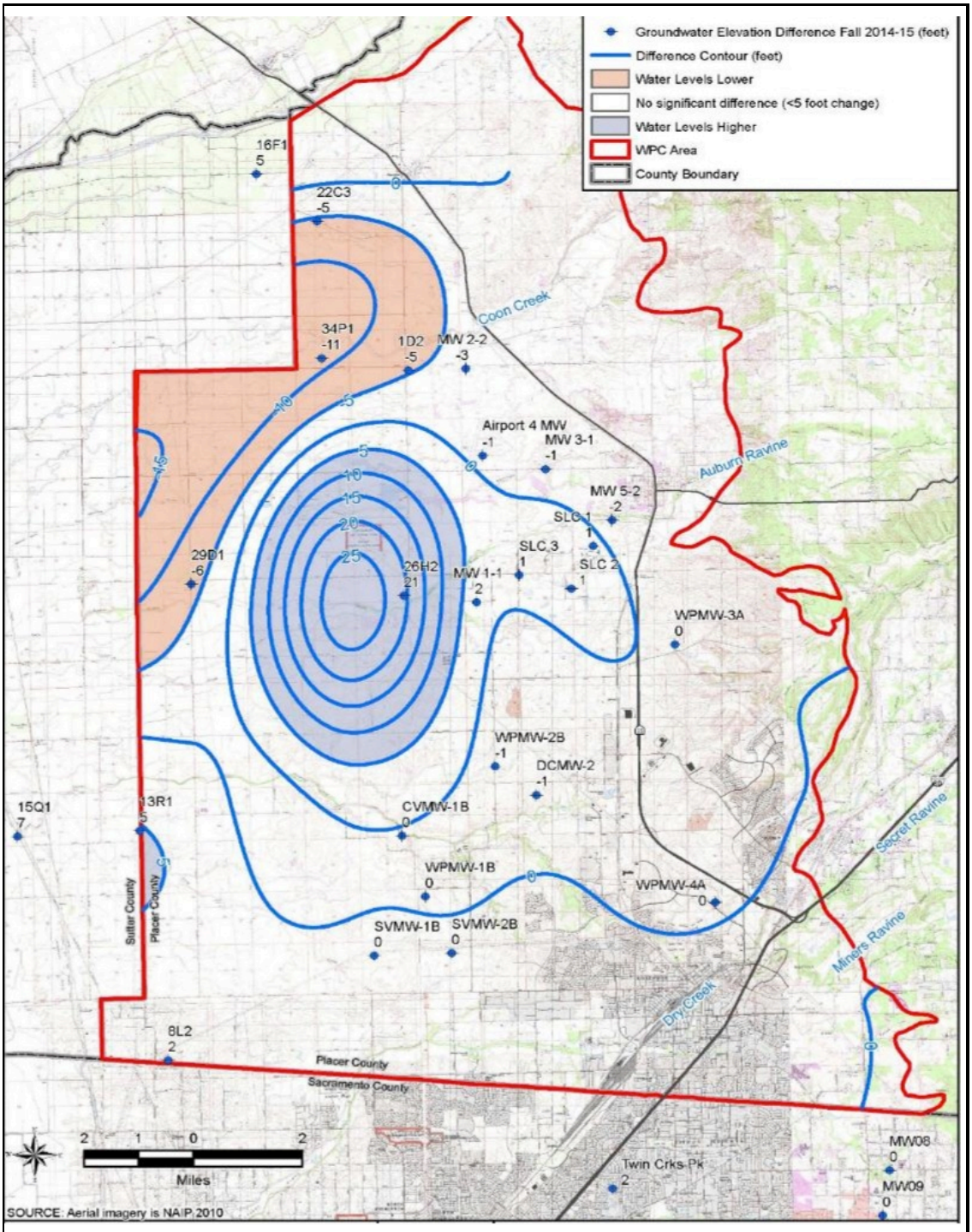
6.3 Current Subbasin Physical Condition

The stability of groundwater levels in the Lincoln area over historical hydrologic conditions is demonstrated by the worked performed by the West Placer County Groundwater Management Plan workgroup. Over the course of the last several decades, the City of Lincoln has successfully converted most of its water usage to surface water sources rather than using groundwater sources. This conversion has resulted in improved groundwater supply conditions in and around the City of Lincoln.

However, other areas of the North American Groundwater Subbasin have experienced significant declines in groundwater levels due to pumping extraction from the Subbasin's aquifer systems. In particular, there are two pumping depressions. The first is centered in northern Sacramento County near McClellan Air Force Base that extends into southwestern Placer County. The second is located in Sutter County as groundwater pumping has increased with cropping pattern changes and the lack of reliable surface supplies during the course of this drought. Although the pumping depressions do not appear to extend to or impact the Lincoln SOI at this time, the implications of aggressive groundwater pumping may manifest into denuded groundwater supply conditions in broader areas of the North American Subbasin.

The current groundwater elevations in the Western Placer County portions of the Subbasin are shown in **Figure 6-5**. The elevations below depict a recovery in groundwater levels in the area just west of the City of Lincoln. This recovery is likely due to the City's efforts to reduce groundwater pumping by better utilizing surface sources of water from PCWA and NID. However, in the most western portion of the basin, groundwater levels are declining. The additional use of groundwater for irrigation during drought conditions – such as those over the course of the last 4 years – have taxed the groundwater basin beyond its normal use in an average year. If the additional groundwater pumping is permanent, the Subbasin will likely continue to witness a growing groundwater depression in that location.

Figure 6-5 – Groundwater Elevation Difference Fall 2014-15



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Image Sources:
GEI - Western Placer County Groundwater Level Summary

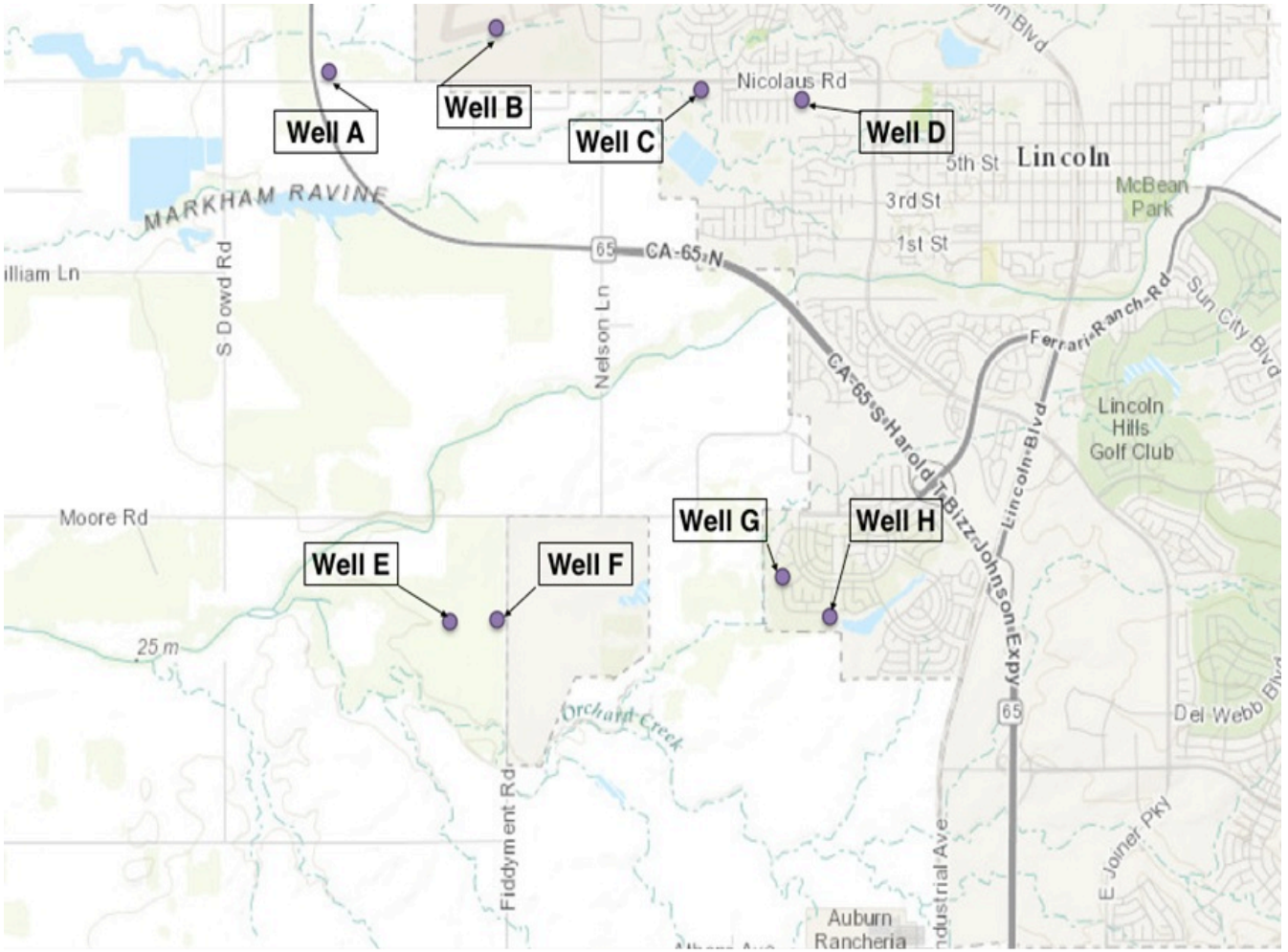
6.3.1 City of Lincoln Groundwater Levels

Prior to the 1960's, groundwater was the sole source of water supply in most parts of the North American Subbasin, including the City of Lincoln. A strong dependence on groundwater existed in the southern central portion of the Subbasin, resulting in groundwater declines at an average rate of up to about one and a half feet per year for about 50 years, through the 1980s to mid-1990s. The introduction of surface water sources throughout the North American Subbasin has subsequently resulted in stabilization and some recovery of groundwater levels. Nevertheless, throughout the North American Subbasin, groundwater levels continue to fluctuate seasonally and through varying climatic and regulatory conditions. As discussed later in this report, regional groundwater pumping may accelerate in the future as regulatory restrictions and streamflow requirements inhibit surface water diversions for human uses.

Groundwater level data was downloaded from the DWR Water Data Library (http://well.water.ca.gov) for all wells monitored by DWR within the City of Lincoln's designated Sphere of Influence. **Figure 6-6** displays the location of each current DWR well within and around the City of Lincoln. DWR provided 620 different groundwater logs in the subbasin region some of which had been abandoned and others lacked adequate records. After sorting all of the data, the following wells were chosen to represent City groundwater elevations as they have an unbroken record of well information: Well A- 388974N1213665W001; Well B- 389011N121354W001; Well C- 388971N1213301W001; Well D- 388963N1213206W001; Well E- 388704N1213544W003; Well F- 388603N1213502W001; Well G- 388637N1213222W001; and Well H- 388607N1213177W001.

The City of Lincoln also manages an array of monitoring wells. These wells are shown below in **Figure 6-7** with selected characteristics as: MW-1, MW-2, MW-3, MW-4, MW-5, SLC-1, SLC-2, and SLC-3.

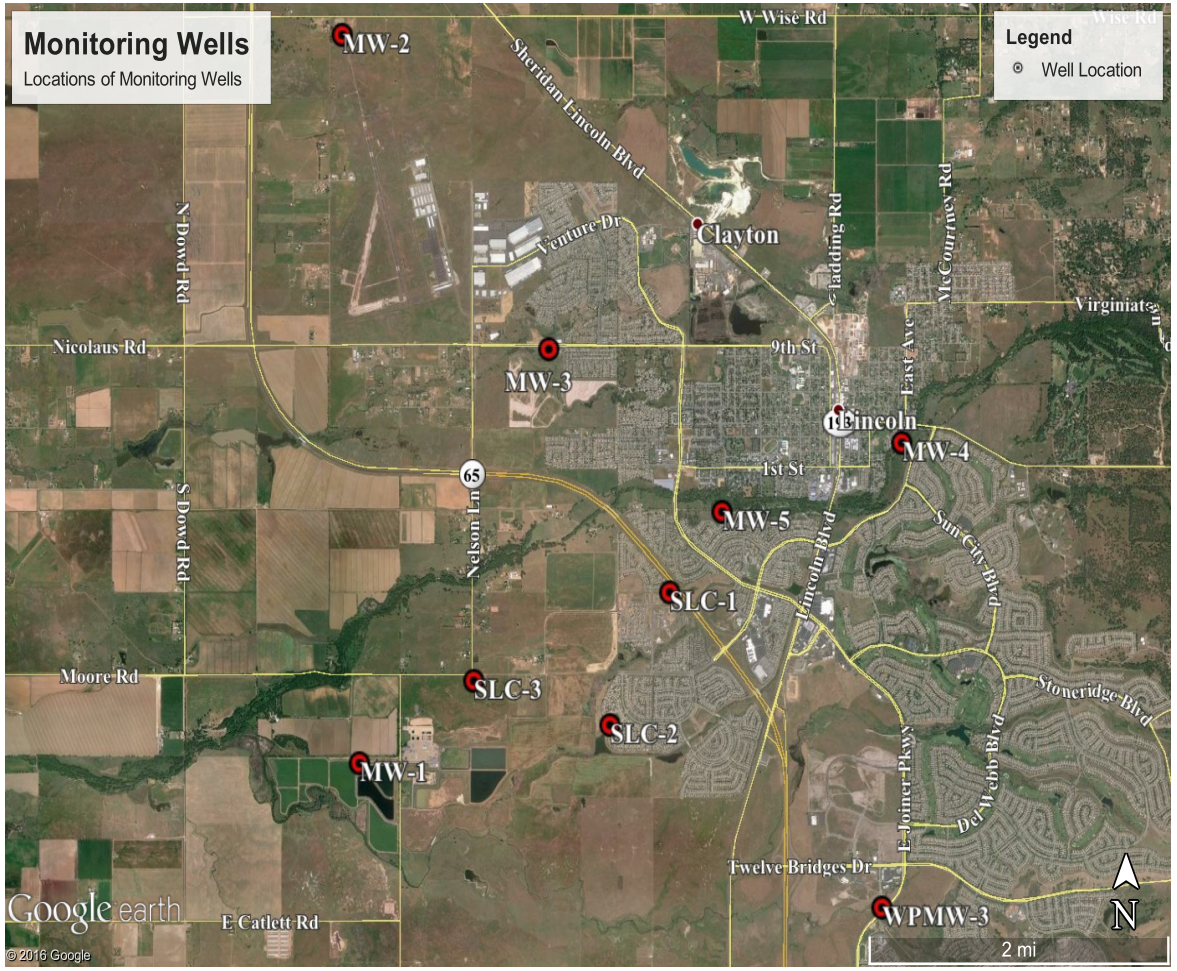
Figure 6-6 – Groundwater Wells in City of Lincoln and SOI



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Image Sources:
DWR Groundwater Well Location Map

Figure 6-7 – Lincoln Monitoring Wells

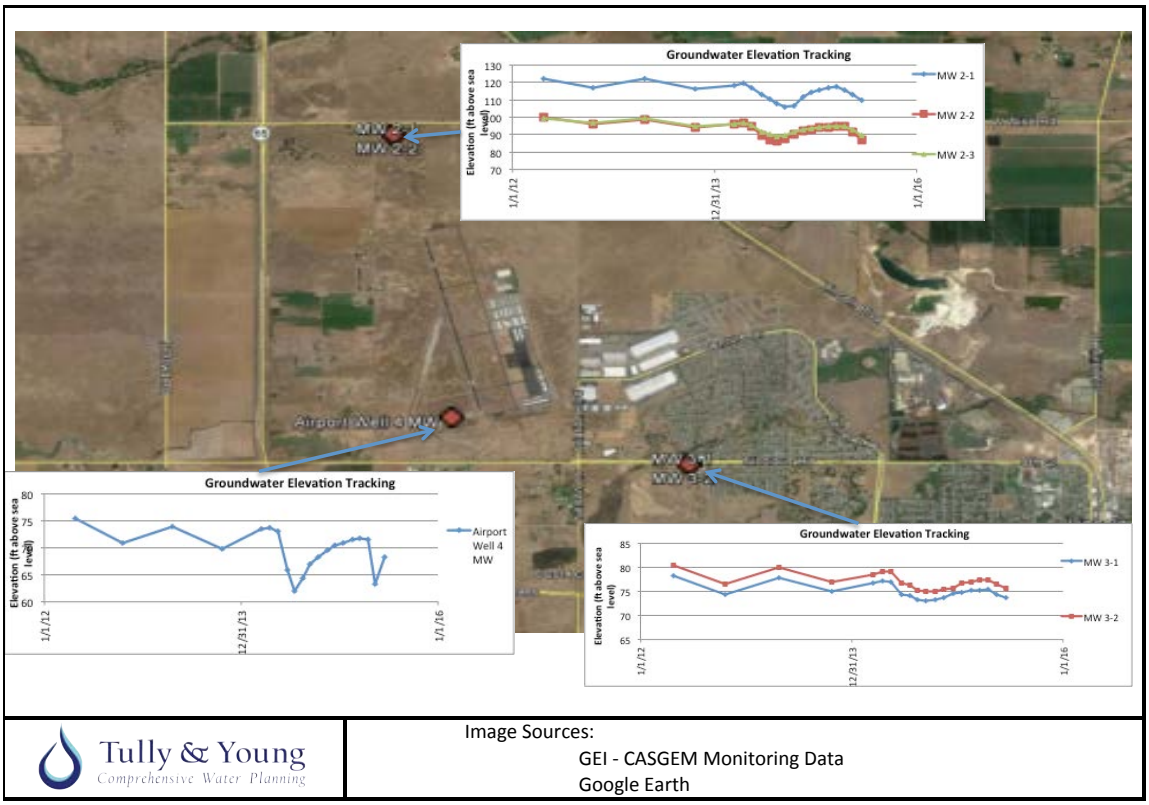


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Image Sources:
Google Earth Pro

Figures 6-8 through **6-11** below, display the historical groundwater elevations for each monitoring well. As shown in the figures, groundwater elevations underlying Lincoln have remained relatively stable.

Figure 6-8 – Groundwater Elevation Tracking (East)



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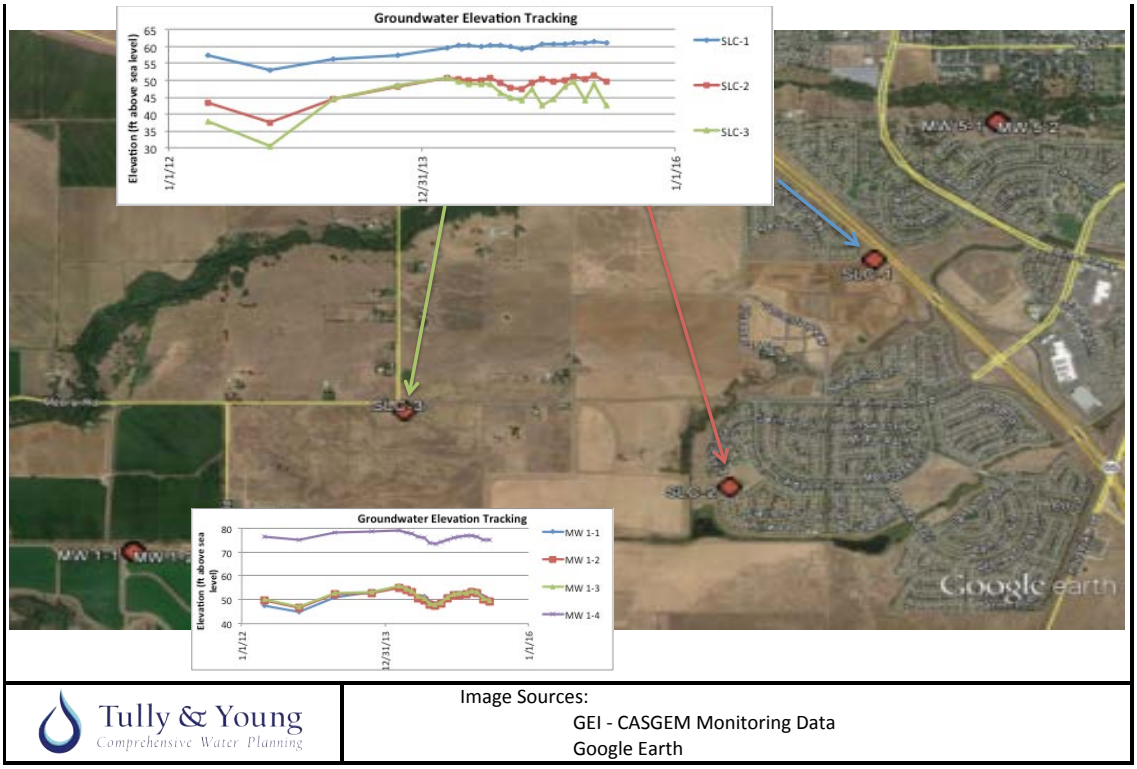
Image Sources:
GEI - CASGEM Monitoring Data
Google Earth

Figure 6-8 above shows the aerial location of three of the City's monitoring wells in the Lincoln Airport area east of the Highway 65. Each of the three locations have 3-year hydrographs that show the annual trend of recovery for the water table. Considering the drought impacts elsewhere in the state, the downward drift in depth to water of 3 to 8 feet in the annual spring peak of recovery, between 2012-2015, is minimal. Note that the lower monitored zones for two of the wells mirror the water table values in the wells.

Figure 6-9 shows the aerial location of four of the City's monitoring wells in the southwestern area of the City, south of the Highway 65. The two hydrographs included show the annual trend of recovery for the water table. The upward drift in depth to water of 0 to 5 feet in the annual spring peak of recovery, between 2012-2015, is small but significant relative to stable groundwater levels in the area. Note that the lower monitored zones for well MW-1 mirror the upper water table values in the well. Also note that Well SLC-3 recovers adequately but has lower minimum levels than the other 2 wells in the area. These

lower values for SLC-3 are due the close proximity, about 500 feet, to a City production well and is influenced by its use.

Figure 6-9 – Groundwater Elevation Tracking (Southwest)

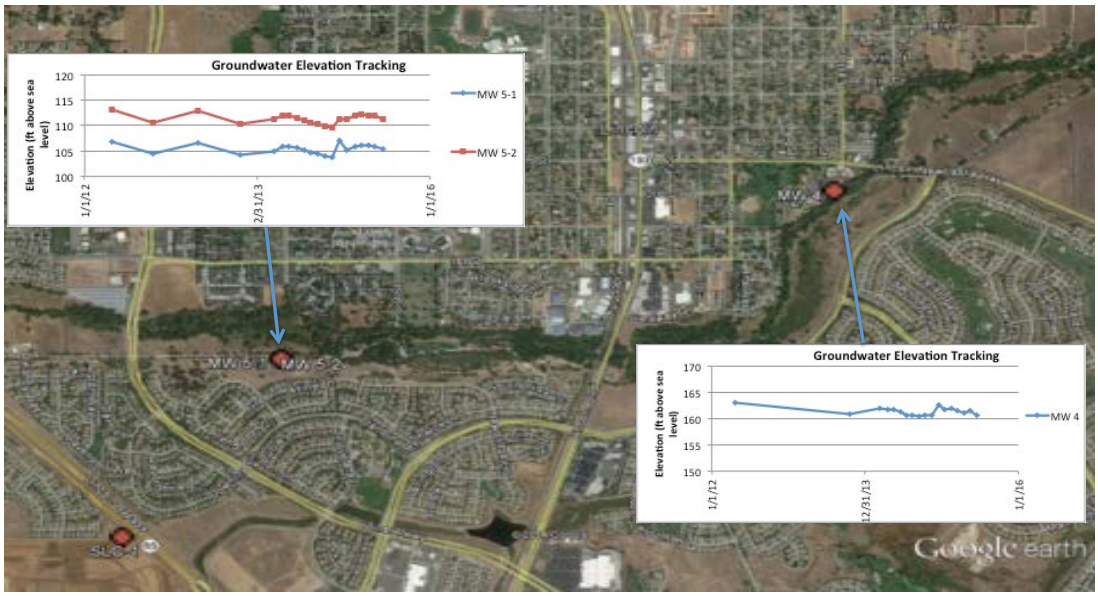


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Image Sources:
GEI - CASGEM Monitoring Data
Google Earth

Figure 6-10 shows the aerial location of two of the City's monitoring wells in the center area of the City, along the Auburn Ravine. The two hydrographs included show the annual trend of recovery for the water table. The stable drift in depth to water of 0 to 3 feet annually can be attributed to the minimum flows maintained in the Auburn Ravine. The blip in December 2014 could be attributed to a storms passing through the watershed that resulted in high flows in the Auburn Ravine floodplain and the corresponding scour of the ravine of accumulated silts and clays to allow more efficient groundwater recharge in the proximity of the two monitoring wells.

Figure 6-10 – Groundwater Elevation Tracking (Center)



Tully & Young Comprehensive Water Planning	Image Sources: GEI - CASGEM Monitoring Data Google Earth

Figure 6-11 – Groundwater Elevation Tracking (Southeast)



Tully & Young Comprehensive Water Planning	Image Sources: GEI - CASGEM Monitoring Data Google Earth

Figure 6-11 shows similar results to **Figure 6-10**. The aerial location of the City's monitoring well lies in the southeastern area of the City, east of the Highway 65. The well is at the westerly edge of the Sierra Nevada foothills with a depth to water of less than 10 feet. The two hydrographs show the annual stability of the water table, in a range of less than 3 feet. Note that the lower monitored zone for the well mirrors the upper water table values in the well.

6.3.2 Recharge

The West Placer Groundwater Management Plan (WPCGMP) has addressed recharge in the Lincoln Area. The technical definition of a recharge area is where water enters the saturated zone and has a net downward flow direction. Thus, to precisely define recharge areas it is necessary to measure the shallow groundwater head gradient in three dimensions across the groundwater basin – in essence requiring groundwater level measurements in a densely spaced monitoring network of wells, each containing piezometers in each aquifer unit. In practice, the direct measurement of a groundwater basin's recharge area is impractical and instead a combination of monitoring well data and indirect methods of inference are employed to delineate probable recharge areas. Currently, there are several indirect indicators of the potential recharge areas within the Lincoln SOI, which are discussed below.

The runoff characteristics and recharge potential of the soil throughout the Lincoln area have been investigated and mapped – providing a qualitative indication of the areal potential for deep percolation of surface water into the aquifer systems. Most of the soil cover across the North American Subbasin has been classified as having high runoff (low infiltration) potential, except in the vicinity of river and stream drainages. Large areas surrounding Auburn Ravine, as well as Coon Creek, were thought to have moderate to high runoff potential (low to moderate infiltration potential). Subsequent analyses indicate that although Coon Creek has a high recharge potential, areas around Auburn Ravine are more limited. Markham Ravine drainage and Orchard Creek drainage are also potential areas of groundwater recharge based on the inferred shallow depth to the upper aquifer zone in these areas.

6.3.3 Estimated Groundwater Quantity

A recent investigation of groundwater resources in the Lincoln area mapped the top and base of the upper aquifer sequence across much of the area, using fairly widespread geophysical surveys and drill hole data to give a more accurate picture of the sub-surface lithology. The results of this investigation indicated that the productive zone of the North American Subbasin pinches out to the east, along a north-south line close to old Highway 65. East of this line, the likely potential water bearing formations are the Ione Formation and fractured granitic bedrock. West of this line, the productive aquifer zone thickens westward, although

there are localized variations in thickness. There are also known variations in the presence and number of clay interbeds and in the hydrologic properties of the aquifer zone, but these properties cannot be determined from the data. The thickness of the upper aquifer system exceeds 300 feet near the western boundary of the Lincoln Sphere of Influence, south of Lincoln Airport. Recent studies indicate that there are significant volumes of recoverable water in and around the City of Lincoln.

6.4 City Wells

The City has a network of wells that are used to augment water supplies to manage peak flows, provide emergency back up, and address drought conditions. The wells are interspersed throughout the City's water infrastructure system. Below in **Figure 6-12** is a map depicting the locations of these wells.

The City currently has five (5) active production wells on-line and available for automatic operation through a SCADA system dedicated to the City water system. Selected characteristics of the 5 active wells is shown in **Table 6-1** below.

Table 6-1 – City of Lincoln Well Production[7]

Well Name	Max. Production (gpm)	Year Built	Status
Nicolaus (Well #2)	900	1984	Active
Westwood (Well #6)	1,000	2000	Active
Moore (Well #7)	1,000	2002	Active
Fiddyment (Well #8)	1,400	2004	Active
Nelson (Well #9)	1,500	2005	Active
Subtotal	**5,800**		
Well #4	n/a	1999	Inactive
Well #5	n/a	1999	Inactive

[7] Groundwater quality from the City wells meets primary and secondary State standards and requires only on-site disinfection.

Figure 6-12 – Production Wells Map



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Image Sources:
Google Earth Pro

Well No. 2 – Nicolaus Road

Well No.2 received a significant upgrade in 2015. Upgrading was required due hydraulic changes in the City distribution system that required increasing the total dynamic head available from the well pump to match the increased system pressures in the area of the well.

The well was originally completed as a City well in 1984. Drilled by cable-tool methodology, a blank 14-inch casing was anchored at about 117 feet-below ground surface (bgs) and an open hole below to -285 bgs. When a severe sanding issue arose in 1990, a well screen was installed below the blank casing, and the well equipped to pump about 650 gpm with an on-site back-up generator for emergency well operations. Until 2003, Well Nos. 2 & 4 exclusively served a portion of the City through a 10,000 gallon hydro-pneumatic tank at each well site, with treated surface water available as an emergency backup supply. In 2003, the hydraulic grade at Well No. 2 was increased as valves were opened in the system to eliminate the separate well zone and allow the treated surface water supply form the City's gravity storage tank to serve the former well zone with Well Nos. 2 & 4 taken offline as inactive until upgraded.

In 2015, Well No. 2 was upgraded with new equipment for automatic, online operation as a backup and peak management source of potable water in the City's distribution system. Significant upgrades included well casing improvements, pumping plant replacement (100HP pump), and pump-to–waste facilities per State requirements.

Well No. 6 – Westwood Well

Well No. 6, or commonly referred to as the Westwood Well, was completed in 2000 and the first of three wells constructed by a developer on behalf of the City. Drilled by the reverse-rotary method, the 16-inch well casing extends to 235 feet-bgs. The Westwood Well was the first of the City's last 4 wells to fully incorporate a standardized approach to production facility design and operation. Housed in a concrete block building and discharging into a 10,000 hydro-pneumatic tank before entering the City distribution system, the 125 HP submersible pump was installed to minimize noise into the nearby residential housing. The Westwood Well is fully automatic for on-line operation from the City SCADA system, and can accommodate temporary stand-by power in case of emergency.

Well No. 7 – Moore Road Well

Well No. 7, or commonly referred to as the Moore Road Well, was completed in 2002 and the second of three wells constructed by a developer on behalf of the City. Drilled by the reverse-rotary method, the 16-inch well casing extends to 300 feet-bgs. The Moore Road Well was the second of the City's last 4 wells to fully incorporate a standardized approach to production facility design and operation. Housed in a concrete block building and discharging into a 10,000 hydro-pneumatic tank before entering the City distribution system, the 150 HP vertical turbine pump was installed. The Moore Road Well is fully automatic for

on-line operation from the City SCADA system, and can accommodate temporary stand-by power in case of emergency. The 150 HP motor has been repaired once since its initial installation.

Well No. 8 – Fiddyment Road Well "A"

Well No. 8, or commonly referred to as the Fiddyment Well, was completed in 2005 and the last of three wells constructed by a developer on behalf of the City. Located on City property near the Regional Wastewater Treatment Facility there was considerable caution taken by the State in approving the well for potable water production due to potential leakage and associated biological contamination from the City's nearby waste treatment and storm water retention ponds. Drilled by the reverse-rotary method, the 16-inch well casing extends to 330 feet-bgs. The Fiddyment Well was the third of the City's last 4 wells to fully incorporate a standardized approach to production facility design and operation. Due to the location, the 200 HP vertical turbine pump was installed outside of the concrete block building, discharging in to a 10,000 hydro-pneumatic tank before entering the City distribution system. The Fiddyment Well is fully automatic for on-line operation from the City SCADA system, and can accommodate temporary stand-by power in case of emergency. Since commencement of operation, there have been no problems with any biological testing of the groundwater pumped from the Fiddyment Well.

Well No. 9 – Moore-Nelson Well

Well No. 9, or commonly referred to as the Nelson Well, was completed in 2005 and the first well constructed by the City since 1990. Located just east of the Fiddyment Well, on City property near the Regional Wastewater Treatment Facility, there was considerable caution taken by the State in approving the well for potable water production due to potential leakage and associated biological contamination from the City's nearby waste treatment and storm water retention ponds. Drilled by the reverse-rotary method, the 16-inch well casing extends to 340 feet-bgs. The Nelson Well was the final of the City's last 4 wells to fully incorporate a standardized approach to production facility design and operation. Due to the location, the 300 HP vertical turbine pump was installed outside of the concrete block building. The Nelson Well is fully automatic for on-line operation from the City SCADA system, and can accommodate temporary stand-by power in case of emergency. Since commencement of operation, there have been no problems with any biological testing of the groundwater pumped from the Nelson Well. The 300-HP vertical turbine motor and pump assembly was replaced with a submersible assembly in 2014.

Table 6-2 – Historic Groundwater Pumping

Acre Feet							
2008	2009	2010	2011	2012	2013	2014	2015
1,085	836	962	2,686	2,620	1,113	691	707

Table 6-3 – Future Groundwater Pumping

Acre-feet					
2020	2025	2030	2035	2040	BO
1,230	1,348	1,530	1,711	2,034	3,568

6.4.1 Groundwater Quality

Groundwater delivered by the City of Lincoln is regularly tested and meets all primary drinking water and secondary standards. Groundwater quality data, summarized from the City's annual Consumer Confidence Report is provided below in **Figure 6-13**.

6.4.1.1 Total Dissolved Solids

TDS concentrations in City of Lincoln wells in production are between 230 and 330 mg/L. The Secondary Maximum Contaminant Level (MCL) concentration of TDS in public drinking water supplies is 500 milligrams per liter (mg/L). Secondary MCLs are set for contaminants in drinking water that primarily affect the aesthetic qualities relating to public acceptance of drinking water.

6.4.1.2 Iron and Manganese

When iron and manganese are present in high concentrations they contribute to plumbing incrustation deposits and surface staining on fixtures. Iron concentrations in the existing City of Lincoln wells range from non-detect (ND) to 1.8 mg/L. Manganese concentrations in the existing water supply wells range from non-detect to 0.07 mg/L. The Secondary MCLs of these constituents in public drinking water supplies are 0.3 mg/L for iron and 0.05 mg/L for manganese. The sources of iron and manganese are naturally occurring.

6.4.1.3 Arsenic

Arsenic concentrations in the City of Lincoln wells range from ND to 4.8 ug/L. The U.S. Environmental Protection Agency is implementing a 10 ug/L standard for arsenic. The source of naturally occurring arsenic in Lincoln groundwater is typically from volcanic deposits.

Figure 6-13 – Groundwater Quality

2015 City of Lincoln Groundwater Quality

Regulated Contaminants

Contaminant (units)	MCL/AL	PHG (MCLG) [MRDLG]	Major Source in Drinking Water (as provided by the State Department of Health Services)	Groundwater (Wells) Range	Average	MCL Violation?
Primary Drinking Water Standards						
Arsenic (ppb)	10	0.004	Erosion of natural deposits	2.2-2.9	2.6	No
Barium (ppm)	1	2	Erosion of natural deposits	ND - 0.1	0.048	No
Chromium (ppb)	50	100	Erosion of natural deposits	ND – 5.0	2.8	No
Fluoride (ppm)	2	1	Erosion of natural deposits; Water additive which promotes strong teeth	0.24 - .0.27	0.25	No
Hexavalent Chromium (ppb)	10	None	Discharge from certain industrial facilities; erosion of natural deposits	1.5 - 4.5	3.6	No
Nitrate (ppm)	10 as N	10 as N	Runoff from fertilizer use; Leaching from septic tanks	1.5 – 3.6	2.2	No
Perchlorate (ppb)	6	6	Environmental contamination from historic industrial operations	ND	ND	No
Regulated Contaminants with Secondary MCLs (California Code of Regulations)						
Odor --- Threshold (units)	3	None	Naturally-occurring organic materials	0 – 2	1.3	No
Turbidity (NTU)	5	None	Soil runoff	0.025 - 0.057	0.15	No
Total dissolved solids (ppm)	1,000	None	Runoff/leaching from natural deposits	210 - 310	240	No
Specific conductance (us/cm)	1,600	None	Substances that form ions when in water; seawater influence	290 - 480	355	No
Chloride (ppm)	500	None	Runoff/leaching from natural deposits; seawater influence	20 - 57	29.8	No
Sulfate (ppm)	500	None	Runoff/leaching from natural deposits; industrial wastes	7.5 - 18	11	No
Manganese	50	None	Leaching from natural deposits	0 - 3	0.75	No
Monitoring of Unregulated Substances						
Sodium (ppm)	No Standard	No Standard	Generally found in ground and surface water	28 - 50	37	No
Hardness (as CaCO3) ppm	No Standard	No Standard	Generally found in ground and surface water	82 - 140	99	No
Alkalinity (as CaCO3) ppm	No Standard	No Standard	Generally found in ground and surface water	91 - 120	103	No
Calcium (ppm)	No Standard	No Standard	Generally found in ground and surface water	15 - 25	18	No
Magnesium (ppm)	No Standard	No Standard	Generally found in ground and surface water	11 - 18	13	No

2015 Surface Water (Placer County Water Agency Purchased Water*)

Regulated Contaminants

Contaminant (units)	MCL/ AL	PHG (MCLG) [MRDLG]	Major Source in Drinking Water (as provided by the State Dept. of Health Services)	Range and Avg. or (HRAA)	MCL Violation?
TTHMs[Total trihalomethanes](ppb)	80	None	By-product of drinking water disinfection	36 – 83 (62.25)	No
Haloacetic Acids (HAA) (ppb)	60	None	By-product of drinking water disinfection	22 - 52 (39.75)	No
Chlorine (ppm)	4	[4]	Drinking water disinfectant added for treatment	0 – 1.22 (0.6)	No
Total Organic Carbon (ppm)	TT=RAA<2	None	N/A	0.9 – 1.4 (1.1)	No
Fluroide	2	1	Water additive that promotes strong teeth	ND	No
Secondary Drinking Water Standards					
Odor --- Threshold (units)	3	None	Naturally-occurring organic materials	ND	No
Total dissolved solids (ppm)	1000	None	Runoff/leaching from natural deposits	50 – 53 51.5	No
Specific conductance (µS/cm)	1,600	None	Substances that form ions when in water; seawater influence	68 – 72 70	No
Chloride (ppm)	500	None	Runoff/leaching from natural deposits; seawater influence	4.9 – 5 4.95	No
Sulfate (ppm)	500	None	Runoff/leaching from natural deposits; industrial wastes	6.7 - 8.1 7.4	No
Monitoring of Unregulated Substances					
Sodium (ppm)	None	None	Generally found in ground and surface water.	5.1– 5.2 5.15	No
Hardness (as CaCO3) ppm	None	None	Generally found in ground and surface water.	17- 18 17.5	No

* Results based on 2015 PCWA water quality report supplied by PCWA to the City of Lincoln.

Turbidity Performance Standards (that must be met through the water treatment process). *Turbidity is a measurement of clarity or the level of suspended matter in the water. In reporting turbidity, the highest single measurement and the lowest monthly percentage of samples meeting the turbidity limits are specified.* Turbidity of the filtered water must 1) be less than or equal to 0.3 NTU in 95% of measurements in a month and 2) not exceed 1 NTU at any time.

Lowest monthly percentage of samples that met Turbidity Performance Standard No. 1	**100% (PCWA)**
Highest single turbidity measurement during the year	**0.21 (PCWA)**
Number of violations of any surface water treatment requirements	**0 (PCWA)**

2015 City of Lincoln Distribution System Water Quality

	MCL (MRDL/ MRDLG)	Running Annual Average	Range of Detections	Typical Source of Contaminant	MCL Violation
TTHMs[Total trihalomethanes](ppb)*	80	34	0 - 55	By-product of drinking water chlorination	No
Haloacetic Acids (HAA) (ppb) *	60	22	0 - 35	By-product of drinking water chlorination	No
Chlorine (ppm)	(4 / 4)	0.59	0.28 – 1.7	Disinfectant added for treatment	No
Total Coliform Bacteria	5%	1.6% ◊	ND	Naturally present in environment; an indicator that potentially harmful bacteria may be present	No
Vanadium	50*	2.5	0 - 21	* = Notification level	No
Chromium	50	0.27	0 - 3	Erosion of natural deposits	No
Hexavalent Chromium	10	0.09	0.035 - 0.18	Discharge from certain industrial facilities; erosion of natural deposits	No

MCL = Systems that collect more than 40 samples per month: More than 5% positive samples in any one month

◊ = Highest number of positive samples in any one month

* = No samples were collected during the third quarter in 2015

Monitoring of Unregulated Substances

Chlorate	n/a	181	88 - 280		No
Strontium	n/a	43	0 - 210	Decay of natural and man-made deposits	No

Lead and Copper Action Levels at Residential Taps

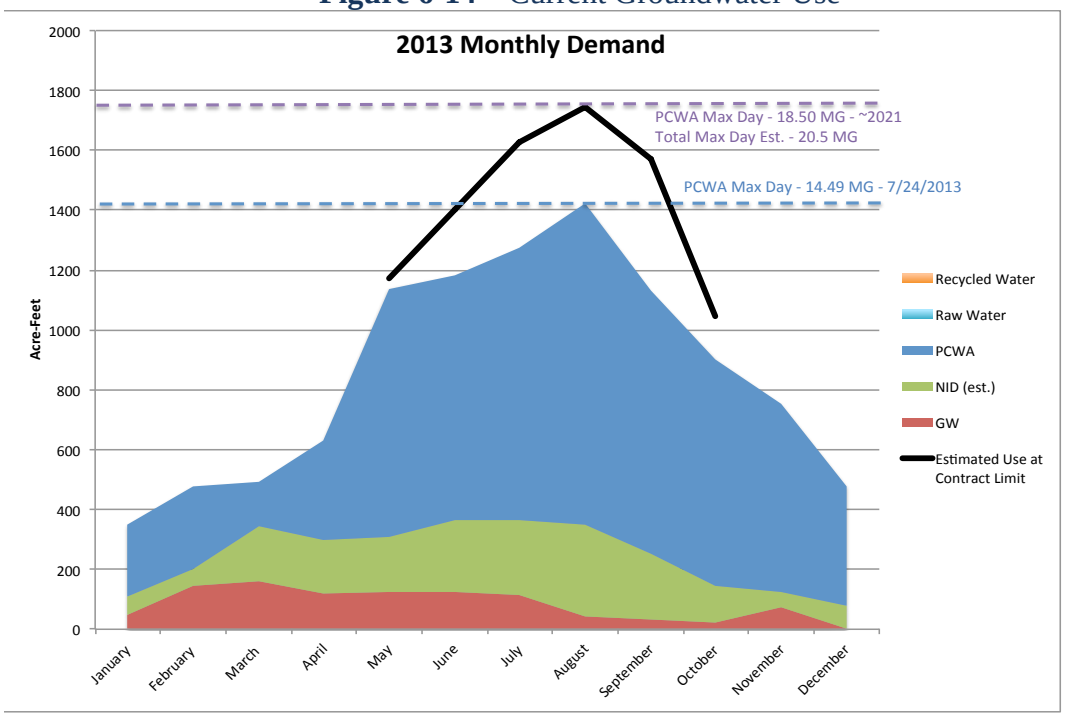
	Action Level (AL)	PHG (MCLG)	90th Percentile Value	Sites Exceeding AL	Number of Sites Tested	Typical Source of Contaminant	AL Violation?	MCL Violation?
Lead (ppb)	15	0.2	1.6	0	30	Corrosion of household plumbing	No	No
Copper (ppb)	1,300	300	6.3	0	30	Corrosion of household plumbing	No	No

6.5 City's Groundwater Usage

The City's current groundwater usage is tiered from policies established through the City's General Plan, WPCGMP partnership, and recent workshops conducted in the development of this Water Master Plan. Specifically, the City has set a policy to meet 10 percent of its average annual demand with groundwater.[8] The City has been successful in meeting this demand over the course of the last five years. Operationally, the City utilizes groundwater in all months of the year – managing its system to meet 10 percent usage per month. This management effort meets the overall intent of the policy but could be modified to better meet other congruent City policies for long-term groundwater management. **Figure 6-14** below shows the overall water use, and the groundwater use highlighted in red, for 2013 – the last "normal" water use year.

Future groundwater management could be altered to utilize the City's groundwater in only the summer months. In this way, the City could best manage its surface and groundwater assets to meet its long-term needs, reduce costs, and reserve groundwater to meet emergency and back-up needs. This type of groundwater management change may require adjustments to current policy implementation.

Figure 6-14 – Current Groundwater Use



[8] This policy is derived from the City of Lincoln's 2008 General Plan.

In 2011, PCWA's Bear River Canal failed due to a landslide and Lincoln aggressively used its groundwater assets to offset the reduced PCWA deliveries. This intensive pumping resulted in localized declines in the groundwater table. However, upon repair of the canal and resumption of surface water deliveries, the groundwater basin recovered because of the active recharge provided by the snowmelt and aquifer systems. Utilizing the groundwater basin to address these sorts of management issues is critical for long-term planning. The City's groundwater usage since 2008 is previously depicted in **Table 6-2** and below, **Table 6-4** provides projections of future groundwater use, including emergency usage.

Table 6-4 – Projected Use of Groundwater Supplies

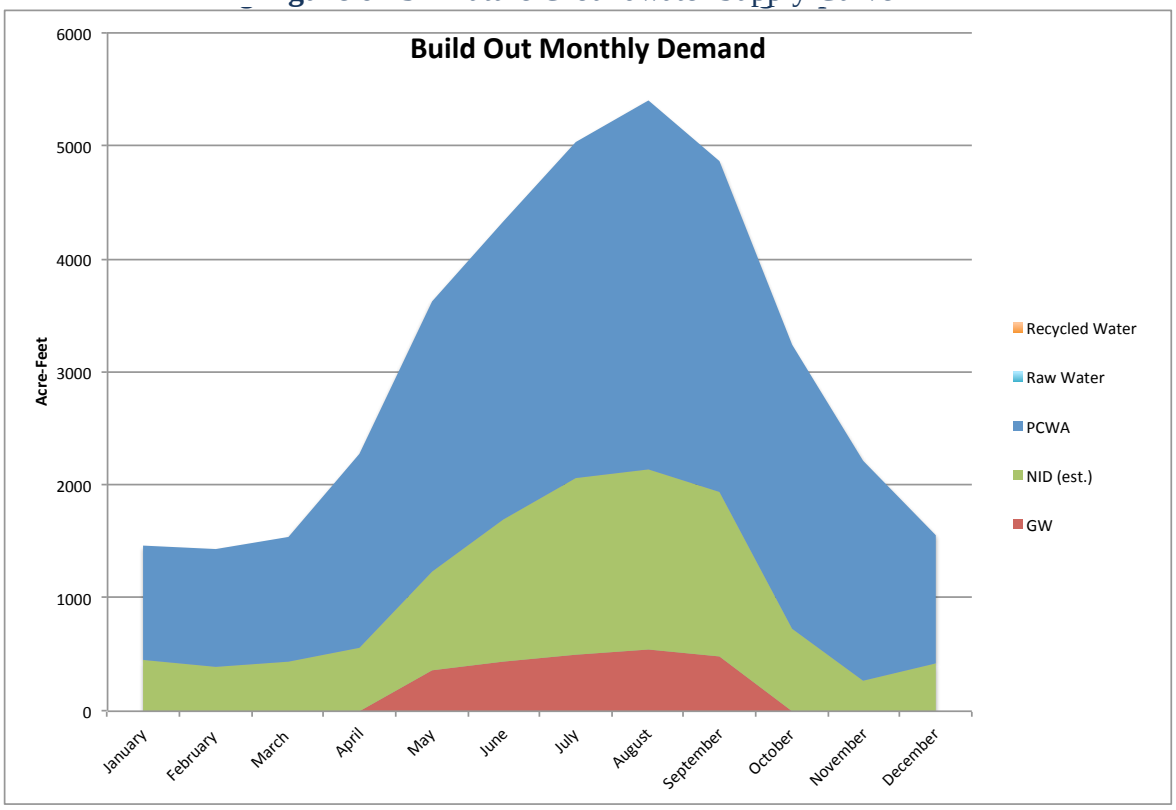
Groundwater	Estimated Supply (af/yr)					
	Current	2020	2025	2030	2035	2040
Normal Year	--	1,106	1,213	1,377	1,540	1,830
Emergency Usage	--	3,687	4,043	4,588	5,134	6,100
Long-Term Average	999	1,229	1,348	1,529	1,711	2,033

Note: The current long-term average, being from 2008 to 2015 requires the removal of drought years with low use and years with high use from canal outages. If viewed as a running average, the City's use is still high from impacts of the canal outage but the trend is dropping closer to the 10% target each year.

The City, through its 2015-16 workshops, resolves to utilize the groundwater basin to manage peaking in the summer months. Under this new management effort, groundwater would be used mostly in the summer months to offset system peaking and, subsequently, extend the duration and usability of PCWA supplies. In this scenario, more surface water could potentially be delivered by PCWA to the City than the current operations allow. But, in the same instance, the maximum day water use for the PCWA surface supply could be reduced. In addition, groundwater would be used to manage the summer months peaking and the basin would experience a shorter period of withdrawal and longer annual recharge period. The revised pumping regime would result in a supply curve depicted in **Figure 6-15** that uses groundwater in the most efficient manor and requires the most on-site technical management.

The key constraints to implementing this alternative operation are: the lack of a comprehensive and modern SCADA system; the limiting capacity of the 30-inch pipe from the City's 5MG tank at Catta Verdera the completion of the PCWA Phase III Project; the lack of adequate above ground water storage; and the need to manage the existing grouped City well locations to manage significant pressure spikes when wells are individually activated. All of these issues are currently being addressed.

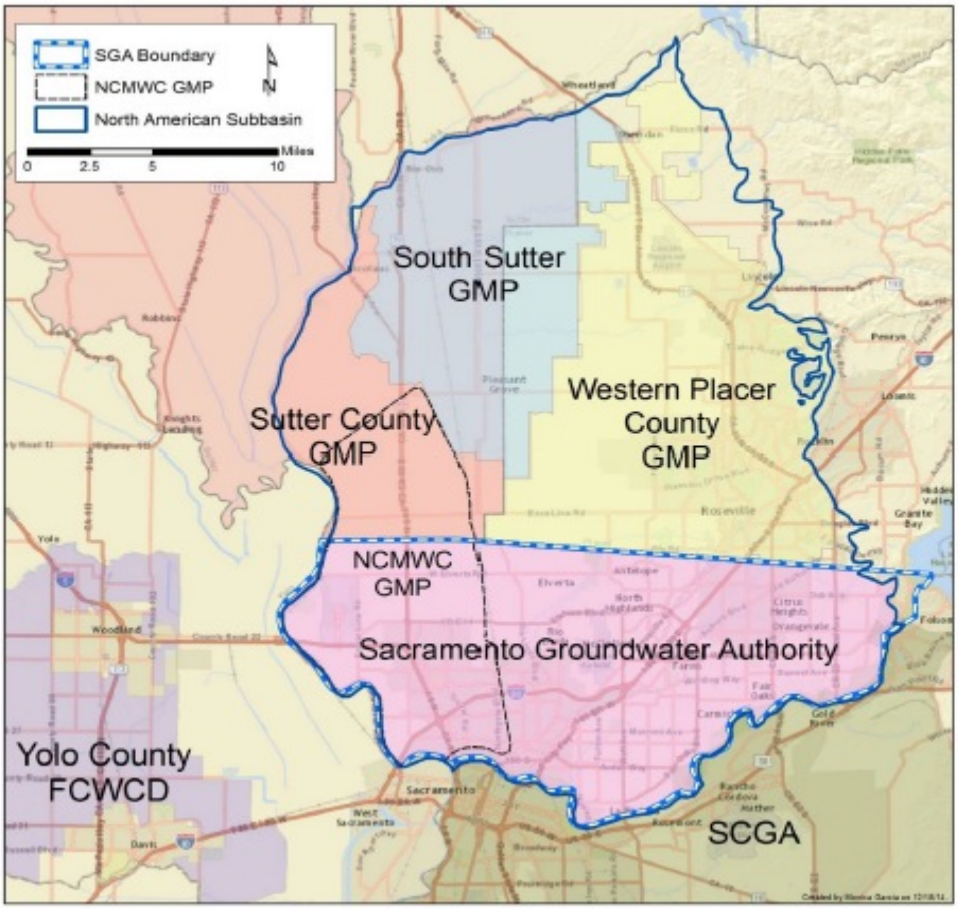
Figure 6-15 – Future Groundwater Supply Curve



6.6 North American Subbasin Governance

The governance of the North America Subbasin has numerous components – many of which will evolve over the course of the next five years. The existing governance structure congeals around the development of groundwater management plans under the Groundwater Management Act (Water Code §§ 10750 *et seq.*). Numerous plans have been developed to cover the North American Subbasin, including: Sacramento Groundwater Authority's Groundwater Management Plan, Western Placer County Groundwater Management Plan, Natomas Area Groundwater Management Plan, South Sutter Water District Groundwater Management Plan, and Sutter County Groundwater Management Plan. There is some land area that overlies the North American Subbasin in Placer County that is not incorporated into a groundwater management plan. These areas are subject to the judicial rules associated with groundwater rights and priorities. Below in **Figure 6-16** is a map depicting the various groundwater management plans affecting the North American Subbasin.

Figure 6-16 – Map Depicting North American Subbasin GMPs[9]



The Groundwater Management Plans within the North American Subbasin reflect the original groundwater management strategies of the forming entities over the course of the last decade. Under the new Sustainable Groundwater Management Act (SGMA), discussed later in **Section 6.6.3**, new groundwater sustainability plans and groundwater sustainability agencies will be developed to meet the updated legislative requirements.

6.6.1 Water Forum Agreement

In 1993, the City of Sacramento and Sacramento County created the Water Forum to address concerns over both water supply reliability and environmental degradation in the Sacramento Region and the Lower American River (LAR). Specifically, the region was experiencing a prolonged drought and surface and groundwater conditions were becoming critical. Moreover, there was an increasing awareness of the environmental conditions along the LAR and that further dilapidation of the LAR might lead to

[9] Sacramento Groundwater Authority Groundwater Management Plan, 2014 at p. 8.

permanent problems. The LAR supports 43 species of fish, including federally protected species – fall run Chinook salmon and Central Valley steelhead.

The Water Forum Agreement is a signed document that seeks to meet specific objectives in the American River watershed. The Agreement is a package of linked elements with two, co-equal objectives: to provide a reliable and safe water supply for the region's economic health and planned development to the year 2030; and preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River. In order to meet these co-equal objectives, the Water Forum Agreement incorporates seven key elements: increased surface water diversions; actions to meet customer needs while reducing diversion impacts in drier years; support for improved pattern of fishery flow releases from Folsom Reservoir; Lower American River habitat management; water conservation; groundwater management; and Water Forum Successor Effort.

The City of Lincoln is not a signatory to the Water Forum Agreement or a member of the Water Forum (although it participates in the Regional Water Authority – (described below)), so the Agreement is only applicable through its impact on surrounding entities – in particular, Placer County Water Agency. PCWA has specific obligations under the Agreement and its subsequent Purveyor Specific Agreement that may impact PCWA's ability to build surface water diversion facilities and deliver surface water to the City of Lincoln. Accordingly, the actions and efforts within the Water Forum Agreement have direct bearing on the City's use of surface water from the American River as well as the longevity of its groundwater assets.

6.6.2 Groundwater Governance

There are numerous governing bodies that assert jurisdiction over groundwater supplies in the North American Subbasin. At the fundamental basin-wide level, however, groundwater rights underpin each water user's ability to capture and use groundwater supplies. Specifically, overlying groundwater rights are available to water users that extract groundwater and use it on overlying property that the water user owns. For instance, a City that owns a park may extract groundwater through a well and use that water for irrigation on the park. This manifestation of an overlying groundwater right on the users property is generally a secure water right.

In contrast, appropriative groundwater rights are available to water users that extract groundwater that is *surplus* to the needs of the overlying users. The groundwater appropriators use the water on property that either (a) does not overly the groundwater basin; or (b) does not belong to the overlying water user. For example, a City that extracts groundwater and delivers the groundwater to its customers utilizes an

appropriative groundwater right because it delivers water to property that the City does not own (its customer). Under California case law, overlying users may impede groundwater appropriators pumping when there is no surplus water in a groundwater basin. However, groundwater appropriators that pump groundwater even when aquifer conditions are not in surplus may "prescribe" against an overlying water right and obtain water rights to the detriment of the overlying water right user. The judicial action sorting out the various groundwater rights in an overdrafted basin with numerous users is tedious and uncertain. Moreover, groundwater banking activities may further cloud the ownership and usability of underground water resources.

Additional water supplies and efforts may be developed through contracts. For instance, a groundwater user may retain the right to pump groundwater under an overlying water right but may restrict his actual pumping and use by entering a contract with a neighbor declaring his intent to reduce use. These voluntary agreements may supersede the underlying water rights that make up the basis of a water use. Many of the groundwater management plans described above have elements of contractual agreements that may bind water users to capture less water then their rights might otherwise allow.

There are numerous federal, state, regional, and local agencies that have an interest in governing groundwater extraction and use in the North American Subbasin. The federal agencies include, but are not limited to: U.S. Bureau of Reclamation, US Army Corps of Engineers, US Fish and Wildlife Service, US Environmental Protection Agency, and National Marine Fisheries Service. At the State level there are several agencies that impact groundwater: California Department of Water Resources, State Water Resources Control Board, and California Department of Fish and Wildlife. The regional agencies that impact the North American Groundwater Subbasin include: Regional Water Authority (RWA), Sacramento Groundwater Authority (SGA), and the Western Placer County Groundwater Management Partnership (WPGMP). Last, there are approximately 20 local agencies that impact groundwater issues in the North American Groundwater Basin near the City of Lincoln – including the City of Roseville, South Sutter Water District, Sutter County and Placer County. The City of Lincoln is also a local governing body that asserts independent governance authority over the North American Subbasin.

6.6.2.1 RWA, SGA, WPCGMP Partnership

This section provides a brief synopsis of the regional entities that have jurisdiction over groundwater in the North American Subbasin. The City participates in two of these entities – RWA and WPCGMP Partnership. The third entity, SGA, shares an Executive Director with RWA and, thus, coordinates SGA activities with RWA activities – like legislative interactions.

Regional Water Authority

The Regional Water Authority (RWA) is a joint powers authority formed in 2001 to promote collaboration on water management and water supply reliability programs in the greater Sacramento, Placer, and El Dorado County region. RWA is an outgrowth of the Water Forum, whose original intent was to allow regional agencies to collectively implement the provisions of the Water Forum Agreement. RWA currently represents 24 water suppliers and associated agencies in the greater Sacramento Area – including suppliers that have no connection to the North American Subbasin. The mission of RWA is to serve and represent the regional water supply interest and to assist Members in protecting and enhancing the reliability, availability, affordability, and quality of water resources. A nine-member Executive Committee is elected annually to guide RWA.

Sacramento Groundwater Authority

The Sacramento Groundwater Authority (SGA), formerly the Sacramento North Area Groundwater Management Authority, was formed as a joint powers authority and charged with the management of Sacramento County's Region of the North Area Groundwater Basin. The SGA's formation in 1998 resulted from a coordinated effort by the Sacramento Metropolitan Water Authority and the Water Forum to establish an appropriate management entity for the basin. SGA draws its authority from a joint powers agreement signed by the cities of Citrus Heights, Folsom and Sacramento as well as the County of Sacramento to exercise their common police powers to manage the underlying groundwater basin. In turn, these agencies chose to manage the basin in a cooperative fashion by allowing representatives of the 14 local water purveyors and representatives from the agricultural and self-supplied pumper interests to serve as the Board of Directors of the SGA. SGA has recently sought authorization to be a Sustainability Agency under the Sustainable Groundwater Management Act (SGMA) discussed below.

Western Placer County Groundwater Management Partnership

The WPCGMP is designed to assist the City of Lincoln, City of Roseville, Placer County Water Agency (PCWA), and the California American Water Company (CAL-AM) in an effort to maintain a safe, sustainable and high-quality groundwater resource within a zone of the North American River Groundwater Subbasin. The WPCGMP has as its objective the maintenance of groundwater resources to meet backup, emergency, and peak demands without adversely affecting other groundwater uses within the WPCGMP area. Moreover, the WPCGMP provides a framework to coordinate groundwater management activities through a set of basin management objectives and specific implementation actions that were agreed to by all of the participants. The policies and actions that were agreed to by the City of Lincoln are further described in later in this section.

6.6.2.2 City of Lincoln Groundwater Management

The City of Lincoln has been very active in managing and governing groundwater within the current City boundary as well as within the City's Sphere of Influence. Before the turn of the Century, the City of Lincoln relied heavily on groundwater to meet its needs. As a deeper understanding of the value of robust aquifers was understood, the City transitioned to surface water sources delivered from neighboring wholesale agencies – Placer County Water Agency and Nevada Irrigation District. Moreover, the City took additional significant steps to address its long-term groundwater management by (a) developing policies in its General Plan and other planning documents that address groundwater usage; and (b) agreeing to groundwater management parameters in concert with the WPCGMP partnership – PCWA, City of Roseville, and Cal American Water Company (note that Placer County is not a partner in the WPCGMP). In developing groundwater management objectives, the City has developed numerous policies in a number of planning forums – the key ones are described in the sections below.

6.2.2.3 City General Plan Policies

The City has adopted the following policies applicable to groundwater as part of its General Planning process. Additional policies may be incorporated in other documents, like Development Agreements, that have the force and effect of a City Ordinance.

Policy PFS 2.7 Groundwater Supplies: The City shall consider development of groundwater supplies in the western portions of the City's sphere of influence to provide emergency back up and to supplement the domestic supply provided by the PCWA and NID.

Policy PFS 2.11 Groundwater Recharge: The City shall evaluate groundwater recharge capabilities as necessary, but at lest every five years and ensure adequate long-term protection of groundwater resources.

Policy PFS 2.19 Regional Sustainability of Groundwater Supplies: The City shall work in concert with the County of Placer, other cities and local water purveyors to share groundwater data, develop a mutually beneficial Integrated Regional Water Resources Management Program, define the long-term sustainability of the groundwater basin, and work to manage groundwater uses in ways that facilitate the basin's sustainability.

Policy OSC-1.5 Protection of Minerals: The City will protect mineral resources such as groundwater, clay deposits, as well as groundwater recharge areas from urban development.

Policy OSC-4.2 Develop Groundwater Management Plan: The City shall develop and periodically update a groundwater management plan to protect local aquifers.

Policy OSC-4.3 Protect Surface Water and Groundwater: The City shall ensure that new development projects do not degrade surface water and groundwater.

Policy OSC-4.4 Protection and Management of Flood Plains: The City shall encourage the protection of 100 year floodplains and where appropriate, obtain public easements for purposes of flood protection, public safety, wildlife preservation, groundwater recharge, access and recreation.

Policy OSC-4.6 Best Management Practices: The City shall continue to require the use of feasible and practical best management practices (BMPs) to protect surface water and groundwater from the adverse effects of construction activities and urban runoff. Additionally, the City shall require, as part of its Storm Water NPDES Permit and ordinances, to implement the Storm Water Pollution Prevention Plan (SWPPP) during construction activities for any improvement projects, new development and redevelopment projects for reducing pollutants to the maximum extent possible.

6.2.2.4 WPCGMP Policies

In addition to its General Plan policies, the City has consented to additional management objectives as described in the Western Placer County Groundwater Management Plan to which it was a participating agency. The Basin Management Objectives identified in the WPCGMP are listed below:

1. Management of the groundwater basin shall not have a significant adverse effect on groundwater quality;

2. Manage groundwater elevations to ensure an adequate groundwater supply for backup, emergency, and peak demands without adversely impacting adjacent areas;

3. Participate in State and Federal land surface subsidence monitoring programs;

4. Protect against adverse impacts to surface water flows in creeks and rivers due to groundwater pumping; and

5. Ensure groundwater recharge projects comply with State and federal regulations and protect beneficial uses of groundwater.

6.6.3 Sustainable Groundwater Management Act

In 2014, Assemblyman Roger Dickinson and Senator Fran Pavley developed legislation – the Sustainable Groundwater Management Act (SGMA) – that addresses the State's ongoing groundwater overdraft and groundwater contamination issues. The legislation

requires two things that affect the City of Lincoln's groundwater assets: (1) the development of groundwater sustainability agencies (GSA) by 2017 in medium and high-priority groundwater basins; and (2) the development of groundwater sustainability plans (GSP) by the GSA's in all medium and high-priority basins by 2022. The North American Subbasin is a medium priority basin. Thus, failure to develop a groundwater sustainability agency and groundwater sustainability plan in the prescribed time period will invite DWR to determine the regional GSA that will develop the GSP – likely the local counties overlying the affected groundwater basins.

The implementation of SGMA and the ultimate impacts it will have on the North American Subbasin is a complex issue due to the diversity of the impacted purveyors. As seen in **Figure 6-17**, over ten different purveyors overlay the subbasin. The resulting GSA and GSP for the area, will involve a complex mix of priorities and goals between all the purveyors political viewpoints and approaches towards water management.

6.6.3.1 SGMA Overview

The SGMA was codified in Water Code sections 10720 et seq. and the implementing guidelines are found in Title 23 of the California Code of Regulations. The Act, and implementing regulations, generally favor local control of groundwater resources as well as upholding of existing groundwater rights law. However, the SGMA is based in the reasonable use doctrine of Article X, Section 2 of the California Constitution, notes the potential for "state intervention", and creates an expedited groundwater adjudication process. All of these concepts indicate that the status quo will not be maintained for California's groundwater management.

The first step in SGMA compliance is creating a groundwater sustainability agency to govern the defined groundwater basin. Water Code Section 10721(j) defines a groundwater sustainability agency as follows:

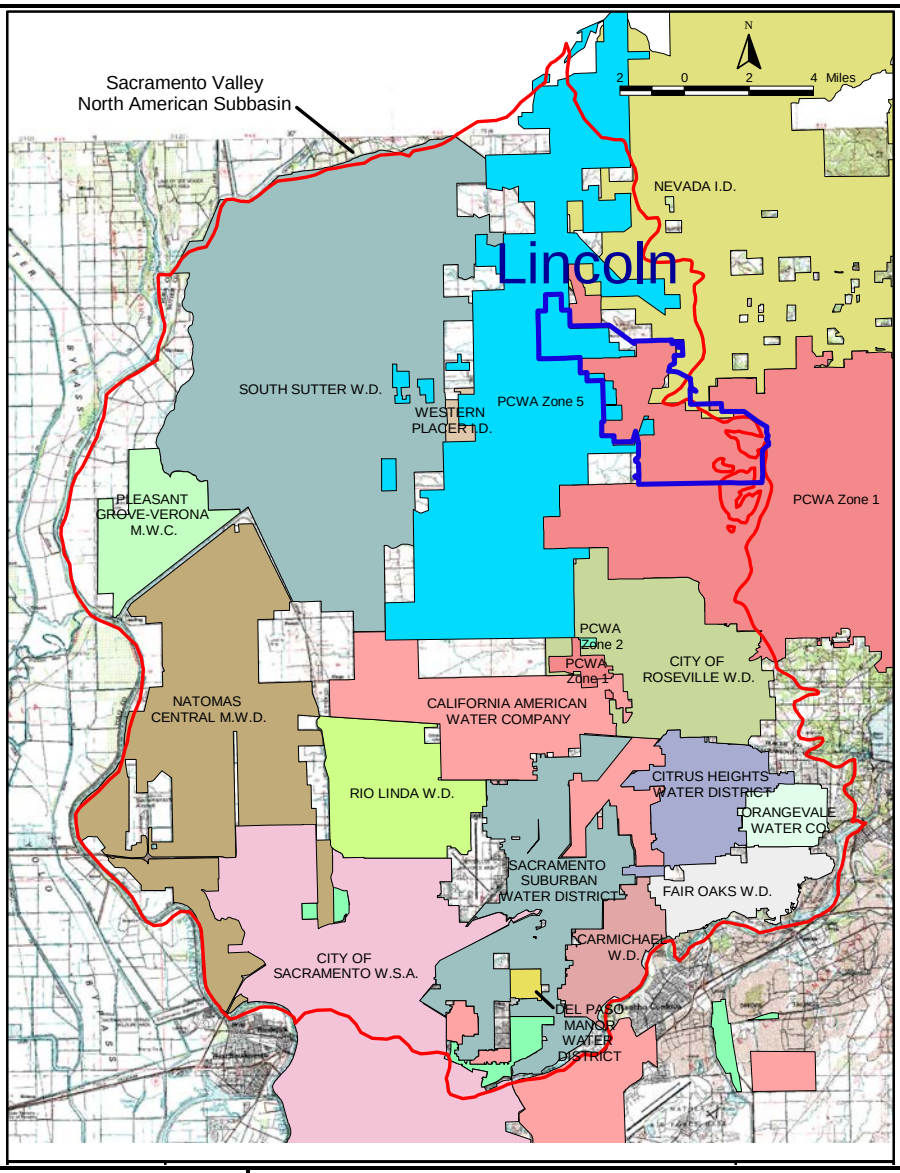
> *"Groundwater sustainability agency" means one or more local agencies that implement the provisions of this part [Part 2.74]. For purposes of imposing fees pursuant to Chapter 8 (commencing with [Water Code] Section 10730) or taking action to enforce a groundwater sustainability plan, "groundwater sustainability agency" also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.*

A GSA may be comprised of numerous local agencies. The local agencies may be derived from numerous existing public agencies.

"Local agency" means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

These definitions inform the formation of the new GSA's. The GSA's require development of joint powers authority's (JPA) or other legal or contractual relationships between agencies and individuals. The key aspect for SGMA compliance is that the newly formed GSA must have responsibility for managing and regulating groundwater use in the identified groundwater basin.

Figure 6-17 – Overlying Water Suppliers within the North American Subbasin



Tully & Young
Comprehensive Water Planning

Image Sources:
City of Lincoln
Groundwater Management Plan 2003, page 16.

In order to become a GSA, a local agency must provide public notice of its intent to form a GSA by itself, or in conjunction with other local agencies. Following a notification period, Water Code 10723(b) requires that the agencies hold a public hearing in all the counties overlying the groundwater basin. The code also identifies 15 specific entities deemed GSAs but none of the agencies listed are located near the City of Lincoln.

Water Code Section 10723.8(a) provides the specific requirements of what must be filed with DWR to successfully form a GSA. These requirements include:

- Proof that notice of GSA formation was submitted to DWR within 30 days of the decision.
- The definition of the proposed GSA's service area including a map depicting the proposed area and narrative describing the service area boundaries.
- A descriptions of the basin, or portion of the basin, that the GSA intends to manage as well as any other agencies managing groundwater within the basin.
- A copy of the resolution or contract forming the new GSA
- Any bylaws, ordinances, or new authorities adopted by the GSA
- A list of interested parties developed under Water Code Section 10723.2 and discussion of how their interests will be considered in the development and operation of the GSA and GMP.

If multiple local agencies form separate GSAs in a basin within a 90-day period, and if any of those GSA formations result in a service area overlap in the areas proposed to be managed, then none of the local agencies will become the exclusive GSA unless the overlap is resolved. This means that the defined boundaries of a proposed GSA's jurisdiction is a critically important element of the GSA formation for interested parties, in case multiple GSA's have overlapping definitions, invalidating their eligibility to oversee that area until it is resolved.

Identifying the groundwater basin boundaries is a major consideration in forming the GSA. Specifically, the groundwater basin may follow political jurisdictions (like county lines), groundwater basin boundaries (that often cross county lines), or potentially smaller-subsets of the groundwater basin already subject to some regulatory jurisdiction (e.g. SGA's jurisdiction over the north area groundwater basin). The definition of the political boundary that will be the basis of the GSA is an important facet of GSA formation that will affect the City's groundwater assets and long-term groundwater management efforts.

In the North American Subbasin, only the Sacramento Groundwater Authority (SGA) has formed a GSA. On October 8, 2015, SGA resolved to form a GSA over its portion of the North American Subbasin and on October 20, 2015 it provided notice to the California Department of Water Resources (DWR) of SGA's intent to be a GSA. SGA noted its GSA formation boundary in the notice as only a portion of the North American Subbasin.

In addition to establishing guidelines for establishing GSAs and GMPs, SGMA also defines the types of groundwater use allowed under Water Code Section 10721(v) as follows:

> *"Sustainable groundwater management" means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.*

Undesirable results under 10721(x)[10] include:

> (1) chronic lowering of groundwater levels (not including overdraft during a drought, if a basin is otherwise managed);
>
> (2) significant and unreasonable reductions in groundwater storage;
>
> (3) significant and unreasonable seawater intrusion;
>
> (4) significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies;
>
> (5) significant and unreasonable land subsidence; and
>
> (6) depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Although the GSP is directed to avoid undesirable results by practicing sustainable groundwater management, actions taken by the GSA can still have an adverse impact on Lincoln's water rights and control over its current groundwater supply. These potential impacts require Lincoln's participation in the formation of the new GSA in order for the City to preserve its groundwater rights as well as the governance authority over regional groundwater assets.

[10] This list includes the most relevant information provided from the statutory section for purposes of informing the reader. For a full quotation, see Water Code section 10721(x)(1)-(6).

The development of the groundwater sustainability plan (GSP) is the second step in the two-step SGMA compliance process. Water Code Section 10723.2 requires GSAs to consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing GSPs. An explanation of how those interests will be considered by a GSA when developing and implementing a GSP is required as part of the GSA formation notification requirements. The interests of water rights holders to be considered in the formation of a GSP include:

(a) Holders of overlying groundwater rights, including (1) Agricultural Users and (2) Domestic well owners.

(b) Municipal well operators.

(c) Public water systems.

(d) Local land use planning agencies.

(e) Environmental users of groundwater.

(f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies.

(g) The federal government, including, but not limited to, the military and managers of federal lands.

(h) California Native American Tribes.

(i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems.

(j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.

The GSP will require the participating agencies to establish groundwater pumping criteria that meet the long-term sustainable yield needs of the identified groundwater basin. Such a formulation may impact the existing management planning efforts that were put in place to do the same thing. For instance, WPCGMP has a groundwater management plan that identifies basin safe yield, develops pumping criteria, and assess groundwater pumping for participating agencies. It is unclear whether these existing items will be contained in a new GSP that will be developed by a new GSA. Or whether multiple GSA's and multiple GSP's will be in place requiring multi-agency coordination. The new

GSA may determine that existing planning activities related to a groundwater basin must be reconsidered and reinvented. As such, the City should actively participate in the formation of the region's GSA(s) and GSP(s) since groundwater is one of the City's most important water assets.

6.6.3.2 AB 1390 and SB 226 Intersection with SGMA

In 2015, AB 1390 and SB 226 were signed into law and became effective January 1, 2016. These two bills conjunctively reformed the judicial procedures for groundwater adjudication without impacting existing groundwater rights. These new procedures focus on incorporating recognition of SGMA and the new GSA's into the adjudication process and ensuring that decisions encompass all water rights holders in the basin, whether or not they are currently pumping groundwater. The court can now determine the groundwater rights of all parties overlying the basin and whether others may export water from the basin. Through basin adjudications, courts can require the cooperation of users who otherwise might resist limits the on pumping of groundwater. Under these new laws, the courts are now authorized to issue a preliminary injunction (limiting or restricting certain appropriations, extractions, allocations and transfers) upon a finding that the basin is in a condition of "long-term overdraft." Long-term overdraft is defined as a "condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus." The court is required to issue a preliminary injunction if (1) the basin is in a condition of long-term overdraft; (2) the basin has been designated as a probationary basin or if the Sustainable Groundwater Management Act (SGMA) planning deadlines for implementing a groundwater sustainability plan have not been met; and (3) there is no interim plan in effect under Section 10735.8 of the Water Code. Additionally the court may now adopt a proposed stipulated judgment as to the stipulating parties, if it is supported by more than 50 percent of all parties and is supported by groundwater extractors responsible for at least 75 percent of the groundwater extractions.

6.6.3.3 Potential Impacts of SGMA

The SGMA provides a legislative solution to groundwater overdraft that permeates many groundwater basins throughout California. The SGMA will alter the current governing landscape for groundwater management and likely produce a new groundwater management structure that affects the City of Lincoln's groundwater assets.

The City must engage in GSA formation and retain jurisdiction over groundwater assets that underlie the City and its Sphere of Influence. The GSA formation in the WPCGMP region may be problematic for a number of reasons: (1) the original WPCGMP group will need to be augmented to include all relevant entities interested in groundwater in the

WPCGMP area (including Nevada Irrigation District and Placer County); (2) the SGA has formed a GSA over a portion of the North American Subbasin that will required negotiation for congruent regional management; (3) Sutter County and South Sutter Water District will likely seek groundwater management authority in the North American Subbasin; (4) agricultural interests with the senior overlying groundwater rights will require representation in the North American Subbasin governance structure; and (5) the diversity of interests and GSA formations will require formulating agreements for governance among interacting GSA's.

In the event that some or all participants in the newly formed governance structure for the North American Subbasin are dissatisfied with the proposed governance structure, a groundwater adjudication may ensue. Such an adjudication would be extremely time consuming and complicated in order to address the various rights and obligations of each user in the basin. Working through formal agreements to find solutions may be prudent to avoid long-term contested adjudication procedures.

6.6.4 Groundwater Banking

The Sacramento Groundwater Authority has developed a Water Accounting Framework, which is a tool to encourage policies and procedures to promote and support conjunctive use operations within the SGA area. The Framework recognizes investments by the SGA member agencies in the development of conjunctive use programs and supports groundwater banking programs that enhance the long-term sustainability of the groundwater basin. The WPCGMP partnership does not yet have a water accounting framework.

The City of Lincoln has expended significant funds to develop surface water resources in order to relieve pressure on the groundwater basin. Moreover, the City has implemented a thoughtful conjunctive use program where groundwater management and asset protection is the central core for long-term sustainability. Accordingly, a primary component of the City's long-term groundwater management strategy should be to promote development of a groundwater banking criteria for the Western Placer zone of the North American Subbasin.

6.7 Groundwater Strategy

The purposes of this section are to outline a long-term groundwater strategy that the City can utilize to meet its long-term land and water planning objectives. The strategy outline is organized into three sections: current and future system operations; long-term policy objectives; and regional groundwater management and governance.

1. Current and Future System Operations

    a. The City currently utilizes groundwater to meet 10% of its customers' demands annually. The City should alter its water management system in order to meet 10 percent of its demands in the summer months under peaking conditions. This would require revising or drafting new policies governing the quantity of groundwater available at different times throughout the year, and reviewing demand management measures.

    b. The City should identify exact volumes of groundwater needed to meet short-term and long-term water needs, including needs in emergency conditions. The City is moving from a long-term projected groundwater demand of approximately 11,800 acre-feet per year to closer to 3,400 acre-feet per year. Peaking management will require evaluation of the utility of this number over regular increments.

    c. The City should quantify its backup groundwater demand need. The City has historically considered emergency backup groundwater supply to be 75 percent of average day demand. With multiple sources planned in the future, assessing total groundwater needs for emergencies, including durations, should be a priority.

    d. Lincoln needs to develop emergency water management protocols and backup electrical and treatment systems to handle water supplies in case of a large-scale outage. Emergency protocols should include identification and installation of backup generators, automated water quality testing, and redundant system management.

    e. The City should begin to identify the best locations for peak management and emergency back up wells in the western part of the City and SOI. This assessment should coincide with the development potential of various areas, especially those associated with active specific plan areas such as Village 5. The groundwater well identification should consider both potable and non-potable water sources.

    f. Lincoln should preserve the agricultural wells that may be available for non-potable uses as development progresses. Numerous agricultural wells cover a broad area where General Plan development is planned. Normally, residential developments destroy agricultural wells. The City

should work with the landowners where development is set to occur as well as the development community to identify and map the agricultural wells for potential future use.

g. The City should conduct regular well system testing to ensure basin hydrology is sustained. The City should further its existing policies to monitor groundwater basin health and evaluate groundwater recharge. In conjunction with the WPCGMP and the emerging GSA, the City should affirmatively manage the groundwater basin by conducting independent and regular testing.

h. Lincoln should continue monitoring and reporting groundwater quality issues. The contamination sites already in and around the City need continued attention to ensure that any contamination area is wholly contained and meeting clean-up objectives. The City should also be diligent in monitoring it groundwater network to identify any further contamination potential.

i. Lincoln should assess threat to resources from industrial development as well as existing groundwater plumes. Inappropriately located industrial facilities – like mining operations – have the potential to disrupt groundwater migration and natural basin recharge. Accordingly, managing locations and operations of industrial facilities will help sustain the long-term health of the Subbasin.

2. Long-term policy objectives

a. The City should maintain 10 percent average annual use for its operations on a 10 year running average. The City's current policy is ambiguous to the measurement of the usage of groundwater. The running average over the course of a 10 year period would allow for fluctuations in groundwater usage based upon hydrological and climatological conditions that may impact how surface water deliveries are made.

b. Lincoln should preserve and store groundwater as a contingency source during drought conditions. The preservation and storage of groundwater requires developing a mechanism to account for groundwater offsets attributable to investments in surface water projects. The City should develop initial protocols to address opportunities to preserve groundwater for additional uses.

c. The City should utilize naturally percolating groundwater to manage peaking and emergency issues. Peaking issues are associated with short-term high demand on a water system that are generally made during the high-water using months in the summer. Peaking is most acute on the hottest days of the year. The City should also preserve the percolating groundwater to handle unforeseeable emergency conditions.

d. The City must work with regional partners throughout the North American Subbasin to protect groundwater assets from any form of contamination. Such work may include not only assessing and controlling potential contamination issues within the City boundary and SOI, but also efforts to manage potential contamination from areas outside the City's influence – including areas that are far removed from the City that may pass through the railway and highway transportation corridors.

e. The City should develop groundwater recharge projects and policies beyond simply in-lieu recharge efforts. The City should assess the opportunities to recharge groundwater systems with systematic application of raw surface water, recycled water and potable water to spreading basin or ASR projects within and around the City. The City of Roseville was successful in developing an ASR project that may be worth considering in the City.

f. Lincoln needs to account for the regional benefits to the groundwater basin through its acquisition of surface water resources. The accounting could include an assessment of total water usage over the course of the last 10 years coupled with a reasonable calculation of loss factor. The improvement to the groundwater levels in and around the City of Lincoln should be evidence of the benefits that the City's modified water use ethic is having on regional systems.

g. The City should assess the issues associated with increased groundwater pumping on the west side of the North American Subbasin. Long-term continued drawdown not only impacts the City's conjunctive use efforts and groundwater banking, but also changes the overall dynamics of the groundwater basin – potentially permanently. The City should actively engage the additional groundwater pumping and basin drawdown to assess potential opportunities to improve basin conditions.

h. The City should continue to protect local and regional flood plains in local drainage systems in order to improve opportunities for groundwater recharge.

3. Regional Groundwater Management and Governance

    a. The City should engage federal and state agencies on their governing interests in the North American Subbasin. The federal and state agencies have diverse interests in the management of these basins and engaging these entities before problems develop should be a priority. Pursuing and engaging Federal and State Executive Staff and Management will assist the City in moving projects forward when acute needs arise.

    b. Lincoln should assess regional and local governing agency involvement in creating sustainability agencies. SGA has already submitted to create its own GSA under the SGMA and since the new GSA will impact groundwater planning, it is critical for the City to continue to be involved with the GSA formation process. As such, the City should actively participate in the formation of SGA's GSA, while the City also takes time to fully digest the pros and cons of this action since groundwater is one of the City's most important water assets. This will help ensure that Lincoln's water rights are preserved and the City's interests are considered as the new GSA plans its GSP. The GSA and eventual GSP efforts will require close coordination with SGA and other regional agencies. Coordinating efforts, aligning interests, and assessing opportunities should be of paramount importance over the course of the next 12 months.

    c. The City and its WPCGMP partners should incorporate stakeholder participation in creating sustainability agencies. The stakeholder groups may have unique perspectives on managing regional water assets and early engagement may stave off unnecessary political opposition. Existing trepidation between private rural citizens and urban areas should be curtailed at the earliest possible time.

    d. The City of Lincoln needs to hold decision-making authority on any governing body formed out of SGMA. The City's groundwater rights cannot be left to the whims of others in an alternative governing body. The City should act as the lead agency in any GSA formation and provide staff support to execute tasks and achieve governance outcomes.

Development of a political plan to work with regional entities to ensure local control of groundwater resources is paramount.

e. The governance group for the GSA must formulate groundwater banking protocols for the North American Subbasin in order to allow the City to preserve and protect its existing groundwater assets. The City's financial and institutional investments to secure and deliver surface water resources has been a significant policy effort over the course of the last decade. The City must assume the benefits of its investments with the support of a robust groundwater accounting effort in the western Placer area of the Subbasin.

f. The City and its regional partners need to develop a sustainability plan (GSP) under the SGMA that outlines key criteria for basin management. Such criteria should be derived from the 5 existing Groundwater Management Plans in the North American Subbasin. These GMP's provide insight on the key substantive issues relevant to neighboring agencies. The GSP must incorporate the key policy criteria from the City and follow governance objective set by the City.

g. The City should seek to maintain local control of groundwater resources as much as possible. Ceding groundwater assets to a regional authority may jeopardize the long-term viability of the asset to the City. Quantification of assets may be a preferred alternative to ceding reasonableness of use of assets – where the City maintains control over its quantified allocation. Particular attention should be put on SGA's bid to become the new GMP for the area.

h. The City and the GSA group should seek federal and state regulatory approval of management plans for groundwater basin. Achieving some form of integration with federal and state agencies may further long-term sustainability objectives by addressing long-term certainty concerns associated with endangered or threatened species and other federal issues. Moreover, establishing basin accounting protocols that meet federal and state standards may help facilitate other forms of conjunctive management in the North American Subbasin.

i. The City should work with its regional partners to create planning opportunities that avoid basin adjudication. These opportunities will require integrating local agencies, regional agencies and individual well

owners into a sustainability plan. A long-term adjudication process will drain resources from all entities involved and likely result in a negotiated basin settlement. Accordingly, identifying key parameters of interested groups and stakeholders may help avoid basin adjudication.

CHAPTER 7. WATER SUPPLY RELIABILITY

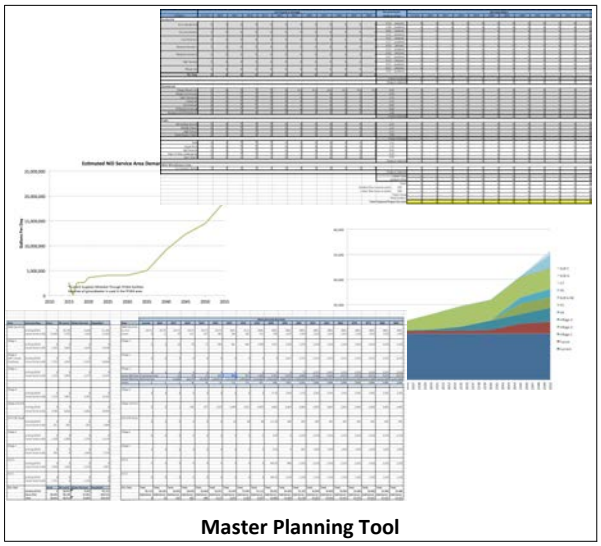
7.1 Introduction

The meaning of water supply reliability is often misconstrued. For instance, the 2015 Urban Water Management Plan update required water purveyors to demonstrate that annual water supplies are sufficient to meet annual water demands under normal and dry hydrological conditions. This annual assessment of water supply reliability is misleading. A water system's reliability must be assessed not only on an annual basis, but also on a monthly and even daily basis. Moreover, reliability is not just a function of annual physical supply availability but also nuanced details of water rights and contracts, regulatory and contractual issues, and water system infrastructure limitations. This Chapter addresses the meaning of water supply reliability and explains the City of Lincoln's analysis of water supply reliability as applied in this Water Master Plan.

7.2 Defining Reliability

The word "reliability" means "to be able to be trusted to do or provide what is needed."[1] Accordingly, in the context of a water purveyor, "water supply reliability" requires a water purveyor to consistently deliver water to its customers and that the water system is dependable to continually deliver additional water supplies to the purveyor's customers into the future. One of the City of Lincoln's primary management goals is to develop a water system that has long-term reliability.

The City's water supply reliability can be disaggregated into its three meaningful parts. First, as described in **Chapter 4** and the **Master Demand Spreadsheet Tool**, the City must accurately calculate its current and future demands. Second, as described in **Chapter 5**, the City must fully understand its water supplies and the risks associated with those water supplies under the State's changing water conditions. Last, as shown in **Chapters 3**, **9**, **10** and **11**, the City must use its knowledge of both demand and supply to construct and manage a water delivery system capable of



Master Planning Tool

[1] http://www.merriam-webster.com/dictionary/reliable

handling changed conditions. Thorough vetting and integration of these components creates a reliable water system.

Ensuring water supply reliability also requires incorporating risk management principles into water resources planning. In its most general form, risk management is the:

> *Identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of risk events and maximize the realization of opportunities.*[2]

In short, risk management weighs the threats and advantages in deciding a course of action. Thus, weighing the threats and advantages of (a) current and future demand calculations, (b) the supply dependability of the City's water asset portfolio, and (c) the stability and utility of the City's existing and planned water supply infrastructure system are the critical elements needed to assess the City's water supply reliability risks and adequately mitigate those risks with actions.

Financial investing is an instructive analogy that illuminates the risk management discussion. In managing a financial investment portfolio, risk management dictates understanding ones current and future needs ("demands"), possessing a diverse asset portfolio to protect against a sudden financial loss associated with a single financial asset ("supplies"), and making sure one is invested in the appropriate financial vehicles to deliver the return on investment to meet future needs ("infrastructure"). Continually monitoring all three components in relation to one's financial objectives ("reliability"), and making adjustments as conditions change, produces a sound financial portfolio.

As further described in the sections below, each water supply reliability component has subparts that require in-depth analysis to draw a reliability conclusion. For instance, demand calculations must consider land-use based and per capita water usage as well as trends in population growth, conservation regulations, and housing constructs. Similarly, the supply assessment requires understanding water rights, California's changing hydrological and regulatory framework, as well as asset redundancy and usability. Last, infrastructure requires analyzing existing system weaknesses, assessing system redundancies, and maximizing long-term structural investments. All of these details are contemplated in the sections below.

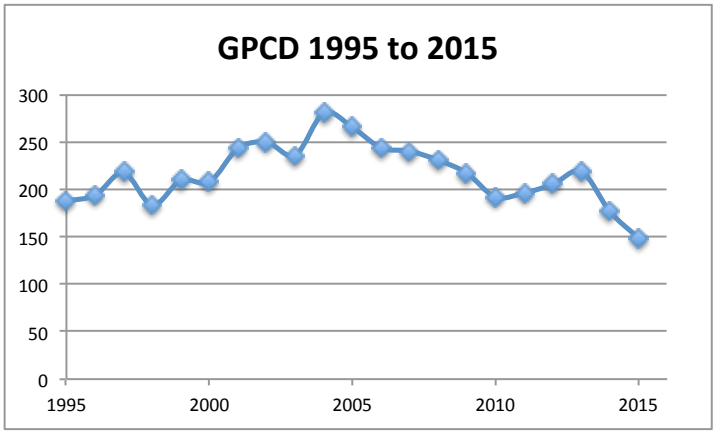
[2] https://en.wikipedia.org/wiki/Risk_management

7.3 Demand Reliability

Calculating demand requires the City to review its current water use, assess the demographic and regulatory factors influencing that use, and then project those findings into predicted future demands. These calculations are complex and require detailed and synthesized analytical rigor. As shown in **Chapter 4** and the **Master Demand Spreadsheet Tool**, demand is calculated based upon the land use classification associated with a water use. These calculations have both spatial and temporal components. For example, it is intuitive that a residential lot with a larger landscaped area likely uses more water for irrigation than does a smaller residential lot with a smaller landscaped area. Thus, in the demand calculations, the spatial element of how water is used on a particular lot size is categorized accordingly. Similarly, water use over time changes. For instance, water use in a residential landscape changes over the course of the year as little or no outdoor irrigation is applied during the winter months while summer month water application is high. To add complexity, demands for similar lot sizes will change over time due to regulatory factors, such as the recent updates to the Model Water Efficient Landscape Ordinance (MWELO) that significantly constrain the use of turf in residential construction – and eliminate it altogether for uses such as street medians.[3] In addition, a City's total volume of water use grows over time as the City's population expands and water consumption grows accordingly. Each of these particulars is captured in **Chapter 4** and further detailed in the **Master Demand Spreadsheet Tool**.

The current water demand for the City is derived from the **Master Demand Spreadsheet Tool** and amalgamated in the City's 2015 Urban Water Management Plan. In that plan, the City reports demand based upon its customer population and gross water use. The current demand is represented as 10,174 acre-feet per year.[4]

Ensuring that the demand assessment and forecast is reliable requires accurately analyzing relevant existing information. As is outlined in **Chapter 4**, the team conducted two different meter studies in 2011 and 2015 in order to assess the water consumption data from existing residential



[3] See Chapter 4 for further discussion of the MWELO.
[4] The value represents "normalized" conditions when analyzing customer demand for several recent years and adjusting for voluntary conservation in 2014 and state-mandated conservation 2015 in response to drought conditions.

and commercial units. As noted in that chapter, the team concluded that the City's overall demands were less than the demand estimates that had previously been predicted as part of the 2008 General Plan. Moreover, the team analyzed the regulatory changes applicable to land-use patterns, including items like the 2015 changes in the MWELO.

The MWELO impacts the overall water demand applicable to each newly constructed house. Specifically, MWELO regulates the percentage of a residential lot that may be irrigated with water as well as the targeted evapotranspiration rates of those irrigated acreages. Thus, the team assessed these new demand components in the context of the meter study and the number of future residential lots to assess the City's future demand. Importantly, the team mitigated this demand analysis by building into the calculation conservative water demand factors that would insulate the demand calculation in the case of unforeseen variables. For instance, even though a housing type may be required to install certain landscape forms under the new MWELO, it is possible that a homeowner removes that landscape and installs a more water intensive landscape in the future. Thus, assuming that the MWELO provides a perfect future formula for calculating demand is misguided. As such, the WMP uses conservative assumptions in assessing demand in order to ensure that the calculations may be relied upon for future planning.

In addition to the housing types and irrigated acreages assessed in the demand calculations, the team also assessed the City's overall growth rate. As discussed in several City Council workshops, the City's growth rates have been sporadic. In the period from 1890 to 1940, the City's population doubled from approximately 1,000 people to just over 2,000 people. But in the period from 1990 to 2000, the City's population swelled from 7,500 people to over 40,000 people. These sporadic growth rates make assessing the precise annual demand for water difficult. As such, the team assessed reasonable Placer County growth rates and discussed the pros and cons of using rapid growth rates and slow growth rates in assessing long-term water demand. As such, in an effort to minimize risk, the City is using a 3% compounded growth rate to substantiate its annual water demand projections.

This overall demand calculation is important because it informs the volume of supply that will be needed in order to meet the City's long-term demand. In other words, if the predicted irrigated landscape acreage or population growth rate are inaccurate, then the volume of water supplied to the City may be either insufficient or excessive at certain time frames in the predicted future conditions. The City's built-in risk management calculations allow it to provide a conservative estimate of need and recalculate annual

water demand on a regular basis.[5] The demand calculations in this WMP allow the City to plan for a water supply that is likely potentially larger than the City will need.[6]

The next important components of demand analyses are the calculations of maximum day demand and peak hour demand. The maximum day demand (MDD) is defined as the single day in a year that the maximum amount of water will move through an identified location in the City's water system. The peak hour demand (PHD) is the single hour within that maximum day that the most water will move through an identified location in the City's water system. These two numbers are extremely important to understand because they inform not only the necessary volume of water supply to meet those peaking demands, but also the sizing of the infrastructure needed to deliver the supplies to meet the demands.

As noted in **Chapter 4**, the City's current MDD is approximately 16.8 million gallons and its peak hour (PHD) is nearly double that figure. Importantly, in assessing these peaking demands, legally required fire flow pressures must also be maintained that do not surpass engineering-based water flow rates through the City's infrastructure system. As such, the demand calculations must assess the water amounts needed in order to deliver adequate water volumes at a particular quality while maintaining appropriate system pressures. Importantly, these demand calculations must be extremely accurate in order to make sure that in the non-theoretical situation, the water delivery system can supply what is needed. As described in **Chapters 3** and **9**, the system models incorporate these demand calculations in order to ensure reliable assessments and practical model testing – through fire flow pressure testing – in order to ensure that the system can meet predicted demands.

In summary, reliably calculating demand is more than merely capturing meter observations. The demand calculations must accurately represent annual, monthly and daily volumes, flow rates, pressures, peaking factors, and growth rates in order for the City to acquire adequate water supplies and to design infrastructure to meet its customers' needs.

7.4 Supply Reliability

A reliable water supply requires that the volumes of water that are necessary to meet the water system demands are available when needed. The physical water supply reliability

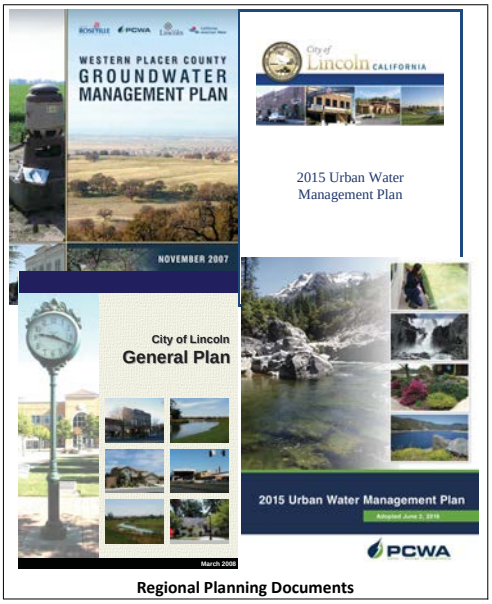
[5] The City's Master Demand Spreadsheet Tool is a detailed mathematical model that will allow the City to calculate at any single point in time the predicted demands in the City as growth occurs in time.
[6] It is important to note that other specific demand items – like water intensive industrial and commercial uses – are also considered in these demand calculations. Companies like micro-breweries that have potable water supplies as a basis of their manufacturing processes must be accounted for in developing long-term demand projections.

is distinguishable from the water supply deliveries discussed below in **Section 7.5**, System Reliability. A water supply assessment requires evaluating the underlying water rights, incorporating California's changing hydrological and regulatory framework into the understanding of those rights, as well as analyzing water asset redundancy and usability under various hydrological, contractual, and regulatory conditions. **Chapter 5** includes extensive discussion on all aspects of the City's water supplies. The purpose of this section is to explain the reliability of the City's water supplies.

As noted in **Section 7.3**, a reliable financial portfolio has a diverse set of financial assets. Similarly, a reliable water supply portfolio should include multiple water sources derived from multiple locations. As noted in **Chapter 5**, the City of Lincoln has the following water sources in its water supply portfolio:

- PCWA treated water under a water supply contract;
- NID treated water under a temporary water service contract;
- Groundwater through overlying and appropriative water rights;
- PCWA raw water through a raw water service contract;
- NID raw water through raw water service contracts; and
- Recycled water derived from the City's Waste Water Treatment and Reclamation Facility.

Each of these water assets in the City's water supply portfolio is subject to fundamental water rights laws. Moreover, each asset is subject to operational management decisions – like diversion to storage facilities – derived from the wholesale water providers. Last, the supplies are subject to hydrological changes and regulatory criteria that modify the utility of each asset under different conditions. When combined, these criteria constitute the reliability determinations that exist in the City's contracts for water supply.



Regional Planning Documents

For example, NID possesses numerous pre-1914 appropriative water rights, several contracts with Pacific Gas & Electric Company for water supply deliveries, and additional SWRCB issued appropriative water rights. NID also maintains nearly 400,000 acre-feet of water storage capabilities in its system that allows it to capture

and serve water to the City. In other words, NID relies upon a number of water sources and management efforts in order to meet its obligations to its customers, including the City. Thus, the significant diversity of NID's water supply portfolio and its management decisions comprise the reliability determination when analyzed as part of the City's water supply portfolio.

In addition to these basic considerations, the project team considered NID's obligations to all of its existing and future customers. The majority of NID's current consumptive-use customers are agricultural users. In time, as these irrigated acreages convert to urban uses, the actual consumptive use (the demands) decline – as urban consumption is generally less on a per-acre basis than nearly all forms of irrigated agriculture. Thus, the long-term demand for NID's water supply will likely decrease.

General longevity of NID's water supplies in the context of issues like climate change – described in **Chapter 1** – are also considered. NID's large water storage capabilities and its plans to develop more water storage, insulate its water supplies from potential reduction derived from the impacts of climate change – more precipitation falling as rain rather than snow and earlier watershed runoff events.

Last, in this NID example, the project team considered the vulnerability of the NID temporary water service agreement with the City. As noted in **Chapter 5**, that agreement can be unilaterally terminated by NID at any time. Thus, on its face, the City's NID water supply is vulnerable to termination. However, NID notes in the Agreement that the development of the Regional Water Supply Project (RWSP) will produce a permanent supply of water to the City. Since the City continues to pursue the RWSP, there is no reason to conclude that the water supply is unreliable.



City Well

Physical water supply reliability requires not only an independent analysis of each wholesale water providers' water assets, but also an assessment of the City's collective water assets. For instance, if NID's water supply to the City were suddenly curtailed – whether by emergency outage or natural phenomena – the City needs to have redundant supplies to meet its needs. As such, the team assessed the City's ability to draw from its other water assets in order to satisfy the water demands. This system redundancy assessment – the ability to pull water from other sources within a water supply portfolio – is a critical aspect of understanding physical water supply reliability.

The City would have essentially four options to meet a major outage in the event its NID water supplies became unavailable. First, it could draw more surface water from Placer County Water Agency. Second, it could pump more groundwater and deliver that water into the City's water system (see **Chapter 6**). Third, it could activate the City's Water Shortage Contingency Plan and reduce demands so that available supplies from its other sources could meet its essential needs. And last, the City could deliver some of its non-potable water supplies to offset potable demands – allowing the potable water supplies to only meet potable water demands (like drinking water). The City's ability to pull surface water from multiple watersheds – the American River and the Yuba/Bear Rivers watersheds – as well as draw upon groundwater resources creates supply redundancy in its sources. This redundancy in water sources makes the City's physical supply availability in all year types and even emergency conditions highly reliable.

This Water Master Plan provides an extensive analysis of the City's overall annual water supply as well as the underlying rights and entitlements, regulatory issues, and wholesale system operational issues that make up the City's annual supply. The City is in the fortunate position to only acquire the volume of supply it needs on a daily basis to meet its demands. Thus, the City used only 7,629 acre-feet of water in 2015 (a drought year) even though an adjusted normal year demand in 2015 (as described in **Section 7.3**) would have been in excess of 10,000 acre-feet. This calculation adjustment is important in helping the City project future supplies accurately and ensuring the City accurately determines if the future supply projections are sufficient to meet the projected demand.

In addition to annual volume, reliable supply is also assessed based upon the ability to meet maximum day and peak hour demands. The City's PCWA contract water entitlement quantifies delivery based upon maximum day measurements. And nearly all of the water right's underlying the City's contracts with PCWA and NID contain express conditions regarding the maximum water diversions that can be utilized to capture the supply. Taken together, all aspects of a supply source, including location of the supply, available diversion rate, and total annual volume available inform the assessment of water supply reliability.

Tables 7-1 through **7-3** below show the City of Lincoln's aggregated water supply reliability in normal years, a single dry year, and multiple dry years based upon annual physical supply availability.

These tables generally depict the City's annual demands and thus the annual supplies that will be needed to meet those demands. The tables do not depict the sources that constitute those water supplies nor the vulnerabilities in those sources or the redundancies in the system. Accordingly, the City can substantiate the reliability of the identified volume of supplies by examining the detailed analysis provided in this WMP.

Table 7-1 – Supply and Demand Comparison (Normal Year)

(acre-feet/yr)	2020	2025	2030	2035	2040	BO
Supplies	12,291	13,478	15,296	17,113	20,336	35,986
Demands	12,291	13,478	15,296	17,113	20,336	35,986
Difference	0	0	0	0	0	0

Table 7-2 – Supply and Demand Comparison (Single Dry Year)

(acre-feet/yr)	2020	2025	2030	2035	2040	BO
Supplies	12,905	14,152	15,908	17,627	20,947	37,066
Demands	12,905	14,152	15,908	17,627	20,947	37,066
Difference	0	0	0	0	0	0

Table 7-3 – Supply and Demand Comparison (Multi-Dry Years)

	(acre-feet/yr)	2020	2025	2030	2035	2040	BO
Year 1	Supplies	12,905	14,152	15,908	17,627	20,947	37,066
	Demands	12,905	14,152	15,908	17,627	20,947	37,066
	Difference	0	0	0	0	0	0
	(acre-feet/yr)	2020	2025	2030	2035	2040	BO
Year 2	Supplies	11,615	12,737	14,317	15,864	18,852	33,359
	Demands	11,615	12,737	14,317	15,864	18,852	33,359
	Difference	0	0	0	0	0	0
	(acre-feet/yr)	2020	2025	2030	2035	2040	BO
Year 3	Supplies	10,324	11,322	12,726	14,101	16,757	29,652
	Demands	10,324	11,322	12,726	14,101	16,757	29,652
	Difference	0	0	0	0	0	0

7.5 System Reliability

As discussed in **Sections 7.3** and **7.4** above, the threshold for determining supply reliability is that the volumes of supply are adequate to meet the City's customer demands. However, in addition to those two factors, the City must also have a water delivery system with sufficiently sized and disseminated infrastructure to transport water from the supply sources to the end users. Accomplishing this objective requires that the City's water infrastructure be designed to (1) deliver water of sufficient volume and pressure to all areas in the City and SOI; (2) address peaking issues that arise during the maximum day and peak hour with adequate fire flow protection; and (3) handle outages through system redundancy allowing access to multiple physical water supplies. The City's current system design minimally meets these threshold requirements but the future system design, as shown in **Chapter 9**, is much more robust.

As discussed **Section 5**, the variety of the City's potable water sources is derived from different purveyors (including the City) that are geographically dispersed. The City's current delivery system, however, limits this natural source water dispersion by directing

all surface sources through PCWA's treatment and delivery systems. In addition, the City adds groundwater derived from its well system to meet peaking needs in limited areas within the City's infrastructure. Thus, although the City can adequately meet its current demands with this infrastructure system, there are vulnerabilities that may significantly tax the water system as demands continue to grow.

Specifically, as noted in **Chapter 3**, the City utilizes water pumps on the PCWA regulated flow ledger to deliver water to a portion of the Catta Verdera development.(upper zone) If this pump system were to fail, the City would have no other viable means of delivering water to this area.[7] Thus, the City has sought to remedy this problem with a specific project – the Phase III water pipeline project (describe in **Chapter 11**) – that would allow more water to be delivered to the City's upper system. This water would be derived from PCWA's unregulated flow ledger and delivered by gravity to these high elevation lots. This infrastructure redundancy would reduce the pumping burden on the lower system and create infrastructure reliability for these high elevation lots in case one system were to fail. To date, the existing system has proven to be reliable because there has not been a system outage.

As the City grows, additional system vulnerabilities need to be corrected in order to meet the City's reliability objectives. For example – as noted in **Chapter 9** – there are still areas in the City that use pipes that were installed as early as 1929. These pipes are not meant to handle the pressures and flow velocities that are needed to meet the City's build-out capacity objectives. Moreover, connecting new pipes constructed with new materials to aging pipes from 1929 is generally an inferior engineering practice. As such, the ongoing Facilities Replacement Program (**Chapter 10**) and Capital Improvement Program (**Chapter 11**) seek to ensure that these system vulnerabilities are rectified over time to meet the infrastructure reliability objectives. Moreover, even in areas within the City with more modern infrastructure, systems could be undersized to meet the long-term build-out objectives for water deliveries. These system vulnerabilities must also be rectified to preserve water system reliability.

The City's long-term system reliability plans will significantly reduce infrastructure vulnerabilities. For instance, the City's development of multiple surface water delivery points from both PCWA and NID through multiple treatment facilities creates water supply and infrastructure redundancy in the City's surface water system. In addition, the strategic placement of water storage tanks and groundwater wells further protect the City from unforeseen outages either from source water or infrastructure failures. These system reliability plans – including looped infrastructure and large backbone delivery

[7] In some discussions, the City has considered emergency water deliveries through fire hoses that would be laid on the land surface that would push water higher up into the City's water system.

lines – allow the City to continue water service in difficult, and even emergency, conditions. All of these model representations are described in detail in **Chapter 9** and the specific CIP projects are described in **Chapter 11**.

7.6 Financial Reliability

In conjunction with demand, supply, and system reliability as discussed in **Sections 7.3, 7.4, and 7.5**, the City must also ensure financial reliability. Successful management of the City's water supplies and system requires financial support for continued maintenance and growth. Sources for revenue including developer fees, connection charges, customer rates, state bond funding, grant funding, and additional surcharges are critical to safeguarding the City's future water supply reliability. As discussed in **Chapter 3**, the City will expand far beyond its existing boundaries and its infrastructure must be adequate to deliver water to every corner while meeting its legal water-delivery requirements. A full financial assessment is beyond the scope of this analysis. Nevertheless, it is critical for the City to maintian financial reliability to ensure it has sufficient monetary assets to support its planned projects and maintain its current supplies.

7.7 Conclusion

Water supply reliability is a complex analysis that requires an ability to predict the future water demand, address the minutia of water rights and contracts, and evaluate infrastructure systems for adequate water delivery. The City has conservatively estimated its water demands and emphasized redundant water supplies and infrastructure systems in its short-term and long-term water planning. Conservative demand estimates are based upon carefully assessed meter studies and practically analyzed regulatory criteria that impact water demand estimates. Moreover, conservative growth estimates that have been evaluated based on regional trends and recorded in the **Master Demand Spreadsheet Tool** can be easily updated to reflect actual observations in the future. These demand assessments provide the foundation for supply augmentation efforts and infrastructure development projects.

The City has planned a redundant physical water supply system by developing six sources of water. Although all of these sources cannot be used for potable deliveries at this time, the ability to offset non-potable demands may allow secured potable supplies to be used more efficiently and cost-effectively. The City's robust water supply portfolio insulates it from outages caused by the failure of one or more of those supplies to materialize for any particular reason. And although there are vulnerabilities in each of the six supplies, actions can be taken to shore-up those supplies as the City continues to

grow and engage on water related issues.[8] As such, the City's physical water supplies are reliable.

Last, the City's infrastructure must be able to deliver the secured supplies to meet current and future demands. The current system configuration has some delivery vulnerabilities that are being addressed through continued modeling work and fire flow testing. The long-term system design, however, would allow the City to deliver water that originates from numerous water sources to meet customer demands throughout the City's system while still providing adequate pressures when the system is under stress. This long-term infrastructure planning renders the City's water system infrastructure reliable.

[8] **Chapter 8** identifies the key areas for the City's long-term strategic engagement.

SECTION 8. STRATEGIC WATER ISSUES

8.1 Introduction

This chapter of the Water Master Plan addresses the strategic water management issues facing the City of Lincoln. The issues facing the City vary in their complexity and geographic scope. In some cases, issues are entirely local and involve specific identifiable actions that are easily discerned. But in other instances, issues are complex with statewide and even global significance that require management actions aimed at mitigating the local risk. All of the issues described in the following sections, however, are relevant to the City's short-term and long-term water management efforts. The following discussion identifies critical City water resource protection challenges with recommended actions, explains the broader water management issues and various forums where the issues are being discussed, and recommends how the City can prioritize and engage in the most critical issues both now and in the future.

A number of water management challenges are facing the City – both internally and externally. It is clear that the management of the City's water assets has become exponentially more complicated since the adoption of the 2008 General Plan. Indeed, the worsening four-year drought crisis has illuminated the lack of statewide water planning, highlighted the growing insurgency of federal and state regulatory agencies into local and regional issues, and underscored the City's water asset and water conveyance vulnerabilities. Critical to the management of the City's water assets is the continued diligence in perfecting the City groundwater rights, recycled water rights and surface water entitlements, and protecting the ability to provide a balanced water supply during wet and dry years to meet customer demands.

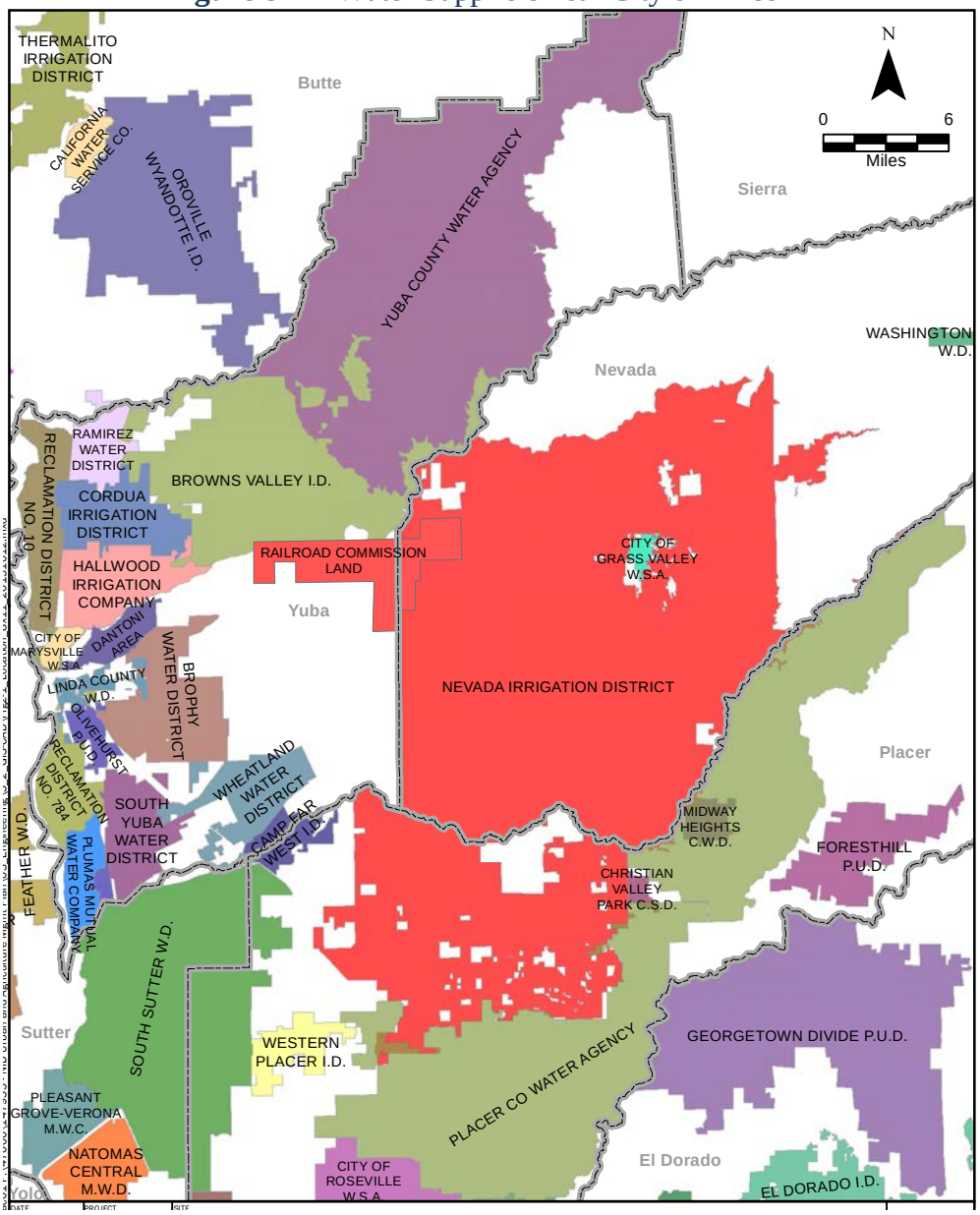
Additionally, the City must be prepared to control a dynamic assortment of issues that continue to evolve in light of the State's limited water resources. This control begins by forming an adaptive issue management structure that enables swift issue identification, clear issue prioritization, and effective issue engagement strategies. This section outlines an engagement framework and recommends the short-term and long-term management actions for the City's Management and staff.

8.2 Intensifying Competition for Water

Perhaps the biggest challenge facing the City is the intensifying competition for water statewide. Fresh water for agriculture and municipal use is an increasingly limited resource, and ongoing ecosystem management challenges, including preservation of endangered and threatened fisheries, create an ongoing and persistent need to balance

the uses of this finite resource. As a result, there are numerous competing interests that could affect the City's water resources and it is important to understand the context and challenges these interests pose in the coming years as illustrated by **Figure 8-1**.

Figure 8-1 – Water Suppliers near City of Lincoln[1]



Like other California municipalities, the City faces elements of change that permeate and underlie the related specific issues that are further described later in this chapter.

[1] NID 2015 UWMP at p. 20.

Specifically, the competition for limited water resources is tied to many of the following issues:

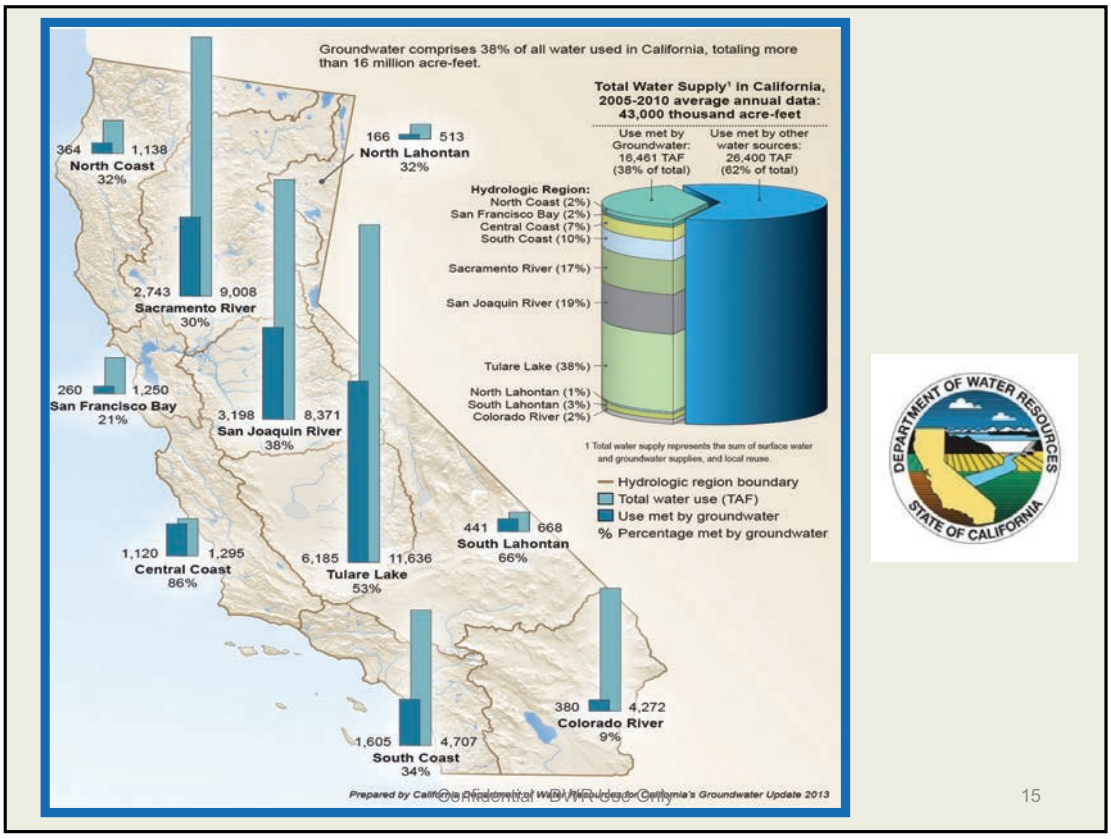
- California's hydrology is changing and fluctuating due to climate change and expanded water use.
- California's population continues to swiftly grow adding pressure to limited water resources and outdated storage and conveyance systems.
- California's water is needed to satiate growing urban, industrial, agricultural and environmental demands.
- California's and the Federal Government's Legislators and Regulatory Agencies are expanding their involvement in local water management issues.
- California's groundwater basins are rapidly depleting and some basins are undergoing significant contamination events.

All of these elements of change generate actions and projects that drive the exponential expansion of smaller issues that impact the City's water management. For instance, as a response to hydrological uncertainty and increased urban and industrial demand, southern California water export interests have reopened the debate on north of Delta water diversions (formerly the peripheral canal discussion and now coined the "Delta Fix") that require the City's attention and engagement. The increased attention on the State's changing natural and demographic circumstances create new forums where water issues are debated and new issues for those forums to debate. These forums and issues will be examined more closely throughout the remaining sections in this chapter.

8.2.1 California's Changing Hydrology

California's hydrology is in a state of flux. Specifically, climate change predictions, measured land and sea surface temperature increases, and observed trends in snowpack storage and stream runoff indicate that changes are occurring in California's hydrological systems. California's Department of Water Resources has observed less natural storage in snowpack (California's largest system of storage) due to warmer temperatures that cause earlier snowmelt and larger runoff events. In other words, the existing measured trends indicated that even if precipitation amounts in California remain fairly static in the face of a changing climate, the reduced natural storage and earlier runoff events appear to be reducing water supply reliability throughout the State. **Figure 8-2** provides an illustration of the complicated makeup of California's surface water supply alone. The existing storage and conveyance systems – most of which were built in the 1970s – are inadequate to handle these sorts of changes and still provide water supply reliability to all Californians.

Figure 8-2 – Total Water Surface Supplies[2]



Changes to California's hydrology, however, are not new. The dendrochronological record shows that the State has undergone 50 to 90 year wet and dry cycles over the last 10,000 years and has been plagued by extreme droughts lasting over 10 years in this same time period.[3] California's current water supply and conveyance systems were designed to handle hydrological uncertainties with a much shorter duration. In other words, California's storage and conveyance systems were designed to complement natural storage in the form of snow pack. As such, these systems are not sufficient to handle water supply for acute droughts lasting 5 years or more, or for climatic trends resulting in reduced annual precipitation and early runoff.

In short, California's hydrology is changing and the City will need to develop and implement new strategies to manage its assets to protect its ratepayers from negative impacts resulting from these changes.

[2] Sustainable Groundwater of California seminar through Law Seminars International on 6/16/16.
[3] Professor Ingram, UC Berkeley 2014.

8.2.2 Population Growth

California's population continues to expand, putting further pressure on the allocation of its limited water resources. In 2015, California's population was estimated at 39 million people.[4] This number should be compared against the entire population of Canada with a total population approximating 36 million people.[5] By 2050, the United States Census Bureau predicts that California's population will swell beyond 50 million people. Providing safe and reliable water supplies to meet this increased human demand in light of climate and hydrological trends will be a huge challenge over the next 35 years.

8.2.3 Expanding Water Demands

The demand for water in California goes beyond meeting only the needs of people in urban environments. Water demands are expanding across numerous sectors of California's economy as well as in various environmental stewardship and conservation locations. For instance, there is growth in water demand in nearly every economic sector to meet:

- agricultural needs, such as expanding permanent crops that require water application in all year types and have limitations on the quality of water used;
- industrial development, like oil production, where water is needed in the extraction and processing of subsurface carbon products; and
- commercial product development, like water-rich soy sauce, where water is the primary ingredient in the marketable food product.

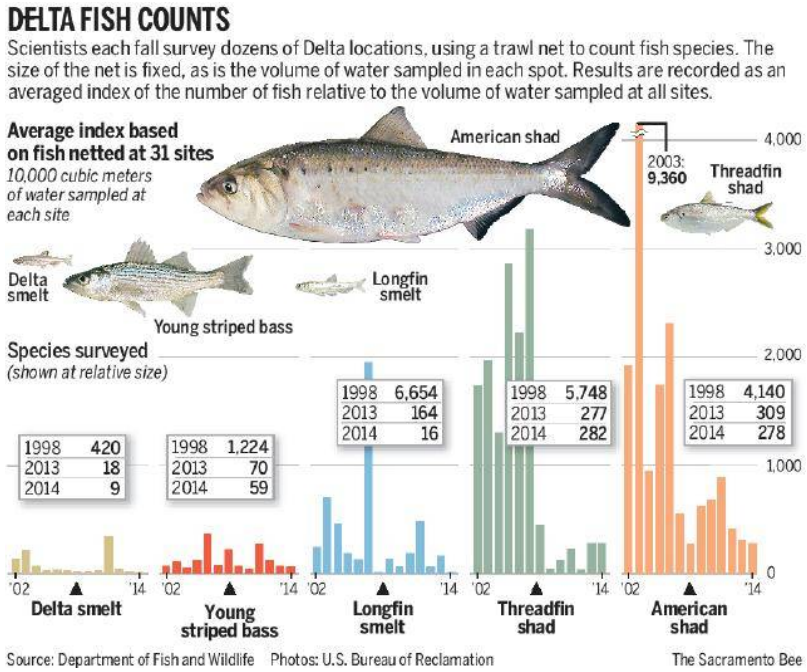
All of these economic areas – agricultural, industrial and commercial are changing the distribution and value of the State's water assets. This economic growth parallels the urban population expansion and all require new sources of water in both normal and dry years.

Similarly, there is tremendous growth in environmental water demands. In California, there are 34 species and subspecies of fish that are listed as either threatened or endangered by the State of California or the federal government. This includes the "famous" delta smelt as seen in **Figure 8-3**. Other avian and terrestrial species also rely on water supplies, and trends indicate that the regulatory agencies will connect water resources with these non-aquatic species as well. Similarly, water quality requirements in California's Delta and in upstream systems (like the cold water pool below Shasta Reservoir) further expand the demand for water resources throughout the State's

[4] http://www.census.gov/quickfacts/table/PST045215/06
[5] http://www.statcan.gc.ca/daily-quotidien/150617/dq150617c-eng.htm

environmental setting. This trend of dedicating water resources to environmental purposes continues to expand as the relationship between water and healthy ecosystems becomes further understood.

Figure 8-3 – Delta Smelt



8.2.4 Government Engagement

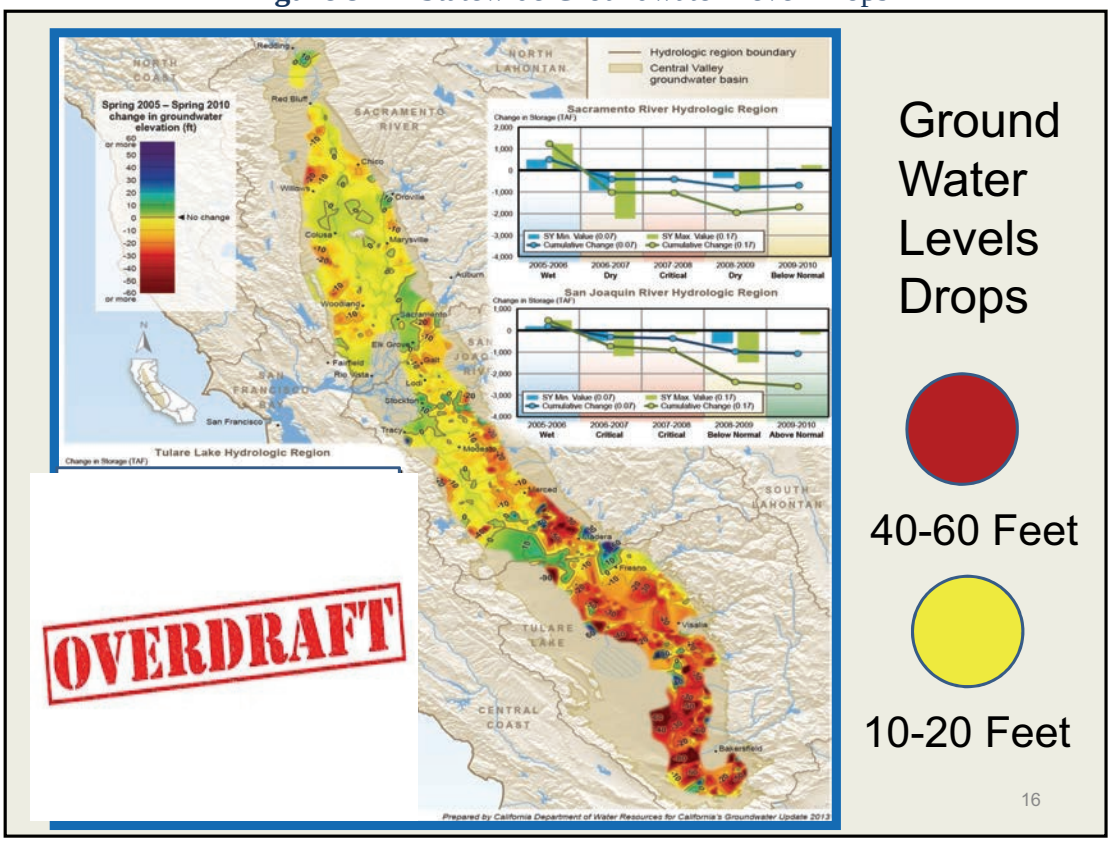
Both the federal and state governments continue to expand their jurisdiction into water resource management. The expansion is occurring in historically regulated sectors – like surface water management – but is also moving into historically unregulated sectors – like groundwater. The regulatory engagement expansion is arising from not only traditional water regulatory agencies, such as the SWRCB and the United States Bureau of Reclamation (USBR), but also is greatly expanding in non-traditional water regulatory agencies, like California's Department of Fish and Wildlife (DFW). For example, DFW requires a streambed alteration permit for any change to any diversion facility on a natural watercourse. Such a permit can greatly expand and complicate changes to traditional water diversions derived from a pre-existing water system. The regulatory regime not only needs to meet the diversion and conveyance requirements of the SWRCB, but also the regulatory objectives of DFW – which can completely modify a planned and engineered system (see the promulgation of fish screens on Sacramento River diversion facilities). This expanded reach into the water sector from new federal and state regulatory agencies will continue in California as more water is needed to meet specific regulatory objectives.

In addition to the state and federal growth in regulation, there is also regulatory growth at the local and regional levels. There are literally thousands of local agencies, special districts, municipalities, counties, joint powers authorities, and private companies in California that regulate water. In addition, as water becomes a preeminent factor in land use issues and environmental enhancement, the number of local agencies impacting water governance will grow, further complicating the regulatory burdens permeating water management in California. For instance, Placer County and Sutter County – two primarily land-use based agencies – are beginning to assert themselves in water issues where they have historically remained silent. In short, the City can expect expanded government and regulatory activity in the area of water resource management.

8.2.5 Groundwater Depletion

Groundwater depletion and contamination issues are rapidly emerging into the forefront of California's water management consciousness. **Figure 8-4** illustrates the statewide problem of groundwater depletion. There are 515 identified groundwater basins and sub-basins (collectively "basins") in California. Each of these basins has its own set of water supply and quality issues, water demands to satisfy, and regulatory systems governing the resource. In some areas, groundwater is heavily regulated through sophisticated plans, hydrogeological analyses, and integrated local and regional governance. In other areas, groundwater is wholly unregulated and massive depletions are occurring at alarming rates causing wells to run dry and land subsidence. In response to these wholly unregulated areas and areas that have ineffective management structures, the California legislature – in 2014 – enacted a sweeping set of groundwater laws and regulations called the Sustainable Groundwater Management Act (SGMA). The SGMA is described in detail in **Chapter 6** of this Water Master Plan.

Figure 8-4 – Statewide Groundwater Level Drops[6]



Groundwater contamination is also implicating the reliability of groundwater resources. Local contamination in the Placer County and Sacramento County areas, caused by industrial development, has resulted in a far-reaching regulatory structure requiring clean up and mitigation. Other longer-term contamination issues – like nitrogen fixation in the soils and water systems of the Central Valley – have traditionally been unregulated. In some areas of the Central Valley, the groundwater contamination situation has required a complete cessation in water use for human consumption. As the scientific understanding of water quality issues associated with human activity and development become better understood, the implications to groundwater cleanup and use will likely expand, impacting water resource management for urban areas throughout California.

8.2.6 Groundwater Contamination

The Placer County region has been addressing groundwater contamination in numerous locations in the City for decades. There are nearly 40 identified potential groundwater contamination sites in or near Lincoln's Sphere of Influence, including a former federal

[6] Sustainable Groundwater of California seminar through Law Seminars International on 6/16/16.

Titan Missile Site, Alpha Explosives Site, and numerous underground storage tank issues. These issues have required continual assessment over the course of the last 30 years. The status of the groundwater contamination and site remediation is not within the purview of this analysis. However, further assessment of the status of regional clean up activities is warranted in order to ensure that threats to groundwater assets are avoided and eradicated.

8.2.7 Water Use Efficiency

The City maintains an existing comprehensive water use efficiency program. The City participated in the State Water Resources Control Board (SWRCB) water conservation efforts in the 2015 drought and has taken active steps in reducing consumption in housing developments throughout its service area. The City participates in water fixture rebate retrofit programs, large landscape water budget developments, and commodity rate metering. The City also employs a public outreach and education program as well as many other best management practices to improve water use efficiency. The City will continue to comply with the Water Conservation Act of 2009 and is following the water efficiency efforts required by State government.

The City's 2011 meter study indicated approximately an 11 percent unaccounted for water, and further analysis in 2015 suggests the City's unaccounted for water is less than 10% in 2013, 2014 and 2015. Ten percent (10%) or less unaccounted for water is generally considered within acceptable limits. The most recent analysis, detailed in **Chapter 4**, is the first time the City has been in a position to quantify water consumption to determine the amount of unaccounted for water. Water that is quantified as "unaccounted for use" may include some or all of the following:

- Meter inaccuracy
- Unpermitted construction water
- Water system flushing
- Leaks in water mains, valves, and fire hydrants
- Leaks in services prior to the meter
- Emergency water for fire prevention or other hydrant activity

The most recent State water planning legislation includes a greater focus on quantifying leak and unaccounted for water. DWR working with the American Water Works Association (AWWA), prepared the Water Conservation Guidebook No. 5 focusing a leak audit on the following key steps:

- Quantify water sources
- Quantify water use
- Evaluate meter accuracy
- Calibrate meters
- Conduct leak survey
- Sonic Survey of all valves

The City has a leak detection program. The City should consider revamping its leak detection program to ensure consistency with the Urban Water Management Planning Act amendments as well as engage in thorough protocols to evaluate system vulnerabilities and unaccounted for water. Losses due to leaks tend to be constant whereas losses due to meters tend to be proportionately larger during the peak use period. The City could enhance the leak survey by evaluating winter minimum demand readings, conducting fire hydrant testing, and incorporating specific evaluation criteria into its new modeling system.

The California Water Conservation Act of 2009 requires a 20 percent reduction in per capita local agency water use by 2020. The City's plan for compliance with this mandate and current level of participation in the various Best Management Practices (BMPs) is documented in the 2015 Urban Water Management Plan (UWMP). While the City will maintain a robust conservation program into the future, the benefits of continued coordination with the Regional Water Authority on Demand Management Measures is necessary to meet the conservation requirement mandates and mechanisms to achieve them.

8.2.8 Source Water Quality

The City has two of the best quality surface water supply sources in the State of California: the American River watershed and the Yuba/Bear Rivers watershed (**Figure 8-5**). The American River watershed is low in dissolved solids, has very few upstream urban discharges above Placer County Water Agency's (PCWA) diversion, and is considered "generally excellent" in the 2013 American River Watershed Sanitary Survey.

All regulated drinking water parameters fall below maximum contaminant level standards. The Yuba/Bear Rivers also has very few upstream urban discharges and is derived from snowy-mountain run off that lie above urban centers. Nevada Irrigation District's (NID) diversions and storage allow runoff sediments to fall from the water, therein allowing better quality water deliveries through their conveyance system.

Figure 8-5 – Yuba-Bear Watershed Sources



8.3 Regional Forums and Programs

Throughout the broader Sacramento watershed, there are numerous forums that participate in developing and advocating water planning and management issues. These forums generally serve the City's needs by advocating positions on policy and legal issues and defending intrusions into local and regional water management and water

rights issues. In short, these entities' objectives are aimed at protecting the region's water supplies. However, the importance of water resources in California has exponentially grown and, in line with this growth, the forums that discuss water issues have expanded and diversified. The purpose of this subsection is to: (1) describe the regional water

groups that the City should be monitoring, (2) outline the programs and issues that each forum is coordinating, and (3) assess the City's engagement opportunities in these forums in order to maximize the effectiveness of implementing the City's water management strategies.

8.3.1 Water Forum and Water Forum Agreement

In 1993, the City of Sacramento and Sacramento County created the Water Forum to address concerns over both water supply reliability and environmental degradation in the Sacramento Region and the Lower American River (LAR). Specifically, the region was experiencing a prolonged drought and surface and groundwater conditions were becoming critical. Moreover, there was an increasing awareness of the environmental conditions along the LAR and that further deterioration of the LAR might lead to permanent environmental problems. The LAR supports 43 species of fish, including federally protected species – fall run Chinook salmon and Central Valley steelhead.

The Water Forum Agreement (WFA) is a signed document that seeks to meet specific objectives in the American River watershed. The Agreement is a package of linked elements with two, co-equal objectives: to provide a reliable and safe water supply for the region's economic health and planned development to the year 2030; and preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River. In order to meet these co-equal objectives, the Water Forum Agreement incorporates seven key elements: increased surface water diversions; actions to meet customer needs while reducing diversion impacts in drier years; support for improved pattern of fishery flow releases from Folsom Reservoir; Lower American River habitat management; water conservation; groundwater management; and Water Forum Successor Effort.

The City of Lincoln is not a signatory to the Water Forum Agreement or a member of the Water Forum (although it participates in the Regional Water Authority – (described below)), so the Agreement is only applicable through its impact on surrounding entities – in particular, Placer County Water Agency. PCWA has specific obligations under the Agreement and its subsequent Purveyor Specific Agreement (PSA) that may impact PCWA's ability to build surface water diversion facilities and deliver surface water to the City of Lincoln. PCWA's PSA requires it to reduce diversions from the American River less than the total allocation available on under its water right permits in order to make water available for use in the LAR. PCWA, however, is able to capture foregone water at

the mouth of the American River and transfer that water to other agencies. The WFA and PCWA's PSA have a direct bearing on the City's use of surface water from the American River as well as the longevity of its groundwater assets because a source the City relies upon is limited by the WFA and the WFA's PSA implementation.

8.3.2 Regional Water Authority

The Regional Water Authority (RWA) is a joint powers authority formed in 2001 to promote collaboration on water management and water supply reliability programs in the greater Sacramento, Placer, and El Dorado County region. It is an outgrowth of the Water Forum that was developed to allow regional agencies to collectively implement the provisions of the Water Forum Agreement.

RWA represents 24 water suppliers and associated agencies in the greater Sacramento Area. The mission of RWA is to serve and represent the regional water supply interest and to assist Members in protecting and enhancing the reliability, availability, affordability, and quality of water resources. A nine-member Executive Committee is elected annually to guide RWA. Recently, RWA has changed objectives and morphed into a broader advocacy forum and water management group that includes non-Water Forum members. In September 2013, RWA Board unanimously adopted the updated Goals and Objectives for the RWA Strategic Plan. The four goals are: Planning Goal, Implementation Goal, Information/Education Goal, and Advocacy Goal.

The Planning Goal seeks to develop a regional water reliability plan to identify the most promising regional opportunities to improve water supply reliability; evaluate and respond to external impacts on the region's water supplies and operations; and create an Implementation Plan for the Planning Goal and update it annually. RWA has initiated the regional water reliability planning effort.

The Implementation Goal seeks to promote implementation of the American River Basin Integrated Regional Water Management Plan; support a lower American River Flow Management Standard that is consistent with the Water Forum coequal goals; support implementation of water transfers among agencies intra-and interregional that are beneficial for the region; support programs to benefit from economies of scale in purchasing; fully implement the regional mutual aid program template for equipment, manpower, and water supply; promote improvements in water use efficiency in the region to meet future water needs; and create an Implementation Plan for the implementation goal and update it annually.

The Information and Education Goal seeks to educate and inform members and other interested parties on water management issues affecting the region; raise RWA profile

and credibility to external audiences through a focused public outreach effort; develop and maintain strong partnerships to advance RWA member interests; develop a comprehensive public outreach and education program among members to create and implement a consistent message for RWA and the region; and create an Implementation Plan for the Information/Education Goal and update it annually.

The Advocacy Goal seeks to engage state and federal legislators representing the region and legislators on relevant committees to discuss an agenda for legislative action that represents a collective RWA member vision on items of regional importance; and evaluate, comment, and advocate on statewide water regulatory issues that may impact the region and its water supply reliability.

8.3.2.1 Restructure of Joint Powers Authority

In October of 2013, the RWA members amended its Joint Powers Authority in order to be a more effective entity in furthering its membership's objectives. Specifically, RWA modified its voting structure so as to allow the membership to take positions on various issues without the memberships' unanimous consent. This change in voting structure is likely to elevate RWA's effectiveness in advocating and analyzing water issues throughout California's legislative and regulatory processes.

8.3.2.2 RWA Integrated Regional Water Management Plan

In April of 2004, sixteen of RWA's members and associate members elected to embark on the development of an Integrated Regional Water Management Plan (IRWMP) on behalf of the entire RWA membership. RWA's IRWMP's addresses complex water resource management challenges by identifying water supply and infrastructure issues and finding regional cooperative solutions and financing mechanisms to resolve the challenges.

RWA's IRWMP provides the following benefits:

- Establishes a common vision and goals and a stronger regional understanding of water resources issues and potential solutions.
- Creates opportunities to identify projects that align with the vision and goals.
- Creates opportunities to develop multi-partner projects with better economics of scale and more potential funding sources.
- Establishes a framework to monitor and evaluate the region's progress toward meeting its goals.
- Establishes an adaptive process to address tomorrow's water resources challenges.

The City has been active in identifying issues and developing solutions as part of the IRWMP process. The IRWMP process in California legislative and regulatory law is becoming the paramount planning forum that allows regional agencies to obtain state funding from legislative enactments and proposition initiatives. Continuing participation in RWA's IRWMP process is critical to meet the City's long-term water management objectives.

To further these objectives, a comprehensive update to the IRWMP was adopted in July 2013 that furthered the ongoing effort to promote regional sustainable water resources. This update greatly expanded beyond the original efforts in the 2006 IRWMP to incorporate new stakeholder-derived issues and concerns. In addition to the 2006 goals, a vision statement was added to the IRWMP effort. The vision states "The American River Basin Region will responsibly manage water resources to provide lasting health to our community, economy, and environment." A list of primary goals was incorporated into the document to help guide and inform actions made within the IWRMP. The goals serve to help all the stakeholders realize the vision by:

1. Providing reliable and sustainable water resources, sufficient to meet the existing and future needs of the region.

2. Protecting and enhancing the quality of surface water and groundwater.

3. Protecting and enhancing the environmental resources of the watersheds within the region.

4. Protecting the people, property, and environmental resources of the region from damaging flooding.

5. Promoting community stewardship of our region's water resources.

The new vision and goals help inform stakeholders in deciding the appropriate actions to execute that affect the American River Basin. The 2013 update provides adaptive management practices and informs participating entities about strategy, implementation of projects and system flexibility. Additional information on the following topics have also been included:

- Updates to all basic water-related, environmental, and socioeconomic data
- Development of vision and goals, principles, objectives, and strategies for meeting water resource management needs
- A summary of regional climate change vulnerabilities and adaptation measures

- Addressing issues associated with a reliable and safe water supply for disadvantaged communities
- Documentation of increasingly extensive stakeholder outreach, including the development of a Web-based interface to ensure ongoing collaboration and communication beyond plan adoption
- A comprehensively updated project prioritization method and project list
- Updated details on financing and implementation

Overall, the 2013 update has expanded the IWRMP while still adhering to the original plan's framework and guiding principles of sustainable resource management and integration.

8.3.3 Association of California Water Agencies (ACWA)

The Association of California Water Agencies (ACWA) is the largest coalition of public water agencies in the country. Originally created in 1910, its nearly 450 public agency members collectively are responsible for 90 percent of the water delivered to cities, farms and businesses in California. ACWA has a primary mission to assist its members in promoting the development, management and reasonable beneficial use of water in an environmentally balanced manner.

ACWA identifies issues of concern to the water community and the general public. The association accumulates and communicates the best available scientific and technical information to the public and policy makers; facilitates consensus building; develops reasonable goals and objectives for water resources management; advocates sound legislation; and fosters cooperation among all interest groups concerned with stewardship of the state's water resources. In addition to its public agency members, ACWA has numerous affiliate members that include mutual water companies as well as other non-profit and non-public water suppliers. Hundreds of firms and corporations with an interest in water also belong to ACWA as associate members. A 33-member Board of Directors governs the association. The membership is organized into 10 geographic regions, which play an active role in setting the association's policy agenda (**Figure 8-6**).

Figure 8-6 – ACWA Geographic Regions



The size of ACWA has made it difficult to be an effective advocate of statewide water policies that benefit all of its members. In 2009, ACWA took political actions that were adamantly against the needs of its northern California membership. These actions nearly resulted in a mass exodus of northern California interests from ACWA's membership as distrust permeated the Association's leadership ranks. Instead, ACWA's board policies were modified to prevent factional dominance.

In 2014, ACWA was active in helping facilitate the Governor's Water Action Plan, groundwater legislation, and potential modifications to the Water Bond. Again, in 2014, ACWA leadership took actions that were counter to the needs of the RWA regional interest. In 2015, ACWA lobbied on behalf of the State's water purveyors asserting that the Governor's conservation targets were overreaching. The effort was not productive and the drastic conservation requirements were implemented and most acutely felt in the RWA region. And as California moves into the next legislative session, ACWA will need to address its position on the Delta Fix – Governor Brown's primary water supply and infrastructure objective – further discussed in **Section 8.4.2** below. The City should consider developing an ACWA membership in order to track important water issues among the state's water purveyors, develop new relationships with water interests outside the regional boundaries, and understand legislative and regulatory actions impacting the City's water assets.

8.3.4 Western Placer County Groundwater Management Plan

The 2007 Western Placer County Groundwater Management Plan (WPCGMP) is designed to assist the City of Lincoln, City of Roseville, Placer County Water Agency

(PCWA), and the California American Water Company (Cal-Am) in an effort to maintain a safe, sustainable and high-quality groundwater resource within a zone of the North American River Groundwater Subbasin. The WPCGMP has as its objective the maintenance of groundwater resources to meet backup, emergency, and peak demands without adversely affecting other groundwater uses within the WPCGMP area. Moreover, the WPCGMP provides a framework to coordinate groundwater management activities through a set of basin management objectives and specific implementation actions that were agreed to by all of the participants. In 2013, the partnership completed the Western Placer County Sustainable Yield effort that is designed to understand the usage, storage capacity and sustainable yield of the aquifers, and to develop management strategies to protect and enhance the partnership's groundwater assets.

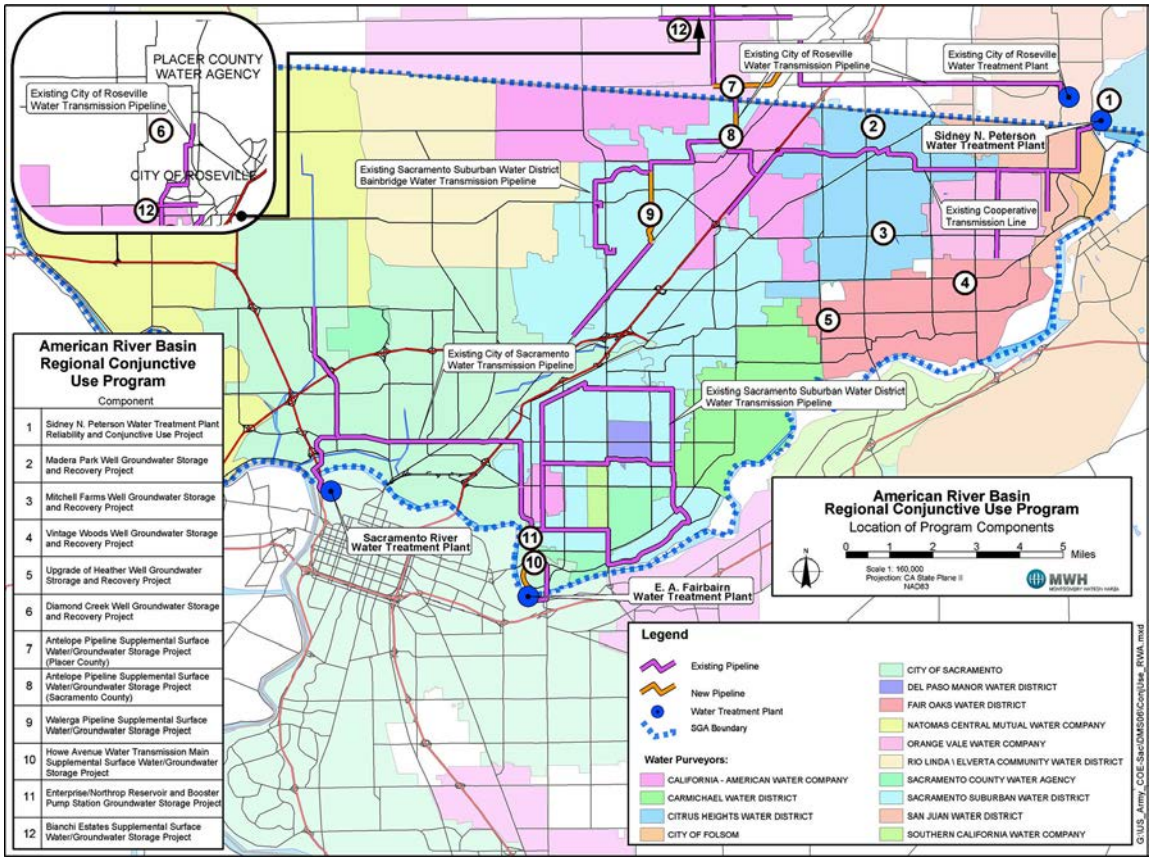
The City is an active participant in the WPCGMP effort. The focus of this group at this time is to develop and implement compliance activities related to the Sustainable Groundwater Management Act (detailed in **Chapter 6**). These activities will require not only collaboration with the WPCGMP partners, but also Placer County, Sutter County

and members of the Sacramento Groundwater Authority (SGA). SGA is a JPA formed to manage groundwater in the Sacramento County portion of the North American Subbasin and has applied to become a GSA under the 2014 SGMA Legislative package.

8.3.5 American River Basin Regional Conjunctive Use Project

SGA and RWA are conjointly working to develop a groundwater banking program. For SGA this effort grew out of their primary goals and conjuctive use focus. SGA and RWA are further promoting conjunctive use throughout the region and with their respective stakeholders related to the North Area Basin – a basin with excess storage capacity estimated at 2 million acre-feet. The program area is bound on the east by Folsom Lake, on the south by the American River, on the west by the Sacramento River and by the Bear River to the north. A map of the planned project can be seen in **Figure 8-7.**

Figure 8-7 – American River Basin Regional Conjunctive Use Project[7]



The program aims to maximize surface water use in normal and wet years, while in dry years surface water use would be conserved to help serve in stream environmental purposes. Specifically, SGA anticipates the water banking program to be based on direct and in-lieu recharge during wet years when groundwater is not as needed with ample surface water supplies. Then in dry years, participating members will increase groundwater pumping and decrease their surface water use, allowing that water to satisfy environmental needs such as in-stream flows, water quality and fishery habitat. Although this program is not fully developed, SGA has 16 water purveyors seeking participation. Last, SGA intends to work with outside entities interested in banking water in the North Basin region. The program seeks to improve groundwater storage and banking by improving regional water supply infrastructure.

8.3.6 Legal Defense and Political Organizations

There are numerous legal defense and political organizations that work within the American River and Yuba/Bear Rivers watershed region. Only two of these

[7] Regional Water Authority Map of American River Basin Regional Conjunctive Use Project

organizations are described in this section. The primary purpose of these types of organizations is to defray costs associated with legal representation and advocacy. The organizations that affect the American River and Yuba/Bear Rivers basins are as follows:

- Sacramento Valley Water Users Joint Defense Agreement – The Sacramento Valley Water Users Joint Defense Agreement was established in the 1990s to handle issues associated with the development and implementation of the Bay Delta Water Quality Control Plan. This Agreement has been signed by numerous water agencies in the American River Watershed.

- American River Watershed Joint Defense Agreement – Recognizing that some water issues are isolated in priority to the American River region, a group of American River water diverters established this joint defense agreement to defray costs associated with battling these issues.

The primary issues that these legal defense entities will face include: (1) the Delta Water Fix; (2) the Bay Delta Water Quality Control Plan Update; and (3) the Lower American River flow standard. All of these issues impact the water users within this region and may affect long-term reliability. Specifically, more stringent regulatory actions related to water rights and water supplies may affect long-term supply reliability even if the hydrology of the region stabilizes. As such, these entities may be used to legally challenge certain laws, rulings, or regulations that affect water supply reliability on behalf of regional stakeholders.

8.4 Regional and Statewide Issues Affecting Water Assets

California is replete with water-related issues. The complexity and sophistication of the various issues as well as the diverse forums in which these issues are discussed make tracking each of them very difficult. The purpose of this section is to describe the most pertinent regional and statewide water issues facing the City and to assess the City's best opportunities to engage and influence these issues.

8.4.1 Bay Delta Water Quality Control Plan Update

The Bay Delta Water Quality Control Plan (WQCP) is the responsibility of the State Water Resources Control Board (SWRCB). The SWRCB updates the WQCP every 3 years, with the intent of protecting the beneficial uses of water within the Bay-Delta and its tributaries as well as the water quality issues associated with managing the states' waters to meet these beneficial uses. The last Bay-Delta WQCP update was completed in 2006 and is currently undergoing revision.

The recent update process started in 2009 and is a multi-phase effort to review both water quality and stream flow rates for Delta tributaries to meet Delta outflow requirements. The most recent approved amendments were issued in Spring 2016 with SWRCB hearing on the planned changes to the WQCP scheduled for "Fall 2016." Phase 1 is currently under development and is providing recommended flow regimes for future management of tributaries to the San Joaquin River. In this Phase, it is becoming increasingly clear that upstream water rights will be modified in some way to meet recommended flow criteria downstream. The Phase 2 effort will focus on the Sacramento River Water Quality Control Plan component and the necessary flows to meet Delta water quality needs. Then, in Phase 3 Water Rights, the State will determine how to address flow recommendations in the context of the Sacramento region's water rights. By the time this phase of the effort is moving forward, the flow regimes in the San Joaquin, Sacramento, and other Delta tributaries will be fixed. As such, the City should monitor Phases 1, 2 and 3 of the WQCP update in order to understand the tactics and implementation goals of the SWRCB. The findings in Phase 1 will be telling of SWRCB's application of those goals and objectives in Phases 2 and 3.

The specific threats to the City posed by the WQCP Update relate to the City's surface water entitlements that are derived from water rights in the American River and Yuba/Bear Rivers watersheds. The WQCP Update could radically change the volumes of water available for diversion under various water rights for potable uses. Moreover, the WQCP may also include mandated discharges under the City's NPDES permit that may end up as permanent. Under current conditions, Delta water quality requirements are the sole responsibility of the federal and state projects. In other words, if there is insufficient water in the system to meet the needs of the Delta, then the projects must provide that water from stored supplies. But this oversimplification does not adequately address the prevailing thinking on the water issues at the state regulatory level.

The SWRCB wants to vastly increase the flow regimes on river systems tributary to the Delta. This increased flow regime is not necessarily going to be the responsibility of the project purveyors. Where natural flows need to be increased on Delta watershed tributaries, junior water right holders' water rights may be jeopardized. Or, in another potential scenario, the SWRCB may attempt to utilize principles under the Public Trust Doctrine to reduce both junior and senior water rights in order to meet additional flow needs. Either scenario impacts the City's water assets. Accordingly, paying very close attention to the Bay Delta WQCP proceedings as well as working with regional stakeholders to develop and propose water supply solutions that meet the primary objectives of the WQCP update is paramount.

8.4.2 California WaterFix and California EcoRestore

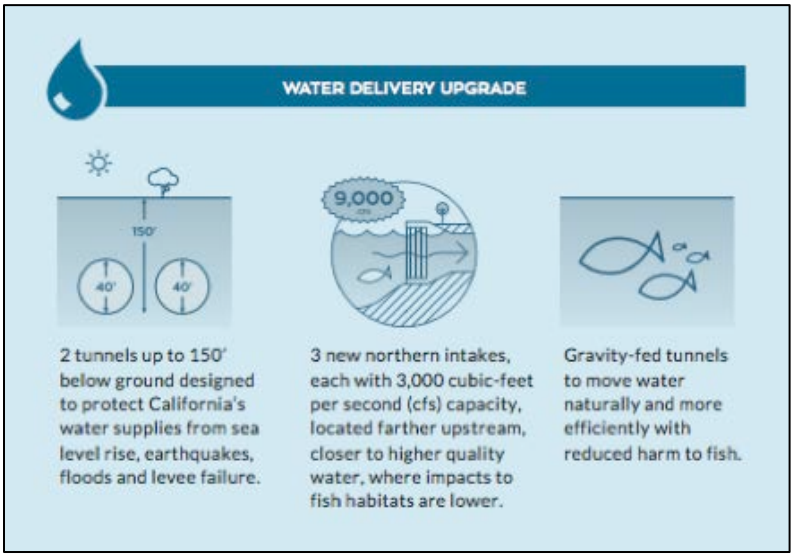
The Bay Delta Conservation Plan (BDCP) was recently changed to reflect public comments and fulfill the requirement of the 2009 Delta Reform Act. State and Federal agencies are proposing a new sub-alternative – Alternative 4A – which would replace Alternative 4 (the proposed BDCP) as the State's proposed project. Alternative 4A reflects the State's proposal to separate the conveyance facility and habitat restoration measures into two separate efforts: California WaterFix and California EcoRestore.

The California WaterFix would seek to improve water conveyance to water exporters by building facilities that meet export needs. Specifically, the WaterFix would build two tunnels in the north delta that are approximately 150 feet underground with three separate intakes, see **Figure 8-8**. Each intake will be capable of diverting approximately 3,000 cubic feet per second for a total of 4.9 million acre-feet annually to the export communities. The WaterFix is an effort to improve California's infrastructure for delta-watershed export communities. Minimum limits will be placed on the water flow to ensure hydrologic conditions do not prevent fish populations from gaining beneficial use from the water.

The California WaterFix would also include habitat restoration. California WaterFix will include approximately 2,300 acres of habitat restoration to mitigate for the construction and operation of the new water facilities. These costs will be paid for exclusively by water agencies benefiting from the project. Through 2020, the WaterFix will pursue more than 30,000 acres of critical Delta restoration under the California EcoRestore program, and pursuant to pre-existing regulatory requirements and various enhancements to improve the overall health of the Delta. Proposition 1 funds and other state public dollars will be directed exclusively for public benefits unassociated with any regulatory

compliance responsibilities. The cost to fix California's primary water delivery system is estimated at $14.9 billion – or about $5 a month for urban water users – and will be paid for by public water agencies that rely on the supplies.

Figure 8-8 – WaterFix Proposed Tunnels



California EcoRestore (EcoRestore) will accelerate and implement a comprehensive suite of habitat restoration actions to support the long-term health of the Sacramento-San Joaquin Delta's (Delta) native fish and wildlife species. Through 2020, EcoRestore will pursue environmental enhancements in the Delta through existing regulatory structures and other identified enhancements. EcoRestore looks to enhance as much as 30,000 acres of land in and around the Delta through this effort. EcoRestore will be funded through Proposition 1 funds and other state funds that are directed exclusively at public benefits.

The City should work with RWA executive management to get a full understanding of the implications of the WaterFix project and EcoRestore project to affect regional water supply reliability.

8.4.3 Delta Plan

The Delta Plan is a planning document that addresses environmental and water quality requirements in the legal Delta. The Delta Plan is governed by the Delta Stewardship Council (DSC) and requires updating and modification as conditions change. While the Delta Plan does not in itself make changes to system operations or management, it is enforceable and works as the overarching guidance document for many of the plans and policies being developed to manage the Delta going forward.

The Delta Plan incorporates a requirement to establish delta outflow objectives. Delta outflow objectives can only be satisfied by assessing water rights and supplies in the entire Delta watershed system – from the headwaters of the San Joaquin and Sacramento

Rivers to their confluence in the Delta. Although the Delta Plan does not grant jurisdictional authority to the DSC beyond the boundaries of the legal delta, it is ambiguous as to the DSC's authority in managing resources beyond the Delta that have a lasting impact in the Delta. In this way, it is unclear whether the Delta Plan grants DSC the authority to manipulate water assets outside the legal Delta and should be closely monitored by Sacramento area water interests. There is little doubt, however, that the DSC will recommend specific actions to the SWRCB in order to modify delta outflow objectives.

The Delta Plan also calls for a Delta Water Master who has been appointed to help implement the Delta Plan. The Water Master is charged with ensuring that the water diversions and uses in the delta are legal. Specifically, not only is the Water Master tasked with stopping illegal diversions of water, but he is also charged with assessing the reasonable and beneficial use of water in the Delta for irrigation, urban and industrial uses. The Water Master does not have authority to manage water assets outside the legal Delta but the implications of a Water Master with this limited range of water management may not meet the Delta Plan objectives. Accordingly, the City should be monitoring the Delta Plan and its implementation through participation in the RWA.

8.4.4 Climate Change

Climate change resulting in increased hydrologic uncertainty, more pervasive and longer-lasting droughts, and decreased snow pack in the Sierra's could also influence operations and further increase competition for water supply when it is available. For example, hydrologic modeling of Folsom Dam Operations conducted for the California WaterFix and EcoRestore concluded that Folsom Dam will reach dead pool storage levels approximately once every 10 years, in part due to climate change projections. Dead pool storage is the level at which no additional river releases out of Folsom Reservoir are possible. Similarly, Nevada Irrigation District (NID) has initiated efforts to plan, design, and construct an additional reservoir in order to mitigate the effects of climate change on its water management system. In short, it is looking to build a reservoir that is capable of capturing more runoff falling as rain since snowpack may be reduced in climate change conditions.

The City's existing water assets, however, rely upon the ability of the upstream diverters to capture and deliver water under those diverters' water rights. PCWA and NID manage significant watersheds and have large reservoirs to capture water under their water rights. However, the potential for change in the ability to capture these supplies – and thus the reliability of these supplies – still exists if the climate change implications manifest as predicted. These predictions are noted below.

First, with warming regional temperatures, precipitation will fall more as rain than as snow. Rain does not accumulate in snowpack (the largest source of storage in California) and tends to rapidly melt existing snowpack. As such, the change in precipitation form can impact the natural flow of the source-water watersheds by lessening the amount of snowpack in the system.

Second, climatologists predict that in many areas there will be less precipitation due to climate change. If this prediction manifests, the amount of water available for diversion in the source water systems will be less – like a perennial drought.

Last, with warming regional temperatures, the timing and pattern of runoff from the snowpack will also likely change. Here, the time period to melt the snowpack will be shortened as the temperatures surrounding the snowpack rise. This means that there will be earlier snowmelts in the Sierra watershed. Earlier snowmelts mean that the natural flow of the river systems will be higher in the prevailing runoff months but will last for a shorter period throughout the dry periods in the summer. As such, water diversions of the natural flow in summer may be significantly decreased.

The regulatory issues predicted with climate change are perhaps more dire. As described in the previous example, the regulatory issues in the Delta may be greatly exacerbated with climate change requiring longer and more substantial releases of water from existing reservoir systems. Simply put – if sea level rises as predicted, then more water will be needed to meet the delta water quality requirements as promulgated by the SWRCB. Accordingly, there is growing concern that climate change could exacerbate hydrological and regulatory droughts and directly impact the City's water assets.

8.4.5 State Water Resources Control Board Authority

The State Water Resources Control Board (SWRCB) has expansive jurisdiction over water supplies in California. As described in earlier sections, the State retains ownership of all water in California and water purveyors merely possess the right to use the water. SWRCB has been charged with managing water rights in California and has expanded its ability to carry out this mandate by expanding its reach into surface and groundwater resources.

For instance, in managing surface water resources, the SWRCB has declared that it holds the waters of the State in trust for the people for Public Trust uses. In California Supreme Court case law, the Public Trust Doctrine takes priority over all other uses of water in the State – in other words, a pre-emptive senior water right that was not recognized until the 1980s. The SWRCB seeks to use this California Supreme Court doctrine priority to further acquire water resources to protect public trust uses.

On the groundwater side (besides the SGMA described in **Chapter 6**), the SWRCB has long been isolated from groundwater jurisdiction. Although it has made political requests to obtain the authority to regulate groundwater, it has generally been thwarted. However, SWRCB has used its regulatory authority to enter the groundwater management arena. The first foray was to establish hydrological connectivity between certain surface water and groundwater sources. In this instance, the SWRCB reasoned that where groundwater was feeding surface water systems, surface water purveyors had relied on these supplies to fulfill the balance of their surface water rights. As such, some groundwater has been subject to SWRCB's jurisdiction.

More recently, the California Legislature is requiring regions to engage in groundwater planning which may give the SWRCB more authority to enforce new planning regulations. Moreover, in Siskiyou County, a trial court has recently ruled that the Public Trust Doctrine applies to groundwater resources. This case will likely be appealed but the implications to groundwater management could be staggering.

Last, the Governor's latest Emergency Drought Declaration and the driest conditions since the 1976-1977 drought have prompted the State Water Resources Control Board to take dramatic action to protect the Public Trust State water resources. Severe drought conditions have caused the SWRCB to implement water rights curtailments in the American River and Yuba/Bear Rivers watersheds as well as implement drastic water demand curtailment orders. These actions are unprecedented in California.

The SWRCB's Order mandating water use restrictions in local jurisdictions was particularly problematic for the City of Lincoln – requiring a 36% reduction in 2015. Under the order, wasting water is subject to a $500 per day fine on individual water wasters (e.g. washing down sidewalks, washing cars without a shutoff nozzle, or allowing irrigation to run off property). Cities must also activate their dry year water plans and ordinances including outdoor water use restrictions. As the SWRCB continues to aggressively pursue assurance of curtailment and water conservation compliance, it is critical that the City take measured actions to assure reliable water supplies by diversifying its water supply portfolio and aggressively protecting the assets currently within that portfolio.

8.4.6 Water Conservation and Water Use Efficiency

The Water Conservation Act of 2009, also known as SBX7-7 signed by Governor Schwarzenegger implemented new requirements and restrictions on the use of water

throughout the State of California. One of the major tenants of the new law is the requirement for Urban Water Suppliers (including the City) to achieve a 20 percent

statewide water use reduction on a per capita basis by 2020. The primary reporting and accountability mechanism for tracking progress and compliance towards meeting the conservation targets is via the Urban Water Management Plan water resource planning documents. The City completed and submitted its 2015 UWMP which includes the 2015 interim update and 2020 SBX7-7 compliance target.

The City has met the 2015 compliance target and is currently on track to meet the 2020 compliance target. An important element of water conservation for the City is preservation of its water rights and entitlements despite the potential decrease in overall water use. In order to accomplish this, the City is advised to account for water demand reduction savings by recording and reporting those savings under Water Code sections 1010 and 1011 to further protect water assets.

8.4.7 California Water Bond

In 2009, Californians adopted a California Water Bond as part of a comprehensive package of legislative reforms geared towards repairing California's struggling water delivery systems and ecosystems. These reforms were aimed at establishing a new paradigm in California as it related to water diversions, the Delta ecosystem, and long-term water supply reliability throughout the state.

A second Water Bond, Proposition 1, was put to the voters for approval in November 2014. It passed overwhelmingly. The Water Bond provides for $7.545 billion in expenditures (including repurposing $425 million of unspent funds). The key expenditures are for safe drinking water ($520 million) water supply reliability and integrated regional water management projects ($310 million); watershed protection ($1.495 billion); statewide water system operational improvements and storage ($2.7 billion); conservation and watershed recycling ($1.785 billion); groundwater protection and water quality ($900 million); water recycling ($725 million); and statewide flood management ($395 million). In some instances under this provision, the funding is continuously appropriated. The City should monitor the bond situation both through RWA and its participation in the legislative advocacy program within this group.

8.4.8 PCWA Permit Renewal Process

Placer County Water Agency is currently seeking to renew its American River water right permits – Permit 18356 and 18358 – with priority dates of 1958. For post-1914 appropriative water rights issued by the State Water Resources Control Board, a permit renewal is an effort to continue to validate the utility of the issued water right. The SWRCB water right process has three stages – application stage, permit stage, and

license stage. The application stage is the initial filing where the applicant demonstrates the need for water, the availability of water on the system, and the plan and ability to put the water to beneficial uses. When the SWRCB agrees with the applicant, it issues a water right permit that outlines specific conditions and timelines that the applicant needs to meet in order to "legally perfect" the water right and obtain a license.

PCWA's permits have specific terms about diverting volumes of water and applying those waters to beneficial use by a specific time. PCWA did not meet the timelines that were outlined in its water right permits and is now engaging the SWRCB to extend those timelines. Historically, these time extensions have been casually granted by the SWRCB. However, more recently, SWRCB has been extremely fickle about extending timelines and, in some cases in the American River region, has terminated the water right in its entirety.

PCWA's permit renewal process is important for the City of Lincoln because the water supply contained in those permits constitute the water supplies that will be diverted into the Ophir water treatment plant once it is constructed. If the supplies are somehow diminished or never perfected, the City's investments in PCWA infrastructure may be suspect. Accordingly, the City should monitor PCWA's permit renewal process and support PCWA's efforts to utilize the water assets derived from its permits in the Placer County region.

8.5 Strategic Engagement Recommendations

The analysis in this section has focused on the key issues affecting the City's water assets. California's water management system is fluid – regulatory issues continue to appear and then evolve over time with some fading away and others becoming more important. The purpose of this section is to outline the list of issues and prioritize City actions related to those issues so that the City may take appropriate steps to protect its water assets and secure long-term supply reliability. These issues will change over time and should be revisited annually to determine their relevance and prioritization.

8.5.1 High Priority Issues and City Actions

Regional Water Authority – The City should continue to be a leading entity in RWA. The evolution of that entity from implementation of the WFA to a regional advocacy and IRWMP implementation program direct impacts the City's long-term water asset management strategy.

WPCGMP – The City should take a leadership role in the WPCGMP as that entity is developing the western Placer County region's efforts in complying with the 2014 groundwater legislation described below.

Bay Delta Water Quality Control Plan Update – The City should engage with regional stakeholders on the WQCP Update. This effort could implicate the City's water assets directly and permanently. RWA should work diligently to be in front of this issue with City support.

2014 Groundwater Legislation and Regulation – The City should work to influence the 2014 groundwater legislation implementation. The stakes to the City's groundwater assets are high and, as described in **Chapter 6**, the creation of a Groundwater Sustainability Agency (GSA) and Groundwater Sustainability Plan (GSP) will have lasting implications to the City.

Regional Groundwater Use and Quality – The City should be constantly vigilant about groundwater use and quality in the North American Subbasin. Monitoring within the City is paramount but assessing plume migration, water rights issues, and associated uses within and without all of Placer County should also be closely monitored.

SWRCB Authority – The City should be addressing the expansion of SWRCB authority of surface water and groundwater. The demand reduction order in 2015 indicates that the SWRCB believes in top down management of water supplies and demands. And SWRCB's incursion into groundwater regulation should be carefully monitored. Moreover, the City should be particularly interested in the application of the public trust doctrine to the North Basin groundwater resources.

Water Conservation and Water Use Efficiency – The City should continue to implement its water conservation and water efficiency measures. Importantly, the City should document the water savings under Water Code sections 1010 and 1011 and assert control over the conserved water assets for City benefit.

8.5.2 Medium Priority Issues and City Actions

City Groundwater Banking – The City should continue to develop and refine its conjunctive use efforts. The City should work one-on-one with neighboring agencies to gather support for developing groundwater banking protocols and incorporating those protocols into any GSA or GSP affecting the North American Subbasin. The City should be working with RWA and SGA in the context of those entities current development of groundwater banking programs.

Water Forum – The City should work with PCWA to monitor implementation of the WFA and PCWA's PSA. The City's leadership position within RWA may provide political support to PCWA's efforts and provide for a more active role for the City in supporting the WFA. The LAR may be an important component to afford particular attention.

WaterFix and EcoRestore Programs – The City should continue to monitor the WaterFix and EcoRestore Programs and understand the implications of the construction of the tunnels on City's water assets. The City should work with RWA and encourage RWA staff to prepare regular reports on this effort. The City should consider joining regional litigation efforts through participating agencies in order to further support the City's interests in regional supply reliability.

Climate Change – The City should monitor scientific studies on climate change and the impacts of climate change to the American River and Yuba/Bear Rivers watersheds. The City may seek to work with RWA to commission an assessment of such impacts.

8.5.3 Low Priority Issues and City Actions

Delta Plan – The City should work with RWA staff to obtain regular updates on the Delta Stewardship Council and the implementation of the Delta Plan. The City should monitor legislative efforts aimed at expanding the authority of the DSC and the influence of the Delta Plan to upstream watersheds.

ACWA – The City should consider joining ACWA in order to better position itself as a leader in water asset management issues. The City's projected buildout population coupled with the development of the regional water treatment facility necessitate broader participation in statewide water management activities.

CHAPTER 9. WATER MODEL PRESENTATION AND ASSUMPTIONS

9.1 Introduction and Background

The City of Lincoln has a long history of providing water to its residents – likely dating back before its incorporation in 1890. In providing water, the City became responsible for the development and upkeep of water conveyance system. The City still manages and operates a potable water system with pieces of infrastructure that date back to at least 1929.[1] The water system contains pipes from every construction era since that time all coalesced into a single conveyance arrangement. The pipe materials include: concrete, iron, steel, and PVC with the oldest redwood pipes having been fully removed. The City has continued to grow expanding from a small town to a City with over 45,000 residents. The miles of pipe, number of valves, pressure settings, and infrastructure locations all require maps, spreadsheets, and databases to monitor and service. Furthermore, the additions to the system must be carefully engineered to comply with the newest fire flow and design standards as well as tested and verified to keep the existing City water system in compliance with applicable law and regulations.

Since the 1970's, universities and private companies have been writing computer software to process engineering complexities in urban water systems. Computers are now capable enough to store all of a City's water system details and display the impacts of system changes in advance of problems arising. In the early 2000's, the City of Lincoln was tracking water system expansions and maintenance projects in a Geographic Information System (GIS) format and had developed a water system model. With the housing crisis of the late 2000's, City growth substantially slowed and the need for modeling additions to the water system essentially ended. Coupling the downturn with a lack of funding, the GIS database was mothballed. Fast forward to the mid 2010's, development has returned to the City of Lincoln as well as the need for an accurate, scalable, and robust water system model and comprehensive GIS database. The primary purpose of this chapter is to provide an overview of the City's updated model and explain its functional utility.

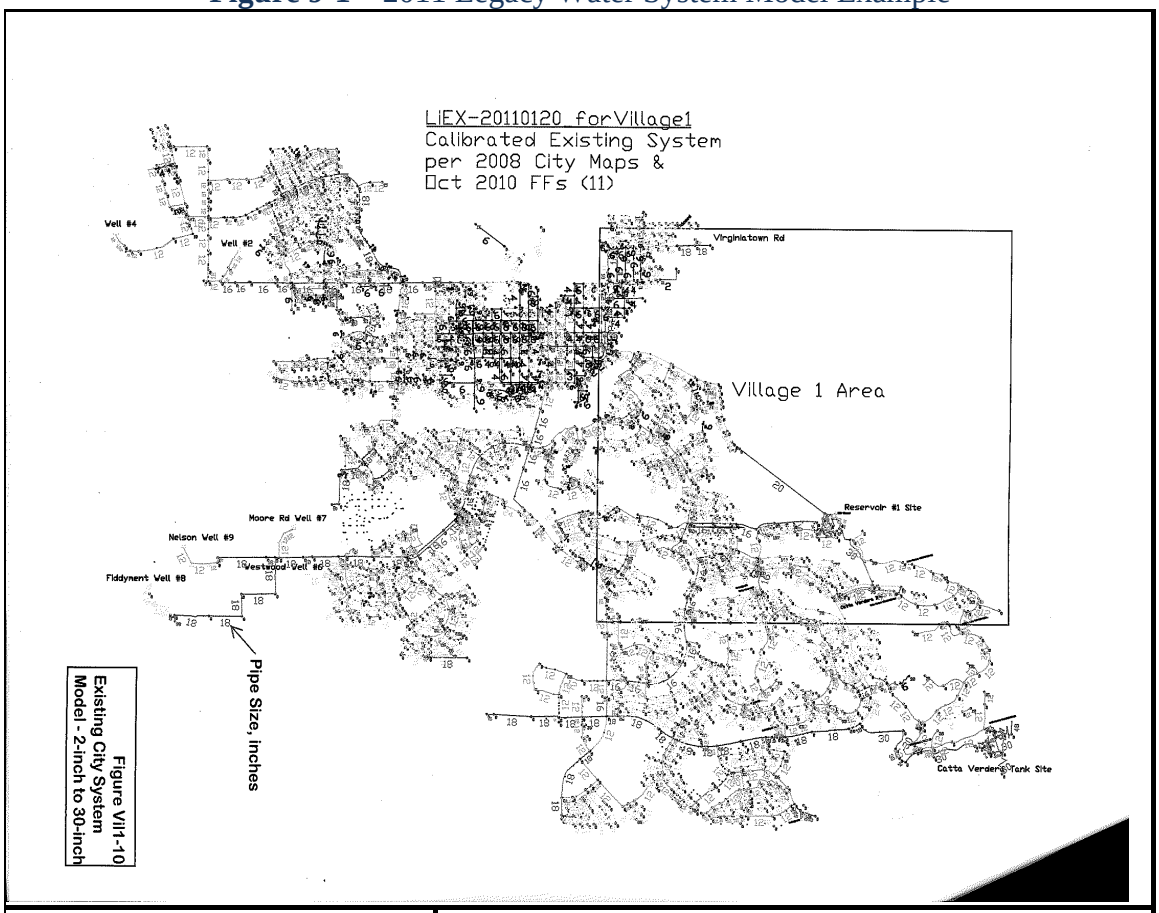
The City's water system has been capably operated since the City's last water model update. With the downturn in City development, the system operations could be

[1] 1929 is the oldest category of infrastructure cataloged in the City GIS system in 2009 by Ecologic. Much of the raw water systems controlled by the PCWA and NID date back to the gold rush days. As described in **Chapter 1**, these systems provided water to the City in its earliest years.

maintained to meet status quo standards. However, the system saw several instances when it was nearly exhausted and vulnerabilities in the system, although suspected, have not yet been fully vetted. In short, the old water model technology was insufficient to meet the City's expansive development needs.

Specifically, the City's previous water model of the existing system was last updated in 2011 to derive some early infrastructure sizing and available number of new connection estimates for the proposed Village 1 development. **Figure 9-1** presents an example of the 2011 model and the details provided in that model. Similar early phased development service capacity from the existing City water system was also completed for Village 7 in 2013 using the 2011 model. Since then, only minor changes have occurred within the City for new pipes as well as in the operations of Pressure Reducing Valves (PRVs), tanks, and wells. With over 200 miles of pipe and nearly 3,000 pipe sections, there was a significant amount of work involved with updating the model representation of the City's constructed infrastructure and cross-checking infrastructure assumptions against the field maps to make necessary corrections. Minor corrections to the new model will be ongoing in the future as updated drawings are reviewed and analyzed. These corrections will have negligible impact on the overall results of the model and will not change the validity of the results drawn from the model.

Figure 9-1 – 2011 Legacy Water System Model Example

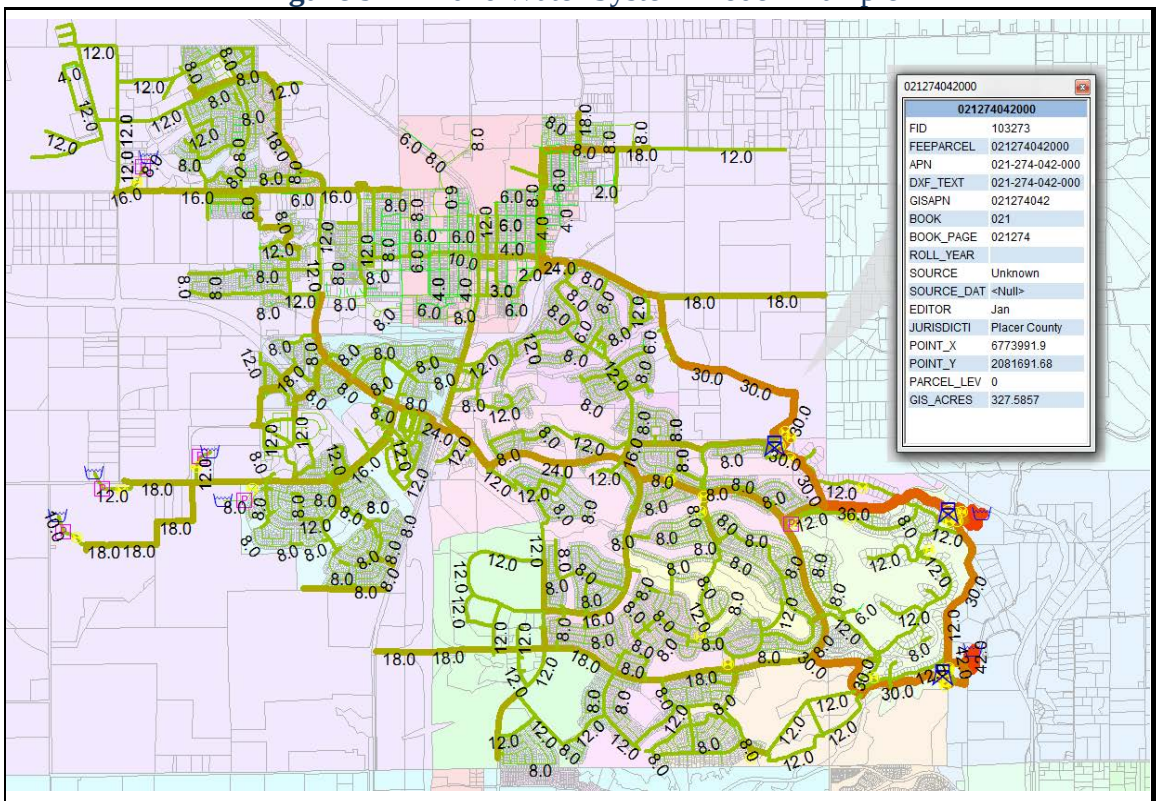


Tully & Young
Comprehensive Water Planning

Image Sources:
2011 Village 1 Water System Constraint Analysis

Recently, growth in computer processing power has allowed for water system information to be stored in complex mapping environments rather than simple computerized system blueprints. **Figure 9-2** presents and example of the detail to be found in the new modeling software. Unlike the earlier model that is limited to a simple wire frame model, the new software is capable of changing the way the system is projected as well as working with interactive background layers including street maps, satellite photos, and interactive parcel maps.

Figure 9-2 – 2016 Water System Model Example



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Plumbing Codes and Fire Codes have become more stringent, requiring less water per house on a daily basis yet requiring larger service lines to supply fire sprinklers. This chapter discusses the process of updating the water model, the key assumptions used in the model, and the results and recommendations resulting from the model update process.

9.2 Model Conversion and Update

Before the revised and refined water demand allocations and model validation were built into the system, the existing model required model platform conversion in order to work in the new software purchased from Innovyze.[2] Specifically, the new Innovyze software runs on top of an ArcGIS environment. The older software ran on top of an AutoCAD environment. This switch in base environment is necessary and logical because

[2] Innovyze was not the only software option for modeling the City's water system. The decision to go with Innovyze rather than another software vender for modeling software was due to a number of factors including consultant familiarity with the software, inverted compatibility of some files from the old model, and recommendations from neighboring agencies.

AutoCAD has shifted away from large infrastructure modeling and ArcGIS has become the industry standard in utilities modeling.

Raw data file conversion was an independent step required to run the new model. Consulting Staff with Innovyze assisted in executing the data files and platform conversions. There were no significant issues with the conversion and once compiled into the new software, additional analytical tools were available to troubleshoot the new City model. Following the software conversion, the new model was updated with additional information. Specifically, the model is using 2013 metered and measured flow data to represent the best available information for model execution.

9.2.1 Data Collection

The City's old H2ONET model (old model) was used as the base for planning future infrastructure upgrades. The old model had last been updated prior to the establishment of new City-wide planning demand numbers which significantly impacted the projected buildout demands.

The City and other City Consultants provided Tully & Young the following data for model update purposes:

- Old H2ONET-AutoCAD based model.
- Latest GIS database for comparison and use in updating the old model regarding infrastructure locations and corresponding elevations.
- City water system base maps showing water infrastructure on top of parcel maps and aerial photo layers. Where differences between the projected drawings and base maps were found, the City was consulted and location resolutions were finalized.
- SCADA screenshots for system pressures, flows, tank levels, and control valve settings for the key period of about a week in July 2013 when the peak system flow occurred.
- SCADA data and handwritten records as available.
- Valve Information.
- System hydraulic grade information.
- Storage Tank information.
- Well production information.
- Blueprints and as-builts of key infrastructure within the City's system.

9.2.2 Pipelines

Based on staff and consultant assessments, the pipes in the old model were compared to the field maps and GIS pipe layers. Any differences were noted and clarified with City staff, developers, and consultants. The new Innovyze software features displayed disconnected pipes and that resulted from the file conversion process. The pipes input into the new model contained lengths and diameters obtained from the old model. Since the old model was not spatially-referenced, all pipes were updated from the GIS database in order to give proper lengths and connections. While some existing pipes in the old model had material information, it was not always consistent with that listed in the GIS database. Spot checks in several identified areas in the City's water system are ongoing with City staff and should be completed in the near future.

Table 9-1 below shows the total length and counts of pipelines by diameter in both the 2013 Model and the build-out Model. The build-out model represents the pipe systems that would be necessary to meet the long-term City demands. The location of these pipes in the model represents a placeholder for pipe sizing in the future that may not be located in these exact locations. The 2013 model pipe locations are shown in **Figure 9-3** and the build-out model is shown in **Figure 9-4**.

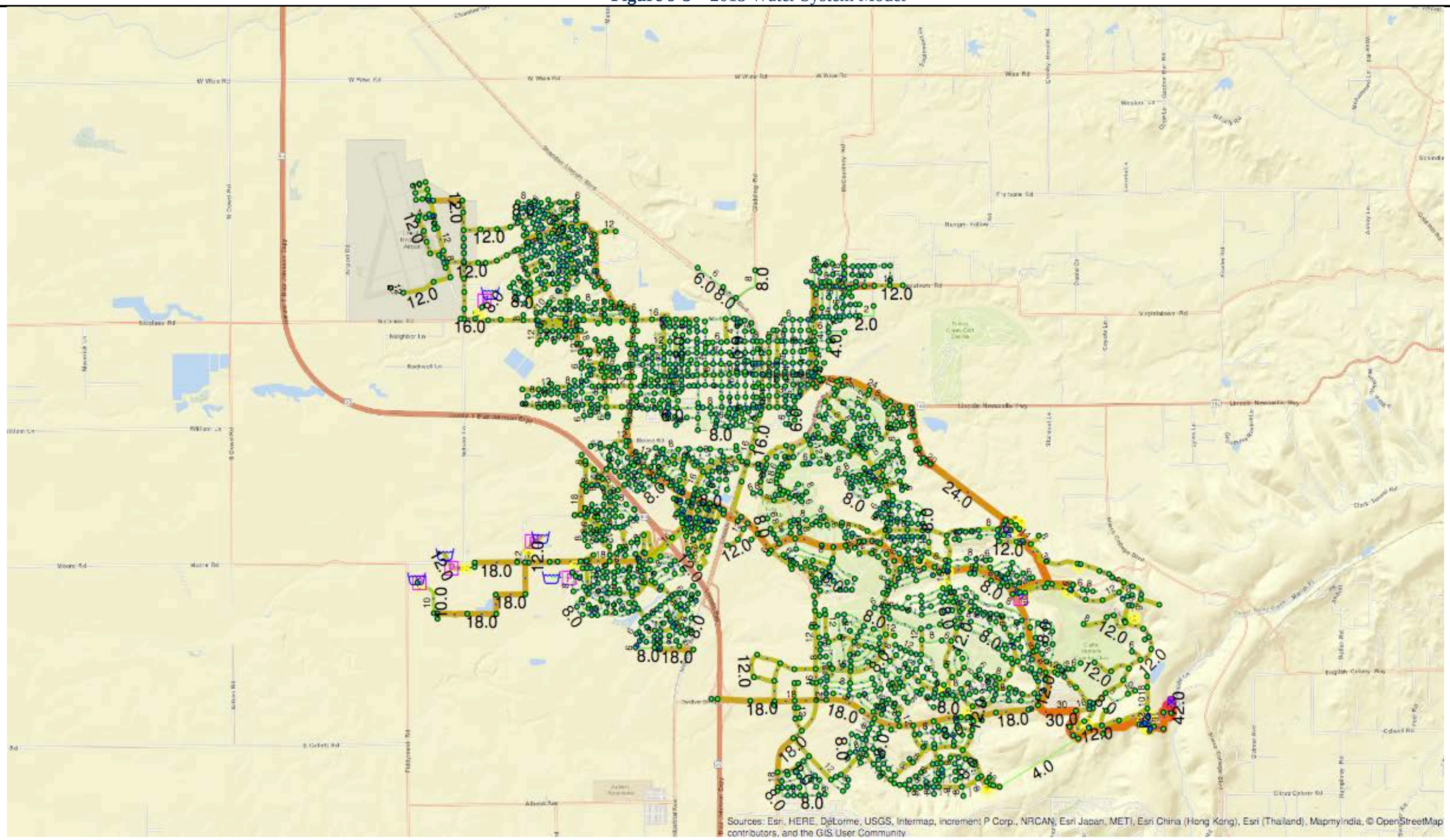
Table 9-1 – Summary of Pipe Data

	2013 Model		Buildout Model	
Pipe Diameter	Sum of Length (ft)	Number of Pipes	Sum of Length (ft)	Number of Pipes
2	2,884	6	2,884	6
3	374	1	374	1
4	33,686	73	29,541	72
6	72,410	223	72,410	223
8	517,230	1,279	515,826	1,277
10	14,734	47	15,031	42
12	360,298	785	603,731	881
14	9,968	33	10,063	34
16	48,664	89	63,131	93
18	72,375	117	227,696	172
24	50,898	83	72,717	89
30	11,909	23	24,938	21
36	458	2	9,535	4
Grand Total	1,195,889	2,761	1,647,877	2,915
	226	Miles	312	Miles

Both the old and new models use the Hazen-Williams head-loss equation for calculating head-loss in pipes and have assigned C factors ranging from 80 to 140.[3] The C factor is the coefficient used in the Hazen-Williams equation that is based on the material type and condition. However, considering that the values from the old model were calibrated and that the lower C values were more conservative and realistic, the values from the old model were used in the new model in most places except for where specific errors were identified. Newer sections of pipe were also checked for uncharacteristic low values and updated with realistic numbers. The C factors for added pipes were estimated using the C factor from adjacent pipes or from industry standards depending on likely age, material, and location within the City. These C factor values will be updated following future fire flow analysis and corresponding model calibration with the analysis.

[3] The Hazen-Williams equation is an empirical formula used to calculate the pressure drop in a pipe based on the physical properties of the pipe. The material and age of the pipe determine the roughness of the pipe and through the equation, how much energy is lost in the pipe due to friction and measured as a pressure drop.

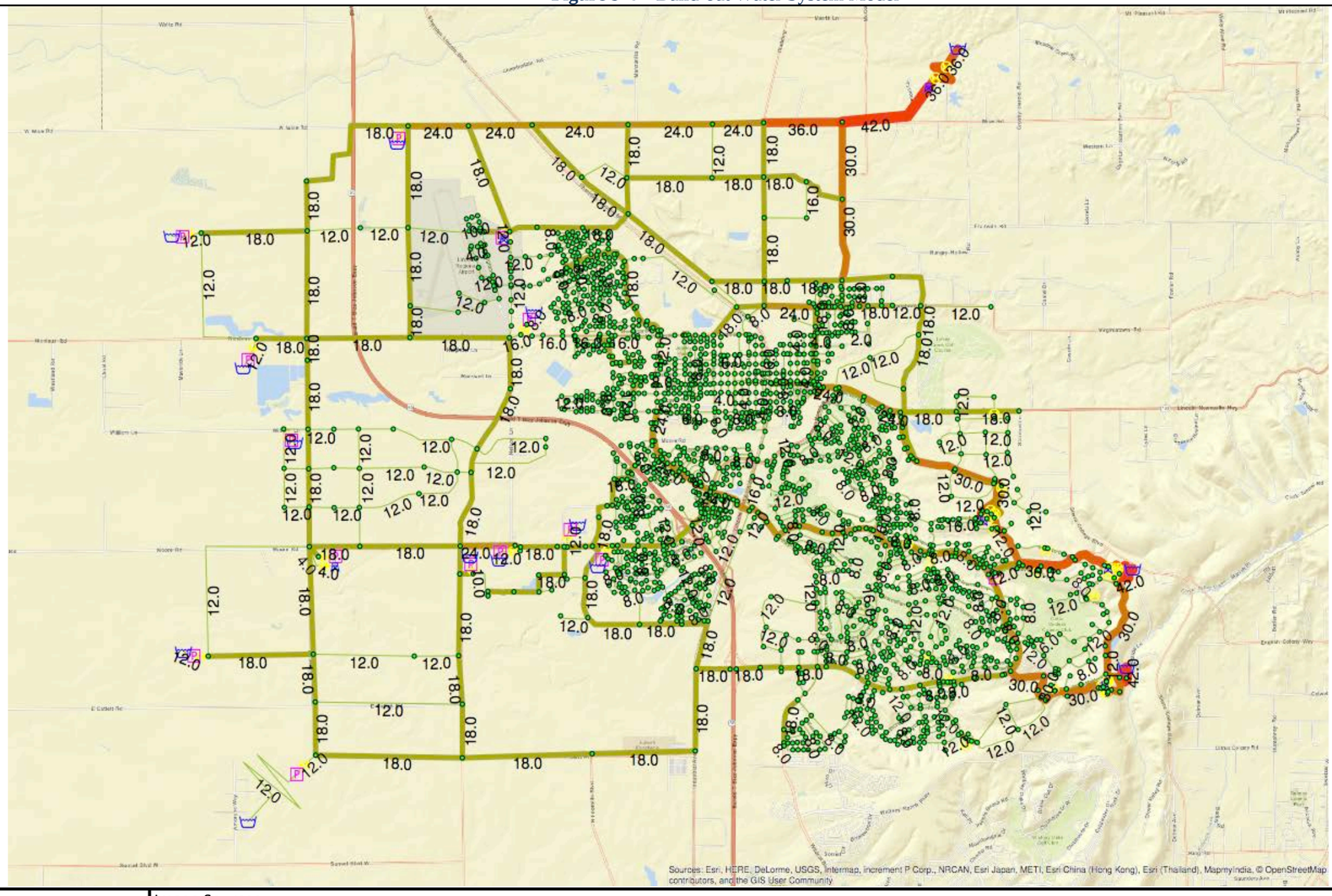
Figure 9-3 – 2013 Water System Model



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Figure 9-4 – Build-out Water System Model



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

9.2.3 Junctions

Junctions, also referred to as nodes, are located at the end of each pipeline segment in the model. Additional junction information, including approximate locations and elevations, was assigned manually in the model based on GIS data and staff observations. Elevation data was derived from multiple sources. The best available data was found to be 20-foot contour maps available from the Placer County GIS Clearing House online. Updated elevations were plotted for junctions and compared to the 20-foot contour maps, with corrections made as necessary. In areas with significant topography, USGS topographic maps were used as the default source for elevation data. Developed areas with significant grading were set using as-built maps where available and reasonable judgment after consultation with City Staff. These junctions relying on reasonable judgment and staff consultation have been noted for future confirmation and updating.

Additional elevation checks were necessary after new model expansions or changes due to new junctions defaulting under the model parameters to zero feet elevation. The pressure spikes caused by the zero feet elevations were easy to identify and correct in the model.

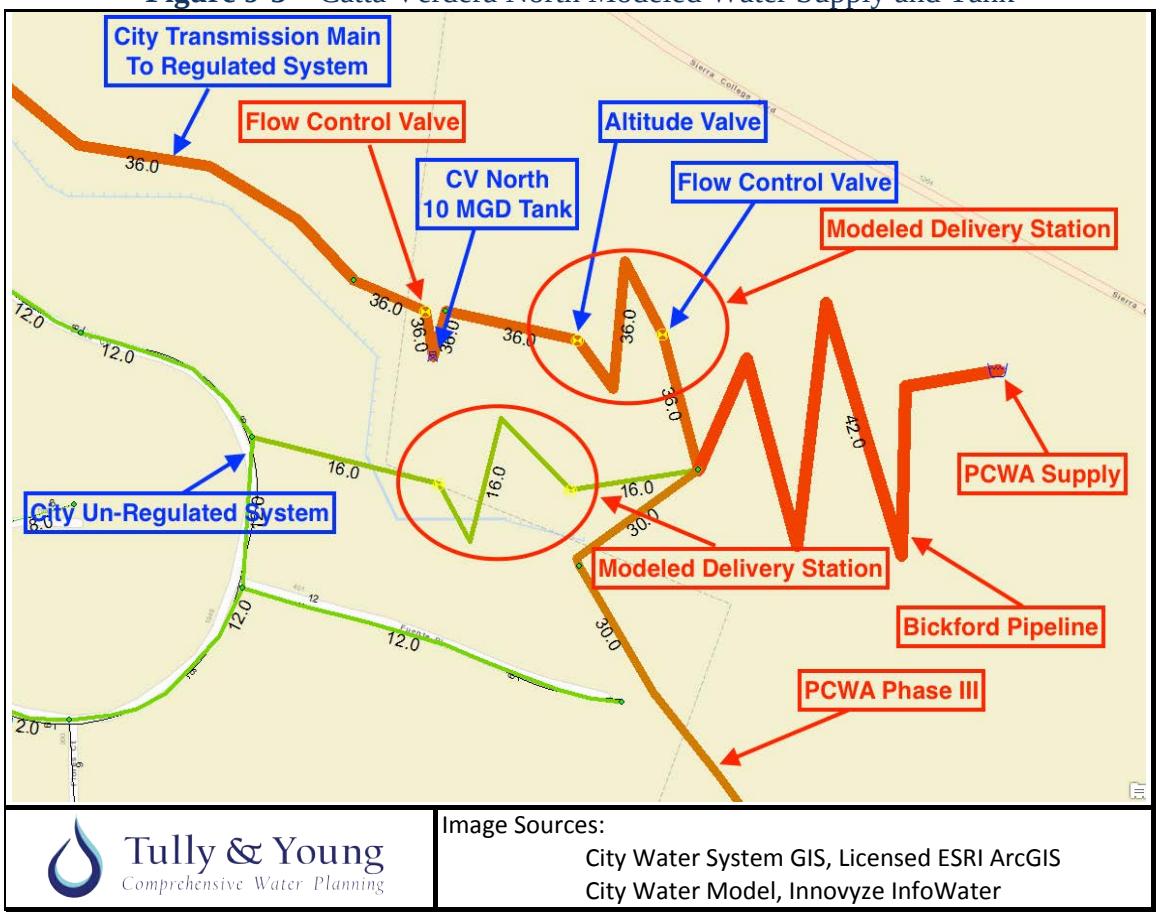
9.2.4 Tanks and Reservoirs

City Storage tanks and theoretical reservoirs related to the well configurations and the Placer County Water Agency (PCWA) treated surface supply were modeled as junction nodes in the old model. As part of the new model update, tank sites in the system were modeled as gravity tanks. The PCWA and Nevada Irrigation District (NID) water treatment plants (both existing and planned) for the treated surface water supplies were modeled as source points with fixed head. Tank elevation information was derived from the old model and checked against as-built schematics when available. **Table 9-2** shows tank elevations, operating levels, capacities, and dimensions necessary for the existing system model. **Figure 9-5** presents a modeled example of a water storage tank and a surface water supply source.

Table 9-2 – Summary of Tank Data

ID	Type	Elevation (ft)	Minimum Level (ft)	Maximum Level (ft)	Initial Level (ft)	Diameter (ft)	Minimum Volume (ft3)
T-4-CATTAVERDERAPT	0: Cylindrical	565	2	30	21	170	0
T-3-3MGHGL385	0: Cylindrical	365	2	30	23	127	62667
T-7-PCWAFOOTHILL (Imaginary tank for modeling purposes)	0: Cylindrical	755	10	55	30	175	0

Figure 9-5 – Catta Verdera North Modeled Water Supply and Tank



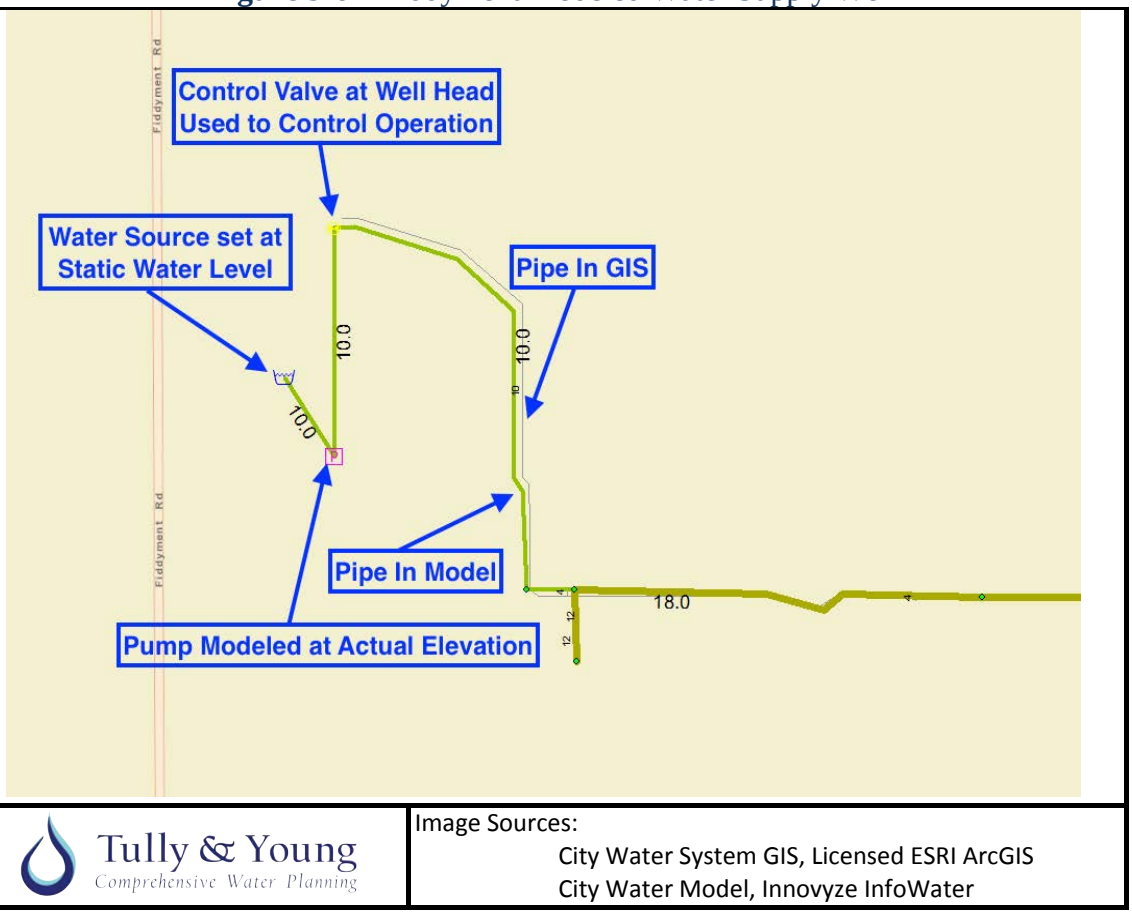
9.2.5 Pump Stations

Pump station locations, pump curves, and operational logic were developed based on information in the old model and additional available information. Pump controls were adjusted to meet necessary flows and the software was allowed to "self balance" these flows as necessary. This effort was performed because the majority of water demands are met from surface water and critical pipe infrastructure is related to these surface water connections. A summary of pumps and pump status needed for existing system model is shown in **Table 9-3**. **Figure 9-6** presents a modeled example of a well water supply source.

Table 9-3 – Summary of Pump Station Status

ID	Type	Elevation (ft)	Diameter (in)	Constant Power (hp)	Shutoff Head (ft)	Design Head (ft)	Design Flow (gpm)	High Head (ft)	High Flow (gpm)
WELL7-MOORERDPUMP	2: Exponential 3-Point Curve	120	12		310	240	1200	0	1500
WELL6-WSTWDWELLPUMP	2: Exponential 3-Point Curve	120	10	0	306	235	900	0	1100
WELL8-FIDDYMNTA-PUMP	2: Exponential 3-Point Curve	120	10	0	306.7	286	1400	0	1800
WELL2-PUMP	2: Exponential 3-Point Curve	120	10		310	230	800	0	1200
WELL9-NELSON-PUMP	2: Exponential 3-Point Curve	120	10	0	306	245	2100	0	2400
PMP-7006 (Catta Verdera Pump)	2: Exponential 3-Point Curve	320	12	300	400	360	2500	270	3000

Figure 9-6 – Fiddyment Modeled Water Supply Well



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

9.2.6 Valves

All valves were revised to match 2013 summer operations status. Inlet tank valves were set and adjusted to maintain the proper system inflow to match data from PCWA. PRVs located on Twelve Bridges Drive (south 18-inch transmission line) and on Stoneridge Drive (north 24-inch transmission line) were adjusted from summer 2013 numbers as necessary to balance flow conditions between the north and south transmission lines. The sensitivity in the system to changes in these PRVs allowed adjustments of 1 to 2 psi to make significant changes that would be within the level of accuracy of the recording data at each of these PRVs. For future operations, with additional demands and system infrastructure, it was assumed that these PRVs would be adjusted to necessary settings in the field so no set number was used in controlling them. Currently, typical system operation requires the adjustment of some PRV setting multiple times per year to keep flows balanced. For modeling, the team is focused upon the PRV setting in a peak flow period. The actual field setting will vary from time to time. **Figure 9-7** presents an example schematic of a PVR setup and **Figure 9-8** presents a modeled PRV.

Figure 9-7 – Example PRV Schematic

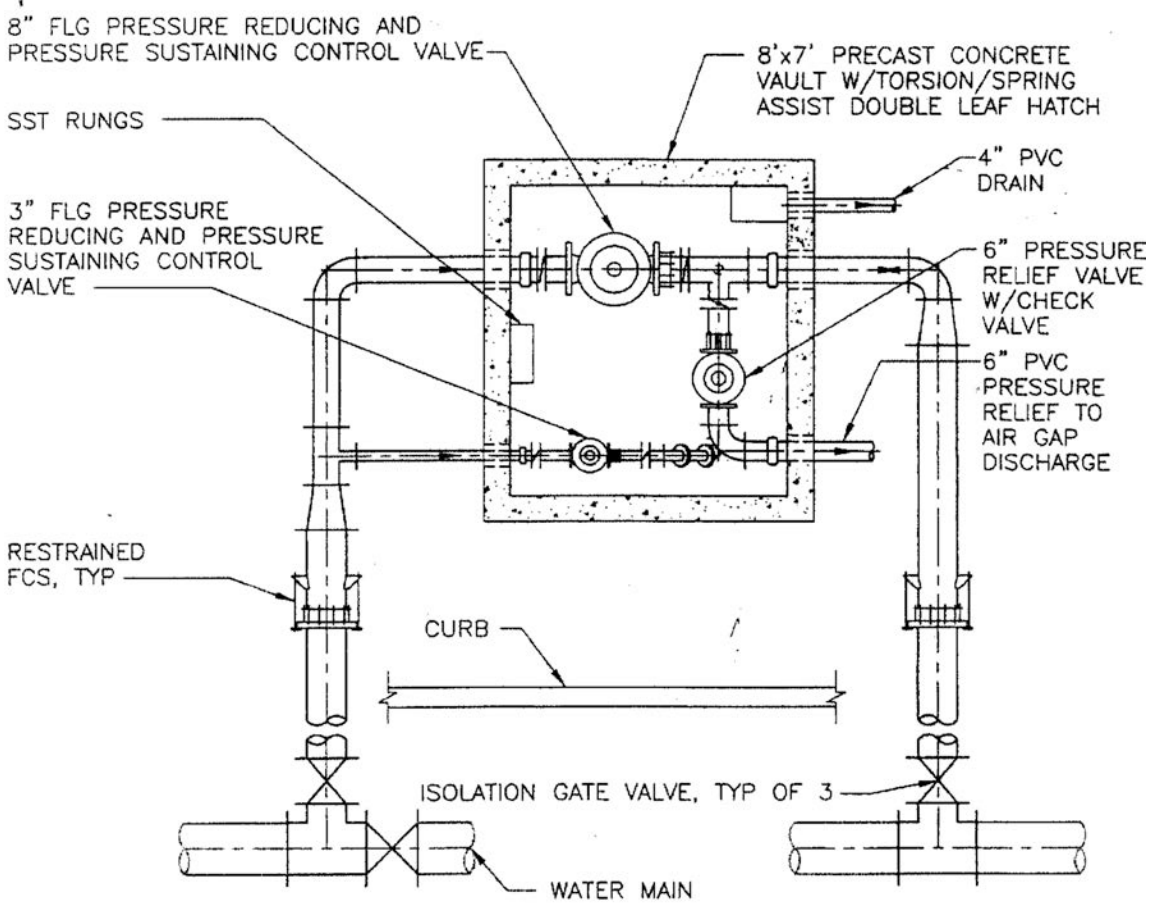
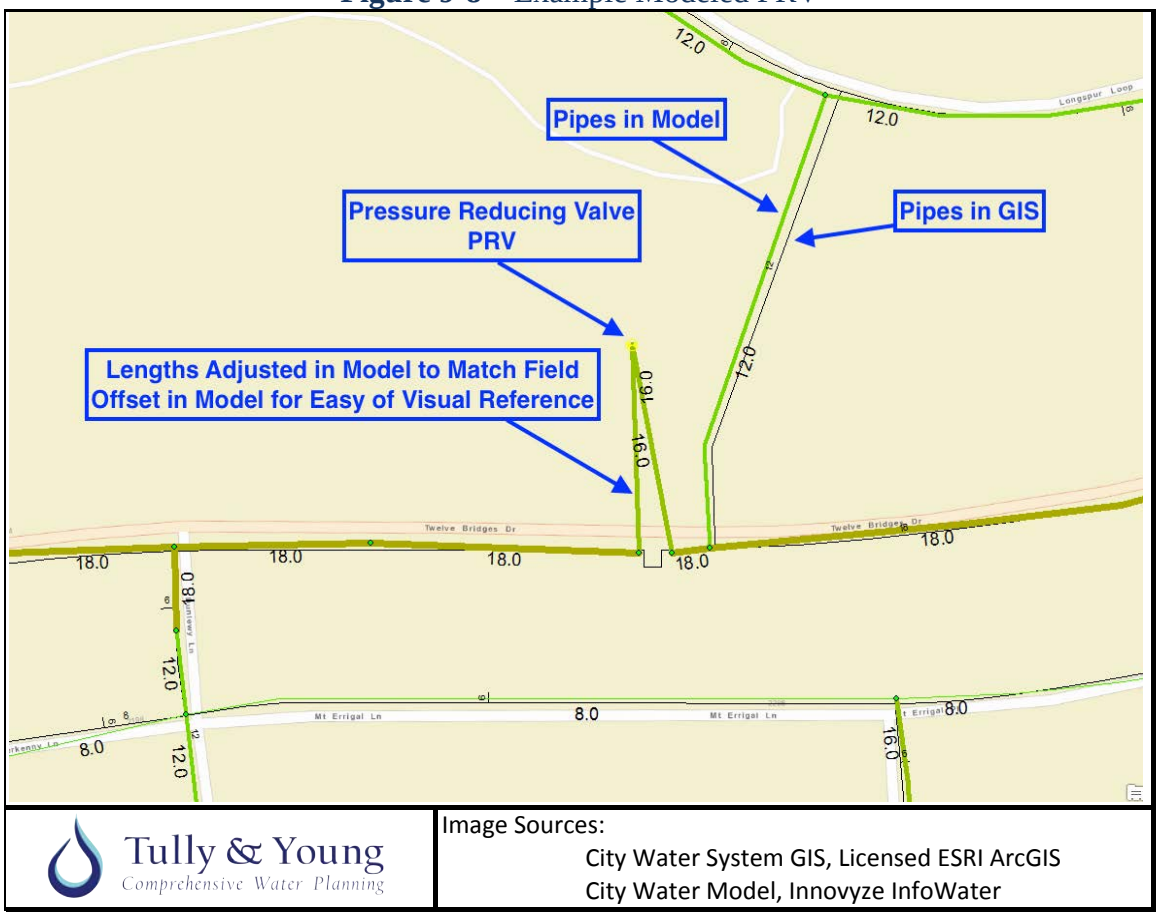


Figure 9-8 – Example Modeled PRV



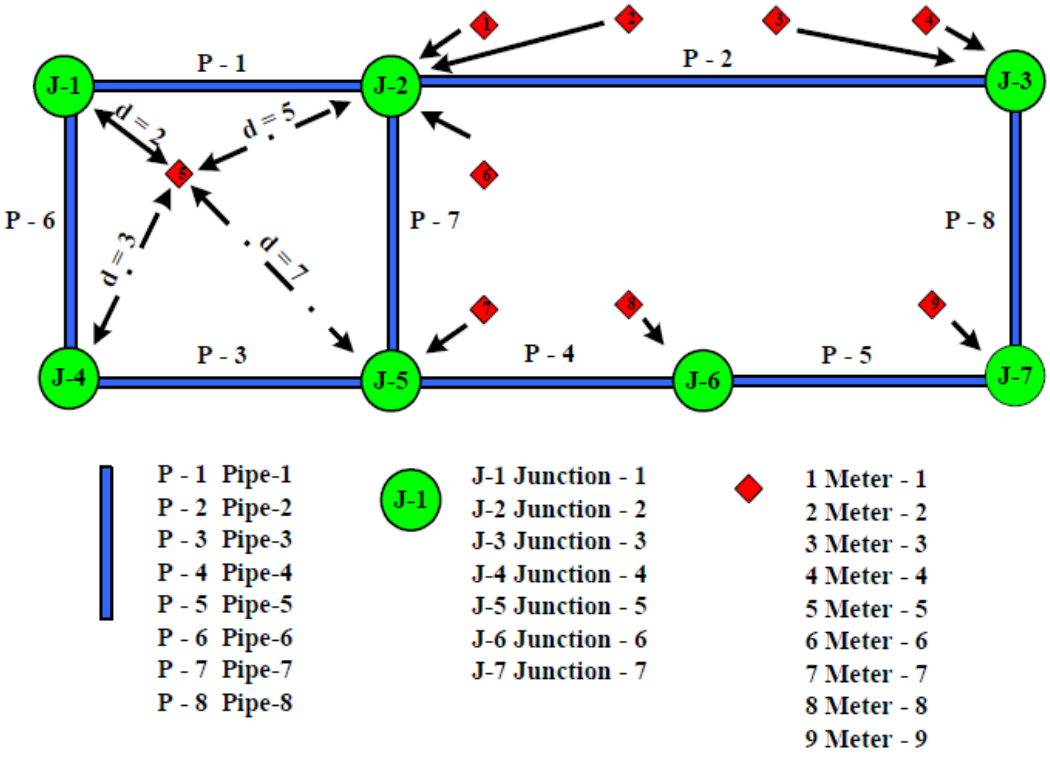
It should be noted that the PRV schematic presents a more complex system than what is represented in the model. This is simply because the valves in a PRV can only operate efficiently within a certain range of flows whereas a computer has no such limits. In reality, the PRV system has one smaller PRV for typical water use or nighttime flows and a parallel larger PRV for peak use time and fire flow needs.

9.3 Demand Allocation

Demand allocation was conducted based on 2013 meter data using tools built into the new Innovyze and underlying ArcGIS software. With the new software, demands are mapped using the address data in the City's meter database through a process called geo-coding. In this process the ArcGIS base software uses the internet to search for the meter's address (its location), much like someone would look up directions to a residential location, and then places a dot on the City map at that approximate location. Once this was complete for all 18,000+ City water meters, the meter demand is assigned to the nearest junction in the new model through the Innovyze software. **Figure 9-9** shows the meter to node assignment as performed by the Innovyze software. A few

hundred City meter addresses were found to be without results and were adjusted as necessary, or eliminated if deemed insignificant. Note that of the 18,000+ City water meters available in the 2013 data file, less than 2% were eliminated.

Figure 9-9 – Innovyze Meter Assignment



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Image Sources:
Innovyze Meter Allocation Guide

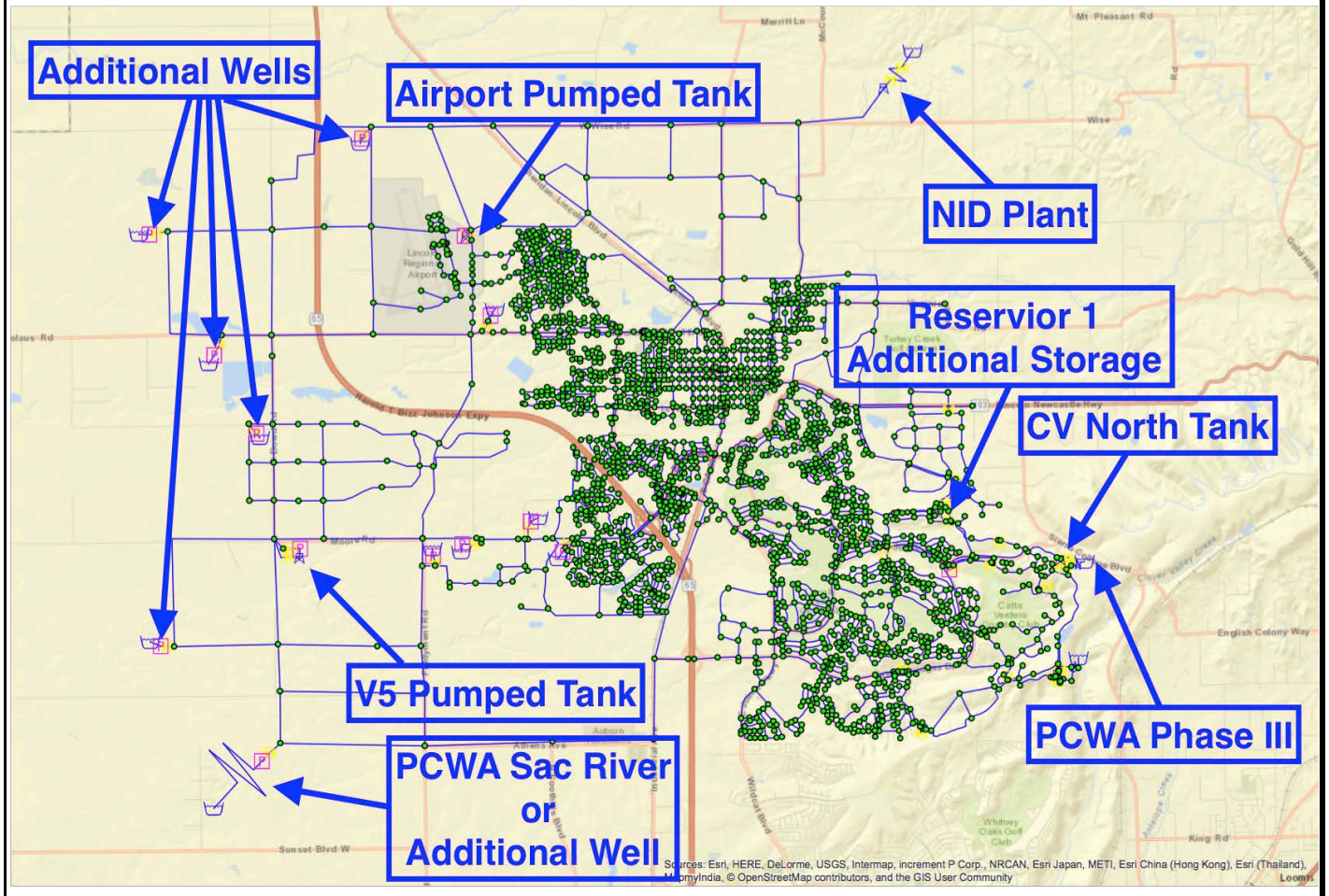
9.3.1 Selection of Supply and Infrastructure Scenarios

Over the course of eight City Council Workshops, information was presented with staff to assist the Lincoln City Council to formally give direction on desired future goals for the City's short and long-term water supplies. Since the previous 2008 General Plan, the projected build-out maximum day demand for potable water has been reduced from about 118 Million Gallons per Day (MGD) down to 67 MGD. This demand reduction is driven primarily by the reduction in projected per acre and per dwelling unit demands as discussed in detail in **Chapter 4**.[4] By substituting potential raw and reclaimed supplies

[4] The demand factors used in the 2008 General Plan were based on meter records from the late 1980s which were prior to the efficient plumbing codes of the early 1990s or later landscape and water efficient codes.

for potable supplies, the total potable demand could be further reduced to a maximum day demand of 47 MGD. As a conservative approach, a maximum day of 57 MGD potable demand was chosen by the City Council as the target build-out demand for future modeling and Public Facilities Element planning. Additional discussions were conducted and a City Council decision was made to plan on treated surface supplies from the two existing PCWA connections at the 5 million gallon Catta Verdera South Tank site and through two future PCWA connections at the former City Pond site now known as Catta Verdera North, and a future connection from the proposed NID regional water treatment plant and pipeline near McCourtney and Wise Roads. **Figure 9-10** shows the future water supply sources as used in various water supply scenarios.

Figure 9-10 – Future Modeled Water Supplies



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

During the course of the eight workshops, a number of explanatory model runs were completed to check if individual supply and piping scenarios would be viable. Since the workshop in December 2015, updates and corrections have been completed to the model scenarios, with focus concentrated on a few scenarios and additional model runs relevant to long-term planning have been undertaken at the request of engineering staff. The bullet list below summarizes the model scenarios completed and saved, including those superseded and abandoned, and those updated to continue further analyses as requested. This list is not meant to be exhaustive and will be modified with additional inputs or requested changes in the future.

Early Model Runs:

- 2013 Model A – Used for initial calibration, superseded and abandoned
- 2013 Model B – Used for initial calibration, superseded and abandoned
- 67 MGD build-out – Used to check sources and main infrastructure, superseded and abandoned
- 67 MGD build-out – Version with PCWA only, superseded and abandoned
- 67 MGD build-out – Version with NID only, superseded and abandoned
- 47 MGD build-out – Used to minimize infrastructure, superseded and abandoned

Primary Model Runs in use:

- 57 MGD build-out – Updated and in use, primary model for long term planning decisions
- Existing City with Phase III – Updated and in use, primary model for near term planning decisions

Temporary Planning and Engineering Model Runs[5]:

- Existing City with Phase III, V1, and Village 5 Phase 1 – Completed and key results recorded, to be abandoned

[5] The details of these model runs will be summarized in an engineering memo for later use by City Staff. The results of these runs were used in the planning for build-out as presented in this document.

- Existing City with Phase III, V1, V5 – Completed and key results recorded, to be abandoned
- Existing City with Phase III, V1, V5 and V7 – Completed and key results recorded, to be abandoned
- Existing City with Phase III, V1, and Max V5 without V7 intertie – Completed and key results recorded, to be abandoned
- Model run for City Engineering Staff, build-out emergency with NID treatment offline – Completed and key results recorded, to be abandoned
- Model run for City Engineering Staff, build-out emergency with PCWA treatment severely impacted – Completed and key results recorded, to be abandoned
- Model run for City Engineering Staff, near build-out with NID treatment online before Villages 2 and 3 have built, single NID delivery line on McCourtney Rd. – Completed and key results recorded, to be abandoned
- Model run for City Engineering Staff, capacity for build-out of west side without Village 2 and Village 3 east to west transmission mains – Completed and key results recorded, to be abandoned
- Model run for City Engineering Staff, capacity for build-out with existing system and Phase III – Completed and key results recorded, to be abandoned
- 2016 Fireflow Calibration Model – In development, early results used to verify model accuracy, final results to update BO and Existing Models, to be abandoned

9.3.2 Peaking Factors

Industry standard peaking factors for potable water use in similar sized systems in the region use a 2.5 to 1.0 ratio for the maximum day of a year to the average day of the same year (max day to average day ratio, or max day demand factor) and a 1.6 to 1.0 ratio for the peak hour of the maximum day of the year to the maximum day of the same year (peak hour to max day ratio, or peak hour demand factor). Before redeveloping the model, City Staff and consultants surveyed neighboring agencies and assess relevant reference materials to establish appropriate factors to be considered in the modeling efforts. The previous modeling information prepared in 2010 has a table, **Table 9-4** below, tracking the max day to average day ratio. As can be seen in **Table 9-4**, the trend of this max day to average day ratio since 2004 has been about 2.0. The 2013 City meter data is consistent with 2.0 to 1.0 ratio of max day to average day.

Table 9-4 – Maximum Day to Average Day Demand Factors

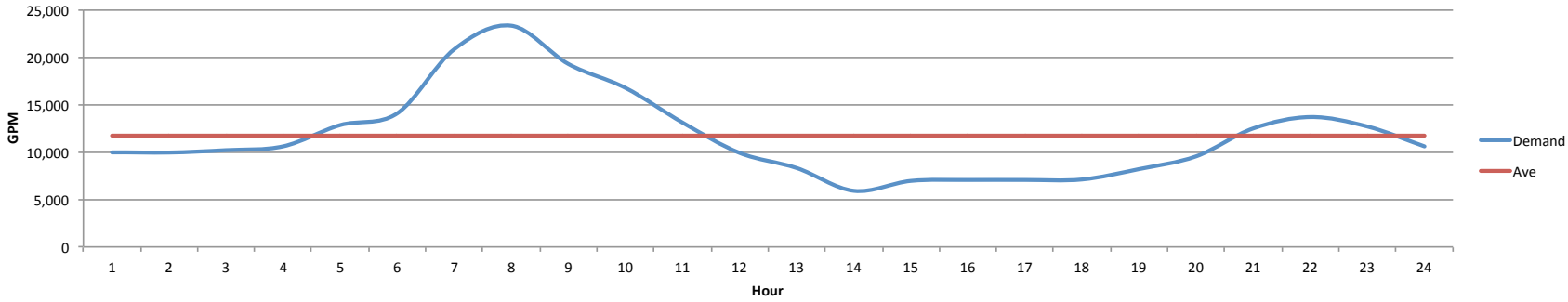
Table Vil1-5
City Historical Municipal Water Deliveries & Demand Factors
per
City of Lincoln California Department of Health Services Annual Report Data
1996 - 2009

Year	Estimated Population	# of Services	Annual Potable Surface Water Delivered by PCWA* (AFY)	Max Day Potable Surface Water Delivered (MGD)	Annual Ground Water Delivered (AFY)	Total Annual Potable Water Delivered (AFY)	Average Daily Potable Water Delivered (MGD)	Max Day Ground Water Delivered (MGD)	Max Day Demand Surface & Ground Water (MGD)	Max Day to Ave Day Ratio	Ground water to Total Annual **	Increase in Potable Demand from Prior Year
1996	8,500	2,536	1,338	3.1	516	1,853	1.7	0.9	4.0	2.4	28%	
1997	8,500	2,602	1,678	3.2	484	2,162	1.9	1.1	4.3	2.2	22%	17%
1998	8,600	2,933	1,421	3.2	433	1,854	1.7	0.9	4.1	2.5	23%	-14%
1999	7,224	2,408	1,783	3.8	469	2,252	2.0	0.9	4.7	2.3	21%	21%
2000	12,500	5,035	2,041	3.6	569	2,610	2.3	1.2	4.8	2.1	22%	16%
2001	14,510	6,413	3,326	5.1	408	3,734	3.3	2.1	7.2	2.2	11%	43%
2002	20,141	7,619	4,063	6.7	713	4,776	4.3	1.4	8.1	1.9	15%	28%
2003	26,000	9,767	4,845	8.8	543	5,388	4.8	1.9	10.7	2.2	10%	13%
2004	27,000	11,794	7,243	11.5	298	7,541	6.7	2.0	13.5	2.0	4%	40%
2005	33,513	13,681	7,828	12.9	515	8,343	7.4	2.0	14.9	2.0	6%	11%
2006	36,277	15,541	8,780	14.3	1,789	10,569	9.4	1.4	15.7	1.7	17%	27%
2007	37,000	16,238	9,017	14.7	924	9,941	8.9	1.3	16.0	1.8	9%	-6%
2008	37,000	16,483	9,097	14.3	1,084	10,181	9.1	1.3	15.6	1.7	11%	2%
2009	40,157	16,584	8,851	14.3	837	9,688	8.6	2.7	17.0	2.0	9%	-5%
						Average Annual Values	1996-2009			2.1	15%	
							2005-2009			1.8	10%	

For the peak hour to max day ratio, it was noted as early as 2009 that this ratio was increasing from the old, estimated 1.6 multiplier. For this 2016 modeling effort, data was collected from 2013 SCADA data by City staff to verify the peak hour demand factor. **Figure 9-11** below presents the hourly cycle of demand within the City on the maximum day of demand, July 8, 2013. The 2013 data is being used due to drought-related restrictions on potable water use in the state. The drought related conditions in Lincoln render similar data for 2014 and 2015 moot. The hourly data that establishes the curve in **Figure 9-11** is what allows for running the model demands on an hourly demand basis for the twenty-four hours of the maximum day (extended period modeling), as well as identifying the peak hour demand factor.

Figure 9-11 – Max Day Hourly Analysis

Hour	1:00	2:00	3:00	4:00	5:00	6:00	7:00	**8:00**	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
Demand	10,000	9,950	10,200	10,600	12,850	14,090	20,870	23,350	19,300	16,775	13,110	9,910	8,310	5,900	6,950	7,050	7,050	7,100	8,200	9,550	12,500	13,700	12,700	10,600
Ave	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692
Ratio	0.855	0.851	0.872	0.907	1.099	1.205	1.785	**1.997**	1.651	1.435	1.121	0.848	0.711	0.505	0.594	0.603	0.603	0.607	0.701	0.817	1.069	1.172	1.086	0.907



9.4 Model Validation

In order for the model to run correctly and provide accurate results, the model must be validated. The model was validated by using system conditions from the old 2010 model and 2010 field fire flow results. Additional 2016 fire flow results are being assessed in the model but were not incorporated at the time of this drafting. The City's previous model was prepared in 2010-2011 to derive some early infrastructure sizing estimates for the Village 1 development. Since then only minor changes have occurred within the City for new pipes and minor changes were made in the operations of Pressure Reducing Valves (PRVs), tanks, and wells. With over 200 miles of and nearly 3,000 sections of pipe in the model, differences were expected due to base environment conversion. Two versions were created in 2015, referred to as 2013 Model A and 2013 Model B, based on the year of the demand data and system configuration. These initial models have been superseded as discussed in **Section 3.2.1**. **Table 9-5** presents a comparison across models for the selected hydrant locations.

Table 9-5 – Fire Flow Comparison Table

	Field Tests		2010 Model	2010 Model	2010 Model
Junction	Measured Flow	Measured Pressure	2010 Pressure	2013 Upgrade A	2013 Upgrade B
J-5374	915	95	90.4	98.6	105.9
J-5395	1280	96	82.1	90.8	98.1
J-5429	990	96	86.9	87.7	105.3
J-5193	1280	92	76.6	95.1	103.5
J-5203	990	89	88.8	105.3	113.7
J-5454	1338	99	93.4	101.9	109.5
J-5257	959	85	78.7	89.8	98.4
J-5493	1091	95	77.7	87.1	94.3
J-DW-1682	915	54	55.3	47.2	56.5
J-5069	1021	75	65.3	93.9	102.5
J-212	1289	105	103.0	113.4	120.1

2013 Upgrade A - Changed a few demand and pump curves, 2010 Calibration Day demand
2013 Upgrade B - Upgrade A + significant elevation adjustments, 2010 Calibration Day demand
2013 Model A- Updated piping, pump & valve set points, 2010 Calibration Day demand
2013 Model B - Updated piping, pump & valve set points, 2013 Ave Day demand

The 2010 Model had pressures an average of 8% lower than measured in the field. With Upgrade A, the average was 3% higher than measured but there was variability both higher and lower and the absolute error being 9%. The 2013 Upgrade B resulted in an average of 13% higher than measured flows but with improved consistency than 2013 Upgrade A. To account for this higher flow result, a fire flow limit above the state mandate is used when sizing City infrastructure.

Once the 2013 Upgrade B model was calibrated to the best available data, it was used as the basis for all subsequent model scenarios. Drought-related restrictions were minimal in 2016 so the City completed fire flow testing in August of 2016. The newest pipe information available has been included in a new 2016 Calibration Model.

The locations of desired fireflow test results were provided to staff for discussion. Staff concluded that it was appropriate to conduct fireflow testing at a number of the locations including all locations used for the 2013 Model Calibration. Some locations were not tested due to know pipe issues and risks of breakage. The results of the fireflow analysis were compared to the latest pipe system with calibration data from the 2013 Update Model with the results presented in **Table 9-6**.

Table 9-6 – 2016 Calibration Table

	2016 Field Tests		2016 Model in
Junction	Measured Flow	Measured Pressure	Use Pressure
J-5374	944	95	94.4
J-5395	1269	96	95.2
J-5429	1026	96	95.5
J-5193	1269	92	100.7
J-5203	1026	89	100.6
J-5454	1310	99	94.7
J-5257	1000	85	85.3
J-5493	1121	95	90.8
J-DW-1682	944	60	56.9
J-5069	1182	82	76.1
J-212	1253	107	99.7

The 2016 Model in use was found to be much more accurate than the previous calibration runs. Average pressures were found to be only 1% lower than field measured pressures. Individual error was generally around 5% with one hydrant pressure being 13% over actual. Additional fireflow tests were conducted in other locations throughout the City. The results of this testing show that newer parts of the City are generally better modeled than older areas. This is consistent with known details about the system and the condition of GIS records.

The results of this 2016 fireflow testing support the results developed out of the buildout and current models. Results concerning legacy areas of town including the downtown area are subject to more error however the modeled results are still useful for planning and engineering decisions. Field testing is risky in older pipes and breakage as a result of testing would be expensive. By modeling the old areas of town and applying a conservative safety factor usable numbers can be generated.

As the large FRP projects in the old parts of the system are completed it will be necessary to preform ongoing checks of the model to verify the impacts of pipe replacement actions. As the 2016 fireflow testing established a high level of accuracy for the current model, these checks need only be preformed every few years. The model still has minor correction and sizing errors that will be caught as part of ongoing reviews and edits which will likely improve the model accuracy further.

9.5 Model Limits, Operational Standards, and Future Infrastructure Design Criteria for Model

In the production of the system water model, some basic limits and rules must be followed. System Operational Standards relate to the conditions and limits in system operations including pressures, pipe velocities, tank operations, PRV settings, maximum day exceptions, and well operation. System Design Standards or City design criteria relates to a number of details used in the design of the City's potable water system including minimum pipe sizes, looping of mains, tank sizing, well redundancy, and pipe materials. The pertinent details of these items are presented in the sections described below. For the City of Lincoln these come from City policies set in the Design Criteria & Procedures Manual from June 2004, additional industry standard engineering assumptions, and practical field operations. The City's design criteria that are presented in this chapter include applicable current regulatory and engineering standards references as follows: SWRCB-Division of Drinking Water (DDW) standards, Uniform Fire Code, and American Water Works Association (AWWA) standards. Other non-policy and standards based operations determined in the field by operations staff are still a necessary part of the operations standards for modeling purposes. This section presents these limits, operational settings, rules and assumptions, as well as provides the reasoning for their inclusion in existing and future City policy where appropriate.

9.5.1 Pipes

Pipe sizing is determined by the operational criteria, follows fire code requirements, and complies with some general engineering standards related to minimum sizing. For instance, no mains are sized smaller than 8-inch and no looped mains are smaller than 12 inches.

Pipe materials, standard sizes, and roughness calculations for new pipe shall comply with the following table.

Table 9-7 – Pipeline Criteria

Pipeline Criteria (as applied to Computer modeling)	
Hazen-William roughness coefficient for pipes less than 16 inches in diameter	120-130
Hazen-William roughness coefficient for pipes 16 inches in diameter and larger	140
Approved Pipe Materials	Ductile Iron Pipe, PVC, Motar-lined Steel Pipe
Approved Pipe Sizes in Inches Diameter	8, 12, 16, 18, 24, 30, 36, 42, 48

The purpose of these rules is to maintain the performance of the water system in peak demand situations that include operational water, fire flow, and emergency needs. The 12-inch looped mains provide significantly better total water transmission capacity in the event of a fire and provide redundancy in the event of a pipe failure. On non-looped sections of main, an 8" line provides adequate supply for fire hydrants so long as the pipe is not too long.[6] Pipe materials listed are the current industry standard and are selected based on a balance of cost, operational performance, and longevity.

9.5.2 Storage

Storage Reservoirs (Tanks) shall be sized to provide 50% of average day capacity, plus fireflow storage, as well as an emergency storage volume while leaving 10% of average day minimum head space. Fireflow storage shall be defined as the water needed to serve the largest fireflow and duration as defined by the California Fire Code. Emergency storage shall be defined as 24 hours water for every resident at California Health and Safety minimums, currently 55 gallons per day per person. Head space in the storage tanks shall be defined as the unused capacity on a maximum day.

This tank sizing differs from previous City design standards for the purpose of complying with modern industry standards. This sizing criteria differs from that presently defined in the City General Plan documents, and is more conservative – meaning it meets industry baselines. This conservative sizing also allows the City a buffer time to bring other supplies online in the event of an emergency. Head space is required in the tanks due to the need to accommodate the fluctuating City demands and the operation of and distance from source water PCWA treatment plants. Previous tank sizing standards did not expressly identify then need or operational impacts of head space.

9.5.3 Wells

Well criteria set in this section does not account for the impacts of new groundwater regulation and agreements within the western placer groundwater basin. Future City wells shall have a production capacity of at least 1 mgd (1,400 gpm for 12 hours of operation per day). Total well pumping capacity was historically equal to 75% of

[6] A proposed limit of 2,000ft foot for non-looped mains has been presented in the standards recommendations at the end of this chapter.

average day demand. This pumping capacity may be modified when multiple surface water sources and delivery systems are available to the City. Wells shall be operational during maximum day demands with 1 well offline as backup for every 3 in operation. Total annual production target is limited to 10% of average annual total of treated surface water deliveries and groundwater production. The average annual production total is based upon a 10 year running average.

These criteria serve the purpose of creating a reliable potable water supply for the City of Lincoln. The benefits of this type of conjunctive use program were seen in 2011 with the Bear River Canal outage. The City was able to rely on water stored in the aquifer to augment reduced PCWA deliveries to the City until the PCWA supplies were back online, minimizing impacts to City customers. The utility of the conjunctive use system also avoided lasting impacts to the underlying aquifer.

9.5.4 Demand Multipliers

Demand multipliers are monitored and updated as system operations change. Currently the average day of the year to maximum day for the same year multiplier is 2.0. Currently the peak hour of the maximum day to the maximum day multiplier is 2.0. This represents a shift in the proportions of the multipliers since the early 1990s (2.5 and 1.6 respectively). This follows the documented trend from meter records of reducing the maximum day multiplier and increasing the peak hour multiplier and is consistent with trends seen by other water purveyors in the region.

Current multipliers are as follows:

- Max Day Demand (MDD) = Average Day Demand (ADD) x 2
- Peak Hour Demand (PHD) = MDD x 2

9.5.5 System Pressures

Normal System pressures shall be operated between 50 and 130 psi. Minimum pressures during peak hour of maximum day shall not drop to 40 psi. Minimum pressure during a maximum day fire flow event is 20 psi. (Note that the current water model is using 25 psi (minimum residual pressure during fire flow as a conservative buffer until normal year fire flow calibrations can be performed). These pressures are within the limits of current regulatory and industry standards.

9.5.6 Pipe Velocities

Pipes are designed and operated so velocities are maintained below 7 ft/sec during maximum day demands. Maximum day fire flows may allow for 10 ft/sec in key

delivery pipes. Maximum day peak hour flows shall be allowed to exceed the 7ft/sec limit so long as the hour before and the hour after do not exceed the 7 ft/sec limit and the single peak hour does not exceed 10 ft/sec.

These pipe velocities are in line with industry standards and balance the cost of pipe upsizing with longevity, while maintaining acceptable minimum system pressures and related piping head losses. Some local agencies use lower valves for maximum velocity standards but the City of Lincoln lacks the extreme elevation changes or rugged conditions to necessitate lower limits.

9.5.7 Tank Operations

Tank operations are gravity fed except where future pumped storage is planned. Tank levels are managed as operations staff deems necessary. Tanks should not drop below emergency and fire flow storage levels during maximum day use. As operational limits are observed, additional storage should be constructed to maintain storage levels and system security prior to new demands coming online.

9.5.8 PRV Settings

Pressure Reducing Valves (PRV) settings at City PRV stations maintain pressure and flow from; 1) the higher storage tanks in the Catta Verdera area to the remainder of the system, and 2) higher pressure zones to lower zones. PRV setting adjustments are at the discretion of operations staff to provide the best possible service to customers. These settings are adjusted in the field seasonally and for varying operational conditions. System designs shall not rely on frequent field PRV setting adjustments or regular remote adjustments through SCADA for proper maximum day operation.

9.5.9 Well Operations

Seasonally, in order to maximize the benefit of City wells and minimize PCWA contract limit increases, the City production wells shall be operated as much as possible in peak months and minimized on shoulder months around the peak months. Daily well operations for the model have been assumed to be no more than 12 hours per day. Based on City experience, this goal for normal operation reduces potential for stress on the aquifer, mechanical equipment, and effects on nearby private wells. This seasonal goal will result in real savings in terms of contract and surface water treatment plants capacity needs, with the added benefit of regular utilization of backup supply infrastructure.

9.5.10 Extended Period Model Operation

Previous City water models only represented an instantaneous look at the water system

performance. This representation was mainly due to insufficient data to accurately represent dynamic system performance. Although the scope of work for this study called for a modeling of 24-hour periods related to the average day and maximum day, the models developed utilize data that allows modeling the system for up to 60 hours. The purpose for simulating the longer period is to be able to graphically illustrate the abilities of well operation to help maintain tank storage levels with fixed delivery rates from PCWA and NID source supplies. This longer model time allows for the verification that the system is balanced and not just operating on stored water.

9.5.11 California Fire Code Requirements

The State of California Fire Code includes more detail since the last model update. The Fire Code is updated every three years. The City's current water model, as required by law, followed the design and operational criteria set in the most recent version of the California Fire Code available at the time of development, dated 2013. When a revised Fire Code was adopted for 2016, all applicable design standard changes were recognized. As new codes are adopted the model will continue to be updated where necessary.

With new residences having fire sprinkler requirements, some fire hydrant flow code requirements have potentially been reduced. However, in practice of development design, hydrant flows still require analysis in residential as well as non-residential areas. This analysis is due to mixed use along the pipeline routes and new fire sprinkler flow requirements that increase with home square footage. Some larger homes may have fire sprinkler flow requirements similar to commercial buildings.

City fire flow testing (for system model calibration) was postponed until August of 2016 due to reduced maximum day demand on the water system during the peak usage months in 2014 and 2015 largely due to drought restrictions. The results of the 2016 fireflow testing only served to verify the accuracy of the model. As a result, the model serves as a tool for the City engineering staff to use to identify areas of deficient fireflow capacity. Some older areas of the City are served by aged pipes that as undersized for modern fireflow requirements. These areas have been identified for replacement as part of the City's FRP program. **Chapter 10** of this document provides more details on the individual FRP projects including some that are already underway.

9.5.12 Improved Security

This section is discusses the impact of the input assumptions and policy goals on the water model and on the City water system as a whole.

Many of the details in this section are carried from previous City standards but some received key changes that will result in significant changes in the future water system.

Details on the policy and standards changes can be found in **Section 9.8.6**. By increasing the tank size requirements, the City will create more emergency storage and will give City staff additional flexibility in system operations in order to conduct much needed maintenance and repairs. Pipe looping requirements serve to improve the redundancy within the system and ensure fire protection is not restricted by a single pipe outage or closed valve.

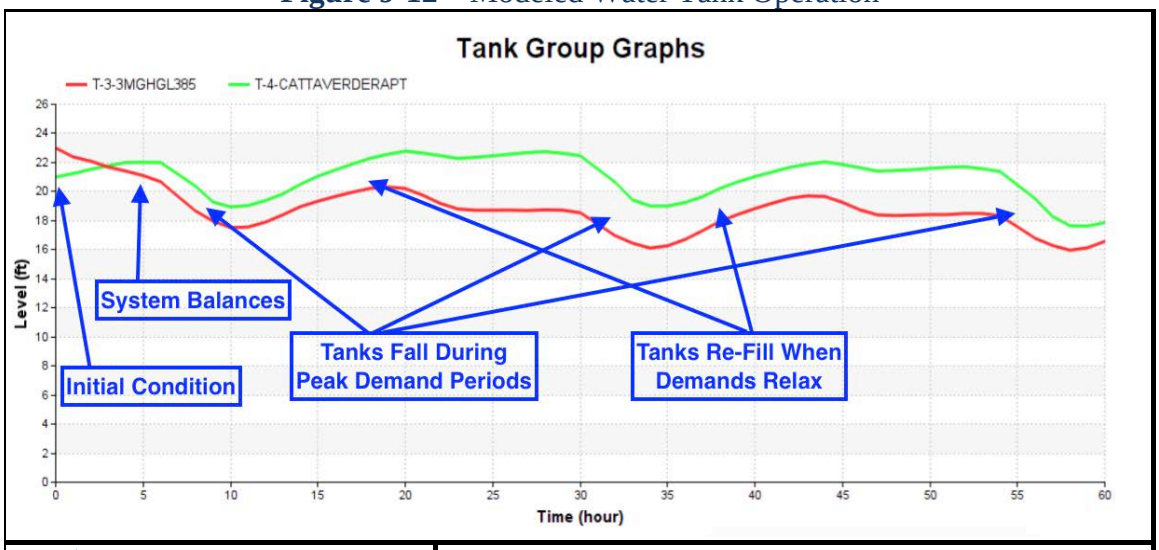
9.6 Modeled System Evaluation Criteria

The system evaluation criteria were based on Lincoln design criteria taken from the adopted City standards and recommended standards presented and agreed upon by staff. In order to ensure compliance with the policies and standards, some more conservative limits were used in the model to analyze system operations. The following criteria are used to assess the system capacity:[7]

- Source Water Balance. A source (i.e., WTP) is deficient if the water demand exceeds the source capacity.
- Tank Water Balance. A tank is deficient if the outflow is greater than the inflow (i.e., a negative water balance) or tank levels decline significantly in extended period modeling. **Figure 9-12** presents an example of water tanks cycling in an EPS model.
- Velocity. The transmission pipelines are flagged if the velocity exceeds 10 feet per second (fps) during peak hour demand, or for fireflows during max day demand, and 7fps on Max Day.
- Pressure. Junction pressures greater than 125 psi or below 40 psi are flagged, and 25 psi is the minimum system pressure allowed during max day demand plus a single fire flow (20% has been added to the State minimum requirement for existing infrastructure to be conservative until such time as the model has been re-calibrated with new fire flow testing). New development is to maintain 45 psi (about 10% above the State minimum requirement of 40 psi) in the system at all times except during a fire flow. **Figure 9-13** presents and example of peak hour pressure mapping.
- Areas with chronic legacy issues are flagged and continually checked. The circled area in **Figure 9-13** represents an example of a legacy issue.

[7] The limits and criteria in this list may differ from actual policy or design standards.

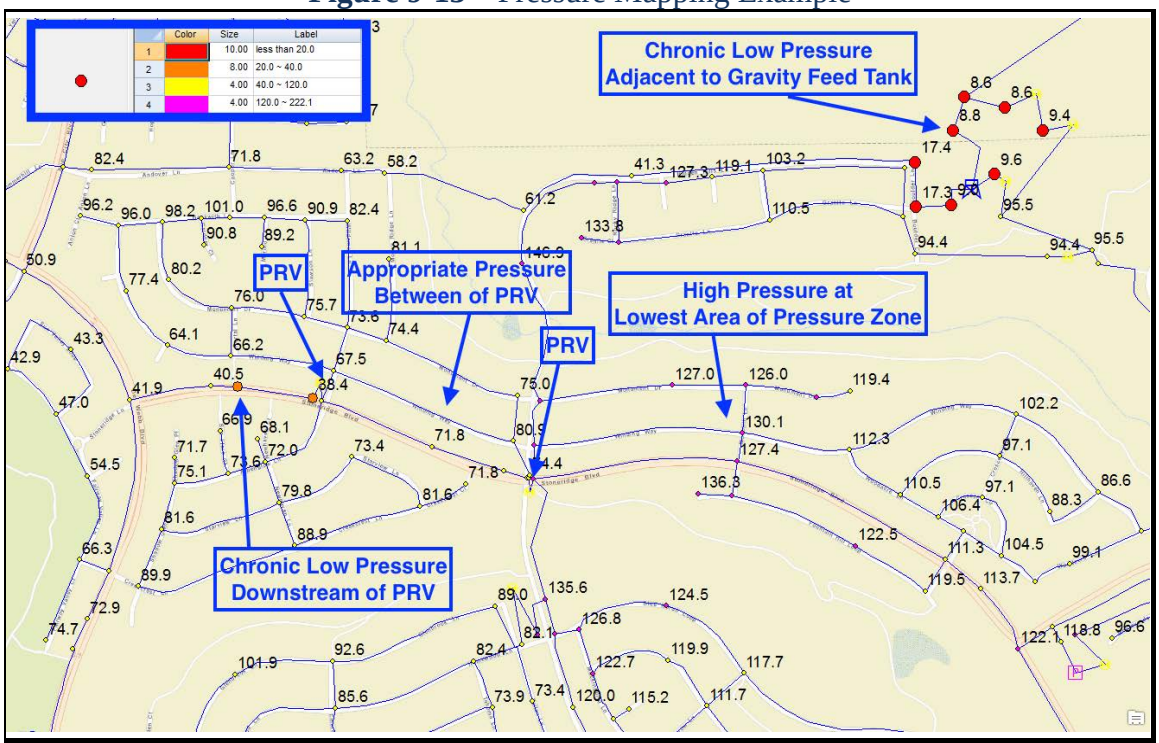
Figure 9-12 – Modeled Water Tank Operation



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Image Sources:
City Water Model, Innovyze InfoWater

Figure 9-13 – Pressure Mapping Example



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

9.7 System Analysis

The objective of the system analysis is to determine the maximum capacity of the existing system and capacity of proposed future system improvements. The assumptions and analysis are described below.[8]

9.7.1 Model Assumptions

The following assumptions are made during the system capacity analysis:

- All storage tanks are assumed to use the same approximate starting level of about 22 feet in depth and operated to cycle but refill to approximately 2/3s or to a 28 foot maximum.
- Only the gravity option is examined for treated surface water supplies to the City. There is no pumping except from City wells, the Catta Verdera Booster Pumping Station, and at dedicated City pumped storage locations where applicable in future models.
- Low pressures: Chronically low pressures near storage tanks and pressure regulating valves are identified, but not included in the analysis. Since the pressures at the tanks are controlled by the tank level and pressures at pressure regulating valves by the valve setting, it is assumed that these values are correct. Pressures below zero are identified as possible problems to be rectified with the analysis.
- High pressures: Pressures over 125 psi are flagged and re-checked for confirmation. Pressures adjacent to well pumps are chronic defaults, and are ignored as each well has a downstream flow control valve connected to the system and used to balance system flows.
- Low pressures: Chronic low pressure issues such as in the legacy area of old town and at high points in the easterly edge of the Del Webb development are ignored but flagged for future improvements.
- High velocities: Chronic high-velocity areas such as in undersized road crossings and at undersides PRVs are ignored but flagged for future improvements.

9.7.2 Initial System Evaluation

Once the 2013 B model was calibrated with available tools and information, the now completed 67 MGD model was started.[9] Numerous steps were taken to improve the

[8] The limits and criteria in this list may differ from actual policy or design standards.

speed with which subsequent models could be derived from this ultimate build-out scenario including standard naming conventions, variable feature settings, and a control structure which allowed for easy changes to total supplies entering the system, as well as changes in sources of supplies.

Once the 67 MGD model was complete, multiple rounds of trouble shooting were conducted to identify disconnected pipes, correct elevation errors, correct valve direction issues, develop realistic pressure reducing valve and pump settings, and sizing of mains to allow 4 separate in-City tank locations to operate in conjunction with each other, as well as the surface water supplies. Some operational issues required the temporary inclusion of flow control valves that do not exist in the real system to eliminate variable flows from the 67 MGD model and allow the system to solve correctly. Once the system was balanced, these "imaginary" valves were removed.

The result was a 67 MGD model that allowed for operation at the planned maximum or with a focus on PCWA or NID supplies with no infrastructure changes necessary in the existing system. It should be noted that areas with chronic pressure and flow limitations were not significantly improved but new developments could be met with pipes smaller than those identified in the previous 2010-118 MGD max day model.

Since the completion of the 67 MGD model, the City Council has agreed that a diversified supply involving 10 MGD from raw water supplies and 57 MGD from treated supplies should be the City's target at build-out. To accommodate this a version of the 67 MGD model was modified to meet the lower 57 MGD requirement with the benefit of smaller pipes, fewer tanks, and fewer new wells which all result in savings to the City.

9.8 Conclusion

This section addresses the results of the model update and the purposes of the model moving forward.

9.8.1 Model Limitations

Currently the 2016 57 MGD model is only limited to the quality of the data available to input into it. Software limitations exist but the current issue regarding the accuracy of the 2016 model is quality data to calibrate it. Specifically, fire flow tests during a drought year would provide less meaningful data than tests rendered in normal water years. The current level of accuracy is sufficient to develop large-scale system wide projects and to

[9] As discussed later in this section, the 67 MGD model has been replaced with the current 57 MGD model. The 67 MGD model is only referenced to maintain accuracy in telling the story of the model update process.

assess fire flows for pending development projects. Any model result, when taken with the conservative buffers presented in the assumptions section, is the best current information available for decision makers.

As previously discussed, new fire flow tests were conducted in August of 2016. The results of those tests shows an improvement in model accuracy from the 2013 Model updates. As seen from the 2016 fireflow testing, the model accuracy is lacking in the older areas of the system where the condition and details of the pipes in the ground is largely unknown. As the FRP projects begin to replace these older and functionally deficient pipes, model accuracy will continue to improve. Further, assumptions related to external drivers of water use such as conservation and future codes can impact the results of the model.

9.8.2 Data Limitations

As discussed earlier, the accuracy of the 2016 model is only as good as the data used to build and calibrate it. The 2016 model is based on GIS data of the water system that lacks detail in some areas of the City. Numerous developments adjacent to each other prior to the use of GIS systems have unclear records of interconnection. This lack of complete records is most notable in the older parts of City where the water lines dating back to the 1920s are infrequently connected to the newer pipes of 1990s developments.

The lack of recent fire flow data, a limited fire flow location sample set, and limited fire flow tests approximating maximum day demand conditions contribute to reduced accuracies and increased uncertainties in the 2016 model performance. This limitation has been discussed with City staff in modeling presentation meetings. Additional fire flow testing was conducted and showed the accuracy of the model in areas were the system data was best. In the older areas of the City and in areas with known functionally deficient pipes, the accuracy of the model suffers.

9.8.3 System Limitations

As derived from the modeling process and in the process of updating the 2016 model, the City's water system appears deficient in a number of geographical and functional areas.

Physical limitations exist throughout the City but with the updated demands and demand factors, areas not meeting the operating assumptions for minimum pressure and maximum pipe velocities are isolated. Examples of these limitations include older areas of the City with undersized laterals, phased pipe segments with varying diameters, undersized pipes in overpasses, undersized connecting pipes to City production wells, and lack of current above ground storage capacity. All of these issues can be either

individually addressed or mitigated to meet build-out demands without extensive replacement.

The current SCADA control system for the treated water system is functional but lacks many features of the newer systems. The limits of the current SCADA system make water system model updates cumbersome but do allow for extended period modeling without issue. As the treated water system expands and complete utilization of the second supply source as part of the PCWA Phase III Pipeline and Metering Station Project, City water system operations will become difficult to manage without expanded SCADA based pressure and flow controls.

9.8.4 Summary of Phased Planned Build-out of the City Treated Water System

Currently the 2016 model is being used to establish the number of new services that can be provided to pending developments prior to key treated water system infrastructure having to be online. The areas of Village 1, Village 5, SUD B and Village 7 are the largest pending developments for the City. These developments, as well as smaller potential development areas within the existing City limits, have been analyzed as part of the Lincoln Water Master Plan modeling process as the first major phase of City expansion as the City approaches build-out.

The remainder of the City's Sphere of Influence developable areas are on the northern and western edges of the City. As no detailed information is currently available for these areas and there is no clear indication as to which area will develop first, the next phases of planned City expansion require multiple models. Models are being prepared to establish the limits of growth under two primary scenarios, the first being west side development fed primarily through the existing service mains with PCWA as the primary surface supply, and the second being north side development prior to the NID treatment plant coming online.

The final treated water model for phased build-out is the "Buildout Model." A number of models have been created to represent build-out conditions and the current 2016 model will be revised many times before build-out is reached. The purpose of this final treated water model is to set the sizing of key infrastructure needed at build-out so that new waterlines that are needed immediately will not be undersized before meeting final build-out conditions.

Additional versions of this build out model and some interim models were completed to identify key infrastructure segments and inform decision-making. Options for redundancy and the capacity of the system in emergency situations are also helpful planning tools for the water system engineers and land planners. The information gained

from these other model runs will be used to determine the best option for the City water system based on the path development actually takes and will be updated as new information becomes available.

9.8.5 Summary of Recommended Corrective and Continued Actions

This section details the recommended actions to maintain the quality of the City's treated water model and improve accuracy over time.

- Conduct normal year max day fire flow tests and re-calibrate the model to within 10% (completed for August 2016, recommend repeating every few years)
- Continue O&M operations and update the model with system changes created in this process.
- Continue to update model with as-built and maps of areas in question, especially in regards to components of the existing system.
- Establish records of areas without redundancy or fireflow capacity and plan for field upgrades.
- Update the model incrementally with each new development to document needed infrastructure to meet supply criteria.
- Integrate new operations technologies such as AMI or advanced SCADA into the model as they become available.
- Check alternate pipe alignments and pipe designs against build-out and intermediate phase models to identify potential impacts.
- Ensure treated water models reflect all City-planned Capital Improvements and Facility Replacements for the treated water system.
- The City should formally review, update, adopt and codify updated system design and engineering standards for the water system.
- The City should require developers to perform and submit development specific water modeling with defining parameters and product expectations
- Siting, design, and construction of City Capital Improvement Projects involving storage tank, well production and booster pump station facilities, along with PCWA and NID water supply contracts should be handled solely by staff and not subject to the control of outside developer-related entities via development agreements

9.8.6 Summary of City Policy and Design Standard Update Actions

This section details the recommended updates to City Policies and the Engineering and Design Standards.

- Revise the language so that the deign standards, as required by law, follows the design and operational criteria set in the most recent version of the California Fire Code, dated 2016. (update every 3 years along with the California Fire Code.)
- Establish a City Policy of well use for peaking and minimized use in non-peak demand periods.
- Establish a City Policy of total well pumping capacity to be greater than or equal to 75% of average day demand.
- Establish a City Policy that well pumping capacity must account for 1 well to be offline as backup for every 3 in operation.
- Establish a City Policy that well pumping target should be 10% of average annual demand as seen on a 10 year running average.
- Establish a Design Standard that City Wells should be capable of producing at least 1 MGD (1,400 GPM for 12 hours per day).
- Establish a Design Standard that new City Well shall operate on VFD.
- Establish a City Policy that minimum storage shall provide 50% of average day capacity, plus fireflow storage, as well as an emergency storage volume while leaving 10% of average day minimum head space.
- Establish a City Policy that additional storage facilities shall be constructed as additional demands are placed on the system.
- Establish a Design Standard of no mains smaller than 8 inches.
- Establish a Design Standard of no non-looped mains longer than 2,000 feet.
- Establish a Design Standard of no looped mains are smaller than 12 inches.
- Establish a Design Standard that pipes shall follow the criteria set **Section 9.5.2**
- Establish a City Policy that demand multipliers shall be monitored yearly and updated as system operations change.
- Establish a City Policy that future system infrastructure shall not require frequent PRV adjustment in order for the system to remain balanced.

- Establish a Design Standard of operating pressures between 50 and 130 psi.
- Establish a Design Standard of operating pressures during peak hour of maximum day shall not drop below 40 psi.
- Establish a Design Standard of operating pressures during a maximum day fire flow event shall not drop below 20 psi.
- Establish a Design Standard of operating velocities maintained below 7 ft/sec during maximum day demands.
- Establish a Design Standard of operating velocities maintained below 10 ft/sec in maximum day fireflow demands.
- Establish a Design Standard of operating velocities maintained below 10 ft/sec in maximum day peak hour so long as all other hours follow the 7 ft/sec standard.

CHAPTER 10. FACILITY REPLACEMENT PROGRAM

The purpose of this chapter is to discuss the potable water supply projects identified as part of the Facility Replacement Program (FRP) for the City of Lincoln based on water system infrastructure ages, materials, known conditions, and modeling results. The recommended FRP projects will assist the City in meeting build-out demand as well as current fire flow conditions. This chapter was developed in consultation with City Staff and ongoing projects and recommended projects are based upon conditions known as of Summer, 2016.

10.1 Introduction

Unlike the CIP program where projects are tied to specific developments and milestones within the water system, the FRP deviates from the modeled hypothetical schematics and addresses acute conditions that actually exist in the current water delivery system. The City of Lincoln operates a water system that has changed water supply sources multiple times and, therefore, relies on many incongruent engineering and operational improvements to maintain service. With some pipes being cataloged in the database as installed as early as 1929, the FRP is as much of an information tracking program as it is a repair program. Moreover, the variety of pipe materials incorporated into the City system may cause unforeseen issues not predicted by the infrastructure records relating to dates alone.

"Spot Repairs" – repairs that occur in specific areas on an as needed basis – occur regularly in many parts of the City and occasionally involve up-sizing pipes. Specifically, if a spot repair is needed and the Capital Improvement Program (CIP is discussed in **Chapter 11**) identifies the location as needing a pipe up-sizing, the City takes actions to accommodate the CIP in making the spot repair. As the spot repairs grow in number, due to the age and materials of the older water system, engineers and operators anticipate related issues that may arise in other parts of the system and try to make adjustments. Unlike CIP project planning and construction, FRP planning is an ongoing effort that spans decades with continued system assessment and infrastructure upgrades. City employees that identify and report issues need to prioritize projects so that the most problematic and far-reaching projects are addressed ahead of lesser projects. Accordingly, this chapter develops a critical list of Facility Replacement Program projects to address current water delivery system issues.

The projects listed below cover the main FRP issues identified in coordination with City Staff. Many of these FRPs are not yet disaggregated into individual projects but represent potential existing vulnerabilities in the system. **Section 10.2** identifies projects

underway while **Section 10.3** identifies the specific projects ready for repair. **Section 10.4** identifies the longer-term projects with broader implications to the City's overall water system.

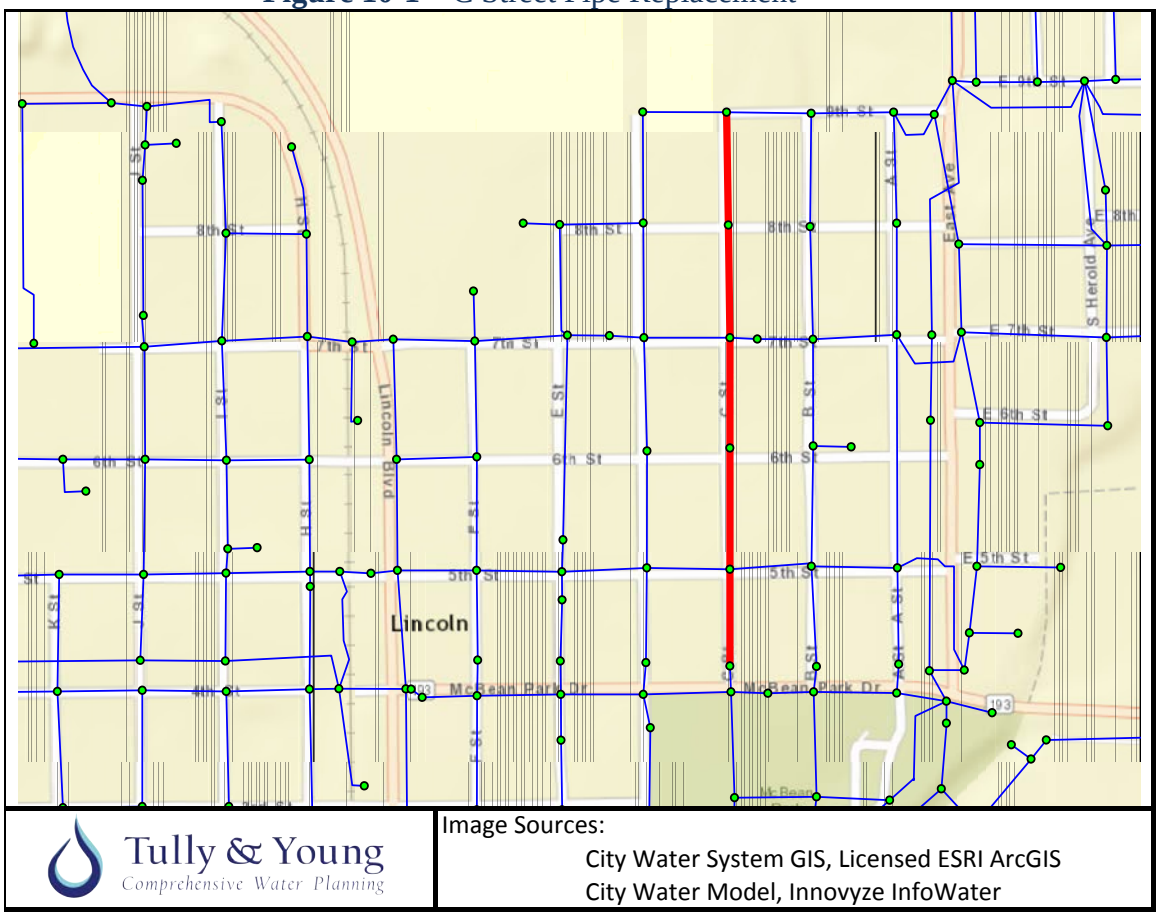
10.2 Projects Underway

The projects noted in the following subsections are underway as of the Summer of 2016. Projects currently underway are generally related to smaller single pipe projects ranging from a few hundred feet to a few blocks (approximately 3/10ths of a mile). Current system operations staff and engineering staff worked together to identify the key infrastructure needing replacement and prioritized the projects that have been initiated. The following subsections are not an exhaustive list of the projects underway. The subsections describe the system benefits resulting from their completion.

10.2.1 C Street from McBean Park to 9th Street

The City is currently replacing the 4-inch CIP pipe along C Street with new 8-inch PVC line. The section of pipe currently serves 6 fire hydrants, 2 of which are only capable of fire flow around 750 gpm prior to hitting design velocity limits. In addition, the 4-inch pipe is labeled in the GIS as being installed in 1929 or earlier meaning the pipes are over 85 years old. The replacement pipe measures approximately 2,400 feet as shown below in **Figure 10-1**. Following the completion of this replacement project, all fire flows in this area should be above about 2,000 gpm.

Figure 10-1 – C Street Pipe Replacement



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

10.3 Projects Currently Identified

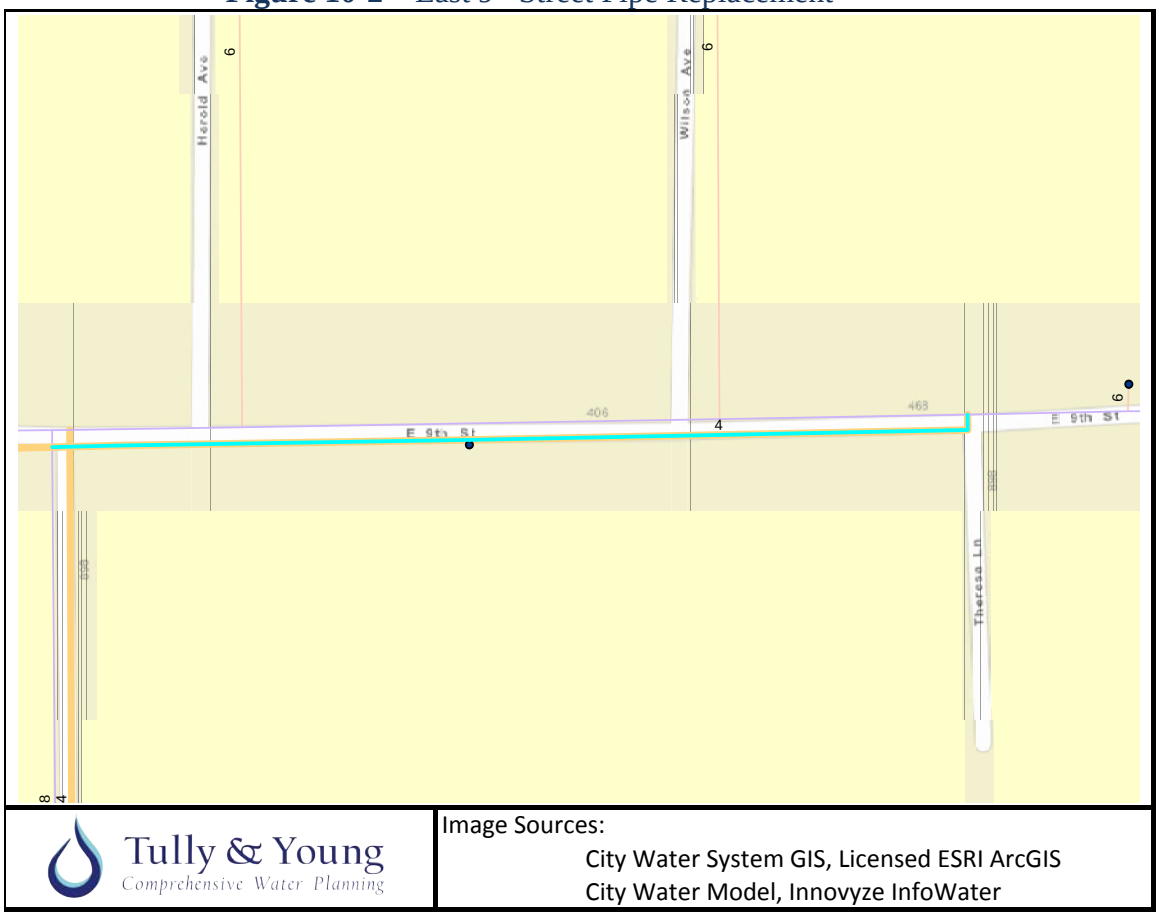
These projects listed in the subsections below are anticipated to begin shortly. The projects currently identified are generally related to smaller single pipe projects ranging from a few hundred feet to about a half-mile but also include some system-wide general replacement projects. System operations staff and engineering staff worked together to identify the key infrastructure needing replacement and prioritized the projects listed below. The following subsections detail the projects identified and the benefits resulting from their completion.

10.3.1 East 9th Street

The City is currently replacing the 4-inch CIP pipe along East 9th Street with new 8-inch PVC line. The section of pipe currently serves 2 fire hydrants, one of which is only capable of fire flow around 750 gpm prior to hitting design velocity limits. In addition, the pipe in question is labeled in the GIS system as being installed in 1929 – making the pipe over 85 years old. The replacement pipe measures approximately 700 feet as shown

below in **Figure 10-2** in green. Following the completion of this replacement project all fire flows in this area should be above about 2,900 gpm. This project is anticipated to be completed in Spring of 2017.

Figure 10-2 – East 9th Street Pipe Replacement

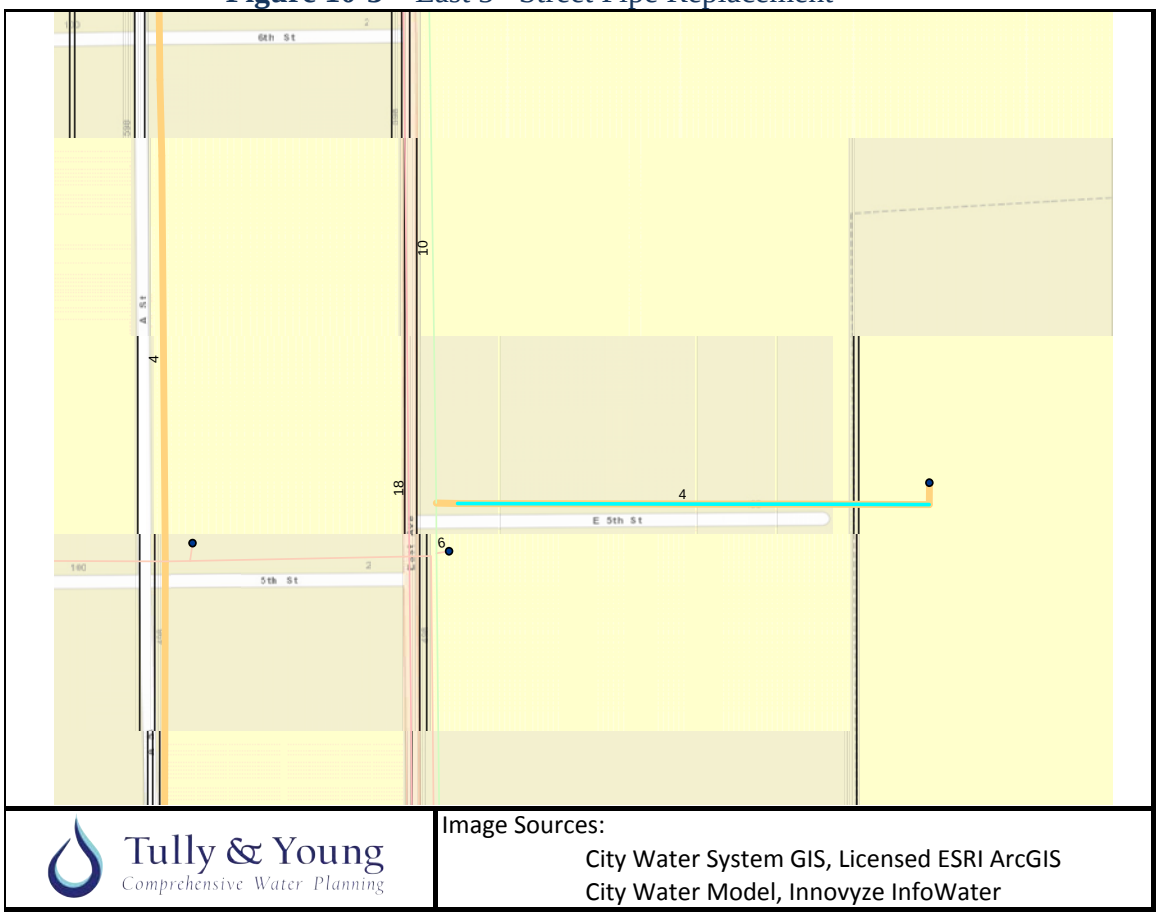


10.3.2 East 5th Street

The City is currently replacing the 4-inch CIP pipe along East 5th Street with new 6-inch PVC line. The section of pipe currently serves 1 fire hydrant that is only capable of fire flow around 400 gpm prior to hitting design velocity limits and is the only fire protection available for a number of houses. In addition, the identified pipe is listed in the GIS system as installed in 1929, exceeding 85 years old. The replacement pipe measures approximately 260 feet as shown below in **Figure 10-3**. Following the completion of this replacement project all fire flows in this area should be above about 2,300 gpm.[1] This project is anticipated to be completed in Summer of 2017.

[1] This 2,300 ft. value exceeds the 10 ft/sec limit in the 6 inch pipe but due to the unique location is being treated as a hydrant lateral in terms of design consideration. Fireflow velocity considerations are only

Figure 10-3 – East 5th Street Pipe Replacement

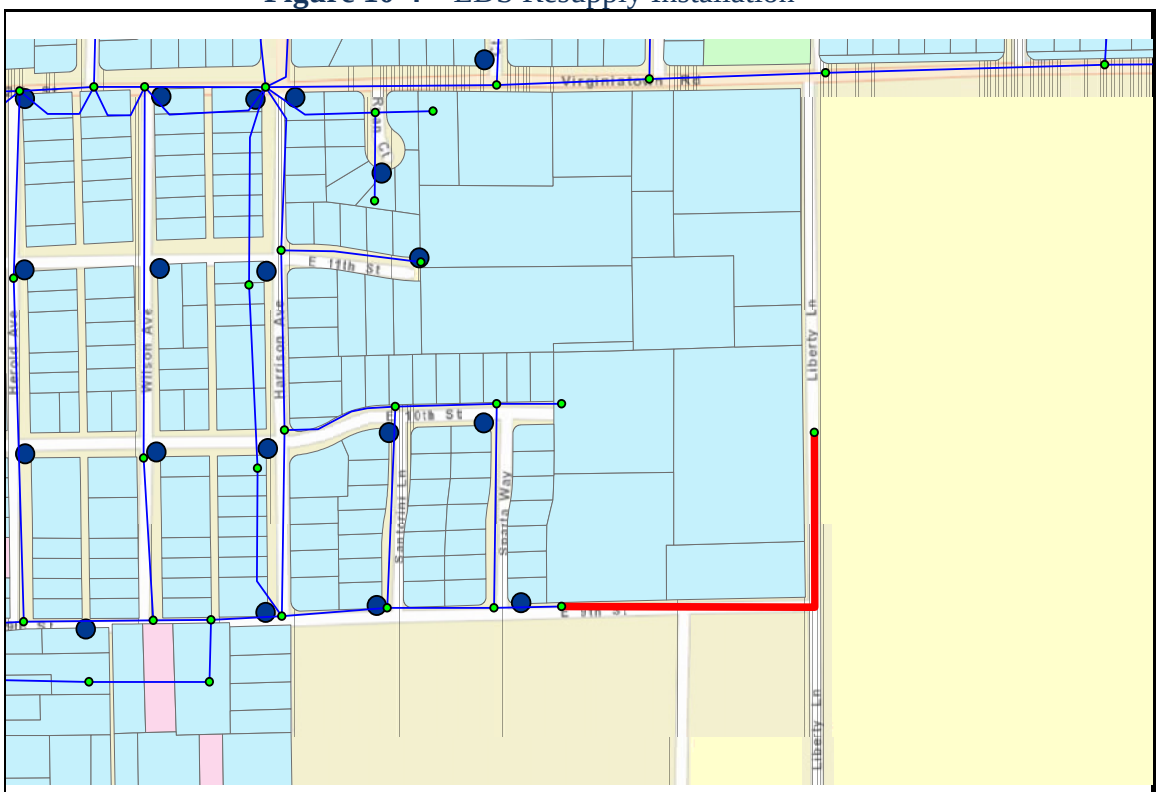


10.3.3 LDS

The City is installing new 8-inch and 12-inch PVC pipes along Red Leaf Way and Liberty Lane of the LDS parcel. This section of the City's current service area is currently only served by a single 2-inch non-looped water line. Although the water line is PVC and was installed in 1990, it is only capable of about 50 gpm. The existing pipe is shown below in **Figure 10-4**. Following the completion of this resupply project, all fire flows should be above suitable for residential and commercial services. This project is anticipated to be completed in 2017.

applied to system mains for design purposes. The velocity in a hydrant lateral may exceed the 10 ft/sec design limit.

Figure 10-4 – LDS Resupply Installation



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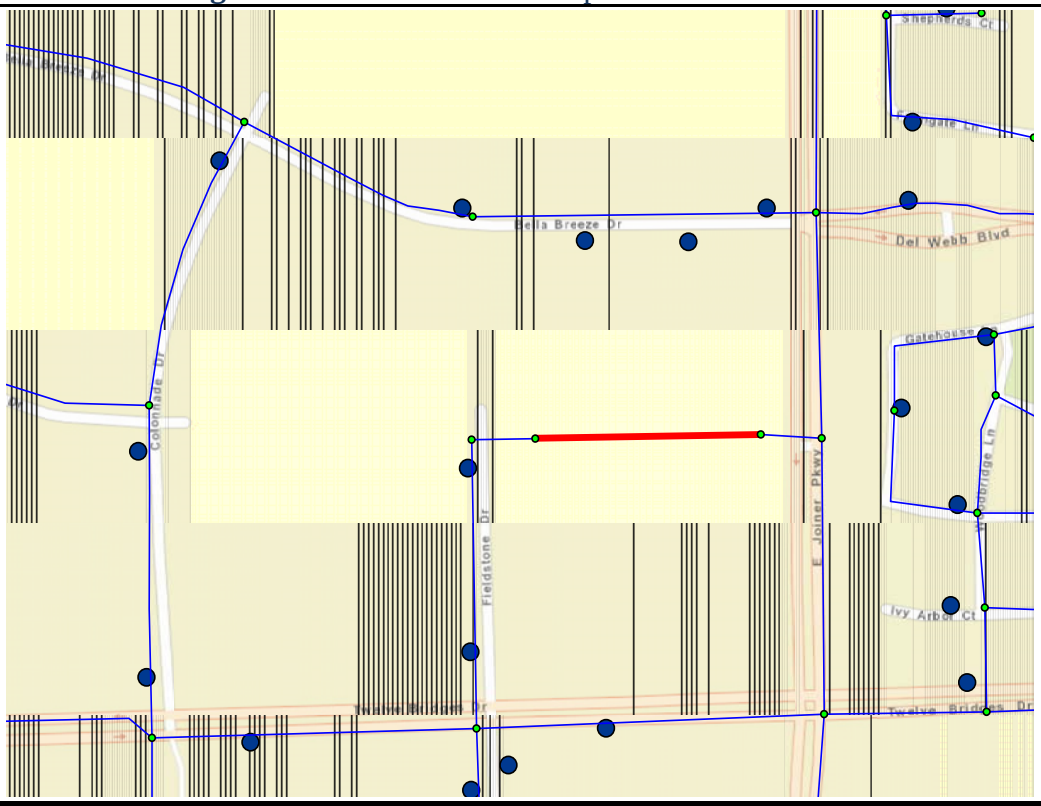
Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

10.3.4 SummerPlace

The City is installing new 8-inch and 12-inch PVC pipes along Red Rock Road to provide fire protection and water service to the SummerPlace project. Adjacent waterlines were installed in 2004 and can provide fireflows around 3,500 gpm. The new 12-inch main pipe measures approximately 650 feet as shown below in **Figure 10-5**.[2] Following the completion of this replacement project all fire flows in this area should be above about 6,500 gpm and the 12-inch line will loop the water system on Red Rock Road. This project is anticipated to be completed in 2017.

[2]For the purposed of this analysis the 8-inch waterlines on site are considered laterals in fire flow modeling.

Figure 10-5 – SummerPlace Pipe Installation



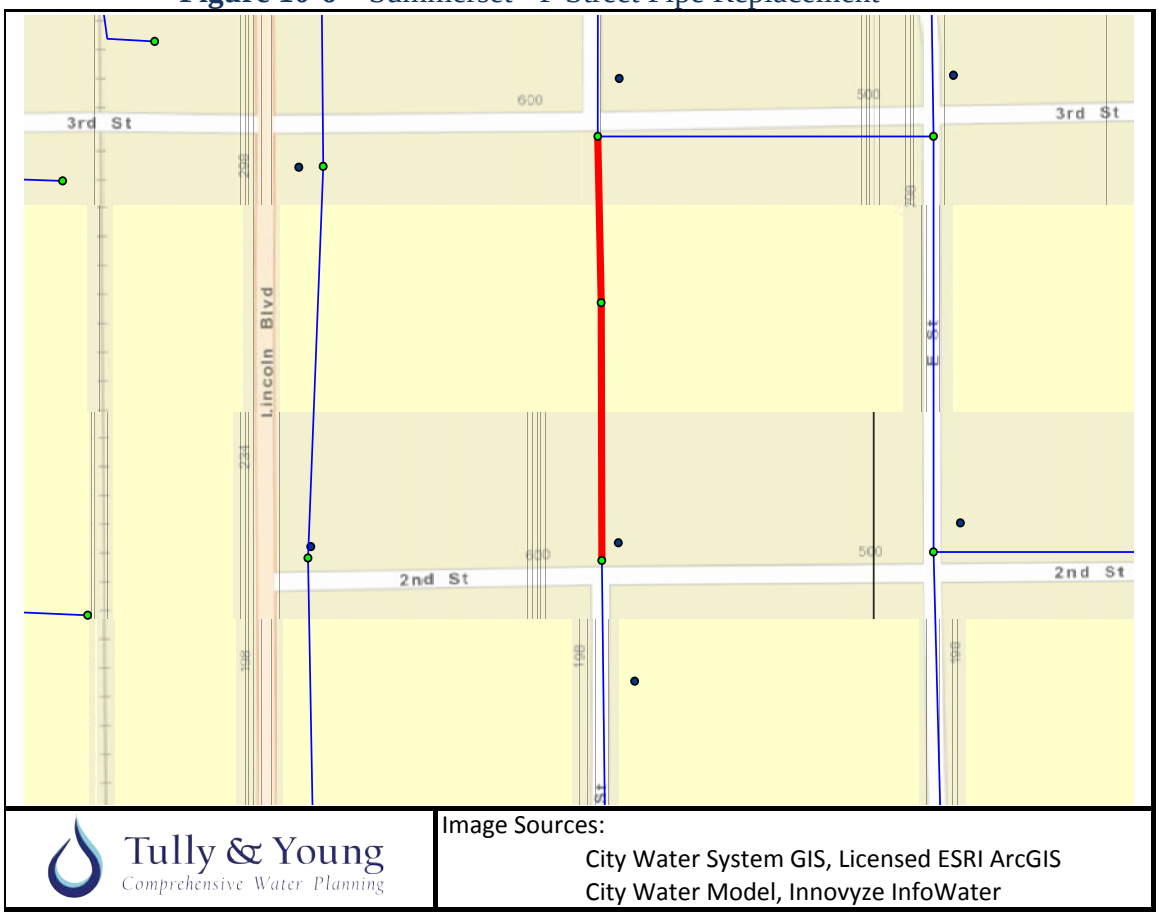
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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

10.3.5 Summerset – F Street

The City is currently replacing the 4-inch CIP pipe along F Street between 2nd and 3rd Streets with new 12-inch PVC line. The section of pipe is only capable of fire flow around 700 gpm prior to hitting design velocity limits. In addition, the pipe in question is approximately 90 years old with an install year listed in the GIS system of 1929. The replacement pipe measures approximately 400 feet as shown below in **Figure 10-6**. Following the completion of this replacement project all fire flows in this area should be above about 6,500 gpm. This project should be completed in 2017.

Figure 10-6 – Summerset - F Street Pipe Replacement



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

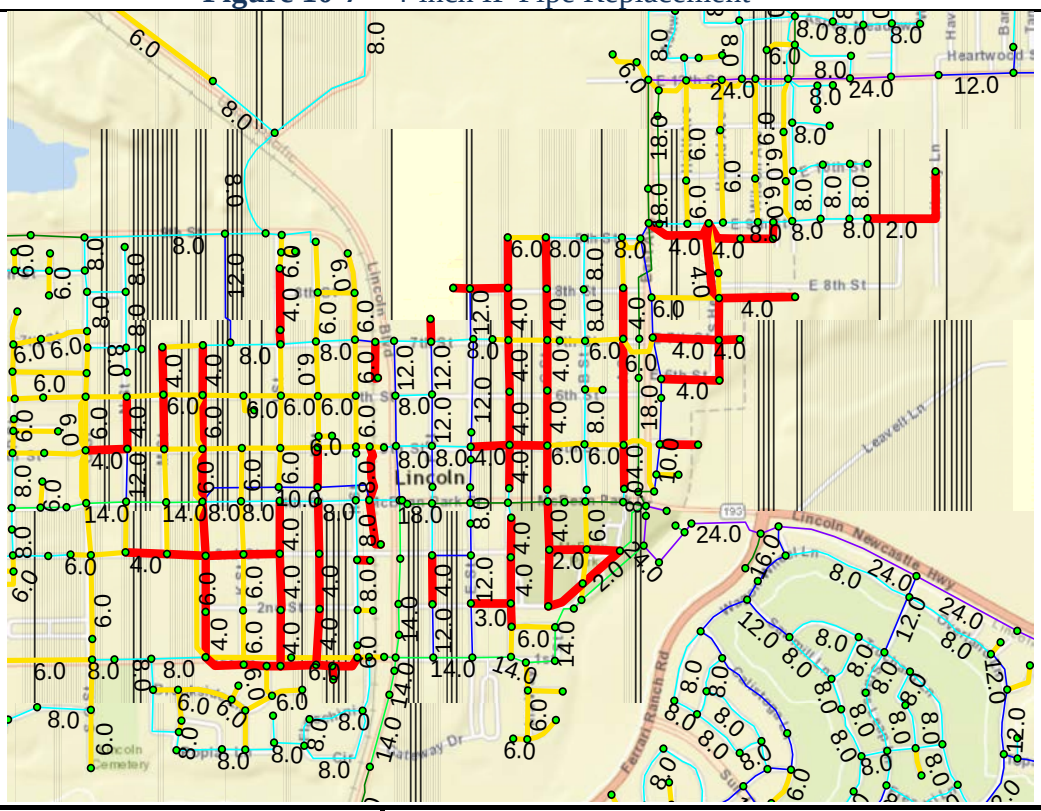
10.3.6 Greater 4-Inch CIP Replacement

Many of the projects listed above are related to water mains constructed of 4-inch Cast Iron Pipe (IP). This pipe is too small to effectively serve fire flows without violating the 10 ft/sec design standard and has suffered from corrosion. The City is currently in the process of identifying key sections of and replacing all of the 4-inch IP pipe along with new PVC line. The size of the new PVC line is determined by the engineering staff but will generally be an 8-inch water line. The 147 sections remaining of this IP totals 3.6 miles and together with 1.7 miles of 4-inch ACP pipe currently serves about 60 fire hydrants, many of which are only capable of fire flow around 700 gpm prior to hitting design velocity limits. In addition, the pipes identified were all installed between 1929 and 1960. The pipes to be replaced are shown below in **Figure 10-7**.[3] Following the replacement of the 4-inch pipes, looped fire flows in this area will all be above at least

[3] The pipes in this table include some pipes labeled as ACP in the GIS system. The City is awaiting some field verifications as ACP pipe was far more common in 6-inch diameters

about 2,000 gpm. These projects are anticipated to be completed in approximately 5 years.

Figure 10-7 – 4-inch IP Pipe Replacement



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Table 10-1 – Example Table of all 4inch IP Pipes

OBJECTID_1	OBJECTID	comment	dia	type	material	pipe_id	status	year_	Shape_Length	source	year_install	precon_date	material_class	subdivision
5874	1,573		4	wtpi	CIP	5874	existing	1929	570.8	nolte data	1929	1929	CL 150	First St.
6116	528		4	wtpi	STEEL	6116	existing	1929	527.3	Sectional Map of Water Distribution System Showing Proposed Improvements	1929	1929	CL 150	Herold Ave.
6799	434		4	wtpi	CIP	6799	existing	1929	516.6	Lincoln East E Ninth-Herold-E Eighth pgs 2,3,4 of 10 Jan 1987.pdf	1929	1929	CL 150	E. Ninth St.
3555	625		4	wtpi	CIP	3555	existing	1929	501.1	nolte data	1929	1929	CL 150	J St.
5962	762		4	wtpi	CIP	5962	existing	1929	485.2	nolte data	1929	1929	CL 150	M St.
11512	536		4	wtpi	CIP	11512	existing	1929	478.3	av-water.dwg	1929	1929	CL 150	D St.
3584	628	material taken from water leak record	4	wtpi	STEEL	3584	existing	1929	463.5	nolte data	1929	1929	CL 150	I St.
11522	510		4	wtpi	CIP	11522	existing	1929	454.1	nolte data	1929	1929	CL 150	A St.
6044	536		4	wtpi	CIP	6044	existing	1929	453.6	nolte data	1929	1929	CL 150	D St.
11506	508		4	wtpi	CIP	11506	existing	1929	453.2	nolte data	1929	1929	CL 150	C St.
11508	536		4	wtpi	CIP	11508	existing	1929	452.6	nolte data	1929	1929	CL 150	D St.
20428	615		4	wtpi	CIP	20428	existing	1929	435.7	nolte data	1929	1929	CL 150	D St.
6747	558		4	wtpi	STEEL	6747	existing	1929	429.8	nolte data	1929	1929	CL 150	Fifth St.
6197	461		4	wtpi	CIP	6197	existing	1929	428.4	nolte data	1929	1929	CL 150	C St.
6159	461		4	wtpi	CIP	6159	existing	1929	425.4	nolte data	1929	1929	CL 150	C St.
30594	615		4	wtpi	CIP	20428	existing	1929	424.8	nolte data	1929	1929	CL 150	D St.
5960	742		4	wtpi	CIP	5960	existing	1929	417.8	nolte data	1929	1929	CL 150	M St.
23276	510		4	wtpi	CIP	11523	existing	1929	408.8	nolte data	1929	1929	CL 150	A St.
11502	470		4	wtpi	CIP	11502	existing	1929	403.4	nolte data	1929	1929	CL 150	C St.
6236	628		4	wtpi	CIP	6236	existing	1929	401.2	nolte data	1929	1929	CL 150	I St.
6256	625		4	wtpi	CIP	6256	existing	1929	393.3	nolte data	1929	1929	CL 150	J St.
23290	621		4	wtpi	CIP	11494	existing	1929	392.4	nolte data	1929	1929	CL 150	F St.
11456	628		4	wtpi	CIP	11456	existing	1929	391.5	legacy gps	1929	1929	CL 150	I St.
23373	528		4	wtpi	STEEL	11541	existing	1929	383.9	av-water.dwg	1929	1929	CL 150	Herold Ave.
6648	888		4	wtpi	STEEL	6648	existing	1929	382.9	nolte data	1929	1929	CL 150	D St.
5771	601		4	wtpi	CIP	5771	existing	1929	373.4	nolte data	1929	1929	CL 150	Third St.
6262	1,360		4	wtpi	CIP	6262	existing	1929	359.0	nolte data	1929	1929	CL 150	First St.
6137	464		4	wtpi	CIP	6137	existing	1929	358.9	nolte data	1929	1929	CL 150	A St.
6820	434		4	wtpi	CIP	6820	existing	1929	353.7	Lincoln East E Ninth-Herold-E Eighth pgs 2,3,4 of 10 Jan 1987.pdf	1929	1929	CL 150	E. Ninth St.
5775	601		4	wtpi	CIP	5775	existing	1929	342.6	nolte data	1929	1929	CL 150	Third St.
11510	644		4	wtpi	CIP	11510	existing	1929	335.4	nolte data	1929	1929	CL 150	Eighth St.
5790	601		4	wtpi	CIP	5790	existing	1929	334.2	nolte data	1929	1929	CL 150	Third St.
6171	664		4	wtpi	CIP	6171	existing	1929	326.8	nolte data	1929	1929	CL 150	Fifth St.
6163	566		4	wtpi	CIP	6163	existing	1929	324.1	nolte data	1929	1929	CL 150	Fifth St.
6344	604		4	wtpi	CIP	6241	existing	1929	319.0	nolte data	1929	1929	CL 150	K St.
3632	639		4	wtpi	CIP	3632	existing	1929	298.6	nolte data	1929	1929	CL 150	Lincoln Offsite
6666	888		4	wtpi	CIP	6666	existing	1929	291.9	nolte data	1929	1929	CL 150	D St.
5782	601		4	wtpi	CIP	5782	existing	1929	282.8	nolte data	1929	1929	CL 150	Third St.
23071	1,614	diameter from water leak record	4	wtpi	CIP	5979	existing	1929	280.9	nolte data	1929	1929	CL 150	Fifth St.
5931	675		4	wtpi	CIP	5931	existing	1929	275.4	nolte data	1929	1929	CL 150	Eighth St.
28287	464		4	wtpi	CIP	6137	existing	1929	274.7	nolte data	1929	1929	CL 150	A St.
28339	445		4	wtpi	STEEL	6122	existing	1929	248.6	Sectional Map of Water Distribution System Showing Proposed Improvements	1929	1929	CL 150	E. Eighth St.
6819	434		4	wtpi	CIP	6819	existing	1929	243.0	Lincoln East E Ninth-Herold-E Eighth pgs 2,3,4 of 10 Jan 1987.pdf	1929	1929	CL 150	E. Ninth St.
6136	464		4	wtpi	CIP	6136	existing	1929	164.1	nolte data	1929	1929	CL 150	A St.

10.4 General Long-Term Projects

The general long-term projects described in the subsections below are underway as of the Summer of 2016. Projects currently underway are generally related to smaller single pipe projects ranging from a few hundred feet to a few blocks. Current system operations staff and engineering staff worked together to identify the key infrastructure needing replacement and prioritized the projects currently underway. The following subsections detail the projects underway and the benefits resulting from their completion.

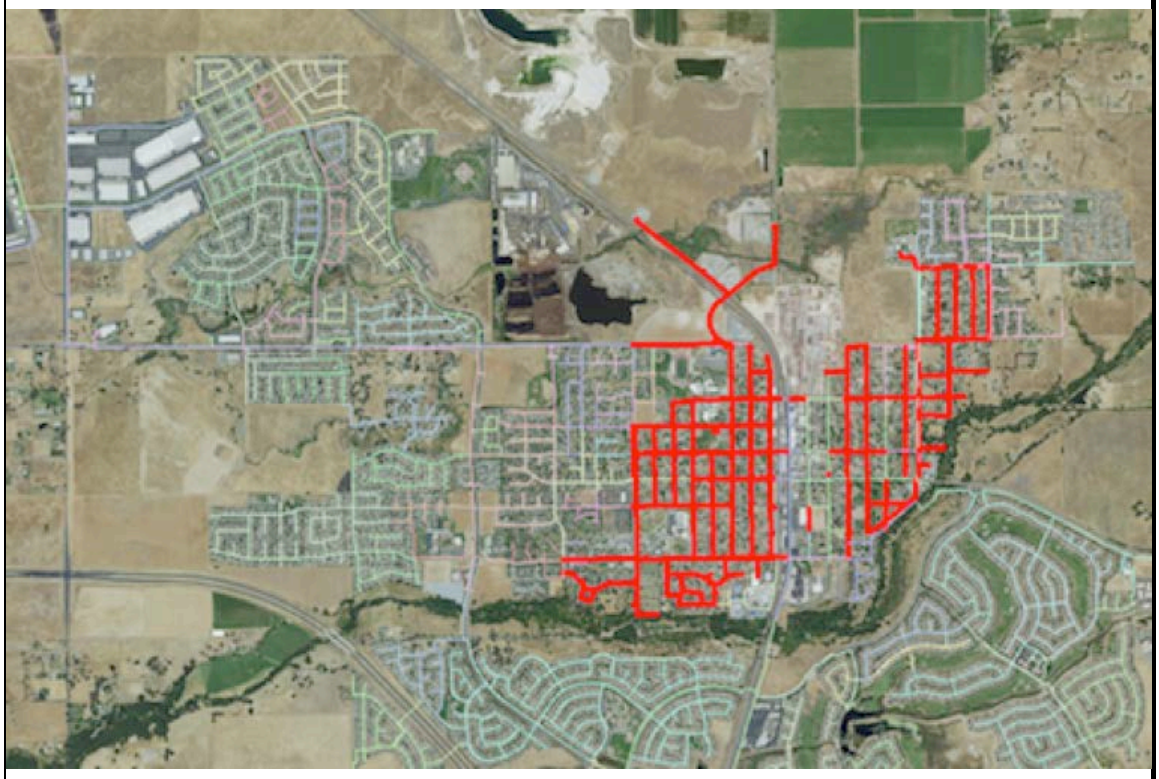
10.4.1 Pipes Exceeding Their Design Lives

The City GIS database lists a number of pipes dating from as far back as 1929. All of these pipes are well beyond their useful design life and commonly undersized for current City demands and legally required fire flows. Repairs performed in areas of the City with these older pipelines typically call for replacing smaller pipe sections. While this replacement works over time, it does lead to some remnant pipeline sections that are older and less reliable. These pipe sections are shown in **Figure 10-8**. For the purposes of this subsection, pipes older than 1960 have been identified in the GIS system and have generally exceeded their design limits.[4] This age-limit tags 815 separate pipes in the GIS system with a total length of 17.9 miles. As the FRP will be an ongoing effort between operations and engineering, the age-limit details determined to be outside of the useful design life will be adjusted as more information about the condition of pipes in the

[4] The current choice of a 1960 design life threshold is arbitrary and is to be adjusted before specific projects are identified.

ground is collected. It is anticipated that location and material will result in modification to the design life threshold.

Figure 10-8 – Map of all Pipes older than 1960



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

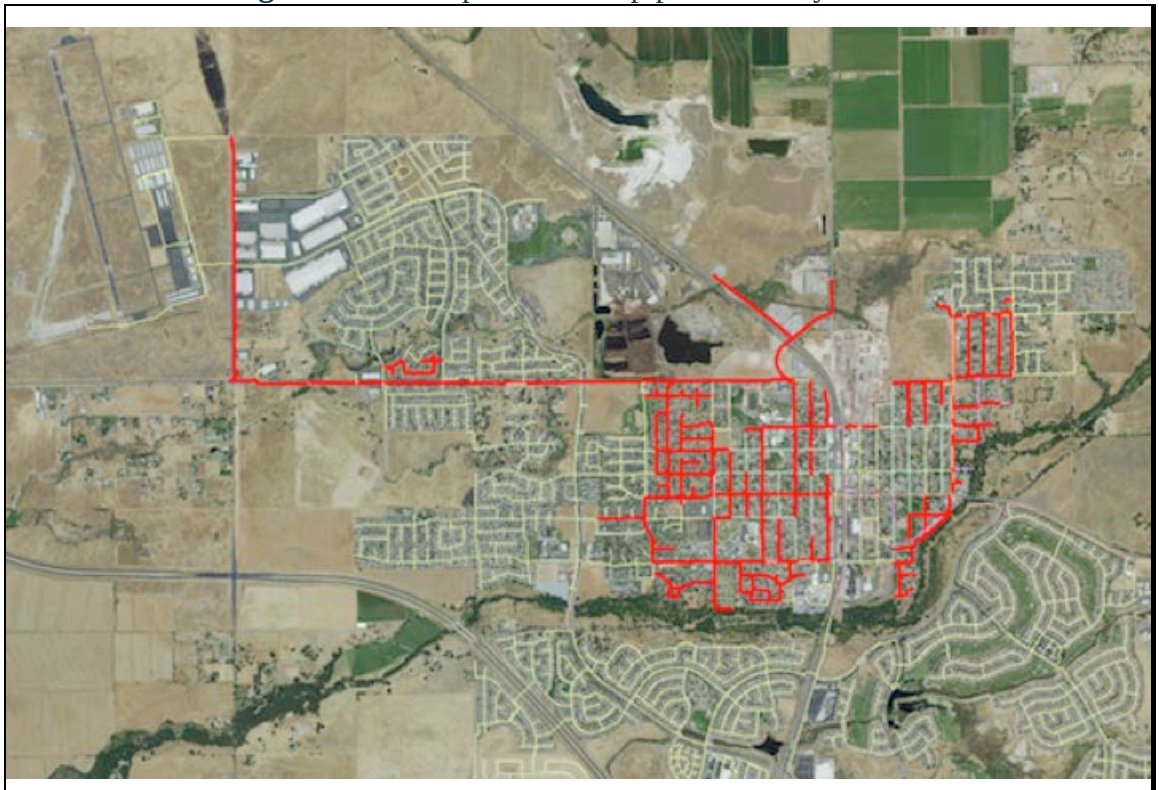
Table 10-2 – Summary Table of all Pipes older than 1960

Diameter (inches)	Count	Total Length (miles)	Median Year Installed
2	6	0.3	1929
4	225	5.3	1929
6	445	8.2	1959
8	115	3.4	1959
10	24	0.6	1959

10.4.2 ACP Pipe

Through the course of water system design, pipe materials have greatly varied – as engineering and infrastructure preferences as well as technology have changed. One such pipe is the Asbestos Cement Pipe (ACP). This pipe was used widely in the middle of the 20th century and presented a significant cost savings over the iron pipe of the era. Today, ACP is considered brittle and leak-prone compared to modern Iron and PCV pipes. The City of Lincoln has a number of ACP water mains scheduled for replacement but many still remain and are not yet identified specifically for replacement. With the newest of these pipes being approximately 30 years old, these pipes are more than half way through their useful design life. As the pipe becomes more brittle with age, repairing and connecting new pipes to this ACP pipe has become more difficult. The City considers this type of pipe functional but has identified them for replacement. In total, the City has 937 individual ACP pipes identified in the GIS system with a total length of nearly 21 miles. **Figure 10-9** shows the distribution of these pipes in the older parts of the City.

Figure 10-9 – Map of all ACP pipe in the City



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Table 10-3 – Summary Table of all ACP Pipes

Diameter (inches)	Count	Total Length (miles)	Median Year Installed
2	4	0.2	1929
4	81	1.7	1929
6	489	8.4	1960
8	183	5.3	1960
10	71	1.5	1978
12	50	1.1	1984
14	25	0.8	1978
16	33	1.9	1984

10.4.3 Older Rail Undercrossings

The City of Lincoln grew out of what is today called "Old Town." This area straddled old Highway 65 and the railroad tracks near the current City Hall. Pipes located in and around old Highway 65 and the railroad tracks are difficult and expensive to maintain, repair and replace. Old Town currently has 5 of the 7 rail undercrossings. Most pipelines imbedded in the undercrossings are generally small and many of those pipelines have exceeded their useful design life. With the newly constructed Highway 65 bypass that circumnavigates Old Town, the cost of replacing one of these crossings has fallen and become less procedurally burdensome. Maintaining, repairing, and replacing pipelines that transverse the railroad tracks is still expensive due to the complexities of railway management issues. **Figure 10-10** shows the distribution of rail undercrossing pipes in the older parts of the City.

Figure 10-10 – Map of Old Town Rail Undercrossings

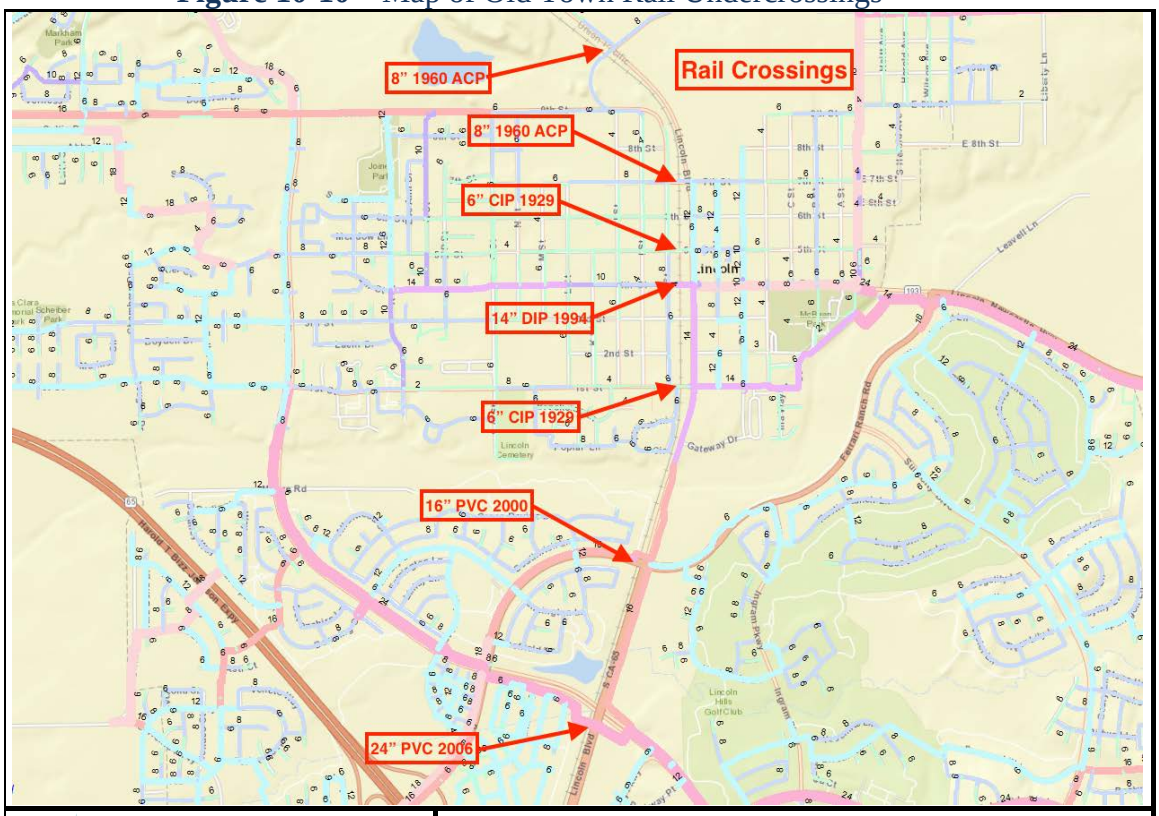


Table 10-4 – Table of Undercrossings

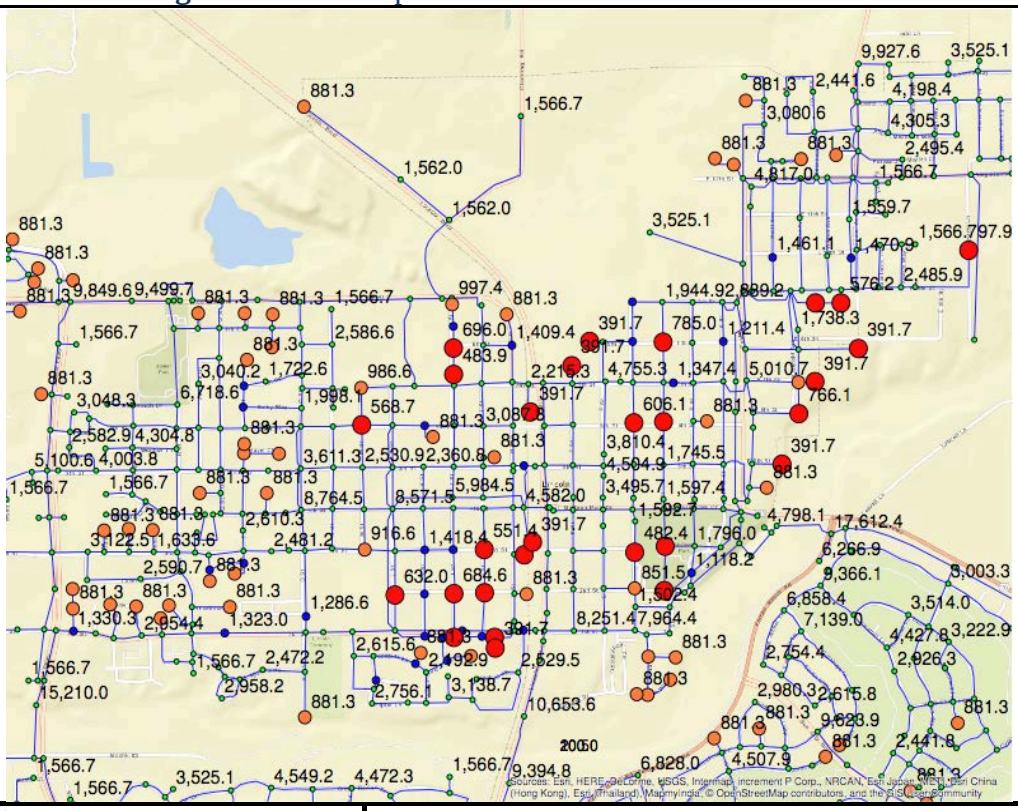
Location	Diameter	Material	Year
Gladding & 9th	8"	ACP	1960
7th	8"	ACP	1959
5th	6"	CIP	1929
4th	14"	DIP	1994
1st	6"	CIP	1929
Ferrari Ranch	16"	PVC	2000
Joiner Parkway	24"	PVC	2006

10.4.4 Current Fire Flow Issues

The City of Lincoln has a number of areas that are supplied by older pipe infrastructure that cannot handle the flows required under todays Fire Code. As most of these areas will see replacement under the larger 4-inch CIP program and later by the ACP replacement program, areas still not satisfying Fire Code requirements will need to be addressed. With the completion of the 4-inch CIP and ACP pipe replacement, all current

areas will be able to serve at least 1,500 gpm fire flows needed to serve residential areas. Some areas may be short of commercial and industrial fire flows but these will be addressed on a case by case basis by City staff as this development progresses.

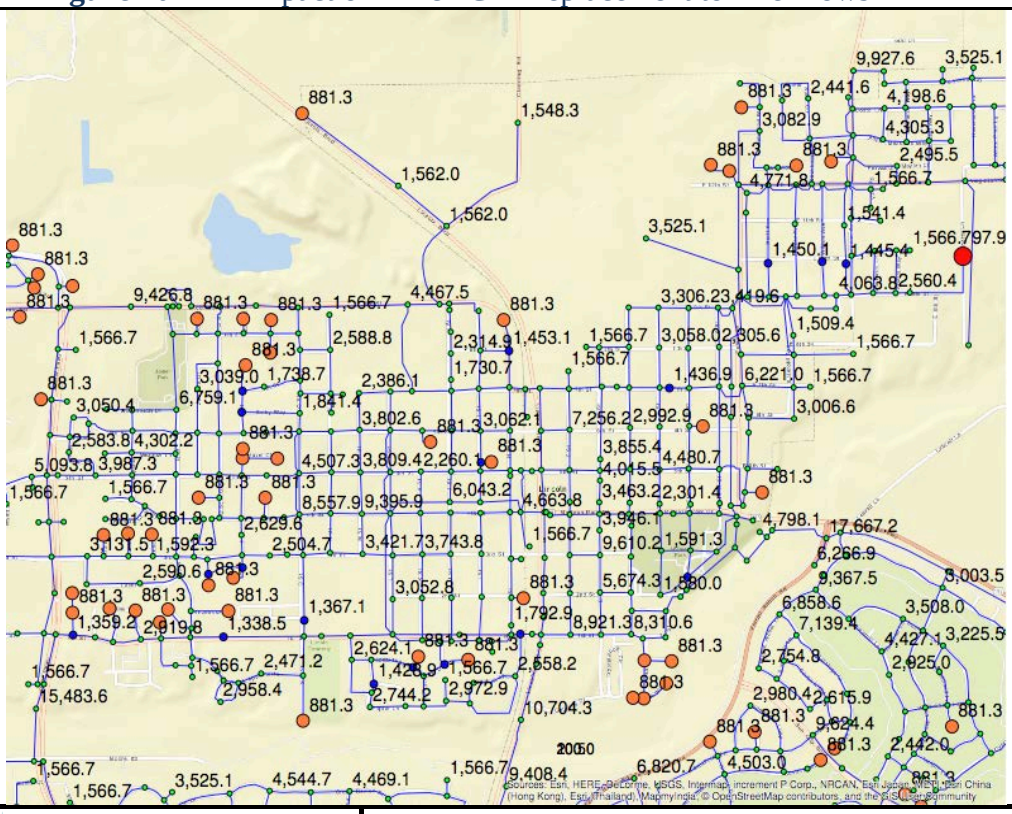
Figure 10-11 – Map of Current Fire Flow Issues



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

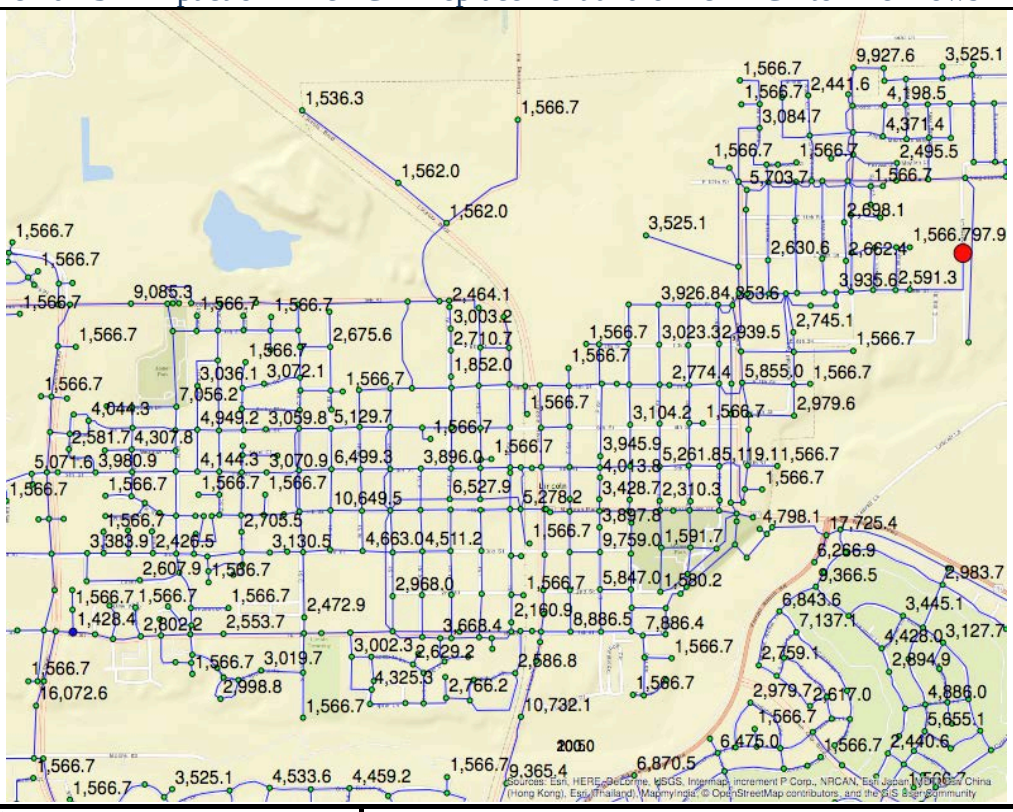
Figure 10-12 – Impact of 4-inch CIP Replacement to Fire Flows



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Figure 10-13 – Impact of 4-inch CIP Replacement and 6-inch ACP to Fire Flows


1,536.3
1,566.7
1,562.0
1,562.0
1,566.7
1,566.7
9,085.3
1,566.7
1,566.7
1,566.7

CHAPTER 11. CAPITAL IMPROVEMENT PROGRAM

11.1 Introduction

The purpose of this chapter is to discuss the potable water supply projects identified for the Capitol Improvement Program (CIP) for the City of Lincoln based on the City's build-out demand water modeling results, water supply portfolio, and water shortage planning. As the City of Lincoln's potable water system expands to meet additional needs, major infrastructure systems and pipelines will be constructed by affected developers in order for those developments to meet their fundamental project needs. In this chapter, these directly affected projects are termed "primary developments."[1] In some instances, additional developments are affected by the infrastructure needs located in a primary development. In this chapter, these additional developments are called "secondary developments." The interplay between the water infrastructure needs of primary developments and secondary developments, coupled with the overarching needs of the City to maintain water supply reliability, is critical to assessing long-term infrastructure planning. In short, the reliance of a secondary development and the City on the infrastructure that will be placed in a primary development requires system upsizing and expansion as well as the payment of the associated costs.

The City's existing infrastructure policies enable the City to pay for upsizing and expansion costs beyond those needed for a primary development. The secondary development, when it matures, reimburses the City for the costs (adjusted for inflation and interest charges) of the upsizing and expansion. If upsizing and expansion goes beyond the needs of the primary development and secondary development (e.g. is slated to satisfy a City need), then the City would pay for the incremental component on its own. Nevertheless, the critical issue for the City is identifying and developing the appropriate water infrastructure upsizing and expansion during the primary development phase so that all water delivery obligations can be met – both now and in the future. If these actions are circumvented, then upsizing and expansion must occur in the future to satisfy the secondary development's requirements and the City's additional needs – potentially at much greater effort and expense.

[1] The phrase "primary development" is used interchangeably with the phrase "primary developer" and "primary project." The phrase is used to only discern a project that is moving forward in time ahead of another development that was identified in the City's General Plan. Nothing in this memo is meant to indicate that a "primary" development has any special status that would separate it in some way from a "secondary development."

The projects listed in this chapter cover the CIP efforts that will be required for each major stage of City development. Many of these CIPs are categorized by and identified "Village" – the terminology associated with individual developments listed in the City's 2008 General Plan – in order to simplify the analysis and cost allocations.

11.2 Projects Underway

The projects listed in this subsection are already budgeted and underway. These projects are important as they form the foundation for all future projects that will be needed to serve the developments contemplated in the City's General Plan as well as additional supply conditions necessary to meet the City's water supply reliability objectives.

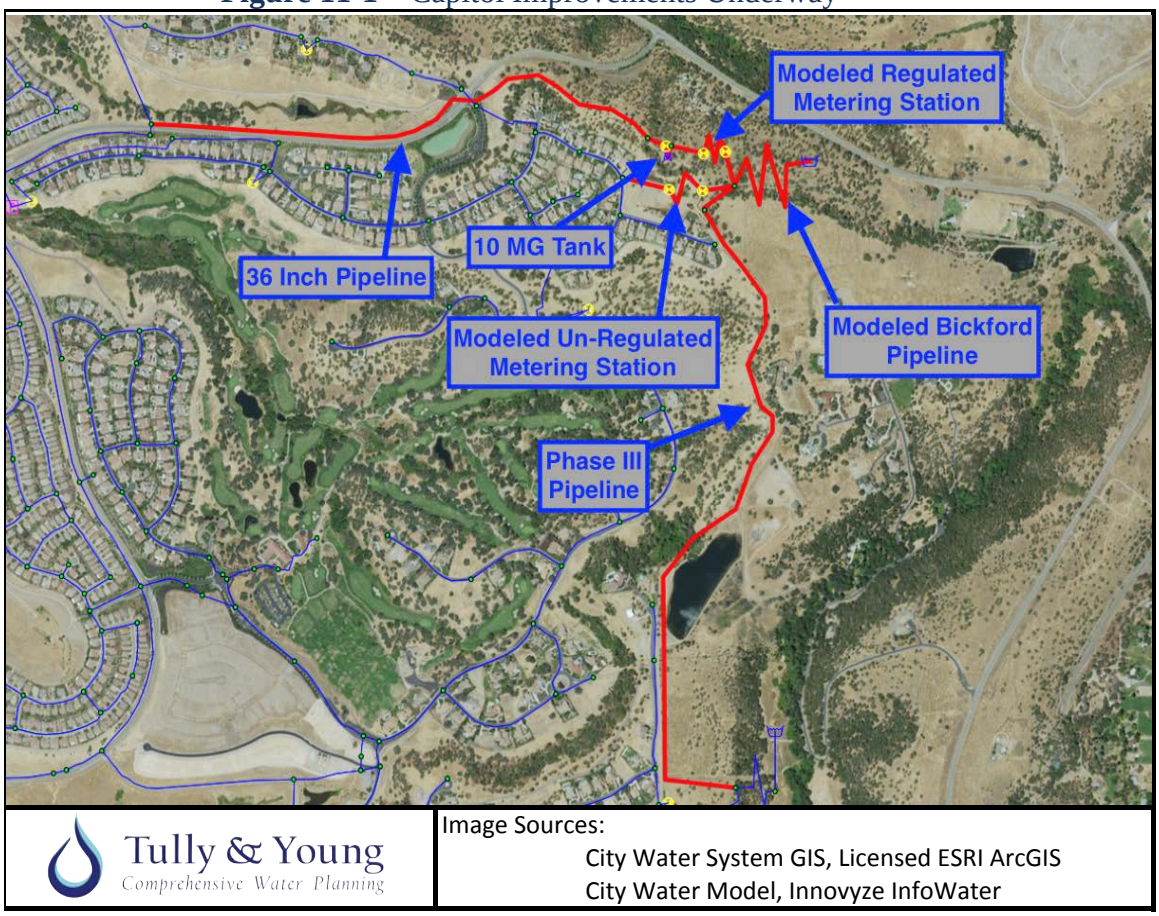
11.2.1 PCWA Phase III Pipeline and Metering Station at Catta Verdera North for Two New Points of Delivery for the City

The PCWA Phase III Pipeline and Metering Station (Phase III) is already budgeted and underway. The Phase III project is a foundational element of this modeling analysis because the model considers this water infrastructure component as completed for future condition model runs. The Phase III project must be completed in order for the City to increase its existing contract limit for treated surface water deliveries from Placer County Water Agency (PCWA) because the existing facilities have reached their capacity limits. In other words, the existing constraints on the City's delivery system prohibit additional water deliveries from PCWA beyond the existing contract numbers unless the Phase III project is completed. **Figure 11-1** shows the approximate location of the Phase III pipeline and metering station. The Phase III project is anticipated to be completed by 2018.

11.2.2 Tank #3 10 MG Tank at Catta Verdera North, 36-inch Transmission Line, and 16-inch High Pressure Connection to Catta Verdera Service Area (Catta Verdera North Project)

The Catta Verdera North Project is already underway and is not contemplated as a future project in this CIP analysis. The Catta Verdera North Project is already in the proposal stage and is a fundamental component of the CIP. As more development arises, the Catta Verdera North Project will be necessary to manage water system operational criteria and meet peaking demands. The 10 MG tank that is associated with this project is a critical component of the City's long-term storage needs. **Figure 11-1** shows the approximate location of the City infrastructure needed to utilize the Catta Verdera North Project.

Figure 11-1 – Capitol Improvements Underway



The Nevada Irrigation District (NID) service area within the City of Lincoln and the Sphere of Influence includes Villages 1, 2, and 3 as well as additional areas. But the City's growth will incorporate additional areas beyond the NID service area. As such, the pipe sizes incorporated into the Catta Verdera North Project exceed the capacities needed to only serve Villages 1, 2, and 3. Specifically, the sizing of connecting pipes to the west of these areas is critical for system redundancy – meaning the looping of system capacity for service to Villages 4, 5, and the existing City. Additionally, the transmission mains are oversized in order to address water system redundancy considerations at build-out so that NID and PCWA water supply sources can be interchanged. Last, the sizing of the pipes is designed to include future potential PCWA water supply deliveries through the NID treatment and delivery system to service connections within the PCWA service area. This redundant design is analogous to the current NID water supply and delivery through PCWA's water supply infrastructure system.

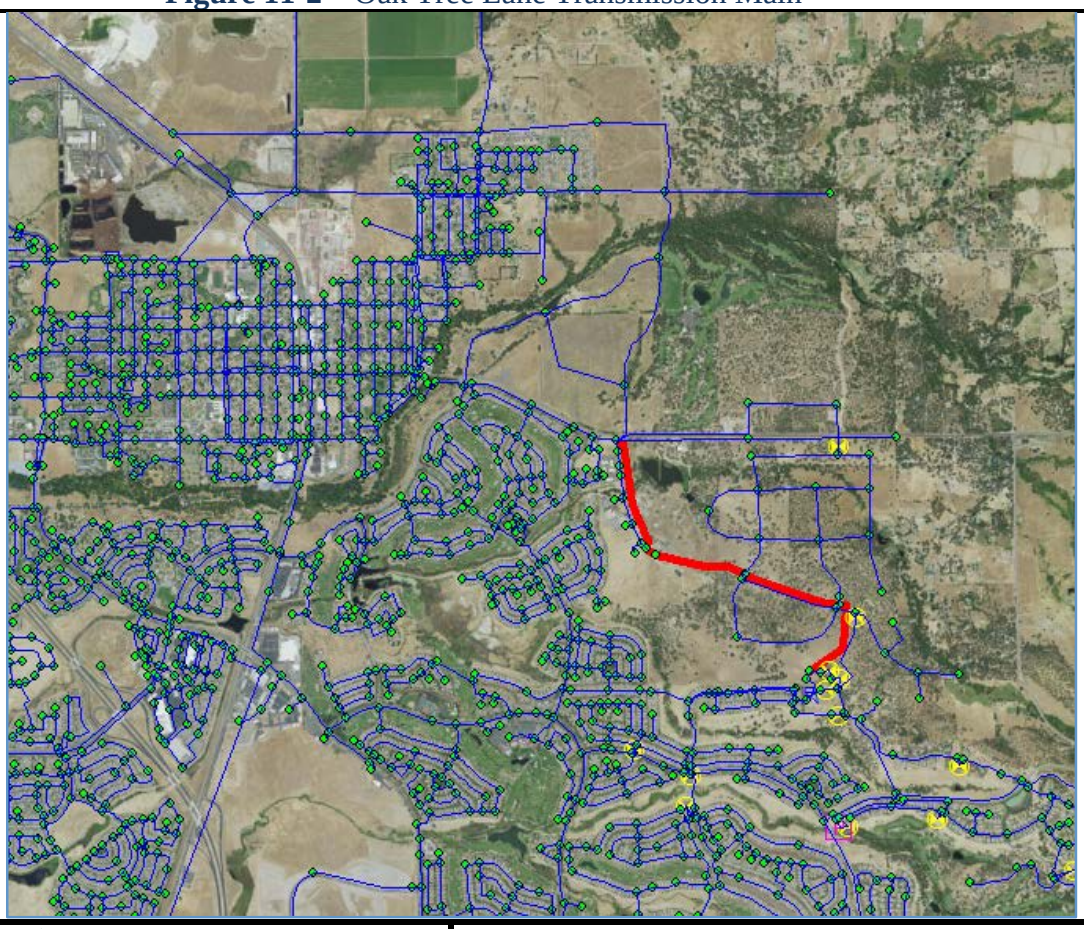
11.3 Near-Term Projects

Near-Term projects are the additional CIP projects that are likely to be needed as development progresses in the City. Specifically, the initial development activities indicate that these near term projects will be required to address infrastructure needs that meet the primary development and secondary development needs as well as the City's longer-term needs. The projects listed in this subsection have some limited planning documents but have analyzed the associated developments and corresponding water infrastructure projects in more detail than longer term projects. These projects are important for the City's water infrastructure system as they form additional foundation elements for longer term projects described in **Section 11.4**. As such, this section provides a summary of the proposed near-term infrastructure. The details on the infrastructure of each identified project described in **Subsection 11.3** can be found in the project specific documentation.

11.3.1 Oak Tree Lane Transmission Main Replacement and Realignment

The Oak Tree Lane Transmission Main upgrade consists of new segments of 30-inch pipe running downhill from the 3 million gallon (MG) tank at the Reservoir 1 site, and an 18-inch transmission line running parallel to the existing 24-inch transmission line in Oaktree Lane. The two segments will allow the City to abandon the aging 20-inch asbestos cement pipeline installed in the 1970's. The new 18-inch segment will extend easterly along Highway 193 from Oaktree Lane to meet Village 1 as well as the NID services requirements in the City to the east. The Oak Tree Lane Transmission Main upgrade is incorporated into the Village 1 project. However, the inferior condition of the existing Oak Tree pipeline necessitate the new pipelines being activated before the Village 1 development schedule is completed.

Figure 11-2 – Oak Tree Lane Transmission Main



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Table 11-1 depicts the pipe lengths and diameters necessary for the Oak Tree Lane Transmission Main Replacement and Realignment Project.

Table 11-1 – Oak Tree Lane Pipe Table

ID (Char)	Length (ft)	Diameter (in)
P-6316	1,000	30
P-6330	6,800	30
P-6114	2,495	18

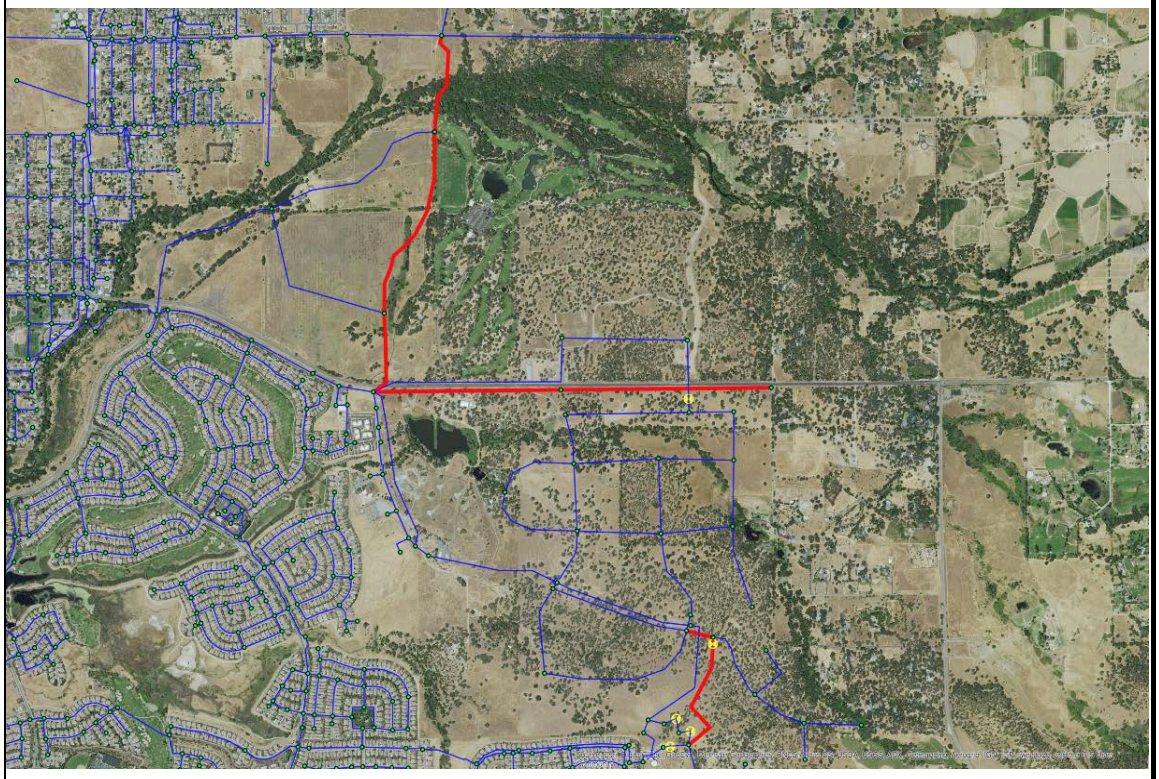
The proposed Oak Tree Lane Transmission infrastructure is a multi-purpose infrastructure improvement. The pipeline will mitigate an existing vulnerability in the City's current water system, provide a reliable transmission component that will support growth in the City, and allow for system redundancy when additional surface water delivery facilities come online. Total costs as presented in the final table account for approximately $6.4 million[2].

[2] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.3.2 Village 1 Backbone Infrastructure

The Village 1 Backbone infrastructure consists of the pipelines north of Highway 193 to Virginia Town Road and the pipeline running east along 193 to the service area and SOI boundary. Depending on the phasing of the Village 1 project, it is possible that a portion of the backbone infrastructure key to the NID Regional Water Supply Project (RWSP) water deliveries will have to be completed by the City and require reimbursement from additional developments dependent upon that system at a later time. The Village 1 potable water infrastructure will include significant infrastructure oversizing beyond the size needed to meet Village 1 demands in order to provide third party capacity to Village 2, future NID service to the east, the ability to supply NID areas with PCWA supplies in emergencies, and connection to existing City infrastructure. **Figure 11-3** shows the Village 1 Backbone Infrastructure.

Figure 11-3 – Village 1 Backbone Infrastructure



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Table 11-2 identifies the pipelines incorporated into Village 1 including their lengths and diameters.

Table 11-2 – Village 1 Pipes

ID (Char)	Length (ft)	Diameter (in)
P-6062	2,907	18
P-6262	1,559	18
P-6318	3,263	18
P-6324	2,959	18
P-6326	1,289	18
P-6334	86	24
P-V1-100	424	24
P-V1H-100	1,892	24

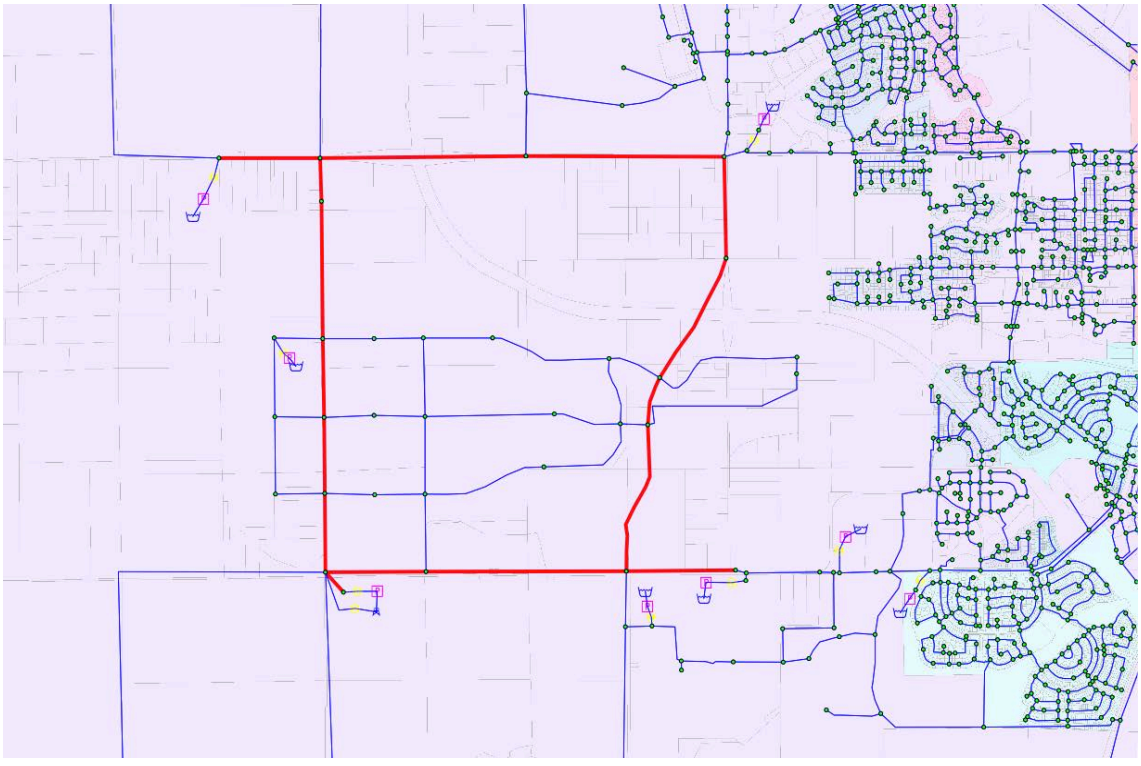
The proposed Village 1 infrastructure will be critical to supporting Village 2 and 3 as well as future NID service to the east of the Village 1 project. Total costs as presented in the final table account for approximately $6.3 million[3]. For more details on the specifics of the Village 1 infrastructure, please refer to the Village 1 Water System Master Plan. Details of this Plan have been incorporated into the City's current build-out water model.

[3] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.3.3 Village 5/SUD B Backbone Infrastructure

The Village 5 Backbone infrastructure consists of the pipelines running from Nicolaus Road on the North side of the City across Auburn Ravine and in the south along Dowd and Fiddyment Roads. The Village 5 Backbone infrastructure also runs from the existing City infrastructure on the East out to the edge of the SOI on the West. Depending on the phasing of the Village 5/SUD B project, it is possible that a portions of the backbone infrastructure key to water deliveries for other current and future projects as well as the City's redundancy objectives will have to be completed as a specific City-financed project that will require reimbursement at a later time. The Village 5/SUD B potable water infrastructure will include key oversizing above Village 5/SUD B needs to provide third party capacity to Village 6, Village 4, and connection to existing City infrastructure. **Figure 11-4** depicts the Village 5/SUD B Backbone Infrastructure.

Figure 11-4 – Village 5/SUD B Backbone Infrastructure



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Image Sources:
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Table 11-3 shows the pipeline lengths and diameters associated with the Village 5/SUD B Project.

Table 11-3 – Village 5/SUD B Pipes

ID (Char)	Length (ft)	Diameter (in)
P-6278	691	18
P-V5A-100	2,570	18
P-V5A-102	3,510	18
P-V5A-108	1,250	18
P-V5A-124	2,852	24
P-V5A-126	5,221	18
P-V5A-128	2,622	18
P-V5F-122	3,871	18
P-V5F-142	5,174	18
P-V5F-144	5,365	18
P-V5F-146	2,639	18
P-V5F-150	1,997	18
P-V5F-152	1,927	18
P-V5F-154	1,997	18
P-V5F-156	3,485	18
P-V5F-158	1,094	18

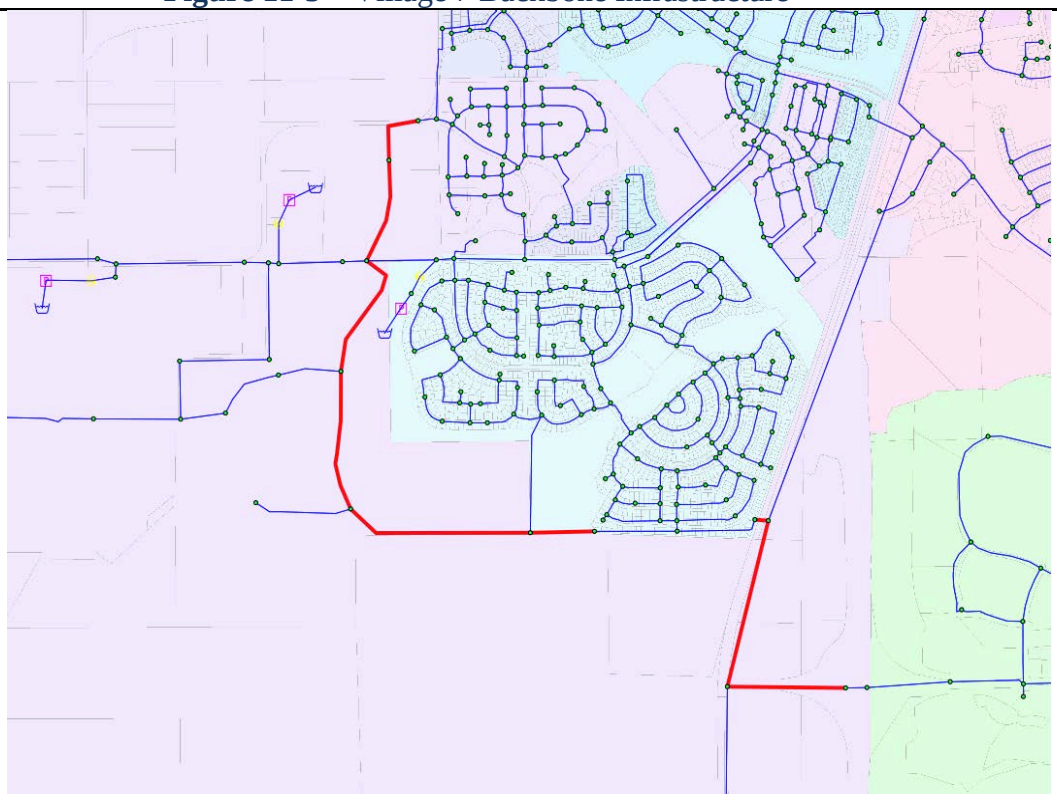
The proposed Village 5/SUD B infrastructure is critical to support the Oak Tree Lane Transmission main upgrades (described in **Section 11.3.1**) and other adjacent City areas as well as future NID service to the East. Total costs as presented in the final table account for approximately $20 million[4]. For more details on the specifics of the Village 5/SUD B infrastructure, please refer to the Village 5/SUD B Water System Master Plan. Details of this Plan have been incorporated into the City's current build-out water model.

[4] This project cost will be determined upon further consultation with the City Staff.

11.3.4 Village 7 Backbone Infrastructure

The Village 7 Backbone infrastructure consists of the pipelines along Moore Road adjacent to the existing Sorrento development then south to the western edge of Lincoln Crossing. Depending on the phasing of the Village 7 project, it is possible that a portion of the backbone infrastructure that is essential for water deliveries to other projects and City redundancy will have to be completed as a specific City-financed project that will require reimbursement at a later time. The Village 7 potable water infrastructure will include significant oversizing above Village 7's needs in order to provide additional capacity to Village 5, SUD C, as well as a looping connection to the City's existing infrastructure. One important pipeline associated with the Village 7 Backbone Infrastructure plan runs along the southern edge of Lincoln Crossing and will connect into an existing Highway 65 crossing at Twelve Bridges Drive. This component expands the number of Highway 65 crossings and removes a supply redundancy bottleneck in the broader water system. **Figure 11-5** depicts the Village 7 Backbone Infrastructure described in this section.

Figure 11-5 – Village 7 Backbone Infrastructure



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Image Sources:
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City Water Model, Innovyze InfoWater

Table 11-4 identifies the specific pipeline lengths and diameters that are associated with the Village 7 project.

Table 11-4 – Village 7 Pipes

ID (Char)	Length (ft)	Diameter (in)
P-6018	1,770	18
P-6020	2,489	18
P-6030	2,820	18
P-6044	2,049	18
P-6046	1,949	18
P-6048	1,537	18
P-6052	950	18
P-6170	200	18
P-6386	960	18

The proposed Village 7 infrastructure will improve redundancy over Highway 65 and other adjacent City areas as well as future service to the south and east. Total costs as presented in the final table account for approximately $6.1 million[5]. For more details on the specifics of the Village 7 infrastructure, please refer to the Village 7 Water System Master Plan. Details of this Plan have been incorporated into the City's current build-out water model.

[5] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4 Long Term Projects

The projects listed in this section are considered longer term projects because they will only be constructed as future development progresses beyond the initial development thresholds. Specifically, none of the projects listed in this section have active or pending Water Supply Assessments (WSA's), specific plans, or any other pending development activity. These projects are examined on an individual Village basis that correlates with the 2008 General Plan designations for future development areas. In cases where the infrastructure may be necessary for more than one Village, the infrastructure is assigned to whatever Village is likely to be built first or whichever Village is adjacent to existing City infrastructure. It is likely that the Village(s) that seek land use changes or urbanization opportunities will be responsible for constructing the water mains incorporated as part of this analysis.

In addition to the individual Village infrastructure, overall system storage is a critical component of providing backup supply and proper system redundancy at build-out. Storage components, unlike in-village transmission infrastructure, are not individually necessary to supply the system at build-out but provide additional water system reliability and help manage peaking events. For example, in the event that the City's groundwater extraction was reduced as part of the newly adopted groundwater management rules, additional system storage would help the City provide sufficient water during high demand times – essentially taking the place of a portion of the burden carried by the groundwater wells. In this hypothetical example, the groundwater pumping restrictions would require additional water supplies from alternative locations. Thus, surface water storage would be necessary to meet the increased demands. This section serves as a long term planning guide that may change with future water system design and engineering standards.

11.4.1 Airport Water Storage and Pump Station

Before the City reaches build-out conditions, the City must develop water storage on the west side of the water system in order to ensure proper system operation, manage peaking events, and provide backup supply. An easy way to achieve system operation would be to use high elevation water storage, like water towers, where gravity maintains the system elevation pressures. However, the potential impacts of fire flow demands make the required tank sizing in a water tower cost prohibitive. One proposed project seen as the best option is the Airport Water Storage and Pump Station. This piece of infrastructure, on the west side of town near the Lincoln Airport, would allow for surface water to be delivered across town in low water use periods and pumped back into the system during peak demand periods. As currently modeled, this pumped storage would produce approximately 5,000 gallons per minute (gpm) under typical use with total pump time

limited by the amount of water in the 5 MG tank at the time. The sizing of this tank and pump would allow for the project to supply an emergency fire flow situation at the airport or nearby industrial areas. Though the specific parcel designated for this tank has changed over the years based on available lands that are owned by the City, substantial pipe infrastructure was built with developments in the area anticipating the pumped storage would be installed in the future. **Figure 11-6** depicts the Airport Water Storage and Pump Station.

Figure 11-6 – Airport Water Storage and Pump Station

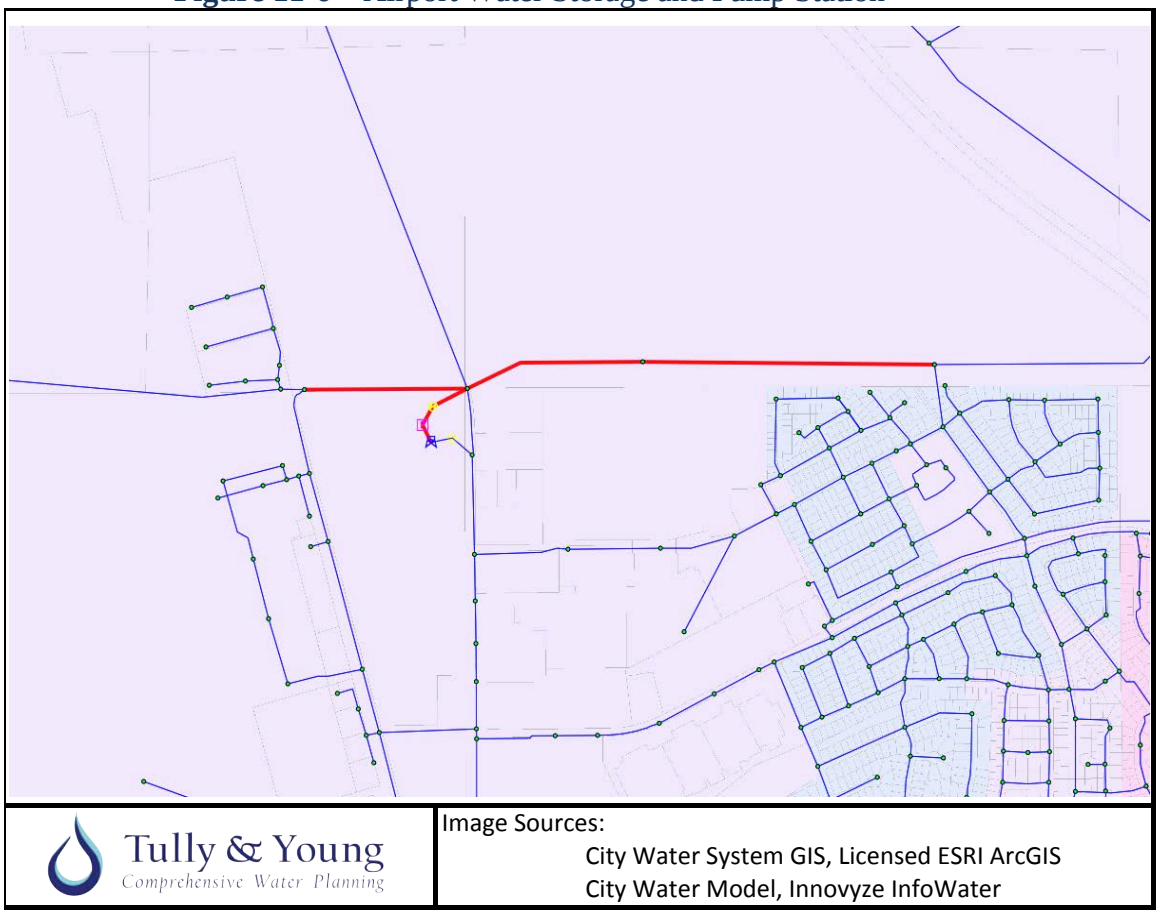


Table 11-5 identifies the lengths and diameters of pipe necessary to deliver water from the proposed Airport Water Storage and Pump Station.

Table 11-5 – Airport Water Storage and Pump Station Associated Pipe Infrastructure

ID (Char)	Length (ft)	Diameter (in)
P-1230	1,206	18
P-5980	2,374	18
P-5982	1,473	18
P-6240	155	18
P-6242	168	18
P-6244	316	18

The proposed Airport Pumped Storage in the western portion of the water system is currently the best option to support future build-out and address groundwater pumping restrictions. Total costs as presented in the final table account for approximately $2.3 million at current costs[6].

11.4.2 Reservoir 1 Expanded Storage

Prior to attaining build-out, water storage on the east side of the water system is important to ensure proper system operation, manage peaking events, and provide backup supply. One proposed project currently under consideration is expanded storage on the east side of town at the Reservoir 1 site. This piece of infrastructure would allow for expanded surface water use and proper storage capacity to be maintained to handle peaking conditions. As currently modeled, this project would add approximately 10 MG of additional storage at the Reservoir 1 site. The sizing of this tank would allow for the City to expand beyond the 10 MG storage capacity limits covered in the other project at that location described in **Section 11.2.2**. As modeled, this tank could be built at the Catta Verdera North site and provide the same level of service so long as delivery pipelines were adequately upsized. The Reservoir 1 site is the more efficient choice as the land requires far less grading and there is capacity in the planned and existing pipelines not fully utilized by the existing 3 MG tank. **Figure 11-7** depicts the Reservoir 1 Expanded Storage project.

[6] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

Figure 11-7 – Reservoir 1 Expanded Storage

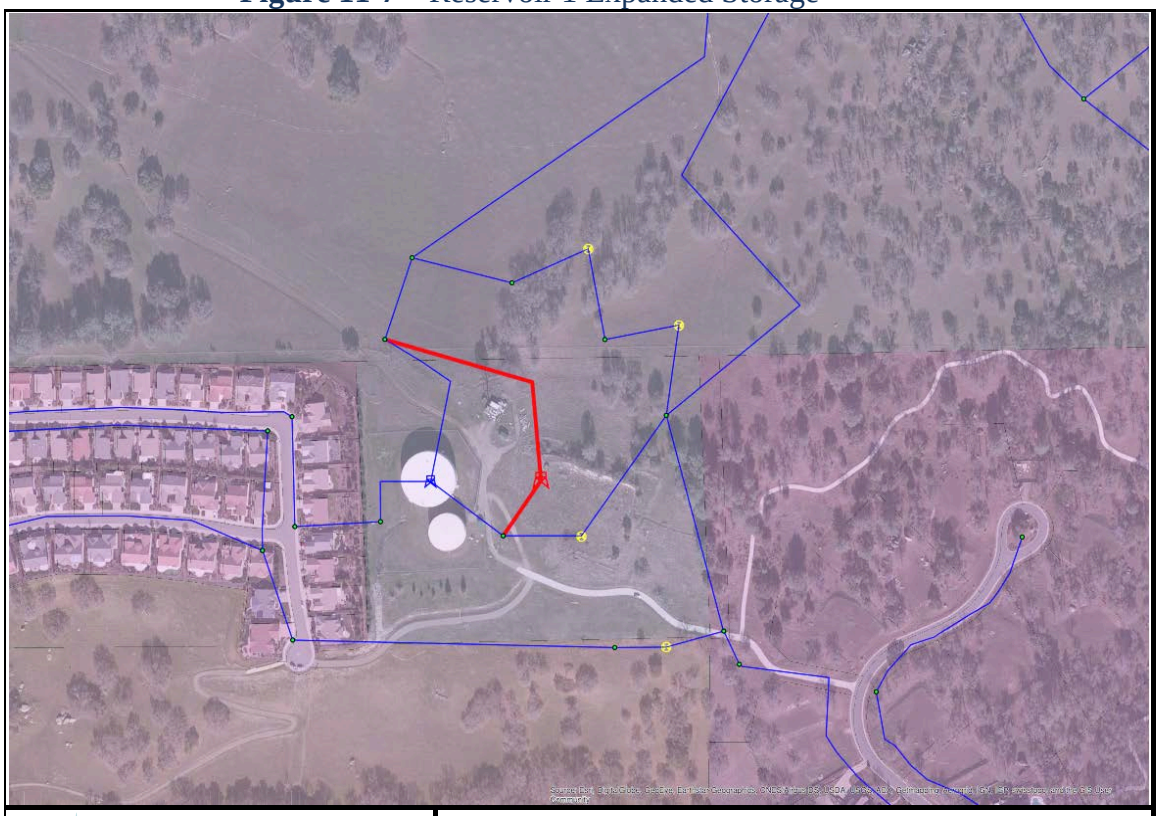


Table 11-6 identifies the additional pipe lengths and diameters that would be required as part of the Reservoir 1 Storage Tank project.

Table 11-6 – Reservoir 1 Pipe Table

ID (Char)	Length (ft)	Diameter (in)
P-6388	162	18
P-6390	615	36

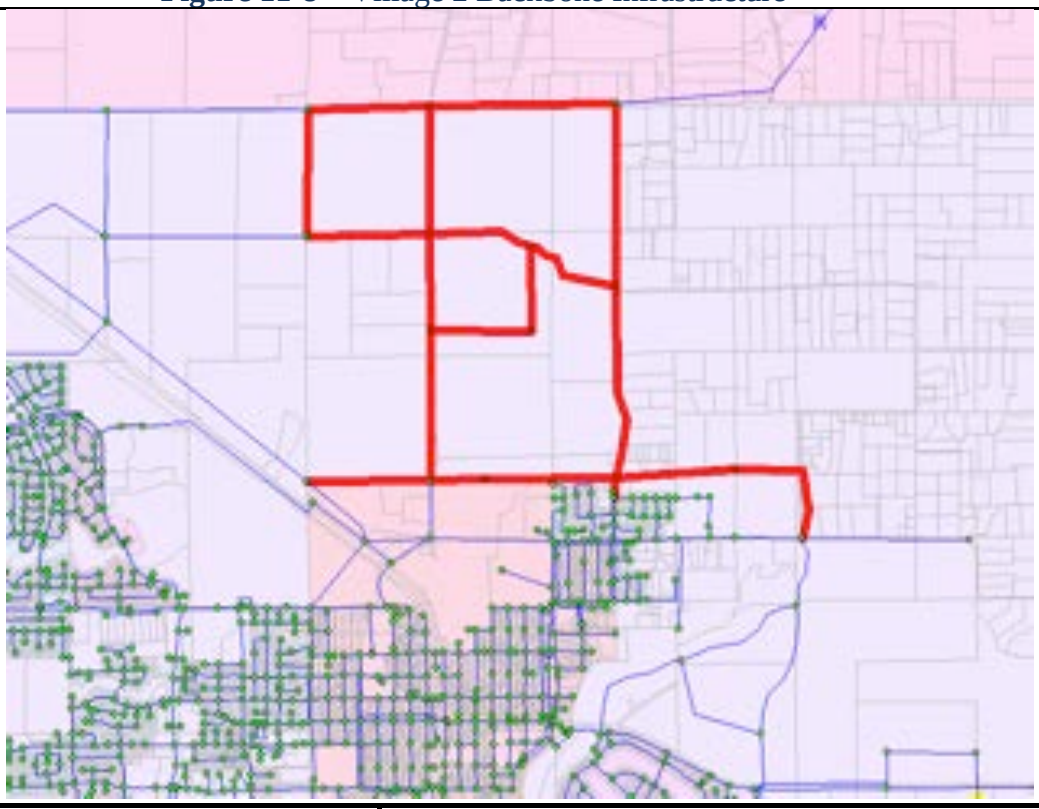
The proposed Reservoir 1 Expanded Storage in the eastern portion of the water system is currently the best option to support future build-out and comply with storage capacity design criteria. Total costs as presented in the final table account for approximately $0.6 million at current costs[7].

[7] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4.3 Village 2 Backbone Infrastructure

The Village 2 Backbone infrastructure consists of the pipelines north of the existing City and Village 1 as well as the main transmission lines from the future NID regional water treatment facilities to serve the NID service area of Villages 1 and 2. Due to the current lack of City-developer activity on the Village 2 project, it is possible that a portion of the backbone infrastructure that is critical for the NID RWSP will be completed as a specific City-financed project that will require reimbursement at a later time. The Village 2 potable water infrastructure will include significant oversizing above the Village 2 water supply needs to provide third party capacity to Villages 1 and 3 as well as connection to existing City infrastructure. **Figure 11-8** shows the Village 2 Backbone Infrastructure components.

Figure 11-8 – Village 2 Backbone Infrastructure



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
City Water Model, Innovyze InfoWater

Table 11-7 shows the pipe lengths and diameters associated with the Village 2 Backbone Infrastructure project.

Table 11-7 – Village 2 Pipes

ID (Char)	Length (ft)	Diameter (in)
P-5046	448.1	18
P-5946	4152.2	30
P-5948	3896.3	30
P-5950	4090.4	36
P-5952	2743.1	18
P-5956	2055.7	18
P-5958	2852.2	18
P-6074	2660.8	24
P-6094	1198.4	18
P-6112	2686.1	18
P-6178	2219.6	18
P-6180	1821.4	16
P-6256	2626.1	18
P-6258	2944.6	18
P-6272	3210.1	18

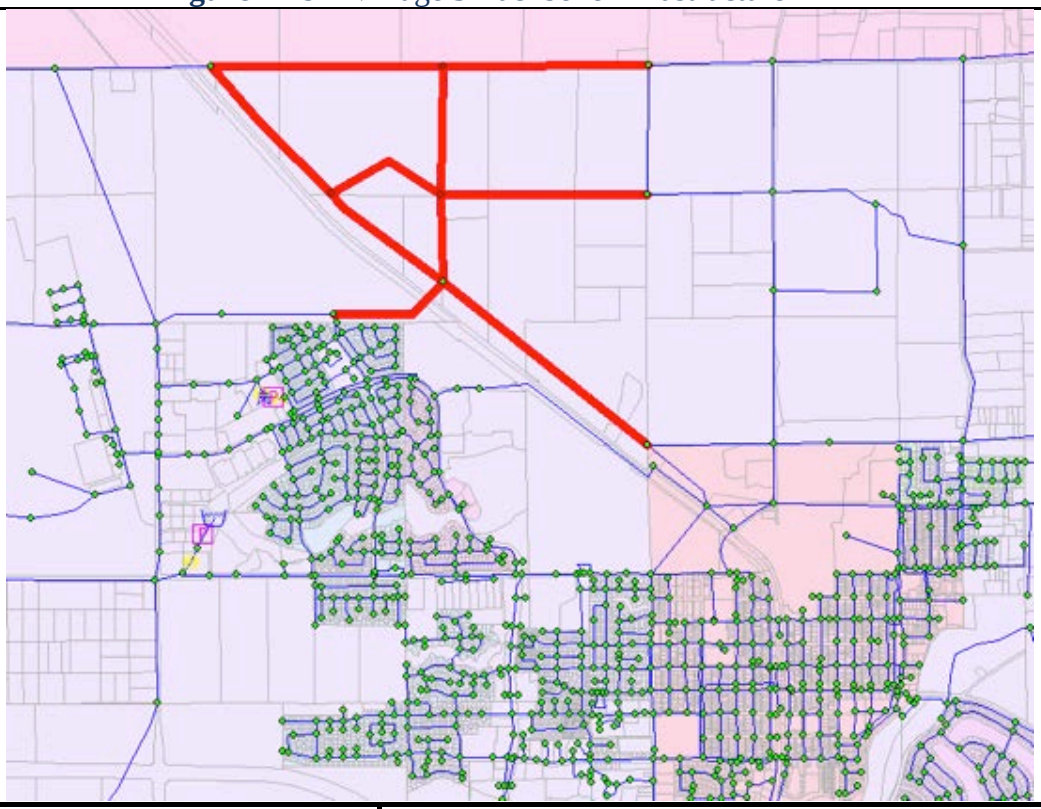
The proposed Village 2 infrastructure will be cornerstone project for serving the Village 3 development and other adjacent City areas as described above. Total costs as presented in the final table account for approximately $21 million[8].

[8] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4.4 Village 3 Backbone Infrastructure

The Village 3 Backbone infrastructure consists of the pipelines north of the existing City and west of Village 2 as well as the transmission lines from the future NID regional water treatment facilities to serve the NID service area that includes Village 3. Due to the current lack of City-developer activity on the Village 3 project, it is possible that a portion of the backbone infrastructure key to the NID RWSP will have to be completed as a specific City-financed project. The Village 3 potable water infrastructure will require oversizing above Village 3 needs to provide redundancy to other adjacent villages, and connection to existing City infrastructure. **Figure 11-9** depicts the Village 3 Backbone Infrastructure project.

Figure 11-9 – Village 3 Backbone Infrastructure



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Image Sources:
City Water System GIS, Licensed ESRI ArcGIS
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Table 11-8 shows the pipe lengths and diameters associated with the Village 3 Backbone Infrastructure project.

Table 11-8 – Village 3 Pipes

ID (Char)	Length (ft)	Diameter (in)
P-5968	1819.7	18
P-5970	4394.6	24
P-5972	4987	24
P-5976	2657.7	18
P-6078	4427.1	18
P-6352	2680.8	18

The proposed Village 3 infrastructure is a critical component for providing redundant service to the Village 4 development and other adjacent City areas as described above. Total costs as presented in the final table account for approximately $10 million[9].

[9] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4.5 Village 4/SUD A Backbone Infrastructure

The Village 4/SUD A Backbone infrastructure consists of the pipelines west of Village 3, at least 2 wells, and major north-south water supply connector pipelines near the airport. Due to the current lack of City-developer activity on the Village 4 project, it is possible that a portion of the backbone infrastructure key to looping supplies out to the western edge of the City will have to be completed as a specific City-financed project that will require reimbursement at a later time. The Village 4/SUD A potable water infrastructure will include significant oversizing above specific development needs to provide third party capacity to Villages 5 and 3 as well as a connection to existing City infrastructure around the airport. **Figure 11-10** shows the Village 4/SUD A Backbone Infrastructure Project.

Figure 11-10 – Village 4/SUD A Backbone Infrastructure

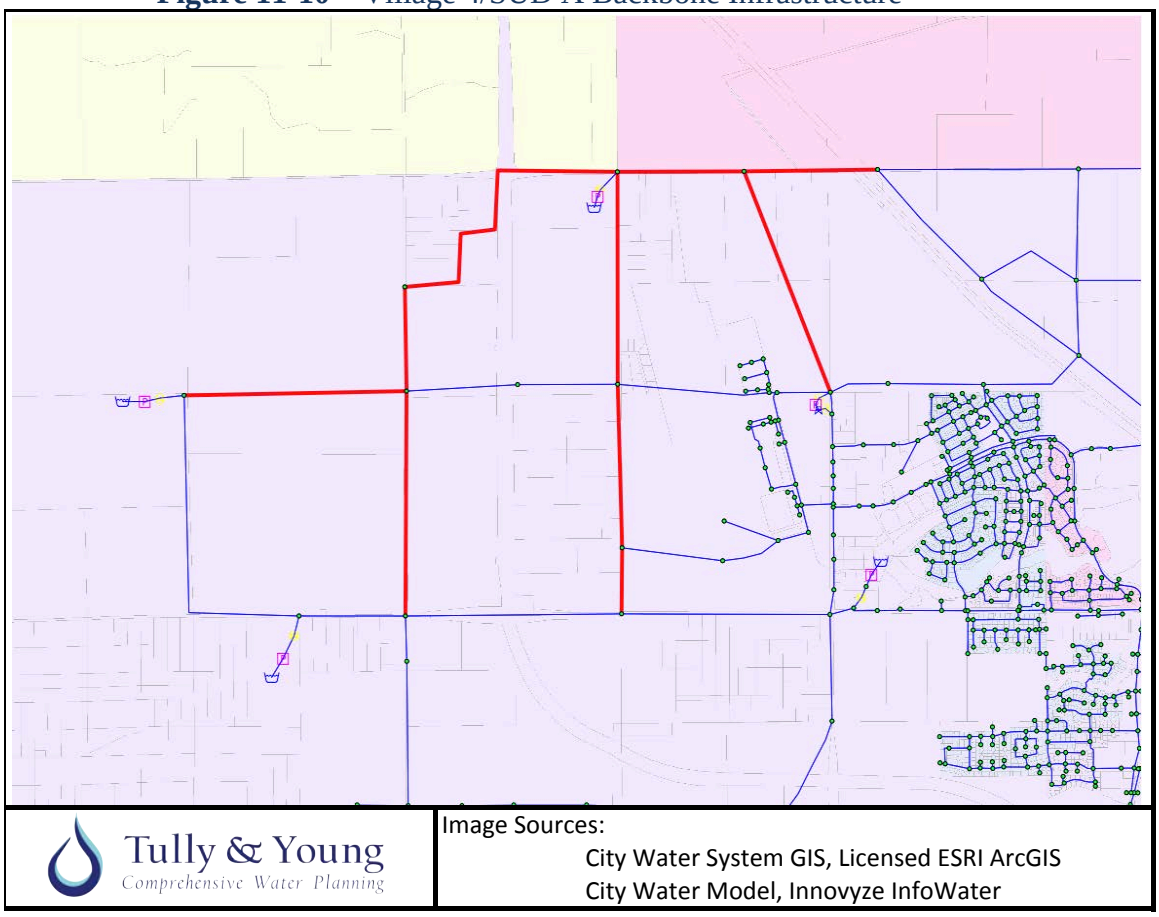


Table 11-9 shows the pipe lengths and diameters associate with the Village 4/SUD A Backbone Infrastructure Project.

Table 11-9 – Village 4/SUD A Pipes

ID (Char)	Length (ft)	Diameter (in)
P-5984	3,315	24
P-5986	5,745	18
P-5988	3,144	24
P-5990	5,124	18
P-5992	3,949	18
P-5996	1,595	18
P-6002	7,758	18
P-6072	5,429	18
P-6082	5,522	18
P-6110	2,513	18

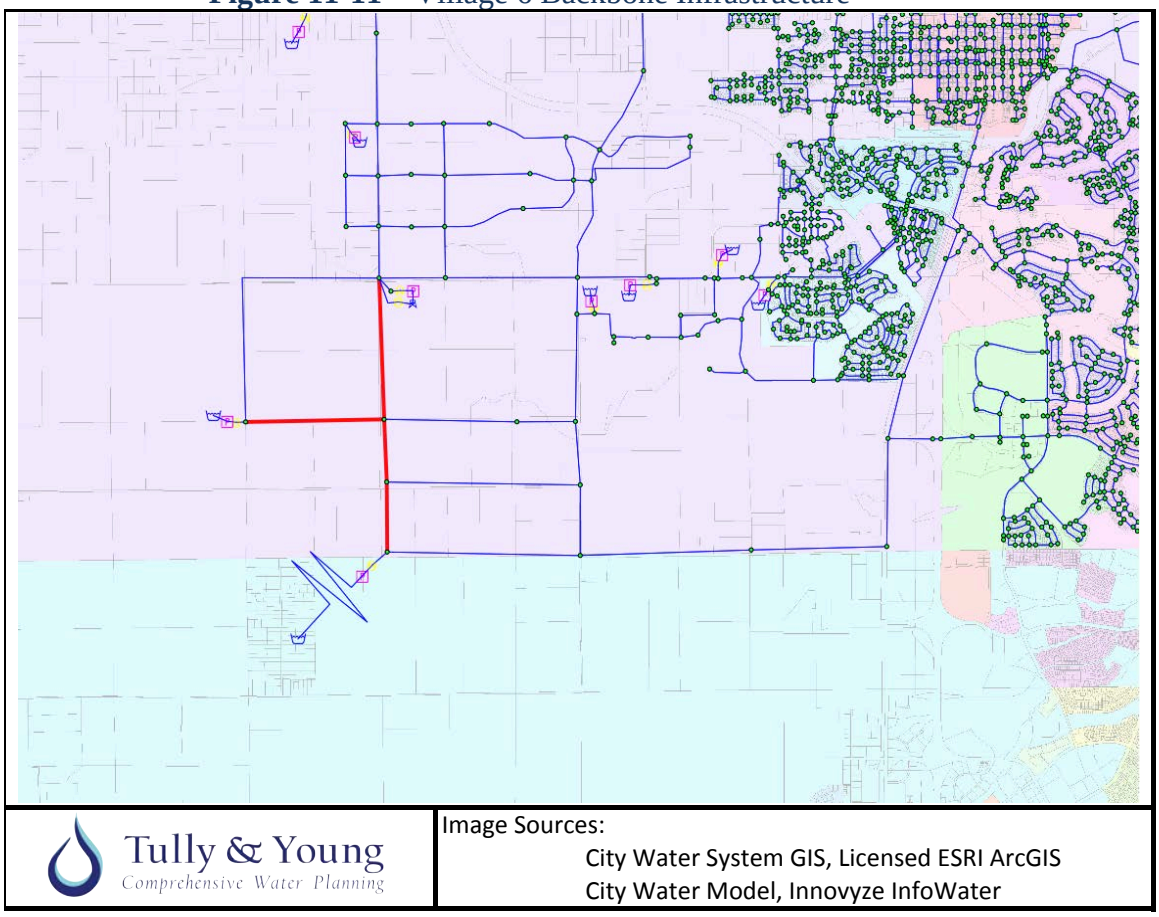
The proposed Village 4/SUD A infrastructure components are important for looping City-wide system supplies and serving other adjacent City areas as described above. Total costs as presented in the final table account for approximately $19 million[10].

[10] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4.6 Village 6 Backbone Infrastructure

The Village 6 Backbone Infrastructure consists of the pipelines running through Village 6 and connecting Village 5 to SUD C as well as completing the southern loop in the City's water system. These connections are necessary in order to meet system requirements commensurate with PCWA completing a potential surface water treatment plant. Due to the current lack of City-developer activity on the Village 6 project, it is possible that a portion of the backbone infrastructure key to PCWA treatment plant will have to be completed as a specific City-financed project that will require reimbursement at a later time. The Village 6 potable water infrastructure will include significant oversizing above Village 6 needs to provide third party capacity to Villages 5 and SUD C. **Figure 11-11** below depicts the Village 6 Backbone Infrastructure described in this section.

Figure 11-11 – Village 6 Backbone Infrastructure



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Table 11-10 below shows the pipe lengths and diameters needed to develop the Village 6 Backbone Infrastructure project.

Table 11-10 – Village 6 Pipes

ID (Char)	Length (ft)	Diameter (in)
P-6010	5,431	18
P-6066	2,412	18
P-6084	5,470	18
P-6274	2,685	18

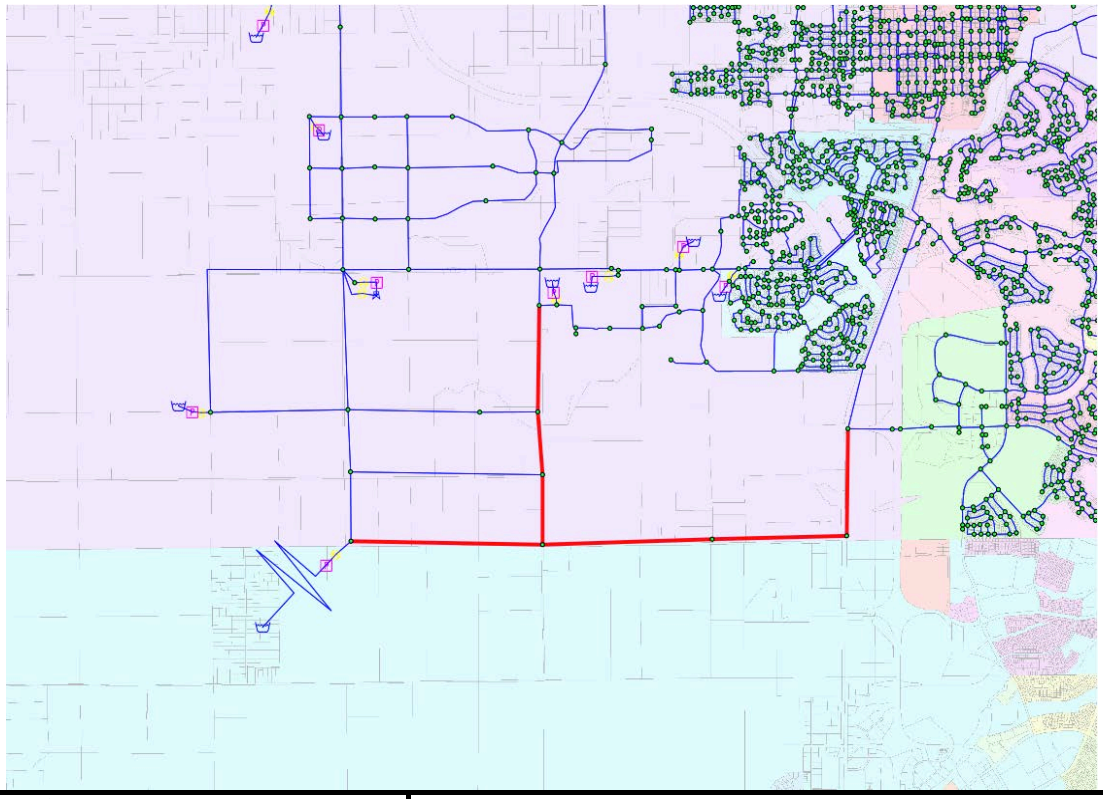
The proposed Village 6 infrastructure will be key to serving the south-west City development and other adjacent City areas as described above. Total costs as presented in the final table account for approximately $8 million[11].

[11] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

11.4.7 SUD C Backbone Infrastructure

The SUD C Backbone infrastructure consists of the pipelines along the southern City boarder west of Highway 65. Due to the current lack of City-developer activity on the SUD C project, it is possible that a portion of the backbone infrastructure key to Village 6 and a PCWA treatment plant connection will have to be completed as a specific City-financed project that will require reimbursement at a later time. The SUD C potable water infrastructure will include significant oversizing above SUD C requirements in order to provide third-party capacity to Villages 5 and 6, a possible PCWA treatment plant, and connection to existing City infrastructure. **Figure 11-12** depicts the SUD C Backbone Infrastructure project.

Figure 11-12 – SUD C Backbone Infrastructure



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Image Sources:
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Table 11-11 shows the pipe lengths and diameters associated with the SUD C Backbone Infrastructure project.

Table 11-11 – SUD C Pipes

ID (Char)	Length (ft)	Diameter (in)
P-6012	7,630	18
P-6014	6,758	18
P-6016	4,147	18
P-6104	2,708	18
P-6304	2,445	18
P-6346	4,126	18
P-6372	5,358	18

The proposed SUD C infrastructure will be instrumental for serving the Village 6 development and other adjacent City areas as described above. Total costs as presented in the final table account for approximately $13.8 million[12].

[12] Cost does not include the extra costs arising from crossings of creeks, highways, railroads, or other significant barrier.

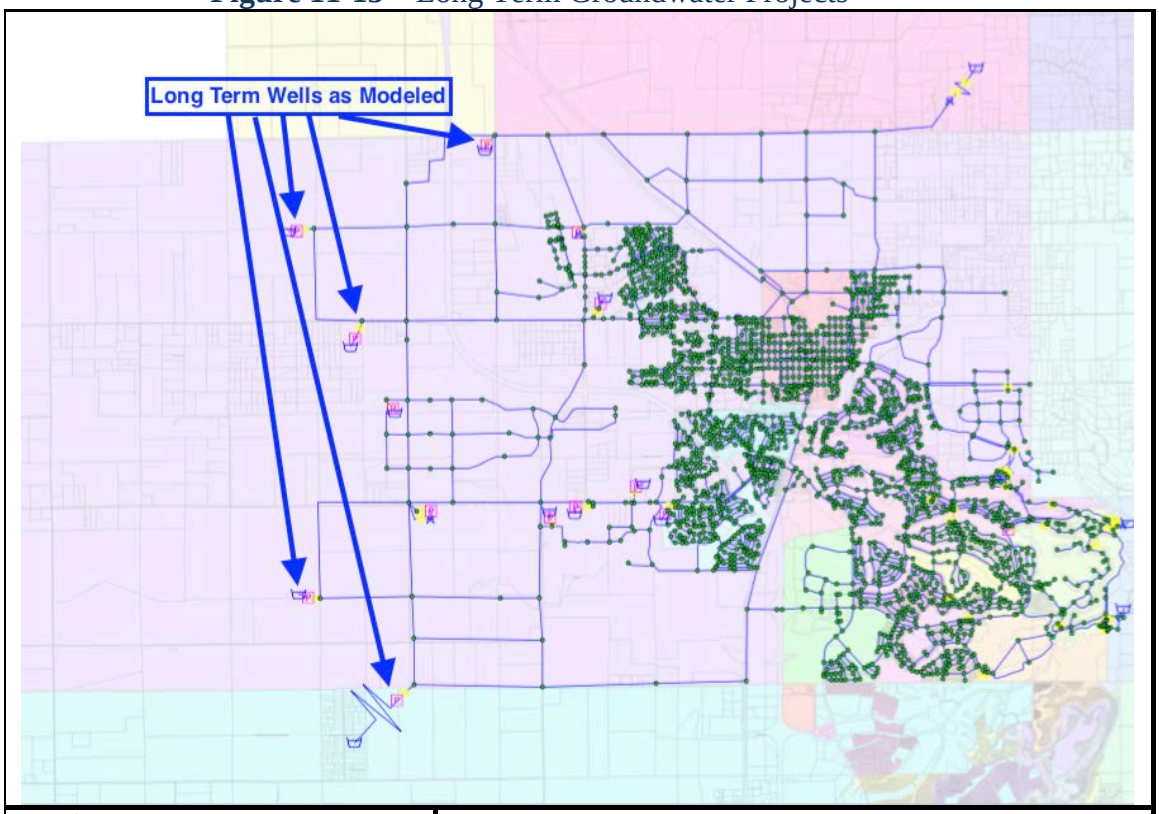
11.5 Groundwater Projects

Prior to reaching build-out, the City will need a number of groundwater projects to be constructed in order to maintain the City's peaking and backup groundwater supplies. Specifically, as noted in Chapters 3 and 6, the City anticipates deriving approximately 10% of its average annual supply from groundwater. Moreover, the City anticipates having the ability to pump as much as 75% of its average day demand in order to handle emergency conditions. **Chapter 9** depicts the model presentations and assumptions as related to the City's groundwater peaking and backup supplies. With the recent Well #2 and Nelson well upgrades the City now has adequate groundwater capacity to meet its system objectives for all near-term development that is underway or planned to be underway in the near future. Projects currently in the general near-term planning stages would likely need only one additional well. Currently, this additional well is planned to be located at the western portion of Village 5.

Long-term groundwater planning as modeled for build-out conditions includes five (5) additional wells located throughout the groundwater bearing areas in the City. The northernmost well is generally located in the SUD A area northwest of the airport. Two additional wells are planned for Village 4. And the two final wells are planned for the western and southern portions of Village 6.[13] No specific well locations in these general areas have yet been determined but initial investigations should be undertaken. No wells are planned for the SUD C area due to the distance from landfill and sewage treatment facilities. **Figure 11-13** depicts the potential future well locations as considered in the Innovyze model.

[13] The southern most well as modeled could also be considered a connection to a future PCWA Sacramento River water supply. Although these two sources would be significantly different when they come to fruition, the model allows both scenarios to be considered with the only differences being the size of the pump and delivery pipes. The potential for a potable surface water supply connection to the Sacramento River through the PCWA system is discussed in **Chapter 5**.

Figure 11-13 – Long Term Groundwater Projects



11.6 Long-Term Major Infrastructure Outside of City

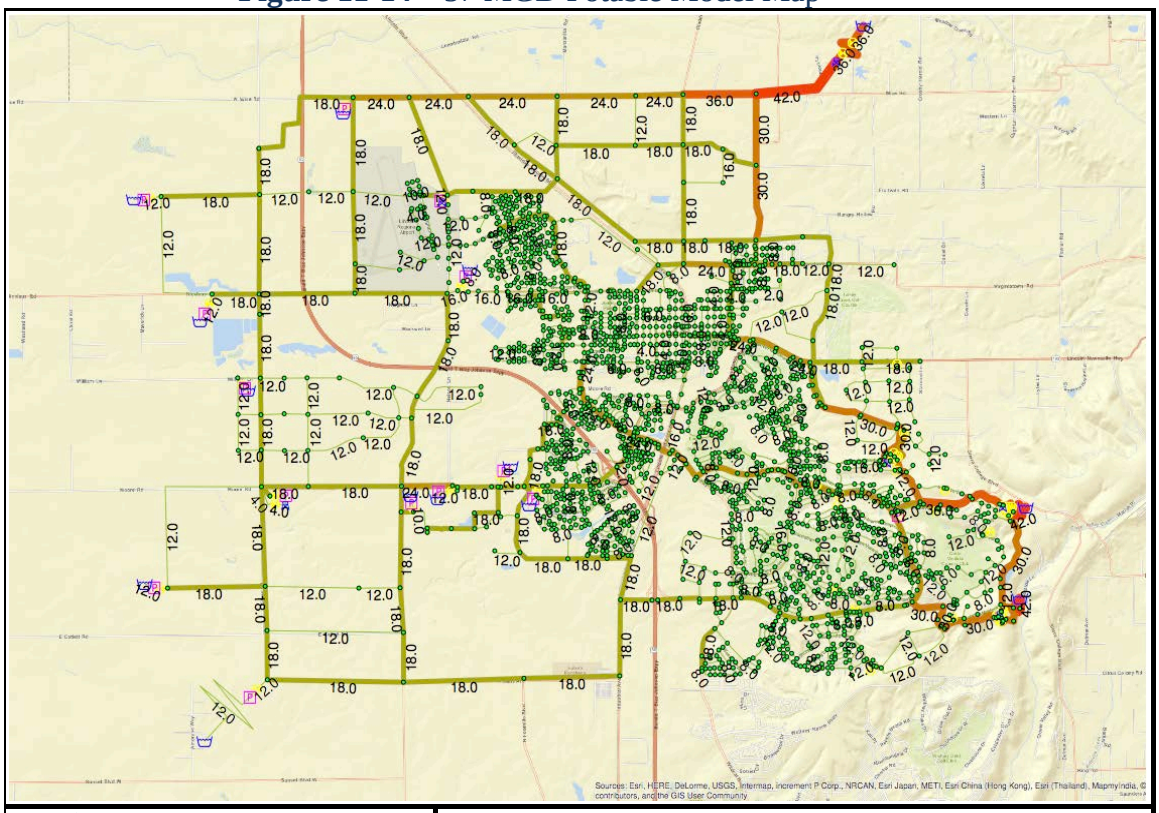
The City has been participating in the initial planning stages of PCWA's and NID's major infrastructure projects. The current proposals involve the City financially participating in the planning and feasibility studies as well as design and construction. For PCWA, the projects include the Bickford Ranch Pipeline, the Ophir Water Treatment Plant and the Sacramento River Diversion Project.[14] For NID, the project is the Regional Water Supply Project and the numerous raw water and treatment system components of that project. All of these projects are considered long-term projects for purposes of this analysis despite having been in the planning phases for many years. The development of both of these projects have a significant impact on the City's water supply reliability objectives – as noted in Chapter 7 – as well as large financial investments needed in order

[14] The December 2015 financial syllabus for the Bickford Pipeline and Ophir Water Treatment Plant indicates that the costs associated with the PCWA project will also include reimbursements for other previously constructed portions of the PCWA system that are linked to those facilities.

to bring them to fruition. As such, special consideration should be given to these projects.

The City's eight water workshops spanning from October 2014 to December 2015 considered the total max day water system facilities that the City should consider for its long-term water supply reliability (See **Chapter 7** that describes the considerations addressed in determining water supply reliability). The workshop results determined that the City should develop a reliable water supply system capable of delivering 67 MGD max day demand of which 57 MGD would meet potable water demands. **Figure 11-14** is a large-scale model map depicting the 57 MGD potable water delivery system.

Figure 11-14 – 57 MGD Potable Model Map



The City Council considered the options to deliver between 26 and 33 MGD of that 57 MGD through PCWA's treated water system and between 18 and 25 MGD through the NID treated water system. The City Council did not conclude where in this system build-out configuration it should choose until further information is developed. **Table 11-12** shows the summary supply scenarios for purposes of meeting the City's overall demand.

Table 11-12 – Alternatives Chosen to Meet City's 57 MGD Potable Demand

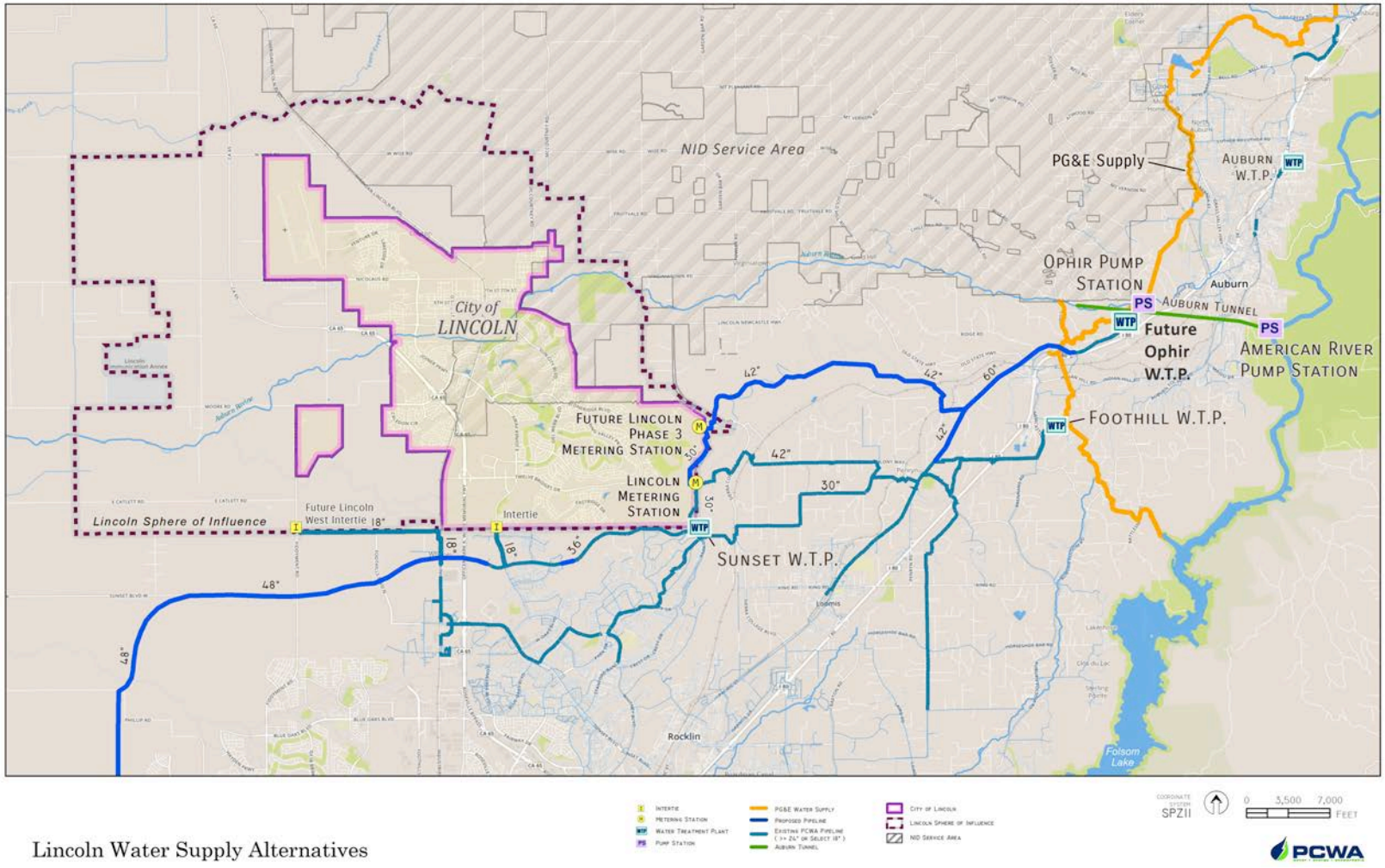
Capacity (MGD)	Scenario 3	
	Alt 1	Alt 2
PCWA Treated	33	26
NID Treated	18	25
Potable Groundwater	6	6
Non-Potable	10	10
Total	**67**	**67**

The treated water deliveries from PCWA's system could be derived from a number of sources but the primary additional source would be the Ophir Water Treatment Plant and the associated infrastructure. The treated water deliveries from NID's system would be derived from the Regional Water Supply Project.

11.6.1 PCWA Facilities

As described in Chapter 3, the City is considering major capital investments in facilities that will be owned and operated by PCWA. These facilities include the PCWA Ophir Water Treatment Plant and 60-inch transmission line, the 42-inch Bickford Pipeline, and the Sacramento River Diversion Project. **Figure 11-15** shows the Ophir Water Treatment Plant and 60-inch transmission line as well as the 42-inch Bickford Pipeline planned alignment.

Figure 11-15 – PCWA Future Ophir Water Treatment Plant and Transmission Facilities



The Ophir Water Treatment Plant, the 60-inch transmission main, and the 42-inch Bickford Pipeline are incorporated into the cost assessment provided by PCWA in December 2015.[15] These cost assessments are shown below, collectively with the NID RWSP cost assessments, in **Table 11-13**.

Table 11-13 – PCWA and NID Treatment and Conveyance Cost Table[16]

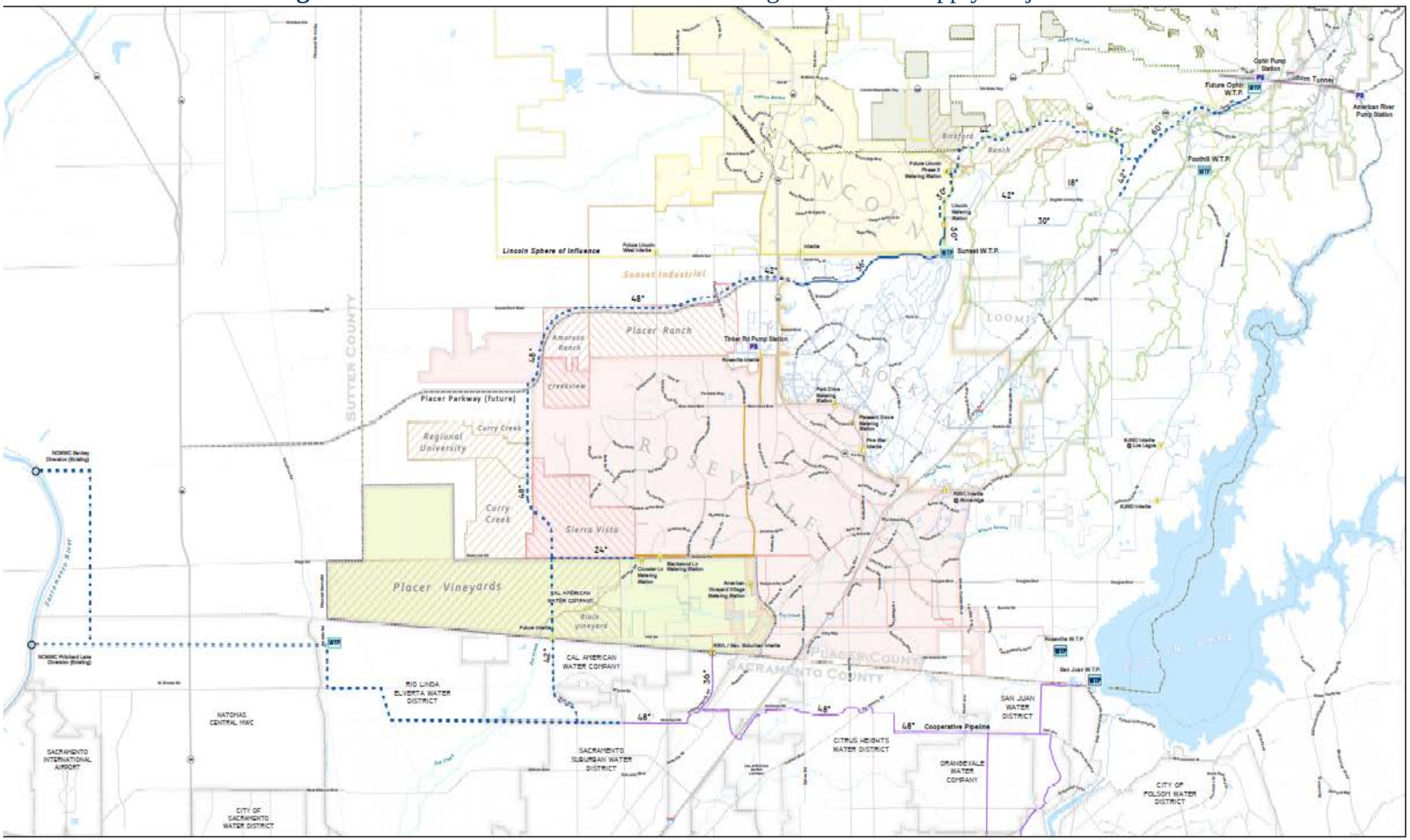
Costs ($ Millions)	Scenario 3	
	Alt 1	Alt 2
PCWA Treated	143 – 218	72 - 113
NID Treated	120	*166
Potable Groundwater	25	25
Non-Potable	38 - 55	38 - 55
Total	**326 - 418**	**301 - 359**

Also relevant to this discussion is the possibility of eventually receiving water from PCWA's Sacramento River Diversion Project. Although the City has decided to not consider this project in its long-term water supply reliability planning, it is important to consider in order to understand the potential for PCWA wholesale water deliveries derived from this facility in the future. **Figure 11-16** shows the one alignment of the pipeline supplying water from the Sacramento River Regional Water Supply Project. There are no cost assessments considered for this project at this time.

[15] Additional cost assessments that may be available related to this project have not been considered in this CWMP but should be assessed as the projects progress.

[16] This table also depicts the approximate costs of 6 MGD of groundwater well capacity as well as 10 MGD of non-potable water supplies derived from raw and recycled sources.

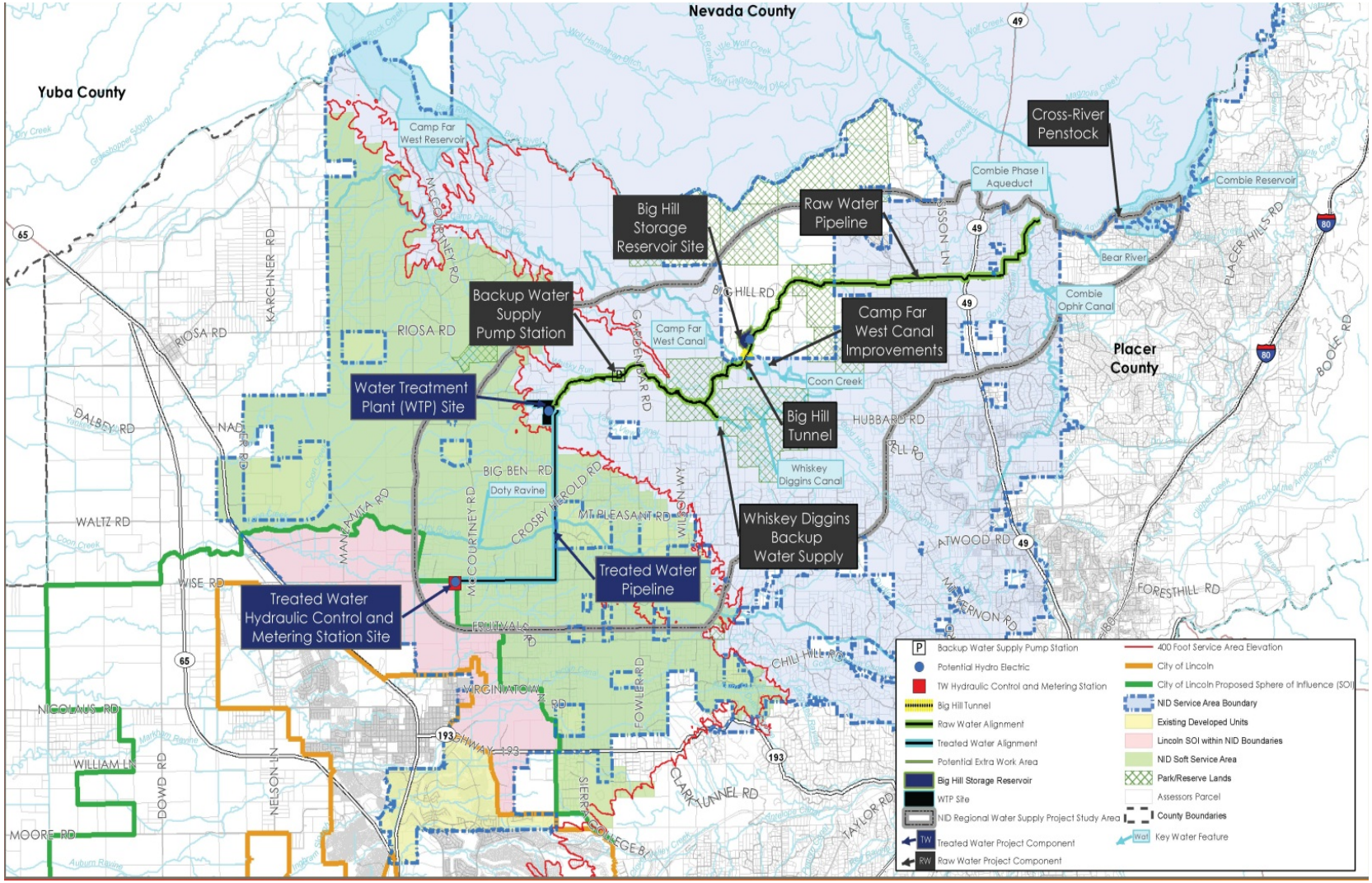
Figure 11-16 – PCWA's Sacramento River Regional Water Supply Project



11.6.2 NID Regional Water Supply Project

The NID Regional Water Supply Project incorporates a number of project improvements to NID's overall system as well as construction of a water treatment plant that would result in potable water deliveries to the City of Lincoln. All of these components are considered in the cost phasing provided by NID. **Figure 11-17** shows the planned alignments of infrastructure for the NID Regional Water Supply Project.

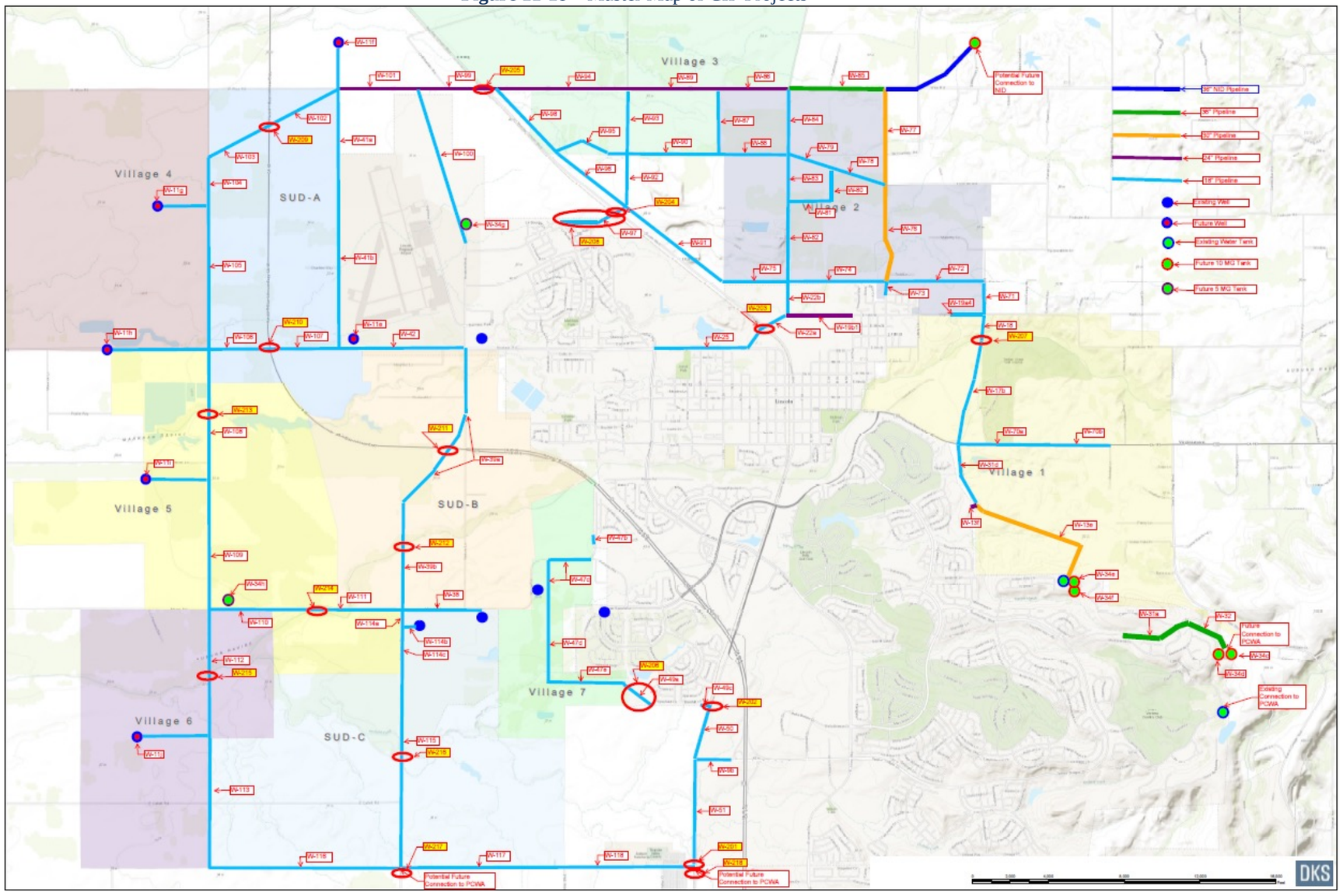
Figure 11-17 – NID Future Transmission Facilities



11.7 Summary of CIP Projects Necessary for Build-out

All of the internal City projects considered in this Chapter are currently planned for development in order to meet build-out demands in the City of Lincoln. The projects are collectively shown in the following map shown in **Figure 11-18**. This figure does not depict the major infrastructure projects that were noted in **Section 11.6**. The City will continue to investigate the feasibility of the identified external projects and consider those projects in the context of the City's water supply reliability assessments as noted in **Chapter 7**.

Figure 11-18 – Master Map of CIP Projects[17]



[17] Map as of February 22, 2016

The details of all pipes included in this analysis are detailed in the table below. Total costs are estimated in 2015 dollars to be about $120 million before accounting for the extra costs of creek, rail, and highway crossings[18].

Table 11-14 – PFE Pipes

* BO *	PFE Proj. No.	Length (ft)	Dia. (in)	Estimate Cost
E. Wise Road	W-85	4,090	36	$ 3,416,302.08
D/S Reservoir 1-repl 20"	W-13e	6,800	30	$ 4,732,800.00
D/S Res 1 Tank-repl 20"	W-13f	1,000	30	$ 696,000.00
S. off P-5948	W-76	4,152	30	$ 2,889,931.20
S off NID 36" at Wise Rd	W-77	3,896	30	$ 2,711,824.80
Wise Rd, w of P-5984 & P-5946	W-101	3,145	24	$ 1,751,136.00
Virginiatown, W of East@McCoffin	W-19b1	2,672	24	$ 1,487,602.56
Moore Rd , e of Nelson	W-38	2,851	24	$ 1,587,436.80
Wise Rd, east of P-5972	W-86	7,055	24	$ 3,928,224.00
Wise Rd , east of old H65	W-94	4,987	24	$ 2,776,761.60
Wise Rd west of old H65	W-99	3,315	24	$ 1,845,624.96
W of H65, s from Wise Rd	W-100	5,745	18	$ 2,398,944.96
Wise to Dowd, nw corner	W-102	3,800	18	$ 1,586,880.00
	W-103	3,958	18	$ 1,652,860.80
Dowd Rd, N P-6072 from Nicolaus	W-104	2,513	18	$ 1,049,261.76
Dowd Rd, N of Nicolaus	W-105	5,430	18	$ 2,267,568.00
Nicolaus Rd E from Dowd	W-106	2,600	18	$ 1,085,760.00
"	W-107	2,770	18	$ 1,156,752.00
Dowd, s of Nicolaus Rd	W-108	4,579	18	$ 1,912,190.40
Dowd Rd, n of Moore Rd	W-109	5,920	18	$ 2,472,192.00
Moore Rd, e of Dowd Rd	W-110	2,843	18	$ 1,187,236.80
"	W-111	5,000	18	$ 2,088,000.00
Dowd Rd, s of Morre Rd	W-112	5,430	18	$ 2,267,568.00
Dowd Rd, n of Athens	W-113	5,096	18	$ 2,128,089.60
Fiddyment Rd, s of Moore Rd	W-114	700	18	$ 292,320.00
To FiddmntRd from FiddmntWell	W-114b	691	18	$ 288,436.32
Fiddymnt, s of Well tie-in	W-114c	1,000	18	$ 417,600.00
Fiddyment Rd, n of Athens Rd	W-115	9,000	18	$ 3,758,400.00
Athens Rd, e of Dowd Rd	W-116	7,600	18	$ 3,173,760.00
Athens Rd , w of Industrial Rd	W-117	6,614	18	$ 2,762,006.40
"	W-118	5,500	18	$ 2,296,800.00
Oaktree Lane, n of H193	W-17b	4,768	18	$ 1,991,116.80
	W-18	1,000	18	$ 417,600.00
Crossing old Hiway 65 at Pottery	W-22	3,300	18	$ 1,378,080.00
S of Vtown, e of Old H65	W-22b	1,263	18	$ 527,428.80
Verify W-25 w of Pottery/Old H65	W-25	4,000	18	$ 1,670,400.00
Nelson Rd, s of Nicolaus Rd	W-39a	6,080	18	$ 2,539,008.00
Nelson Rd, n from Moore Rd	W-39b	5,120	18	$ 2,138,112.00
S from Wise Rd, off P-5988	W-41a	5,124	18	$ 2,139,782.40
Airport Rd, n of Nicolaus	W-41b	5,545	18	$ 2,315,592.00
Nicolaus Rd E of P-V5F-144	W-42	5,180	18	$ 2,163,168.00
N frm Moore Rd & P-6044	W-47c	4,500	18	$ 1,879,200.00
S frm Moore Rd, e of Linc Crossing	W-47d	4,000	18	$ 1,670,400.00
S end of Lincoln Crossing, frm ex 18"	W-47e	3,860	18	$ 1,611,936.00
RR Crossing in Industrial to LCrssng	W-49c	200	18	$ 83,520.00
Industrial Rd, n of Athens Rd	W-51	4,150	18	$ 1,733,040.00
Highway193, e of Oaktree	W-70a	2,907	18	$ 1,214,130.24
H193, e of P-6062	W-70b	3,263	18	$ 1,362,754.08
North of P-6324	W-71	1,450	18	$ 605,520.00
East of s end of 30-inch P-5946	W-72	4,090	18	$ 1,707,984.00
S off 30" & W-72-tie to ex.	W-73	300	18	$ 125,280.00
West of s end 30"-P-5946	W-74	4,050	18	$ 1,691,280.00
W of W-74, e of old H65	W-75	3,000	18	$ 1,252,800.00
18" e of 30"	W-78	2,201	18	$ 919,304.64
Verify Diagonal pipe w of 30"W-77	W-79	2,300	18	$ 960,480.00
S of Diagonal Pipe, w of 30" W-76	W-80	1,300	18	$ 542,880.00
"	W-81	1,400	18	$ 584,640.00
	W-82	3,210	18	$ 1,340,537.76
S of P-5952 off w end of 36' in Wise	W-83	2,056	18	$ 858,460.32
S from Wise Rd, P-5970 & P-5950	W-84	2,743	18	$ 1,145,518.56
S of Wise Rd, E of old Hiway 65	W-87	2,700	18	$ 1,127,520.00
E of H65,parallel to Wise (orP6078)	W-88	3,113	18	$ 1,299,988.80
Wise Rd, east of P-5972	W-89	4,300	18	$ 1,795,680.00
E of H65,parallel to Wise (orP6078)	W-90	4,000	18	$ 1,670,400.00
E of & parallel to old H65, n of W-75	W-91	5,800	18	$ 2,422,080.00
S., Crossing H65, from P-6352	W-92	1,500	18	$ 626,400.00
S from Wise Rd - P-5984 & 5970	W-93	2,681	18	$ 1,119,502.08
Dogleg s of Wise, e of old H65	W-95	3,800	18	$ 1,586,880.00
Wise Rd , east of old H65	W-96	4,200	18	$ 1,753,920.00
Wise Rd , east of old H65	W-97	3,000	18	$ 1,252,800.00
Twelve Bridges Dr, e of Industrial Rd	W-98	1,770	18	$ 739,152.00
				$ 118,030,547.52

[18] This preliminary cost estimates in the document are based on a $16 per inch diameter per foot with an additional 45% soft cost for design and engineering.

CHAPTER 12. WATER MANAGEMENT RECOMMENDATIONS

The purposes of this chapter are to summarize the strategic recommendations derived from the previous eleven chapters of the Water Master Plan that meet the City's long-term water management objectives. These fundamental objectives include protecting the City's water supply reliability, improving water planning and management, and constructing the necessary infrastructure to meet current and future demands. As described in **Chapter 1**, the ever-changing California Water Framework coupled with the City's rapid expansion necessitate continued diligence on water management issues in order to protect the City's water interests. Maintaining reliable long-term water supplies requires persistent efforts to stabilize the water asset acquisition, finance and build key infrastructure, create system flexibility to adapt to changed conditions, and stabilize internal water management efforts. All of these points are fundamental to the detailed recommendations in the pages that follow.

Chapter 1. Recommendations

Chapter 1 outlined the California Water Framework's primary components and provided a brief history of the City of Lincoln's water use and management efforts. The primary recommendations derived from **Chapter 1** are to continue to monitor the big-picture issues that constitute California's Water Framework and identify additional issues as they arise and are integrated into the Water Framework. In this implementing these recommendations, the key areas that the City should continue monitoring in California's Water Framework are:

- Demographic trends and urbanization growth rates.
- Climate change and statewide hydrological pattern changes.
- Water rights law and the continuous changes to those laws.
- Water governance including the intrusion of additional State and Federal regulatory agencies into the water realm.
- Trends in integrated land and water planning, including new laws and regulations that further intertwine the two specialty fields.
- Opportunities to develop long-term infrastructure projects that may be funded by alternative sources.

From an historical perspective, and as recommended in **Chapters 10** and **11**, the City should assess the projects associated with its long-term Capital Improvement Program

and replace aged infrastructure through its Facilities Replacement Program. The City should also remain cognizant of the continuous changes in water use that have permeated the City's history and anticipate that additional water use changes will occur in the future as California's economy, and the City of Lincoln, continue to evolve. Recognizing the potential for change in how and where water is used in the City translates into more intelligent and flexible water system infrastructure design.

Chapter 2. Recommendations

Chapter 2 overviewed the City's organization as it relates to water management as well as the numerous planning documents associated with water management that affect the City. The primary recommendation from this chapter is to fully integrate the land planning staff and water planning staff in future planning efforts in order to produce a logical and thorough progression for specific land planning processes. Specifically, the City should:

- Improve communications through all vertical and horizontal layers of the City's governance through the City Manager's strategic organizational staff placement and coordinated project management.
- Identify and rectify critical water cross-over issues in each department, like the importance of documenting water demand for the City Engineer and Community Development Department for infrastructure and water reliability planning as well as the billing needs of the Support Services Division.
- Create a strategic planning process for organizing and synthesizing all planning documents as described in **Chapter 2**.
- Develop a reasonable timeline to regularly modify overarching planning documents so as to best inform more detailed planning documents and development agreements. For instance, update the Water Master Plan and Urban Water Management Plan on a joint cycle every 5 years.
- Assign key staff organizational authority and consultation privileges as they are applicable to water and land planning documents.
- Create a specific land and water planning procedure that is applicable to all large and small development projects within the City. Cross-reference planning documents in the context of this planning procedure.
- Update important planning documents on a timely basis like the Housing Element of the 2008 General Plan.

- Track updates to the California Environmental Quality Act (CEQA) that are applicable to the water and land planning efforts to the City – like the California Supreme Court's *Vineyard* Decision.

- Update planning policies that are relevant to the City's ongoing water planning efforts. For example, clarifying and formalizing the policy related to the groundwater percentage that will be available for the City's annual and emergency uses.

- Establish water management and planning protocols related to low threshold projects – those that do not meet the statutory minimum for preparing water planning documentation.

- Enhance the City's water reclamation plan and develop strategies for utilizing reclaimed water either through direct delivery to City end-users or to other users so that alternative supplies can be created for additional City use.

These recommendations require a synthesized assessment of City governmental communications and departmental utility through the City Manager's office. Creating a thoughtful planning process and integrating key staff into that process requires inter-disciplinary management communication and a coordinated substantive planning review processes.

Chapter 3. Recommendations

Chapter 3 described PCWA's and NID's wholesale water facilities used by the City and planned for the City as well as the City's retail water system. The primary recommendation derived from this Chapter is to continue to document the City's specific water infrastructure so as to have accurate system representations for purposes of model development (**Chapter 9**), the Facilities Replacement Program (**Chapter 10**), and Capitol Improvement Program (**Chapter 11**). Inaccurate or incomplete information related to the City's water system may lead to poor infrastructure planning and emergency conditions. For instance, as described in **Section 3.2.2.4**, the Catta Verdera Booster Pump provides water from the City's regulated system into the Catta Verdera development. A failure of this Booster Pump station would create dire conditions for Catta Verdera as there is currently no redundant system to deliver water. The City's understanding of this infrastructure constraint led to a fast-track for the Phase III project that would direct more water assets into the Catta Verdera development from an alternative location and allow the booster pump station to become a back-up facility. Accurate mapping and cataloguing of the City's system is a foundational element for all project planning activities and should be regularly updated as new information becomes available.

Chapter 4. Recommendations

Chapter 4 details the City's water demands as needed for assessing long-term City urbanization water supplies as well as peaking factors needed for infrastructure sizing. The recommendations derived from this Chapter are as follows:

- Complete a comprehensive customer meter study every 5 years to evaluate any necessary refinements to land-use based demand factors.
- Regularly update the **Master Demand Spreadsheet Tool** in order to keep real-time demands and future demand predictions updated for project development and implementation.
- Track addresses of residential and commercial water use audits and rebate programs and analyze before and after conditions to assess the benefits of audits (including non-audited customers can help evaluate the benefits of the audit compared to naturally occurring changes in water use).
- Increase the information and functionality of the existing City SCADA system to obtain more data points to further improve pressure and flow management.
- Calibrate system meters and replace undersized system meters.
- Install additional meters on main transmission lines in key areas of the system to enable improved understanding of customer water use dynamics.
- Expand support for PCWA and NID raw water supplies to offset potable demands. Use of raw water will reduce the demands on the City's potable water infrastructure and reduce Max Day and peak hour demands.
- Expand use of recycled water and raw water to also reduce the demand on the City's potable water infrastructure.
- Investigate potential water use policies that can help manage peak hour and Max Day demands in a manner that can decrease pipeline sizing and other infrastructure expansion.

Chapter 5. Recommendations

Chapter 5 analyzes the City's surface water assets, including supplies available for potable and non-potable uses. The primary recommendation from this section is that the City should take all reasonable efforts to maintain its surface water assets from all sources. In order to implement this recommendation, the City should take the following actions:

- Assess and rectify potential discrepancies in the PCWA Treated Water Supply Contract. Such discrepancies may include the delivery status and costs associated with regulated and unregulated water supplies as well as the availability of water under certain ambiguous conditions.

- Monitor and support PCWA's permit renewal process for water right permits 13856 and 13858.

- Assess the long-term reliability of PCWA permitted water rights in light of increased demand on the American River watershed system and the water right priority date of 1958. Consider reliability in light of other regulatory demands, including those associated with maintaining endangered and threatened species in the American River and Sacramento River watersheds as well as Bay-Delta water quality requirements (discussed in **Chapter 8**).

- Fortify the City's desire to receive water assets from the Eastern Sierra watersheds rather than the Sacramento River watershed and assess the City's ability to link supply reliability to PCWA's PG&E contract entitlements as well as storage diverted into PCWA's surface water storage facilities.

- Support PCWA water system upgrades related to improving delivery reliability to the City from PCWA's American River and Yuba/Bear Rivers water assets. The Phase III pipeline and new metering station is an example of this system support.

- Assess PCWA's ability to deliver its CVP contract entitlements to areas within PCWA's service area. Such assessment may include understanding PCWA's future ability to divert and use CVP contract entitlement water from the American River watershed system as well as the Sacramento River system.

- Understand PCWA's long-term demand for its water assets throughout PCWA's service area. Assess growth rates and patterns to understand whether growth in PCWA's service area may impact the reliability of PCWA supplies delivered to the City.

- Coordinate with PCWA in its efforts to assess water supply reliability issues associated with climate change and variable hydrological runoff patterns as they change over time.

- Support PCWA and NID conveyance agreements where redundancy is created in both entities water systems in order to deliver surface supplies derived from both entities into the City from both delivery systems.

- Secure PCWA's raw water deliveries to the City of Lincoln and its SOI in order to reduce costs and demands on the potable water system and maintain a broad water supply portfolio.

- Support PCWA's decision to design and construct the Ophir Water Treatment Plant.

- Correct the potential reliability issues associated with the NID Temporary Water Service Contract to the City of Lincoln. The City should immediately meet with NID management in order to gain further assurances of the water services provided by the service contract.

- Monitor filings and developments associated with NID's pre-1914 and post-1914 appropriative water rights. Specifically, the City should continue to review the legally required filings provided by NID and assess the usability of NID's water assets in the City over time.

- Assess the long-term reliability of NID water rights in light of increased demand in Placer County and Nevada County, including demands associated with maintaining endangered and threatened species as well as Bay-Delta water quality requirements (discussed in **Chapter 8**).

- Fortify the City's desire to receive NID water assets from the Eastern Sierra watersheds.

- Support NID water system upgrades related to improving delivery reliability to the City from the American River and Yuba/Bear Rivers water assets. Improvements in conveyance through components associated with the NID Regional Water Supply Project (depicted in **Figure 3-4**) would improve delivery reliability.

- Understand NID's long-term demand for its water assets throughout NID's service area in both Placer and Nevada counties, including NID's "soft-service area." Assess growth rates and patterns to understand whether growth in NID's service area may impact the reliability of NID supplies delivered to the City. Assess the water supply reliability impacts from converting agricultural lands to urban lands.

- Coordinate with NID in its efforts to assess water supply reliability issues associated with climate change and variable hydrological runoff patterns as they change over time. Specifically, support NID's additional water rights filings as well as its commitment to build additional surface water storage to handle impacts associated with climate change.

- Secure NID's raw water deliveries to the City of Lincoln and its SOI in order to reduce costs and demands on the potable water system and maintain a broad water supply portfolio.

- Support NID's desire to design and construct the Regional Water Treatment Plant in order to create surface water supply reliability within the City of Lincoln as well as create redundant infrastructure systems capable of supporting the City in emergency outage conditions.

- Continue to develop and enhance the City's recycled water supply and develop associated uses for that supply that relieve tension on the potable water system.

- Identify non-potable demands both within and without the City of Lincoln and its SOI that may be available to use recycled water supplies.

- Update the City's master reclamation permit in order to increase the opportunities for conveyance and use of reclaimed water to areas in and around the City of Lincoln.

- Secure the City's wastewater discharges into Auburn Ravine by formally identifying those waters as foreign, developed, and salvaged supplies and documenting the utility of the supplies for the City.

- Preserve surface water assets associated with lands scheduled for development. Assign developmental water assets to the City in order to meet potable and non-potable water supply needs.

All of these recommendations will require the City management and staff to take affirmative actions in order to best protect the City's water assets for current and future uses. Preservation of the City's water supply portfolio is a fundamental component to ensure well-planned growth within the City and its SOI.

Chapter 6. Recommendations

Chapter 6 analyzes the City's groundwater system by defining the groundwater basin, assessing the City's groundwater infrastructure and uses, and highlighting the groundwater governance issues associated with the City's groundwater rights. The primary recommendation derived from this chapter is that the City should secure and preserve its groundwater rights for long-term water supply reliability. Accordingly, the City should take the following actions:

- Alter the City's water management efforts in order to meet 10 percent of its average annual demands by increasing pumping in the summer months under peaking conditions rather than throughout the course of the year. This would require revising or drafting new policies governing the quantity of groundwater available at different

times throughout the year and how those supplies can be accessed. It may also require some level of infrastructure improvement in the City's water system, including additional wells.

- Identify exact volumes of groundwater needed to meet short-term and long-term water needs, including needs in emergency conditions. The City is moving from a long-term projected annual groundwater demand of approximately 11,800 acre-feet per year under the 2008 General Plan to closer to 3,500 acre-feet per year. Peaking management will require evaluation of the utility of this number over regular increments.

- Quantify the City's backup groundwater demand need. The City has historically considered emergency backup groundwater supply to be 75 percent of average day demand. With multiple surface water and groundwater sources planned in the future, assessing total groundwater needs for emergencies, including pumping durations, is a priority.

- Develop emergency water management protocols and backup electrical and treatment systems to handle water supplies in case of a large-scale outage. Emergency protocols should include identification and installation of backup generators, automated water quality testing, and redundant system management.

- Identify the best locations for peak management and emergency back up wells in the western part of the City and SOI. This assessment should coincide with the development approvals in various areas within the City and its SOI, especially those associated with active specific plan areas such as Village 5. The groundwater well identification should consider both potable and non-potable water sources.

- Preserve the agricultural wells that may be available for non-potable uses as development progresses. Numerous agricultural wells cover a broad area where General Plan development is planned. The City should work with the landowners where development is set to occur as well as the development community to identify and map the agricultural wells for potential future use.

- Conduct regular independent well system testing to ensure basin hydrology is sustained. The City should further its existing policies to monitor groundwater basin health and evaluate groundwater recharge.

- Monitor groundwater quality issues. The contamination sites already in and around the City need continued attention to ensure that any contamination area is wholly contained and meeting clean-up objectives. The City should also be diligent in monitoring its groundwater network to identify any further contamination potential.

- Assess threats to resources from industrial development as well as existing groundwater plumes. Inappropriately located industrial facilities – like mining operations – have the potential to disrupt groundwater migration and natural basin recharge. Accordingly, managing locations and operations of industrial facilities will help sustain the long-term health of the Subbasin.

- Create formal City Council policy that maintains 10 percent average annual groundwater use for City water supply operations that is calculated on a 10-year running average. The City's current policy is ambiguous to the measurement of the usage of groundwater. The running average over the course of a 10-year period would allow for fluctuations in groundwater usage based upon hydrological and climatological conditions that may impact how surface water deliveries are made.

- Preserve and store groundwater as a contingency source during drought conditions. The preservation and storage of groundwater requires developing a mechanism to account for groundwater offsets attributable to investments in surface water projects. The City should develop initial protocols to address opportunities to preserve groundwater for additional uses.

- Utilize naturally percolating groundwater to manage peaking and emergency issues. Peaking issues are associated with short-term high demand on a water system that is generally made during the high-water using months in the summer. Peaking is most acute on the hottest days of the year. The City should also preserve the percolating groundwater to handle unforeseeable emergency conditions.

- Develop groundwater recharge projects and policies beyond in-lieu recharge efforts. The City should assess the opportunities to recharge groundwater systems with systematic application of raw surface water, recycled water and potable water to spreading basin or ASR projects within and around the City. The City of Roseville was successful in developing an ASR project that may be worth considering in the City.

- Account for the regional benefits to the groundwater basin that the City's acquisition of surface water resources has created. The accounting could include an assessment of total water usage over the course of the last 10 years coupled with a reasonable calculation of loss factor. The improvement to the groundwater levels in and around the City of Lincoln should be evidence of the benefits that the City's modified water use ethic is having on regional systems.

- Assess the issues associated with increased groundwater pumping on the west side of the North American Subbasin. Long-term continued drawdown not only impacts the City's conjunctive use efforts and groundwater banking, but also changes the overall dynamics of the groundwater basin – potentially permanently. The City should

actively engage the additional groundwater pumping and basin drawdown to assess potential opportunities to improve basin conditions.

- Protect local and regional flood plains in local drainage systems in order to improve opportunities for groundwater recharge.

- Engage Federal, State, and regional agencies on their governing interests in the North American Subbasin. The Federal and State agencies have diverse interests in the management of these basins and engaging these entities before problems develop should be a priority.

- Assess regional and local governing agency involvement in creating sustainability agencies. SGA has already submitted to create its own GSA under the SGMA. Since SGA's new GSA will impact groundwater planning in the North Area Subbasin, it is critical for the City to continue to be involved with the GSA formation process. As such, the City should actively participate in the formation of GSA's within the North Area Subbasin boundary.

- Coordinate GSA formation with SGA and other regional agencies. Coordinating efforts, aligning interests, and assessing opportunities should be of paramount importance over the course of the next few months.

- Facilitate stakeholder participation in creating the WPCGMP sustainability agency. The stakeholder groups may have unique perspectives in managing regional water assets and early engagement may quell unnecessary political opposition. Existing trepidation between private rural citizens and urban areas should be curtailed at the earliest possible time.

- Preserve decision-making authority for the City on any governing body formed out of SGMA. The City's groundwater rights must be preserved through active City governance in a GSA.

- Lead any GSA formation and provide staff support to execute tasks and achieve governance outcomes. Development of a political plan to work with regional entities to ensure local control of groundwater resources is paramount.

- Formulate groundwater banking protocols for the North American Subbasin through the GSA in order to allow the City to preserve and protect its existing groundwater assets. The City's financial and institutional investments to secure and deliver surface water resources have been a significant policy effort over the course of the last decade. The City must assume the benefits of its investments with the support of a robust groundwater accounting effort in the Western Placer area of the Subbasin.

- Develop a groundwater sustainability plan (GSP) under the SGMA that outlines key criteria for basin management. Such criteria should be derived from the 5 existing Groundwater Management Plans in the North American Subbasin. These GMP's provide insight on the key substantive issues relevant to neighboring agencies. The GSP must incorporate the key policy criteria from the City and follow governance objective set by the City.

- Maintain local control of groundwater resources in the GSP. Ceding groundwater assets to a regional authority may jeopardize the long-term viability of the asset to the City. Quantification of assets may be a preferred alternative to ceding reasonableness of use of assets – where the City maintains control over its quantified allocation.

- Avoid basin adjudication as an outcome of the SGMA processes of forming a GSA and GSP. This effort will require integrating local agencies, regional agencies and individual well owners into a sustainability plan. A long-term adjudication process will drain resources from all entities involved and likely result in a negotiated basin settlement. Accordingly, identifying key parameters of interested groups and stakeholders may help avoid basin adjudication.

As described in **Chapter 6**, the City's groundwater rights are important to preserve. Moreover, opportunities to better manage groundwater in the basin – both naturally occurring groundwater and banked groundwater – could help the City save money and further its long-term water management objectives.

Chapter 7. Recommendations

Chapter 7 analyzed Water Supply Reliability and whether the City's current management efforts meet this fundamental objective. In short, the chapter concluded that the City's water supply is reliable. The primary recommendation from that chapter is to continue to monitor the City's water demands, assess and fortify its water supplies, and develop infrastructure plans in light of changing conditions within and around the City. Moreover, the City should regularly synthesize these analyses in order to determine present and future water supply reliability. To further this recommendation, the City should:

- Continue to assess its water demands as drafted in **Chapter 4**.

- Continue to examine and augment its water supply portfolio as discussed in **Chapters 5** and **6**.

- Continue to analyze the City's infrastructure conditions and need in the context of **Chapters 3**, **9**, **10** and **11**.

Chapter 8. Recommendations

Chapter 8 focused on the key strategic issues affecting the City's water assets that have statewide significance. California's water management system is fluid. Regulatory issues continue to emerge and evolve, changing the oversight landscape. The purpose of this chapter is to outline the list of issues and prioritize City actions related to those issues, enabling the City to take appropriate steps to protect its water assets and secure long-term supply reliability. The primary recommendation of this chapter is to engage in these ongoing broad water management issues through the listed venues while continuing to re-prioritize engagement as emerging issues take precedence. The City should engage as follows:

- Regional Water Authority – The City should continue to be a leading entity in RWA. The evolution of that entity from implementation of the WFA to a regional advocacy and IRWMP implementation program direct impacts the City's long-term water asset management strategy.

- WPCGMP – The City should take a leadership role in the WPCGMP as that entity is developing the Western Placer County region's efforts in complying with the 2014 Sustainable Groundwater Management Act.

- Bay Delta Water Quality Control Plan Update – The City should engage with regional stakeholders on the WQCP Update. This effort could implicate all of the City's water assets directly and permanently. RWA should work diligently to engage this issue with City support.

- Sustainable Groundwater Management Act (SGMA) – The City should work to influence the SGMA implementation. The stakes to the City's groundwater assets are high and, as described in **Chapter 6**, the creation of a Groundwater Sustainability Agency (GSA) and Groundwater Sustainability Plan (GSP) will have lasting implications to the City.

- Regional Groundwater Use and Quality – The City should be constantly vigilant about groundwater use and quality in the North American Subbasin. Monitoring within the City is paramount but assessing plume migration, water rights issues, and associated uses within and without all of Placer County should also be closely monitored.

- SWRCB Authority – The City should be addressing the expansion of SWRCB authority of surface water and groundwater. The demand reduction order in 2015 indicates that the SWRCB believes in authoritative management of water supplies and demands. And SWRCB's incursion into groundwater regulation should be carefully monitored. Specifically, the City should be particularly interested in the

application of the public trust doctrine to the North Basin groundwater resources (see **Chapter 6**).

- Water Conservation and Water Use Efficiency – The City should continue to implement its water conservation and water efficiency measures. Importantly, the City should document the water savings under Water Code sections 1010 and 1011 and assert control over the conserved water assets for City benefit.

- PCWA Permit Renewal Process – The City should support PCWA in all aspects of its permit renewals on water right permits 18356 and 18358 so as to preserve the supplies available under those rights for uses in the City of Lincoln and its SOI as well as other areas in PCWA's service area.

- City Groundwater Banking – The City should continue to develop and refine its conjunctive use efforts. The City should work one-on-one with neighboring agencies to gather support for developing groundwater banking protocols and incorporating those protocols into any GSA or GSP affecting the North American Subbasin. The City should be working with RWA and SGA in the context of those entities current development of groundwater banking programs.

- Water Forum – The City should work with PCWA to monitor implementation of the WFA and PCWA's PSA. The City's leadership position within RWA may provide political support to PCWA's efforts and provide for a more active role for the City in supporting the WFA. The LAR may be an important component to afford particular attention.

- WaterFix and EcoRestore Programs – The City should continue to monitor the WaterFix and EcoRestore Programs and understand the implications of the construction of the tunnels on City's water assets. The City should work with RWA and encourage RWA staff to prepare regular reports on this effort. The City should consider joining regional litigation efforts through participating agencies in order to further support the City's interests in regional supply reliability.

- Climate Change – The City should monitor scientific studies on climate change and the impacts of climate change to the American River and Yuba/Bear Rivers watersheds. The City may seek to work with RWA to commission an assessment of such impacts.

- Delta Plan – The City should work with RWA staff to obtain regular updates on the Delta Stewardship Council and the implementation of the Delta Plan. The City should monitor legislative efforts aimed at expanding the authority of the Delta Stewardship Council and the influence of the Delta Plan to upstream watersheds.

- ACWA – The City should consider joining ACWA in order to better position itself as a leader in water asset management issues. The City's projected buildout population coupled with the development of the regional water treatment facility necessitate broader participation in statewide water management activities.

All of these issues and venues impact the City's water supply reliability. Strategic engagement in the appropriate venues may prove more beneficial in protecting the City's water interests than a full engagement approach where the City attempts to be involved in all venues at all times. Importantly, teaming with other local and regional interests could provide more substantive engagement with coordinated issue identification and monitoring.

Chapter 9. Recommendations

Chapter 9 delineated the primary model representations and assumptions associated with the City's infrastructure system. The items below are the recommended actions needed to maintain the quality of the City's treated water model and improve its accuracy.

- Conduct normal year max day fire flow tests and re-calibrate the model to within 10% of the test calibration.
- Continue O&M operations and update the model with system changes created in this process.
- Continue to update model with as-builts and maps of areas that lack thorough information, especially related to components of the existing system.
- Establish records of areas without redundancy or fire flow capacity and plan for field upgrades.
- Update the model incrementally with each new development to document needed infrastructure to meet supply criteria.
- Integrate new operations technologies such as AMI or advanced SCADA into the model as they become available.
- Check alternate pipe alignments and pipe designs against build-out and intermediate phase models to identify potential impacts.
- Ensure treated water models reflect all City-planned Capital Improvements and Facility Replacements for the treated water system.
- Formally review, update, and adopt updated system design and engineering standards for the water system.

- The City should require developers through newly adopted policies to perform and submit development specific water modeling with defining parameters and product expectations.
- Siting, design, and construction of the City's CIP projects involving storage tank, well production and booster pump station facilities, along with PCWA and NID water supply contracts should be thoroughly vetted and coordinated with City Staff and Management.
- Revise the policy language so that the design standards follows the design and operational criteria set in the most recent version of the California Fire Code, dated 2013.
- Establish a City Policy of well use for peaking and minimized use in non-peak demand periods (see **Chapter 6**).
- Establish a City Policy of total well pumping capacity to be greater than or equal to 75% of average day demand in order to manage emergency conditions.
- Establish a City Policy that well pumping capacity must account for 1 well to be offline as backup for every 3 in operation.
- Establish a City Policy that well pumping target should be 10% of average annual demand as seen on a 10 year running average.
- Establish a Design Standard that City Wells should be capable of producing at least 1 MGD (1,400 GPM for 12 hrs. per day).
- Establish a Design Standard that new a City Well shall operate on Variable Frequency Drive (VFD).
- Establish a City Policy that minimum storage shall provide 50% of average day capacity, plus fire flow storage, as well as an emergency storage volume while leaving 10% of average day minimum head space.
- Establish a City Policy that additional storage facilities shall be constructed as additional demands are placed on the system.
- Establish a Design Standard of no mains smaller than 8 inches.
- Establish a Design Standard of no non-looped mains longer than 2,000 feet.
- Establish a Design Standard of no looped mains smaller than 12 inches.
- Establish a Design Standard that pipes shall follow the criteria set **Section 9.5.2.**

- Establish a City Policy that demand multipliers shall be monitored yearly and updated as system operations change.
- Establish a City Policy that future system infrastructure shall not require frequent PRV adjustment in order for the system to remain balanced.
- Establish a Design Standard of operating pressures between 50 and 130 psi.
- Establish a Design Standard of operating pressures during peak hour of maximum day shall not drop below 40 psi.
- Establish a Design Standard of operating pressures during a maximum day fire flow event shall not drop below 20 psi.
- Establish a Design Standard of operating velocities maintained below 7 ft/sec during maximum day demands.
- Establish a Design Standard of operating velocities maintained below 10 ft/sec in maximum day fire flow demands.
- Establish a Design Standard of operating velocities maintained below 10 ft/sec in maximum day peak hour so long as all other hours follow the 7 ft/sec standard.

Chapter 10. Recommendations

Chapter 10 described the City's Facilities Replacement Program needed to address aging and undersized water infrastructure facilities in the City. The primary recommendation derived from this Chapter is that the City continue its efforts to update system infrastructure replacement by identifying and prioritizing vital components of its water system management. The FRP outlined in Chapter 10 identifies the ongoing efforts of the City and can be used as the primary reference for City FRP-related actions.

Chapter 11. Recommendations

Chapter 11 described the City's Capitol Improvement Program (CIP). This program requires analyzing and assessing the City's long-term infrastructure needs and expenditures based upon the City's growth projections. The primary recommendation from this Chapter is to continually assess the City's long-term capitol improvement project needs and assign costs associated with those projects to development interests before the projects are finalized. As such, we recommend the following actions:

- Refine the meaning of water supply reliability as described in Chapter 7 in the context of the major water infrastructure projects that are being considered for development. As refinements occur, adjust CIP projects to meet projected needs.

- Undertake rigorous cost assessment of major potable water infrastructure projects – specifically, NID's Regional Water Supply Project and its associated infrastructure as well as PCWA's Ophir Water Treatment Plant project and its associated infrastructure.

- Develop a strategic assessment team that will organize CIP potable water projects and create processes to determine each project's utility. Utilize strategic assessment team to allocate costs for projects in coordination with City finance team.

- Complete long-term financial assessment that addresses the mechanisms to pay for CIP projects.

- Analyze CIP projects for non-potable water supply systems that may have dual utility to the City for emergency potable supply purposes.

- Coordinate CIP projects with Waste Water Treatment and Reclamation Facility improvement projects.

- Continue to utilize City water infrastructure model outlined in **Chapter 9** to analyze major in-City water infrastructure improvements that are needed for incorporation in major City development projects.

- Coordinate CIP project development with PCWA and NID in order to address long-term infrastructure planning as well as financial considerations.

The City's CIP projects have been analyzed in the context of the City's 2008 General Plan land uses as well as more recently adopted specific plans relevant to City growth. Projects assessed in this section should continually be reviewed based upon long-term growth projections assessed by the City.