CHAPTER 9
Rehabilitation and Replacement Program

Previous chapters of this WMPU have focused on the hydraulic capacity of the water system and evaluation of the ability to meet demands under existing and projected future conditions. This chapter presents the desktop study performed to assess the condition of water pipelines and the recommended pipeline R&R program. The results of a visual condition assessment of major water system facilities are also presented. Recommendations from the pipeline and major facilities assessments will be incorporated into the overall capital improvement program.

Major sections in this chapter include:

- Existing Pipeline R&R Approach
- Pipeline Asset Registry
- Pipeline Remaining Useful Life Assessment
- 10-Year Pipeline R&R Projections
- Condition Assessment of Major Facilities
- Next Steps

9.1 EXISTING PIPELINE REHABILITATION AND REPLACEMENT APPROACH

The City currently develops a pipeline replacement list every year which focuses on older pipelines and areas that have frequent leaks, breaks and/or maintenance calls. The water department meets with operations staff to identify the highest need pipelines and they are grouped into replacements for the following two fiscal years (FY). All appurtenances (valves, hydrants, sampling stations, etc.) are replaced when the adjacent pipeline is replaced. The City develops a GIS-based plan which identifies replacements through the next five to seven FY. At the time of the development of the recommended R&R program discussed in Section 9.4, the City's most recent Water CIP Replacement Plan was dated May 2024 and shown in Figure 9-1.

It should be noted that the City continuously updates its Water CIP Replacement Plan and versions more recent than the May 2024 plan are not included in this WMPU, as they were not used for the development of the recommended R&R program. The City's most recent publicly available CIP information, including a CIP Tracker report and a ArcGIS-based Active CIP web map public information on CIP including items like a CIP tracker report and ArcGIS CIP web-based map, can be accessed on the City's website at: https://www.lincolnca.gov/our-government/capital-improvement-projects/.

For the past few years, the quantity of pipelines to be replaced has largely been dictated based on available budget, which has been between $1.2M and $3M per year. The City's 2023 Water and Wastewater Rate Study (Raftelis) proposes a capital improvement plan which anticipates replacement of up to 1 mile per year of pipeline starting in FY 2026 and increasing up to 2 miles per year of pipeline by FY 2029, which is based on pipelines that have exceeded their service life.

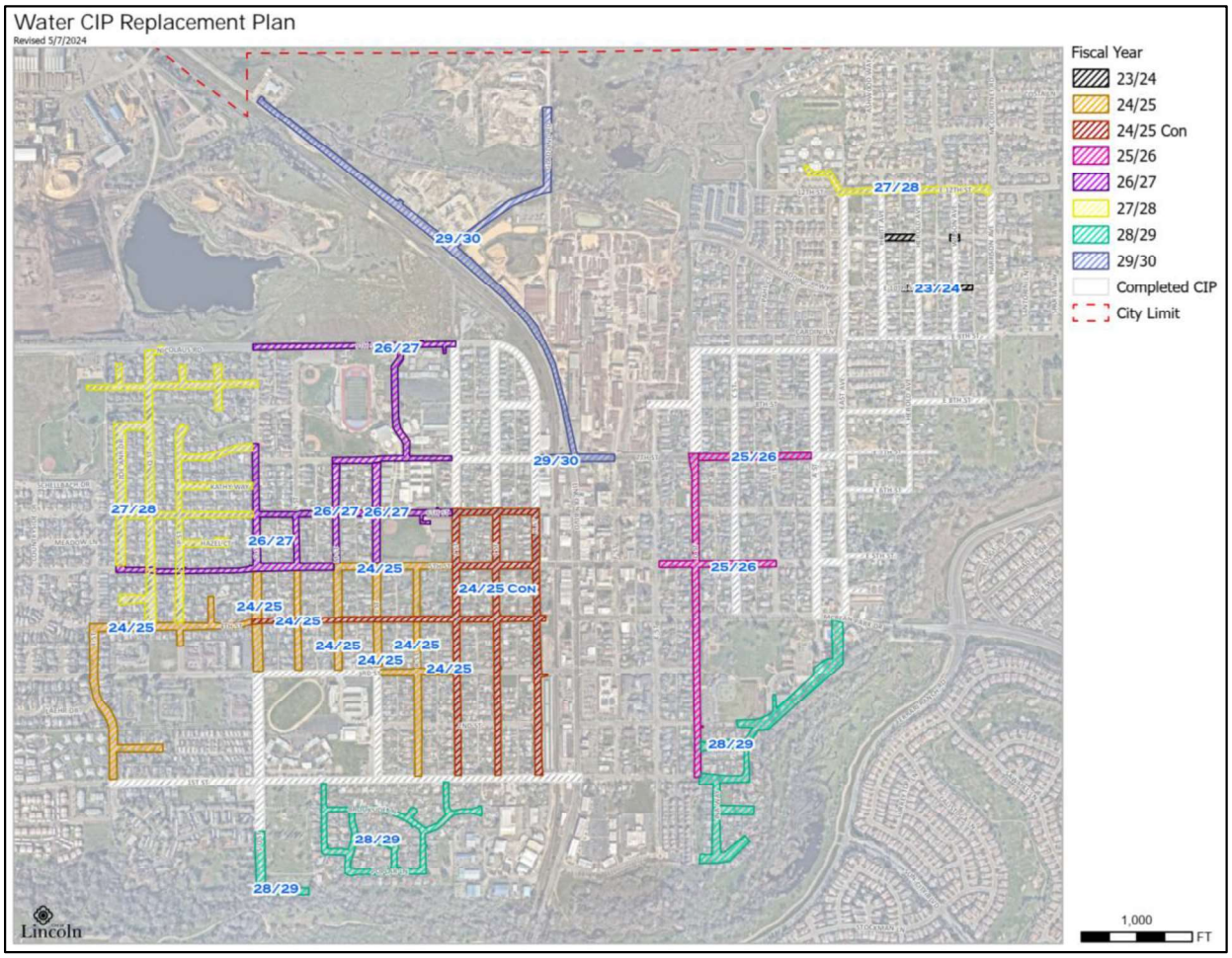


Figure 9-1. Water CIP Replacement Plan (May 2024)

9.2 PIPELINE ASSET REGISTRY

The City provided a GIS database that was used to create an inventory of existing pipelines within the City's potable water system (asset register). The asset register consists of 11,611 pipeline segments and associated asset data (e.g., pipeline age, size, material, etc.). Table 9-1 presents a summary of the City's water pipelines by diameter. Table 9-2 presents a summary of the City's water pipelines by material. In Chapter 2, Table 2-8 and Figure 2-4 present the water pipelines by decade of installation. The majority of pipelines (56-percent) were installed in the 2000s, with only five percent installed in the 1970s or earlier.

Table 9-1. Existing Pipeline Summary, by Diameter[a]

Pipeline Diameter, inches	Length of Pipeline, miles	Percent in Water System by Length	Count of Pipeline Segments
1-3	0.7	0.2	58
4	3.0	1.1	178
6	22.1	8.0	1,060
8	129.6	47.2	5,623
10	3.6	1.3	180
12	77.0	28.0	3,625
14	1.8	0.6	64
16	8.4	3.1	180
18	14.5	5.3	362
20	1.0	0.4	3
24	8.9	3.2	209
30	1.9	0.7	37
36	1.1	0.4	27
42	1.2	0.4	1
Unknown	0.01	<0.01	4
Total	**274.6**	**100%**	**11,611**

Source: City's water system GIS database provided in April 2024.

(a) Only pipelines managed by the City are included.

The majority of the City's water system pipelines, approximately 77 percent, have diameters between 8 inches and 12 inches.

Table 9-2. Existing Pipeline Summary, by Material[a]

Pipeline Material	Length of Pipeline		Percent in Water System, percent
	feet	miles	
Asbestos Cement	77,960	14.7	5.4
Cast Iron	14,030	2.7	1.0
Copper	30	< 1.0	< 0.1
Ductile Iron	159,420	30.2	11.0
High-Density Polyethylene (HDPE)	90	< 1.0	< 0.1
Polyvinyl Chloride (PVC)	1,183,130	224.1	81.6
Steel	12,220	2.3	0.8
Unknown	3,170	0.6	0.2
Total	**1,450,050**	**274.6**	**100%**

Source: City's water system GIS database provided in April 2024.

(a) Only pipelines managed by the City are included.

The majority of the City's water system pipelines, approximately 82 percent, are PVC.

As described in the following sections, the asset register was used to develop remaining useful life (RUL) estimates and develop a proposed pipeline rehabilitation and repair schedule.

9.3 PIPELINE REMAINING USEFUL LIFE ASSESSMENT

Asset *useful life* (UL) is the time that an asset provides valued service, after which it does not meet its intended service level. End of life is not necessarily indicative of catastrophic failure, and in most cases an asset can still hold functionality when it has reached the end of its useful life. Asset *RUL* can be estimated by comparing the actual age of assets to its useful life. In the absence of condition or performance data, this approach provides an initial determination of assumed condition and can be used to project estimated renewal needs. If available in the future, asset condition or performance data can be used to support or supersede RUL estimates.

The following section presents the method used to estimate RUL of City pipelines.

9.3.1 Remaining Useful Life

Each pipeline's RUL was estimated by subtracting the estimated useful life (UL) from its age (how long the asset has been installed):

$$RUL = UL - age$$

For example, an asset with a 50-year useful life that has been in service 35 years would have a RUL of 15 years.

9.3.1.1 Useful Life Expectancies

Municipal utility system assets vary by type, manufacturer, design, construction, and quality. They have different characteristics in how they operate and, consequently, will have different profiles of how they perform and ultimately fail. Standard UL expectancies are documented by the American Water Works Association, Water Environment Research Foundation, in addition to other industry associations. UL expectancies were developed for the City's pipelines using these industry standards.

Each pipe material and diameter within the City's water system was assigned a useful life. Considerations were made to account for variable environmental conditions. Based on discussions with City staff, the City has experienced brittle AC pipe of all diameters (in clay soils with high shrink-swell potential, asbestos cement pipes are prone to breaks due to the brittle nature of the material). The City has not experienced corrosive soils within the service area, which can impact the useful life of metallic pipelines. The standard useful life expectancies are presented in Table 9-3. Once each pipeline was assigned a standard useful life, the RUL of each of the City's water pipelines was calculated.

Table 9-3. Standard Useful Life of Buried Pipelines, by Material	
Material	Useful Life, years
Asbestos Cement[(a)]	50
Cast Iron	90
Copper	50
Ductile Iron	95
High Density Polyethylene (HDPE)	80
Polyvinyl Chloride (PVC)	80
Steel	75
Unknown	50

(a) Asbestos cement pipe typically has a useful life of 65-100 years. When exposed to clay soils with high shrink-swell potential, asbestos cement pipes are prone to breaks due to the brittle nature of the material.

9.3.1.2 RUL Classification

Based on the pipeline estimated RUL, each pipeline was assigned an assumed condition from *Like New* to *Poor*, as presented in Table 9-4. Newer assets with 50 percent or more of their useful life remaining are expected to be in Good to Like New condition. Older assets with less than 50 percent of their useful life remaining are expected to be in fair to poor condition.

Table 9-4. RUL to Condition Translation	
Percent RUL	Assumed Condition
100 to 80%	Like New
79 to 50%	Good
49 to 20%	Fair
19% to >0%	Poor

Table 9-5 summarizes the assumed condition of pipelines based on each pipeline's estimated RUL. Note that the Poor condition category was split between pipes with greater than zero percent RUL and less than or equal to zero RUL.

Table 9-5. Pipeline RUL-Based Condition Summary			
Condition	Length of Pipelines		Percent of System, percent
	feet	miles	
Like New (100% to 80% RUL)	301,820	57.2	21
Good (79% to 50% RUL)	1,053,340	199.5	73
Fair (49% to 20% RUL)	21,380	4.0	1
Poor (greater than 0% to 19% RUL)	19,540	3.7	1.3
Beyond RUL (0% RUL)	53,970	10.2	4
Total	**1,450,050**	**274.6**	**100%**

This information provides a snapshot view of the condition of the City's potable water pipelines based on the estimated RUL and where future R&R may be required. Approximately 94-percent of the City's pipelines are in Good to Like New condition. Approximately fourteen miles of pipeline, or about five percent of the water system, are expected to be in Poor condition. The last row in Table 9-5 shows the pipelines that are already beyond useful life (10.2 miles or four percent of pipelines).

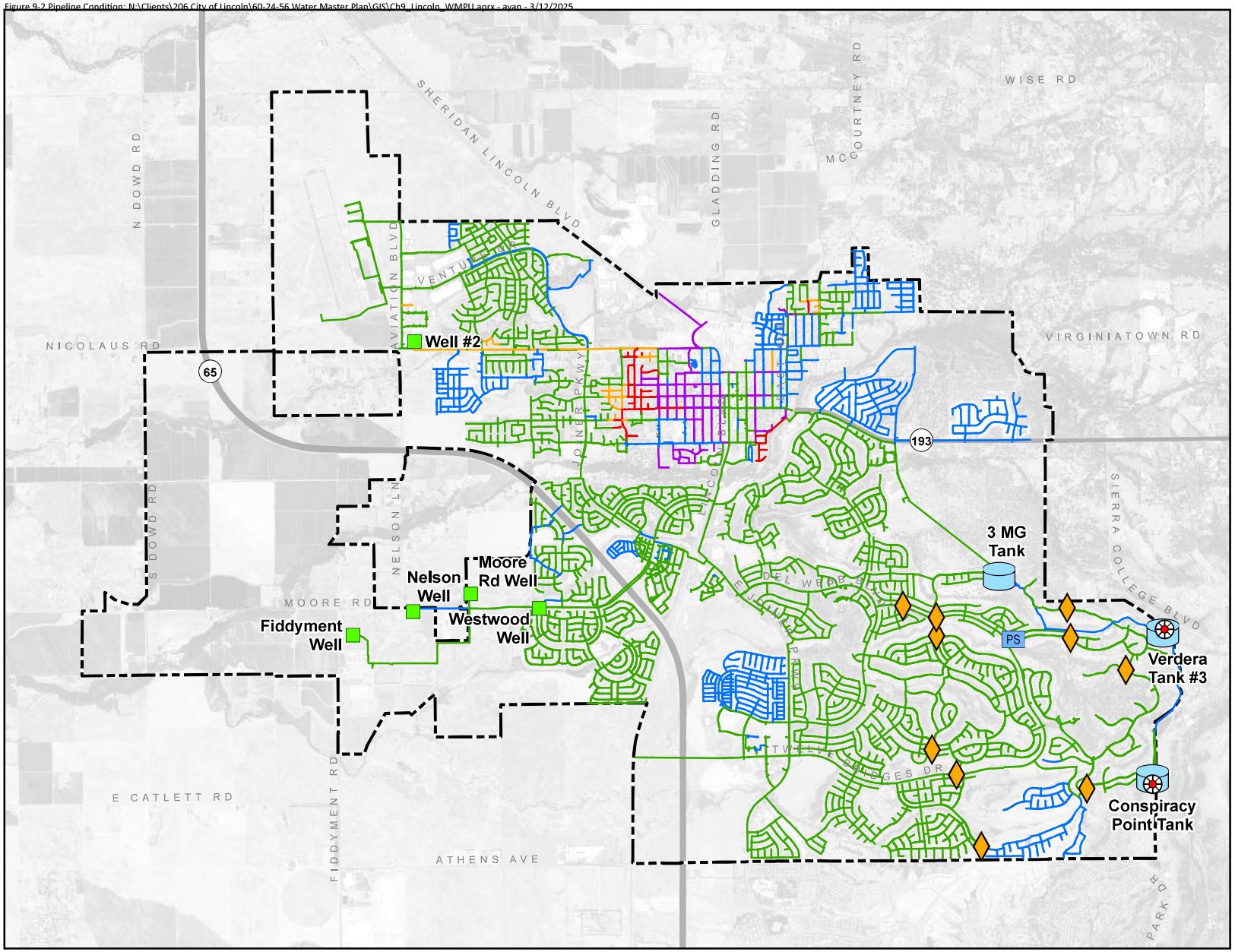
Figure 9-2 presents the RUL-based condition of pipelines.

9.4 PIPELINE R&R PROJECTIONS

The purpose of this effort is to improve the City's approach to pipeline R&R by identifying assets that are beyond their expected useful life, incorporate the City's institutional knowledge of chronic issues, and combine those assets into a prioritized program that can be implemented strategically by the City over the next 10 years.

Once the RUL analysis was complete, West Yost held a workshop with City staff to discuss the initial replacement projections and receive feedback on any issues in the system such as areas/neighborhoods, certain pipeline materials, or certain pipeline sizes with chronic leak/breaks, or maintenance calls. Existing and proposed projects were also discussed for potential inclusion in the program such as replacement of lead goosenecks (largely completed through CIP Plan), backflow preventer installation/replacements (agreed to require more study and more appropriate in the Downtown Specific Plan), and replacement of specific pipelines for access improvement. Most of these projects were agreed to be included in other planning efforts, except for the realignment of 14-inch pipelines at 1st Street/D Street that currently runs under a house.

Figure 9-2 Pipeline Condition: N:\Clients\206 City of Lincoln\60-24-56 Water Master Plan\GIS\Ch9_Lincoln_WMPU aprx - ayan - 3/12/2025



Pipeline Condition by Percent of Remaining Useful Life

- Beyond Remaining Useful Life
- Poor (1-19%)
- Fair (20-49%)
- Good (50-79%)
- Like New (80-100%)

Existing System Facilities

- Placer County Water Agency Metering Station
- Groundwater Well
- Catta Verdera Pump Station
- Pressure Regulating Station
- Storage Tank

Boundary

- City Limit

Notes:

1. Facilities shown are based on GIS data provided by the City in April 2024.
2. Pipeline condition is determined based on the asset's age and expected useful life. Expected useful life is estimated based on pipeline material and industry standards.

Prepared by:

WEST YOST

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0 3,000 6,000 Feet

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Pipeline Condition

Figure 9-2

9.4.1 10-Year Pipeline R&R Program

The City's May 2024 Water CIP Replacement Plan[1], the RUL estimates, and other projects identified by the City were used to develop a 10-year pipeline R&R program.

The City's 2023 Water and Wastewater Rate Study specifies replacement of up to 1 mile of pipeline per year starting in FY 2026, increasing up to 2 miles per year by FY 2029. City Staff provided feedback to incrementally increase pipeline replacements per year, as follows: replacement of 1 mile per year though FY 2028, followed by 1.5 miles per year in FY 2029-2031, and 2 miles per year thereafter.

For each year of the plan, pipelines were included based on the following hierarchy:

1. Pipelines included in the City's current Water CIP Replacement Plan, by FY
2. Pipelines identified to have less than or equal to zero RUL
3. Other pipelines identified by the City (e.g., 1st Street/D Street realignment of 14-inch pipeline under house), which were matched with adjacent replacements

The 10-year pipeline R&R program is presented in Table 9-6 and Figure 9-3. The last two columns in Table 9-6 present the oldest pipeline remaining after replacements are performed for that year, and the count of pipelines beyond useful life after replacements are performed for that year. At Year 10 (2034), the program will "catch up" with overdue replacements and all pipelines beyond their useful life will have been replaced. At that point, is expected that unplanned and emergency pipeline repairs and replacements will decrease because the oldest and poorest condition pipelines will no longer be in the system.

Details on the 10-Year R&R program including pipelines by year are included in Appendix F.

[1] As discussed in Section 9.1, at the time of the development of the 10-year pipeline R&R program, the City's most current Water CUP Replacement Plan was dated May 2024.

Table 9-6. 10-Year Pipeline R&R Program					
Year	Length of Pipelines, miles	Unit Cost for Pipeline Replacement[(a)]	Capital Cost Estimate, dollars[(b)]	Remaining Oldest Pipe after Replacements	Count of Pipes Beyond UL after Replacements
Year 1 (2025)	1	$475 / linear foot	2,528,160	1929	430
Year 2 (2026)	1		2,607,757	1929	376
Year 3 (2027)	1		2,766,406	1929	323
Year 4 (2028)	1		2,792,331	1945	304
Year 5 (2029)	1.5		4,268,664	1945	269
Year 6 (2030)	1.5		4,367,729	1945	199
Year 7 (2031)	1.5		4,369,866	1960	131
Year 8 (2032)	2		6,121,991	1971	84
Year 9 (2033)	2		6,389,702	1971	23
Year 10 (2034)	2		6,522,755	1971	0

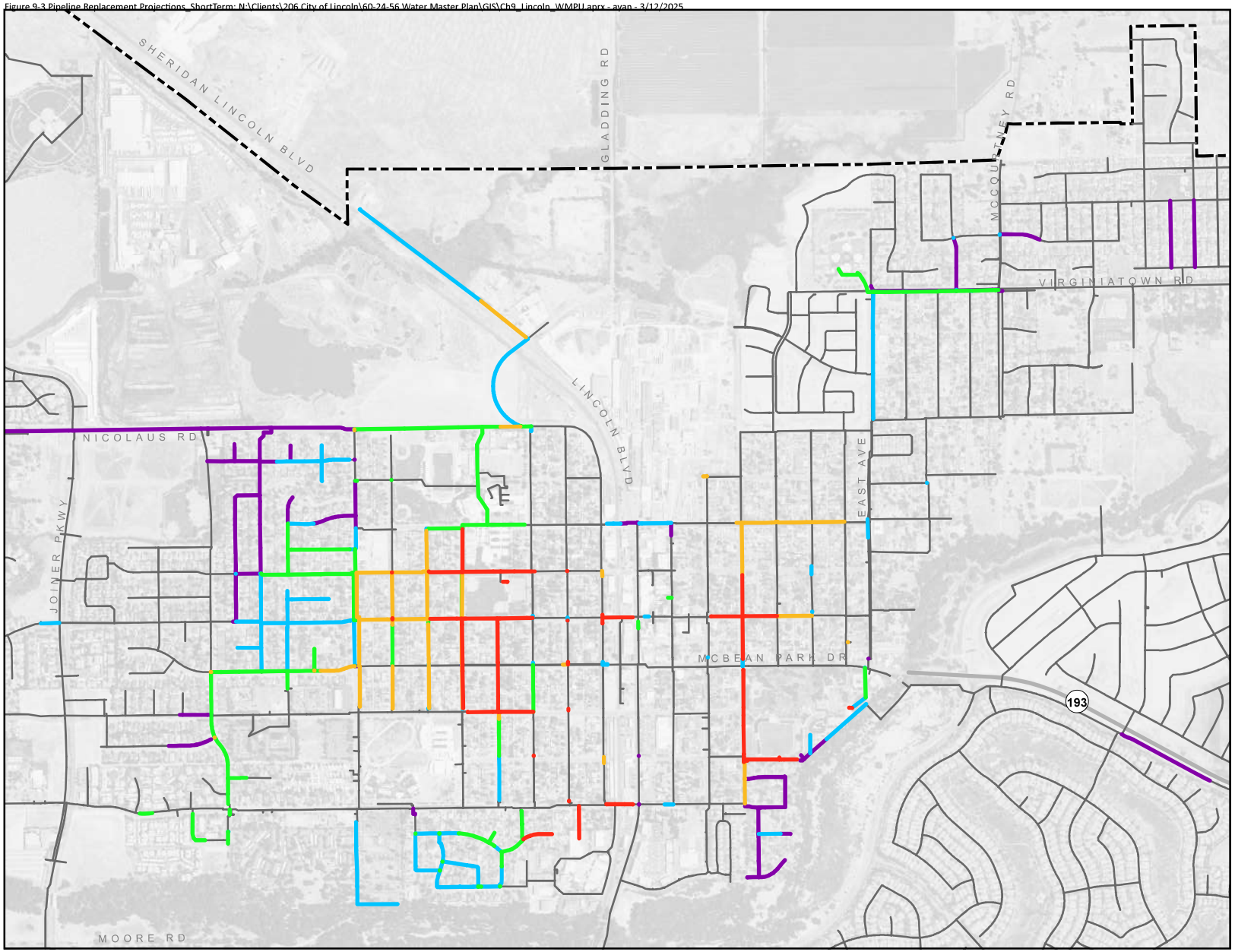
(a) Unit construction cost estimate is based on 8-inch diameter pipeline built in developed area.
(b) 3% inflation rate applied for years subsequent to 2025.

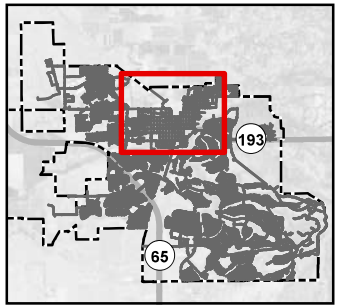
9.4.2 Future Pipeline Replacements

After Year 10 of the R&R program, there are several years where no pipelines reach the end of their useful life. Because the majority of the City's system was installed in the 1990s and 2000s, it is expected these assets will create a "replacement wave" where a significant number of assets reach the end of their useful lives around the same time, requiring simultaneous replacement or upgrades. To understand the longer-term outlook on pipeline replacements, the RUL projections were extended an additional 70-years beyond the 10-Year program (to year 2104). Table 9-7 presents the pipeline replacement projections based on RUL for 10-year increments, ending in year 2104.

Table 9-7. Long-Term Pipeline R&R Projections			
Year	Length of Pipelines, feet	Length of Pipelines, miles	Percent of System, percent
Year 11-20 (2035-2044)	13,274	2.5	2.5
Year 21-30 (2045-2054)	4,120	0.8	0.3
Year 31-40 (2055-2064)	16,710	3.2	1.2
Year 41-50 (2065-2074)	63,010	11.9	4.3
Year 51-60 (2075-2084)	686,760	130.1	47
Year 61-70 (2085-2094)	241,670	45.8	17
Year 71-80 (2095-2104)	322,790	61.1	22

Figure 9-3 Pipeline Replacement Projections_ShortTerm: N:\Clients\206 City of Lincoln\60-24-56 Water Master Plan\GIS\Ch9_Lincoln_WMPU.aprx - ayan - 3/12/2025





Pipeline Replacement Year

- 2025 - 2026
- 2027 - 2028
- 2029 - 2030
- 2031 - 2032
- 2033 - 2034
- Beyond 2034

Boundary

- City Limit

Notes:

1. Infrastructure shown are based on GIS data provided by the City in April 2024.
2. Projection of pipeline replacement is determined based on City CIP plans and the asset's age and expected useful life. Expected useful life is estimated based on pipeline material and industry standards.
3. Several standalone segments are located throughout the city and fall outside the figure boundaries, they are included in appendices.

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WEST YOST

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0 750 1,500 Feet

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Pipeline Replacement Projections - 10-Year CIP

Figure 9-3

As shown in Table 9-7, there are a small number of expected replacements (less than four percent of the system) until Years 51-60, when 47 percent of the system is expected to require replacement. The following decades also have significant replacements expected (17 percent and 22 percent, respectively).

To proactively plan for the wave of replacements, it is recommended the City:

1. **Implement a Staggered Replacement Strategy**
    - Spread replacements over time by prioritizing segments based on condition, risk, location, or strategic importance, instead of waiting for mass end-of-life events.
    - To support the replacement prioritization, consider conducting a condition assessment to identify pipelines that may require early replacement due to wear or operational conditions, which can help to out the replacement timeline.
    - Considering the challenges and costs associated with assessing the condition of water mains, the City should adopt a cost-benefit-driven approach to prioritize assessments strategically – this could include risk-based prioritization, a representative sampling-based approach, or other strategies.
2. **Establish a Long-Term Capital Reserve Fund**
    - The dedicated fund should be similar to what was developed as part of the 2023 Water and Wastewater Rate Study and should serve long-term needs.
3. **Continue and Enhance the Collaborative Approach**
    - The City currently utilizes a collaborate approach to develop the replacement plan. Continue this approach and support decisions with data (maintenance records, condition assessment, work order history, the program presented here).
    - Coordinate with other City departments (sewer, roads) to align replacement schedules and reduce costs.

9.5 BASIC CONDITION ASSESSMENT OF MAJOR FACILITIES

As discussed in Chapter 2, the City's major water system facilities include: three storage tanks, five groundwater wells, one booster pump station, and multiple pressure reducing stations.

On May 23, 2024, West Yost conducted a basic condition assessment of the City's major facilities to evaluate the condition, performance, and efficiency of each facility. Table 9-8 summarizes the condition of the evaluated facilities and any associated comments and/or recommendations. Generally, all evaluated facilities were in good condition with no major issues. West Yost recommends installing an exterior ladder with a safety cage on the Verdera Tank No. 3.

9.6 NEXT STEPS

Recommendations from the pipeline program and major facilities assessments will be incorporated into the overall capital improvement program.

Table 9-8. Summary of Basic Condition Assessment of Major Facilities		
Name	General Condition	Comments
Storage Tanks		
Conspiracy Point Tank	Good	• There is an unknown PRV vault on site, City is uncertain if this is a PCWA vault. • No standby power.
3 MG Tank	Good	• No issues.
Verdera Tank #3	Good	• New PRV is currently under construction. • Tank needs an exterior ladder with a safety cage. There is currently no access to the top of tank due to the lack of an exterior ladder. • No standby power.
Groundwater Wells		
Well 2	Good	• Currently, Well 2 is only operated periodically (pumped to waste) each month due to PFAS being detected in the well water. However, the PFAS level is not above the MCL. • The City uses Well 2 only as necessary during times of high demand. • At the time of the site visit (May 23,2024), the generator was unable to start in “Auto” mode due to issues with the automatic transfer switch and the only way to operate the generator was to start it in “Manual” mode when there was no PG&E power available onsite. • As of July 11, 2024, the generator was repaired and is fully functional.
Well 6 – Westwood	Good	• No issues.
Well 7 – Moore Rd	Good	• No standby power but has a connection for a portable generator.
Well 8 – Fiddyment	Good	• No issues.
Well 9 – Nelson	Good	• No standby power but has a connection for a portable generator.
Catta Verdera BPS		
Overall	Good	• BPS is only needed if the PCWA line is out of service. • City staff keeps the BPS operational by operating it weekly, however, this requires a lot of time and cost.
Pump 1	Good	• Frequent check valve replacement when the pump station is operational.
Pump 2	Good	• Frequent check valve replacement when the pump station is operational.
Pump 3	Good	• No VFD. • Frequent check valve replacement when the pump station is operational.
Pump 4	Good	• No VFD. • Pump has not been run in more than five years.

Table 9-8. Summary of Basic Condition Assessment of Major Facilities		
Name	General Condition	Comments
Pressure Reducing Stations (PRS)		
Twelve Bridges PRS	Good	• 4-inch and 12-inch ClaVals were recently rebuilt. • Piping has minor coating issues. • No standby power. • There are traffic speeding issues at the PRS site, which causes an employee safety issue when working on the PRS. • No site lighting
Eastridge PRS	Good	• No standby power. • No site lighting.
Village 13 PRS	Good	• No standby power.
Village 19 PRS	Good	• No site power, SCADA, or standby power. • No alarms. • No site lighting. • No PG&E.

CHAPTER 10
Capital Improvement Program

This chapter presents the recommended Capital Improvement Program (CIP) for the City's existing and future (5-Year, 10-Year, 15-Year, 20-Year, and Buildout) water system, based on the evaluations described in Chapters 7 and 8 and the recommended R&R program described in Chapter 9. This chapter provides a summary of the recommended improvement projects, along with estimates of probable construction and capital costs for each proposed Project.

It should be noted that the recommended CIP only identifies improvements at a master plan level and does not necessarily include all required on-site infrastructure or provide design of improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

The following sections of this chapter summarize the cost estimating methodology and present the CIP of recommended upgrades to improve the existing system and support future demands:

- Cost Estimating Assumptions
- Recommended CIP
- Basis of Recommendations

10.1 COST ESTIMATING ASSUMPTIONS

Cost estimates prepared for this WMPU are in accordance with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 5 Estimate. AACE International defines a Class 5 Estimate in the following manner:

> *Class 5 Estimate: This estimate is prepared based on limited information, where little more than proposed plant type, its location, and the capacity are known. Strategic planning purposes include, but are not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class estimate are -20 to -50 percent on the low side and +30 to +100 percent on the high side.*

Construction and Capital Cost estimates are presented in August 2025 dollars based on an Engineering News Record Construction Cost Index (ENR CCI) of 20-cities average (13,913.52). Construction costs were developed based on a combination of data supplied from manufacturers, bids on other water facilities projects, construction costs previously estimated by West Yost, and from standard cost estimating guides. Total CIP costs include contingencies equal to 49.5 percent of base construction costs, including construction contingency and other costs for engineering and implementation.

For this WMPU, it is assumed that recommended distribution system facilities will be developed in public rights-of-way or on public property; therefore, land acquisition costs have not been included. Construction cost estimates do not include costs for annual operations and maintenance. A complete description of the assumptions used in developing the estimates of probable construction cost is provided in Appendix G.

10.2 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

This section summarizes the overall recommended CIP, which is based on the evaluations described in Chapters 7 and 8 and recommendations in Chapter 9. A high-level summary of the overall program is provided below, and subsequent sections provide more detail for each of the evaluated time frames. Figure 10-1 shows overall recommendations for the City's existing, 5-Year, 10-Year, 15-Year, 20-Year, and Buildout water system. Pipelines intended to serve future development areas and their associated costs are included for reference in the CIP; only pipelines that are 12-inch diameter or greater are included. These pipelines, however, are recommended to be funded by Project proponents in the future, as part of connection fees, and alignments are expected to change as future development plans are refined.

10.2.1 Summary of Estimated Capital Costs

Table 10-1 summarizes the estimated total capital costs by time frame and responsible party for the costs (i.e., the City or future development). As shown in Table 10-1, the overall capital improvement costs are estimated to be approximately $539 million (M). Approximately 98 percent of the overall program ($529M), is recommended to be allocated to future development and paid for through connection fees, as the identified infrastructure is needed to support future demands. The top three contributors to the overall program costs are Villages 2 through 4 and SUD-A at approximately 45 percent ($240M), Village 5 at approximately 23 percent ($125M), and Village 6 and SUD-C at approximately 15 percent ($82M). The City is responsible for the remaining 2 percent ($10M) of overall program costs which is attributed to improving existing infrastructure and/or developing studies to improve water supply quality and/or reliability.

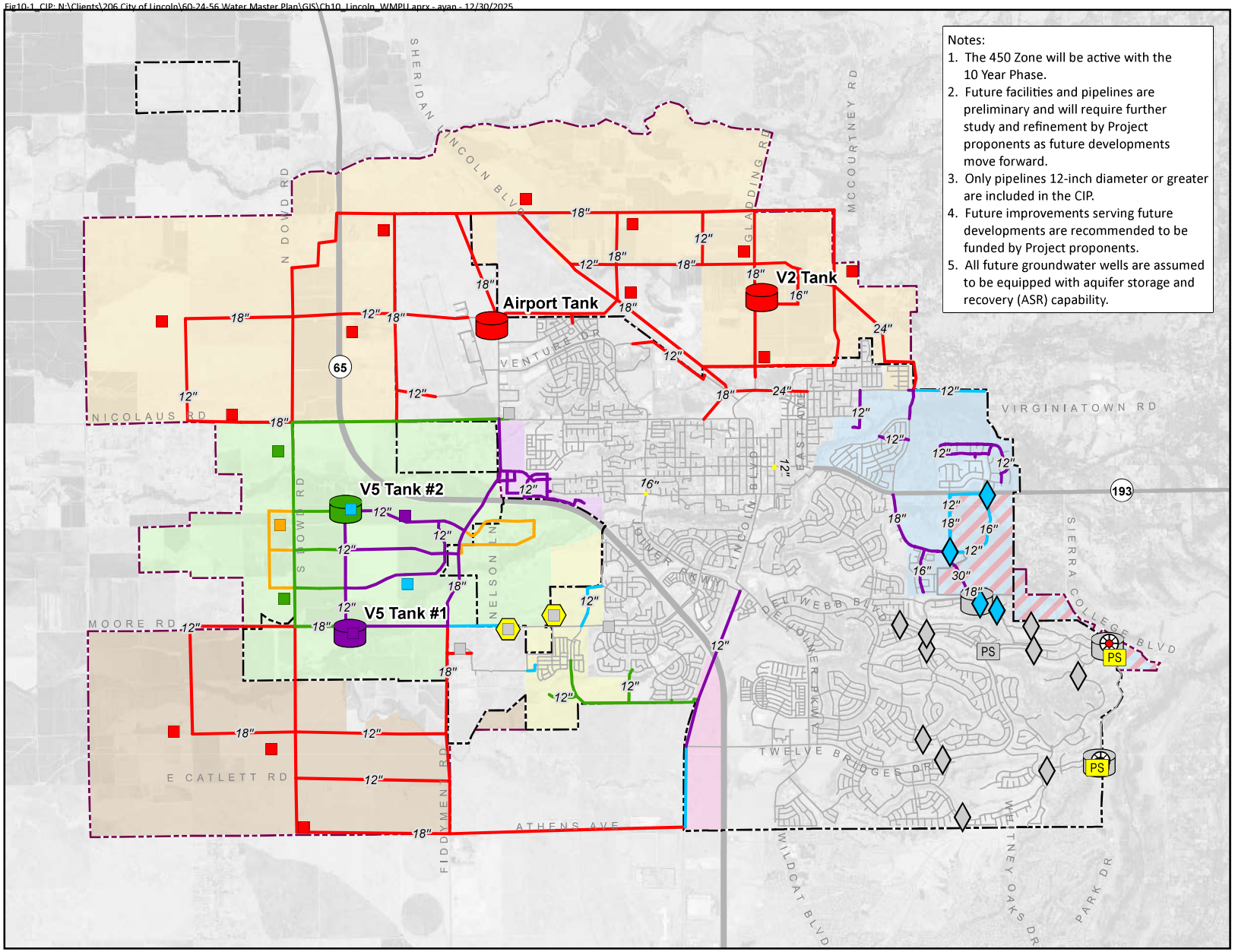
The improvement costs presented in Table 10-1 do not include improvements from the recommended R&R programs, which should be completed on an on-going basis and are not included in this WMPU. These programs and associated costs are summarized below and described in detail in Chapter 9.

Table 10-1. Summary of Improvement Costs by Time Frame and Responsible Party, dollars[(a)]

Improvement Type	Existing	5-Year	10-Year	15-Year	20-Year	Buildout	Total
City							
Storage and Pumping	7,073,000	0	0	0	0	0	7,073,000
Pipeline	113,000	1,884,000	0	0	0	0	1,997,000
Other Improvements	0	700,000	0	0	0	0	700,000
Subtotal	**7,186,000**	**2,584,000**	**0**	**0**	**0**	**0**	**9,770,000**
Lincoln 270							
Pipeline	0	6,898,000	4,281,000	207,000	0	0	11,386,000
Subtotal	**0**	**6,898,000**	**4,281,000**	**207,000**	**0**	**0**	**11,386,000**
SUD-B							
Pipeline	0	12,558,000	0	0	0	0	12,558,000
Subtotal	**0**	**12,558,000**	**0**	**0**	**0**	**0**	**12,558,000**
Village 1							
Pressure Reducing Station	0	0	1,935,000	0	0	0	1,935,000
Pipeline	0	23,699,000	15,304,000	0	0	0	39,003,000
Subtotal	**0**	**23,699,000**	**17,239,000**	**0**	**0**	**0**	**40,938,000**
Village 5							
Supply	0	8,615,000	8,615,000	8,615,000	4,308,000	0	30,153,000
Storage and Pumping	0	10,017,000	0	10,017,000	0	0	20,034,000
Pipeline	0	32,854,000	3,219,000	30,738,000	8,292,000	0	75,103,000
Subtotal	**0**	**51,486,000**	**11,834,000**	**49,370,000**	**12,600,000**	**0**	**125,290,000**
Village 7							
Pipeline	0	3,119,000	2,535,000	10,805,000	0	0	16,459,000
Jack & Bore	0	0	0	128,000	0	0	128,000
Subtotal	**0**	**3,119,000**	**2,535,000**	**10,933,000**	**0**	**0**	**16,587,000**
Village 2, Village 3, Village 4, and SUD-A							
Supply	0	0	0	0	0	43,073,000	43,073,000
Storage and Pumping	0	0	0	0	0	28,792,000	28,792,000
Pipeline	0	0	0	0	0	168,005,000	168,005,000
Jack & Bore	0	0	0	0	0	575,000	575,000
Subtotal	**0**	**0**	**0**	**0**	**0**	**240,445,000**	**240,445,000**
Village 6 and SUD-C							
Supply	0	0	0	0	0	12,922,000	12,922,000
Storage and Pumping	0	0	0	0	0	0	0
Pipeline	0	0	0	0	0	68,515,000	68,515,000
Jack & Bore	0	0	0	0	0	128,000	128,000
Subtotal	**0**	**0**	**0**	**0**	**0**	**81,565,000**	**81,565,000**
Total Costs	**$7,186,000**	**$100,344,000**	**$35,889,000**	**$60,510,000**	**$12,600,000**	**$322,010,000**	**$538,539,000**

(a) Costs shown are based on August 2025 CCI of 20-cities average (13913.52).

Fig10-1_CIP: N:\Clients\206 City of Lincoln\60-24-56 Water Master Plan\GIS\Ch10_Lincoln_WMPU.aprx - ayan - 12/30/2025



Phase Color Legend

- Existing (No Improvement)
- Existing (Improvement)
- 5 Year
- 10 Year
- 15 Year
- 20 Year
- Buildout

System Facilities

- Groundwater Well
- Placer County Water Agency Metering Station
- Backup Power
- PS Pump Station
- Pressure Reducing Station
- Storage Tank
- Pipeline

Future Development

- Lincoln 270
- Village 1
- Villages 2-4 and SUD-A
- Village 5
- Village 7
- SUD-B
- Village 6 and SUD-C

Boundaries

- New 450 Pressure Zone
- Existing City Limit
- City Sphere of Influence

Prepared by:

WEST YOST

Prepared for:

City of Lincoln
Water Master Plan Update

Recommended Capital Improvement Projects
Figure 10-1

10.2.2 Recommended Existing System Improvements

Chapter 7 provided a summary of the evaluation of the City's existing water system and its ability to meet recommended water system planning and design criteria described in Chapter 5. In general, the analysis recommended the following:

- **Storage and Pumping:**
  - Address the existing storage deficit in the 375 Pressure Zone through installation of dedicated on-site backup power at the Nelson and Moore Wells to provide 1.76 MG of EGWC and improve system reliability.
  - Address the existing storage deficit in the 750 Pressure Zone through construction of a new booster pump station with back-up power at the Verdera Tank No. 3 site with a minimum capacity of 2 mgd.
  - Address the existing storage deficit in the 775 Pressure Zone through construction of a new booster pump station with back-up power at the Conspiracy Point Tank site with a minimum capacity of 4 mgd.
- **Pipelines:**
  - Replace 8-inch diameter pipeline at intersection of 1st Street and Joiner Parkway with a new 16-inch diameter pipeline to mitigate velocity exceedance.
  - Replace 8-inch diameter pipeline at intersection of E Street and McBean Park Drive with a new 12-inch diameter pipeline to mitigate velocity exceedance.
- **Rehabilitation and Replacement:**
  - Enhance the City's existing pipeline R&R program to accelerate the replacement of aging and undersized distribution pipelines on a proactive and programmatic basis before failure and require emergency repair and replacement. A recommended program is described in Chapter 9. Upsizing many of the smaller diameter pipelines would improve fire flow in the downtown area of the City.

No specific capital improvement projects besides the above listed capacity-related improvements were identified for the existing water system.

10.2.3 Recommended Future System Improvements

Chapter 8 provided a summary of the evaluation of the City's water distribution system and its ability to support future (5-Year, 10-Year, 15-Year, 20-Year, and Buildout) demands while meeting recommended water system planning and design criteria described in Chapter 5. Table 10-2 summarizes recommended future system improvements resulting from the analysis.

Recommended improvements and the associated costs are presented in Table 10-3, and locations are shown on Figure 10-1. Improvements addressing existing and aging infrastructure are expected be allocated to existing water customers, and improvements triggered by increased demands associated with future development should be allocated to future development and paid through connection fees.

Table 10-2. Summary of Recommended Future System Improvements

Improvement Type	5-Year	10-Year	15-year	20-Year	Buildout
Supply	• Construct two new ASR wells with backup power to improve supply reliability.	• Construct additional two new ASR wells with backup power to improve supply reliability.	• Construct additional two new ASR wells with backup power to improve supply reliability.	• Construct an additional new ASR well with backup power to improve supply reliability.	• Construct additional 13 new ASR wells with backup power to improve supply reliability.
	Total (Previous and Current Phases): • 2 ASR wells	Total (Previous and Current Phases): • 4 ASR wells	Total (Previous and Current Phases): • 6 ASR wells	Total (Previous and Current Phases): • 7 ASR wells	Total (Previous and Current Phases): • 20 ASR wells
	• Alternative water supplies will be explored and/or advanced to offset the need for additional groundwater capacity. Refer to Chapter 4 for additional detail.				
Storage and Pumping	• Construct a 2 MG storage tank and pump station in Village 5 to mitigate the storage deficit in the 375 Zone.	• None	• Construct an additional 2 MG storage tank and pump station in Village 5 to mitigate the storage deficit in the 375 Zone.	• None	• Construct a 5 MG storage tank and pump station in Village 2 to mitigate the storage deficit in the 375 Zone. • Construct a 3 MG storage tank and pump station in the Airport Area to mitigate the storage deficit in the 375 Zone.
	Total (Previous and Current Phases): • 1 new storage tank • 1 new associated pump station	Total (Previous and Current Phases): • 1 new storage tank • 1 new associated pump station	Total (Previous and Current Phases): • 2 new storage tanks • 2 new pump stations	Total (Previous and Current Phases): • 2 new storage tanks • 2 new pump stations	Total (Previous and Current Phases): • 4 new storage tanks • 4 new pump stations
Pressure Reducing Station	• None	• Construct four new pressure reducing stations for the proposed 450 Zone.	• None		
Pipelines	• Construct new transmission pipelines to support future development areas. • City should continue to rehabilitate and replace older and undersized (i.e., smaller than 8-inch diameter) pipelines, with the R&R previously discussed in Chapter 7 and described in detail in Chapter 9.				

Table 10-3. Recommended Capital Improvement Projects[a]

Responsible Party	Improvement Type	Justification	Improvement Description	Quantity and Unit	Construction Cost, dollars [b,c]	Capital Cost, dollars (includes markups)[b,d]
Existing System						
Storage and Pumping Improvements						
City	Backup Power	Addresses the existing storage capacity deficit in the 375 Pressure Zone by increasing the emergency groundwater credit (EGWC). Nelson and Moore Wells do not currently have backup power and do not contribute to EGWC.	Installation of dedicated on-site backup power at the Nelson and Moore Wells to provide 1.76 MG of EGWC.	2 each	$476,000	$1,186,000
City	Booster Pump Station	Addresses the existing storage deficit in the 750 Pressure Zone through construction of emergency booster pump station.	Installation of emergency booster pump station at the Verdera Tank #3 tank site with backup power.	2 mgd	$1,700,000	$2,542,000
City	Booster Pump Station	Addresses the existing storage deficit in the 775 Pressure Zone through construction of emergency booster pump station.	Installation of emergency booster pump station at the Conspiracy Point Tank site with backup power.	4 mgd	$2,238,000	$3,345,000
				Subtotal - Storage and Pumping Improvements	**$4,414,000**	**$7,073,000**
Pipeline Improvements						
City	Pipeline	Addresses high velocities observed in existing pipelines.	Replace existing 8-inch diameter pipeline at intersection of 1st Street and Joiner Parkway with new a 16-inch diameter pipeline.	25 LF	$21,000	$31,000
City	Pipeline	Addresses high velocities observed in existing pipelines.	Replace existing 8-inch diameter pipeline at intersection of E Street and McBean Park Drive with a new 12-inch diameter pipeline.	80 LF	$55,000	$82,000
				Subtotal - Pipeline Improvements	**$76,000**	**$113,000**
				Total Existing System Capital Improvements	**$4,490,000**	**$7,186,000**
5-Year System						
Supply Improvements						
Village 5	Supply (ASR Wells)	Improves supply reliability for increased demands in the 5-Year Phase.	Construction of 2 new ASR wells, equipped with backup power.	2 wells	$5,763,000	$8,615,000
				Subtotal - Supply Improvements	**$5,763,000**	**$8,615,000**
Storage and Pumping Improvements						
Village 5	Above-Ground Concrete Storage Tank	Addresses projected future storage deficit in the 375 West Zone as a result of increased demands in the 5-Year Phase. Sizing of facilities accounts for increased demands in the 10-Year Phase.	Construction of Village 5 Tank #1	2 MG	$4,700,000	$7,027,000
	Storage Tank Pump Station		Village 5 Tank #1 Pump Station, equipped with backup power	3 mgd	$2,000,000	$2,990,000
				Subtotal - Storage and Pumping Improvements	**$6,700,000**	**$10,017,000**
Pipeline Improvements						
City	Pipeline	Provides pipelines to support future development areas. *(It should be noted this pipeline is currently a developer obligation, however, an amendment is under review that may revise this to a City funded pipeline. For the purposes of the CIP, this pipeline is added to the City's responsibility to have a complete understanding of the City's potential financial needs*).	New 24-inch diameter pipeline crossing the Auburn Ravine	1,500 LF	$1,260,000	$1,884,000
Lincoln 270	Pipeline	Provides pipelines to support future development areas.	New 12-inch diameter pipelines	5,970 LF	$2,896,000	$4,329,000
	Pipeline		New 18-inch diameter pipelines	2,490 LF	$1,719,000	$2,569,000
SUD-B	Pipeline		New 12-inch diameter pipelines	13,050 LF	$6,330,000	$9,463,000
	Pipeline		New 18-inch diameter pipelines	3,000 LF	$2,070,000	$3,095,000
Village 1	Pipeline		New 12-inch diameter pipelines	12,600 LF	$6,111,000	$9,136,000
	Pipeline		New 16-inch diameter pipelines	2,270 LF	$1,453,000	$2,172,000
	Pipeline		New 18-inch diameter pipelines	2,730 LF	$1,884,000	$2,817,000
	Pipeline		Replace existing 20-inch diameter transmission main from the 3 MG Tank with new 30-inch diameter transmission main	5,875 LF	$6,404,000	$9,574,000
Village 5	Pipeline		New 12-inch diameter pipelines	25,890 LF	$12,557,000	$18,773,000
	Pipeline		New 18-inch diameter pipelines	13,650 LF	$9,419,000	$14,081,000
Village 7	Pipeline		New 12-inch diameter pipelines	1,540 LF	$747,000	$1,117,000
	Pipeline		New 18-inch diameter pipelines	1,940 LF	$1,339,000	$2,002,000
				Subtotal - Pipeline Improvements	**$54,189,000**	**$81,012,000**

Table 10-3. Recommended Capital Improvement Projects[a]

Responsible Party	Improvement Type	Justification	Improvement Description	Quantity and Unit	Construction Cost, dollars[b,c]	Capital Cost, dollars (includes markups)[b,d]
Other Improvements						
City	Study	A water supply study is recommended to investigate feasible water supply sources for Buildout. The outcome of the study will be used as a framework for Project proponents to provide supply solutions to meet the increase in water demands for their developments. The supply solutions should be included in the development approval process with the City.	Water Supply Options Study	1 lump sum	-	$100,000
	Study	A groundwater recharge study is recommended to perform field investigation and testing on the sites identified in the 2023 groundwater recharge site feasibility study completed by WPGSA. This study will also further evaluate whether implementation of recharge is viable in the City.	Groundwater Recharge Study	1 lump sum	-	$150,000
	Study	An ASR well study is recommended to investigate the feasibility of implementing ASR capabilities in future wells.	ASR Wells Study	1 lump sum	-	$100,000
	Study	The City should update the 2019 Reclamation Master Plan and continue to work with developers and Lincoln Sewer Maintenance District 1 Wastewater Authority (LiSWA) to maximize the future use of recycled water to offset potable demands.	Recycled Water Feasibility Study	1 lump sum	-	$350,000
			Subtotal - Other Improvements		**$0**	**$700,000**
			Total 5-Year System Capital Improvements		**$66,652,000**	**$100,344,000**
10-Year System						
Supply Improvements						
Village 5	Supply (ASR Wells)	Improves supply reliability for increased demands in the 10-Year Phase.	Construction of 2 new ASR wells, equipped with backup power.	2 wells	$5,763,000	$8,615,000
			Subtotal - Supply Improvements		**$5,763,000**	**$8,615,000**
Pressure Reducing Station Improvements						
Village 1	Pressure Reducing Station	Provides main supply from the 575 Pressure Zone to the new 450 Pressure Zone.	New PRS for the 450 Pressure Zone.	1 PRS	$324,000	$484,000
Village 1	Pressure Reducing Station	Provides emergency supply from the 610 Pressure Zone to the new 450 Pressure Zone.	New PRS for the 450 Pressure Zone.	1 PRS	$324,000	$484,000
Village 1	Pressure Reducing Station	Provides emergency supply from the new 450 Pressure Zone to the 375 Pressure Zone.	New PRS for the 450 Pressure Zone.	2 PRS	$647,000	$967,000
			Subtotal - Pressure Reducing Station Improvements		**$1,295,000**	**$1,935,000**
Pipeline Improvements						
Lincoln 270	Pipeline	Provides pipelines to support future development areas.	New 18-inch diameter pipelines	4,150 LF	$2,864,000	$4,281,000
Village 1	Pipeline		New 12-inch diameter pipelines	9,390 LF	$4,555,000	$6,809,000
	Pipeline		New 16-inch diameter pipelines	3,670 LF	$2,349,000	$3,512,000
	Pipeline		New 18-inch diameter pipelines	4,830 LF	$3,333,000	$4,983,000
Village 5	Pipeline		New 18-inch diameter pipelines	3,120 LF	$2,153,000	$3,219,000
Village 7	Pipeline		New 12-inch diameter pipelines	3,495 LF	$1,696,000	$2,535,000
			Subtotal - Pipeline Improvements		**$16,950,000**	**$25,339,000**
			Total 10-Year System Capital Improvements		**$24,008,000**	**$35,889,000**

Table 10-3. Recommended Capital Improvement Projects[a]

Responsible Party	Improvement Type	Justification	Improvement Description	Quantity and Unit	Construction Cost, dollars [b,c]	Capital Cost, dollars (includes markups)[b,d]
15-Year System						
Supply Improvements						
Village 5	Supply (ASR Wells)	Improves supply reliability for increased demands in the 15-Year Phase.	Construction of 2 new ASR wells, equipped with backup power.	2 wells	$5,763,000	$8,615,000
				Subtotal - Supply Improvements	**$5,763,000**	**$8,615,000**
Storage and Pumping Improvements						
Village 5	Above-Ground Concrete Storage Tank	Addresses projected future storage deficit in the 375 West Zone as a result of increased demands in the 15-Year Phase. Sizing of facilities accounts for increased demands in the 20-Year Phase.	Construction of Village 5 Tank #2	2 MG	$4,700,000	$7,027,000
	Storage Tank Pump Station		Village 5 Tank #2 Pump Station, equipped with backup power	3 mgd	$2,000,000	$2,990,000
				Subtotal - Storage and Pumping Improvements	**$6,700,000**	**$10,017,000**
Pipeline Improvements						
Lincoln 270	Pipeline	Provides pipelines to support future development areas.	New 18-inch diameter pipelines	200 LF	$138,000	$207,000
Village 5	Pipeline		New 12-inch diameter pipelines	7,870 LF	$3,817,000	$5,707,000
	Pipeline		New 18-inch diameter pipelines	24,265 LF	$16,743,000	$25,031,000
Village 7	Pipeline		New 12-inch diameter pipelines	3,370 LF	$1,635,000	$2,444,000
	Pipeline		New 18-inch diameter pipelines	8,105 LF	$5,593,000	$8,361,000
	Jack & Bore		Jack & Bore is needed for portions of 18-inch diameter pipeline crossing Southern Pacific Railroad	60 LF	$86,000	$128,000
				Subtotal - Pipeline Improvements	**$28,012,000**	**$41,878,000**
				Total 15-Year System Capital Improvements	**$40,475,000**	**$60,510,000**
20-Year System						
Supply Improvements						
Village 5	Supply (ASR Wells)	Improves supply reliability for increased demands in the 20-Year Phase.	Construction of 1 new ASR well, equipped with backup power.	1 wells	$2,882,000	$4,308,000
				Subtotal - Supply Improvements	*$2,882,000*	*$4,308,000*
Pipeline Improvements						
Village 5	Pipeline	Provides pipelines to support future development areas.	New 12-inch diameter pipelines	17,095 LF	$8,292,000	$8,292,000
				Subtotal - Pipeline Improvements	*$8,292,000*	*$8,292,000*
				Total 20-Year System Capital Improvements	**$11,174,000**	**$12,600,000**
Buildout System						
Supply Improvements						
Village 2, Village 3, Village 4, and SUD-A	Supply (ASR Wells)	Addresses supply deficit and Improves supply reliability for increased demands in Buildout.	Construction of 10 new ASR wells, equipped with backup power.	10 wells	$28,811,000	$43,073,000
Village 6 and SUD-C	Supply (ASR Wells)		Construction of 3 new ASR wells, equipped with backup power.	3 wells	$8,644,000	$12,922,000
				Subtotal - Supply Improvements	**$37,455,000**	**$55,995,000**
Storage and Pumping Improvements						
Village 2, Village 3, Village 4, and SUD-A	Above-Ground Concrete Storage Tank	Addresses projected future storage deficit in the 375 West Zone as a result of increased demands in Buildout.	Construction of Village 2 Tank	5 MG	$8,200,000	$12,259,000
	Storage Tank Pump Station		Village 2 Tank Pump Station, equipped with backup power	6.5 mgd	$2,822,000	$4,218,000
	Above-Ground Concrete Storage Tank	Addresses projected future storage deficit in the 375 West Zone as a result of increased demands in Buildout.	Construction of Airport Tank	3 MG	$6,000,000	$8,970,000
	Storage Tank Pump Station		Airport Tank Pump Station, equipped with backup power	4 mgd	$2,238,000	$3,345,000
				Subtotal - Storage and Pumping Improvements	**$19,260,000**	**$28,792,000**

Table 10-3. Recommended Capital Improvement Projects[a]

Responsible Party	Improvement Type	Justification	Improvement Description	Quantity and Unit	Construction Cost, dollars [b,c]	Capital Cost, dollars (includes markups)[b,d]
Pipeline Improvements						
Village 2, Village 3, Village 4, and SUD-A	Pipeline	Provides pipelines to support future development areas.	New 12-inch diameter pipelines	30,665 LF	$14,873,000	$22,235,000
	Pipeline		New 16-inch diameter pipelines	2,320 LF	$1,485,000	$2,220,000
	Pipeline		New 18-inch diameter pipelines	126,200 LF	$87,078,000	$130,182,000
	Pipeline		New 24-inch diameter pipelines	10,645 LF	$8,942,000	$13,368,000
	Jack & Bore		Jack & Bore is needed for portions of 12-inch diameter pipeline crossing Southern Pacific Railroad	120 LF	$129,000	$192,000
	Jack & Bore		Jack & Bore is needed for portions of 18-inch diameter pipeline crossing Southern Pacific Railroad	180 LF	$256,000	$383,000
Village 6 and SUD-C	Pipeline		New 12-inch diameter pipelines	26,595 LF	$12,899,000	$19,284,000
	Pipeline		New 18-inch diameter pipelines	47,725 LF	$32,931,000	$49,231,000
	Jack & Bore		Jack & Bore is needed for portions of 18-inch diameter pipeline crossing Southern Pacific Railroad	60 LF	$86,000	$128,000
			Subtotal - Pipeline Improvements		**$158,679,000**	**$237,223,000**
			Total Buildout System Capital Improvements		**$186,583,000**	**$322,010,000**
			Total Capital Improvements		**$333,382,000**	**$538,539,000**

(a) Costs shown are based on August 2025 CCI of 20-cities average (13913.52).

(b) Costs rounded to the nearest $1,000.

(c) Estimated construction costs reflect typical conditions and do not account for construction uncertainties or reflect economic bidding climate. Costs include construction contingency of 15 percent from base construction costs

(d) Costs include project contingencies equal to 30 percent (Engineering: 10 percent; Construction Management: 10 percent; Program Implementation, CEQA, Legal: 10 percent).

In addition to the capacity-related improvements in Table 10-2, the following studies were recommended: Water Supply Options Study, Groundwater Recharge Study, ASR Wells Study, and Recycled Water Feasibility Study. These projects are included to improve system and/or water supply reliability and are described in detail in Chapter 8. These recommendations are also summarized in Table 10-3, along with their associated timing and estimated costs which are assumed to be funded by the City.

10.2.4 Recommended Rehabilitation and Replacement Programs

Chapter 9 provided an overview of recommended enhancements to the City's existing R&R programs that will allow the City to replace aging infrastructure on a proactive and programmatic basis before system assets fail and require emergency repair and/or replacement.

As discussed in Section 9.4.1, the City's current Water CIP Replacement Plan, the RUL estimates, and other projects identified by the City were used to develop a 10-Year Pipeline R&R Program that includes pipeline replacement lengths and associated replacement costs for each year. After Year 10 of the R&R Program, there are several years where no pipelines reach the end of their useful life. These assets will create a "replacement wave" where a significant number of assets reach the end of useful life around the same time, requiring simultaneous replacement or upgrades. To proactively plan for the wave of replacements, it is recommended the City implement a staggered replacement strategy, establish a long-term capital reserve fund, and continue and enhance the collaborative approach. Details on each of these recommendations are discussed further in Section 9.4.2.

10.3 BASIS OF RECOMMENDATIONS

The evaluations described in this WMPU and the recommended CIP presented in this chapter are based on several key assumptions which are described throughout this report. These assumptions include the timing, type, and extent of future development projects within the City. The current assumptions for future planned development, used for this WMPU, are described in Chapter 3. Should these assumptions change (e.g., development timing is expedited or delayed, future planned land uses are changed, or the extent of development is changed or does not occur at all) the timing, need and sizing for water system improvements may be affected. Before the City proceeds with the design and construction of recommended water system improvements, future development plans and associated water system facility capacity needs should be reviewed and confirmed. As discussed in Chapter 1, this 2025 WMPU is a living document and will be updated every 5 to 8 years to incorporate new information and updates that occur after its completion.