Water Reuse System Asset Management Plan

City of San Marcos

APAI Project 0600-025-01

February 2016

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

City of San Marcos
Water Reuse System
Asset Management Plan

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TABLE OF CONTENTS

LIST OF TABLES

No. **Description** **Page**

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMP	Asset Management Plan
APAI	Alan Plummer Associates, Inc.
AV	Air and Vacuum
CA	Community Activity
CBLD	Control Building
CCTV	Closed-Circuit Television
CFR	Code of the Federal Regulations
CIP	Capital Improvement Program
CIPP	Cured-In-Place Pipe
CMMS/EAMS	Computerized Maintenance Management/Enterprise Asset Management System
COF	Consequence of Failure
DMR	Discharge Monitoring Report
DW	Dry Well
ELD	Elderly
EPA	U.S. Environmental Protection Agency
FM	Force Mains
FY	Fiscal Year
GFRP	Glass Fiber Reinforced Plastic (Fiberglass)
GIS	Geographical Information System
GM	Gravity Main
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
gpd/1,000 ft.	Gallons Per Day Per 1,000 Feet of Pipe
gpd/idm	Gallons Per Day Per Inch Diameter Per Mile of Pipe
HGL	Hydraulic Grade Line
I&I	Infiltration and Inflow
I&I Plan	Infiltration and Inflow Plan
IW	Industrial Warehouse

LF	Linear Feet
LOD	Lodging
LOF	Likelihood of Failure
LOS	Level of Service
LS	Lift Station
LTSP	Long-Term Sustainability Plan
MF	Multi-Family Dwelling
MGD	Million Gallons per Day
O&M	Operations and Maintenance
OFF	Office
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride Pipe
RIM	Renewal, Inspect, Mitigate
ROF	Risk of Failure
RSTR	Restaurant
SCS	Staff Condition Score
SSES	Sewer System Evaluation Study
SUB	Submersible
TCEQ	Texas Commission on Environmental Quality
TM	Technical Memorandum
USEPA	U.S. Environmental Protection Agency
UV	Ultraviolet
VCP	Vitrified-Clay Pipe
VV	Valve Vault
W/D	Wet Well/Dry Well
WW	Wet Well
WWTP	Wastewater Treatment Plant

1 Introduction

The City of San Marcus is planning an expansion of its existing water reuse system and is seeking to better manage the existing and future reuse infrastructure asset investments. While the reuse system represents a small part of the City's overall public infrastructure, it is an integral part of the City's long term water resource plan. As the City expands the water reuse system, it is looking for ways to improve the overall life cycle cost management for all of the reuse system assets.

The City is currently using its Maximo computerized maintenance management system (CMMS) to program maintenance activities on its reuse facility assets. Not all of the reuse system assets are currently contained in the Maximo CMMS inventory, therefore, there is a need to expand. Therefore, the City has requested the development of an asset management plan for its existing water reuse system. The existing water reuse system consists of a reuse pump station with three pumps, disinfection system, and ancillary piping, electrical switch gear and instrumentation, reuse distribution system piping, control valves, reuse service meters.

1.1 Background

The City of San Marcos, Texas is a part of the Austin–Round Rock–San Marcos metropolitan area. San Marcos is located along the Interstate 35 corridor between Austin and San Antonio and is the seat of Hays County (see Figure 1.1). Founded on the banks of the San Marcos River, the area is thought to be among the oldest continuously inhabited sites in the Americas. Archeologists have discovered evidence along the San Marcos River that suggest these sites may have been inhabited by humans for over 10,000 years. Fed by the San Marcos Springs, the River remains as a key feature within the City. Home to Texas State University with a student population in excess of 34,000, the City has rapidly expanded over the past decade to a 2010 census population of nearly 45,000 residents.

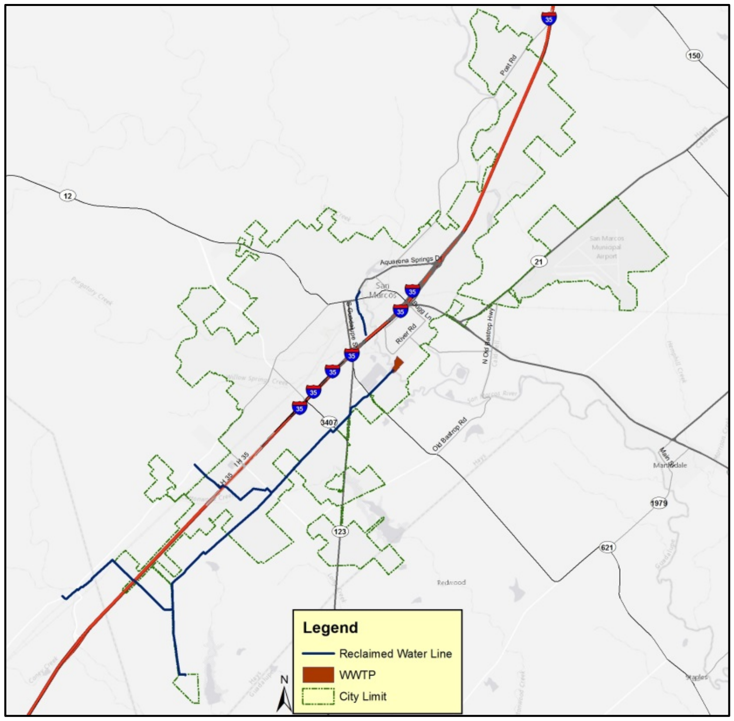

Figure 1.1 – Map of the City of San Marcos

1.2 <u>The San Marcos Water reuse System</u>

The existing treated wastewater reuse system, also known as reclaimed water, consists of a reuse pump station, an effluent wet well, an electrical motor control center, and a disinfection system, which is located at the San Marcos Wastewater Treatment Plant (WWTP). The effluent is withdrawn after filtration, chlorine is added for disinfection, and is transported via an 18-inch pipeline extending approximately 7.5 miles south of the WWTP. This 18-inch line currently provides reclaimed water to Hays Energy for power plant cooling. A 12-inch line, approximately 3 miles long tees-off from the 18-inch line, and provides reclaim water to Martin Marietta industries for process water, Heldenfels concrete plant, and a cement plant. A new 12-inch water line is under construction, which will provide reclaimed water to Kissing Tree for golf course irrigation, as per agreements made by the City. A separate 16-inch reclaimed water line approximately 4,700 linear feet is located at the north-west side of the WWTP, which will provide reclaim water to the Texas State University thermal plants. Air/Vacuum release valves, gate valves, butterfly valves, flow meters, and valve vaults also constitutes an integral part of the reclaimed water system. The reclaim system is shown on Figure1.2.

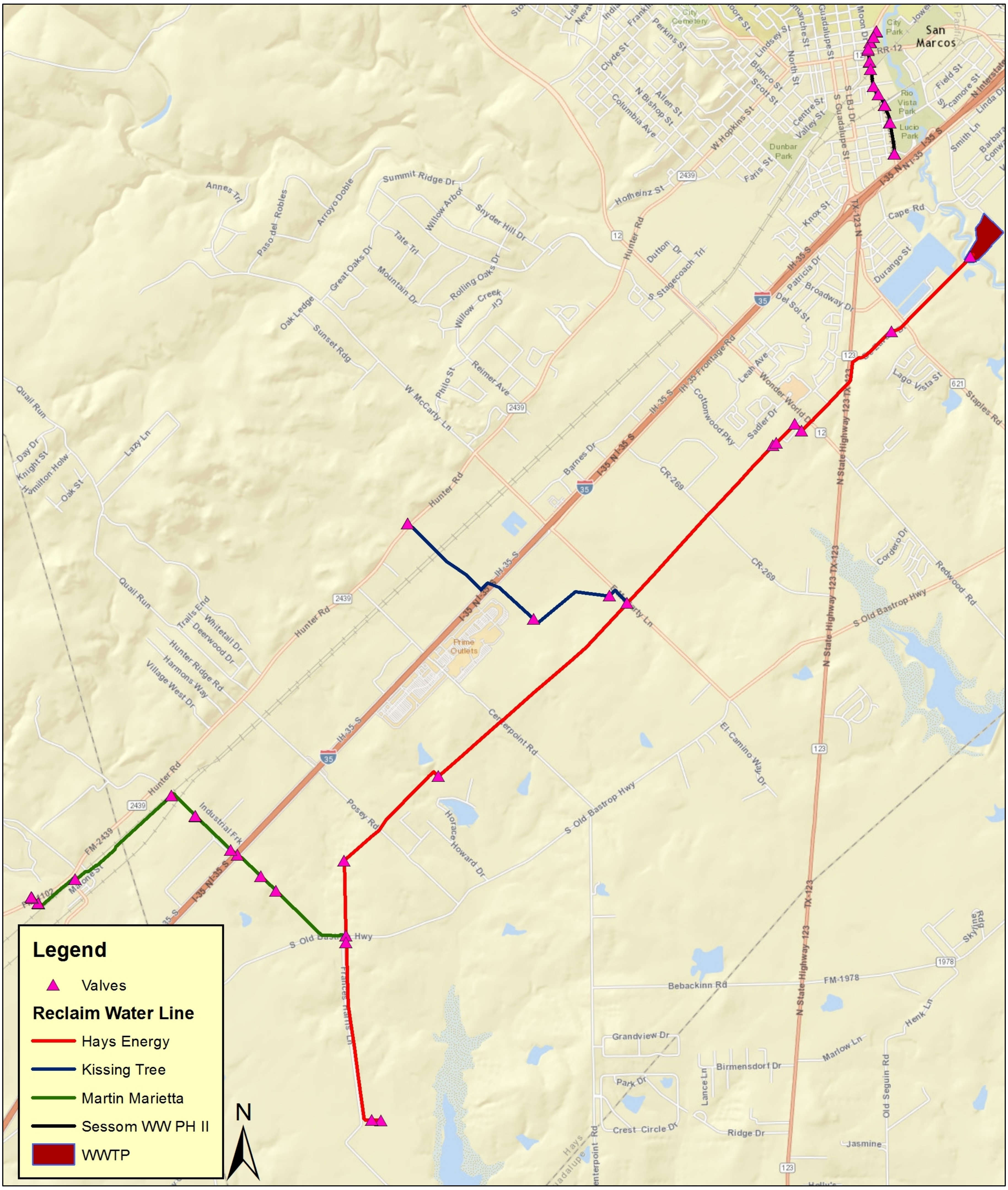

Figure 1.2 – City of San Marcos Water Reuse System

1.3 Organization of the San Marcos Asset Management Plan

The AMP is presented in seven sections which follow this Section 1 Introduction. These sections are:

1. **Asset Management Approach** – provides an introduction to asset management concepts and the approach undertaken in this plan
2. **San Marcos Reuse System Inventory** – summarizes the water reuse system asset inventory for the San Marcos system
3. **San Marcos Reuse System Condition Assessment** – provides a summary of the staff condition assessment and system performance data
4. **San Marcos Reuse System Risk Assessment** – presents the detailed results of the asset risk analysis to prioritize assets for further investigation
5. **State of the Assets** - summarizes the system inventory, condition assessment, and risk analysis and long-term investment forecast.
6. **Asset Management Implementation** – identifies information systems, policies, and business processes to support implementation of the asset management program at San Marcos
7. **Asset Investment Plan** – summarizes the investment requirements for existing system assets including a long term sustainable renewal forecast.

2 Asset Management Approach

This AMP summarizes the initial phase of asset management development for San Marcos with a focus on the first six steps of the EPA's Ten-step Asset Management Process. These steps focus on inventorying and assessing San Marcos's existing assets and prioritizing asset renewal. Figure 2.1 provides the overall framework that guided the initial phase of asset management development. This Section describes the approach used in following sections to develop the data, information, results, and recommendations that are compiled in the Section 6, State of the Assets.

Figure 2.1 – San Marcos Asset Management Framework

2.1 <u>What is Asset Management</u>

The San Marcos system composed of approximately thirteen (13) miles of reclaim water mains, valve vaults, and flow meters designed and constructed to meet prescribed performance objectives in support of the overall water reuse system's performance goals. However, aging assets deteriorate and performance diminishes over time, requiring increased operation and maintenance attention. As assets continue to deteriorate, they become unreliable and require a major rehabilitation or complete replacement.

Asset management can be described as:

1. A management philosophy coupled with business processes, practices, and tools that are applied to the entire portfolio of infrastructure assets at all levels in the organization.
2. A sequential optimization process that continuously improves the infrastructure inventory, condition, performance, and maintenance knowledge based on an asset-by-asset basis.

3. A management practice to minimize the total life-cycle cost of owning and operating infrastructure assets while delivering the desired levels of service and performance at an acceptable level of risk to the organization.

2.2 Benefits Derived from Asset Management

Achieving the lowest life-cycle cost for a given infrastructure asset requires informed decisions on the appropriate levels of maintenance, repair, rehabilitation, and on the ultimate replacement and disposal of an asset. Asset management provides the framework for making appropriate decisions on the investments required for rehabilitating, repairing, or replacing an asset. Asset management allows a utility to shift from a reactive infrastructure management approach that relies primarily on staff experience and knowledge to a more proactive approach that predicts asset investment requirements as a means to achieve and fund sustainable infrastructure. As an asset management program evolves in an organization, it incorporates detailed asset inventories, operation and maintenance functions, and long-range financial planning to build system capacity, and it puts systems on the road to sustainability.

There are a number of benefits that can be derived from an effective asset management program:

1. Prolonging asset life and aiding in rehabilitation, repair, and replacement decisions through efficient and focused operations and maintenance.
2. Meeting performance demands with a focus on system sustainability.
3. Developing capital, operations, and maintenance costs based on sound operational and financial planning data and information.
4. Long-term budget forecasts focused on activities critical to sustained performance.
5. Meeting service expectations and regulatory requirements.
6. Improving responses to emergencies.
7. Reducing overall costs for both operations and capital expenditures.

2.3 EPA Asset Management Principles

The EPA has developed recommended asset management principles and practices for the water utility industry. The EPA asset management principles are centered on a framework of five core questions, which provide the foundation for many asset management best practices:

1. What is the current state of the assets?
2. What is the required "sustainable" level of service?
3. Which assets are critical to sustained performance?
4. What are the minimum life-cycle costs?
5. What is the best long-term funding strategy?

These five core principles form the basis for the US EPA's Ten-step Process for advanced asset management illustrated in Figure 2.2. This initial San Marcos Asset Management Plan (AMP) effort focuses on an assessment of existing assets for prioritized renewal.

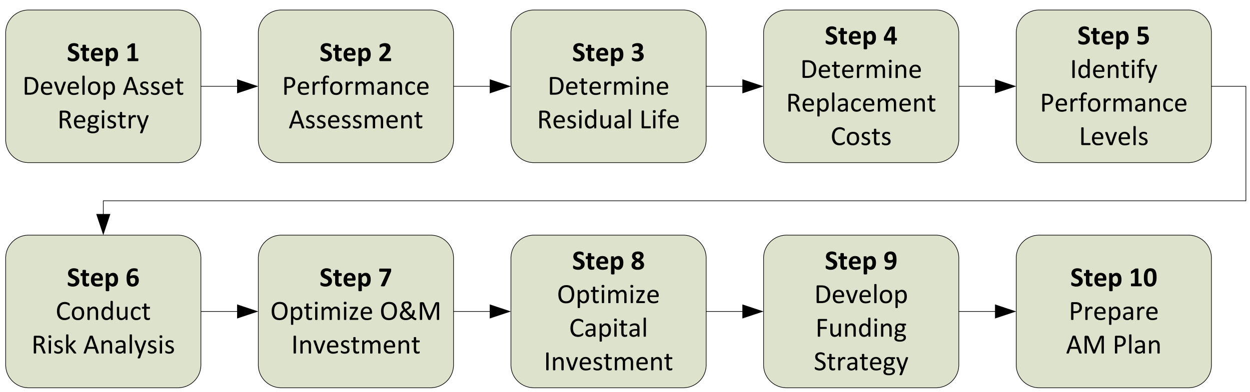

Figure 2.2 – EPA Ten-Step Advanced Asset Management Process

As asset management evolves at San Marcos, it will provide a decision framework that includes planning, engineering, construction, operations, and maintenance. Asset management is not a software program or a concept limited to a single project or program. It is a coordinated action plan that consistently delivers the desired levels of customer service at the lowest total asset life-cycle cost.

2.4 What the San Marcos Asset Management Plan Provides

The goal of San Marcos in developing this Asset Management Plan (AMP) is to provide a clear picture of its water reuse system infrastructure assets and the future investments required to sustain their required levels of performance. This document consolidates information that is currently available for San Marcos's existing assets in a single concise document. The AMP also identifies the requirements for new infrastructure to meet future capacity needs. This AMP defines the intended asset management programs or strategies for the infrastructure assets based on San Marcos's understandings of customer requirements, regulatory compliance issues, and the ability of the assets to meet their performance goals. The AMP also serves as a vehicle for communication between San Marcos and the reuse customers, regulators, and other stakeholders.

This initial AMP represents the beginning of a dynamic planning process and will be routinely updated to account for system improvements and changes in the condition of San Marcos's water reuse assets.

An AMP is a planning document that San Marcos can use to define a path forward for the water reuse infrastructure investment. The AMP provides the rational framework for decision making on all water reuse assets based on the following:

1. An inventory of all of the water reuse assets that San Marcos owns and their required performance level.
2. An estimate of the value of each asset based on its replacement cost.
3. The current and future requirements for infrastructure assets with a focus on those assets that are critical for providing service to the reuse customers and their retail customers.
4. An estimate of the short-term, medium-term, and long-term financial investments necessary to maintain the assets at their required level of performance.
5. An assessment of the relative business risk exposure for the San Marcos reuse system assets which is used to prioritize more detailed evaluations and options for asset renewal.

This AMP provides the baseline asset inventory, condition assessment, and risk of failure analysis for the San Marcos system assets. Development of the detailed system inventory and asset register has progressed San Marcos towards an asset centric management program with the ability to maintain system integrity and performance on an asset-by-asset basis.

3 San Marcos System Inventory

Developing an inventory of individual assets that make up the San Marcos water reuse system is the first key step in any asset management program. Detailed asset inventories were developed for the San Marcos reuse system including reuse pump station, pipelines and associated valves, flow meters, and control systems.

The inventories were developed using existing data and information contained in San Marcos' geographical information system (GIS), Maximo CMMS system, record construction drawings, staff interviews, and field surveys.

Available data that helped characterize the asset including size, material type, and other attribute data, were also collected as the asset inventories were developed. A summary of the data and information collected for each asset is described in the following Section. There were six essential pieces of information common to all assets developed during the inventory process:

1. **Asset identification** – a unique number assigned to each asset based on the City's standard asset numbering convention.
2. **Year installed and asset age** – age is a critical factor in evaluating the current state of an asset relative to its overall life cycle.
3. **Asset material or Manufacturer** – asset material and manufacturer are used as an indication of common deterioration or aging characteristics.
4. **Asset useful life** – average useful life data were developed based on industry standards adapted for the San Marcos reuse system by operations and maintenance staff.
5. **Asset remaining useful life –** Average useful life minus the current asset age.
6. **Asset replacement value** – A replacement value was estimated for each asset and included in the overall inventory.

The asset inventory effort created an essential first snapshot of data and information required to manage the San Marcos' infrastructure on an asset-centric basis.

Much of the inventory data compiled for the San Marcos reuse system pipeline assets were gathered from information in the existing San Marcos GIS database. Existing individual asset identification numbers (asset ID) in either GIS or Maximo were used for each asset. Some of the longer reuse pipelines were subdivided into smaller asset segments to better characterize their likelihood and consequence of failure characteristics.

3.1 **Asset Inventory**

The San Marcos asset inventory was organized into an asset hierarchy grouping the various assets into asset classes with common function, performance, and deterioration characteristics. The reuse system inventory is provided in Table 3.1. The Maximo asset ID numbers were used throughout the inventory and supplemented if no Maximo ID was available. The reuse pipelines were divided into pipe segments to differentiate different likelihood and consequence of failure characteristics. A letter was added to the existing ID to identify the new line segment designations.

Maximo PFX	Dia (in)	Project	Material	Shape Length (ft)	Install Date	Age 2016	Avg Useful Life	Avg Useful Life Remain	Depth (ft)	Staff Rating	Replacement Cost ($)
NPWL2C	18	Hays Energy	PVC	2,908	2000	16	125	109	5	2	$298,100
NPWL2L	18	Hays Energy	PVC	1,732	2000	16	125	109	5	2	$177,500
NPWL2M	18	Hays Energy	PVC	3,150	2000	16	125	109	5	2	$322,900
NPWL2R	18	Hays Energy	PVC	2,671	2000	16	125	109	5	2	$273,700
NPWL2S	18	Hays Energy	PVC	3,070	2000	16	125	109	5	2	$314,700
NPWL2V	18	Hays Energy	PVC	5,001	2000	16	125	109	5	2	$512,600
NPWL2W	18	Hays Energy	PVC	3,050	2000	16	125	109	5	2	$312,600
NPWL2Z	18	Hays Energy	PVC	5,001	2000	16	125	109	5	2	$512,600
NPWL2A	18	Hays Energy	PVC	250	2000	16	125	109	6	2	$25,600
NPWL2B	18	Hays Energy	PVC	110	2000	16	125	109	50	2	$11,300
NPWL2D	18	Hays Energy	PVC	210	2000	16	125	109	8	2	$21,500
NPWL2E	18	Hays Energy	PVC	1,523	2000	16	125	109	5	2	$156,100
NPWL2F	18	Hays Energy	PVC	350	2000	16	125	109	5	2	$35,900
NPWL2G	18	Hays Energy	PVC	95	2000	16	125	109	6	2	$9,700
NPWL2H	18	Hays Energy	PVC	810	2000	16	125	109	5	2	$83,000
NPWL2I	18	Hays Energy	PVC	230	2000	16	125	109	8	2	$23,600
NPWL2J	18	Hays Energy	PVC	1,652	2000	16	125	109	5	2	$169,300
NPWL2K	18	Hays Energy	PVC	132	2000	16	125	109	10	2	$13,500
NPWL2N	18	Hays Energy	PVC	100	2000	16	125	109	10	2	$10,300
NPWL2O	18	Hays Energy	PVC	1,751	2000	16	125	109	5	2	$179,400
NPWL2P	18	Hays Energy	PVC	2,260	2000	16	125	109	5	2	$231,700
NPWL2Q	18	Hays Energy	PVC	70	2000	16	125	109	8	2	$7,200
NPWL2T	18	Hays Energy	PVC	90	2000	16	125	109	8	2	$9,200
NPWL2U	18	Hays Energy	PVC	1,841	2000	16	125	109	5	2	$188,700
NPWL2Y	18	Hays Energy	PVC	1,781	2000	16	125	109	5	2	$182,500
NPWL2X	18	Hays Energy	PVC	170	2000	16	125	109	7	2	$17,400
NPWL6A	12	Kissing Tree	PVC	5,498	2014	2	125	123	5	1	$472,400
NPWL6B	12	Kissing Tree	PVC	412	2014	2	125	123	16	1	$35,400
NPWL6C	12	Kissing Tree	PVC	2,190	2014	2	125	123	5	1	$188,100
NPWL6D	12	Kissing Tree	PVC	200	2014	2	125	123	10	1	$17,200
NPWL6E	12	Kissing Tree	PVC	1,098	2014	2	125	123	5	1	$94,300
NPWL6F	12	Kissing Tree	PVC	196	2014	2	125	123	15	1	$16,800
NPWL211	16	Sessom	PVC	8	2014	2	125	123	5	1	$800
NPWL231	16	Sessom	PVC	8	2014	2	125	123	5	1	$700
NPWL251	12	Sessom	PVC	31	2014	2	125	123	5	1	$2,700
NPWL271	16	Sessom	PVC	421	2014	2	125	123	12	1	$39,800
NPWL291	8	Sessom	PVC	8	2014	2	125	123	5	1	$500
NPWL311	16	Sessom	PVC	239	2014	2	125	123	10	1	$22,700
NPWL331	8	Sessom	PVC	10	2014	2	125	123	5	1	$700
NPWL351	16	Sessom	PVC	457	2014	2	125	123	10	1	$43,200
NPWL371	8	Sessom	PVC	9	2014	2	125	123	5	1	$700
NPWL391	16	Sessom	PVC	846	2014	2	125	123	12	1	$80,000

NPWL151	16	Sessom	PVC	1,067	2014	2	125	123	8	1	$100,900
NPWL171	8	Sessom	PVC	4	2014	2	125	123	5	1	$300
NPWL411	8	Sessom	PVC	4	2014	2	125	123	5	1	$300
NPWL191	16	Sessom	PVC	773	2014	2	125	123	20	1	$73,100
NPWL412	16	Sessom	PVC	645	2014	2	125	123	8	1	$61,000
NPWL431	16	Sessom	PVC	4	2014	2	125	123	5	1	$400
NPWL1E	12	Martin Marietta	PVC	3,957	2011	5	125	120	5	1	$339,900
NPWL1A	12	Martin Marietta	PVC	4,653	2011	5	125	120	6	1	$399,700
NPWL1B	12	Martin Marietta	PVC	353	2011	5	125	120	10	1	$30,300
NPWL1C	12	Martin Marietta	PVC	2,457	2011	5	125	120	5	1	$211,100
NPWL1D	12	Martin Marietta	PVC	300	2011	5	125	120	8	1	$25,800
NPWL1I	12	Martin Marietta	PVC	1,272	2011	5	125	120	5	1	$109,300
NPWL1F	12	Martin Marietta	PVC	156	2011	5	125	120	4	1	$13,400
NPWL1G	12	Martin Marietta	PVC	430	2011	5	125	120	5	1	$36,900
NPWL1H	12	Martin Marietta	PVC	458	2011	5	125	120	18	1	$39,300
NPWL1J	12	Martin Marietta	PVC	242	2011	5	125	120	8	1	$20,800

Table 3.1 – San Marcos Water Reuse System Inventory

Maximo ID	Description	Manufacturer	Install Date	Age	Avg Useful Life	Avg Useful Life Rmn	Size/ Capacity	Units	# of Work Orders		Condition Score (1-3)	Replacement Cost ($)
				2016					Reactive	Proactive		
Pumps & Motors												
RW-001	Reclaimed Pump #1	Fairbanks Morse	2012	4	35	31	2,000	gpm	22	13	1	45,300
RW-002	Reclaimed Pump #2	Fairbanks Morse	2012	4	35	31	2,000	gpm	16	13	1	45,300
RW-003	Reclaimed Pump#3	Fairbanks Morse	2012	4	35	31	2,000	gpm	11	6	1	45,300
DIS-002	Disinfection Chemical Pump	Fairbanks Morse	2000	16	35	19					1	8,000
Electrical												
RMCC	Reclaim Wtr Motor Control Center And Building	Siemens	2000	16	35	19			0	5	2	131,000
Controls												
PLC-RW	Programable Logic Controller Panel Reclaim Water	Schneider Electric	2000	16	20	4			3	6	1	3,000
LIT-001	Level Transmitter Reclaimed Water	Milltronics	2000	16	20	4			3	2	1	3,500
FS-001	Reclaim Flow Switch	McDonnell & Miller	2000	16	20	4			1	0	1	2,500
FIT-001	Flowmeter Reclaim Water Station	Badger	2000	16	20	4			0	0	1	2,500
ANP-001	Rosemount Flowmeter 3051 Inf. ANP-001		2000	16	20	4			No Info		1	7,000
ANP-002	Rosemount Flowmeter ANP-002 Eff.		2000	16	20	4			No Info		1	7,000
Pump Station Piping & Valves												
ARV-01	Air Release Valve #1 RW-001 2"	APCO	2000	16	75	59	2	in	1	0	1	3,100
ARV-02	Air Release Valve #2 RW-002 2"	APCO	2000	16	75	59	2	in	1	0	1	3,100
ARV-03	Air Release Valve #3 RW-003 2"	APCO	2000	16	75	59	2	in	1	0	1	3,100
BFV-01	Butterfly Valve #1 10" RW-001	Henry Pratt	2000	16	75	59	10	in	1	0	2	1,600
BFV-02	Butterfly Valve #2 10" RW-002	Henry Pratt	2000	16	75	59	10	in	1	0	2	1,600
BFV-03	Butterfly Valve #3 10" RW-003	Henry Pratt	2000	16	75	59	10	in	1	0	2	1,600
PCV-01	Pump Control Valve RW-001	OCV	2000	16	75	59			0	0	1	10,000
PVC-02	Pump Control Valve 2 RW-002	OCV	2000	16	75	59			0	0	1	10,000
PVC-03	Pump Control Valve RW-003	OCV	2000	16	75	59			0	0	1	10,000
PSP-001	Pump Station Piping										2	7,800
Structure												
RECLAIM WET	Reclaim Water Wet Well	Bryan Construction	2000	16	80	64			0	1	1	10,000
DIS-001	Disinfection Chemical Tank	PolyProcessing	2000	16	80	64			No Info		1	500

Table 3.2 - Reclaimed Water Assets

3.1.1 **Asset Replacement Costs**

Replacement costs for each asset in the San Marcos reuse system was developed as the basis for asset valuation. The replacement costs figures represent conceptual level costs estimates including both material and installation costs on an asset-by-asset basis. The asset replacement costs figures were reviewed with San Marcos staff in the Condition/Risk Workshop. The replacement costs for each asset are shown in the asset inventory, Table 3.1, for facility and pipeline assets. The estimated cost to replace the entire San Marcos reuse system is approximately $7 million.

4 San Marcos Reuse System Condition Assessment

Establishing the condition of each asset is a key component in developing an understanding of the overall state of San Marcos reuse system assets. The initial top-down assessment of asset condition reported herein utilized all available data and information along with staff knowledge and experience to develop an overall system condition assessment. Asset condition data were developed through a review of available operation and maintenance data combined with staff knowledge capture sessions. In the staff knowledge capture sessions, San Marcos and maintenance staff shared their hands-on knowledge and experience in dealing with the individual assets or groups of assets. The condition data available for each asset was then incorporated into an overall asset inventory.

4.1 Staff Interview Results

Information on the general operating condition of the San Marcos reuse system was gathered by interviewing current San Marcos management, operation, and maintenance staff members and wastewater treatment plant contract operations personnel at meetings held on February 17, 2016. The condition assessment data gathering included ranking of typical industry standard reuse system operations and maintenance issues by San Marcos Staff, characterization of potential reuse system issues , and a prioritized listing of potential reuse system components to be improved.

Figure 4.1 provides the results of San Marcos staff rankings of industry standard reuse system component issues relative to the San Marcos system. The pump station was identified at the top of the staff ranking list.

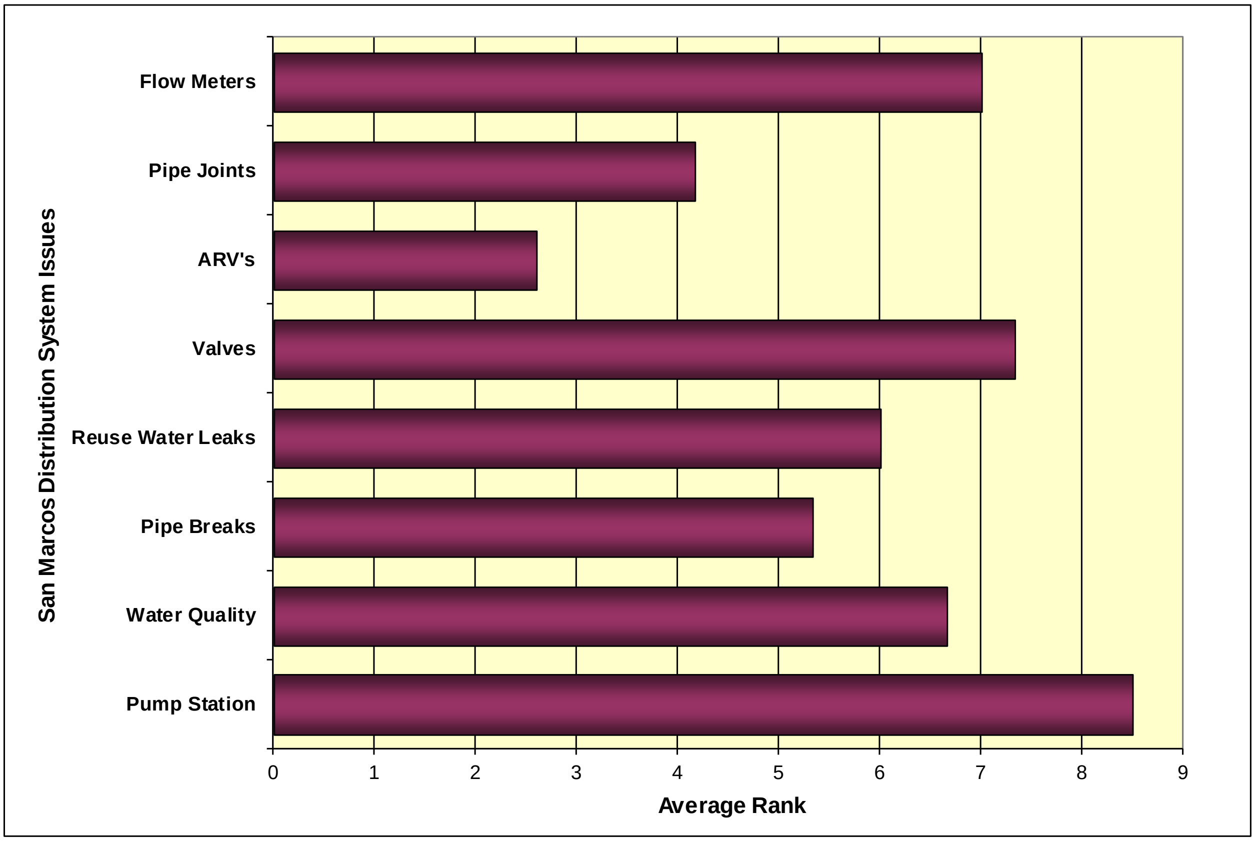

Figure 4.1 – Industry Standard Reuse System Issue Ranking by San Marcos Staff

Staff members were then asked to identify the top five potential performance issues that may be encountered within the San Marcos reuse system. The results were grouped into similar categories. Figure 4.2 shows the relative ranking or the number of times the issue was identified by staff as an indication of its significance. Water quality was at the top of the performance issues list with pump failure also listed on a number of responses.

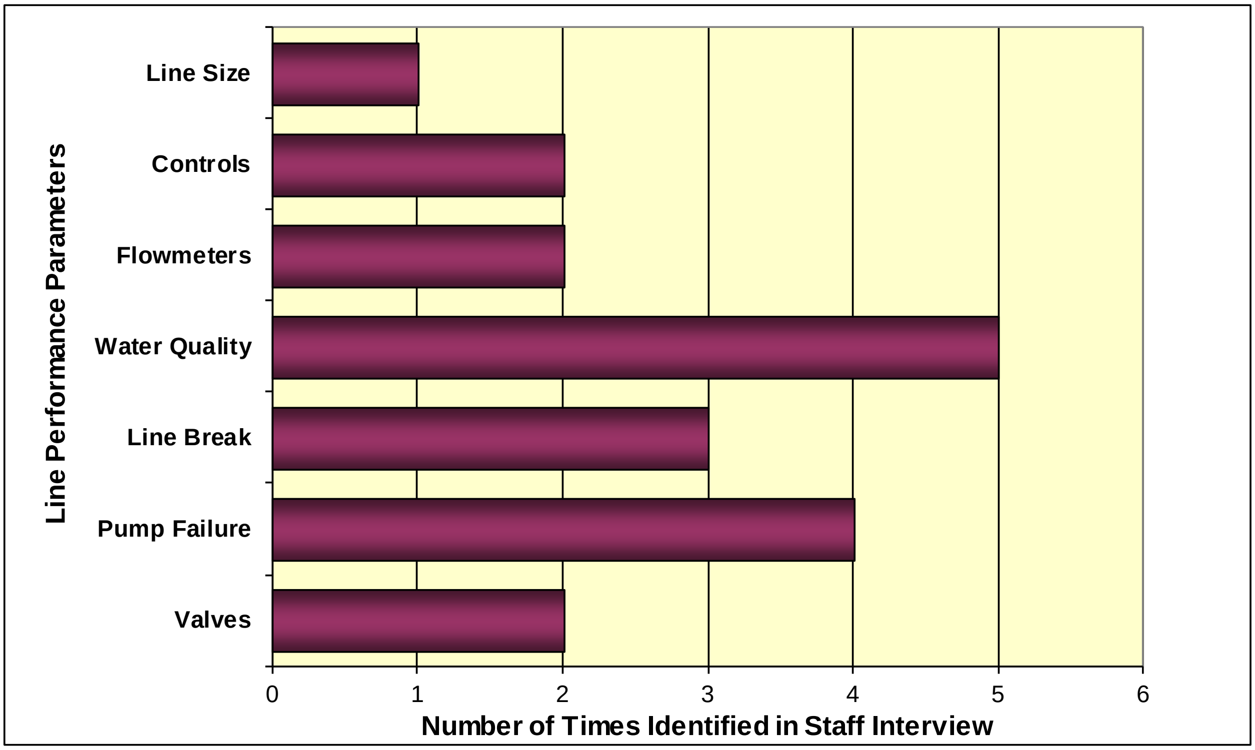

Figure 4.2 – Causes of Distribution System Performance Identified by San Marcos Staff

The San Marcos Staff interview responses pointed to pump failure in the distribution system as the item most likely to cause operation and maintenance problems. Water quality and line breaks were also noted as items on which to focus attention.

Following the identification of potential operation and maintenance issues within the reuse system, the staff were asked to suggest what improvements could be made to the system or in the operations and maintenance to address some of their potential concerns. Figure 4.3 shows the results of the ideas suggested by staff for system improvement.

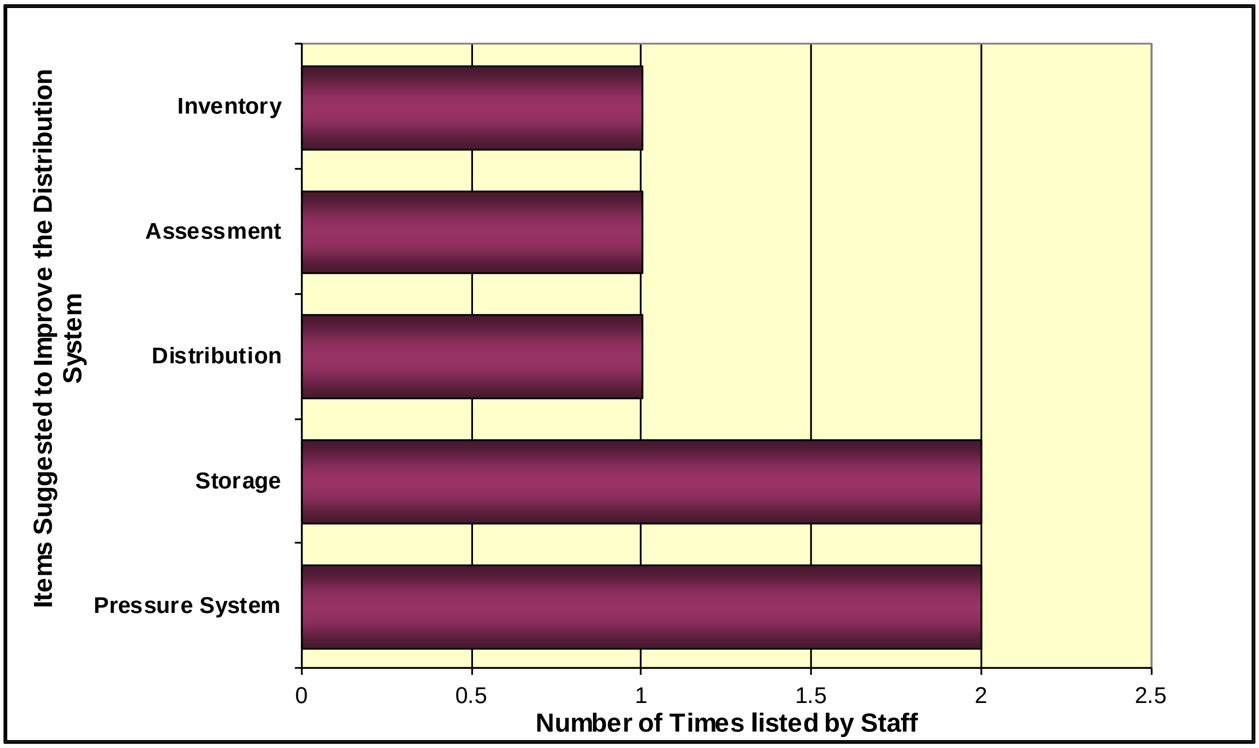

Figure 4.3 – System Improvements Suggested by San Marcos Staff

4.2 Staff Condition Scores for Reuse Facility Assets

San Marcos reuse system operation and maintenance and contract operations staff members were asked to rate the condition of reuse system facility asset. San Marcos Staff members assigned condition scores according to the condition descriptions listed below. The scores were then averaged to produce a composite area asset condition score.

> **Score 1 – Good Condition** - the asset is in good structural shape, minimal wear, requires only routine preventive maintenance, any major repair or rehabilitation will not be required for at least 10 years
>
> **Score 2 – Fair Condition** – the asset has some normal wear but is physically/structurally sound, minor maintenance and repairs have been performed and the asset may have had some other minor problems, will probably need more work or a major overhaul within the next 10 years
>
> **Score 3 – Poor Condition** – the asset is physically/structurally weak, maintenance and repairs have been on the increase, requires attention and potential physical failure is a concern, should be rehabilitated or replaced within the next 5 years

The staff collectively developed a consensus condition score for each facility asset as presented in Table 4.1. The green, yellow, or red color coding for asset condition and risk scores indicating good, fair, or poor condition or low, medium, or high likelihood/risk or consequence of failure are used throughout the AMP. In general, the color red indicates assets of concern that need some near term attention.

Maximo ID	Description	Manufacturer	Install Date	Condition Score (1-3)	Replacement Cost ($)
Pumps & Motors					
RW-001	Reclaimed Pump #1	Fairbanks Morse	2012	1	45,300
RW-002	Reclaimed Pump #2	Fairbanks Morse	2012	1	45,300
RW-003	Reclaimed Pump#3	Fairbanks Morse	2012	1	45,300
DIS-002	Disinfection Chemical Pump	Fairbanks Morse	2000	1	8,000
Electrical					
RMCC	Reclaim Wtr Motor Control Center And Building	Siemens	2000	2	131,000
Controls					
PLC-RW	Programable Logic Controller Panel Reclaim Water	Schneider Electric	2000	1	3,000
LIT-001	Level Transmitter Reclaimed Water	Milltronics	2000	1	3,500
FS-001	Reclaim Flow Switch	McDonnell & Miller	2000	1	2,500
FIT-001	Flowmeter Reclaim Water Station	Badger	2000	1	2,500
ANP-001	Rosemount Flowmeter 3051 Inf. ANP-001			1	7,000
ANP-002	Rosemount Flowmeter ANP-002 Eff.			1	7,000
Pump Station Piping & Valves					
ARV-01	Air Release Valve #1 RW-001 2"	APCO	2000	1	3,100
ARV-02	Air Release Valve #2 RW-002 2"	APCO	2000	1	3,100
ARV-03	Air Release Valve #3 RW-003 2"	APCO	2000	1	3,100
BFV-01	Butterfly Valve #1 10" RW-001	Henry Pratt	2000	2	1,600
BFV-02	Butterfly Valve #2 10" RW-002	Henry Pratt	2000	2	1,600
BFV-03	Butterfly Valve #3 10" RW-003	Henry Pratt	2000	2	1,600
PCV-01	Pump Control Valve RW-001	OCV	2000	1	10,000
PVC-02	Pump Control Valve 2 RW-002	OCV	2000	1	10,000
PVC-03	Pump Control Valve RW-003	OCV	2000	1	10,000
PSP-001	Pump Station Piping			2	7,800
Structure					
RECLAIM WET	Reclaim Water Wet Well	Bryan Construction	2000	1	10,000
DIS-001	Disinfection Chemical Tank	PolyProcessing	2000	1	500

Table 4.1 - San Marcos Staff Condition Scores for Reuse Facility Assets

4.3 Staff Condition Scores for Pipeline Assets

The San Marcos and contract operations staff also provided condition scoring for the various reuse pipeline segments using a similar approach as the facility asset condition scoring. The staff indicated the condition scoring using the same 1 (good), 2 (fair), 3 (poor) condition scoring as described above for each pipeline segment on reuse pipeline maps. The green, yellow, or red color coding for asset condition indicating good, fair, or poor was again used in Figure 4.4 showing the staff reuse pipeline condition scores.

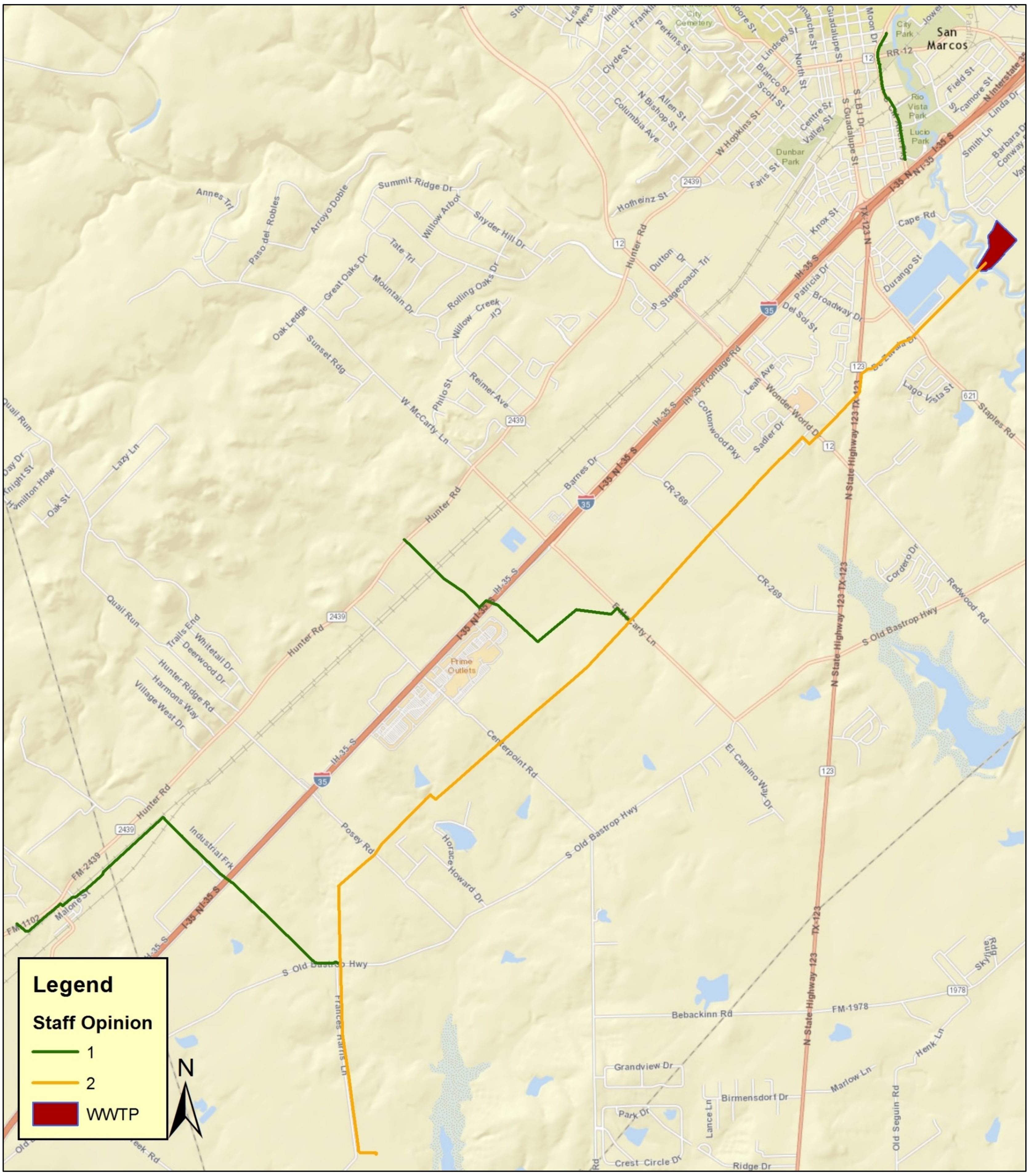

Figure 4.4 – Staff Reuse Pipeline Condition Scores

5 San Marcos Reuse System Relative Risk Assessment

5.1 <u>Risk Assessment Process</u>

For most utilities, it is a challenge to prioritize asset replacement and/or rehabilitation and to set the timeline over which renewal actions should take place. A business risk assessment can help a utility establish inspection, maintenance, and repair priorities for its existing assets. The business risk assessment is a standard approach used in advanced asset management to better manage an individual asset across its entire economic life. The risk assessment considers the condition of a system asset in terms of how likely it is to fail. The risk assessment also factors in the consequence associated with failure of an asset. The following section summarizes the business risk assessment conducted for the San Marcos reuse system assets.

The objective of the business risk assessment process is to mathematically compute the risk of asset failure (ROF), which is accomplished using the following equation (Figure 5.1):

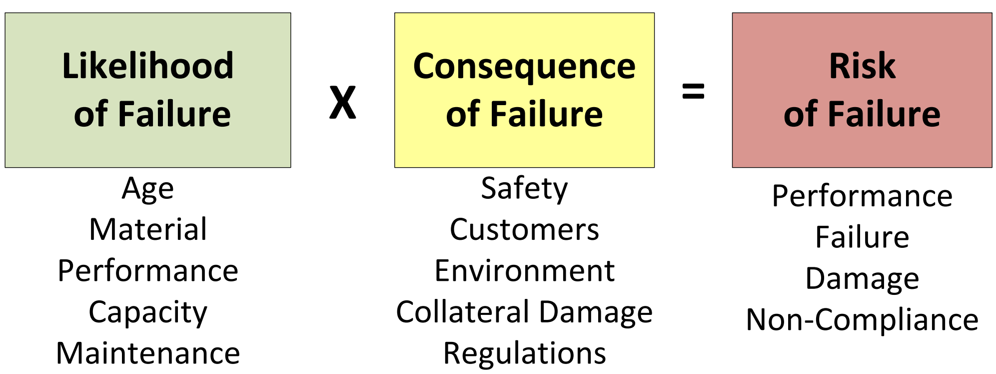

Figure 5.1 - Risk of Failure Equation

The Likelihood of Failure (LOF) is an assessment of an asset's ability to meet its intended levels of service. The Consequence of Failure (COF) measures the potential impact that an asset failure may have on utility customers and the surrounding area. Consequence of failure is generally related to location and links the impact of the failure in terms of repair cost, disruption to the public and economy, impairment of system operation, regulatory compliance, public health and safety, and damage to the environment.

LOF and COF components were selected by San Marcos staff in a workshop held on February 17, 2016, to form a risk matrix specifically for San Marcos reuse system. Table 5.1 shows a summary of the LOF and COF risk matrix components chosen for the reuse system facility assets and Table 5.2 provides the LOF and COF components for the reuse pipeline assets. The staff also determined the specific weights that should be applied to each component in the overall risk analysis. Detailed scoring tables defining the source of data and methodology were then developed for input into the APAI Risk Model.

City of San Marcos
Asset Management Plan
Risk Assessment - Reuse Water Assets

LIKELIHOOD OF FAILURE COMPONENTS (Total weight: 100)

	Component	Weight
1	Staff opinion of condition	15
2	Reactive Repair History (Work orders / year)	15
3	Age (yr)	15
4	Duty (hrs/day or year)	15
5	Maintenance Requirements (WO)	15
6	Redundancy	25

CONSEQUENCE OF FAILURE COMPONENTS (Total weight: 100)

	Component	Weight
1	Utility employees health and safety	35
2	Utility - Loss of revenue	20
3	Utility - Repair cost	20
4	Effluent quality	25

Table 5.1 - San Marcos Reuse System Facility Assets Relative Risk Matrix

City of San Marcos
Asset Management Plan
Risk Assessment - Reclaim Water Lines

LIKELIHOOD OF FAILURE COMPONENTS		100
	Component	**Weight**
1	Staff opinion of condition - staff score	10
2	Age (yr) - age	25
3	Material - material; also includes cathodic protection	10
4	No of A/V relief valves	10
5	Burial depth (ft)	15
6	High Pressure	20
7	Thrust	10

CONSEQUENCE OF FAILURE COMPONENTS		100
	Component	**Weight**
1	Public safety	5
2	Utility employees health and safety	25
3	Number of customers affected	15
4	Utility - Inhouse Repair Capability	10
5	Loss of service to critical facilities	20
6	Proximity to main roads or railroads	15
7	Discharge to Sensitive Environments - schools, lakes, parks, streams	10

Table 5.2 –San Marcos Reuse System Pipeline Assets Relative Risk Matrix

The risk analysis was conducted using GIS database tools which compute risk scores based on the scoring tables and available geospatial attributes. The risk results provided composite LOF and COF scores and a ROF score for each asset. The assets in each group were then ranked in order of their risk score.

Risk results are displayed in a variety of formats. The risk result matrix shown below in Figure 5.2 is a typical example showing assets with common likelihood and consequence of failure scores. Assets that fall in the red area are considered high risk assets. In the risk analysis, the high risk category is related to the condition of all of the assets in the San Marcos system and not an indication of any immediate failure potential. The high risk assets in the San Marcos system are assigned the top priority for further evaluation or more routine monitoring and inspection. Asset monitoring and inspection can be used to identify any needed repairs and help forecast when a more comprehensive rehabilitation program may be required. The assets in the yellow area are typically programmed for inspection and evaluation within the next ten years. The low risk assets in the green area should be monitored and reevaluated in updates to the renewal forecast. As assets age, their LOF scores will normally increase. In general the COF scores do not change much unless the overall environment surrounding the asset changes.

Asset Renewal Programming Are Based on Relative Risk Results											
		Likelihood of Failure Scores									
		1	2	3	4	5	6	7	8	9	10
Consequenceof Failure Scores	10										
	9				Medium risk				High risk assets may		
	8				program				require near term attention,		
	7	Low risk assets			assessment for				investigate and repair		
	6	periodically monitor			the future				program for future rehab		
	5	assess and update									
	4	LOF scores for									
	3	renewal in future									
	2										
	1										

Figure 5.2 – Typical Relative Risk Results Matrix

The risk scores for reuse system facility and pipeline assets were then calculated, compiled, and plotted to indicate the relative state of the assets in each risk of failure category. The composite risk of failure score for each asset provided the basis for prioritizing or ranking the assets for future monitoring, maintenance, inspection and evaluation.

5.2 San Marcos Water Reuse Facility Asset Relative Risk Results

A detailed risk analysis for the reuse facility assets was developed based on the risk matrix shown in Table 5.1 using a GIS-based risk analysis tool adapted for the San Marcos data. The analysis computed the LOF, COF, and ROF scores for all twenty-three (23) individual reuse system facility assets are shown in Table 5.3. Figure 5.3 provides a risk profile for the reuse facility assets.

Maximo ID	Description	Manufacturer	Install Date	Age	Staff Condition Score	Replace-ment Cost	LOF Scores						COF Scores				LOF (A)	COF (B)	Risk Score (A*B)/10	Risk Rank
				2016			Staff Opinion	Repair	Age	Duty	Maint-enance	Redun-dancy	Utility Safety	Loss of Revenue	Repair Cost	Effluent				
Pumps & Motors																				
RW-001	Reclaimed Pump #1	Fairbanks Morse	2012	4	1	$45,300	1	10	1	2	10	10	6	10	7	3	7.4	6.25	4.625	2
RW-002	Reclaimed Pump #2	Fairbanks Morse	2012	4	1	$45,300	1	8	1	10	10	10	6	10	7	3	7.7	6.25	4.8125	1
RW-003	Reclaimed Pump#3	Fairbanks Morse	2012	4	1	$45,300	1	8	1	6	7	10	6	10	7	3	6.85	6.25	4.28125	3
DIS-002	Disinfection Chemical Pump	Fairbanks Morse	2000	16	1	$8,000	1	1	5	8	1	5	6	10	2	10	3.8	7	2.66	5
Electrical																				
RMCC	Reclaim Wtr Motor Control Center And Building	Siemens	2000	16	2	$131,000	5	1	5	1	1	5	10	10	10	3	3.5	8.25	2.8875	4
Controls																				
ANP-001	Rosemount Flowmeter 3051 Inf. ANP-001		2000	16	1	$7,000	1	1	5	1	1	5	10	5	7	3	2.6	6.65	1.729	7
ANP-002	Rosemount Flowmeter ANP-002 Eff.		2000	16	1	$7,000	1	1	5	1	1	5	10	5	7	3	2.6	6.65	1.729	8
FIT-001	Flowmeter Reclaim Water Station	Badger	2000	16	1	$2,500	1	1	5	1	1	5	10	5	1	3	2.6	5.45	1.417	11
FS-001	Reclaim Flow Switch	McDonnell & Miller	2000	16	1	$2,500	1	1	5	1	1	5	10	5	1	3	2.6	5.45	1.417	12
LIT-001	Level Transmitter Reclaimed Water	Milltronics	2000	16	1	$3,500	1	1	5	1	1	5	10	5	5	3	2.6	6.25	1.625	9
PLC-RW	Programable Logic Controller Panel Reclaim Water	Schneider Electric	2000	16	1	$3,000	1	1	5	1	5	5	10	5	5	3	3.2	6.25	2	6
Piping & Valves																				
ARV-01	Air Release Valve #1 RW-001 2"	APCO	2000	16	1	$3,100	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	18
ARV-02	Air Release Valve #2 RW-002 2"	APCO	2000	16	1	$3,100	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	19
ARV-03	Air Release Valve #3 RW-003 2"	APCO	2000	16	1	$3,100	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	20
BFV-01	Butterfly Valve #1 10" RW-001	Henry Pratt	2000	16	2	$1,600	5	1	5	1	1	5	4	2	1	3	2.7	2.75	0.7425	15
BFV-02	Butterfly Valve #2 10" RW-002	Henry Pratt	2000	16	2	$1,600	5	1	5	1	1	5	4	2	1	3	2.7	2.75	0.7425	16
BFV-03	Butterfly Valve #3 10" RW-003	Henry Pratt	2000	16	2	$1,600	5	1	5	1	1	5	4	2	1	3	2.7	2.75	0.7425	17
PCV-01	Pump Control Valve RW-001	OCV	2000	16	1	$1,000	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	21
PVC-02	Pump Control Valve 2 RW-002	OCV	2000	16	1	$1,000	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	22
PVC-03	Pump Control Valve RW-003	OCV	2000	16	1	$1,000	1	1	5	1	1	5	4	2	1	3	2.3	2.75	0.6325	23
PSP-001	Pump Station Piping		2000	16	2	$7,800	5	1	5	1	1	5	4	2	2	3	2.7	2.95	0.7965	14
Structure																				
DIS-001	Disinfection Chemical Tank	PolyProcessing	2000	16	1	$500	1	1	5	1	1	5	5	2	1	10	2.3	4.85	1.1155	13
RECLAIM WET	Reclaim Water Wet Well	Bryan Construction	2000	16	1	$1,000	1	1	5	1	1	5	5	10	1	3	3.1	4.7	1.457	10

Table 5.3 - San Marcos Reuse Facility Asset Relative Risk Results

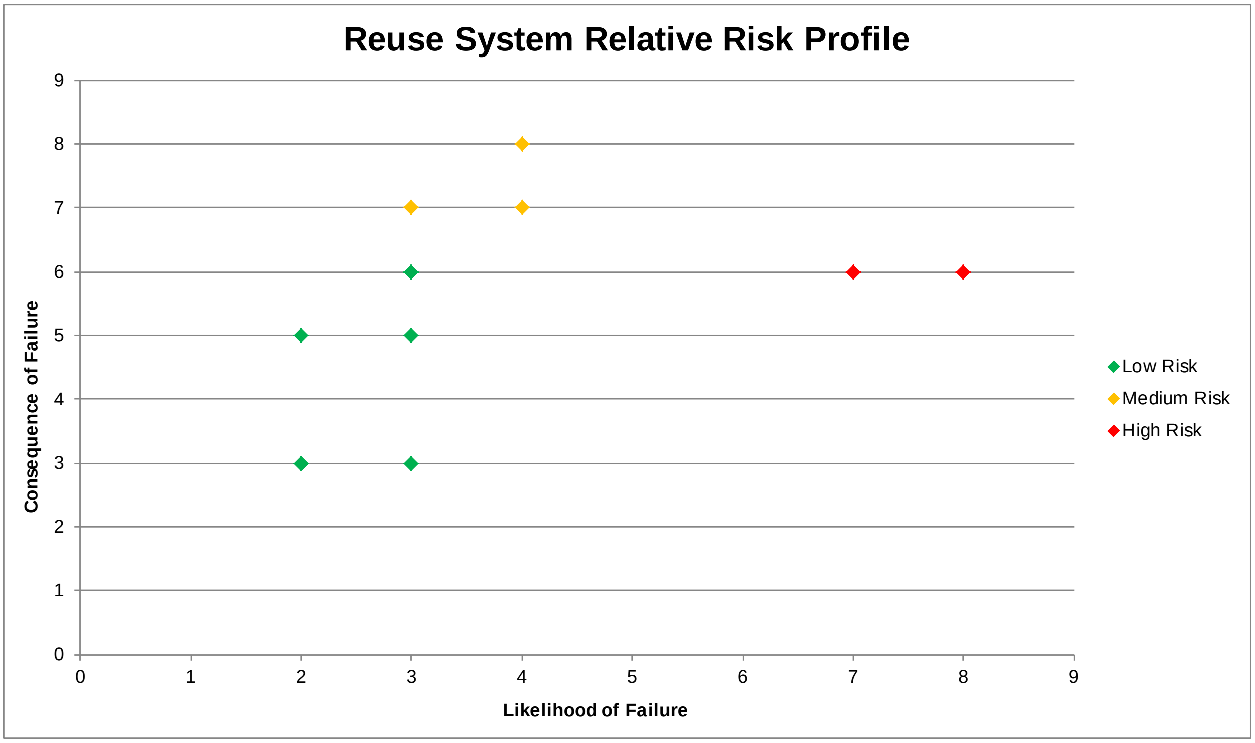

Figure 5.3 - San Marcos Reuse Facility Assets Relative Risk Profile

5.3 <u>San Marcos Reuse System Pipeline Relative Risk Results</u>

A similar risk analysis was performed for the reuse system pipelines based on the risk matrix shown in Table 5.2 using a GIS-based risk analysis tool. The analysis computed the LOF, COF, and ROF scores for all 58 individual reuse pipeline segments. Table 5.4 summarizes the LOF, COF, ROF and Risk Rank for each reuse pipeline segment which is also illustrated in Figure 5.4. Table 5.4 presents the risk results in terms of total linear footage in the San Marcos system and Figure 5.5 provides a map of the reuse pipeline segments with their corresponding low risk (green), medium risk (yellow), and high risk (red) color designations.

Most of the City's reuse pipeline assets fall into the medium or low risk categories. Five line segments on the Hays Energy reuse line were consider high risk based on Risk of Failure scores above 4.0. The higher risk scores on these line segments were caused by the relatively high Consequence of Failure (COF) scores for these particular line segments. While it is typically difficult to mitigate high COF scores, these assets may warrant more frequent monitoring and inspection to maintain their condition and avoid potential failure.

Maximo PFX	Dia (in)	Project	Shape Length (ft)	Replacement Cost	LOF (A)	COF (B)	Risk Score (A*B)/10	Risk Rank
NPWL2X	18	Hays Energy	170	$17,400	6.4	7.1	4.54	1
NPWL2B	18	Hays Energy	110	$11,300	4.8	8.95	4.30	2
NPWL2Q	18	Hays Energy	70	$7,200	5.4	7.9	4.27	3
NPWL2K	18	Hays Energy	132	$13,500	4.8	8.65	4.15	4
NPWL2N	18	Hays Energy	100	$10,300	4.8	8.55	4.10	5
NPWL2D	18	Hays Energy	210	$21,500	4.8	8.15	3.91	6
NPWL2G	18	Hays Energy	95	$9,700	4.8	8.15	3.91	7
NPWL2I	18	Hays Energy	230	$23,600	4.8	8.15	3.91	8
NPWL2T	18	Hays Energy	90	$9,200	5.4	7.1	3.83	9
NPWL191	16	Sessom	773	$73,100	4.45	8.15	3.63	10
NPWL2P	18	Hays Energy	2,260	$231,700	4.45	8.05	3.58	11
NPWL391	16	Sessom	846	$80,000	4.45	7.85	3.49	12
NPWL271	16	Sessom	421	$39,800	4.45	7.4	3.29	13
NPWL2W	18	Hays Energy	3,050	$312,600	5.05	6.2	3.13	14
NPWL2Y	18	Hays Energy	1,781	$182,500	5.45	5.6	3.05	15
NPWL2C	18	Hays Energy	2,908	$298,100	3.85	7.85	3.02	16
NPWL2M	18	Hays Energy	3,150	$322,900	3.85	7.85	3.02	17
NPWL351	16	Sessom	457	$43,200	3.7	8.15	3.02	18
NPWL2A	18	Hays Energy	250	$25,600	3.9	7.55	2.94	19
NPWL412	16	Sessom	645	$61,000	3.7	7.65	2.83	20

Table 5.4 – San Marcos Reuse Pipeline Relative Risk Results

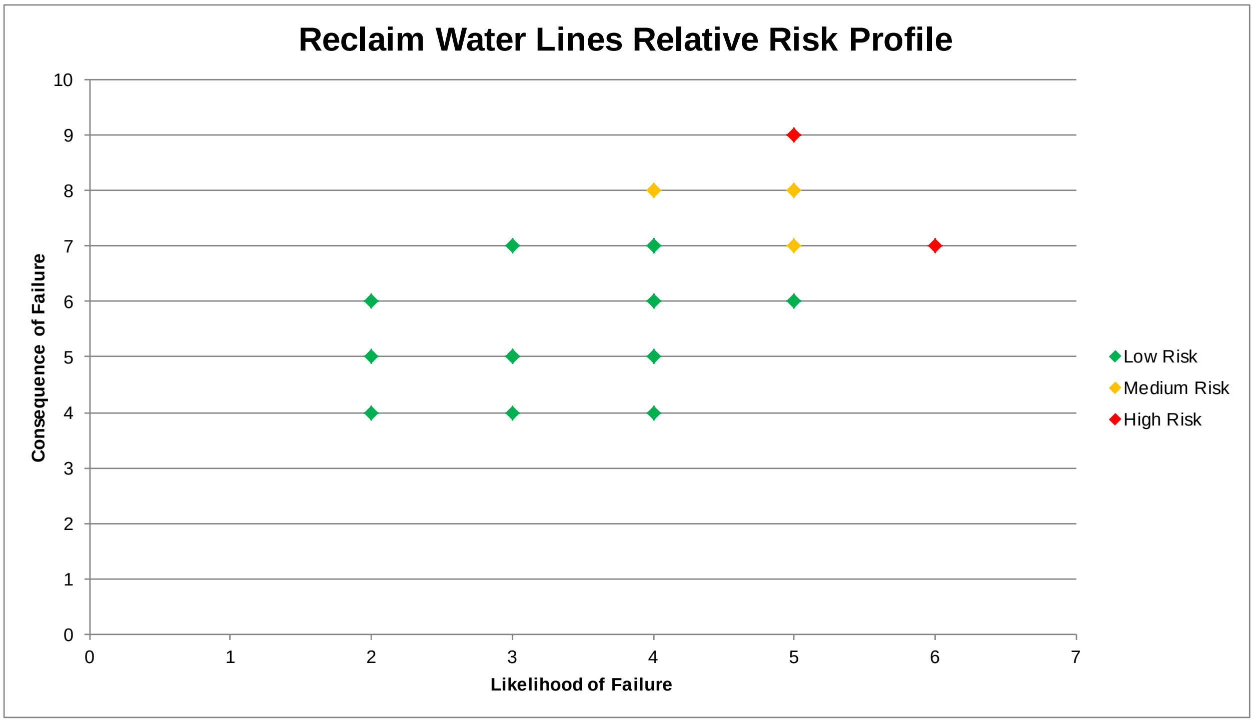

Figure 5.4 – San Marcos Reuse Pipeline Relative Risk Profile

		Likelihood of Failure Scores										
		1	2	3	4	5	6	7	8	9	10	Total (ft)
Consequenceof Failure Scores	10											
	9											
	8											
	7											
	6							170				170
	5						10,289	90	605	342		11,326
	4				4,653	542	10,264	9,073	11,288			35,821
	3				3,957	641		3,950				8,547
	2				3,729	31	8,786					12,546
	1											
Total (ft)					12,339	1,214	29,340	13,283	11,893	342		68,410

Table 5.2 – Relative Risk Results Matrices for Reuse Pipelines by Linear Foot

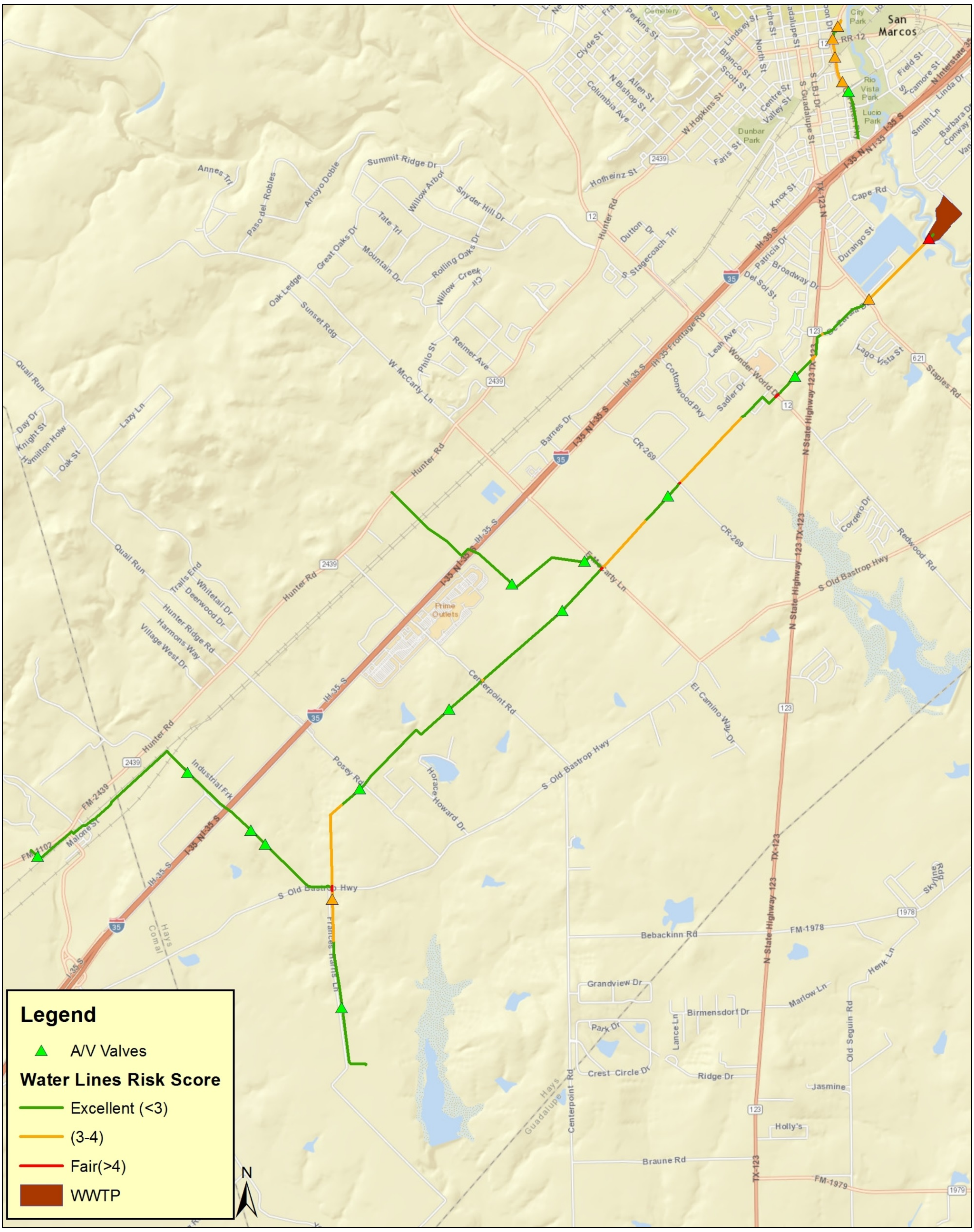

Figure 5.5 – San Marcos Reuse Pipeline Relative Risk Results Map

6 State of the Assets

The twenty three (23) reuse system facility assets and fifty eight (58) reuse pipeline assets provide reclaimed water to key industrial and commercial customers in San Marcos. This reuse system is an integral part of the City's current and future long term water supply plans. As the City plans to expand the overall reuse system, it is critical that the existing reuse facility asses and pipeline assets remain reliable and efficient source of reclaimed water into the future.

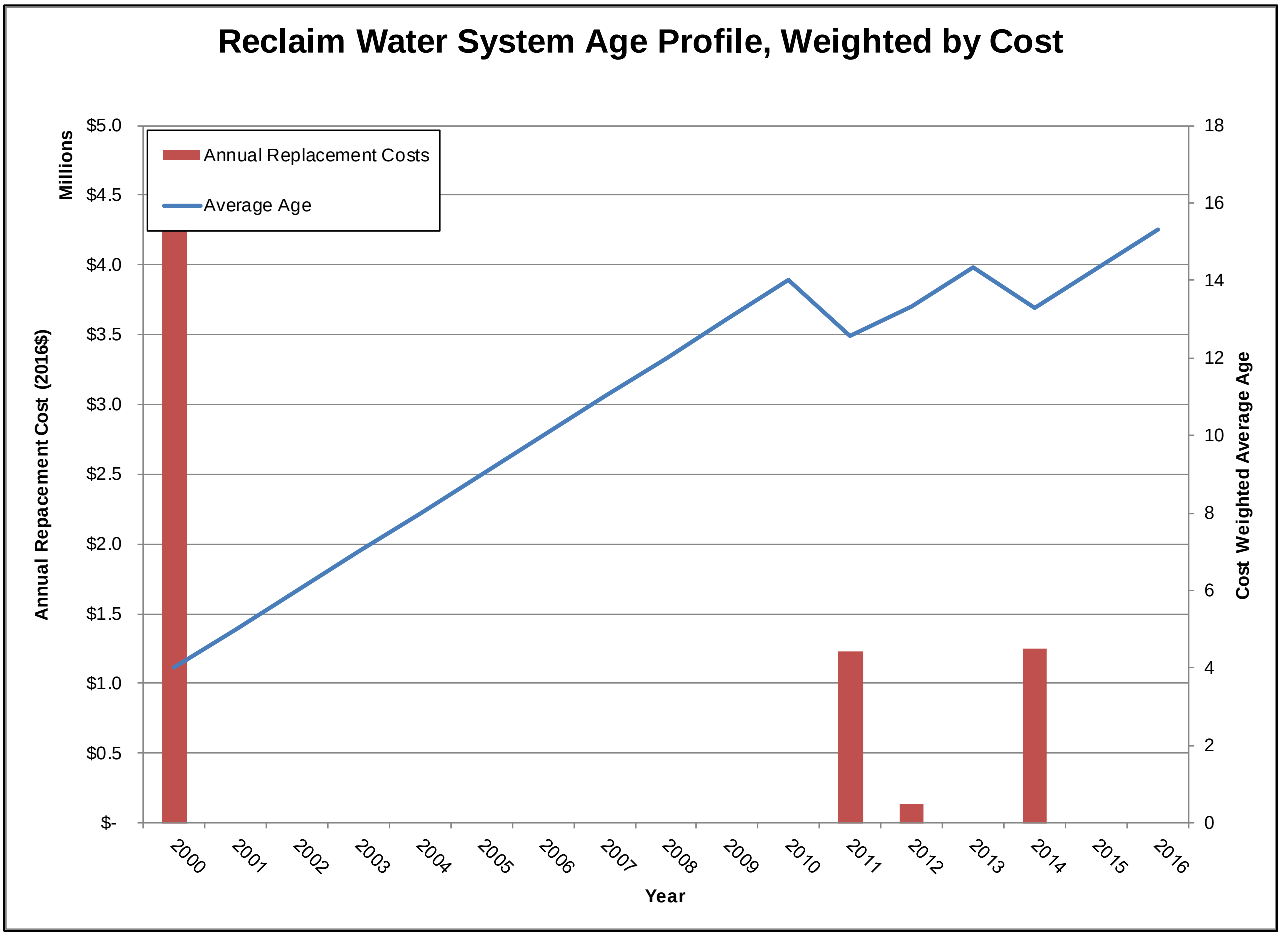

Figure 6.1 – The San Marcos Reuse System Asset Investment

The San Marcos reuse system was constructed steadily over the last fifteen years as the reuse system expanded to serve new customers. Figure 6.1 shows the investment profile for reuse facility and pipeline assets based on the asset replacement costs and cost-weighted age based on the replacement cost figures for all of the reuse systems.

The average cost weighted age of the San Marcos reuse system is 13 years. The total replacement cost for the reclaim water line assets in the reuse system is estimated to be $6.6 million. The overall system is relatively young compared to other City water and wastewater infrastructure assets. Since most of the San Marcos system piping is PVC, the anticipated average useful life the San Marcos reuse system pipelines is over 100 years. Therefore, the San Marcos water reuse system should not require any major rehabilitation or replacement for years to come. The reuse system facility assets have a much shorter useful life expectancy and will likely require some rehabilitation or replacement within the next 10 years.

Figure 6.2 and 6.3 plot all of the reuse system facility and pipeline assets based on their composite risk of failure scores and LOF/COF scores respectively. Since a similar scoring approach was used for the pipeline and facility assets their risk of failure scores can be compared to prioritize all system assets. Since the majority of assets fall into the low or medium risk categories, the system will generally require routine monitoring, inspections, and repairs with only isolated asset rehabilitation and replacement to address localized failure conditions.

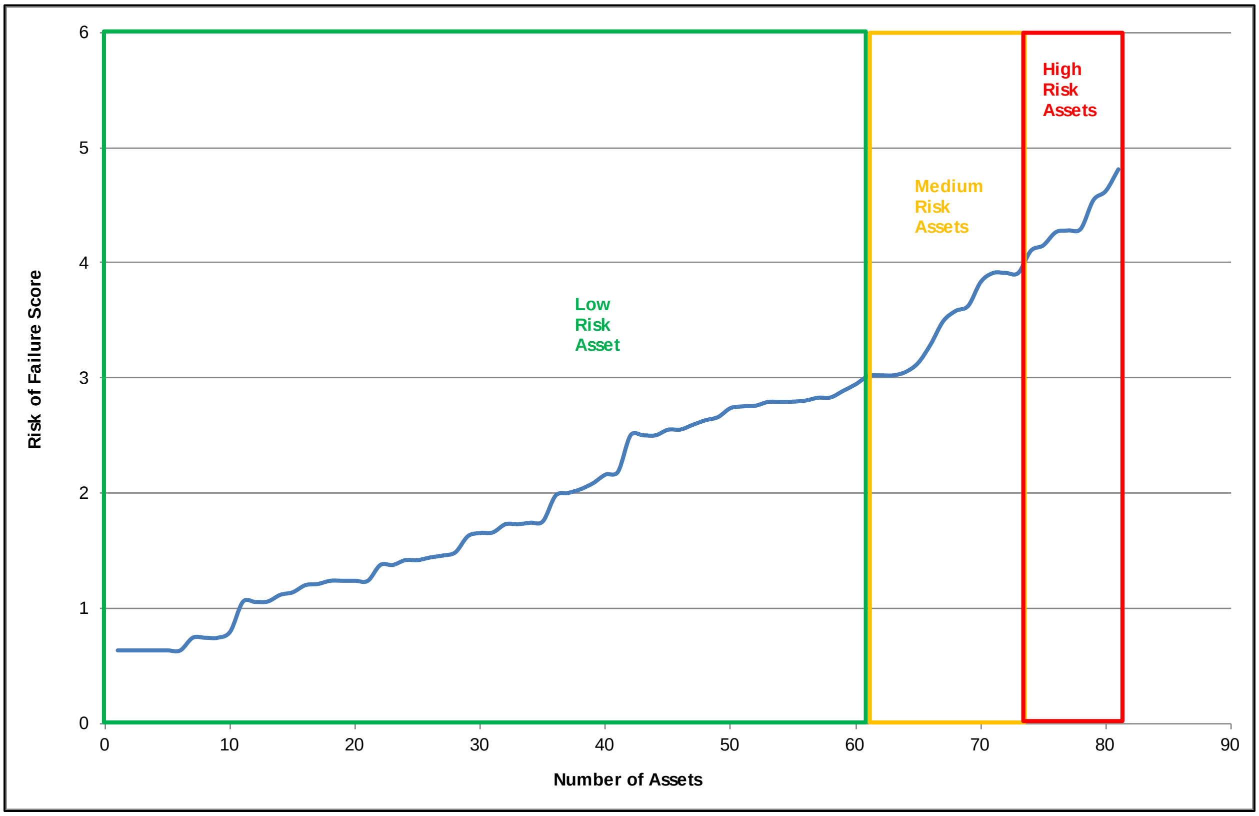

Figure 6.2 - San Marcos Overall Reuse System Asset Relative Risk of Failure

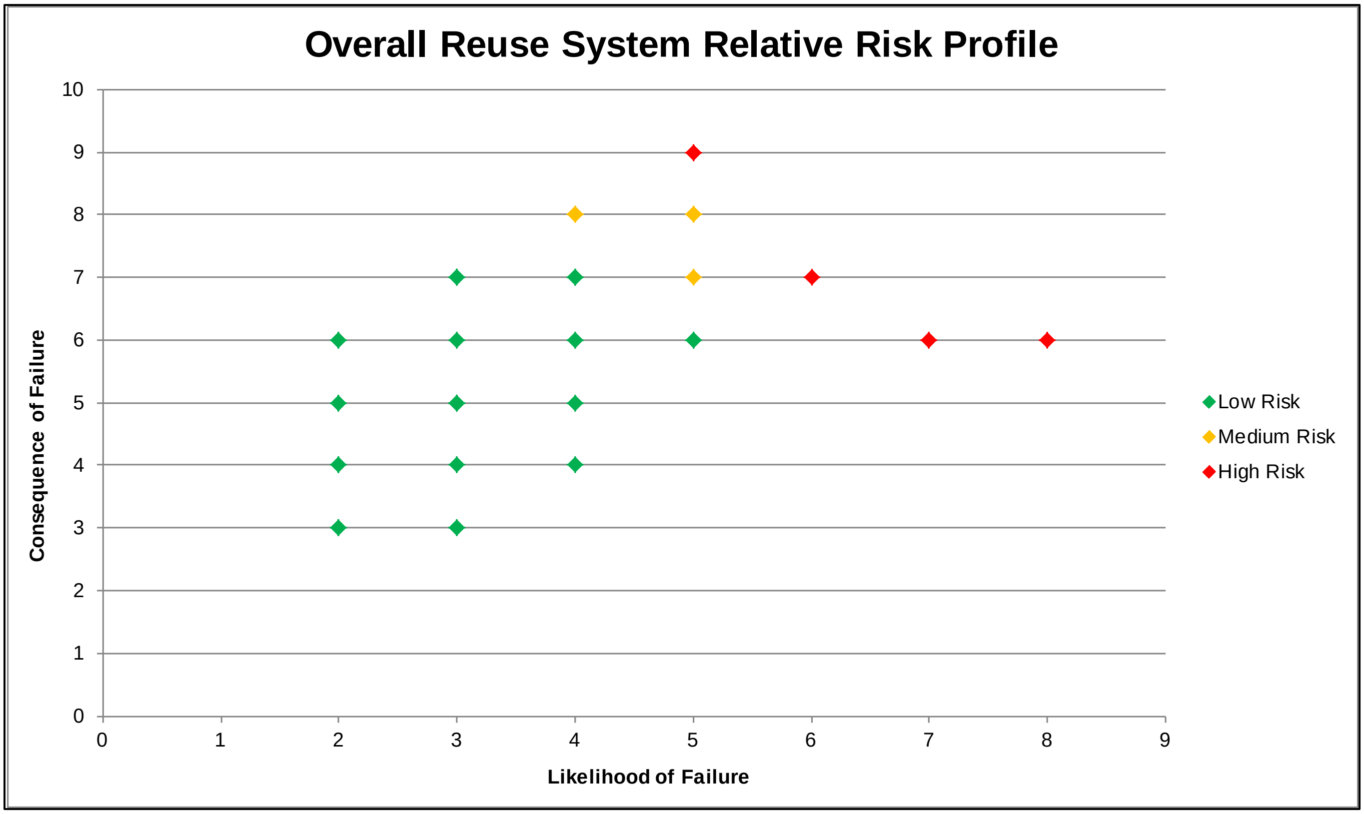

Figure 6.3 – San Marcos Overall Reuse System Relative Risk Profile

7 Asset Management Implementation

This initial San Marcos Water Reuse System Asset Management Plan (AMP) provides the baseline to implement an advanced asset management program for San Marcos Water reuse System. The existing comprehensive asset inventory provided the initial step to track and manage individual reuse facility and pipeline assets, each with a unique identification number. The attribute data in the existing asset inventories or asset registers were expanded to provide key information to manage each asset over its entire life cycle. Key asset management data including age, useful life, remaining useful life, and replacement costs were recorded for each asset.

The initial asset condition assessment relied heavily on San Marcos staff knowledge and experience. LOF, COF, and ROF scores are also largely based on top down or desk top data. A reliance on input from the people who really know the system provided a level of assurance that these initial results can be used to target the higher priority assets for routine monitoring, maintenance inspections and repairs.

The work completed for this AMP is an initial step in a process to develop a water reuse system asset management initiative to improve the efficiency and effectiveness of each reuse system asset over its life cycle. Asset management is typically developed over time in a process of continuous improvement. Based on the EPA's 10 steps to implement an asset management process, the initial asset management work accomplished is summarized in Table 7.1 along with a summary of the next steps for asset implementation. Policies and business practices associated with document and information management, asset management information systems, operations and maintenance integration, and strategic decision making will need to be developed to support continued implementation and improvement of the overall asset management process.

7.1 Asset Information Management

The San Marcos Maximo CMMS is the primary information management system used for the water reuse facility and pipeline assets. The asset inventory in Maximo should be updated to include all reuse system assets with the designated reuse pipeline segments integrated for better management. The additional key attribute data should be added to the Maximo database where applicable. The condition and risk data developed for each asset could be included in the

San Marcos Maximo database or maintained in a separate database linked to Maximo by asset ID.

EPA 10-Step Advanced Asset Management Process	Asset Management Components Completed in Development of the San Marcos Water Reuse System Asset Management Plan	Asset Management Steps for the Continued Development of an Asset Management Program
1. Develop Asset Registry	The asset inventory contained in Maximo and GIS were updated and expanded to include additional attribute data.	Not all of the assets were included in the Maximo asset inventory which should be expanded to include fixed and linear assets. Attribute data should be added or linked to the Maximo asset data base
2. Asset Performance, Failure Modes	Initial condition and performance assessments were completed and documented.	Begin more detailed condition assessments of priority assets and analyze their potential failure modes.
3. Determine Residual Life	Asset age and survival curve data were developed as the basis for determining asset residual life	Validate age and useful life data. Identify conditions that can impact the useful life of facility and pipeline.
4. Life-Cycle and Replacement Costs	Initial asset replacement costs were developed for all assets in the inventory	Validate and update replacement cost data
5. Set Target Levels of Service	Levels of service were not reviewed or developed as part of the AMP	Review or develop target service levels to help measure progress towards asset management goals and objectives
6. Determine Business Risk (criticality)	Risk matrices were developed with LOF and COF components, weights and scoring criteria. A baseline business risk assessment was performed for all assets.	Link or incorporate the risk of failure data into San Marcos's Maximo CMMS and develop a business process to update and maintain LOF, COF, and ROF data current in the system
7. Optimize O&M Investment	Existing work order maintenance data were included in the overall risk assessment.	Initiate processes to link asset performance and maintenance data in Maximo work order system to evaluate maintenance practices for all reuse system assets..
8. Optimize Capital Investment	Capital investment strategies are currently focused on reuse system expansion and improvements.	As reuse system assets begin to fail, develop a programmed asset rehabilitation or replacement program to maintain system performance.
9. Determine Funding Strategy	The AMP did not address funding strategies for reuse system expansion or future rehabilitation	Analyze the impact of the various funding options on the service rates, and long term investment requirements.
10. Build AMP	The initial AMP was developed.	Develop a process to update the AMP on an five year cycle

Table 7.1 – Summary of FY 2016 Accomplishments and Required Next Steps for Asset Management Implementation

7.2 <u>Asset Management Business Processes</u>

The AMP covers the initial phase of asset management development for San Marcos's water reuse system. This top-down approach leveraged available data and information to build an asset inventory, complete an initial condition assessment, and perform a detailed desk-top risk assessment. As the AMP is implemented, physical inspections and other condition performance measures can be used to refine the baseline data developed in the AMP and improve San Marcos's assessment of the remaining useful life and renewal options for all of its water reuse system assets.

The initial baseline data summarized in this plan can be enhanced through the development or refinement of a number of asset management business practices as summarized in the following:

1. **Asset Register Updates** – The updated San Marcos reuse System asset register would be maintained in the existing Maximo CMMS database. Validation and updating of the asset inventory data in the water reuse system asset register should be an ongoing process.
2. **Asset Condition and Failure Assessments** – Validation and update of asset condition data should be continued through maintenance information and field inspections. More detailed asset failure analyses can be developed for high risk assets.
3. **Performance Data Updates –** The San Marcos work order system should be used to enhance the ability to collect performance, service, maintenance, and other asset performance data for each reuse system asset.
4. **Integrate Operation and Maintenance Practices** - The initial asset management plan focuses on asset inventories, condition assessment, and risk assessments to develop capital renewal plans. As the San Marcos asset management program develops, operations and maintenance information should be tied to assets for updating performance and to optimize O&M costs on an asset basis. O&M cost should be combined with the capital cost projections for a total asset cost forecast.
5. **Update Asset Risk Assessment** – Performance data combined with inspection and rehabilitation data can be used to update LOF and COF scores and reprioritize assets based on new ROF scores.

6. **Refine Replacement Costs and Useful Life Data -** Tracking asset replacements as they occur will help update and customize the survival curve projections and actual replacement costs data. This should allow for a more refined analysis in future years.

8 Asset Investment Plan

8.1 **Long-Term Investment Forecast**

The long-term investment forecasts the pace and magnitude of long term investment needed to sustain the City's water reuse system assets into the future. The long-term forecast is designed to predict the level of asset rehabilitation or replacement required to maintain City's standards of customer service and system performance over the coming decades. Because the City's system assets is relatively young and have anticipated useful lives exceeding 90 years, major rehabilitation or replacement costs were forecasted through the year 2080. The long-term analysis looks at broad categories of assets or cohorts that have similar useful lives and degradation profiles. This high level overview of the system is used to forecast costs based on industry replacement data that have been customized with specific institutional knowledge from within the City.

The long-term forecast provides justification for budgetary targets relative to City's current investment in its assets. Given that many utilities have fallen behind with their system renewal efforts, the long-term forecast provides the fiduciary motivation to maintain more informed renewal budgets over time. It can also help communicate to stakeholders the value of the existing infrastructure assets and the renewal investment required to sustain those assets.

The reuse system assets were grouped by equipment type under the assumption that similar equipment will have comparable aging characteristics. Failure curves for each asset type were started with industry standard life expectancies, which were then adjusted by City's staff for the specific conditions in the reuse system. Figures 8.1, 8.2 and 8.3 are examples of failure curves developed for reuse system assets, reclaim water line, and reclaim water valves respectively. Failure curves are based on the number of years from installation to the point where:

- 100% of the original asset would still be functional or the number of years until the first major asset failure.
- 50% of the asset would still be in service without substantial rehabilitation/replacement or the number of years identified as the average useful life of an asset group or cohort.

- 10% of the original asset would still be in service without replacement or substantial rehabilitation, which essentially represents the maximum useful life of an asset group or cohort.

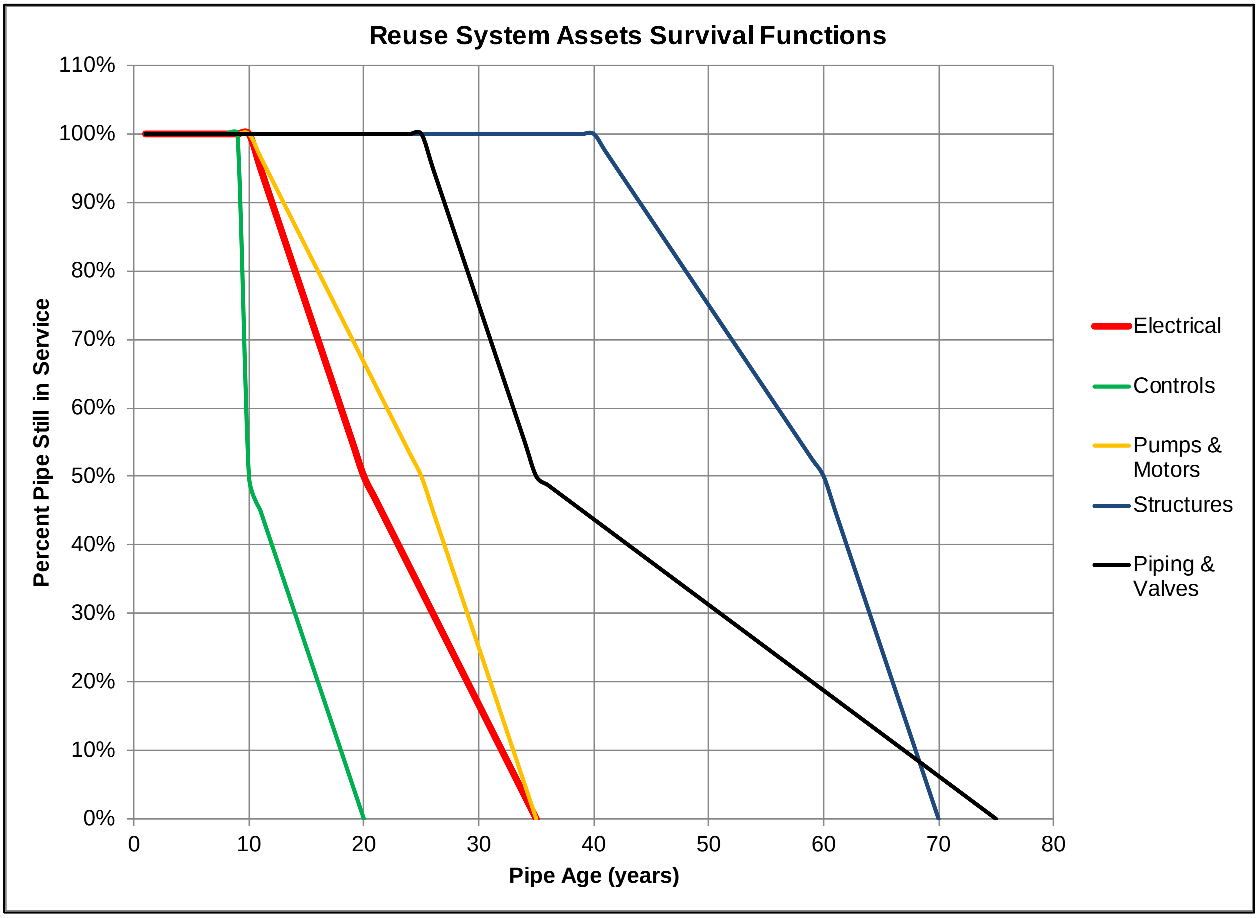

Figure 8.1 – Reuse System Assets Survival Functions

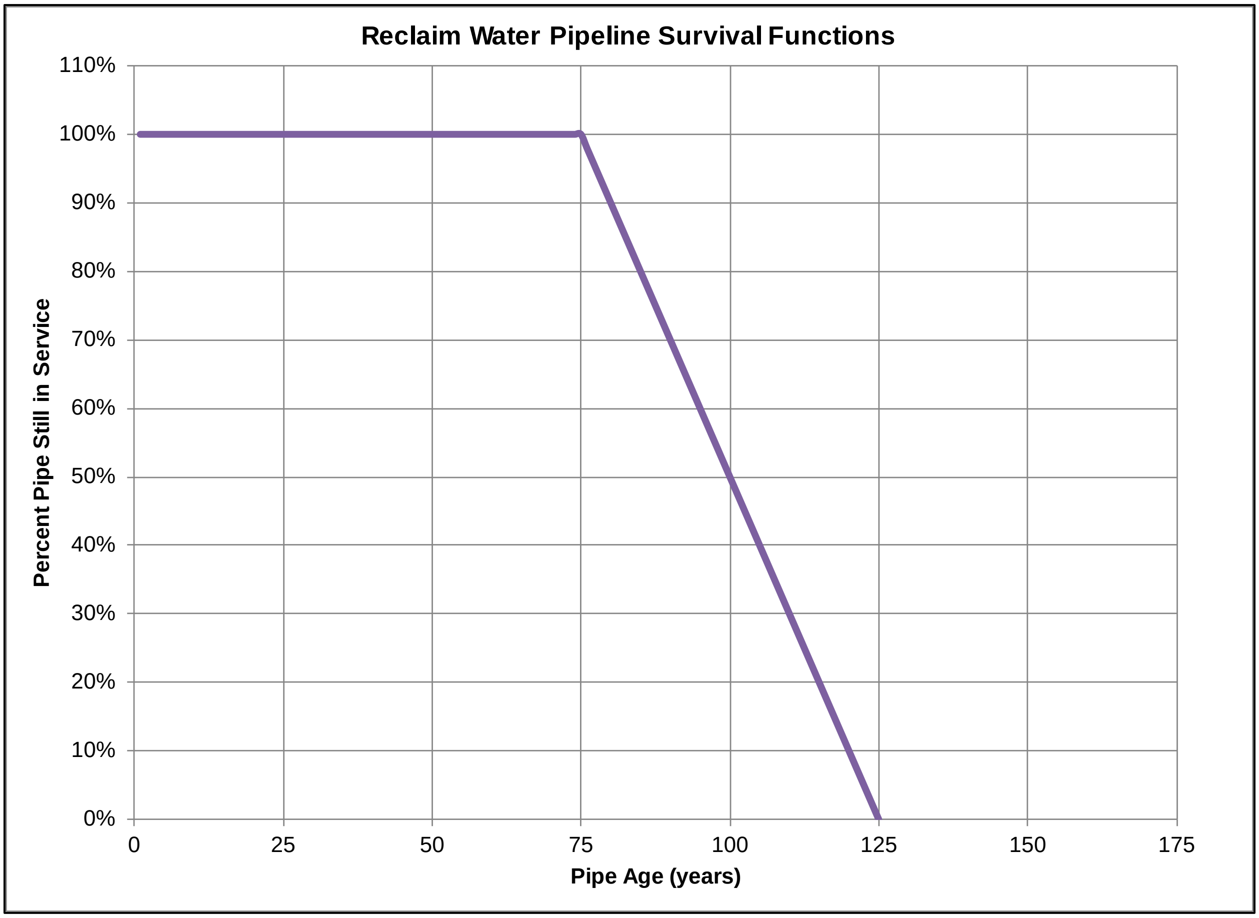

Figure 8.2 – Reclaim Water Pipeline Survival Functions

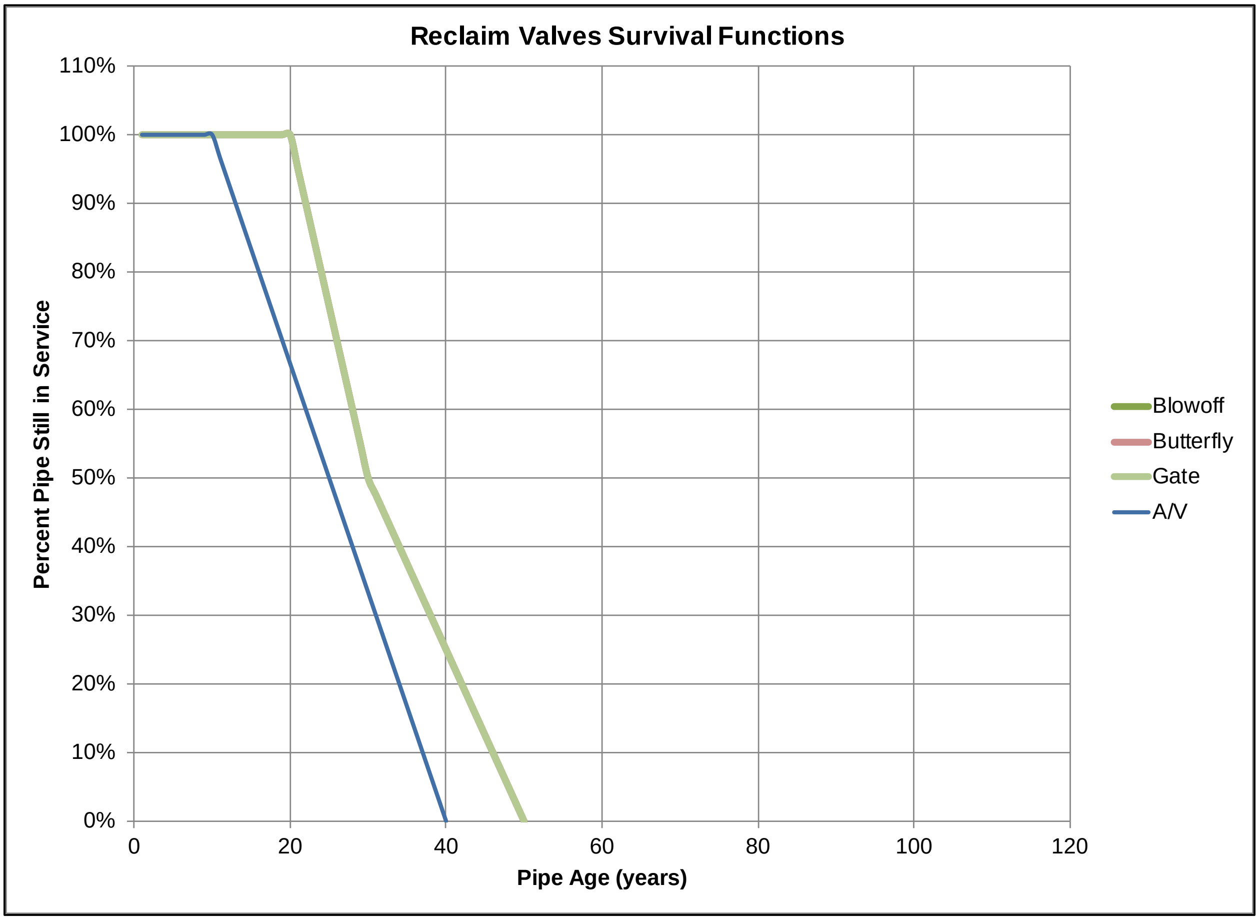

Figure 8.3 – Reclaim Valves Survival Function

This basic survival curve data in combination with asset age and replacement costs data in the asset inventories can provide a good forecast of the aggregate asset rehabilitation or replacement requirements into the future. The long-term forecast analysis is based on asset replacement costs and provides a conservative asset renewal forecast since asset rehabilitation costs are typically lower. The long-term forecast does not take into account future growth, expansion, or changes to future installations.

8.2 <u>Reuse Asset Survival Trends</u>

Figure 8.4 shows the long-term forecast for the City's reuse system replacement and rehabilitation through the year 2080. As shown in Figure 8.4, replacement or rehabilitation of controls should begin around 2025 and represents the major reinvestment requirements until 2080 when major structures, pumps, piping and valves will begin to require some major rehabilitation or replacement. The reclaim water pipelines, with a life expectancy of 125 years, are shown to have some minor rehabilitation around 2075.

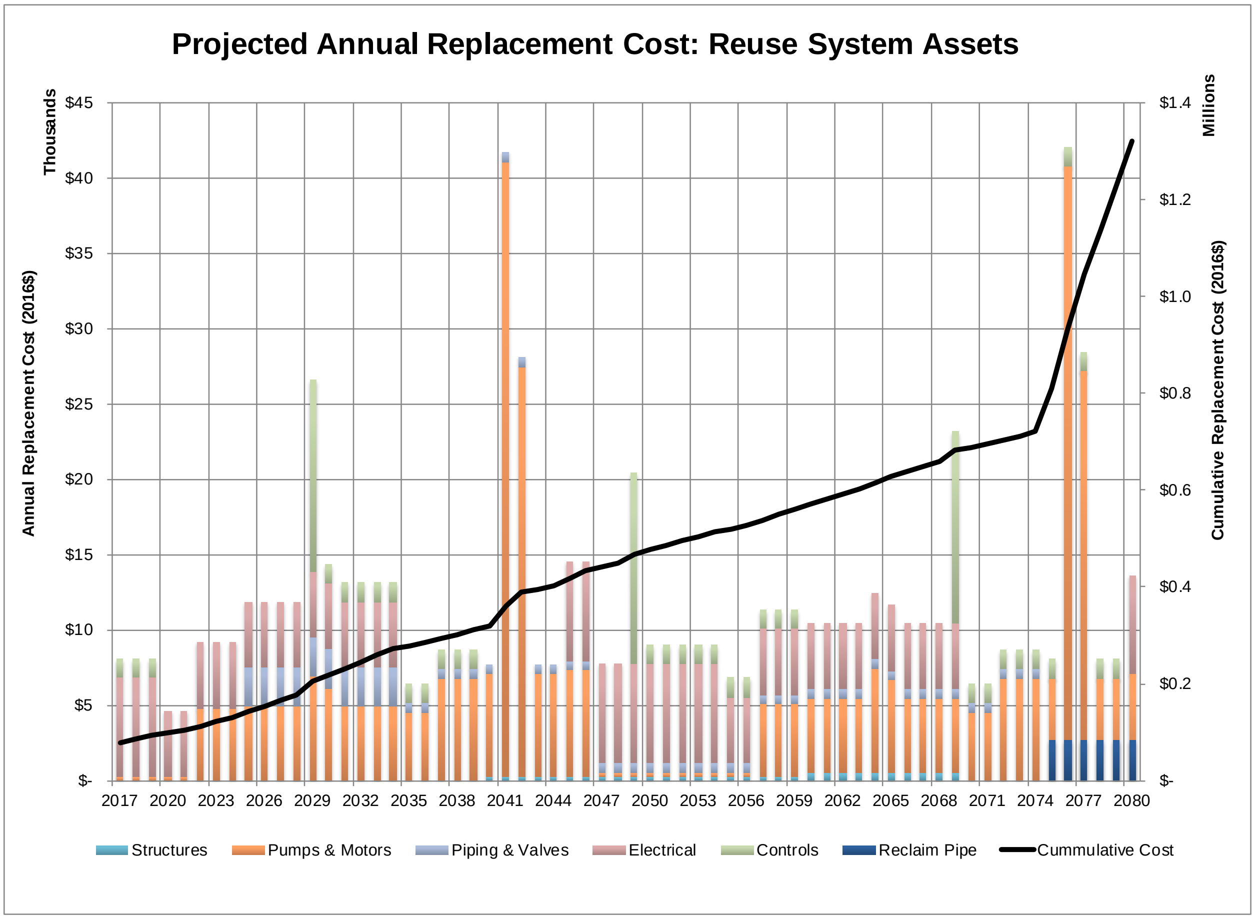

Figure 8.4 - Projected Annual Replacement Cost: All Reuse System Assets

The long-term forecasts are based on estimated survival curves and replacement costs in today's dollars. These forecasts represent average asset replacement requirements. Ongoing inspections, maintenance, and repair histories will provide better insight into the long term performance of the various pipe materials. This data can be used to validate the assumed useful life and survival curve data and update the long-term forecast.