PREPARED FOR:

Cottonwood Improvement District

PREPARED BY:

BOWEN COLLINS & ASSOCIATES

SEWER CAPITAL FACILITIES PLAN

JANUARY 2022

SEWER
CAPITAL FACILITIES
PLAN

January 2022

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1-26-22
STATE OF UTAH

Prepared for:

Cottonwood Improvement District

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CHAPTER 1
INTRODUCTION

INTRODUCTION

Cottonwood Improvement District has retained Bowen Collins & Associates (BC&A) to prepare a Capital Facilities Plan for the District's wastewater collection system. The purpose of this sewer Capital Facilities Plan report is to identify recommended improvements that will resolve existing and projected future deficiencies in the wastewater collection system throughout the District's service area.

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of the District's sewer collection system and its ability to meet the present and future wastewater needs of its residents. As part of the Sewer Capital Facilities Plan, BC&A completed the following tasks.

Task 1: Collected information as needed to develop the Sewer Capital Facilities Plan. This included reviewing existing District data including flow data and facility information. It also included meeting with the member entities of the District to identify planned redevelopment areas within the District. Coordination on future development involved coordination with Cottonwood Heights City, Holladay City, Midvale City, Murray City, Sandy City, Big Cottonwood Canyon Improvement District, and Salt Lake County Service Area 3.

Task 2: Updated population projections and estimated growth in sewer flow to evaluate future system needs.

Task 3: Updated a hydraulic computer model of the District's collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using data from the District's existing GIS database.

Task 4: Identified existing operating deficiencies based on current system loading.

Task 5: Identified projected future operating deficiencies for both 10-year growth and projected development at full buildout.

Task 6: Evaluated alternative improvements for resolving deficiencies identified in Tasks 4 and 5.

Task 7: Developed a comprehensive capital facilities plan incorporating all required improvements identified for the collection system.

In conjunction with the Capital Facilities Plan, an Impact Fee Facilities Plan, Impact Fee Analysis, and Rate Study were also completed by BC&A. The results of these activities are documented in separate reports.

NOTES REGARDING THE DECEMBER 2021 UPDATE

During the District's efforts to update their sewer capital facilities plan in 2020 they discovered that the sewer flow metering at the outfall to the Central Valley Water Reclamation Facility (CVWRF) was not correctly calibrated. The CVWRF meter was properly calibrated in September of 2020 resulting in lower sewer flow readings at the District's outfall meter. BC&A completed an initial capital facilities plan analysis based on the higher historic flow readings and produced a draft report of this analysis at the end of 2020. However, with the lower observed flows after calibration, the District decided to hold off on publishing the results to give time for a full years' worth of new sewer flow metering data to be collected. BC&A reanalyzed the CVWRF metering data from October 2020 through August 2021 and updated the capital facilities plan based on the metering results. This report reflects the updated results.

With the extra time afforded by the additional data gathers, the District also decided to conduct a sewer collection system asset management analysis. The results of this analysis and corresponding asset management plan have also been added to this report.

ACKNOWLEDGMENTS

The BC&A team wishes to thank the following individuals from Cottonwood Improvement District and member entities for their cooperation and assistance in working with us in preparing this report:

Gregory Neff	Cottonwood Improvement District – General Manager
Spencer Evans	Cottonwood Improvement District – Chief Financial Officer
Andrew Hulka	Cottonwood Heights City – City Planner
Paul Allred	Holladay City – City Planner
Jason Binks	Midvale City – City Planner
Jared Hall	Murray City – City Planner
Brian McCuistion	Sandy City – City Planner
John Guldner	Alta Town – City Planner
Brian Martain	Big Cottonwood Canyon Improvement District – Engineer
Keith Hansen	Salt Lake County Service Area 3 – Engineer

PROJECT STAFF

The project work was performed by the BC&A's team members listed below. Team member's roles on the project are also listed. The project was completed in BC&A's Draper, Utah office. Questions may be addressed to Brent Packer, Project Manager at (801) 495-2224.

Brent Packer	Project Manager
Wyatt Andersen	Project Engineer
Keith Larson	Senior Review

CHAPTER 2
EXISTING SYSTEM FEATURES

INTRODUCTION

As part of this Capital Facilities Plan, BC&A has assembled an inventory of existing infrastructure within the sewer collection system. The purpose of this chapter is to present a summary of the facilities in the Cottonwood Improvement District (CID) existing sewer collection system that can be used as a reference for future studies.

SERVICE AREA

CID's sewer collection service area is generally shown in Figure 2-1 and includes portions of Cottonwood Heights City, Holladay City, Midvale City, Murray City, and Sandy City. It will be noted that the District serves some unincorporated portions of the county; however, these areas are served by city water systems. For simplicity in the presentation of this report, these unincorporated areas have been included as part of the city by which they are served. In addition to the area served as shown in Figure 2-1, CID provides service to development up Big and Little Cottonwood Canyons. This includes service to the Towns of Alta and Brighton, as well as Solitude, Alta, and Snowbird resorts. CID receives these flows into their system at the mouth of each canyon. The CID sewer system service area is approximately 14,350 acres or 22.4 square miles.

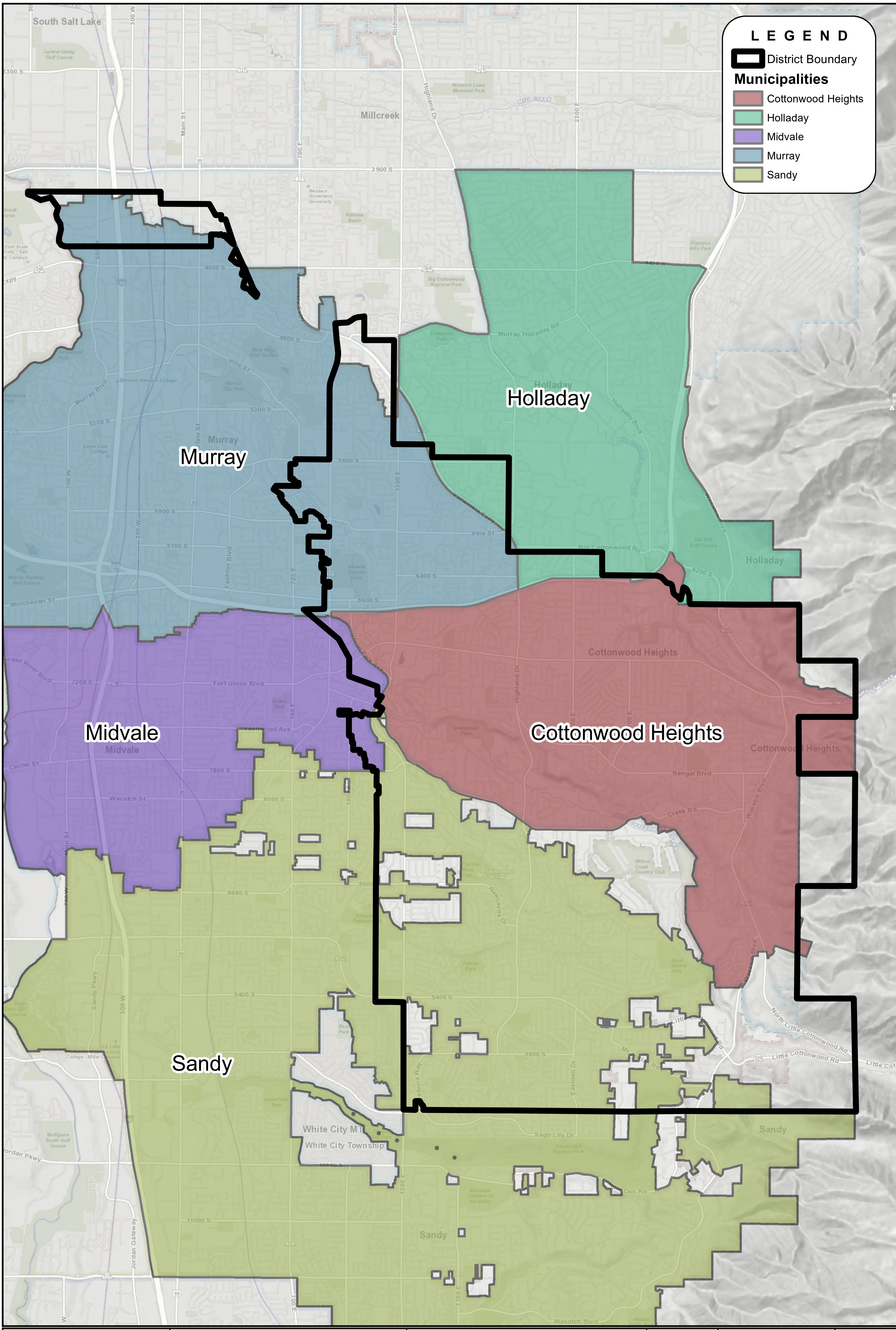
The topography of the District generally slopes from southeast to northwest, with all flows eventually reaching the Central Valley Water Reclamation Facility (CVWRF) east of the Jordan River at 3100 South.

COLLECTION SYSTEM

Major attributes of the various components of the collection system are summarized in the following sections.

Sewer Collection Pipes

There are about 1,642,000 feet (311 miles) of sewer pipe and about 8,400 manholes in the CID sewer system that are cataloged in the District's GIS database. Figure 2-2 shows all of the sewer pipes in the CID sewer collection system and color codes these pipes by diameter. Table 2-1 contains a summary of the sewer pipes by size for the CID sewer collection system. As can be seen in the table, more than 80 percent of the pipe in the system is 8 inches in diameter. This represents the vast network of small collection mains in neighborhoods throughout the District.



COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

SERVICE AREA

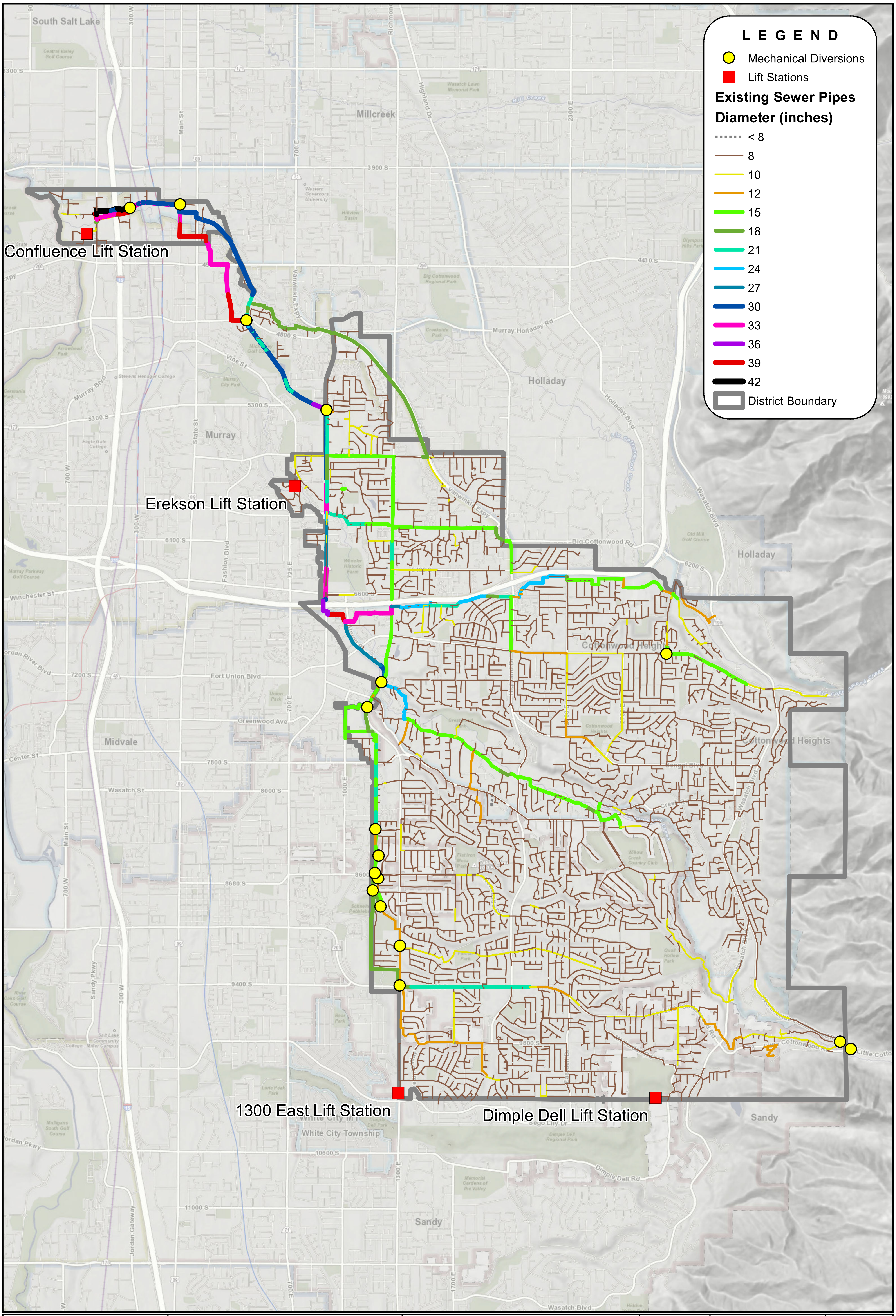
NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 2-1

BOWEN COLLINS & ASSOCIATES

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 2-1 - Service Area.mxd wandersen 12/2/2020



COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

EXISTING COLLECTION SYSTEM

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 2-2

BOWEN COLLINS & ASSOCIATES

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Table 2-1
Sewer Collection System Sizes and Lengths

Diameter	Length (ft)	Length (mi)	Percentage
<8	2,664	0.50	0.16%
8	1,339,939	253.78	81.59%
10	92,809	17.58	5.65%
12	38,109	7.22	2.32%
15	60,433	11.45	3.68%
18	26,526	5.02	1.62%
21	25,122	4.76	1.53%
24	9,123	1.73	0.56%
27	6,157	1.17	0.37%
30	18,478	3.50	1.13%
33	13,422	2.54	0.82%
36	1,490	0.28	0.09%
39	6,152	1.17	0.37%
42	1,860	0.35	0.11%
Total	1,642,284	311	100.00%

Lift Stations

The District has 4 lift stations that they own, operate, and maintain, which can be seen on Figure 2-2. Table 2-2 summarizes the names and locations of the District's existing lift stations.

Table 2-2
Sewer Lift Stations

Lift Station Name	Address
1300 East	10170 S 1300 E
Erekson	720 E Oxford Hollow Court
Confluence Avenue	545 W Confluence Avenue
Dimple Dell	10190 Dimple Dell Lane

These District lift stations are small local lift stations that are not projected to see much growth in wastewater inflow. The District has also indicated that they all have significant available capacity beyond their existing flows. Correspondingly, there will be no further examination of these lift stations as part of this report.

Diversions

The District has 18 mechanical diversions in its collection system, which are equipped with slide gates to control flow direction. The location of these diversions can be seen on Figure 2-2. In addition to the mechanical diversions shown in the figure, there are also a number of locations where two pipelines exit a common manhole, but no mechanical control exists. In these locations, flow is normally in a single direction, but may overflow into the second pipe in a different direction if surcharging occurs at the manhole.

TREATMENT FACILITIES

All wastewater from CID is currently treated at the Central Valley Water Reclamation Facility (CVWRF). The CVWRF is owned and operated by seven member entities including Cottonwood Improvement District, Granger-Hunter Improvement District, Kearns Improvement District, Mount Olympus Improvement District, Murray City, South Salt Lake City, and Taylorsville-Bennion Improvement District. The facility's current capacity is 75 MGD. Table 2-3 summarizes capacity availability and percent capacity for each member entity.

Table 2-3
Central Valley Water Reclamation Facility Capacity Rights

Member Entity	Capacity Percentage (%)	Current Capacity Availability (MGD)
Cottonwood Improvement District	**15.65**	**11.74**
Granger-Hunter Improvement District	25.65	19.24
Kearns Improvement District	10.86	8.15
Mount Olympus Improvement District	24.30	18.23
Murray City	7.76	5.82
South Salt Lake City	4.89	3.67
Taylorsville-Bennion Improvement District	10.88	8.16
Total	**100.0**	**75.00**

New nutrient removal requirements will require modifications to the facility. Current CVWRF plans include improvements that will address both nutrient removal needs and affect the rated capacity of the plant. As a result, the capacity will be increased from 75 MGD to 84 MGD in 2022 when nutrient removal requirements are officially implemented.

CVWRF has a unique approach to ownership and availability of capacity. Percentages summarized in Table 2-3 do not represent fixed ownership or access to capacity at the CVWRF. Instead, ownership is continually adjusted based on the flows from each entity. However, if it is assumed that CID's percent of capacity remains approximately equal into the future, CID's capacity in the facility will be increased from 11.74 MGD to approximately 13.15 MGD with the implementation of the planned improvements.

CHAPTER 3
FUTURE GROWTH AND FLOW PROJECTIONS

INTRODUCTION

There are several methods that can be used to estimate domestic wastewater flow into the future. This study develops domestic wastewater flow projections based on two factors: residential and non-residential populations. Projections for the District have been developed using population projections from the Wasatch Front Regional Council. BC&A also coordinated with the District's member entities to verify that the regional projections include the most current development information for each of the cities.

The methodology of this study can be summarized as follows:

1. Define the service area.
2. Divide the service area into a number of smaller sub-areas using geographical information system (GIS) mapping.
3. Project residential and non-residential populations for each sub-area based on existing and projected patterns of development.
4. Estimate the contribution of various wastewater flow components including domestic flow, infiltration, inflow, and other contributions of wastewater.
5. Convert projections of residential and non-residential development to wastewater flow rates based on their historic contributions.

Each step of this process is summarized in the sections below.

SERVICE AREA

The service area for this analysis is based on the District's service area as shown in Chapter 2 with contributions from parts of Cottonwood Heights, Holladay, Murray, Midvale, and Sandy Cities, as well as flow from Big and Little Cottonwood Canyon. The District does not expect to expand its boundaries but is committed to providing quality service to all of its users within its current boundary.

SUB-AREAS

Division of the service area into smaller sub-areas is important for two reasons. First, it increases the accuracy of the population and flow projections by examining land use and development patterns at a smaller scale. Second, it yields projections that are distributed spatially across the service area, an important requirement for future modeling efforts.

For this study, sub-areas were defined based on Traffic Analysis Zones (TAZs). A TAZ is the smallest geographic unit used for residential and non-residential population projections developed by the Wasatch Front Regional Council (WFRC). Non-residential population data includes employees (retail, business, and industrial) and other non-residents. TAZ boundaries are established on an arbitrary basis by the WFRC for travel demand modeling.

TAZ boundaries were used in part for this analysis because population projections have already been developed from census data for TAZ areas by the WFRC. The projections are provided every year starting in 2015 and continuing to 2050. TAZ boundaries were also used because they are small enough to give an adequate distribution of flow across the service area for use in modeling.

RESIDENTIAL AND NON-RESIDENTIAL GROWTH

There are a number of planning agencies that produce growth estimates covering the area included in the Cottonwood Improvement District including:

- **State Level Projections –** The State of Utah Governor's Office of Management and Budget (GOMB), in conjunction with the Kem C. Gardner Policy Institute, prepares statewide population projections that are generally broken down only to a county level. As a result, planning estimates at this scale are unhelpful for service districts like CID because projection boundaries by county do not line up with service district boundaries. Correspondingly, GOMB projections will not be used directly in this document (but do form the foundation for regional level planning as discussed below).
- **Regional Level Planning –** The Wasatch Front Regional Council (WFRC) does planning on a regional scale. It takes countywide numbers prepared at the state level and then divides these projections into more refined projection for a group of urban counties in northern Utah (Salt Lake, Tooele, Davis, Weber, Box Elder, and Morgan). These projections are used largely for traffic modeling and planning, but are also valuable for other growth planning activities. The WFRC develops traffic analysis zones (TAZs) that include residential and employment projections divided into relatively small areas representative of collector roads. As a result, the WFRC projections are more helpful than State of Utah estimates for projecting rates of growth for population and employment growth for service districts.
- **Local Level Planning –** Beyond what can be understood at a regional level, local cities and towns are aware of specific development plans for properties within their boundaries. While most of these municipalities do not prepare comprehensive long-term projections of growth, they are a valuable source for property specific data that can be used to augment other planning value.

Based on this understanding of available planning data, this report projects future growth using the following general approach. The most recent version of WFRC projections have been used as the starting point for residential and non-residential growth in this report. This has then been augmented with additional data collected on individual properties from local level planning entities. This is discussed in greater detail in the following sections.

WFRC Residential and Non-Residential Populations. Wasatch Front Regional Council residential and non-residential projections were developed from present to 2050. The residential population projections were taken from the WFRC Household Projections Report, 2020 Baseline. Non-residential populations were taken directly from the WFRC All Jobs Projections Report, 2020 Baseline. Since the TAZ boundaries are not always consistent with the District's service area boundaries, the TAZ data was clipped to the District's boundary. If a TAZ was only partially in the study area boundary, then the percentage inside the boundary was determined. WFRC projections were then multiplied by this percentage to determine the portion of the TAZ projection within the study area boundary.

To facilitate projections and simplify the discussion, residential and non-residential populations were then converted to equivalent residential units (ERU's). Residential projections were converted to ERUs by dividing the projected residential population by the average household size from the US Census Bureau for the District (2.77 persons per household). Non-residential projections were converted to ERUs by converting the non-residential population to an equivalent residential population[1] and then dividing by 2.77.

Figure 3-1 shows the increase of total ERUs (including both residential and non-residential populations) from present to buildout according to unmodified WFRC projections.

Member Entity Growth and Redevelopment Areas. Conversations with planning personnel from the District and the member entities served by the District provided additional information about specific areas of growth and redevelopment. These areas were identified within individual parcels where possible or within the general vicinity of the development if specific parcels could not be identified. Each development was assigned a land use type and timeline for development: within the next 10 years, or beyond 10-years.

Growth within redevelopment areas was identified either with a known density based on land use type or by an exact number of units. The planning density of equivalent residential units (ERU) per acre was used with the acreage of the parcels to calculate how many ERU's would be added at each location. Since the data received from the member entities was ERU or dwelling unit based instead of population based, the step of converting to ERUs from population was not necessary for this data.

For apartment (high density residential) and hotel developments, the following conversions were used:

- Apartments - For planning purposes, each apartment unit was estimated as 80 percent of a single ERU. The average household size within the District's service area is 2.77 persons/household and many of the apartment developments proposed within the District include a mix of one and two room apartments that would likely have net lower household size. Thus, although two room and larger apartments are likely very similar to a full ERU, a planning value of 80 percent appears to be reasonable for apartment units overall.
- Hotels – Each hotel room proposed within the redevelopment areas was estimated as 48 percent of a single ERU. This was based on an estimated average production from hotel rooms of 100 gpd per room. This use rate is based on a State of Utah published value of 125 gpd/unit (Table 3 of State of Utah Administrative Rules R317-4-13) with a reduction of 20 percent to account for observed conservation since the guidance was established. It is also consistent with references from other States.

The specific growth and redevelopment areas identified by planning personnel from the member entities can be seen in Figure 3-2. This figure symbolizes the identified growth and redevelopment areas by development type (commercial, high density residential, hotel, mixed use, residential, and school). The values seen on each of the individual growth and redevelopment areas is the calculated ERU increase (residential and non-residential) from existing to buildout.

Final ERU Growth Projections. ERU projections developed from WFRC and from member entity planning personnel were compared for each TAZ sub-area within the District. While the projected growth for many areas is similar in both projections, the projections have some distinct

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[1] It is estimated that one non-residential employee is equivalent to one third of a permanent resident. This is based on observed water use data and is consistent with the concept that employees are typically at their place of employment for 8 of 24 hours in a day.

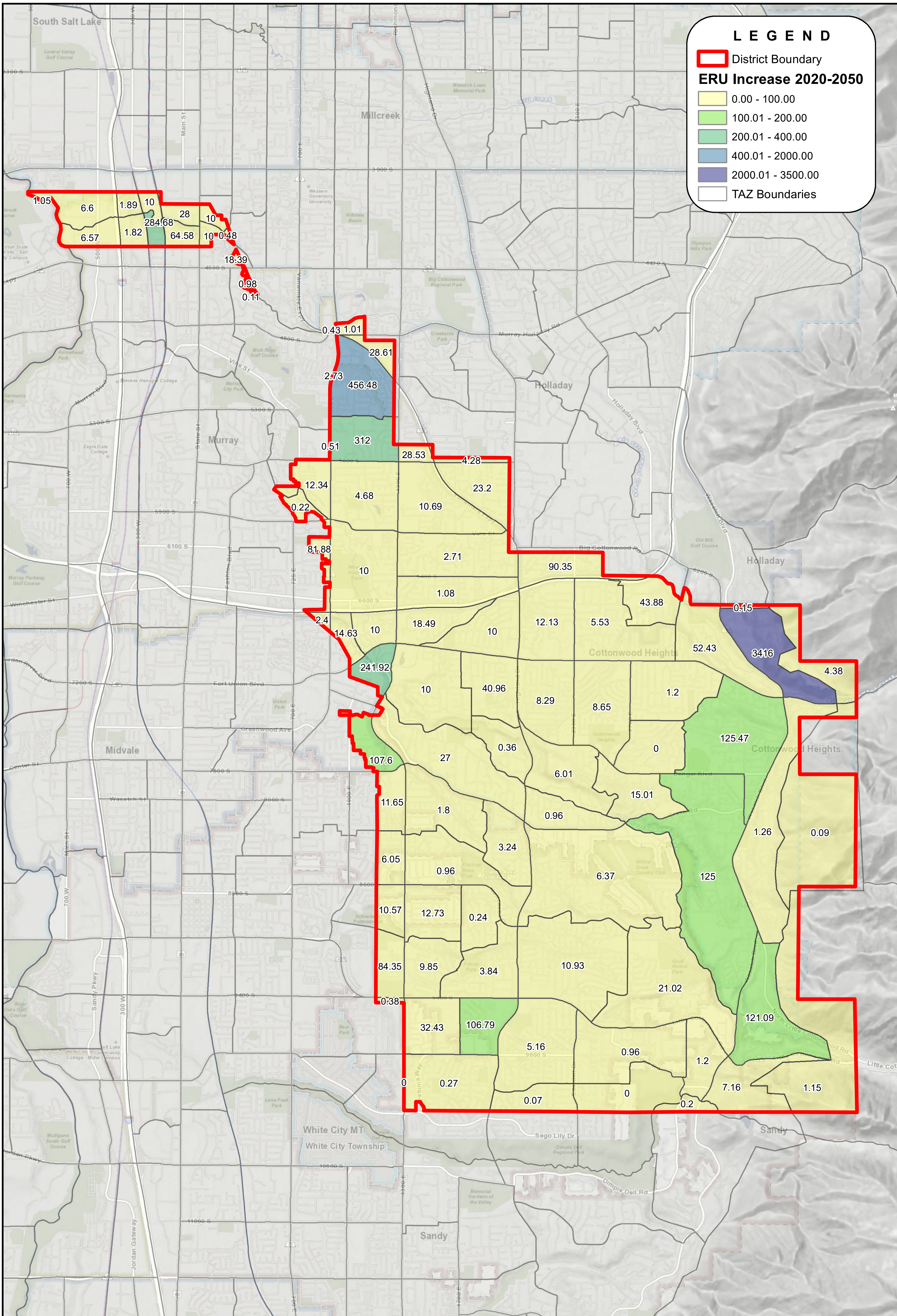
differences. In general, the local redevelopment projections were only focused on specific properties and correspondingly missed some of the small infill and densification captured by the TAZ projections. Conversely, the TAZ projections may have failed to capture the potential density and magnitude of some projects identified for specific properties identified in the redevelopment projections. To make sure the District is prepared for both types of growth, a composite projection was developed based on the following process:

- First, the TAZ projections were adjusted slightly to better match the available property for development. Specifically, in some areas where significant redevelopment was projected, TAZ projections were notably low, but projections in an adjacent TAZ were higher than expected even though little or no potential for redevelopment was identified. In these cases, it appears that the TAZ projections may be generally capturing the potential for growth, but haven't quite been aligned with the correct properties. In these cases, projections for immediately adjacent TAZ's were aggregated and redistributed to better align with potential redevelopment properties.
- Second, after the TAZ projections had been adjusted as described above, a comparison was made between the adjusted TAZ projection and the redevelopment projection for each area. The greater of the two growth projections was then used for each subarea. The comparison of these values can be seen in Figure 3-3 in which the WFRC projections are labeled as TAZ and the redevelopment projections are labeled RD.

The results of the residential and non-residential projections described above are summarized in Table 3-1.

Table 3-1
Growth Projections

Year	Residential ERUs	Non-Residential ERUs	Total ERUs
2019	32,418	5,044	37,462
2020	32,589	5,078	37,667
2030	36,455	5,519	41,973
2050	40,716	6,420	47,136



COTTONWOOD IMPROVEMENT DISTRICT

SEWER CAPITAL FACILITIES PLAN

TAZ ERU INCREASE 2020-2050

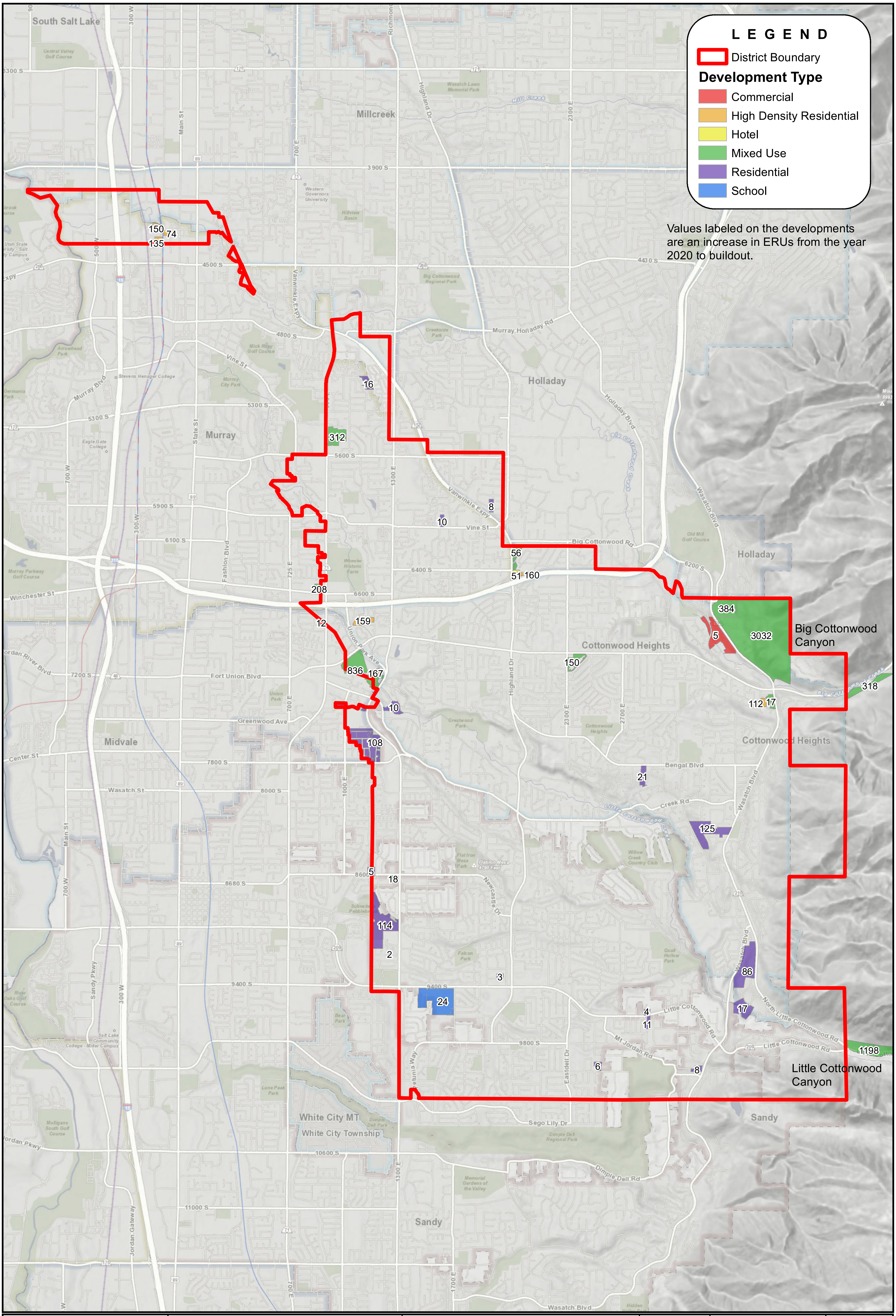
NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 3-1

BOWEN COLLINS & ASSOCIATES

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 3-1 - TAZ Residential Percent Developed.mxd wandersen 12/2/2020



COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

PROPOSED REDEVELOPMENT
ERU INCREASE 2020-2050

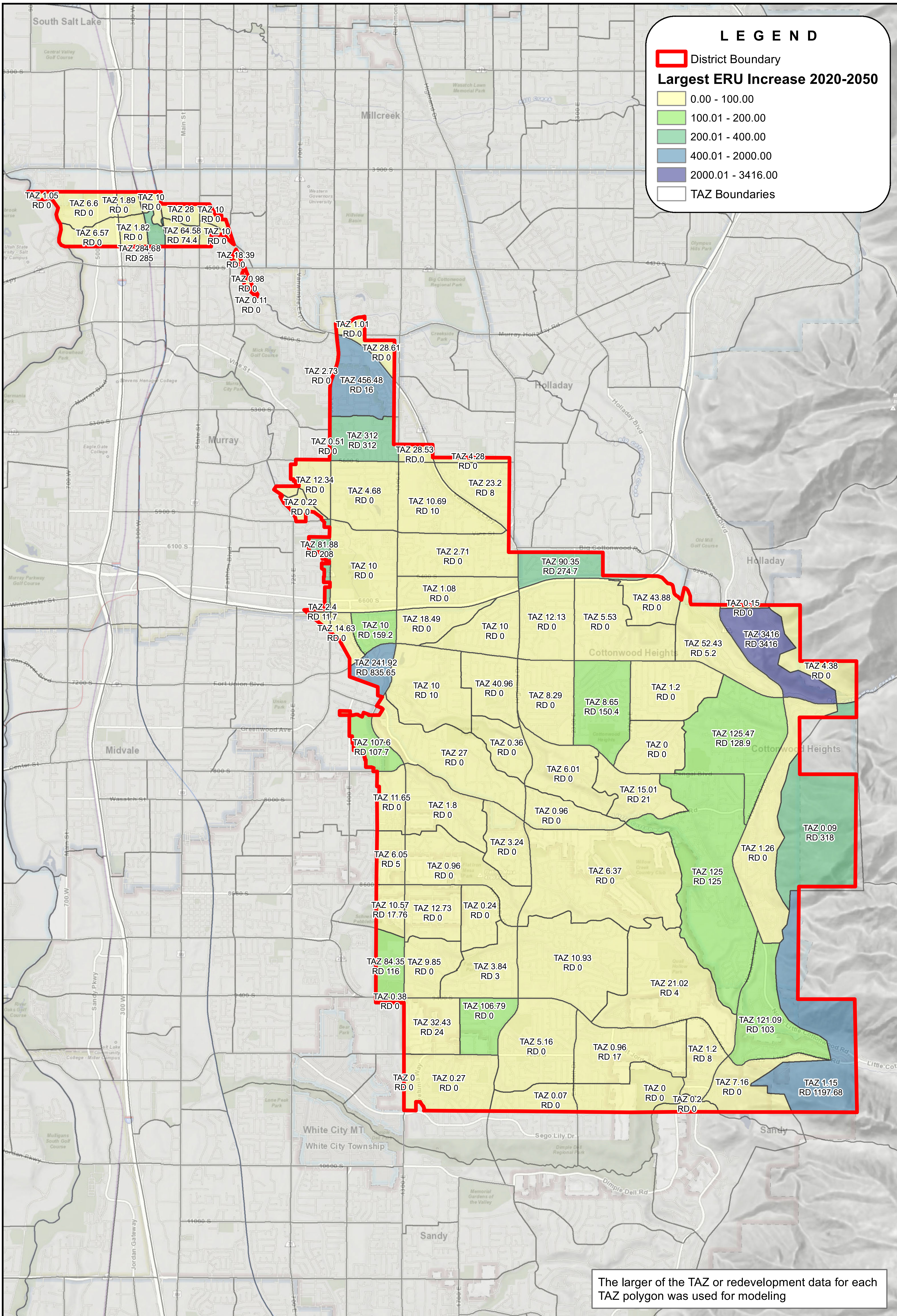
BOWEN COLLINS & ASSOCIATES

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 3-2

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 3-2 - Entity Redevelopment Data.mxd wandersen 12/2/2020



BOWEN COLLINS & ASSOCIATES

COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

TAZ AND REDEVELOPMENT ERU INCREASE COMPARISON

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 3-3

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 3-3 - TAZ and Redevelopment Comparison.mxd wandersen 12/2/2020

WASTEWATER COMPONENTS

Before projecting future growth in wastewater, one must first have an accurate understanding of wastewater flows. This includes an estimate of both the quantity and distribution of existing and future flows. For most wastewater service providers, wastewater flow can be grouped into three major components: domestic wastewater, infiltration, and inflow. Each of these are components are discussed in further detail in the following sections.

Domestic Wastewater

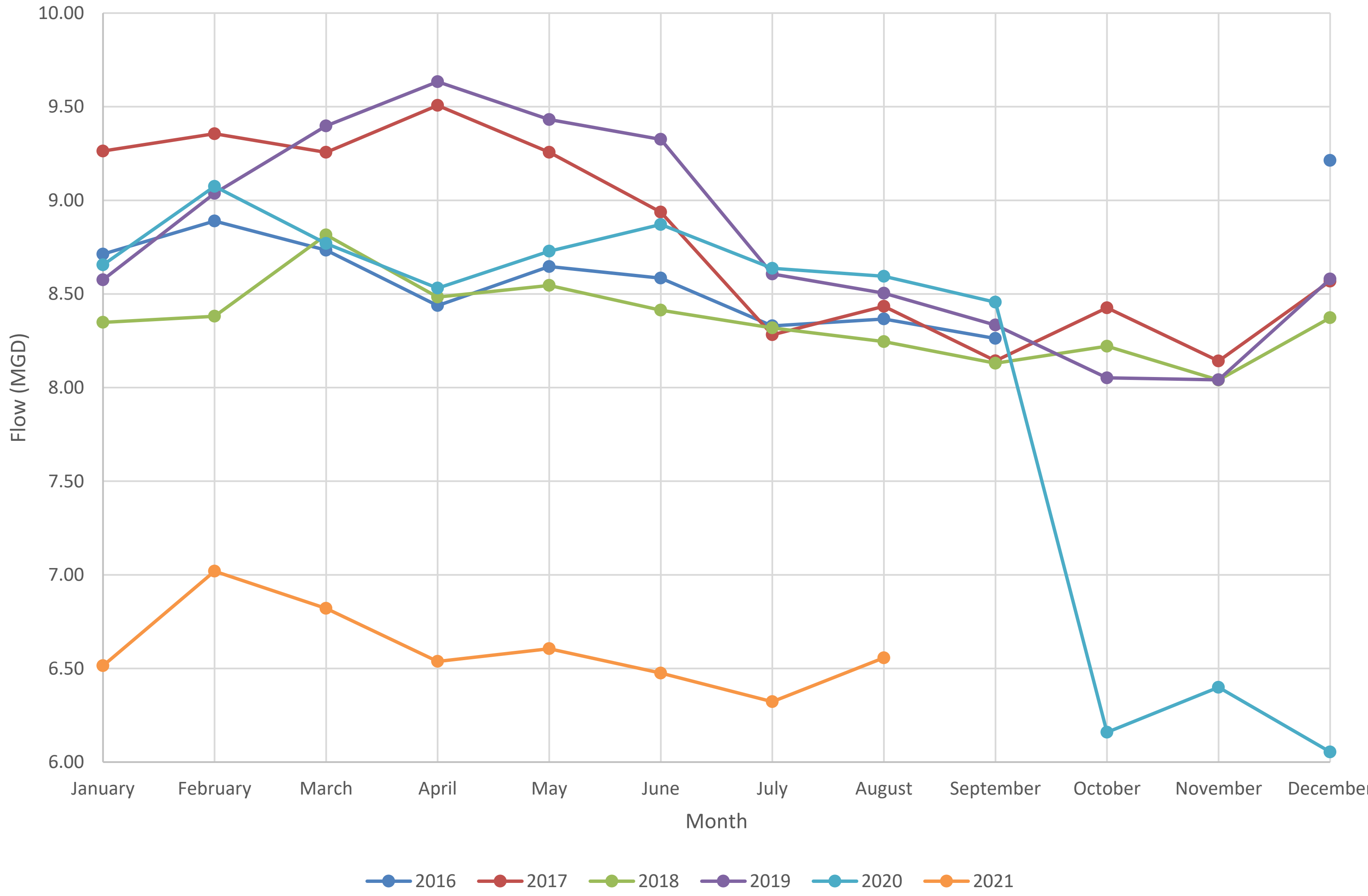
Domestic flow consists of the wastewater contributions of residential and non-residential customers. While domestic flow varies significantly throughout the day (as will be discussed in Chapter 4), it is relatively consistent from year to year and its growth can be closely tied to the growth of development in the District. Correspondingly, estimating domestic flows in the District can be assembled based on historic flow per ERU. Table 3-2 and Figure 3-4 show the average wastewater at the District's meter at the wastewater treatment plant from January of 2016 through August of 2021.

Table 3-2
Existing Wastewater Production (MGD)

Month	2016	2017	2018	2019	2020	2021
January	8.71	9.26	8.35	8.58	8.66	6.51
February	8.89	9.36	8.38	9.04	9.07	7.02
March	8.73	9.26	8.82	9.40	8.77	6.82
April	8.44	9.51	8.48	9.63	8.53	6.54
May	8.65	9.26	8.55	9.43	8.73	6.61
June	8.58	8.94	8.41	9.33	8.87	6.48
July	8.33	8.28	8.32	8.61	8.64	6.32
August	8.37	8.43	8.25	8.50	8.59	6.56
September	8.26	8.14	8.13	8.33	8.46	
October		8.43	8.22	8.05	6.16	
November		8.14	8.04	8.04	6.40	
December	9.21	8.57	8.37	8.58	6.05	

As is starkly visible in the figure, Central Valley began making adjustments to the meters that come from each of their seven member entities starting in October of 2020. The new data has shown a drop in monthly average data from the District's meter for the months of October 2020 through August 2021. Based on all available information, the District believes that the new data is a more accurate representation of actual flows in the system. Corresponding, it was decided that the flow data from October 2020 through August 2021 would be the basis for this analysis. Data prior to October of 2021 will still be useful for understanding general variability from month to month and year to year, but the overall magnitude of wastewater flow will be based on the more recent data.

Figure 3-4
Monthly Average Wastewater Flow to CVWRF



As can be seen in Figure 3-4, there is an observable trend of seasonal variability in the District's total wastewater production. The months of March through June have visibly higher monthly averages than the months of August through December. It is believed that this difference can be explained by seasonal infiltration (see next section). Correspondingly, domestic flow was estimated based on average daily flow during lower infiltration periods. Based on the data in Table 3-2 and Figure 3-4, the average of the lowest monthly averages for the newest data set (April of 2021through August of 2021) is 6.50 mgd. It has been assumed that this is approximately equal to the domestic flow in the system without infiltration (or minimal year-round infiltration). Based on this total estimated flow and dividing by the existing ERUs, domestic flow per ERU was calculated as 173 gpd/ERU.

Infiltration

The next component of wastewater flow that must be considered is infiltration. Infiltration is defined as water that enters into the sewer system which is not directly or indirectly related to either domestic wastewater or to a specific storm event. This flow can enter as a result of open pipe joints, cracks in pipes, pipes poorly connected at manholes, leaky lateral connections, roots, etc. Temporary increases in the amount of water that enters the system after a storm because of an increase in ground water or direct connection to collection lines will be considered as inflow.

Factors that can affect infiltration include pipe age, material, and number and condition of lateral connections. Age can contribute to infiltration in two ways. First, older pipes are more likely to be in poor condition. Cracks, separated joints, and other defects can contribute significantly to increased infiltration. Second, older pipes do not have the benefit of improvements in construction techniques that have occurred over time. Gasketed pipe joints, rubber boots at manholes and laterals, and other improvements have contributed greatly to reducing system infiltration over time.

Infiltration can be difficult to estimate because it can vary over time. Infiltration is generally a function of groundwater levels. Groundwater levels in the service area fluctuate depending on climate and season. Infiltration rates will correspondingly change seasonally and from year to year depending on climate. Seasonal infiltration was calculated using the difference of the average daily flow with high infiltration and the average daily flow with low infiltration. From the data above, the difference between average daily flow in months with low infiltration and the average daily flow in month high infiltration is 1.59 mgd (based on observed flows for high infiltration years – 2017 and 2019). If this is divided by the existing ERUs, the estimated maximum seasonal infiltration per unit is 42 gpd/ERU.

Inflow

The third and final component of wastewater flow that must be considered for wastewater facility planning is inflow. Inflow is defined as any water that enters into the sewer system which is directly or indirectly related to a storm event. It can come directly from storm runoff through improper connections to the storm water system, missing or leaky manhole covers, roof drains connected to the system, etc. Storm events can also cause the ground water to raise temporarily, which can cause an increase in flow in the sewer system through the same mechanisms that result in groundwater infiltration during dry weather (cracked pipes, leaky laterals, etc.). Any temporary increase in sewer flow due to raising levels of ground water as a result of snowmelt or rain is considered inflow.

The magnitude and distribution of inflow can be very difficult to predict because it occurs only during storm events and can vary greatly depending on the intensity and distribution of precipitation. As part of the District's previous capital facility plan, an analysis of long-term flow monitoring was conducted to estimate inflow responses to precipitation events. However, the study conclude that the observed inflow response was minimal compared to other factors affecting peak demands. As a result, no further analysis of inflow was recommended.

A cursory analysis of available data collected since the last master plan appears to confirm this recommendation. Significant increases in meter flow do not appear to result from precipitation events. As a result, inflow has not been included directly in the flow projections contained in this master plan. However, it is still recommended that the District to include extra hydraulic capacity in its collection and treatment system above and beyond projected domestic and infiltration flows to account for inflow events and other variations in flow. This will be discussed in additional detail as part of system evaluation criteria in Chapter 4.

WASTEWATER GROWTH PROJECTIONS

With the contribution of each type of flow identified and growth in the District projected through the planning window. It is possible to project future wastewater flows in the District as follows:

- **Domestic Flow –** The projected domestic flow in future years can be estimated as the number of ERUs in that year (see Table 3-1) times the average observed domestic flow per ERU (173 gallons per day).
- **Seasonal Infiltration –** Although future infiltration will be a function of many different variables (water table, pipe depth, pipe diameter, pipe length, construction materials, etc), projections of future infiltration have been estimated at approximately 42 gallons per day for each added equivalent residential connection. This estimate is consistent both with levels of infiltration observed historically and with planning recommendations for current construction materials and methods (200 to 400 gpd/inch-diameter/mile) and average development density in the District.
- **Total Peak Month, Average Day –** The projected total peak month, average day wastewater flows are estimated by simply adding the domestic flow and the seasonal infiltration. This results in a peak month, average day flow of 215 gallons per day per ERU.
- **Total Peak Day –** Beyond the seasonal variations in infiltration discussed above, flow in the system will vary slightly from day to day. Historical data suggests that observed peak day wastewater flows have been about 1.09 times peak month, average day wastewater flows. This results in a peak day flow of 234 gallons per day per ERU.
- **Total Peak Hour –** Projected peak hour wastewater flows can be estimated by multiplying the total peak day wastewater flows by the maximum hour peaking factor from a residential diurnal curve (1.76 – this peaking factor is discussed in more detail in Chapter 4 of this report). This results in a peak hour flow equal to 412 gallons per day per ERU.

Unit flow rates for the District are summarized in Table 3-3.

Table 3-3
Projected Flow Per Equivalent Residential Unit

Flow Type	Flow Per ERU (gpd)
Domestic Flow	173
Seasonal Infiltration	42
Peak Month, Average Day	215
Peak Day	234
Peak Hour	412

Based on these projections, Table 3-4 shows the expected growth in wastewater flows in the District through the year 2050.

Table 3-4
Projected Growth in Wastewater

Year	Domestic Wastewater (mgd)	Seasonal Infiltration (mgd)	Peak Month, Average Day Wastewater (mgd)	Peak Day Wastewater (mgd)	Peak Hour Wastewater (mgd)
2020	6.50	1.59	8.09	8.82	15.55
2030	7.24	1.77	9.01	9.83	17.33
2050	8.13	1.99	10.12	11.04	19.46

WATER RECLAMATION FACILITY CAPACITY

As summarized in Table 3-4, growth projections through 2050 for the CID sewer service area result in a projected peak month, average day wastewater flow of 10.12 mgd. With a current available capacity of 11.74 mgd and a potential estimated future capacity of 13.15 mgd, it appears that CID has more than enough available capacity at the Central Valley Water Reclamation Facility to accommodate projected growth through 2050.

CHAPTER 4
HYDRAULIC MODELING

INTRODUCTION

A critical component in identifying required areas in the CID collection system where pipes have capacity deficiencies is the development of a hydraulic computer model. An extended period simulation (EPS) hydraulic model was developed using Innovyze's XPSWMM software using data provided by CID. The purpose of this chapter is to present a summary of the methodology used to develop an updated model for the District.

MODEL HISTORY

The current model used by the District was originally setup by the consulting firm Nolte Associates in 2009. However, District personnel currently maintain the existing model and update the model whenever changes in the collection system are constructed. As pipes are lined or replaced, CID personnel update geometry of the model accordingly. As a result, the update for this master plan included only a modest update of geometric model data, with more effort being focused on updating flow data for new growth projections.

GEOMETRIC MODEL DATA

There are two major types of data required to develop a hydraulic model of a sewer system: geometric data and flow data. Geometric data consists of information on the location and size of system facilities including pipes, manholes, and lift stations. It also includes the physical characteristics of the facilities including pipe roughness, invert elevations at manholes, pump settings in lift stations, and a description of any diversions present. This information is generally collected from system inventory data or through direct field measurement. The following sections describe how geometric data was assembled for use in the hydraulic model.

Pipeline and Manhole Locations

CID has spent considerable time assembling a GIS inventory of its existing sewer facilities. As such, the existing model has been directly based on the pipeline and manhole information contained in the District's existing GIS inventory. Not all manholes and pipes in the District's collection system are included in its hydraulic model. To keep the modeling activities efficient and most useful, only the main trunklines in the District and their respective manholes are included in the model.

Pipe Flow Coefficients

Pipe flow coefficients used throughout the hydraulic model were assumed to have a Manning's coefficient of 0.013. This is approximately equal to the expected roughness coefficient of concrete or clay pipe. While there are other materials in the system with lower published roughness coefficients (e.g. PVC), 0.013 was used throughout the system as a conservative approach for estimating pipe capacity. In addition, most collection pipes can develop thin layers of bacteria and solids (a slime layer) that result in a relatively uniform flow coefficient despite varying materials.

Sediment and Debris

Because of the transportable nature of grease and debris in a sewer collection system, it is very difficult to identify the exact location and quantity of grease or debris accumulation in the system at any specific point in time. Similarly, the build-up and erosion rates of sediment in sanitary sewer systems are not always well understood. As a result, the detailed modeling of sediment, grease, and debris on a system wide basis is not possible because of continually changing conditions. Therefore, no sediment was included in the various runs of the hydraulic model. Instead, the design and evaluation criteria for the CID collection system is based on "clean" pipes, with an allowance for capacity lost to the accumulation of sediment (see Evaluation Criteria in Chapter 5).

Lift Stations

The District has four lift stations, but only the 1300 East Lift Station is included in the hydraulic model. This lift station is being modeled using an operating point with the design flow rate and total dynamic head.

Diversions

The District has 18 existing mechanical diversions in their sewer collection system. There are other manholes in the District's sewer collection system that act as overflows. For each of these mechanical diversions in the sewer model, the District determined which flow direction they would use and established that flow direction in the sewer model.

FLOW DATA

Once all required geometric data was verified for the physical model of the system, flow data was entered into model to evaluate the system hydraulics. Three types of flow information were required for hydraulic modeling: domestic wastewater magnitude and distribution, domestic wastewater flow timing, and infiltration magnitude and distribution. Each of these flow characteristics is discussed below.

Domestic Wastewater Magnitude and Distribution

The total magnitude of domestic wastewater was based on projected growth/redevelopment data from member entities, land use, and undeveloped areas as described in Chapter 3. The distribution of existing domestic wastewater was based on the District's sewer model that was created around 10 years ago and continually updated by the District. The distribution of future domestic wastewater was based on identified growth in each Traffic Analysis Zone (TAZ) as discussed in Chapter 3.

Domestic Wastewater Timing

It will be noted that the flow rates shown in Chapter 3 are primarily based on average flow over a 24-hour period. Since sanitary sewer flows vary throughout the day with varying indoor water demands, of much greater importance for the purposes of modeling collection system capacity is the calculation of peak flows that occur during the day. To predict the magnitude and timing of peak flows in the model, it is important to understand how flow varies throughout the day.

The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. These patterns vary depending on the type of user. When the District created their sewer model about 10 years ago, typical diurnal patterns for weekday and weekend wastewater production at the treatment plant were analyzed and calibrated. These same patterns have been used for this analysis. The typical diurnal pattern for weekday and weekend wastewater production at the treatment plant is shown on Figure 4-1. Based on these patterns, a diurnal pattern for weekday flows was determined to be the most conservative and was used in hydraulic model simulations. This pattern was applied to all residential users throughout the District. A separate diurnal pattern was created for commercial users based off of typical commercial daily flow patterns. Table 4-1 shows both of the residential patterns and the commercial pattern.

Figure 4-1
Diurnal Patterns

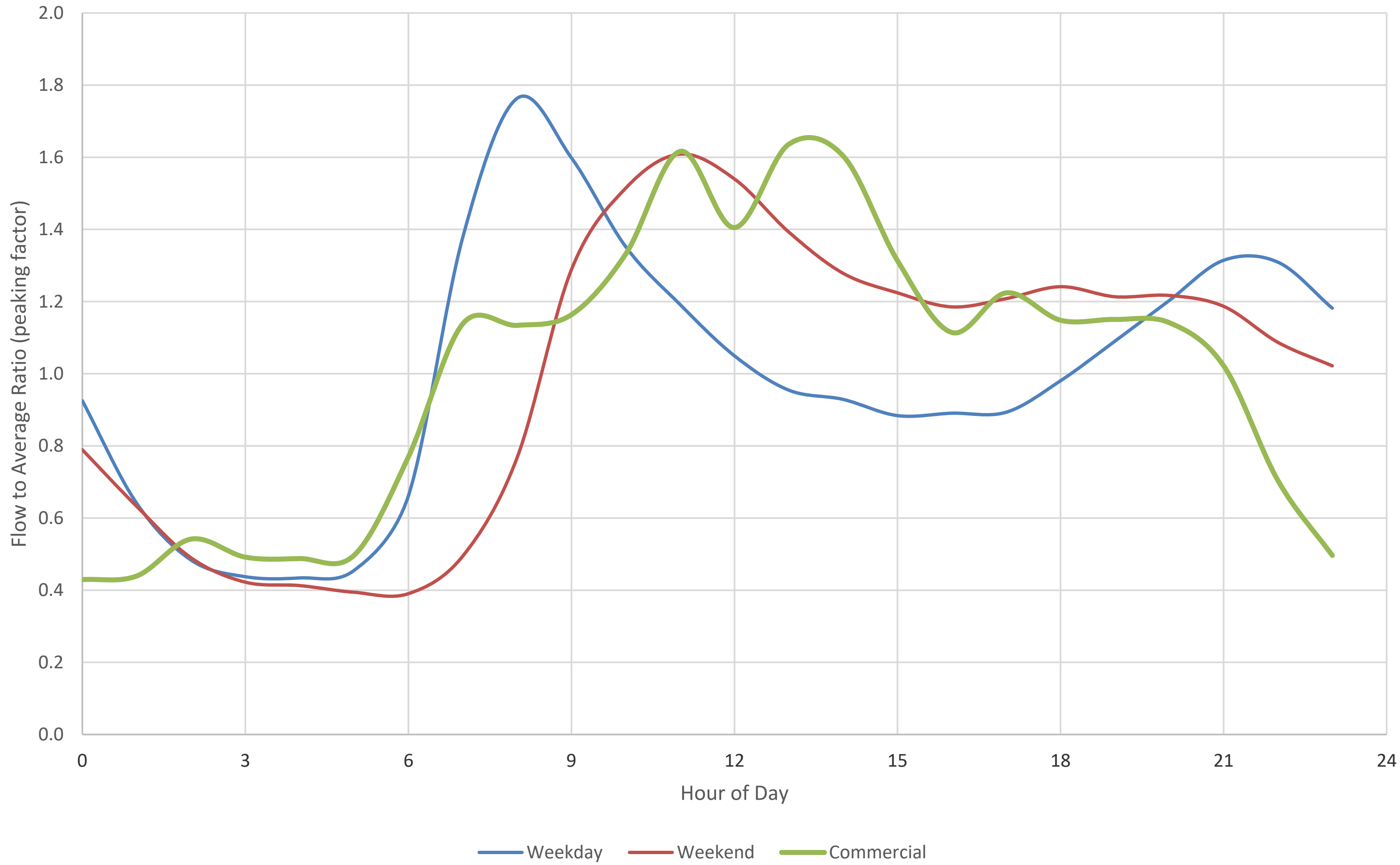


Table 4-1
Hydraulic Model Diurnal Pattern

Hour	Hourly Factors		
	Residential Weekday	Residential Weekend	Commercial
0	0.925	0.789	0.429
1	0.641	0.632	0.439
2	0.483	0.489	0.542
3	0.437	0.422	0.492
4	0.434	0.413	0.488
5	0.455	0.394	0.497
6	0.662	0.390	0.770
7	1.378	0.495	1.138
8	1.763	0.767	1.134
9	1.598	1.289	1.164
10	1.352	1.515	1.332
11	1.192	1.609	1.616
12	1.050	1.540	1.405
13	0.954	1.393	1.636
14	0.929	1.278	1.604
15	0.884	1.224	1.313
16	0.891	1.185	1.114
17	0.893	1.208	1.224
18	0.981	1.241	1.148
19	1.090	1.213	1.151
20	1.203	1.217	1.142
21	1.314	1.187	1.022
22	1.309	1.087	0.704
23	1.182	1.022	0.496

Infiltration Magnitude and Distribution

As discussed in Chapter 3, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. Thus, it has been assumed that infiltration remains constant throughout the day in the collection system model. The total magnitude of infiltration was discussed in more detail in Chapter 3. Existing infiltration was added to each ERU that was added to the model.

Inflow

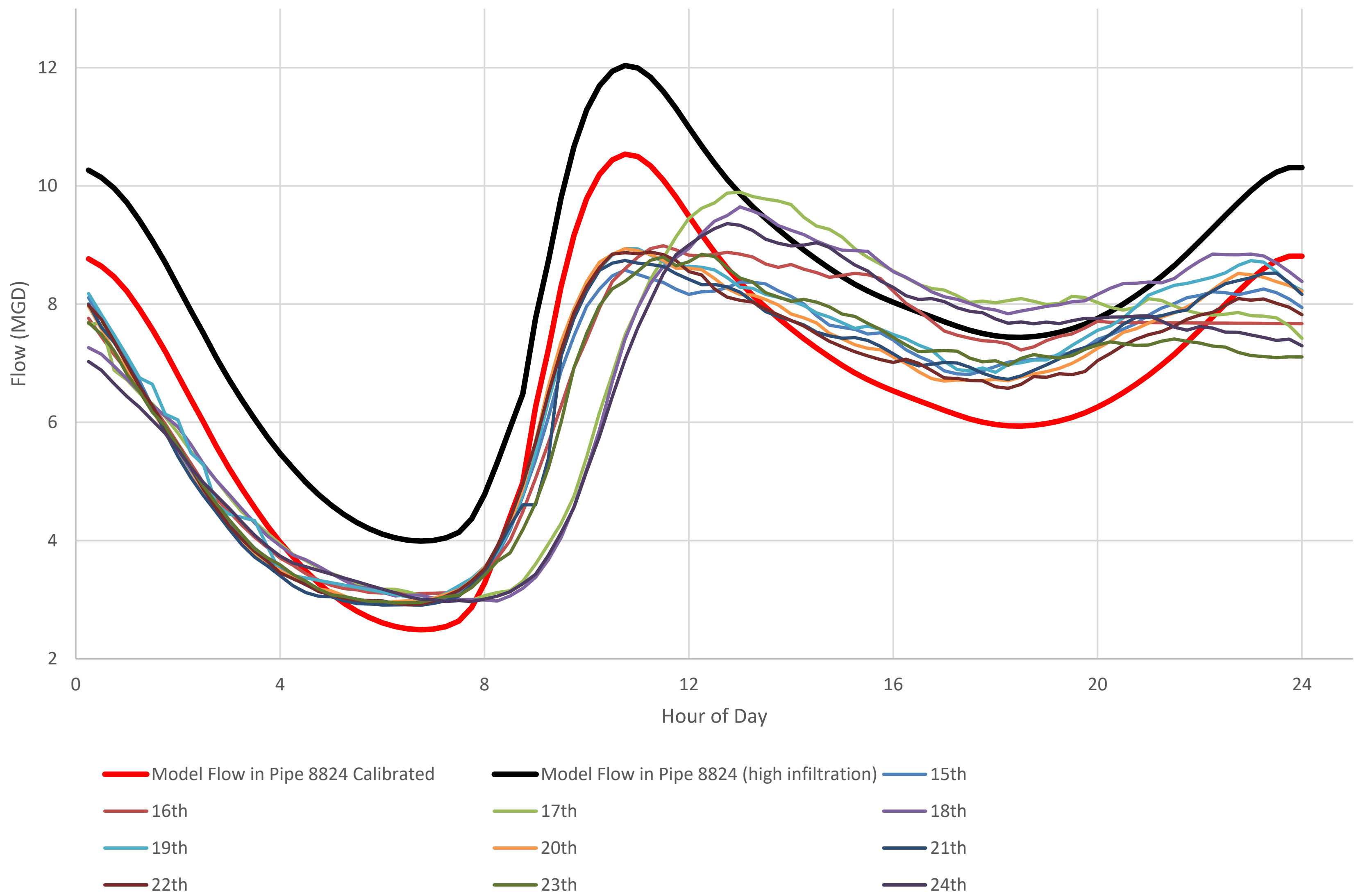
For this study, inflow has not been modeled directly because of both the unpredictability of inflow response and the historical observation of low impact from past storm events in the District. For design purposes, the District has included a capacity allowance in its design criteria to account for inflow into its collection system.

CALIBRATION

The process of model calibration involves adjusting or modifying certain model parameters in order to better match the actual conditions of the sewer system. Calibration of the model was performed using available historical CVWRF meter data of total flow from the District. Figure 4-2 shows flows total flows from the District in April of 2021 compared to the model simulation. April of 2021 was chosen because it had the highest observed infiltration since the District's meter was recalibrated in October of 2020. A comparison of model results against the historic flow monitoring results appears to indicate that, in general, the model is reproducing system conditions within a reasonable level of accuracy.

Additional flow monitoring in other parts of the collection system could potentially improve the model calibration. However, District personnel were not able to conduct flow monitoring as part of this Capital Facilities Plan update. Additional flow monitoring may be justified where initial model results indicate deficiencies. In these locations, additional flow monitoring should be conducted to verify system needs before designing capital improvements.

Figure 4-2
Model Calibration



CHAPTER 5
SYSTEM EVALUATION

With the development and calibration of a hydraulic sewer model, it is possible to simulate sewer system operating conditions for both present and future conditions. The purpose of this chapter is to evaluate hydraulic performance of the collection system and identify potential hydraulic deficiencies.

EVALUATION CRITERIA AND LEVEL OF SERVICE

In evaluating the performance of the collection system, it is necessary to first define the required level of service for the various components of the system. This level of service is the same for both existing and future customers:

Sewer Main Level of Service

BC&A recommends that Cottonwood Improvement District require all sewer mains be designed to the following level of service:

- **Pipeline Capacity (15-inch and larger)** – Peak flow in the pipe must be less than 75 percent of the full flow pipe capacity.
- **Pipeline Capacity (12-inch and smaller) –** Peak flow in the pipe must be less than 50 percent of the full flow pipe capacity. A more aggressive criteria has been presented for pipes that are smaller than 15 inches in diameter because these pipes tend to have more variation in flow patterns as a result of servicing smaller drainage areas.

This design standard will be used as the level of service for system evaluation.

It should be noted that, while this chapter identifies all existing smaller diameter pipes that fall between 50 and 75 full as a deficiency, these pipelines may or may not need to be replaced depending on the location and extent of the deficiency. For isolated smaller diameter pipelines with peak flows between 50 and 75 percent, it may be sufficient to monitor the status of these pipelines for a time instead of identify them for immediate replacement. This will be discussed in greater detail in the next chapter.

Force Main Level of Service

Cottonwood Improvement District Engineering Standards and Specifications require that lift station force mains should be designed such that peak velocity through the force main does not exceed 7 ft/sec. By eliminating excessive pipeline velocities, this standard optimizes pump efficiency, limits potential for hydraulic surge issues, and maximizes the life of the force main.

Lift Station Level of Service

Based on industry standards and good design practice, it is recommended that peak daily flow to a lift station not exceed 85 percent of the lift station's hydraulic pumping capacity. Allowing for a modest amount of capacity above projected flows accounts for unknowns associated with flow projections and mechanical wear at each lift station. The minimum design level of service for lift stations has correspondingly been established at 15 percent higher than estimated peak flows at build-out.

The minimum wet well volume for lift stations should be large enough to prevent excessive cycling of lift station pumps. Based on manufacture recommendations for pump operation, the maximum number of cycles per hour should be six or less. Exceeding this value will significantly shorten the lifespan of the lift station pumps. The number of cycles that will occur at a lift station can be calculated using one of the following two equations:

Equation 1: $V_{min} \geq \frac{60 \times Q_D (Q_P - Q_D)}{N \times Q_P}$ When $Q_D < 0.5*Q_p$

Equation 2: $V_{min} \geq \frac{15 \times Q_P}{N}$ When $Q_D \geq 0.5*Q_p$

Where:

N – Maximum number of cycles per hour

Q_D – Peak design flow into the wet well

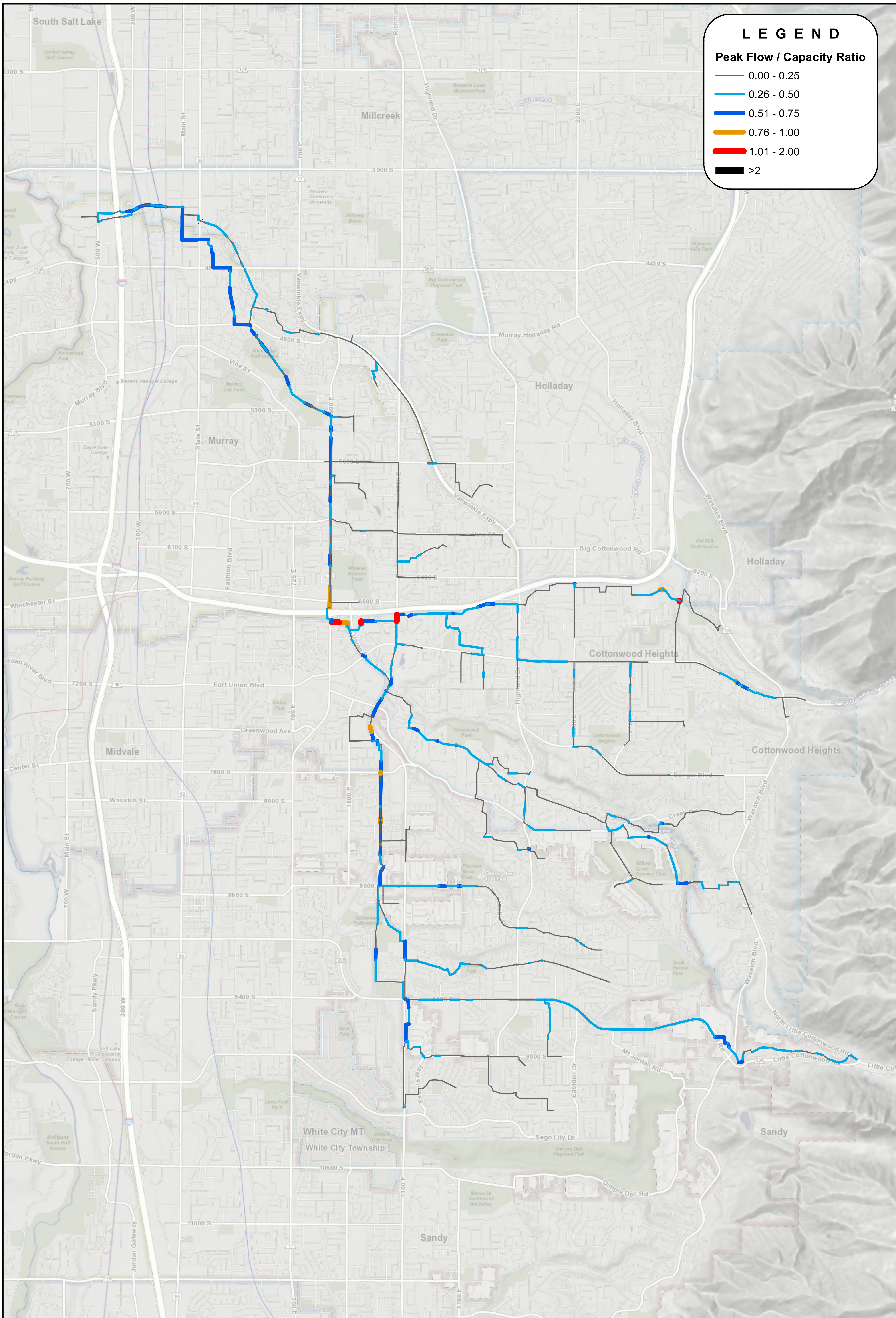
Q_P – Pump capacity out of wet well

V_{min} – Minimum wet well volume

While lift station and force main level of service criteria have been included here for documentation purposes, it should be noted that no evaluation of the District's four existing lift stations has been completed as part of this analysis. This is because the lift stations are relatively small, are reported to have more than adequate capacity for existing flows, and have very limited potential for future growth. However, if future growth patterns ever change such that increased loading is expected at one of the lift stations, the criteria above can be used for evaluation.

EXISTING SYSTEM ANALYSIS

Figure 5-1 displays the hydraulic capacity of the sewer system under existing peak hour flow conditions. Pipes in the figure are color coded to show the ratio of peak flow in the pipe to pipe's full flow capacity. Based on peak flow and pipe capacities alone, there are quite a few isolated deficiencies scattered throughout the system. The most severe deficiencies are generally due to pipes being laid on a flat slope, which decreases the full flow capacity.



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COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

EXISTING CONDITION PIPE CAPACITY EVALUATION

NORTH:

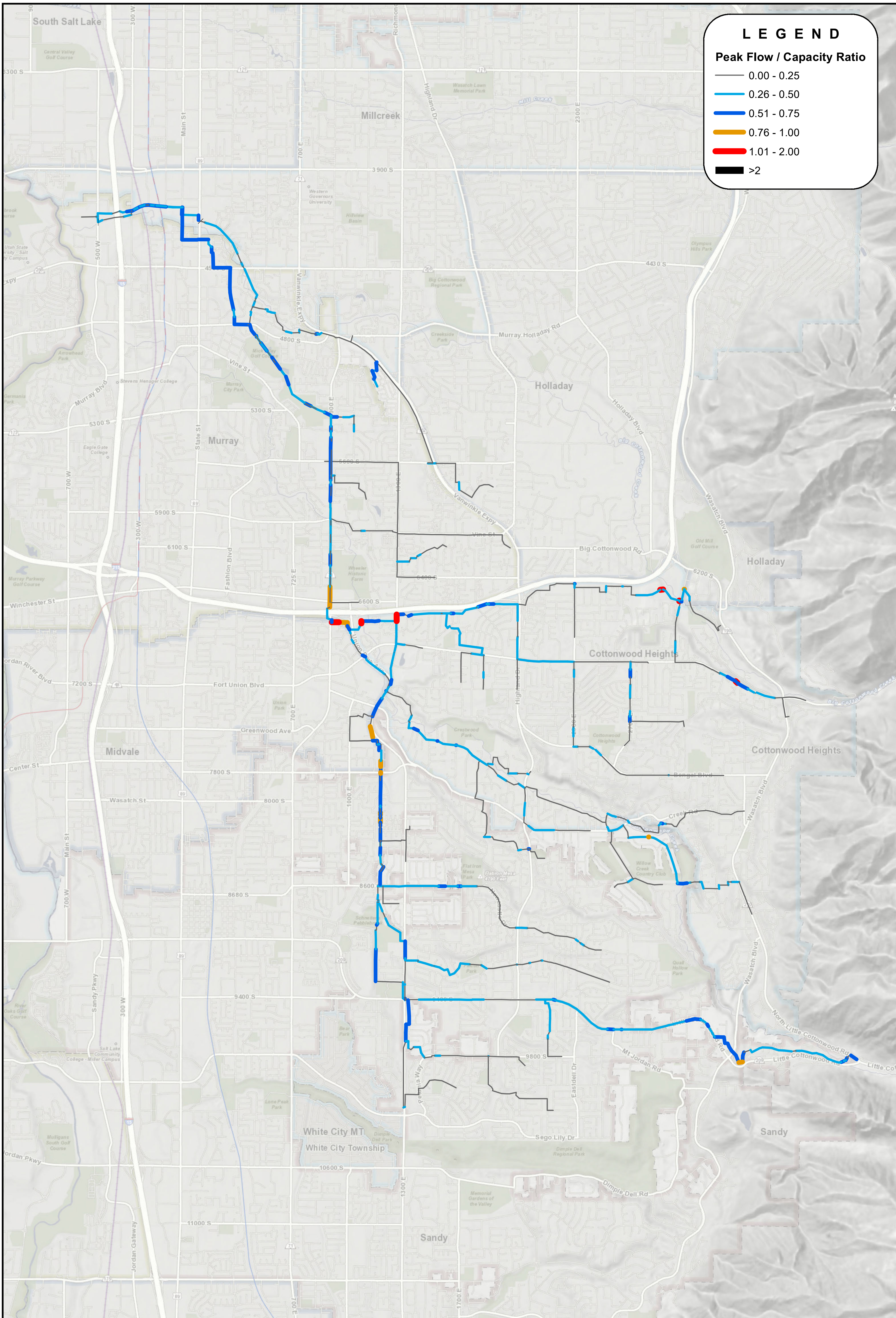
SCALE: 0 2,000 4,000 Feet

FIGURE NO. 5-1

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 5-1 - Existing Deficiencies.mxd wandersen 10/18/2021

FUTURE SYSTEM ANALYSIS

Figures 5-2 and 5-3 show the hydraulic performance as calculated in the hydraulic model for future sewer flows for 2031 and buildout development conditions, respectively, as projected using methods described in Chapters 3 and 4 if no improvements are made to the existing system. As seen in these figures, there are substantial changes from existing to future development conditions. While the majority of the system under buildout conditions has adequate capacity, some significant future capacity needs can be observed in the model results. Figures 5-2 and 5-3 help identify how soon some of the future capacity needs are projected to occur.



COTTONWOOD IMPROVEMENT DISTRICT

SEWER CAPITAL FACILITIES PLAN

10-YEAR CONDITION PIPE CAPACITY EVALUATION

BOWEN COLLINS & ASSOCIATES

NORTH: NORTH

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 5-2

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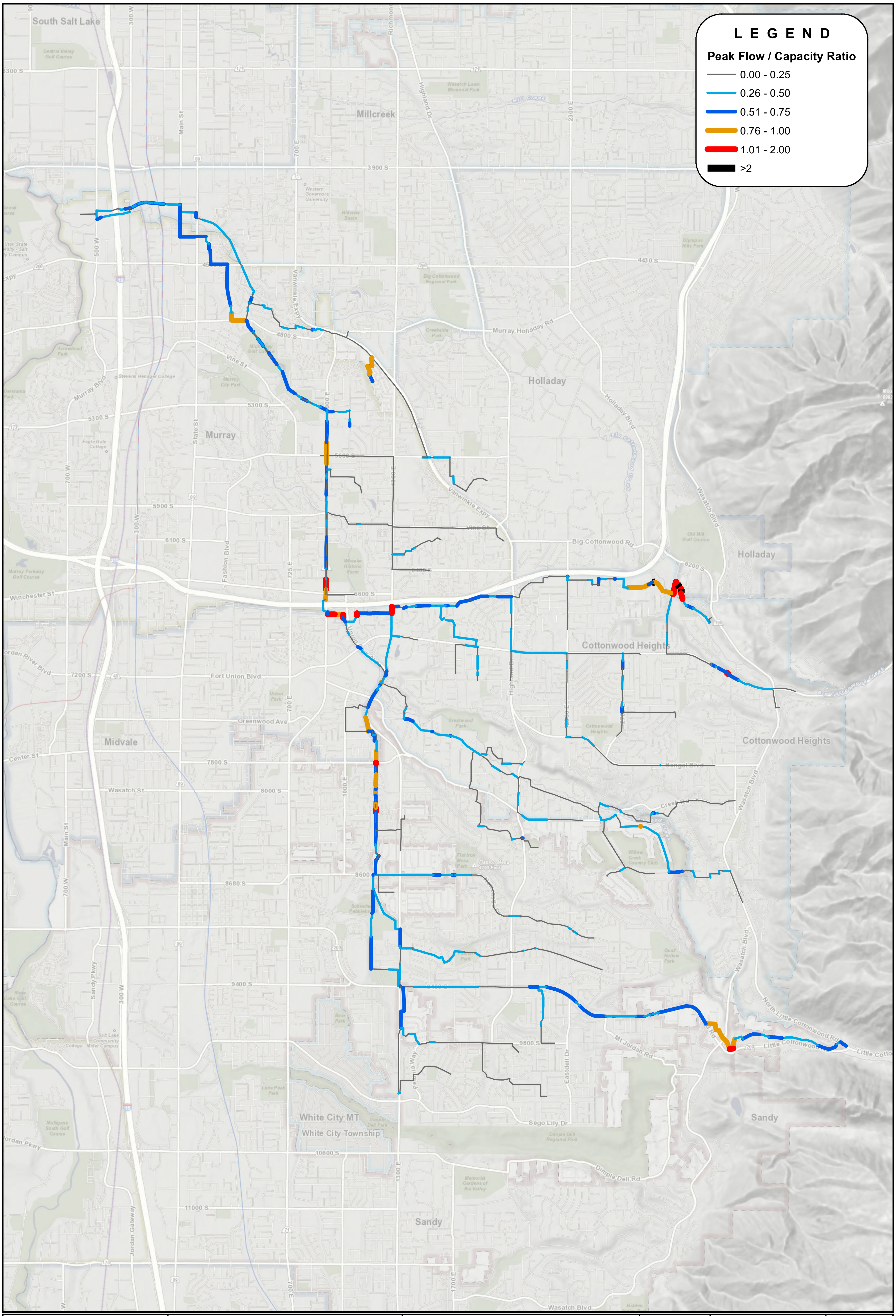

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SEWER CAPITAL FACILITIES PLAN

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BUILDOUT CONDITION PIPE CAPACITY EVALUATION

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 5-3

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 5-3 - Buildout Deficiencies.mxd wandersen 10/18/2021

CHAPTER 6
CAPACITY RELATED CAPITAL IMPROVEMENTS

The hydraulic model results were used to evaluate various alternatives to eliminate projected future needs for capacity in the sewer system under existing and build-out conditions. This chapter identifies all required system improvements to solve capacity needs as the District approaches buildout. Prioritization, phasing, and other issues relative to project timing will be addressed as part of the implementation plan for the improvements as a later chapter of this report.

COLLECTION SYSTEM IMPROVEMENTS

Detailed lists of identified capital projects and related information such as preliminary sizing, design flows, lengths, as well as other appropriate details have been identified in this CFP as follows. These projects have been organized by project type.

Collection System Pipe Improvements

A number of system improvements have been identified to resolve hydraulic deficiencies related to existing or projected wastewater flows. Figure 6-1 shows the location of projects required for capacity related deficiencies. Table 6-1 summarizes the collection system pipe improvements, along with estimated project length, pipe diameter, design capacity, and total project cost. Several items should be noted regarding this figure and table:

- Not every pipeline outside of the District evaluation criteria has been identified for replacement with an immediate improvement project. There are three cases where postponing or elimination of an improvement project may be merited:
    - There are a number locations where a capacity deficiency has been identified in a short, isolated section of pipe. This often occurs in locations were a single segment of pipe is laid at a slope significantly flatter than its neighbors. While these flat segments of pipe are generally undesirable, they may not represent a capacity problem for the District. If the offending pipe is short enough, the hydraulics may result in a little extra depth at the upstream end of the pipe, but not enough to represent a significant increased risk of surcharging of flooding for the District. Where this is the case, no project has been identified for the "deficiency".
    - There are a few locations throughout the District's sewer collection system where the pipeline has actually been designed to operate with depths greater than the standard evaluation criterion. Examples of this include siphons or pipelines that are downsized for a short section to avoid utility conflicts. In these cases, a "deficiency" will be identified by the model results but will not be a problem in most cases. These sections of pipe have been designed to be able to handle surcharging without adverse effects to upstream hydraulic conditions. Thus, each of these cases have been identified and examined closer to decide if they merit a project or not.
    - As noted in the previous chapter, the recommended level of service includes a larger safety factor for the design and evaluation of small diameter pipes (12-inch and smaller). This is primarily to account for the increased variability of flows in the smaller areas normally served by these smaller pipelines. However, the District has some unique circumstances where additional consideration should be applied to some of the smaller diameter pipelines in the system. Specifically, much of the District's service area includes some relatively steep slopes as it falls down and away from the mountains to the east. As a result, many of the District's trunklines can be

relatively small for the size of area they serve as a result of their slope. Where this is the case, increasing the safety factor for the smaller diameter pipes may not be necessary since there is not the same concern with small area variability. As a result, Figure 6-1 identifies a number of pipelines where a project is not currently identified, but where BC&A would recommend ongoing monitoring for capacity related deficiencies. These pipelines represent those small diameter pipelines that are projected to exceed the 50 percent full criterion identified in the previous chapter, but do not yet exceed 75 percent full. It is recommended that the District gather additional flow information to determine if projects are actually needed.

- Diameters given for new projects in the table are for planning and budgeting purposes only. Once detailed design of each sewer main commences, it is expected that the designer engineer will verify total existing flow, peaking characteristics, potential service area (with corresponding projected build-out flows), and available slope before selecting the final pipe size.
- Unit costs for replacing short sections of pipe can often be higher than unit costs for longer replacement projects because the ratio of mobilization costs to material and other construction costs is relatively high. The District may wish to combine several small projects into a single combined project to keep mobilization and corresponding unit costs consistent with the assumptions used here.

Table 6-1
Collection System Pipe Improvements

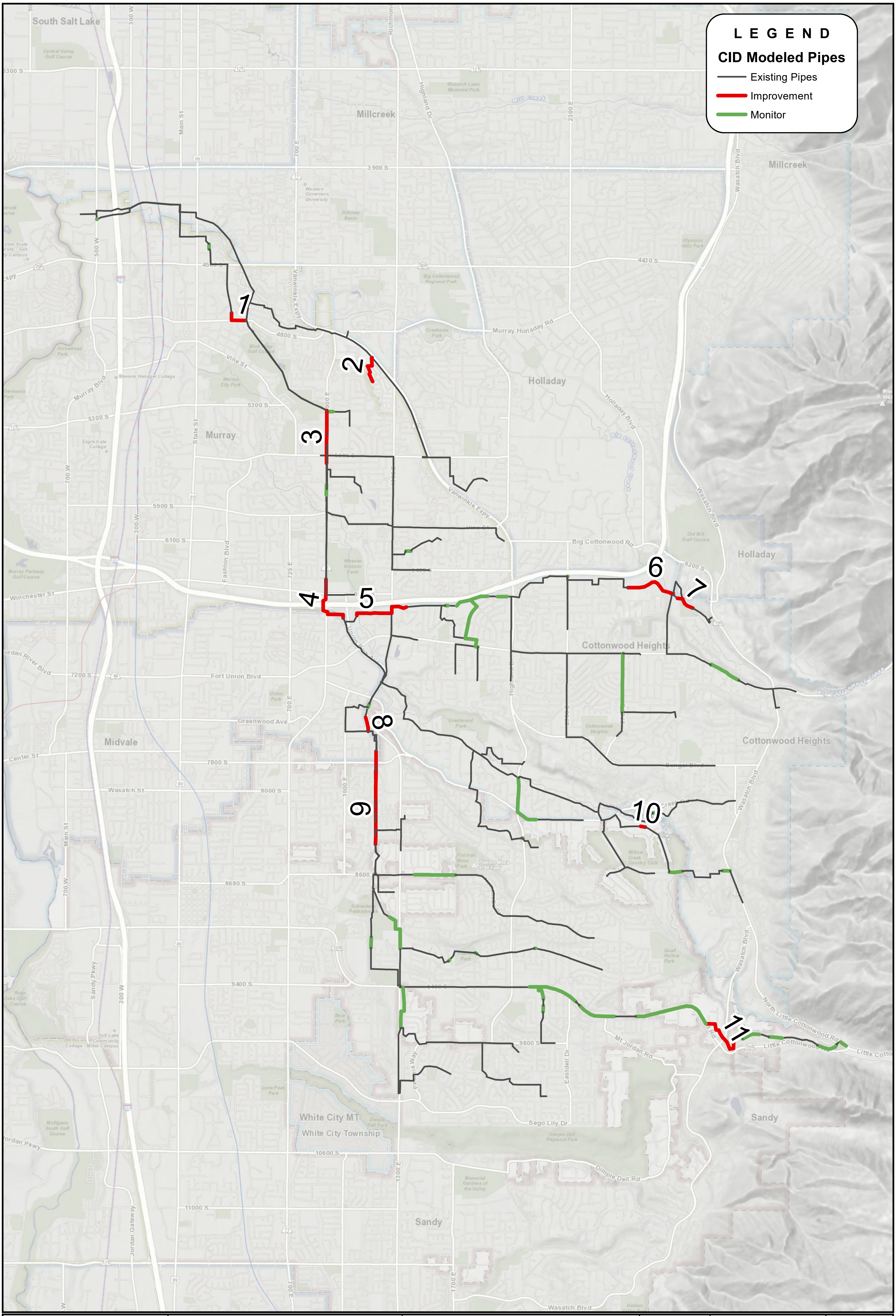
Project No.	Project Name	Project Timing	Pipe Length (ft)	Diameter (inches)	Design Peak Flow (mgd)	Project Cost
1	4800 South Atwood Blvd Upsize	>10 years	981	42	11.1	$1,183,086
2	Camino Real Drive Upsize	5-10 years	1,431	12	0.4	$590,717
3	5600 South 900 East Upsize	>10 years	2,504	36	12.0	$2,460,931
4	I-215 900 East Upsize	0-5 years	2,790	48	12.0	$3,836,808
5	6720 South 1100 East Upsize	0-5 years	2,771	42 and 33	7.0	$2,881,286
6	Cottonwood Pkwy Upsize	>10 years	2,436	24	2.2	$2,231,863
7	BCC Road Upsize	5-10 years	940	15	1.5	$434,280
8	Union Park Ave 7400 South Upsize	5-10 years	676	24	3.7	$412,901
9	7800 South 1200 East Upsize	5-10 years	4,144	24	3.7	$2,531,155
10	Robidoux Road 2700 East Upsize	5-10 years	225	12	0.4	$92,880
11	Little Cottonwood Road Wasatch Blvd Upsize	5-10 years	2,521	18	4.6	$1,291,760
					Total	**$17,947,667**

Water Reclamation Facility Improvements

Although there is adequate treatment capacity at the CVWRF for existing and future flows, changes in regulatory requirements may require upgrades to the plant to meet new permit requirements. The Utah Division of Water Quality has been developing new criteria for the Utah Pollutant Discharge Elimination System (UPDES) Permit related to treatment plant nutrient removal requirements. The new permit requirements were released by the State in the Spring of 2014. As a result of the new permit requirements, some improvements will need to be constructed and in operation by 2025. Bowen Collins & Associates developed a technical memorandum for the Central Valley Water Reclamation Facility regarding their sewer impact fee calculations. This technical memorandum can be found in Appendix A of this report and summarizes the project costs that will be required at CVWRF between 2021 and 2037. The total cost of these future projects at CVWRF is $516 million.

Planning Projects

In addition to capital facility projects, the District will need to update its sewer Capital Facilities Plan, Impact Fee Facility Plan, and Impact Fee Analysis approximately every 3-5 years. This will be especially important to consider as changes in nutrient removal requirements at the treatment plant proceed. Planning costs for CID are anticipated to be approximately $60,000 every 3-5 years based on past historical planning study costs. As part of the next Capital Facilities Plan update, some flow monitoring may also be warranted based on recent observations in some parts of the system. BC&A would also recommend that the District budget $30,000 to purchase some flow meters and installation equipment that can then be used to monitor flows in various areas of the system for design and evaluation purposes.



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COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

BUILDOUT CONDITION SYSTEM IMPROVEMENTS

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 6-1

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 6-1 - Improvements.mxd wandersen 10/18/2021

CHAPTER 7
PIPELINE CONDITION ASSESSMENT

INTRODUCTION

Cottonwood Improvement District has retained Bowen Collins & Associates (BC&A) to prepare a basic asset management plan for the District's sewer collection system as part of this report. The purpose of this plan will be to determine the existing condition of the sewer infrastructure in the Cottonwood Improvement District service area and provide budgetary costs for recommended improvements to maintain the infrastructure. Asset management is discussed in two chapters. Chapter 7 focuses on documenting the District's existing sewer collection asset inventory and identifying the expected condition of these assets. Chapter 8 uses the inventory and condition assessment data to develop a plan of action.

It should be emphasized that this study is just the first step in developing a comprehensive asset management program. This study will assess the existing condition of the District's assets based on available data, and then use the results to project the remaining service life of the infrastructure throughout the District. The District can then augment these results with additional condition assessment data over time to track observed degradation of the assets and better project their remaining service life.

EXISTING SEWER COLLECTION SYSTEM

The first step in preparing an asset management plan for Cottonwood Improvement District's sewer collection system was to obtain data from the District on the nature and condition of their sewer collection system. Cottonwood Improvement District's GIS shapefile for their sewer collection system consists of the following attributes that are related to asset management:

- Individual pipe identification number
- Diameter and length of individual pipes
- Installation year of individual pipes
- Material of individual pipes
- PACP scores for individual pipes
- Date of most recent video inspection
- Pipes that have been rehabilitated
- Cleaning schedule for individual pipes

Some of these attributes are not available or are inaccurate for some of the pipes in the GIS database. There are also some useful attributes (relative to asset management in a sewer system) that are missing from the District's sewer collection system GIS database (e.g. estimates of hydrogen sulfide (H_2S) concentrations in each pipeline, etc.). A summary of each of the sewer pipeline attributes noted above is contained in the following sections. Additional details regarding the District's inventory database are contained in Appendix B, C, and D.

Pipe Diameter

In general, the pipe diameter attribute of the GIS database was mostly complete and is believed to be accurate. Figure 2-2 in Chapter 2 shows the pipe diameter for each pipe in the District's sewer collection system. About 0.16 percent of the total length of pipe in the District's sewer collection system does not have a pipe diameter assigned in the GIS database. This information is also summarized in Table 2-1.

Pipe Material

The pipe material attribute of the GIS database was mostly complete and the data that is contained in the current attribute field is believed to be accurate. There is about 0.9 percent of the total length of pipe in the District's sewer collection system that does not have pipe material currently assigned in the GIS database.

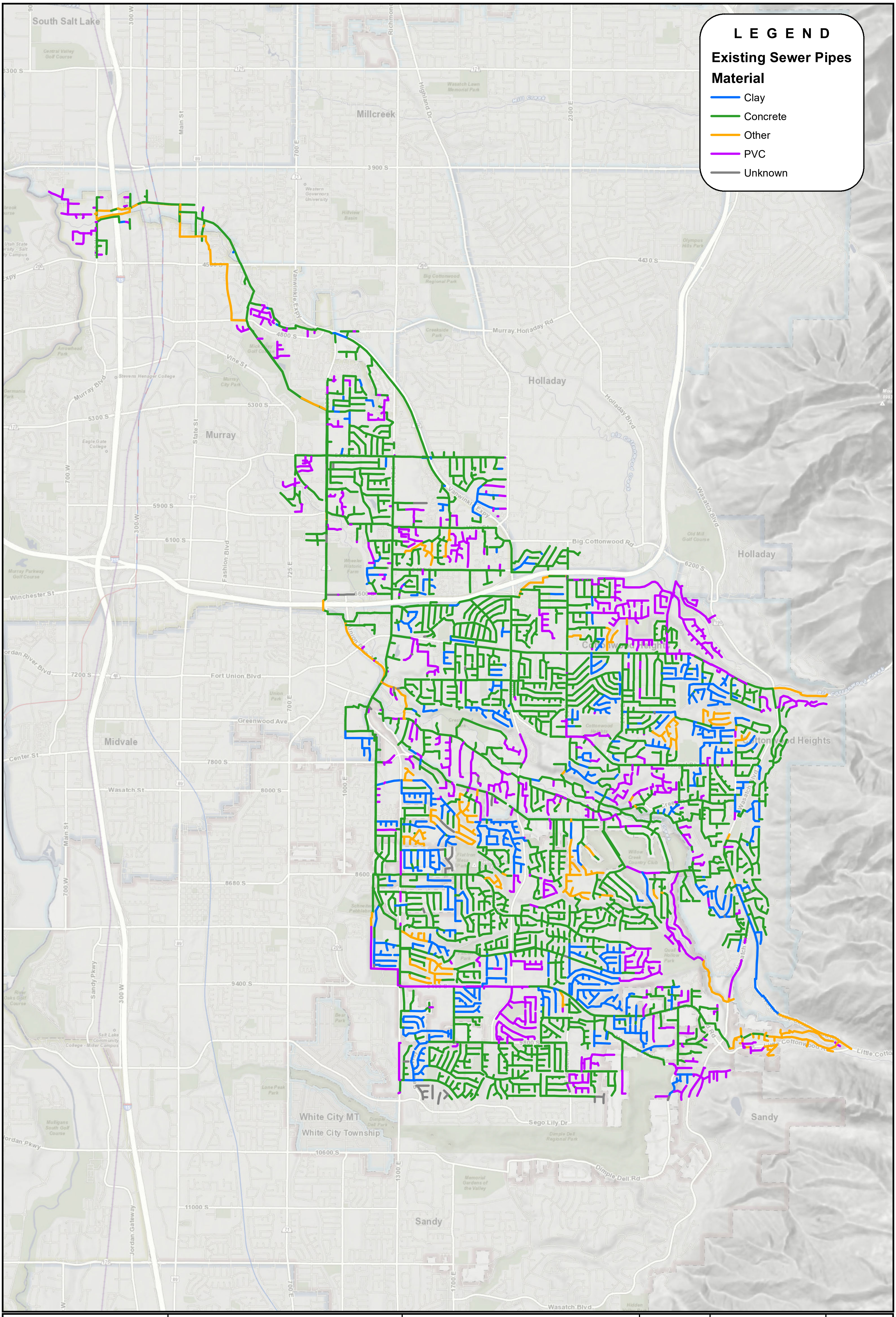
Figure 7-1 shows the pipe material for each pipe in the District's sewer collection system. It should be noted that the District's sewer collection system has multiple known pipe materials, but concrete, clay, and PVC are the most common materials and encompass the vast majority of pipelines in the system. Correspondingly, all other pipe material types have simply been grouped under the category "Other". This information is also summarized in Table 7-1.

Table 7-1
Sewer Collection System Material

Pipe Material	Percentage of Collection System by Pipe Length
Unknown	0.92%
Clay	15.45%
Concrete	60.81%
PVC	16.36%
Other	6.45%
Total	100.00%

Installation Year and Age

Cottonwood Improvement District's sewer collection system GIS database included information on the installation year of pipes in the system. This information is critical to estimating the remaining life of pipes in the system. Figure 7-2 shows the estimated pipe installation year for the District's sewer collection system. This information is also summarized in Table 7-2.



BOWEN COLLINS & ASSOCIATES

COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

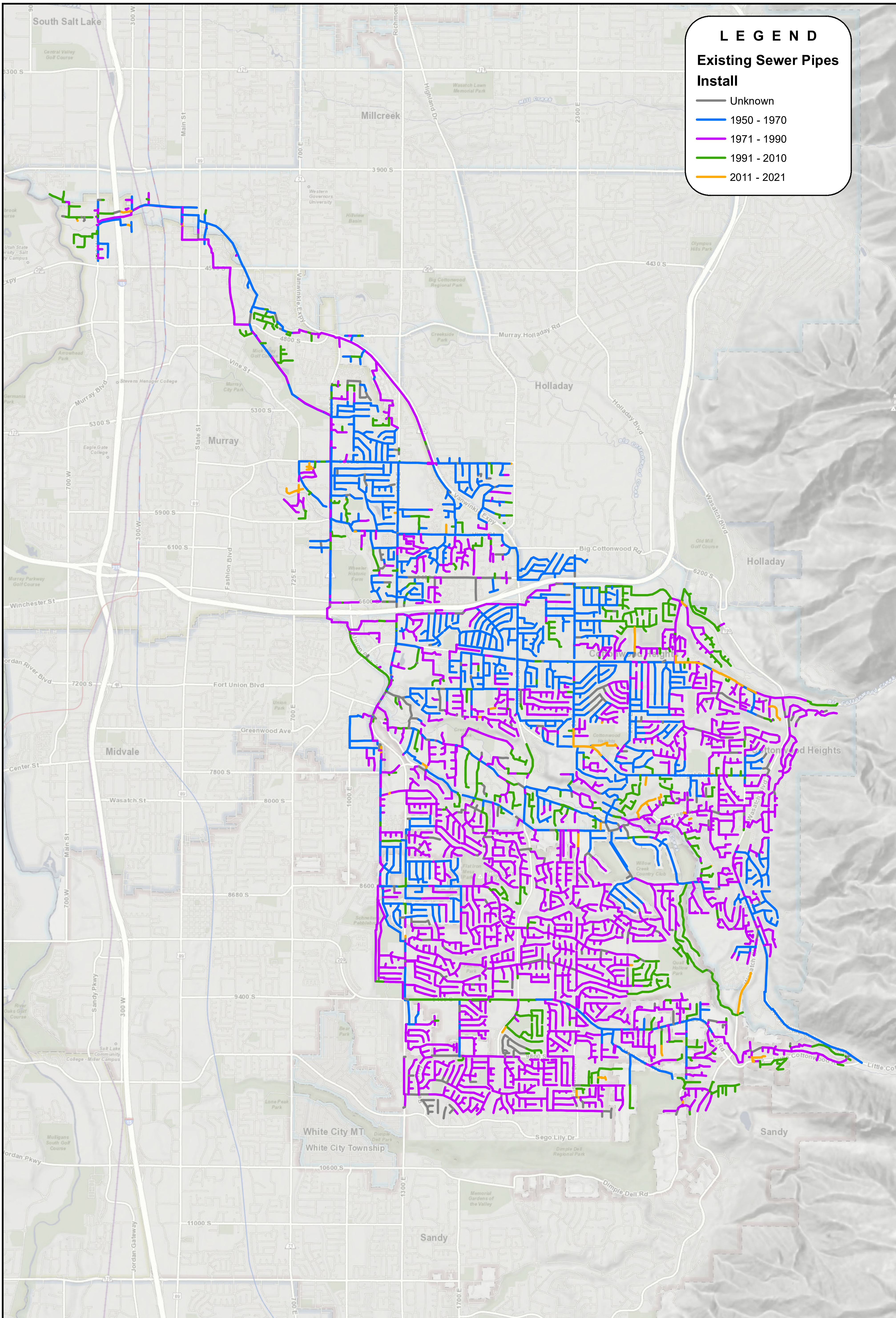
EXISTING SYSTEM PIPE MATERIAL

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 7-1

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 7-1 - Existing Pipe Material.mxd wandersen 10/13/2021



COTTONWOOD IMPROVEMENT DISTRICT

SEWER CAPITAL FACILITIES PLAN

EXISTING SYSTEM INSTALLATION YEAR

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 7-2

BOWEN COLLINS & ASSOCIATES

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 7-2 - Installation Year.mxd wandersen 10/13/2021

Table 7-2
Sewer Collection System Installation Date

Installation Year	Percentage of Collection System by Pipe Length
Unknown	5.02%
1950 - 1970	30.12%
1971 - 1990	51.70%
1991 - 2010	11.57%
2011 - 2021	1.59%
Total	100.00%

As summarized in the table, most of the construction of the Cottonwood Improvement District collection system was completed prior to 1990. While some construction continued in the 1990s and 2000s, very little has been construction over the last decade.

Cleaning and Inspection Data

Cottonwood Improvement District's sewer collection system database is relatively complete for data that pertains to inspections and cleaning. Appendix C and Appendix D discuss cleaning and inspection data documentation processes for the District's sewer collection system in greater detail.

Recommended Modifications for Future Data Collection

Modifications and recommended additions to the District's sewer collection system GIS database can be found in Appendix B. Recommended documentation of cleaning and inspection activities for the District and its databases can be found in Appendix C and Appendix D.

PIPELINE CONDITION ASSESSMENT

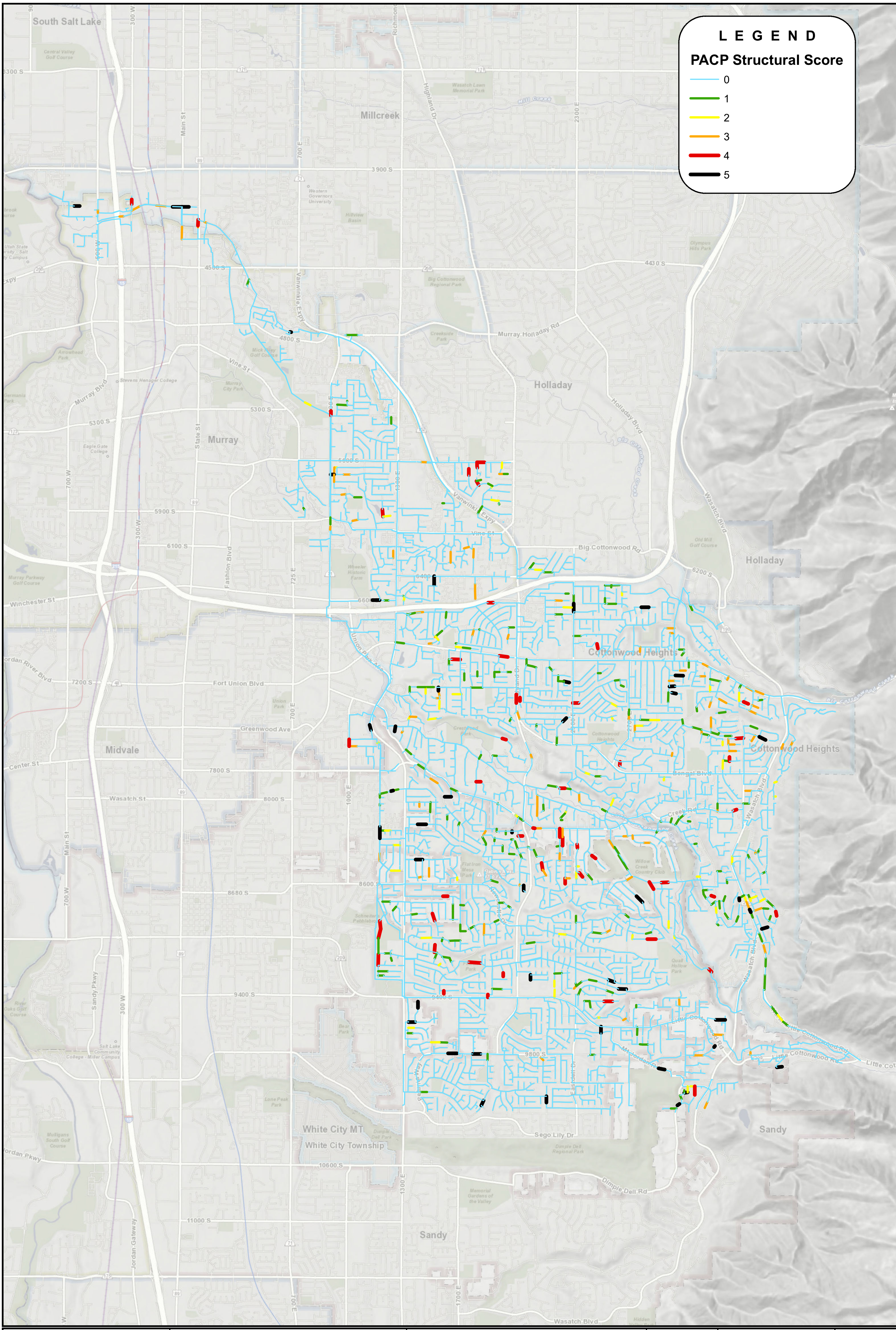
Perhaps the most important step of any collection system asset management plan is determining the existing condition of pipes in the collection system. The most common way to determine the existing condition of pipes in a collection system is to have a trained crew use their equipment to video inspect the inside of the pipes. The crew is trained to recognize defects in the pipe and code them accordingly.

Historic District Condition Assessment Practices

Cottonwood Improvement District owns their own equipment for inspecting their collection systems via video. Cottonwood Improvement District personnel have been trained to operate the video equipment and they have used this equipment to video inspect portions of the District's collection system. A detailed assessment of Cottonwood Improvement District's existing condition assessment practices can be found in Appendix D. A summary of that assessment is contained here.

- **Quality of Inspection Video Data** – As explained in greater detail in Appendix D, Cottonwood Improvement District uses a pipe inspection database called Pipeline Observation System Management (POSM). Access to the District's POSM database was given to BC&A to review all the District's inspection videos of their collection system. In general, the video available through the interface is high quality and provides excellent images of pipe condition. The POSM database also provides the District with a way to give each pipe in the sewer collection system a structural score based on inspection observations.

- **Quantity of Inspection Videos** – The District has inspected all of the pipelines in its sewer collection system over the last several years. The video for these pipelines is saved and available in their pipeline inspection database. Figure 7-3 shows the structural condition score for each of the pipelines.



COTTONWOOD IMPROVEMENT DISTRICT

SEWER CAPITAL FACILITIES PLAN

EXISTING SYSTEM INSPECTED PIPES AND PACP SCORES

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 7-3

BOWEN COLLINS & ASSOCIATES

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 7-3 - Inspected Pipes and PACP.mxd wandersen 10/20/2021

PACP Coding

To have a consistent system of assessing the District's collection system deficiencies, the District uses the structural condition scoring system from the Pipeline Assessment and Certification Program (PACP). Official PACP structural condition scoring needs to be performed by someone who is certified by PACP and has been through the training to recognize all the types of deficiencies and how to score them accordingly.

PACP structural scoring works by first identifying a specific, standardized type of deficiency (e.g. a circumferential crack will have a PACP deficiency code of CC, hydrogen sulfide corrosion resulting in visible aggregate will have a PACP deficiency code of SAVC, etc.). The location and extent of each of these deficiencies is also identified and all deficiency data is stored in a standardized, searchable database. Associated with each standardized deficiency is a numerical structural deficiency value that represents the level of concern associated with each deficiency (e.g. a circumferential crack has a PACP structural code of 1, hydrogen sulfide corrosion resulting in visible aggregate has a PACP structural code of 3, etc.). This structural scoring provides a numeric value that can be objectively determined for each pipe following established standards. Table 7-3 summarizes the PACP structural scoring categories.

Table 7-3
PACP Structural Condition Scoring Categories

PACP Structural Scoring	General Condition
0	No observable deficiencies
1	Pipe segment has minor defects – failure unlikely in the foreseeable future
2	Pipe segment has minor defects – failure unlikely for at least 20 years
3	Pipe segment has moderate defects – continued deterioration may result in failure in less than a 20-year timeframe
4	Pipe segment has severe defects – it is near the end of its useful life
5	Pipe segment is beyond its useful life – failure has occurred or is imminent

EXPECTED LIFE

A significant deliverable of this asset management plan is a prediction of the expected design life of each pipe in the District's collection system. BC&A used the PACP structural scores from the table above to develop an estimate of expected remaining design life for all pipelines with available inspection data. Pipelines with a structural rating of 5 are beyond their expected design life, pipelines with a structural rating of 4 are very near the end of their expected design life, etc.

This data, along with experience from other sewer collection systems, can then be used to calibrate an expected life formula for all of the pipelines in the system based on their individual characteristics. This process is described in the following section. The process varies slightly depending on pipeline material. About 93% of the pipelines in the District's sewer collection system are either concrete, clay, or PVC pipe materials. For this expected life analysis, concrete and clay pipe materials were grouped together and the same expected life formula was used for these pipe material types. A separate formula was used for PVC. For the relatively small number of pipes falling in the "Other" category, HDPE, HOBAS, and lined pipe materials were grouped together with PVC with all remaining pipes grouped with concrete and clay.

Concrete Sewer Pipelines Expected Life Formula

For concrete pipes, the primary cause of failure is expected to be hydrogen sulfide corrosion. Thus, design life for concrete pipes is expected to be a function of both age and hydrogen sulfide concentration. The District does not have any detailed data on hydrogen sulfide concentrations in the system. However, hydrogen sulfide concentrations generally increase as wastewater age increases. Thus, concentrations are often the highest in larger diameter pipelines that are lower in the collection system and contain the most amount of flow. With this is mind, BC&A estimated the expected life of concrete pipes in the sewer system based on pipe diameter and location in the collection system.

For pipes with smaller diameters, little hydrogen sulfide corrosion is projected. This is consistent with system inspection data. Few, if any, of the District's inspected concrete pipelines 8-inch and smaller show any significant signs of hydrogen sulfide corrosion. Based on these observations, it has been estimated that 8-inch pipelines will have an expected design life of about 100 years.

Conversely, pipes with the largest diameters in the system (42-inch and greater) are generally projected to have much greater potential for hydrogen sulfide corrosion. This also is consistent with system inspection data. Signs of hydrogen sulfide corrosion are present in many of the District's larger, concrete outfall pipelines. Based on observed corrosion, it has been estimated that 42-inch and greater pipelines will have an expected design life of no more than 80 years.

In an ideal situation, data would be available to estimate similar design life expectations for all pipelines sizes. Additional data on location and wastewater travel time could also be used ot improve the accuracy of design life expectations. However, the District's system is new enough that it doesn't have a lot of pipelines approaching failure to refine these estimates. With the limited data available, The expected design life for concrete pipelines between the largest and smallest sizes were predicted using simple linear interpolation based on diameter. This very rough approximation can be refined in future years as more pipelines near the end of their design life.

It will be noted that these estimated design lives are longer than might usually be expected for concrete pipe. In areas with aggressive hydrogen sulfide corrosion, the expected life span of concrete pipe can be 50 years or less. However, observed hydrogen sulfide corrosion in the District is much less than observed elsewhere[1]. Pipes that are already 60 or 70 years old and located toward the bottom of the system are still showing only moderate corrosion and appear to have around 20 years of remaining service life. Hence, the longer expected design lives identified here.

PVC Sewer Pipelines Expected Life Formula

Unlike concrete, PVC pipes (and other similar pipe materials) are highly resistant to corrosion associated with hydrogen sulfide. With this in mind, the expected design life of PVC pipes was estimated to be 100 years, no matter what the predicted hydrogen sulfide concentration is in the pipeline.

[1] The reason for less observed corrosion in unknown. One possible explanation is the topography of the District. With comparatively steep pipe slopes throughout the District, higher flow velocities may result in lower wastewater age and less formation of hydrogen sulfide. Higher velocities may also result in more air flow through the system, diffusing any hydrogen gas that is formed. Whatever the explanation, the District's extensive inspection data confirms that corrosion is less than that observed in most other similarly sized systems.

Pipes that did not have a material type identified were conservatively assigned an expected design life of 80 years.

Expected Life Results

Once expected design life was predicted for all of the pipes in the collection system, the age of each pipeline was compared to its expected design life to calculate the expected remaining life for each pipe in the collection system. This value is important to determine which pipes are close to reaching the end of their expected design life, which pipes are past their expected design life, or which pipes have quite a few years until they reach their expected design life.

Table 7-3 shows the percentage of pipe in the District's sewer collection system based on expected remaining design life.

Table 7-3
Percentage of Sewer Collection System versus Expected Design Life

Years Until End of Expected Design Life	Percentage of Sewer Collection System
Already Exceeded	0.00%
0-10 years	0.20%
10-30 Years	2.93%
30-60 Years	74.34%
60-90 Years	21.03%
90-110 Years	1.49%

CONCLUSIONS

The following major conclusions can be made from the analysis contained in this chapter:

- Overall, the District's existing database is in excellent condition and contains nearly all the system inventory information needed for a successful asset management plan. A few minor changes are suggested to improve the usefulness of data collection for asset management purposes.
- Cottonwood Improvement District does not have many short-term needs for rehabilitation and replacement. Over the next 30 year, only about 3 percent of the system is expected to reach the end of its useful service life.
- The District's real asset management challenge will occur in 30 to 60 years. During this period, the District will need to rehabilitate or replace about three quarters of its collection system.

CHAPTER 8
ASSET MANAGEMENT PLANNING

EXPECTED SYSTEM REHABILITATION AND REPLACEMENT NEEDS

Determining the cost and timing of expected rehabilitation and replacement of the District's collection system is important for future budgeting purposes. The purpose of this chapter is to estimate the expected needed investment in the Cottonwood Improvement District sewer collection system to sustainably maintain these assets.

COLLECTION SYSTEM REHABILITATION AND REPLACEMENT

To determine the expected collection system rehabilitation and replacement costs for Cottonwood Improvement District, BC&A used a database for sewer system rehabilitation and replacement unit costs that BC&A has developed over the last several years. This database uses past project costs and the current Engineering News Record (ENR) cost index to estimate unit costs for collection system pipes. Appendix E has more detail regarding expected collection system rehabilitation and replacement costs and the value of assets.

Expected Rehabilitation and Replacement Schedule

Cottonwood Improvement District's sewer collection system is composed of almost 311 miles of pipe. The total cost to completely replace all of the pipes in the CID collection system would be approximately $536 million based on 2021 construction costs. However, it will not be necessary to completely replace the entire system as it ages because of rehabilitation technologies (e.g. slip lining, cast-in-place pipe, etc.). Rehabilitation costs are much lower than replacement costs (generally 20 to 60 percent depending on pipe diameter). If CID were able to rehabilitate the entire system rather than replace components, it would drastically reduce the "replacement value" to $114 million. Unfortunately, it is generally not possible to rehabilitate all system components due to either condition or capacity issues. Some pipes are beyond saving with rehabilitation, while others may require upsizing or correction of grade issues; all these scenarios would require a full replacement.

To account for the limitations on rehabilitation, BC&A recommends budgeting for system renewal based on a combination of rehabilitation and replacement. Assuming pipes in the District's collection systems need to be 50% rehabilitated and 50% replaced, BC&A calculated the rehabilitation and replacement "value" of the sewer collection system at $325 million. Table 8-1 summarizes system values under various scenarios.

Table 8-1
Sewer Collection System Rehabilitation and Replacement Costs

System Renewal	System Value (2021 Dollars)
Replacement of all system components	$535,600,000
Rehabilitation of all system components	$114,000,000
50% replacement 50% rehabilitation	**$324,800,000**

If all of the pipelines in the collection system had a service life of 100 years, the resulting recommended annual rehabilitation and replacement budget for the District would be $3,245,000. This budget would apply to all system investment including completion of the specific collection system projects identified above along with routine rehabilitation and replacement of aging infrastructure.

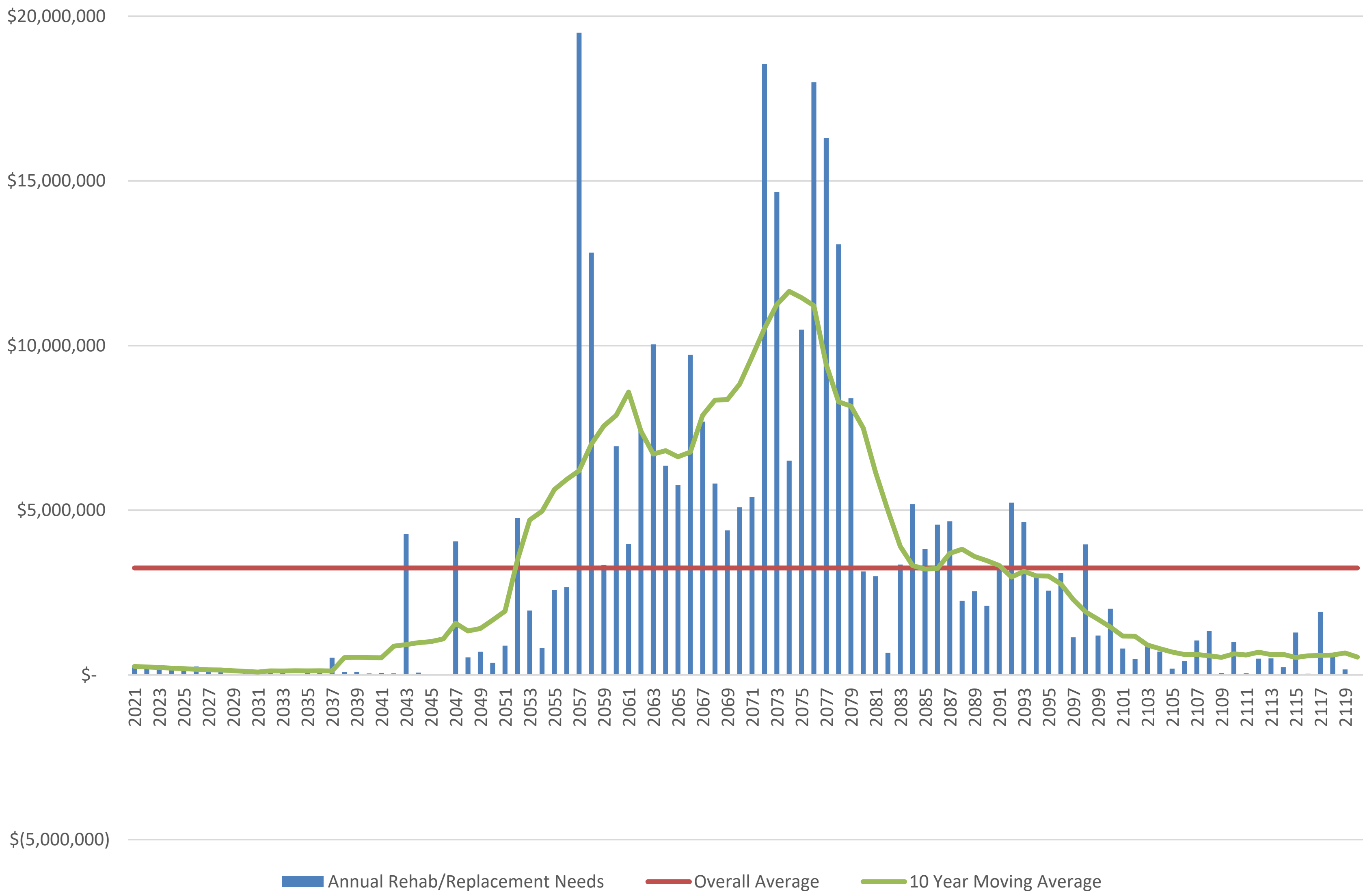
Beyond this simple overall analysis, however, the District can use the condition assessment data summarized in Chapter 7 to better estimate when and where rehabilitation and replacement should occur. Figure 8-1 shows the rehabilitation and replacement needs for Cottonwood Improvement District's sewer collection system based on the expected remaining system life of each individual existing asset as discussed previously. This figure includes:

- The cost of rehabilitation and replacement in each year based on the current estimate of each pipe's end of life.
- A 10-year moving average cost. The 10-year moving average gives a better overall indication of the recommended level of investment required to meet system needs.
- The average annual cost of investment if the total cost is distributed equally from 2021 to 2121.

From Figure 8-1, a few major conclusions can be made:

- Average recommended long-term investment in rehabilitation and replacement of sewer collection system facilities is $3.3 million/year. This is significantly more than the District has been investing in rehabilitation and replacement activities in the past. This recommended annual investment does not need to be reached in the next few years but is more of a long-term goal for the District.
- There are about 85 sewer pipes that need spot repairs based on having PACP structural scores of 4 and 5 with only one or two instances of these scores in each pipe. The estimated cost of replacing and/or rehabilitating these pipelines is $1.5 million. Action on these pipelines is recommended as soon as feasible if the District wants to avoid the potential for costly pipeline failures.
- Because nearly all of the District's existing pipelines still have significant remaining service life, there is a relatively low need for rehabilitation and replacement investment over the next 20 years. However, the District will face a large asset management challenge starting in about 30 years. For several decades after this point, the District is projected to have rehabilitation and replacement needs ranging from $5 million to $10 million annually.
- The District will want to prepare for the future by investing in rehabilitation and replacement where possible now. Of specific focus should be cast-in-place pipe (CIPP) lining of existing, larger diameter, concrete pipes. Aggressively budgeting for these types of projects over the next few decades will significantly extend the lives of these pipelines. In addition to being far less expensive in the long-run, this will help with District cash flow down the road when other rehabilitation and replacement needs are greater.

Figure 8-1
Expected Sewer Rehabilitation and Replacement Needs



ASSET MANAGEMENT PLANNING

The primary purpose of the analysis above was to establish a recommendation for the appropriate level of funding to invest in rehabilitation and replacement of these systems. With a budget established, the next step is to identify and prioritize which assets need to be addressed first and identify a specific plan for their rehabilitation. Developing a detailed plan for all the Cottonwood Improvement District system is beyond the scope of this report. The purpose of this chapter is to identify a recommended process for developing a detailed plan.

Two important components of an asset management plan are evaluation of consequence of failure and probability of failure. Each of these are discussed in the following sections. Once consequence of failure and probability of failure are analyzed for the collection systems, the product of these two factors can be used to establish asset criticality. Asset criticality is a measurement of the priority for rehabilitation of an asset and can be used to then create a detailed asset management plan.

CONSEQUENCE OF FAILURE

To prioritize maintenance and condition assessment activities in the District's collection systems, it is necessary to create a method for rating the importance of individual pipes and manholes in the system. The relative importance of the pipes and manholes is rated based on the consequences of failure. The purpose of this section is to outline a proposed procedure for rating the consequence of failure for individual pipes in the Cottonwood Improvement District sewer collection system.

Importance of Consequence of Failure

Consequence of failure is an estimate of the importance of a pipe based on the impacts that would result if the pipe were to fail. The repercussions of sudden failure can come from public perception, public safety, health concerns, and other factors. The reliability that the pipe adds to the system is also a factor that is considered in rating its consequence of failure. For example, an 8" sewer main that receives the wastewater from 3 houses is obviously not as vital to the reliability and performance of the District sewer system as the 24" trunkline that collects flow from half of the District.

It should be noted that consequence of failure refers to the overall importance of a pipeline without consideration of its condition. In other words, if there are two pipelines that are identical in every way except that one is in excellent condition and the other is nearing failure, they will still have the same consequence of failure. For asset management purposes, pipeline condition is considered separately as "probability of failure". To make wise decisions regarding pipeline maintenance, the District will obviously need to consider both consequence of failure and probability of failure. However, to make sure both issues are considered and weighed appropriately, these concepts need to be discussed and considered separately first.

Proposed Consequence of Failure Rating System

While it is easy to understand the general principle behind consequence of failure, it is much more difficult to implement a rating system to accurately represent consequence of failure. While some consequences are easy to quantify from pipe to pipe (e.g. pipeline replacement costs), most consequences of failure are much more difficult to represent quantitatively (e.g. impacts to health and safety or results of regulatory violations). Instead of trying to quantify each category of consequence, BC&A proposes using a few easily quantifiable factors to rank the pipes. This ranking gives a relative indication of consequence of failure. Four factors are proposed to estimate the consequence of failure of a sewer pipe: the flow rate in the pipe, the category of road over the pipe, the zoning of the area, and the depth of the pipe.

Sewer Flow Rate. Flow rate in a sewer pipe is the single most important indicator of the importance of a pipe. In most situations, the higher the flow rate, the larger the area that pipe serves. Pipes that have a higher flow rate that do not service a large area still need to have a have a higher consequence of failure rating than pipes with lower flow rates. Bypass pumping cost, the risk of property damage, environmental and regulatory consequences, the cost of pipe replacement, and problems from sewage backing up in the system are all greater for larger flow rates. In a worst-case scenario, if a pipe collapses or becomes blocked and the manholes surcharge resulting in wastewater flows in basements and the street, there is a greater health hazard to the public with a larger wastewater flow rate.

It is proposed that the average day flow rate be used as the base rating for the consequence of failure for each pipe in the Cottonwood Improvement District Sewer System. For the purpose of this chapter, estimated flow has been based on 2021 model results.

The other three factors that influence the rating can then be used as multipliers to adjust the sewer flow rate to produce a final rating. Table 8-2 lists the proposed multipliers to be assigned to each rating factor. An explanation of each classification and its proposed multiplier is included in the following sections.

Table 8-2
Consequence of Failure Multipliers

Road Class	Multiplier	Zone	Multiplier	Depth	Multiplier
No Road or Residential	1	Open Space/ Industrial	1	0-12 feet	1
Collector	1.2	Residential	1.5	12-20 feet	1.2
Major Arterial	3	Commercial/ Institutional	1.7		
Freeway	10				
Canal X-ing	3				
Rail X-ing	10				

Road Category. There is a direct connection between the density of traffic and the cost and time associated with maintenance and repairs on sewer pipes. Based on GIS information available from Cottonwood Improvement District, BC&A grouped streets into four major classifications: interstates, major arterials, collector streets and residential streets.

- **Interstates** – Interstates are assigned the highest ranking because the cost of crossing the freeway is significantly higher than traditional pipe installation methods. The risks to property and potential social disruption impacts that may result if traffic is affected are additional impacts that are considered in this category. The proposed multiplier for the pipes under the freeway was intentionally set to be high enough to generally push these pipes into the highest level of consequence of failure.
- **Major arterials** – The next classification is the major arterials. They include Highland Drive, 1300 East, Fort Union Boulevard, and other multi-lane major streets. More disruption would result from traffic control for work on these streets than streets in the other

categories. The time and money associated with maintaining the pipes in these streets is fairly high.

- **Collector Streets** – The third classification in this category is the collector streets. These streets do not have the volume of traffic that the major arterials have, but still have more traffic than residential streets. Their multiplier is reflective of the traffic volume.
- **Residential Streets** – The fourth classification in this category is residential and other small streets. These streets have the smallest volume of traffic and do not add to the criticality ranking of a pipe. Pipes not located in roadways were also included in this classification.

Also included in the road category is consideration of two additional types of crossings, canal and railroad crossings with multipliers as shown in Table 8-2.

Zoning. Zoning is also a factor that impacts the consequence of failure rating. A sewer pipe in an open field will not have as large a consequence of failure as the same sized pipe located in a residential subdivision or in commercial areas. For this analysis, zoning has been grouped into classifications:

- **Commercial** – In commercial areas of the District, there is high potential for costly impacts since these areas can be congested. The multiplier for commercial areas in the District is the highest out of the three zoning categories.
- **Residential** – Residential areas do not generally have the same potential for costly impacts as do more congested commercial areas. However, they do have more potential for adverse public health effects than do areas of industrial or open space zoning.
- **Open Space and Industrial** – Areas zoned for industrial or open space are assumed to have the least impact from a failed pipe.

Depth of Pipe. The depth of the pipe can have a significant impact on the cost of repairs and rehabilitation of sewer pipe. Extensions on backhoes, very wide trenches, possible dewatering, etc. make repairs and maintenance much more expensive and time consuming on deeper pipes. For the purpose of this analysis, the depth of pipe was grouped into two categories:

- **Less than 12 feet** – Pipes that are less than 12 feet deep can generally be maintained and repaired using standard construction techniques.
- **12 to 20 feet** – Once the depth of a pipeline exceeds 12 feet, repairs and maintenance begin to become more expensive and can be more time consuming. Additional equipment and special construction techniques add to the cost of working on these deep pipes.

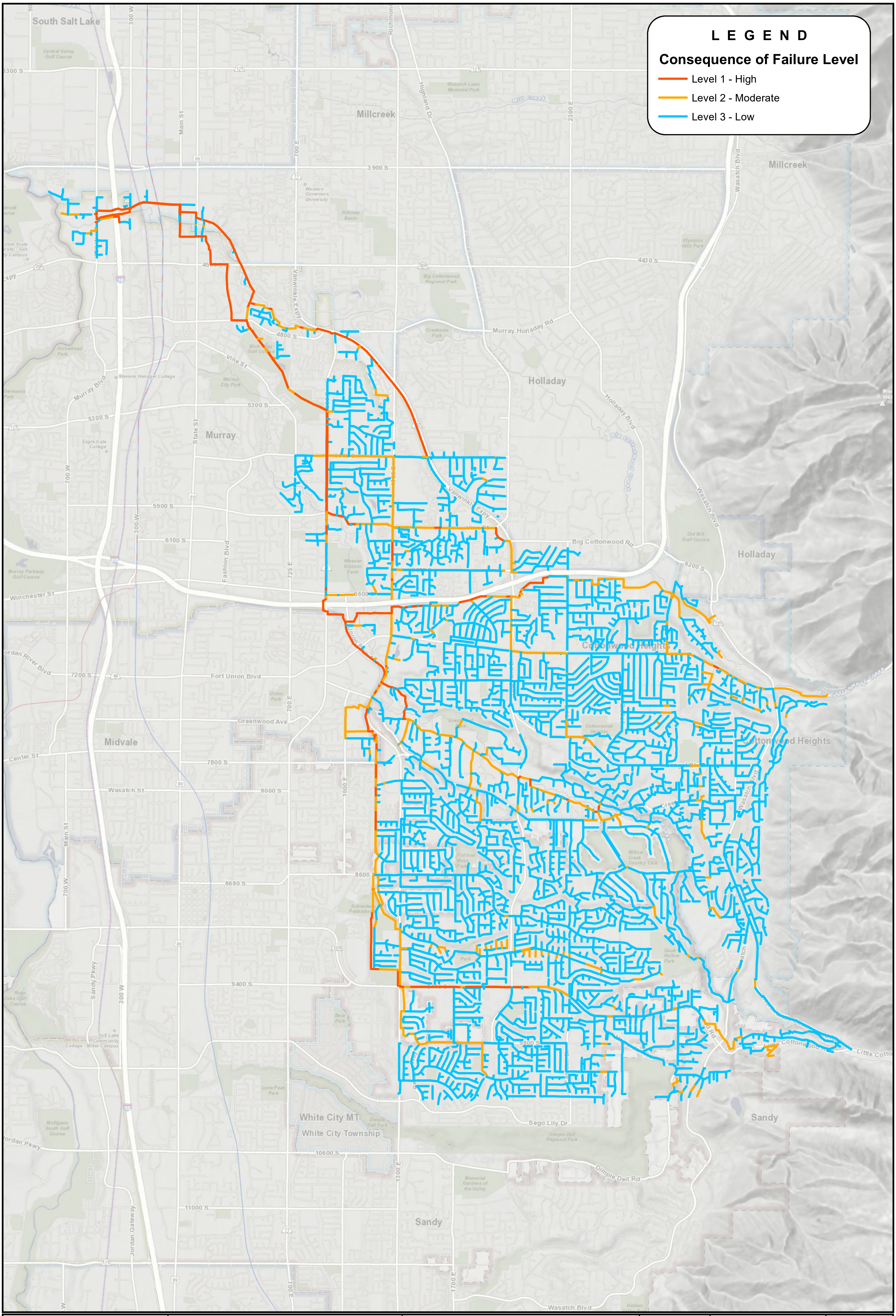
Consequence of Failure Results

Based on the proposed approach described above, ratings were developed for the pipelines in the Cottonwood Improvement District sewer collection system. For discussion purposes, the pipe ratings were divided into three levels representing increasing consequence of failure as shown in Figure 8-2. This includes Level 1, 2, and 3 ratings. The consequence of failure is relative only to the rest of the system. The top 5 percent of the pipe ratings are identified as Level 1, the highest importance of pipes in the system. The next 10 percent of the pipes have a consequence of failure Level 2. The rest of the pipes are rated Level 3 (remaining 85 percent of the system). Characteristics of each level are summarized in Table 8-3.

Table 8-3
Consequence of Failure Levels

Level	Total Length of Pipe (ft)
1 – Highest Consequence of Failure	96,941
2 – Moderate Consequence of Failure	156,228
3 – Lowest Consequence of Failure	1,389,114

Occasionally, well-intentioned policy makers desire to modify the designation of consequence of failure such that a higher portion of pipelines are included in Level 1 or Level 2. Their purpose is to make sure that all the "important" pipelines are receiving the attention they deserve. However, an important principle of asset management is that resources will always be limited. An asset management plan will only be successful if it can properly prioritize and focus its resources on the area of greatest need. In practicality, the five percent identified for Level 1 is already the upper limit of pipelines than can be focused on without overwhelming or diluting available resources.



BOWEN COLLINS & ASSOCIATES

COTTONWOOD IMPROVEMENT DISTRICT

SEWER CAPITAL FACILITIES PLAN

CONSEQUENCE OF FAILURE LEVEL

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 8-2

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PROBABILITY OF FAILURE

Probability of failure is a measurement of the potential for a resource to fail in a given year[1]. Ideally, probability of failure would be defined in terms of an actual probability (i.e. a given segment of pipe has an estimated __% chance of failure in a given year). This would allow for a statistical evaluation of each pipe which would compare the expected cost of continuing without rehabilitation verses the cost of rehabilitation. Unfortunately, estimating the actual probability of failure for a sewer pipe requires an extensive data set on pipe condition and attributes and also extensive information on historic failures that have occurred. Cottonwood Improvement District does not yet have this type of data available. It has been recommended in previous chapters that the District implement pipe condition assessment and subsequent tracking of pipe condition over time as part of this asset management plan effort; however, until this data is collected over the next several decades, the District will have to use a less detailed approach to probability of failure.

B&A would propose using the structural condition rating for each pipeline to define the probability of failure for each pipeline. As described in Chapter 7, these ratings were developed based on the PACP structural score of each pipe. While this does not assign a specific probability of failure for each pipe, it does give a general indication of the condition of each pipe. In general terms, the lower the level of service rating a pipe has, the higher its probability of failure.

- **Level of Service Grade A** – The PACP structural rating does not exceed 1.0.
- **Level of Service Grade B** – The PACP structural rating falls between 1.0 and 1.9.
- **Level of Service Grade C** – The PACP structural rating falls between 2.0 and 2.9.
- **Level of Service Grade D** – The PACP structural rating falls between 3.0 and 3.9.
- **Level of Service Grade E** – The PACP structural rating falls between 4.0 and 4.9.
- **Level of Service Grade F** – The PACP structural rating is equal to or exceeds 5.0.

Increasing Probability Of Failure

[1] The only cause of failure considered in this evaluation of probability of failure is failure based on loss of structural integrity. Other failure causes such as natural disasters, vandalism, or damage by contractors are not included in this evaluation because there is no way to predict these types of events for individual pipe segment.

CRITICALITY

Criticality is defined as the combined consideration of the consequence of failure and the probability of failure of an asset. The term criticality is often used interchangeably in asset management with the term risk. This is because criticality is used to compare the risk associated with a given asset relative to the rest of the assets in the system. Criticality is the key component used in decision making for asset management. It is the calculation of criticality that prioritizes the attention and resources of the District as they manage the collection system. The purpose of this chapter is to identify an approach to consider probability of failure and then use this to approach in the calculation of criticality for District assets.

Figure 8-3 depicts the theory of criticality. Criticality is the combined consideration of consequence of failure and probability of failure. As shown in Figure 8-3, the greater the probability of failure, and the more important a pipe is, the higher it will be ranked in criticality.

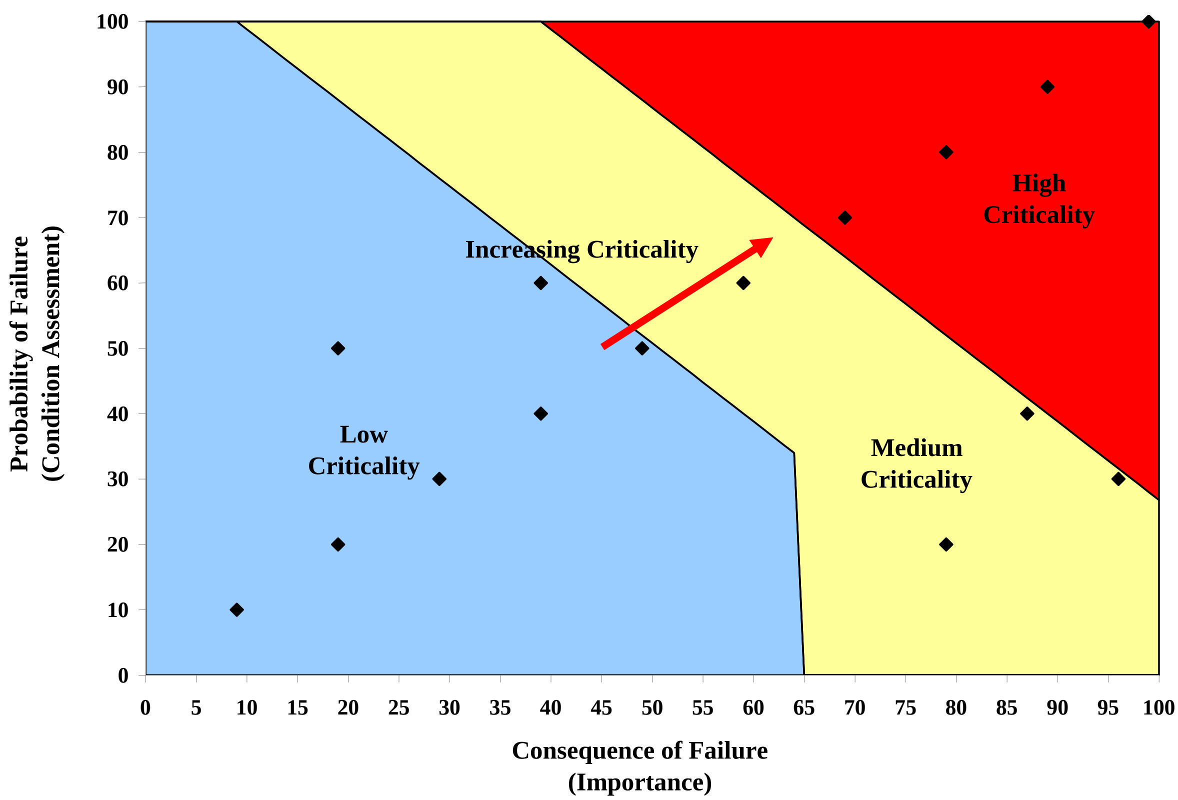


Figure 8-3: Criticality (Risk)

Criticality Analysis of Cottonwood Improvement District Assets

With probability and consequence of failure defined for each pipe segment, criticality can be calculated. Given current limitations in data, it is proposed that a criticality matrix be developed as shown in Figure 8-4. Instead of using discrete data points for probability of failure and consequence of failure, this matrix groups this information into basic level of service grades for probability of failure and consequence of failure levels. As additional information is gathered in the future, this matrix can be refined. Criticality in the matrix increases from the lower left corner to the upper right.

Increasing Probability of Failure

Structural Level of Service	**Pipe Importance Level 3** Recommended Action	**Pipe Importance Level 2** Recommended Action	**Pipe Importance Level 1** Recommended Action
F	Short Term Condition Assessment	High Priority Condition Assessment	High Priority Condition Assessment
E	Mid Term Condition Assessment	Short Term Condition Assessment	High Priority Condition Assessment
D	Short Term Inspection Schedule	Mid Term Condition Assessment	Short Term Condition Assessment
C	Mid Term Inspection Schedule	Short Term Inspection Schedule	Short Term Inspection Schedule
B	Mid Term Inspection Schedule	Mid Term Inspection Schedule	Short Term Inspection Schedule
A	Long Term Inspection Schedule	Mid Term Inspection Schedule	Short Term Inspection Schedule

Increasing Consequence of Failure

Figure 8-4: Criticality – Recommended Actions Based on Structural Rating

Included in the matrix are recommended actions based on criticality. The intent of the recommended actions is to provide guidelines for the decision-making process and focus resources on the assets which are most critical. The recommended actions include both condition assessment and regular inspection activities. Condition assessment refers to specific engineering attention and evaluation for the purpose of identifying rehabilitation needs. Regular inspection refers to the systematic, schedule CCTV inspection conducted as part of routine maintenance activities. In both cases, the recommended schedule for the time frames listed in the figure are as follows:

High Priority	0-1 year
Short Term	1-2 years
Mid Term	2-8 years
Long Term	More than 8 years

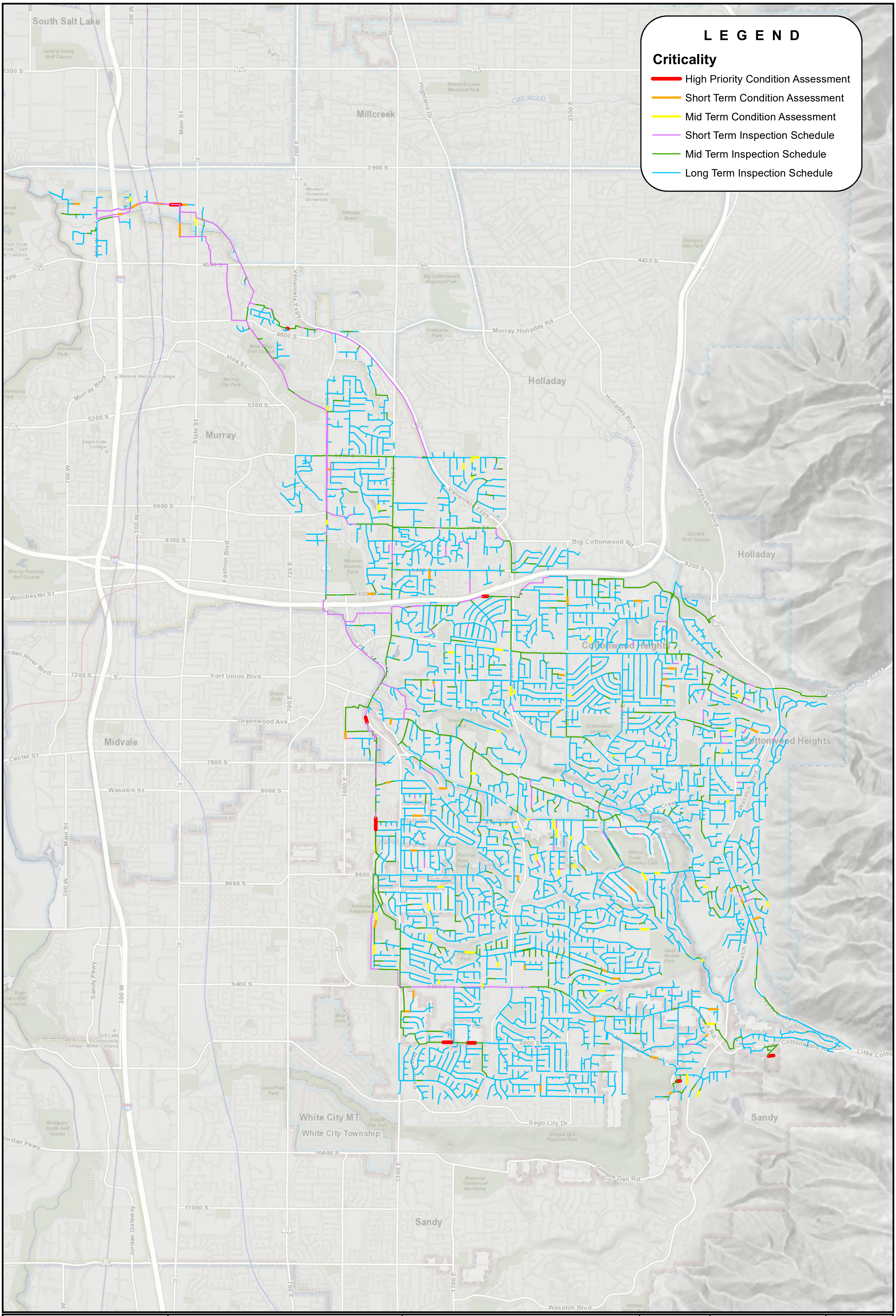
It should be noted that this matrix is only a starting point. Two things should be remembered as it is used to help develop future rehabilitation and inspection schedules:

- First, the matrix is not intended as a replacement for engineering judgment. As each pipeline is evaluated, additional issues not covered by the matrix will need to be considered by District personnel when making final rehabilitation and replacement decisions. For example, if a pipe is generally good condition, but has one isolated structural problem, its overall level of service rating may be relatively good. As a result, it may be classified as a low criticality pipeline even though the isolated problem may merit immediate attention. In these cases, it is expected that District personnel will use their judgment to increase the criticality of the pipeline and accelerate resolution of the problem. Despite this limitation, it is believed that using the matrix to augment engineering judgment will enable better asset management than relying on institutional knowledge only.

- Second, the proposed matrix has been developed using data available from a limited time period. As additional data is collected, there is significantly more analysis the District will be able to do regarding criticality. Some sewer agencies are using the criticality information and cost data to assign a cost of failure and rating the payback of inspections and other maintenance activity. This type of analysis can provide an agency with the best operation and maintenance returns on limited budget resources. It is recommended that the District review this matrix periodically to review the recommended actions and identify possible improvements to the evaluation procedure. Ultimately, the goal of the District is to adopt best practices and maximize the use of resources in addressing system management needs.

Preliminary Criticality Results

Based on the analysis and criticality matrix defined above, recommended actions for each of the pipelines in the Cottonwood Improvement District service area are shown in Figure 8-5. It should be re-emphasized that these results are based on preliminary probability of failure estimates only and that all pipes identified for condition assessment activities will need to be reexamined closely before it can be determined if rehabilitation or replacement work is merited. However, this figure provides the District with a good action plan for beginning its inspection and rehabilitation work.



BOWEN COLLINS & ASSOCIATES

COTTONWOOD IMPROVEMENT DISTRICT
SEWER CAPITAL FACILITIES PLAN

CRITICALITY

NORTH:

SCALE:
0 2,000 4,000 Feet

FIGURE NO.
8-5

P:\Cottonwood Improvement District\667-20-01 Cottonwood IFFP IFA & Rate Study\4.0 GIS\Figure 8-5 - Criticality.mxd wandersen 12/2/2021

ASSET MANAGEMENT RECOMMENDATIONS AND CONCLUSIONS

The following are recommendations and conclusions for Cottonwood Improvement District's asset management system:

- **Continue Data Collection** – It is recommended that Cottonwood Improvement District continue to gather asset management data and look for opportunities to improve the collection process. Appendix B, Appendix C, and Appendix D go into more detail on this recommendation.
- **Adequately Budget for Rehabilitation and Replacement** – It is recommended that Cottonwood Improvement District adequately budget for rehabilitation and replacement in its sewer collection system. A detailed proposal of recommended funding levels is identified in the following chapter. Funding rehabilitation and replacement at recommended levels may require increases to the District's current sewer budget and corresponding increases to sewer rates. While nobody likes to see increases in utility rates, failure to adequately fund asset management now will result in costly system failures later and much higher long-term costs for customers.

CHAPTER 9
IMPLEMENTATION PLAN

Previous chapters of this sewer master plan have identified improvements to resolve future deficiencies and to accommodate wastewater flow from future growth while providing an acceptable level of service. The purpose of this chapter is to assemble a 10-year capital improvement program to implement the recommended improvements. This plan should be updated at least every five years to re-prioritize system improvements to achieve District goals.

CAPITAL IMPROVEMENT PRIORITIZATION

A discussion of each of the major budget categories and how they will be prioritized in the 10-year implementation plan is included below:

- **Collection System Capacity Improvements** – BC&A used the growth projections discussed in Chapter 3 of this report and the existing collection system hydraulic model to determine when collection system capacity improvements are needed. Because these improvements are based on capacity needs, changes in the timing of projects more than a year or two are not generally recommended. In the case of the District, however, there are two possible issues that may alter the timing of these projects:
    - ***Growth Rates*** **–** If growth occurs at the rates projected, failure to complete the projects at the recommended dates will result in the District running out of available capacity and risking surcharging or backups in the system. However, if growth does not materialize as quickly as projected, it may be possible to postpone some of the identified projects. It is recommended that the District closely monitor growth to verify the timing of each project and adjust budgets as needed.
    - ***Wastewater Production Rates*** **–** As noted in Chapter 3, the District has observed a decrease in their flow measurements at the CVWRF metering location as a result of recent calibration activities. It is believed that the metering data better reflects actual flows and all improvement needs and timing have correspondingly be based on these flows. Because only about a year's worth of data has been collected with the recalibrated meters, it is recommended that the District continue to monitor wastewater flows over the next several years to determine if any adjustments in flow projections and corresponding project timing is merited.
- **Collection System Rehabilitation and Replacement Improvements** – A recommended long-term budget level for collection system rehabilitation improvements was developed in Chapter 8 (approximately $3.25 million/year). However, it was also noted that most of the District's system still has significantly expected life remaining and investing at this level will likely not be required for several more decades. Although the long-term amount is not needed in the near future, it is still be important to make sure that rehabilitation and replacement is adequately funded. Failure to invest in the system over time will result in system degradation and costly system failures.

  Thus, this implementation plan recommends that the District stay ahead of their rehabilitation and replacement needs by budgeting for rehabilitation or maintenance of all large diameter, Level 1 criticality concrete pipes in the system over the next 10 years. This equates to an expected rehabilitation budget need of approximately $11.6 million (i.e. an average investment of $1.16 million per year). While this is below the long-term recommended need, it is an aggressive level of funding for current needs that will help keep the District's system in excellent condition.

It should be noted that the CVWRF improvements are not specifically included in this implementation plan. This implementation plan focuses on the District's sewer collection system only. Costs associated with the CVWRF improvements should be considered as part of the District's overall rate study.

RECOMMENDED 10-YEAR CAPITAL IMPROVEMENT PLAN

Based on the system improvements identified in Chapter 6 and the overall budgeting approach discussed above, Table 9-1 lists improvement projects that are recommended within the next 10-years, the budget required to complete those projects, and the recommended timing of those projects. For budgeting purposes, capital costs for most major capital improvements have been split up into at least two years; the first year usually includes about 10% of the total project cost for design services, while future years include the remaining budget for actual construction.

Figure 9-1 summarizes the annual capital expenditures that will be required to support the recommended capital improvement plan. Expenditures have been grouped by major category for reference. As shown in the figure, rehabilitation and replacement expenditures are largely flexible and have been correspondingly budgeted to avoid years in which other large capital expenditures are budgeted.

For comparison purposes, Figure 9-1 also includes the historic level of funding available for capital improvements based on data from the District for 2009 through 2020 budgets. The average, inflation adjusted expenditures for collection system capital improvements in the District during this period was $1.2 million (2021 dollars) as shown in the figure.

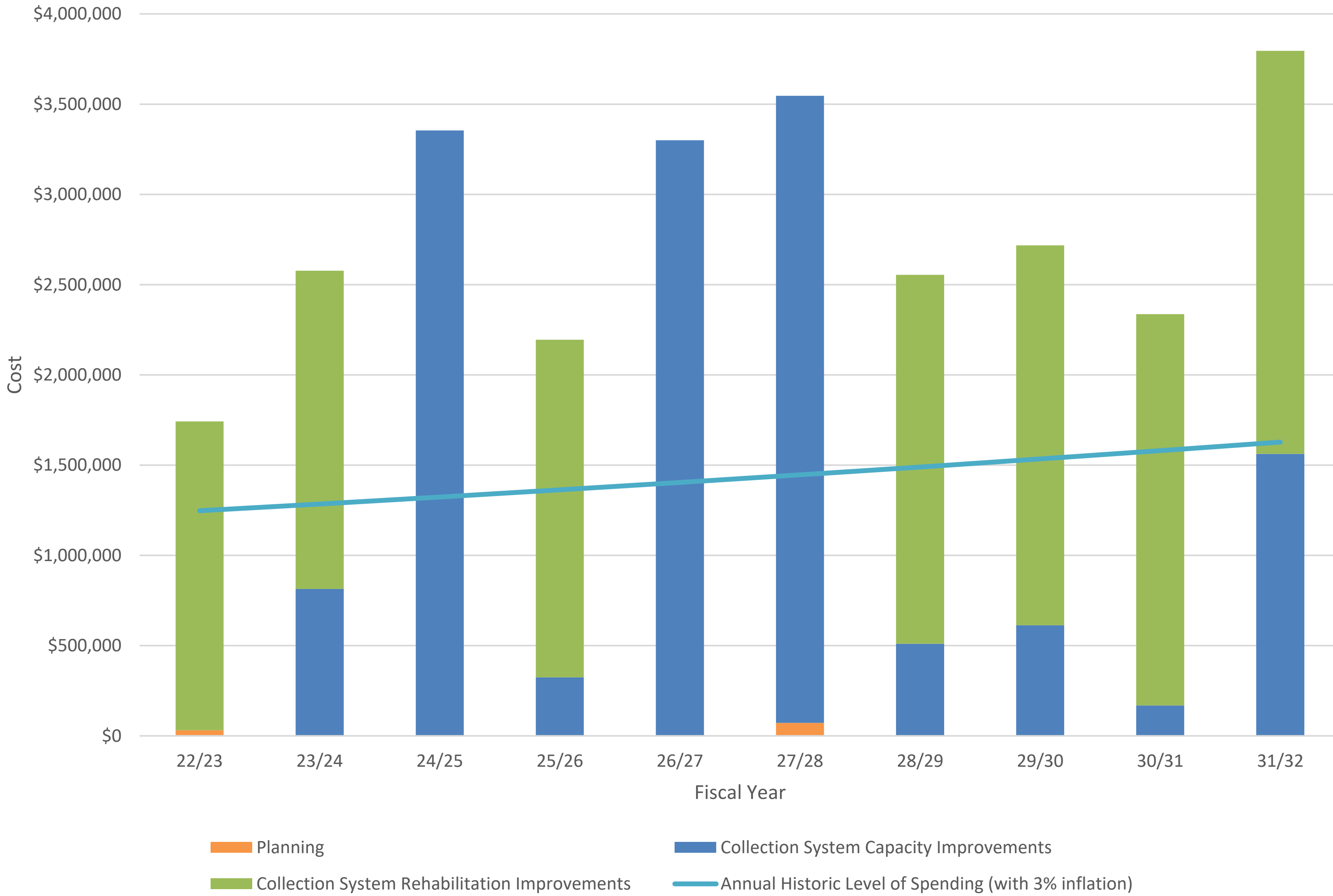
A few conclusions can be made based on Table 9-1 and Figure 9-1:

- **Short-term Level of Funding** – The District is projected to have some upcoming expenditures that will exceed its historic level of funding for capital improvements in the collection system. This is the result of both capacity and rehabilitation needs expected in the next five to ten years. To meet these projected expenditures, the District will need to increase funding levels in this area above its historic amount.
- **Long-term Level of Funding** – Even once the District addresses its short-term needs, expected future needs are projected to be higher than current funding levels. Thus, it is recommended that long-term funding be gradually increased to meet expected rehabilitation and replacement needs.

Table 9-1
Recommended 10-Year Collection System Capital Improvement Plan

Project ID	Project Name	Project Total (2020 $s)	FY 22/23	FY 23/24	FY 24/25	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30	FY 30/31	FY 31/32	10-yr Total
Collection System Capacity Improvements													
1	4800 South Atwood Blvd Upsize	$1,183,086											$0
2	Camino Real Drive Upsize	$590,717						$705,347					$705,347
3	5600 South 900 East Upsize	$2,460,931											$0
4	I-215 900 East Upsize	$3,836,808		$814,094	$3,354,067								$4,168,161
5	6720 South 1100 East Upsize	$2,881,286				$324,291	$3,006,180						$3,330,471
6	Cottonwood Pkwy Upsize	$2,231,863											$0
7	BCC Road Upsize	$434,280							$53,411	$495,120			$548,531
8	Union Park Ave 7400 South Upsize	$412,901						$49,303	$457,034				$506,337
9	7800 South 1200 East Upsize	$2,531,155					$293,430	$2,720,099					$3,013,529
10	Robidoux Road 2700 East Upsize	$92,880								$117,658			$117,658
11	Little Cottonwood Road Wasatch Blvd Upsize	$1,291,760									$168,545	$1,562,416	$1,730,962
Subtotal		***$17,947,667***	***$0***	***$814,094***	***$3,354,067***	***$324,291***	***$3,299,610***	***$3,474,748***	***$510,445***	***$612,777***	***$168,545***	***$1,562,416***	***$14,120,994***
Collection System Rehabilitation Improvements													
1	Annual Rehab and Replacement Improvements	$11,631,505	$1,711,493	$1,762,838	$0	$1,870,194	$0	$0	$2,043,612	$2,104,920	$2,168,068	$2,233,110	$13,894,235
Subtotal		***$11,631,505***	***$1,711,493***	***$1,762,838***	***$0***	***$1,870,194***	***$0***	***$0***	***$2,043,612***	***$2,104,920***	***$2,168,068***	***$2,233,110***	***$13,894,235***
Planning Costs													
1	Flow Monitoring	$30,000	$30,900										$30,900
2	Master Planning	$60,000						$71,643					$71,643
Subtotal		**$90,000**	**$30,900**	**$0**	**$0**	**$0**	**$0**	**$71,643**	**$0**	**$0**	**$0**	**$0**	**$102,543**
TOTAL		**$29,669,172**	**$1,742,393**	**$2,576,932**	**$3,354,067**	**$2,194,486**	**$3,299,610**	**$3,546,391**	**$2,554,057**	**$2,717,698**	**$2,336,613**	**$3,795,526**	**$28,117,773**

Figure 9-1
10-Year Revenue and Expenditures - Collection System Capital Improvements



RECOMMENDATIONS

Based on the analysis contained in this report and the conclusions above, the following actions are recommended:

- **Make Preparations For Future Projects Following the Proposed Implementation Plan –** The 10-year capital improvement plan summarized in Table 9-1 represents the best available assessment of District capital needs in the upcoming years. It is recommended that this plan be used for budgeting and planning purposes for the near-term.
- **Include the Updated Implementation Plan in the District's Upcoming Rate Study –** After updating the implementation plan, it should serve as the basis for the District's rate planning activities. As noted above, historic funding levels are not projected be adequate to address District needs over the next several years. The District will need to explore options for funding the recommended projects. This will likely include increasing rates, bonding for projects, or some combination of the two. It is recommended that the District include the recommended level of funding in its upcoming detailed rate study to explore their options.
- **Update this Sewer Master Plan Regularly –** This sewer master plan should be viewed as a living document. The conclusions contained herein are based on several assumptions that will assuredly change from time to time. Examples of this include assumptions associated with development patterns, regulatory requirements, economic conditions, etc. As changes occur in these areas, the conclusions and recommendations in this report may need to be revised. For this reason, it is recommended that this report be updated on a regular basis. This should be done approximately once every 5 years and more often if necessitated by a major change in the District (e.g. major new regulatory requirement, annexation of a new area, etc.)

APPENDIX A

CVWRF MEMO

TECHNICAL MEMORANDUM

TO:	Brandon Heidelberger P.E., CVWRF Justin Zollinger, CPA, CVWRF
COPIES:	File
FROM:	Keith Larson, P.E. & Andee Harris, E.I.T.
DATE:	21 December 2021
SUBJECT:	Analysis of CVWRF for Impact Fee Calculations
JOB NO.:	107-20-01

CENTRAL VALLEY WATER RECLAMATION FACILITY

INTRODUCTION

Central Valley Water Reclamation Facility (CVWRF) (Facility) currently has a contractual agreement with 7 entities which are: Cottonwood Improvement District (CID), Granger-Hunter Improvement District (GHID), Kearns Improvement District (KID), Mt. Olympus Improvement District (MOID), Murray City, South Salt Lake City, and Taylorsville-Bennion Improvement District (TBID). While the CVWRF does not charge its own impact fee, all of its member agencies do charge impact fees for the portion of capacity they own at the Facility. The purpose of this memorandum is to document information regarding CVWRF that is common to the member agencies for the purpose of allowing any individual member agency to prepare an impact fee facilities plan and/or perform an impact fee analysis.

This memorandum was originally written in October of 2020, but has been updated to reflect updated construction costs. Thus, references to growth still use 2020 as the basis for “existing” condition, but all costs are now representative of expected 2022 dollars.

CVWRF GROWTH AND CAPACITY

As detailed in the State of Utah’s Impact Fee Act, an impact fee is generally calculated by identifying the available existing and future capacity in a facility and then dividing the value of that capacity by the amount of new growth that will benefit from the unused capacity. The purpose of this section is to identify both projected growth and available capacity at the Facility.

Projected Growth

CVWRF’s average annual flows have slightly increased over the past few years, and are expected to continue increasing as its member agencies experience more growth. Recent flow data shows that CVWRF’s peak month average day flow was as high as 65.66 million gallons per day (mgd) in April of 2019. Using this value and assuming a slight increase due to recent growth since 2019, the current maximum month flow (MMF) for the plant has been estimated as 66 mgd. To project future flows, CVWRF recently completed a Facility Plan which examines expected growth in its member agencies. Projected growth identified in the facility plan identifies a future maximum month flow rate of 83.9

mgd, expected to around the year 2045. If it is assumed that growth will be roughly linear for this period, flows for the years of interest to this memorandum can be projected as summarized in Table 1. These projected flows are used as the basis for wasteload allocations associated with CVWRF's planned expansion.

Table 1: Existing and Projected CVWRF Capacity

Year	MMF (mgd)
2020	66
2030	73.2
2045	83.9

Available Capacity

It is reported in the Facility Plan that CVWRF currently has a permitted process flow capacity of 75 mgd. As shown in Table 1, flows are projected to surpass the current capacity before the end of the 25-year design horizon. Thus, the Facility has multiple expansion and rehabilitation projects planned to expand its MMF capacity to roughly 84 mgd by the year 2045.

To fairly calculate an impact fee, it is necessary to determine the percentage of the both existing facilities and future improvements that will service future users. However, this is a very difficult task in the case of CVWRF because the vast majority of the future projects proposed at the plant have multiple purposes. These project include components that expand capacity, improve level of service (e.g. improve nutrient removal capabilities), and rehabilitate aging existing infrastructure. As a result, it is extremely difficult to break costs for any single project into that portion serving existing users vs. that portion serving growth.

To avoid conflict and potential legal challenges over how a particular project was allocated, this memorandum recommends a simpler approach. Instead of trying to evaluate each individual project, it is recommended the existing facility and its proposed improvements be considered one comprehensive project to achieve a final level of service. If this approach is taken, the percent use of capacity can be simply calculated for both existing and future facilities as the percent of flow based the Facility's planned MMF expansion value of 84 mgd. The calculated percentage allocations based on this approach are shown below in Table 2.

Table 2: Percent Use of Total Design Capacity

	Existing	10 yr	Beyond 10 yr
CVWRF Assets	78.6%	8.6%	12.9%

Admittedly, this is an under representation of the true costs of serving future growth. There is most assuredly some portion of capacity for existing users that can be satisfied less expensively in the existing plant facilities than it will cost to add capacity for new users. However, using the cost allocation approach recommended here will remove any claim future development may have that cost allocation at the Facility is inequitable.

EXISTING SYSTEM COST

In order to calculate an impact fee, it is necessary to document the existing Facility's actual cost in accordance with Utah Code. Actual costs of existing facilities that will serve new development may be incorporated into the impact fee (at the proportion used to service the growth).

A complete list of CVWRF's Capital Assets was used to carefully identify which projects are and are not eligible for the impact fee (for a detailed table, refer to Appendix B-1). Facilities that cannot be included in the calculation of the fee include:

- Facilities without excess capacity available to service future growth
- Facilities with a lifespan of less than ten years (e.g. maintenance, IT, and vehicles)
- Facilities that have been/will be replaced by future projects in the 10-year planning window
- Facilities not specifically used for providing wastewater treatment services (e.g. golf course improvements).

Any facilities falling into the categories above have been removed from calculation of the impact fee. The total documented system value is shown in Table 3 along with the remaining total system value after removing non-eligible facilities.

Table 3: Existing CVWRF Value

Description	Value
Total Documented Value of CVWRF's Existing System	$326,072,303
Total Value of Non-Eligible Facilities and Facilities that have been/will be Replaced	$120,725,284
Remaining Impact Fee Eligible Total	**$205,347,019**

FUTURE SYSTEM IMPROVEMENTS

The cost of the Facility's future system improvements must also be determined in order to calculate an impact fee. The cost of CVWRF's future impact fee eligible improvements has been calculated using a recent update to the CVWRF Capital Improvement Plan (CIP) Summary (first published in 2020) which includes projects from the year 2020 to 2037 (for a detailed table, refer to Appendix B-2). Total project costs for the plan are approximately $515 million as summarized in Table 4. In order for a project to classify as eligible, the following requirements were applied:

- The project is required to maintain (but not exceed) the proposed level of service in the system.
- The project is expected to be built within ten years.
- The project is for a facility meeting the requirements of the Impact Fee Act as described above. In the case of case of CVWRF, this meant excluding projects associated with the categories of "Rolling Stock", "IT Projects", "Lab Projects", or "Maintenance Projects" in CVWRF's CIP Summary, along with a few other projects in other categories.

The total, excluded, and qualifying cost of future projects at the Facility are summarized in Table 4.

Table 4: Future CVWRF Cost

Description	Cost
Total Cost of All Projects	$515,571,226
Total Cost of Non-Eligible Projects	$53,459,836
Remaining Impact Fee Eligible Total	**$462,111,390**

BONDING AND INTEREST

CVWRF has bonded for financing over the years and plans to continue bonding for their upcoming projects. The Facility's four existing bonds are shown in Table 5 along with the total principle and interest costs (for a detailed payment schedule see Appendix B-3).

Table 5: CVWRF Existing Bonds

Bond	Principle	Interest	Total
2017A Sewer Revenue Bonds	$28,600,000	$15,400,754	$44,000,754
2017B Sewer Revenue Bonds	$3,445,000	$394,136	$3,839,136
2019A Sewer Revenue Bonds	$35,390,000	$18,955,618	$54,077,275
2020A State SRF Loan	$65,100,000	$12,387,451	$77,487,451
Total	**$132,535,000**	**$47,137,960**	**$179,404,616**

Member agencies are not required to participate in each bond. Therefore, a specific bond may or may not apply when calculating interest costs for an impact fee. This is also applicable when incorporating future bonds. CVWRF recently issued three new bonds. The amount, names, and terms of each bond are as follows:

1. 2021 A Bond - $23 million at a 1.90 percent interest rate for 20 years
2. 2021 B Bond - $25 million at a 1.99 percent interest rate for 20 years
3. 2021 C Bond - $150 million at a 2.40 percent interest rate for 25 years

IMPACT FEE IMPLICATIONS

Typically impact fee calculations are defined in terms of equivalent residential units (ERUs). However, since CVWRF provides service to multiple member agencies, each individual agency could have a varying definition of an ERU. Consequently, impact fee eligible costs in this memo will be defined in terms of gallons per day (gpd), instead of ERUs. This will then allow each individual agency to calculate their applicable cost based on their own definition of an ERU and their own expected future growth.

Percentage and price allocations for CVWRF's existing assets and future improvements are shown in Table 6 along with the calculated impact fee eligible costs defined in terms of cost/gpd.

Table 6: CVWRF Percentage and Price Allocations

	Cost	Existing	10 yr	Beyond 10 yr	Existing	10 yr	Beyond 10 yr	10 yr Growth (gpd)	$/gpd
CVWRF Existing Assets	$205,347,019	78.6%	8.6%	12.9%	$161,344,087	$17,601,173	$26,401,760	7,200,000	$2.44
CVWRF Future Projects	$462,111,390	78.6%	8.6%	12.9%	$363,087,521	$39,609,548	$59,414,322	7,200,000	$5.50
Total	$667,458,409				$524,431,607	$57,210,721	$85,816,081		$7.95

In addition to these capital costs, the member agencies may also incur interest costs associated with historical and future expected bonding. Because participation in bonding is unique for each agency, these costs will need to be calculated separately as part of individual impact fees. The same is true for the calculation of user fee credits for ongoing debt where appropriate.

While the amount of debt service to be paid by each entity can be calculated directly by looking at the payment schedule for each bond, the portion of this debt service applicable to each category is less straightforward. If all the costs at the Facility were being covered through bonding, the percentage for debt service would simply match the percentage for the Facility as a whole. However, this is not the case. In addition to bonding revenue, each entity is also contributing some portion of cash to fund the improvements. Any contributions made separate from the bonds need to be credited against existing users debt service obligation. Since each entity can make a separate decision on whether they want to pay cash or participate in each bond, the cost allocation will vary based on bond participation as well as the nature of growth and use of capacity for each entity. Because the percent allocation of debt service will need to be calculated for impact fees, Table 7 shows which bonds each individual entity is currently participating in. (For a complete payment schedule of existing bonds refer to Appendix B-3).

Table 7: CVWRF Member Agency Bond Participation

Member Agency	2017A Sewer Revenue Bonds	2017B Sewer Revenue Bonds	2019A Sewer Revenue Bonds	2020A State SRF Loan	2021 A Bond	2021 B Bond	2021 C Bond
CID	x		x	x	x	x	x
GHID	x		x	x	x	x	x
KID	x	x	x	x	x	x	x
Mt. Olympus				x	x	x	x
Murray	x		x	x	x	x	x
South Salt Lake	x		x	x	x	x	
TBID				x	x	x	x

Appendix B-1

CVWRF Capital Assets

Table B-1.1: CVWRF Capital Assets

Description	Original Cost	Impact Fee Eligible	Impact Fee Portion
SLCSSD #1 Land/facility land	$3,876,860	Yes	$3,876,860
Richards - Moench Land	$1,800,000	Yes	$1,800,000
Rss Building 1 (East)	$965,968	Yes	$965,968
SECONDARY CLARIFIER #01 Arm	$110,134	Yes	$110,134
Preliminary and Final Site Work	$1,222,226	No	0
Aeration Basin 4 (Solids Contact)	$500,000	No	0
Digester 4	$1,381,615	Yes	$1,381,615
Trickling Filter 1	$1,660,950	no	0
SECONDARY CLARIFIER #04 Drive	$40,000	No	0
Fire Management System	$436,283	No	0
SECONDARY CLARIFIER #01	$1,190,113	Yes	$1,190,113
Trickling Filter 3	$2,002,542	No	0
Filtrate East	$175,000	Yes	$175,000
Lawns, Sprinklers and other improvements	$1,963,353	No	0
Aeration Basin 3 (Solids Contact)	$500,000	No	0
Storm Pipes	$265,050	Yes	$265,050
PRIMARY CLARIFIER #6 Arm	$556,068	Yes	$556,068
Digester 5	$1,869,023	Yes	$1,869,023
PRIMARY CLARIFIER #4	$1,189,662	Yes	$1,189,662
Maint. Building	$5,239,407	No	0
PRIMARY CLARIFIER #3	$1,189,662	Yes	$1,189,662
Construction of 900 West Curb and Gutter Improvements	$99,982	No	0
SECONDARY CLARIFIER #05 Arm	$110,134	Yes	$110,134
PRIMARY CLARIFIER #2	$1,189,662	Yes	$1,189,662
Engineering	$3,992,589	No	0
Digester 3	$1,381,615	Yes	$1,381,615
Construction of 12-inch Water Line	$41,767	No	0
SECONDARY CLARIFIER #01 Drive	$40,000	No	0
Land Improvements	$5,007,502	No	0
Pump Station (For Trickling Filters 1-3)	$1,818,750	No	0
Digester Control Building (1-4)	$1,381,615	No	0
SECONDARY CLARIFIER #02 Arm	$110,134	Yes	$110,134
Supply and Installation of Railroad Spur	$153,536	No	0
PRIMARY CLARIFIER #6	$1,189,662	Yes	$1,189,662
Digester 1	$1,381,615	Yes	$1,381,615
PRIMARY CLARIFIER #2 Arm	$556,068	Yes	$556,068
Chlorine Contact Tank Aeration Blower	$49,266	No	0
RSS PUMP #05	$60,000	No	0

Aeration Basin 2 (Solids Contact)	$500,000	No	0
RSS PUMP #07	$60,000	No	0
Gravity Belt Thickener Building	$1,823,174	No	0
3W Building	$200,000	No	0
Dewatering Building	$7,540,049	No	0
Pc 1B	$1,868,817	No	0
"Electrical equipment"	$3,950,530	No	0
Truck Barn	$164,902	No	0
SECONDARY CLARIFIER #06	$1,190,113	Yes	$1,190,113
Road	$56,355	Yes	$56,355
Digester 2	$1,381,615	Yes	$1,381,615
Fencing	$37,339	Yes	$37,339
Digester Control Building (5-7)	$1,869,023	No	0
SECONDARY CLARIFIER #07 Arm	$110,134	Yes	$110,134
Power Gen Building	$9,580,522	No	0
Roughing Filters, Recirculation Pumps	$2,136,266	No	0
PRIMARY CLARIFIER #1	$1,189,662	Yes	$1,189,662
Utility Hookups	$53,653	Yes	$53,653
SECONDARY CLARIFIER #05	$1,190,113	Yes	$1,190,113
RSS PUMP #06	$60,000	No	0
SECONDARY CLARIFIER #06 Arm	$110,134	Yes	$110,134
SECONDARY CLARIFIER #03	$1,190,113	Yes	$1,190,113
Process Control and Instrumentation System	$3,819,245	No	0
PRIMARY CLARIFIER #4 Arm	$556,068	Yes	$556,068
SECONDARY CLARIFIER #03 Arm	$110,134	Yes	$110,134
Trickling Filter 2	$2,002,542	No	0
SECONDARY CLARIFIER #02 Drive	$40,000	No	0
SECONDARY CLARIFIER #04	$1,190,113	Yes	$1,190,113
Filtrate West	$175,000	Yes	$175,000
SECONDARY CLARIFIER #08	$1,190,113	Yes	$1,190,113
PRIMARY CLARIFIER #1 Arm	$556,068	Yes	$556,068
RSS PUMP #04	$60,000	No	0
West Entrance Road	$363,882	No	0
PRIMARY CLARIFIER #3 Arm	$556,068	Yes	$556,068
SECONDARY CLARIFIER #07	$1,190,113	Yes	$1,190,113
Headworks Building	$12,085,136	No	0
Landscaping/Irrigation	$804,012	No	0
SECONDARY CLARIFIER #04 Arm	$110,134	Yes	$110,134
Admin Building	$5,162,675	No	0
Aeration Basin 1 (Solids Contact)	$500,000	No	0
PRIMARY CLARIFIER #5	$1,189,662	Yes	$1,189,662

SECONDARY CLARIFIER #02	$1,190,113	Yes	$1,190,113
SECONDARY CLARIFIER #06 Drive	$40,000	No	0
PRIMARY CLARIFIER #5 Arm	$556,068	Yes	$556,068
RSS PUMP #08	$60,000	No	0
RSS PUMP #01	$60,000	No	0
Ricoh Aficio Mp 6001 Copier (Zues)	$14,994	No	0
South Salt Lake Interceptor	$2,303,166	Yes	$2,303,166
AIR HANDLER UNIT - AHU05101 (F5151)	$65,000	No	0
Ultrasonic Nebulizer	$8,750	No	0
Granger-Hunter Interceptor	$1,910,615	Yes	$1,910,615
Murray/Cottonwood Interceptor	$7,249,005	Yes	$7,249,005
1988 Load King TRAILER LOWBOY	$31,965	No	0
Won-Door Corp Land	$116,559	Yes	$116,559
Cromar Land	$228,500	Yes	$228,500
Berrett Land	$60,604	Yes	$60,604
Paulsen Land	$204,000	Yes	$204,000
Vitro Ditch	$195,638	No	0
Grit Tank	$65,293	No	0
Maintanance Storage (Boneyard Building)	$98,999	No	0
BELT FILTER PRESS #4	$350,000	No	0
BELT FILTER PRESS #5	$350,000	No	0
Incubator	$11,924	No	0
BELT FILTER PRESS #6	$350,000	No	0
CHILLER - CENTRIFUGAL	$300,000	No	0
1994 One Jet FLUSHER TRAILER	$31,000	No	0
1972 Fruehauf TANKER	$11,000	No	0
Sampler	$7,401	No	0
Snowblower	$7,999	No	0
CAD	$7,268	No	0
Deere Disc	$8,623	No	0
1995 International TRUCK BOOM	$30,623	No	0
Sludge Bins	$1,659,090	No	0
Post Areation	$1,301,044	No	0
Jail Line	$443,720	Yes	$443,720
East Concrete Pad	$538,745	Yes	$538,745
Pump Station (For Trickling Filters 5-7)	$1,500,000	no	0
Expansion Equip	$6,967,016	No	0
Aeration Basin 6 (Solids Contact)	$500,000	Yes	$500,000
PRIMARY CLARIFIER #7 Arm	$1,701,754	Yes	$1,701,754
PRIMARY CLARIFIER #7	$1,000,000	Yes	$1,000,000
Muffin Monster	$9,927	No	0

Trickling Filter 6	$1,500,000	No	0
Expansion	$13,372,806	Yes	$13,372,806
Trickling Filter 5	$1,500,000	No	0
Aeration Basin 5 (Solids Contact)	$500,000	Yes	$500,000
Trickling Filter 7	$1,500,000	No	0
PRIMARY CLARIFIER #7 Drive	$40,000	Yes	$40,000
PRIMARY CLARIFIER #8	$1,000,000	Yes	$1,000,000
PRIMARY CLARIFIER #8 Arm	$1,701,754	Yes	$1,701,754
PRIMARY CLARIFIER #8 Drive	$40,000	Yes	$40,000
PRIMARY CLARIFIER #9	$1,000,000	Yes	$1,000,000
PRIMARY CLARIFIER #9 Arm	$1,701,754	Yes	$1,701,754
PRIMARY CLARIFIER #9 Drive	$40,000	Yes	$40,000
PRIMARY CLARIFIER #10	$1,000,000	Yes	$1,000,000
PRIMARY CLARIFIER #10 Arm	$1,701,754	Yes	$1,701,754
PRIMARY CLARIFIER #10 Drive	$40,000	Yes	$40,000
New Security Gates & Camera	$230,133	No	0
1999 International DUMP TRUCK	$99,925	No	0
LOADER - JOHN DEERE 624H	$104,904	No	0
Digester 7	$6,792,378	Yes	$6,792,378
Land Improvements	$3,008,336	No	0
Digester 6	$6,792,378	Yes	$6,792,378
Sand Filter	$1,650,860	No	0
Egg Digester Equipment Building	$1,509,417	Yes	$1,509,417
2001 GMC SERVICE TRUCK (FAT ALICE)	$58,028	No	0
Grit Container	$15,075	No	0
Fence	$153,580	No	0
Golf Building	$497,471	No	0
Lab Autoclave	$6,198	No	0
Lab Distillation	$10,350	No	0
2002 J&J TRAILER	$62,910	No	0
Tay-Ben Line Re-Route	$359,845	Yes	$359,845
Cedar Valley Property - Blaine McKinney	$3,525,764	Yes	$3,525,764
Cedar Valley Property - Marvin Carson	$335,610	Yes	$335,610
ENGINE GENERATOR #05 - AT	$869,153	No	0
SECONDARY CLARIFIER #08 Drive	$40,000	Yes	$40,000
GENIE SCISSOR LIFT	$13,642	No	0
SECONDARY CLARIFIER #09 Drive	$40,000	Yes	$40,000
DUMBWAITER	$155,506	No	0
SECONDARY CLARIFIER #10 Drive	$40,000	Yes	$40,000
SECONDARY CLARIFIER #10	$2,954,118	Yes	$2,954,118
SECONDARY CLARIFIER #08 Arm	$110,134	Yes	$110,134

ELEVATOR	$155,506	No	0
ENGINE GENERATOR #03 - AT	$755,113	No	0
ENGINE GENERATOR #04 - AT	$879,230	No	0
SECONDARY CLARIFIER #09 Arm	$954,600	Yes	$954,600
SECONDARY CLARIFIER #09	$2,954,118	Yes	$2,954,118
SECONDARY CLARIFIER #10 Arm	$954,600	Yes	$954,600
Lab-Discrte Analyzer	$50,363	No	0
COMPOST COVER PLACEMENT MACHINE CPM1	$154,000	No	0
Compost Covers (13)	$60,000	No	0
Compost Covers (9)	$60,000	No	0
Compost Covers (6)	$60,000	No	0
Compost Covers (2)	$60,000	No	0
Compost Covers (5)	$60,000	No	0
Compost Covers (7)	$60,000	No	0
Compost Covers (14)	$60,000	No	0
Secondary Cat Engine	$164,026	No	0
Compost Covers (11)	$60,000	No	0
AIR HANDLER UNIT - AHU05104	$145,184	No	0
2005 CASE BACKHOE 580 SUPUVM	$235,000	No	0
JLG AERIAL LIFT PLATFORM Model 600A	$54,000	No	0
Equipment Barn	$160,882	Yes	$160,882
Flask scrubber	$6,000	No	0
Compost Covers (10)	$60,000	No	0
Compost Covers (1)	$60,000	No	0
Compost Covers (4)	$60,000	No	0
Compost Covers (3)	$60,000	No	0
Compost Covers (12)	$60,000	No	0
Compost Covers (8)	$60,000	No	0
AIR HANDLER UNIT - ACU05152	$32,000	No	0
Rss Building 2 (West)	$800,000	No	0
CHILLER - MULTI-STAGE	$236,306	Yes	$236,306
Siloxane System	$242,163	No	0
Polymer Feed	$66,419	No	0
KOMATSU LOADER Model WA500	$200,000	No	0
Network Cable	$92,505	No	0
2008 Peterbilt Tractor	$0	No	0
Scarab Barn	$150,000	Yes	$150,000
PETERSON WOODCHIP GRINDER Model 4710B	$507,609	No	0
Camera/Dvr system	$66,160	No	0
GEHL SKIDSTEER MODEL 5240	$25,076	No	0
TOYOTA ELECTRIC FORKLIFT MODEL ZFBCU30	$32,000	No	0

GEHL SKIDSTEER #2 MODEL 5240	$25,552	No	0
Sand Filter (UV)	$114,800	Yes	$114,800
2011 Peterbilt TRACTOR ROTOMIX	$117,000	No	0
Rdndnt Modbus Network	$93,553	No	0
Fence	$121,427	Yes	$121,427
MCCLOSKEY INTERNATIONAL TROMMEL MODEL 621RE	$254,750	No	0
UV Structure	$4,064,838	Yes	$4,064,838
2010 Williamsen TRAILER PUP	$42,807	No	0
2011 Ford F-150 PICKUP	$25,312	No	0
ROTOCHOPPER MODEL GO-BAGGER 250 (COMPOST BAG MACHINE)	$46,886	No	0
RYLIND ROLL-OUT BUCKET ONLY (KOMATSU LOADER MODEL WA500 BUCKET ATTACHMENT)	$33,321	No	0
2011 Rotomix machine on Peterbilt Tractor	$118,366	No	0
Dry Polymer Injection System	$71,374	Yes	$71,374
Tink - Roll Out Bucket	$26,306	No	0
Snow plow and spreader	$6,300	No	0
UV Equipment	$2,196,533	Yes	$2,196,533
SCARAB COMPOST TURNER MODEL 27X11	$464,750	No	0
TARP WINDER	$32,000	No	0
Compost Monitoring Equipment	$41,116	No	0
Solids Contact Basin upgrades	$157,600	Yes	$157,600
PICKUP WAREHOUSE - 205688EX	$26,631	No	0
New Cameras thoughout plant	$46,796	No	0
Int Rehab Granger Hunter	$444,100	Yes	$444,100
Modicon/Unity	$95,432	No	0
Road - Compost Site	$110,089	Yes	$110,089
Storage Bldg	$272,145	No	0
Tarp System	$33,964	Yes	$33,964
New Compost Camera System	$27,602	No	0
Tarp system	$33,964	No	0
2012 Toyota Tacoma	$28,845	No	0
Millcreek Stabilization	$77,290	Yes	$77,290
2010 Peterbilt Tractor/Flatbed	$0	No	0
LANDA PRESSURE WASHER - W/ TRAILER MODEL ST20	$10,404	No	0
ICP & HG Analyzer	$137,438	No	0
Digester Gas Dryer	$104,783	Yes	$104,783
Tarp Rack	$30,623	Yes	$30,623
Interceptor To Twin- Granger Hunter	$1,348,887	Yes	$1,348,887
GRAVITY BELT THICKENER #3	$96,526	Yes	$96,526
2014 Peterbilt TRACTOR	$119,656	No	0
GRAVITY BELT THICKENER #2	$96,526	Yes	$96,526

Fire monitoring computer system	$16,331	No	0
Service Air Dryer	$30,747	Yes	$30,747
GRAVITY BELT THICKENER #1	$96,526	Yes	$96,526
Backup UV Sand Filter	$111,470	Yes	$111,470
RSS East HVAC unit	$14,900	Yes	$14,900
Ion Chromatograph	$69,098	Yes	$69,098
AIR HANDLER UNIT - ACU05106	$45,250	No	0
Capacitor protection system	$50,027	No	0
Aeration Ponds	$19,364	No	0
Video Management System	$19,200	No	0
RSS East HVAC Unit Upgrades	$27,680	No	0
2014 Toyota Tacoma	$29,765	No	0
2014 Great Dane Box Trailer (40')	$9,369	No	0
Interceptor South Of 3300 South	$1,424,015	Yes	$1,424,015
2016 DODGE RAM 2500 4X4	$38,905	No	0
Replace GHID Siphon	$1,657,565	Yes	$1,657,565
Oil heater for barn	$13,690	No	0
2016 GMC PICKUP	$38,495	No	0
MMG Compressor	$18,418	Yes	$18,418
Compressed Air System	$51,950	No	0
2016 International TRACTOR	$116,692	No	0
2016 International TRACTOR	$110,472	No	0
PI Tags	$47,512	No	0
PI Archive - Coresight System	$14,140	No	0
Vulcan Housing	$14,330	No	0
Rotomix conveyor add-on	$67,080	No	0
Server	$19,476	No	0
Vehicle Gate Access-south gate	$10,308	No	0
Sound system for board room	$21,412	No	0
Roll Out Bucket for LOADER18 (John Deere)	$27,855	No	0
Toyota electric Forklift model 8Fbcu32	$37,069	No	0
2016 Spec Tec Trailer	$83,600	No	0
2016 Spec Tec Trailer	$87,250	No	0
2016 Cogen Construction	$800,759	Yes	$800,759
2016 Spec Tec Trailer	$82,049	No	0
Secondary Clarifier Drive Rebuild #5	$42,400	Yes	$42,400
PRIMARY CLARIFIER #5 Drive - Complete Rebuild	$42,535	Yes	$42,535
Gas Chromatograph	$132,575	Yes	$132,575
GHID Siphon Structure And Meter Sulfide	$238,756	Yes	$238,756
Flow Stations New Radio Frequency Dial	$84,046	No	0
2017 Toyota Tacoma	$34,254	No	0

Refrigerated Centrifuge	$10,137	Yes	$10,137
2017 Toyota Tacoma	$33,071	No	0
PRIMARY CLARIFIER #2 Drive - Complete Rebuild	$41,673	Yes	$41,673
PRIMARY CLARIFIER #1 Drive - Complete Rebuild	$41,673	Yes	$41,673
Secondary Clarifier Drive Rebuild #3	$42,400	Yes	$42,400
Cogen Replacement	$607,025	Yes	$607,025
Admin Building Access Control	$51,528	No	0
RSS PUMP #02	$59,330	Yes	$59,330
Cyber Security Upgrades	$62,962	No	0
VERMEER VACUUM TRAILER MODEL VX50-500	$70,796	No	0
Wireless Network Upgrade	$20,339	No	0
Backup Servers	$15,670	No	0
2017 Cogen Construction	$5,438,213	Yes	$5,438,213
Secondary Clarifier Drive #6 Rebuild	$44,285	No	0
2017 Odor Control Design	$63,748	Yes	$63,748
2017 Engine Replacement	$181,261	Yes	$181,261
2017 Nutrient Removal	$1,061,987	Yes	$1,061,987
2017 Digester Gas Piping System	$185,372	Yes	$185,372
2017 Secondary Clarifiers 11 & 12	$165,676	Yes	$165,676
Master Control Conduit Bucket	$41,937	Yes	$41,937
PRIMARY CLARIFIER #4 Drive - Complete Rebuild	$41,310	Yes	$41,310
PRIMARY CLARIFIER #3 Drive - Complete Rebuild	$53,215	Yes	$53,215
Secondary Clarifier Drive Rebuild #7	$42,400	Yes	$42,400
Cottonwood/Murray Slip Lining Project	$5,406	Yes	$5,406
Cottonwood/Murray Slip Lining Project	$1,807,339	Yes	$1,807,339
JOHN DEERE WHEEL LOADER MODEL 844K-III	$440,000	No	0
AIR HANDLER UNIT - ACU05150	$52,508	No	0
Spitfire Dying Machine	$16,150	No	0
West Gate and Camera system	$10,303	No	0
SST Cabinet - Headworks	$28,000	Yes	$28,000
2018 Chevrolet 2500 HD 4x4 truck	$37,112	No	0
Absorption Chiller	$35,760	Yes	$35,760
Absorption Chiller	$35,760	Yes	$35,760
Absorption Chiller	$35,760	Yes	$35,760
Network switches upgrade	$107,588	No	0
ifix keys	$14,268	No	0
GBT Cameras	$43,483	No	0
Voice over IP system (VOIP)	$53,868	No	0
Alteryx - new data analyticas software	$5,195	No	0
Orion weather system	$7,536	No	0
Wireless network upgrade	$33,384	No	0

Fuel Tanks	$189,282	Yes	$189,282
LIMS System (5 years)	$71,642	No	0
PRIMARY CLARIFIER #6 Drive - Complete Rebuild	$48,641	No	0
Nexgen Software	$359,037	No	0
Handrails 0-11/30/2017	$24,316	No	0
UPS System - UV	$33,730	No	0
Compost PLC	$13,857	No	0
Nexgen Software	$106,902	No	0
UPS System - RSS West	$33,730	No	0
UPS System - GBT	$33,730	No	0
2013 Grove RT-540E Crane	$274,100	No	0
2018 UV Structure Add-on	$7,500	Yes	$7,500
2018 Headworks Automatic Transfer Switch	$87,547	Yes	$87,547
Fuel Tanks, Stairs, & Grating	$24,891	No	0
2017 UV Structure add-on	$53,410	Yes	$53,410
XLIMS Lab Software	$7,534	No	0
Plant Security Cameras and System	$48,923	No	0
Rotocut Chopper 1	$19,125	No	0
2018 Toyota Tacoma SR5	$30,831	No	0
Rotocut Chopper 2	$19,125	No	0
Rotocut chopper 2	$49,463	No	0
Rotocut Chopper 1	$49,463	No	0
2018 Dodge Ram 2500	$38,102	No	0
2018 JLG Telehandler Model 1055	$148,780	No	0
Plant Process Control Network	$157,041	No	0
2018 Backup Server	$7,899	No	0
2018 Cogen Automatic Transfer Switch	$364,660	Yes	$364,660
2018 Backup Server	$7,899	No	0
2018 Dual Core Heat Exchangers	$119,628	Yes	$119,628
2018 MCC Buckets (Power Gen Building)	$30,536	Yes	$30,536
AQ400 Discrete Analyzer	$56,485	No	0
2018 Spector 38ft Push Trailer	$86,751	No	0
2019 International Tractor	$136,907	No	0
2018 Headworks Generators	$9,022	Yes	$9,022
2018 Biogas H2S Removal System	$396,679	Yes	$396,679
2018 Biogas Siloxane Removal System	$537,464	Yes	$537,464
2018 Chillers Air-Glycol	$115,670	Yes	$115,670
2018 Cogen Construction	$2,577,056	Yes	$2,577,056
2018 Odor Control Construction	$759,504	Yes	$759,504
2018 Nutrient Removal	$3,937,549	Yes	$3,937,549
2018 Secondary Clarifier 11 & 12	$5,579,015	Yes	$5,579,015

2018 3W Pump & Cooling Station	$403,848	Yes	$403,848
2018 Digester Gas Piping System	$1,362,740	Yes	$1,362,740
2018 Digester Mixing Systems #1, 2, 4	$21,660	Yes	$21,660
2018 Septage Receiving Software	$49,748	No	0
2018 Primary & Secondary Clarifiers Launders & Weirs #1 & #7	$138,606	Yes	$138,606
2018 Engine Replacement	$2,344,860	Yes	$2,344,860
2018 UV #2 Pass Equipment	$51,678	No	0
New Tunnel Doors	$10,979	No	0
Tyler Incode Software	$153,997	No	0
Power Gen ATS	$67,959	Yes	$67,959
Power Gen Breaker Feeders	$118,821	Yes	$118,821
2018 CHEVROLET SILVERADO 2500	$38,235	No	0
2018 International Roll-off Truck	$167,601	No	0
2019 Flo-Dar Equipment	$14,114	No	0
2019 Gas Flare System	$25,301	Yes	$25,301
2019 IFIX Primary Server	$10,914	No	0
2019 IFIX Secondary Server	$10,914	No	0
2019 Unity Server	$10,914	No	0
2019 Becker Server Primary	$5,338	No	0
2019 Becker Server Primary	$5,338	No	0
2019 Genie Runabout lift	$13,003	No	0
2019 Mini Excavator E35 ZTS	$50,161	No	0
2019 International Dump Truck	$181,695	No	0
2019 Toyota Tacoma	$31,600	No	0
2019 Video Server	$6,337	No	0
2019 Video Server	$6,337	No	0
2019 Video Server	$6,337	No	0
2019 Genetec Video Platform & Access Control Badges	$38,889	No	0
2019 Roll-off Bin	$8,950	No	0
2019 Hyster Forklift	$50,315	No	0
2019 Genetec Video Access Platform	$35,119	No	0
2019 Modicon OPC Server Software	$10,469	No	0
Absorption Chiller	$175,644	Yes	$175,644
2019 Def Fueling Station	$33,428	Yes	$33,428
2020 PJ Dump Trailer	$10,445	No	0
2019 PJ Dump Trailer	$10,445	No	0
2019 Dry Polymer Feed System & Control System	$6,020	No	0
2019 Secondary Clarifier Motor #8 (Rebuild)	$44,620	Yes	$44,620
2019 Cisco Video Network	$143,424	No	0
2019 Steam Scrubber Dishwasher	$9,647	No	0
2019 M580 PLC UV	$51,387	Yes	$51,387

2019 Primary Clarifier #3 Launders	$113,247	Yes	$113,247
2019 Maintenance Metal Building Expansion	$238,984	No	0
2019 On Point Server	$14,886	No	0
2019 Secondary Clarifier #2 Launders	$124,182	Yes	$124,182
2007 Madvac Street Sweeper	$24,896	No	0
2019 Power Gen Elevator Rebuild	$91,160	Yes	$91,160
2019 Process Lore Server	$13,525	No	0
2019 Corporate Lore Server	$13,525	No	0
2019 South Interconnection	$863,561	Yes	$863,561
Murray/Cottonwood Slip Lining	$2,894,204	Yes	$2,894,204
2013 John Deere 624K Loader	$157,484	No	0
2019 Headworks HVAC Replacement & Design	$96,988	Yes	$96,988
2019 Maintenance Building HVAC Replacments	$14,400	No	0
2019 Mitsubishi 1100 UPS	$32,460	No	0
2019 Misubishi 1100 UPS	$32,460	No	0
2019 Tunnel HVAC Replacement	$22,750	Yes	$22,750
2019 Food Waste Receiving Station	$243,807	Yes	$243,807
2019 Headworks Backup Generator	$644,518	Yes	$644,518
2019 Chillers Air-Glycol	$74,812	Yes	$74,812
2019 Nutrient Removal	$8,043,201	Yes	$8,043,201
2019 Biogas H2S Removal System	$112,216	Yes	$112,216
2019 Power Gen Seismic	$142,626	Yes	$142,626
2019 Primary Clarifier #4 Launders	$205,171	Yes	$205,171
2019 Cogen Engine Replacement	$2,410,553	Yes	$2,410,553
2019 Cogen Tunnel & Utility Relocation	$1,524,413	Yes	$1,524,413
2019 Digester Gas Management	$1,797,393	Yes	$1,797,393
2019 Secondary Clarifiers 11 & 12	$2,824,206	Yes	$2,824,206
2019 Odor Control Construction	$2,878,059	Yes	$2,878,059
2019 SCADA Upgrades	$290,504	No	0
2019 3W Pump & Cooling Station	$1,207,338	Yes	$1,207,338
2019 Headworks Screening & Grit System	$768,741	Yes	$768,741
2019 South Salt Lake Force Main	$507,672	Yes	$507,672
2019 Digester 4 Mixing Systems	$279,055	Yes	$279,055
2019 Cogen Construction	$374,405	Yes	$374,405
2019 Centrifugal Chiller	$275,635	Yes	$275,635
2019 Admin Building Seismic	$31,176	No	0
2019 UV Pass #2 Equipment	$663,315	Yes	$663,315
Hydromantis Software	$29,920	No	0
2019 Kobota Tractor	$18,952	No	0
2019 Sidestream Phosphurous	$20,000	Yes	$20,000
2019 Sidestream Nitrogen	$20,000	Yes	$20,000

2019 Seeq Server	$8,252	No	0
2019 Hyper-V Server	$10,566	No	0
2019 Seeq Software	$11,400	No	0
2019 Plant Security Cameras and System	$50,488	No	0
2019 M580 PLC Headworks	$148,840	Yes	$148,840
GHID Slip Lining	$1,777,784	Yes	$1,777,784
Blend Tank Rebuild	$1,173,448	Yes	$1,173,448
Equal Tank Rebuild	$1,173,448	Yes	$1,173,448
Influent Box Culvert	$3,738,228	Yes	$3,738,228
2019 Office Trailer	$115,452	No	0
2019 Restroom Trailer	$135,998	No	0
2019 Blower Building	$388,146	Yes	$388,146
2019 Secondary Clarifier #1 Launders	$124,157	Yes	$124,157
2019 Primary Clarifier #5 Launders	$119,876	Yes	$119,876
2020 Chevy Silverado 2500 Diesel	$50,467	No	0
2020 Hyper-V Server	$22,239	No	0
2020 Hyper-V Server	$22,238	No	0
2020 Modicon Power Gen MCC Controller	$4,410	No	0
2020 South Interconnection	$53,938	Yes	$53,938
2020 Primary Clarifier #4 Launders	$33,096	Yes	$33,096
2020 Johnson Control IFI Workstation	$35,626	No	0
2020 Headworks Backup Generator	$4,531	Yes	$4,531
2020 Cisco Video Network	$33,805	No	0
2020 Secondary Clarifier #9 Launders	$900	Yes	$900
2020 Digester 4 Mixing Systems	$68,786	Yes	$68,786
2020 Muffle Furnace	$10,652	No	0
2020 Natural Gas Storage Trailer	$31,035	No	0
2021 International Truck	$159,916	No	0
2020 Flask Scrubber	$10,910	No	0
2020 Plant Security Cameras and System	$59,808	No	0
2020 Primary Sludge Line Replacement	$52,498	Yes	$52,498
2020 Centrifugal Chiller	$57,020	Yes	$57,020
2020 Cisco Firewall	$83,082	No	0
2020 Sludge Bin Load Cells	$45,455	Yes	$45,455
2020 Roll-off Bin	$6,060	No	0
2020 Roll-off Bin	$6,060	No	0
2020 Toyota Tacoma TRD Double Cab	$33,759	No	0
2020 Toyota Tacoma Access Cab	$28,497	No	0
2020 Dingo Walk Behind Loader	$23,131	No	0
2020 UV Pass #2 Equipment	$201,897	Yes	$201,897
2020 Secondary Clarifier #1 Launders	$26,551	Yes	$26,551

2020 Secondary Clarifier #2 Launders	$26,551	Yes	$26,551
2020 Headworks System Controls	$9,629	Yes	$9,629
2020 3 Water & Pump Building System Controls	$5,156	Yes	$5,156
2020 Cogen System Controls	$47,030	Yes	$47,030
2020 Fuel Trailer	$19,807	No	0
2020 Digester #3 Lid	$685,130	Yes	$685,130
2020 Fire Alarm System	$76,135	Yes	$76,135
2020 UV Forbay & Afterbay Mixing System	$86,428	Yes	$86,428
2020 SCADA Upgrades	$53,520	No	0
2020 Murray/Cottonwood Siphon	$84,854	Yes	$84,854
2020 3 Water & Pump Building	$5,268,776	Yes	$5,268,776
2020 BNR Construction	$3,080,045	Yes	$3,080,045
2020 Blower Building	$3,730,811	Yes	$3,730,811
2020 Sidestream Phosphorus	$550,590	Yes	$550,590
2020 Sidestream Nitrogen	$303,911	Yes	$303,911
2020 Thickening Building	$686,243	Yes	$686,243
2020 Secondary Clarifier #4 Launders	$220,471	Yes	$220,471
2020 South Salt Lake Force Main	$1,377,189	Yes	$1,377,189
2020 Odor Control Construction	$386,904	Yes	$386,904
2020 Secondary Clarifiers 11 & 12	$241,209	Yes	$241,209
2020 Headworks Bar Screens and Screw Conveyers	$2,408,477	Yes	$2,408,477
2020 Power Gen Elevator Rebuild	$82,044	Yes	$82,044
2020 Headworks Switch Gear 5KV	$21,759	Yes	$21,759
2020 Cogen Engine Replacement	$2,102,920	Yes	$2,102,920
2020 Digester Gas Management	$162,666	Yes	$162,666
2020 Trash Pump	$90,548	Yes	$90,548
Total	**$326,072,303**		**$205,347,019**

Appendix B-2

CVWRF Capital Improvement Plan

Table B-2.1: CVWRF CIP

Project ID	Project Name	Project Total	Impact Fee Eligible	Eligible Project Cost
I. Collection System/Field Projects				
FLD01	Cottonwood Murray (South of 3300 S) Sliplining	$0	No	$0
FLD02	South Salt Lake Force Main (Interceptor) Rehabilitation/Replacement (New Lining 2021)	$1,682,522	Yes	$1,450,000
FLD03	Influent Box Channel (Rehab, Gates, Vent)	$0	No	$0
FLD04	GHID Siphon Lining/Rehabilitation	$0	No	$0
FLD05	Influent Bypass Box and Vitro Ditch Piping Lining/Rehabilitation	$2,907,450	Yes	$0
FLD08	Big Cottonwood Creek Siphon/Inlet Box Rehab and Tunnel Filtrate Line CIPP Lining, GH Vent	$2,402,000	Yes	$2,402,000
FLD09	Lid/Gates for GH Siphon Inlet	$100,000	Yes	$100,000
A. Liquid Treatment Process Projects				
LTP01A	Maintenance Building HVAC Upgrades	$1,665,000	Yes	$1,665,000
LTP02B	Maintenance Building Seismic Upgrades	$1,450,000	Yes	$1,450,000
	UV HVAC Replacment	$106,250	Yes	$106,250
LTP01E	Digester Buildings HVAC Upgrades	$500,000	Yes	$500,000
LTP01F	Tunnel and Misc. Building HVAC Upgrades	$1,590,000	Yes	$1,590,000
LTP02G	Tunnel and Misc. Building Seismic Upgrades	$825,000	Yes	$825,000
LTP02E	East & West Digester Control Buildings Seismic Upgrades	$1,400,000	Yes	$1,400,000
LTP02F	Headworks Channels/Grit Tanks/Primary Influent Channel Rehab and Lining	$1,050,000	Yes	$1,050,000
LTP05	Headworks Screenings and Grit System Replacement (CC10C)	$18,220,440	Yes	$17,409,815
LTP11	Primary & Secondary Clarifier Launder Replacement	$3,953,079	Yes	$3,165,579
LTP12	New RAS Pumps 1-8	$1,415,000	Yes	$1,235,000
LTP14	Rebuild Primary Clarifier Drives 7-10	$228,300	Yes	$228,300
LTP15	Rebuild Secondary Clarifier Drives	$208,000	No	$0
LTP16	Secondary Clarifier No. 1-8 Gate Repair/Replacement (8 units)	$205,800	Yes	$205,800
LTP17	3W/Cooling Pump Station, Hypochlorite System, Reuse Filters	$34,504,440	Yes	$30,454,440
LTP21	UV Pass No. 2 Equipment	$210,000	No	$0
LTP23	Headworks, Fermentors, Sludge Thickening Odor Control	$550,000	Yes	$550,000
LTP25	New Influent Pumps	$3,599,260	Yes	$1,199,260
LTP07	Influent Pump Right Angle Gear Drive Rebuild and new impeller	$382,450	Yes	$314,200
LTP27	UV Equipment Replacement	$4,764,375	Yes	$0
LTP28	UV Building Screen Replacement	$367,500	Yes	$367,500
LTP29	Aeration Basin Diffuser Replacement	$2,100,000	No	$0
LTP32	UV Forbay and Afterbay Mixing	$239,000	Yes	$239,000
LTP34	Headworks Area Piping Replacement	$86,800	Yes	$86,800
LTP23	Odor Control Buildout	$285,000	Yes	$285,000

	Admin Building Improvements & Expansion	$0	Yes	$0
CV16-2020	Dumpster Veyor	$23,000	Yes	$23,000
	Deep Sump Cover and Safety System	$50,000	Yes	$50,000
B. Biosolids Treatment and Disposal Projects				
BTD06	Digester No. 6-7 Mixing Pump Replacement	$579,461	Yes	$329,461
BTD07	Sludge Cake and Polymer Pump Rebuild	$175,000	Yes	$0
BTD08	New Dry Polymer Feed System/Upgrade Controls Existing System	$52,500	No	$0
BTD09	Refurbish Filtrate Tanks	$1,000,000	Yes	$1,000,000
BTD10	Refurbish Equalization and Blend Tanks	$550,000	No	$0
BTD11	Compost Covers (six)	$750,883	Yes	$675,883
BTD13	Digester 1-5 Mixing Systems Replacement (Vaughn Jet Mixing)	$2,208,364	Yes	$2,040,864
BTD 14	Digester 1-5 Cover Replacement	$17,021,125	Yes	$17,021,125
BTD 15	Replace Dewatering Seismic, Ventilation, Sludge Silo, and Equipment	$31,100,000	Yes	$31,100,000
BTD03	Egg Shaped Digester Recoating / New Exterior Sheathing (2)	$4,350,000	Yes	$4,350,000
BTD17	Primary sludge line replacement	$85,000	Yes	$85,000
BTD18	Roll Off Bins	$31,620	Yes	$31,620
	Sludge Drainage Pond Lining	$0	No	$0
BTD19	BFP Sludge Pump	$100,000	Yes	$100,000
	Contingency	$3,817,025		$0
C. Energy Management Projects				
EM04	Rebuild Transformers (every 5 years)	$354,636	Yes	$215,988
EM06	New Jenbacher Future Projects (Total Overhaul)	$3,000,000	Yes	$750,000
EM07	New Jenbacher Future Projects (Top end rebuild)	$1,000,000	Yes	$1,000,000
EM14	Cogen System Upgrades (Gas Treatment, Engine 1 &2 Replacement, Cooling System Replacement)	$6,561,600	Yes	$5,736,600
EM15	Heat Loop Circulation Pump Replacement (2 units)	$0	No	$0
EM16	Centrifugal Chiller and 3-stage Chiller Replacement	$797,000	Yes	$429,500
EM18	Aeration and Channel Blower Replacement	$0	Yes	$0
EM19	Air Compressor Replacement	$426,300	No	$0
EM21	Cathodic Protection Replacement	$850,000	Yes	$850,000
EM-M	Hydropneumatic Tank Replacement	$200,000	Yes	$200,000
EM22	Headworks 5KV Switchgear Replacement	$1,462,600	Yes	$1,462,600
EM23	Headworks Backup Generator (2 New 4160 V)	$0	No	$0
EM10	Power Gen. Swamp Coolers Replacement	$0	No	$0
EM24	NG Storage Trailer for PreChamber	$203,500	Yes	$203,500
EM25	Air Gap Tank Replacement	$50,000	Yes	$50,000
EM26	Plant Wide Load Shed	$297,965	Yes	$297,965
D. General Facilities and Grounds Projects				
GFG03	Fire Protection System Changeout	$574,350	Yes	$574,350

GFG03	Power Gen	$700,000	Yes	$700,000
	Headworks	$350,000	Yes	$350,000
	3 Water	$80,000	Yes	$80,000
	Blower Building	$455,000	Yes	$455,000
	Maintenance	$300,000	Yes	$300,000
	Sidestream Phosphorous	$75,000	Yes	$75,000
	Filtrate Building	$25,000	Yes	$25,000
	Sidestream Nitrogen	$75,000	Yes	$75,000
	RAS/WAS	$130,000	Yes	$130,000
	Strainer Bldg	$350,000	Yes	$350,000
	RAS/WAS Selector Electrical (BNR)	$60,000	Yes	$60,000
	Area 16 EB (BNR)	$75,000	Yes	$75,000
	Admin Building	$150,000	Yes	$150,000
	Dewatering	$500,000	Yes	$500,000
	UV Building	$105,000	Yes	$105,000
GFG05	Secondary Clarifiers Gearbox Rebuild (2 units)	$0	No	$0
GFG06	Metal Building Expansion	$223,650	No	$0
GFG07	Metal Building Rehab	$456,750	Yes	$456,750
GFG08	Blowdown Pond Improvement and Sealing	$374,850	Yes	$374,850
GFG10	Underground fuel storage tank removal	$0	No	$0
GFG11	Power Gen Elevator	$249,000	Yes	$149,000
GFG12	Tunnel Filtrate Line CIPP Lining	$0	No	$0
GFG13	DEF Fueling Station	$25,000	No	$0
GFG15	Shower and Eye Wash Tempering	$154,545	Yes	$154,545
LTP02D	Admin Building Seismic Upgrades	$1,200,000	Yes	$1,200,000
GFG16	Admin Building Roof/HVAC units	$400,000	Yes	$400,000
GFG17	Security Fencing & Gate Upgrades Around Plant	$210,000	Yes	$210,000
GFG18	Additional Diesel Storage Tank	$150,000	Yes	$150,000
GFG19	Electrical Conduit Bending Equipment	$8,000	Yes	$8,000
GFG20	Pretreatment Ice Machine	$6,000	No	$0
GFG21	Pretreatment Sampling Equipment	$13,900	No	$0
GFG22	Safety Gantry Equipment	$10,000	No	$0
GFG23	Natural Gas Meter Relocation	$670,000	Yes	$670,000
GFG24	Landa Pressure Washers	$82,500	No	$0
	Headworks Bridge Crane	$0	No	$0
	Headworks Overhead Crane (2)	$0	No	$0
	Maintenance Building Crane	$0	No	$0
	Maintenance Building Roof	$0	No	$0
	Dewatering Building Roof	$0	No	$0
	Digester Building Roofs	$0	No	$0
	GBT Building Roof	$0	No	$0
	Ras Building Roof	$0	No	$0
	Taco Building Roofs	$0	No	$0
	Power Gen Building Roof	$0	No	$0
E. Rolling Stock				
RS01	Compost Rotomix Conveyor (for Existing Truck)	$165,900	No	$0
RS02	New Compost Rotomix and Truck	$670,950	No	$0
RS03	Scarab Compost Turner	$1,096,200	No	$0
RS04	Tarp Winder	$274,050	No	$0
RS05	Compost Screen	$617,400	No	$0
RS06	Wood Chipper	$1,637,150	No	$0

RS07	Sludge Trucks and Trailers	$1,931,720	No	$0
RS08	Grit/Screenings Truck and Roll Off Dumpsters	$687,750	No	$0
RS09	Scissor Lift/Boom Lift	$257,250	No	$0
RS10	Fork Lift	$236,950	No	$0
RS11	Boom Truck/Crane	$562,500	No	$0
RS12	10 Wheel Dump	$727,650	No	$0
RS13	Engineering/Field Services Pickup	$0	No	$0
RS14	Pretreatment Sampling Vehicle	$899,145	No	$0
RS15	Front End Loader	$1,796,000	No	$0
RS16	Operations and Maintenance Pickups	$1,101,127	No	$0
RS17	Mini Excavator	$105,000	No	$0
RS18	Large telehandler lift	$225,000	No	$0
RS19	Trash Pump	$100,000	No	$0
RS20	Dingo Skid Steer	$23,155	No	$0
CV17 - 2020	Fuel Trailer	$19,000	No	$0
CV18 - 2020		$0	No	$0
RS21	Skid steer loader	$115,000	No	$0
RS22	Spider Crane	$65,000	No	$0
RS23	John Deere Roll Off Bucket	$37,000	No	$0
F. IT Projects				
IT05	Asset Management Software and Setup	$651,000	No	$0
IT06	Phone VOIP Replacement	$95,550	No	$0
IT07	Flow Stations - New Radio Frequency (digital)	$198,450	No	$0
IT10	Color Copier/Scanner	$35,700	No	$0
IT12	Endura VMS (Video Management System)	$159,600	No	$0
IT13	Fiber Network Upgrades	$0	No	$0
IT15	Electronic O&Ms	$78,750	No	$0
IT16	SCADA/PLC Changeout and Upgrades	$4,670,830	No	$0
IT 19	Control Room Console Equipment and Screen Replacement	$393,750	No	$0
IT 20	IT Server Replacement Rotation	$193,948	No	$0
IT 21	Plant Gates	$210,000	No	$0
IT 22	UV Channel Power Distributions Units	$437,000	No	$0
IT 23	Operator Logbook replacement	$50,000	No	$0
IT 24	PLC M580 Change Out Headworks/UV	$100,000	No	$0
IT 25	Pretreatment IUMS Software	$50,000	No	$0
IT 26	HR Software	$82,100	No	$0
IT 27	Septage Receiving Station	$103,000	No	$0
IT 28	PI Tags	$40,000	No	$0
IT 29	New Process Control Network HLS	$0	No	$0
IT 30	Admin & Headworks & PowerGen Roof Cameras	$92,000	No	$0
IT 31	Firewall Upgrade	$90,000	No	$0
IT 32	Hach/Wims (Engineering)	$50,000	No	$0
G. Lab Projects				
LAB01	GC/MS System	$411,600	No	$0
LAB02	LIMS System	$247,450	No	$0
LAB03	Discrete Analyzer	$112,350	No	$0
LAB04	LC/MS System	$446,250	No	$0
LAB05	Flask Scrubber Washer	$55,656	No	$0
LAB06	Muffle Furnace	$56,450	No	$0
LAB07	ICP MS	$450,000	No	$0
LAB08	Drying Oven	$14,260	No	$0

LAB09	Analytical Pump	$49,000	No	$0
LAB10	Autoclave Sterilizer	$40,000	No	$0
H. Nutrient Removal Upgrade Projects				
CC 10B	PRIMARY EFFLUENT CHANNEL - SOUTH INTERCONNECTION CC 10B	$500	Yes	$500
CC 30AE	CONSTRUCTION CONTRACT 30A (CC 30A) BLOWER BUILDING	$77,079,095	Yes	$77,079,095
CC 30B	CONSTRUCTION CONTRACT 30B (CC 30B) BNR BASINS/PEPS	$126,239,306	Yes	$126,239,306
CC 30C	CONSTRUCTION CONTRACT 30C (CC 30C) SIDESTREAM PHOSPHORUS	$16,303,725	Yes	$16,303,725
CC 30D	CONSTRUCTION CONTRACT 30D (CC 30D) THICKENING BUILDING	$53,249,033	Yes	$53,249,033
CC 30EF	CONSTRUCTION CONTRACT 30E (CC 30E) SIDESTREAM NITROGEN	$27,957,503	Yes	$27,957,503
	CONSTRUCTION CONTRACT 30E (CC 30E) SIDESTREAM N Seismic	$0	Yes	$0
CC 10D	CONSTRUCTION CONTRACT 10D (CC 10D) SITE RESTORATION/Demo	$8,812,685	Yes	$8,812,685
NUT05	Accelerate design/construction of Two Secondary Clarifiers for Nutrient Removal	$1,956,000	Yes	$210,000
NUT06	Food Waste Receiving Facility	$8,624,000	Yes	$8,200,000
	Total	**$515,571,226**		**$462,111,390**

Appendix B-3

CVWRF Bond Payment Schedule

Table B-3.1: CVWRF Existing Bond Payment Schedule

	2017A Sewer Revenue Bonds			2017B Sewer Revenue Bonds			2019A Sewer Revenue Bonds			2020A State SRF Loan		
Year	Interest	Principal	Balance	Interest	Principal	Balance	Interest	Principal	Balance	Interest	Principal	Balance
2016												
2017	$148,204		$28,600,000			$3,445,000						
2018	$1,287,725	$905,000	$27,695,000	$90,491	$350,000	$3,095,000						
2019	$1,255,450	$935,000	$26,760,000	$74,065	$410,000	$2,685,000	$268,343		$35,390,000			
2020	$1,217,250	$975,000	$25,785,000	$65,655	$420,000	$2,265,000	$1,610,100	$1,090,000	$34,300,000			$15,000,000
2021	$1,177,450	$1,015,000	$24,770,000	$56,088	$430,000	$1,835,000	$1,554,100	$1,150,000	$33,150,000	$675,000	$0	$45,000,000
2022	$1,130,650	$1,060,000	$23,710,000	$45,535	$440,000	$1,395,000	$1,495,225	$1,205,000	$31,945,000	$976,500	$1,010,000	$65,100,000
2023	$1,076,275	$1,115,000	$22,595,000	$33,960	$450,000	$945,000	$1,433,350	$1,270,000	$30,675,000	$976,500	$2,815,297	$62,284,703
2024	$1,019,025	$1,175,000	$21,420,000	$21,143	$465,000	$480,000	$1,368,225	$1,335,000	$29,340,000	$934,271	$2,857,526	$59,427,177
2025	$958,775	$1,235,000	$20,185,000	$7,200	$480,000	$0	$1,310,150	$1,390,000	$27,950,000	$891,408	$2,900,389	$56,526,788
2026	$895,400	$1,300,000	$18,885,000				$1,260,325	$1,440,000	$26,510,000	$847,902	$2,943,895	$53,582,893
2027	$828,775	$1,365,000	$17,520,000				$1,197,575	$1,505,000	$25,005,000	$803,743	$2,988,054	$50,594,839
2028	$758,775	$1,435,000	$16,085,000				$1,120,450	$1,580,000	$23,425,000	$758,923	$3,032,874	$47,561,965
2029	$692,900	$1,500,000	$14,585,000				$1,039,325	$1,665,000	$21,760,000	$713,429	$3,078,368	$44,483,597
2030	$631,700	$1,560,000	$13,025,000				$953,950	$1,750,000	$20,010,000	$667,254	$3,124,543	$41,359,054
2031	$568,000	$1,625,000	$11,400,000				$864,325	$1,835,000	$18,175,000	$620,386	$3,171,411	$38,187,643
2032	$501,700	$1,690,000	$9,710,000				$770,200	$1,930,000	$16,245,000	$572,815	$3,218,982	$34,968,661
2033	$432,700	$1,760,000	$7,950,000				$671,200	$2,030,000	$14,215,000	$524,530	$3,267,267	$31,701,394
2034	$351,500	$1,840,000	$6,110,000				$577,950	$2,125,000	$12,090,000	$475,521	$3,316,276	$28,385,118
2035	$257,125	$1,935,000	$4,175,000				$491,250	$2,210,000	$9,880,000	$425,777	$3,366,020	$25,019,098
2036	$157,875	$2,035,000	$2,140,000				$401,050	$2,300,000	$7,580,000	$375,286	$3,416,511	$21,602,587
2037	$53,500	$2,140,000	$0				$307,150	$2,395,000	$5,185,000	$324,039	$3,467,758	$18,134,829
2038							$195,500	$2,550,000	$2,635,000	$272,022	$3,519,775	$14,615,054
2039							$65,875	$2,635,000	$0	$219,226	$3,572,571	$11,042,483
2040										$165,637	$3,626,160	$7,416,323
2041										$111,245	$3,680,552	$3,735,771
2042										$56,037	$2,725,771	$0
2043												
Total	**$15,400,754**	**$28,600,000**		**$394,136**	**$3,445,000**		**$18,955,618**	**$35,390,000**		**$12,387,451**	**$65,100,000**	

Table B-3.2: CVWRF 2021 Bonds A, B, & C Payment Schedule

Year	2021 A Bond	2021 B Bond	2021 C Bond
2022	$1,393,067	$1,527,443	$8,048,556
2023	$1,393,067	$1,527,443	$8,048,556
2024	$1,393,067	$1,527,443	$8,048,556
2025	$1,393,067	$1,527,443	$8,048,556
2026	$1,393,067	$1,527,443	$8,048,556
2027	$1,393,067	$1,527,443	$8,048,556
2028	$1,393,067	$1,527,443	$8,048,556
2029	$1,393,067	$1,527,443	$8,048,556
2030	$1,393,067	$1,527,443	$8,048,556
2031	$1,393,067	$1,527,443	$8,048,556
2032	$1,393,067	$1,527,443	$8,048,556
2033	$1,393,067	$1,527,443	$8,048,556
2034	$1,393,067	$1,527,443	$8,048,556
2035	$1,393,067	$1,527,443	$8,048,556
2036	$1,393,067	$1,527,443	$8,048,556
2037	$1,393,067	$1,527,443	$8,048,556
2038	$1,393,067	$1,527,443	$8,048,556
2039	$1,393,067	$1,527,443	$8,048,556
2040	$1,393,067	$1,527,443	$8,048,556
2041	$1,393,067	$1,527,443	$8,048,556
2042			$8,048,556
2043			$8,048,556
2044			$8,048,556
2045			$8,048,556
2046			$8,048,556
Principal	**$23,000,000**	**$25,000,000**	**$150,000,000**
Interest	$4,861,339	$5,548,858	$51,213,895
Total	**$27,861,339**	**$30,548,858**	**$201,213,895**

APPENDIX B

PIPELINE INVENTORY DATA

APPENDIX B
PIPELINE INVENTORY DATA

INTRODUCTION

An important component of any asset management program is an accurate inventory of existing assets. BC&A has reviewed the District's existing GIS database for pipeline data. In general, the pipe inventory aspects of the database appear to be relatively complete and functional. However, a few changes are recommended by BC&A to the structure of the database and there is some essential inventory data within the existing database that is currently missing.

Modifications To Pipeline Database

Based on our review of the District's existing GIS database, BC&A would offer the following recommendations regarding the structure of the pipeline inventory database:

1. Most of the existing fields in the District's sewer collection system GIS database are useful and should continue to be used. However, there are a few fields in the existing GIS database that BC&A would recommend modifying:
   a. MATERIAL – To be consistent with future data collection, BC&A would recommend that the existing codes used to describe material types be modified to be consistent with PACP material codes:
      - AC= Asbestos cement
      - BR= Brick
      - CAS= Cast iron
      - CMP= Corrugated metal pipe
      - CP= Concrete pipe (non-reinforced)
      - CT= Clay tile (not vitrified clay)
      - DIP= Ductile Iron
      - FRP= Fibreglass reinforced pipe
      - PE= Polyethylene
      - PP= Polypropylene
      - PSC= Plastic / steel composite
      - PVC= PolyVinyl Chloride
      - RCP= Reinforced concrete pipe
      - SP= Steel pipe
      - TTE= Transite
      - VCP= Vitrified clay pipe
      - XXX= Not known
      - ZZZ= Other
2. As the District strives to strengthen its pipeline condition assessment data, it is expected that the District will want to collect some additional pipeline inventory data that may be useful to include in the existing sewer GIS databases. Inventory fields BC&A would recommend that the District consider adding to the databases include:
   a. Hydrogen Sulfide – The District should sample hydrogen sulfide (H_2S) concentrations throughout their sewer collection system and document results in the GIS database. Sampling is typically done at individual manholes, so the

data could be stored in the manhole GIS database or in the pipeline GIS database for the connecting pipelines.

b. Location – PACP includes a data field for identifying the location of the pipeline. This inventory field could be useful in establishing the criticality of pipelines and future construction costs. The codes used in the PACP collection process are summarized as follows:

- A = Main – Urban (Interstate highway, thoroughfare with heavy traffic)
- B = Intermediate – Urban (city streets with moderate traffic)
- C = Light (rural road with light traffic, District back streets, and residential streets)
- D = Easement / Right of way
- E = Woods
- F = Sidewalk
- G = Parking lot
- H = Alley
- I = Ditch
- J = Building
- K = Creek
- L = Railway
- M = Airport
- Y = Yard
- Z = Other

c. Consequence of failure – As part of the asset management process, the District will develop an importance rating for each pipe. This rating will likely be reported as Level “1”, “2”, or “3” and should be stored in the GIS database for easy reference.

d. Other Asset Management – While most of the other information collected for asset management will be stored in other databases, there may be some summary asset management data that will be useful to store in the GIS database. It may be wise to plan for two or three additional summary fields in the GIS database for this purpose.

APPENDIX C

DOCUMENTATION OF CLEANING ACTIVITIES

APPENDIX C
DOCUMENTATION OF CLEANING ACTIVITIES

INTRODUCTION

Cottonwood Improvement District has long recognized the importance of collecting data regarding cleaning activities in the sewer system. Sewer system maintenance activities can generally be divided between pipeline, lift station, and treatment plant activities. The District does not operate any treatment plant facilities and evaluation of lift station assessment is beyond the scope of this study, but pipelines are discussed in the following section.

Cleaning Database

The District currently maintains a GIS database that includes detailed inspection and cleaning data. Cleaning data includes date of last cleaning, cleaning schedule for each pipe, and any cleaning comments for each pipe in the collection system in their GIS database. This database keeps historical records of cleaning data so that the District can look back and find anything that happened in the past.

Recommended Pipe Cleaning Practices

The District currently maintains more than 311 miles of gravity sewer pipelines and the District currently cleans all of these pipelines once every year. Over time, each of these pipelines will see a reduction in capacity as a result of: sediment deposition; accumulation of fats, oils, and greases; tree root infiltration, etc. District crews do currently clean these pipelines regularly. However, a few possible modifications to the cleaning schedule could improve the efficacy of the District's cleaning activities. It is recommended that the District's pipeline cleaning program be designed to accomplish the following goals:

- **Data Collection Associated with Cleaning Activities –** Because cleaning is important to avoiding restrictions in pipeline and costly sewer backups, most cities have a goal to clean all their pipelines over a given intervals (usually once a year or every other year). However, while cleaning is important and necessary, it can be hard on pipelines. Especially for concrete pipelines experiencing hydrogen sulfide degradation, aggressive cleaning can accelerate wear and shorten the life span of pipelines. Unnecessary cleaning is also a waste of time for District personnel. Thus, a good cleaning program should be designed to clean the pipelines often enough to avoid significant reductions in capacity, but not so often that it unnecessarily damages pipes or wastes District time.

  The ideal approach is to establish a cleaning schedule based on the needs of each pipeline. However, to do this, the District will need to continue to closely track the results of cleaning activities. It is recommended that the District continue to use their GIS database to document cleaning results. This database should record the pipeline inventory number, the date of cleaning, and the amount of sediment or debris encountered during each cleaning event. Once sufficient data is collected, the District will be then able to develop a customized schedule for the cleaning of pipelines. For some pipelines, this may still be once per year (or even more frequently). For others, cleaning may be necessary only once every 10 to 15 years.

- **Cleaning Baseline –** It is recommended that the District continue to maintain a schedule to clean all the pipelines in its system over the next 2 to 3 years. Any pipelines identified as high or medium priority in this Asset Management Plan should be cleaned within no more than 1 year. Lower priority pipelines should then be cleaned. All data should continue to be collected and assembled into the database as described above.

The following table can be used by the District in their maintenance database to track the results of each cleaning activity.

Data Category	Possible Data Entries
Reason for Clean	Routine Cleaning
	Complaint Call or Observed Problem
	Other
Results - Sediment	Little to none
	Less than 5 percent pipe depth
	5-10 percent pipe depth
	10-25 percent pipe depth
	Greater than 25 percent pipe depth
Sediment Type	Fine sediment and sludge only
	Coarse sands and gravels
	Rocks, chunks of concrete, or other large debris
Results - Grease	Little to none observed
	Minor
	Significant
Results - Roots	Little to none observed
	Minor
	Significant
Results – Other Debris	Little to none observed
	Significant other debris observed
Field Assessment	Cleaning not needed – Significant increase in cleaning interval recommended
	Cleaning produced modest results – Small increase in cleaning interval recommended
	Cleaning productive – No change in cleaning interval recommended
	Cleaning overdue – Decrease in cleaning interval recommended

APPENDIX D

PIPELINE CONDITION ASSESSMENT DATA

APPENDIX D
PIPELINE CONDITION ASSESSMENT DATA

INTRODUCTION

The most fundamental component of an asset management program is the development of a program to accurately assess the condition of existing assets. BC&A has reviewed the District's existing condition assessment program for pipelines. Based on this review, we have concluded the District's existing condition assessment program is currently very useful.

EXISTING CONDITION ASSESSMENT PROCESS

Based on interviews with Cottonwood Improvement District personnel, the following are known items pertaining to the District's current condition assessment program:

1. CCTV inspections are based on District personnel availability and all of the pipes within the District's sewer collection system are inspected every two years.
2. The pipe inspection videos are uploaded to an online database called Pipeline Observation System Management (POSM) where the videos can be viewed and other attributes of the pipes can be observed (pipe length, pipe diameter, pipe material, date of inspection, pipe identification numbers, and upstream/downstream manhole identification numbers).
3. Pipe inspection data from POSM can then be exported to the District's GIS database.

PACP Coding

To have a consistent system of assessing the District's collection system deficiencies, the District uses the structural condition scoring system from the Pipeline Assessment and Certification Program (PACP). Official PACP structural condition scoring needs to be performed by someone who is certified by PACP and has been through the training to recognize all the types of deficiencies and how to score them accordingly.

PACP structural scoring works by first identifying a specific, standardized type of deficiency (e.g. a circumferential crack will have a PACP deficiency code of CC, hydrogen sulfide corrosion resulting in visible aggregate will have a PACP deficiency code of SAVC, etc.). The location and extent of each of these deficiencies is also identified and all deficiency data is stored in a standardized, searchable database. Associated with each standardized deficiency is a numerical structural deficiency value that represents the level of concern associated with each deficiency (e.g. a circumferential crack has a PACP structural code of 1, hydrogen sulfide corrosion resulting in visible aggregate has a PACP structural code of 3, etc.). This structural scoring provides a numeric value that can be objectively determined for each pipe following established standards. Table 1 summarizes the PACP structural scoring categories.

Table 1
PACP Structural Condition Scoring Categories

PACP Structural Scoring	General Condition
0	No observable deficiencies
1	Pipe segment has minor defects – failure unlikely in the foreseeable future
2	Pipe segment has minor defects – failure unlikely for at least 20 years
3	Pipe segment has moderate defects – continued deterioration may result in failure in less than a 20-year timeframe
4	Pipe segment has severe defects – it is near the end of its useful life
5	Pipe segment is beyond its useful life – failure has occurred or is imminent

INSPECTION DATABASE

The District currently maintains a GIS database that includes inspection data. The following are existing attributes in the District's GIS database that pertain to inspection:

- Date – This attribute is a date showing when each pipe was last tv inspected.
- PacpQuickS – This attribute is the PACP quick structural score for the pipe at the latest inspection.
- PacpStruct – This attribute is the PACP structural score for the pipe at the latest inspection.
- PacpQuickM – This attribute is the PACP quick maintenance score for the pipe at the latest inspection.
- PacpMaint – This attribute is the PACP maintenance score for the pipe at the latest inspection.
- PacpQuickO – This attribute is the overall PACP quick score for the pipe at the latest inspection.
- PacpOverall – This attribute is the overall PACP score for the pipe at the latest inspection.

DATA STORAGE

At the end of a PACP inspection, two major sources of data are produced. The first is a video image of the pipe. The second is an inspection database that is populated with observation codes from the inspection. The District switched over to POSM from CIMS in 2019 for inspection database software and still has access to all of their CIMS inspection data from 2009 to 2019.

ESTABLISH A GOAL FOR COLLECTING CONDITION ASSESSMENT DATA FOR THE SYSTEM

It is recommended that all inspection activities be prioritized by criticality (see Chapter 8). See page 8-11 of the main body of the report for the recommended inspection schedule. It is okay to inspect the entire system every two years, but the District could allocate their resources more appropriately if this recommended inspection schedule is followed.

APPENDIX E

VALUE OF ASSETS

APPENDIX E
VALUE OF ASSETS

INTRODUCTION

An important component of an asset management program is the development of a system to quantify the value associated with various assets. The purpose of this chapter is to develop a standard for establishing the value of assets that can be used to make asset management decisions. This includes assessing the value of existing assets in the ground as well as quantifying future capital improvement costs.

Pipelines And Manhole Values

For master planning valuation purposes, Bowen Collins and Associates (BC&A) would propose grouping pipeline and manholes together. Since these facilities are nearly always constructed together, this will greatly simplify the valuation procedure without significantly compromising accuracy. Instead of needing to count the number of individual manholes along an existing pipeline or estimate their location on a future pipeline, using a combined valuation wraps the cost of manholes at average spacing into the total pipe cost.

BC&A has kept a master planning cost estimate database for the past few years that keeps track of real project costs for different pipe sizes. A national cost estimating database for sewer pipes was also consulted to provide data for larger diameter pipes, and to confirm pipe costs for smaller pipes. Based on this research, the proposed valuation for pipelines in the Cottonwood Improvement District collection system is as summarized in Table 1 for sewer pipelines. The unit costs are based on December 2021 dollars with an ENR cost index of 12,500.

Table 1
Proposed Sewer Pipeline Valuation

Pipe Diameter (in)	New Pipe ($/LF)	Replace Pipe ($/LF)	Replace Pipe After Failure ($/LF)	CIPP ($/LF)	Pavement Restoration ($/LF)
8	$193	$233	$365	$58	$75
12	$219	$263	$394	$72	$81
15	$255	$299	$449	$89	$86
18	$292	$336	$496	$117	$91
24	$365	$409	$613	$175	$100
27	$409	$467	$700	$219	$105
30	$467	$525	$788	$263	$110
36	$642	$700	$1,051	$365	$119
42	$817	$876	$1,313	$467	$129
48	$949	$1,007	$1,518	$569	$139
54	$1,051	$1,124	$1,693	$671	$148
60	$1,124	$1,211	$1,824	$773	$158
66	$1,197	$1,284	$1,941	$861	$167
72	$1,270	$1,372	$2,058	$919	$177
78	$1,343	$1,445	$2,174	$992	$186

The table includes values for pipes under various conditions:

- **New Pipe –** This column represents the cost of installing a sewer pipe, complete in a new area. It includes excavation, pipe, stub outs for laterals, manholes, backfill, and traffic control. Because it is new pipe, there does not need to be bypass pumping, or reconnections to existing sewer lines.
- **Replace Pipe –** This column entails replacing an existing sewer pipe as part of a planned construction package. It includes everything in the new pipe column, but also includes bypass pumping and reconnections to existing sewer lines.
- **Replace Pipe After Failure –** The cost of replacing pipe after a failure will obviously be more expensive than if the replacement were previously planned. There are additional construction costs associated with prolonged bypass pumping or emergency diversion, a fast tract construction project, and other costs associated with dealing with the unexpected. There are also non-construction costs such as property damage, protection of health or safety, etc. Unfortunately, both construction and non-construction additional costs will vary widely depending on the nature of the failure, making these types of costs difficult to quantify. For simplicity, it was decided to assume that the cost after failure should be estimated to be 50 percent more than replacing the pipe without failure. It should be understood that the actual cost of some replacement projects will be much greater than this, especially if the replacement only consists of a short section of pipe.
- **Cast in Place Pipe (CIPP)** – The most common form of pipeline rehabilitation is CIPP. Thus, it was deemed useful to include costs for this type of work. The costs for this category are based on estimates provided by two major companies that perform CIPP on larger pipe projects, along with bid results from various recently completed projects.

- **Pavement Restoration –** To be able to distinguish between pipes under pavement versus those outside pavement, asphalt restoration has not been included as part of the cost categories above. A separate number for pavement restoration is included in the table based on recent construction bids.

It should be noted that the values in Table 1 are for master planning and asset valuation purposes only. The actual costs of construction can vary greatly between projects. Some factors that could contribute to variations in these prices include pipe material type, level of traffic control, soil conditions, depth of pipe, number of laterals or pipe connections, flow rate that requires bypass pumping, etc. These issues will need to be considered for more detailed cost estimation.

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