CITY OF FLAGSTAFF
WATER INFRASTRUCTURE MASTER PLAN
EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

This Water Infrastructure Master Plan provides a comprehensive roadmap by which the City can plan and implement a reliable and high quality water supply from now through build-out of the service area. Two main planning periods are prescribed: A short-term (10 year) Capital Improvement Program (CIP) period and a build-out plan. The resulting recommendations for the short-term period are specific based on criticality and priority. Recommendations for build-out scenarios are more general and conceptual.

The City of Flagstaff's "Water Infrastructure Master Plan" has been developed based on its goals, objectives, and policies as stated in the City's Utilities Integrated Master Plan (UIMP).

The Flagstaff Regional Plan (updated 2014) projected land uses at build-out and forms the basis for the City's Utilities Integrated Master Plan (UIMP). The first chapter of the UIMP, the Water Resources Master Plan (2011), provides a summary and discussion of water resources and water production in Flagstaff. This Water Infrastructure Master Plan forms another chapter in the UIMP, builds on the issues within the Water Resources Master Plan, and expands to address water distribution, treatment, storage and overall system improvements for the City of Flagstaff. It provides guidance for the orderly expansion of the water service system, including both production and distribution system facilities, and identifies the need and priorities for system improvements.

The Flagstaff Water Infrastructure Master Plan addresses the drinking water system component of the UIMP. It documents the existing status of water resources and the water system, and outlines a capital improvement plan to improve the condition and reliability of the system and to provide adequate capacity for the next 10 years.

Project phases included a kick-off meeting; site visits and data review (including staff interviews and workshop); assessments of pressure reducing valves, wells, booster stations, inter-basin pipeline, and surface water treatment facilities; an Automated Meter Reading (AMR) cost assessment; and development of draft and final Water Infrastructure Master Plan reports. A detailed 10-year CIP report with costing and prioritization for all improvements was also developed. These assessments included all components except the SCADA and control systems, and building structure.

The initial task that was vital in developing this Master Plan was the asset condition assessment. This was comprised of facility assessments for above ground infrastructure and an asset management analysis of buried infrastructure using NCS' software tool. Future demands were identified based on water needs at build-out. Water resources availabilities (supply and demand) were assessed based on growth requirements, capacity limitations of existing equipment, and network limitations for future demands. Hydraulic modeling was used to identify infrastructure upgrades required to support future demands for different growth scenarios. Finally, an optimal course of action for the next ten years was identified.

The Water Infrastructure Master Plan is intended to serve as a "road map" to implementing infrastructure improvements to meet the City's goals.

Sections 1 and 2 of the Water Infrastructure Master Plan include a system overview, descriptions of pressure zones, treatment, storage, and systems operations. Water demands and future scenarios are presented and discussed in Section 3. Section 4 presents the current water production and distribution system infrastructure. Section 5 summarizes the water system facility evaluations. Section 6 presents the hydraulic modeling and calibration activities conducted to assess future distribution system infrastructure needs. Section 7 discusses water distribution and storage infrastructure upgrade needs. Section 8 provides the cost basis for future budget needs. Section 9 summarizes the recommended 10-year CIP action items in terms of required upgrades and priorities. Facility assessment reports and forms, hydraulic model calibration plan, references, and referenced reports are attached in the Appendices.

EXISTING WATER SYSTEM COMPONENTS

The City of Flagstaff is comprised of 64 square miles nestled at the base of the San Francisco Peaks. The Utilities Division serves drinking water to the City's population of 65,870 (U.S. Census Bureau 2010).

In 2013, 8,645 acre-feet of drinking quality water were distributed at an average of 7.72 million gallons per day (MGD), with a maximum day demand of 13 MGD. Total water production for 2013 increased approximately 2 percent over 2012. Non-revenue water is currently estimated at 14 percent.

The sources of drinking water include lake, reservoir, springs and wells. In 2013, the Utilities Division distributed approximately 8,645 acre-feet of drinking quality water at an average of 7.72 million gallons per day (MGD) (CCR 2013), with a maximum day demand of 13 MGD. Total water production for 2013 increased approximately 2% over 2012. Non-revenue water is estimated at 14 percent (2014 Report to the Water Commission). The Water Infrastructure Master Plan was based on 2011 data, water demand was reported at 7.5 MGD and 11% percent non-revenue water.

The City's water system consists of two surface water treatment plants (WTPs), 24 active wells, four main pressure zones (and several other smaller zones served through seven PRVs), three concrete storage reservoirs and six steel water storage tanks, and seven pump stations.

The sources of drinking water include reservoirs, springs and groundwater wells. The City's water supply is mainly served by wellfields within City Limits, in the vicinity of Lower Lake Mary and Woody Mountain, and by surface water from Upper Lake Mary.

The City's primary water supply is the Lake Mary well field groundwater and surface water from Lake Mary. In 2013, Lake Mary Wells provided 20% of the water produced, Local Wells 29%, Upper Lake Mary 18% and Woody Mountain Wells 32% (2014 Water Commission report). The average day production of 9,913 acre-feet per year (AFY) (8.85 MGD) is available from the wells. It has been

determined that 9,913 AFY to be sustainable yield by ADWR as per the City's Designation of Adequate Water Supply.

Upper Lake Mary surface water is treated at the Lake Mary Water Treatment Plant (WTP) and Inner Basin surface water and groundwater is treated at the North Reservoir Filtration Plant (NRFP). Theoretically, 8 MGD is available from the Lake Mary WTP, however only 5.5 MGD is considered available for peak day production. An average day of 2 MGD has been used historically as a reliable quantity. Inner Basin (IB) wells and surface water are considered supplemental water and are not considered a reliable source of supply. Typically, they provide an average of 200 gpm. This is essentially free water when it is available.

Drinking water delivered from the City's water sources and treatment facilities is transported to the users through the network of distribution system pipelines and storage tanks. Adequate pressures are maintained within zones through the use of gravity (taking advantage of elevation differences) and pressure reducing valves and booster pump stations.

Water is conveyed throughout the City's water system to meet:

- ***Peak daily demands***
- ***Fire fighting needs***
- ***Emergency conditions***

In order to meet future demands, more wells can be drilled locally to meet peak demand provided the annual average remains below the ADWR approved limit for Designation of Adequate Water Supply sustainability compliance. The City has rights to 16,500 AFY from Red Gap Ranch but self-limits pumping to 8,000 AFY (7.14 MGD) based on an agreement with the Navajo Nation.

The current system configuration has four main pressure zones and four additional pressure zones that are supplied through seven pressure reducing stations. There are eight water storage facilities of various capacities within the City's service area, three concrete reservoirs and six steel tanks. The City has seven pump stations; three are within the distribution system to maintain pressure and provide the required water delivery capacity (booster pump stations). Water mains range in diameters from 0.75 inch to 36 inches, and pipe materials include asbestos cement, black iron, cast iron, copper tubing, ductile iron, galvanized steel, poly vinyl chloride (PVC), and steel.

WATER DEMANDS

A water demand analysis was conducted to determine the future water supply requirements that will establish system component adequacy and sizing. This analysis builds upon the work initially completed within the Water Resources Master Plan that utilized 2001 land uses. However, this analysis utilizes the updated land uses identified within the Flagstaff Regional Plan 2030 (ratified in 2014). This study forms the basis for the City to identify long term water needs and plan for future water resources in a proactive manner.

The major objective of the water demand analysis was to update the City's water demands at build-out and the current growth trend using the latest land uses approved by the voters. Water demands include water delivered to meet all customer needs, water required for fire-fighting, water used for system flushing, and accounting for some leakage.

Water demand projections were performed for Scenarios A, B, D, and the Known Development Scenario. The following conclusions are drawn on average day demand:

- Scenario A (Sprawled Development) additional water demand is calculated at 7.7 MGD (8,600 AFY), corresponding to a total build-out demand of 15.2 MGD (17,000 AFY).
- Scenario B (Intermediate Density) additional water demand is calculated at 8.1 MGD (9,100 AFY), corresponding to a total build-out demand of 15.6 MGD (17,500 AFY).
- Scenario D (Dense Development) additional water demand is calculated at 7.5 MGD (8,500 AFY), corresponding to a total build-out demand of 15.0 MGD (16,900 AFY).
- The Known Development additional water demand is calculated at 2.7 MGD (3,000 AFY), corresponding to a total water demand of 10.2 MGD (11,400 AFY).

The existing available maximum day production (firm capacity) is 16.9 MGD. Allowing for committed development (i.e., developments that have already been assured a 100-year water supply), a deficit of 1.8 MGD (1,250 gpm) is anticipated. Five new wells will be needed in the CIP plan to provide adequate water supply in the Known Development plus committed development scenario.

FACILITY EVALUATIONS

The Water Infrastructure Master Plan project team conducted on-site assessments and staff interviews to evaluate the current conditions of the water infrastructure. Site visits were conducted during October 2013 to assess the City's water system facilities. The facilities visited included PRV stations, well sites, booster pump stations, and water treatment facilities. The primary purpose of the assessments was to evaluate operational concerns, design considerations, current condition, and remaining asset life.

Facilities were inspected and assessed for operational concerns, design considerations, current condition, and remaining asset life. Most of the facilities were deemed in "good to excellent" condition.

Hydraulic modeling and geo-spatial software tools were used as planning tools in developing practical and cost-effective infrastructure solutions.

Facilities were prioritized according to condition and "useful asset life remaining". Two components at the Lake Mary WTP (sedimentation basins and sludge lagoons) were found to be nearing the end of their useful lives, and

mechanical and concrete surface improvements are required immediately. Additional facility improvements are required within the next two years (flocculation basins and electrical upgrades). These lower priority projects will need to be addressed within the coming five years. Ongoing improvements, such as the pipe replacement program, will continue indefinitely.

DISTRIBUTION SYSTEM INFRASTRUCTURE PLANNING

In conjunction with facility evaluations, future growth scenarios were laid out and new infrastructure capacity needs were identified to meet the City's desired performance criteria**.** Distribution system infrastructure consisting of several elements, including reservoirs (storage tanks), pumps, pipelines and PRVs were analyzed through hydraulic modeling runs and evaluated to meet the City's future needs.

For each future scenario, optimization calculations were conducted to identify the lowest cost pipe upgrades that would maintain the required pressures in the system, and not exceed maximum velocities. In addition, the Known Development Scenario was analyzed for fire-flow and peak hour conditions.

To address challenges associated with an aging pipe system, a systematic approach to pipe rehabilitation/pipe replacement was utilized to identify the most economical and technically acceptable solution.

For each of the water system facilities assessed in October 2013, improvements and priority rakings were identified. An assessment report was prepared for each facility, including cost details for improvements associated with each facility. Capital costs were developed based on recent projects with similar components, manufacturer's budget estimates, existing studies, standard construction cost estimating manuals, and engineering judgment

Eight projects were identified in this report relating to energy efficiency improvement. Complete conversion to 100% Automatic Meter Reading technology (from the current 77%), and studies on flow meter accuracy, non-revenue water (e.g., leakage) and IB pipeline assessment were recommended and included in short term future budget needs. All of these pieces would yield maximum benefit the sooner they are initiated and completed. For this reason, these actions are recommended to be completed by the end of the current fiscal year (2015-16).

CAPITAL IMPROVEMENT PROGRAM (2015 – 2024)

The recommended 10-year capital improvement program has a total cost of $82.3 million, as shown below.

The water system master planning process has identified a capital improvement program through 2024 totaling just over $82 million.

These capital investments will allow Flagstaff to achieve its objective to: "professionally and cost effectively provide water services that meet the present and future environmental, health, and safety needs of the community."

The facility assessments revealed two projects that are assessed as Priority 1 and recommended to be completed within the next 1 to 2 years. Priority 2 items have been scheduled to be completed by the end of the fifth year into the CIP cycle. Priority 3 items are those that have a remaining asset life between 5 and 10 years, therefore these improvements are scheduled to be completed by the end of the tenth CIP year. Storage facility rehabilitation projects, notwithstanding further assessments, are scheduled as Priority 3, to be completed by the end of the tenth year. Timing of these projects may be accelerated, pending further field evaluation.

Growth related improvements should be timed in sync with the City's growth rate and the progression of development.

Pipe Replacement Program - $ 32 M

Infrastructure Improvements - $30 M

Facility Improvements - $ 17.4 M

Growth Related Upgrades - $1.5 M

Energy Related Projects - $ 660 K

Recommended Studies - $ 760 K

As with the energy efficiency related projects, three recommended studies (flow meter accuracy, non-revenue water, and IB pipeline assessment) would yield maximum benefit the sooner they are completed and the findings are implemented. For this reason, these are recommended to be completed by the end of fiscal year (2015-16). A rate study analysis is recommended to be performed every three years, beginning in the 2016-17 fiscal year.

It is recommended to implement the pipeline rehabilitation project soon after pipeline study. This project may take up to two years for completion and should be initiated beginning of fiscal year 2016-17.

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