CHAPTER EIGHT
DISTRIBUTION SYSTEM

A. Introduction

The distribution system is characterized by three pressure zones which are gravity fed from reinforced concrete tanks; the Coombe Flat and the two Canyon tanks in Zone 3 and the Eck Tank in Zone 2. Exhibit 8-1 shows Providence City's existing distribution system is characterized by pipelines ranging from 1 to 12 inches in diameter. This chapter reviews the adequacy of the distribution system to meet existing and future requirements, describes the computer model used to evaluate the pipe network, and recommends improvements to the system.

B. Distribution System Requirements

The Providence City water distribution system was evaluated in terms of the State PDWRs, the *Uniform Fire Code* (UFC), and the *Uniform Building Code* (UBC). The State requires that residual water pressure at all locations within a water system maintain a minimum pressure of 20 psi during the peak instantaneous flow conditions. Providence City's existing distribution system requirements are summarized in Chapter 3 Page 3.

The water system distribution requirements for a system can be defined as follows:

Q_t = Total Distribution System Requirement

Q_d = Indoor Flow Requirement

Q_i = Irrigation Flow Requirement

Q_f = Fire Flow Requirement

Indoor Flow Requirement

Peak instantaneous flow for indoor domestic use is defined in the State PDWRs as:

$$Q_d = 10.8\ (N)^{0.64}$$

where "N" equals the number of connections.

The following summarizes indoor flow requirements for the three zones shown in Tables 3-1 through 3-12.

Zone	No. of Connections	Existing Peak Instantaneous Demand	Future Peak Instantaneous Demand
1	723	730 gpm	1276 gpm
2	527	596 gpm	961 gpm
3	32	99 gpm	480 gpm

Irrigation Flow Requirement

The irrigation demand was determined using the State PDWRs guideline for zone 4, and peak day City spring flow and pumping records. The following summarizes the irrigation requirements shown in Tables 3-1 through 3-12.

Zone	Existing Irrigation Requirement	Year 2020 Irrigation Requirement
1	616 gpm	1349 gpm
2	428 gpm	896 gpm
3	25 gpm	303 gpm

Fire Flow Requirement

State PDWRs specify that community water systems must meet fire code requirements as stated in the UFC. Using the UFC, the UBC (which classifies types of construction) fire flows for Providence City were determined for the purposes of this study. For residential housing, a minimum of 1500 gpm for a two hour duration was used as the base requirement. For primary buildings, such as schools, churches, or large commercial buildings, and large residential projects, a fire flow of 2500 gpm for the two hours was used as the base requirements. Therefore, due to the existing development, the fire flow requirement for Zone 1 is 2500 gpm, for Zone 2 is 2500 gpm, and for Zone 3 is 2500 gpm.

Total Demand

The combination of indoor, irrigation, and fire flow requirements is summarized below:

Zone	Existing Requirement	Year 2020 Requirement
1	3543 gpm	4841 gpm
2	3226 gpm	4022 gpm
3	2543 gpm	3015 gpm

C. Distribution System Computer Model

A water distribution system analysis was performed using a personal computer. The computer software used for the pipe network analysis was CYBERNET Version 3.0, which runs within AutoCAD R-14. The general procedures used to define the model are summarized as follows:

- All elements of the water system are coded for input into the model. Each pipe is coded by assigning it a number, length, diameter and material type. Each junction of pipes, or end of pipe, is coded by assigning it a number and an elevation.
- Reservoir data are similarly coded by assigning it an elevation (hydraulic grade) linking it to appropriate pipes.
- Appropriate water demands are entered at each junction node to simulate various water demand scenarios such as peak instantaneous flow, average day flow, or fire flow, etc.
- The computer model is then run to compute the response of the system to the defined demands.
- Output from the model includes rate of flow, direction, velocity, and pressure loss for each pipe in the system. The system pressure for each junction node in the system is also output.
- Inflows and outflows from the system are summarized at the tanks (fixed grade nodes).
- Calibration of the model.
- Exhibit 8-1 shows junction node/pipe numbers for the water system model. This figure is the key to understanding the input to and output from the model.
- Output from several computer models of both the existing system and the proposed system have been summarized.

D Existing Distribution System

Exhibit 8-1 shows the existing Providence City System.

Pipe Sizes

The existing distribution system is characterized by 1-inch through 12-inch diameter pipelines. The following is a list of approximate lengths of each pipe diameter within the system and the percentage each represents in the network.

Pipe Diameter	Total Length	Percentage of Network
1" pipe	160'	0.09 %
2" pipe	10,088'	5.75 %
4" pipe	11,530'	6.57 %
5" pipe	7,813'	4.46 %
6" pipe	62,605'	35.69 %
8" pipe	42,481'	24.22 %
10" pipe	15,657'	8.93 %
12" pipe	25,061'	14.29 %
Total:	**175,395'**	**100.00 %**

Fire Hydrants

Generally, existing fire hydrants in Providence are 600 to 700 feet apart. The UFC requires that fire hydrants be no farther than 500 feet apart, or no structures more than 250 feet from a fire hydrant, for areas with fire flow requirements of 1,750 gpm or less. In addition, the UFC requires that fire hydrants be no farther than 450 feet apart, or no structures farther than 225 feet from a hydrant, for areas with fire flow requirements of 2500 gpm. The State of Utah requires hydrants to be installed on water lines 8-inches in diameter or larger unless engineering is produced to show that a 6-inch line is adequate for specific locations. Much of the area currently served by the water system does not meet this protection criteria, but has improved substantially over the last five years. Approximately 57.6% of the water lines in the distribution system were 6-inch or greater 5 years ago. Today, 93.1 % of the water lines are 6-inch in diameter or greater.

As previously mentioned, the State PDWRs require that distribution systems be capable of maintaining a system pressure of 20 psi at all locations within the system while both peak day and fire flow demands are being supplied. The CYBERNET computer modeling of the existing Providence City distribution system shows that this requirement is not being met in all areas, but has substantially improved over the last five years.

The majority of the city is now capable of meeting the UFC requirement of 1500 gpm fire flow. The Baur Avenue area, Hillsborough Subdivision and Bindrup Subdivision are the 3 areas that are substandard. In addition the City should be moving towards being capable of providing a fire flow of 2500 gpm in commercial zones and areas where the buildings exceed 9400 square feet without automatic sprinklers.

Therefore, our conclusion is that there are elements of the existing distribution system that

are undersized for existing and future demands and they should be systematically replaced as funds are available.

E. Proposed Distribution System Improvements

Exhibit 8-2 shows the proposed distribution system improvements for Providence City.

In general, all lines less than 8 inches in diameter should be replaced with at least 8-inch diameter lines to comply with the State of Utah fire hydrant requirement. The computer modeling demonstrated that these improvements will meet State PDWR requirements regarding peak day system demands.

Zone 1 Improvements

The improvements to this Zone should include the following:

A. A new 1.5 million gallon reservoir should be built at the Eck Tank location.

B. A pump house and pump needs to be built for use of the 4th South Well.

C. It is recommended that 8-, 10-, and 16-inch diameter lines be constructed to tie in the existing 1st East Well and the new 4th South Well to the new Eck Tank in Zone 2.

Zone 2 Improvements

The improvements in this Zone should include the following:

1. Construction of a 12-inch diameter line linking the proposed Eck Booster Pump Station upgrade to the Zone 3 Redds Tanks.

2. The construction of 10-inch diameter lines along Canyon Road and South Bench Road (400 East). These improvements would increase the fire protection capability of this area of the City.

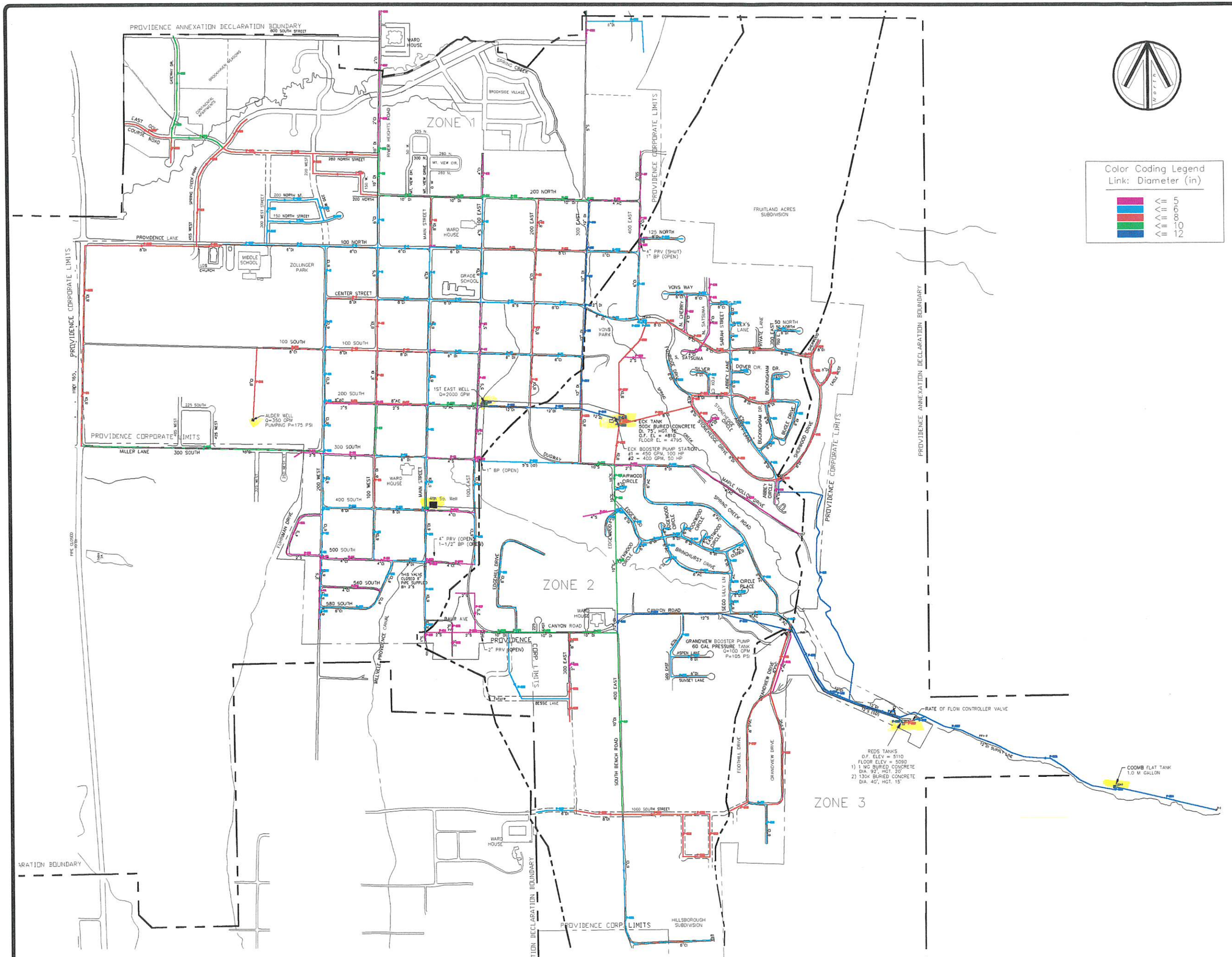
3. In general, upgrading any lines smaller than 6 inches in diameter to 6-inch diameter to comply with the UFC requirements.

Zone 3 Improvements

Improvements in this Zone should include the following:

1. A new 12-inch diameter supply line connecting the proposed Canyon Booster Pump Station and Coombe Flat Tank.

2. A new 8-inch diameter line and PRV station from Grandview Dr. south to connect the Hillsborough Subdivision.



Color Coding Legend
Link: Diameter (in)

5
6
8
10
12

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PROVIDENCE CITY WATER SYSTEM MASTER PLAN

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EXISTING DISTRIBUTION SYSTEM

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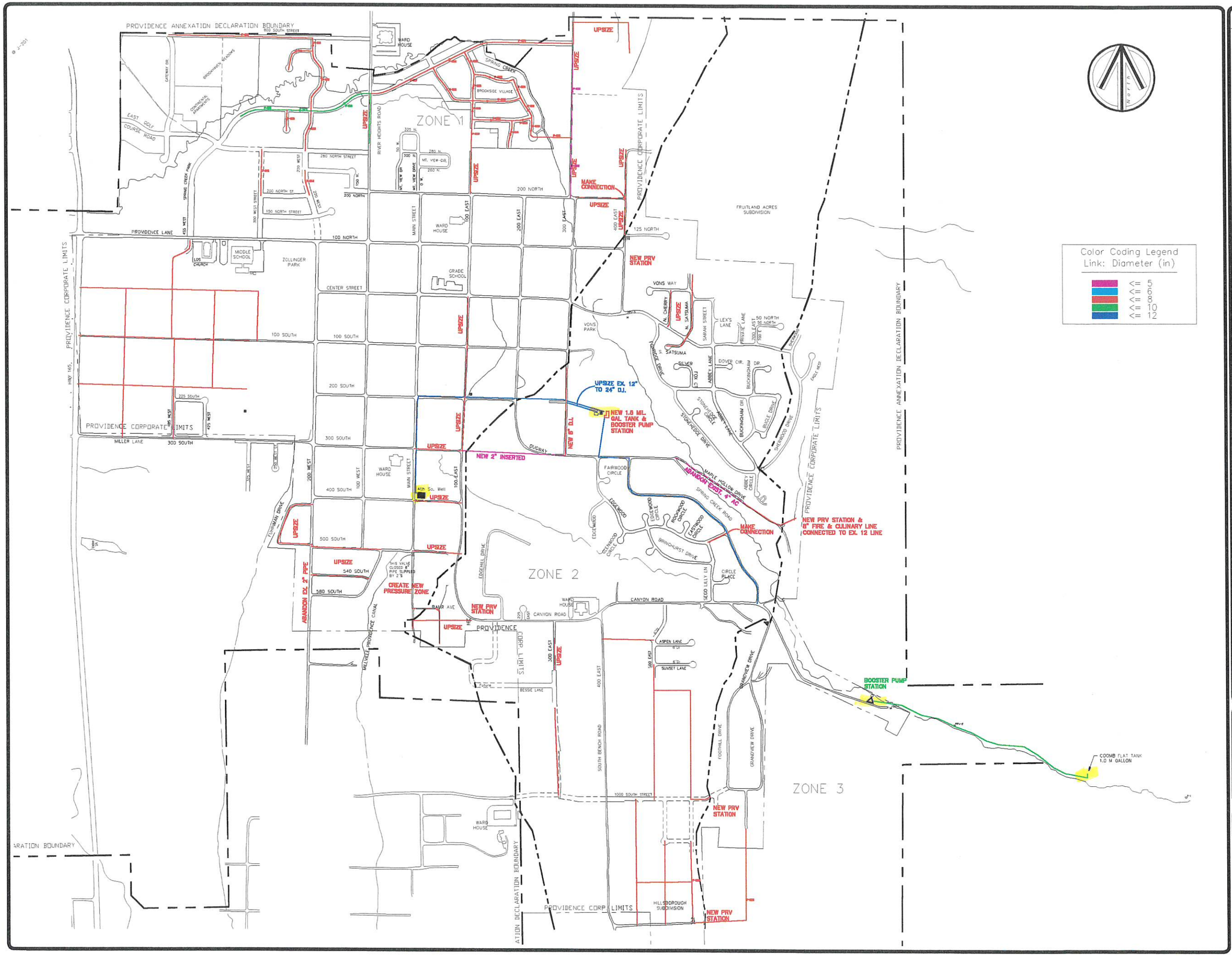

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PROPOSED DISTRIBUTION SYSTEM

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