# WATER SYSTEM MASTER PLAN

## City of Cave Junction

Josephine County, Oregon


December 2013

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December 2013

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# Executive Summary

**Section ES**

## ES.1 Introduction

The City of Cave Junction holds water rights at the East Fork of the Illinois River (WR# S-23847), the Daisy Hill well field (WR# G-10965) and the Rockydale well field (WR# G-2767) in the Illinois River Valley. The City first obtained these rights in June of 1949 to supply 1.0 cubic feet per second (cfs) for municipal use. Three wells at the Rockydale site were added as an additional source in 1964 and an additional 2.0 cfs was obtained in 1971 from the East Fork of the Illinois River. The Daisy Hill site was then added in the early 1980's to supplement the surface water from the river. The current water rights held by the city total 4.6 cfs or 2,065 gallons per minute.

The Cave Junction water system currently serves a population of 2,188 (2010 figure). The majority of the customers are within the city limits. In July 2010 the neighboring Kerby Water District (KWD) entered into contract services with the city to have water provided to them. At the time of this study approximately 305 residents, which totals 127 accounts, of the KWD were receiving water from Cave Junction.

In February 1995, Lee Engineering completed a "Water System Master Plan" for the City of Cave Junction. To reevaluate the current situation in light of regulatory issues and rules in place today, and to refine improvement needs and a Capital Improvement Plan, a new Water System Master Plan was commissioned. This Master Plan investigates the needs within the current UGB plus areas encompassing the water supply and transmission facilities for a 20-year period into the future, ending in the year 2035.

The estimated full-time service population of 2,188 persons is projected to grow to 3,884 persons by the year 2035. The growth projections are based on a 2.5% average annual growth as indicated by the City of Cave Junction and Josephine County.

## ES.2 Water Demand

### ES.2.1 Current Water Demand

The City of Cave Junction accesses water from two points: the Illinois River and the Daisy Hill Well field. They provide their own water treatment at their centrally located water treatment plant. The production of these two sources has been monitored by the City since July of 2000. A summary of the current water demand is presented below. See Section 3.2 for more details.

**Table ES.2.1-1 – Cave Junction/Kerby Actual Metered Usage Summary**

| City of Cave Junction (Including 305 Kerby residents) 2010 Data | | | 2,188 persons | |
|---|---|---|---|---|
| **Unit** | **ADD** | **MMD** | **MDD** | **PHD** |
| gpd | 336,819 | N/A | 943,094 | 1,178,868 |
| P.F. | 1.0 | N/A | 2.8 | 3.5 |
| gpcd | 154 | N/A | 431 | 539 |

### ES.2.2 Future Water Demand

Water demand projections over the planning period of 20 years are estimated by multiplying an average per capita demand of 154 gpcd by the projected future population estimates. By the end of the planning period, the ADD is projected to increase to nearly 600,000 gallons per day while the MDD is projected to increase to approximately 1.67 mgd. See Section 3.3 for more information

Based on the 20-year water demand projections, supply and treatment facilities must be designed to deliver at least 1.67 million gallons per day or 2.59 cubic feet per second.

## ES.3 Existing Water System

### ES.3.1 Water Supply

The city has two authorized points of diversion on the East Fork of the Illinois River. Currently only the southeast diversion is in use. The other source of system water comes from the Daisy Hill Well. With these two water sources the city currently has sufficient supply to meet the demand. The city has additional water rights that are currently either not perfected or not being used. Section 6 goes into more detail about the water rights along with a more extensive report by GSI Water Solutions in the Appendix.

The City water department operates and maintains the City's water infrastructure, including:

- Raw water intake
- Water treatment plant
- Three reservoirs
  - South Old Stage – 300,000 gallons
  - Laurel Road #3 – 500,000 gallons
  - Laurel Road #4 – 1.5 million gallons
- All internal water mains (over 18 miles)
- All water meters (1,071 meters)

### ES.3.2 Water Treatment

The Cave Junction Water Treatment Plant is a conventional surface water treatment plant. Construction on the existing facility was completed in 1999. The adjacent steel Clearwell at the plant was also constructed in 1999. The plant has a maximum capacity of 2.0 million gallons per day or 1,389 gallons per minute. One great benefit of the plant location and the design of this plant is the opportunity for future expansion. There is space and possible locations for expansion as the city needs. Based on the planning numbers the capacity of this plant is sufficient for this planning period.

The 500,000 gallon Clearwell tank provides some storage however its primary function is to provide the necessary chlorine contact time needed for disinfection prior to water reaching the first user. The Clearwell has a minimum water surface elevation of 1348.0 and an overflow elevation 1364.0 depth which is the full point where filtration is ceased. The base of the tank is located at elevation 1339.0 feet. The tank is baffled to allow for through flow and the contact time is 68 minutes in the winter (Temperature = 0.5ºC) and 18 minutes in the summer (Temperature = 20ºC).

Various sections of the plant are looked at in more detail in Section 6.2.

### ES.3.3 Treated Water Storage

The City has a total storage capacity of 2.3 million gallons in three different reservoirs.

The South Old Stage Tank, or Reservoir #1, is located at the end of S. Old Stage Road in the southern portion of the City. The tank is 16.67 feet tall, has a diameter of 60 feet and is made of concrete. This tank was built in 1971 or 1972 and has a storage capacity of 300,000 gallons. It is located within a fenced area adjacent to a telecommunications tower.

The two other reservoirs are located adjacent to each other east of the City and east of Laurel Road. Reservoir #3 is a glass-fused-to-steel, circular tank by AquaStore that was built in 1991. It has a capacity of 500,000 gallons and is 18-feet tall with a diameter of 70 feet. The base elevation of the tank is located at 1512 feet above sea level.

Approximately 12 feet below this tank is Reservoir #4. This tank provides 1.5 million gallons of storage and was constructed in 1998. The tank is 40 feet tall and approximately 80 feet in diameter. This tank has a base elevation of 1490 feet above sea level and an overflow elevation of 1530 feet. The tank is welded steel and painted green. See Section 6.3 for more details.

### ES.3.4 Distribution System

Currently the City of Cave Junction only operates under one pressure zone. There has not been a need to separate portions of the city into different pressure zones with pressure reducing valves (PRVs), pump stations or any other type of equipment.

Besides the distribution pumps at the WTP, there is one pump station that is included in the system. It is the Kerby Booster Pump Station (BPS) which belongs to the Kerby Water District (KWD). It is a recently built structure that supplies the KWD with additional pressure and flow if needed. It helps in meeting required fire flows for the KWD. It is very rarely operated.

The City of Cave Junction water system includes over 98,000 feet (over 18 miles) of piping. Nearly 60% of the system is currently 8" pipe. Only about 2% of the system is sized 4" or smaller. Compared to neighboring communities, this sizing of pipe is very good and allows for good flows and possible growth throughout the system. Also, 93% of the existing system pipe material is PVC.

## ES.4 Improvement Needs

### ES.4.1 Water Supply

The City of Cave Junction, as previously mentioned, currently draws 1.0 cfs of water from the Illinois River and 0.45 cfs of water from the Daisy Hill well field. These amounts have been sufficient so far for the city. They also have additional water rights which end up totaling 4.6 cfs. Future projections, shown in Section 3, say by the year 2035 that the demand will have increased to 1.7 MGD or 2.6 cubic feet per second. Even though the city has sufficient water rights to meet these future demands, a number of various water supply projects are needed to make sure that happens.

Rehabilitating the Rockydale well field would be a great solution to the supply issues that will arise in the future. It is a well field that has been used in the past. There is also interest from the nearby state park in utilizing the wells. Section 7 itemizes the costs to accomplishing this and other recommended water supply improvements that will put the city in a good position over the next 20 years.

### ES.4.2 Water Treatment

In general, the Cave Junction Water Treatment Plant is well maintained, well operated and produces high quality treated water. The plant has a capacity of 2.0 MGD. Fortunately for today's residents, this capacity should be enough to get the City through the planning period. In order to continue producing safe drinking water though, a few minor improvements will be required. Each of these improvements will allow the plant to supply the necessary water through this current planning period.

The recommendations are as follows:

1. Replace filter media
2. Modify sedimentation basins by adding baffling, tube settlers, launders and a streaming current controller
3. Replace disinfection system
4. Determine the appropriate covers that can be used to prevent outside contamination and UV issues

Section 7.3 goes into further detail about each of these recommendations. By accomplishing these projects, Cave Junction will have a much more efficient plant and continue to produce safe drinking water for the residents.

### ES.4.3 Treated Water Storage

The storage goal is to provide storage for 3 average days of water demand plus equalization volume (to account for the regular daily fluctuation in tank level) plus fire storage. For the schools and other significant commercial structures, fire storage equal to at least 3000 gpm for 3 hours is recommended. Based upon the stated storage goal; a total of 1.7 million gallons (MG) of storage in the water system is needed. Since existing storage totals equal 2.3 MG, the City has sufficient storage for the coming years. Storage will be exceeded though during the years 2025-2030. Refer to Table ES.4.3-1 for a storage summary.

**Table ES.4.3-1 – Cave Junction Storage Capacity Needs (gallons)**

| Year | Equalization | Emergency | Fire Reserve | Total Storage | Surplus/(Deficit) |
|---|---|---|---|---|---|
| 2010 | 188,619 | 1,010,458 | 540,000 | 1,739,077 | 560,923 |
| 2015 | 212,224 | 1,137,444 | 540,000 | 1,889,668 | 410,332 |
| 2020 | 238,774 | 1,279,740 | 540,000 | 2,058,514 | 241,486 |
| 2025 | 268,685 | 1,440,054 | 540,000 | 2,248,739 | 51,261 |
| 2030 | 302,303 | 1,620,234 | 540,000 | 2,462,537 | (162,537) |
| 2035 | 334,801 | 1,794,408 | 540,000 | 2,669,209 | (369,209) |

In order to prevent a storage deficit a new 500,000 gallon tank should be built within the next 8-10 years. This will meet the required storage that is needed. The city should begin to locate property where this structure can be built. Along with meeting storage, the existing tanks need regular maintenance. Two of the tanks require either new coatings or replacement coatings. The third tank will require resealing and repair. It is also recommended to install cathodic protection in each of these tanks for preventative maintenance. See Section 7.4 for more information.

### ES.4.4 Distribution System

Computer hydraulic modeling was developed for the entire distribution system. Per OAR, the system must maintain at least 20 psi at all service connections (at the property line) at all times, even during fire flow events. In addition, at least 40 psi is typically desirable at any structure during normal peak flows but is not expected during fire flows. Piping deficiencies exist in several areas of the system resulting in inadequate fire flow availability. Some water lines within the City are asbestos-cement lined and need to be replaced. See Section 7.5 for more information on pipe deficiencies.

Figure 6.4.4-1 shows the various hydrant locations. The City currently has fairly uniform coverage. Some additional hydrants should be installed to provide better coverage. Those new hydrant locations are shown in Figure 7.5.4-1.

As mentioned, the existing water distribution system contains some pipe that is constructed of asbestos-cement. This pipe was installed in the 1950's and 1960's and has a useful service life of 50 years. It is recommended that this pipe be replaced as needed and as other projects are initiated and completed in the areas where this pipe is located. See Section 7.5.4 for more information.

## ES.5 Capital Improvement Plan

The various improvements recommended in the Master Plan are prioritized and separated into two phases or priorities of work. The total cost for all improvement in the Capital Improvement Plan (CIP) is approximately $5.5 million.

The two priority categories are described as follows:

Priority 1 accomplishes the improvements that are to be made to the Water Treatment Plant and the storage tanks. It also includes restoration of the Rockydale well field. Completing these projects first accomplishes a few different goals. One, this is a great time to improve the treatment plant because demand is not as high as it will be in 10-20 years. Doing this now will improve the water quality for the residents of Cave Junction and also provide them good equipment for well through this planning period. Two, by improving the storage tanks now there is a lot more flexibility with water storage. As time goes on surplus storage will start to decrease and it will be much harder to drain and take out of commission tanks for maintenance. Finally, by bringing the Rockydale well field back online it provides for an increase in the water going into the system and allows once again for more flexibility with operating the plant.

Priority 2 will then accomplish the remainder of the needs of the city. It will provide for the storage that will be required by the end of this planning period while at the same time upgrade many of the old waterlines throughout the system. The AC replacement projects can be incorporated into the plan whenever is convenient for the city. If there is a current project going on near any AC replacement project it would prudent to incorporate that in at that time.

The table below (Table ES.5-1) provides a summary of the priorities.

**Table ES.5-1 – Prioritized CIP Summary**

| Priority | Summary | Cost Estimate |
|---|---|---|
| 1 | Projects should be undertaken within the next five years. These projects allow improvements to be made to the existing well field (Rockydale), the WTP and the reservoirs while having more flexibility to complete them. | $ 3,050,199 |
| 2 | Projects should be undertaken 8-12 years from now. These projects will improve the existing piping, enhance the fire protection throughout the city and prepare for future water needs. | $ 2,406,625 |
| | **ESTIMATE TOTAL** | $ 5,456,824 |

# ES.6 Financing

Existing water rates in Cave Junction are low. Based on 2011-2013 water sales records, the average single-family dwelling uses an average of 4,203 gallons of water per month. Under the existing rate structure this average home has a monthly water bill of $28.80 ($0.0069/gallon). Funding agencies often use a value of 7,500 gallons per month as the normal residential use. Under the current rate structure, the average residential rate per EDU then becomes $35.03 for 7,500 gallons.

To qualify for grant assistance for water system improvements it is likely that water rates must first meet the Oregon State average for a residential water bill which is approximately $55 per month. According to the current rate structure in Section 9, Cave Junction only charges 64% of what the average Oregonian pays. By raising water consumption rates, the City of Cave Junction may fund all of the Capital Improvement Projects listed which results in an average monthly bill of $55.22 for each equivalent dwelling unit (EDU). This puts the city right at the State average. See Section 9.4 and the table below (Table ES.6-1) for more information.

Funding assistance for municipal water improvements in Oregon primarily comes through programs administered through the Infrastructure Finance Authority (IFA) – which formerly was known as the Oregon Economic and Development Department (OECDD) – and USDA Rural Development Rural Utilities Service (RUS). Programs through IFA include Block Grants, the Safe Drinking Water Revolving Loan Fund, Special Public Works Fund, and Water/Wastewater Financing. Federal money is available with grant and loans through RUS. Each program has various advantages and disadvantages and various requirements. To determine which programs are available to the City for any specific project or projects, a "One-Stop" financing meeting should be conducted once this Master Plan is adopted and a decision to move forward on specific improvements is made. The One-Stop meetings are held in Salem once per month and it is recommended that this step be initiated as soon as possible after Master Plan adoption.

**Table ES.6-1 – Potential Cave Junction Revenue Increase per EDU**

| Item | Full CIP | Priority 1 | Priority 2 |
|---|---|---|---|
| Capital Cost | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Loan Needed | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Interest Rate | 3.5% | 3.5% | 3.5% |
| Loan Period | 20 | 20 | 20 |
| Annual Annuity | $ 383,473.24 | $ 214,349.89 | $ 169,123.36 |
| Monthly Income Required | $ 31,956.10 | $ 17,862.49 | $ 14,093.61 |
| **Monthly Income Required + 10%** | **$ 35,151.71** | **$ 19,648.74** | **$ 15,502.97** |
| No. of EDU's at 4,203 gallons | 1330 | 1330 | 1330 |
| **Add'l Monthly Cost per EDU** | **$ 26.42** | **$ 14.77** | **$ 11.65** |

# Introduction

**Section 1**

## 1.1 Background and Need

### 1.1.1 Water System Background

The city of Cave Junction is located in Josephine County, Oregon approximately 30 miles southwest of Grants Pass. It is the gateway to the Oregon Caves National Monument and the commercial, service and cultural center for a rural community. Cave Junction is located within the Illinois River Valley and is nestled in the mountains known as the Siskiyous in the Klamath Range. The City is located along US Route 199 (Redwood Highway) and Oregon Route 46 (Caves Highway). Figure 1.1.1-1 shows the location of Cave Junction and its proximity to Grants Pass.

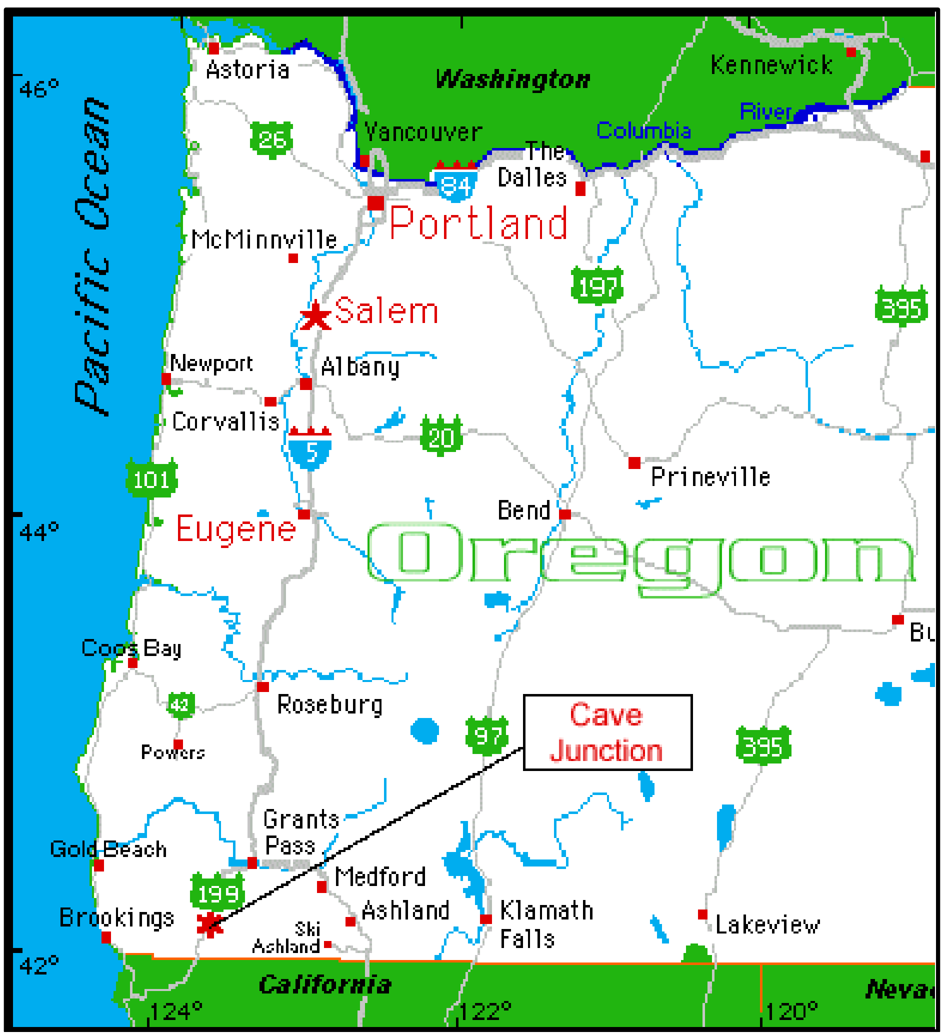



**Figure 1.1.1-1 – Location map for the City of Cave Junction**

For thousands of years, the Illinois River Valley was inhabited by the Takelma Indians. When gold was discovered in the 1850's, the native culture declined and they were moved to one of two reservations so gold mining opportunities could be developed. After World War II, timber became the main source of income for residents. In 1948, the City became incorporated with a population of approximately 280 people. The City grew fast in the 1960's and 1970's but growth slowed throughout the 1980's and 1990's as a result of the timber decline (Lee Engineering, 1995).

The City currently has two main sources of water supply:

1. The Illinois River; and
2. The Daisy Hill Well.

The main source of drinking water is the Illinois River. This river travels through a 232 square mile water shed including the East Fork Illinois River, Sucker Creek, and Althouse Creek watersheds. The point of diversion is located at the south end of the City. The City of Cave Junction has water rights to withdraw a total of 3 cubic feet per second (cfs) – or 1,347 gallons per minute (gpm) – from two locations on the East Fork of the Illinois River (WR# S-23847 and S-48026). Only 1 cfs is currently perfected, or utilized, and it is recommended that the right for the remaining 2 cfs be perfected soon.

The City's water system began construction in 1944. The first construction included a well by the Illinois River, a 60,000 gallon concrete reservoir located at the south end of the City and a single 8" steel pipe between the reservoir and the intersection of Caves Highway and Caves Avenue. In 1954, three more wells were constructed, and in 1976 construction was completed on the City's water treatment plant and the river intake system (Lee Engineering, 1995). Since then, the original raw water intake and water treatment plant have been demolished and were rebuilt in 1998.

The City currently has six production wells but only one is in operation. Three of the remaining five wells, Rockydale well site, still have their casings and well house but all pumps have been removed. The final two wells, Berard and Meyers, no longer exist. The Daisy Hill Well, the only well that is operational, has a water right of 0.60 cfs (WR# G-10965). Presently, it is able to produce approximately 0.33 cfs – or 150 gpm – and the water is disinfected by the addition of chlorine.

In July of 2010, the City of Cave Junction began providing water and contract services to the Kerby Water District. The Kerby Water District includes approximately 127 customers.

### 1.1.2 Need for Plan

Lee Engineering, Inc. of Oregon City, Oregon prepared a report for the City of Cave Junction titled "Water System Master Plan" on February 20, 1995. This report included an assessment of the current water system and recommendations of capital improvements. It has been almost twenty years since the completion of that water master plan and the City considers it prudent to reevaluate overall system needs and to complete a new 20-year Water System Master Plan in accordance with OAR 333-061-0060(5). This has also been mandated in a letter from the Oregon Drinking Water Protection (DWP) Program.

### 1.1.3 Plan Authorization

The services of Civil West Engineering were secured to complete a new Water Master Plan for the City in January 2013.

### 1.1.4 Past Studies and Reports

The following plans and reports were used as background:

- *Water System Master Plan,* February 1995, Lee Engineering, Inc.
- *Water System Improvements, Contract Documents,* August 1997, Lee Engineering, Inc.

- *Reservoir #1, Report of Findings from Diving Operations,* 14 June 2011, Liquivision Technologies Diving Services
- *Reservoir #3, Report of Findings from Diving Operations,* 14 June 2011, Liquivision Technologies Diving Services

## 1.2 Study Objective

The purpose of the Water System Master Plan is to furnish Cave Junction with a comprehensive planning document that provides engineering assessment of system components and guidance for future planning and management of the water system over the next 20 years.

Principal plan objectives include:

- Description and mapping of existing water system
- Prediction of future population and water demands
- Creation of digital hydraulic model based on available mapping
- Evaluation of existing water system components
- Evaluation of the capability of the existing system to meet future needs and regulations
- Recommendations for improvements needed to meet future needs and/or address deficiencies
- Background provisions to support updated water System Development Charges (SDC's)

This Plan details infrastructure improvements required to maintain compliance with State and Federal standards as well as provide for anticipated growth. Capital improvements are presented as projects with estimated costs to allow the City to plan and budget as needed.

## 1.3 Scope of Study

### 1.3.1 Planning Period

The planning period for this Water System Master Plan must be at least 20 years in accordance with OAR 333-061-0060(5)(b) and OAR 690-086-0170. The period must be short enough for current users to benefit from system improvements, yet long enough to provide reserve capacity for future growth and increased demand. Existing residents should not pay an unfair portion for improvements sized for future growth, yet it is not economical to build improvements that will be undersized in a relatively short period of time. The end of the planning period for this Master Plan is the year 2035, or 20 years from the completion of the Plan.

### 1.3.2 Planning Area

The Master Plan planning area is that contained within the Cave Junction Urban Growth Boundary (UGB), as well as the immediate area surrounding water system components outside the boundary, such as the pump station and water main lines. The area within the UGB includes approximately 1150 acres or 1.8 square miles. Additional information and maps for the planning area are presented in Section 2.

### 1.3.3 Work Tasks

In compliance with Drinking Water program standards, this plan provides descriptions, analysis, projections, and recommendations for the water system over the planning period. The following elements are included:

- Study area characteristics, including land use and population trends and projections
- Description of the existing water system including transmission, storage and distribution
- Existing regulatory environment including regulations, rules and plan requirements
- Current water usage quantities and allocations
- Projected water demands
- Existing system capacity analysis and evaluation
- Improvement alternatives and recommendations with associated costs
- A summary of recommendations with a Capital Improvement Plan
- Funding options
- Maps of the existing system and recommended improvements

## 1.4 Acknowledgments

Various members of the City Staff have contributed time and effort to ensure complete information and proper planning of the community's water system needs. Water treatment operators, water distributions staff, billing records personnel, and others have all helped to complete this effort. We wish to acknowledge and thank the following persons in particular:

Carl Jacobson Jr. – Mayor
Ryan Nolan – City Recorder
Pat Foley – Community Development Specialist, RVCG
Steven Bethke – Water Treatment Plant Manager
Travis Robbins – Lead Maintenance Operator

# Study Area

**Section 2**

## 2.1 Physical Environment

### 2.1.1 Planning Area Location

The city of Cave Junction is a southern Oregon community located approximately 60 miles southwest of Medford, and 270 miles south of Portland. The City lies within the Illinois River Valley in the Siskiyou Mountains at an elevation of approximately 1,390 feet. The Siskiyou Mountains are only one of two mountain ranges that run west to east in the entire United States. The City limits on the south are defined by the approximate path of the East Fork of the Illinois River and Illinois River Forks State Park. The western boundary extends along the Illinois River and joins the northern boundary located north of Laurel Road. The eastern boundary is defined by the approximate path of Laurel Road with the southeastern corner the approximate intersection of Laurel Road and Oregon Caves Highway. The City of Cave Junction is located at 42º09’46”N, 123º38’52”W in Township 39S, Range 8W, and spreads into portions of Sections 15, 16, 20, 21, and 22.

The planning area in this Master Plan is primarily contained within the Cave Junction City limits. A portion of the master plan will refer to the Kerby Water District (KWD) which is located approximately two miles north of Cave Junction on Highway 199. The KWD is referenced at times in this report due to the fact that the City of Cave Junction currently provides water and contract services for certain residents in Kerby. Modeling and mapping will not be done for the KWD. Figure 2.1.1-1 shows the City of Cave Junction.

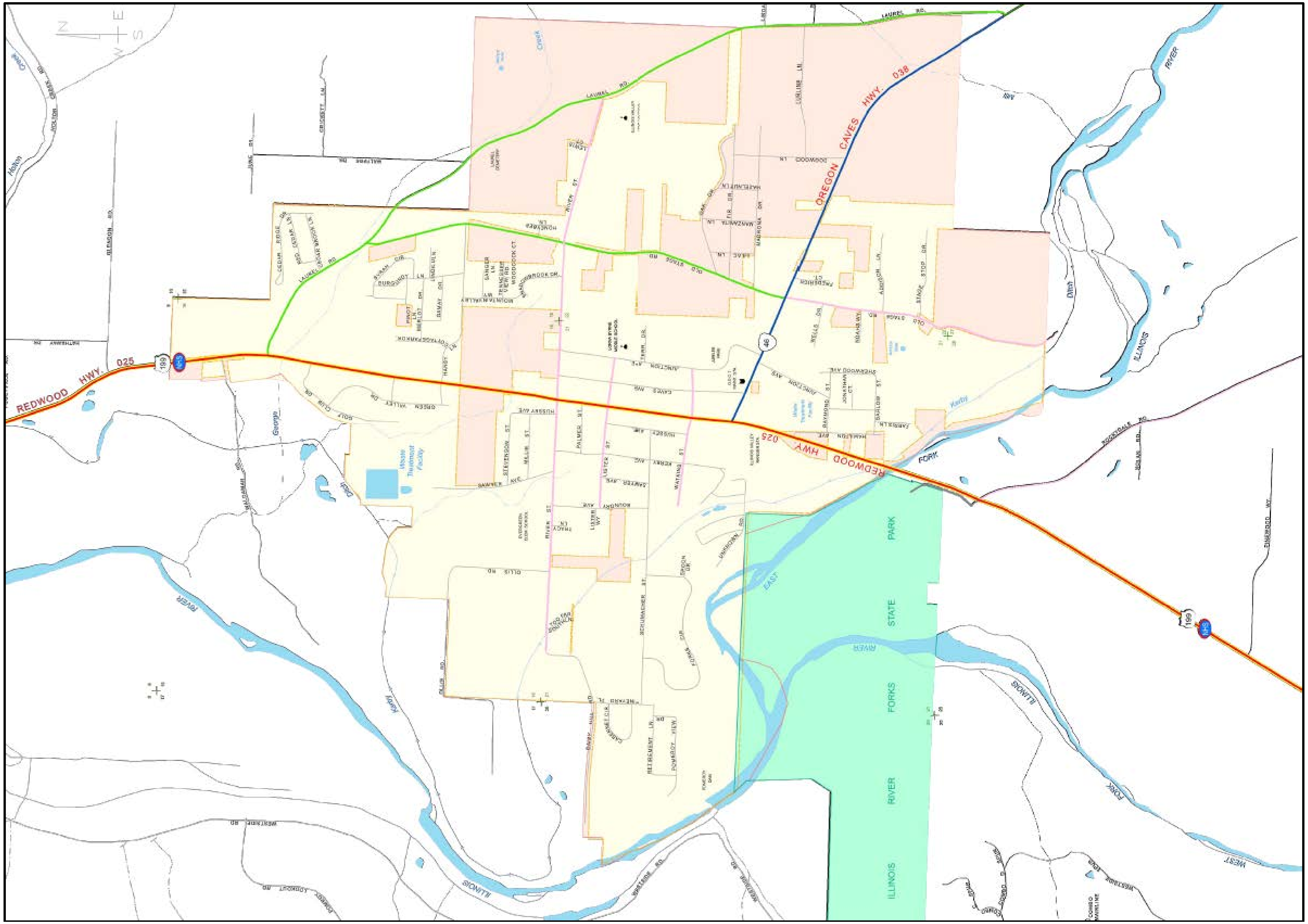


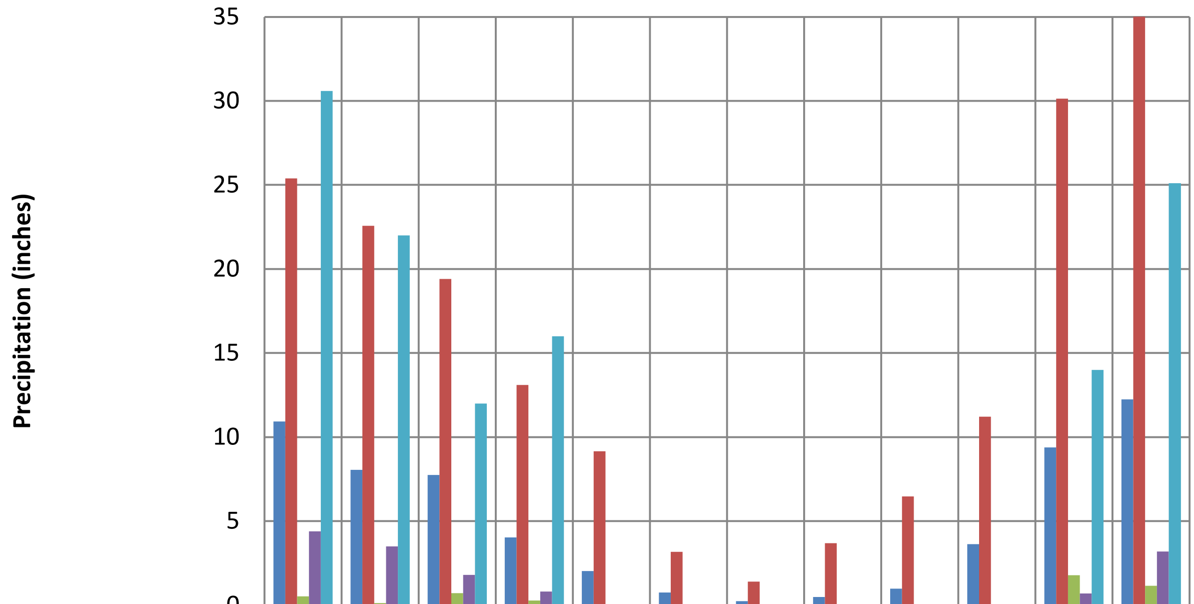

**Figure 2.1.1-1 – Map of the City of Cave Junction including city limits and UGB**

### 2.1.2 Climate

Climate data was obtained using long-term records collected at the Cave Junction weather station (Station 351448) as reported by the National Climatic Data Center.

Average annual snowfall is approximately 14.4 inches in Cave Junction. Record high snowfall of 51.6 inches was recorded in 1992-1993. On average, the majority of snowfall occurs from November to March. No statistically significant increasing or decreasing trend in annual snowfall is evident.

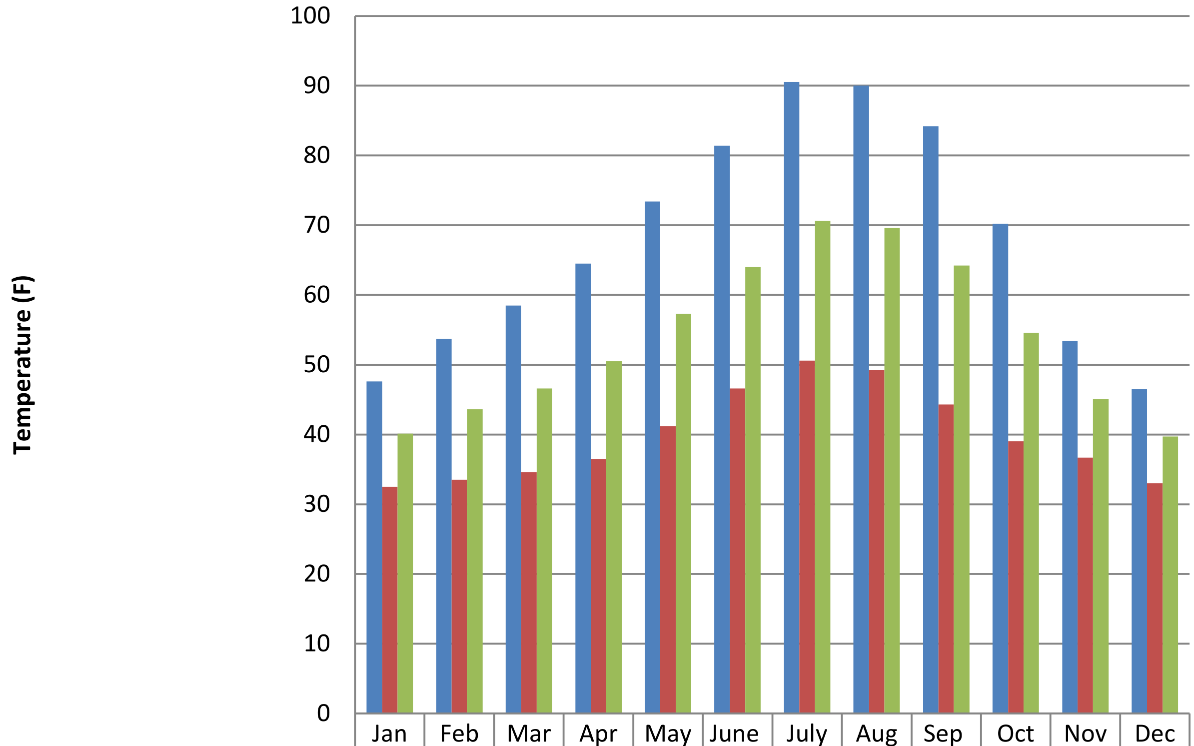
Average annual precipitation is approximately 61.7 inches in Cave Junction. Record low and high precipitation years recorded were 29.4 inches in 1976 and 104.2-inches in 1996, respectively. On average the majority of rainfall occurs from November to March. No statistically significant increasing or decreasing trend in annual rainfall is evident. Based on the NOAA Atlas 2, Volume X Isopluvial maps, the 5-year storm 24-hour rainfall is 5.5 inches. Figure 2.1.2-1 shows graphically the precipitation that occurs in the Cave Junction area.




| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean (in.) | 10.92 | 8.05 | 7.74 | 4.03 | 2.03 | 0.75 | 0.24 | 0.49 | 0.98 | 3.63 | 9.38 | 12.25 |
| High (in.) | 25.39 | 22.57 | 19.4 | 13.1 | 9.15 | 3.17 | 1.4 | 3.69 | 6.47 | 11.22 | 30.13 | 35.29 |
| Low (in.) | 0.53 | 0.13 | 0.72 | 0.27 | 0 | 0 | 0 | 0 | 0 | 0 | 1.79 | 1.16 |
| Mean Snowfall (in.) | 4.4 | 3.5 | 1.8 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 3.2 |
| High Snowfall (in.) | 30.6 | 22 | 12 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 25.1 |

**Figure 2.1.2-1 – Precipitation Norms, NCDC 1962-2012**

The average annual temperature in Cave Junction ranges from 32.5° to 90.5º F with an annual mean of 53.8° F. A record high temperature of 114° F was recorded in August of 2008. A record low temperature of -6°F was recorded in December of 1972. July is statistically the warmest month with a mean of 70.6° F while December is the coldest with a mean of 39.7° F. Figure 2.1.2-2 shows graphically the temperature of the Cave Junction area.




| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Mean Temperature (F) | 47.6 | 53.7 | 58.5 | 64.5 | 73.4 | 81.4 | 90.5 | 90 | 84.2 | 70.2 | 53.4 | 46.5 |
| Low Mean Temperature (F) | 32.5 | 33.5 | 34.6 | 36.5 | 41.2 | 46.6 | 50.6 | 49.2 | 44.3 | 39 | 36.7 | 33 |
| Mean Temperature (F) | 40.1 | 43.6 | 46.6 | 50.5 | 57.3 | 64 | 70.6 | 69.6 | 64.2 | 54.6 | 45.1 | 39.7 |

**Figure 2.1.2-2 – Temperature Norms, NCDC 1962-2012**

### 2.1.3 Land Use

Land use within Cave Junction is a mixture of residential, commercial, and recreational. The City has a total area of 1.82 square miles, of which 0.1 square miles is covered by water. After the decline of gold mining and the lumber industry, the City has turned to tourism and commercial services. There is also light industry within the city limits.

### 2.1.4 Zoning Information

Much of the City is zoned as residential with a small amount of commercial zoning in the center of the City. There is also an area zoned as light industrial. A Zoning Map is provided as Figure 2.1.4-1 on the following page.

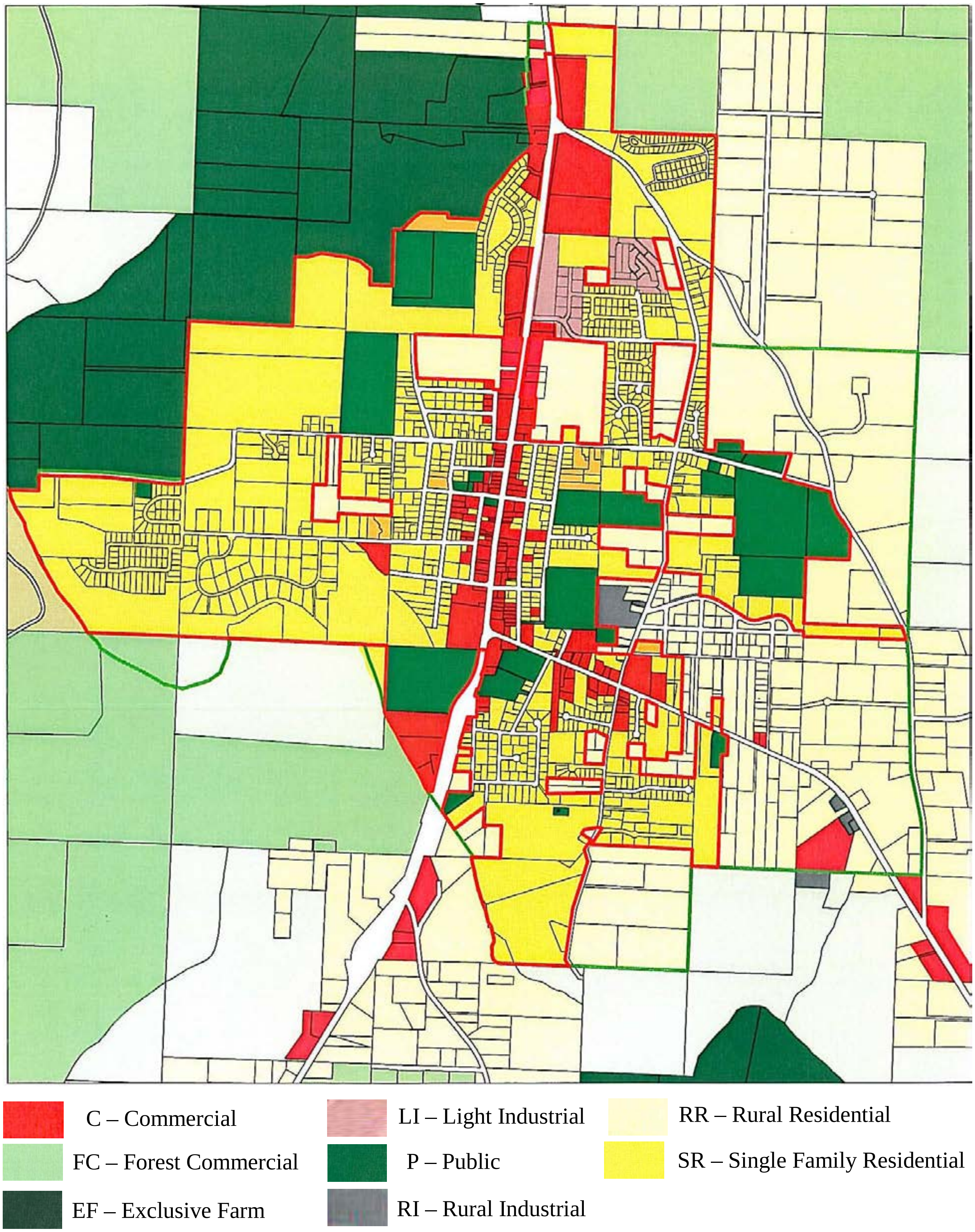



**Figure 2.1.4-1 – Zoning map for the City of Cave Junction**

### 2.1.5 Floodplains

Areas within the City are within the 100-year floodplain. All floodplain areas occur along the Illinois River. Figure 2.1.5-1 below shows the areas of the City within the 100-year flood plain.

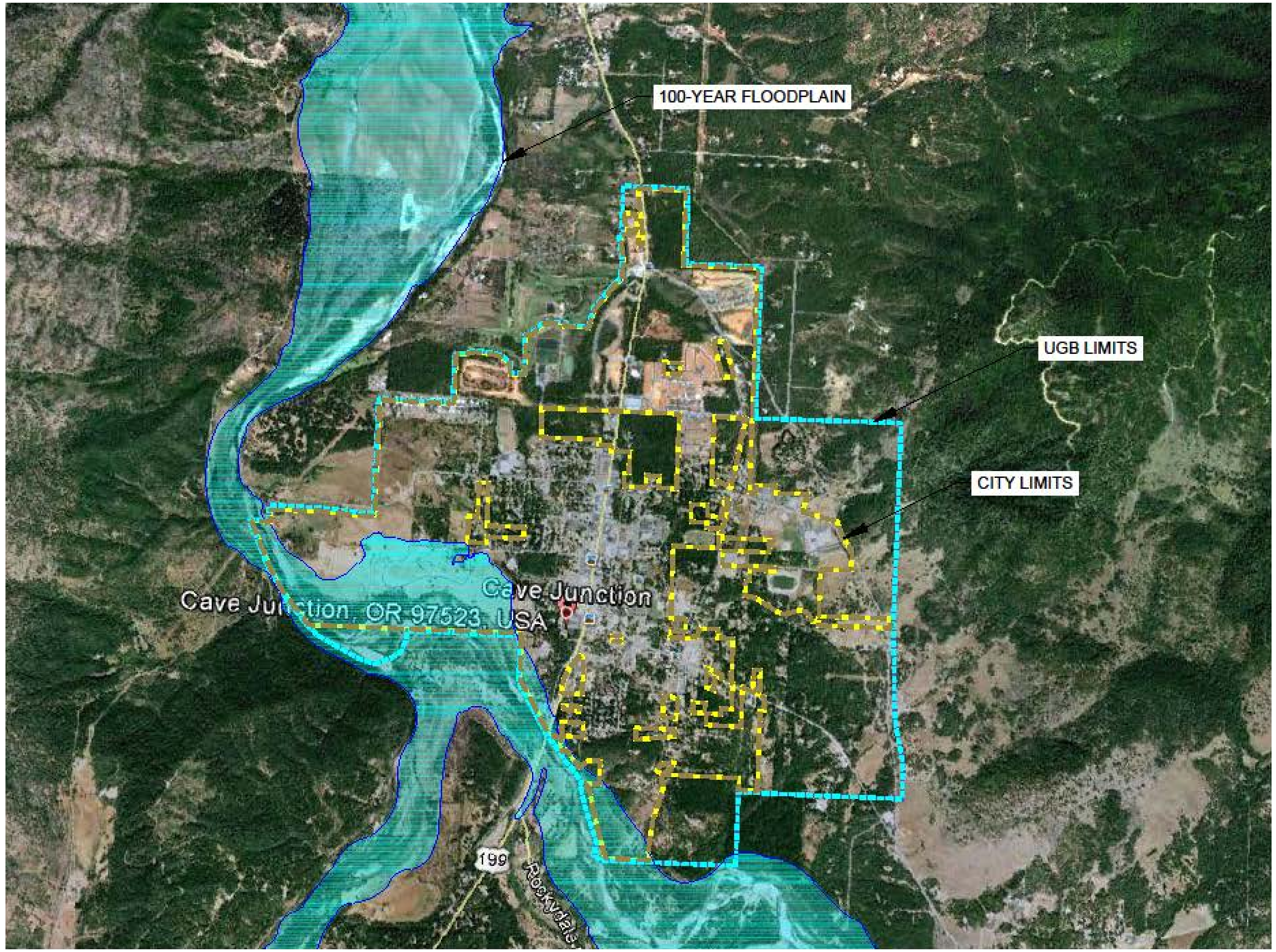



**Figure 2.1.5-1 – Floodplains map of the area surrounding the City of Cave Junction**

### 2.1.6 Wetlands

There are wetlands located on the western end of the City as identified by the National Wetlands Inventory. These wetlands mostly follow along the Illinois River basin and are just outside the UGB. The wetland map is shown below as Figure 2.1.6-1.

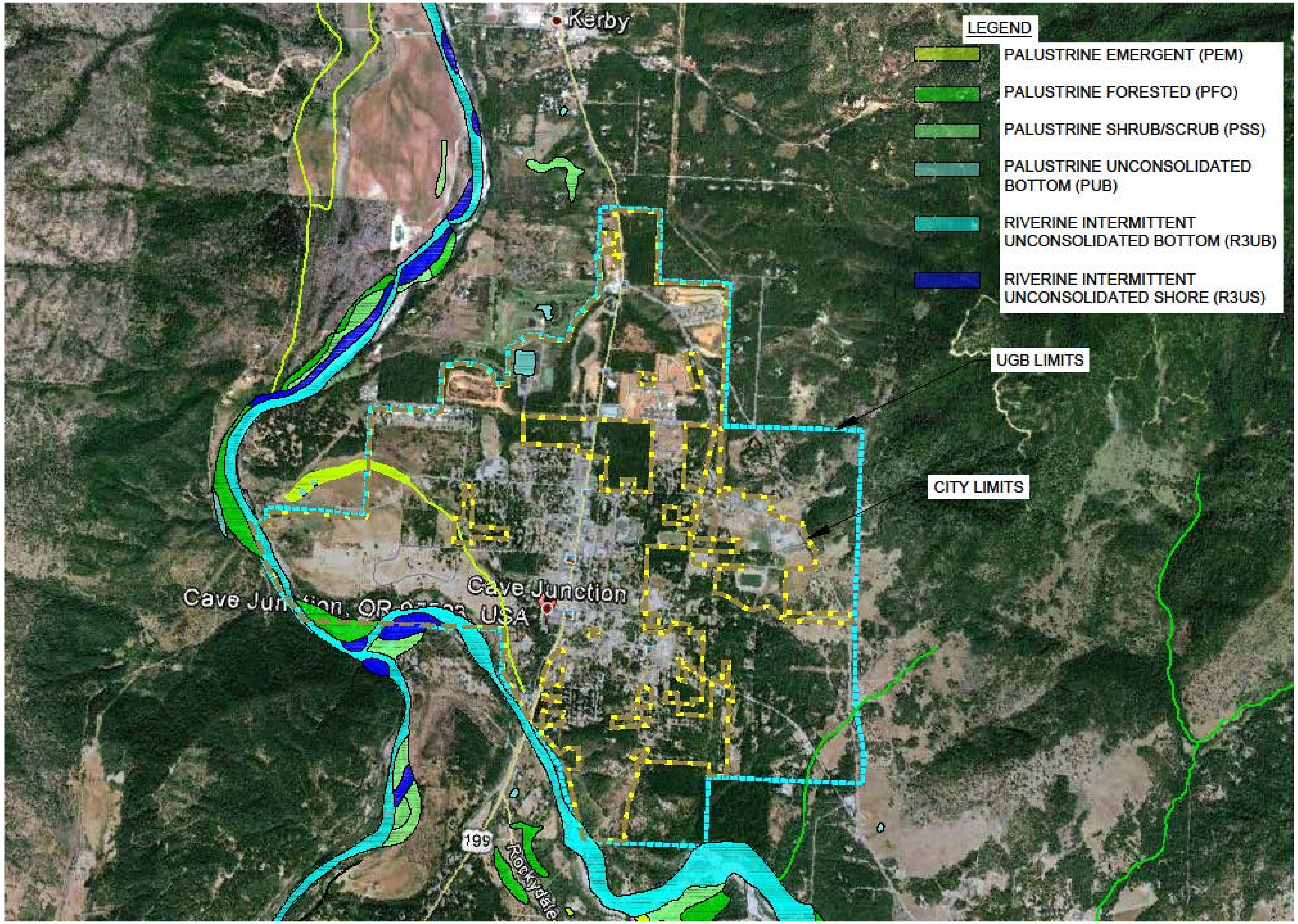



**Figure 2.1.6-1 – Wetlands map of the area surrounding the City of Cave Junction**

### 2.1.7 Cultural Resources

According to the National Register of Historic Places, several historical sites are listed for Cave Junction, but are located outside the UGB for the city. These historical sites are listed for informational purposes since they are outside the planning area.

**Table 2.1.7-1 – National Register Historic Properties, Cave Junction vicinity**

| Historic Property/Site Name | Street Address | Period of Significance | Listed Date | NR Number |
|---|---|---|---|---|
| Allen Gulch Mill | 1 mile SE of Junction of Waldo and Waldo Lookout Roads | 1925-1949 | 2001 | 01001148 |
| Allen Gulch Townsite | 1 mile SE of Junction of Waldo and Waldo Lookout Roads | 1850-1874 | 2001 | 01001136 |
| Cameron Mine | 2 miles south of Junction of Waldo and Waldo Lookout Roads | 1900-1949 | 2001 | 01001144 |
| Cedar Guard Station No. 1019 | Illinois Valley Road | 1925-1949 | 1986 | 86000837 |
| Deep Gravel Mine | 1 mile north of Junction of Waldo Rd and BLM Road 40-8-28 | 1875-1924 | 2001 | 01001141 |
| Esterly Pit No. 2 – Llano De Oro Mine | 1.5 mile north of Junction of Waldo Rd and BLM Road 40-8-28 | 1925-1974 | 2001 | 01001145 |
| Fry Gulch Mine | 0.75 mile from Junction of Waldo Rd and BLM Road 40-8-28 | 1875-1949 | 2001 | 01001143 |
| High Gravel Mine | 1.3 mile south of Junction of Waldo Rd and BLM Road 40-8-28 | 1900-1949 | 2001 | 0101142 |
| Logan Cut | Historic Channel of Logan Cut | 1875-1949 | 2001 | 01001154 |
| Logan Drain Ditches | 2 miles north of Junction of Waldo Rd and BLM Road 40-8-28 | 1900-1949 | 2001 | 01001155 |
| Logan Wash Ditch | Historic Channel of Logan Wash Ditch | 1900-1949 | 2001 | 01001153 |
| Middle Ditch | Historic Channel of Logan-Esterly Middle Ditch | 1850-1949 | 2001 | 01001150 |
| Old Placer Mine | 0.65 mile west of Junction of Rockydale Road and BLM Road 40-8-15 | 1850-1899 | 2001 | 01001140 |
| Oregon Caves Chateau | Off of State Road 46, Oregon Caves National Monument | 1925-1949 | 1987 | 87001346 |

| Historic Property/Site Name | Street Address | Period of Significance | Listed Date | NR Number |
|---|---|---|---|---|
| Oregon Caves Historic District | Off of State Road 46, Oregon Caves National Monument | 1900-1949 | 1992 | 92000058 |
| Osgood Ditch | Historic Channel of Osgood Ditch | 1900-1949 | 2001 | 01001151 |
| Plataurica Mine | 0.75 mile SE of Junction of Waldo and Waldo Lookout Roads | 1925-1949 | 2001 | 01001146 |
| Siskiyou Smokejumper Base | Smokejumper Way, 4 miles SE of OR 199 | 1925-1974 | 2006 | 06001035 |
| St. Patrick's Roman Catholic Cemetery | 1 mile SE of Junction of Waldo and Waldo Lookout Roads | 1850-1924 | 2001 | 01001137 |
| Store Gulch Guard Station No. 1020 | Illinois Valley Road | 1925-1949 | 1986 | 86000838 |
| Upper Ditch | Historic Channel of Logan-Esterly Upper Ditch | 1850-1949 | 2001 | 01001149 |
| Waldo Cemetery | 0.5 mile SW of Junction of Waldo Road and BLM Road 40-8-28 | 1850-1924 | 2001 | 01001138 |
| Waldo Chinese Cemetery | 0.5 mile SW of Junction of Waldo Road and BLM Road 40-8-28 | 1850-1949 | 2001 | 01001139 |
| Waldo Mine | SW of Junction of Waldo Road and BLM Road 40-8-28 | 1925-1949 | 2001 | 01001147 |
| Wimer Ditch | Historic Channel of Wimer Ditch | 1875-1949 | 2001 | 01001152 |

### 2.1.8 Biological Resources

Biological resources in the area include numerous fish, birds and mammals. Fish species in the Illinois River include Coho salmon, Chinook salmon, and steelhead. Several species of birds are known to breed in forests around Cave Junction. Mammals such as black bear, black-tailed deer and raccoon inhabit this area.

### 2.1.9 Coastal Resources

The City of Cave Junction is located outside the coastal zone.

# 2.2 Population

## 2.2.1 Historic and Existing Population

According to US Census data of 2010, the population for the City of Cave Junction increased from 1,363 people in 2000 to 1,883 in the year 2010. This indicates a population growth of 38% over the eleven year time period. Other 2010 US Census Data for Cave Junction includes:

2.30 persons per housing unit (total population / total housing units)
89% of housing units occupied
11% of housing units vacant

Table 2.2.1-1 summarizes the historic population for the City of Cave Junction over the last 50 years.

**Table 2.2.1-1 – Historical Population Summary for Cave Junction**

| Historic Population | |
|---|---|
| **Year** | **Population** |
| 1960 | 248 |
| 1970 | 415 |
| 1980 | 1,023 |
| 1990 | 1,126 |
| 2000 | 1,363 |
| 2010 | 1,883 |

According to US Census data of 2010, the population of Kerby was 595. Other 2010 US Census Data for Kerby includes:

2.40 persons per housing unit (total population / total housing units)
87% of housing units occupied
13% of housing units vacant

As of July 2013, the Cave Junction water system serviced 127 accounts within the Kerby Water District.

## 2.2.2 Projected Population

In 2007 Josephine County came up with a coordinated growth number that would be used throughout the county for future planning. At that time there were plans for extreme growth throughout the county. Due to the slowdown of new growth and the economic downturn compared to the previous years, the city and county are in the process of updating the coordinated number. For the purposes of this report the two agencies agreed to move forward with a 2.50% growth annually. This will apply to the customers located within the City of Cave Junction.

When the City agreed to provide water to the Kerby Water District, an upper limit of monthly water supplies was established at 3,740,500 gallons per month maximum. When calculating the current per customer water consumption rates, this maximum monthly allowance would allow Kerby to expand from their current customer base of 127 accounts to approximately 200 accounts. Therefore, for the purposes of this analysis, we will assume that build-out for Kerby is capped at 200 total accounts.

If Kerby is also assumed to grow at a 2.50% annual rate until they met the upper limit of 200 accounts, they will reach the build-out limit around the year 2030. After 2030, growth in Kerby is assumed to be zero. Figure 2.2.2-1 illustrates in graphical form the projected growth of the City of Cave Junction and the Kerby Water District.

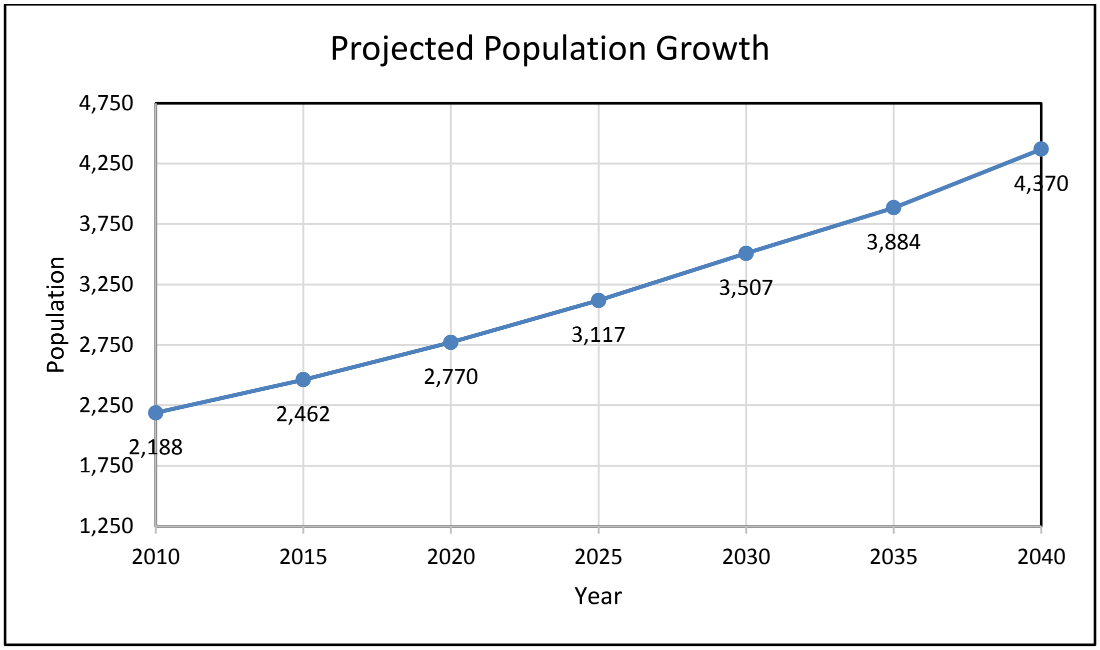



**Figure 2.2.2-1 – Population Growth Projection (Cave Junction/Kerby)**

The table above shows the growth in population, including the estimated population in Kerby, for the planning period. The figures represent the estimated total number of persons served by water during the planning period. Growth is 2.50% across both the Cave Junction and Kerby accounts until 2030 at which point growth in Kerby stops and only growth in Cave Junction continues at the projected 2.50% rate.

The Cave Junction population presented above shows annual growth of 2.50% and does not take into account the limitations on growth presented by availability of land within the City limits, zoning and land restraints, and density of housing. Thus a population of 3,884 people in the year 2035 may not be feasible for the City. For the sake of planning and the purposes of this report, the forecasted numbers will be used.

# Water Demand Analysis

**Section 3**

## 3.1 Definitions

System water demand is the quantity of water that must enter the system in order to meet all water needs in the community. Water demand includes water delivered to the system to meet the needs of consumers, water used for fire-fighting, system flushing, and other unaccounted water. Additionally, all systems have a certain amount of leakage that cannot be economically removed and thus total demand typically includes some leakage. The difference between the amount of water metered and sold and the total amount delivered to the system is referred to as unaccounted water. Unaccounted water is discussed later in this section. Water demand varies seasonally with the lowest usage in winter months and the highest usage during summer months. Variations in demand also occur with respect to the time of day. Diurnal peaks typically occur during the morning and early evening periods while the lowest usage occurs during nighttime hours.

The objective of this section is to determine the current water demand characteristics and to project future demand requirements that will establish system component adequacy and sizing needs. Water demand is described in the following terms:

*Average Annual Demand (AAD)* - The total volume of water delivered to the system in a full year expressed in gallons. When demand fluctuates up and down over several years, an average is used.

*Average Daily Demand (ADD)* - The total volume of water delivered to the system over a year divided by 365 days. The average use in a single day expressed in gallons per day.

*Maximum Month Demand (MMD)* - The gallons per day average during the month with the highest water demand. The highest monthly usage typically occurs during a summer month.

*Peak Weekly Demand (PWD)* - The greatest 7-day average demand that occurs in a year expressed in gallons per day. Not commonly determined or used in water planning.

*Maximum Day Demand (MDD)* - The largest volume of water delivered to the system in a single day expressed in gallons per day. The water supply and treatment facilities should be designed to handle the maximum day demand.

*Peak Hourly Demand (PHD)* - The maximum volume of water delivered to the system in a single hour expressed in gallons per day or gallons per minute. Distribution systems should be designed to adequately handle the peak hourly demand or maximum day demand plus fire flows, whichever is greater. During peak hourly flows, storage reservoirs supply the demand in excess of the maximum day demand.

Demands described above, expressed in gallons per day (gpd), can be divided by the population or Equivalent Dwelling Units (EDUs) served. These calculations will lead to a demand per person or per capita which is expressed in gallons per capita per day (gpcd), or demand per EDU (gpd/EDU). These unit demands can be multiplied by future population or EDU projections to estimate future water demands for planning purposes.

# 3.2 Current Water Demand

## 3.2.1 Cave Junction Records

The City of Cave Junction accesses water from two points: the Illinois River and the Daisy Hill Well field. They provide their own water treatment at their centrally located water treatment plant. The production of these two sources has been monitored by the City since July of 2000. This information is presented in Table 3.2.1-1 and Figure 3.2.1-1 below. The fiscal year designation refers to July-June, i.e. FY 2001 is July 2001-June 2002.

**Table 3.2.1-1 – Cave Junction Annual Water Production (in gallons)**

| Year | Daisy Hill Well | Water Plant | Total |
|---|---|---|---|
| FY 2000 | 18,242,000 | 91,000,000 | 109,242,000 |
| FY 2001 | 27,432,000 | 107,857,000 | 135,289,000 |
| FY 2002 | 31,752,000 | 105,396,000 | 137,148,000 |
| FY 2003 | 38,368,000 | 114,790,000 | 153,158,000 |
| FY 2004 | 32,664,000 | 95,325,000 | 127,989,000 |
| FY 2005 | 35,872,000 | 98,729,000 | 134,601,000 |
| FY 2006 | 35,021,000 | 108,431,000 | 143,452,000 |
| FY 2007 | 40,456,000 | 95,253,000 | 135,709,000 |
| FY 2008 | 37,909,000 | 98,577,000 | 136,486,000 |
| FY 2009 | 33,113,000 | 97,890,000 | 131,003,000 |
| FY 2010 | 33,590,000 | 96,470,000 | 130,060,000 |
| FY 2011 | 33,521,000 | 107,500,000 | 141,021,000 |

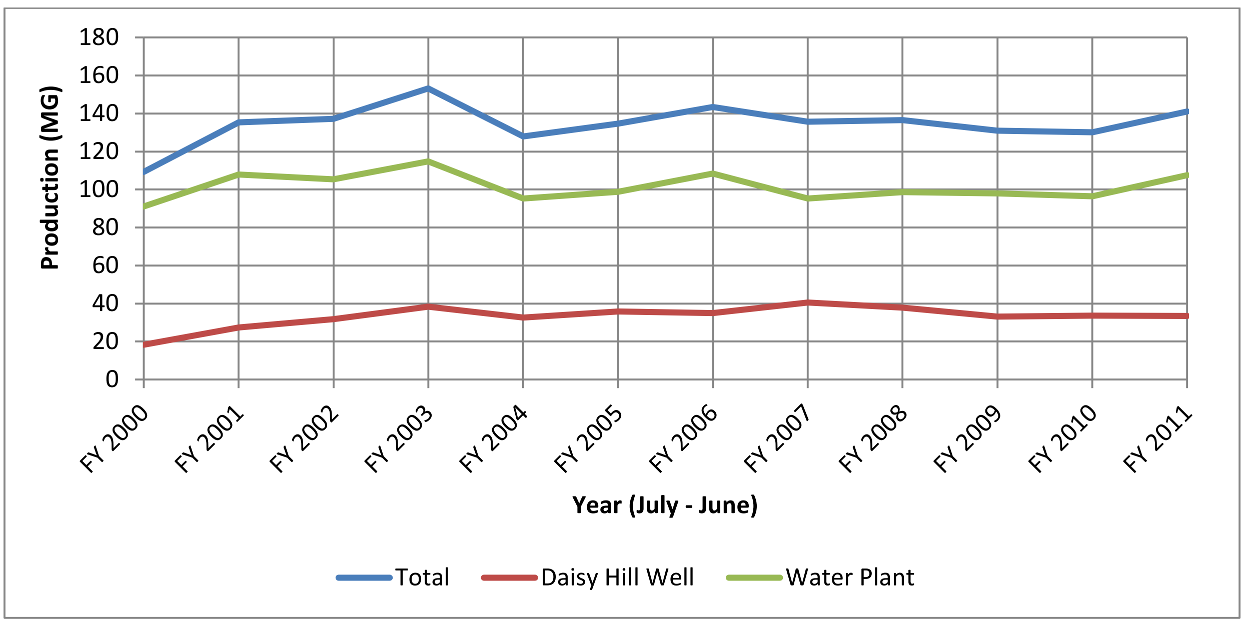



**Figure 3.2.1-1 – Cave Junction Annual Water Production (in millions of gallons)**

The table and figures above show that the City's annual use of water increased during the FY 2003 time period but has leveled to an almost constant level.

### 3.2.2 Cave Junction Demand Summary

As mentioned, the City of Cave Junction obtains all of its water through the treatment plant and the Daisy Hill Well. From the information above, an average daily demand (ADD) can be calculated by dividing the numbers in Table 3.2.1-1 by 365 and taking an average. From that information, a maximum monthly demand (MMD), maximum daily demand (MDD), and peak hourly demand (PHD) can be calculated. These numbers are presented in Table 3.2.2-1.

**Table 3.2.2-1 – Cave Junction/Kerby Water Production Summary**

| City of Cave Junction (Including 305 Kerby residents) 2010 Data | | | 2,188 persons | |
|---|---|---|---|---|
| **Unit** | **ADD** | **MMD** | **MDD** | **PHD** |
| gpd | 368,758 | 667,480 | 1,042,000 | 1,475,030 |
| P.F.* | 1.0 | 1.8 | 2.8 | 4.0 |
| gpcd | 169 | 305 | 476 | 674 |

*Peaking Factor is a multiple of ADD and is assumed to be 4.0 for PHD

For the current MDD of 1.04 million gallons per day the current water supply should be at least 724 gallons per minute if operation was possible 24 hours per day. As this is not practical, maximum daily demand should be greater than 724 gpm.

As discussed above, in Table 3.2.2-1 demand numbers were calculated using the plant production numbers. These production numbers were much higher than the actual usage data received from the City. Table 3.2.2-2 below illustrates the variation. This table also uses a more typical peaking factor which was compared with surrounding areas. Section 3.2.5 goes into more detail about the issue of unaccounted water and possible areas of concern.

**Table 3.2.2-2 – Cave Junction/Kerby Actual Metered Usage Summary**

| City of Cave Junction (Including 305 Kerby residents) 2010 Data | | | 2,188 persons | |
|---|---|---|---|---|
| **Unit** | **ADD** | **MMD** | **MDD** | **PHD** |
| gpd | 336,819 | N/A | 943,094 | 1,178,868 |
| P.F. | 1.0 | N/A | 2.8 | 3.5 |
| gpcd | 154 | N/A | 431 | 539 |

For the current MDD of 0.94 million gallons per day the current water supply should be at least 655 gallons per minute. The summaries above for current demand on the water system do include the residents of the 127 accounts currently serviced in Kerby. This was calculated based on multiplying the 127 accounts by the average household size for Kerby found in Section 2.2.

### 3.2.3 Current Demand Summary

Water use in America is documented by the U.S. Department of the Interior in the 2000 U.S. Geological Survey - Circular 1268, updated last in 2005. According to the study, the average per capita water use for Oregon is 207 gallons per capita per day (gpcd) including domestic, commercial, industrial, public use and loss. Of the total 207 gpcd, 63% is residential, commercial and public use/loss; 34% is industrial; and 3% is related to thermoelectric power generation. Note that the ADD value for Cave Junction is (196 gpcd produced and 179 gpcd metered) which is less than the State average. This difference could be attributed to the high residential population and lack of industry in the Cave Junction area.

### 3.2.4 Water Sales Records

Typical for most communities, the quantity of water sold in Cave Junction is less than the quantity of water entering the system (water produced) due to leakage and other unaccounted water loss. The City of Cave Junction produced 141 million gallons from July 2011 to June 2012, yet only 101 million gallons were actually billed consumption. Section 3.2.5 discusses unaccounted water.

Data anomalies were discovered in the months of February, August, November of 2011, and July and October of 2010. During these months, the amount of difference between water production and billed water use was either very large or very small when compared with the data from other months. These months were omitted from the data set when averages were calculated.

### 3.2.5 Unaccounted Water

The difference between the quantity of water measured entering the distribution system (water demand) and the quantity of water measured exiting the distribution system is unaccounted water. This comparison is typically called a "water balance". Measured water exiting the system is primarily measured through individual customer water meters (water sold). Authorized non-consumptive uses such as pipeline flushing, firefighting and unauthorized uses such as water theft, line breaks and leakage are other sources of exiting water.

In addition to "real" water loss resulting from leakage or unmetered flushing, unaccounted water can also include "apparent" water loss due to meter inaccuracies or meter reading errors. In general, as water meters age they tend to read lower and lower resulting in higher and higher "apparent" water loss.

If there were no leakage in the system, all water meters were 100% accurate and every drop of water used for firefighting and system flushing was measured there would be zero unaccounted water. In reality every water system has a certain amount of leakage, water meters are not 100% accurate, and it is rare for every drop of water used in town to be metered and measured. Therefore, virtually every community water system has unaccounted water.

The volume of unaccounted water varies significantly month by month due to meter discrepancies, differences in dates of reading master meters versus individual customer meters, and the number of days it takes to read individual meters. These factors make monthly unaccounted water comparisons of little value and annual comparisons (annual water audits) are used to lessen the impact of these variables. Annual values for Cave Junction indicate a 2 ½ year total for unaccounted water of 99 million gallons or 31.3% of the total water demand over that same time frame. Table 3.2.5-1 breaks down the unaccounted water per year for the City of Cave Junction.

Nearby communities of Eagle Point and Jacksonville have recently completed new water master plans. Jacksonville had a very good three year average of 8.9%. This small percentage of unaccounted water was right in line with OAR for a community that size. Eagle Point had much more at 28%. Fortunately, they have undertaken a very large project of detecting and repairing leaks and have actually lowered the unaccounted water number significantly with just a few minor repairs. They were also able to improve billing software issues that have had a positive impact on these numbers.

**Table 3.2.5-1 – Unaccounted Water for the City of Cave Junction**

| Year | Water Production (million gallons) | Water Consumption (million gallons) | Difference (million gallons) | Percentage |
|---|---|---|---|---|
| July 2011-June 2012 | 141.02 | 101.24 | 39.78 | 28.2% |
| July 2010 – June 2011 | 132.06 | 92.68 | 39.38 | 29.8% |
| Jan 2010 – June 2010 | 48.71 | 27.93 | 20.78 | 42.7% |
| Total | 321.79 | 221.84 | 99.9 | 31.3% |

According to OAR 690-086 (Water Resources Department – Water Management and Conservation Plans), if the annual water audit indicates leakage exceeding 10%, a regularly scheduled and systematic program should be in place to detect leaks in the transmission and distribution system using methods and technology appropriate to the size and capabilities of the municipal water supplier. Other provisions in OAR 690-086 can require system wide leak repair or line replacement programs. This will reduce leakage to no more than 15% under certain circumstances such as water permit extension requests or water diversion expansions and initiations.

The 2 ½ - year average for unaccounted water is 31.3%, which is greater than the required 10% under OAR 690-086 though it is not clear as to what percentage of the unaccounted water is due to leakage. Unaccounted water can be a result of many different variables such as, non-metered flushing, non-metered public facilities/locations or discrepancies in the billing or billing software of the city. The city should continue efforts to detect and repair leaks when discovered. The billing software for the city should also be reviewed to make sure proper readings are being made and that the software is processing the accounting accurately. This is an area that can be corrected quickly and without additional funding. Efforts should also be made to measure and record water used for flushing and other authorized non-metered uses such as park irrigation and fire department use.

### 3.2.6 EDU Analysis

Equivalent Dwelling Unit (EDU) calculations are based on the actual water meter data obtained from the city. The information that was used for these calculations ranged from January 2010-December 2012, a three year time frame. An EDU is used in water master planning as a type of measurement. It will tell us what the typical single-family dwelling is using during the span of one month. This can then be used to plan for future development.

The meter data that was obtained from the City of Cave Junction itemized the meters into five user categories: Residential, Commercial, Other, Industrial and Unassigned. The totals for each of these categories are shown in Table 3.2.6-1 below. Residential users account for 82% of the total users in Cave Junction. As was mentioned before, this reiterates why Cave Junction has below average readings of water usage per day per capita. With more commercial or industrial customers those numbers would begin to go up.

**Table 3.2.6-1 – Types of water users in Cave Junction**

| Type of User | Total Users | % of Users |
|---|---|---|
| Residential | 882 | 82% |
| Commercial | 162 | 15% |
| Other | 18 | 2% |
| Industrial | 1 | 0% |
| Unassigned | 8 | 1% |

The meter data was also itemized into meter sizes. The various meter sizes are shown on the following page in Figure 3.2.6-2. This chart is complimentary to the previous. Due to the large amount of residential users there is a large amount of 3/4" meters, which is the typical meter size for a single-family dwelling. The percentages are also shown next to the total numbers of each category.

**Table 3.2.6-2 – Size of water meters in Cave Junction**

| Water Meter Size | Total per Size | % of Meters |
|---|---|---|
| ¾" | 842 | 79% |
| 1" | 45 | 4% |
| 1 ½" | 5 | 0% |
| 2" | 11 | 1% |
| 3" and bigger | 10 | 1% |
| Blank | 158 | 15% |

In determining the appropriate EDU for the city, the meter data had to be modified slightly. These modifications helped to produce the most accurate analysis for Cave Junction. The first step was to remove all the categories except for the residential meters. This is due to the fact that the EDU analysis is based on residential water consumption, therefore, all other consumptions must be removed. Then the months of May-October were removed. We found that in these "summer" months there were a variety of unexplained or very high readings that were affecting the analysis. Using just the "winter" months, November-April, we were able to obtain much more consistent numbers with fewer data anomalies. This process was applied over the entire three year span of data available. A small portion of outliers, both high and low, were also removed.

Based on this analysis of the modified water sales records for the last 3 years, the average quantity of water sold to a typical single-family dwelling unit is 4,203 gallons per month. This volume sold per month becomes the basis for Equivalent Dwelling Unit (EDU) calculations with 1 EDU = 4,203 gallons per month in metered sales. Other users can then be described as an equivalent number of EDUs based on their relative water consumption. For example, a commercial business that had an average metered consumption of 8,406 gallons per month uses twice the amount of water as the typical single-family dwelling and can be considered 2 EDUs. This analysis can be a benefit to the city for current and future planning and will apply to the SDC analysis as well.

## 3.3 Future Water Demand

### 3.3.1 Basis for Projections

Water demand estimates for future years are determined by multiplying the current unit demand values (gallons per person or per EDU) by the projected number of future users in the water system. It is assumed new users added to the system will consume water at the same rate as current users. Population projections are presented in Section 2.2.2. The unit water demand values are presented in Section 3.2.2

and 3.2.3. The projections are based on an agreed average annual growth rate of 2.5% for the city of Cave Junction and a maximum growth of 200 accounts, or 480 residents, for Kerby

### 3.3.2 Water Demand Projections

The average and maximum daily demands were calculated through the end of the planning period. The table of values provided in Table 3.3.2-1 categorize the demand projections into five year spans for the entire planning period. These projections are based upon actual meter readings and not plant production numbers. At the year 2030, Kerby exceeded the maximum number of accounts that Cave Junction has agreed to service. Therefore, for the calculations after 2030, which is 2035, the population number only shows the Cave Junction population.

**Table 3.3.2-1 – Average and Maximum Daily Demand Projections**

| Year | Population | ADD (gallons per day) | MDD (gallons per day) |
|---|---|---|---|
| 2010 | 2,188 | 336,819 | 943,064 |
| 2015 | 2,462 | 379,148 | 1,061,122 |
| 2020 | 2,770 | 426,580 | 1,193,870 |
| 2025 | 3,117 | 480,018 | 1,343,427 |
| 2030 | 3,507 | 540,078 | 1,511,517 |
| 2035 | 3,884 | 598,136 | 1,674,004 |

### 3.3.3 Design Values

Table 3.3.3-1 below shows the current values and the future values of the water demand for the Cave Junction water system.

**Table 3.3.3-1 – 20-Year Water Demand Values**

| City of Cave Junction Water Demand (gallons per day) | | | | | |
|---|---|---|---|---|---|
| | **Population** | **ADD** | **MMD** | **MDD** | **PHD** |
| Current | 2,188 | 336,819 | n/a | 943,094 | 1,178,868 |
| Future | 3,884 | 598,136 | n/a | 1,674,004 | 2,093,476 |

Therefore, the sizing criterion, based on maximum day demand for future supply and treatment needs, is 1.7 million gallons per day or 2.59 cubic feet per second.

### 3.3.4 Future Unaccounted Water Assumptions

As discussed earlier in this section, unaccounted water levels in the City of Cave Junction are relatively high with an average of over 31% for the data set that was analyzed in this report. However, it should be emphasized that this does not necessarily constitute a high rate of leakage. It does, however, mean that the City is not currently capable of accounting for all of the water they produce. This could be a result of:

- Meter inaccuracies (master and/or consumption)
- Accounting or entry errors
- Software glitches or errors
- Timing problems (between reading master vs. consumption)
- Not recording public water use (fire, water plant, City Hall, parks, etc.)
- Administrative processes

- And some amount of leakage

With this in mind, we recommend the City investigate all internal processes and procedures to eliminate or correct administrative issues to close the gap on unaccounted water. Until we know how much of the unaccounted water levels are a result of leakage, it is not appropriate to assume any change in the future water production rates. Making assumptions that future water demands would be less due to efforts or results that are only hypothetical at this point could potential leave the City in a water supply deficit.

However, if in the future the City reduces demand through leak repairs, conservation, or other proactive means, modifying projected water demands in future plan updates would be appropriate. Until that time, the projected demands in this report should stand. Therefore, the projected water demands described include the current level of unaccounted water. The actual future demands may go down if the unaccounted water is largely due to leakage that can be corrected or, it may stay the same if the unaccounted water is a result of administrative issues.

# Design Criteria and Service Goals

**Section 4**

## 4.1 Design Life of Improvements

The design life of a water system component is the time that the component is expected to be useful based on its intended use and required function. Design life is sometimes referred to as service life or life expectancy. Actual realized design life can depend on factors such as the type and intensity of use, type and quality of materials used in construction, and the quality of workmanship during installation. The estimated and actual design life for any particular component may vary depending on the above factors. The establishment of a design life provides a realistic projection of service upon which to base an economic analysis of new capital improvements.

The planning period for a water system and the design life for its components may not be identical. The typical 20-year planning period is limited due to the need to limit economic burdens on current population and inaccuracies that result from attempts at projecting needs too far into the future. Design life can be greater to or less than the planning period. For example, a properly maintained steel storage tank may have a design life of 60 years, but the projected fire flow and consumptive water demand for a planning period of 20 years determine its size. At the end of the initial 20-year planning period, water demand may be such that an additional storage tank is required; however, the existing tank with a design life of 60 years would still be useful and remain in service for another 40 years. The typical design life for system components are discussed below.

### 4.1.1 Equipment and Structures

Equipment used in water systems such as pumps, valves, and other major treatment related equipment is sized for a 20-year demand and has a similar 20-year expected design life. Minor equipment such as less expensive chemical feed pumps, turbidimeters, and other instrumentation sometimes must be replaced or updated when less than 20-years old, typically at 10 to 15 years old. The useful life of some equipment can be extended with proper maintenance if sufficient capacity still exists. It is not uncommon to see larger pumps still in service after 30 years or more if properly maintained.

Major structures used in water systems, such as concrete basins and intake wetwells, can last 50 years or more when properly constructed and maintained.

### 4.1.2 Transmission and Distribution Piping

Water transmission and distribution piping should easily have a useful life of 50 to 60 years if quality materials and workmanship are incorporated into the construction and the pipes are adequately sized. Steel piping used in the 1950's and 1960's that has been buried, commonly exhibits significant corrosion and leakage within 30 years. Cement mortar lined ductile iron piping can last up to 100 years when properly designed and installed. PVC and HDPE pipe manufacturers claim a 100-year service life for pipe.

### 4.1.3 Treated Water Storage

Distribution storage tanks should have a design life of 60 years (painted steel construction) to 80 years (concrete construction). Steel tanks with a glass-fused coating can have a design life similar to concrete construction. Actual service life will depend on the quality of materials, the workmanship during installation, and the timely administration of maintenance activities. Several practices, such as the use of cathodic protection, regular cleaning and frequent painting can extend or assure the service life of steel reservoirs. Painting intervals for steel tanks is 15 to 25 years. The life of steel tanks is greatly reduced if not repainted periodically as needed.

## 4.2 Sizing and Capacity Criteria and Goals

The 20-year projected water demands presented in Section 3 are used to size improvements. Various components of the system demand are used for sizing different improvements. Methods and demands used are discussed below.

### 4.2.1 Water Supply

The current water supply, including pumping capacity, should at minimum be sufficient to meet the projected 20-year maximum daily demand (MDD). Considering the difficulty in obtaining new water rights, raw water supply should meet a longer-term need and it is not unreasonable to plan today for 60-year demand water sources. Currently the MDD is 0.94 million gallons per day (mgd) or 1.5 cubic feet per second (cfs). At the end of the 20-year planning period, the projected MDD is 1.7 mgd or 2.6 cfs. In order to plan for long-term water supply options, projections beyond the planning period are shown assuming the same growth rate as the planning period.

*Immediate Supply Capacity Goal – 20-year MDD of 1.7 mgd (2.6 cfs)*
*Supply Capacity Goal – 40-year MDD of 2.7 mgd (4.2 cfs)*
*Supply Capacity Goal – 60-year MDD of 4.3 mgd (7.5 cfs)*

### 4.2.2 Water Treatment

Water treatment plant equipment and components such as pumps, filters, flocculators, etc. are typically sized to provide for the 20-year MDD. Conventional filter basins are sized for 20 year flows and media may have to be replaced once during that 20-year period. Membrane filters are more modular and initial designs must have space for 20-year flow capacity but fewer modules may be installed initially. Any discussion of treatment sizing must include an additional 5-10% allowance for water use that would occur at a treatment plant itself (90-95% of water going to town) if demand estimates do not already include such allowances. Difficult to construct items with a long design life such as buried piping and concrete wetwells for surface water intakes should be sized to accommodate at least a 40 to 50 year flow capacity need. Other components such as concrete clearwells and buildings may be oversized beyond the 20-year MDD depending on future expansion ease.

*Treatment Capacity Goal – 1.7 mgd (1,182 gpm) assuming a 24 hour run time for water plant.*

- For 18 hour run times, assume 1,574 gpm
- For 20 hour run times, assume 1,416 gpm
- For 22 hour run times, assume 1,288 gpm

By allowing the plant to run less than 24 hours and still meet MDD demands, time is available for shutdowns, maintenance, cleaning, and other activities that require the plant to be offline for part of an operation day.

### 4.2.3 Fire Protection

According to the 2010 Oregon Fire Code, the minimum fire-flow requirements, duration requirements and capacity goals are illustrated in Tables 4.2.3-1, 4.2.3-2 and 4.2.3-3 as follows:

**Table 4.2.3-1 – Fire Flow Requirements**

| Description of Facility | Minimum Fire Flow Requirements |
|---|---|
| One and two family dwellings not exceeding 3600 square feet | 1,000 gallons per minute |
| Square footage is greater than 3,600 square feet and less than 4,800 square feet | 1,750 gallons per minute |
| Square footage is greater than 4,800 square feet and less than 6,200 square feet | 2,000 gallons per minute |
| Other types of structures (2007 OFC Table B105.1) | 8,000 gallons per minute |

**Table 4.2.3-2 – Fire Flow and Duration Requirements**

| Required Fire Flows | Required Duration |
|---|---|
| 1,000 gallons per minute or less | 1 hour |
| Between 1,000-2,750 gallons per minute | 2 hours |
| Between 3,000-3,750 gallons per minute | 3 hours |
| 4,000 gallons per minute and above | 4 hours |

When flows of 1,750 gpm or less are warranted, a single fire hydrant is required to be accessible within 250 feet (200 feet on dead-end streets) resulting in a maximum hydrant spacing of 500 feet (400 feet on dead-end streets). For structures which require 4,000 gpm, at least 4 hydrants must be available and spaced not more than 350 feet apart.

**Table 4.2.3-3 – Fire Flow Capacity Goals**

| Fire Flow Capacity Goals | |
|---|---|
| Residential Only Outlying Areas | 1,500 gallons per minute |
| General Commercial Areas | 1,750 gallons per minute |
| Central Town Area, Industrial, and Schools | 3,500 gallons per minute |

### 4.2.4 Treated Water Storage

Total storage capacity must include reserve storage for fire suppression, equalization storage, and emergency storage. In larger communities it is common to provide storage capacity equal to the sum of equalization storage plus the larger of fire storage or emergency storage. In small communities it is recommended that total storage be the sum of all three: fire plus equalization plus emergency storage. This is considered prudent since it is possible for fire danger to increase during water emergencies, such as power failures when alternative sources of heating and cooking might be used.

Equalization storage is typically set at 20-25% of the MDD to balance out the difference between peak demand and supply capacity. When peak hour flows are known, equalization storage is the difference

between the MDD and PHD for duration of 8 hours [(PHD-MDD) x 8 hrs.]. Equalization storage typically rises and falls daily or hourly as storage tank levels fluctuate normally.
Emergency storage is required to protect against a total loss of water supply such as would occur with a broken transmission line, an electrical outage, equipment breakdown, or source contamination. Emergency storage should be an adequate volume to supply the system's average daily demand for the duration of a possible emergency. For most systems, emergency storage should be equal to one maximum day of demand or 2.5 to 3 times the average day demand.

Fire reserve storage is needed to supply fire flow throughout the water system to fight a major fire. The fire reserve storage is based on the maximum flow and duration of flow required to confine a major fire. Fire flows are discussed in Section 4.2.3.

With lengthy lines of water transmission piping separating water supply from treatment facilities in Cave Junction, it is considered prudent to set emergency storage equal to 3 average days of water demand. Since the PHD is estimated for Cave Junction with peaking factors, rather than being measured, the equalization storage should be set to 20% of the MDD (PHD-MDD x 8 hrs. is overly conservative). Fire storage volume is 3000 gpm for 3 hours. In addition to the basic volume calculations, storage locations and hydraulic distribution must be considered to assure each area of the system has sufficient flow and volume. In Table 4.2.4-1, storage is currently calculated to be:

**Table 4.2.4-1 - 2010 Storage Capacity Needs**

| Equalization Storage (gallons) | Emergency Storage (gallons) | Fire Reserve Storage (gallons) | Total Storage (gallons) |
|---|---|---|---|
| 0.2 * MDD | 3.0 * ADD | 3 hours * 3000 gpm | **1,739,077** |
| 188,619 | 1,010,458 | 540,000 | |

The City of Cave Junction has approximately 2.3-million gallons of storage currently if all tanks are full.

Storage for the next twenty years was calculated using the above model. Table 4.2.4-2 provides storage needs annually until the end of the planning period in 2035.

**Table 4.2.4-2 – Cave Junction 20-year Storage Capacity Needs (Metered data)**

| Year | Equalization Storage | Emergency Storage | Fire Reserve Storage | TOTAL (gallons) |
|---|---|---|---|---|
| 2010 | 188,619 | 1,010,458 | 540,000 | 1,739,077 |
| 2015 | 212,224 | 1,137,444 | 540,000 | 1,889,668 |
| 2020 | 238,774 | 1,279,740 | 540,000 | 2,058,514 |
| 2025 | 268,685 | 1,440,054 | 540,000 | 2,248,739 |
| 2030 | 302,303 | 1,620,234 | 540,000 | 2,462,537 |
| 2035 | 334,801 | 1,794,408 | 540,000 | 2,669,209 |

According to the above table, it is predicted that the City of Cave Junction will need 2.7 million gallons of storage to provide fire flows and emergency storage.

Another important design parameter for treated water storage reservoirs is elevation. Efforts should be made to locate all reservoirs at the same elevation when possible within a pressure zone. As a consistent water surface is maintained in all reservoirs, the need for altitude valves, pressure reducing valves (PRVs), booster pumps, and other control devices may be minimized. Distribution reservoirs should also be located at an elevation that maintains adequate water pressure throughout the system; sufficient water pressures at high elevations and reasonable pressures at lower elevations. The ideal pressure range for a distribution system is between 40 and 80 psi.

If there are subdivisions at higher elevations than allowed within the main pressure zone, a design review would have to be completed in order to determine the better solution of storage tanks or hydropneumatic tank booster pump stations. Tank size needs to be determined on a case-by-case basis as part of the design review. Fire pumps with a capacity of at least 1,000 gpm together with standby generators should be provided when a storage tank is not possible. Minimum tank size should be 120,000 gallons fire storage (1,000 gpm for 2 hours) plus 1 times the MDD per EDU. For very small developments, individual sprinkler systems may be most appropriate.

### 4.2.5 Distribution System

Distribution mains are typically sized to convey projected maximum day flows plus simultaneous fire flows while maintaining at least 20 psi at all connections, or projected peak hourly flows while maintaining approximately 40 psi, whichever case is more stringent. Looped mains should be at least six inches in diameter to provide minimum fire flow capacity. The State of Oregon requires a water distribution system be designed and installed to maintain a pressure of at least 20 psi at all service connections (at the property line) at all times, even during fire flow conditions. OAR 333-061-0050 governs the construction standards for water systems including distribution piping. The size and layout of pipelines must be designed to deliver the flows indicated above.

The installation of permanent dead-end mains and dependence of relatively large areas on a single main should be avoided. In all cases, except for minor looping using 6-inch or larger pipe, a hydraulic analysis should be performed to ensure adequate sizing.

*Distribution Capacity Goal – Worst Case of projected MDD + fire flow with at least 20 psi residual pressure or Projected PHD with 40 psi residual pressure*

### 4.2.6 Transmission Piping

When un-looped transmission piping is designed, such as raw water supply mains or long runs of treated water transmission along rural routes, it is often prudent to size this piping to convey quantities beyond the 20-year demands. Since it is likely that the pipe itself will be in good condition in 20 years, and the cost increase to upsize slightly is small (approximate same labor cost with small increase in material cost), it may be desirable to ensure the piping can adequately convey 40 or 50 years flows.

## 4.3 Basis for Cost Estimates

The cost estimates presented in this Plan will typically include four components: construction cost, engineering cost, contingency, and legal/non-engineering project management costs. Each of the cost components is discussed in this section. The estimates presented herein are preliminary and are based on the level and detail of planning presented in this Study. Construction costs are based on competitive bidding as public works projects with State prevailing wage rates. As projects proceed and as site-specific information becomes available, the estimates may require updating.

### 4.3.1 Construction Costs

The estimated construction costs in this plan are based on actual construction bidding results from similar work, published cost guides, and other construction cost experience. Construction costs are preliminary budget level estimates prepared without design plans and details.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index (CCI) is most commonly used. This index is based on the value of 100 for the year 1913. Average yearly values for the past 10 years are summarized in Table 4.3.1-1.

**Table 4.3.1-1 – ENR Construction Cost Index (CCI) 2003-2013**

| YEAR | ENR CCI | % CHANGE/YR |
|---|---|---|
| 2003 | 6695 | 2.40% |
| 2004 | 7115 | 6.27% |
| 2005 | 7446 | 4.65% |
| 2006 | 7751 | 4.10% |
| 2007 | 7967 | 2.79% |
| 2008 | 8310 | 4.31% |
| 2009 | 8570 | 3.13% |
| 2010 | 8801 | 2.70% |
| 2011 | 9070 | 3.06% |
| 2012 | 9309 | 2.64% |
| 2013 | 9536* | 2.43% |
| **Average since 2003** | | 3.50% |

* = Index was taken as average from Jan.-Nov. of current year.

Cost estimates presented in this Plan are based on the average of 2013 dollars with an ENR CCI of 9536. For construction performed in later years, costs should be projected based on the then current year ENR Index using the following method:

Updated Cost = Plan Cost Estimate x (current ENR CCI / 9536)

### 4.3.2 Engineering Cost

The cost of engineering services for major projects typically includes special investigations, predesign reports, surveying, foundation exploration, preparation of contract drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 18% to 25% of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small or complicated projects.

Engineering costs for basic design and construction services presented in this Plan are estimated at 20% of the estimated total construction cost. Other engineering costs such as specialized geotechnical exploration, easement research and preparation, and/or specific pre-design reports will typically be in addition to the basic engineering fees charged by firms.

### 4.3.3 Contingencies

A contingency factor equal to approximately twenty percent (20%) of the estimated construction cost has been added to the budgetary costs estimated in this Plan. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs. Upon final design completion of any project, the contingency can be reduced to 10%. A contingency of at least 10% should always be maintained going into a construction project to allow for variances in quantities of materials and unforeseen conditions.

### 4.3.4 Legal and Management

An allowance of five percent (5%) of construction cost has been added for legal and other project management services. This allowance is intended to include internal project planning and budgeting, funding program management, interest on interim loan financing, legal review fees, advertising costs, wage rate monitoring, and other related expenses associated with the project that could be incurred.

### 4.3.5 Land Acquisition

Some projects may require the acquisition of additional right-of-way, property, or easements for construction of a specific improvement. The need and cost for such expenditures is difficult to predict and must be reviewed as a project is developed. Effort was made to include costs for land acquisition, where expected, within the cost estimates included in this Plan.

# Regulatory Conditions

**Section 5**

## 5.1 Responsibilities as a Water Supplier

Per OAR 333-061-0025, water suppliers are responsible for taking all reasonable precautions to assure that the water delivered to water users does not exceed maximum contaminant levels, water system facilities are free of public health hazards and water system operation and maintenance are performed as required by these rules. This includes, but is not limited to, the following:

- Routinely collect and submit water samples for laboratory analyses at the frequencies and sampling points prescribed by OAR 333-061-0036 "Sampling and Analytical Requirements";

- Take immediate corrective action when the results of analyses or measurements indicate that maximum contaminant levels have been exceeded and report the results of these analyses as prescribed by OAR 333-061-0040 "Reporting and Record Keeping";

- Continue to report as prescribed by OAR 333-061-0040, the results of analyses or measurements which indicate that maximum contaminant levels (MCLs) have not been exceeded;

- Notify all customers of the system, as well as the general public in the service area, when the maximum contaminant levels have been exceeded;

- Notify all customers served by the system when the reporting requirements are not being met, or when public health hazards are found to exist in the system, or when the operation of the system is subject to a permit or a variance;

- Maintain monitoring and operating records and make these records available for review when the system is inspected;

- Maintain a pressure of at least 20 pounds per square inch (psi) at all service connections at all times (at the property line);

- Follow-up on complaints relating to water quality from users and maintain records and reports on actions undertaken;

- Conduct an active program for systematically identifying and controlling cross connections;

- Submit, to the DWP, plans prepared by a professional engineer registered in Oregon for review and approval before undertaking the construction of new water systems or major modifications to existing water systems, unless exempted from this requirement;

- Assure that the water system is in compliance with OAR 333-061-0205 "Water Personnel Certification Rules - Purpose" relating to certification of water system operators.

- Assure that Transient Non-Community water systems utilizing surface water sources or sources under the influence of surface water are in compliance with OAR 333-061-0065 "Operation and Maintenance" (2)(c) relating to required special training.

## 5.2 Public Water System Regulations

Water providers should always be informed of current standards, which can change over time, and should also be aware of pending future regulations. As of this writing, OAR Chapter 333, Division 61 covering Public Water Systems is over 300 pages in length and the latest effective version is dated 5-18-2009. This section is not meant to be a comprehensive list of all requirements but a general overview of the requirements.

Specific information on the regulations concerning public water systems may be found in the Oregon Administrative Rules (OAR), Chapter 333, Division 61. The rules can be found on the Internet at http://egov.oregon.gov/DHS/ph/dwp/rules.shtml where copies of all the rules and regulations can be printed out or downloaded for reference. A summary of Oregon drinking water quality standards is published in "*Pipeline*" (Volume 21, Issue 4, Fall 2006) by the State Drinking Water Program.

Drinking water regulations were established in 1974 with the signing of the Safe Drinking Water Act (SDWA). This act and subsequent regulations were the first to apply to all public water systems in the United States. The Environmental Protection Agency (EPA) was authorized to set standards and implement the Act. With the enactment of the Oregon Drinking Water Quality Act in 1981, the State of Oregon accepted primary enforcement responsibility for all drinking water regulations within the state. Requirements are detailed in OAR Chapter 333, Division 61. The SDWA and associated regulations have been amended several times since inception with the goal of further protection of public health.

SDWA requires the EPA to regulate contaminants which present health risks, are known or are likely, to occur in public drinking water supplies. For each contaminant requiring federal regulation, EPA sets a non-enforceable health goal, or maximum contaminant level goal (MCLG). This is the level of a contaminant in drinking water below which there is no known or expected health risk. The EPA is then required to establish an enforceable limit, or maximum contaminant level (MCL), which is as close to the MCLG as is technologically feasible, taking cost into consideration. Where analytical methods are not sufficiently developed to measure the concentrations of certain contaminants in drinking water, the EPA specifies a treatment technique instead of an MCL to protect against these contaminants.

Water systems are required to collect water samples at designated intervals and locations. The samples must be tested in State approved laboratories. The test results are then reported to the State, which determines whether the water system is in compliance or violation of the regulations. There are three main types of violations:

> (1) MCL violation — occurs when tests indicate that the level of a contaminant in treated water is above the EPA or State's legal limit (states may set standards equal to, or more protective than, EPA's). These violations indicate a potential health risk, which may be immediate or long-term.
>
> (2) Treatment technique (TT) violation — occurs when a water system fails to treat its water in the way prescribed by EPA (for example, by not disinfecting). Similar to MCL violations, treatment technique violations indicate a potential health risk to consumers.
>
> (3) Monitoring and reporting violation — occurs when a system fails to test its water for certain contaminants or fails to report test results in a timely fashion. If a water system does not monitor its water properly, no one can know whether or not its water poses a health risk to consumers.

If a water system violates EPA/State rules, it is required to notify the State and the public. States are primarily responsible for taking appropriate enforcement actions if systems with violations do not return to compliance. States are also responsible for reporting violation and enforcement information to the EPA quarterly.

To comply with the regulations water systems must provide adequate treatment techniques, operate treatment processes to meet performance standards, and properly protect treated water to prevent subsequent contamination after treatment.

A separate set of standards exists to address the beneficial use of public water, conservation, curtailment, and water planning. Governed by the Oregon Water Resources Department, OAR 690-086 includes provisions governing water consumption and conservation in Oregon. Section 690-086 requires that all public water systems develop and maintain a planning document known as a Water Management and Conservation Plan (WMCP). The WMCP includes four major components:

1. Water System Description
2. Water Conservation Plan
3. Water Curtailment Plan
4. Long-Range Water Supply Plan

The purpose of the plan is to help an agency plan for and responsibly and beneficially utilize public water resources for human demands. The goal of the planning is to reduce or eliminate water demand that is not beneficial through efficiencies, conservation, education, and other practices.

The City of Cave Junction currently does not have a WMCP. While not part of the scope of work for this planning effort, it is recommended that the City seek funding for and complete a WMCP as soon as possible in order to take advantage of efficiencies and common planning elements prepared within this master plan.

## 5.3 Current Standards

There are now EPA-established drinking water quality standards for 91 contaminants, including 7 microbials and turbidity, 7 disinfectants and disinfection byproducts, 16 inorganic chemicals (including lead and copper), 56 organic chemicals (including pesticides and herbicides), and 5 radiologic contaminants. These standards either have established MCLs or treatment techniques. In addition, there are secondary contaminant levels for 16 contaminants that represent desired goals, and in the case of fluoride, may require special public notice.

### Total Coliform Rule

The total coliform rule was established by the EPA in 1989 to reduce the risk of waterborne illness resulting from disease-causing organisms associated with animal or human waste. Routine samples collected by Oregon public water suppliers are analyzed for total coliform bacteria. The number of monthly samples required varies based on population served. For Cave Junction, a minimum of two samples per month are required.

Compliance is based on the presence or absence of total coliforms in any calendar month. Sample results are reported as “coliform-absent” or “coliform-present”. If any routine sample is coliform-present, a set of at least three repeat samples must be collected within 24 hours. If any repeat sample is total coliform-present, the system must analyze that culture for fecal coliforms or *E. coli*, and must then collect another set of repeat samples, unless the MCL has been violated and the system has notified the state. Following a positive routine or repeat total coliform result, the system must collect a minimum of five routine samples the following month.

Systems which collect fewer than 40 samples per month are allowed no more than one coliform-present sample per month including any repeat sample results. Larger systems (40 or more samples per month) are allowed no more than five percent coliform-present samples in any month including any repeat sample results. Confirmed presence of fecal coliform or *E. coli* presents a potential acute health risk and requires immediate notification of the public to take protective actions such as boiling or using bottled water. Any fecal coliform-positive repeat sample or *E. coli*-positive repeat sample, or any total coliform-positive repeat sample following a fecal or *E. coli*-positive routine sample is a violation of the MCL.

**Surface Water Treatment Rules**

All water systems using surface water must provide a total level of filtration and disinfection treatment to remove/inactivate 99.9 percent (3-log) of *Giardia lamblia*, and to remove/inactivate 99.99 percent (4-log) of viruses. In addition, filtered water systems must physically remove 99 percent (2-log) of *Cryptosporidium.* Systems with source water *Cryptosporidium* levels exceeding specified limits must install and operate additional treatment processes.

Filtered water systems must meet specified performance standards for combined filter effluent turbidity levels. Water systems using conventional and direct filtration must also record individual filter effluent turbidity and take action if specified action levels are exceeded. When more than 1 filter exists each filter's effluent turbidity must be monitored continuously and recorded at least every 15 minutes. The combined flow from all filters must have a turbidity measurement at least every four hours by grab sampling or continuous monitoring. Turbidity monitoring must occur prior to any storage such as a clearwell or contact tank. Turbidity monitoring equipment must be calibrated using an approved method at least once per quarter. General requirements for systems utilizing conventional or direct filtration are:

- Individual filter turbidity monitored continuously and recorded every 15 minutes or less
- Combined filter turbidity monitored continuously or grab sample taken at least every 4 hours
- Combined filter turbidity less than 1 NTU in 100% of measurements
- Combined filter turbidity less than or equal to 0.3 NTU in 95% of measurements in a month
- Specific follow-up actions if individual filter turbidity exceeds 1.0 NTU twice

General requirements for systems utilizing slow sand, and alternative filtration (membrane filtration and cartridge filtration) are:

- Combined filter turbidity monitored continuously or grab sample taken at least every 4 hours Department may reduce to once per day if determined to be sufficient
- Combined filter turbidity less than 5 NTU in 100% of measurements
- Combined filter turbidity less than or equal to 1 NTU in 95% of measurements in a month
- Department may require lower turbidity values if the above levels cannot provide the required level of treatment

All water systems must meet specified CxT [concentration x time] requirements for disinfection, and meet required removal/inactivation levels. In addition, a disinfectant residual must be maintained in the distribution system.

- Continuous recording of disinfectant residual at entry point to the distribution system. Small system may be allowed to substitute 1-4 daily grab samples.
- Daily calculation of CxT at highest flow (peak hourly flow)
- Provide adequate CxT to meet needed removal/inactivation levels
- Maintain a continuous minimum 0.2 mg/L disinfectant residual at entry point to the distribution system
- Maintain a minimum detectable disinfectant residual in 95% of the distribution system samples (collected at coliform bacteria monitoring points)

Filtered water systems that recycle spent filter backwash water or other waste flows must return those flows through all treatment processes in the filtration plant. Systems wishing to recycle filter backwash water must provide notice to the State including a plant schematic showing the origin, conveyance, and return location of recycled flows. Design flows, observed flows, and typical recycle flows are also required along with a state-approved plant operating capacity.

**Disinfectants and Disinfection Byproducts**

Disinfection treatment chemicals used to kill microorganisms in drinking water can react with naturally occurring organic and inorganic matter in source water called DBP precursors to form disinfection byproducts (DBPs). Some disinfection byproducts have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans. The challenge is to apply levels of disinfection treatment needed to kill disease-causing microorganisms while limiting the levels of disinfection byproducts produced. The primary disinfection byproducts of concern in Oregon are the total trihalomethanes (TTHM) and the haloacetic acids (HAA5).

Disinfection byproducts must be monitored throughout the distribution system at frequencies of daily, monthly, quarterly, or annually. This depends on the population served, type of water source, specific disinfectant applied, and in accordance with an approved monitoring plan. Disinfectant residuals must be monitored at the same locations and frequency as coliform bacteria.
Total organic carbon (TOC) is an indicator of the levels of DBP precursor compounds in the source water. Systems using surface water sources and conventional filtration treatment must monitor source water for TOC and alkalinity monthly and practice enhanced coagulation to remove TOC if it exceeds 2.0 mg/L as a running annual average.

Compliance is determined based on meeting maximum contaminant levels (MCLs) for disinfection byproducts and maximum levels for disinfectant residual (MRDLs) over a running annual average of the sample results, computed quarterly.

- TTHM/HAA5 monitoring required in distribution system. One sample per quarter for systems serving 500-9,999 persons. One sample per year in warmest month required for systems serving less than 500.
- MCL for TTHM is 0.080 mg/L. MCL for HAA5 is 0.060 mg/L.
- Any system having TTHM > 0.064 mg/L or HAA5 > 0.048 based on a running annual average must conduct disinfection profiling.
- TOC and alkalinity monitoring in source water monthly. Enhanced coagulation if TOC greater than 2.0 mg/L
- Comply with MRDLs. Limit for chlorine (free $Cl_2$ residual) is 4.0 mg/L. Limit for chloramines is 4.0 mg/L (as total $Cl_2$ residual). Limit for chlorine dioxide is 0.8 mg/L (as $ClO_2$)
- Bromate MCL of 0.010 mg/L
- Chlorite MCL of 1.0 mg/L

**Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)**

LT2ESWTR was published by the U.S. EPA on January 5, 2006. The rule requires source water monitoring for public water systems that use surface water or ground water under the influence of surface water. Based on the system size and filtration type, systems must monitor for *Cryptosporidium*, *E. coli*, and turbidity. Source water monitoring data will be used to categorize the source water *Crypto* concentration into four “bin” classifications that have associated treatment requirements. Systems serving 10,000 or more people are required to conduct 24 months of *Crypto* monitoring. Systems serving fewer than 10,000 people are required to conduct 12 months of *E. coli* monitoring and 12-24 months of *Crypto* monitoring if E. coli trigger levels are exceeded. The rule provides other options to comply with the initial source water monitoring that include either submitting previous *Crypto* data meeting (grandfathered data) the requirements or committing to provide a total of at least 5.5-log treatment for *Cryptosporidium*. A second round of source water monitoring will follow 6 years after the system makes its initial bin determination.

<u>Critical Deadlines for LT2ESWTR for systems serving less than 10,000 persons include:</u>
Comply with Rule: ………………………………………………………October 1, 2014
Begin second round of source water monitoring: ………………………….Oct. 1, 2017 (April 1, 2019*)
** Cryptosporidium monitoring - applies to filtered systems that exceed E. coli trigger*

**Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR)**

The Stage 2 DBPR was published by the U.S. EPA on January 4, 2006. The rule builds on existing regulations by requiring water systems to meet disinfection byproduct (DBP) MCLs at each monitoring site in the distribution system. Whereas the Stage 1 Rule controls average DBP levels across distribution systems, the Stage 2 Rule controls the occurrence of peak DBP levels within distribution systems.

The rule requires all community water systems to conduct an Initial Distribution System Evaluation (IDSE). The goal of the IDSE is to characterize the distribution system and identify monitoring sites where customers may be exposed to high levels of TTHM and HAA5. There are four ways to comply with the IDSE requirements: Standard Monitoring, System Specific Study, 40/30 Certification, and Very Small System (VSS) Waiver.

Standard monitoring (SM) is one year of increased monitoring for TTHM and HAA5 in addition to the data being collected under Stage 1 DBPR. These data will be used with the Stage 1 data to select Stage 2 DBPR TTHM and HAA5 compliance monitoring locations. Any system may conduct standard monitoring to meet the Initial Distribution System Evaluation (IDSE) requirements of the Stage 2 DBPR. The number of monitoring sites, the monitoring periods, and monitoring frequency vary depending on population served.

Systems that have extensive TTHM and HAA5 data (including Stage 1 DBPR compliance data) or technical expertise to prepare a hydraulic model may choose to conduct a system specific study (SSS) to select the Stage 2 DBPR compliance monitoring locations.

The term “40/30” refers to a system that during a specific time period has all individual Stage 1 DBPR compliance samples less than or equal to 0.040 mg/L for TTHM and 0.030 mg/L for HAA5 and no monitoring violations during the same period. These systems have no IDSE monitoring requirements, but will still need to conduct Stage 2 DBPR compliance monitoring.

The Very Small System (VSS) Waiver applies to systems that serve fewer than 500 people and have eligible TTHM and HAA5 data. The VSS eligibility does not depend on the actual TTHM and HAA5 sample results. These systems also have no IDSE monitoring requirements, but will still need to conduct Stage 2 DBPR compliance monitoring. 40/30 certifications were previously due for systems larger than 10,000 persons.

<u>Critical Deadlines for Stage 2 DBPR for systems serving less than 10,000 persons include:</u>
Begin Compliance Monitoring: ……………………………………………October 1, 2013*
** Systems under 10,000 population that have to monitor for Cryptosporidium may begin Stage 2 compliance monitoring October 1, 2014.*

The city has met the compliance monitoring for Stage 2 DBP. They plan to take samples quarterly starting in November.

### Lead and Copper

Excessive levels of lead and copper are harmful and rules exist to limit exposure through drinking water. Lead and copper enter drinking water mainly from corrosion of plumbing materials containing lead and copper. Lead comes from solder and brass fixtures. Copper comes from copper tubing and brass fixtures. Protection is provided by limiting the corrosivity of water sent to the distribution system. Treatment alternatives include pH adjustment, alkalinity adjustment, or both, or adding passivating agents such as orthophosphates.

Samples from community systems are collected from homes built prior to the 1985 prohibition of lead solder in Oregon. One-liter samples of standing water (first drawn after 6 hours of non-use) are collected at homes identified in the water system sampling plan. Two rounds of initial sampling are required, collected at 6-month intervals. Subsequent annual sampling from a reduced number of sites is required after demonstration that lead and copper action levels are met. After three rounds of annual sampling, samples are required every 3 years. The number of initial and reduced samples required is dependent on the population served by the water system.

In each sampling round, 90% of samples from homes must have lead levels less than or equal to the Action Level of 0.015 mg/L and copper levels less than or equal to 1.3 mg/L. Water systems with lead above the Action Level must conduct periodic public education, and either install corrosion control treatment, change water sources, or replace plumbing.

- Have Sampling Plan for applicable homes
- Collect required samples
- Meet Action Levels for Lead and Copper (0.015 mg/L for Lead and 1.3 mg/L for Copper)
- Rule out source water as a source of significant lead levels
- If Action Levels not met, provide corrosion control treatment and other steps

On October 10, 2007 EPA published the 2007 Final Revisions to the Lead and Copper Rule. The rule addresses confusion about sample collection by clarifying language that speaks to the number of samples required and the number of sites from which samples should be collected. The rule also modifies definitions for monitoring and compliance periods to make it clear that all samples must be taken within the same calendar year. Finally, the rule adds a new reduced monitoring requirement, which prevents water systems above the lead action level to remain on a reduced monitoring schedule.

### Inorganic Contaminants

The level of many inorganic contaminants is regulated for public health protection. These contaminants are both naturally occurring and can result from agriculture or industrial operations. Inorganic contaminants most often come from the source of water supply, but can also enter water from contact with materials used for pipes and storage tanks. Regulated inorganic contaminants include arsenic, asbestos, fluoride, mercury, nitrate, nitrite, and others. A possible future MCL for Nickel is currently being evaluated by EPA.

Compliance is achieved by meeting the established MCLs for each contaminant. Systems that cannot meet one or more MCL must either install treatment systems (such as ion exchange or reverse osmosis) or develop alternate sources of water.

- Sample quarterly for Nitrate (reduction to annual may be available)
- Communities with Asbestos Cement (AC) pipe must sample every 9 years for Asbestos
- Sample annually for Arsenic. New MCL of 0.010 mg/L effective January 2006

- Sample annually for all other inorganics. Waivers are available based on monitoring records showing three samples below MCLs. MCLs vary based on contaminant

**Organic Chemicals**

Organic contaminants are regulated to reduce exposure to harmful chemicals through drinking water. Examples include acrylamide, benzene, 2,4-D, styrene, toluene, and vinyl chloride. Major types of organic contaminants are Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs). Organic contaminants are usually associated with industrial or agricultural activities that affect sources of drinking water supply, including industrial and commercial solvents and chemicals, and pesticides. These contaminants can also enter from materials in contact with the water such as pipes, valves and paints and coatings used inside water storage tanks.

At least one test for each contaminant from each water source is required during every 3-year compliance period. Public water systems serving more than 3,300 people must test twice during each 3-year compliance period for SOCs. Public water systems using surface water sources must test for VOCs annually.

Compliance is achieved by meeting the established MCL for each contaminant. Quarterly follow up testing is required for any contaminants that are detected above the specified MCL. Only those systems determined by the State to be at risk must monitor for dioxin. Water systems using polymers containing acrylamide or epichlorohydrin in their water treatment process must keep their dosages below specified levels. Systems that cannot meet one or more MCL must either install or modify water treatment systems (such as activated carbon and aeration) or develop alternate sources of water.

- At least one test for each contaminant (for each water source) every 3-year compliance period
- Sample twice each compliance period for each SOCs when system over 3,300 people
- Test VOCs annually
- Quarterly follow up testing required for any detects above MCL
- Maintain polymer dosages in treatment process below specified levels
- MCLs vary based on contaminant

**Radiologic Contaminants**

Radioactive contaminants, both natural and man-made, can result in an increased risk of cancer from long-term exposure and are regulated to reduce exposure through drinking water. Rules were recently revised to include a new MCL for uranium (30 μg/L), and to clarify and modify monitoring requirements. Initial monitoring tests, quarterly for one year at the entry point from each source, were to be completed by December 31, 2007 for gross alpha, radium-226, radium-228 and uranium. A single analysis for all four contaminants collected between June 2000 and December 2003 will substitute for the four initial samples. Gross alpha may substitute for radium-226 if the gross alpha result does not exceed 5 pCi/L and may substitute for uranium monitoring if the gross alpha result does not exceed 15 pCi/L. Subsequent monitoring is required every three, six, or nine years depending on the initial results, with a return to quarterly monitoring if the MCL is exceeded. Compliance with MCLs is based on the average of the four initial test results, or subsequent quarterly tests. Community water systems than cannot meet MCLs must install treatment (such as ion exchange or reverse osmosis) or develop alternate water sources.

## 5.4 Future Water System Regulations

The 1996 Safe Drinking Water Act (SDWA) requires EPA to review and revise as appropriate each current standard at least every six years. Data is continually collected on contaminants currently unregulated in order to support development of future drinking water standards. Drinking water contaminant candidate lists (CCL) are prepared and revised every five years. The first DWCCL (CCL1) was published on March 2, 1998 which included 51 chemicals and 9 microbials. In 2003, EPA decided not to regulate any of the 9 microbials from the initial list. In 2005 EPA published the second CCL (CCL2) consisting of the remaining 51 contaminants from the first list. The Agency published the preliminary regulatory determinations for 11 of the 51 contaminants listed on the second CCL in April of 2007. In 2008 EPA published the draft third Contaminant Candidate List (CCL3) to help identify unregulated contaminants that may require a national drinking water regulation in the future. In September 2009 EPA finalized CCL3which includes 104 chemicals or chemical groups and 12 microbiological contaminants. The EPA must publish a decision on whether to regulate at least five contaminants from the CCL every 5 years. As a result, additional contaminants can become regulated in the future.

In addition, rule revisions and new rules will occur to further address health risks from disinfection byproducts and pathogenic organisms. Rules such as the Long-Term Stage 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 Disinfectants/Disinfection Byproducts Rule (State 2 DBPR) have recently gone into effect at the federal level and require systems to begin planning for compliance. New and revised drinking water quality standards are mandated under the 1996 federal SDWA.

Water suppliers should be aware of and familiar with these mandates and deadlines, and plan strategically to meet them. DHS, under the Primacy Agreement with the EPA, has up to two years to adopt each federal rule after it is finalized. Water suppliers generally have at least three years to comply with each federal rule after it is finalized; however, some of these rules will likely establish a significant number of compliance dates for water suppliers that will occur prior to state adoption of the rules. These “early implementation” dates will likely have to be implemented in Oregon directly by the EPA, because the state program will not yet have the rules in place or the resources to carry them out.

These anticipated rules are described generally below. Additional details will be found in the final EPA rules once they are promulgated.

**Radon Rule**

All community water systems using groundwater sources will conduct quarterly initial sampling at distribution system entry points for one year. Subsequent sampling will occur once every 3 years. The Radon MCL is expected to be 300 pCi/L. An alternative MCL (AMCL) of 4,000 pCi/L is proposed if the State develops and adopts an EPA-approved statewide Multi-Media Mitigation (MMM) program. Local communities may have the option of developing an EPA-approved local MMM program in the absence of a statewide MMM program, and meeting the AMCL.

**Distribution Rule**

Under this rule, current requirements for coliform bacteria will be revised, emphasizing fecal coliforms and *E. coli*, and focusing on protection of water within the distribution system. The rule will apply to all public water systems and will involve identifying and correcting sanitary defects and hazards in water systems and using best management practices for disinfection to control coliform bacteria in the system.

## 5.5 Water Management and Conservation Plans

The Municipal Water Management and Conservation Planning (WMCP) program provides a process for municipal water suppliers to develop plans to meet future water needs. Municipal water suppliers are encouraged to prepare water management and conservation plans, but are not required to do so unless a plan is prescribed by a condition of a water use permit; a permit extension; or another order or rule of the

Commission. These plans will be used to demonstrate the communities' need for increased diversions of water under the permits as their demands grow. A master plan prepared under the requirements of the Department of Human Resources Drinking Water Program or the water supply element of a public facilities plan prepared under the requirements of the Department of Land Conservation and Development which substantially meets the requirements of OAR 690-086-0125 to 690-086-0170 may be submitted to meet the requirements for WMCPs. Rules for WMCPs are detailed in OAR 690, Division 86.

A WMCP provides a description of the water system, identifies the sources of water used by the community, and explains how the water supplier will manage and conserve supplies to meet future needs. Preparation of a plan is intended to represent a pro-active evaluation of the management and conservation measures that suppliers can undertake. The planning program requires municipal water suppliers to consider water that can be saved through conservation practices as a source of supply to meet growing demands if the saved water is less expensive that developing new supplies. As such, a plan represents an integrated resource management approach to securing a community's long-term water supply.

Many of the elements required in a plan are also required under similar plans by the Drinking Water Section of the state Department of Human Services (water system master plans) and Department of Land Conservation and Development (public facilities plans). Water providers can consolidate overlapping plan elements and create a single master plan that meets the requirements of all three programs.

Every municipal water supplier required to submit a WMCP shall exercise diligence in implementing the approved plan and shall update and resubmit a plan consistent with the requirements of the rules as prescribed during plan approval. Progress reports are required showing 5-year benchmarks, water use details, and a description of the progress made in implementing the associated conservation or other measures.

The WMCP shall include the following elements:

1) <u>Water System Description</u> including infrastructure details, supply sources, service area and population, details of water use permits and certificates, water use details, customer details, system schematic, and leakage information.

2) <u>Water Conservation Element</u> including description of conservation measures implemented and planned, water use and reporting program details, progress on conservation measures, and conservation benchmarks.

3) <u>Water Curtailment Element</u> including current capacity limitations and supply deficiencies, three or more stages of alert for potential water shortages or service difficulties, levels of water shortage severity and curtailment action triggers, and specific curtailment actions to be taken for each stage of alert.

4) <u>Water Supply Element</u> detailing current and future service areas, estimates of when water rights and permits will be fully exercised, demand projections for 10 and 20 years, evaluation of supply versus demand, and additional details should an expansion of water rights be anticipated.

Failure to comply with rules for WMCPs can result in enforcement actions by the Water Resources Department Director. Enforcement actions can include requirements for additional information and planning, water use regulation, cancellation of water use permits, or civil penalties under OAR 690-260-0005 to 690-260-0110.

## 6.1 Water Supply

### 6.1.1 Water Sources

The City of Cave Junction holds water rights at the East Fork of the Illinois River (WR# S-23847), the Daisy Hill well field (WR# G-10965) and the Rockydale well field (WR# G-2767) in the Illinois River Valley. The City first obtained these rights in June of 1949 to supply 1.0 cubic feet per second (cfs) for municipal use. Three wells at the Rockydale site were added as an additional source in 1964 and an additional 2.0 cfs was obtained in 1971 from the East Fork of the Illinois River. The Daisy Hill site was then added in the early 1980's to supplement the surface water from the river.

### 6.1.2 Water Rights

A full report from GSI Water Solutions, Inc. can be found at the conclusion of this report in Appendix A. The following information is meant to be a summary of their findings. Water rights held by the City of Cave Junction total 4.6 cubic feet per second or 2,065 gallons per minute. Table 6.1.2-1 summarizes the current water rights that the City of Cave Junction hold.

**Table 6.1.2-1 – Water Rights Summary for Cave Junction**

| Source | Priority Date | Water Right | Authorized Withdrawal (cfs) | Authorized Withdrawal (mgd) | Type of Beneficial Use | Authorized Date for Completion |
|---|---|---|---|---|---|---|
| **Surface Water** | | | | | | |
| East Fork Illinois River | June 16, 1949 | App. S-23847<br>Permit S-18785<br>Cert. 55491 | 1.0 | 0.65 | Municipal | N/A |
| East Fork Illinois River | March 8, 1971 | App. S-48026<br>Permit S-36172 | 2.0 | 1.3 | Municipal | October 1, 1999 |
| **Groundwater** | | | | | | |
| Well 1<br>Well 2<br>Well 3 | January 20, 1964 | App. G-2767<br>Permit G-2570<br>Cert. 59983 | 1.0 | 0.65 | Municipal | N/A |
| Original Well (Well 4), Meyers Well, Berard Well | May 13, 1983 | App. G-10965<br>Permit G-10166<br>Cert. 85648 | 0.6 | 0.39 | Municipal | N/A |

As the table above shows, the city has rights to withdraw a total of 3.0 cfs (1,347 gpm) from the East Fork of the Illinois River. However, only 1.0 cfs (449 gpm) is perfected, therefore it is recommended that work begin soon on perfecting the remaining 2.0 cfs. Perfecting requires information to be submitted to the state and a certificate number will have to be obtained. Further clarification/instructions are discussed by GSI Water Solutions in Appendix A. The rest of the current water supply comes from the Daisy Hill well, where approximately 0.45 cfs is being pumped into the water system after chlorination at the well site. Therefore the city only uses 1.45 cfs (651 gpm) of the available 4.6 cfs of their current water rights.

In section 4.2.1 the 20-year supply goal was calculated to be 2.6 cfs, thus the current rate of withdrawal will not sustain the planning period of this study. Additionally, the availability of water in the East Fork of the Illinois River fluctuates greatly and it is possible that the entire 3.0 cfs may not be available when the water demand of the City requires it.

The City holds water rights to six groundwater wells within the Illinois River Basin and those should be utilized more efficiently. Only one well, Daisy Hill, is functional and three have been abandoned in place with the well houses and casing still in place but all the pumps removed. The final two, Meyers and Berard, were taken out of commission due to their lack of productivity. There has been recent interest from the state park officials to bring back online the Rockydale site which is located south of town. This would be a benefit to the park and the city to utilize that 1.0 cfs water right. By utilizing the existing well houses and casings that site could become functional again. This would provide for enough water supply for the city well beyond the 20-year period for this study.

### 6.1.3 East Fork of Illinois River Raw Water Intake

The City has two authorized points of diversion. One is shown in Figure 6.1.3-1. Only the southeast diversion is in use. The intake consists of three stainless steel, well inlet screen pipes laid four feet under the river bed. The screens are 16" in diameter. The screens are ensconced in gravel under the river bed and provide initial filtration to the water entering the water treatment plant.

**Figure 6.1.3-1 – Point of diversion in the Illinois River**

The three 16" pipes are reduced to three 12" pipes and pumped through a pump house that contains three vertical turbine pumps: two 15 Hp (350 gpm) pumps and one 25 Hp (700 gpm) pump. This is shown in Figure 6.1.3-2. The intake has been sized to handle 1.5 MGD. This is slightly undersized if the city proceeds to withdraw the full 3.0 cfs in their water rights from the Illinois River. Withdrawing the full 3.0 cfs from the river is equivalent to nearly 2.0 MGD.

**Figure 6.1.3-2 – Three vertical turbine pumps at the intake station**

The building is made of concrete brick and was built in 1998 and appears to be in good condition at the time of the preparation of this report.

Raw water is conveyed from the pump station to the existing water treatment plant through a 12-inch ductile iron pipe that is approximately 2,300 feet in length. The pipe is routed through an emergency power generator to provide power to the pump station and the water treatment plant in the case of an emergency. This is a 135 KW generator and was installed in 1998 in parallel with the Water Treatment Plant upgrades.

## 6.1.4 Daisy Hill Well Site


**Figure 6.1.4-1 – Daisy Hill (Well No. 4) well house**

The Daisy Hill well is located to the west of town just off Daisy Hill Road. As has been mentioned, it is the only well in operation for the City of Cave Junction. The well is mainly used to augment water production, when needed. It can also supply the city with the required water when the plant is offline during the weekends. Typically the well supplies between 150-200 gpm. The facility has been equipped with backup power generation and is fenced and secured. Overall, the well is in very good condition.

The water drawn from this well is considered clean and the only treatment that is needed is chlorine injection.

**Figure 6.1.4-2 – Inside the Daisy Hill well house. Chlorine injection is shown in the left of the picture.**

## 6.2 Water Treatment Plant

### 6.2.1 General

The Cave Junction Water Treatment Plant is a conventional surface water treatment plant. Construction on the existing facility was completed in 1999. The adjacent steel Clearwell at the plant was also constructed in 1999. Primary plant control is through a SCADA control system. The plant has a maximum capacity of 2.0 million gallons per day or 1,389 gallons per minute. Figure 6.2.1-1 below illustrates the locations and proximity of the overall WTP facilities. One great benefit of the plant location and the design of this plant is the opportunity for future expansion. There is space and possible locations for expansion as the city needs. Based on the planning numbers the capacity of this plant is sufficient for this planning period. There is the opportunity for improving plant efficiency, which could benefit the city and its customers. These recommendations will be discussed in Section 7.

Water reaches the treatment plant and travels through the various areas labeled in Figure 6.2.1-1. Chlorine, alum, soda ash and a filter aid polymer are added at various phases throughout the treatment process as needed. The water then flows into the baffled Clearwell tank where it achieves proper chlorine contact time (CT) and travels on to the system. The following sections detail each of these areas.

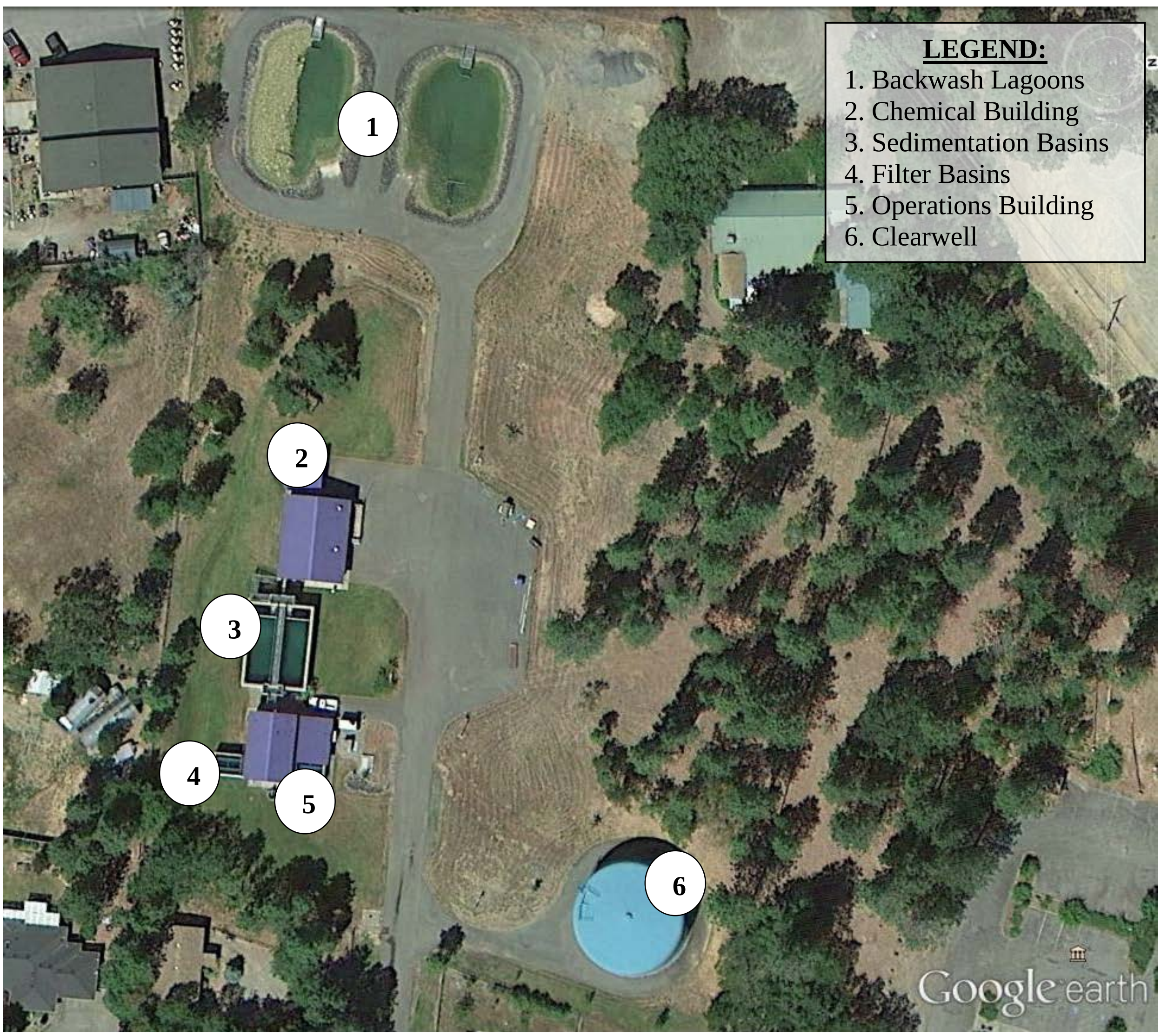



**Figure 6.2.1-1 – Image of the existing water treatment plant (Courtesy, Google Earth 2013)**

### 6.2.2 Chemical Addition and Rapid Mix


**Figure 6.2.2-1 – Chemical storage tanks at the water treatment plant. Two tanks on the left hold the polymer and the tank to the right holds soda ash.**

Chemical addition at the water treatment plant includes chlorine, alum, soda ash and superfloc n-300 polymer. Each of these chemicals are contained in the chemical building of the plant. The superfloc is used as a filter aid.

Alum is used to assist in the process of flocculation. It helps various bacteria or solids to settle in the sedimentation basins. The alum is added prior to the sedimentation basins and is typically added at a dosage of 67-126 pounds per day (ppd) of 48% alum. During periodic storm events dosage may be increased as needed. The liquid alum is stored in an 8,000 gallon tank in the chemical building.

The water then travels to the sedimentation basins which lead to the filters. Before traveling through the filters, the superfloc n-300 polymer is added. Typical dosage of superfloc n-300 is 0.3-0.6 ppd. If soda ash is required it is added for pH adjustment and corrosion control after the filters. An average of 22-41 ppd of soda ash is typically added. Liquid chlorine is then added for final disinfection before the water is stored in the Clearwell.

### 6.2.3 Sedimentation Basins

There are two sedimentation basin sections, each measuring 15.3 feet by 43 feet by 14.5 feet deep inside dimensions. The water surface elevation in the sedimentation basins is 1350.25 feet which translates to 13 feet of water depth according to the 1997 plans provided. Therefore, with the water surface elevation being 13 feet the volume of each basin is 8,571 $ft^3$ or 64,122 gallons each. The basins can be independently shut-off and dewatered. Each sedimentation basin provides a theoretical hydraulic detention time of 92 minutes or 1.54 hours at 2.0 mgd. Surface area is 659 $ft^2$ each (1,318 $ft^2$ total) which results in a gross surface overflow rate of 1,517 gpd/$ft^2$ or 1.05 gpm/$ft^2$ at 2.0 mgd.

**Figure 6.2.3-1 – Sedimentation basins at water treatment plant.**

Sedimentation basin design criteria according to EPA (Optimizing Water Treatment Plant Performance Using the Composite Correction Program, 1998, EPA/625/6-91/027) suggests a maximum surface overflow rate (SOR) of 0.6 gpm/ft$^2$ for turbidity removal and 0.4 gpm/ft$^2$ for color removal for conventional rectangular basins with depth between 12 and 14 feet. With vertical tube settlers (>45°), the SOR can be increased to 2.0 gpm/ft$^2$ for turbidity removal and 0.75 gpm/ft$^2$ for color removal (based on area over tubes only). AWWA/ASCE recommends (Water Treatment Plant Design, Third Edition) a SOR of 0.55 to 0.83 for turbidity removal with reduction to 0.35 to 0.55 gpm/ft$^2$ for water with high algae content. The AWWA/ASCE text also recommends SOR of 1.0 to 3.0 gpm/ft$^2$ over tube settlers with the normal design based on 2.0 gpm/ft$^2$. The 10-State Recommended Standards for Waterworks, requires 4 hours of detention time as well as a maximum horizontal through velocity of 0.5 fpm. Detention time may be reduced when the SOR is less than 0.5 gpm/ft$^2$.

The surface overflow rate for the settling basin is very large for the design flows when compared to the recommended SOR of 0.55 to 0.83 for turbidity removal. One way to bring this value down would be to install baffles in the sedimentation basins to increase the surface area of sedimentation without new construction of the sedimentation basins.

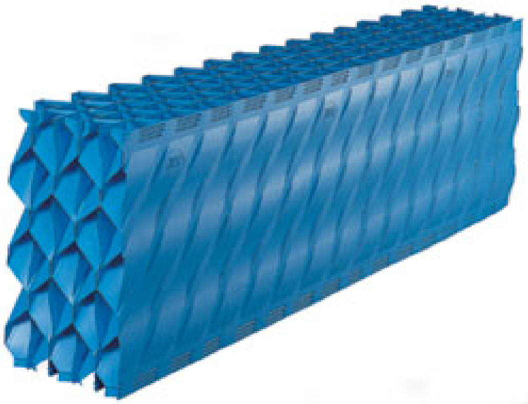


**Figure 6.2.3-2 – Tube Settlers. This is a possible improvement that can be made to the existing basins.**

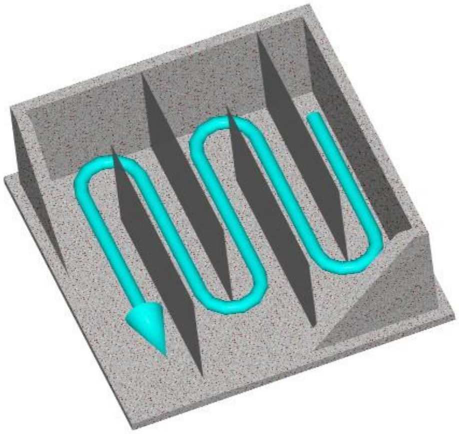


**Figure 6.2.3-3 – A section view of the proposed baffling that could be added to the existing basins.**

Another way to increase the amount of particle settling is to install tube settlers (Figures 6.2.3-2 and 6.2.3-3). These are multiple tubular channels sloped at an angle of 60º and adjacent to each other, which combine to form an increased effective settling area. This provides for a particle settling depth that is significantly less than the settling depth of a conventional basin, reducing settling times.

Tube settlers capture the settleable fine flocculants that escape the clarification zone beneath the tube settlers and allows the larger flocculants to travel to the tank bottom in a more settleable form. The tube settler's channel collects solids into a compact mass which promotes the solids to slide along the tube channel.

**Figure 6.2.4-1 – One filter at the treatment plant.**

### 6.2.4 Filtration

Each of the two mixed-media filters measure 10 feet by 14 feet providing 140 $ft^2$ each or 280 $ft^2$ of total filter surface area. At the design flow of 700 gpm the filter loading rate is 5.0 $gpm/ft^2$. At the current peak flows of 327 gpm through one filter at a time, the filter loading rate is 2.34 $gpm/ft^2$/filter.

The 20-year projected MDD of 1,182 gpm will push about 591 gpm/filter. Therefore, the filter loading rate will be 4.22 $gpm/ft^2$/filter. This exceeds the maximum filter loading rate of 4.0 $gpm/ft^2$ which is recommended by EPA and AWWA for mixed media filters in good condition and no signs of air binding. If the filter loading rate approaches this value then the city may be required to prove that the filters are still able to perform properly at these higher loading rates.

The filter underdrain consists of HDPE blocks. A 12-inch thick layer of graded support gravel lies on top of the HDPE underdrain. The actual filter media consists of a 12-inch layer of silica sand (specific gravity of 2.6, effective size of 0.45-0.55 mm, uniformity coefficient 1.40 or less) under an 18-inch thick layer of anthracite (specific gravity of 1.6, effective size of 0.95-1.05 mm, uniformity coefficient 1.40 or less). The filter media is original to the plant. City staff has indicated that the media should be replaced. This is due to the age of the media and the regular backwashing and draining that occurs.

### 6.2.5 Distribution Pumps

Three pumps are used at the end of the treatment process to pump the treated water into the system for residential use. Two of the pumps are 40 Hp and supply 350 gpm at approximately 220 feet of total dynamic head (TDH). These two pumps are manufactured by Aurora Pump and serviced locally by Queen/FNW Pump in Portland. The third pump is 60 Hp and supplies 700 gpm at approximately 220 TDH. The manufacturer and service representative are identical to the other two distribution pumps. Each of these are a vertical split-case model of pump. Staff has said that these pumps are in good condition.

# 6.3 Treated Water Storage

## 6.3.1 South Old Stage Tank – Reservoir #1

The South Old Stage Tank, or Reservoir #1, is located at the end of S. Old Stage Road in the southern portion of the City. The tank is 16.67 feet tall, has a diameter of 60 feet and is made of concrete. This tank was built in 1971 or 1972 and has a storage capacity of 300,000 gallons. It is located within a fenced area adjacent to a telecommunications tower.

Reservoir 1 has a floor elevation of 1512.9 feet and an overflow elevation of 1529 feet. The concrete walls and roof of the tank appeared to be in good condition at the preparation of this report.

**Figure 6.3.1-1 – Reservoir 1**

Liquivision completed a diving operation on June 14, 2011 to identify any problems with the tank from the interior. The walls, floor, and ceiling are in very good condition. However, there was significant corrosion noted on the Man way, inlets, drains, outlet, and overflows. Liquivision recommended that regular maintenance be performed on this tank to eliminate rust and corrosion from the tank interior.

## 6.3.2 Clearwell Storage Tank – Reservoir #2

The 500,000 gallon Clearwell tank provides some storage however its primary function is to provide the necessary chlorine contact time needed for disinfection prior to water reaching the first water user. If the clearwell water level is allowed to drop significantly, the contact time provided also drops significantly. The clearwell has a minimum water surface elevation of 1348.0 and an overflow elevation 1364.0 depth which is the full point where filtration is ceased. The base of the tank is located at elevation 1339.0 feet. The tank is baffled to allow for through flow and the contact time is 68 minutes in the winter (Temperature = 0.5ºC) and 18 minutes in the summer (Temperature = 20ºC).

**Figure 6.3.2-1 – Clearwell tank at Water Treatment Plant**

The tank is a steel tank that is painted green. It was constructed in 1998 and fabricated and erected by Trusco Tank, Inc. of San Luis Obispo, California. The tank appears to be in good condition but the tank surface needs to be sand blasted and repainted. Spot rust is visible and the ladder and the walls are losing paint. Regular cleaning of the tank exterior should be added to the maintenance procedure of this tank.

**Figure 6.3.3-1 – Reservoir 3**

**Figure 6.3.3-2 – Reservoir 4**

### 6.3.3 Laurel Road Tanks – Reservoirs #3 and #4

Two reservoirs are located adjacent to each other east of the City and east of Laurel Road. Reservoir #3 is a glass-fused-to-steel, circular tank by AquaStore that was built in 1991. It has a capacity of 500,000 gallons and is 18-feet tall with a diameter of 70 feet. The base elevation of the tank is located at 1512 feet above sea level. This tank appeared to be in good condition with some minor damages on the exterior of the tank. It is recommended that this tank receive regular maintenance procedures such as, resealing joints, repairs to equipment and repairs to outside bolts and panels as needed.

Approximately 12 feet below this tank is Reservoir #4. This tank provides 1.5 million gallons of storage and was constructed in 1998. The tank is 40 feet tall and approximately 80 feet in diameter. This tank has a base elevation of 1490 feet above sea level and an overflow elevation of 1530 feet. The tank is welded steel and painted green. The tank was manufactured and erected by Trusco Tank, Inc. of San Luis Obispo, California. This tank appeared to be in good condition with some repainting on the tank that was a different color.

The area where these tanks are located is completely surrounded by a chain link fence and a locked gate.

## 6.4 <u>Distribution System</u>

### 6.4.1 Pressure Zones

Currently the City of Cave Junction only operates under one pressure zone. There has not been a need to separate portions of the city into different pressure zones with pressure reducing valves (PRVs), pump stations or any other type of equipment.

### 6.4.2 Kerby Booster Pump Station

Besides the distribution pumps at the WTP, there is one pump station that is included in the system. It is the Kerby Booster Pump Station (BPS) which belongs to the Kerby Water District (KWD). It is a recently built structure that supplies the KWD with additional pressure and flow if needed. It helps in meeting required fire flows for the KWD. It is very rarely operated and wasn't taken into consideration with our modeling due to the fact that this plan is limited to the city limits of Cave Junction. Since this BPS is used rarely, it is recommended to run this on some type of schedule to keep it functioning properly if it was needed. This will also allow for preventative maintenance on the equipment.

### 6.4.3 Piping System Summary

The City of Cave Junction water system includes over 98,000 feet (over 18 miles) of piping. Nearly 60% of the system is currently 8" pipe. Only about 2% of the system is sized 4" or smaller. Compared to neighboring communities, this sizing of pipe is very good and allows for good flows and possible growth throughout the system. Also, 93% of the existing system pipe material is PVC. PVC has very long life expectancy and the overall piping system should be in good condition throughout this planning period.

In Section 7, the CIP lists all of the 2" and 4" piping as being recommended for replacement, which will leave the system in good condition as far as sizing and pipe material is concerned. Table 6.4.3-1 below summarizes the size of piping for Cave Junction. Table 6.4.3-2 summarizes the type of piping in Cave Junction. Figure 6.4.3-1 is an overall map of the current system. This figure is for visual purposes and can illustrate the system that is in place. A much larger size of map, that is similar to this, has been created and distributed to the appropriate staff members. The large map will be able to help with planning for the future.

**Table 6.4.3-1 – Current pipe size summary**

| Pipe Size | Length |
|---|---|
| 2" | 643 |
| 4" | 1,607 |
| 6" | 19,439 |
| 8" | 57,861 |
| 10" | 16,750 |
| 12" | 2,345 |
| 14" | 2,464 |

<u>NOTE:</u> Piping within the WTP site has been excluded from total

**Table 6.4.3-2 – Current pipe type summary and Distribution**

| Pipe Type | Length (ft) |
|---|---|
| Asbestos Cement | 5,321 |
| Ductile Iron | 844 |
| Galvanized Iron | 643 |
| PVC | 92,046 |

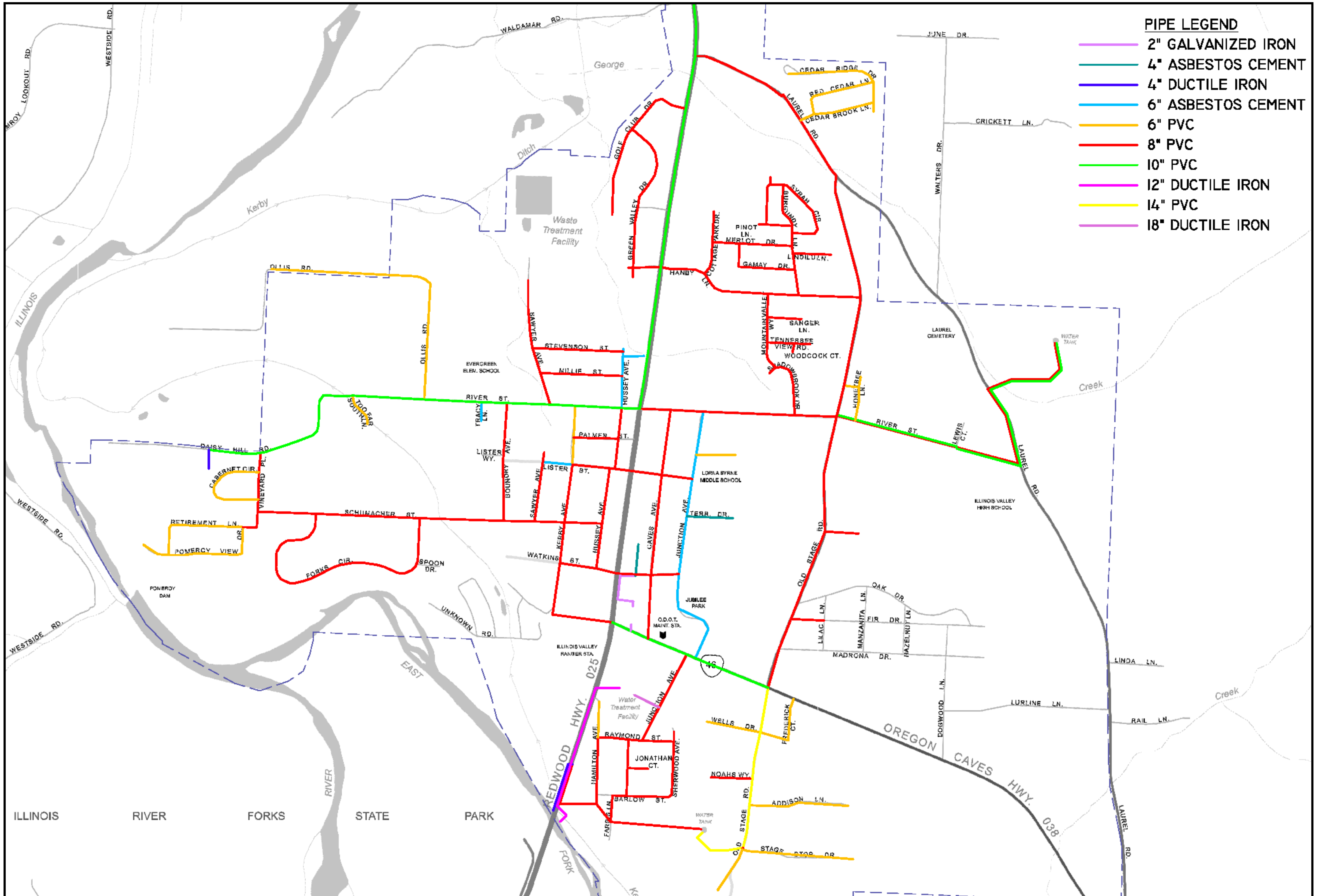



**Figure 6.4.3-1 – Existing water system map for the City of Cave Junction**

### 6.4.4 Fire Protection

The City of Cave Junction has 147 public fire hydrants. Nearly all hydrant assemblies are connected to pipe that are at least 6-inches in diameter. One hydrant located on Terrace Lane is currently connected to a 4-inch AC line. This Terrace Ln. pipe is on the CIP list and it is recommended to replace this hydrant when the improvements are made. Fire protection coverage is fairly good within the City limits with just a few areas that need additional coverage.

Fire code requires a minimum flow of 1,000 gallons per minute (gpm) from each hydrant with a minimum residual pressure of 20 psi. Based on past fire flow tests received from the City, only one hydrant didn't meet this requirement. However, when the hydraulic model calculated fire flows at all junctions within the system it was found that there were a few other areas that did not meet the required fire flow. The full detailed results of the model can be found in Appendix B. It should be noted that these problem areas all occurred at dead end lines, therefore, by simply upsizing the pipe in these areas, the model showed that fire flows could be met. Section 7 lists these areas in more detail and shows the recommendations. It should be noted that the fire flows that resulted in completion of the hydraulic model are the flows in the pipe at or below the hydrant. A significant amount of head and friction loss occurs as water travels through the hydrant, into a fire house, and out a nozzle.

The existing fire hydrants within the City are shown in Figure 6.4.4-1. Circles with a radius of 250 feet are drawn around each fire hydrant to illustrate the coverage provided by each fire hydrant. As can be seen, fire protection coverage of the City is fairly good with some overlapping regions of influence. However, there are some areas that have lapses in coverage. Those areas are addressed in the CIP list in Section 7. There are also some privately owned areas that are lacking in coverage and flows that should be addressed by the property owners.

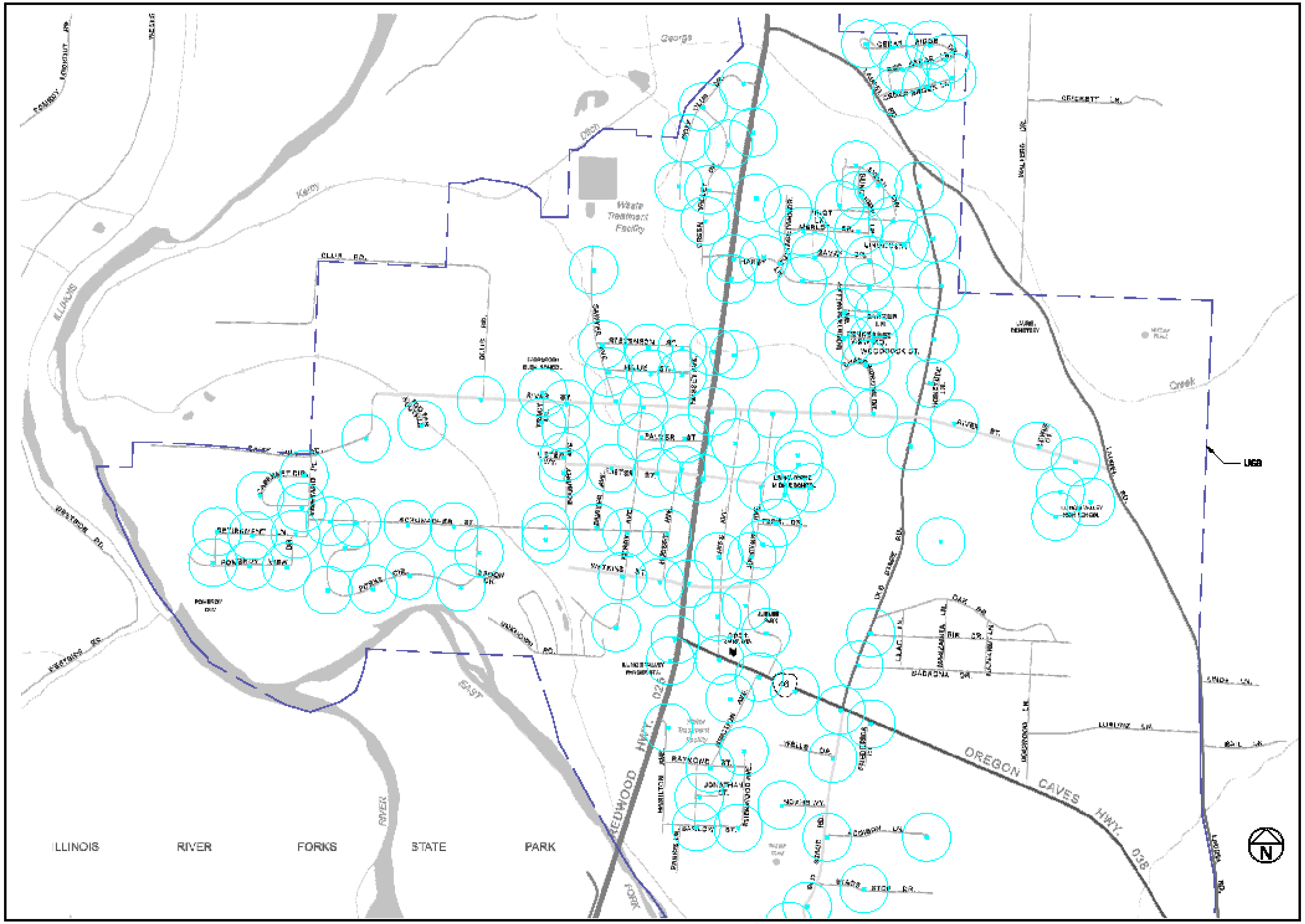



**Figure 6.4.4-1 – Existing Fire Hydrant Coverage**

# Improvement Alternatives — Section 7

## 7.1 Improvement Alternatives Introduction

The purpose of this section is to present various alternatives for the major infrastructure components along with analysis and background information that will be required to make an informed selection from the presented alternatives. Improvements presented in this section were developed using the following information:

1. Site Inspection;
2. Conversations with City Staff; and
3. Results of Hydraulic Modeling Efforts.

They are organized and presented in the following order and will be addressed this way in the following sections:

1. Raw Water Supply
2. Water Treatment
3. Water Storage
4. Water Distribution.

In order to keep track of the many projects that are presented, they have been numbered in chronological order with a two or three letter acronym in front to identify the type of project. The acronyms are defined below:

1. WS – Water Supply
2. WT – Water Treatment
3. WS – Water Storage Facilities
4. WDS – Water Distribution System
5. WAC – Replacement of asbestos/cement pipe

The locations of the projects are presented in Figure 7.4.2-1 in the last section.

## 7.2 Water Supply Needs and Alternatives

### 7.2.1 Effect on Raw Surface Water Supplies Resulting from Increased Abstraction

The City of Cave Junction is projected to grow in the future as discussed within this plan in various sections. As the water consuming population grows, the demand for water will increase requiring more water to be diverted from the wells and river water supplies. For the purposes of this analysis, the increase in water demand will result in an increased diversion of water from the Illinois River referred to as an abstraction.

If we assume the increase in peak conditions during the planning period will result in an increased abstraction from the river, the following data points are estimated:

2010 Peak Illinois River Abstraction ......................... 943,064 gpd (1.46 cfs)
2035 Peak Illinois River Abstraction ......................... 1,674,004 gpd (2.60 cfs)

This projection suggests a potential increased abstraction from the River of 1.13 cfs over the planning period or a 78% increase. This analysis assumes that no water will be diverted from the wells in order to illustrate the worst case scenario of obtaining all raw water from the river.

Data was obtained from a gauging station on the Illinois River located near the City of Cave Junction. This information was utilized in the City's Wastewater Facilities Planning effort to evaluate the impacts and permit conditions on the wastewater outfall facilities located downstream of the raw water intake (approximately 2.75 river miles between raw water intake and outfall). The data evaluated included daily flow data from April of 2012 to April of 2013. While not an exhaustive evaluation, the results provide the perspective necessary.

Flows in the data set range from a high of over 18,400 cfs (Dec. 2, 2012) to a low of around 27 cfs (Sept 16, 2012). Other critical dates related to the City's discharge permit include the following approximate flow rates:

June 1st .................................523 cfs
October 31st .........................334 cfs

The above dates are important from a wastewater perspective as they are the dates which govern the City's ability to discharge effluent into the River.

From the perspective of increased river abstraction, it is important to point out the following:

1. Increased abstraction from the river, during the lowest flow season, can have a significant impact on the conditions and environment in and around the river. In this analysis, we are predicting that the abstraction rate, during the lowest flow period, could increase from around 5.4% of the total flow to around 10% of the total flow. However, the low flow period does not generally correspond to salmonid returns to the River which generally occur later in the year.
2. During the lowest flow conditions (June to November), the City is not to discharge effluent into the River. Therefore, the abstraction during these periods is effectively permanent and not just limited to the 2.75 river-mile stretch between the raw water intake and wastewater outfall.
3. After November 1st, flows steadily increase and the abstraction rate becomes insignificant. This is a positive thing for salmonid species that make their runs generally after November 1st. In the data we evaluated, flows in the river steadily rise to over 10 cfs by mid-October making the abstraction rate a small percentage of total flow.
4. By the time the City is able to discharge effluent to the river in November, the flows are approaching 1,000 cfs which improves the dilution and mixing conditions for effluent discharge.

The above information is provided to shed light on the potential impacts of increased abstraction on the Illinois River. The impact of abstraction on the wastewater outfall are discussed in greater detail and more appropriately in the wastewater facilities plan (2013) and mixing zone study (2013) for the wastewater outfall.

Additional discussion on the reduction in future abstraction should be addressed in an upcoming water management and conservation plan that the City should undertake as soon as possible. Reducing leakage, improving efficiency, encouraging and promoting conservation, and other practices to make more beneficial use of the water diverted by the City will decrease the required abstraction and the resulting impacts that has on the Illinois River. Due to the high level of unaccounted water in Cave Junction, there is certainly room for improvement in this area.

### 7.2.2 Potential Effects from Increased Groundwater Abstraction

The analysis above assumes all water demand will be satisfied by the City's surface water supplies. However, in reality, the City obtains a significant supply of water from groundwater and has plans to evaluate their ability to expand groundwater facilities in the coming planning period. This effort should be pursued with a level of caution as there are limits to the groundwater supplies in the area.

The Daisy Hill well has consistently provided a high level of water supplies to the City. Other wells in the area have been abandoned due to reductions in yield. The City wishes to investigate new well production in the Daisy Hill area as well as around the High School and rehabilitating the old wells in the Rockydale area.

While it is appropriate to evaluate these locations for water quality and quantity (yield) availability, it should be done with caution. For example, it may be possible to drill a new well in the Daisy Hill area and impact negatively the yield from the existing well or from private property wells nearby. If the same aquifer is penetrated or if the aquifers are connected, one well could damage or reduce the yield in another. Therefore, a qualified well consultant and driller should carry out the well evaluations to ensure that no existing wells in the vicinity of the test wells are injured or affected by a new well or wells.

Also, groundwater quality in western Oregon can also be problematic. Issues related to iron, manganese, arsenic, and other compounds and minerals are common. Before developing wells, the quality of the water should be evaluated and efforts taken to not corrupt a good aquifer with a bad one.

### 7.2.3 Water Supply Needs

The City of Cave Junction, as previously mentioned, holds both groundwater and surface water rights. Currently they draw 1.0 cfs of water from the Illinois River and 0.45 cfs of water from the Daisy Hill well field. These amounts have been sufficient so far for the city. They also have additional water rights which end up totaling 4.6 cfs. Refer to Section 6 for more detailed information on water sources. According to future projections in Section 3, by the year 2035 the demand will have increased to 1.7 MGD or 2.6 cubic feet per second. Even though the city has sufficient water rights to meet these future demands, a number of various water supply projects are needed to make sure that happens.

Years ago the city took out of commission the Rockydale well field where they hold a water right of 1.0 cfs. At the time there were three active wells located at this well field. This was done due to well production issues and the feasibility of transmitting the water to the treatment plant. There has been recent discussion in bringing at least one of these wells back online. When these wells were initially shut down the pumps and other equipment were removed but the well houses and casings were capped and left intact. The nearby Illinois River Forks State Park has expressed interest in utilizing this well site which would be a benefit to them and the city.

In order for this well field to be brought back in to the distribution system, the current condition of the piping, casings and well houses will have to be assessed. Once the condition is verified, additional piping needs to be installed to connect this area to the water treatment plant. When the new Highway 199 (Redwood Hwy) bridge was installed, the piping to connect these wells to the treatment plant was never installed on the bridge. Approximately 450 feet of pipe will need to be hung from the bridge in order to complete this distribution line. Due to the large amount of unknowns for this project the contingency was increased to 40% in order to accommodate for issues that may arise, mainly from the underground things that we cannot see. The following table, Table 7.2.1-1, illustrates the cost of WS-1.

**Table 7.2.1-1 – Well investigation estimate**

| WS-1 - Well Improvements - Rockydale well field restoration | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 29,800 | $ 29,800 |
| 2 | Analyze existing wells | ls | 1 | $ 15,000 | $ 15,000 |
| 3 | Analyze all existing piping | ls | 1 | $ 15,000 | $ 15,000 |
| 4 | Pump & Motor, 100 gpm | ea | 1 | $ 2,000 | $ 2,000 |
| 5 | Install new 12" DI Pipe across bridge | lf | 450 | $ 160.00 | $ 72,000 |
| 6 | Mech. & Elec. Modifications as needed | ls | 1 | $ 30,000 | $ 30,000 |
| 7 | Misc. restoration & clean-up | ls | 1 | $ 15,000 | $ 15,000 |
| | | Construction Total | | | $ 178,800 |
| | | Contingency (40%) | | | $ 71,520 |
| | | Subtotal | | | $ 250,320 |
| | | Engineering (20%) | | | $ 50,064 |
| | | Administrative Costs (3%) | | | $ 7,510 |
| | | **Total Project Costs** | | | **$ 307,894** |

In addition to this project, the other discussions have included investigating another well at Daisy Hill well field and investigating a brand new well site near the Illinois Valley High School. At the Daisy Hill location the current pump is at capacity by drawing between 150-200 gpm. So there is opportunity to install another well in order to get the full use out of the existing water right. Investigation will need to be done at both these locations to determine the possibility of pursuing these items further. The following tables, Tables 7.2.1-2 and 7.2.1-3, summarize these costs.

**Table 7.2.1-2 – Well investigation estimate**

| WS-2 - Well Improvements - High school well site investigation | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 8,100 | $ 8,100 |
| 2 | Well drilling | ea | 1 | $ 25,000 | $ 25,000 |
| 3 | Water Quality Testing | ea | 1 | $ 5,000 | $ 5,000 |
| 4 | Well Source Study | ea | 1 | $ 15,000 | $ 15,000 |
| | | Construction Total | | | $ 53,100 |
| | | Contingency (20%) | | | $ 10,620 |
| | | Subtotal | | | $ 63,720 |
| | | Engineering (20%) | | | $ 12,744 |
| | | Administrative Costs (3%) | | | $ 1,912 |
| | | **Total Project Costs** | | | **$ 78,376** |

**Table 7.2.1-3 – Well investigation estimate**

| WS-3 - Well Improvements - Additional well investigation at Daisy Hill well field | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 8,100 | $ 8,100 |
| 2 | Well drilling | ea | 1 | $ 25,000 | $ 25,000 |
| 3 | Water Quality Testing | ea | 1 | $ 5,000 | $ 5,000 |
| 4 | Well Source Study | ea | 1 | $ 15,000 | $ 15,000 |
| | | Construction Total | | | $ 53,100 |
| | | Contingency (20%) | | | $ 10,620 |
| | | Subtotal | | | $ 63,720 |
| | | Engineering (20%) | | | $ 12,744 |
| | | Administrative Costs (3%) | | | $ 1,912 |
| | | **Total Project Costs** | | | **$ 78,376** |

## 7.3 Water Treatment Needs and Alternatives

### 7.3.1 Water Treatment Plant Needs Summary

In general, the Cave Junction Water Treatment Plant is well maintained, well operated and produces high quality treated water. The plant has a capacity of 2.0 MGD. Fortunately for today's residents, this capacity should be enough to get the City through the planning period. In order to continue producing safe drinking water though, a few minor improvements will be required. Each of these improvements will allow the plant to supply the necessary water through this current planning period.

The recommendations are as follows:

1. Replace filter media
2. Modify sedimentation basins by adding baffling, tube settlers, launders and a streaming current controller
3. Replace disinfection system
4. Determine the appropriate covers that can be used to prevent outside contamination and UV issues

Two of the four items listed above are general maintenance and upkeep of the facility. The first is replacing the filter media. The water treatment plant is about 15 years old. By replacing the filter media it will allow for the plant to continue to function properly for the duration of this planning period. The shipping of the media and the demolition/installation of the product will vary with time. While the filters are drained it is also recommended to protect them by coating them with the same type of protective coating for the storage tanks. This coating is discussed further in Section 7.4. The costs for this can be found in Table 7.3.1-1 below.

**Table 7.3.1-1 – Filter Media replacement estimate**

| WT-1 - Treatment plant improvements - Filter Media Replacement | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 7,092 | $ 7,092 |
| 2 | Demo/Installation | ls | 1 | $ 10,000 | $ 10,000 |
| 3 | Filter Sand (0.45-0.55 mm) | cf | 280 | $ 5.00 | $ 1,400 |
| 4 | Support Gravel (varying sizes) | cf | 280 | $ 7.00 | $ 1,960 |
| 5 | Anthracite (0.95-1.05 mm) | cf | 420 | $ 11.00 | $ 4,620 |
| 6 | Shipping/Freight | ls | 1 | $ 5,500 | $ 5,500 |
| 7 | Blasting/Patching | sf | 1,440 | $ 8.00 | $ 11,520 |
| 8 | Protective coating | sf | 1,440 | $ 10.00 | $ 14,400 |
| | | Construction Total | | | $ 56,492 |
| | | Contingency (20%) | | | $ 11,298 |
| | | Subtotal | | | $ 67,790 |
| | | Engineering (20%) | | | $ 13,558 |
| | | Administrative Costs (3%) | | | $ 2,034 |
| | | **Total Project Costs** | | | **$ 83,382** |

In order to improve the efficiency of the current sedimentation basins, there are a number of recommendations that can be done with them. In Table 7.3.1-2 each of these items is listed individually in order to be able to see the various improvements. The first recommendation is to install curtain baffle walls. For planning purposes 4 curtains were designed for. This will vary depending on the design that is decided upon at the time of installation. This will allow for better movement of the water in the basins, which in turn will also improve settling. The other improvement that assists in settling is tube settlers. The figure in Section 6 shows tube settlers. These are also intended to allow for better settling of unwanted solids.

The streaming current controller is something that will allow better monitoring of the water and the chemicals in it. There is a large amount of alum that is being used for treatment. Through the use of this controller that dosage can be monitored more closely and adjusted by operators automatically.

**Table 7.3.1-2 – Sedimentation basin improvements**

| WT-2 - Treatment plant improvements - Sedimentation basins modifications | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 43,740 | $ 43,740 |
| 2 | New Curtain Baffle walls, (4 @ 10' x 14'/basin) | ls | 1 | $ 120,000 | $ 120,000 |
| 3 | Installation of Tube Settlers | ls | 1 | $ 95,000 | $ 95,000 |
| 4 | Installation of End Launders | ls | 1 | $ 20,000 | $ 20,000 |
| 5 | Streaming Current Controller | ea | 1 | $ 8,000 | $ 8,000 |
| | | Construction Total | | | $ 286,740 |
| | | Contingency (20%) | | | $ 57,348 |
| | | Subtotal | | | $ 344,088 |
| | | Engineering (20%) | | | $ 68,818 |
| | | Administrative Costs (3%) | | | $ 10,323 |
| | | **Total Project Costs** | | | **$ 423,228** |

As has been discussed, the WTP is about 15 years old. So the disinfection system is the same age and is due for replacement. This is due to the fact that disinfection breaks down with age and that there is new technology that can save communities money. Disinfection systems can come in a large variety, currently this system is a liquid chemical addition type system. For planning purposes the same system is being estimated, but there are other options that could benefit the city in the long run. Table 7.3.1-3 shows the estimate.

**Table 7.3.1-3 – WTP disinfection replacement**

| WT-3 - Treatment plant improvements - Replace disinfection system | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 18,000 | $ 18,000 |
| 2 | Disinfection Equipment, 25-30 ppd | ls | 1 | $ 90,000 | $ 90,000 |
| 3 | Electrical & Controls | ls | 1 | $ 10,000 | $ 10,000 |
| | | Construction Total | | | $ 118,000 |
| | | Contingency (20%) | | | $ 23,600 |
| | | Subtotal | | | $ 141,600 |
| | | Engineering (20%) | | | $ 28,320 |
| | | Administrative Costs (3%) | | | $ 4,248 |
| | | **Total Project Costs** | | | **$ 174,168** |

According to city staff, there are concerns that the sedimentation basins could be contaminated with outside contamination. This contamination could be from leaves, algae (from UV) or vandalism. By installing basin covers on each of these, the threat of outside contamination is significantly decreased. Each of the basins estimated below are aluminum material covers. They are meant to be safe to walk on with structural support underneath them. These covers do not prohibit access to the inside of the basins. They come in panels that can be removed or a hatch can be put in for access. Table 7.3.1-4 shows the estimate.

**Table 7.3.1-4 – Sedimentation basin cover estimate**

| WT-4 - Treatment plant improvements - Basin covers | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 11,520 | $ 11,520 |
| 2 | Basin covers (15' x 43') | ls | 1 | $ 64,000 | $ 64,000 |
| 3 | Basin cover installation | ls | 1 | $ 8,000 | $ 8,000 |
| | | Construction Total | | | $ 83,520 |
| | | Contingency (20%) | | | $ 16,704 |
| | | Subtotal | | | $ 100,224 |
| | | Engineering (20%) | | | $ 20,045 |
| | | Administrative Costs (3%) | | | $ 3,007 |
| | | **Total Project Costs** | | | **$ 123,276** |

Currently, coming into the Water Treatment Plant there is a water purchase station just before the exterior fence line. This purchase station has caused problems with access to the plant. City staff employees have said that customers will park in the roadway that enters the plant, making it difficult to get around. This problem is easily solved with installing a parking pad on the opposite side of the roadway. This would allow the customers to pull out of the roadway and purchase the water as needed. Table 7.3.1-5 shows the costs associated with this improvement.

**Table 7.3.1-5 – Purchase station parking pad estimate**

| WT-5 - Purchase station improvements - New parking pad at purchase station | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 1,080 | $ 1,080 |
| 2 | Gravel Surfacing/Base (4" thick) | cf | 675 | $ 3.00 | $ 2,025 |
| 3 | Asphalt paving (3" thick, 15' x 15' pad) | cf | 675 | $ 5.00 | $ 3,375 |
| | | Construction Total | | | $ 6,480 |
| | | Contingency (20%) | | | $ 1,296 |
| | | Subtotal | | | $ 7,776 |
| | | Engineering (20%) | | | $ 1,555 |
| | | Administrative Costs (3%) | | | $ 233 |
| | | **Total Project Costs** | | | **$ 9,564** |

# 7.4 Treated Water Storage Needs and Alternatives

## 7.4.1 Water Storage Needs Analysis

As discussed in Section 4, the goal for treated water storage is to have 3 average days of emergency water (3 x ADD), a modest amount of equalization storage to provide for diurnal fluctuations in tank water levels (20% of one MDD), plus fire storage sufficient to supply 3000 gpm for 3 hours. The existing storage for the City of Cave Junction includes Reservoir 1 (Old Stage Rd.), Reservoir 3 (Laurel Rd.) and Reservoir 4 (Laurel Rd.) which hold 0.3, 0.5 and 1.5 million gallons respectively. This totals to 2.3 million gallons of current storage. There is also the 500,000 gallon Clearwell at the treatment plant. This will not be included in the inventory since its primary function is chlorine contact time.

At the end of the planning period, in the year 2035, the City's calculated required storage is approximately 2.7 million gallons. With current capacity at 2.3 MG and a future capacity of 2.7 MG in the year 2035, the City will be 400,000 gallons short of storage. The first year of a storage deficit will occur in the years 2025-2030. Table 7.4.1-1 provides a detailed list of the City's storage needs annually to the year 2035.

**Table 7.4.1-1 – Cave Junction Storage Capacity Needs (gallons)**

| Year | Equalization | Emergency | Fire Reserve | Total Storage | Surplus/(Deficit) |
|---|---|---|---|---|---|
| 2010 | 188,619 | 1,010,458 | 540,000 | 1,739,077 | 560,923 |
| 2015 | 212,224 | 1,137,444 | 540,000 | 1,889,668 | 410,332 |
| 2020 | 238,774 | 1,279,740 | 540,000 | 2,058,514 | 241,486 |
| 2025 | 268,685 | 1,440,054 | 540,000 | 2,248,739 | 51,261 |
| **2030** | **302,303** | **1,620,234** | **540,000** | **2,462,537** | **(162,537)** |
| 2035 | 334,801 | 1,794,408 | 540,000 | 2,669,209 | (369,209) |

In addition to more storage volume being needed, the existing storage facilities must be maintained. The expected coating life of the epoxy-based coatings on the existing tanks is 20 to 25 years when properly applied.

## 7.4.2 Water Storage Improvement Alternatives

As discussed, Cave Junction has three storage tanks and one Clearwell tank. Each tank has some type of maintenance or repair that is needed. In 2011 Liquivision performed a diving investigation in Reservoir 1 to analyze the condition of the tank inside and out. They were able to locate some areas that need to be addressed as soon as possible. The exterior of the tank was in good condition but there were indications of multiple locations of rust and corrosion inside the tank.

The recommendations for this tank are meant to prolong the life of this tank. This tank has the ability to service the city for many years to come if regular maintenance is performed. The first recommendation is to put a protective coating on the interior and exterior of this tank. This is an epoxy coating that will seal and protect the concrete. This coating will require three coats be applied, especially since this is a concrete tank that has never been coated. The tank will need to be drained and then blasted. Once blasted it may be required to do patching prior to coating the tank. This tank also is in need of cathodic protection in order to prevent more corrosion in the future. Table 7.4.2-1 below shows an itemized estimate of the costs for Reservoir 1.

**Table 7.4.2-1 – Reservoir 1 estimate**

| WSF-1 - Reservoir maintenance - Reservoir 1 maintenance (300,000 gal.) | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 76,023 | $ 76,023 |
| 2 | Blasting/Patching | sf | 5,843 | $ 8.00 | $ 46,747 |
| 3 | Interior/Exterior Coating | sf | 35,060 | $ 10.00 | $ 350,602 |
| 4 | Add Cathodic Protection | ea | 20 | $ 1,000 | $ 20,000 |
| 5 | Flushing and Disinfection | ls | 1 | $ 5,000 | $ 5,000 |
| | | Construction Total | | | $ 498,372 |
| | | Contingency (20%) | | | $ 99,674 |
| | | Subtotal | | | $ 598,046 |
| | | Engineering (20%) | | | $ 119,609 |
| | | Administrative Costs (3%) | | | $ 17,941 |
| | | **Total Project Costs** | | | **$ 735,597** |

Reservoir 3 is a glass-fused-to-steel tank that Liquivision also investigated in 2011. This tank also requires some regular maintenance. With glass tanks, there is not any required coating but still parts of the tank need maintenance. The biggest portion of maintenance is the joint re-sealant. These tanks are put together by panels and then each of those joints are sealed on the interior and the exterior. In order to prolong the life of this tank the joints need to be inspected and resealed as needed.

At the time of our site visit there was also some damage done to the exterior of the tank. This should be inspected and repaired as well. This could range from replacing a panel or just simply applying sealant to the damaged areas. From discussion with the local glass tank representative, sealant was decided to repair the exterior damage but additional cost may be incurred if further damage is observed. This tank also is in need of cathodic protection in order to prevent more corrosion in the future. Table 7.4.2-2 below shows an itemized estimate of the costs for Reservoir 3.

**Table 7.4.2-2 – Reservoir 3 estimate**

| WSF-2 - Reservoir maintenance - Reservoir 3 maintenance (500,000 gal.) | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 11,400 | $ 11,400 |
| 2 | Resealing interior and exterior joints | ls | 1 | $ 30,000 | $ 30,000 |
| 3 | Add Cathodic Protection | ea | 20 | $ 1,000 | $ 20,000 |
| 4 | Liquid Level Indicator Guide Wire | ea | 1 | $ 2,000 | $ 2,000 |
| 5 | Flushing and Disinfection | ls | 1 | $ 5,000 | $ 5,000 |
| | | Construction Total | | | $ 68,400 |
| | | Contingency (20%) | | | $ 13,680 |
| | | Subtotal | | | $ 82,080 |
| | | Engineering (20%) | | | $ 16,416 |
| | | Administrative Costs (3%) | | | $ 2,462 |
| | | **Total Project Costs** | | | **$ 100,958** |

Reservoir 4 does not require the kind of maintenance that Reservoir 1 does since it is a steel tank and already has a coating on it. There are problem areas on the interior and exterior of the tank that will require blasting and recoating. Since this has already been coated it will only need to have the one coat of epoxy applied to it. This tank also is in need of cathodic protection in order to prevent more corrosion in the future. Table 7.4.2-3 below shows an itemized estimate of the costs for Reservoir 4.

**Table 7.4.2-3 – Reservoir 4 estimate**

| WSF-3 - Reservoir maintenance - Reservoir 4 maintenance (1.5 MG) | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 73,258 | $ 73,258 |
| 2 | Interior/Exterior Blasting | sf | 15,080 | $ 5.00 | $ 75,398 |
| 3 | Interior/Exterior Coating | sf | 30,159 | $ 10.00 | $ 301,593 |
| 4 | Add Cathodic Protection | ea | 25 | $ 1,000 | $ 25,000 |
| 5 | Flushing and Disinfection | ls | 1 | $ 5,000 | $ 5,000 |
| | | Construction Total | | | $ 480,250 |
| | | Contingency (20%) | | | $ 96,050 |
| | | Subtotal | | | $ 576,299 |
| | | Engineering (20%) | | | $ 115,260 |
| | | Administrative Costs (3%) | | | $ 17,289 |
| | | **Total Project Costs** | | | **$ 708,848** |

The Clearwell tank is in similar condition to Reservoir 4 since it is a steel tank and already has a coating on it. This will only require blasting around the problem areas of the interior and exterior of the tank, then recoating will be required. Since this has already been coated it will only need to have the one coat of epoxy applied to it as well. This tank also is in need of cathodic protection in order to prevent more corrosion in the future. Table 7.4.2-4 below shows an itemized estimate of the costs for the Clearwell.

**Table 7.4.2-4 – Clearwell estimate**

| WSF-4 - Reservoir maintenance - Clearwell maintenance (500,000 gal.) | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 44,112.83 | $ 44,113 |
| 2 | Interior/Exterior Blasting | sf | 7,823 | $ 5.00 | $ 39,113 |
| 3 | Interior/Exterior Coating | sf | 15,645 | $ 10.00 | $ 156,451 |
| 4 | Add Cathodic Protection | ea | 20 | $ 1,000 | $ 20,000 |
| 5 | Flushing and Disinfection | ls | 1 | $ 5,000 | $ 5,000 |
| | | Construction Total | | | $ 259,677 |
| | | Contingency (20%) | | | $ 51,935 |
| | | Subtotal | | | $ 311,612 |
| | | Engineering (20%) | | | $ 62,322 |
| | | Administrative Costs (3%) | | | $ 9,348 |
| | | **Total Project Costs** | | | **$ 383,283** |

After general maintenance and upkeep of existing tanks is reviewed, new water storage must be looked at. As was mentioned in Section 7.4.1, Cave Junction will be deficient in water storage by the year 2020. This deficiency will continue to grow throughout the rest of the planning period without the implementation of additional storage somewhere in the city. An additional reservoir should be constructed prior to this time in order to account for this lack of water storage.

By building a new tank it will also provide for ample storage in the case of the failure of Reservoir 1. Reservoir 1 is the oldest of the tanks, it was built in the 1970s and at the end of the planning period will be approximately 60 years old. With the recommended maintenance mentioned earlier this concrete tank can last up to 80 years but a new tank will allow for some flexibility and put the city in a good situation for future growth and expansion.

The first step of building a new tank would be to locate property that would be adequate for this structure. The proposed location of this tank is shown on the following page as Figure 7.4.2-1 with the other projects listed in this CIP. Currently, the city does not own any property that this tank could be built at. Therefore, this should be the first step and should begin quickly in order to allow for ample time to get this completed. When a new tank is built it is ideal to try to keep it at the same elevations as the existing tanks in order to have the same hydraulic grade and pressures throughout the system. If the same elevations cannot be achieved then other scenarios, that include PRVs or pump stations, will have to be reviewed. The current tanks have an approximate floor elevation of 1513 feet and an approximate overflow elevation of 1530 feet. The new tank should be a 500,000 gallon reservoir.

Table 7.4.2-5 below shows an itemized estimate of the costs for a new 500,000 gallon tank.

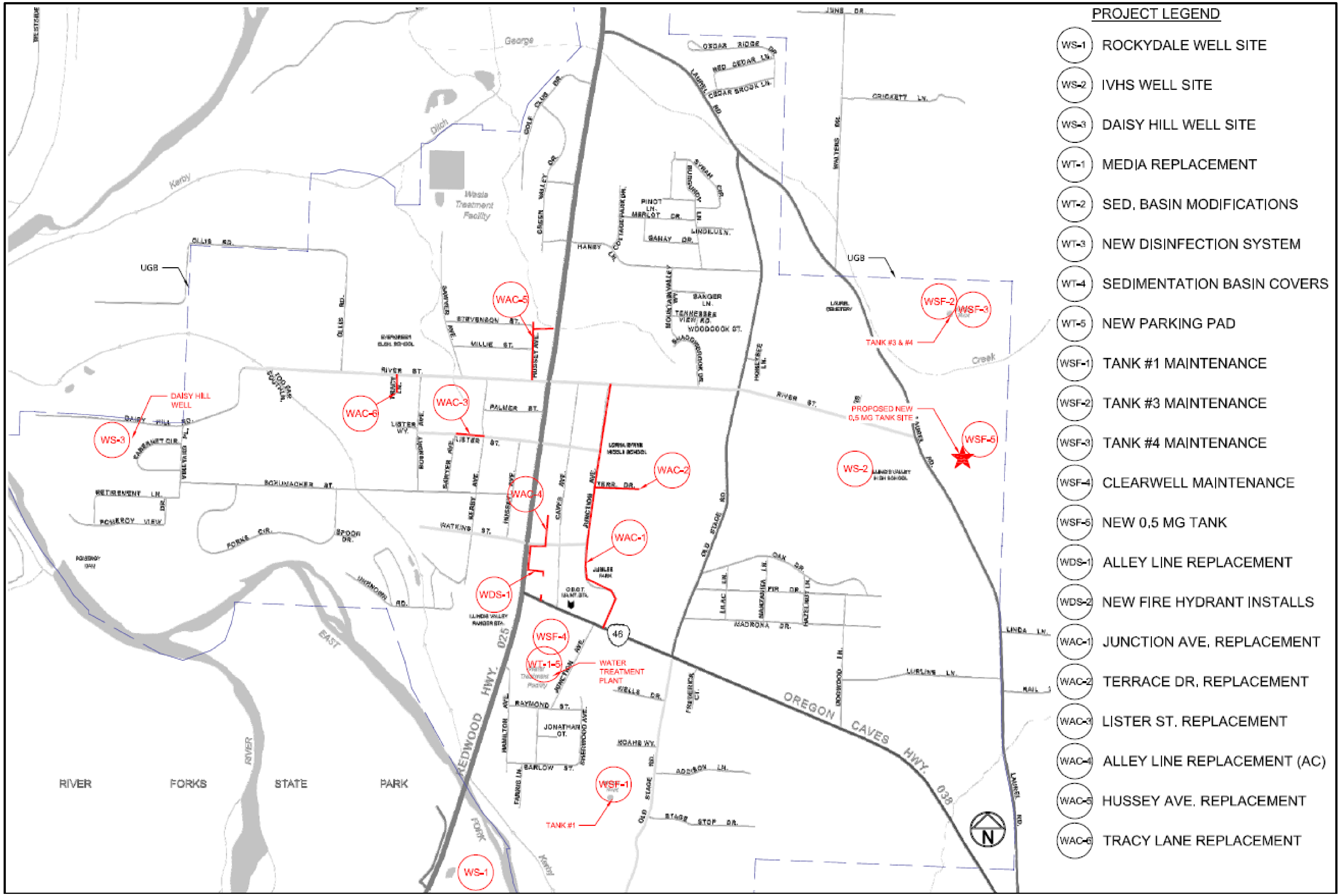



**Figure 7.4.2-1 – Overall map of Cave Junction water system improvements**

**Table 7.4.2-5 – New 500,000 gallon tank estimate**

| WSF-5 - New reservoir - New 500,000 gallon tank | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 131,760 | $ 131,760 |
| 2 | Glass Fused, Bolted Steel tank, 24' X 62' | ls | 1 | $ 475,000 | $ 475,000 |
| 3 | Earthwork, Grading | ls | 1 | $ 45,000 | $ 45,000 |
| 4 | Gravel Surfacing/Base | sf | 10,000 | $ 1.50 | $ 15,000 |
| 5 | Vault | ls | 1 | $ 10,000 | $ 10,000 |
| 6 | Site Piping (incl. valves) | ls | 1 | $ 20,000 | $ 20,000 |
| 7 | System Connection Piping, 12" | lf | 1,200 | $ 110.00 | $ 132,000 |
| 8 | Level Transducer and Telemetry Panel | ls | 1 | $ 20,000 | $ 20,000 |
| 9 | Flushing and Disinfection | ls | 1 | $ 5,000 | $ 5,000 |
| 10 | Site Fencing | ls | 1 | $ 10,000 | $ 10,000 |
| | | Construction Total | | | $ 863,760 |
| | | Contingency (20%) | | | $ 172,752 |
| | | Subtotal | | | $ 1,036,512 |
| | | Engineering (20%) | | | $ 207,302 |
| | | Property Acquisition | | | $ 15,000 |
| | | Administrative Costs (3%) | | | $ 31,095 |
| | | **Total Project Costs** | | | **$ 1,289,910** |

### 7.4.3 Recommended Water Storage Improvements

The first four storage facility projects, the general maintenance and improvements of the tanks, should be implemented as soon as possible. This will extend the life of each of these structures and will save money for the city in the long run.

The construction of a new storage tank, WSF-5, should be something that is completed in the next 8-10 years. This will bring the city storage capacity up to the 2.8 MG that will be needed by the year 2025. Depending on the exact location of this tank, there may also be the other issues to address that were mentioned previously.

## 7.5 Distribution System Needs and Alternatives

### 7.5.1 Water Distribution System Hydraulic Analysis

As discussed in Section 6.4.3, the system contains some undersized piping which limits fire flow ability. In order to accurately investigate potential problems and determine the most economical solutions a computer model of the system is developed to mimic the actual physical system in spatial layout, elevation, storage tank locations and pipe sizes. A program called Bentley WaterCAD V8i was used to model the system. A water system base map was also started in AutoCAD which will be used as a base map for the system. Elevations were determined by using Google Earth.

The modeling is used to check that the goals outlined in Section 4 are met. In general those goals include:

1) During Peak Hourly Demands, the system maintains at least 40 psi
2) During Fire Flow Demands plus Maximum Day Demands, the system maintains at least 20 psi

Existing conditions and future conditions were modeled to determine deficiencies and solutions. As is typical, pipe size needs are almost entirely dictated by fire flow goals with normal domestic water demands having little impact. Fire flow availability is limited by the rule which requires at least 20 psi in the system at all times. The model predicts the maximum flow that can be withdrawn at any location before pressures either at that location or anywhere else in the system are pulled below 20 psi.

### 7.5.2 Water Distribution System Pipe Deficiencies

In general, the distribution system in the City of Cave Junction is sized sufficiently for the current flows. There were discovered some deficiencies in fire flows that are listed later in this Section in more detail. These deficiencies were limited to dead end pipe and undersized AC pipe. With the replacement and upgrading of these areas fire flows throughout the city will be satisfactory for the Illinois Valley Fire Department.

### 7.5.3 Fire Hydrant Deficiencies

There are 147 fire hydrants within the City of Cave Junction water system with fairly uniform coverage. According to the Oregon Fire Code, fire hydrant spacing should not exceed 500 feet. Figure 6.4.4-1 shows the locations and coverage of fire hydrants in the system based on a 250 foot hose reach (500 foot diameter or hydrant spacing) at each hydrant. Areas with no coverage can be clearly seen in the figure and additional hydrants should be considered for placement in these areas.

### 7.5.4 Water Distribution System Improvement Recommendations

In Section 7.4, Figure 7.4.2-1 shows the piping improvements necessary to correct the various deficiencies in the distribution system. Cost estimates for these various pipeline improvements are shown on the following pages. Between Caves Avenue and Redwood Highway, there is a small 2" galvanized iron line servicing the area there. This line has two dead ends that cause problems with fire flow in the area. It is recommended to upgrade (Table 7.5.4-1) this line to an 8-inch water line to allow for better flow and protection during fires. This will provide much more protection for the neighboring businesses and homes.

**Table 7.5.4-1 – New alley water line estimate**

| WDS-1 - Dist. pipe replacement - Alley line between Caves Ave. and Redwood Hwy. | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 9,245 | $ 9,245 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 642 | $ 55.00 | $ 35,310 |
| 3 | Asphalt Patching | lf | 642 | $ 25.00 | $ 16,050 |
| | | Construction Total | | | $ 60,605 |
| | | Contingency (20%) | | | $ 12,121 |
| | | Subtotal | | | $ 72,726 |
| | | Engineering (20%) | | | $ 14,545 |
| | | Administrative Costs (3%) | | | $ 2,182 |
| | | **Total Project Costs** | | | **$ 89,453** |

There are a number of areas of the city that have inadequate fire protection because of the lack of fire hydrants. Figure 6.4.4-1 showed the areas of greatest concern and Figure 7.5.4-1 shows the proposed hydrant coverage. Some areas are as follows:

- Hamilton Avenue
- Junction Avenue (near WTP)
- Addison Lane
- Noahs Way
- Frederick Court
- Wells Drive

Table 7.5.4-2 is an estimate of installing hydrants around the city to provide for more fire protection. Figure 7.5.4-1 shows the proposed locations in red on the following page.

**Table 7.5.4-2 – New hydrant installation estimate**

| WDS-2 - Install new hydrants throughout city | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 12,800 | $ 12,800 |
| 2 | Fire Hydrant Assemblies | ea | 16 | $ 4,000 | $ 64,000 |
| | | Construction Total | | | $ 76,800 |
| | | Contingency (20%) | | | $ 15,360 |
| | | Subtotal | | | $ 92,160 |
| | | Engineering (20%) | | | $ 18,432 |
| | | Administrative Costs (3%) | | | $ 2,765 |
| | | **Total Project Costs** | | | **$ 113,357** |

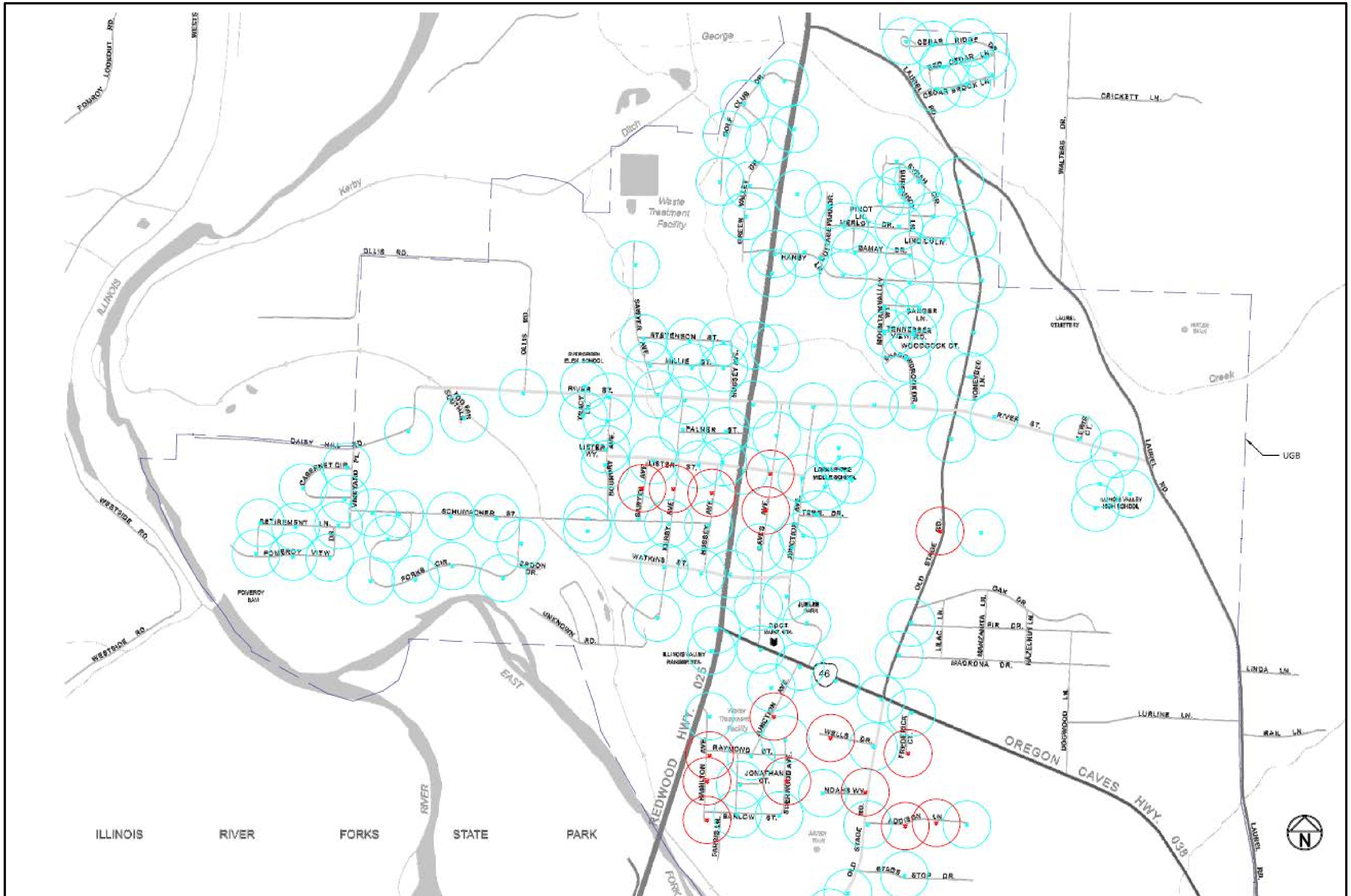



**Figure 7.5.4-1 – Proposed locations of new fire hydrants**

A portion of the Cave Junction water system consists of asbestos cement piping. This piping was installed during the 1940's, 1950's, and 1960's. Asbestos cement (A/C) pipe lasts approximately 50 years and may be nearing the end of its useful life. As presented in Section 6, approximately 5,321 feet of pipe within the City of Cave Junction consists of A/C pipe and needs to be replaced at some point in the future. Figure 6.4.3-1 shows the locations of known existing A/C pipe sections in Cave Junction.

It is unknown the condition of the A/C pipe. In some areas, the pipe may be functioning well and in others areas, it could be deteriorating and leakage could be occurring. Efforts should be made to determine the areas of piping that need replacement and work. Additionally, the replacement of A/C pipe can be accomplished in conjunction with other projects such as roadway or other utility projects. Table 7.5.4-3 is a summary of the cost of replacing the A/C piping in the city. The tables that follow, Tables 7.5.4-4a-f, show each project in more detail.

**Table 7.5.4-3 – Water Line Replacement of Asbestos-Cement Piping Summary**

| Item | Description | Cost Estimate |
|---|---|---|
| WAC-1 | Junction Avenue Replacement | $ 431,875 |
| WAC-2 | Terrace Drive Replacement | $ 82,486 |
| WAC-3 | Lister Street Replacement | $ 50,585 |
| WAC-4 | Alley between Caves Ave. & Redwood Hwy. | $ 45,484 |
| WAC-5 | Hussey Avenue Replacement | $ 121,360 |
| WAC-6 | Tracy Lane Replacement | $ 25,364 |
| | TOTAL: | $ 757,155 |

**Table 7.5.4-4a – Asbestos-Cement piping estimate**

| WAC-1 - AC Pipe replacement - Junction Ave. | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 40,358 | $ 40,358 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 3,053 | $ 55.00 | $ 167,915 |
| 3 | Asphalt Patching | lf | 3,053 | $ 25.00 | $ 76,325 |
| 4 | Fire Hydrant Assemblies | ea | 2 | $ 4,000 | $ 8,000 |
| | | Construction Total | | | $ 292,598 |
| | | Contingency (20%) | | | $ 58,520 |
| | | Subtotal | | | $ 351,118 |
| | | Engineering (20%) | | | $ 70,224 |
| | | Administrative Costs (3%) | | | $ 10,534 |
| | | **Total Project Costs** | | | **$ 431,875** |

**Table 7.5.4-4b – Asbestos-Cement piping estimate**

| WAC-2 - AC Pipe replacement - Terrace Dr. | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 8,525 | $ 8,525 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 542 | $ 55.00 | $ 29,810 |
| 3 | Asphalt Patching | lf | 542 | $ 25.00 | $ 13,550 |
| 4 | Fire Hydrant Assemblies | ea | 1 | $ 4,000 | $ 4,000 |
| | | Construction Total | | | $ 55,885 |
| | | Contingency (20%) | | | $ 11,177 |
| | | Subtotal | | | $ 67,062 |
| | | Engineering (20%) | | | $ 13,412 |
| | | Administrative Costs (3%) | | | $ 2,012 |
| | | **Total Project Costs** | | | **$ 82,486** |

**Table 7.5.4-4c – Asbestos-Cement piping estimate**

| WAC-3 - AC Pipe replacement - Lister St. | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 5,712 | $ 5,712 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 357 | $ 55.00 | $ 19,635 |
| 3 | Asphalt Patching | lf | 357 | $ 25.00 | $ 8,925 |
| | | Construction Total | | | $ 34,272 |
| | | Contingency (20%) | | | $ 6,854 |
| | | Subtotal | | | $ 41,126 |
| | | Engineering (20%) | | | $ 8,225 |
| | | Administrative Costs (3%) | | | $ 1,234 |
| | | **Total Project Costs** | | | **$ 50,585** |

**Table 7.5.4-4d – Asbestos-Cement piping estimate**

| WAC-4 - AC Pipe replacement - Alley line between Caves Ave. & Redwood Highway | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 5,136 | $ 5,136 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 321 | $ 55.00 | $ 17,655 |
| 3 | Asphalt Patching | lf | 321 | $ 25.00 | $ 8,025 |
| | | Construction Total | | | $ 30,816 |
| | | Contingency (20%) | | | $ 6,163 |
| | | Subtotal | | | $ 36,979 |
| | | Engineering (20%) | | | $ 7,396 |
| | | Administrative Costs (3%) | | | $ 1,109 |
| | | **Total Project Costs** | | | **$ 45,484** |

**Table 7.5.4-4e – Asbestos-Cement piping estimate**

| WAC-5 - AC Pipe replacement - Hussey Ave. | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 12,542 | $ 12,542 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 821 | $ 55.00 | $ 45,155 |
| 3 | Asphalt Patching | lf | 821 | $ 25.00 | $ 20,525 |
| 4 | Fire Hydrant Assemblies | ea | 1 | $ 4,000 | $ 4,000 |
| | | Construction Total | | | $ 82,222 |
| | | Contingency (20%) | | | $ 16,444 |
| | | Subtotal | | | $ 98,667 |
| | | Engineering (20%) | | | $ 19,733 |
| | | Administrative Costs (3%) | | | $ 2,960 |
| | | **Total Project Costs** | | | **$ 121,360** |

**Table 7.5.4-4f – Asbestos-Cement piping estimate**

| WAC-6 - AC Pipe replacement - Tracy Lane | | | | | |
|---|---|---|---|---|---|
| **Item No.** | **Description** | **Units** | **Quantitiy** | **Unit Cost** | **Total Cost** |
| 1 | Bonds, Insurance, Mobilization and Overhead | ls | 1 | $ 2,864 | $ 2,864 |
| 2 | 8-inch PVC Pipe, Trenching and Backfill | lf | 179 | $ 55.00 | $ 9,845 |
| 3 | Asphalt Patching | lf | 179 | $ 25.00 | $ 4,475 |
| | | Construction Total | | | $ 17,184 |
| | | Contingency (20%) | | | $ 3,437 |
| | | Subtotal | | | $ 20,621 |
| | | Engineering (20%) | | | $ 4,124 |
| | | Administrative Costs (3%) | | | $ 619 |
| | | **Total Project Costs** | | | **$ 25,364** |

# Capital Improvement Plan

**Section 8**

## 8.1 Capital Improvement Plan Purpose and Need

This section summarizes the water system capital improvements needed to properly serve the community's needs over the next 20 years as determined by the detailed analyses in this Water System Master Plan. The Capital Improvement Plan (CIP) consists of various projects to maintain and protect existing water system assets, projects to correct deficiencies, and projects necessary to increase water system capacity to serve the growing population.

The water system CIP is used to help establish funding needs, user rates, system development charges (SDCs), and to plan for and prioritize various project needs. The CIP can change over time as projects are completed and/or new unforeseen needs arise. An attempt should be made to annually update the CIP and keep the list of needs current.

## 8.2 Capital Improvement Plan Projects

### 8.2.1 CIP Summary

Based on the alternatives developed in Section 7, a Capital Improvement Plan has been assembled that is comprised of recommended projects that the City of Cave Junction should undertake during the planning period to maintain and upgrade their water system. The various water supply, water treatment, water storage and water distribution projects recommended in this Water System Master Plan for the 20-year planning period are summarized below.

**Table 8.2.1-1 CIP Project Summary**

| Item | Project Description | Cost Estimate |
|---|---|---|
| WS-1 | Rockydale well field restoration | $307,894 |
| WS-2 | Investigation of possible well site near IVHS | $78,376 |
| WS-3 | Investigation of additional well at Daisy Hill | $78,376 |
| | | |
| WT-1 | Filter media replacement | $83,382 |
| WT-2 | Modify sedimentation basins | $423,228 |
| WT-3 | Replace WTP disinfection system | $174,168 |
| WT-4 | Install covers over sedimentation basins | $123,276 |
| WT-5 | Install parking pad at purchase station | $9,564 |
| | | |
| WSF-1 | Reservoir #1 maintenance | $735,597 |
| WSF-2 | Reservoir #3 maintenance | $100,958 |
| WSF-3 | Reservoir #4 maintenance | $708,848 |
| WSF-4 | Clearwell maintenance | $383,283 |
| WSF-5 | New 500,000 gallon reservoir | $1,289,910 |
| | | |
| WDS-1 | Alley waterline replacement between Caves Ave. & Redwood Hwy. | $89,453 |
| WDS-2 | Installation of additional fire hydrants | $113,357 |
| | | |
| WAC-1 | Junction Ave. waterline replacement | $431,875 |

| Item | Project Description | Cost Estimate |
|---|---|---|
| WAC-2 | Terrace Dr. waterline replacement | $82,486 |
| WAC-3 | Lister St. waterline replacement | $50,585 |
| WAC-4 | Alley waterline replacement between Cave Ave. & Redwood Hwy. | $45,484 |
| WAC-5 | Hussey Ave. waterline replacement | $121,360 |
| WAC-6 | Tracy Lane waterline replacement | $25,364 |

### 8.2.2 CIP Priorities

The cost for the water system improvement needs is great and there may be reason to prioritize the improvements or take projects on in phases. The following table, Table 8.2.2-1 outlines one approach for prioritizing the CIP list. The City should undertake Priority 1 projects within the next five years, then undertake Priority 2 within the next 8-12 years.

**Table 8.2.2-1 Prioritized CIP Summary**

| Priority | Summary | Cost Estimate |
|---|---|---|
| 1 | Projects should be undertaken within the next five years. These projects allow improvements to be made to the existing well field (Rockydale), the WTP and the reservoirs while having more flexibility to complete them. | $ 3,050,199 |
| 2 | Projects should be undertaken 8-12 years from now. These projects will improve the existing piping, enhance the fire protection throughout the city and prepare for future water needs. | $ 2,406,625 |
| | **ESTIMATE TOTAL** | $ 5,456,824 |

Priority 1 accomplishes the improvements that are to be made to the Water Treatment Plant and the storage tanks. It also includes restoration of the Rockydale well field. Completing these projects first accomplishes a few different goals. One, this is a great time to improve the treatment plant because demand is not as high as it will be in 10-20 years. Doing this now will improve the water quality for the residents of Cave Junction and also provide them good equipment for well through this planning period. Two, by improving the storage tanks now there is a lot more flexibility with water storage. As time goes on surplus storage will start to decrease and it will be much harder to drain and take out of commission tanks for maintenance. Finally, by bringing the Rockydale well field back online it provides for a boost in the water going into the system and allows once again for more flexibility with operating the plant.

Priority 2 will then accomplish the remainder of the needs of the city. It will provide for the storage that will be required by the end of this planning period while at the same time upgrade many of the old waterlines throughout the system. The AC replacement projects can be incorporated into the plan whenever is convenient for the city. If there is a current project going on near any AC replacement project it would prudent to incorporate that in at that time.

This priority list is only a recommendation. The City should classify the projects into their own list of priorities as City resources become available or as needs dictate. No prior approval is needed from the State or regulating authorities to move projects from one category into another or to eliminate projects as the City sees fit. For example, if the City deems it necessary to move a water line replacement from Priority 2 to a construction project that will be completed within the next year, it would be prudent for the City to do that.

Table 8.2.2-2 shows a detailed list of all the projects and the correlating priority they are in.

**Table 8.2.2-2 – Detailed list by priority**

| Priority | Project No. | Project Cost | Total Priority Cost |
|---|---|---|---|
| 1 | WS-1 | $307,894 | $3,050,199 |
| | WT-1 | $83,382 | |
| | WT-2 | $423,228 | |
| | WT-3 | $174,168 | |
| | WT-4 | $123,276 | |
| | WT-5 | $9,564 | |
| | WSF-1 | $735,597 | |
| | WSF-2 | $100,985 | |
| | WSF-3 | $708,848 | |
| | WSF-4 | $383,283 | |
| 2 | WS-2 | $78,376 | $2,406,625 |
| | WS-3 | $78,376 | |
| | WSF-5 | $1,289,910 | |
| | WDS-1 | $89,453 | |
| | WDS-2 | $113,357 | |
| | WAC-1 | $431,875 | |
| | WAC-2 | $82,486 | |
| | WAC-3 | $50,585 | |
| | WAC-4 | $45,484 | |
| | WAC-5 | $121,360 | |
| | WAC-6 | $25,364 | |

### 8.2.3 CIP Updates

Periodically the Capital Improvement Plan should be updated and evaluated. It is suggested that every 3 to 5 years the CIP be evaluated and modified as necessary to reflect current development trends, system needs, and prior accomplishments. The City may modify the CIP at any time under ORS 223.309(2).

## 9.1 Existing Water Rates and Charges

### 9.1.1 Existing Rate Structure

The current rate structure for the City of Cave Junction was implemented in September 2005. It has an increasing facilities charge based on the size of water meter installed and has a tiered rate structure based on the amount of water used. The current rate structure for a 3/4" meter is shown in Table 9.1.1-1.

**Table 9.1.1-1 – Current Water Rate Structure**

| Consumption in Cubic Feet | Consumption in Gallons | Base Charge | Rate Per 100 cubic feet |
|---|---|---|---|
| 0-500 | 0 - 3,740 | | N/A |
| 501-1,000 | 3,741 – 7,480 | | $1.30 |
| 1,001-2,000 | 7,481 – 14,960 | $28.00 | $1.40 |
| 2,001-3,000 | 14,961 – 22,440 | | $1.50 |
| 3,001 + | 22,441 + | | $1.60 |

The base charge for a single family dwelling (3/4" meter) is $28.00 with an average residential water use of 4,203 gallons per month (see Section 3.2.6) per typical single family dwelling. This results in an average monthly water bill of $28.80 ($0.0069/gallon) for a Cave Junction resident. Additional charges also apply for delivery outside the city limits:

- Under 1" = $10.00/month
- 1" = 17.00/month
- 1 1/2" – 2" = $34.00/month
- 3" = $51.00/month
- 4" = $68.00/month
- 6" = $85.00/month
- 8" = $102.00/month
- 10" = $119.00/month
- 12" = $136.00/month

Funding agencies often use a value of 7,500 gallons per month as the normal residential use. Under the current rate structure, the average residential rate per Equivalent Dwelling Unit (EDU) then becomes $35.03 for 7,500 gallons per month. The average water bill in the state of Oregon is approximately $55.00 per EDU. According to the rate structure above, Cave Junction only charges 64% of what the average Oregonian pays.

### 9.1.2 Connection Fees

Like most communities, Cave Junction charges a connection fee when a new water service is installed inside the service boundary where no previous connection existed. The connection fee varies by type of connection and is meant to match the actual cost of labor, equipment, and material furnished by the City as required for providing and installing the service line and meter. The following table (Table 9.1.2-1) summarizes the connection fee assessed by the City. For all new service connections, where no previous service existed, a minimum of $350 deposit is also required in addition to the fees listed below.

**Table 9.1.2-1 – Current Connection Fees**

| Connection Type | Fee Imposed |
|---|---|
| Single-family/single commercial on single lot including subdivision lot | Actual costs incurred by the city plus 15% administrative overhead |
| Two-family/double commercial on single lot | Actual costs incurred by the city plus 15% administrative overhead; and $200.00 for the second unit |
| Multi-family/multiple commercial (Includes apartment, mobile home parks, condominiums, shopping center, office complexes, etc.) | Actual costs incurred by the city plus 15% administrative overhead; and $200.00 per unit thereafter |
| Connection made on line that has been installed for service to other lot | Actual costs incurred by the city plus 15% administrative overhead |

In addition to charging a connection fee, Cave Junction also charges a System Development Charge (SDC) for new water service connections. This should not be categorized as a connection fee. The SDC will be discussed later in this Section in more detail.

### 9.1.3 Water Fund Budget

Information posted for fiscal year 2012-2013 shows that the water fund has estimated expenses of $553,500. This is a slight increase of approximately $9,000 from the previous year. Table 9.1.3-1 below shows a simplified expense summary for the City of Cave Junction water fund dating back to 2009-2010.

**Table 9.1.3-1 – Cave Junction Water Fund**

| Description | Actual 09-10 | Actual 10-11 | Actual 11-12 | Adopted 12-13 |
|---|---|---|---|---|
| Total Material & Services | $ 127,367.00 | $ 128,375.00 | $ 179,387.00 | $ 188,000.00 |
| Capital Outlay | $ 9,607.00 | $ 9,607.00 | $ 4,057.00 | $ 5,000.00 |
| Contingency | $ - | $ - | $ - | $ 70,903.00 |
| Total Transfers Out | $ 288,897.00 | $ 288,897.00 | $ 288,897.00 | $ 289,597.00 |
| TOTAL EXPENDITURES | $ 425,871.00 | $ 426,879.00 | $ 472,341.00 | $ 553,500.00 |
| UNAPPROPRIATED ENDING FUND BALANCE | $ 104,433.00 | $ 179,069.00 | $ 72,158.00 | $ - |
| **TOTAL** | $ 530,304.00 | $ 605,948.00 | $ 544,499.00 | $ 553,500.00 |

## 9.2 Revenue Increase Needed

### 9.2.1 Capital Improvement Costs

The Capital Improvement Plan in Section 8 has an estimated total cost of $5.46 million.

### 9.2.2 Additional Annual Revenue Required

The following table (Table 9.2.2-1) shows potential revenue increases needed to fund the CIP based on average standard funding terms including a 3.5% interest rate and a 20-year payback. The analysis assumes the worst case scenario of no grant, no city funds, and all the money required from a loan.

**Table 9.2.2-1 – Potential Revenue Increases Required**

| Item | Full CIP | Priority 1 | Priority 2 |
|---|---|---|---|
| Capital Cost | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Loan Needed | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Interest Rate | 3.5% | 3.5% | 3.5% |
| Loan Period | 20 | 20 | 20 |
| Annual Annuity | $ 383,473.24 | $ 214,349.89 | $ 169,123.36 |
| **Monthly Income Required** | **$ 31,956.10** | **$ 17,862.49** | **$ 14,093.61** |

## 9.3 Potential Grant and Loan Sources

### 9.3.1 Background Data for Funding

Funding for municipal water system capital improvements occurs with loans, grants, principal forgiveness, bonds, or a combination thereof. Parameters such as the local and State median household income (MHI), existing debt service, water use rates, low/moderate income level percentages, financial stability, and project need are used by funding agencies to evaluate the types and levels of funding assistance that can be received by a community.

The calculation for the water user rate can incorporate, when applicable, fee-equivalents derived from other local funding sources that are or will be used to pay for the water system, including any special levy on taxable property within the system's territory.

### 9.3.2 Infrastructure Finance Authority (IFA)

Recent restructuring in the State has resulted in the creation of the Oregon Business Development Department (OBDD) / Infrastructure Finance Authority (IFA) from what previously was the Oregon Economic and Community Development Department.

IFA administers resources aimed at community development activities primarily in the water and wastewater infrastructure areas. The IFA Regional Coordinator for Josephine County is Fumi Schaadt (503-986-0027) and any application process should begin by contacting her. The funding programs through IFA include:

- Community Development Block Grants (CDBG)
- Safe Drinking Water Revolving Loan Fund (SDWRLF)
- Special Public Works Funds
- Water/Wastewater Financing

The SDWRLF generally must be used to address a health or compliance issue and could potentially provide a loan up to $6 million per project. To receive a loan the project must be ranked high enough on the Project Priority List in the Intended Use Plan developed by the State. A Letter of Interest (LOI) must be submitted before a project can be listed in the Intended Use Plan. The LOI process is now open year round for submissions. Loan terms are typically 3-4% interest for 20 years, however, "Disadvantaged Communities" can potentially qualify for 1% loans for 30 years as well as some principal forgiveness.

All recipients of SDWRLF awards need to complete an environmental review on every project in accordance with the State Environmental Review Process (SERP), pursuant to federal and state environmental laws. The Environmental Report typically required can cost $25,000 to $75,000 depending on the specific biological, cultural, waterway, and wetland issues that arise.

Loans and grants are available through the Special Public Works Funds and Water/Wastewater Financing depending on need and financial reviews by IFA.

### 9.3.3 Rural Development / Rural Utilities Service (RUS)

The United States Department of Agriculture (USDA) Rural Utilities Service (RUS) has a Water Programs Division which provides loans, guaranteed loans, and grants for water infrastructure projects for towns of less than 10,000 persons. Grants are only available when necessary to keep user costs to reasonable levels (very similar to IFA threshold rate). Loans can be made with repayment periods up to 40 years. Interest rates vary but often are around 4% for design/construction loans. Environmental reporting is required similar to that for the SDWRLF but with slightly different criteria.

### 9.3.4 Bond Sales

A brief summary of the types of bonds that are available is presented below.

**General Obligation Bonds.** General obligation or GO bonds are municipal bonds that are “backed” by the full faith and credit of the issuer. GO bonds are generally repaid through an increase in property taxes. For a community such as Cave Junction, the GO bonds can be an attractive option as the property tax payments are tax deductible, are not based on water use, and are collected whether a customer occupies the home full or part time. GO bonds guarantee a stable and consistent stream of revenue. As they are considered a lower risk investment, the interest rates on GO bond issues is generally lower than other alternatives. GO bonds require voter approval for issuance.

The City of Cave Junction could benefit from getting a GO bond and raising the property taxes. As most property owners do not want to risk losing their property for unpaid tax bills, they will generally pay their increased taxes and the City will be able to pay back the GO bond. Additionally, the GO bond generally has a low interest rate so the cost of borrowing the money is lessened. A GO bond also does not take into account the price of water within the City as compared to the State average.

**Revenue Bonds.** Revenue bonds differ from GO bonds in that they are repaid through a municipality’s revenue stream or by user rates. The full faith of the issuer is not behind revenue bonds; therefore, the interest rate on revenue bonds is generally higher than GO bonds. One advantage of revenue bonds is that they do not require voter approval.

A revenue bond is supported by the revenue from a specific project. They are used to finance an income-producing project within a municipality. As most of the projects recommended in Section 7 are not income-producing and general improvements to the water system, this source of funding may not be the best for the City of Cave Junction.

## 9.4 Potential Water Rate Increases

Because of the various options in funding programs and requirements for contact and communication with the Regional Coordinators prior to applications, the recommended first step in exploring funding options is to attend a “One-Stop” financing meeting. The One-Stop meeting is held in Salem once a month with the goal of gathering the State and federal funding agencies together at one time and one place to discuss all potential funding possibilities and issues. No funding commitments are made at the meeting, but probable funding sources and details are provided to enable the City to choose the best alternatives possible at that time and to initiate funding application steps.

To start this analysis, it was assumed that the existing water rates and the existing expenses are equal to each other. This analysis is only for the Capital Improvement Projects that are presented in this report and does not include any other factors.

Since Cave Junction's definition of an EDU uses 4,203 gallons per month per EDU, there are 1,330 total EDUs in Cave Junction. The following Table shows a possible scenario with the needed increase in revenue spread evenly over all 1,330 EDUs. To be conservative, the same number of EDUs was used throughout the planning period even though the number will likely increase as time passes. See Table 9.4.1-1 for the required revenue increase.

**Table 9.4.1-1 – Potential Cave Junction Revenue Increase per EDU**

| Item | Full CIP | Priority 1 | Priority 2 |
|---|---|---|---|
| Capital Cost | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Loan Needed | $ 5,456,824.28 | $ 3,050,198.89 | $ 2,406,625.38 |
| Interest Rate | 3.5% | 3.5% | 3.5% |
| Loan Period | 20 | 20 | 20 |
| Annual Annuity | $ 383,473.24 | $ 214,349.89 | $ 169,123.36 |
| Monthly Income Required | $ 31,956.10 | $ 17,862.49 | $ 14,093.61 |
| **Monthly Income Required + 10%** | **$ 35,151.71** | **$ 19,648.74** | **$ 15,502.97** |
| No. of EDU's at 4,203 gallons | 1330 | 1330 | 1330 |
| **Add'l Monthly Cost per EDU** | **$ 26.42** | **$ 14.77** | **$ 11.65** |

Based upon the information and analysis presented in the table above, a total cost of $26.42 per EDU per month is needed to fund the entire Capital Improvement Plan. This results in a total monthly bill of $55.22 for 4,203 gallons ($0.013/gallon). This puts the city just at the State average of $55.00 per EDU per month. Most funding agencies will require the City to be at or above the state average before receiving a grant or low interest loan support. Rather than raising water rates, a private option or GO bond sale may be preferred by the City of Cave Junction. As stated above, the City could keep water rates low and obtain a GO bond but raise property taxes to pay the bond.

## 9.5 SDC's

SDCs are charged to new customers to retire investments required to provide capacity for new customers to join the system. The City of Cave Junction currently utilizes a SDC program to collect revenues from new customers to aid in upsizing facilities for growth. The table below (Table 9.5-1) lists the current charges at the time of this report.

**Table 9.5-1 – Existing SDC rates**

| Water System Development Charge | |
|---|---|
| **Meter Size** | **Fee to be Charged** |
| 5/8" to 3/4" | $ 2,150.00 |
| 1" | $ 5,375.00 |
| 1 1/2" | $ 10,750.00 |
| 2" | $ 17,200.00 |
| 3" | $ 34,400.00 |
| 4" | $ 53,750.00 |
| 6" | $ 107,500.00 |
| 8" | $ 172,000.00 |
| 10" | $ 247,250.00 |
| 12" | $ 483,750.00 |

The disadvantage of using SDCs for infrastructure investment include that the revenue stream from SDCs varies with the economy and with the development market. As such, it is not reliable. Also, projects often have to be funded through other means as SDCs are often not collected until after an improvement is constructed. This requires interim or bridge funding that can often not be retired by SDCs in a timely manner. It is also important to understand that financial institutions, including public funding agencies, do not loan against SDCs.

The existing Methodology was completed in 1995 in the Water Master Plan (Lee Engineering, 1995). During the years in between Water Master Plans, Cave Junction has recovered some of the costs through SDCs for the improvements that have been made to the system. Civil West Engineering is in the process of creating a new Methodology that will incorporate the new CIP list presented in Section 8.

# APPENDIX A

DRAFT

**To:** Garrett Pallo, Civil West Engineering Services, Inc.

**From:** Adam Sussman
Kimberly Grigsby

**Date:** May 22, 2013

**Re:** **Cave Junction Water Rights Inventory**

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This memorandum provides an inventory of the existing municipal water rights held by the City of Cave Junction (Cave Junction or City), including a water right summary table. This memorandum describes Cave Junction's water rights and describes the status of each right, including development deadlines and any water right conditions. In addition, this memorandum describes the current capacity of Cave Junction's "water system capacity" and compares it to the City's "water rights capacity."

## Introduction to Water Rights

Under Oregon water law, with a few exceptions, the use of public water requires a water right from the Oregon Water Resources Department (OWRD). The right to use water is typically first granted in the form of a water use permit. The permit describes the priority date, amount of water that can be used, point of diversion, type of water use, and place of use. The permit allows the water user to develop the infrastructure needed to put the water to full beneficial use. Permits also often contain a number of water use conditions.

When development of a permit is complete and a claim of beneficial use is approved by OWRD, a water right certificate is issued confirming the status of the right. Holders of municipal water rights can partially certificate, or "partially perfect," a permit as long as the partial perfection is not less than 25 percent of the quantity originally authorized by the permit. Obtaining a water right certificate is the best way to ensure the protection of the water use because municipal water use certificates generally are not subject to cancellation due to non-use and are not subject to legislative and administrative changes affecting undeveloped uses.

Water right permits typically have timelines for making full beneficial use of the water. If more time is needed than provided in the permit, the permit holder may request an "extension of time" from OWRD. In the past, extensions of time were granted routinely by OWRD. Under current rules, an extension of time may involve an analysis of potential impacts to state and federally listed fish species if the "undeveloped portion of the permit" were to be used. In addition, following approval of a permit extension, municipal water providers are typically required to develop a Water Management and Conservation Plan in order to access the undeveloped portion of the permit.

There are two different administrative processes that allow modification of a water right. When a water right is in the permit phase (still being developed), the permit holder may modify the water use by changing the location of use and the point where water is diverted through an application for a permit amendment. When a water right has a certificate, the water right holder can modify the location of use, the point where water is diverted, and the type of use made under the water right through an application for a water right transfer.

Typically, if the holder of a water right certificate does not use water for five consecutive years, a presumption of forfeiture is established and OWRD can initiate a proceeding to cancel the water right. Water rights held by cities for "reasonable and usual municipal purposes," however, are typically not subject to forfeiture.

Finally, it should be noted that municipal water suppliers are required to report to OWRD their annual water use.

## Existing Water Rights

Cave Junction holds a total of four water rights for municipal use: two surface water rights and two groundwater rights. The surface water rights are evidenced by one certificate and one water use permit that together authorize the use of up to 3.0 cubic feet per second (cfs) ( or 1.9 million gallons per day (mgd)) of water from the East Fork Illinois River for municipal use. Cave Junction's groundwater rights are evidenced by two water right certificates that together authorize the use of up to 1.6 cfs (1.0 mgd) of groundwater for municipal use. **Attachment A** provides a table summarizing these water rights.

Each of Cave Junction's identified municipal water rights is described in more detail below.

### Surface Water Rights

**Application S-48026**
**Permit S-18785**
**Certificate 55491**

*Priority date: June 16, 1949*
*Source: East Fork Illinois River*
*Rate: 1.0 cfs*

This water right authorizes the use of up to 1.0 cfs from the East Fork Illinois River for municipal use. The authorized point of diversion for this certificate is at SW ¼ SE ¼, Section 21, T39S R8W WM; 670 feet North and 770 feet East from the S ¼ corner, Section 21, which is the same as the authorized point of diversion for Permit S-36172, as described below.

This water right does not include any performance conditions.

***Compliance Issues / Recommendations:*** No compliance issues or recommendations have been identified for this water right.

**Application S-48026**
**Permit S-36172**

*Priority date: March 8, 1971*
*Source: East Fork Illinois River*
*Rate: 2.0 cfs*

Cave Junction's surface water permit (Permit S-36172) authorizes the use of up to 2.0 cfs from the East Fork Illinois River. In April 1997, the OWRD approved a permit amendment, at the City's request, to change the authorized point of diversion. The permit, as amended, now has a point of diversion that is the same as that authorized for Certificate 55491 ( SW ¼ SE ¼, Section 21, T39S R8W WM; 670 feet North and 770 feet East from the S ¼ corner, Section 21). This is the general location of the City's intake facility.

Permit S-36172 was originally issued in December 1972 and required the City to complete development and put the water to full beneficial use by October 1, 1975. Since that time, the City has received six extensions of time. The most recent extension was issued in October 1995 and extended the development deadline to October 1, 1999. OWRD's official file for this water right does not include any record of the City filing another permit extension application.

We understand that the City's water treatment plant has a capacity of approximately 1 million gallons per day (mgd) (1.547 cfs). When the plant is operating at full capacity, OWRD would consider the City to be appropriating 1 cfs under Certificate 55491 and 0.547 cfs under Permit S-36172 (for a total of 1.547 cfs).

***Compliance Issues / Recommendations:*** The development timeline for Permit S-36172 has expired. If the City intends to retain the opportunity to develop the full 2.0 cfs authorized under this permit, it should immediately file an application for an extension of time. It is likely that the extension would include conditions related to maintaining the persistence of listed fish and requiring development of a Water Management and Conservation Plan.

If the City has records demonstrating beneficial use of 1.547 cfs (1 mgd) before October 1, 1999, it could potentially obtain a partial perfection water right certificate for the 0.547 cfs portion of Permit S-36172 that has been developed. Obtaining a certificate is recommended because municipal certificates are very secure and obtaining a certificate is the best way to protect a water right. The remaining 1.453 cfs portion of the right would remain in permit status and could be developed in the future.

## Groundwater Rights

**Application G-2767**
**Permit G-2570**
**Certificate 59983**

*Priority date: January 20, 1964*
*Source: groundwater from 3 wells*
*Rate: 1.0 cfs:*
*0.5 cfs from Well 1*
*0.13 cfs from Well 2*
*0.37 cfs from Well 3*

Water right certificate 59983 authorizes the use of up to 1.0 cfs of groundwater for municipal purposes from three wells, which are identified as Wells 1, 2 and 3. The total authorized rate is divided among the three wells as follows: 0.5 cfs from Well 1, 0.13 cfs from Well 2, and 0.37 cfs from Well 3.

We understand that the City does not currently use Wells 1, 2 or 3. Non-use of this water right does not subject it to potential forfeiture because that provision does not apply to water rights held by cities. Consequently, if the City chose to restore the wells, it could begin using this water right again. We understand that the wells are expected to produce approximately 300 gallons per minute (or 0.67 cfs). The City could consider "transferring" the right to add additional wells as authored points of appropriation to allow appropriation of the full 1.0 cfs.

***Compliance Issues / Recommendations:*** No compliance issues or recommendations were identified for this water right.

**Application G-10965**
**Permit G-10166**
**Certificate 85648**

*Priority date: May 13, 1983*
*Source: groundwater from 3 wells*
*Rate: 0.6 cfs, limited to:*
*0.6 cfs from "Original" well (Well 4)*
*0.08 cfs from Meyers Well*
*0.08 cfs from Berard Well*

Water right certificate 85648 authorizes the use of up to 0.6 cfs of groundwater from three wells. The maximum authorized rate (0.6 cfs) can be appropriated from Well 4, which the certificate identifies as "Original well." In addition, up to 0.08 cfs can be appropriated from both Meyers Well and Berard Well (for a total of 0.16 cfs). However, the total appropriation from all three wells cannot exceed a maximum combined rate of 0.6 cfs.

We understand that Well 4 (Original Well) is currently operated, but that Meyers and Berard Wells no longer exist. We understand that the City runs Well 4 at 150 to 200 gallons per minute (gpm) (0.33-0.45 cfs). If Well 4 does not produce the full 0.6 cfs authorized by Certificate 85648 and the City wanted to maximize its use of groundwater under this right, it could "transfer" the right to add an additional well that would allow appropriation of the maximum authorized rate.

This certificate is conditioned to require an in-line flow meter or other suitable measuring devices for measuring and recording the quantity of water used. The measuring device must be approved by OWRD.

*Compliance Issues / Recommendations:* No compliance issues or recommendations have been identified for this water right.

## Water Use Reporting

GSI reviewed OWRD's on-line water use reporting records for the City's water rights, but did not find any annual water use reports for the years after 2009. It is unclear whether the City has submitted these records but OWRD has not posted the information on-line, or whether the City has not provided OWRD with more recent annual water use reports.

## Water Rights Held by the City of Cave Junction

| Source | Priority Date | Water Right | Authorized Withdrawal (cfs) | Authorized Withdrawal (mgd) | Type of Beneficial Use | Authorized Date for Completion | Comments |
|---|---|---|---|---|---|---|---|
| **Surface Water** | | | | | | | |
| East Fork Illinois River | June 16, 1949 | App. S-23847<br>Permit S-18785<br>Cert. 55491 | 1.0 | 0.65 | Municipal | N/A | |
| East Fork Illinois River | March 8, 1971 | App. S-48026<br>Permit S-36172 | 2.0 | 1.3 | Municipal | October 1, 1999 | An application for an extension of time should be submitted to OWRD.<br><br>The City could potentially “partially perfect” the permit and obtain a certificate for a portion of the permit. |
| **Groundwater** | | | | | | | |
| Well 1,<br>Well 2,<br>Well 3 | January 20, 1964 | App. G-2767<br>Permit G-2570<br>Cert. 59983 | 1.0 | 0.65 | Municipal | N/A | No current use of groundwater.<br><br>The City could transfer the water right to add a well to maximize its capacity. |
| Original Well (Well 4),<br>Meyers Well,<br>Berard Well | May 13, 1983 | App. G-10965<br>Permit G-10166<br>Cert. 85648 | 0.6 | 0.39 | Municipal | N/A | Only Well 4 is currently in use.<br><br>The City could transfer the right to add an a well to maximize its capacity. |

RECEIVED
MAR 8 1971
STATE ENGINEER
SALEM, OREGON

Permit No. 36172

AMENDED by special order V. 51 pg. 413

*APPLICATION FOR PERMIT

# To Appropriate the Public Waters of the State of Oregon

I, City of Cave Junction (Name of applicant)

of P. O. Box 252 , Cave Junction (Mailing address),

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation January 9, 1948 at Cave Junction, Oregon

1. The source of the proposed appropriation is East Fork of the Illinois River, (Name of stream) a tributary of Rogue River

2. The amount of water which the applicant intends to apply to beneficial use is 2.0 cubic feet per second. (If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is Municipal Supply (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located ~~XXX~~ 200 ft. ~~N~~ S (N. or S.) and ~~XXX~~ 1350 ft. W (E. or W.) from the ~~EastXXX~~ SE corner of Sec. ~~28~~ 21, T. 39 S, R. 8 W, W.M. (Section or subdivision)

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NW 1/4 of the NE 1/4 (Give smallest legal subdivision) of Sec. 28, Tp. 39 S (N. or S.), R. 8 W (E. or W.), W. M., in the county of Josephine

5. The Pipe line (Main ditch, canal or pipe line) to be 5 miles (Miles or feet) in length, terminating in the S-1/2, NW-1/4, SW-1/4 NE-1/4 (Smallest legal subdivision) of Sec. 16, 21, 22, 28, Tp. 39 S (N. or S.), R. 8 W (E. or W.), W. M., the proposed location being shown throughout on the accompanying map.

## DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam ........ feet, length on top ........ feet, length at bottom ........ feet; material to be used and character of construction ........ (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate ........ (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description 25 Horse Fairbanks Morse (Size and type of pump)
25 H.P. - Fairbanks Morse 250 G.P.M. (Size and type of engine or motor to be used, total head water is to be lifted, etc.)

T 7702

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

Canal System or Pipe Line— **36172**

7. *(a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) ........................ feet; width on bottom ........................ feet; depth of water ........................ feet; grade ........................ feet fall per one thousand feet.*

*(b) At ........................ miles from headgate: width on top (at water line) ........................ feet; width on bottom ........................ feet; depth of water ........................ feet; grade ........................ feet fall per one thousand feet.*

*(c) Length of pipe, ........................ ft.; size at intake, ........................ in.; size at ........................ ft. from intake ........................ in.; size at place of use ........................ in.; difference in elevation between intake and place of use, ........................ ft. Is grade uniform? ........................ Estimated capacity, ........................ sec. ft.*

8. *Location of area to be irrigated, or place of use ........................*

| Township North or South | Range E. or W. of Willamette Meridian | Section | Forty-acre Tract | Number Acres To Be Irrigated |
|---|---|---|---|---|
| 39 S | 8W | 15 | SW 1/4 | within city |
| 39 | 8 | 16 | S 1/2, | " " |
| 39 | 8 | 21 | NE 1/4, NW 1/4, SE 1/4 | " " |
| 39 | 8 | 22 | W 1/2 | " " |
| ~~39~~ | ~~8~~ | ~~28~~ | ~~NE 1/4~~ | ~~" "~~ |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

(If more space required, attach separate sheet)

*(a) Character of soil ........................*

*(b) Kind of crops raised ........................*

Power or Mining Purposes—

9. *(a) Total amount of power to be developed ........................ theoretical horsepower.*

*(b) Quantity of water to be used for power ........................ sec. ft.*

*(c) Total fall to be utilized ........................ (Head) feet.*

*(d) The nature of the works by means of which the power is to be developed ........................*

*(e) Such works to be located in ........................ (Legal subdivision) of Sec. ........................, Tp. ........................ (No. N. or S.), R. ........................ (No. E. or W.), W. M.*

*(f) Is water to be returned to any stream? ........................ (Yes or No)*

*(g) If so, name stream and locate point of return ........................, Sec. ........................, Tp. ........................ (No. N. or S.), R. ........................ (No. E. or W.), W. M.*

*(h) The use to which power is to be applied is ........................*

*(i) The nature of the mines to be served ........................*

T 7702

**Municipal or Domestic Supply—**

36172

10. (a) To supply the city of Cave Junction, Oregon

Josephine (Name of) County, having a present population of 398 and serves 200 outside city.

and an estimated population of 1,200 in 1995

(b) If for domestic use state number of families to be supplied 400

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ ~~Unknown at this time~~. $15,000.00

12. Construction work will begin on or before ~~Unknown at this time~~. 3-1-73

13. Construction work will be completed on or before ~~Unknown at this time~~. 3-1-78

14. The water will be completely applied to the proposed use on or before ~~Unknown at this time~~. 3-1-78

T.A. Kaufman City Recorder
(Signature of applicant)

Remarks: This application is in addition to permit G. 2570 and Permit No. 18785.

STATE OF OREGON,
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for ~~completion~~ ~~correction and completion~~ completion

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ~~May 24th~~, 19~~71~~.
December 18, 1972 ~~July 11~~ ~~72~~ ~~October 24~~ ~~72~~ ~~November 27~~ ~~72~~

WITNESS my hand this ~~22nd~~ ~~11th~~ ~~24th~~ ~~27th~~ day of ~~March~~ ~~May~~ ~~August~~ ~~September~~, 19~~71~~ ~~72~~ ~~72~~ ~~72~~ 19th day of October, 1972

CHRIS L. WHEELER
STATE ENGINEER

By Larry W. Jebousek
Larry W. Jebousek Assistant

RECEIVED MAR 17 1972 STATE ENGINEER SALEM, OREGON

RECEIVED MAY 21 1971 STATE ENGINEER SALEM, OREGON

RECEIVED OCT 5 1972 STATE ENGINEER SALEM, OREGON

RECEIVED OCT 25 1972 STATE ENGINEER SALEM, OREGON

T 7702

RECEIVED JUL 11 1972 STATE ENGINEER SALEM, OREGON

RECEIVED SEP 21 1972 STATE ENGINEER SALEM, OREGON

AMENDED by special order
v. 51 pg. 413

PERMIT

STATE OF OREGON, }
County of Marion, } ss.

*This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:*

*The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed* 2.0 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* East Fork Illinois River

*The use to which this water is to be applied is* municipal

*If for irrigation, this appropriation shall be limited to* ........ *of one cubic foot per second or its equivalent for each acre irrigated*

*and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.*

*The priority date of this permit is* March 8, 1971

*Actual construction work shall begin on or before* December 27, 1973 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*74.

Extended to Oct. 1 1975 B Extended to Oct. 1 1980

Extended to Oct. 1985 Extended to October 1, 1990 *

*Complete application of the water to the proposed use shall be made on or before October 1, 19*75.

Extended to Oct. 1 1975 C Extended to Oct. 1 1980

Extended to Oct. 1985 Extended to October 1, 1990 *

*WITNESS my hand this* 27th *day of* December, 19 72

~~nded to October 1, 19~~

[signature]
STATE ENGINEER

B+C * Extended to October 1, 1995, B+C ext to 10-1-99

Application No. 48026
Permit No. 36172

**PERMIT**
TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

*This instrument was first received in the office of the State Engineer at Salem, Oregon, on the* 8th *day of* March, 1971, *at* 8:00 *o'clock* A. *M.*

*Returned to applicant:*

*Approved:*
December 27, 1972

*Recorded in book No.* .... *of Permits on page* 36172

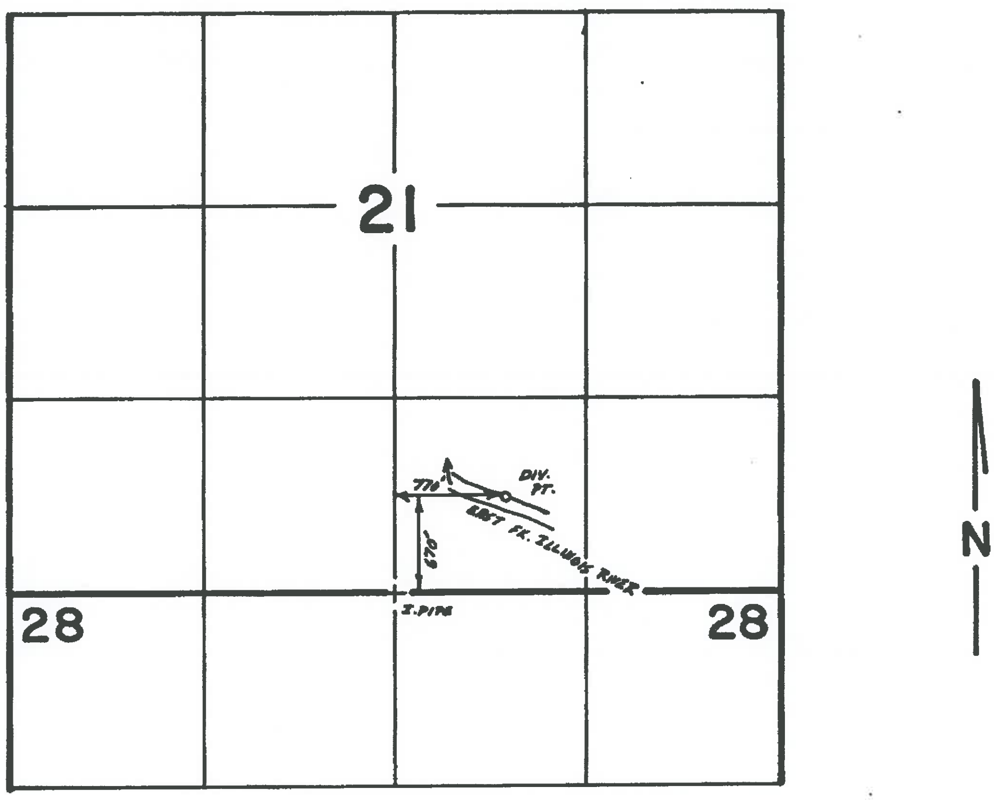
CHRIS L. WHEELER
STATE ENGINEER

*Drainage Basin No.* 15 *page* 564

*Fees* $27.00

State Printing

# T. 39 S., R. 8 W., W. M.




Scale 4" = 1 Mile

FEB 02 1987

WM. DIST. 14
GRANTS PASS, ORE.

## FINAL PROOF SURVEY

UNDER

Application No. 23847 Permit No. 18785
IN NAME OF

CITY OF CAVE JUNCTION

Surveyed Aug. 24. 1982, by B.R. SUND

PTS-1982-14A

690-10-PG-1

STATE OF OREGON

County of JOSEPHINE

# PERMIT TO APPROPRIATE THE PUBLIC WATERS

This is to certify that I have examined APPLICATION G-10965 and do hereby grant the same SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

This permit is issued to City of Cave Junction of PO Box F, Cave Junction, Oregon 97523, phone 592-2156, for use of the waters from one well

for the PURPOSE of municipal

that the PRIORITY OF THE RIGHT dates from May 13, 1983

and is limited to the amount of water which can be applied to beneficial use and shall not exceed 2.0 cubic feet per second

measured at the point of diversion from the well, or its equivalent in case of rotation with other water users.

The well is to be LOCATED: 747.69 feet South and 513.18 feet West from the Northeast Corner of Section 20, being within the NE 1/4 NE 1/4 of Section 20, Township 39 South, Range 8 West, WM, in the County of Josephine.

A description of the PLACE OF USE under the permit, and to which such right is appurtenant, is as follows:

| | | | | |
|---|---|---|---|---|
| Township 39 South, Range 8 West, WM | Section 15 | SW 1/4 | | municipal use |
| | Section 16 | SE 1/4 | SW 1/4 | municipal use |
| | Section 21 | NE 1/4 | NW 1/4 | municipal use |
| | | SE 1/4 | | municipal use |
| | Section 22 | NW 1/4 | SW 1/4 | municipal use |

The well shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works constructed shall include an air line and pressure gauge or an access port for measuring line, adequate to determine water level elevation in the well at all times. The permittee shall install and maintain a weir, meter, or other suitable measuring device, and shall keep a complete record of the amount of ground water withdrawn.

Actual construction work shall begin on or before December 2, 1984, and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1985. Extended to October 1, 1991

Complete application of the water to the proposed use shall be made on or before October 1, 1986. Extended to October 1, 1991

Witness my hand this 2nd day of December, 1983.

/s/ WILLIAM H. YOUNG

WATER RESOURCES DIRECTOR

This permit is for the beneficial use of water. By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan. It is possible that the land use you propose may not be allowed if it is not in keeping with the goals and the acknowledged plan. Your city or county planning agency can advise you about the land-use plan in your area.

APPLICATION G-10965 "CERTIFICATE NO. 67669 PERMIT G10166

STATE OF OREGON

COUNTY OF JOSEPHINE

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF CAVE JUNCTION
PO BOX 1396
CAVE JUNCTION OREGON 97523

confirms the right to use the waters of THREE WELLS, in the ILLINOIS RIVER BASIN, for MUNICIPAL USE.

This right was perfected under Permit G-10166. The date of priority is MAY 13, 1983. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.60 CUBIC FOOT PER SECOND (CFS); BEING 0.60 CFS FROM ORIGINAL WELL, 0.08 CFS FROM MEYERS WELL, AND 0.08 CFS FROM BERARD WELL, provided the total quantity appropriated from all wells does not exceed 0.60 cfs, if available at the original well, or its equivalent in case of rotation, measured at the wells.

The wells are located as follows:

| Well | Twp | Rng | Mer | Sec | Q-Q | Measured Distances |
|---|---|---|---|---|---|---|
| ORIGINAL | 39 S | 8 W | WM | 20 | NE NE | 748 FEET SOUTH AND 513 FEET WEST FROM THE NE CORNER, SECTION 20 |
| MEYERS | 39 S | 8 W | WM | 16 | SW SW | 82.75 FEET NORTH AND 704.46 FEET EAST FROM THE SW CORNER, SECTION 16 |
| BERARD | 39 S | 8 W | WM | 21 | SW NW | 1431.75 FEET SOUTH AND 100 FEET EAST FROM THE NW CORNER, SECTION 21 |

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use to which this right is appurtenant:

SERVICE AREA OF THE CITY OF CAVE JUNCTION

The wells shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon.

The quantity of water diverted at the new points of appropriation (wells), together with that diverted at the old point of appropriation, shall not exceed the quantity of water available from the original point of appropriation.

When required by the Department the water use shall install in-line flow meters or other suitable devices for measuring and recording the quantity of water used. The type and plans of the measuring devices must be approved by the Department prior to beginning construction and shall be installed under the general supervision of the Department.

**NOTICE OF RIGHT TO RECONSIDERATION OR JUDICIAL REVIEW**

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080, you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Water shall be acquired from the same aquifer as the original point of appropriation.

This certificate is issued to confirm ADDITIONAL POINTS OF APPROPRIATION and a CHANGE IN PLACE OF USE approved by an order of the Water Resources Director entered July 25, 1994, at Special Order Volume 48, Page 248, approving Transfer Application 7159, and supersedes Certificate 67669, State record of Water Right Certificates.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

Issued JUL 17 2009.

Dwight French for
Phillip C. Ward, Director

STATE OF OREGON

COUNTY OF JOSEPHINE

# CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF CAVE JUNCTION
P.O. BOX F,
CAVE JUNCTION, OREGON 97523

confirms the right to use the waters of THREE WELLS in the EAST FORK ILLINOIS RIVER BASIN for the purpose of MUNICIPAL.

The right has been perfected under Permit G-2570. The date of priority is JANUARY 20, 1964. The right is limited to not more than 1.0 CUBIC FOOT PER SECOND, BEING 0.5 CFS FROM WELL 1, 0.13 CFS FROM WELL 2, AND 0.37 CFS FROM WELL 3, or its equivalent in case of rotation, measured at the well.

The wells are located as follows:

SW 1/4 NE 1/4, SECTION 28, T 39 S, R 8 W, W.M.; WELL 1- 350 FEET NORTH & 440 FEET EAST; WELL 2 - 175 FEET NORTH & 500 FEET EAST; WELL 3 - 25 FEET NORTH & 580 FEET EAST, ALL FROM C1/4 CORNER SECTION 28.

The right shall conform to such reasonable rotation system as may be ordered by the proper state officer.

NW 1/4 NW 1/4
S 1/2 NW 1/4
NW 1/4 SW 1/4
S 1/2 SW 1/4
SW 1/4 SE 1/4
SECTION 15

NE 1/4 NE 1/4
S 1/4 NE 1/4
NE 1/4 SW 1/4
S 1/2 SW 1/4
SE 1/4
SECTION 16

NE 1/4
NW 1/4
SE 1/4
SECTION 21

NW 1/4 NE 1/4
NW 1/4
SW 1/4
SECTION 22

NE 1/4 NW 1/4
SECTION 27

E 1/2 NE 1/4
SECTION 28

TOWNSHIP 39 SOUTH, RANGE 8 WEST, W.M.

This certificate is being issued to correctly describe the point of appropriation as identified by an order of the Water Resource Director entered OCTOBER 17, 1988, and supersedes certificate 55492, State Record of Water right Certificates.

The issuance of this superseding certificate does not confirm the status of the water right in regard to the provisions of ORS 540.610 pertaining to forfeiture or abandonment.

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described.

WITNESS the signature of the Water Resources Director, affixed this date FEBRUARY 9, 1989.

/s/ WILLIAM H. YOUNG
Water Resources Director

Recorded in State Record of Water Right Certificates numbered 59983

G-2767.BE

690-10-SBC

# STATE OF OREGON

COUNTY OF JOSEPHINE

# CERTIFICATE OF WATER RIGHT

**This is to certify,** *That* CITY OF CAVE JUNCTION

*of* PO Box F, Cave Junction *, State of* OR 97523 *, has made proof to the satisfaction of the Water Resources Director, of a right to the use of the waters of* East Fork Illinois River

*a tributary of* Illinois River *for the purpose of* municipal

*under Permit No.* 18785 *and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* June 16, 1949

*that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed* 1.0 cubic feet per second

*or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the* SW 1/4 SE 1/4, Section 21, T39S, R8W, WM; 670 feet North and 770 feet East from S 1/4 corner Section 21.

*The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to* ------------ *of one cubic foot per second per acre,*

*and shall conform to such reasonable rotation system as may be ordered by the proper state officer.*

*A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:*

| | | | |
|---|---|---|---|
| NW 1/4 NW 1/4<br>S 1/2 NW 1/4<br>NW 1/4 SW 1/4<br>S 1/2 SW 1/4<br>SW 1/4 SE 1/4<br>Section 15 | NE 1/4 NE 1/4<br>S 1/2 NE 1/4<br>NE 1/4 SW 1/4<br>S 1/2 SW 1/4<br>SE 1/4<br>Section 16 | NE 1/4<br>NW 1/4<br>SE 1/4<br>Section 21<br><br>NW 1/4 NE 1/4<br>NW 1/4<br>SW 1/4<br>Section 22 | NE 1/4 NW 1/4<br>Section 27<br><br>E 1/2 NE 1/4<br>Section 28 |

Township 39 South, Range 8 West, WM

*The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described and is subject to minimum flows established by the Water Resources Commission with an effective date prior to this right.*

*WITNESS the signature of the Water Resources Director, affixed this date.* January 22, 1987

/s/ William H. Young

*Water Resources Director*

*Recorded in State Record of Water Right Certificates, Volume* 51 *, page* 55491

7462D/TS
23847

**STATE OF OREGON**

**COUNTY OF JOSEPHINE**

**ORDER APPROVING A CHANGE IN POINT OF DIVERSION**

Pursuant to ORS 537.211, after notice was given and no objections were filed, and finding that no injury to existing water rights would result, this order approves, as conditioned or limited herein, PERMIT AMENDMENT T-7702 submitted by

CITY OF CAVE JUNCTION
P.O. BOX F
CAVE JUNCTION, OREGON 97523.

The permit to be modified is Permit 36172 with a date of priority of MARCH 8, 1971. The permit allows the use of the EAST FORK OF THE ILLINOIS RIVER, a tributary of the ILLINOIS RIVER, for MUNICIPAL USE. The amount of water to which this permit is entitled is limited to an amount actually beneficially used and shall not exceed 2.0 cubic feet per second, if available at the authorized point of diversion: NW¼ NE¼, SECTION 28, T 39 S, R 8 W, W.M.; 200 FEET SOUTH AND 1350 FEET WEST FROM THE SE CORNER OF SECTION 21, T 39 S, R 8 W, W.M., or its equivalent in case of rotation, measured at the point of diversion from the source.

The use shall conform to any reasonable rotation system ordered by the proper state officer.

The authorized place of use is located as follows:

SW¼
SECTION 15

S½
SECTION 16

NE¼
NW¼
SE¼
SECTION 21

W½
SECTION 22

TOWNSHIP 39 SOUTH, RANGE 8 WEST, W.M.

The right to use the water for the above purpose is restricted to beneficial use on the lands or place of use described

The applicant proposes to change the point of diversion to:

SW¼ SE¼, SECTION 21, T 39 S, R 8 W, W.M.; 670 FEET NORTH AND 770 FEET EAST FROM THE S¼ CORNER, SECTION 21.

THIS CHANGE TO AN EXISTING WATER PERMIT MAY BE MADE PROVIDED THE FOLLOWING CONDITIONS ARE MET BY THE WATER USER:

1. The quantity of water diverted at the new point of diversion shall not exceed the quantity of water lawfully available at the original point of diversion.

2. When required by the Department, the water user shall install and maintain a headgate, an in-line flow meter, weir, or other suitable device for measuring and recording the quantity of water diverted. The type and plans of the headgate and measuring device must be approved by the Department prior to beginning construction and shall be installed under the general supervision of the Department.

3. Water shall be acquired from the same surface water source as the original point of diversion.

4. All other terms and conditions of the permit remain the same.

Permit 36172, in the name of CITY OF CAVE JUNCTION, is amended as described herein.

WITNESS the signature of the Water Resources Director,

affixed April 24, 1997.

Martha O. Pagel, Director

# APPENDIX B

## FlexTable: Pipe Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| Addison | 6.0 | PVC | 1,143 | 4 | 0.05 |
| Barlow Street | 8.0 | PVC | 464 | 184 | 1.18 |
| Barlow Street | 8.0 | PVC | 143 | 383 | 2.45 |
| Boundary | 8.0 | PVC | 607 | 42 | 0.27 |
| Bumblebee Lane | 6.0 | PVC | 179 | 6 | 0.07 |
| Burgundy | 8.0 | PVC | 71 | -12 | 0.07 |
| Burgundy | 8.0 | PVC | 143 | -10 | 0.06 |
| Burgundy | 8.0 | PVC | 179 | 0 | 0.00 |
| Burgundy | 8.0 | PVC | 357 | -21 | 0.13 |
| Caves Highway | 10.0 | PVC | 71 | 706 | 2.88 |
| Cedar Brook Ln. | 6.0 | PVC | 143 | 11 | 0.13 |
| Cedar Ridge Dr. | 6.0 | PVC | 214 | 0 | 0.00 |
| Cottage Park | 8.0 | PVC | 429 | -44 | 0.28 |
| Eastern Spur | 8.0 | PVC | 500 | 1 | 0.00 |
| Farris Lane | 8.0 | PVC | 321 | 2 | 0.01 |
| Farris Lane | 8.0 | PVC | 250 | -239 | 1.53 |
| Farris Lane | 8.0 | PVC | 250 | 381 | 2.43 |
| Fir Drive | 8.0 | PVC | 250 | 1 | 0.00 |
| Hanby | 8.0 | PVC | 714 | -42 | 0.27 |
| Hanby | 8.0 | PVC | 286 | -24 | 0.15 |
| Honeybee Lane | 6.0 | PVC | 208 | 1 | 0.01 |
| Honeybee Lane | 6.0 | PVC | 143 | 0 | 0.00 |
| Hussey | 6.0 | Asbestos Cement | 357 | -27 | 0.30 |
| Hussey | 8.0 | PVC | 393 | 75 | 0.48 |
| Hussey | 8.0 | PVC | 643 | 76 | 0.49 |
| Hussey | 8.0 | PVC | 500 | 75 | 0.48 |
| Hussey | 8.0 | PVC | 321 | 91 | 0.58 |
| Jonathon Court | 8.0 | PVC | 250 | 1 | 0.01 |
| Junction | 6.0 | Asbestos Cement | 214 | -55 | 0.62 |
| Junction | 6.0 | Asbestos Cement | 571 | -49 | 0.56 |
| Junction | 6.0 | Asbestos Cement | 393 | 34 | 0.39 |
| Junction Avenue | 8.0 | PVC | 321 | 199 | 1.27 |
| Junction Avenue | 8.0 | PVC | 571 | 645 | 4.11 |
| Junction Avenue | 8.0 | PVC | 321 | 202 | 1.29 |
| Kerby | 8.0 | PVC | 464 | 86 | 0.55 |
| Kerby | 8.0 | PVC | 607 | 67 | 0.43 |
| Kerby | 6.0 | PVC | 357 | 44 | 0.50 |
| Kerby | 6.0 | PVC | 321 | 19 | 0.21 |
| Laurel Road | 8.0 | PVC | 929 | -34 | 0.22 |
| Lindilu Lane | 8.0 | PVC | 357 | 2 | 0.01 |
| Lister | 6.0 | Asbestos Cement | 357 | -30 | 0.34 |
| Lister | 8.0 | PVC | 321 | -38 | 0.24 |
| Merlot Drive | 8.0 | PVC | 179 | -44 | 0.28 |
| Mntn Valley Way | 8.0 | PVC | 179 | -19 | 0.12 |
| Mntn. Valley | 8.0 | PVC | 321 | -10 | 0.06 |
| Mntn. Valley | 8.0 | PVC | 357 | -14 | 0.09 |
| Old Stage Road | 8.0 | PVC | 357 | -63 | 0.40 |

# FlexTable: Pipe Table (System Model_background2.wtg)
# Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| Old Stage Road | 8.0 | PVC | 786 | -8 | 0.05 |
| Ollis Road | 6.0 | PVC | 1,179 | 30 | 0.34 |
| P-14 | 4.0 | Ductile Iron | 250 | 0 | 0.00 |
| P-15 | 4.0 | Ductile Iron | 286 | 0 | 0.00 |
| P-20 | 8.0 | PVC | 321 | 194 | 1.24 |
| P-60 | 8.0 | PVC | 357 | -33 | 0.21 |
| P-70 | 8.0 | PVC | 286 | 1 | 0.01 |
| P-73 | 8.0 | PVC | 83 | 1 | 0.01 |
| P-86 | 8.0 | PVC | 107 | 0 | 0.00 |
| P-87 | 8.0 | PVC | 107 | 1 | 0.01 |
| P-99 | 6.0 | Asbestos Cement | 250 | -7 | 0.08 |
| P-100 | 6.0 | Asbestos Cement | 214 | 3 | 0.04 |
| P-153 | 8.0 | PVC | 179 | -97 | 0.62 |
| P-154 | 8.0 | PVC | 214 | -81 | 0.51 |
| P-158 | 8.0 | PVC | 357 | 0 | 0.00 |
| P-161 | 6.0 | PVC | 571 | 0 | 0.00 |
| P-168 | 8.0 | PVC | 3,679 | 125 | 0.80 |
| P-172 | 4.0 | Asbestos Cement | 321 | 7 | 0.17 |
| P-177 | 10.0 | PVC | 214 | 168 | 0.68 |
| P-178 | 10.0 | PVC | 286 | 164 | 0.67 |
| P-179 | 10.0 | PVC | 286 | 9 | 0.04 |
| P-190 | 10.0 | PVC | 464 | 373 | 1.52 |
| P-191 | 8.0 | PVC | 929 | -620 | 3.96 |
| P-192 | 14.0 | PVC | 679 | -592 | 1.23 |
| P-193 | 8.0 | PVC | 107 | 3 | 0.02 |
| P-194 | 6.0 | PVC | 393 | 0 | 0.00 |
| P-195 | 6.0 | PVC | 429 | 0 | 0.00 |
| P-196 | 14.0 | PVC | 464 | -596 | 1.24 |
| P-198 | 14.0 | PVC | 286 | -607 | 1.27 |
| P-199 | 8.0 | PVC | 571 | 4 | 0.03 |
| P-200 | 14.0 | PVC | 500 | -613 | 1.28 |
| P-201 | 6.0 | PVC | 357 | 5 | 0.06 |
| P-202 | 6.0 | PVC | 393 | 2 | 0.02 |
| P-203 | 6.0 | PVC | 643 | 2 | 0.02 |
| P-204 | 14.0 | PVC | 536 | -623 | 1.30 |
| P-205 | 10.0 | PVC | 1,821 | 55 | 0.23 |
| P-206 | 8.0 | PVC | 1,214 | -47 | 0.30 |
| P-213 | 6.0 | PVC | 125 | 1 | 0.01 |
| P-222 | 12.0 | Ductile Iron | 5 | -863 | 2.45 |
| P-223 | 12.0 | Ductile Iron | 5 | 431 | 1.22 |
| P-225 | 12.0 | Ductile Iron | 5 | -431 | 1.22 |
| P-227 | 18.0 | Ductile Iron | 10 | 1,725 | 2.18 |
| P-237 | 10.0 | PVC | 404 | 623 | 2.55 |
| P-238 | 10.0 | PVC | 429 | 619 | 2.53 |
| P-240 | 6.0 | PVC | 179 | 0 | 0.00 |
| P-241 | 8.0 | PVC | 308 | -7 | 0.04 |
| P-242 | 8.0 | PVC | 275 | -8 | 0.05 |

# FlexTable: Pipe Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| P-243 | 8.0 | PVC | 1,286 | -12 | 0.07 |
| P-244 | 8.0 | PVC | 297 | -14 | 0.09 |
| P-248 | 10.0 | PVC | 1,990 | -280 | 1.14 |
| P-249 | 8.0 | PVC | 299 | -154 | 0.98 |
| P-250 | 8.0 | PVC | 465 | -158 | 1.01 |
| P-251 | 8.0 | PVC | 353 | -89 | 0.57 |
| P-252 | 8.0 | PVC | 397 | -94 | 0.60 |
| P-253 | 8.0 | PVC | 220 | -49 | 0.31 |
| P-254 | 8.0 | PVC | 280 | -46 | 0.29 |
| P-255 | 4.0 | Asbestos Cement | 209 | 5 | 0.14 |
| P-256 | 4.0 | Asbestos Cement | 333 | 5 | 0.14 |
| P-257 | 6.0 | Asbestos Cement | 329 | 42 | 0.47 |
| P-259 | 6.0 | Asbestos Cement | 88 | 42 | 0.47 |
| P-260 | 6.0 | Asbestos Cement | 291 | 45 | 0.51 |
| P-261 | 8.0 | PVC | 813 | 91 | 0.58 |
| P-262 | 8.0 | PVC | 270 | 96 | 0.61 |
| P-263 | 6.0 | Asbestos Cement | 209 | 76 | 0.86 |
| P-265 | 6.0 | Asbestos Cement | 341 | 77 | 0.88 |
| P-266 | 6.0 | Asbestos Cement | 617 | 80 | 0.91 |
| P-267 | 8.0 | PVC | 269 | 203 | 1.30 |
| P-268 | 8.0 | PVC | 398 | 205 | 1.31 |
| P-269 | 8.0 | PVC | 57 | 53 | 0.34 |
| P-270 | 8.0 | PVC | 103 | 52 | 0.33 |
| P-271 | 8.0 | PVC | 139 | -6 | 0.04 |
| P-272 | 8.0 | PVC | 486 | -4 | 0.03 |
| P-273 | 10.0 | PVC | 480 | -327 | 1.34 |
| P-274 | 10.0 | PVC | 817 | -324 | 1.32 |
| P-275 | 8.0 | PVC | 544 | -70 | 0.45 |
| P-276 | 8.0 | PVC | 539 | -72 | 0.46 |
| P-278 | 8.0 | PVC | 375 | -34 | 0.22 |
| P-279 | 8.0 | PVC | 503 | -31 | 0.20 |
| P-280 | 8.0 | PVC | 538 | -33 | 0.21 |
| P-281 | 8.0 | PVC | 283 | -50 | 0.32 |
| P-282 | 8.0 | PVC | 259 | -51 | 0.33 |
| P-283 | 8.0 | PVC | 393 | -13 | 0.08 |
| P-284 | 8.0 | PVC | 250 | -18 | 0.12 |
| P-285 | 8.0 | PVC | 423 | -96 | 0.61 |
| P-286 | 8.0 | PVC | 493 | -96 | 0.61 |
| P-287 | 8.0 | PVC | 85 | 0 | 0.00 |
| P-288 | 8.0 | PVC | 82 | 0 | 0.00 |
| P-289 | 8.0 | PVC | 98 | -16 | 0.10 |
| P-290 | 8.0 | PVC | 235 | -21 | 0.14 |
| P-291 | 8.0 | PVC | 214 | 1 | 0.01 |
| P-293 | 8.0 | PVC | 269 | 2 | 0.01 |
| P-294 | 8.0 | PVC | 231 | 2 | 0.01 |
| P-295 | 8.0 | PVC | 401 | 1 | 0.01 |
| P-296 | 8.0 | PVC | 275 | 1 | 0.01 |

# FlexTable: Pipe Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| P-297 | 8.0 | PVC | 114 | 1 | 0.01 |
| P-298 | 8.0 | PVC | 386 | 1 | 0.01 |
| P-300 | 10.0 | PVC | 132 | -203 | 0.83 |
| P-302 | 8.0 | PVC | 303 | -33 | 0.21 |
| P-304 | 8.0 | PVC | 426 | -31 | 0.20 |
| P-305 | 10.0 | PVC | 530 | -73 | 0.30 |
| P-307 | 8.0 | PVC | 489 | -31 | 0.20 |
| P-308 | 8.0 | PVC | 532 | -31 | 0.20 |
| P-309 | 8.0 | PVC | 171 | -30 | 0.19 |
| P-310 | 8.0 | PVC | 662 | -31 | 0.19 |
| P-311 | 6.0 | PVC | 190 | 5 | 0.06 |
| P-312 | 6.0 | PVC | 185 | 1 | 0.01 |
| P-314 | 6.0 | PVC | 89 | 2 | 0.03 |
| P-315 | 6.0 | PVC | 67 | 2 | 0.02 |
| P-316 | 6.0 | PVC | 218 | 2 | 0.03 |
| P-318 | 6.0 | PVC | 152 | 0 | 0.01 |
| P-319 | 6.0 | PVC | 315 | 0 | 0.01 |
| P-320 | 6.0 | PVC | 283 | 0 | 0.01 |
| P-322 | 8.0 | PVC | 471 | -20 | 0.12 |
| P-323 | 8.0 | PVC | 131 | -15 | 0.10 |
| P-324 | 8.0 | PVC | 356 | -15 | 0.10 |
| P-325 | 8.0 | PVC | 496 | -25 | 0.16 |
| P-326 | 8.0 | PVC | 379 | -28 | 0.18 |
| P-327 | 10.0 | PVC | 400 | -181 | 0.74 |
| P-329 | 6.0 | PVC | 500 | -16 | 0.18 |
| P-330 | 6.0 | PVC | 429 | -18 | 0.21 |
| P-331 | 6.0 | PVC | 403 | 1 | 0.01 |
| P-333 | 6.0 | PVC | 442 | 1 | 0.01 |
| P-334 | 6.0 | PVC | 357 | 1 | 0.01 |
| P-335 | 6.0 | PVC | 391 | 1 | 0.01 |
| P-337 | 6.0 | PVC | 313 | 1 | 0.01 |
| P-338 | 6.0 | PVC | 357 | 1 | 0.01 |
| P-339 | 8.0 | PVC | 294 | -97 | 0.62 |
| P-340 | 8.0 | PVC | 164 | -97 | 0.62 |
| P-342 | 8.0 | PVC | 299 | -60 | 0.38 |
| P-343 | 8.0 | PVC | 149 | -60 | 0.38 |
| P-344 | 8.0 | PVC | 260 | -60 | 0.38 |
| P-346 | 8.0 | PVC | 161 | -34 | 0.22 |
| P-348 | 8.0 | PVC | 265 | 35 | 0.22 |
| P-350 | 8.0 | PVC | 268 | 35 | 0.23 |
| P-352 | 8.0 | PVC | 238 | 37 | 0.23 |
| P-354 | 8.0 | PVC | 297 | 37 | 0.24 |
| P-355 | 8.0 | PVC | 245 | 37 | 0.24 |
| P-356 | 8.0 | PVC | 318 | 37 | 0.24 |
| P-357 | 8.0 | PVC | 319 | 35 | 0.22 |
| P-358 | 8.0 | PVC | 306 | 34 | 0.22 |
| P-359 | 8.0 | PVC | 350 | -85 | 0.54 |

# FlexTable: Pipe Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| P-360 | 8.0 | PVC | 1,192 | -93 | 0.60 |
| P-361 | 8.0 | PVC | 643 | 145 | 0.92 |
| P-362 | 8.0 | PVC | 536 | 130 | 0.83 |
| P-363 | 8.0 | PVC | 252 | -48 | 0.31 |
| P-364 | 8.0 | PVC | 165 | -49 | 0.31 |
| P-365 | 8.0 | PVC | 394 | 0 | 0.00 |
| P-366 | 8.0 | PVC | 689 | 0 | 0.00 |
| P-367 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-368 | 6.0 | PVC | 709 | 0 | 0.00 |
| P-369 | 6.0 | PVC | 749 | 0 | 0.00 |
| P-370 | 10.0 | PVC | 668 | -73 | 0.30 |
| P-371 | 10.0 | PVC | 635 | -73 | 0.30 |
| P-372 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-373 | 10.0 | PVC | 303 | -203 | 0.83 |
| P-374 | 10.0 | PVC | 523 | -203 | 0.83 |
| P-375 | 6.0 | PVC | 50 | 0 | 0.00 |
| P-376 | 8.0 | PVC | 243 | 1,079 | 6.88 |
| P-377 | 8.0 | PVC | 257 | 1,079 | 6.88 |
| P-378 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-379 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-380 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-381 | 10.0 | PVC | 366 | -281 | 1.15 |
| P-382 | 10.0 | PVC | 181 | -281 | 1.15 |
| P-383 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-384 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-385 | 6.0 | PVC | 100 | 0 | 0.00 |
| P-386 | 6.0 | PVC | 25 | 0 | 0.00 |
| P-394 | 18.0 | Ductile Iron | 5 | 2,501 | 3.15 |
| P-395 | 8.0 | Ductile Iron | 10 | 1,250 | 7.98 |
| P-396 | 8.0 | Ductile Iron | 10 | 1,250 | 7.98 |
| P-397 | 8.0 | Ductile Iron | 10 | 1,250 | 7.98 |
| P-398 | 8.0 | Ductile Iron | 10 | 1,250 | 7.98 |
| P-399 | 18.0 | Ductile Iron | 10 | 1,725 | 2.18 |
| P-400 | 12.0 | Ductile Iron | 5 | -431 | 1.22 |
| P-401 | 12.0 | Ductile Iron | 5 | -431 | 1.22 |
| P-402 | 12.0 | Ductile Iron | 5 | -431 | 1.22 |
| P-403 | 12.0 | Ductile Iron | 5 | -431 | 1.22 |
| P-404 | 12.0 | Ductile Iron | 5 | -863 | 2.45 |
| P-405 | 12.0 | Ductile Iron | 5 | 863 | 2.45 |
| P-406 | 18.0 | Ductile Iron | 20 | 2,523 | 3.18 |
| P-408 | 4.0 | Ductile Iron | 47 | 280 | 7.16 |
| P-409 | 4.0 | Ductile Iron | 61 | 280 | 7.16 |
| P-410 | 4.0 | Ductile Iron | 59 | 280 | 7.16 |
| P-411 | 10.0 | PVC | 654 | -181 | 0.74 |
| P-412 | 10.0 | PVC | 464 | -280 | 1.15 |
| P-413 | 8.0 | PVC | 286 | -99 | 0.63 |
| P-414 | 8.0 | PVC | 786 | -244 | 1.56 |

# FlexTable: Pipe Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Diameter (in) | Material | Length (User Defined) (ft) | Flow (gpm) | Velocity (ft/s) |
|---|---|---|---|---|---|
| P-415 | 6.0 | PVC | 321 | 0 | 0.00 |
| P-416 | 8.0 | PVC | 321 | 244 | 1.56 |
| P-417 | 8.0 | PVC | 429 | 36 | 0.23 |
| P-419 | 2.0 | Galvanized iron | 571 | 0 | 0.00 |
| P-420 | 2.0 | Galvanized iron | 71 | 0 | 0.00 |
| Raymond Street | 8.0 | PVC | 143 | 447 | 2.85 |
| Red Cedar Ln. | 6.0 | PVC | 179 | 4 | 0.05 |
| Redwood | 10.0 | PVC | 607 | -103 | 0.42 |
| Redwood Highway | 8.0 | PVC | 250 | 2 | 0.01 |
| River | 10.0 | PVC | 500 | -120 | 0.49 |
| River | 10.0 | PVC | 786 | -181 | 0.74 |
| River | 10.0 | PVC | 357 | -178 | 0.73 |
| River | 10.0 | PVC | 643 | -146 | 0.60 |
| River | 10.0 | PVC | 500 | -164 | 0.67 |
| River | 10.0 | PVC | 286 | -105 | 0.43 |
| River | 10.0 | PVC | 286 | -134 | 0.55 |
| River St. | 10.0 | PVC | 143 | -234 | 0.96 |
| River St. | 8.0 | PVC | 357 | -113 | 0.72 |
| River Street | 8.0 | PVC | 321 | -30 | 0.19 |
| River Street | 8.0 | PVC | 464 | -155 | 0.99 |
| Sanger Lane | 8.0 | PVC | 357 | 4 | 0.02 |
| Sawyer | 8.0 | PVC | 357 | -57 | 0.37 |
| Sawyer | 8.0 | PVC | 286 | -28 | 0.18 |
| Sawyer | 8.0 | PVC | 750 | 3 | 0.02 |
| Sawyer | 8.0 | PVC | 607 | 41 | 0.26 |
| Schumaker | 8.0 | PVC | 393 | -13 | 0.09 |
| Schumaker | 8.0 | PVC | 357 | -43 | 0.27 |
| Schumaker | 8.0 | PVC | 321 | 2 | 0.01 |
| Shadow Brook Dr. | 8.0 | PVC | 250 | 4 | 0.02 |
| Sherwood Avenue | 8.0 | PVC | 643 | 188 | 1.20 |
| Shewood Court | 8.0 | PVC | 214 | 0 | 0.00 |
| Spur | 8.0 | PVC | 208 | 0 | 0.00 |
| Spur | 6.0 | PVC | 464 | 0 | 0.00 |
| Tennessee View | 8.0 | PVC | 286 | 3 | 0.02 |
| Too Far Lane | 6.0 | PVC | 500 | 2 | 0.02 |
| Tracy | 6.0 | Asbestos Cement | 179 | 3 | 0.04 |
| Watkins | 8.0 | PVC | 286 | -41 | 0.26 |
| Watkins | 8.0 | PVC | 179 | 63 | 0.40 |
| West Palmer | 8.0 | PVC | 500 | -20 | 0.13 |

# FlexTable: Junction Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| J-3 | 1,339.00 | 2 | 1,533.76 | 84.3 |
| J-6 | 1,361.00 | 1 | 1,529.76 | 73.0 |
| J-8 | 1,376.00 | 1 | 1,529.53 | 66.4 |
| J-10 | 1,384.00 | 2 | 1,528.96 | 62.7 |
| J-11 | 1,386.00 | 0 | 1,528.37 | 61.6 |
| J-12 | 1,373.00 | 3 | 1,528.62 | 67.3 |
| J-13 | 1,311.00 | 1 | 1,528.62 | 94.2 |
| J-14 | 1,322.00 | 2 | 1,528.62 | 89.4 |
| J-15 | 1,306.00 | 0 | 1,528.62 | 96.3 |
| J-16 | 1,290.00 | 0 | 1,528.62 | 103.2 |
| J-17 | 1,340.00 | 0 | 1,529.43 | 82.0 |
| J-19 | 1,369.00 | 6 | 1,529.99 | 69.7 |
| J-23 | 1,357.00 | 2 | 1,525.52 | 72.9 |
| J-25 | 1,366.00 | 1 | 1,523.90 | 68.3 |
| J-26 | 1,375.00 | 3 | 1,523.90 | 64.4 |
| J-30 | 1,384.00 | 6 | 1,523.93 | 60.5 |
| J-31 | 1,384.00 | 0 | 1,523.93 | 60.5 |
| J-32 | 1,385.00 | 0 | 1,523.93 | 60.1 |
| J-34 | 1,377.00 | 2 | 1,523.90 | 63.6 |
| J-36 | 1,341.00 | 2 | 1,524.14 | 79.2 |
| J-37 | 1,339.00 | 0 | 1,524.12 | 80.1 |
| J-41 | 1,359.00 | 1 | 1,524.14 | 71.4 |
| J-44 | 1,358.00 | 2 | 1,524.14 | 71.9 |
| J-45 | 1,317.00 | 55 | 1,524.16 | 89.6 |
| J-46 | 1,305.00 | 0 | 1,524.20 | 94.8 |
| J-47 | 1,317.00 | 0 | 1,524.24 | 89.7 |
| J-51 | 1,333.00 | 0 | 1,524.30 | 82.8 |
| J-55 | 1,373.00 | 7 | 1,524.11 | 65.4 |
| J-60 | 1,377.00 | 4 | 1,524.11 | 63.6 |
| J-61 | 1,376.00 | 0 | 1,524.11 | 64.1 |
| J-63 | 1,377.00 | 0 | 1,524.11 | 63.6 |
| J-65 | 1,372.00 | 0 | 1,524.11 | 65.8 |
| J-68 | 1,365.00 | 0 | 1,524.12 | 68.8 |
| J-69 | 1,368.00 | 0 | 1,524.12 | 67.5 |
| J-74 | 1,369.00 | 2 | 1,524.11 | 67.1 |
| J-76 | 1,368.00 | 1 | 1,524.11 | 67.5 |
| J-77 | 1,364.00 | 0 | 1,524.11 | 69.3 |
| J-78 | 1,363.00 | 4 | 1,524.11 | 69.7 |
| J-81 | 1,338.00 | 7 | 1,524.54 | 80.7 |
| J-83 | 1,336.00 | 0 | 1,524.54 | 81.6 |
| J-87 | 1,327.00 | 5 | 1,524.62 | 85.5 |
| J-97 | 1,325.00 | 4 | 1,524.71 | 86.4 |
| J-107 | 1,283.00 | 0 | 1,524.93 | 104.7 |
| J-109 | 1,282.00 | 0 | 1,525.09 | 105.2 |
| J-110 | 1,274.00 | 0 | 1,525.51 | 108.8 |
| J-113 | 1,345.00 | 4 | 1,524.67 | 77.7 |
| J-115 | 1,354.00 | 5 | 1,524.59 | 73.8 |

# FlexTable: Junction Table (System Model_background2.wtg)
## Active Scenario:  Max. Day_Fire Flow

**Current Time:  0.000 hours**

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| J-118 | 1,351.00 | 2 | 1,524.71 | 75.2 |
| J-119 | 1,361.00 | 5 | 1,524.69 | 70.8 |
| J-120 | 1,349.00 | 72 | 1,524.84 | 76.1 |
| J-123 | 1,331.00 | 1 | 1,524.79 | 83.8 |
| J-125 | 1,280.00 | 0 | 1,525.04 | 106.0 |
| J-127 | 1,271.00 | 0 | 1,525.18 | 110.0 |
| J-134 | 1,263.00 | 0 | 1,525.18 | 113.4 |
| J-138 | 1,345.00 | 3 | 1,524.85 | 77.8 |
| J-139 | 1,338.00 | 3 | 1,524.84 | 80.8 |
| J-140 | 1,336.00 | 7 | 1,524.82 | 81.7 |
| J-142 | 1,337.00 | 4 | 1,525.31 | 81.5 |
| J-153 | 1,403.00 | 1 | 1,523.24 | 52.0 |
| J-159 | 1,385.00 | 2 | 1,523.50 | 59.9 |
| J-162 | 1,372.00 | 3 | 1,523.69 | 65.6 |
| J-164 | 1,388.00 | 2 | 1,523.69 | 58.7 |
| J-166 | 1,383.00 | 1 | 1,523.93 | 61.0 |
| J-167 | 1,339.00 | 0 | 1,533.77 | 84.3 |
| J-168 | 1,339.00 | 0 | 1,350.99 | 5.2 |
| J-178 | 1,336.72 | 0 | 1,524.29 | 81.2 |
| J-179 | 1,340.00 | 0 | 1,524.47 | 79.8 |
| J-180 | 1,355.00 | 0 | 1,529.84 | 75.6 |
| J-181 | 1,409.03 | 0 | 1,522.97 | 49.3 |
| J-182 | 1,339.00 | 22 | 1,339.96 | 0.4 |
| J-183 | 1,339.00 | 0 | 1,351.01 | 5.2 |
| J-184 | 1,275.40 | 0 | 1,525.30 | 108.1 |
| J-185 | 1,345.48 | 0 | 1,529.43 | 79.6 |
| J-186 | 1,337.30 | 0 | 1,524.84 | 81.1 |
| J-187 | 1,337.09 | 0 | 1,525.31 | 81.4 |

# FlexTable: Hydrant Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| H-1 | 1,338.00 | 0 | 1,529.43 | 82.8 |
| H-2 | 1,327.00 | 9 | 1,525.26 | 85.8 |
| H-3 | 1,331.00 | 10 | 1,525.26 | 84.0 |
| H-4 | 1,340.00 | 1 | 1,524.83 | 80.0 |
| H-5 | 1,337.00 | 3 | 1,524.68 | 81.2 |
| H-6 | 1,340.00 | 1 | 1,524.55 | 79.8 |
| H-7 | 1,329.00 | 3 | 1,524.62 | 84.6 |
| H-7A | 1,332.00 | 0 | 1,524.47 | 83.3 |
| H-8 | 1,340.00 | 0 | 1,524.34 | 79.8 |
| H-9 | 1,345.00 | 0 | 1,524.31 | 77.6 |
| H-10 | 1,357.00 | 0 | 1,524.29 | 72.4 |
| H-11 | 1,328.00 | 0 | 1,524.26 | 84.9 |
| H-12 | 1,300.00 | 1 | 1,524.25 | 97.0 |
| H-13 | 1,285.00 | 1 | 1,524.26 | 103.5 |
| H-14 | 1,282.00 | 0 | 1,524.26 | 104.8 |
| H-15 | 1,316.00 | 0 | 1,524.26 | 90.1 |
| H-16 | 1,295.00 | 0 | 1,524.27 | 99.2 |
| H-17 | 1,323.00 | 0 | 1,524.28 | 87.1 |
| H-18 | 1,334.00 | 2 | 1,524.29 | 82.3 |
| H-19 | 1,360.00 | 0 | 1,524.22 | 71.1 |
| H-20 | 1,365.00 | 1 | 1,524.14 | 68.9 |
| H-21 | 1,364.00 | 0 | 1,524.12 | 69.3 |
| H-22 | 1,373.00 | 4 | 1,524.12 | 65.4 |
| H-23 | 1,378.00 | 6 | 1,524.11 | 63.2 |
| H-24 | 1,376.00 | 0 | 1,524.11 | 64.1 |
| H-25 | 1,374.00 | 0 | 1,524.11 | 64.9 |
| H-26 | 1,371.00 | 0 | 1,524.11 | 66.2 |
| H-27 | 1,370.00 | 0 | 1,524.11 | 66.7 |
| H-28 | 1,371.00 | 0 | 1,524.11 | 66.2 |
| H-29 | 1,377.00 | 0 | 1,524.11 | 63.6 |
| H-30 | 1,372.00 | 2 | 1,524.11 | 65.8 |
| H-31 | 1,378.00 | 2 | 1,524.11 | 63.2 |
| H-32 | 1,372.00 | 6 | 1,524.11 | 65.8 |
| H-33 | 1,377.00 | 2 | 1,524.11 | 63.6 |
| H-34 | 1,368.83 | 1 | 1,524.13 | 67.2 |
| H-35 | 1,371.00 | 1 | 1,524.11 | 66.2 |
| H-36 | 1,374.00 | 4 | 1,524.11 | 64.9 |
| H-37 | 1,367.00 | 1 | 1,524.11 | 68.0 |
| H-38 | 1,366.00 | 0 | 1,524.11 | 68.4 |
| H-39 | 1,364.44 | 2 | 1,524.11 | 69.1 |
| H-40 | 1,366.00 | 3 | 1,524.11 | 68.4 |
| H-41 | 1,366.00 | 4 | 1,524.24 | 68.5 |
| H-42 | 1,355.00 | 4 | 1,524.45 | 73.3 |
| H-43 | 1,346.00 | 5 | 1,524.60 | 77.3 |
| H-44 | 1,360.00 | 0 | 1,524.59 | 71.2 |
| H-45 | 1,358.00 | 0 | 1,524.59 | 72.1 |
| H-46 | 1,361.00 | 0 | 1,524.59 | 70.8 |
| H-47 | 1,357.00 | 0 | 1,524.59 | 72.5 |

# FlexTable: Hydrant Table (System Model_background2.wtg)
# Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| H-48 | 1,352.00 | 18 | 1,524.66 | 74.7 |
| H-49 | 1,359.00 | 0 | 1,524.70 | 71.7 |
| H-50 | 1,349.00 | 3 | 1,524.78 | 76.1 |
| H-50A | 1,349.00 | 0 | 1,524.77 | 76.0 |
| H-51 | 1,341.00 | 4 | 1,524.80 | 79.5 |
| H-52 | 1,347.00 | 2 | 1,524.96 | 77.0 |
| H-53 | 1,345.00 | 2 | 1,525.05 | 77.9 |
| H-54 | 1,352.00 | 3 | 1,525.15 | 74.9 |
| H-55 | 1,346.00 | 0 | 1,525.35 | 77.6 |
| H-56 | 1,355.00 | 0 | 1,525.70 | 73.9 |
| H-57 | 1,352.00 | 0 | 1,529.84 | 76.9 |
| H-58 | 1,363.00 | 4 | 1,530.21 | 72.3 |
| H-59 | 1,374.00 | 2 | 1,529.53 | 67.3 |
| H-60 | 1,390.00 | 0 | 1,529.30 | 60.3 |
| H-61 | 1,398.00 | 4 | 1,529.58 | 56.9 |
| H-62 | 1,364.00 | 0 | 1,529.99 | 71.8 |
| H-63 | 1,361.36 | 4 | 1,524.73 | 70.7 |
| H-64 | 1,366.00 | 2 | 1,523.89 | 68.3 |
| H-65 | 1,381.00 | 4 | 1,523.69 | 61.7 |
| H-66 | 1,397.00 | 4 | 1,523.50 | 54.7 |
| H-67 | 1,392.00 | 6 | 1,523.40 | 56.9 |
| H-68 | 1,377.00 | 4 | 1,523.40 | 63.3 |
| H-69 | 1,385.00 | 0 | 1,523.24 | 59.8 |
| H-70 | 1,396.00 | 3 | 1,523.24 | 55.0 |
| H-70A | 1,382.00 | 0 | 1,523.24 | 61.1 |
| H-71 | 1,369.00 | 2 | 1,523.69 | 66.9 |
| H-71A | 1,362.00 | 1 | 1,523.89 | 70.0 |
| H-72 | 1,362.00 | 0 | 1,523.90 | 70.0 |
| H-73 | 1,383.00 | 1 | 1,523.90 | 61.0 |
| H-74 | 1,374.00 | 2 | 1,523.90 | 64.9 |
| H-75 | 1,389.00 | 3 | 1,523.62 | 58.2 |
| H-76 | 1,401.00 | 43 | 1,523.14 | 52.8 |
| H-77 | 1,413.00 | 1 | 1,522.89 | 47.5 |
| H-78 | 1,414.00 | 0 | 1,522.97 | 47.1 |
| H-79 | 1,413.00 | 0 | 1,522.97 | 47.6 |
| H-80 | 1,402.00 | 0 | 1,522.97 | 52.3 |
| H-81 | 1,379.00 | 1 | 1,523.93 | 62.7 |
| H-82 | 1,381.00 | 2 | 1,524.00 | 61.9 |
| H-83 | 1,377.00 | 1 | 1,524.08 | 63.6 |
| H-84 | 1,363.50 | 2 | 1,524.09 | 69.5 |
| H-85 | 1,357.00 | 1 | 1,524.11 | 72.3 |
| H-86 | 1,353.00 | 2 | 1,524.14 | 74.0 |
| H-87 | 1,357.00 | 4 | 1,524.14 | 72.3 |
| H-88 | 1,358.00 | 1 | 1,524.14 | 71.9 |
| H-89 | 1,358.24 | 0 | 1,524.14 | 71.8 |
| H-90 | 1,360.00 | 0 | 1,524.14 | 71.0 |
| H-91 | 1,366.00 | 0 | 1,524.14 | 68.4 |
| H-92 | 1,368.00 | 0 | 1,524.14 | 67.6 |

# FlexTable: Hydrant Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| H-93 | 1,368.00 | 0 | 1,524.14 | 67.6 |
| H-94 | 1,328.00 | 0 | 1,524.62 | 85.1 |
| H-95 | 1,328.00 | 4 | 1,524.63 | 85.1 |
| H-96 | 1,322.00 | 6 | 1,524.63 | 87.7 |
| H-96A | 1,292.00 | 3 | 1,524.63 | 100.6 |
| H-97 | 1,334.00 | 5 | 1,524.62 | 82.5 |
| H-98 | 1,328.00 | 3 | 1,524.63 | 85.1 |
| H-99 | 1,322.00 | 1 | 1,524.64 | 87.7 |
| H-100 | 1,334.00 | 4 | 1,524.59 | 82.5 |
| H-101 | 1,324.00 | 4 | 1,524.64 | 86.8 |
| H-102 | 1,323.00 | 2 | 1,524.66 | 87.2 |
| H-103 | 1,326.00 | 4 | 1,524.74 | 86.0 |
| H-104 | 1,332.00 | 9 | 1,524.78 | 83.4 |
| H-105 | 1,332.00 | 3 | 1,524.78 | 83.4 |
| H-106 | 1,340.00 | 3 | 1,524.86 | 80.0 |
| H-107 | 1,337.00 | 30 | 1,524.76 | 81.2 |
| H-108 | 1,349.00 | 0 | 1,524.76 | 76.0 |
| H-109 | 1,351.00 | 0 | 1,524.76 | 75.2 |
| H-110 | 1,282.00 | 2 | 1,524.93 | 105.1 |
| H-111 | 1,277.00 | 0 | 1,525.17 | 107.4 |
| H-112 | 1,330.00 | 1 | 1,524.75 | 84.3 |
| H-113 | 1,332.00 | 7 | 1,524.76 | 83.4 |
| H-114 | 1,326.00 | 12 | 1,524.75 | 86.0 |
| H-115 | 1,324.00 | 4 | 1,524.65 | 86.8 |
| H-116 | 1,333.00 | 5 | 1,524.65 | 82.9 |
| H-117 | 1,330.00 | 0 | 1,524.69 | 84.2 |
| H-118 | 1,326.00 | 1 | 1,524.71 | 86.0 |
| H-119 | 1,330.00 | 12 | 1,524.77 | 84.3 |
| H-120 | 1,333.00 | 3 | 1,524.77 | 83.0 |
| H-121 | 1,334.00 | 4 | 1,524.77 | 82.5 |
| H-122 | 1,336.00 | 13 | 1,524.83 | 81.7 |
| H-123 | 1,332.00 | 7 | 1,524.84 | 83.4 |
| H-124 | 1,326.00 | 15 | 1,525.01 | 86.1 |
| H-125 | 1,328.00 | 8 | 1,524.84 | 85.2 |
| H-125A | 1,330.00 | 0 | 1,524.84 | 84.3 |
| H-126 | 1,278.32 | 0 | 1,525.05 | 106.8 |
| H-127 | 1,277.00 | 1 | 1,525.05 | 107.3 |
| H-128 | 1,275.00 | 1 | 1,525.05 | 108.2 |
| H-129 | 1,273.00 | 1 | 1,525.06 | 109.1 |
| H-130 | 1,273.00 | 0 | 1,525.07 | 109.1 |
| H-131 | 1,272.00 | 0 | 1,525.07 | 109.5 |
| H-132 | 1,270.00 | 0 | 1,525.08 | 110.4 |
| H-133 | 1,272.00 | 0 | 1,525.09 | 109.5 |
| H-134 | 1,272.00 | 0 | 1,525.10 | 109.5 |
| H-135 | 1,272.00 | 0 | 1,525.15 | 109.5 |
| H-136 | 1,272.00 | 1 | 1,525.24 | 109.6 |
| H-137 | 1,271.50 | 2 | 1,525.23 | 109.8 |
| H-138 | 1,271.00 | 0 | 1,525.21 | 110.0 |

# FlexTable: Hydrant Table (System Model_background2.wtg)
# Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Elevation (ft) | Demand (gpm) | Hydraulic Grade (ft) | Pressure (psi) |
|---|---|---|---|---|
| H-139 | 1,270.00 | 0 | 1,525.18 | 110.4 |
| H-140 | 1,267.00 | 0 | 1,525.18 | 111.7 |
| H-141 | 1,265.00 | 0 | 1,525.18 | 112.6 |
| H-142 | 1,265.00 | 0 | 1,525.18 | 112.6 |
| H-143 | 1,267.00 | 0 | 1,525.18 | 111.7 |
| H-144 | 1,268.00 | 0 | 1,525.18 | 111.3 |

# FlexTable: Tank Table (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Elevation (Base) (ft) | Elevation (Minimum) (ft) | Elevation (Initial) (ft) | Elevation (Maximum) (ft) | Diameter (ft) | Flow (Out net) (gpm) | Hydraulic Grade (ft) |
|---|---|---|---|---|---|---|---|
| T-3 | 1,513.00 | 1,519.00 | 1,522.00 | 1,530.50 | 70.00 | -280 | 1,522.00 |
| T-4 | 1,490.00 | 1,518.00 | 1,525.00 | 1,530.50 | 80.00 | 125 | 1,525.00 |
| T-1 | 1,513.00 | 1,518.00 | 1,523.00 | 1,529.00 | 60.00 | -1,212 | 1,523.00 |
| T-2 | 1,339.00 | 1,342.00 | 1,351.00 | 1,364.00 | 60.00 | -775 | 1,351.00 |

# Fire Flow Node FlexTable: Fire Flow Report (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Satisfies Fire Flow Constraints? | Fire Flow (Needed) (gpm) | Fire Flow (Available) (gpm) | Pressure (Residual Lower Limit) (psi) | Pressure (Calculated Residual) (psi) |
|---|---|---|---|---|---|
| J-3 | True | 1,000 | 3,500 | 20.0 | 74.8 |
| J-6 | True | 1,000 | 3,500 | 20.0 | 53.8 |
| J-8 | True | 1,000 | 3,500 | 20.0 | 27.7 |
| J-10 | True | 1,000 | 3,500 | 20.0 | 41.6 |
| J-11 | True | 1,000 | 3,500 | 20.0 | 43.6 |
| J-12 | True | 1,000 | 3,500 | 20.0 | 43.2 |
| J-13 | True | 1,000 | 3,500 | 20.0 | 50.2 |
| J-14 | True | 1,000 | 3,500 | 20.0 | 30.0 |
| J-15 | True | 1,000 | 1,097 | 20.0 | 20.0 |
| J-16 | False | 1,000 | 780 | 20.0 | 20.1 |
| J-17 | True | 1,000 | 2,143 | 20.0 | 20.0 |
| J-19 | True | 1,000 | 3,500 | 20.0 | 43.6 |
| J-23 | True | 1,000 | 3,500 | 20.0 | 66.3 |
| J-25 | True | 1,000 | 3,500 | 20.0 | 32.2 |
| J-26 | True | 1,000 | 3,500 | 20.0 | 35.8 |
| J-30 | True | 1,000 | 2,692 | 20.0 | 20.0 |
| J-31 | True | 1,000 | 1,959 | 20.0 | 20.0 |
| J-32 | True | 1,000 | 2,111 | 20.0 | 20.0 |
| J-34 | True | 1,000 | 3,500 | 20.0 | 53.9 |
| J-36 | True | 1,000 | 3,500 | 20.0 | 27.5 |
| J-37 | True | 1,000 | 3,500 | 20.0 | 29.5 |
| J-41 | True | 1,000 | 2,131 | 20.0 | 20.0 |
| J-44 | True | 1,000 | 2,301 | 20.0 | 20.0 |
| J-45 | True | 1,000 | 3,355 | 20.0 | 20.0 |
| J-46 | True | 1,000 | 3,500 | 20.0 | 58.6 |
| J-47 | True | 1,000 | 3,500 | 20.0 | 58.9 |
| J-51 | True | 1,000 | 3,500 | 20.0 | 50.2 |
| J-55 | True | 1,000 | 3,500 | 20.0 | 41.4 |
| J-60 | True | 1,000 | 3,500 | 20.0 | 28.9 |
| J-61 | True | 1,000 | 3,428 | 20.0 | 20.0 |
| J-63 | True | 1,000 | 3,139 | 20.0 | 20.0 |
| J-65 | True | 1,000 | 3,233 | 20.0 | 20.0 |
| J-68 | True | 1,000 | 3,500 | 20.0 | 37.1 |
| J-69 | True | 1,000 | 3,500 | 20.0 | 25.5 |
| J-74 | True | 1,000 | 3,500 | 20.0 | 21.9 |
| J-76 | True | 1,000 | 3,339 | 20.0 | 20.0 |
| J-77 | True | 1,000 | 3,500 | 20.0 | 43.0 |
| J-78 | True | 1,000 | 3,500 | 20.0 | 27.9 |
| J-81 | True | 1,000 | 3,500 | 20.0 | 65.0 |
| J-83 | True | 1,000 | 3,500 | 20.0 | 53.0 |
| J-87 | True | 1,000 | 3,500 | 20.0 | 37.7 |
| J-97 | True | 1,000 | 3,500 | 20.0 | 69.3 |
| J-107 | True | 1,000 | 3,500 | 20.0 | 72.0 |
| J-109 | True | 1,000 | 3,500 | 20.0 | 68.0 |
| J-110 | True | 1,000 | 3,500 | 20.0 | 60.3 |
| J-113 | True | 1,000 | 3,500 | 20.0 | 62.5 |

# Fire Flow Node FlexTable: Fire Flow Report (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

**Current Time: 0.000 hours**

| Label | Satisfies Fire Flow Constraints? | Fire Flow (Needed) (gpm) | Fire Flow (Available) (gpm) | Pressure (Residual Lower Limit) (psi) | Pressure (Calculated Residual) (psi) |
|---|---|---|---|---|---|
| J-115 | True | 1,000 | 3,500 | 20.0 | 32.0 |
| J-118 | True | 1,000 | 3,483 | 20.0 | 20.0 |
| J-119 | False | 1,000 | 635 | 20.0 | 20.0 |
| J-120 | True | 1,000 | 3,500 | 20.0 | 55.9 |
| J-123 | True | 1,000 | 3,500 | 20.0 | 60.3 |
| J-125 | True | 1,000 | 3,500 | 20.0 | 57.1 |
| J-127 | True | 1,000 | 3,500 | 20.0 | 62.0 |
| J-134 | True | 1,000 | 1,896 | 20.0 | 20.0 |
| J-138 | True | 1,000 | 3,500 | 20.0 | 64.6 |
| J-139 | True | 1,000 | 3,500 | 20.0 | 65.3 |
| J-140 | False | 1,000 | 951 | 20.0 | 20.0 |
| J-142 | True | 1,000 | 3,500 | 20.0 | 68.8 |
| J-153 | True | 1,000 | 3,500 | 20.0 | 50.3 |
| J-159 | True | 1,000 | 3,500 | 20.0 | 57.0 |
| J-162 | True | 1,000 | 2,378 | 20.0 | 20.0 |
| J-164 | True | 1,000 | 1,600 | 20.0 | 20.0 |
| J-166 | True | 1,000 | 1,734 | 20.0 | 20.0 |
| J-167 | True | 1,000 | 3,500 | 20.0 | 74.8 |
| J-168 | False | 1,000 | 0 | 20.0 | 5.2 |
| H-56 | True | 1,000 | 3,500 | 20.0 | 67.2 |
| H-55 | True | 1,000 | 3,500 | 20.0 | 67.5 |
| H-67 | True | 1,000 | 3,500 | 20.0 | 54.4 |
| H-65 | True | 1,000 | 3,500 | 20.0 | 58.2 |
| H-64 | True | 1,000 | 3,500 | 20.0 | 64.3 |
| H-120 | True | 1,000 | 3,500 | 20.0 | 67.8 |
| H-117 | True | 1,000 | 3,500 | 20.0 | 69.4 |
| H-116 | True | 1,000 | 3,500 | 20.0 | 66.3 |
| H-101 | True | 1,000 | 3,500 | 20.0 | 70.3 |
| H-102 | True | 1,000 | 3,500 | 20.0 | 69.6 |
| H-103 | True | 1,000 | 3,500 | 20.0 | 65.4 |
| H-104 | True | 1,000 | 3,500 | 20.0 | 59.4 |
| H-106 | True | 1,000 | 3,500 | 20.0 | 50.0 |
| H-68 | True | 1,000 | 1,253 | 20.0 | 20.0 |
| H-69 | True | 1,000 | 1,968 | 20.0 | 20.0 |
| H-70A | True | 1,000 | 2,092 | 20.0 | 20.0 |
| H-70 | True | 1,000 | 3,500 | 20.0 | 46.8 |
| H-66 | True | 1,000 | 3,324 | 20.0 | 20.0 |
| H-71 | True | 1,000 | 1,635 | 20.0 | 20.0 |
| H-63 | True | 1,000 | 3,500 | 20.0 | 64.5 |
| H-2 | True | 1,000 | 3,500 | 20.0 | 64.4 |
| H-3 | True | 1,000 | 3,500 | 20.0 | 68.6 |
| H-1 | True | 1,000 | 2,616 | 20.0 | 20.0 |
| H-60 | True | 1,000 | 3,500 | 20.0 | 39.2 |
| H-61 | True | 1,000 | 3,500 | 20.0 | 28.4 |
| H-59 | True | 1,000 | 3,500 | 20.0 | 44.0 |
| H-58 | True | 1,000 | 3,500 | 20.0 | 54.8 |

# Fire Flow Node FlexTable: Fire Flow Report (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Satisfies Fire Flow Constraints? | Fire Flow (Needed) (gpm) | Fire Flow (Available) (gpm) | Pressure (Residual Lower Limit) (psi) | Pressure (Calculated Residual) (psi) |
|---|---|---|---|---|---|
| H-62 | True | 1,000 | 3,500 | 20.0 | 32.6 |
| H-72 | True | 1,000 | 3,500 | 20.0 | 49.4 |
| H-71A | True | 1,000 | 3,500 | 20.0 | 55.5 |
| H-73 | True | 1,000 | 2,863 | 20.0 | 20.0 |
| H-74 | True | 1,000 | 3,500 | 20.0 | 47.1 |
| H-76 | True | 1,000 | 3,500 | 20.0 | 38.9 |
| H-77 | True | 1,000 | 3,500 | 20.0 | 33.9 |
| H-78 | True | 1,000 | 2,877 | 20.0 | 20.0 |
| H-80 | True | 1,000 | 2,021 | 20.0 | 20.0 |
| H-79 | True | 1,000 | 2,217 | 20.0 | 20.0 |
| H-57 | True | 1,000 | 3,500 | 20.0 | 42.6 |
| H-40 | True | 1,000 | 3,500 | 20.0 | 53.1 |
| H-41 | True | 1,000 | 3,500 | 20.0 | 49.3 |
| H-42 | True | 1,000 | 3,500 | 20.0 | 55.3 |
| H-6 | True | 1,000 | 3,500 | 20.0 | 65.6 |
| H-43 | True | 1,000 | 3,500 | 20.0 | 57.6 |
| H-48 | True | 1,000 | 3,500 | 20.0 | 52.3 |
| H-44 | True | 1,000 | 1,898 | 20.0 | 20.0 |
| H-45 | True | 1,000 | 1,875 | 20.0 | 20.0 |
| H-46 | True | 1,000 | 1,712 | 20.0 | 20.0 |
| H-47 | True | 1,000 | 1,630 | 20.0 | 20.0 |
| H-5 | True | 1,000 | 3,500 | 20.0 | 63.9 |
| H-49 | True | 1,000 | 1,035 | 20.0 | 20.0 |
| H-50A | True | 1,000 | 3,500 | 20.0 | 21.3 |
| H-50 | True | 1,000 | 3,500 | 20.0 | 25.5 |
| H-51 | True | 1,000 | 3,500 | 20.0 | 60.2 |
| H-52 | True | 1,000 | 3,500 | 20.0 | 34.2 |
| H-54 | True | 1,000 | 3,500 | 20.0 | 20.3 |
| H-53 | True | 1,000 | 3,500 | 20.0 | 62.6 |
| H-4 | True | 1,000 | 3,500 | 20.0 | 64.3 |
| H-7A | True | 1,000 | 3,500 | 20.0 | 54.2 |
| H-39 | True | 1,000 | 3,500 | 20.0 | 44.1 |
| H-37 | True | 1,000 | 3,500 | 20.0 | 40.4 |
| H-38 | True | 1,000 | 3,372 | 20.0 | 20.0 |
| H-35 | True | 1,000 | 3,500 | 20.0 | 40.2 |
| H-36 | True | 1,000 | 3,374 | 20.0 | 20.0 |
| H-33 | True | 1,000 | 3,500 | 20.0 | 39.1 |
| H-75 | True | 1,000 | 3,500 | 20.0 | 46.1 |
| H-81 | True | 1,000 | 3,500 | 20.0 | 42.1 |
| H-82 | True | 1,000 | 3,500 | 20.0 | 33.0 |
| H-83 | True | 1,000 | 3,500 | 20.0 | 37.6 |
| H-85 | True | 1,000 | 3,500 | 20.0 | 25.1 |
| H-84 | True | 1,000 | 3,500 | 20.0 | 30.7 |
| H-30 | True | 1,000 | 3,133 | 20.0 | 20.0 |
| H-31 | True | 1,000 | 3,500 | 20.0 | 32.1 |
| H-29 | True | 1,000 | 3,500 | 20.0 | 29.6 |

# Fire Flow Node FlexTable: Fire Flow Report (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

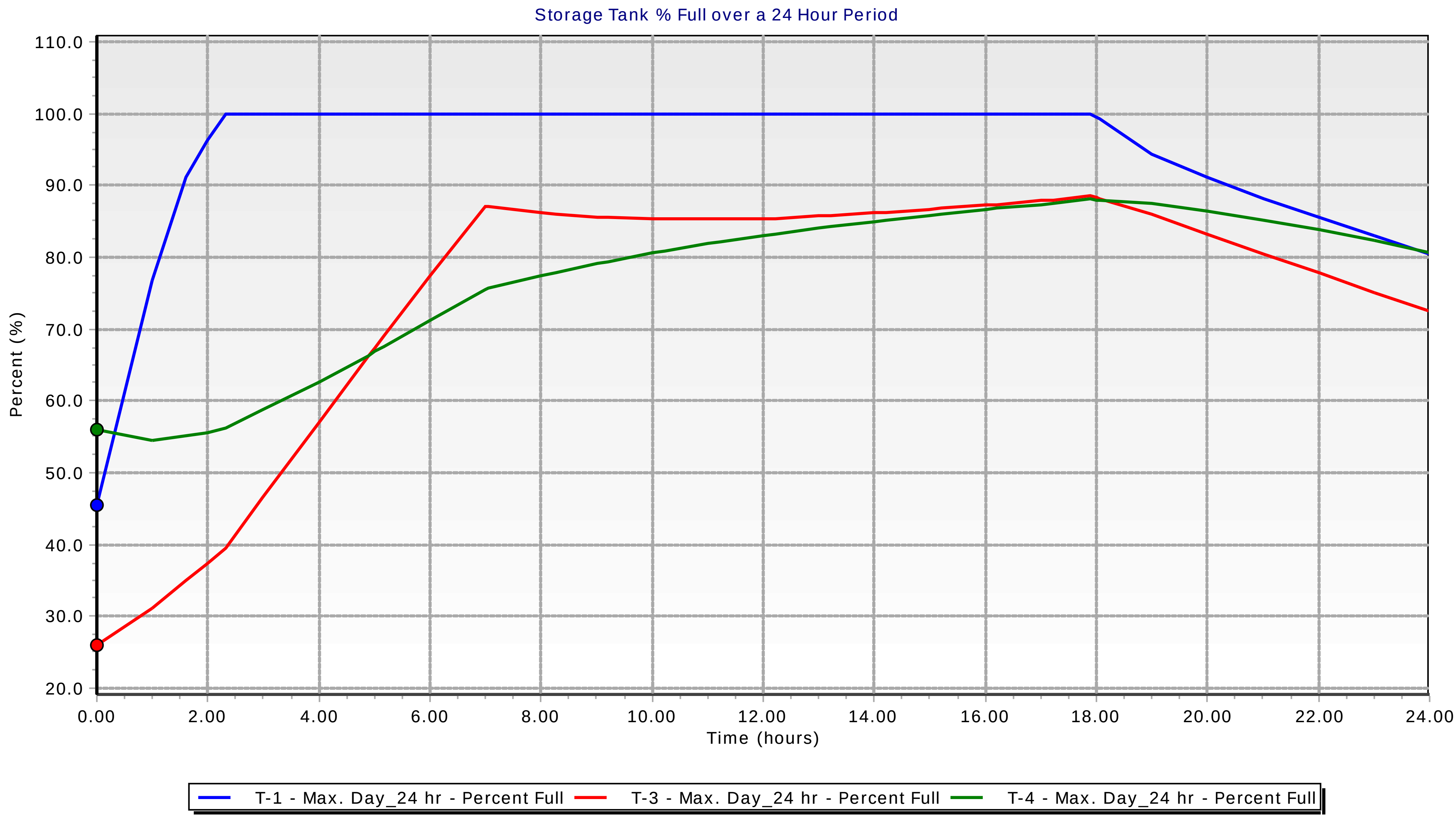
**Current Time: 0.000 hours**

| Label | Satisfies Fire Flow Constraints? | Fire Flow (Needed) (gpm) | Fire Flow (Available) (gpm) | Pressure (Residual Lower Limit) (psi) | Pressure (Calculated Residual) (psi) |
|---|---|---|---|---|---|
| H-34 | True | 1,000 | 3,500 | 20.0 | 40.2 |
| H-32 | True | 1,000 | 3,500 | 20.0 | 30.2 |
| H-20 | True | 1,000 | 3,500 | 20.0 | 43.4 |
| H-19 | True | 1,000 | 3,500 | 20.0 | 44.6 |
| H-21 | True | 1,000 | 3,500 | 20.0 | 32.3 |
| H-22 | True | 1,000 | 3,500 | 20.0 | 33.4 |
| H-23 | True | 1,000 | 3,500 | 20.0 | 28.3 |
| H-28 | True | 1,000 | 3,275 | 20.0 | 20.0 |
| H-26 | True | 1,000 | 3,298 | 20.0 | 20.0 |
| H-25 | True | 1,000 | 3,252 | 20.0 | 20.0 |
| H-27 | True | 1,000 | 3,207 | 20.0 | 20.0 |
| H-24 | True | 1,000 | 3,121 | 20.0 | 20.0 |
| H-7 | True | 1,000 | 2,638 | 20.0 | 20.0 |
| H-9 | True | 1,000 | 3,500 | 20.0 | 57.8 |
| H-8 | True | 1,000 | 3,500 | 20.0 | 60.4 |
| H-18 | True | 1,000 | 3,500 | 20.0 | 43.3 |
| H-17 | True | 1,000 | 3,500 | 20.0 | 42.6 |
| H-15 | True | 1,000 | 2,718 | 20.0 | 20.0 |
| H-10 | True | 1,000 | 3,500 | 20.0 | 21.2 |
| H-11 | True | 1,000 | 3,500 | 20.0 | 55.4 |
| H-16 | True | 1,000 | 3,500 | 20.0 | 52.4 |
| H-13 | True | 1,000 | 3,500 | 20.0 | 58.8 |
| H-12 | True | 1,000 | 3,500 | 20.0 | 61.9 |
| H-93 | True | 1,000 | 1,249 | 20.0 | 20.0 |
| H-88 | True | 1,000 | 2,176 | 20.0 | 20.0 |
| H-87 | True | 1,000 | 2,301 | 20.0 | 20.0 |
| H-86 | True | 1,000 | 2,685 | 20.0 | 20.0 |
| H-89 | True | 1,000 | 2,227 | 20.0 | 20.0 |
| H-90 | True | 1,000 | 2,128 | 20.0 | 20.0 |
| H-92 | True | 1,000 | 1,339 | 20.0 | 20.0 |
| H-91 | True | 1,000 | 1,586 | 20.0 | 20.0 |
| H-96A | True | 1,000 | 3,433 | 20.0 | 20.0 |
| H-100 | True | 1,000 | 3,500 | 20.0 | 68.0 |
| H-96 | True | 1,000 | 3,500 | 20.0 | 50.4 |
| H-95 | True | 1,000 | 3,500 | 20.0 | 39.8 |
| H-94 | True | 1,000 | 3,500 | 20.0 | 37.5 |
| H-97 | True | 1,000 | 3,500 | 20.0 | 49.4 |
| H-98 | True | 1,000 | 3,500 | 20.0 | 50.6 |
| H-99 | True | 1,000 | 3,500 | 20.0 | 60.0 |
| H-105 | True | 1,000 | 3,196 | 20.0 | 20.0 |
| H-109 | False | 1,000 | 878 | 20.0 | 20.0 |
| H-107 | True | 1,000 | 1,391 | 20.0 | 20.0 |
| H-110 | True | 1,000 | 2,507 | 20.0 | 20.0 |
| H-111 | True | 1,000 | 3,500 | 20.0 | 68.5 |
| H-136 | True | 1,000 | 3,500 | 20.0 | 64.6 |
| H-137 | True | 1,000 | 3,500 | 20.0 | 33.3 |

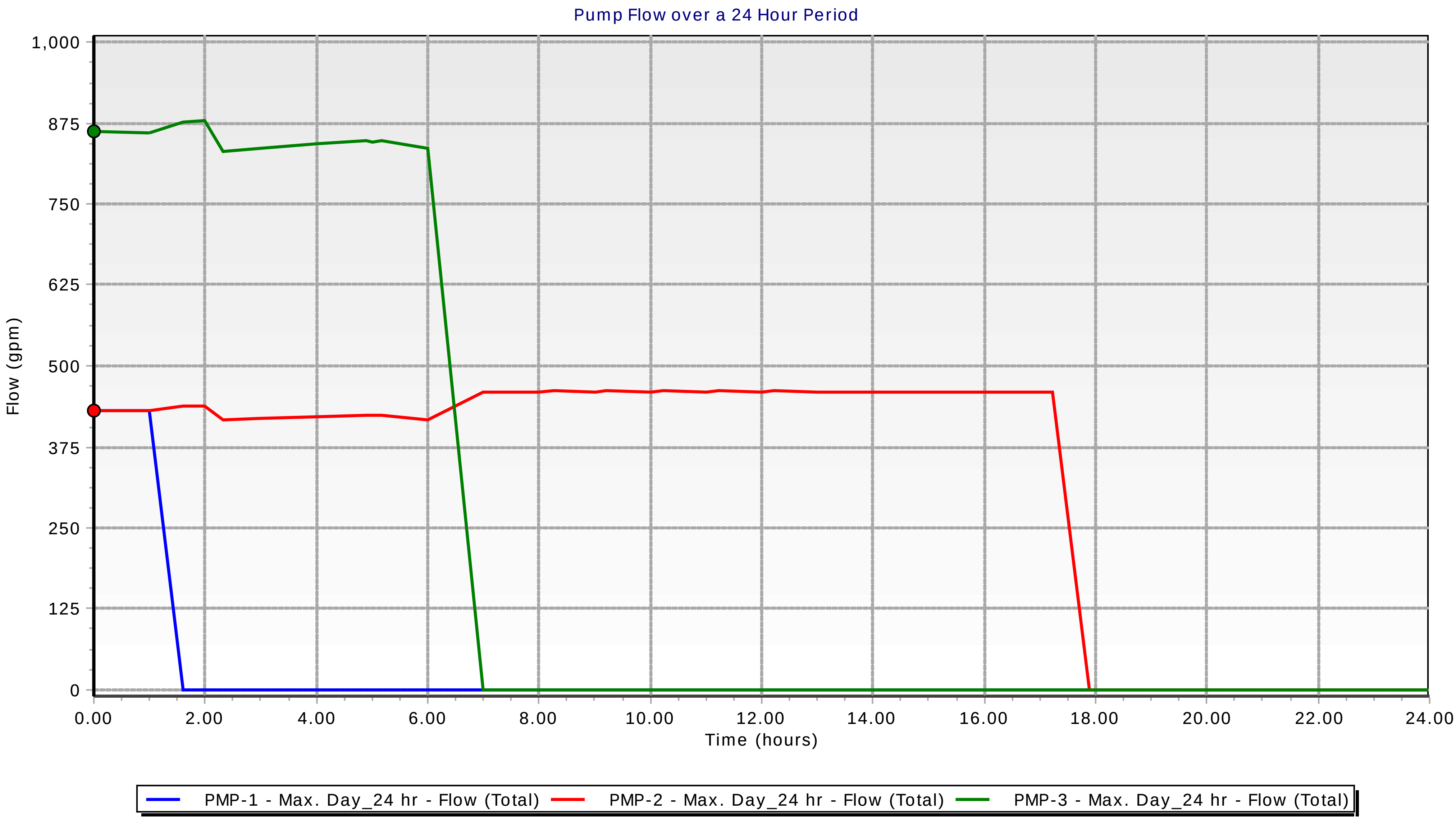
# Fire Flow Node FlexTable: Fire Flow Report (System Model_background2.wtg)
## Active Scenario: Max. Day_Fire Flow

### Current Time: 0.000 hours

| Label | Satisfies Fire Flow Constraints? | Fire Flow (Needed) (gpm) | Fire Flow (Available) (gpm) | Pressure (Residual Lower Limit) (psi) | Pressure (Calculated Residual) (psi) |
|---|---|---|---|---|---|
| H-138 | True | 1,000 | 3,500 | 20.0 | 63.4 |
| H-142 | True | 1,000 | 2,717 | 20.0 | 20.0 |
| H-139 | True | 1,000 | 3,500 | 20.0 | 40.5 |
| H-140 | True | 1,000 | 3,009 | 20.0 | 20.0 |
| H-141 | True | 1,000 | 2,754 | 20.0 | 20.0 |
| H-143 | True | 1,000 | 2,808 | 20.0 | 20.0 |
| H-144 | True | 1,000 | 3,054 | 20.0 | 20.0 |
| H-135 | True | 1,000 | 3,500 | 20.0 | 60.7 |
| H-134 | True | 1,000 | 3,500 | 20.0 | 60.1 |
| H-130 | True | 1,000 | 3,500 | 20.0 | 56.3 |
| H-126 | True | 1,000 | 3,500 | 20.0 | 55.3 |
| H-127 | True | 1,000 | 3,500 | 20.0 | 53.6 |
| H-128 | True | 1,000 | 3,500 | 20.0 | 49.3 |
| H-129 | True | 1,000 | 3,500 | 20.0 | 47.5 |
| H-131 | True | 1,000 | 3,500 | 20.0 | 47.4 |
| H-132 | True | 1,000 | 3,500 | 20.0 | 49.8 |
| H-133 | True | 1,000 | 3,500 | 20.0 | 53.6 |
| H-112 | True | 1,000 | 3,500 | 20.0 | 57.3 |
| H-113 | True | 1,000 | 3,500 | 20.0 | 54.2 |
| H-125 | True | 1,000 | 3,500 | 20.0 | 51.3 |
| H-125A | True | 1,000 | 3,500 | 20.0 | 25.4 |
| H-121 | True | 1,000 | 3,500 | 20.0 | 63.1 |
| H-123 | True | 1,000 | 3,500 | 20.0 | 67.3 |
| H-124 | True | 1,000 | 3,500 | 20.0 | 64.2 |
| H-114 | True | 1,000 | 3,500 | 20.0 | 54.1 |
| H-115 | True | 1,000 | 3,500 | 20.0 | 65.8 |
| H-118 | True | 1,000 | 3,500 | 20.0 | 67.9 |
| H-119 | True | 1,000 | 3,500 | 20.0 | 67.7 |
| H-122 | True | 1,000 | 3,500 | 20.0 | 66.4 |
| H-14 | True | 1,000 | 3,500 | 20.0 | 35.8 |
| H-108 | True | 1,000 | 1,050 | 20.0 | 20.0 |
| J-178 | True | 1,000 | 3,500 | 20.0 | 55.0 |
| J-179 | True | 1,000 | 3,500 | 20.0 | 63.3 |
| J-180 | True | 1,000 | 3,500 | 20.0 | 66.3 |
| J-181 | True | 1,000 | 3,500 | 20.0 | 35.4 |
| J-182 | False | 1,000 | 0 | 20.0 | 0.4 |
| J-183 | False | 1,000 | 0 | 20.0 | 5.2 |
| J-184 | True | 1,000 | 3,500 | 20.0 | 67.1 |
| J-185 | True | 1,000 | 3,500 | 20.0 | 53.8 |
| J-186 | False | 1,000 | 98 | 20.0 | 20.7 |
| J-187 | False | 1,000 | 302 | 20.0 | 20.0 |



Storage Tank % Full over a 24 Hour Period
Percent (%)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
T-1 - Max. Day_24 hr - Percent Full
T-3 - Max. Day_24 hr - Percent Full
T-4 - Max. Day_24 hr - Percent Full


Pump Flow over a 24 Hour Period
Flow (gpm)
1,000
875
750
625
500
375
250
125
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
PMP-1 - Max. Day_24 hr - Flow (Total)
PMP-2 - Max. Day_24 hr - Flow (Total)
PMP-3 - Max. Day_24 hr - Flow (Total)