

Resolution # 04-2018

A RESOLUTION APPROVING A SANITARY SEWER MASTER PLAN

RESOLVED that MOAB informs the Citizens of Moab of the following actions taken by the Moab City Council.

1. Reviewed and approved the attached Sanitary Sewer Master Plan dated January 2018.

NOW THEREFORE, WE, THE GOVERNING BODY OF THE CITY OF MOAB DO HEREBY ADOPT THE PLAN IN SUBSTANTIALLY THE FORM PRESENTED TO THIS MEETING OF THE CITY COUNCIL, AND AUTHORIZE THE APPROPRIATE CITY STAFF TO EXECUTE AND IMPLEMENT THE SANITARY SEWER MASTER PLAN AS A GUIDANCE DOCUMENT FOR CAPITAL AND MAINTENANCE PROGRAMMING AS WELL AS FOR FISCAL PLANNING PURPOSES.

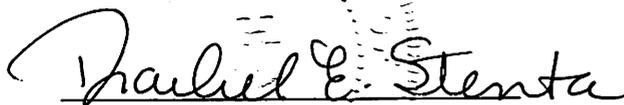
This resolution shall take effect immediately upon passage.

Passed and adopted by action of the Governing Body of Moab City in open session this 9th day of January, 2018.

CITY OF MOAB

By: 
Emily Niehaus
Mayor

Attest:


Rachel E. Stenta
City Recorder

Sanitary Sewer Master Plan

Prepared for:



Prepared by:



SANITARY SEWER MASTER PLAN

January 2018



Prepared for:



Prepared by:



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EXECUTIVE SUMMARY

INTRODUCTION

The City of Moab retained Bowen Collins & Associates (BC&A) to prepare a master plan for the City’s wastewater collection system. The purpose of this sewer master plan report is to identify recommended improvements that will resolve existing and projected future deficiencies in the wastewater collection system throughout the City’s service area.

This executive summary provides a brief summary of the evaluation process and the recommended system improvements.

GROWTH PROJECTIONS

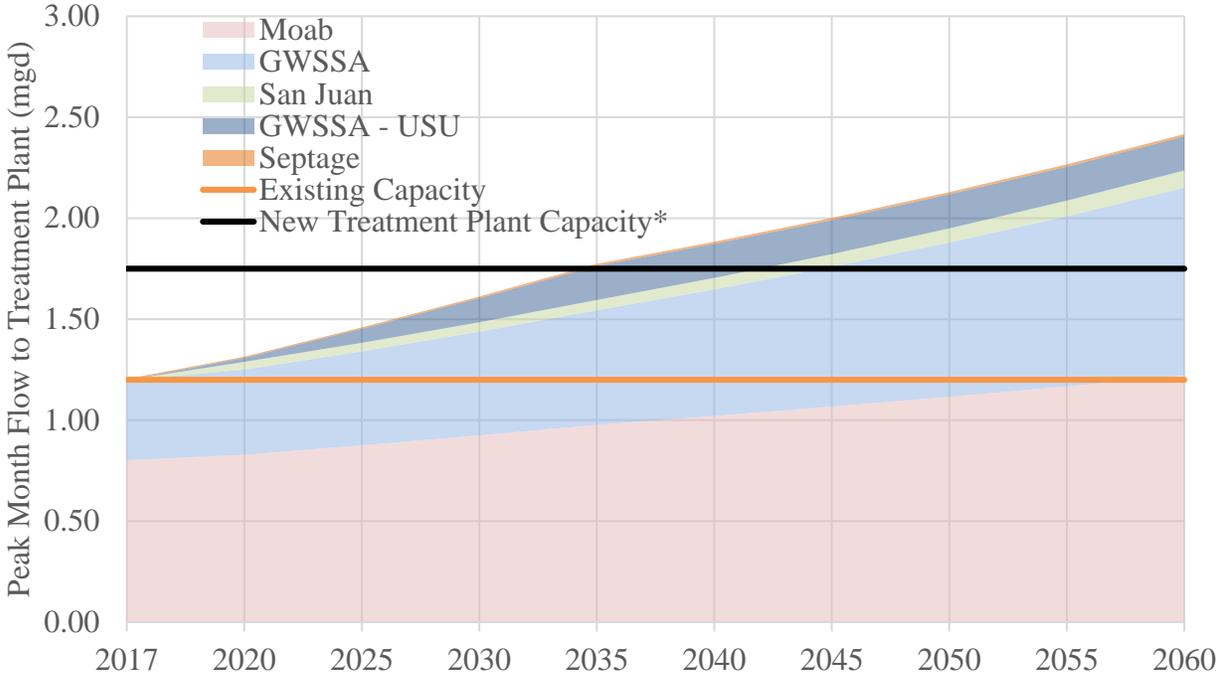
Existing wastewater in the City’s collection system was evaluated based on treatment plant data and flow monitoring conducted as part of this study. Projections of future growth in wastewater were developed based on existing production rates (gallons per day per equivalent residential unit) and anticipated growth as provided by the City of Moab and other contributing agencies. Table ES-1 and Figure ES-1 show projected growth of wastewater in the future.

**Table ES-1
Projected Peak Month Flows to Moab Treatment Plant* (MGD)**

| Year | Moab | San Juan | GWSSA | GWSSA - USU | Septage | Total |
|------|------|----------|-------|----------------|---------|-------|
| 2017 | 0.80 | 0.00 | 0.40 | 0.00 | 0.01 | 1.20 |
| 2020 | 0.83 | 0.04 | 0.42 | 0.02 | 0.01 | 1.31 |
| 2025 | 0.88 | 0.04 | 0.47 | 0.07 | 0.01 | 1.46 |
| 2030 | 0.92 | 0.05 | 0.51 | 0.12 | 0.01 | 1.61 |
| 2035 | 0.98 | 0.05 | 0.57 | 0.17 | 0.01 | 1.77 |
| 2060 | 1.22 | 0.09 | 0.93 | 0.17 | 0.01 | 2.42 |

*estimated peak month flow includes both infiltration and domestic production

Figure ES-1
Peak Month Flow to Moab City Wastewater Treatment Plant



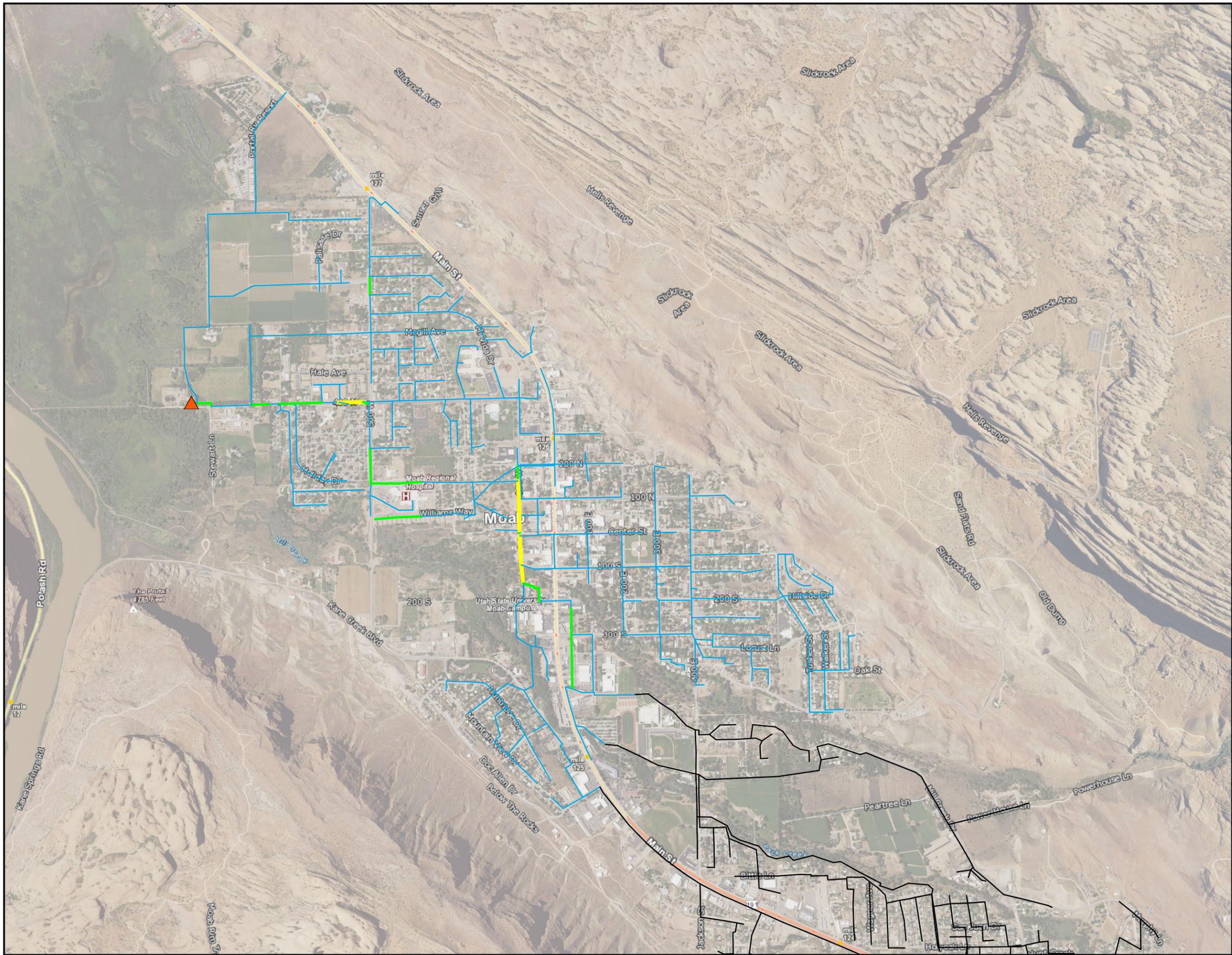
*Treatment plant capacity may include many different components, but in general can be represented as a flow capacity for peak month conditions

SYSTEM EVALUATION

Based on existing wastewater flow and projected growth in wastewater flow, the existing and future flows were simulated in a hydraulic model of the City’s collection system. Figures ES-2 through ES-5 show the hydraulic performance as calculated by the hydraulic model for sewer flows as projected through full buildout conditions if no improvements are made to the existing system. These results assume that sewer flows associated with future development will flow to the nearest manhole in the existing system. While the majority of the system under buildout conditions has ample capacity, some significant deficiencies have been observed in the model results. Most are the result of growth in the GWSSA service area and deficiencies follow the main trunk line to the City’s wastewater treatment plant. Figures ES-3 and ES-4 help identify how soon some of the deficiencies will occur. The City also has a number of lift stations that were evaluated for hydraulic capacity and all appear to have capacity to accommodate growth through buildout for their respective service areas.

SYSTEM IMPROVEMENTS

To resolve potential deficiencies identified as part of the system evaluation, several projects have been proposed to address both future hydraulic deficiencies and the need to service developing areas. Figure ES-6 and Table ES-2 show the projects and associated costs for these projects.



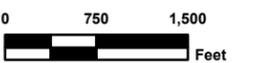
LEGEND

- ▲ WWTP
- GWSSA Pipes
- City of Moab Sewer Pipes (2017)**
Peak discharge depth/ pipe diameter
- Less than 0.4
- 0.4~0.5
- 0.5~0.65
- 0.65~0.75
- Greater than 0.75

NORTH:



SCALE:



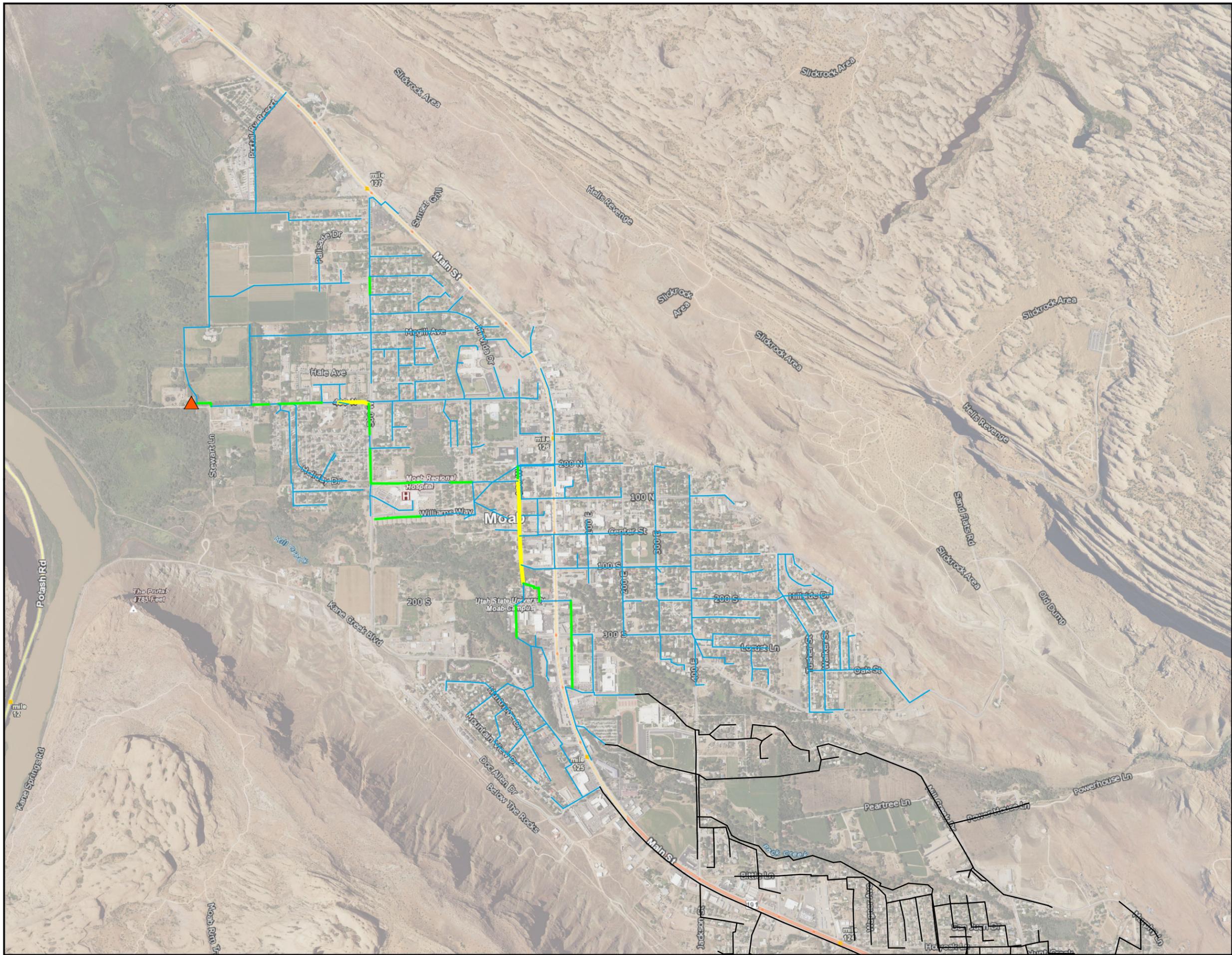
YEAR 2017 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

ES-2



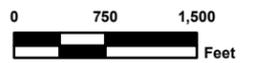
LEGEND

-  WWTP
-  GWSSA Pipes
- City of Moab Sewer Pipes (2022)**
Peak discharge depth/ pipe diameter
-  Less than 0.4
-  0.4~0.5
-  0.5~0.65
-  0.65~0.75
-  Greater than 0.75

NORTH:



SCALE:



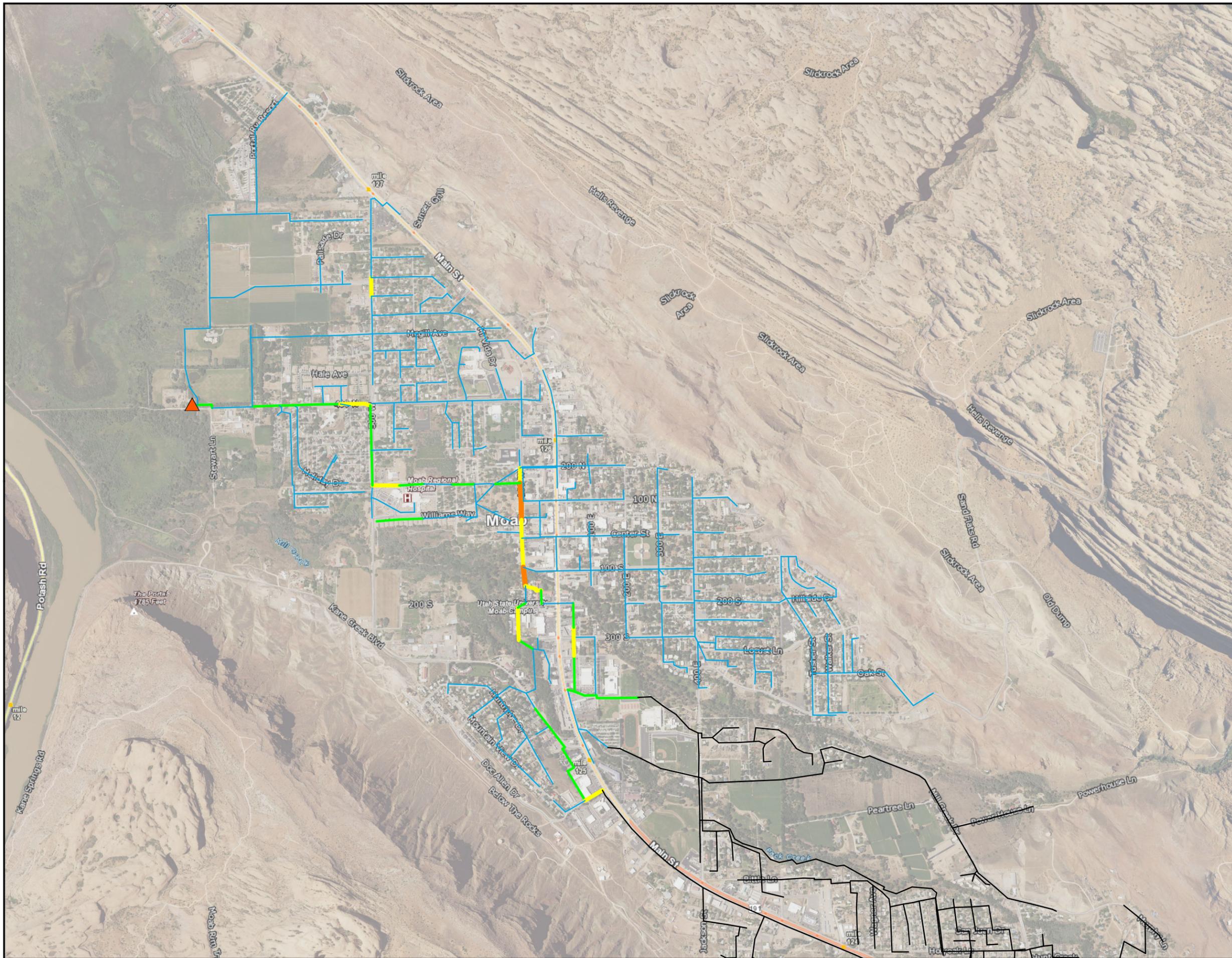
YEAR 2022 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

ES-3



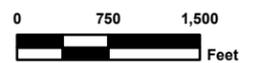
LEGEND

-  WWTP
-  GWSSA Pipes
- City of Moab Sewer Pipes (2030)**
Peak discharge depth/ pipe diameter
-  Less than 0.4
-  0.4~0.5
-  0.5~0.65
-  0.65~0.75
-  Greater than 0.75

NORTH:



SCALE:



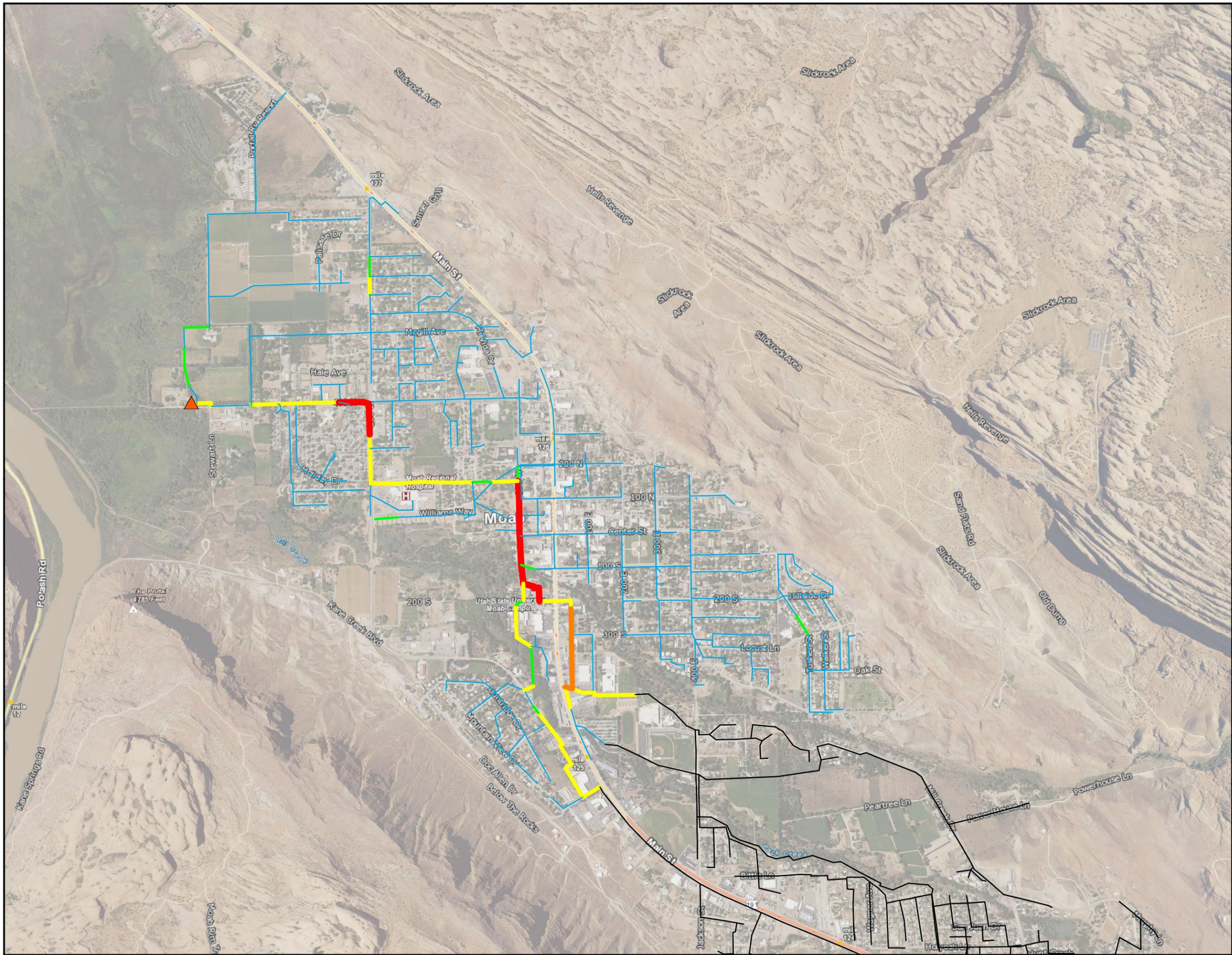
YEAR 2030 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

ES-4



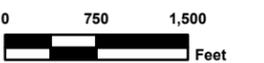
LEGEND

- ▲ WWTP
- GWSSA Pipes
- City of Moab Sewer Pipes (2060)**
Peak discharge depth/ pipe diameter
- Less than 0.4
- 0.4~0.5
- 0.5~0.65
- 0.65~0.75
- Greater than 0.75

NORTH:



SCALE:



YEAR 2060 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

ES-5



LEGEND

● Future Lift Station

▲ WWTP

System Improvement (inch)

----- 6" or less

— 8"

— 10"

— 12"

— 15"

— 18"

— 21"

— 24"

— 30"

— 36"

— 42"

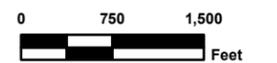
----- Existing Sewer Pipes

▭ Spanish Valley

NORTH:



SCALE:



PROPOSED SYSTEM IMPROVEMENTS

CITY OF MOAB
**SANITARY SEWER
 MASTER PLAN**



FIGURE NO.

ES-6

**Table ES-2
Proposed System Improvements**

| ID | Name | Diameter (inch) | Length (ft) | Total Construction Cost Estimate | Engineering / Admin (15 percent) | Total Project Cost Estimate |
|-----|-------------------------------------|-----------------|-------------|----------------------------------|----------------------------------|-----------------------------|
| 1.1 | 100 West ¹ | 21 | 1,700 | \$755,000 | \$113,000 | \$868,000 |
| 2.1 | Northwest Trunk | 15 | 4,133 | \$992,000 | \$149,000 | \$1,141,000 |
| 2.2 | Northwest Lift Station ² | | | \$320,000 | \$48,000 | \$368,000 |
| 2 | Subtotal Project 2 | | | \$1,312,000 | \$197,000 | \$1,509,000 |
| 3.1 | 1000 North, 500 W to Rb. | 12 | 1,860 | \$141,000 | \$21,000 | \$162,000 |
| 4.1 | South Trunk | 24 | 9,770 | \$4,769,000 | \$715,000 | \$5,484,000 |
| | Total | | | \$6,977,000 | \$1,046,000 | \$8,023,000 |

¹ Includes cost of replacing the existing Mill Creek siphon.

² the required capacity of the Northwest lift station is estimated to be 750 gpm (see Appendix “Northwest Lift Station Memo”). Cost estimated with “Pump Station Design Manual” (2nd Edition, Sanks et al) figure 29-9 adjusted to 2017 dollars.

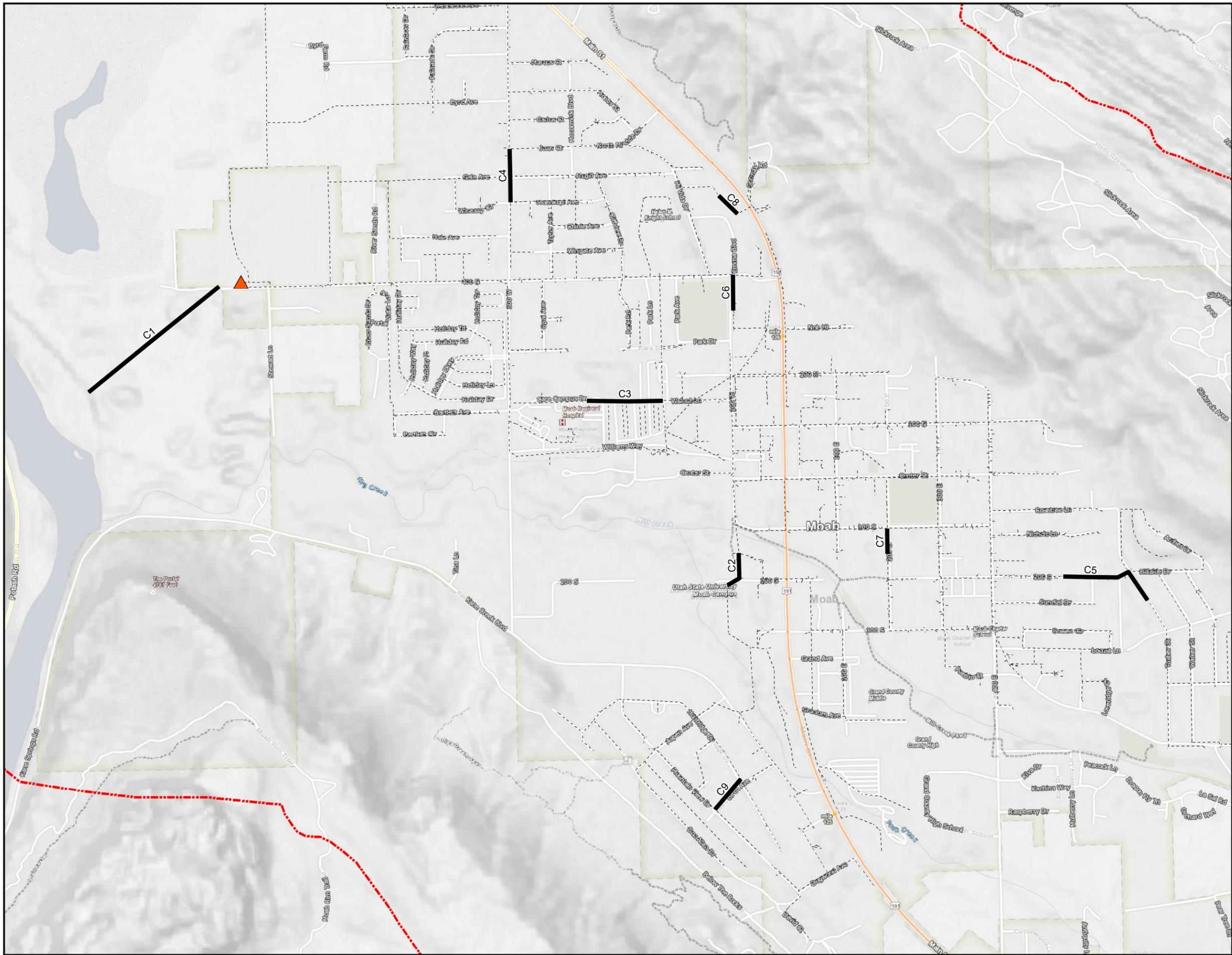
SYSTEM REHABILITATION AND REPLACEMENT

In order to assemble a 10-year capital improvement plan, it is not adequate to consider only capacity related improvements. It is also necessary to budget for the expected rehabilitation and replacement of system components. Table ES-3 summarizes anticipated costs that will be required to rehabilitate or replace severe or critical condition pipes in the City.

**Table ES-3
Summary of Rehab/Replacement Costs for Severe and Critical Wall Condition Pipes**

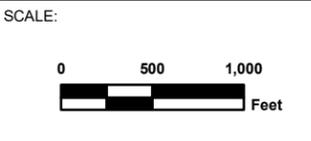
| Diameter (in) | Rehabilitate Severe | Replace Critical |
|---------------|---------------------|--------------------|
| 6 | \$219,798 | \$136,054 |
| 8 | \$871,987 | \$782,560 |
| 10 | \$58,659 | \$0 |
| 12 | \$27,125 | \$310,022 |
| 18 | \$0 | \$2,524,420 |
| 24 | \$50,991 | \$0 |
| Total | \$1,228,560 | \$3,753,056 |

Figure ES-7 shows the location of critical condition pipe projects proposed to be completed within the next 10 years.



LEGEND

-  WWTP
-  Critical Condition Projects
- Existing Sewer Pipes**
-  Existing Sewer Pipes
-  Spanish Valley



CONDITION PROJECT PRIORITIES

CITY OF MOAB
SANITARY SEWER MASTER PLAN



FIGURE NO.
ES-7

10-YEAR CAPITAL IMPROVEMENT PRIORITIES

Table ES-4 lists improvement projects that are recommended within the next 10-years. This table includes several projects not included in the City’s impact fee facilities plan (see Appendix). Projects that are maintenance related or fully developer funded have been omitted from the City’s impact fee facilities plan because they are not impact fee eligible. Pipes with critical wall conditions are prioritized first and are mostly funded over the next 10 years. For the purpose of cost estimating, it has been assumed that all critical condition pipes will require replacement. If rehabilitation is possible through cast-in-place pipe, additional projects to rehabilitate severe wall condition pipe may also be possible in the 10-year time frame. As a result, it is recommended that each condition project be reviewed to determine if rehabilitation is feasible.

**Table ES-4
10-Year Capital Facility Plan**

| ID | Estimated Year of Construction | Name | Diameter (inch) | Length (ft) | Total Project Cost (\$2017 Dollars) |
|-----------|---------------------------------------|--|------------------------|--------------------|--|
| 0 | FYE 2019 | City Project | -- | -- | \$300,000 |
| 1.1 | FYE 2018 | 100 West | 21 | 1,700 | \$868,000 |
| 2.1 | FYE 2019 | Northwest Trunk ¹ | 15 | 4,133 | \$1,141,000 |
| 2.2 | FYE 2019 | Northwest Lift Station ¹ | | | \$368,000 |
| 3.1 | FYE 2020 | 1000 North, 500 W to Rb ² . | 12 | 1,860 | \$162,000 |
| O&M 1 | FYE 2020 | Crit. Cond. – Outfall Pipe | 21 | 1,840 | \$864,800 |
| O&M 2 | FYE 2021 | Crit. Cond. – 100 W, 200 S | 12 | 430 | \$163,300 |
| O&M 3 | FYE 2022 | Crit. Cond. – Walnut Lane | 18 | 830 | \$365,700 |
| O&M 4 | FYE 2022 | Crit. Cond. – 500 West | 12 | 580 | \$213,900 |
| O&M 5 | FYE 2022 | Crit. Cond. – 200 South | 8 | 1,100 | \$351,900 |
| O&M 6 | FYE 2022 | Crit. Cond. – 100 W, 400 N | 8 | 400 | \$139,200 |
| O&M 7 | FYE 2023 | Crit. Cond. – 200 East | 8 | 280 | \$102,400 |
| O&M 8 | FYE 2023 | Crit. Cond. – Emma Blvd | 8 | 290 | \$105,800 |
| O&M 9 | FYE 2023 | Crit. Cond. – Birch Ave | 6 | 440 | \$151,800 |
| O&M | FYE 2024-2026 | Critical – To be determined | -- | -- | \$1,294,200 |
| O&M | FYE 2025-2026 | Severe - To be determined | -- | -- | \$1,229,000 |
| 4.1 | FYE 2026 | South Trunk | 24 | 9,770 | \$5,484,000 |
| | | Total | | | \$13,305,000 |

¹ It is anticipated that this project will be developer funded and reimbursed through a developer agreement.

² The City will pay the upsize cost for this project with the remainder funded by a developer.

CHAPTER 1

INTRODUCTION

INTRODUCTION

The City of Moab has retained Bowen Collins & Associates (BC&A) to prepare a master plan for the City's wastewater collection system. The purpose of this sewer master plan report is to identify recommended improvements that will resolve existing and projected future deficiencies in the wastewater collection system throughout the City's service area. A separate wastewater treatment plant facilities master plan was prepared in February 2015.

PREVIOUS STUDIES

This study follows a number of other important studies regarding the City's wastewater system. In addition to the treatment plant master plan mentioned above, the City also completed a sewer rate study, impact fee facilities plan, and impact fee analysis in February 2017. These studies were followed with a cost of service rate analysis in May 2017. Under ideal conditions, the collection system master plan would have been updated prior to completing these several studies. However, after the City identified the immediate need to reconstruct the treatment plant, it needed to move quickly to identify the financial mechanisms that would be necessary to fund the plant improvements. Thus, all the financial studies had to be completed first, followed by this collection system master plan.

Copies of the several financial studies referenced here are contained in the appendix of this report. Fortunately, none of the conclusions contained in this report represent significant deviations from the assumptions used in the development of those reports. Where small changes do exist, they have been identified in this report.

SCOPE OF SERVICES

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

- Task 1:** Collected information as needed to develop the sewer master plan based on the City's general plan and existing facilities.
- Task 2:** Updated population projections and estimated growth in sewer flow to evaluate future growth needs. This included future growth for each of the contributing agencies that flow through the City to the Moab wastewater treatment plant.
- Task 3:** Developed a hydraulic computer model of the City of Moab collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using data from the City's existing GIS database, water meter data from the City, and flow monitoring within the collection system.

- Task 4:** Identified existing operating deficiencies.
- Task 5:** Identified projected future operating deficiencies.
- Task 6:** Evaluated alternative improvements for resolving deficiencies identified in Tasks 4 and 5. This included evaluating alternatives looking at diversion locations and reuse opportunities.
- Task 7:** Developed a comprehensive capital facilities plan incorporating all required improvements identified for the collection system.
- Task 8:** Documented results of the previous tasks in a report with additional memoranda as needed.

ACKNOWLEDGMENTS

The BC&A team wishes to thank the following individuals from the City of Moab for their cooperation and assistance in working with us in preparing this report:

| | |
|----------------|-----------------------------------|
| Chuck Williams | City Engineer |
| Eric Johanson | Assistant City Engineer |
| Obe Tejada | Sewer Superintendent |
| Greg Fosse | Water Reclamation Section Manager |
| Jennie Ross | Accounting |

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&As' Draper, Utah office. Questions may be addressed to Keith Larson, Project Manager at (801) 495-2224.

| | |
|-----------------|----------------------------------|
| Jeff Beckman | Principle in Charge |
| Keith Larson | Project Manager |
| Andrew McKinnon | Project Engineer, Sewer Modeling |
| Ben Kirk | Project Engineer, Sewer Modeling |
| Mike Hilbert | Clerical |

CHAPTER 2 EXISTING SYSTEM FEATURES

INTRODUCTION

As part of this Master 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 inventory of City's existing sewer collection system that can be used as a reference for future studies.

SERVICE AREAS

For the purpose of this study, the City sewer system has been divided into three service areas. The "City of Moab" service area includes most of the area within the corporate boundaries of the City. Figure 2-1 identifies the approximate boundary of the Moab collection system service area. The "Other Agencies" service area includes all growth outside of the Moab service area that is expected to flow to the City. This could potentially include flow from the Spanish Valley Water & Sewer Improvement District (SVW&SID) and San Juan County. The "Septage Haulers" service area is not associated with a specific area at all, but refers to those customers that will bring septage directly to the City plant from septic tanks, campgrounds, and pit toilets serving the recreational areas both in and around Moab.

TOPOGRAPHY

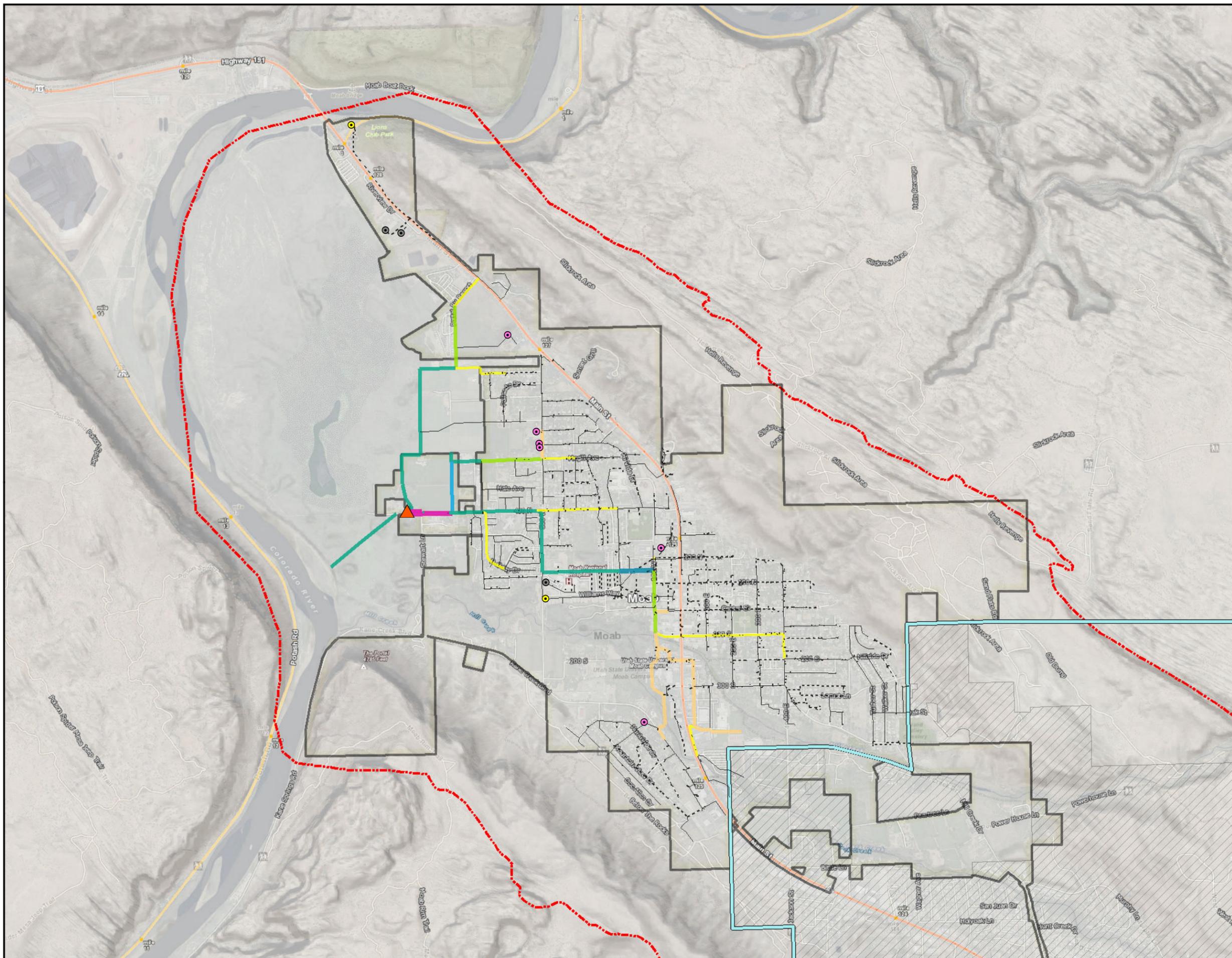
The Moab City sewer system service area is approximately 5 square miles (not including the "Other Agencies") and is bordered by the following: Slick Rock Area to the northeast, the Colorado River to the north and west, and Spanish Valley to the southeast. The topography of the City generally slopes from east to west with the City's treatment plant located at the southwest edge of the City (near the Colorado River). The Spanish Valley slopes from south to north toward Moab City. Most of the City collection system flows by gravity to the treatment plant with a few exceptional areas requiring lift stations (2 City owned lift stations, and several private lift stations).

COLLECTION SYSTEM

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

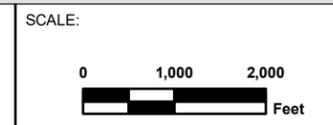
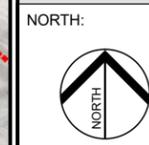
Sewer Collection Pipes

There are about 30 miles of sewer mains and over 570 manholes in the Moab City Sewer System that are cataloged in the GIS database. Table 2-1 contains a summary of the sewer pipes for the Moab City sewer collection system. As can be seen in the table, 55 percent of the pipe in the system is 8 inches in diameter, with another 20 percent of the system being 6 inches in diameter or smaller. This represents the vast network of small collection mains in neighborhoods throughout the City.



Legend

- WWTP
- Lift Station**
- Lift Station**
 - Commercial / Institutional
 - City Owned
 - Household
- Existing Sewer Pipes**
- Pipe Size**
 - 6" or less
 - 8"
 - 10"
 - 12"
 - 15"
 - 18"
 - 21"
 - 24"
 - 30"
 - 36"
 - 42"
- Moab Sewer Area Boundary
- GWSSA Sewer Area
- Moab City Limits
- Spanish Valley



**EXISTING
COLLECTION SYSTEM**

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.
2-1

**Table 2-1
Sewer Collection System Sizes and Lengths**

| Diameter (in) | Length (ft) | Length (mi) | Percentage (%) |
|--------------------------|------------------------|------------------------|---------------------------|
| 3 | 3,265 | 0.62 | 2.09% |
| 4 | 246 | 0.05 | 0.16% |
| 6 | 31,720 | 6.01 | 20.26% |
| 8 | 87,253 | 16.53 | 55.72% |
| 10 | 8,777 | 1.66 | 5.61% |
| 12 | 6,072 | 1.15 | 3.88% |
| 15 | 4,077 | 0.77 | 2.60% |
| 18 | 12,070 | 2.29 | 7.71% |
| 21 | 1,125 | 0.21 | 0.72% |
| 24 | 746.93 | 0.14 | 0.48% |
| 27 | 324.527 | 0.06 | 0.21% |
| 30 | 913.789 | 0.17 | 0.58% |
| Total | 156,589 | 29.66 | 100.00% |

Table 2-2 shows a complete breakdown of pipe materials and pipe diameters. As the City continues to rehabilitate and replace older existing lines, it is anticipated that the percentage of PVC will gradually increase (as this is the preferred material of construction for most new sewer mains).

**Table 2-2
Sewer Main Material Percentages**

| Diameter (inch) | Unknown | PVC | Clay | Transite | Concrete | Sum (%) |
|-----------------|--------------|---------------|---------------|--------------|---------------|-------------|
| 3 | 1.62% | 0.47% | -- | -- | -- | 2.09% |
| 4 | -- | 0.16% | -- | -- | -- | 0.16% |
| 6 | -- | 2.62% | 9.46% | 0.80% | 7.38% | 20.26% |
| 8 | -- | 24.44% | 1.36% | 0.17% | 29.75% | 55.72% |
| 10 | 0.03% | 1.24% | 1.11% | 0.07% | 3.16% | 5.61% |
| 12 | -- | -- | -- | -- | 3.88% | 3.88% |
| 15 | -- | 0.87% | -- | -- | 1.73% | 2.60% |
| 18 | -- | 2.77% | -- | -- | 4.93% | 7.71% |
| 21 | -- | -- | -- | -- | 0.72% | 0.72% |
| 24 | -- | -- | -- | -- | 0.48% | 0.48% |
| 27 | -- | -- | -- | -- | 0.21% | 0.21% |
| 30 | -- | -- | -- | -- | 0.58% | 0.58% |
| Total | 1.65% | 32.57% | 11.94% | 1.04% | 52.81% | 100% |

Lift Stations

Lift station locations are identified in Figure 2-1. Table 2-3 shows the estimated capacity for the larger City owned lift stations. The City also maintains several household lift stations at various locations in the City.

**Table 2-3
Moab Lift Station Characteristics**

| Location | Estimated Total Dynamic Lift (ft) | Estimated Design Flow* (gpm) | Number of Pumps | Backup Power Included | Power (HP) | Model |
|--------------------|-----------------------------------|------------------------------|-----------------|-----------------------|------------|-----------------|
| Lions Park | 109 | 68 | 2 | No | 5 | KEEN KHG5-2301 |
| 500 W Williams Way | 9 | 108 | 2 | Yes | 3 | Barnes SGV3072L |

*capacity estimated based on published pump curves for model type and estimated lift.

Overflows

The City has several overflows that are not used under dry weather flow conditions, but may function during wet weather to prevent surcharging conditions. In addition, there are a number

of manholes in the City that have potential overflow pipes that are primarily used for flushing lines and maintenance. These overflows are discussed more in Chapter 4.

MOAB WASTEWATER TREATMENT FACILITY

The Moab Wastewater Treatment Plant facility (WWTP) is located at 1070 West 400 North and was first constructed in the late 1950s. A secondary treatment process was added in 1967. Additional modifications and expansions have been completed over the life of the plant. The latest expansion was completed in 1996, which included a new headworks facility, additional primary and secondary clarifiers, a new septage receiving station, and several other improvements.

Recently, the City decided to completely replace the existing treatment plant with a new Water Reclamation Facility (WRF). The WRF is currently under construction and is expected to be completed in the fall of 2018. The new WRF includes construction of an improved septage receiving station and screening equipment as part of the primary treatment process. The secondary treatment process includes a sequencing batch reactor (SBR) treatment process. The SBR process utilizes an activated sludge process for biological treatment of the wastewater. Solids are settled and dewatered with a belt filter press for disposal. Ultraviolet light is used to disinfect treated effluent prior to discharge to the Colorado River. The new treatment plant will have an initial capacity of 1.75 mgd, with a peak hydraulic capacity of 3.4 mgd and has sufficient space to expand in the future as required.

CHAPTER 3

FUTURE GROWTH AND FLOW PROJECTIONS

INTRODUCTION

Before attempting to hydraulically model and evaluate the City's sewer collection facilities, 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. The purpose of this chapter is to summarize the results, assumptions, and process of calculating both existing and future wastewater flows.

There are three major components of wastewater flow: domestic wastewater, infiltration, and inflow. Each of these is discussed in detail in this chapter.

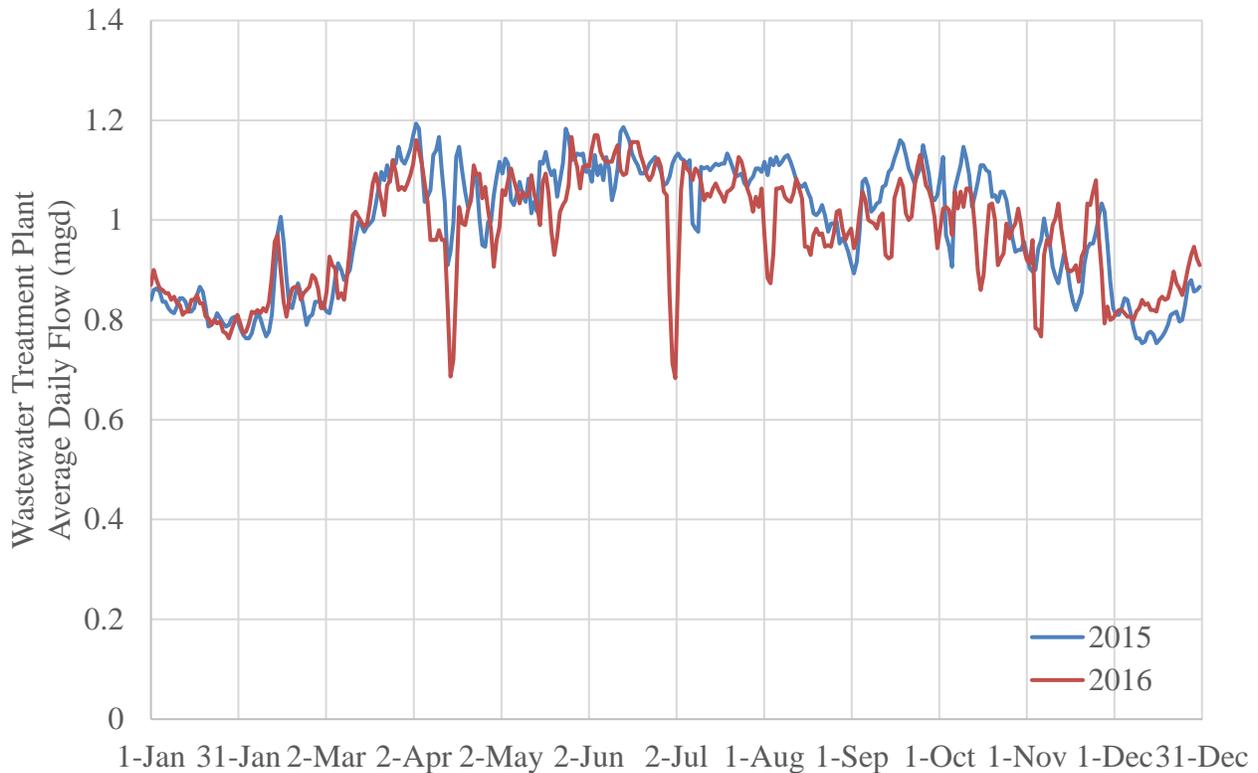
DOMESTIC WASTEWATER

Domestic flow consists of the wastewater contributions of residential and nonresidential customers. Domestic flow from residential and non-residential customers varies throughout the day. Peak flows are generated during the morning hours as residents or tourists shower and prepare for the day. There is a smaller peak in the early evening as residents return from work. Domestic sewer flows are generally lower throughout the remainder of the day and are just a trickle during the early morning hours when most residents are asleep. Flow from industrial or commercial customers may vary from this pattern depending on the type of facility.

Two major challenges are encountered when estimating domestic flow. First, the quantity of wastewater produced varies from area to area depending on the type of water user in the area and the density of development. Second, domestic flow is not a constant value, but varies in time.

Domestic wastewater is most often developed using estimates of residential and/or non-residential connections within a City. The City, however, has a large mix of non-residential connections with a large tourism component that can affect domestic wastewater production patterns. As a result, relying on the local residential population to account for domestic wastewater would under predict domestic wastewater. Figure 3-1 shows the average wastewater at the City's wastewater treatment plant in 2015 and 2016. Flows to the treatment plant in winter months (December, January, February) when tourism in Moab is reduced is approximately 50 percent lower than peak times of the year when flow approaches 1.2 million gallons per day (mgd). Due to the variability in flows due to the large tourism contribution to Moab, domestic flows for the City will be projected based on an "equivalent residential unit" (ERU) defined by indoor residential meter data. The approximate value for indoor water consumption was calculated to be 4,400 gallons per month (147 gallons per day) per ERU during the peak month of consumption. For domestic wastewater production, a consumptive use of 10 percent was estimated for Moab based on treatment plant data, indoor water use, and flow monitoring conducted as part of this study. As a result, the estimated domestic production from each ERU is 3,960 gallons per month.

Figure 3-1
Seasonal Variation in Total Wastewater Flow



INFILTRATION

The second 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. 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 but will generally be constant during a single 24-hour period. Temporary increases in the amount of water that enters the system after a storm because of an increase in ground water 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.

Based on overall measurements at the City's treatment plant, infiltration for the Moab treatment plant service area appears to be relatively low. Total infiltration was estimated to be roughly 10 percent of total flow to the treatment plant for the peak month (0.12 mgd). This is significantly less than infiltration to treatment plants in other parts of the State of Utah. Infiltration in the collection system was identified by comparing indoor meter data to flow data collected at the City's treatment plant. Infiltration for GWSSA and San Juan County has been assumed to be equal to the City of Moab's. Although infiltration is a function of many different variables (water table, pipe depth, pipe diameter, etc), projections of future infiltration are simplified by assuming a specific amount of infiltration per growth in population or ERUs. This assumes the density of the future collection network is approximately the same as for existing conditions. Based on this assumption, infiltration per ERU can be estimated as approximately 15 gallons per day.

INFLOW

Similar to infiltration, inflow is also the intrusion of unwanted water into the sewer system. In the case of inflow, however, this water comes from rainfall and snowmelt instead of groundwater. Inflow may enter the sewer system through roof and foundation drains, yard and area drains, manhole covers, and illicit storm drain connections. In the case of the assorted roof and yard drains, discharge into the sanitary system is against City ordinances. However, illegal connections often exist and can significantly affect the performance of the sewer system.

Inflow into a collection system can be highly variable and depends on the placement and construction of sewer collection systems as well as the type of storm events that occur. In addition, a long record of rainfall and flow monitoring data is needed to accurately predict how storm events may impact the City's collection system or treatment plant. To account for inflow in the sewer master plan, a portion of the capacity of pipe capacity should be reserved for inflow when assessing pipe capacity. In other words, a pipe will be identified as having inadequate capacity at flows somewhat less than the full flow capacity of the pipe. The City of Moab's design criteria for pipe capacity includes a 50 percent buffer for depth for pipes 15-inch and smaller and 25 percent buffer for depth for pipes greater than 15-inch. This buffer provides capacity for inflow and other unusual flow events including holidays when sewer production may peak.

GROWTH PROJECTIONS

Once an understanding of existing wastewater is developed, it is possible to project the growth in wastewater into the future. Growth projections for the City of Moab, Grand Water & Sewer Service Agency (GWSSA), and San Juan County growth can be estimated based on the percent increase from existing conditions. Table 3-1 summarizes the planning rate of growth estimated for each agency. Growth rates from 2010 to 2035 were provided by each agency. Planning growth rates from 2035 to 2060 are based on the average growth rate from the Governor's Office of Management and Budget (GOMB) for that time frame.

**Table 3-1
Planning Growth Rates for Agencies in the Service Area of the WWTP**

| Year | GOMB Predicted Percent Growth for City of Moab | GOMB Predicted Percent Growth for Grand County | GOMB Predicted Percent Growth for San Juan County | City of Moab Planning Percent Growth | GWSSA Planning Percent Growth | San Juan County Planning Percent Growth |
|------|--|--|---|--------------------------------------|-------------------------------|---|
| 2017 | -- | -- | | | | |
| 2020 | 1.11% | 1.11% | 0.59% | 1.10% | 2.00% | 2.00% |
| 2025 | 0.93% | 0.93% | -0.10% | 1.10% | 2.00% | 2.00% |
| 2030 | 0.93% | 0.93% | -0.10% | 1.10% | 2.00% | 2.00% |
| 2035 | 0.73% | 0.73% | -0.19% | 1.10% | 2.00% | 2.00% |
| 2040 | 0.73% | 0.73% | -0.19% | 1.02% | 2.00% | 2.00% |
| 2045 | 0.76% | 0.76% | 0.29% | 1.02% | 2.00% | 2.00% |
| 2050 | 0.76% | 0.76% | 0.29% | 1.02% | 2.00% | 2.00% |
| 2055 | 0.88% | 0.88% | 0.90% | 1.02% | 2.00% | 2.00% |
| 2060 | 0.88% | 0.88% | 0.90% | 1.02% | 2.00% | 2.00% |

The planning growth rates developed for each agency between 2010 and 2035 is higher than the predictions of the GOMB. In addition to the projected growth rate within each agency, two other significant sources of domestic wastewater contribute to Moab’s treatment plant: septage and the future Utah State University (USU) extension. Table 3-2 summarizes projected growth in ERUs anticipated for each agency along with increases in septage and contributions from USU (estimates provided by various affected agencies).

**Table 3-2
Projected Growth in ERUs for Service Area**

| Year | Moab¹ | San Juan County | GWSSA | GWSSA – USU² | Septage² | Total |
|-------------|-------------------------|------------------------|--------------|--------------------------------|----------------------------|--------------|
| 2017 | 5,467 | 0 | 2,707 | 0 | 35 | 8,209 |
| 2020 | 5,649 | 263 | 2,873 | 135 | 43 | 8,963 |
| 2025 | 5,967 | 291 | 3,172 | 473 | 51 | 9,953 |
| 2030 | 6,303 | 321 | 3,502 | 810 | 60 | 10,995 |
| 2035 | 6,657 | 354 | 3,866 | 1,148 | 68 | 12,094 |
| 2060 | 8,320 | 581 | 6,343 | 1,148 | 83 | 16,476 |

¹ Growth projections for Moab were provided by Moab personnel through 2035. Projections between 2035 and 2060 are based on GOMB growth rates. Growth rates for other agencies were maintained constant through 2060.

² includes ERUs associated with flow only.

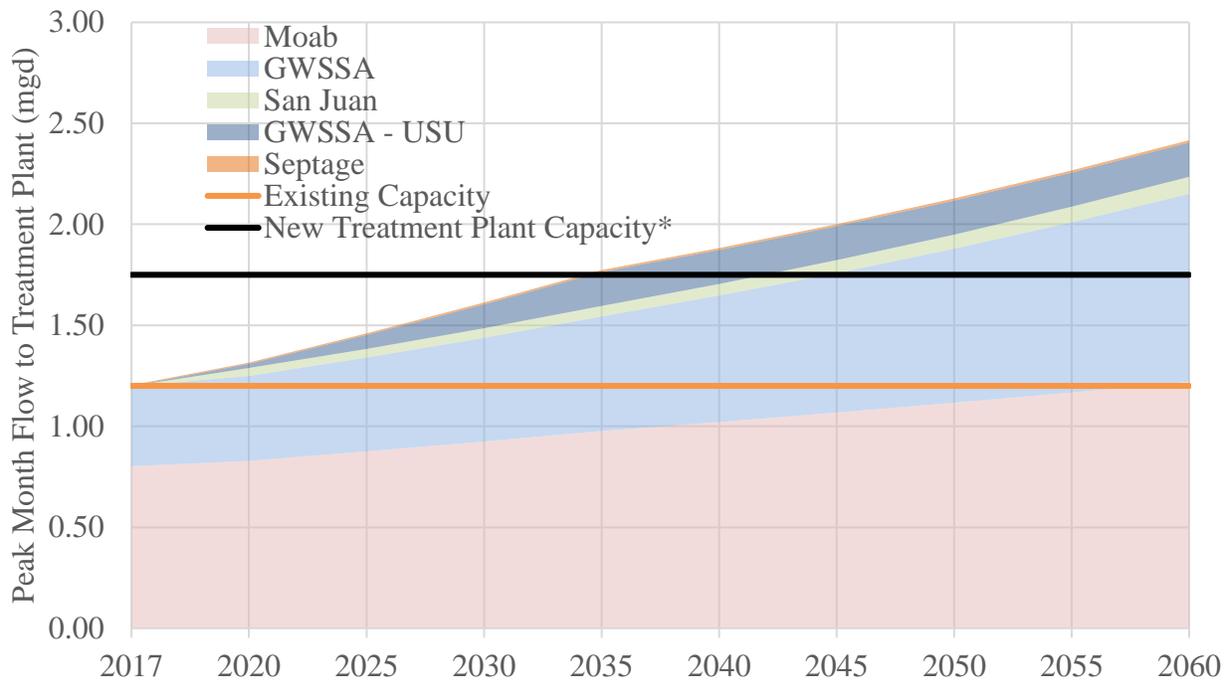
Table 3-2 includes only those equivalent residential units associated with typical residential flows and does not account for differences in biological oxygen demand associated with nonresidential uses. The City’s impact fee and rate studies account for these differences. For additional information on treatment ERUs, the reader should reference those studies. Table 3-3 and Figure 3-2 summarize projected peak monthly flows associated with future growth in the treatment plant service area.

**Table 3-3
Projected Peak Month Flows to Moab Treatment Plant* (MGD)**

| Year | Moab | San Juan | GWSSA | GWSSA - USU | Septage | Total |
|------|------|----------|-------|-------------|---------|-------|
| 2017 | 0.80 | 0.00 | 0.40 | 0.00 | 0.01 | 1.20 |
| 2020 | 0.83 | 0.04 | 0.42 | 0.02 | 0.01 | 1.31 |
| 2025 | 0.88 | 0.04 | 0.47 | 0.07 | 0.01 | 1.46 |
| 2030 | 0.92 | 0.05 | 0.51 | 0.12 | 0.01 | 1.61 |
| 2035 | 0.98 | 0.05 | 0.57 | 0.17 | 0.01 | 1.77 |
| 2060 | 1.22 | 0.09 | 0.93 | 0.17 | 0.01 | 2.42 |

*estimated peak month flow includes both infiltration and domestic production

**Figure 3-2
Peak Month Flow to Moab City Wastewater Treatment Plant**



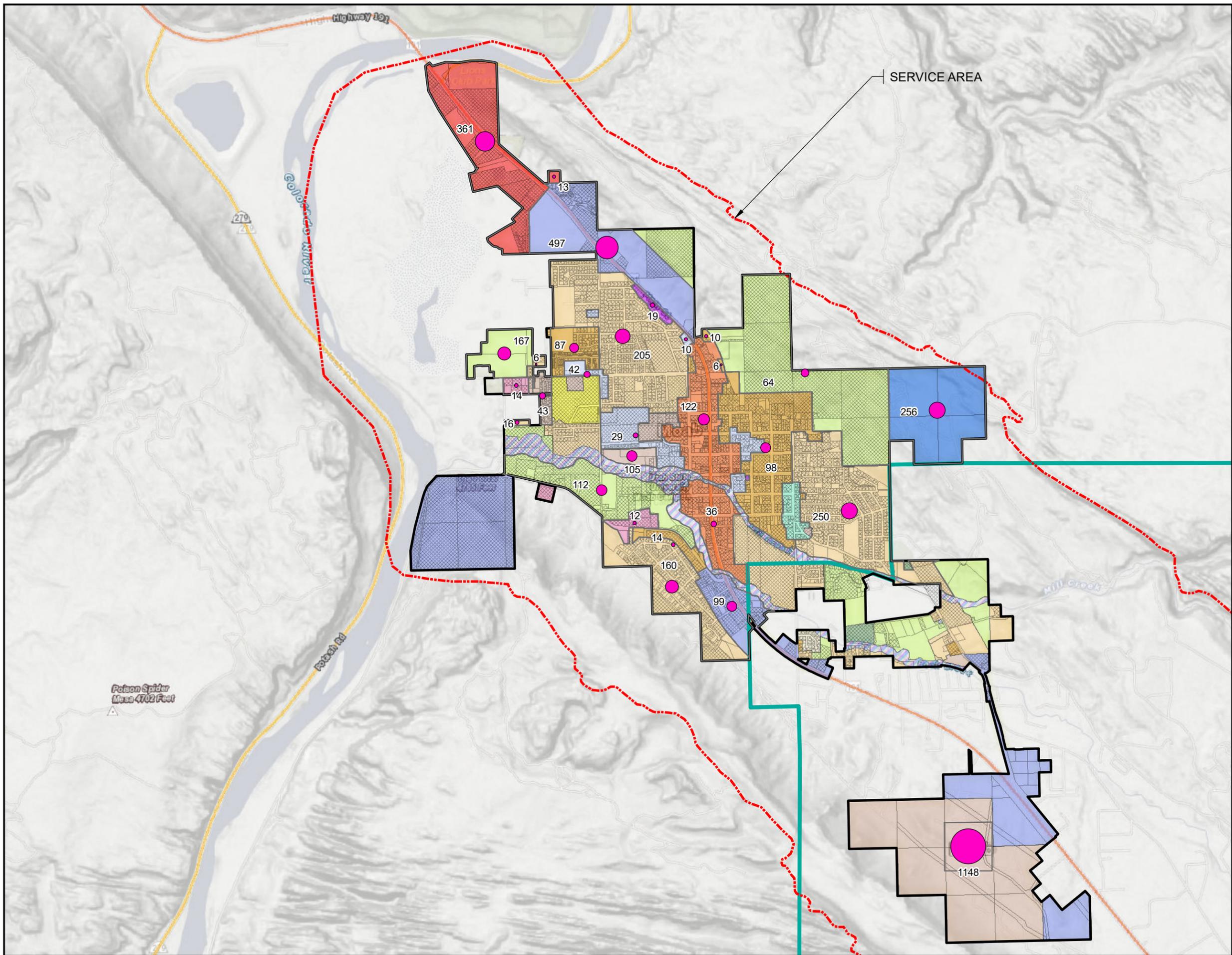
*Treatment plant capacity may include many different components, but in general can be represented as a flow capacity for peak month conditions

The existing treatment plant was designed and constructed with 1.5 mgd of capacity originally. However, due to high loading rates (of biological oxygen demand), the existing treatment plant has only sufficient capacity for existing wastewater. The new treatment plant will begin receiving wastewater in 2018 and has sufficient capacity to accommodate growth through approximately 2035 based on growth projections. There is also sufficient room on the new site if treatment standards increase and additional treatment facilities are needed.

WASTEWATER FLOW DISTRIBUTION

For hydraulic modeling purposes, projections of future flows must be distributed into the City's collection system. For existing conditions, flows were distributed based on winter water use records in combination with flow monitoring data. Additional detail regarding model calibration is provided in Chapter 4. For future growth, all flow from the GWSSA & San Juan County was assumed to follow a new sewer collection line that will eventually be constructed in U.S. Highway 191 (Main Street).

For growth within the City of Moab, BC&A evaluated the percentage of development for various parts of the existing City compared to the City's land use plan. Future growth was then added to the nearest available collection line assuming future collection lines will be extended to areas. Figure 3-3 shows the approximate distribution of future growth in the City.



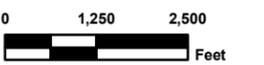
Legend

| Growth (ERUs) | | City Zoning | |
|---------------|---------------------------|-------------|---------|
| | 10 | | R-1 |
| | 100 | | R-2 |
| | 500 | | R-3 |
| | 1,000 | | R-4 |
| | City Limits Moab | | MH/RV-1 |
| | Spanish Valley | | RA-1 |
| | County Boundary | | A-2 |
| | GWSSA Boundary | | C-1 |
| | Developed / Undevelopable | | C-2 |
| | Undeveloped | | C-3 |
| | | | C-4 |
| | | | C-5 |
| | | | I-1 |
| | | | RC |
| | | | SAR |
| | | | FC-1 |

NORTH:



SCALE:



CITY OF MOAB LAND USE & ZONING

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

3-3

CHAPTER 4 HYDRAULIC MODELING

INTRODUCTION

A critical component in identifying required areas in the City 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 Innowyze's InfoSWMM software using data provided by the City. The purpose of this chapter is to present a summary of the methodology used to develop this model.

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

The City has spent considerable time assembling a GIS inventory of its existing sewer facilities. That database includes information on the location and size of manholes and pipelines in the City collection system. Based on direction from City personnel, pipeline and manhole data was taken directly from the GIS database for use in the model.

Pipe Flow Coefficients

Pipe flow coefficients used throughout the hydraulic model were assigned to have a Manning's coefficient of 0.013. This is approximately equal to the flow coefficient of concrete and clay pipe. While there are other materials in the system with lower published flow 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 not possible to identify the exact location and quantity of grease or debris accumulation in the system for 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 City collection system is based on

“clean” pipes, with an allowance for capacity lost to the accumulation of sediment (see Chapter 5).

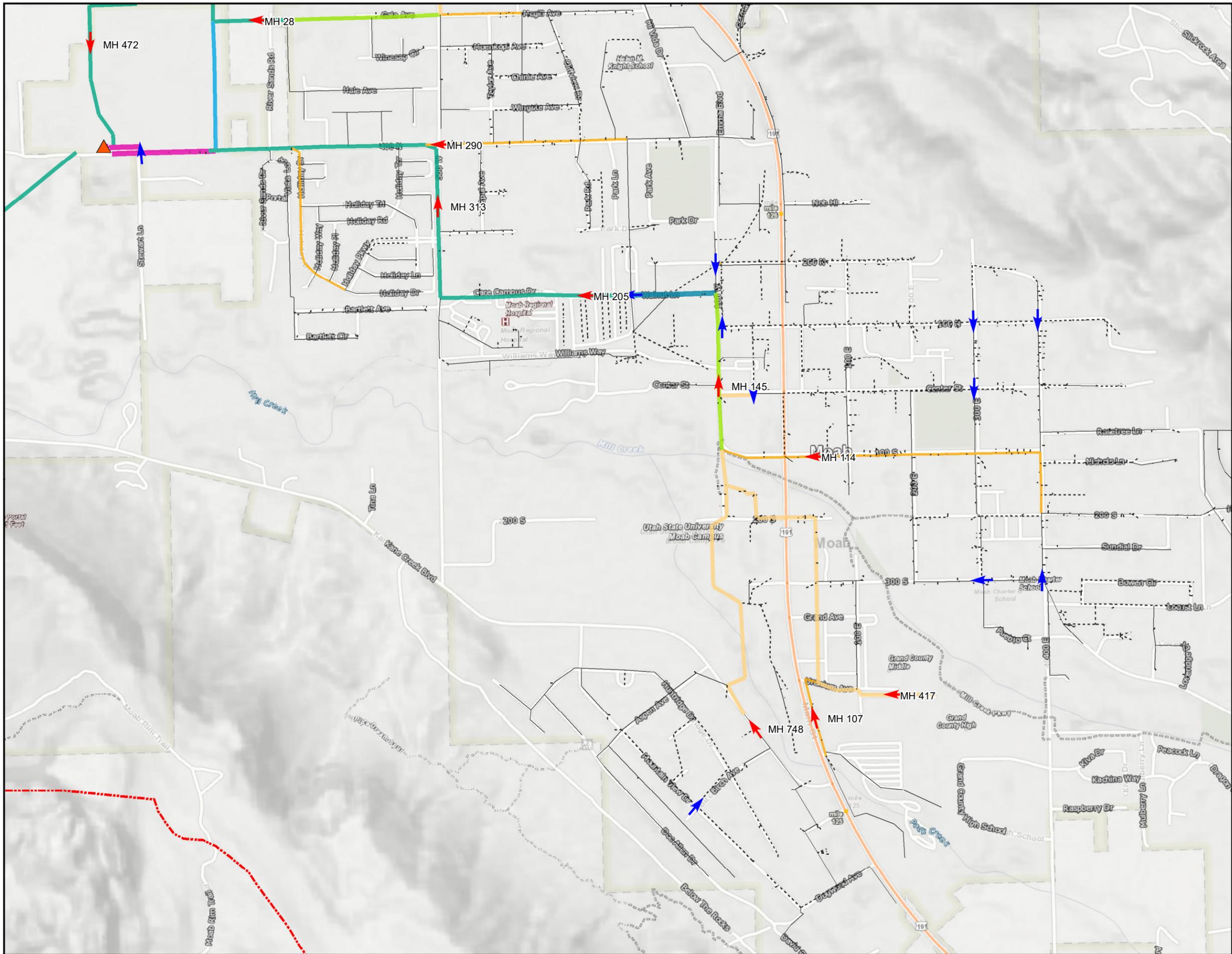
It should be noted that the hydraulic modeling software used to simulate the operation of the City wastewater collection system does have the ability to set sediment depth in pipes. Therefore, if the City does collect detailed sediment data for a given section of pipe, the sediment may be added to the model and its effects evaluated. However, it should be emphasized that any sediment levels defined today will change in the future as flow conditions change.

Overflows

There are a number of manholes that have two potential flow directions based on the available invert information provided by the City. In all cases, there is a primary flow direction where all flow is conveyed under dry weather conditions with a potential “overflow” direction primarily used for flushing lines and system maintenance. Table 4-1 lists the location of these potential overflows along with the primary flow direction which are indicated in Figure 4-1. These potential overflows were identified so that the hydraulic model would correctly simulate the proper flow path for wastewater through the collection system.

**Table 4-1
Manholes with Potential Overflow Directions**

| Manhole ID | Location | Main Flow Direction |
|-------------------|---|----------------------------|
| 220 | 400 N Stewart Ln (Overflow to the west. Typically flows north). GIS for west line may be inaccurate. | North |
| 204 | 250 E Walnut Ln (Overflow to the north. Typically flows west). North line currently plugged. | West |
| 139 | 100 W 200 North (Overflow to the southwest. Typically flows south). | South |
| 142 | 100 W 100 North (Overflow to the north. However, normal main flow direction is plugged to the west. All flow currently goes north through overflow). | North |
| 146 | 40 W Center Street (Overflow to the north. Typically flows south). North line has been capped. | South |
| 85 | 300 E Center Street (Overflow to the west. Typically flows south). | South |
| 83 | 300 E 100 North (Overflow to the west. Typically flows south). | South |
| 78 | 400 E 100 North (Overflow to the west. Typically flows south). | South |
| 319 | 300 E 300 South (Overflow to the north. Typically flows west). | West |
| 36 | 400 E 300 South (Overflow to the west. Typically flows north). | North |
| 200 | Birch Avenue and Mountain View Drive (Overflows to the northwest. Majority of flow goes northeast). | Northeast |



Legend

- Flow Monitoring Site
- Overflow Location**
- Primary Direction of Flow
- WWTP
- Existing Sewer Pipes**
- Diameter (inch)**
- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Spanish Valley

NORTH:

SCALE:

FLOW MONITORING & OVERFLOW LOCATIONS

CITY OF MOAB
SANITARY SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES
Celebrating 20 Years

FIGURE NO. **4-1**

FLOW DATA

Once all required geometric data was collected and a physical model of the system was developed, flow data was obtained to model the system hydraulics. Three types of flow information were required for hydraulic modeling: total magnitude of flow, timing of flow, and distribution of flow across the City service area. Each of these flow characteristics is discussed below.

Flow Monitoring

Several types of data were used to measure the total magnitude, timing, and distribution of wastewater flow for the service area: wastewater treatment plant flow data, indoor culinary water use data, and flow monitoring data. Flow monitors for the service area were selected along key trunk lines in the City with the aid of City personnel as shown in Figure 4-1. Additional discussion of each flow monitoring site is included in the Appendix.

Total Flow

Flow projections for the Moab service area were presented in detail in Chapter 3. Total flow for modeling scenarios examined here are summarized in Table 4-2.

**Table 4-2
Hydraulic Modeling Scenario Total Daily Flow Volumes**

| Scenario | 2017 | 2060 |
|--|------|------|
| Peak Month Dry Weather Flow & Infiltration (mgd) | 1.20 | 2.42 |
| Peak Day Dry Weather Flow & Infiltration (mgd) | 1.50 | 3.63 |
| Peak Day / Peak Month Factor | 1.25 | 1.25 |

Timing of Flow

Both Peak Month and Peak Day dry weather flow/infiltration is shown in Table 4-2. Peak month represents the average daily flow during the peak month of the year. Peak Day dry weather flow represents the peak day of flow during the year. Peak month data is primarily used for sizing of components at the City’s wastewater treatment plant, while peak day data is used for collection system capacity evaluations. Flow monitoring data collected as part of this study identified a peaking daily factor of approximately 1.25 compared to peak month average daily flows. In addition to the peak day to peak month factor, flow monitoring data was also used to identify hourly fluctuations in wastewater production. To predict the magnitude and timing of peak flows in the model, it is important to understand how flow varies throughout the day. This is different for each component of wastewater flow.

Domestic Wastewater – The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. These patterns vary depending on the type of user. Weekday and Weekend patterns for the Moab have very distinct differences and the weekend typically has a higher magnitude and peaking factor than weekdays based on flow monitoring observations. Typical

diurnal patterns for weekend wastewater production are shown in Figure 4-2. Figure 4-2 includes flow monitoring patterns observed at several locations in the City. Ordinarily, it is sometimes useful to flow monitor different types of development to establish a “typical” pattern for use such as residential, commercial, or institutional. The City of Moab, however, has a diverse mix of development types that discharge to the several trunk lines selected for flow monitoring. Only one of the flow monitor locations represent a mostly uniform tributary area (installed at manhole #114 or MH 114) that is mostly residential. MH 290 captures the discharge from mixed development, but appears to represent a large portion of institutional type use based on the peak occurring around noon. This may be a result of the upstream elementary school (Helen M. Knight Elementary).

As can be seen in the figure, peak residential wastewater production typically occurs around 9 a.m. as residents prepare for the day, with a smaller peak occurring around 8 p.m. as residents clean up and prepare for bed.

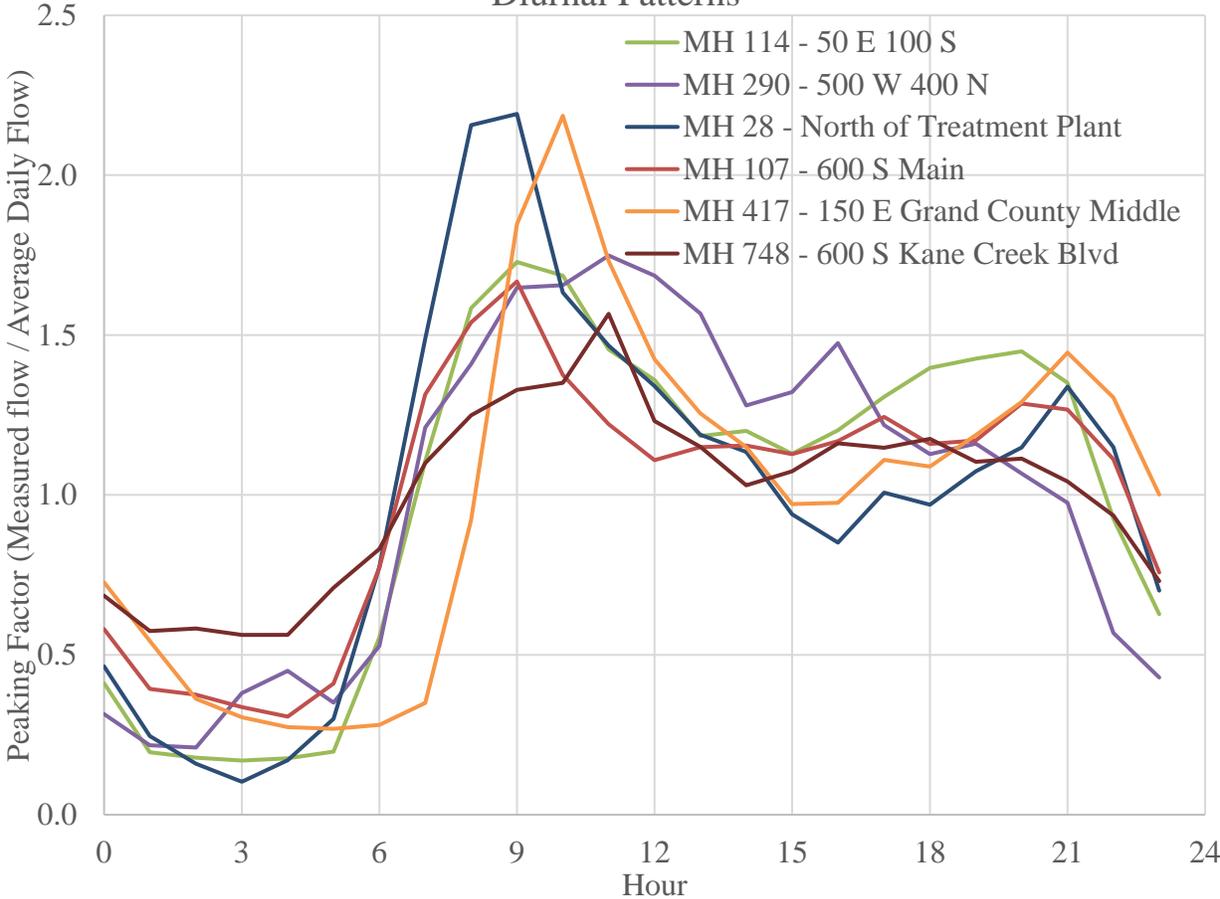
Patterns are also shown for lines coming into the treatment plant from the North (MH 28 and MH 472). These patterns are unique in that they include several Hotels and RV parks along the Highway. Other patterns include lines coming into the system from the south (Labeled “MH 107”, “MH 417”, and “MH 748” for the manhole where the flow monitor was installed). These bring in flows from Grand County and San Juan County.

Infiltration – 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.

Inflow – For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible in the City. For design purposes, the City has included a capacity allowance in its design criteria to account for inflow into its collection system.

Table 4-3 shows the peaking factors used for each hour that represent the patterns used in the hydraulic model. Diurnal patterns represent existing use and were applied to growth in domestic wastewater for areas upstream of the flow monitors so that the pattern of use for future use is approximated by existing use patterns.

Figure 4-2
Diurnal Patterns



**Table 4-3
Moab Service Area Diurnal Patterns**

| Hydraulic Model Diurnal PatternsHour | MH 114 (50 E 100 S) | MH 290 (500 W 400 N from East) | MH 28 - North of Treatment Plant | MH 107 - 600 S Main St | MH 417 - 150 E Grand County Middle | MH 748 600 S Kane Creek Blvd |
|---|----------------------------|---------------------------------------|---|-------------------------------|---|-------------------------------------|
| 0 | 0.41 | 0.31 | 0.46 | 0.58 | 0.73 | 0.68 |
| 1 | 0.20 | 0.22 | 0.25 | 0.39 | 0.54 | 0.57 |
| 2 | 0.18 | 0.21 | 0.16 | 0.38 | 0.36 | 0.58 |
| 3 | 0.17 | 0.38 | 0.10 | 0.34 | 0.31 | 0.56 |
| 4 | 0.18 | 0.45 | 0.17 | 0.31 | 0.27 | 0.56 |
| 5 | 0.20 | 0.35 | 0.30 | 0.41 | 0.27 | 0.71 |
| 6 | 0.55 | 0.53 | 0.78 | 0.77 | 0.28 | 0.83 |
| 7 | 1.11 | 1.21 | 1.49 | 1.32 | 0.35 | 1.10 |
| 8 | 1.58 | 1.41 | 2.16 | 1.54 | 0.92 | 1.25 |
| 9 | 1.73 | 1.65 | 2.19 | 1.67 | 1.85 | 1.33 |
| 10 | 1.69 | 1.66 | 1.63 | 1.38 | 2.19 | 1.35 |
| 11 | 1.45 | 1.75 | 1.47 | 1.22 | 1.73 | 1.57 |
| 12 | 1.36 | 1.69 | 1.34 | 1.11 | 1.42 | 1.23 |
| 13 | 1.18 | 1.57 | 1.19 | 1.15 | 1.26 | 1.15 |
| 14 | 1.20 | 1.28 | 1.13 | 1.15 | 1.15 | 1.03 |
| 15 | 1.13 | 1.32 | 0.94 | 1.13 | 0.97 | 1.07 |
| 16 | 1.20 | 1.48 | 0.85 | 1.17 | 0.98 | 1.16 |
| 17 | 1.31 | 1.22 | 1.01 | 1.24 | 1.11 | 1.15 |
| 18 | 1.40 | 1.13 | 0.97 | 1.16 | 1.09 | 1.18 |
| 19 | 1.43 | 1.16 | 1.07 | 1.17 | 1.19 | 1.10 |
| 20 | 1.45 | 1.07 | 1.15 | 1.29 | 1.29 | 1.11 |
| 21 | 1.35 | 0.98 | 1.34 | 1.27 | 1.45 | 1.04 |
| 22 | 0.93 | 0.57 | 1.15 | 1.11 | 1.30 | 0.94 |
| 23 | 0.63 | 0.43 | 0.70 | 0.76 | 1.00 | 0.73 |
| 24 | 0.41 | 0.31 | 0.46 | 0.58 | 0.73 | 0.68 |

Based on the diurnal patterns used above, peak flows simulated in the model are summarized in Table 4-4.

**Table 4-4
Hydraulic Modeling Scenario Peak Hour Flows (mgd)**

| Scenario | 2017* | 2060* |
|------------------|-------|-------|
| Dry Weather Flow | 2.56 | 4.89 |

*Peak hour WWTP inflow from extended period simulation which accounts for attenuation in the system

Distribution of Flow

With flow magnitude and timing estimated, the final step in developing flow data for the model is distributing it spatially across the City:

Domestic Wastewater – Existing domestic sewer flows included in the hydraulic model were distributed based on winter water use data for the Moab service area. Water billing data collected across the City were assigned to the nearest manhole assuming that the sewer connections from the various culinary water meters would flow to the same manhole. Metered demands which have some inherent inaccuracies with underreporting were factored up to match the estimated domestic production for the City as measured with flow monitors. Future growth of domestic sewer flow was distributed based on estimates of overall growth, landuse, and percentage development. While there will likely be some redevelopment within the City, future growth has been assigned to undeveloped areas of the Moab service area. Growth in domestic wastewater from GWSSA was assumed to growth primarily along SR91.

Infiltration – Existing infiltration was distributed using flow monitoring data collected at the locations shown in Figure 4-1 Table 4-5 shows the total infiltration added to the model at and upstream of the following flow monitoring sites.

**Table 4-5
Hydraulic Modeling Scenario Infiltration Flows (gpm)**

| Manhole Id | Infiltration (gpm) |
|-------------------|---------------------------|
| 28 | 35 |
| 114 | 30 |
| 290 | 20 |
| 313 | 50 |
| 472 | 20 |
| Total | 155 |

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 indoor water billing data and available flow meter data from various locations throughout the City. A comparison of model simulation results against the flow monitoring recordings appears to indicate that, in general, the model is reproducing system conditions within a reasonable level of accuracy. However, model adjustments were made where possible in order to better match the flow monitoring data. Final results for several sample flow monitoring location are shown in Figures 4-3 through 4-5.

As part of initial calibration, indoor water billing records were used to estimate and distribute domestic wastewater for the Moab service area. In cases where the majority of flow comes from GWSSA (Manholes 107, 417, 748), only flow monitoring data was available for estimating wastewater. No distinction is made between domestic production and infiltration in these cases.

It should be understood that the hydraulic model developed for this study relies on the available geometric data provided by the City. The City should continue to update this hydraulic model based on new survey information at least once a year to ensure it reflects current conditions.

Figure 4-3
Observed vs Simulated Flow at Manhole 313 (500 W 300 N)

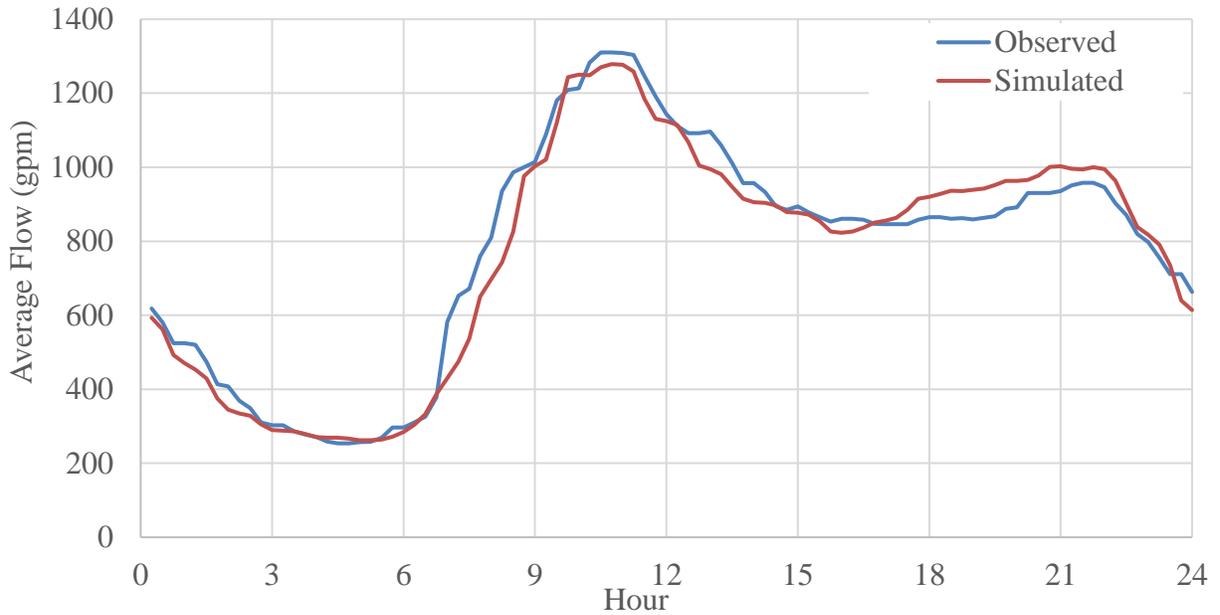


Figure 4-4
Observed vs Simulated Flow at Manhole 290 (500 W 400 N)

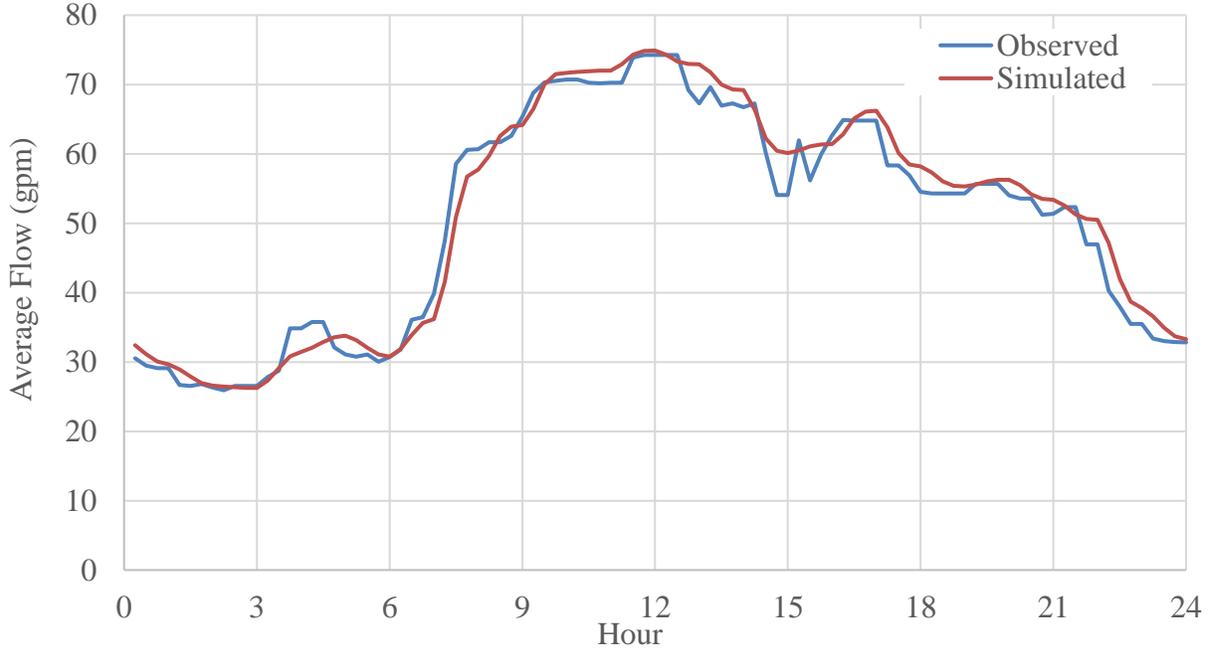
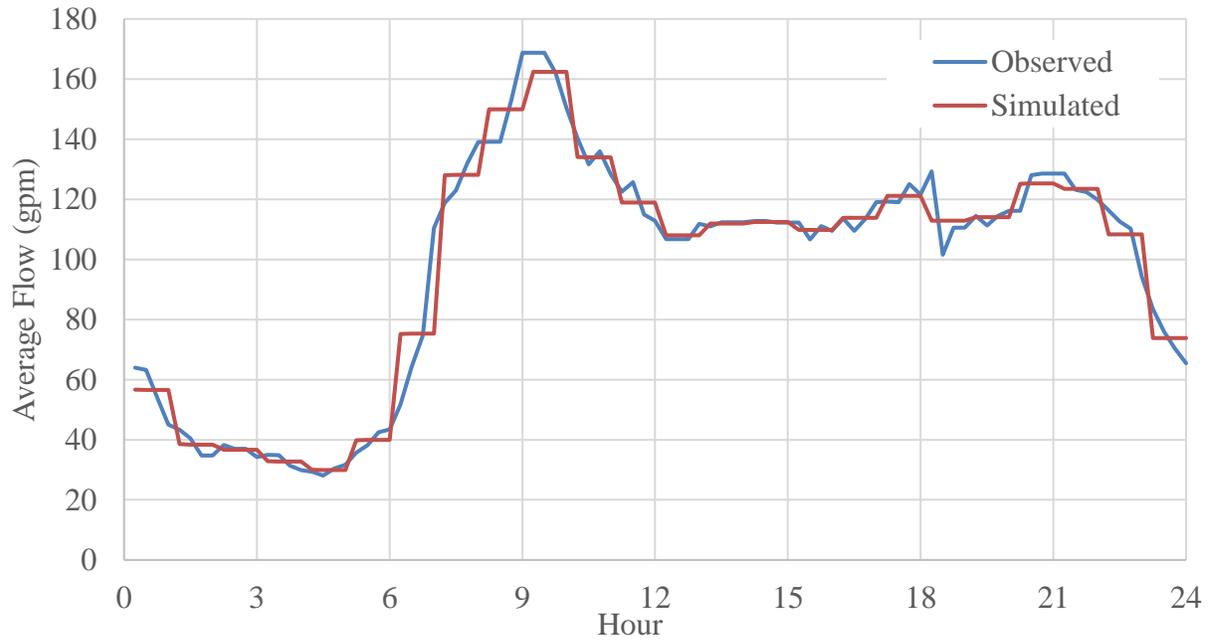


Figure 4-5
Observed vs Simulated Flow at Manhole 107 (600 S Main St)



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.

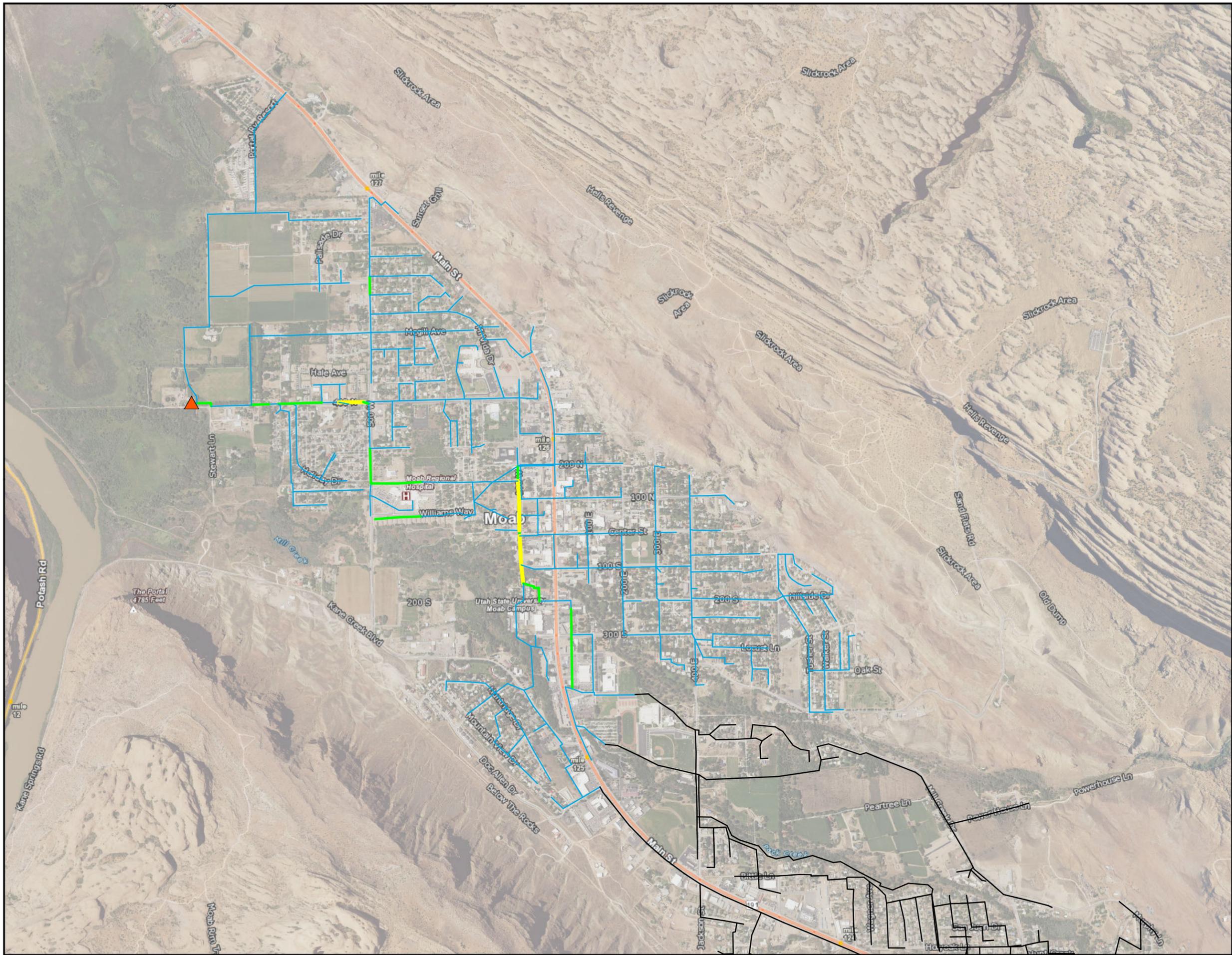
EVALUATION CRITERIA

In defining what constitutes a hydraulic deficiency, it is important to consider the assumptions made in estimating sewer flows in the model. As described in Chapters 3 and 4, the sewer flow included in the model is composed of two parts: domestic sewer flow and infiltration. These inputs are based on available historic data. Because these estimates are based on average values and a limited data set, actual flows will fluctuate and may be greater than the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model (e.g. 1983 was a statewide historically wet year that led to high infiltration and flooding in many areas). The criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model. The following criteria have been established to identify capacity deficiencies in the system:

- **Pipeline Capacity** – The most important deficiency to eliminate in the sewer system is inadequate capacity. The City has adopted design criteria for its collection system to account for higher peaking factors in smaller collection lines that may not affect larger collection lines as much. The design criteria for pipes 15-inch and smaller requires the depth of flow in the pipe to be less than 50 percent of the pipe diameter. For pipes larger than 15-inch, the depth of flow in the pipe is required to be less than 75 percent of the pipe diameter. The remaining capacity in the pipe is reserved for inflow and/or unaccounted for fluctuations in domestic flow and infiltration. A manning’s roughness value of 0.013 was used for all collection pipes to conservatively calculate capacity.
- **Lift Station Capacity** – A lift station capacity deficiency is defined as anytime dry weather peak hour flows exceed 85 percent of the lift station’s primary pumping capacity. Note that all lift stations are required to have at least one backup pump in case of mechanical failure or significant inflow from wet weather events.

EXISTING SYSTEM ANALYSIS

Figure 5-1 displays the hydraulic capacity of the sewer system under existing peak hour flow conditions with the maximum depth at any point along the length of the pipe. Pipes in the figure are color coded to show the ratio of maximum depth in the pipe to the pipe’s full depth. Based on peak flow and pipe capacities alone, the only area of the City that does not meet the City’s design criteria is along 100 West from Millcreek to Walnut Lane. Beyond the capacity deficiencies identified along 100 West, flow monitoring conducted along 100 West also identified irregular flow conditions (various depths for the same flow rate) that may be the result of poor pipe conditions.



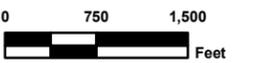
LEGEND

-  WWTP
-  GWSSA Pipes
- City of Moab Sewer Pipes (2017)**
Peak discharge depth/ pipe diameter
-  Less than 0.4
-  0.4~0.5
-  0.5~0.65
-  0.65~0.75
-  Greater than 0.75

NORTH:



SCALE:



YEAR 2017 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

5-1

No lift station deficiencies were observed in the existing sewer system in relation to capacity concerns.

City personnel have expressed concerns about some of the private lift stations in the City. While many private lift stations are supposed to be operated and maintained by the private property owner, City personnel often assist with maintenance or replacement of private lift station components. Where possible, the City would like to eliminate private lift stations to improve maintenance and limit potential sanitary sewer overflow conditions (see Appendix – Technical Memo – Northwest lift station). As the City grows, the City will also explore options to eliminate septic connections where feasible.

FUTURE SYSTEM ANALYSIS

Figures 5-2 through 5-4 show the hydraulic performance as calculated by the hydraulic model for sewer flows as projected through full buildout conditions if no improvements are made to the existing system. These results assume that sewer flows associated with future development will flow to the nearest manhole in the existing system. While the majority of the system under buildout conditions has ample capacity, some significant deficiencies have been observed in the model results. Most are the result of growth in the GWSSA service area and deficiencies follow the main trunk line to the City’s wastewater treatment plant. Figures 5-2 and 5-3 help identify how soon some of the deficiencies will occur.

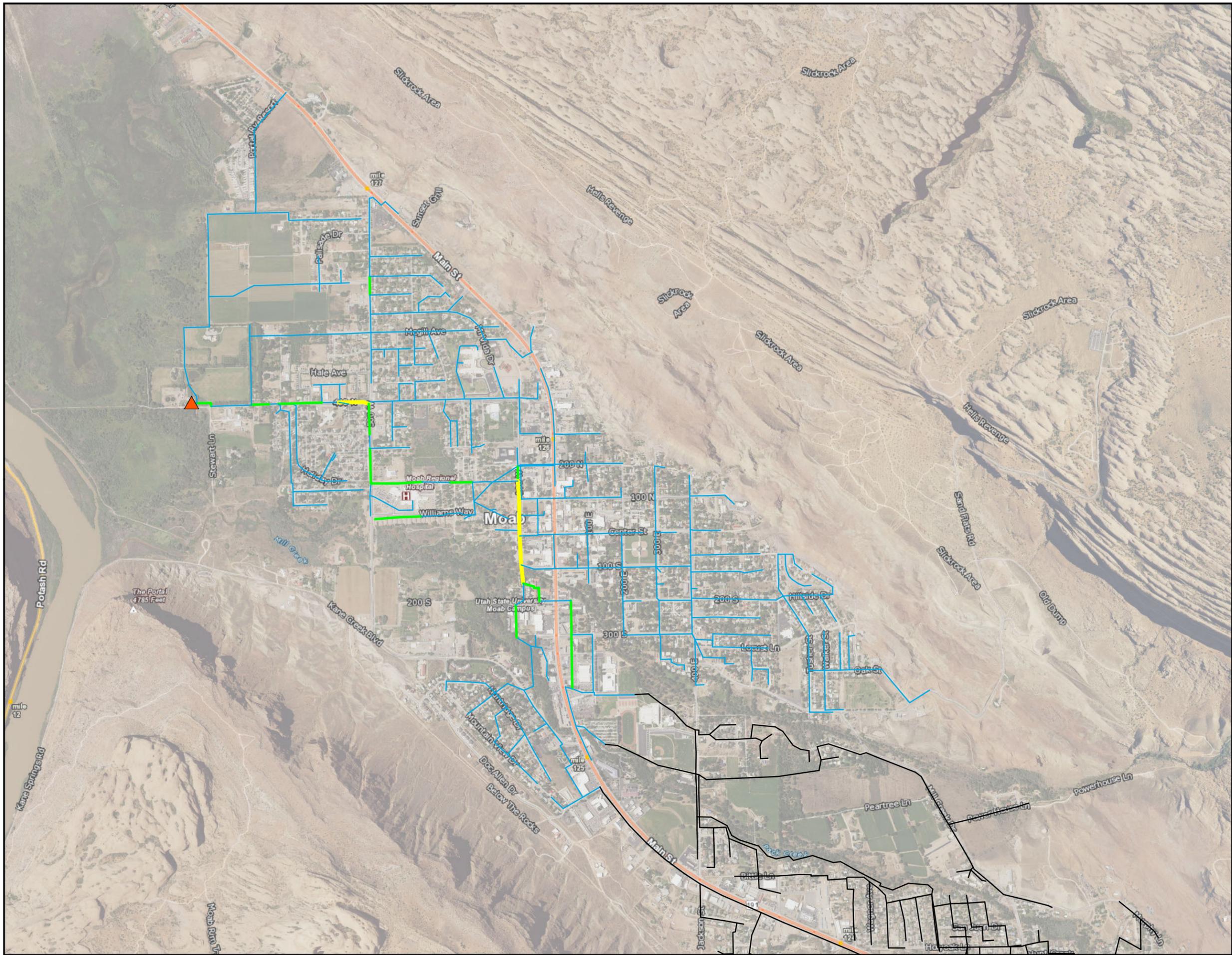
Lift Station Deficiencies

Table 5-1 summarizes the projected buildout flow to the City owned lift stations.

**Table 5-1
Summary of Sewer Lift Stations**

| Location | Design Capacity (gpm) | Existing Dry Weather Peak Flow (gpm) | 2060 Dry Weather Peak Flow (gpm) |
|--------------------|------------------------------|---|---|
| Lions Park | 68 | 13 | 13 |
| 500 W Williams Way | 108 | 10 | 22 |

Based on the limited flow to these lift stations, there is no projected hydraulic deficiency even for growth through 2060. The 500 W. Williams Way lift station may eventually be de-commissioned once a lower gravity pipe is installed in the future (the South trunk line).



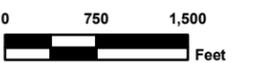
LEGEND

- ▲ WWTP
- GWSSA Pipes
- City of Moab Sewer Pipes (2022)**
Peak discharge depth/ pipe diameter
- Less than 0.4
- 0.4~0.5
- 0.5~0.65
- 0.65~0.75
- Greater than 0.75

NORTH:



SCALE:



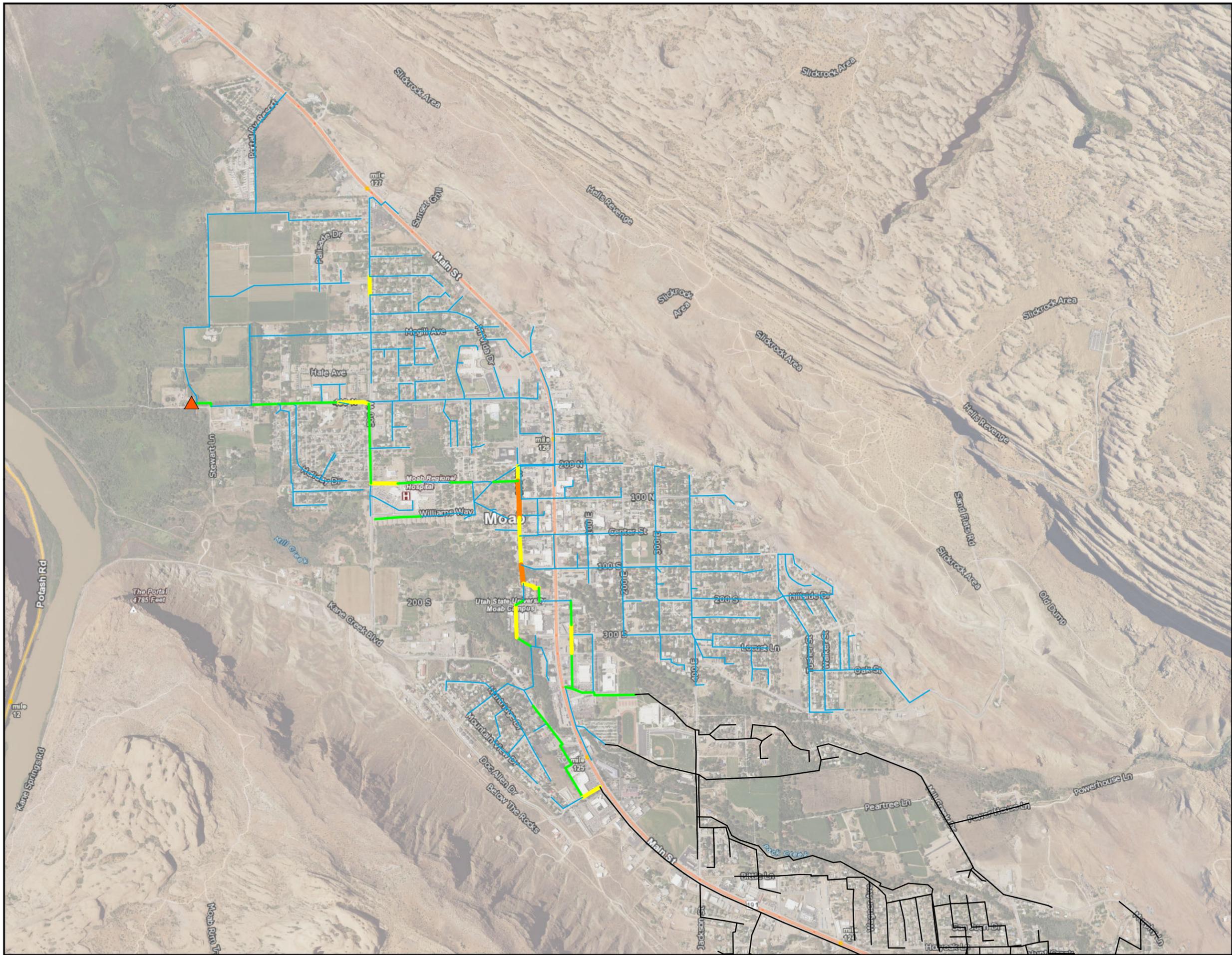
YEAR 2022 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

5-2



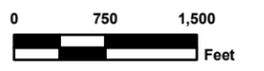
LEGEND

-  WWTP
-  GWSSA Pipes
- City of Moab Sewer Pipes (2030)**
Peak discharge depth/ pipe diameter
-  Less than 0.4
-  0.4~0.5
-  0.5~0.65
-  0.65~0.75
-  Greater than 0.75

NORTH:



SCALE:



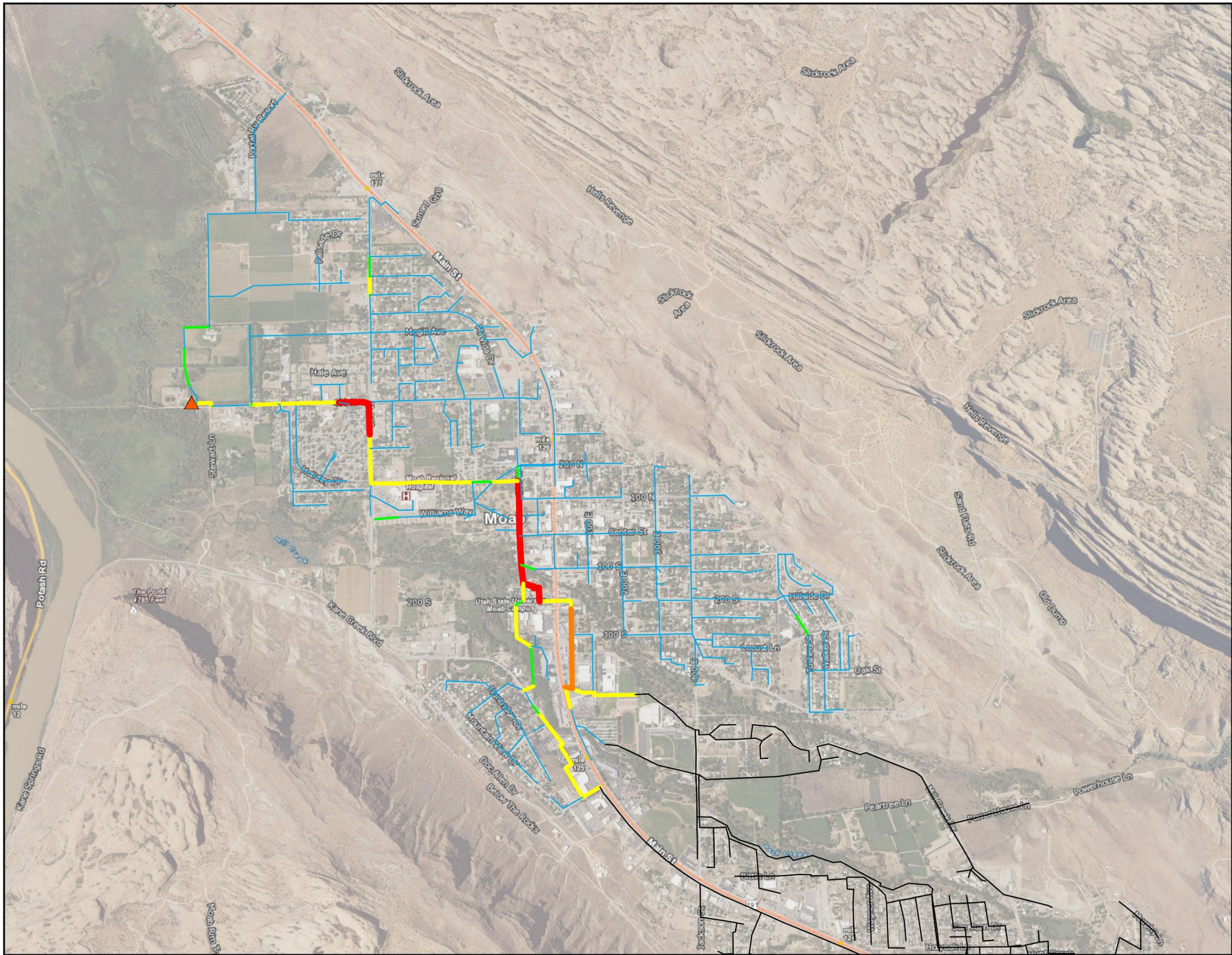
YEAR 2030 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

5-3



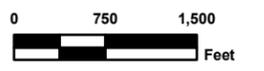
LEGEND

-  WWTP
-  GWSSA Pipes
- City of Moab Sewer Pipes (2060)**
Peak discharge depth/ pipe diameter
-  Less than 0.4
-  0.4~0.5
-  0.5~0.65
-  0.65~0.75
-  Greater than 0.75

NORTH:



SCALE:



YEAR 2060 PIPE CAPACITIES

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

5-4

CHAPTER 6 SYSTEM IMPROVEMENTS

The hydraulic model results have identified potential deficiencies in the sewer system under existing and build-out conditions. This chapter covers system improvements intended to solve deficiencies as the City approaches build-out. Once design of sewer mains commences, the design pipe capacity should be based on projected build-out flows. Improvements are organized in this chapter by locations, and priority of each project is chosen based on the predicted necessity.

COLLECTION SYSTEM CAPACITY IMPROVEMENTS

Four system improvements have been identified to resolve hydraulic deficiencies and improve system operation as identified in Figure 6-1.

Project 1 – 100 West, Mill Creek to Walnut Lane – The existing sewer collection line on 100 West has condition related problems that will require the pipe to be replaced. Connections that tie into the sewer line at adverse angles will be corrected to improve flow conditions. The pipe will also be upsized to accommodate short-term growth until a future southwest trunk line can be constructed.

Project 2 – Northwest Lift Station & Trunk – The City will construct a new lift station and gravity trunk line near the Aarchway Inn & Holiday Inn Express to eliminate the two private lift stations at those properties. The new sewer trunk and lift station will also be used to eliminate the septic system at the Moab RV park (see Appendix – Technical Memorandum – Northwest Lift Station).

Project 3 – South Trunk Line – A new trunk line will be constructed from near Uranium Avenue and Main Street following on the west side of Pack Creek toward the treatment plant. This trunk line will be the primary receiving line for existing and future wastewater from GWSSA. In addition, this trunk line will enable development west of Pack Creek which is currently constrained by limits on septic connections. Existing septic systems west of Pack Creek will also be converted to gravity connections as funding is available.

Project 4 – 1000 North, 500 West to Rubicon Trail – A new 12-inch sewer line will be constructed to divert flows from 500 West to the existing 15-inch trunk line near the Portal RV Resort. This will prevent pipes further downstream on 500 West from exceeding capacity in the future.

Table 6-1 summarizes costs estimates for the proposed projects.



LEGEND

- Future Lift Station
- ▲ WWTP

System Improvement (inch)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"

- Existing Sewer Pipes
- Spanish Valley

NORTH:

SCALE:

PROPOSED SYSTEM IMPROVEMENTS

CITY OF MOAB SANITARY SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES
Celebrating 20 Years

FIGURE NO.
6-1

**Table 6-1
Proposed System Improvements**

| ID | Name | Diameter (inch) | Length (ft) | Total Construction Cost Estimate | Engineering / Admin (15 percent) | Total Project Cost Estimate |
|-----------|-------------------------------------|----------------------------|------------------------|---|---|--|
| 1.1 | 100 West ¹ | 21 | 1,700 | \$755,000 | \$113,000 | \$868,000 |
| 2.1 | Northwest Trunk | 15 | 4,133 | \$992,000 | \$149,000 | \$1,141,000 |
| 2.2 | Northwest Lift Station ² | | | \$320,000 | \$48,000 | \$368,000 |
| 2 | Subtotal Project 2 | | | \$1,312,000 | \$197,000 | \$1,509,000 |
| 3.1 | 1000 North, 500 W to Rb. | 12 | 1,860 | \$141,000 | \$21,000 | \$162,000 |
| 4.1 | South Trunk | 24 | 9,770 | \$4,769,000 | \$715,000 | \$5,484,000 |
| | Total | | | \$6,977,000 | \$1,046,000 | \$8,023,000 |

¹ Includes cost of replacing the existing Mill Creek siphon.

² the required capacity of the Northwest lift station is estimated to be 750 gpm (see Appendix “Northwest Lift Station Memo”). Cost estimated with “Pump Station Design Manual” (2nd Edition, Sanks et al) figure 29-9 adjusted to 2017 dollars.

CHAPTER 7

CAPITAL IMPROVEMENT PLAN

Previous chapters of this report have identified improvements to resolve existing 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 City goals. This will include recommendations regarding levels of funding for system rehabilitation, replacement, and capital improvement projects.

SYSTEM REHABILITATION AND REPLACEMENT

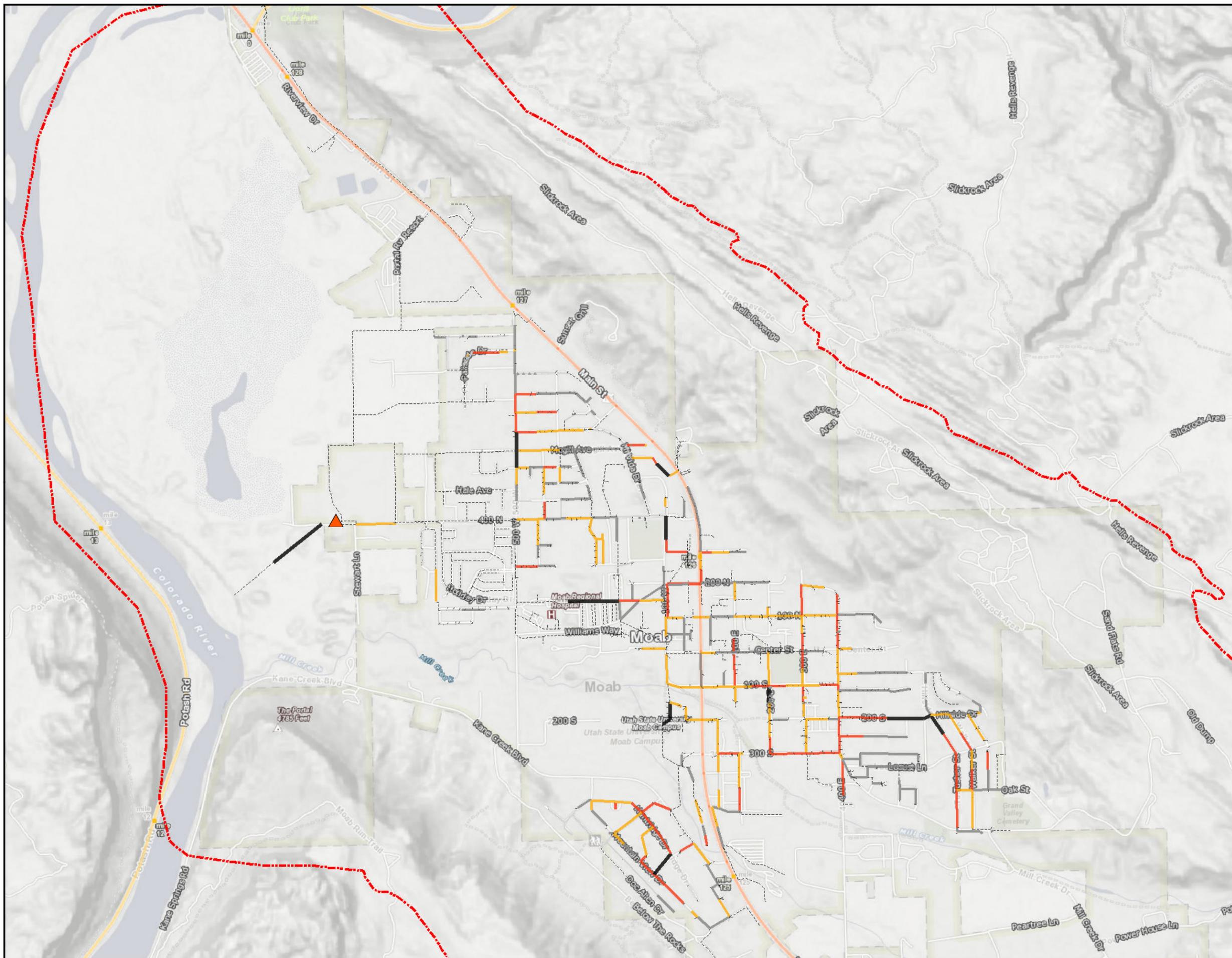
In order to assemble a 10-year capital improvement plan, it is not adequate to consider only capacity related improvements. It is also necessary to budget for the expected rehabilitation and replacement of system components.

Concrete Pipe Assessment and Rehabilitation

One major category of concern relative to sewer system rehabilitation and replacement is the corrosion of existing concrete pipe. Hydrogen sulfide gas in a sewer system can result in the formation of sulfuric acid (H_2SO_4) on pipe and manhole walls. Sulfuric acid can result in severe corrosion of ferrous metals and concrete. The top of a moist concrete pipe is a common area for the formation of sulfuric acid and corresponding corrosion. This is a significant concern for Moab because most of the City's large diameter collection lines are constructed of concrete pipe.

The City regularly videos its collection system and has scored the condition of pipe for various parameters including: wall condition, pipe appearance (cleanliness), pipe joints, roots, ponding (grade), and pests. All of these parameters are important, but capital projects will primarily arise as a function of wall condition. Figure 7-1 and Table 7-1 summarizes wall condition assessments for City pipelines that have been inspected. The higher the number, the worse the pipe condition. Pipes with a score of "0" in Figure 1 represent areas that have not yet been inspected (roughly 40 percent of 6-inch and greater pipes) for maintenance or rehab concerns.

In general, the City has tried to prioritize pipe inspections in those areas where operation personnel believe there may be condition related problems. To estimate the amount of uninspected pipe that may have severe or critical wall conditions, the percentage of inspected pipes with severe or critical pipe conditions was calculated. This percentage was then applied to the uninspected pipe length at a ratio of 0.5 to estimate how much of the uninspected pipe has severe or critical wall conditions. Table 7-2 shows the estimated pipe length of uninspected pipe for each diameter that may have severe or critical wall conditions. The City will be trained to use the Pipeline Assessment Certification Program (PACP), a program to improve pipe condition assessment, in the near future and has a goal to inspect all City pipe using PACP techniques within the next two to three years.



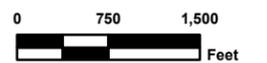
LEGEND

- WWTP
- Existing Sewer Pipes**
- Wall Condition Score**
- 0 - No Data
- 1 - Good
- 2 - Mild
- 3 - Medium
- 4 - Severe
- 5 - Critical
- Spanish Valley

NORTH:



SCALE:



SEWER PIPE WALL CONDITION

CITY OF MOAB
SANITARY SEWER MASTER PLAN



FIGURE NO.

7-1

Based on the City’s wall condition scoring, pipelines that exhibit a critical condition assessment (score 5) should be prioritized for replacement as soon as possible with larger diameter pipelines first. Pipes with a severe condition assessment (score 4) or less can likely be rehabilitated with cast-in-place pipe (CIPP). Table 7-3 summarizes potential costs to rehab or replace pipes with severe or critical wall conditions.

**Table 7-1
Summary of Wall Condition Scores**

| Diameter (in) | Length of Pipe (ft) for Wall Condition Score | | | | | |
|---------------|--|--------------------|-----------------------------|-------------------------------|-------------------------------|---------------------------------|
| | 0 – No Data | 1 – Good Condition | 2 – Mild Condition Concerns | 3 – Medium Condition Concerns | 4 – Severe Condition Concerns | 5 – Critical Condition Concerns |
| 4 | 9,237 | 0 | 307 | 142 | 0 | 0 |
| 6 | 9,039 | 1,819 | 13,097 | 6,429 | 3,737 | 438 |
| 8 | 27,087 | 10,493 | 16,749 | 14,031 | 14,140 | 2,404 |
| 10 | 1,801 | 361 | 1,424 | 4,330 | 936 | 0 |
| 12 | 3,363 | 281 | 372 | 2,101 | 307 | 730 |
| 15 | 3,278 | 0 | 0 | 798 | 0 | 0 |
| 18 | 10,174 | 0 | 0 | 0 | 0 | 1,832 |
| 21 | 1,125 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 407 | 340 | 0 |
| 27 | 325 | 0 | 0 | 0 | 0 | 0 |
| 30 | 257 | 0 | 0 | 657 | 0 | 0 |
| Total | 56,447 | 12,954 | 31,643 | 28,753 | 19,460 | 5,405 |

**Table 7-2
Estimated Length of Uninspected Pipe with Condition Concerns**

| Diameter (in) | 4 – Severe Condition Concerns (ft) | 5 – Critical Condition Concerns |
|---------------|------------------------------------|---------------------------------|
| 6 | 662 | 78 |
| 8 | 3,312 | 563 |
| 10 | 119 | 0 |
| 12 | 136 | 324 |
| 18 | 0 | 5,087 |
| Total | 4,230 | 6,052 |

**Table 7-3
Summary of Rehab/Replacement Costs for
Severe and Critical Wall Condition Pipes**

| Diameter (in) | Severe Condition¹ | Critical Condition¹ |
|--------------------------|---|---|
| 6 | \$219,798 | \$136,054 |
| 8 | \$871,987 | \$782,560 |
| 10 | \$58,659 | \$0 |
| 12 | \$27,125 | \$310,022 |
| 18 | \$0 | \$2,524,420 |
| 24 | \$50,991 | \$0 |
| Total | \$1,228,560 | \$3,753,056 |

¹ – assumes severe pipes are rehabilitated and critical pipes are replaced

System Rehabilitation and Replacement Priorities

Because funding is always limited, it is important to prioritize initial system rehabilitation efforts based on the potential consequence of a pipe not performing as designed. The following criteria may be helpful to City personnel in identifying pipes that are most critical based on their relative importance in the collection system:

- Sewer Flow Rate – Flow rate in a sewer pipe is the single most important indicator of the importance of a pipe. Generally speaking, the higher the flow rate, the larger the area which a pipe serves. Bypass pumping costs, the risk of property damage, environmental and regulatory consequences, the cost of pipe replacement, and problems from sewage up in the system are all more severe for larger flow rates. In a worst case scenario, if a pipe collapses or becomes blocked and surcharging in the pipeline results in flows backing up into basements and streets, there is a much greater health hazard to the public with a high flow pipe.
- Road Type – It is much more difficult and costly to perform sewer line repairs on streets with dense traffic. Therefore, pipelines located in high traffic areas should be considered more critical than lower traffic areas. For example, the cost of pipe failure along State Route 191 (Main Street) would be much greater than an equivalent sized pipe located on a residential street.
- Pipe Depth – 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, dewatering, etc. make repairs and maintenance much more expensive and time consuming on deeper pipes. Repairing such pipes under an emergency situation would only be that more difficult. For this reason, deep pipelines should be prioritized over shallow pipelines when planning a repair or maintenance schedule.

Figure 7-2 shows critical condition pipe projects prioritized primarily by flow rate because road type and depth are approximately equivalent for each of the projects identified.

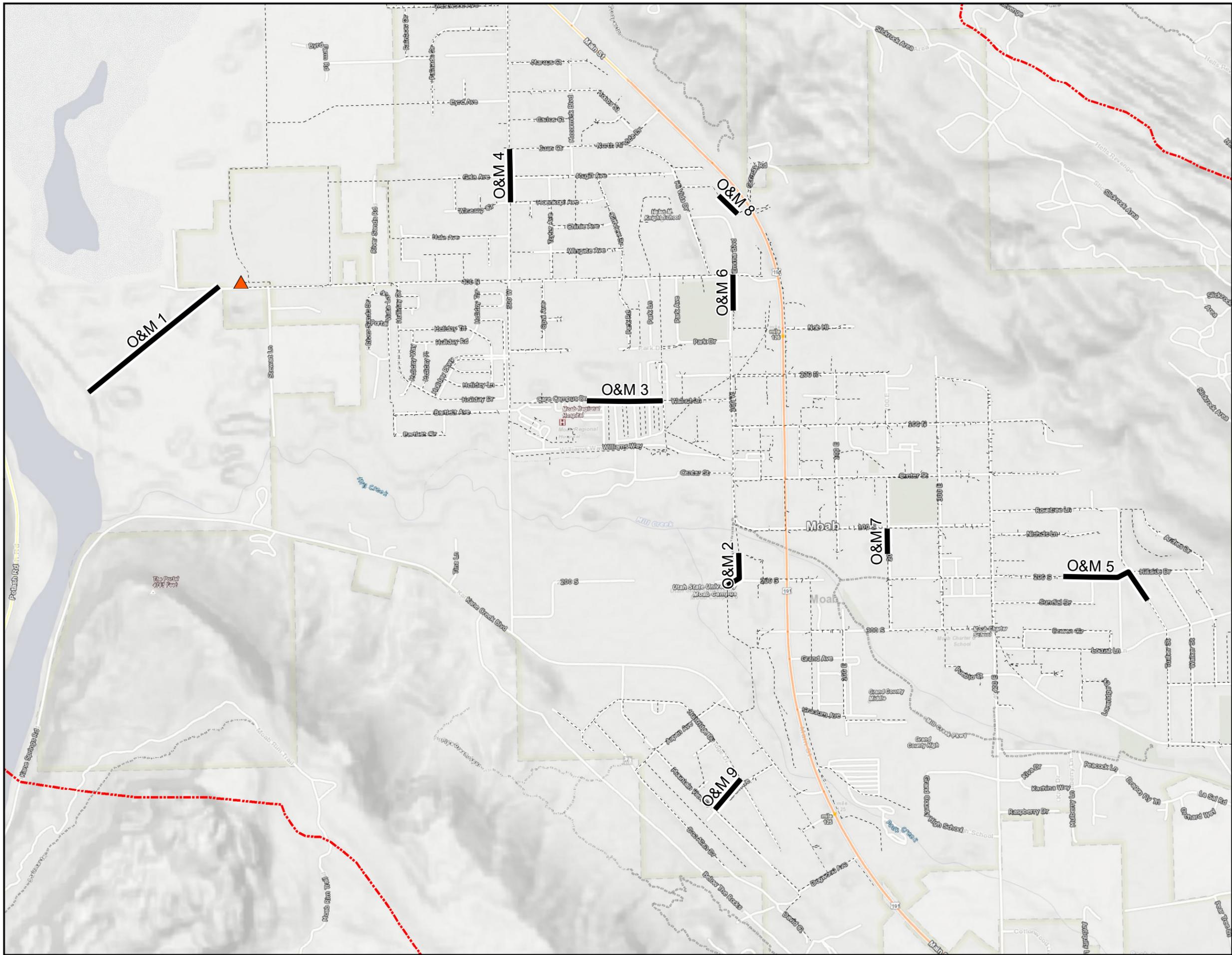
CAPITAL IMPROVEMENTS BUDGET

Before establishing a 10-year capital improvement plan, it is necessary to determine how much funding will be set aside each year for capital improvements. One of the best ways to identify a recommended level of funding is to consider system service life. As with all utilities, each component of a sewer system has a finite service life. Therefore, it is necessary to continually spend money towards the rehabilitation or replacement of these components. If adequate funds are not set aside for regular system renewal, the collection system will fall into a state of disrepair and be incapable of providing the level of service that customers expect.

The City's sewer collection system is composed of about 30 miles of sewer main pipe and about 570 manholes. The total cost to replace and rehabilitate all of the pipes and lift stations in the Moab collection system would be approximately \$45 million based on 2017 construction costs. Using a 90-year life cycle for collection system pipes, the recommended annual budget for system replacement and rehabilitation would be \$500,000/year. It is recommended that the budget be used to replace or rehabilitate severe and critical condition pipes as soon as possible.

10-YEAR CAPITAL IMPROVEMENT PRIORITIES

Based on the maintenance projects identified above and the system improvements identified in Chapter 6, Table 7-3 lists improvement projects that are recommended within the next 10-years. This table includes several projects not included in the City's impact fee facilities plan (see Appendix). Projects that are maintenance related or fully developer funded have been omitted from the City's impact fee facilities plan because they are not impact fee eligible. Pipes with critical wall conditions are prioritized first and are mostly funded over the next 10 years. For the purpose of cost estimating, it has been assumed that all critical condition pipes will require replacement. If rehabilitation is possible through cast-in-place pipe, additional projects to rehabilitate severe wall condition pipe may also be possible in the 10-year time frame. As a result, it is recommended that each condition project be reviewed to determine if rehabilitation is feasible.



LEGEND

- WWTP
- Critical Condition Projects
- Existing Sewer Pipes**
- Existing Sewer Pipes
- Spanish Valley

NORTH:



SCALE:



CONDITION PROJECT PRIORITIES

CITY OF MOAB
SANITARY SEWER MASTER PLAN



FIGURE NO.

7-2

**Table 7-3
10-Year Capital Facility Plan**

| ID | Estimated Year of Construction | Name | Diameter (inch) | Length (ft) | Total Project Cost (\$2017 Dollars) |
|-----------|---------------------------------------|--|------------------------|--------------------|--|
| 0 | FYE 2019 | City Project | -- | -- | \$300,000 |
| 1.1 | FYE 2018 | 100 West | 21 | 1,700 | \$868,000 |
| 2.1 | FYE 2019 | Northwest Trunk ¹ | 15 | 4,133 | \$1,141,000 |
| 2.2 | FYE 2019 | Northwest Lift Station ¹ | | | \$368,000 |
| 3.1 | FYE 2020 | 1000 North, 500 W to Rb ² . | 12 | 1,860 | \$162,000 |
| O&M 1 | FYE 2020 | Crit. Cond. – Outfall Pipe | 21 | 1,840 | \$864,800 |
| O&M 2 | FYE 2021 | Crit. Cond. – 100 W, 200 S | 12 | 430 | \$163,300 |
| O&M 3 | FYE 2022 | Crit. Cond. – Walnut Lane | 18 | 830 | \$365,700 |
| O&M 4 | FYE 2022 | Crit. Cond. – 500 West | 12 | 580 | \$213,900 |
| O&M 5 | FYE 2022 | Crit. Cond. – 200 South | 8 | 1,100 | \$351,900 |
| O&M 6 | FYE 2022 | Crit. Cond. – 100 W, 400 N | 8 | 400 | \$139,200 |
| O&M 7 | FYE 2023 | Crit. Cond. – 200 East | 8 | 280 | \$102,400 |
| O&M 8 | FYE 2023 | Crit. Cond. – Emma Blvd | 8 | 290 | \$105,800 |
| O&M 9 | FYE 2023 | Crit. Cond. – Birch Ave | 6 | 440 | \$151,800 |
| O&M | FYE 2024-2026 | Critical – To be determined | -- | -- | \$1,294,200 |
| O&M | FYE 2025-2026 | Severe - To be determined | -- | -- | \$1,229,000 |
| 4.1 | FYE 2026 | South Trunk | 24 | 9,770 | \$5,484,000 |
| | | Total | | | \$13,305,000 |

¹ It is anticipated that this project will be developer funded and reimbursed through a developer agreement.

² The City will pay the upsize cost for this project with the remainder funded by a developer.

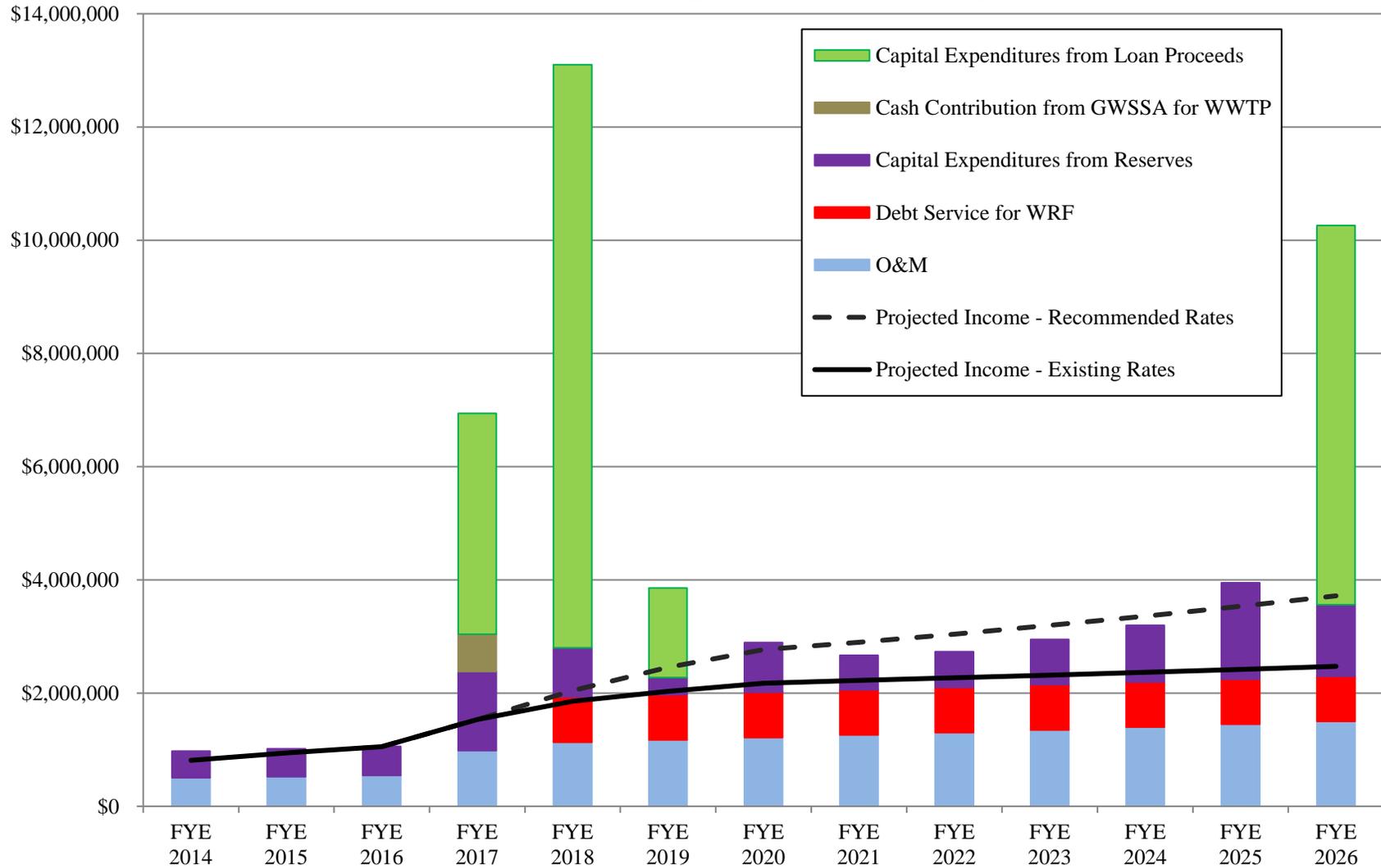
Figure 7-3 shows how system improvement project may be funded over the next 10-years. A discussion of each of the major budget categories in the 10-year budget plan is included below:

- **Operation & Maintenance** – The operation and maintenance budget item shown in Figure 7-3 shows anticipated maintenance costs associated with routine collection system and treatment plant operation and maintenance. Costs are anticipated to increase with commissioning of the City’s new treatment plant.
- **Capital Expenditures from Reserves** – These costs fund pipe replacement or new construction projects needed for the collection system or treatment plant.
- **Capital Expenditures from Loan Proceeds** – The majority of treatment plant costs will be funded with a loan from the State of Utah. Some costs will be funded through capital expenditures from the City’s wastewater reserve fund. In addition to the treatment plant, the City also has some high priority maintenance projects and capital improvement projects to meet the needs of short term and long term growth.

- **Cash Contribution from GWSSA for WWTP** – Some of the costs for the treatment plant will be funded with contribution from the Grand Water and Sewer Service Agency.
- **Debt Service** – Once the City obtains loans for the treatment plant and other urgent collection system projects, the City will need to make payments on the debt associated with the loans.
- **Projected Income – Recommended Rates** – The projected income with recommended rates. Due to the required condition related projects the City intends to repair over the next 10-years, a 3% increase in rates is assumed from 2022 to 2026 to keep up with inflation associated with construction and operation costs. This is a slight change to the 10-year rates presented in Moab City’s Sewer Rate study completed in February 2017.

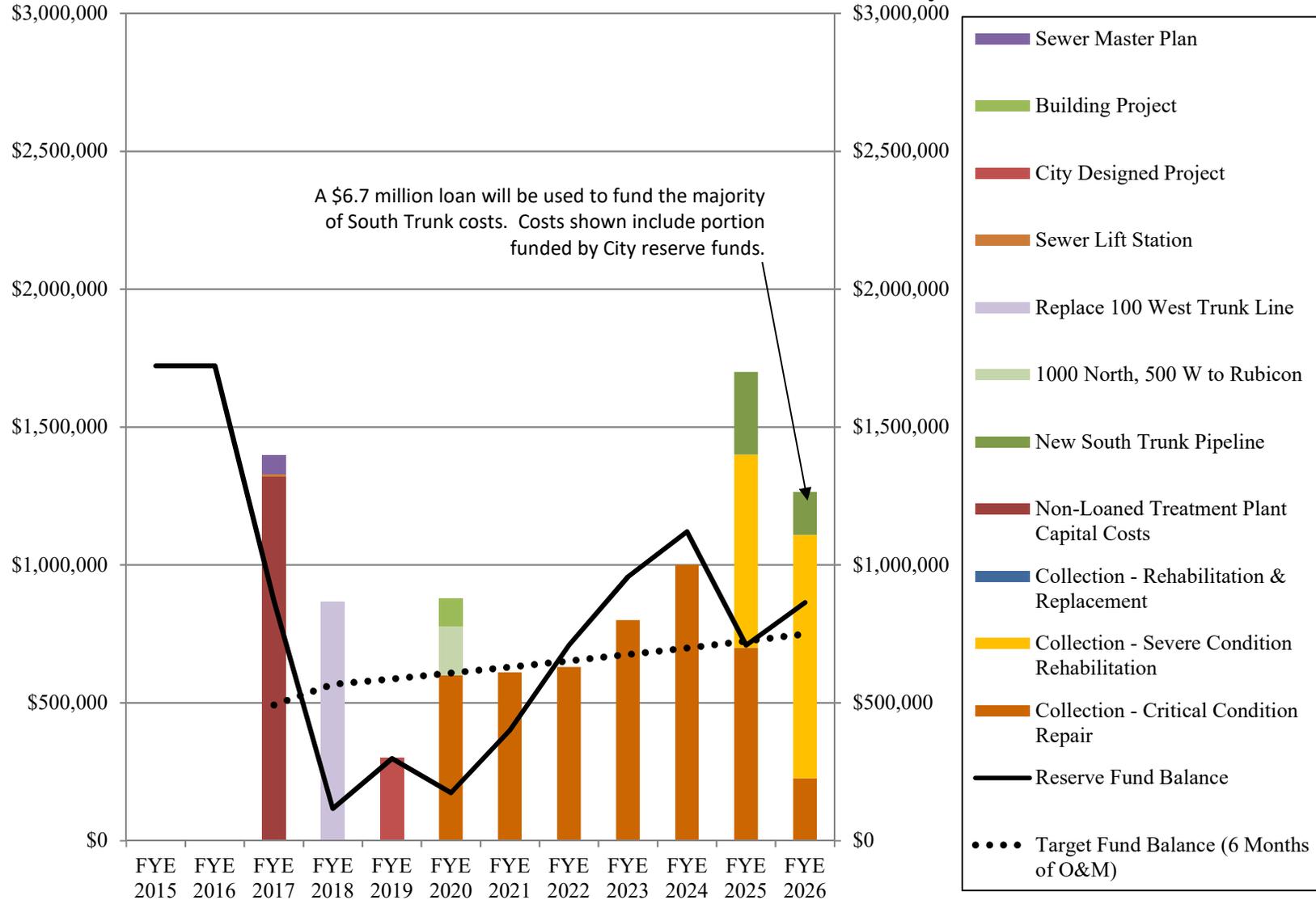
Figure 7-4 shows the effect of the 10-year capital facility plan on the City’s reserve fund.

Figure 7-3
10-Year Revenue and Expenditures - Moab City Sewer



*Includes 3% inflation for O&M and construction costs

Figure 7-4
10-Year Reserve Fund Balance - Moab City Sewer



APPENDIX A

Northwest Lift Station Alternatives Memo



TECHNICAL MEMORANDUM

TO: Chuck Williams
City Engineer
City of Moab

COPIES: Eric Johanson, Obe Tejada

FROM: Jeff Beckman, Keith Larson, Ben Kirk, Andrew McKinnon

DATE: October 2, 2017

SUBJECT: Northwest Lift Station Alternatives

JOB NO.: 130-17-04

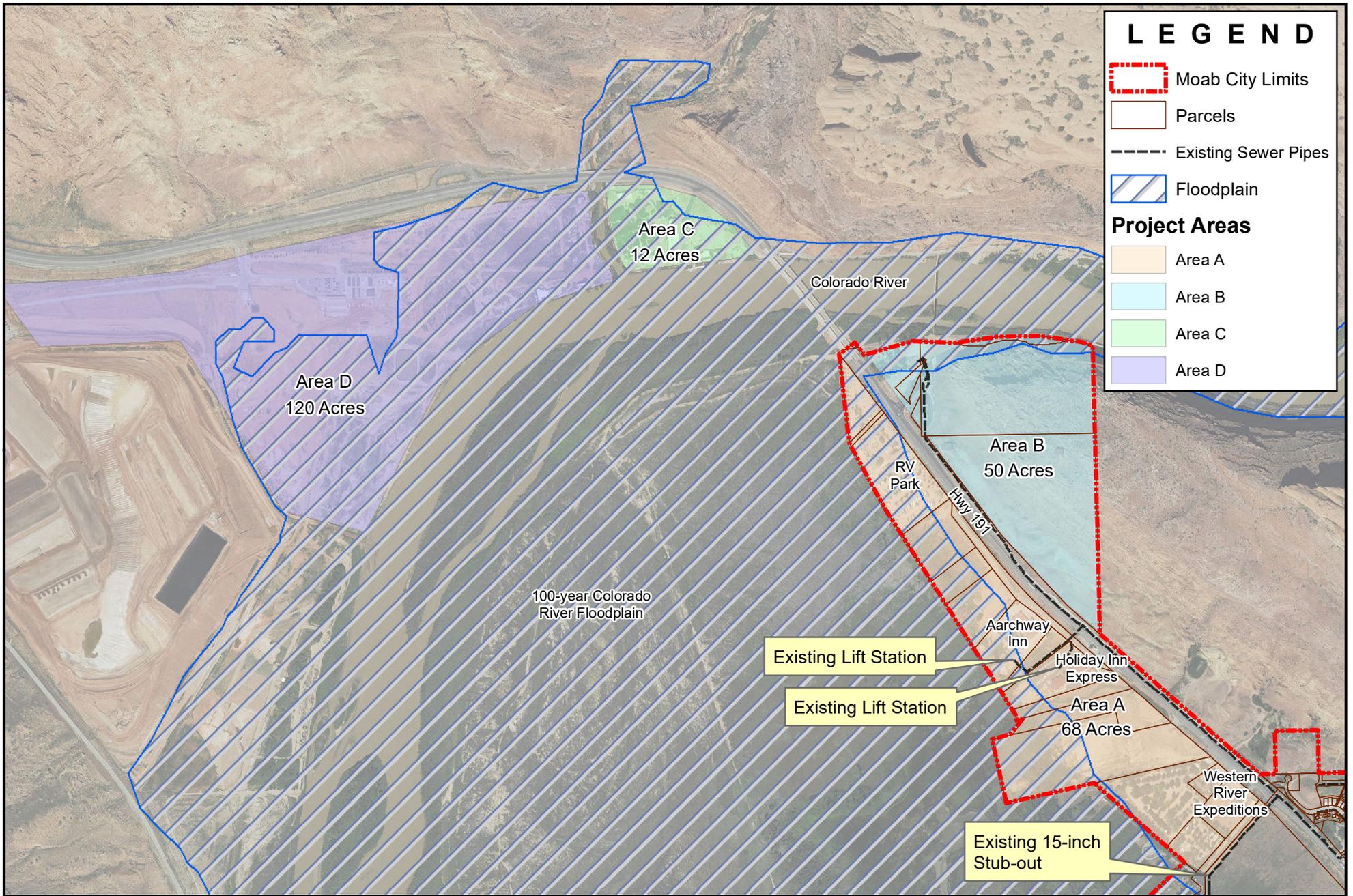
INTRODUCTION

The northwest edge of the City cannot gravity flow to the City's wastewater treatment plant. As a result, there are several private developments that have constructed private lift stations or septic tanks and fields to service their individual properties. During discussions with City personnel, maintenance problems at existing private lift stations frequently become problems for City personnel because of property owners' lack of experience in servicing and maintaining sewer facilities. To reduce potential problems with private lift stations, the City would like to construct a new public lift station in the northwest part of the City to serve both developed and undeveloped properties that will require lift station service. The City would also like to eliminate existing septic fields where possible. The purpose of this memorandum is to explore alternatives for a lift station, sewer mains, and force mains in this area.

PROJECT AREA

The study area includes land that is already developed, as well as land that may soon be developed as shown in Figure 1. The study area consists of several smaller service sub-areas. Area A is the primary service area and stretches on the south side of Highway 191 from the Moab RV Park east to Western River Expeditions. This reach is approximately 4,000 feet long, and includes 68 acres of developable land, some of which is already developed. Within this portion of the service area there are two existing private lift stations that serve the Holiday Inn Express and Aarchway Inn individually. The Moab RV Park is one other developed property in this area. It is not currently connected to the sewer system.

Beyond Area A on the south side of Highway 191, an additional potential service area, Area B, consists of 50 acres of mountainous terrain on the north side of the highway that may be developed in the future. Most of this area is too steep to be developed, but some limited development could occur on this side of the highway. There are also several hotels and other buildings across the Colorado River in Area C that could eventually connect to the system. These facilities currently have their own small package treatment plan, but could eventually be pumped across the river and into the City system. Area D is largely undeveloped. However, it is unknown the amount of useable land in this area, or if the flows from this area would be connected to the Moab Sewer System.



MOAB CITY
**SEWER MASTER PLAN
 RV PARK SEWER OPTIONS**

PROJECT STUDY AREA

NORTH:



SCALE:

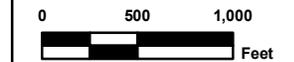


FIGURE NO.

1

FLOWS AND PIPE REQUIREMENTS

Projected Future Flows

The City Zoning Map defines Study Areas A and B as “Resort Commercial”. The Sewer Master Plan has estimated these areas will have sewer flows of 871 gpd/acre in Resort Commercial zones unless otherwise provided by Moab City personnel (existing indoor water billing data or planned development estimates). While Areas C and D lie outside the City boundaries, it is assumed that these areas will have similar sewer patterns. Assuming a typical peaking factor of 3.49 based on the 10 States Standard peaking factor equation, the projected future flows for each area are shown below in Table 1. Table 1 shows the projected peak flows for each area.

Table 1
Projected Future Flows per Study Area

| Study Area | Area (Acres) | Buildout ERU Estimate | Peak Flow ¹ (gpm) |
|--------------|--------------|-----------------------|------------------------------|
| Area A | 68 | 593 | 211 |
| Area B | 50 | 297 | 106 |
| Area C | 12 | 190 | 68 |
| Area D | 120 | 713 | 253 |
| Total | 250 | 1,793 | 637 |

¹ Peaking factor developed from “Water Supply and Waste-water Disposal” (pg. 136)

Based on the projected buildout flow, the lift station should be sized to accommodate 750 gpm of capacity (includes 15 percent buffer for equipment decline). Although it should only be equipped with approximately 375 gpm of capacity until there is potential for collecting areas C and D.

Required Pipe Size

For 15-inch pipes and smaller, the City’s standard assumes a pipe has reached capacity at 0.5 d/D (discharge depth/Diameter). The State of Utah also has standards for minimum pipe slopes. Table 2 shows the flow capacity through pipes assuming minimum slopes and a d/D of 0.5.

Table 2
Pipe Capacities (d/D of 0.5) at Minimum Slope

| Pipe Size (inches) | Minimum Slope (ft/ft) | Flow at 0.5 d/D (gpm) |
|--------------------|-----------------------|-----------------------|
| 12 | 0.00194 | 352 |
| 15 | 0.00144 | 550 |
| 18 | 0.00113 | 792 |

As shown in Table 2, an 18-inch pipe would be needed to convey the potential maximum of 637 gpm at the minimum slope. However, because it is uncertain if areas C & D will ever contribute flow to the trunk line, a 15-inch pipe at minimum slope is recommended to accommodate all of areas A & B with less than 50 percent depth and areas C & D with less than 55 percent depth to diameter. Thus, a 15-inch pipe has been used as part of this analysis. This selection especially makes sense in the downstream segment near the 15-inch stub out. If it is determined that part of the study area is

undevelopable, a segment of the pipe could be downsized to 12-inches or smaller. However, this analysis and decision can be reviewed as part of the final design.

ALIGNMENT OPTIONS

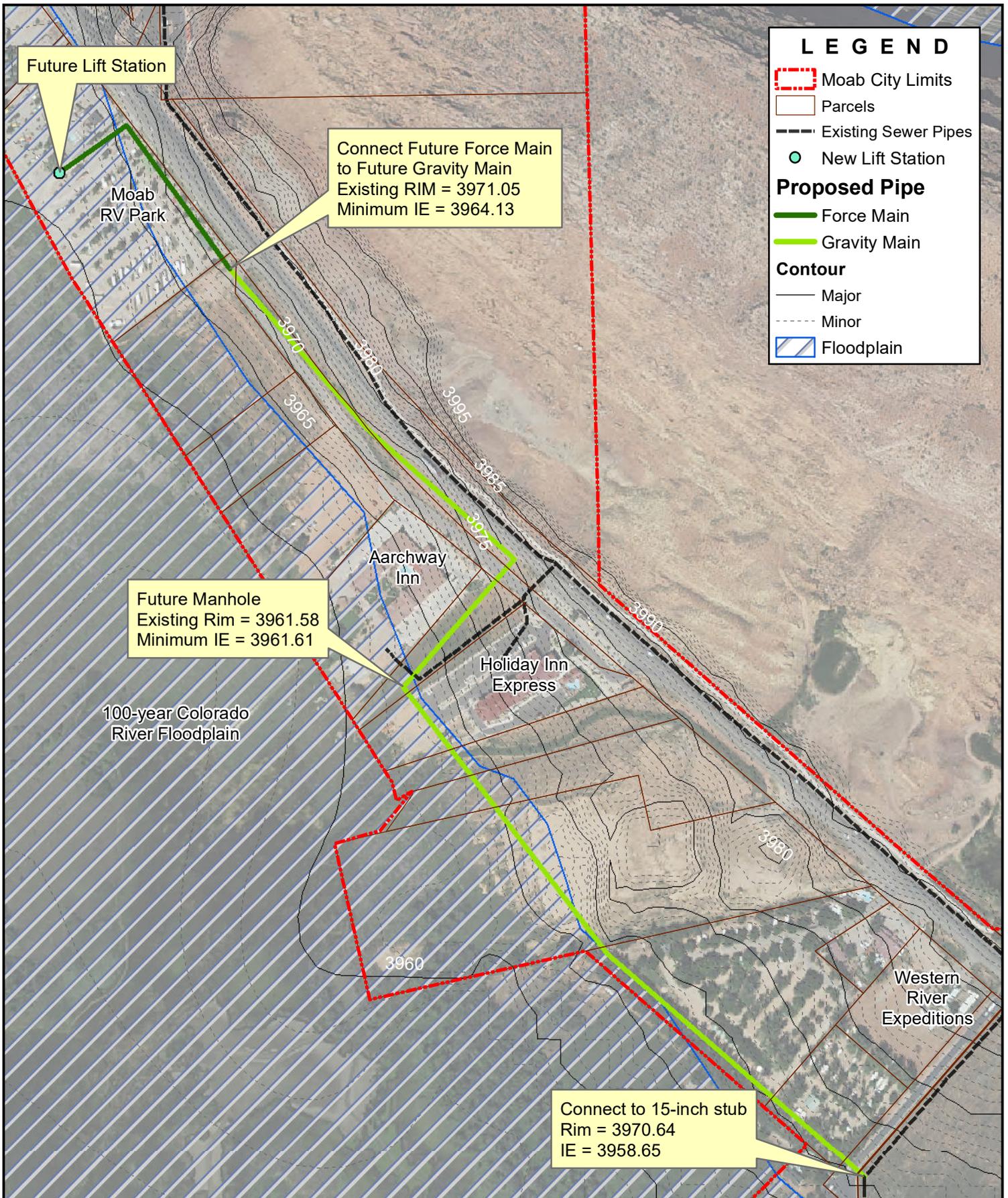
Even at the minimum allowable slope for 15-inch pipe (0.0014 ft/ft), it is not possible to exclusively use gravity pipe from the Moab RV Park all the way to the existing stub-out. To provide service to existing facilities and minimize interference with other utilities, it is recommended that any future sewer line be installed with a minimum of 3 feet of cover. This results in a minimum depth from ground surface to invert elevation of approximately 4.25 ft (neglecting pipe thickness). At the minimum allowable slope, there is not enough grade along the length of the service area to keep the pipe at its required depth. With this in mind, it can be concluded that a lift station will be necessary somewhere in the study area. The following options explore different alignments. Note that all attached figures show elevations in the NVGD 29 datum (The NVGD datum is 3.28 feet lower than NVGD 88).

Option 1

Option 1, as shown in Figure 2, includes a lift station and force main to service the Moab RV Park and a new gravity main to service properties on the south side of Highway 191. Wastewater from the Moab RV Park would be pumped through a force main for approximately 800 feet before connecting to a gravity line on the east corner of the RV Park property. The gravity line (approximately 4000 feet long) would then run east along the south side of the highway before it turns south in between Aarchway Inn and Holiday Inn Express. It would then turn east until it connects with the existing 15-inch stub-out. Some concerns with this alternative are outlined below:

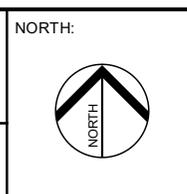
- **Cover & Tie-in Concerns** – A critical component of this option is the manhole in between the Aarchway Inn and Holiday Inn Express. At 0.14% slope (the recommended minimum slope for the gravity main), the invert of this manhole could be no lower than 3961.61 feet (in NVGD datum). However, the existing ground surface at this point is only 3961.58 feet. In order to have the necessary cover, the existing ground surface would need to be raised by more than 4 feet in this area. This may not be possible due to the existing developments and grading conflicts with existing parking lots, etc. An even bigger issue is the inability for existing sewer lines from Aarchway Inn and Holiday Inn Express to connect to the new pipe.
- **Future Development** – Another major concern associated with this option is the ability of future developments between the RV Park and Aarchway Inn to be able to connect to the sewer system. These parcels would either need to raise the ground surface enough to be able to slope to the proposed sewer system or have additional private wastewater pumps.

This option is problematic because it will not be possible for existing sewer lines from Holiday Inn Express and Aarchway Inn to connect by gravity into the new pipeline. It also would require new developments either raise the ground surface or use pumps. Therefore, this option is not feasible.



**RV PARK SEWER OPTIONS
OPTION #1**

MOAB CITY
SEWER MASTER PLAN



SCALE:
0 200 400 Feet

FIGURE NO.
2

Option 2

Option 2, as shown in Figure 3, includes a gravity main (2,250 feet long) from the Moab RV Park to a new lift station at the southeast end of the Holiday Inn Express property. A short force main (320 feet long) then pumps to some more gravity main (1560 feet long) that connects to the City's existing sewer main along Rubicon Trail. The following points explain how problems associated with Option 1 would be resolved by using the proposed alignment in Option 2.

- **Cover & Tie-in** – This option would not require any additional cover. The maximum pipe invert depth would also be limited to less than 9 feet deep making it very feasible.
- **Future Development** – By placing the pipe on the southwest end of the properties, it also allows for future developments to tie-in by gravity flow.

This option represents the best option for both existing and future development.

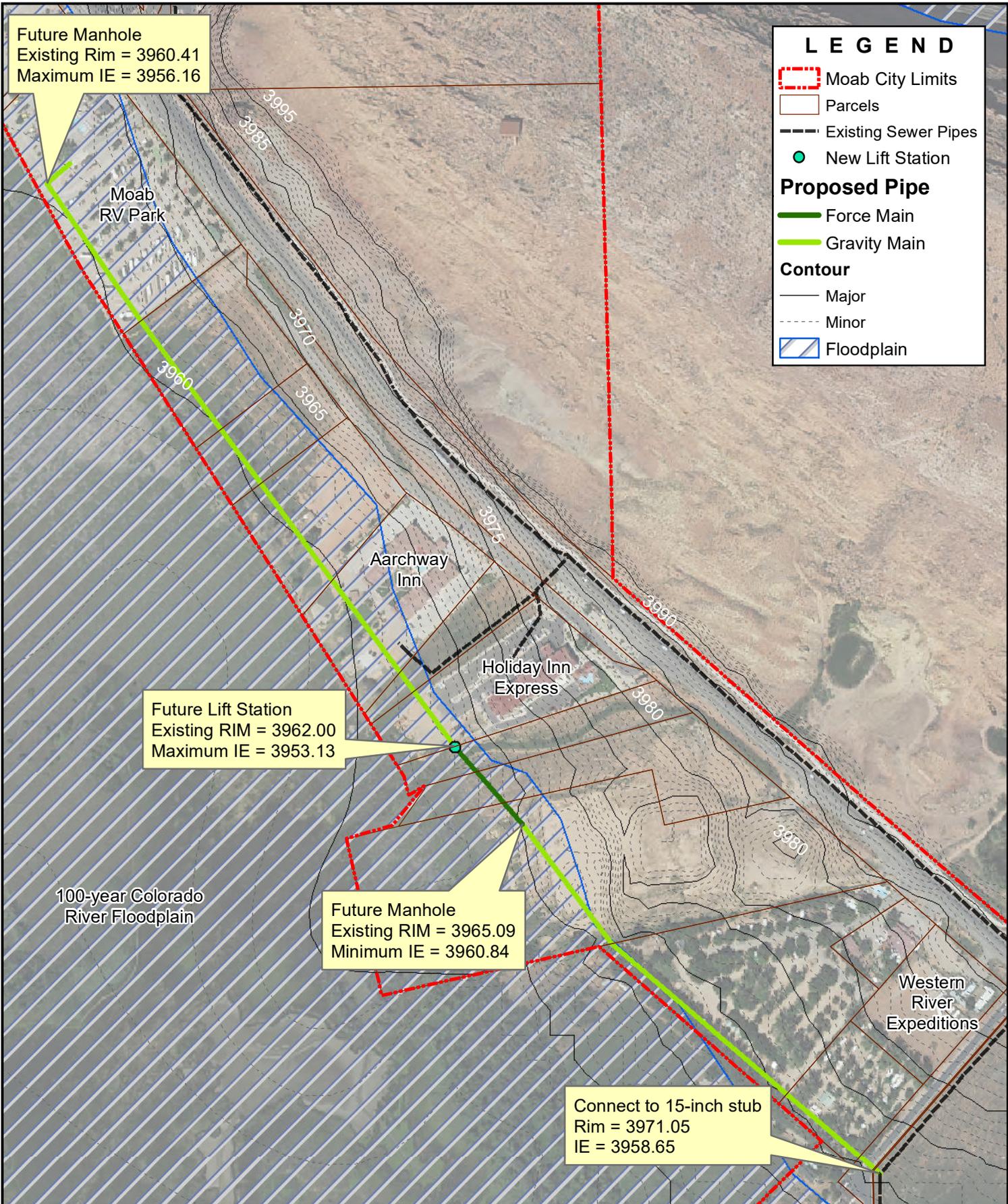
CONCLUSION AND RECOMMENDATION

Based on the analysis described above, the following conclusions and recommendations can be made regarding a future lift station for the northwest area of the City:

- Option 1– Not Feasible – Constructing a gravity line that connects with the 15-inch stub-out would make the elevation of the pipe too high to be able to service the Aarchway Inn and Holiday Inn Express.
- Option 2 – Recommended – Although the exact location of the lift station may be shifted, the location identified in Figure 3 is optimal to minimize the lift station wet well depth and length of gravity and force main pipes. It would also be the location where flood water impacts can be mitigated the most easily.

Since Option 2 would place the lift station and part of the sewer system in the 100-year floodplain, design considerations for this alternative include the following:

- **Lift Station Location** – The lift station is located within the 100-year flood plain, but is on the perimeter of the flood plain such that it should be possible to keep floodwaters from damaging the lift station or being contaminated by wastewater during a flood. The lift station would also be accessible during a 25-year flood event (State of Utah R317-3-3.1).
 - Force Main / Gravity Main Length – The length of gravity and force mains as shown in Figure 3 has been optimized based on a minimum slope of 0.14% and a minimum cover depth of 36-inches to the top of a 15-inch main. The optimized lift station location includes approximately 320 feet of force main. Other options for lift station placement increase the depth of the lift station or the length of the force main. Generally, shorter force mains are preferred to minimize septic conditions and shallower lift stations are preferred to reduce costs of construction.
 - Easements – A construction easement and/or some property may need to be purchased to construct the lift station as proposed.



LEGEND

- Moab City Limits
- Parcels
- Existing Sewer Pipes
- New Lift Station

Proposed Pipe

- Force Main
- Gravity Main

Contour

- Major
- Minor
- Floodplain

BOWEN COLLINS & ASSOCIATES
Celebrating 20 years

**RV PARK SEWER OPTIONS
OPTION #2**

MOAB CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 200 400
Feet

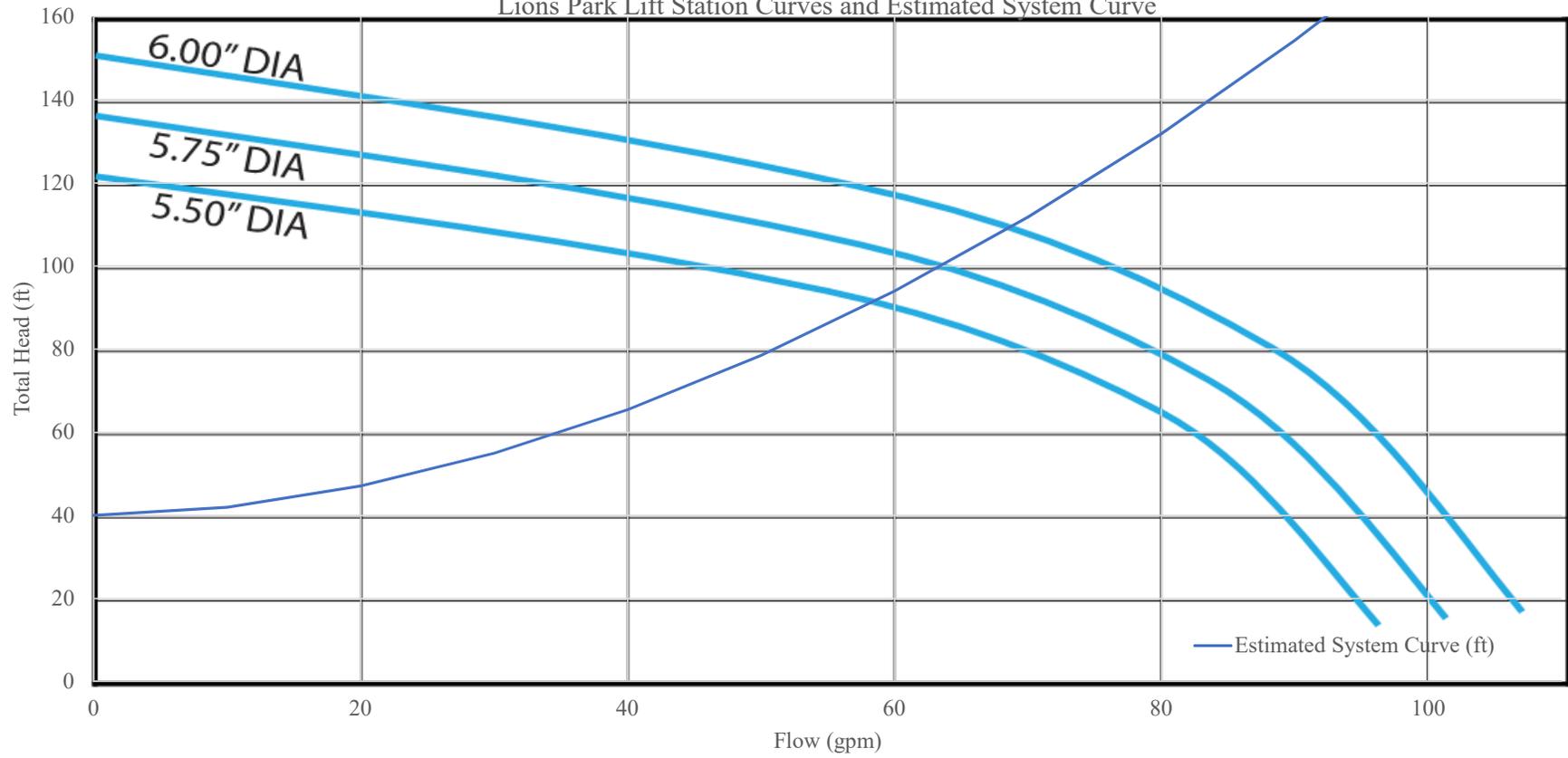
FIGURE NO.
3

- **Gravity Mains** – Per State Administrative Rule R-317-3-2.6(E)(3), all of the manhole lids on the gravity main will need to be water tight.
 - RV Park Connections – When the RV Park septic field is decommissioned, watertight sewer caps should be installed at each RV connection if watertight connections are not already available.
 - Isolation Valve – An isolation valve (plug valve) would be recommended to keep flood water from entering the collection system from the RV park. In the event of a 100-year flood, the isolation valve could be shut to prevent any floodwater from entering through any loose RV park connections.
 - Venting – Because all of the manhole lids will need to be watertight, an air vent may need to be constructed an extended outside of the 100-year flood plain so that a vacuum doesn't develop in the gravity main in a 100-year flood.

APPENDIX B

Lift Station Data

Figure
Lions Park Lift Station Curves and Estimated System Curve



KHG(X)5



5HP High Head Grinder Pump, 1 or 3 Phase (Class 1, Div. 1, Groups C & D Hazardous Location)

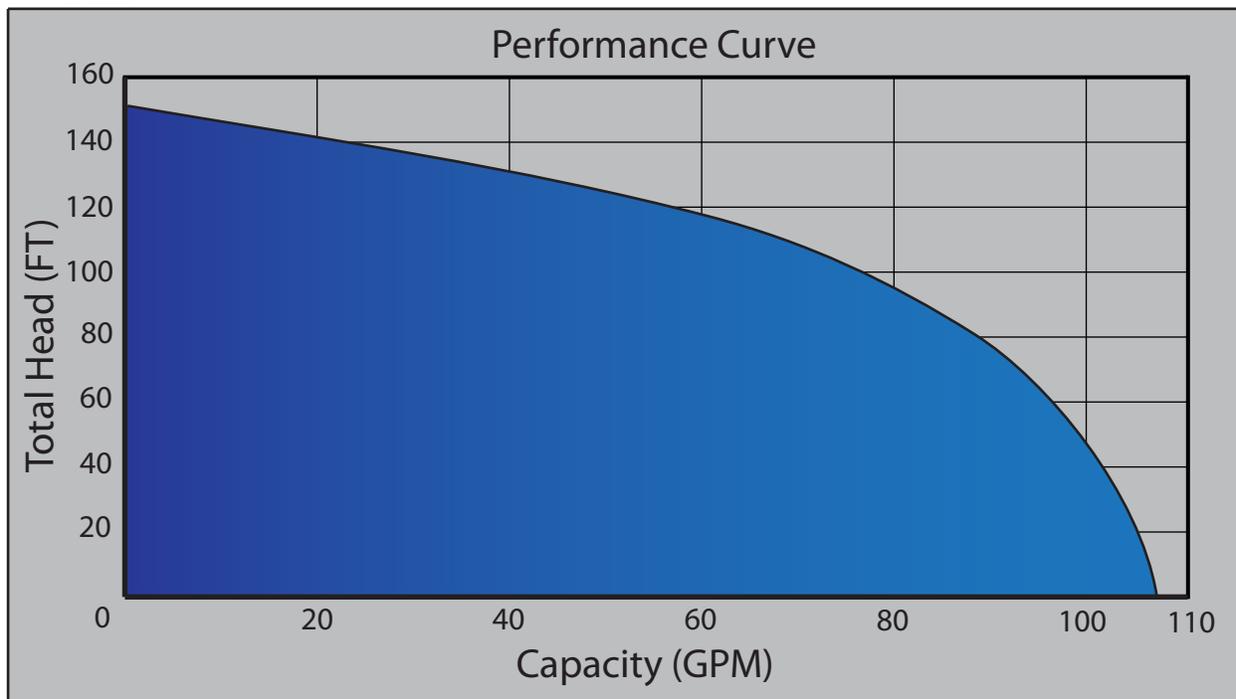


The KEEN PUMP **KHG(X)5** series centrifugal grinder pumps easily handle residential, commercial or industrial sanitary waste, reducing it to a fine slurry. The **KHG(X)5** pump is designed for use in pressure sewer applications or any piping network.

The recessed vortex impeller design of the **KHG(X)5** grinder pump provides trouble-free, non-overloading operation over the entire performance curve. The modular design provides quick and easy serviceability. The hardened stainless steel grinder assembly provides many years of dependable operation.

The **KHG(X)5** series pump features:

- Interchangeable with Competitor Installations
- Dual Silicon-Carbide Mechanical Shaft Seals w/ Viton[®] Elastomers
- Pressed-In Motor with Internal Overload Protection
- 3-Bearing Shaft Support (Upper / Lower / Sleeve)
- Internal Moisture Detection
- Strong Motor, 1-Phase (208/230) Volt or 3-Phase (208/230/460) Volt



Features and Benefits

1. Watertight Cable Entrance

Agency-approved, watertight strain relief cord grip with compression grommet protects outer cord jacket (**FM Explosion-Proof**) or Heavy-duty molded compression grommet protects outer cord jacket. Epoxy-filled inner cord cap provides anti-wicking moisture protection to the motor even if power cable is cut or damaged.

2. Modular Pump Design

Commonality of parts across the Keen product line minimizes the amount of parts required for servicing. Heavy-duty ASTM A48, Class 30 cast iron components.

3. Strong Motor

Powerful high-torque motor for reliable pump operation. Pressed stator securely holds motor and efficiently transfers heat. Class F insulation with overload protection in oil-filled chamber for cool operation and long motor life.

4. 3-Bearing Support

Motor / Pump shaft securely held with upper and lower ball bearing plus additional sleeve bearing in lower seal chamber. Long 100,000 hour L-10 bearing life.

5. Double Mechanical Seal Protection

Dual silicon carbide mechanical shaft seals w/ Viton® Elastomers provide twice the moisture protection for the motor. Dual seals are housed in a secondary oil-filled seal chamber. Tougher silicon carbide seals better handle sand, grit and abrasive materials.

6. Moisture Detection

Dual Seal leak probe signals alarm in control panel for scheduled maintenance.

7. Non-Overloading Hydraulic Design

The recessed centrifugal impeller allows 100% performance curve operation from shut-off to maximum flow without damage to the pump or system. The recessed vortex impeller is out of the passageway of fluid flow, eliminating concerns of blockage or wear.

8. Proven Grinder Assembly

Hardened (Rockwell 56-60) stainless steel grinder assembly has 30+ years proven field experience. The reversible grinder ring and grinder impeller effectively reduce solids into a fine slurry, easily passable in a piping system without concerns of clogging. Highly efficient 12,400 cuts/second.

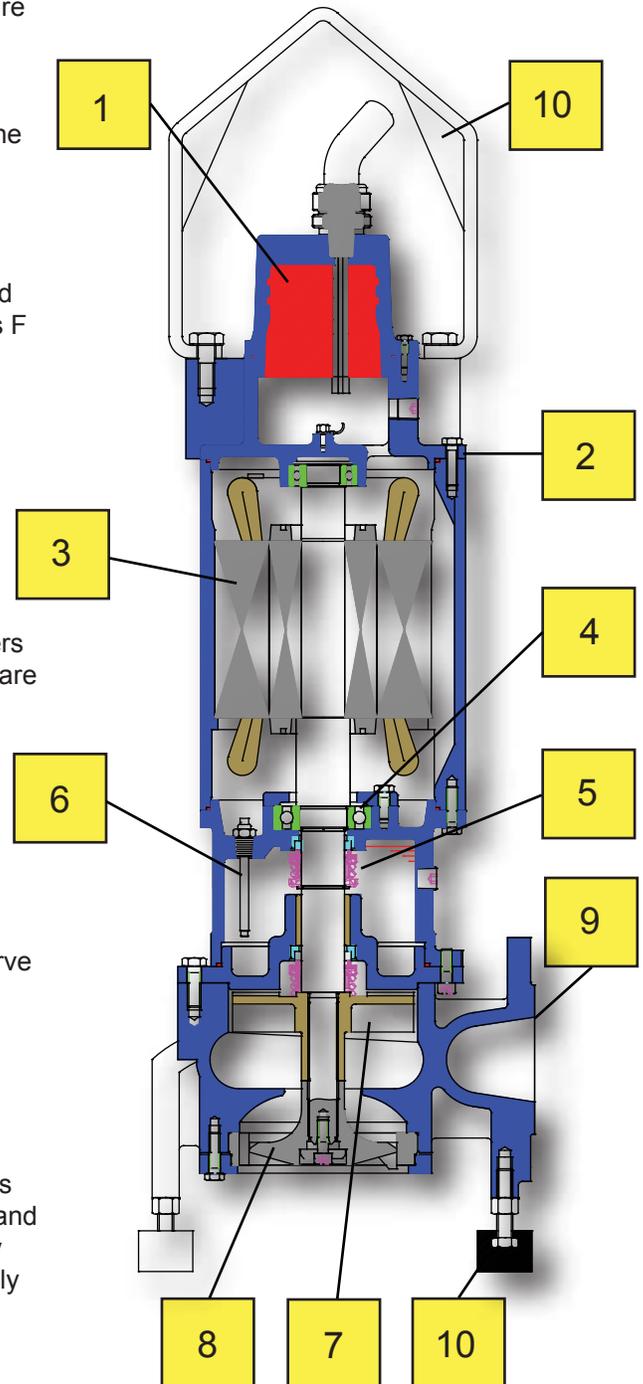
9. Versatile Flange Connection

Combination 2-1/2" and 3" horizontal flange. Industry-standard ANSI Class 125 dimensions.

10. Accessories

Stainless steel lifting handle included. Anti-vibration nylon mounting feet **OPTIONAL**.

5HP Grinder Pump High Head KHG(X)5



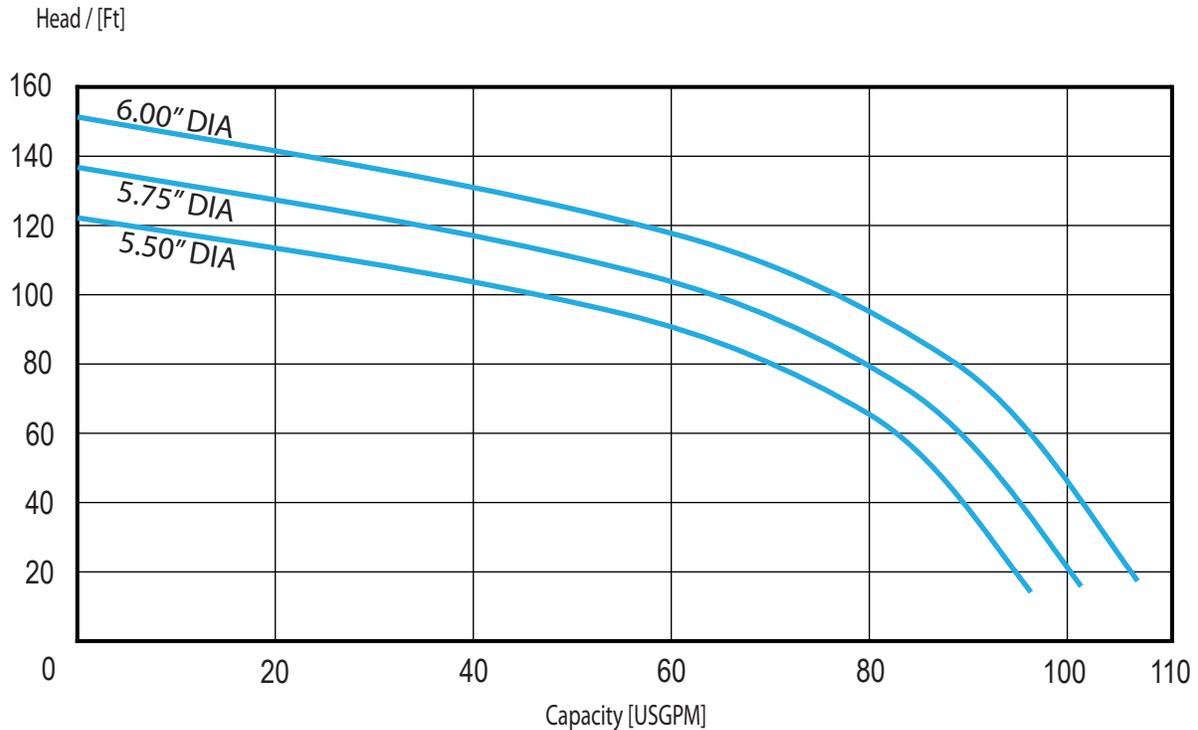
471 US Hwy 250 East · Ashland, Ohio 44805
419.207.9400 fax 419.207.8031
www.keenpump.com



5HP SUBMERSIBLE GRINDER PUMP

| | | | |
|---------------------------|---|---------------------|------------------------|
| GENERAL | | MOTOR DATA | |
| Pump Model | KHG(X)5 | HP / Power Supply | 5HP / 1 ϕ , 60 Hz |
| PUMP DATA | | Full Load Amps 208V | 40 Amps |
| Date | 03/06/2017 | Start Amps 208V | 144 Amps |
| Discharge Flange | 2-1/2 & 3" ANSI Horizontal | Full Load Amps 230V | 34 Amps |
| Grinder Ring | 25 Slots | Start Amps 230V | 122 Amps |
| Impeller Type / Std. Dia. | Recessed / 6.00" | Poles / Rated Speed | 2 P / 3450 rpm |
| Single Phase | START KIT SK-5 includes: Start & Run Capacitors, Relay, and Mounting Hardware | Insulation Class | F Class |
| | | Start Capacitor | 300 ufd, 250 VAC |
| | | Run Capacitor | 30 ufd, 370 VAC |

PERFORMANCE CURVE



| <u>MODEL</u> | <u>HP</u> | <u>Phase</u> | <u>Volts</u> |
|---------------------|------------------|---------------------|---------------------|
| KHG(X)5-2001 | 5 | 1 | 208 |
| KHG(X)5-2301 | 5 | 1 | 230 |

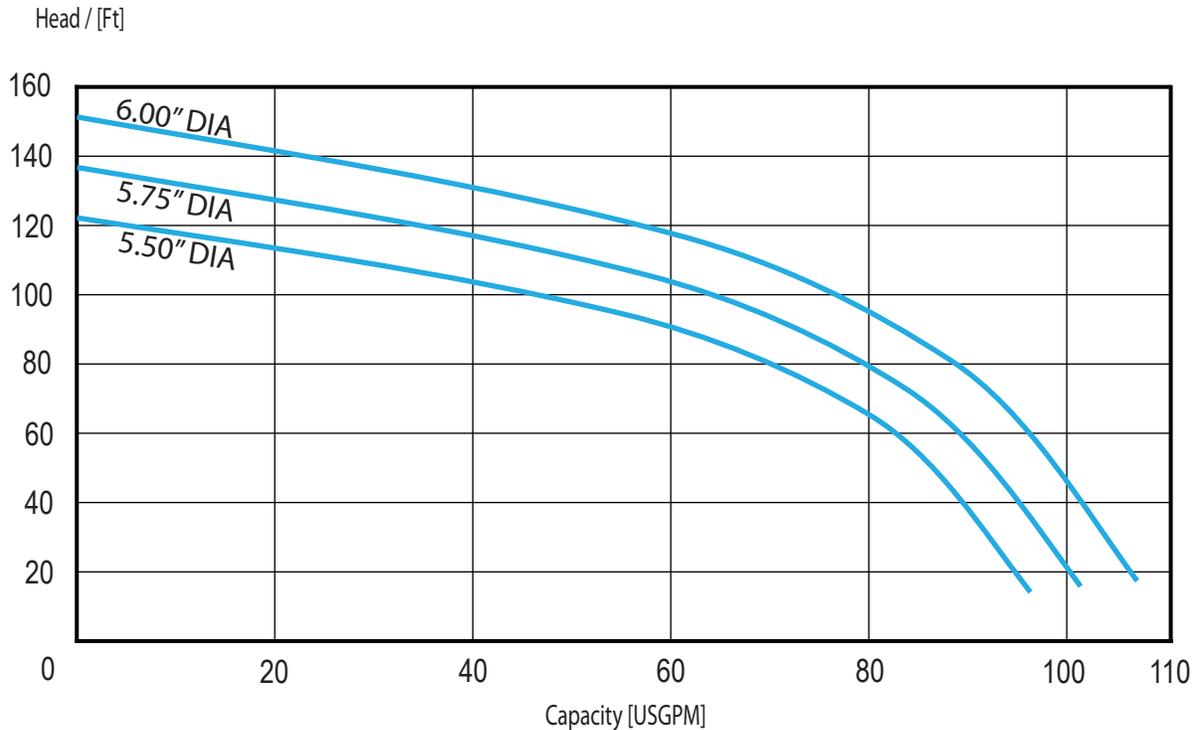
* Performance with clear water and ambient temp 20°C (68°F)



5HP SUBMERSIBLE GRINDER PUMP

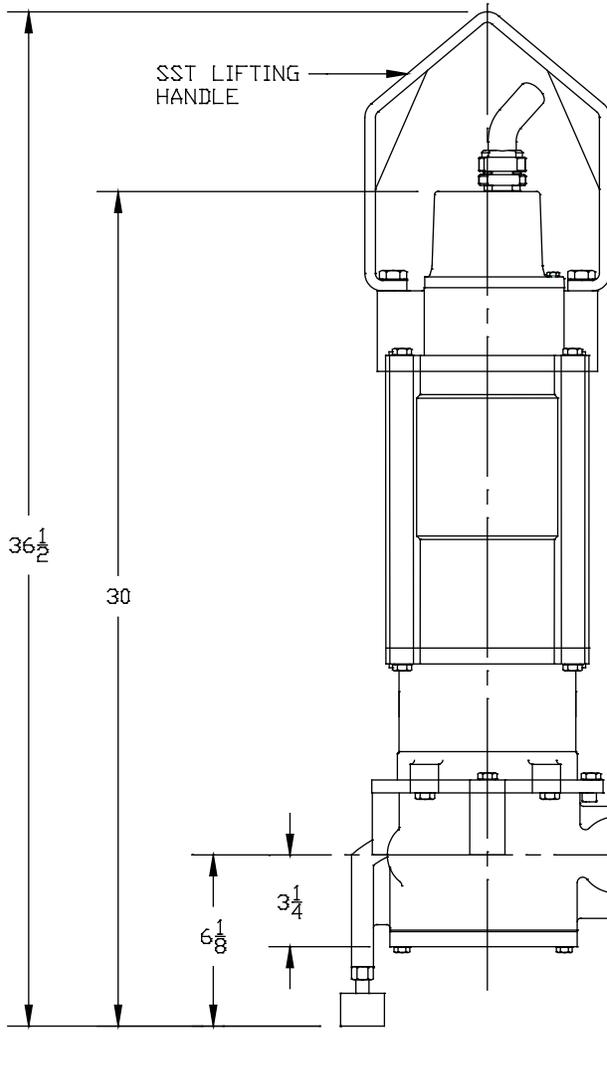
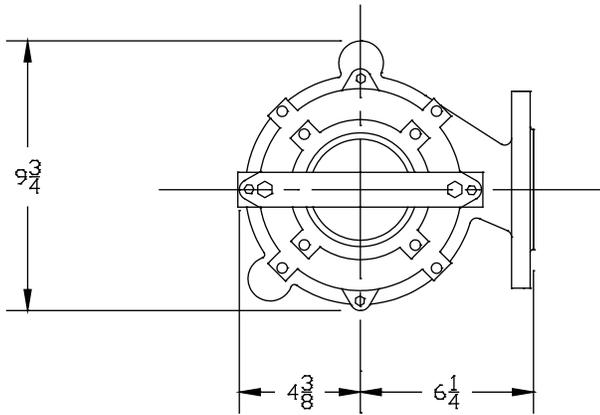
| | | | |
|---------------------------|----------------------------|---------------------|------------------------|
| GENERAL | | MOTOR DATA | |
| Pump Model | KHG(X)5 | HP / Power Supply | 5HP / 3 ϕ , 60 Hz |
| PUMP DATA | | Full Load Amps 208V | 21 Amps |
| Date | 03/06/2017 | Start Amps 208V | 120 Amps |
| Discharge Flange | 2-1/2 & 3" ANSI Horizontal | Full Load Amps 230V | 18 Amps |
| Grinder Ring | 25 Slots | Start Amps 230V | 90 Amps |
| Impeller Type / Std. Dia. | Recessed / 6.00" | Full Load Amps 460V | 9 Amps |
| Three Phase | | Start Amps 460V | 45 Amps |
| | | Poles / Rated Speed | 2 P / 3450 rpm |
| | | Insulation Class | F Class |

PERFORMANCE CURVE



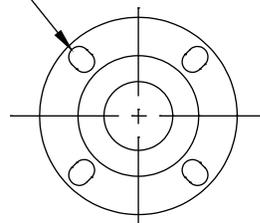
| <u>MODEL</u> | <u>HP</u> | <u>Phase</u> | <u>Volts</u> |
|---------------------|------------------|---------------------|---------------------|
| KHG(X)5-2003 | 5 | 3 | 208 |
| KHG(X)5-2303 | 5 | 3 | 230 |
| KHG(X)5-4603 | 5 | 3 | 460 |

* Performance with clear water and ambient temp 20°C (68°F)



* PUMP STANDARD HORIZONTAL FLANGE
 (2-1/2" OR 3" ANSI) STANDARD BASIN
 PACKAGE DISCHARGE (2" PIPING)
 ACCEPTABLE WITH MACERATED
 SEWAGE SLURRY

* DISCHARGE FLANGE "SLOTS"
 FOR OPTIONAL 2.5" OR 3" ANSI
 DISCHARGE, CLASS 125., 4-BOLT



NOTE: ALL DIMENSIONS FOR
 REFERENCE ONLY

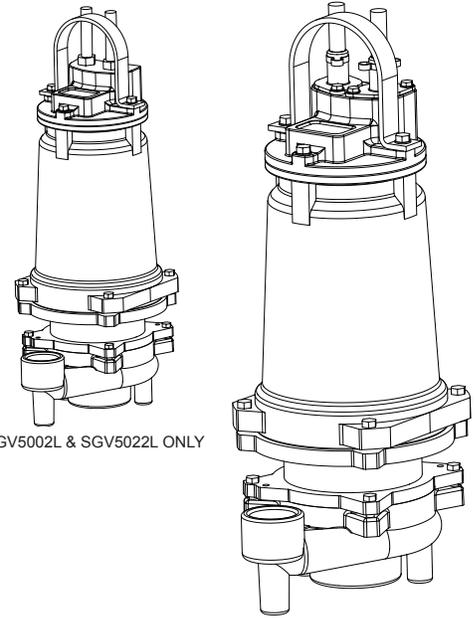
| REV | INITIALS | DATE |
|-----|----------|------------|
| B | SE | 01/06/2017 |
| A | SE | 03/26/2015 |

| | | | |
|---|---------------------------|--|--|
| | | KEEN PUMP CO. 471 US HWY 250 EAST ASHLAND, OHIO 44805 | PHONE: 419-207-9400 FAX: 419-207-8031 |
| TITLE 3-7.5HP HIGH FLOW/HIGH HEAD GR. PUMP DIMENSIONS | | | |
| SCALE NTS | | DWG. # KN-28 | REV. B |
| DWG. BY SE | DATE 01/27/2014 | | |

Submersible Grinder Pumps

Specifications:

| | |
|--------------------------------------|--|
| DISCHARGE | 2" NPT, Vertical |
| LIQUID TEMPERATURE | 104°F (40°C) Continuous |
| VOLUTE | Cast Iron ASTM A-48, Class 30. |
| MOTOR HOUSING | Cast Iron ASTM A-48, Class 30. |
| SEAL PLATE | Cast Iron ASTM A-48, Class 30. |
| IMPELLER: Design | 12 Vane,Vortex, With Pump Out Vanes On Back Side. Dynamically Balanced, ISO G6.3. |
| <i>Material</i> | Cast Iron |
| SHREDDING RING | Hardened 440C Stainless Steel Rockwell® C-55. |
| CUTTER | Hardened 440CStainless Steel, Rockwell® C-55. |
| SHAFT | 416 Stainless Steel |
| SQUARE RINGS | Buna-N |
| HARDWARE | 300 Series Stainless Steel |
| PAINT | Air Dry Enamel. |
| SEAL: Design | Tandem Mechanical, Oil Filled Reservoir. |
| <i>Material</i> | Rotating Faces - Carbon Stationary Faces - Ceramic Elastomer - Buna-N Hardware -300 Series Stainless |
| CORD ENTRY: | |
| <i>SGV5002L & SGV5022L</i> | 30 ft. (9m) Std. Cord. Pressure Grommet for Sealing and Strain Relief. |
| <i>All Other Models</i> | 30 ft. (9m) Std. Cord. Custom Molded Quick Connect for For Sealing and Strain Relief |
| CORD | CSA/UL Approved 10/4, 6/4, 8/4 Type SOW. |
| UPPER BEARING: | |
| <i>Design</i> | Single Row, Ball, Oil Lubricated |
| <i>Load</i> | Radial |
| INTERMEDIATE BEARING: | |
| <i>Design</i> | Single Row, Ball, Oil Lubricated |
| <i>Load</i> | Radial & Thrust |
| LOWER BEARING: | |
| <i>Design</i> | Sleeve, Oil Lubrication: |
| <i>Load</i> | Radial |
| MOTOR: Design | NEMA L-Single Phase, NEMA B-Three Phase Torque Curve. Oil-Filled, Squirrel Cage Induction. |
| <i>Insulation</i> | Class F. |
| SINGLE PHASE | Capacitor Start/Capacitor Run. Requires Overload Protection to be Included In control panel, Requires Barnes® Starter or Control Panel which Includes Capacitors, or Capacitor pack. |
| THREE PHASE | Dual Voltage 240/480; Requires Overload Protection to be Included in control panel. |
| OPTIONAL EQUIPMENT | Seal Material, Impeller Trims, Cord Length. Moisture Sensors, Moveable Fitting |
| RECOMMENDED: | |
| <i>Accessories</i> | Break Away Fitting (BAF) Check Valve Control Panel |
| <i>Seal Kit PN</i> | 085223 |
| <i>Service Kit PN</i> | 115771 |



SGV5002L & SGV5022L ONLY

Series: **SGV**
3, 5, 7.5 HP,
3450RPM, 60Hz



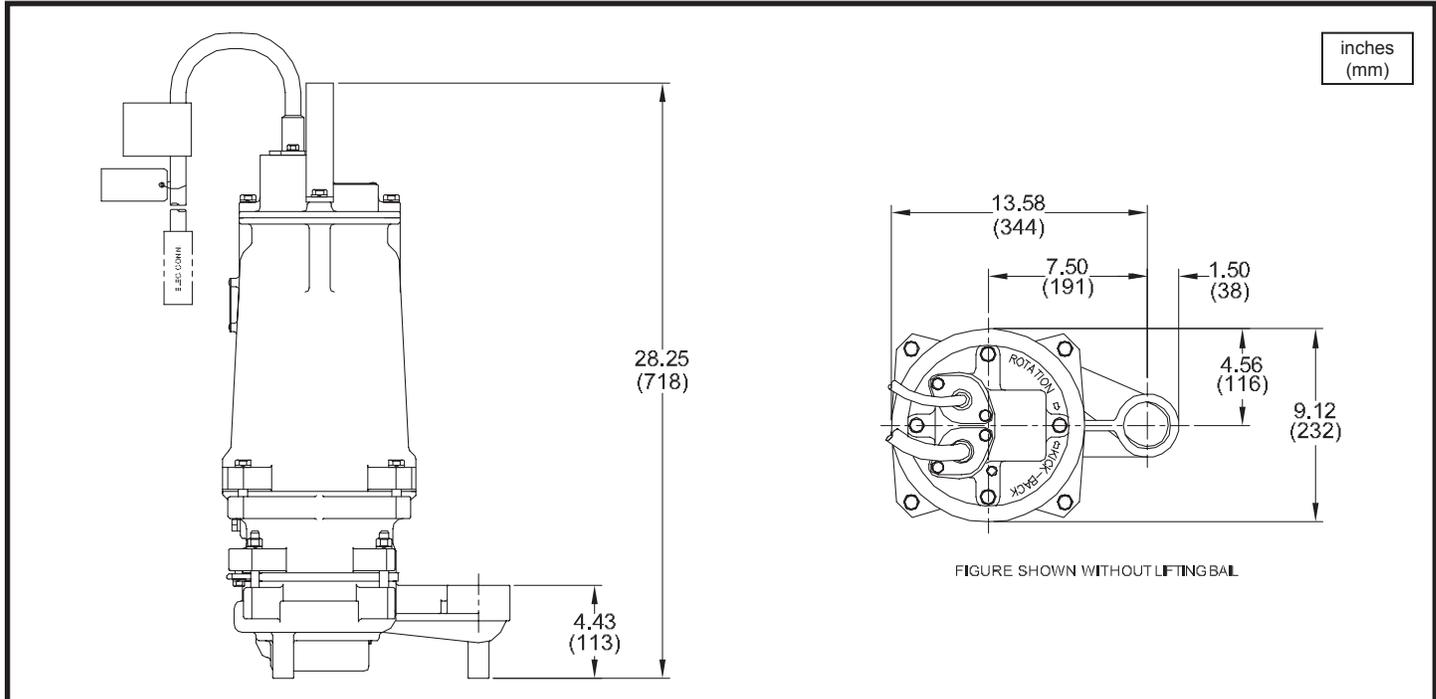
CSA 108 - File No. LR16567
UL 778

Sample Specifications: Section 3 Page 9.

DESCRIPTION:

THE GRINDER PUMP IS DESIGNED TO REDUCE DOMESTIC, COMMERCIAL, INSTITUTIONAL AND LIGHT INDUSTRIAL SEWAGE TO A FINELY GROUND SLURRY.

Submersible Grinder Pumps



| MODEL NO | PART NO | HP | VOLT/PH | Hz | RPM (Nom) | NEMA START CODE | FULL LOAD AMPS | LOCKED ROTOR AMPS | CORD SIZE | CORD TYPE | CORD O.D. ± .02 (.5) in (mm) |
|----------|---------|-----|-----------|----|-----------|-----------------|----------------|-------------------|-----------|-----------|------------------------------|
| SGV3072L | 111608 | 3 | 200/240/1 | 60 | 3450 | G | 25.2/21.7 | 86/75 | 10/4 | SOW | .75 (19) |
| SGV3062L | 111612 | 3 | 200/3 | 60 | 3450 | J | 17.0 | 65.0 | 10/4 | SOW | .75 (19) |
| SGV3032L | 111609 | 3 | 240/3 | 60 | 3450 | K | 14.5 | 62.0 | 10/4 | SOW | .75 (19) |
| SGV3042L | 111610 | 3 | 480/3 | 60 | 3450 | K | 7.2 | 31.0 | 10/4 | SOW | .75 (19) |
| SGV3052L | 111611 | 3 | 600/3 | 60 | 3450 | J | 5.6 | 22.6 | 10/4 | SOW | .75 (19) |
| SGV5002L | 115657 | 5 | 200/1 | 60 | 3450 | F | 42.0 | 134.0 | 6/4 | SOW | 1.03 (26) |
| SGV5022L | 115658 | 5 | 240/1 | 60 | 3450 | H | 39.0 | 136.0 | 8/4 | SOW | .93 (24) |
| SGV5062L | 111619 | 5 | 200/3 | 60 | 3450 | K | 25.0 | 122.0 | 10/4 | SOW | .75 (19) |
| SGV5032L | 111616 | 5 | 240/3 | 60 | 3450 | L | 21.9 | 120.0 | 10/4 | SOW | .75 (19) |
| SGV5042L | 111617 | 5 | 480/3 | 60 | 3450 | L | 11.0 | 60.0 | 10/4 | SOW | .75 (19) |
| SGV5052L | 111618 | 5 | 600/3 | 60 | 3450 | L | 8.8 | 46.0 | 10/4 | SOW | .75 (19) |
| SGV7532L | 111613 | 7.5 | 240/3 | 60 | 3450 | J | 22.3 | 136.0 | 10/4 | SOW | .75 (19) |
| SGV7542L | 111614 | 7.5 | 480/3 | 60 | 3450 | J | 11.2 | 68.0 | 10/4 | SOW | .75 (19) |
| SGV7552L | 111615 | 7.5 | 600/3 | 60 | 3450 | G | 8.2 | 45.0 | 10/4 | SOW | .75 (19) |

Temperature sensor cord for SGV5002L & SGV5022L is 14/2 SOW, 0.55 (14mm) ± .02 (.51mm) O.D.

Temperature sensor cord for all other models is 14/3 SOW, 0.55 (14mm) ± .02 (.51mm) O.D.

Optional - Moisture and Temperature sensor cord for all models is 18/5 SOW, 0.47 (12mm) ± .02 (.51mm) O.D., replaces Temperature sensor cord.

IMPORTANT !

- 1.) PUMP MAY BE OPERATED "DRY" FOR EXTENDED PERIODS WITHOUT DAMAGE TO MOTOR AND/OR SEALS.
- 2.) THIS PUMP IS APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION II HAZARDOUS LOCATIONS.
- 3.) THIS PUMP IS NOT APPROPRIATE FOR THOSE APPLICATIONS SPECIFIED AS CLASS I DIVISION I HAZARDOUS LOCATIONS.
- 4.) INSTALLATIONS SUCH AS DECORATIVE FOUNTAINS OR WATER FEATURES PROVIDED FOR VISUAL ENJOYMENT MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE ANSI/NFPA 70 AND/OR THE AUTHORITY HAVING JURISDICTION. THIS PUMP IS NOT INTENDED FOR USE IN SWIMMING POOLS, RECREATIONAL WATER PARKS, OR INSTALLATIONS IN WHICH HUMAN CONTACT WITH PUMPED MEDIA IS A COMMON OCCURRENCE.

SECTION 3B
PAGE 6
DATE 7/04

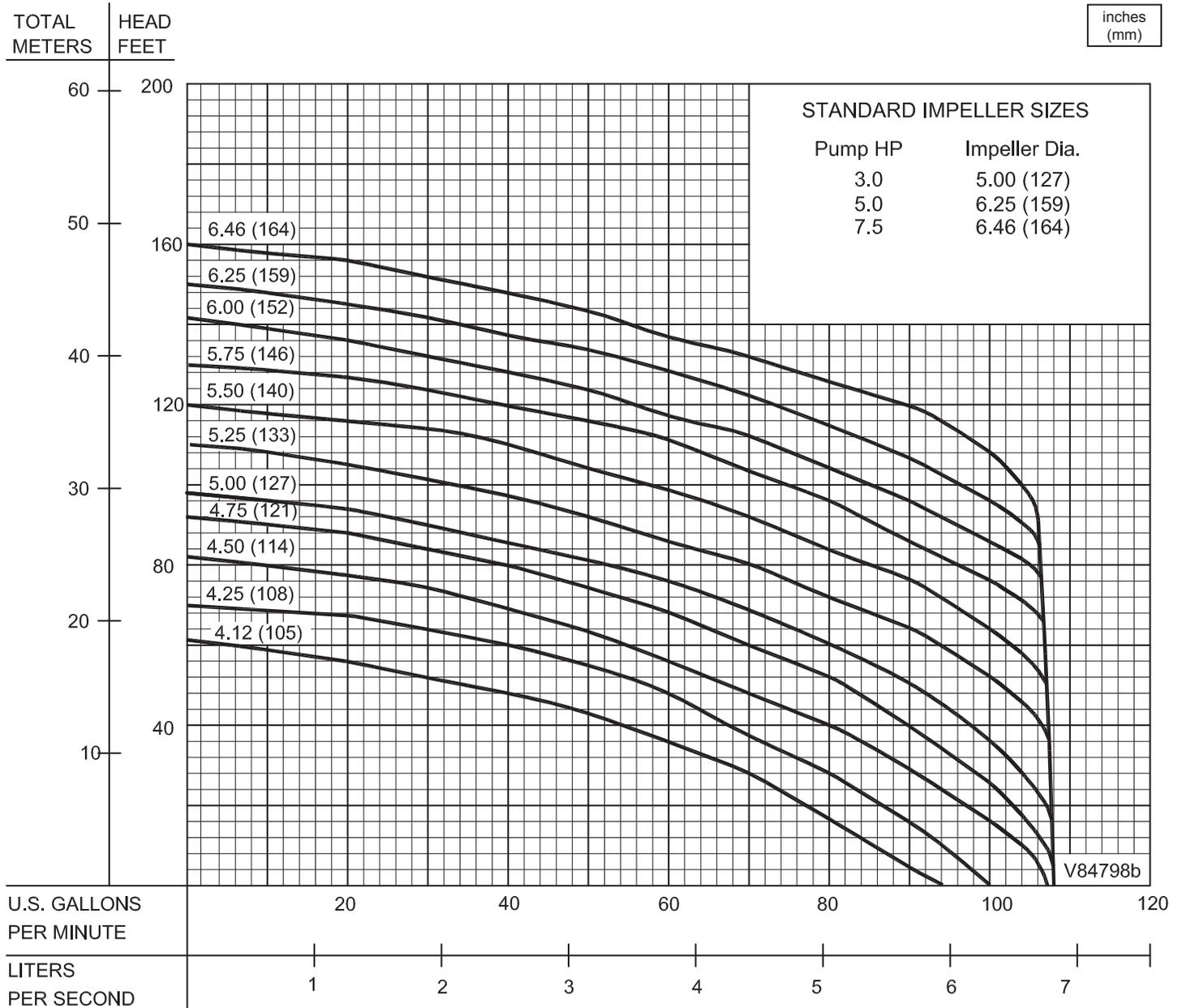
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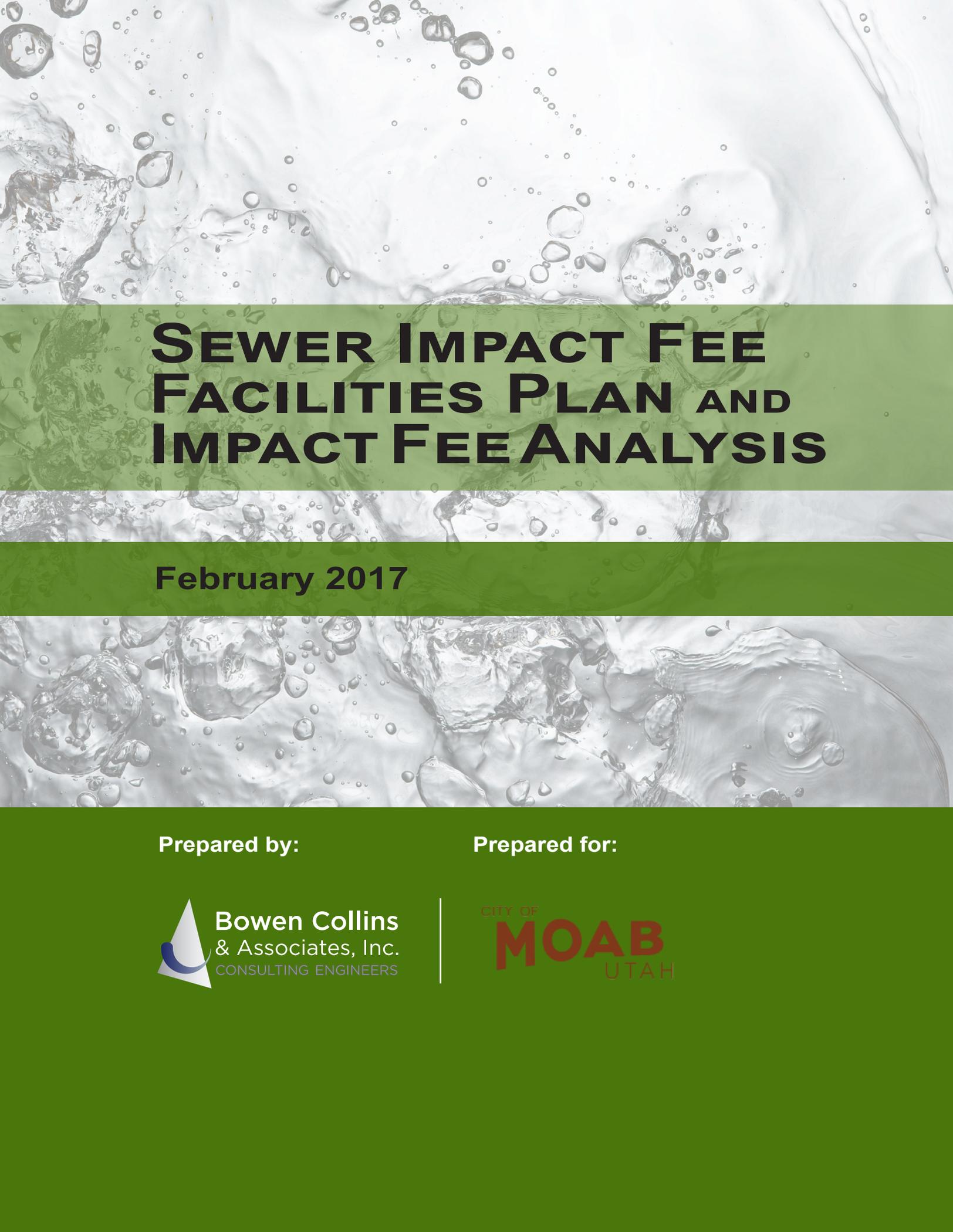
Submersible Grinder Pumps



Testing is performed with water, specific gravity 1.0 @ 68° F @ (20°C), other fluids may vary performance

APPENDIX C

Rate and
Impact
Fee
Studies



SEWER IMPACT FEE FACILITIES PLAN AND IMPACT FEE ANALYSIS

February 2017

Prepared by:



**Bowen Collins
& Associates, Inc.**
CONSULTING ENGINEERS

Prepared for:

CITY OF
MOAB
UTAH

SEWER IMPACT FEE FACILITIES PLAN

February 2017



Prepared for:

CITY OF
MOAB
UTAH

Prepared by:

 **Bowen Collins
& Associates, Inc.**
CONSULTING ENGINEERS

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EXECUTIVE SUMMARY – IFFP (SEWER)

The purpose of an impact fee facilities plan (IFFP) is to identify demands placed upon Moab City facilities by future development and evaluate how these demands will be met by the City. The IFFP is also intended to outline the improvements which may be funded through impact fees.

This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City’s new wastewater treatment plant.

WHY IS AN IFFP NEEDED?

The IFFP provides a technical basis for assessing updated impact fees throughout the City. This document addresses the future infrastructure needed to serve the City. The existing and future capital projects documented in this IFFP will ensure that level of service standards are maintained for all existing and future residents who reside within the service area. Local governments must pay strict attention to the required elements of the Impact Fee Facilities Plan which are enumerated in the Impact Fees Act.

SERVICE AREAS

For the purpose of impact fee calculations, the Moab City sewer system has been divided into three service areas. The “Moab City” service area includes all areas within the corporate boundaries of the City. The “Other Agencies” service area includes all growth outside of the City’s corporate boundary that is still expected to flow to the City. This could potentially include flow from the Spanish Valley Water & Sewer Improvement District (SVW&SID) and San Juan County. The “Septage Haulers” service area is not associated with a specific area at all, but refers to those customers that will bring septage directly to the City plan from septic tanks, campgrounds, and pit toilets serving the recreational areas surrounding Moab City.

PROJECTED FUTURE GROWTH

To evaluate the use of existing capacity and the need for future capacity, it is first necessary to calculate the demand associated with existing development and projected growth. Using available information for existing development and growth projections from the City’s Capital Facilities Plan, projected growth in system demand is summarized in Tables ES-1 and ES-2. Because of the different issues associated with flow and treatment, growth has been evaluated for these two categories separately.

Table ES-1
Projected Moab Sewer System Growth – Flow ERUs

| | Projected Flow ERUs – Moab City | Projected Flow ERUs – Other Agencies | Projected Flow ERUs – Septage | Projected Flow ERUs – Total | Estimated Dry Weather Sewer Flows (mgd) |
|-------------|--|---|--------------------------------------|------------------------------------|--|
| 2017 | 5,467 | 2,707 | 38 | 8,212 | 1.19 |
| 2022 | 5,774 | 3,536 | 47 | 9,357 | 1.35 |
| 2027 | 6,099 | 4,215 | 55 | 10,370 | 1.50 |
| 2032 | 6,442 | 4,931 | 64 | 11,437 | 1.66 |
| 2035 | 6,657 | 5,379 | 69 | 12,105 | 1.75 |
| 2060 | 8,320 | 6,111 | 83 | 14,514 | 2.13 |

Table ES-2
Projected Moab Sewer System Growth – Treatment ERUs

| | Projected Treatment ERUs – Moab City | Projected Treatment ERUs – Other Agencies | Projected Treatment ERUs – Septage | Projected Treatment ERUs – Total |
|-------------|---|--|---|---|
| 2017 | 6,107 | 2,944 | 1,373 | 10,424 |
| 2022 | 6,450 | 3,891 | 1,688 | 12,030 |
| 2027 | 6,813 | 4,688 | 2,004 | 13,505 |
| 2032 | 7,196 | 5,524 | 2,319 | 15,040 |
| 2035 | 7,436 | 6,046 | 2,509 | 15,991 |
| 2060 | 9,147 | 6,722 | 3,191 | 19,060 |

Demands are projected in terms of Equivalent Residential Units (ERUs). An ERU represents the demand that a typical single family residence places on the system. The basis of an ERU (based on both flow and treatment demands) is summarized in Table ES-3.

**Table ES-3
Moab Service Area Flow and Treatment ERUs**

| Item | Value |
|---|--------------|
| Flow | |
| Equivalent Residential Units (ERUs) | 8,232 |
| Domestic Wastewater Production (mgd) | 1.07 |
| Infiltration, Maximum Month (mgd) | 0.12 |
| Average Day, Maximum Month Flow (mgd) | 1.19 |
| Peak Hour Flow (mgd) | 2.98 |
| Flows per ERU | |
| Domestic Wastewater Production (gpd/ERU) | 130.2 |
| Average Day, Maximum Month Flow (gpd/ERU) | 144.6 |
| Peak Hour Flow (gpd/ERU) | 361.5 |
| Average Indoor Water Use (gallons/month/ERU) | 4,400 |
| Treatment | |
| Treatment Equivalent Residential Units (ERUs) | 10,221 |
| BOD Loading, Maximum Month (lbs) | 112,400 |
| TSS Loading, Maximum Month (lbs) | 105,300 |
| Wastewater Strength per ERU | |
| BOD (mg/L) | 300 |
| TSS (mg/L) | 280 |
| BOD (lbs/month/ERU) | 11.0 |
| TSS (lbs/month/ERU) | 10.3 |

LEVEL OF SERVICE

Level of service is defined in the Impact Fees Act as “the defined performance standard or unit of demand for each capital component of a public facility within a service area”. Performance standards are those standards that are used to design and evaluate the performance of facilities. While the Impact Fees Act includes “defined performance standard” as part of the level of service definition, this report will make a subtle distinction between performance standard and level of service. The performance standard will be considered the desired minimum level of performance for each component, while the existing level of service will be the actual current performance of the component and the proposed level of service will be the proposed actual performance of the component in the future. For the wastewater collection system, summary values for each of these categories are contained in Table ES-4.

**Table ES-4
Performance Standards and Level of Service
for Collection System Components**

| | Existing Performance Standard | Existing Level of Service | Proposed Level of Service |
|---|--|--|--|
| Pipeline Capacity | | | |
| Maximum Ratio of Flow ¹ to Pipeline Capacity | 0.75 | 0.74 ² | 0.75 |

¹ Peak hour, dry weather flow

² Because there are thousands of pipeline components, the value given is for the worst case only. All other components have a higher level of service.

For treatment facilities, the City has decided to completely replace the existing treatment plant with a new facility. As a result, the existing facility will effectively provide no existing level of service moving forward from an impact fee perspective. Construction of the new facilities will represent a new level of service to be paid for proportionally by both existing and future users based on the level of benefit received.

EXISTING CAPACITY AVAILABLE TO SERVE FUTURE GROWTH

Projected future growth will be met through a combination of available excess capacity in existing facilities and construction of additional capacity in new facilities. Defining existing system capacity in terms of a single number is difficult. To improve the accuracy of the analysis, the system was divided into two different components (pipeline capacity and treatment, and plant capacity). Excess capacity in each component of the system is as follows:

Pipeline Capacity

Use of collection capacity was evaluated using the updated computer model of the City's collection system. As a whole, the calculated percentage of existing capacity in collection system facilities that is or will be used by varying customer groups is summarized in Table ES-5.

**Table ES-5
Use of Existing Capacity**

| Pipeline Capacity | Existing Users | 10-Year Growth | Growth Beyond 10- Years | Total |
|--------------------------|---------------------------|---------------------------|--|--------------|
| Moab City | 53.2% | 4.7% | 15.9% | 73.8% |
| Other Agencies | 20.6% | 2.4% | 3.2% | 26.2% |
| Septage Haulers | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 73.8% | 7.1% | 19.1% | 100.0% |

Treatment Plant Capacity

As noted previously, no existing treatment plant capacity will be used into the future.

REQUIRED SYSTEM IMPROVEMENTS

Beyond available existing capacity, additional improvements required to serve new growth are summarized in Table ES-6. To satisfy the requirements of state law, Table ES-6 provides a breakdown of the percentage of the project costs attributed to existing and future users. For future use, capacity has been divided between capacity to be used by growth within the 10-year planning window of this IFFP and capacity that will be available for growth beyond the 10-year window. Use of capacity has also been divided between the several service areas.

**Table ES-6
Project Costs Allocated to Projected Development, 10-year Planning Window**

| Name | Total Cost | Percent to Moab City Service Area | | | Percent to Other Agencies Service Area | | | Percent to Septage Haulers Service Area | | |
|---|--------------|-----------------------------------|--------------|--------------|--|--------------|--------------|---|--------------|--------------|
| | | Existing | 10-yr Growth | Beyond 10-yr | Existing | 10-yr Growth | Beyond 10-yr | Existing | 10-yr Growth | Beyond 10-yr |
| New South Trunkline | \$2,100,000 | 0.00% | 5.91% | 23.83% | 0% | 33.34% | 36.92% | 0% | 0% | 0% |
| Replace 400 East Trunkline (1,200 ft 12-inch) | \$389,200 | 10.64% | 70.07% | 19.30% | 0% | 0% | 0% | 0% | 0% | 0% |
| New Wastewater Treatment Plant | \$16,320,595 | 38.25% | 4.42% | 3.83% | 18.44% | 10.92% | 8.45% | 8.60% | 3.95% | 3.14% |

IMPACT FEE FACILITIES PLAN (SEWER)

INTRODUCTION

Moab City has retained Bowen Collins & Associates (BC&A) to prepare an impact fee facilities plan (IFFP) for sewer collection services provided by the City. The purpose of an IFFP is to determine the public facilities required to service development resulting from new development activity. The IFFP is also intended to outline the improvements which may be funded through impact fees.

This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City's new wastewater treatment plant.

Service Areas

For the purpose of impact fee calculations, the Moab City sewer system has been divided into three service areas. The "Moab City" service area includes all areas within the corporate boundaries of the City. The "Other Agencies" service area includes all growth outside of the City's corporate boundary that is still expected to flow to the City. This could potentially include flow from the Spanish Valley Water & Sewer Improvement District (SVW&SID) and San Juan County. The "Septage Haulers" service area is not associated with a specific area at all, but refers to those customers that will bring septage directly to the City plan from septic tanks, campgrounds, and pit toilets serving the recreational areas surrounding Moab City.

It is important to divide the system into service areas because of the difference in facilities that will be used to serve each service area. This is primarily in connection with sewer collection facilities in the City. While the treatment facilities used to service each service area will be essentially identical, the collection facilities will be significantly different. Much of the growth in Moab City will use available capacity in existing collection pipelines throughout the City. Growth in the "Other Agency" service area will predominantly be served by a new trunkline along the southern edge of the City. Septage haulers will not use any collection capacity at all. This different use of collection will be reflected in the calculation of impact fees as described in the remainder of this report.

Requirements

Requirements for the preparation of an IFFP are outlined in Title 11, Chapter 36a of the Utah Code (the Impact Fees Act). Under these requirements, an IFFP shall accomplish the following for each facility:

1. Identify the existing level of service
2. Establish a proposed level of service
3. Identify excess capacity to accommodate future growth at the proposed level of service
4. Identify demands placed upon existing public facilities by new development
5. Identify the means by which demands from new development will be met
6. Consider the following additional issues

- a. revenue sources to finance required system improvements
- b. necessity of improvements to maintain the proposed level of service
- c. need for facilities relative to planned locations of schools

The following sections of this report have been organized to address each of these requirements.

EXISTING LEVEL OF SERVICE - 11-36a-302(1)(a)(i)

Level of service is defined in the Impact Fees Act as “the defined performance standard or unit of demand for each capital component of a public facility within a service area”. This section discusses the level of service being currently provided to existing users. The level of service is the same for all service areas.

Unit of Demand

The projected flow used to design and evaluate system components will vary depending on the nature of each component. For example, most treatment plant processes are designed based on average day, maximum month flow (with consideration of wastewater strength characteristics). Conversely, conveyance pipelines must be designed based on peak hour flow (function of daily flow and diurnal flow variation).

For the purposes of this analysis, it is useful to define these various demands in terms of Equivalent Residential Units (ERUs). An ERU represents the demand that a typical single family residence places on the system. Because of the different types of facilities in the City wastewater system, it is useful to define an ERU in terms of flow only (for use in the evaluation of conveyance facilities), and treatment (considering both flow and wastewater strength). The basis of both flow and treatment ERUs for historical wastewater characteristics and flow rates has been documented in a technical memorandum dated September 21, 2016 and has been included as Appendix A. The major components of the flow and treatment ERUs are summarized in Table 1.

Table 1
Wastewater System Flow and Treatment ERUs

| Item | Value |
|---|--------------|
| Flow | |
| Equivalent Residential Units (ERUs) | 8,232 |
| Domestic Wastewater Production (mgd) | 1.07 |
| Infiltration, Maximum Month (mgd) | 0.12 |
| Average Day, Maximum Month Flow (mgd) | 1.19 |
| Peak Hour Flow (mgd) | 2.98 |
| Flows per ERU | |
| Domestic Wastewater Production (gpd/ERU) | 130.2 |
| Average Day, Maximum Month Flow (gpd/ERU) | 144.6 |
| Peak Hour Flow (gpd/ERU) | 361.5 |
| Average Indoor Water Use (gallons/month/ERU) | 4,400 |
| Treatment | |
| Treatment Equivalent Residential Units (ERUs) | 10,221 |
| BOD Loading, Maximum Month (lbs) | 112,400 |
| TSS Loading, Maximum Month (lbs) | 105,300 |
| Wastewater Strength per ERU | |
| BOD (mg/L) | 300 |
| TSS (mg/L) | 280 |
| BOD (lbs/month/ERU) | 11.0 |
| TSS (lbs/month/ERU) | 10.3 |

Performance Standard and Level of Service

Performance standards are those standards that are used to design and evaluate the performance of facilities. While the Impact Fees Act includes “defined performance standard” as part of the level of service definition, this report will make a subtle distinction between performance standard and level of service. The performance standard will be considered the desired minimum level of performance for each component, while the existing level of service will be the actual current performance of the component. Thus, if the existing level of service is less than the performance standard it is a deficiency. If it is greater than the performance standard it may indicate excess capacity.

To improve the accuracy of the analysis, this impact fee facilities plan has divided the system into two different components (pipeline capacity and treatment capacity). Each of these components has its own set of performance standards and level of service:

Pipeline Capacity

Moab engineering standards require that all sewer mains be designed such that the peak flow depth in the pipe is less than or equal to the depth associated with 75 percent of the pipe's hydraulic capacity, using a Manning's roughness factor n of 0.013 (this is approximately equal to a depth over diameter ratio of 0.65). This allows for a small amount of extra capacity to be reserved in the pipeline to account for potential inflow into the system and other unknowns.

A hydraulic computer model was used to evaluate the existing level of service of pipelines in the City's sewer collection system. The existing level of service compared to the performance standard is summarized in Table 2 below.

**Table 2
Existing Performance Standards and Level of Service
for Sewer Pipelines**

| | Existing Performance Standard | Existing Level of Service |
|---|--|--|
| Pipeline Capacity | | |
| Maximum Ratio of Flow ¹ to Pipeline Capacity | 0.75 | 0.74 ² |

¹ Peak hour, dry weather flow

² Because there are thousands of pipeline components, the value given is for the worst case only. All other components have a higher level of service.

As shown in the table, the City's pipeline existing level of service is actually better than the capacity performance standard. This indicates there is some excess capacity in all of the existing collection pipelines in the system. It should be noted that, because there are hundreds of pipeline components in the sewer collection system, the value given is actually for the worst case only. All other components have a higher level of service. Thus, the excess capacity identified in the table may actually be higher in other parts of the system. Excess capacity will be discussed in subsequent sections of this report.

Treatment Plant Capacity

The Moab WWTP was initially constructed in the late 1950s to provide primary treatment of wastewater for the Moab area. A secondary treatment process was added in 1967. Additional modifications and expansions have been completed over the life of the plant. The latest expansion was completed in 1996, which included a new headworks facility, additional primary and secondary clarifiers, a new septage receiving station, and several other improvements.

The WWTP has adequately met the City's wastewater treatment needs for many years. However, population growth and increased tourism in Moab area have resulted in increased biological loading to the WWTP. The increased loading exceeds the plant's capacity to effectively treat influent wastewater to continuously meet the effluent discharge standards required by the State of Utah. Upgrades to the biological treatment process are necessary to ensure full compliance with requirements of the discharge permit. Additionally, portions of the

plant are over 60 years old and require renovation or replacement in order for the facility to provide continued reliable service.

As a result of these issues, the City has decided to completely replace the existing treatment plant with a new facility. As a result, the existing facility will effectively provide no existing level of service moving forward from an impact fee perspective. Construction of the new facilities will represent a new level of service to be paid for proportionally by both existing and future users based on the level of benefit received. This will be discussed in greater detail in subsequent sections of this report.

PROPOSED LEVEL OF SERVICE - 11-36a-302(1)(a)(ii)

The proposed level of service is the performance standard used to evaluate system needs in the future. The Impact Fees Act indicates that the proposed level of service may:

1. diminish or equal the existing level of service; or
2. exceed the existing level of service if, independent of the use of impact fees, the City implements and maintains the means to increase the level of service for existing demand within six years of the date on which new growth is charged for the proposed level of service.

As with existing level of service, this impact fee facilities plan has divided the system into pipeline capacity and treatment capacity to discuss proposed level of service.

Pipeline Capacity

By definition, the proposed future level of service for sewer system pipelines will be equal to the performance standard as summarized in Table 3.

**Table 3
Proposed Performance Standards and Level of Service
For Sewer Pipelines**

| | Proposed Performance Standard | Proposed Level of Service |
|---|--------------------------------------|----------------------------------|
| Pipeline Capacity | | |
| Maximum Ratio of Flow ¹ to Pipeline Capacity | 0.75 | 0.75 |

¹ Peak hour, dry weather flow

Treatment Plant Capacity

As discussed above, the City is in the process of designing a project to completely replace its existing treatment plant. This represents an increased level of service that will need to be paid for by all users.

A treatment plant consists of a large number of different components. Each component may have different criteria for design depending on the nature of the component. For the majority of treatment related components, design is based on treating the average daily flow during the maximum month. This is the same standard used by the State of Utah Department of Environmental Quality (UDEQ) when rating the capacity of a treatment plant. Within this flow capacity, however, the treatment plant must also be designed to accommodate expected wastewater strengths. This of particular concern for Moab City because of the large amount of septage received from campgrounds and other pit toilets located in recreational areas near the City. Ultimately, capacity will be evaluated based on treatment ERUs as summarized above, which represents a composite of flow and strength.

EXCESS CAPACITY TO ACCOMMODATE FUTURE GROWTH - 11-36a-302(1)(a)(iii)

Projected future growth will be met through a combination of available excess capacity in existing facilities and construction of additional capacity in new facilities. This section discusses use of available existing capacity.

Pipeline Capacity

To calculate the percentage of existing capacity to be used by future growth in existing facilities, existing and future flows were examined in system model for each collection pipeline. The method used to calculate excess capacity available for use by future flows is as follows:

1. **Calculate Flows** – The peak flow in each facility was calculated in the model for both existing and future flows. The capacity at a 0.65 depth to diameter ratio of each pipeline was also calculated.
2. **Identify Available Capacity** – Where a facility has capacity in excess of projected flows at buildout, the available capacity in the facility was defined as the difference between existing flows and buildout flows. Where the facility has capacity less than projected flows at buildout, the available capacity in the facility was defined as the difference between existing flows and the facility’s maximum capacity.
3. **Eliminate Facilities without Excess Capacity** – For the planning window period (in this case, 10 years), the projected growth in flow during the planning window was compared against the facility’s available capacity. Where the future flow exceeded the capacity of the facility, the available excess capacity was assumed to be zero. By definition, this corresponds to those facilities with deficiencies that are identified in the facilities plan. By assigning a capacity of zero, this eliminated double counting those facilities against new users.
4. **Calculate Percent of Excess Capacity Used in Remaining Facilities** – Where the future flow was less than the capacity of the facility, the percent of excess capacity to be used in each facility was calculated by dividing the growth in flow in the facility (future flow less existing flow) by the total capacity (existing flow plus available capacity).
5. **Calculate Excess Capacity for the System as a Whole** – Each pipeline in the system has a different quantity of excess capacity to be used by future growth. To develop an estimate of excess capacity on a system wide basis, the capacities of each of these pipelines and their contribution to the system as a whole must be considered. To do this,

each pipeline must first be weighted based on its estimated cost. For this purpose, each pipeline has been weighted based on the product of its diameter and length (which is a roughly proportional approximation of overall pipeline cost). For example, a pipe that is 36 inches in diameter and is 4,000 ft. long will cost proportionally more than a pipe that is 10 inches in diameter and 300 ft. long. The excess capacity in the system as a whole can then be calculated as the sum of the weighted capacity used by future growth divided by the sum of total weighted capacity in the system.

Based on the method described above, the amount of excess capacity in existing facilities available to accommodate future growth and the demands placed on the existing facilities by new development activity has been calculated for each element in the system by BC&A. Use of the existing capacity has also been divided between the various service areas.

As a whole, the calculated percentage of existing capacity in collection system facilities that is or will be used by varying customer groups is summarized in Table 4. As would be expected, Septage Haulers are not using any portion of the existing collection system.

**Table 4
Use of Existing Capacity**

| Pipeline Capacity | Existing Users | 10-Year Growth | Growth Beyond 10-Years | Total |
|--------------------------|-----------------------|-----------------------|-------------------------------|---------------|
| Moab City | 53.2% | 4.7% | 15.9% | 73.8% |
| Other Agencies | 20.6% | 2.4% | 3.2% | 26.2% |
| Septage Haulers | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 73.8% | 7.1% | 19.1% | 100.0% |

Treatment Capacity

As noted previously, no existing treatment plant capacity will be used into the future.

DEMANDS PLACED ON FACILITIES BY NEW DEVELOPMENT - 11-36a-302(a)(iv)

Growth within the City’s service area, and projections of sewer flows resulting from said growth have been evaluated as part of the City’s new treatment plant design activities. Growth in terms of equivalent residential units is summarized in Tables 5 and 6. Table 5 considers growth in flow ERUs, while Table 6 examines treatment ERUs. Each table includes a breakdown of growth by service area.

Table 5
Projected Moab Sewer System Growth – Flow ERUs

| | Projected Flow ERUs – Moab City | Projected Flow ERUs – Other Agencies | Projected Flow ERUs – Septage | Projected Flow ERUs – Total | Estimated Dry Weather Sewer Flows (mgd) |
|-------------|--|---|--------------------------------------|------------------------------------|--|
| 2017 | 5,467 | 2,707 | 38 | 8,212 | 1.19 |
| 2022 | 5,774 | 3,536 | 47 | 9,357 | 1.35 |
| 2027 | 6,099 | 4,215 | 55 | 10,370 | 1.50 |
| 2032 | 6,442 | 4,931 | 64 | 11,437 | 1.66 |
| 2035 | 6,657 | 5,379 | 69 | 12,105 | 1.75 |
| 2060 | 8,320 | 6,111 | 83 | 14,514 | 2.13 |

Table 6
Projected Moab Sewer System Growth – Treatment ERUs

| | Projected Treatment ERUs – Moab City | Projected Treatment ERUs – Other Agencies | Projected Treatment ERUs – Septage | Projected Treatment ERUs – Total |
|-------------|---|--|---|---|
| 2017 | 6,107 | 2,944 | 1,373 | 10,424 |
| 2022 | 6,450 | 3,891 | 1,688 | 12,030 |
| 2027 | 6,813 | 4,688 | 2,004 | 13,505 |
| 2032 | 7,196 | 5,524 | 2,319 | 15,040 |
| 2035 | 7,436 | 6,046 | 2,509 | 15,991 |
| 2060 | 9,147 | 6,722 | 3,191 | 19,060 |

INFRASTRUCTURE REQUIRED TO MEET DEMANDS OF NEW DEVELOPMENT - 11-36A-302(1)(a)(v)

To satisfy the requirements of state law, the effect of demand placed upon existing system facilities by future development was evaluated using the process outlined below. Each of the steps were completed as part of this plan's development.

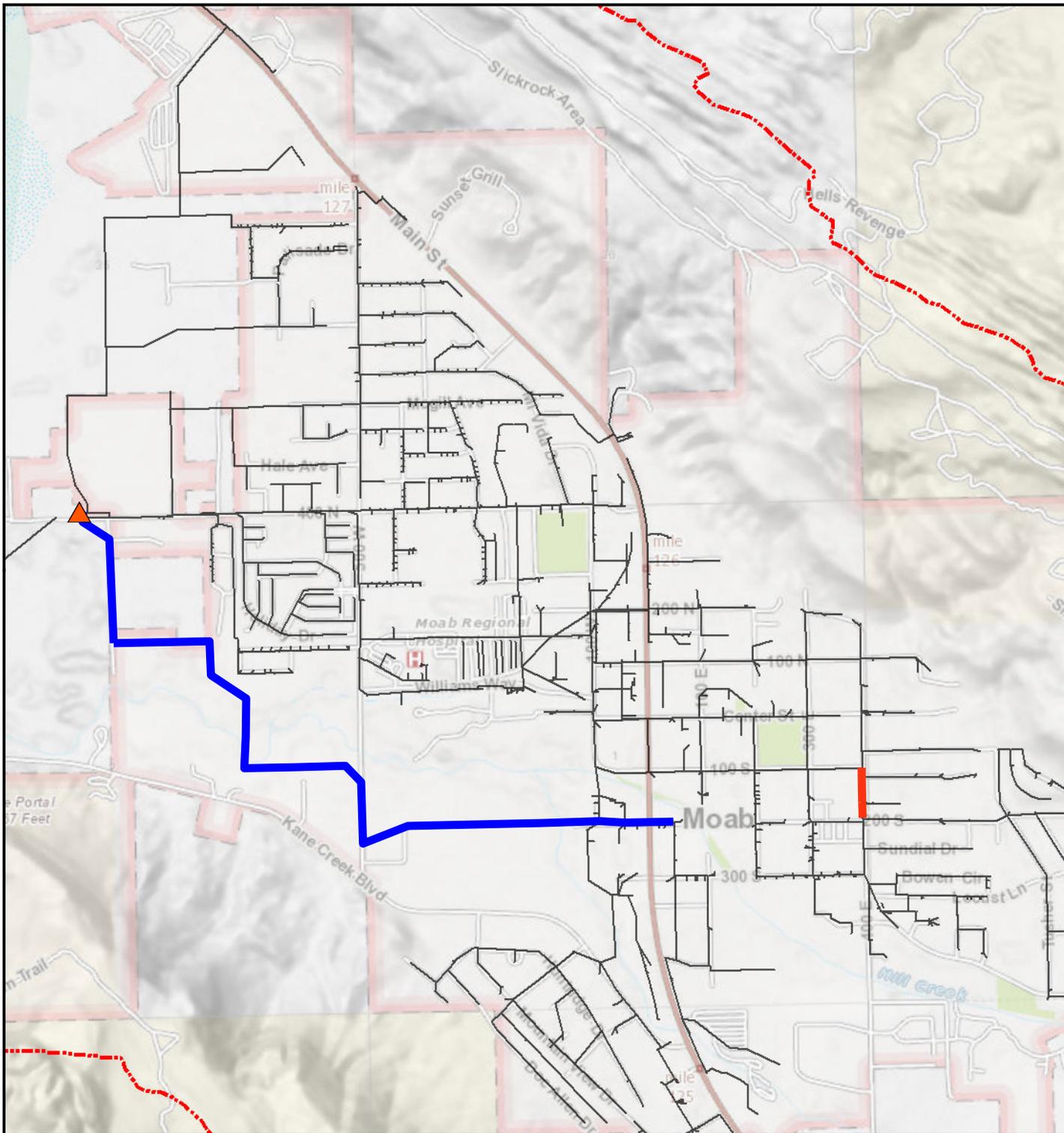
1. **Existing Demand** – The demand existing development places on the City's system was estimated based on historic water use and flow records.
2. **Existing Capacity** – The capacities of existing system collection facilities were estimated using size data provided by the City and a hydraulic computer model.
3. **Existing Deficiencies** – Existing deficiencies in the system were looked for by comparing defined levels of service against calculated capacities. No existing capacity deficiencies in the existing collection system were identified in this study.

4. **Future Demand** - The demand future development will place on the system was estimated based on development projections as summarized above.
5. **Future Deficiencies** - Future deficiencies in the collection system were identified using the defined level of service and results from the computer model.
6. **Recommended Improvements** – Needed system improvements were identified to meet demands associated with future development.

The steps listed above “identify demands placed upon existing public facilities by new development activity at the proposed level of service; and... the means by which the political subdivision or private entity will meet those growth demands” (Section 11-36a-302(1)(a) of the Utah Code).

10-Year Improvement Plan

Through the analysis outlined above, capital facilities projects needed to provide service to various parts of the City through 2060 were identified. Most of these projects will need to be constructed in phases as development occurs. Only infrastructure to be constructed within a ten year horizon will be considered in the calculation of impact fees to avoid uncertainty surrounding improvements further into the future. There are three projects identified in the capital facilities plan that will need to be constructed within the next ten years. These are shown in Figure 1 and are summarized in Table 7.



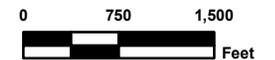
LEGEND

-  New Wastewater Treatment Plant
-  400 East Trunkline
-  South Trunk Line
-  Existing Sewer Pipes
-  Spanish Valley

NORTH:



SCALE:



10-YEAR IFFP PROJECTS

MOAB CITY
IMPACT FEE FACILITIES PLAN

 **Bowen Collins**
& Associates, Inc.
CONSULTING ENGINEERS

FIGURE NO.

1

Table 7
Project Costs Allocated to Projected Development, 10-year Planning Window

| Name | Total Cost | Percent to Moab City Service Area | | | Percent to Other Agencies Service Area | | | Percent to Septage Haulers Service Area | | |
|---|--------------|-----------------------------------|--------------|--------------|--|--------------|--------------|---|--------------|--------------|
| | | Existing | 10-yr Growth | Beyond 10-yr | Existing | 10-yr Growth | Beyond 10-yr | Existing | 10-yr Growth | Beyond 10-yr |
| New South Trunkline | \$2,100,000 | 0.00% | 5.91% | 23.83% | 0% | 33.34% | 36.92% | 0% | 0% | 0% |
| Replace 400 East Trunkline (1,200 ft 12-inch) | \$389,200 | 10.64% | 70.07% | 19.30% | 0% | 0% | 0% | 0% | 0% | 0% |
| New Wastewater Treatment Plant | \$16,320,595 | 38.25% | 4.42% | 3.83% | 18.44% | 10.92% | 8.45% | 8.60% | 3.95% | 3.14% |

Project Cost Attributable to Future Growth

To satisfy the requirements of state law, Table 7 provides a breakdown of the capital facilities projects and the percentage of the project costs attributed to existing and future users for each service area. As defined in Section 11-36a-102(15), the impact fee facilities plan should only include the proportionate share of “the cost of public facilities that are roughly proportionate and reasonably related to the service demands and needs of any development activity.”

For many projects, the division of costs between existing and future users is easy because 100 percent of the project costs can be attributed to one category or the other (e.g. infrastructure needed solely to serve new development can be 100 percent attributed to new growth, while projects related to existing condition or capacity deficiencies can be 100 percent attributed to existing user needs). For projects needed to address both existing deficiencies and new growth or where a higher level of service is being proposed, costs have been divided proportionally between existing and future users based on their needs in the facility. A few additional notes regarding specific projects are as follows:

- New South Trunkline – This is a new trunkline being constructed solely to provide new capacity for growth. As a result, 100 percent of its cost is attributable to new growth. It should be noted that, as part of the overall system master plan, some existing flows will be rerouted into this pipeline. However, this is being done only to free up capacity in existing pipelines for growth elsewhere in the system. As a result, new growth will pay for the new capacity in the South Trunkline that will be used by existing flows in exchange for capacity that becomes available in the existing pipelines.
- Replace 400 East Trunkline – Cost distribution was determined by analyzing current and future demands. To satisfy all future demands, a new 8-inch sewer line would need to be installed parallel to the existing line. Because the existing sewer line has no existing deficiency, 100 percent of this cost can be attributed to new growth. To avoid having parallel pipelines on the same street, however, it is preferred that the existing 8-inch pipeline be replaced with a new 12-inch pipeline (instead of installing a second parallel 8-inch pipeline). Correspondingly, future users have been assessed what cost would have been occurred if an 8-inch pipeline had been installed and existing users have been assessed the cost of upsizing the pipeline from 8- to 12-inch.
- New Wastewater Treatment Plant – As discussed previously, Moab has plans to construct a new wastewater treatment plant to completely replace its existing plant. This essentially represents a new level of service benefiting all users, both existing and future. As a result, this cost was distributed proportionally between existing and future users based on current and projected treatment ERUs into the facility.

Table 7 does not include bond costs related to paying for impact fee eligible improvements. These costs are calculated as part of the impact fee analysis.

Project Cost Attributable to 10-Year Growth

Included in Table 7 is a breakdown of capacity associated with growth both through the next 10 years and from 10 years out through 2060. This is necessary because some of the projects

identified in the table will be built with capacity to accommodate flows beyond the 10-year growth window. This has been done following the same general process as described above.

Basis of Construction Cost Estimates

The costs of construction for projects to be completed within ten years have been estimated based on past City experience with projects of a similar nature and other projects outside of the City. A detailed estimate of costs associated with the treatment plant is contained in Appendix B.

ADDITIONAL CONSIDERATIONS

MANNER OF FINANCING - 11-36a-302(2)

The City may fund the infrastructure identified in this IFFP through a combination of different revenue sources.

Federal and State Grants and Donations

Impact fees cannot reimburse costs funded or expected to be funded through federal grants and other funds that the City has received for capital improvements without an obligation to repay. Grants and donations are not currently contemplated in this analysis. If grants become available for constructing facilities, impact fees will need to be recalculated and an appropriate credit given. Any existing infrastructure funded through past grants will be removed from the system value during the impact fee analysis.

Bonds

None of the costs contained in this IFFP include the cost of bonding. The cost of bonding required to finance impact fee eligible improvements identified in the IFPP may be added to the calculation of the impact fee. This will be considered in the impact fee analysis.

Interfund Loans

Because infrastructure must generally be built ahead of growth, there often arises situations in which projects must be funded ahead of expected impact fee revenues. In some cases, the solution to this issue will be bonding. In others, funds from existing user rate revenue will be loaned to the impact fee fund to complete initial construction of the project and will be reimbursed later as impact fees are received. Consideration of potential interfund loans will be included in the impact fee analysis and should also be considered in subsequent accounting of impact fee expenditures.

Impact Fees

It is recommended that impact fees be used to fund growth-related capital projects as they help to maintain the proposed level of service and prevent existing users from subsidizing the capital needs for new growth. Based on this IFFP, an impact fee analysis will be able to calculate a fair

and legal fee that new growth should pay to fund the portion of the existing and new facilities that will benefit new development.

Developer Dedications and Exactions

Developer exactions are not the same as grants. If a developer constructs a system improvement or dedicates land for a system improvement identified in this IFFP, or dedicates a public facility that is recognized to reduce the need for a system improvement, the developer will be entitled to an appropriate credit against that particular developer’s impact fee liability or a proportionate reimbursement.

If the value of the credit is less than the development’s impact fee liability, the developer will owe the balance of the liability to the City. If the recognized value of the improvements/land dedicated is more than the development’s impact fee liability, the City must reimburse the difference to the developer.

It should be emphasized that the concept of impact fee credits pertains to system level improvements only. Developers will be responsible for the construction of project improvements (i.e. improvements not identified in the impact fee facilities plan) without credit against the impact fee.

NECESSITY OF IMPROVEMENTS TO MAINTAIN LEVEL OF SERVICE - 11-36a-302(3)

According to State statute, impact fees cannot be used to correct deficiencies in the City’s system and must be necessary to maintain the proposed level of service established for all users. Only those facilities or portions of facilities that are required to maintain the proposed level of service for future growth have been included in this IFFP. Additionally, any portion of projects being used to cure existing deficiencies that will be paid for through future user rates will be accounted for through an impact fee credit to be calculated as part of the impact fee analysis. This will result in an equitable fee as future users will not be expected to fund any portion of the facilities that will benefit existing residents.

IMPACT FEE CERTIFICATION - 11-36a-306(1)

This IFFP has been prepared in accordance with Utah Code Title 11, Chapter 36a (the “Impact Fees Act”), which prescribes the laws pertaining to the imposition of impact fees in Utah. The accuracy of this IFFP relies in part upon planning, engineering, and other source data, provided by the City and its designees.

In accordance with Utah Code Annotated, 11-36a-306(1), Bowen Collins & Associates makes the following certification:

I certify that the attached impact fee facilities plan:

1. Includes only the costs of public facilities that are:
 - a. allowed under the Impact Fees Act; and
 - b. actually incurred; or
 - c. projected to be incurred or encumbered within six years after the day on which each impact fee is paid;
2. Does not include:
 - a. costs of operation and maintenance of public facilities;
 - b. cost for qualifying public facilities that will raise the level of service for the facilities, through impact fees, above the level of service that is supported by existing residents; or
 - c. an expense for overhead, unless the expense is calculated pursuant to a methodology that is consistent with generally accepted cost accounting practices and the methodological standards set forth by the federal Office of Management and Budget for federal grant reimbursement; and
3. Complies in each and every relevant respect with the Impact Fees Act.



Keith J. Larson, P.E.

APPENDIX A
TECHNICAL MEMORANDUM # 1
RESIDENTIAL EQUIVALENT STUDY



TECHNICAL MEMORANDUM # 1

TO: Rebecca Davidson
Moab City

COPIES: File

FROM: Keith Larson P.E.
Jeff Beckman P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

DATE: September 21, 2016

PROJECT: Sewer Rate Study

SUBJECT: Residential Equivalent Study

INTRODUCTION

Bowen Collins & Associates (BC&A) has been retained by Moab City (City) to do a study on equivalent residential units (ERUs) for the City. An ERU is the typical water use amount for a single family residence measured in gallons per day or gallons per month. This represents the average flow and strength of wastewater for a residential connection to the City.

The purpose of this study is to create a basis for the City to relate flow from larger non-residential customers to the flow of an average residential connection or ERU. By defining the flow of all the different customer types in terms of ERUs, the City will be able to equally allocate the costs of service in the sewer system to the various system users. This memorandum examines the basis of an ERU in the City and proposes a method of ERU calculation for different customer types.

ERU DEFINITION

The definition of an ERU should be defined based on the average characteristics of a single family residential connection. Based on water use records for 2016, the average residential connection had indoor water use of approximately 4,400 gallons during the peak month of the year. Historically, the City has used an expected domestic wastewater concentration of 300 mg/L when calculating Biological Oxygen Demand (BOD) loading and 280 mg/L when calculating Total Suspended Solids (TSS) loading.

Based on this information, the following definitions and equations are proposed to calculate the number of ERUs for different customer types. To accurately reflect the impact of customers on both collection and treatment facilities, ERUs will be defined in terms of both flow and strength. Fractional ERU values are rounded up to the next whole number.

ERU Definition Based on Flow

(1) $1 \text{ ERU}_{\text{flow}} = 4,400 \text{ gal/month}$

ERU Definition Based on BOD

(2) $1 \text{ ERU}_{\text{BOD}} = 300 \text{ mg/L} \times (8.345 \times 10^{-6} \text{ lbs L/mg gal}) \times 4,400 \text{ gal/month}$

$1 \text{ ERU}_{\text{BOD}} = 11.0 \text{ lbs/month}$

ERU Definition Based on TSS

(3) $1 \text{ ERU}_{\text{TSS}} = 280 \text{ mg/L} \times (8.345 \times 10^{-6} \text{ lbs L/mg gal}) \times 4,400 \text{ gal/month}$

$1 \text{ ERU}_{\text{TSS}} = 10.3 \text{ lbs/month}$

Equation to Calculate ERU Value Based on Flow

(4) $\# \text{ of ERU}_{\text{flow}} = \frac{\text{Customer Flow gal/month}}{4,400 \text{ gal/month per RE}}$

Equation to Calculate ERU Value Based on BOD

(5) $\# \text{ of ERU}_{\text{BOD}} = \frac{\text{BOD}_{\text{conc}} \text{ mg/L} \times (8.345 \times 10^{-6}) \times \text{Cust. Flow gal/month}}{11.0 \text{ lbs/month per ERU}}$

Equation to Calculate ERU Value Based on TSS

(6) $\# \text{ of ERU}_{\text{TSS}} = \frac{\text{TSS}_{\text{conc}} \text{ mg/L} \times (8.345 \times 10^{-6}) \times \text{Customer Flow gal/month}}{10.3 \text{ lbs/month per ERU}}$

Equation to Calculate Number of Treatment ERUs Based on Cost Weighted Average of: Flow, BOD, & TSS

(7) $\# \text{ of Treatment ERU}_{\text{Wt Ave}} = (\text{ERU}_{\text{flow}} \times 33.3\%) + (\text{ERU}_{\text{BOD}} \times 33.3\%) + (\text{ERU}_{\text{TSS}} \times 33.3\%)$

The cost weighted average approach described above takes the estimated percentage spent by the City on treatment based on total flow, BOD, and TSS and calculates a weighted ERU value. For this study, costs have been divided evenly between the three categories¹.

¹ To develop a more refined estimate of actual costs would require a full cost-of-service analysis of the detailed design of the new treatment plant and its subsequent operation costs. Since this data will not be available for several years, the costs have been approximated as shown. These are believed to be relatively accurate estimates based on costs as observed at other established plants. A cost analysis of the Central Valley Water Reclamation Facility in Salt Lake City, Utah calculated costs at 30% flow, 31% BOD, and 39% TSS. A similar analysis of the Timpanogos Wastewater Treatment Plant in Pleasant Grove, Utah calculated costs at 56% flow, 24% BOD, and 20% TSS. While costs will vary from plant to plant depending on the treatment process used and the quality of wastewater being received, the estimate contained here seems reasonable in the absence of additional data.

CUSTOMER ERU CATEGORIES

Based on the City’s current customer billing types, BC&A would propose ten different customer categories for defining ERUs as identified in Table 1.

**Table 1
Proposed ERU Customer Categories**

| Customer Category | Notes |
|-------------------------------|---|
| Residential – Single Family | Includes typical single family residential along with trailers, town homes, duplexes, and large multifamily (see below). |
| Residential – Multifamily | Includes all apartments and condos up to a maximum size of 1,500 square feet per unit. All larger multifamily to be grouped with single family residential. |
| Overnight Accommodations | Any overnight accommodations with sewer service including hotels, motels, and bed & breakfasts. |
| Commercial/Retail Office | |
| Restaurant | Any business whose primary function is to prepare and serve food (including fast food). |
| Schools | |
| Gas Station/Convenience Store | |
| RV/Campground | |
| Other | Any development that is not adequately represented by one of the categories above. Could include medical, churches, car washes, laundromats, etc. |

ERU CATEGORY CALCULATIONS

For the proposed customer categories listed above, BC&A has developed a recommended definition for both Flow ERUs and Treatment ERUs as summarized in Table 2. Definitions for Flow ERUs in this table are based on historic flow data as available from 2016 water use records for Moab City customers. Flow equivalency has been based on estimated peak month indoor water use as approximated from April 2016 water use.

Because water quality data is not readily available for the various Moab City customer categories, Treatment ERUs have been based on data collected as part of a detailed water quality study completed by BC&A for Mt. Olympus Improvement District completed in 2012. Historical data used to assemble the results are contained in Appendix A.

Table 2
Proposed ERU Definitions by Customer Category

| Customer Type | Flow Only Definition 1 ERU = | Treatment Definition 1 ERU = |
|-------------------------------|---|---|
| Residential – Single Family | 1 residence | 1 residence |
| Residential – Multifamily | 1.8 units | 1.8 units |
| Overnight Accommodations | 1.2 units | 1.2 units |
| Commercial/Retail | 6,500 ft ² | 6,500 ft ² |
| Office | 4,000 ft ² | 4,000 ft ² |
| Restaurant | 10.6 Seats | 4.7 Seats |
| Schools | 15 Students | 15 Students |
| Gas Station/Convenience Store | 3,600 ft ² | 3,600 ft ² |
| RV/Campground | By Study | By Study |
| Other | By Study | By Study |

It is recommended that the definitions proposed in Table 2 be used to calculate the number of Flow and Treatment ERUs in the Moab, Spanish Valley Water & Sewer Improvement District, and other systems. This can be accomplished as outlined in Equation (8).

Equation to Calculate Number of ERUs Based on ERU Definition

$$(8) \text{ Number of ERUs} = \frac{\text{Customer Facility Size (ft}^2, \text{ \# seats, etc.)}}{\text{ERU Definition}}$$

Moab Historical Water Use by Customer Category (2016)

Residential – Single Family

| | Connections | Units | Quantity (Peak Month) - kgals | Peak Month Indoor Water consumption kgals | Peak Month Indoor Water consumption gpd | ERUs |
|----------------------------|-------------|-------------|-------------------------------------|---|---|---------------|
| 1 Residential | 1365 | 1368 | 6019.2 | 4.40 | 144.7 | 1368.0 |
| 2 Residential | 11 | 18 | 79.2 | 4.40 | 144.7 | 18.0 |
| Trailer Courts | 12 | 349 | 1490.5 | 4.27 | 140.4 | 338.8 |
| Trailer Court/House | 1 | 3 | 30.0 | 10.00 | 328.8 | 6.8 |
| Trailer Court/2 Apts/House | 2 | 22 | 108.0 | 4.91 | 161.4 | 24.5 |
| County Residential | 12 | 12 | 52.8 | 4.40 | 144.7 | 12.0 |
| Total | 1403 | 1772 | 7779.741787 | 4.39 | 144.3 | 1768.1 |

Residential – Multifamily

| | | | | | | |
|------------------|-----------|------------|-------------|------------|-------------|--------------|
| House/Apartments | 8 | 16 | 39.1 | 2.4 | 80.4 | 8.9 |
| Apartments | 77 | 398 | 972.9 | 2.4 | 80.4 | 221.1 |
| Total | 85 | 414 | 1012 | 2.4 | 80.4 | 230.0 |

Overnight Accommodations

| | | | | | | |
|-----------------------|-----------|--------------------|--------------------|------------|--------------|---------------|
| Hotel/Motel/B&B | 64 | 2393.1 | 8774.9 | 3.7 | 120.5 | 1994.3 |
| Bed & Breakfast 52.94 | 2 | 2 | 2.0 | 1.0 | 32.9 | 0.5 |
| Restaurant Correction | -5 | -5 | -64.9 | -13.0 | -426.7 | -14.8 |
| Total | 61 | 2390.142857 | 8711.957143 | 3.6 | 119.8 | 1980.0 |

Commercial/Retail

| | | | | | | |
|--------------------------------|------------|------------|--------------------|---------------|----------------|--------------|
| Business/House | 6 | 11 | 104.0 | 9.5 | 310.8 | 23.6 |
| Business | 138 | 138 | 3277.2 | 23.7 | 780.8 | 744.8 |
| Business - 4 month water usage | 6 | 7 | 22.3 | 3.2 | 104.6 | 5.1 |
| County Business | 1 | 1 | 6.0 | 6.0 | 197.3 | 1.4 |
| 2 Commercial | 1 | 2 | 2.0 | 1.0 | 32.9 | 0.5 |
| Restaurant Correction | -9 | -9 | -132.2 | -14.7 | -482.9 | -30.0 |
| RV/Campground Correction | -3 | -3 | -626.1 | -208.7 | -6861.4 | -142.3 |
| Total | 140 | 147 | 2653.209368 | -180.0 | -5918.0 | 603.0 |

Office

| | | | | | | |
|-----------------------|-----------|-----------|--------------|-------------|--------------|--------------|
| Office Space Rental | 24 | 24 | 556.0 | 23.2 | 761.6 | 126.4 |
| Restaurant Correction | -4 | -4 | -57.8 | -14.5 | -475.1 | -13.1 |
| Total | 20 | 20 | 498.2 | 24.9 | 819.0 | 113.2 |

Restaurant

| | | | | | | |
|--|-----------|-----------|---------------|-------------|---------------|--------------|
| Restaurant/Bar | 23 | 23 | 1461.0 | 63.5 | 2088.4 | 332.0 |
| Restaurant/Bar Billed Under Other Categories | 20 | 20 | 281.3 | 14.1 | 462.4 | 63.9 |
| Total | 43 | 43 | 1742.3 | 40.5 | 1332.1 | 396.0 |

Schools

| | | | | | | |
|-------------------------------|-----------|-----------|------------|------------|--------------|-------------|
| School | 7 | 7 | 97.0 | 13.9 | 455.6 | 22.0 |
| School - 4 month winter usage | 6 | 6 | 31.0 | 5.2 | 169.9 | 7.0 |
| Total | 13 | 13 | 128 | 9.8 | 323.7 | 29.1 |

Gas Station/Convenience Store

| | | | | | | |
|-------------------------------|----------|----------|--------------|-------------|---------------|-------------|
| Gas Station/Convenience Store | 6 | 6 | 411.4 | 68.6 | 2254.4 | 93.5 |
| Restaurant Correction | -2 | -2 | -26.4 | -13.2 | -434.0 | -6.0 |
| Total | 4 | 4 | 385.0 | 96.3 | 3164.6 | 87.5 |

RV/Campground

| | | | | | | |
|---------------------------------------|----------|----------|--------------|--------------|---------------|--------------|
| RV/Campground Billed Other Categories | 3 | 3 | 626.1 | 208.7 | 6861.4 | 142.3 |
| Total | 3 | 3 | 626.1 | 208.7 | 6861.4 | 142.3 |

Other

| | | | | | | |
|--------------------------------|-----------|-----------|------------|-------------|--------------|--------------|
| Church | 1 | 1 | 1.0 | 1.0 | 32.9 | 0.2 |
| Church - 4 months Winter Usage | 8 | 8 | 57.0 | 7.1 | 234.2 | 13.0 |
| Govt - 4 month winter usage | 3 | 3 | 10.0 | 3.3 | 109.6 | 2.3 |
| Medical Office | 4 | 4 | 21.0 | 5.3 | 172.6 | 4.8 |
| Hospital | 3 | 3 | 431.0 | 143.7 | 4723.3 | 98.0 |
| Total | 19 | 19 | 520 | 27.4 | 899.8 | 118.2 |

Totals

| | | | | | | |
|------------------------------------|-------------|--------------------|--------------------|------------|--------------|---------------|
| Residential – Single Family | 1403 | 1772 | 7779.741787 | 4.4 | 144.3 | 1768.1 |
| Other | 388 | 3053.142857 | 16276.79508 | 5.3 | 175.3 | 3699.3 |
| Total | 1791 | 4825.142857 | 24056.53687 | 5.0 | 163.9 | 5467.4 |

SVW&SID Historical Water Use by Customer Category (2016, including committed but not yet connected)

Residential – Single Family

| | Connections | Units | Quantity (Peak Month) - kgals | Peak Month Indoor Water consumption kgals | Peak Month Indoor Water consumption gpd | ERUs |
|---------------|-------------|--------|-------------------------------------|---|---|--------|
| Residential | 1851 | 1851 | 8144.4 | 4.4 | 144.7 | 1851.0 |
| Trailer Court | 8 | 112.0 | 493 | 4.4 | 144.7 | 112.0 |
| Total | 1859 | 1963.0 | 8637.4 | 4.4 | 144.7 | 1963.0 |

Residential – Multifamily

| | | | | | | |
|-------|----|-----|-----|-----|------|------|
| All | 16 | 135 | 330 | 2.4 | 80.4 | 75.0 |
| Total | 16 | 135 | 330 | 2.4 | 80.4 | 75.0 |

Overnight Accommodations

| | | | | | | |
|-------|---|-------|-----|-----|-------|-------|
| All | 6 | 135.5 | 497 | 3.7 | 120.5 | 113.0 |
| Total | 6 | 135.5 | 497 | 3.7 | 120.5 | 113.0 |

Commercial/Retail

| | | | | | | |
|-------|----|----|--------|-----|-------|------|
| All | 60 | 60 | 414.25 | 6.9 | 227.0 | 94.1 |
| Total | 60 | 60 | 414.25 | 6.9 | 227.0 | 94.1 |

Office

| | | | | | | |
|-------|----|----|-------|------|-------|------|
| All | 17 | 17 | 170.4 | 10.0 | 329.5 | 38.7 |
| Total | 17 | 17 | 170.4 | 10.0 | 329.5 | 38.7 |

Restaurant

| | | | | | | |
|-------|---|---|----|------|-------|------|
| All | 3 | 3 | 83 | 27.7 | 909.6 | 18.9 |
| Total | 3 | 3 | 83 | 27.7 | 909.6 | 18.9 |

Schools

| | | | | | | |
|-------|---|---|----|------|--------|------|
| All | 2 | 2 | 95 | 47.5 | 1561.6 | 21.6 |
| Total | 2 | 2 | 95 | 47.5 | 1561.6 | 21.6 |

Gas Station/Convenience Store

| | | | | | | |
|-------|---|---|-----|-------|--------|------|
| All | 3 | 3 | 410 | 136.7 | 4493.2 | 93.2 |
| Total | 3 | 3 | 410 | 136.7 | 4493.2 | 93.2 |

RV/Campground

| | | | | | | |
|-------|---|-----|-----|-----|------|-------|
| All | 7 | 430 | 938 | 2.2 | 71.7 | 213.2 |
| Total | 7 | 430 | 938 | 2.2 | 71.7 | 213.2 |

Other

| | | | | | | |
|-------|----|----|-------|------|-------|------|
| All | 25 | 25 | 334.6 | 13.4 | 440.0 | 76.0 |
| Total | 25 | 25 | 334.6 | 13.4 | 440.0 | 76.0 |

Totals

| | | | | | | |
|-----------------------------|------|-------------|----------|-----|-------|--------|
| Residential – Single Family | 1859 | 1963.045455 | 8637.4 | 4.4 | 144.7 | 1963.0 |
| Other | 139 | 810.5454545 | 3272.25 | 4.0 | 132.7 | 743.7 |
| Total Connections | 1998 | 2773.590909 | 11909.65 | 4.3 | 141.2 | 2706.7 |

APPENDIX B
PLANT RECONSTRUCTION COST ESTIMATE

MOAB WATER RECLAMATION FACILITY COST SUMMARY

Overall Project Costs

Updated: February 22, 2017

| | Project | Cost | Comment |
|----|--------------------------------------|----------------------|---|
| 1 | Facilities Master Plan Update | \$ 47,000 | Complete |
| 2 | Preliminary Design | \$ 165,210 | Complete |
| 3 | WRF Final Design | \$ 648,385 | Complete (TO 15-03, 16-05,-16-06, 16-07, 16-08) |
| 4 | Site Prep Project - Construction | \$ 1,100,000 | Original Harrison bid + CO #1 thru CO #5, in progress |
| 5 | Site Prep Matl Testing (AGEC) | \$ 60,000 | Estimate - in progress |
| 6 | WRF Construction Estimate | \$ 13,086,000 | Alder Construction - low bid |
| 7 | Const Contingency (about 4%) | \$ 242,000 | \$300k in bid, additional needed to reach 4.3% |
| 8 | Construction Management (BCA) | \$ 670,000 | Under contract - no payments to date |
| 9 | Construction Matl Testing (by owner) | \$ 60,000 | Estimate |
| 10 | City Legal and Administration | \$ 100,000 | Estimate |
| 11 | DWQ Loan Origination | \$ 142,000 | based on 1% of max \$14.2M loan |
| | Total Project Costs | \$ 16,320,595 | |

Moab Contribution

| | Project | Amount | Comment |
|---|-------------------------------|---------------------|--|
| 1 | Facilities Master Plan Update | \$ 47,000 | Paid in full by Moab |
| 2 | Preliminary Design | \$ 165,210 | Paid in full by Moab |
| 3 | WRF Final Design | \$ 648,385 | Paid in full by Moab |
| 4 | Site Prep Project | \$ 1,100,000 | To be paid in full by Moab, up-front instead of cash |
| 5 | Site Prep Matl Testing (AGEC) | \$ 60,000 | To be paid in full by Moab, in progress |
| 6 | City Legal and Administration | \$ 100,000 | To be paid in full by Moab, in progress |
| | Total Moab | \$ 2,120,595 | |

Other Agency Contribution

| | Amount | Comment |
|------------------------------|-------------------|---|
| SVWSID Up-front Contribution | \$ 800,000 | Applied to "Moab Contribution" amount above |
| Total GWSSA | \$ 800,000 | |

| | | |
|---------------------|----------------------|---------------------|
| Total Project Costs | \$ 16,320,595 | |
| Total Contribution | \$ 2,120,595 | |
| Loan Amount | \$ 14,200,000 | new DEQ Loan amount |

SEWER IMPACT FEE ANALYSIS

February 2017



Prepared for:

CITY OF
MOAB
UTAH

Prepared by:

 **Bowen Collins**
& Associates, Inc.
CONSULTING ENGINEERS

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EXECUTIVE SUMMARY – IFA (SEWER)

Introduction

The purpose of the impact fee analysis (IFA) is to calculate the allowable impact fee that may be assessed to new development in accordance with Utah Code. This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City's new wastewater treatment plant.

Why Assess an Impact Fee?

Until new development utilizes the full capacity of existing facilities, the City can assess an impact fee to recover its cost of latent capacity available to serve future development. The general impact fee methodology divides the available capacity of existing and future capital projects between the number of existing and future users. Capacity is measured in terms of Equivalent Residential Units, or ERUs, which represents the demand that a typical single family residence places on the system.

How Are Impact Fees Calculated?

A fair impact fee is calculated by dividing the cost of existing and future facilities by the amount of new growth that will benefit from the unused capacity. Only the capacity that is needed to serve the projected growth within in the next ten years is included in the fee. Costs used in the calculation of impact fees include:

- New facilities required to maintain (but not exceed) the proposed level of service identified in the IFFP; only those expected to be built within ten years are considered in the final calculations of the impact fee.
- Historic costs of existing facilities that will serve new development
- Cost of professional services for engineering, planning, and preparation of the impact fee facilities plan and impact fee analysis

Costs not used in the impact fee calculation

- Operational and maintenance costs
- Cost of facilities constructed beyond 10 years
- Cost associated with capacity not expected to be used within 10 years
- Cost of facilities funded by grants, developer contributions, or other funds which the City is not required to repay
- Cost of renovating or reconstructing facilities which do not provide new capacity or needed enhancement of services to serve future development

Impact Fee Calculation

Impact fees for this analysis were calculated by dividing the proportional cost of facilities required to service 10-year growth by the amount of growth expected over the next 10-years based on

ERUs. This is done for both collection and treatment facilities. Calculated impact fees by component are summarized in Tables ES-1 and ES-2. Table ES-1 covers the cost of impacts on collection and treatment facilities from growth within the Moab City service area. Table ES-2 covers impact fees for capacity associated with agencies outside the City.

**Table ES-1
Impact Fee Calculation per ERU – Moab City Service Area**

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Collection Facilities | | | | | |
| Existing Facilities | \$4,151,529 | 4.71% | \$195,671 | 632 | \$309.59 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 632 | \$0.00 |
| 10-year Projects | \$2,489,200 | 15.94% | \$396,799 | 632 | \$627.82 |
| 10-Year Project Interest Costs | \$0 | 0.00% | \$0 | 632 | \$0.00 |
| Credit for User Fees Paid Toward Existing | | | | | \$0.00 |
| Subtotal | \$6,640,729 | | \$592,470 | | \$937.41 |
| Treatment Plant | | | | | |
| Existing Facilities | \$0 | 0.00% | \$0 | 706 | \$0.00 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 706 | \$0.00 |
| 10-year Projects | \$16,320,595 | 4.42% | \$721,782 | 706 | \$1,022.33 |
| 10-Year Project Interest Costs | \$1,776,681 | 5.08% | \$90,308 | 706 | \$127.91 |
| Credit for User Fees Paid Toward Existing | | | | | -\$574.13 |
| Subtotal | \$18,097,276 | | \$812,090 | | \$576.11 |

Table ES-2
Impact Fee Calculation per ERU – Other Agencies Service Area

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Collection Facilities | | | | | |
| Existing Facilities | \$4,151,529 | 2.39% | \$99,231 | 1,508 | \$65.80 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 1,508 | \$0.00 |
| 10-year Projects | \$2,489,200 | 28.12% | \$700,082 | 1,508 | \$464.19 |
| 10-Year Project Interest Costs | \$0 | 0.00% | \$0 | 1,508 | \$0.00 |
| Credit for User Fees Paid Toward Existing | | | | | \$0.00 |
| Subtotal | \$6,640,729 | | \$799,313 | | \$529.99 |
| Treatment Plant | | | | | |
| Existing Facilities | \$0 | 0.00% | \$0 | 1,744 | \$0.00 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 1,744 | \$0.00 |
| 10-year Projects | \$16,320,595 | 10.93% | \$1,783,176 | 1,744 | \$1,022.33 |
| 10-Year Project Interest Costs | \$1,776,681 | 12.56% | \$223,108 | 1,744 | \$127.91 |
| Credit for User Fees Paid Toward Existing | | | | | -\$362.38 |
| Subtotal | \$18,097,276 | | \$2,006,284 | | \$787.86 |

Utah Code also allows for the cost of planning and engineering associated with impact fee calculations to be recovered as part of an impact fee. The final impact fee will include the cost of this study as summarized in Table ES-3.

Table ES-3
Impact Fee Costs Associated with Studies per ERU

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--------------------------|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Impact Fee Studies | \$24,870 | 100.00% | \$24,870 | 2,158 | \$11.53 |
| Subtotal | \$24,870 | | \$24,870 | | \$11.53 |

The total impact fee per ERU can be calculated by adding up the fee for each type of system component.

Recommended Impact Fee

Total calculated impact fees for 2016 and 2017 for different user types are summarized in Tables ES-4 and ES-5 for the Moab City and Other Agency service areas respectively. Information regarding calculation of impact fees in future years can be found in the body of the full report. This is the legal maximum amount that may be charged as an impact fee. This is separate from any additional charges levied by the City for hookup costs or for other reasonable permit and application fees.

Table ES-4
Recommended Impact Fee, 2016 and 2017 – Moab City

| Customer Type | Units | # Flow ERUs per Unit | # Treatment ERUs per Unit | Flow Impact Fee per Unit* | Treatment Impact Fee per Unit | Total Impact Fee per Unit |
|--|-----------|----------------------|---------------------------|---------------------------|-------------------------------|---------------------------|
| Permanent Residential | | | | | | |
| Single Family | Residence | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Multifamily, 2 Bedrooms or Larger | Unit | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Multifamily, 1 Bedroom or Smaller | Unit | 0.56 | 0.56 | \$531 | \$323 | \$854 |
| Overnight Accommodations | | | | | | |
| Rental Unit with Kitchen, 2 Bedrooms or Larger | Unit | 1.20 | 1.20 | \$1,139 | \$691 | \$1,830 |
| Rental Unit with Kitchen, 1 Bedroom or Smaller | Unit | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Hotel/Motel (No Kitchen) | Unit | 0.78 | 0.78 | \$743 | \$451 | \$1,194 |
| Other | | | | | | |
| Auto Repair | 1,000 ft2 | 0.16 | 0.16 | \$153 | \$93 | \$246 |
| Bakery | 1,000 ft2 | 0.53 | 5.00 | \$499 | \$2,881 | \$3,380 |
| Bank | 1,000 ft2 | 0.50 | 0.50 | \$474 | \$288 | \$763 |
| Beauty/Barber Shop | Chair | 0.25 | 0.25 | \$237 | \$144 | \$381 |
| Campground | Campsite | 0.79 | 0.79 | \$746 | \$453 | \$1,199 |
| Car Wash - Auto | Each | 10.00 | 5.00 | \$9,489 | \$2,881 | \$12,370 |
| Car Wash - Wand | Wand | 5.00 | 2.50 | \$4,745 | \$1,440 | \$6,185 |
| Commercial | 1,000 ft2 | 0.15 | 0.15 | \$146 | \$89 | \$235 |
| Dry Cleaner | 1,000 ft2 | 0.59 | 0.37 | \$558 | \$213 | \$772 |
| Fast Food | 1,000 ft2 | 2.86 | 4.76 | \$2,711 | \$2,743 | \$5,455 |
| Gas Station/Convenience Store | 1,000 ft2 | 0.28 | 0.28 | \$264 | \$160 | \$424 |
| Grocery Store | 1,000 ft2 | 0.32 | 0.32 | \$306 | \$186 | \$492 |
| Laundromat | Washer | 0.71 | 0.33 | \$678 | \$192 | \$870 |
| Office | 1,000 ft2 | 0.25 | 0.25 | \$237 | \$144 | \$381 |
| Restaurant | Seat | 0.09 | 0.21 | \$90 | \$123 | \$212 |
| Retail | 1,000 ft2 | 0.15 | 0.15 | \$146 | \$89 | \$235 |
| Schools | Students | 0.07 | 0.07 | \$63 | \$38 | \$102 |
| Theater | Seat | 0.007 | 0.007 | \$7 | \$4 | \$11 |
| Warehouse | 1,000 ft2 | 0.11 | 0.11 | \$100 | \$61 | \$161 |

*Includes study related costs.

**Table ES-5
Recommended Impact Fee, 2016 and 2017 – Other Agencies**

| Customer Type | Units | # Flow ERUs per Unit | # Treatment ERUs per Unit | Flow Impact Fee per Unit* | Treatment Impact Fee per Unit | Total Impact Fee per Unit |
|--|--------------|-----------------------------|----------------------------------|----------------------------------|--------------------------------------|----------------------------------|
| Permanent Residential | | | | | | |
| Single Family | Residence | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Multifamily, 2 Bedrooms or Larger | Unit | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Multifamily, 1 Bedroom or Smaller | Unit | 0.56 | 0.56 | \$303 | \$441 | \$744 |
| Overnight Accommodations | | | | | | |
| Rental Unit with Kitchen, 2 Bedrooms or Larger | Unit | 1.20 | 1.20 | \$650 | \$945 | \$1,595 |
| Rental Unit with Kitchen, 1 Bedroom or Smaller | Unit | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Hotel/Motel (No Kitchen) | Unit | 0.78 | 0.78 | \$424 | \$617 | \$1,041 |
| Other | | | | | | |
| Auto Repair | 1,000 ft2 | 0.16 | 0.16 | \$87 | \$127 | \$214 |
| Bakery | 1,000 ft2 | 0.53 | 5.00 | \$285 | \$3,939 | \$4,224 |
| Bank | 1,000 ft2 | 0.50 | 0.50 | \$271 | \$394 | \$665 |
| Beauty/Barber Shop | Chair | 0.25 | 0.25 | \$135 | \$197 | \$332 |
| Campground | Campsite | 0.79 | 0.79 | \$426 | \$619 | \$1,045 |
| Car Wash - Auto | Each | 10.00 | 5.00 | \$5,415 | \$3,939 | \$9,354 |
| Car Wash - Wand | Wand | 5.00 | 2.50 | \$2,708 | \$1,970 | \$4,677 |
| Commercial | 1,000 ft2 | 0.15 | 0.15 | \$83 | \$121 | \$205 |
| Dry Cleaner | 1,000 ft2 | 0.59 | 0.37 | \$319 | \$292 | \$610 |
| Fast Food | 1,000 ft2 | 2.86 | 4.76 | \$1,547 | \$3,752 | \$5,299 |
| Gas Station/Convenience Store | 1,000 ft2 | 0.28 | 0.28 | \$150 | \$219 | \$369 |
| Grocery Store | 1,000 ft2 | 0.32 | 0.32 | \$175 | \$254 | \$429 |
| Laundromat | Washer | 0.71 | 0.33 | \$387 | \$263 | \$649 |
| Office | 1,000 ft2 | 0.25 | 0.25 | \$135 | \$197 | \$332 |
| Restaurant | Seat | 0.09 | 0.21 | \$51 | \$168 | \$219 |
| Retail | 1,000 ft2 | 0.15 | 0.15 | \$83 | \$121 | \$205 |
| Schools | Students | 0.07 | 0.07 | \$36 | \$53 | \$89 |
| Theater | Seat | 0.007 | 0.007 | \$4 | \$5 | \$9 |
| Warehouse | 1,000 ft2 | 0.11 | 0.11 | \$57 | \$83 | \$140 |

*Includes study related costs.

IMPACT FEE ANALYSIS (SEWER)

INTRODUCTION

Moab City has retained Bowen Collins & Associates (BC&A) to prepare an impact fee analysis (IFA) for its sewer system based on a recently completed impact fee facilities plan. An impact fee is a one-time fee, not a tax, imposed upon new development activity as a condition of development approval to mitigate the impact of the new development on public infrastructure. The purpose of an IFA is to calculate the allowable impact fee that may be assessed to new development in accordance with Utah Code.

This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City's new wastewater treatment plant.

Service Areas

For the purpose of impact fee calculations, the Moab City sewer system has been divided into the same three service areas identified in the Impact Fee Facilities Plan. The "Moab City" service area includes all areas within the corporate boundaries of the City. The "Other Agencies" service area includes all growth outside of the City's corporate boundary that is still expected to flow to the City. This could potentially include flow from Spanish Valley Water & Sewer Improvement District (SVW&SID) and San Juan County. The "Septage Haulers" service area is not associated with a specific area at all, but refers to those customers that will bring septage directly to the City plan from septic tanks, campgrounds, and pit toilets serving the recreational areas surrounding Moab City.

It is important to divide the system into service areas because of the difference in facilities that will be used to serve each service area. This is primarily in connection with sewer collection facilities in the City. While the treatment facilities used to service each service area will be essentially identical, the collection facilities will be significantly different.

Requirements

Requirements for the preparation of an IFA are outlined in Title 11, Chapter 36a of the Utah Code (the Impact Fees Act). Under these requirements, an IFA shall accomplish the following for each facility:

1. Identify the impact of anticipated development activity on existing capacity
2. Identify the impact of anticipated development activity on system improvements required to maintain the established level of service
3. Demonstrate how the impacts are reasonably related to anticipated development activity
4. Estimate the proportionate share of:
 - a. Costs of existing capacity that will be recouped
 - b. Costs of impacts on system improvements that are reasonably related to the new development activity
5. Identify how the impact fee was calculated
6. Consider the following additional issues
 - a. Manner of financing improvements

- b. Dedication of system improvements
- c. Extraordinary costs in servicing newly developed properties
- d. Time-price differential

The following sections of this report have been organized to address each of these requirements.

IMPACT ON SYSTEM - 11-36a-304(1)(a)(b)

Growth within the City's service area, and projections of sewer flows resulting from said growth is discussed in detail in the City's Impact Fee Facilities Plan. For the purposes of impact fee calculation, growth in the system has been expressed in terms of equivalent residential units (ERUs). An ERU represents the demand that a typical single family residence places on the system. Growth in ERUs projected for the service area is summarized in Tables 1 and 2. Table 1 considers growth in flow ERUs, while Table 2 examines treatment ERUs.

Table 1
Projected Moab Sewer System Growth – Flow ERUs

| | Projected Flow ERUs – Moab City | Projected Flow ERUs – Other Agencies | Projected Flow ERUs – Septage | Projected Flow ERUs – Total | Estimated Dry Weather Sewer Flows (mgd) |
|-------------|--|---|--------------------------------------|------------------------------------|--|
| 2017 | 5,467 | 2,707 | 38 | 8,212 | 1.19 |
| 2022 | 5,774 | 3,536 | 47 | 9,357 | 1.35 |
| 2027 | 6,099 | 4,215 | 55 | 10,370 | 1.50 |
| 2032 | 6,442 | 4,931 | 64 | 11,437 | 1.66 |
| 2035 | 6,657 | 5,379 | 69 | 12,105 | 1.75 |
| 2060 | 8,320 | 6,111 | 83 | 14,514 | 2.13 |

Table 2
Projected Moab Sewer System Growth – Treatment ERUs

| | Projected Treatment ERUs – Moab City | Projected Treatment ERUs – Other Agencies | Projected Treatment ERUs – Septage | Projected Treatment ERUs – Total |
|-------------|---|--|---|---|
| 2017 | 6,107 | 2,944 | 1,373 | 10,424 |
| 2022 | 6,450 | 3,891 | 1,688 | 12,030 |
| 2027 | 6,813 | 4,688 | 2,004 | 13,505 |
| 2032 | 7,196 | 5,524 | 2,319 | 15,040 |
| 2035 | 7,436 | 6,046 | 2,509 | 15,991 |
| 2060 | 9,147 | 6,722 | 3,191 | 19,060 |

As indicated in the table, projected growth for the 10-year planning window of this impact fee analysis is 2,158 flow ERUs and 3,081 treatment ERUs (with a large part of the difference the result of increased septage deliveries). In order to maintain the established level of service, projected future growth will be met through a combination of available excess capacity in existing facilities and construction of additional capacity in new facilities. Use of excess capacity and required system improvements are detailed in the Impact Fee Facilities Plan.

RELATION OF IMPACTS TO ANTICIPATED DEVELOPMENT - 11-36a-304(1)(c)

To satisfy the requirements of state law, it is necessary to show that all impacts identified in the impact fee analysis are reasonably related to the anticipated development activity. This has been documented in detail in Impact Fee Facilities Plan. In short, only that capacity directly associated with demand placed upon existing system facilities by future development has been identified as an impact of the development. The steps completed to identify the impacts of anticipated development are as follows.

1. **Existing Demand** – The demand existing development places on the system was estimated based on historic demand records.
2. **Existing Capacity** – The capacities of existing facilities were calculated based on the level of service criteria established for each type of facility in the Impact Fee Facilities Plan.
3. **Existing Deficiencies** – Existing deficiencies in the system were looked for by comparing defined levels of service against calculated capacities. If existing deficiencies exist, projects were identified to eliminate the deficiencies. Costs associated with existing deficiencies were not assigned to impacts of development.
4. **Future Demand** - The demand future development will place on the system was estimated based on development projections as discussed in the Impact Fee Facilities Plan.
5. **Future Demand Use of Existing Capacity** – Whenever possible, excess capacity in existing facilities has been used to serve future demands. Where this occurs, the amount of capacity used by future growth has been calculated as described in detail in the Impact Fee Facilities Plan.
6. **Future Deficiencies** – Where excess capacity is inadequate to meet projected demands, future deficiencies in the system were identified using the same established level of service criteria used for existing demands.
7. **Recommended Improvements** – Needed system improvements were identified to meet demands associated with future development.

PROPORTIONATE SHARE ANALYSIS - 11-36a-304(d)

A comprehensive proportionate share analysis associated with anticipated future development and its impact on the system was completed as part of the Impact Fee Facilities Plan. A summary of that analysis is contained here with additional discussion of the costs of facilities impacted by growth.

Excess Capacity to Accommodate Future Growth

As discussed previously, the City will be replacing its existing treatment plant and, as a result, there is no existing treatment plant capacity to accommodate future growth. For collection system facilities, the capacity of existing capacity used by each type of user was analyzed in detail as part of the Impact Fee Facilities Plan. Based on the analysis, the calculated percentage of existing capacity in system facilities used by existing users, growth during the 10 year planning window, and growth beyond the 10 year planning window by each service area is summarized in Table 3.

Table 3
Use of Existing Capacity

| Pipeline Capacity | Existing Users | 10-Year Growth | Growth Beyond 10-Years | Total |
|--------------------------|-----------------------|-----------------------|-------------------------------|--------------|
| Moab City | 53.2% | 4.7% | 15.9% | 73.8% |
| Other Agencies | 20.6% | 2.4% | 3.2% | 26.2% |
| Septage Haulers | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 73.8% | 7.1% | 19.1% | 100.0% |

Existing System Infrastructure Costs

To calculate the actual cost of excess capacity in the existing system, BC&A first looked at the actual cost of all existing facilities. Table 4 lists the actual construction costs of existing components of the City's wastewater system. There are not depreciated replacement costs, but the estimated actual cost at the time of construction. These costs were estimated from the City's existing database of assets. In this study, public facility costs already incurred by the City will be included in the impact fee only to the extent that new growth will be served by the previously constructed improvements. Since the treatment plant will be completely replaced, its existing cost is shown as zero.

Table 4
Existing Infrastructure Costs

| | Collection | Treatment¹ |
|--------------------------------------|-------------------|------------------------------|
| Existing Infrastructure Costs | \$4,151,529 | \$0 |

¹ Moab will completely replace its existing treatment plant.

Reimbursement Agreements

There are no current reimbursement agreements existing within the system.

Future Improvements

In addition to using available existing capacity, demand associated with projected future development will be met through the construction of additional capacity in new facilities. A primary focus of the Impact Fee Facilities Plan was the identification of projects required to serve new development. The results of the Impact Fee Facilities Plan are summarized in Table 5. Included in the table are the costs of each required project and the portion of costs associated with development.

Table 5
Impact Fee Eligible Capital Projects

| Project | City Construction Cost | Percent Attributable to 10-Year Growth | Cost Attributable to 10-Year Growth |
|--|-------------------------------|---|--|
| <i>Service Area – Moab City</i> | | | |
| New South Trunkline | \$2,100,000 | 5.91% | \$124,101 |
| Replace 400 East Trunkline | \$389,200 | 70.07% | \$272,698 |
| New Wastewater Treatment Plant | \$16,320,595 | 4.42% | \$721,782 |
| Total | | | \$1,118,581 |
| <i>Service Area – Other Agencies</i> | | | |
| New South Trunkline | \$2,100,000 | 33.34% | \$700,082 |
| Replace 400 East Trunkline | \$389,200 | 0% | \$0 |
| New Wastewater Treatment Plant | \$16,320,595 | 10.93% | \$1,783,176 |
| Total | | | \$2,483,258 |
| <i>Service Area – Septage Haulers</i> | | | |
| New South Trunkline | \$2,100,000 | 0% | \$0 |
| Replace 400 East Trunkline | \$389,200 | 0% | \$0 |
| New Wastewater Treatment Plant | \$16,320,595 | 3.94% | \$643,398 |
| Total | | | \$643,398 |

All cost estimates contained in this IFA have been taken directly from the IFFP. The basis of these estimates are documented in the IFFP.

IMPACT FEE CALCULATION - 11-36a-304(1)(e)

Using the information contained in the previous sections, impact fees can be calculated by dividing the proportional cost of facilities required to service 10-year growth by the amount of growth expected over the next 10-years. This is done for both collection and treatment system components as discussed previously. Calculated impact fees by component are summarized in Tables 6 and 7 for Moab City and Other Agencies service areas. Impact fees have not been calculated for the Septage Hauler service area. Although this service area does result in increases in system demand as documented above, there is no specific way to tie these increases to individual users and collect an appropriate impact fee. As a result, payment for the cost of impacts associated with increased septage loading will need to be incorporated into septage billing rates and collected over time.

**Table 6
Impact Fee Calculation per ERU – Moab City Service Area**

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Collection Facilities | | | | | |
| Existing Facilities | \$4,151,529 | 4.71% | \$195,671 | 632 | \$309.59 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 632 | \$0.00 |
| 10-year Projects | \$2,489,200 | 15.94% | \$396,799 | 632 | \$627.82 |
| 10-Year Project Interest Costs | \$0 | 0.00% | \$0 | 632 | \$0.00 |
| Credit for User Fees Paid Toward Existing | | | | | \$0.00 |
| Subtotal | \$6,640,729 | | \$592,470 | | \$937.41 |
| Treatment Plant | | | | | |
| Existing Facilities | \$0 | 0.00% | \$0 | 706 | \$0.00 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 706 | \$0.00 |
| 10-year Projects | \$16,320,595 | 4.42% | \$721,782 | 706 | \$1,022.33 |
| 10-Year Project Interest Costs | \$1,776,681 | 5.08% | \$90,308 | 706 | \$127.91 |
| Credit for User Fees Paid Toward Existing | | | | | -\$574.13 |
| Subtotal | \$18,097,276 | | \$812,090 | | \$576.11 |

Table 7
Impact Fee Calculation per ERU – Other Agencies Service Area

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Collection Facilities | | | | | |
| Existing Facilities | \$4,151,529 | 2.39% | \$99,231 | 1,508 | \$65.80 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 1,508 | \$0.00 |
| 10-year Projects | \$2,489,200 | 28.12% | \$700,082 | 1,508 | \$464.19 |
| 10-Year Project Interest Costs | \$0 | 0.00% | \$0 | 1,508 | \$0.00 |
| Credit for User Fees Paid Toward Existing | | | | | \$0.00 |
| Subtotal | \$6,640,729 | | \$799,313 | | \$529.99 |
| Treatment Plant | | | | | |
| Existing Facilities | \$0 | 0.00% | \$0 | 1,744 | \$0.00 |
| Existing Facility Interest Costs Outstanding | \$0 | 0.00% | \$0 | 1,744 | \$0.00 |
| 10-year Projects | \$16,320,595 | 10.93% | \$1,783,176 | 1,744 | \$1,022.33 |
| 10-Year Project Interest Costs | \$1,776,681 | 12.56% | \$223,108 | 1,744 | \$127.91 |
| Credit for User Fees Paid Toward Existing | | | | | -\$362.38 |
| Subtotal | \$18,097,276 | | \$2,006,284 | | \$787.86 |

Bonding Interest Costs

In addition to construction costs, Tables 6 and 7 include the cost of bond interest expense where applicable. This could include any outstanding interest costs on existing facilities where new growth will benefit from excess capacity and future interest costs for bonds required to build projects needed for growth as identified in the Impact Fee Facilities Plan. Similar to project construction costs, only that portion of interest expense associated with capacity for growth is included in the impact fee calculation. In the case of the Moab City wastewater system, the only bond interest costs currently contemplated are the result of a low interest loan from the State of Utah revolving construction fund. This will be used exclusively for the construction of the new wastewater treatment plant. Interest associated with this loan has been calculated based on a 1.15% interest rate and a payback period from Moab to the State of 20 years, and from outside agencies to Moab of 25 years. The percentage of interest assigned to future growth is slightly higher than the percentage calculated for the actual project to reflect the amount of cash on-hand to be contributed by existing users toward construction.

Credit for User Fees

The City's current plans call for both Moab City and SVW&SID to pay cash for a portion of the

new wastewater treatment plant costs. However, not all of the cost associated with existing capacity needs can be paid for from existing cash reserves. As a result, the plan includes a portion of the State of Utah loan going towards the construction of capacity that will benefit existing users. In this situation, user fees will be used to pay for the loan over its lifetime.

As currently structured, future users will pay for their portion of capacity via impact fees. They cannot also be expected to pay through user rates the portion of future bonds that will be used to build capacity for existing users. This creates the need for a credit for future users. Calculation of this credit is summarized in Tables 8 and 9. This table includes the following information:

- **Existing Portion of Loan Paid Through User Fees** – This represents the total amount paid each year by the District toward the portion of the loan used to build capacity for existing users.
- **Cost Per ERU** – This column takes to the total amount paid and divides it by the number of ERUs projected for each year. This represents the amount paid in each year by each ERU.
- **Present Value Cost per ERU** – This column takes into account the time value of money assuming a rate of return of 3 percent annually.
- **Total User Fee Credit** – At the bottom of the table, the present value costs for all future years are added together to develop the total user fee credit.

It will be noted that, because the user fee credit is the summation of user fees paid toward existing deficiencies in each year, a new user who joins the system in five or ten years will pay less in total user fees than someone who joins the system next year. Thus, the user fee credit will decrease over time. The appropriate user fee can be calculated by adding the present value cost for all years subsequent to a new user's connection to the system.

Table 8
Credit for User Fees Paid Toward Existing – Moab City

| Year | Moab Treatment ERUs | Existing Capacity Portion of Loan Paid Through User Fees | Cost Per ERU | Present Value Cost Per ERU |
|------------------------------|----------------------------|---|---------------------|-----------------------------------|
| 2017 | 6,107 | \$0.00 | \$0.00 | \$0.00 |
| 2018 | 6,174 | \$276,934.88 | \$44.85 | \$41.05 |
| 2019 | 6,242 | \$276,934.88 | \$44.37 | \$39.42 |
| 2020 | 6,311 | \$276,934.88 | \$43.88 | \$37.85 |
| 2021 | 6,380 | \$276,934.88 | \$43.41 | \$36.35 |
| 2022 | 6,450 | \$276,934.88 | \$42.93 | \$34.91 |
| 2023 | 6,521 | \$276,934.88 | \$42.47 | \$33.52 |
| 2024 | 6,593 | \$276,934.88 | \$42.00 | \$32.19 |
| 2025 | 6,666 | \$276,934.88 | \$41.55 | \$30.91 |
| 2026 | 6,739 | \$276,934.88 | \$41.10 | \$29.69 |
| 2027 | 6,813 | \$276,934.88 | \$40.65 | \$28.51 |
| 2028 | 6,888 | \$276,934.88 | \$40.21 | \$27.38 |
| 2029 | 6,964 | \$276,934.88 | \$39.77 | \$26.29 |
| 2030 | 7,040 | \$276,934.88 | \$39.34 | \$25.25 |
| 2031 | 7,118 | \$276,934.88 | \$38.91 | \$24.25 |
| 2032 | 7,196 | \$276,934.88 | \$38.48 | \$23.28 |
| 2033 | 7,275 | \$276,934.88 | \$38.07 | \$22.36 |
| 2034 | 7,355 | \$276,934.88 | \$37.65 | \$21.47 |
| 2035 | 7,436 | \$276,934.88 | \$37.24 | \$20.62 |
| 2036 | 7,517 | \$276,934.88 | \$36.84 | \$19.80 |
| 2037 | 7,598 | \$276,934.88 | \$36.45 | \$19.02 |
| 2038 | 7,679 | \$0.00 | \$0.00 | \$0.00 |
| 2039 | 7,760 | \$0.00 | \$0.00 | \$0.00 |
| 2040 | 7,841 | \$0.00 | \$0.00 | \$0.00 |
| Total User Fee Credit | | | | \$574.13 |

Table 9
Credit for User Fees Paid Toward Existing – Other Agencies Service Area

| Year | Other Agency Treatment ERUs | Existing Capacity Portion of Loan Paid Through User Fees | Cost Per ERU | Present Value Cost Per ERU |
|------------------------------|------------------------------------|---|---------------------|-----------------------------------|
| 2017 | 2,944 | \$0.00 | \$0.00 | \$0.00 |
| 2018 | 3,003 | \$102,207.26 | \$34.04 | \$31.15 |
| 2019 | 3,148 | \$102,207.26 | \$32.47 | \$28.85 |
| 2020 | 3,583 | \$102,207.26 | \$28.53 | \$24.61 |
| 2021 | 3,736 | \$102,207.26 | \$27.36 | \$22.91 |
| 2022 | 3,891 | \$102,207.26 | \$26.27 | \$21.36 |
| 2023 | 4,048 | \$102,207.26 | \$25.25 | \$19.93 |
| 2024 | 4,206 | \$102,207.26 | \$24.30 | \$18.63 |
| 2025 | 4,365 | \$102,207.26 | \$23.42 | \$17.42 |
| 2026 | 4,526 | \$102,207.26 | \$22.58 | \$16.31 |
| 2027 | 4,688 | \$102,207.26 | \$21.80 | \$15.29 |
| 2028 | 4,852 | \$102,207.26 | \$21.06 | \$14.34 |
| 2029 | 5,018 | \$102,207.26 | \$20.37 | \$13.47 |
| 2030 | 5,185 | \$102,207.26 | \$19.71 | \$12.65 |
| 2031 | 5,354 | \$102,207.26 | \$19.09 | \$11.90 |
| 2032 | 5,524 | \$102,207.26 | \$18.50 | \$11.19 |
| 2033 | 5,696 | \$102,207.26 | \$17.94 | \$10.54 |
| 2034 | 5,870 | \$102,207.26 | \$17.41 | \$9.93 |
| 2035 | 6,046 | \$102,207.26 | \$16.90 | \$9.36 |
| 2036 | 6,222 | \$102,207.26 | \$16.43 | \$8.83 |
| 2037 | 6,398 | \$102,207.26 | \$15.98 | \$8.34 |
| 2038 | 6,573 | \$102,207.26 | \$15.55 | \$7.88 |
| 2039 | 6,749 | \$102,207.26 | \$15.14 | \$7.45 |
| 2040 | 6,925 | \$102,207.26 | \$14.76 | \$7.05 |
| 2040 | 6,925 | \$102,207.26 | \$14.39 | \$6.67 |
| 2040 | 6,925 | \$102,207.26 | \$14.05 | \$6.32 |
| Total User Fee Credit | | | | \$362.38 |

It will be noted that the credits for the Moab City and Other Agency service areas are different. This is the result of the different growth rate projected for the two areas and the difference in payback period on the loan. Because growth outside Moab is projected to be greater than growth within Moab, there will be more connections paying toward the cost of the loan in later years. This results in a lower cost per ERU (and a corresponding lower credit).

Impact Fee Studies

Utah Code allows for the cost of planning and engineering associated with impact fee calculations to be recovered as part of an impact fee. The final impact fee will include the cost of this study as summarized in Table 10.

Table 10
Impact Fee Costs Associated with Studies per ERU

| System Components | Total Cost of Component | % Serving 10-year Growth | Cost Serving 10-year Growth | 10-year ERUs Served | Cost Per ERU |
|--------------------------|--------------------------------|---------------------------------|------------------------------------|----------------------------|---------------------|
| Impact Fee Studies | \$24,870 | 100.00% | \$24,870 | 2,158 | \$11.53 |
| Subtotal | \$24,870 | | \$24,870 | | \$11.53 |

Recommended Impact Fee

The total calculated impact fees are summarized in Tables 11 and 12. Included in these tables are the appropriate user fee credits for both collection and treatment and corresponding overall fee. This is the legal maximum amount that may be charged as an impact fee. A lower amount may be adopted if desired, but a higher fee is not allowable under the requirements of Utah Code.

Table 11
Recommended Per ERU Impact Fee – Moab City Service Area

| Maximum Allowable Impact Fee (Per ERU, by year) | | | | | | |
|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Collection Base Impact Fee (includes study costs) | \$948.94 | \$948.94 | \$948.94 | \$948.94 | \$948.94 | \$948.94 |
| Treatment Base Impact Fee | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 |
| Treatment User Fee Credit | -\$574.13 | -\$574.13 | -\$533.08 | -\$493.67 | -\$455.81 | -\$419.46 |
| Net Treatment Impact Fee | \$576.11 | \$576.11 | \$617.16 | \$656.57 | \$694.43 | \$730.78 |
| Total Overall Fee | \$1,525.05 | \$1,525.05 | \$1,566.09 | \$1,605.51 | \$1,643.37 | \$1,679.72 |

Table 12
Recommended Per ERU Impact Fee – Other Agencies Service Area

| Maximum Allowable Impact Fee (Per ERU, by year) | | | | | | |
|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Collection Base Impact Fee (includes study costs) | \$541.51 | \$541.51 | \$541.51 | \$541.51 | \$541.51 | \$541.51 |
| Treatment Base Impact Fee | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 | \$1,150.24 |
| Treatment User Fee Credit | -\$362.38 | -\$362.38 | -\$331.24 | -\$302.39 | -\$277.78 | -\$254.87 |
| Net Treatment Impact Fee | \$787.86 | \$787.86 | \$819.01 | \$847.85 | \$872.46 | \$895.37 |
| Total Overall Fee | \$1,329.37 | \$1,329.37 | \$1,360.52 | \$1,389.37 | \$1,413.98 | \$1,436.88 |

As discussed previously, the calculated user fee credit associated with the impact fees will decrease over time. As a result, the allowable impact fee will increase over time as shown in the tables. Impact fees beyond 2021 can be calculated by reducing the user fee credit by the amount shown for each successive year in the credit calculation tables.

To this point, impact fee calculations have focused on the cost per ERU for both flow and treatment ERUs. In administering impact fees, it is also useful to have impact fees defined in terms of easily measurable parameters for different types of users. Calculation of system demand in terms of ERUs has been defined in a technical memorandum dated September 21, 2016 that has been included in the appendix of the City's IFFP. Some additional categories have also been developed based on projected demand characteristics from other studies conducted by BC&A for sewer providers in Utah. Based on these definitions, total calculated impact fees (2016 and 2017 calendar years) for different user types are summarized in Tables 13 and 14 for the Moab City and Other Agency service areas respectively. Future years can be recalculated using the flow and net treatment impact fees per ERU as summarized in Tables 11 and 12. This is the legal maximum amount that may be charged as an impact fee. A lower amount may be adopted if desired, but a higher fee is not allowable under the requirements of Utah Code. This is separate from any additional charges levied by the City for hookup costs or for other reasonable permit and application fees.

Table 13
Recommended Impact Fee, 2016 and 2017 – Moab City

| Customer Type | Units | # Flow ERUs per Unit | # Treatment ERUs per Unit | Flow Impact Fee per Unit* | Treatment Impact Fee per Unit | Total Impact Fee per Unit |
|--|--------------|-----------------------------|----------------------------------|----------------------------------|--------------------------------------|----------------------------------|
| Permanent Residential | | | | | | |
| Single Family | Residence | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Multifamily, 2 Bedrooms or Larger | Unit | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Multifamily, 1 Bedroom or Smaller | Unit | 0.56 | 0.56 | \$531 | \$323 | \$854 |
| Overnight Accommodations | | | | | | |
| Rental Unit with Kitchen, 2 Bedrooms or Larger | Unit | 1.20 | 1.20 | \$1,139 | \$691 | \$1,830 |
| Rental Unit with Kitchen, 1 Bedroom or Smaller | Unit | 1.00 | 1.00 | \$949 | \$576 | \$1,525 |
| Hotel/Motel (No Kitchen) | Unit | 0.78 | 0.78 | \$743 | \$451 | \$1,194 |
| Other | | | | | | |
| Auto Repair | 1,000 ft2 | 0.16 | 0.16 | \$153 | \$93 | \$246 |
| Bakery | 1,000 ft2 | 0.53 | 5.00 | \$499 | \$2,881 | \$3,380 |
| Bank | 1,000 ft2 | 0.50 | 0.50 | \$474 | \$288 | \$763 |
| Beauty/Barber Shop | Chair | 0.25 | 0.25 | \$237 | \$144 | \$381 |
| Campground | Campsite | 0.79 | 0.79 | \$746 | \$453 | \$1,199 |
| Car Wash - Auto | Each | 10.00 | 5.00 | \$9,489 | \$2,881 | \$12,370 |
| Car Wash - Wand | Wand | 5.00 | 2.50 | \$4,745 | \$1,440 | \$6,185 |
| Commercial | 1,000 ft2 | 0.15 | 0.15 | \$146 | \$89 | \$235 |
| Dry Cleaner | 1,000 ft2 | 0.59 | 0.37 | \$558 | \$213 | \$772 |
| Fast Food | 1,000 ft2 | 2.86 | 4.76 | \$2,711 | \$2,743 | \$5,455 |
| Gas Station/Convenience Store | 1,000 ft2 | 0.28 | 0.28 | \$264 | \$160 | \$424 |
| Grocery Store | 1,000 ft2 | 0.32 | 0.32 | \$306 | \$186 | \$492 |
| Laundromat | Washer | 0.71 | 0.33 | \$678 | \$192 | \$870 |
| Office | 1,000 ft2 | 0.25 | 0.25 | \$237 | \$144 | \$381 |
| Restaurant | Seat | 0.09 | 0.21 | \$90 | \$123 | \$212 |
| Retail | 1,000 ft2 | 0.15 | 0.15 | \$146 | \$89 | \$235 |
| Schools | Students | 0.07 | 0.07 | \$63 | \$38 | \$102 |
| Theater | Seat | 0.007 | 0.007 | \$7 | \$4 | \$11 |
| Warehouse | 1,000 ft2 | 0.11 | 0.11 | \$100 | \$61 | \$161 |

*Includes study related costs.

Table 14
Recommended Impact Fee, 2016 and 2017 – Other Agencies

| Customer Type | Units | # Flow ERUs per Unit | # Treatment ERUs per Unit | Flow Impact Fee per Unit* | Treatment Impact Fee per Unit | Total Impact Fee per Unit |
|--|--------------|-----------------------------|----------------------------------|----------------------------------|--------------------------------------|----------------------------------|
| Permanent Residential | | | | | | |
| Single Family | Residence | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Multifamily, 2 Bedrooms or Larger | Unit | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Multifamily, 1 Bedroom or Smaller | Unit | 0.56 | 0.56 | \$303 | \$441 | \$744 |
| Overnight Accommodations | | | | | | |
| Rental Unit with Kitchen, 2 Bedrooms or Larger | Unit | 1.20 | 1.20 | \$650 | \$945 | \$1,595 |
| Rental Unit with Kitchen, 1 Bedroom or Smaller | Unit | 1.00 | 1.00 | \$542 | \$788 | \$1,329 |
| Hotel/Motel (No Kitchen) | Unit | 0.78 | 0.78 | \$424 | \$617 | \$1,041 |
| Other | | | | | | |
| Auto Repair | 1,000 ft2 | 0.16 | 0.16 | \$87 | \$127 | \$214 |
| Bakery | 1,000 ft2 | 0.53 | 5.00 | \$285 | \$3,939 | \$4,224 |
| Bank | 1,000 ft2 | 0.50 | 0.50 | \$271 | \$394 | \$665 |
| Beauty/Barber Shop | Chair | 0.25 | 0.25 | \$135 | \$197 | \$332 |
| Campground | Campsite | 0.79 | 0.79 | \$426 | \$619 | \$1,045 |
| Car Wash - Auto | Each | 10.00 | 5.00 | \$5,415 | \$3,939 | \$9,354 |
| Car Wash - Wand | Wand | 5.00 | 2.50 | \$2,708 | \$1,970 | \$4,677 |
| Commercial | 1,000 ft2 | 0.15 | 0.15 | \$83 | \$121 | \$205 |
| Dry Cleaner | 1,000 ft2 | 0.59 | 0.37 | \$319 | \$292 | \$610 |
| Fast Food | 1,000 ft2 | 2.86 | 4.76 | \$1,547 | \$3,752 | \$5,299 |
| Gas Station/Convenience Store | 1,000 ft2 | 0.28 | 0.28 | \$150 | \$219 | \$369 |
| Grocery Store | 1,000 ft2 | 0.32 | 0.32 | \$175 | \$254 | \$429 |
| Laundromat | Washer | 0.71 | 0.33 | \$387 | \$263 | \$649 |
| Office | 1,000 ft2 | 0.25 | 0.25 | \$135 | \$197 | \$332 |
| Restaurant | Seat | 0.09 | 0.21 | \$51 | \$168 | \$219 |
| Retail | 1,000 ft2 | 0.15 | 0.15 | \$83 | \$121 | \$205 |
| Schools | Students | 0.07 | 0.07 | \$36 | \$53 | \$89 |
| Theater | Seat | 0.007 | 0.007 | \$4 | \$5 | \$9 |
| Warehouse | 1,000 ft2 | 0.11 | 0.11 | \$57 | \$83 | \$140 |

*Includes study related costs.

Calculation of Non-Standard Impact Fees

The calculations above have been based on a limited number of defined customer classes. The

Impact Fee Enactment should include a provision that allows for calculation of a fee for customers and situations that vary from those outlined above. Calculating an impact fee for a non-standard user should be based on the methodology established in the September 21, 2016 technical memorandum referenced previously. Once appropriate values for flow and treatment ERUs have been established for the customer, the corresponding impact fee can be calculated using the values per ERU in Tables 11 and 12.

ADDITIONAL CONSIDERATIONS - 11-36a-304(2)

MANNER OF FINANCING - 11-36a-304(2)(a-e)

As part of this Impact Fee Analysis, it is important to consider how each facility has been or will be paid for. Potential infrastructure funding includes a combination of different revenue sources.

User Charges

Because infrastructure must generally be built ahead of growth, there often arises situations in which projects must be funded ahead of expected impact fee revenues. In some cases, the solution to this issue will be bonding. In others, funds from existing user rate revenue will be loaned to the impact fee fund to complete initial construction of the project and will be reimbursed later as impact fees are received. Interfund loans should be considered in subsequent accounting of impact fee expenditures.

Special Assessments

Where special assessments exist, the impact fee calculation must take into account funds contributed. No special assessments currently exist in the Moab City wastewater system.

Pioneering Agreements

Where pioneering agreements exist, the impact fee calculation must take into account payback requirements under each pioneering agreement. No pioneering agreements currently exist in the Moab City wastewater system.

Bonds

None of the costs contained in the IFFP included bonding. Where City financial plans identify bonding will be required to finance impact fee eligible improvements, the portion of bond cost and interest expense attributable to future growth has been added to the calculation of the impact fee.

General Taxes

If taxes are used to pay for infrastructure, they should be accounted for in the impact fee calculation. Specifically, any contribution made by property owners through taxes should be credited toward their available capacity in the system. In this case, no taxes are proposed for the construction of infrastructure.

Federal and State Grants and Donations

Impact fees cannot reimburse costs funded or expected to be funded through federal grants and other funds that the City has received for capital improvements without an obligation to repay.

Grants and donations are not currently contemplated in this analysis. If grants become available for constructing facilities, impact fees will need to be recalculated and an appropriate credit given. Any existing infrastructure funded through past grants has been removed from the system cost.

DEDICATION OF SYSTEM IMPROVEMENTS - 11-36a-304(2)(f)

Developer exactions are not the same as grants. If a developer constructs a system improvement or dedicates land for a system improvement identified in this IFFP, or dedicates a public facility that is recognized to reduce the need for a system improvement, the developer may be entitled to an appropriate credit against that particular developer's impact fee liability or a proportionate reimbursement.

If the value of the credit is less than the development's impact fee liability, the developer will owe the balance of the liability to the City. If the recognized value of the improvements/land dedicated is more than the development's impact fee liability, the City may be required to reimburse the difference to the developer.

It should be emphasized that the concept of impact fee credits pertains to system level improvements only. Developers will be responsible for the construction of project improvements (i.e. improvements not identified in the impact fee facilities plan) without credit against the impact fee.

EXTRAORDINARY COSTS - 11-36a-304(2)(g)

The Impact Fees Act indicates the analysis should include consideration of any extraordinary costs of servicing newly developed properties. In cases where one area of potential growth may cost significantly more to service than other growth, a separate service area may be warranted. No areas with extraordinary costs have been identified as part of this analysis.

TIME-PRICE DIFFERENTIAL - 11-36a-304(2)(h)

Utah Code allows consideration of time-price differential in order to create fairness for amounts paid at different times. To address time-price differential, this analysis includes a conversion to present value cost for future expenditures. In the case of future construction costs, it has been assumed that the return rate on investment will be roughly equivalent to construction inflation and current construction estimates have been used in the calculation of impact fees. Per the requirements of the Code, existing infrastructure cost is based on actual historical costs without adjustment.

IMPACT FEE CERTIFICATION - 11-36a-306(2)

This report has been prepared in accordance with Utah Code Title 11, Chapter 36a (the “Impact Fees Act”), which prescribes the laws pertaining to the imposition of impact fees in Utah. The accuracy of this IFFP relies in part upon planning, engineering, and other source data, provided by the City and its designees.

In accordance with Utah Code Annotated, 11-36a-306(2), Bowen Collins & Associates makes the following certification:

I certify that the attached impact fee analysis:

1. Includes only the costs of public facilities that are:
 - a. allowed under the Impact Fees Act; and
 - b. actually incurred; or
 - c. projected to be incurred or encumbered within six years after the day on which each impact fee is paid;
2. Does not include:
 - a. costs of operation and maintenance of public facilities;
 - b. costs of qualifying public facilities that will raise the level of service for the facilities, through impact fees, above the level of service that is supported by existing residents; or
 - c. an expense for overhead, unless the expense is calculated pursuant to a methodology that is consistent with generally accepted cost accounting practices and the methodological standards set forth by the federal Office of Management and Budget for federal grant reimbursement; and
3. Complies in each and every relevant respect with the Impact Fees Act.



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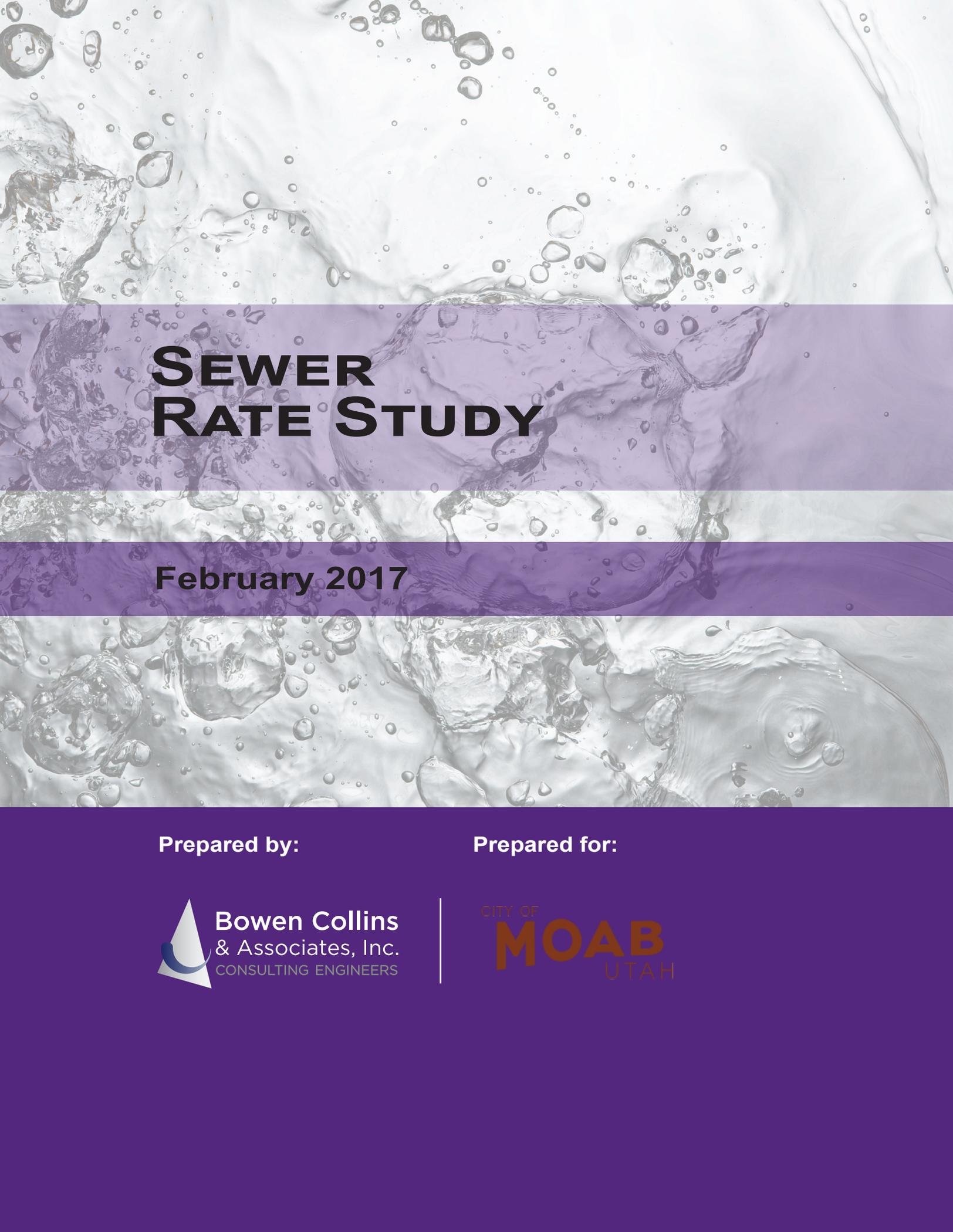
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Bowen Collins
& Associates, Inc.
CONSULTING ENGINEERS

A high-speed photograph of water splashing, creating numerous bubbles and ripples. The image is overlaid with a semi-transparent purple band.

SEWER RATE STUDY

February 2017

Prepared by:



Prepared for:



SEWER RATE STUDY

February 2017



Prepared for:

CITY OF
MOAB
UTAH

Prepared by:

 **Bowen Collins
& Associates, Inc.**
CONSULTING ENGINEERS

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EXECUTIVE SUMMARY

INTRODUCTION

Moab City is in the process of designing a complete replacement of its existing wastewater treatment facility. As a result of this project and general system growth, the City faces potential capital improvement costs, loan service costs, as well as maintenance and operation costs which will likely increase in the years to come. The purpose of this study is to update the City's sewer service charges as necessary to meet those cost needs. Implementing the recommendations contained in this report will assist Moab City in adequately funding potential infrastructure improvements and staying on track with projected operation budgets.

This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City's new wastewater treatment plant.

SEWER RATE ANALYSIS

The primary objective of this sewer rate analysis is to establish rates that will be sufficient to meet revenue requirements for the City. To accomplish this goal, this analysis focused on six major tasks:

- 1. Projecting Growth:** The Moab City sewer system is currently composed of approximately 2,481 individual accounts comprising 5,528 residential equivalent residential units (ERUs). Based on Moab City water reclamation facility planning information, the estimated total population growth rate for the next six years was estimated to be approximately 1.1% for all customers.
- 2. Calculating Revenue Requirements:** Total revenue requirements for the City were projected for the next several years. Those requirements included operations and maintenance costs, capital improvement costs, facilities rehabilitation/replacement costs, and debt service. Revenue generated outside of sewer rates (impact fees, sewer sales to SVW&SID, septage sales, finance charges, etc.) was deducted from the total to give the net revenue requirement to be recovered from service charges.
- 3. Comparing Revenue to Required Revenue:** Once revenue requirements are projected, it is possible to compare required revenue to revenue projections. The City has historically been able to fund most projects without bonding and consequently has been able to minimize interest charges that might otherwise be required for capital projects. Unfortunately, projected future capital improvement needs, as well as increases in operation and maintenance costs, show Moab City revenues falling below projected revenue requirements in future years.
- 4. Developing a Funding Plan to Meet Projected Needs:** In order for the City to meet projected expenditures and maintain its reserve fund to acceptable levels, it is important that revenue be sufficient to accommodate future projects. This study develops a plan to maintain the City's savings fund and maintain funding levels appropriate to provide the desired level of service in the wastewater system.

- 5. Calculating Final Sewer Rates:** Using the City's existing rate structure, sewer rates were calculated to recover needed revenue based on operation and maintenance costs, debt service, and capital improvement costs.

Because of the need to have a viable rate plan in place before construction of the treatment plant begins, this rate study has been limited to a revenue needs analysis. It does not include a full cost-of-service analysis or look at the individual components of the City's existing rate structure in any way. It is expected that the City will revisit its rate structure based on cost-of-service principles in the near future and update its rate structure as necessary.

REQUIRED RATES TO MEET REVENUE NEEDS

The sewer rates shown in Table ES-1 reflect a multiple year rate schedule needed to meet the projected costs of capital improvements and system renewal. After an initial three years of increases to bring rates up to the recommended sustainable long-term level of funding, further annual increases can likely be delayed until after the study period.

Table ES-1
Required Rates to Meet Projected Revenue Needs

| Monthly Base Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Residential | \$14.40 | \$17.28 | \$20.74 | \$23.22 | \$24.27 | \$24.27 |
| Commercial | \$19.10 | \$22.92 | \$27.50 | \$30.80 | \$32.19 | \$32.19 |

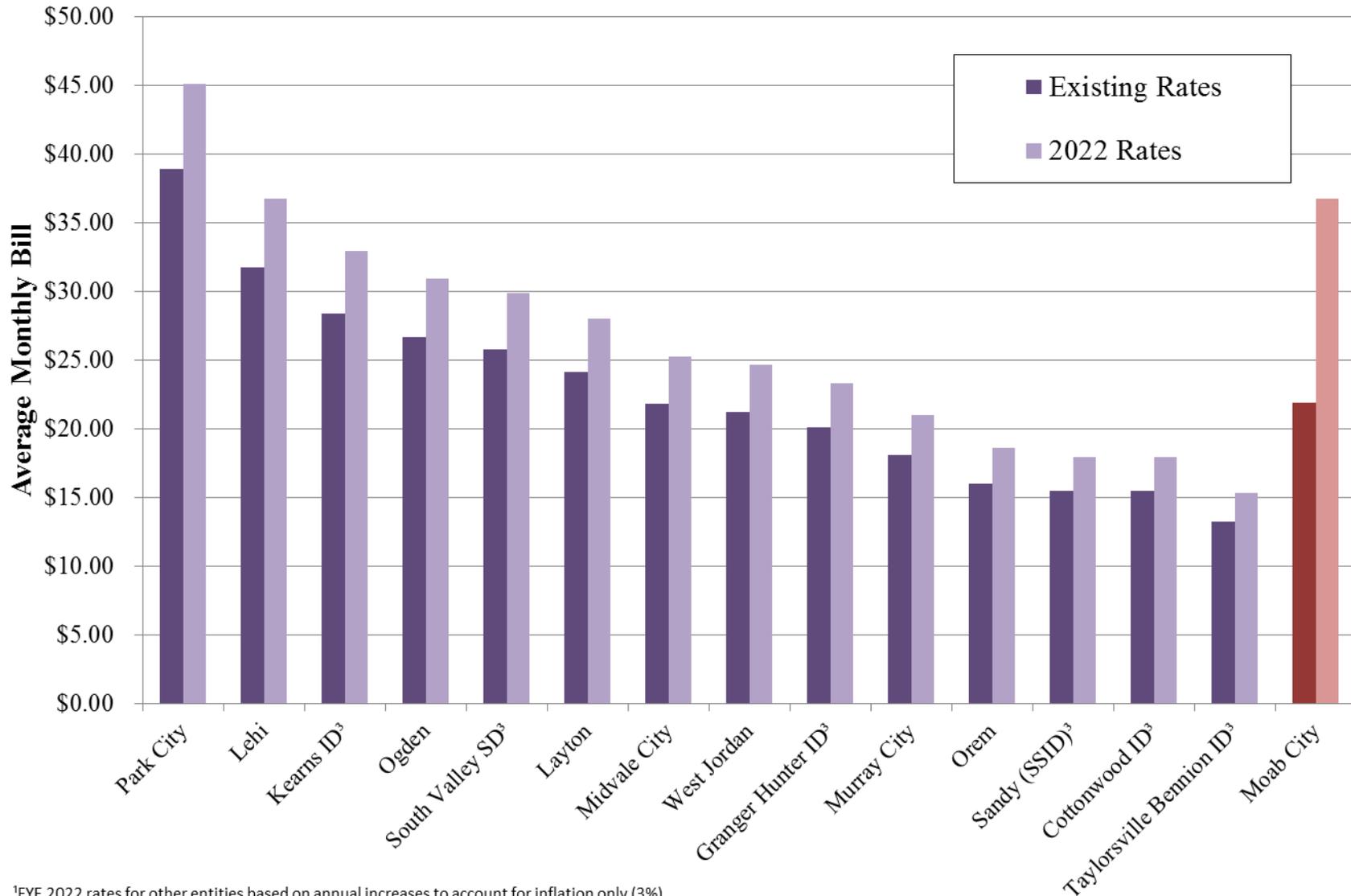
| Volume Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Residential | \$1.70 | \$2.04 | \$2.45 | \$2.74 | \$2.87 | \$2.87 |
| Commercial | \$1.85 | \$2.22 | \$2.66 | \$2.98 | \$3.12 | \$3.12 |

| | | | | | | |
|----------------------------------|---------|---------|---------|---------|---------|---------|
| Average Monthly Residential Bill | \$21.88 | \$26.26 | \$31.51 | \$35.29 | \$36.88 | \$36.88 |
|----------------------------------|---------|---------|---------|---------|---------|---------|

IMPACT ON MOAB CITY CUSTOMERS

As shown in Figure ES-1 (next page), the City's existing rates are a little lower than the average of service entities surveyed as part of this study. With the rate increases shown in Table ES-1, the monthly rates in Moab City will be toward the upper end of the entities compared, but not the highest surveyed. Considering that the proposed plan accomplishes the complete replacement of the treatment facility, the proposed rates increases appear to be reasonable and not out of line with what would be expected in this situation.

**Figure ES-1
Comparison of Monthly Sewer Rates, Average Residential Customer**



¹FYE 2022 rates for other entities based on annual increases to account for inflation only (3%)

²Average bill based on an assumed 4,400 gal/month use per residential customer

³Entities may charge taxes that are not reflected in monthly bills

SEWER RATE ANALYSIS

INTRODUCTION

Moab City is in the process of designing a complete replacement of its existing wastewater treatment facility. As a result of this project and general system growth, the City faces potential capital improvement costs, loan service costs, as well as maintenance and operation costs which will likely increase in the years to come. The purpose of this rate study is to update Moab City's (City) sewer rates based on system revenue requirements that have occurred since the City last established rates. The rate study will calculate detailed rates for the next six years and present a longer term finance plan to achieve the City's primary objectives of:

- Maintain high quality and reliable sewer service at affordable prices for customers;
- Sustain stable revenue generation adequate to fund system needs; and
- Minimize the City's long-term costs by avoiding further debt where possible.

Implementing the recommendations contained in this report will help Moab City keep its sewer system adequately funded to maintain its current infrastructure and continue to provide dependable service to its customers.

This report was originally completed in October of 2016, but was updated in February of 2017 to reflect higher than expected construction costs associated with the City's new wastewater treatment plant.

BACKGROUND AND COST DIVISIONS WITH OTHER ENTITIES

Moab City presently provides sanitary sewer collection and treatment services to all customers within the City's boundaries. In addition, it accepts wastewater collected from Spanish Valley Water & Sewer Improvement District (SVW&SID) for treatment at the City's existing wastewater treatment plant (WWTP). Moab City separately charges SVW&SID for that service. Moab City also charges fees to private septage haulers in order to accept and treat septage from nearby campgrounds and other similar establishments.

As part of this sewer rate study, *Technical Memorandum #2: Cost Share of Future Sanitary Sewer System Costs* was updated to reflect the modified cash contributions from Moab City and Spanish Valley Water & Sewer Improvement District (SVW&SID) for the new wastewater treatment plant and the finalized impact fees developed by Bowen, Collins & Associates, Inc. The updated document is included in Appendix A. This document provides all the information necessary for establishing Moab City charges for sewer service outside its retail service area.

Moab Charges to SVW&SID

Based on the results summarized in Technical Memorandum #2, recommended rates charged by Moab to SVW&SID are as summarized in Table 1.

Table 1
Projected Charges from Moab to SVW&SID for Operation and Maintenance Costs¹

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Flow ERUs | 2,707 | 2,761 | 2,884 | 3,273 | 3,404 | 3,536 |
| Treatment ERUs | 2,944 | 3,003 | 3,148 | 3,583 | 3,736 | 3,891 |
| Flow Costs/Month | \$10,958 | \$11,388 | \$12,046 | \$13,535 | \$14,262 | \$15,014 |
| Treatment Costs/Month | \$13,722 | \$16,996 | \$18,112 | \$20,692 | \$21,948 | \$23,254 |
| Total Costs/Month | \$24,680 | \$28,384 | \$30,158 | \$34,226 | \$36,209 | \$38,268 |
| Monthly Flow O&M Cost/ERU | \$4.05 | \$4.12 | \$4.18 | \$4.14 | \$4.19 | \$4.25 |
| Monthly Treatment O&M Cost/ERU | \$4.66 | \$5.66 | \$5.75 | \$5.78 | \$5.87 | \$5.98 |
| Total Monthly O&M Cost/ERU | \$8.71 | \$9.78 | \$9.93 | \$9.91 | \$10.06 | \$10.22 |
| Total O&M Costs | \$296,157 | \$340,614 | \$361,900 | \$410,718 | \$434,513 | \$459,215 |
| Annual Loan Payment | \$0 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 |
| Impact Fee Credit Offset/New ERU/Year | \$362.38 | \$331.24 | \$302.39 | \$277.78 | \$254.87 | \$233.51 |
| Estimated Total Credit Offset | \$20,919 | \$19,503 | \$43,859 | \$120,743 | \$39,163 | \$36,204 |
| Total Costs/Year | \$317,076 | \$462,324 | \$507,966 | \$633,668 | \$575,883 | \$597,626 |

¹Includes projected future San Juan connection costs and USU extension costs

²The large increase in 2020 assumes connections from San Juan occur in this year

As shown in the table, it is recommended that the monthly bill to SVW&SID be generated based on four items:

- The number of flow ERUs multiplied by the rate per flow ERU
- The number of treatment ERUs multiplied by the rate per treatment ERU
- A fixed amount for loan costs through the life of the loan (independent of ERUs)
- Impact fee credit offset multiplied by the number of new treatment ERUs (will vary based on actual number of new connections)¹

It should be emphasized that Table 1 represents charges from Moab to SVW&SID only and is not intended to be a full rate study for SVW&SID customers. It is recommended that SVW&SID evaluate its existing rates to ensure sufficient funding to cover the amounts shown.

¹ For a more detailed description of this credit, see the 2016 Moab Sewer Impact Fee Analysis and the Technical User Fee Credit Memorandum dated May 25, 2016.

Moab Charges for Septage Service

Also based on the results of Technical Memorandum #2, projected septage revenue requirements are shown in Table 2. Based on those projections, Table 2 lists the calculated and recommended septage sales rates to meet the revenue projections.

Table 2
Projected Septage Costs

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---|-------------|-------------|-------------|-------------|-------------|-------------|
| Treatment Costs | \$76,755 | \$97,478 | \$103,438 | \$108,193 | \$114,478 | \$120,972 |
| Debt Service Costs | - | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 |
| Additional Treatment Costs | - | - | \$36,257 | \$36,257 | \$36,257 | \$36,257 |
| Total Costs | \$76,755 | \$241,341 | \$283,559 | \$288,314 | \$294,599 | \$301,093 |
| Cumulative Costs | \$76,755 | \$318,096 | \$601,655 | \$889,969 | \$1,184,568 | \$1,485,661 |
| Projected Septage Treatment ERUs | 1,372 | 1,435 | 1,498 | 1,561 | 1,624 | 1,687 |
| Projected Septage Flows (MGD) | 0.0055 | 0.0057 | 0.0060 | 0.0063 | 0.0065 | 0.0068 |
| Calculated Septage Rate (\$/gal) to Meet Total Costs | \$0.060 | \$0.180 | \$0.202 | \$0.197 | \$0.194 | \$0.191 |

From the table, it can be seen that the calculated septage rate jumps up over the first two years and then begins to decline after FYE 2019 because the number of septage ERUs continues to increase while the debt service costs associated with the WWTP construction remain fixed. To avoid raising and then lowering of rates during the study period, BC&A would recommend modifying the rates slightly as shown in Table 3 to gradually increase from the current 9 cents per gallon to 19 cents per gallon in FYE 2020 before leveling off. If the total revenue generated by these rates is compared against actual costs as summarized in Table 2, it can be seen that the recommended rates generate a little more revenue than needed to meet costs up front, but then draw on these reserves in a few of the first years after the plant is constructed. By the end of the planning period, cumulative costs and cumulative revenues are nearly identical.

Table 3
Recommended Septage Rates

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--|----------------|----------------|----------------|----------------|----------------|----------------|
| Recommended Septage Rate (\$/gal) | \$0.090 | \$0.180 | \$0.180 | \$0.190 | \$0.190 | \$0.190 |
| Recommended Septage Rate Revenue | \$115,551 | \$241,700 | \$252,299 | \$277,503 | \$288,690 | \$299,878 |
| Cumulative Revenue from Recommended Rates | \$115,551 | \$357,251 | \$609,550 | \$887,053 | \$1,175,743 | \$1,475,621 |

PROJECTED REVENUE NEEDS

With rates established for SVW&SID and septage users, Moab can begin to look at its own customers in greater detail and the overall plan for meeting the future revenue needs of the City. The first step in this process is to project future expenditures. Historic and projected expenditures for the City from FYE 2014 to FYE 2026 are shown in Figure 1. Future expenditures can be grouped into three categories:

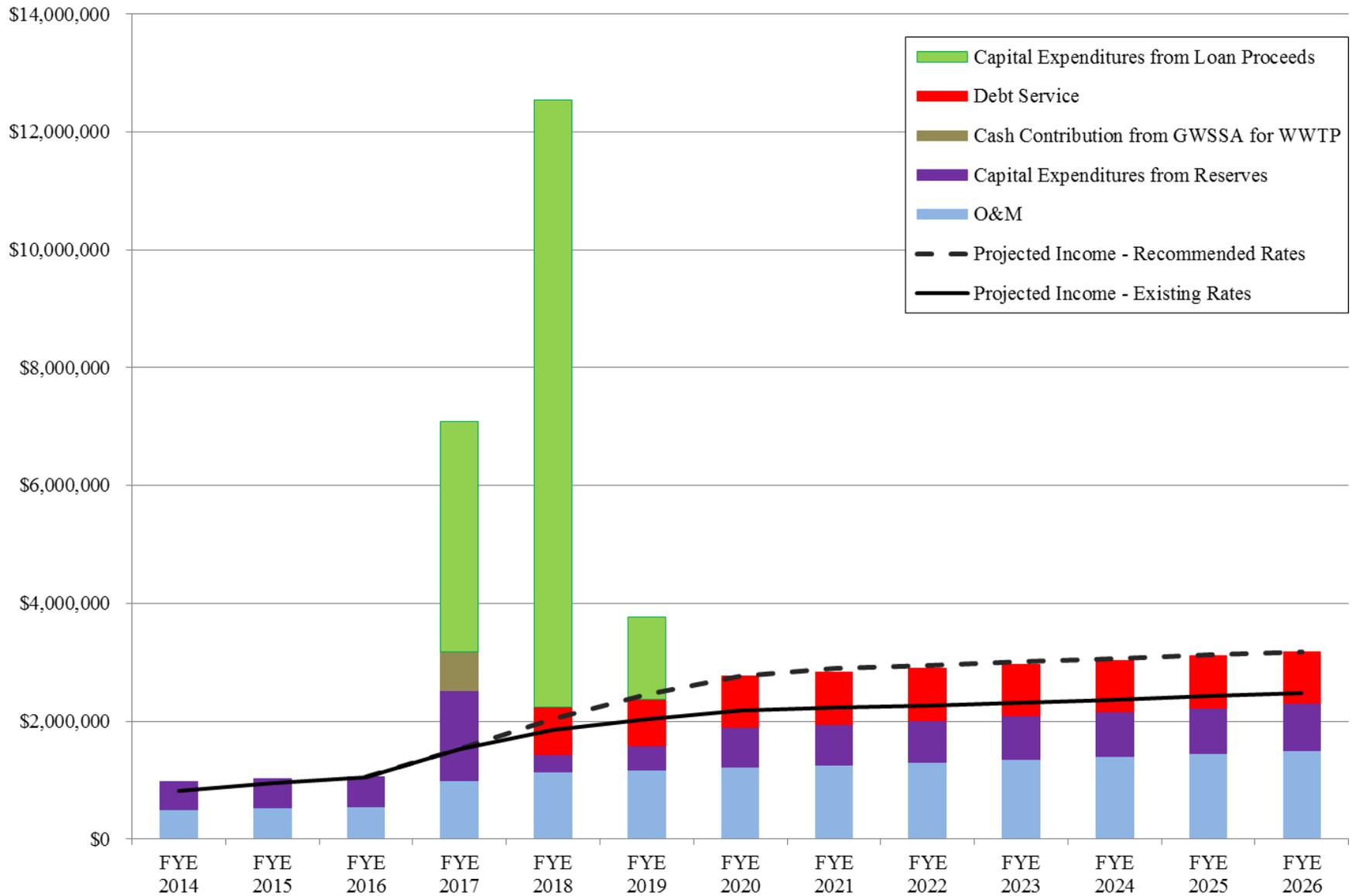
- **Operation and Maintenance Expenditures** – These are the annual costs of running the system. They include items such as salaries and benefits for Moab City staff, equipment and supplies, power costs, system repairs, and all other costs associated with doing business throughout the year. The projected operation and maintenance costs for Moab City were based on the City’s budgeted amount for FYE 2017. Beyond FYE 2017, it has been assumed that all of the O&M cost categories will annually increase at an assumed inflation rate of 3.0 percent added to half the connected growth rate.

The one exception to this is treatment costs. Construction of the City’s new treatment plant is tentatively scheduled to be completed in FYE 2018. Following the upgrade, it is anticipated that annual wastewater treatment O&M costs will increase by approximately \$115,000. It is typically recommended that rates be re-evaluated every 3 to 5 years. Depending on the actual timing of the new WWTP construction and the magnitude of the subsequent potential treatment O&M cost increase, it is recommended that the City be prepared to update rates to maintain recommended funding levels.

- **Debt Service** – These are the costs paid toward the loan planned to be taken out by the City in the near future. These costs are easily predictable because they are tied to set loan repayment schedules. Currently, the City does not have any sewer related debt. It is anticipated that the new WWTP will require a loan of approximately \$14,200,000. Another loan of approximately \$1,400,000 is expected in FYE 2019 in association with the construction of the South Trunk Line project. The projected debt service costs for the City have been taken from the City’s proposed loan payment schedule.
- **Capital Improvement Expenditures from Reserves and Loan Proceeds** – These are costs for constructing new facilities within Moab City. This can include completely new facilities or replacement of existing facilities. Capital improvement expenditures are usually the most volatile of expenditure categories. Because O&M and debt service costs are basically fixed, budgets are usually balanced by increasing or decreasing capital improvement expenditures as necessary.

For this study, only three major new City capital improvement projects are projected to occur during the evaluated time period. The first is the new WWTP. As part of this project, Moab City and SVW&SID will each contribute an agreed upon amount from cash reserves to partially fund the project, \$1,320,595 and \$800,000 respectively. Moab City will take out a loan for the remaining balance. The second major project is the South Trunk Line. Costs associated with this project are \$2,100,000 and have been spread over two years in the rate model. To maintain cash reserves at an acceptable level, it is expected that the City will need a loan for \$1,400,000 in FYE 2019 in association

Figure 1
10-Year Revenue and Expenditures - Moab City Sewer



with this project. The final project is the 400 East trunk pipeline which is expected to be replaced in FYE 2021.

The remaining expenditures of this category primarily account for rehabilitation and replacement of existing infrastructure and other minor improvements. As with most things, each component of a sewer system has a finite service life. As such, it is necessary to continually budget money for the rehabilitation or replacement of these system components. If adequate funds are not set aside for regular investment into the system, the system will fall into disrepair and be incapable of providing the level of service customers in the City expect. To maintain the sewer system in good operating condition, it is recommended that the City's annual investment into the system be approximately equal to the replacement value of the system divided by its estimated service life. The City's sewer infrastructure (not including the WWTP) is expected to have a remaining service life of approximately 90 years with a combined replacement and rehabilitation cost of approximately \$45,000,000. Therefore, the annual investment into the system should be approximately \$500,000 in FYE 2017. This number can be refined in the future if the City develops a more detailed asset management plan, but has been used in this study as the basis for future system investment.

A detailed table of projected system expenditures is contained in Appendix B of this report.

10-YEAR BUDGET PLAN

With the expected expenditures outlined above, it is possible to prepare a future budget plan. A budget plan has been developed and is shown with projected expenditures in Figure 1. The process of creating this budget plan was as follows:

- 1. Identify projected revenue based on existing sewer rates** – Using Moab City's existing sewer rates, Bowen, Collins & Associates (BC&A) calculated the revenue the City could expect to receive over the next 10 years. These projections include consideration of future system growth.
- 2. Compare projected revenue to required revenue** – Once revenue projections have been developed, it is possible to compare revenue projections to required revenue. As can be seen in Figure 1, projected revenue based on existing rates will begin to fall short of expenditures in FYE 2017. In FYE 2017 and moving forward, the situation is expected to get consistently worse. To satisfy the City's anticipated loan repayment schedule and to fund projected capital improvement projects in the future, a rate increase will definitely be needed.
- 3. Create a plan to transition from existing revenue to revenue adequate to support long-term system needs** – To close the gap between projected revenue from existing rates and recommended rate revenue for long-term system needs, it is recommended that existing rates be increased over the next three years. To meet projected rate revenue needs (including minimum bond coverage requirements) a large initial increase will be required. To generate the revenue shown in the budget plan in Figure 1, approximate annual overall rate revenue increases will need to be as shown in Table 4.

Table 4
Recommended Annual Revenue Increases for the 10-Year Budget Plan

| Year | Rate Revenue Increase |
|----------|-----------------------------|
| FYE 2018 | 20% |
| FYE 2019 | 20% |
| FYE 2020 | 12% |
| FYE 2021 | 4.5% |
| FYE 2022 | 0%* |
| FYE 2023 | 0%* |
| FYE 2024 | 0%* |
| FYE 2025 | 0%* |
| FYE 2026 | 0%* |

* No significant increase expected, but small annual adjustments may be needed to account for inflation or other issues.

After the initial transition period to bring rates up to the recommended sustainable long-term levels, no annual rate increases other than minor inflation adjustments are expected to be required throughout the study window.

4. **Modify capital improvement expenditures to fit within the identified budget** – As noted previously, there is not much change that can be made to O&M or debt service expenditures. Therefore, any modifications required to meet the recommended budget plan will need to come through capital improvement expenditures. The capital expenditures shown in Figure 1 represent the level of expenditures that can be supported by the budget plan. See Appendix B for additional details on the magnitude and timing of capital expenditures.
5. **Maintain an acceptable savings balance** – Presently, the City combines the water and sewer reserve fund. BC&A has assumed that the amount of the reserve fund which can be expected to be available for sewer related purposes is based on the proportion of water and sewer expenditures. Of the FYE 2016 water/sewer reserve fund balance of \$3,012,093, it has been assumed that approximately \$1,722,000 is available for sewer related expenditures. BC&A recommends that the City attempt to maintain a sewer reserve fund balance approximately equal to 6 months of O&M expenses. A reserve fund balance will allow the City flexibility to deal with various potential issues such as unexpected revenue reductions, ability to avoid bonding for smaller projects, or other emergency purposes. The proposed 10-year budget plan will include transfers into and out of the City’s reserve fund based on the timing of capital improvements and system revenue. For example the new wastewater treatment plant construction is tentatively scheduled to occur in FYE 2017-2018. The revenue model plans to transfer money in FYE 2017 out of savings for part of this expense. In FYE 2018, loan proceeds will pay for the remaining portion of the plant and the reserve fund will have unused funds transferred back into it. In FYE 2019 when the bulk of the South Trunk line project funding becomes due, the savings can be utilized to cover a large portion of its balance.

Figure 2 shows the anticipated 10-year savings fund balance with expected transfers into and out of savings based on system revenue and capital improvement projects. The capital expenses for the yet to be determined system replacement and rehabilitation projects are planned to generally be delayed until FYE 2020 to avoid bonding for the other previously named projects. Then from FYE 2023 through FYE 2025 the dollar amounts of replacement and rehabilitation projects that were deferred in FYE 2017 through FYE 2019, will be added to the replacement and rehabilitation budgets of those later years to avoid falling behind on system upgrades. In FYE 2026 and beyond, it is recommended that the City utilize all the full amount budgeted for system rehabilitation and replacement on actual capital improvement projects.

RATE CALCULATION

Because of the need to have a viable rate plan in place before construction of the treatment plant begins, this rate study has been limited to a revenue needs analysis. It does not include a full cost-of-service analysis or look at the individual components of the City's existing rate structure in any way. It is expected that the City will revisit its rate structure based on cost-of-service principles in the near future and update its rate structure as necessary.

With this report limited to a revenue needs analysis, the final step in the rate calculation process is to simply multiply the City's existing rate structure by the percent increases identified in Table 4. The resulting recommended rates are summarized in Table 5.

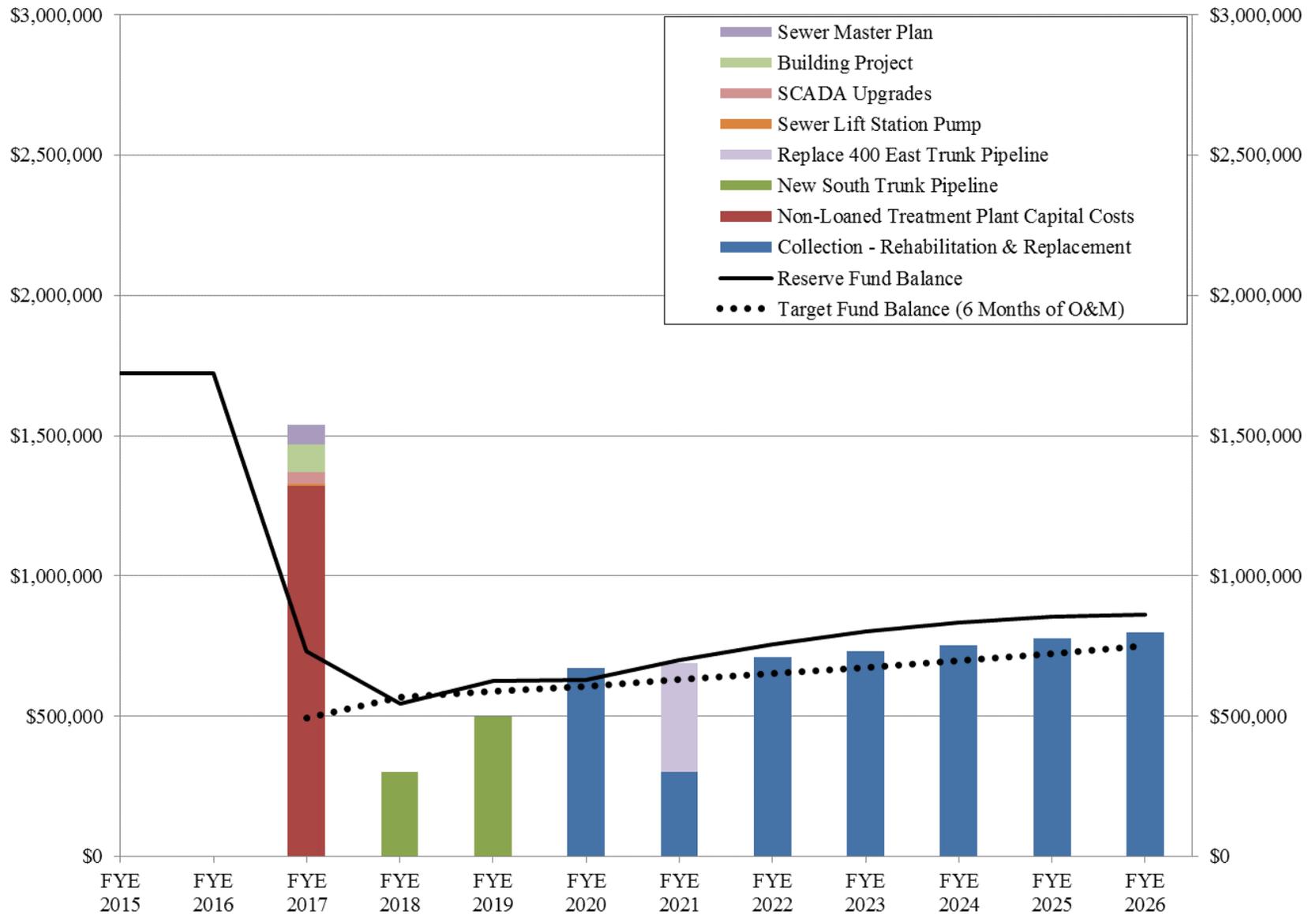
Table 5
Required Rates to Meet Projected Revenue Needs

| Monthly Base Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Residential | \$14.40 | \$17.28 | \$20.74 | \$23.22 | \$24.27 | \$24.27 |
| Commercial | \$19.10 | \$22.92 | \$27.50 | \$30.80 | \$32.19 | \$32.19 |

| Volume Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Residential | \$1.70 | \$2.04 | \$2.45 | \$2.74 | \$2.87 | \$2.87 |
| Commercial | \$1.85 | \$2.22 | \$2.66 | \$2.98 | \$3.12 | \$3.12 |

| | | | | | | |
|----------------------------------|---------|---------|---------|---------|---------|---------|
| Average Monthly Residential Bill | \$21.88 | \$26.26 | \$31.51 | \$35.29 | \$36.88 | \$36.88 |
|----------------------------------|---------|---------|---------|---------|---------|---------|

Figure 2
10-Year Reserve Fund Balance - Moab City Sewer



RATE COMPARISON

Figure 3 shows a comparison of Moab City's current and proposed sewer rates for an average residential customer with other communities in Utah. The figure displays the projected 2017 average monthly sewer rate and the estimated sewer rate in 2022 for several sewer service entities. As shown in the figure, the City's current rates are a little lower than average compared to other cities and service districts. With the proposed rate increases over the next several years, Moab City's monthly sewer fee will be toward the upper end of the entities compared, but not the highest surveyed.

RECOMMENDATIONS

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

Adopt Recommended Rates: It is recommended that Moab City adopt the rates summarized in Table 5. These increases are needed to meet immediate operation and maintenance needs and to fund capital expenditures to meet the City's longer-term system investment goals.

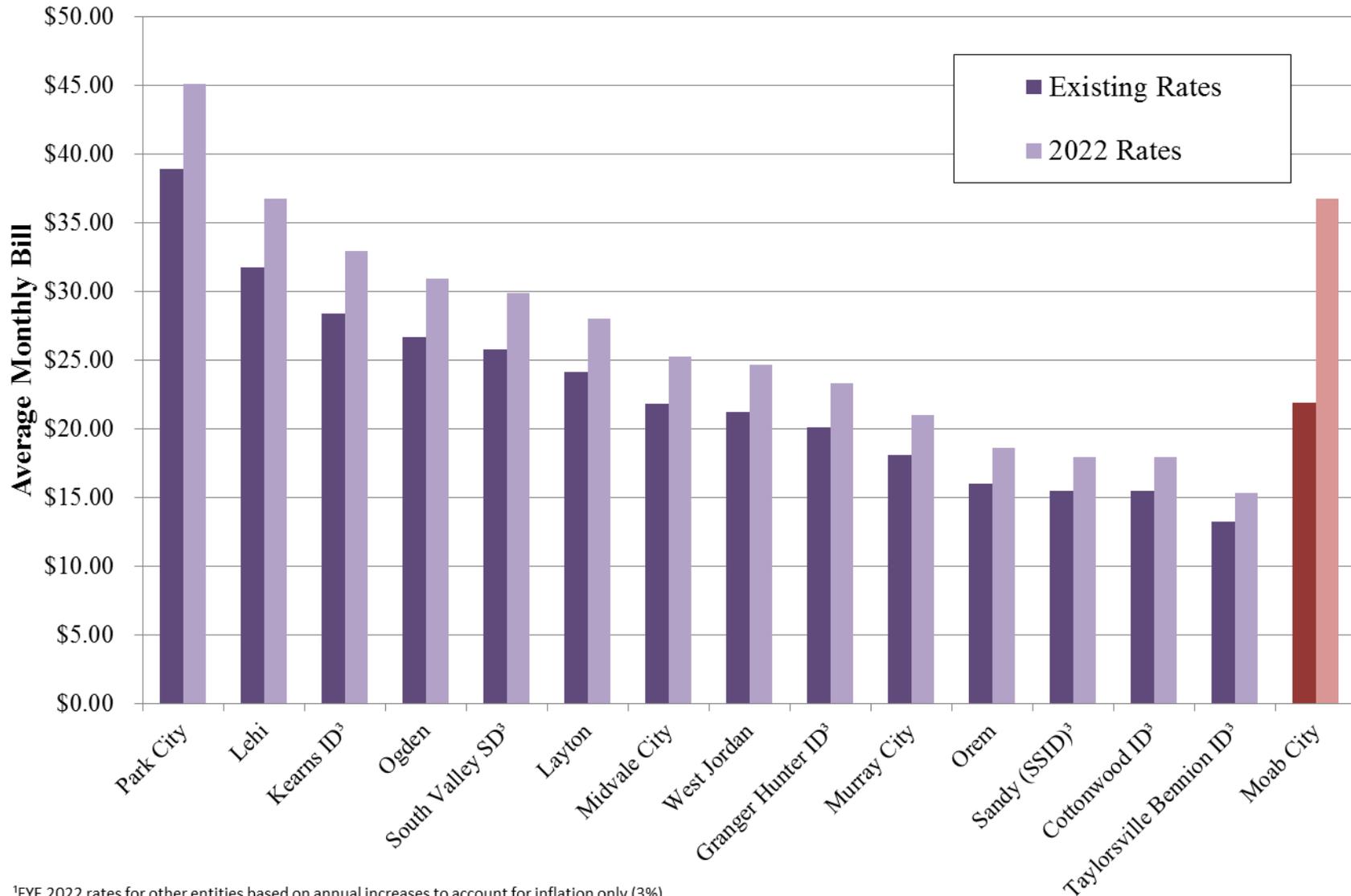
Consider a Multiple Year Rate Schedule: If at all possible, it is recommended that the City adopt the full multiple year rate schedule through 2022. By adopting a multiple year rate schedule, the City can program the desired increases to the rates consistent with the results of this report and provide longer notice to customers.

Consider Maintaining Separate Water and Sewer Reserve Fund Accounts: An objective of the recommended rate schedule is to maintain a reserve fund balance approximately equal to six months of O&M costs for emergencies and other purposes. The ability to continually track the sewer reserve fund balance will assist in detecting unexpectedly drops or trends before financial issues become too significant. As part of future rate studies, the existing revenues and reserve fund balances should be evaluated. If water and sewer reserve funds are co-mingled, it will be more difficult to evaluate the performance of the rates recommended as part of this study.

Prepare a Cost-of-Service Rate Analysis: Because of the need to have a viable rate plan in place before construction of the treatment plant begins, this rate study has been limited to a revenue needs analysis. It is recommended that the City follow this study up with a full cost-of-service analysis to look at the individual components of the City's existing rate structure and verify each customer is being charged fairly.

Update This Rate Study Frequently: After the implementation of any major change to the rate structure, we would suggest that the City monitor customer responses and system revenue for a period to two to three years. Following this initial observation period, the rates should be re-examined to determine if there should be any subsequent rate adjustments. A comprehensive review of this rate study should also be performed in three to five years. The projections, assumptions, and data contained in this report may need to be revised over time. For these reasons, it is prudent to update the rates to ensure they are sufficient to meet system requirements, as well as maintain cost-of-service equity in charges to customers.

Figure 3
Comparison of Monthly Sewer Rates, Average Residential Customer



¹FYE 2022 rates for other entities based on annual increases to account for inflation only (3%)

²Average bill based on an assumed 4,400 gal/month use per residential customer

³Entities may charge taxes that are not reflected in monthly bills

APPENDIX A
TECH MEMO #2: COST SHARE OF SYSTEM COSTS



TECHNICAL MEMORANDUM #2

February 2017 Update

TO: David Everitt
Moab City

COPIES: File

FROM: Keith Larson P.E.
Jeff Beckman P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

DATE: February 27, 2017

PROJECT: Sewer Rate Study

SUBJECT: Cost Share of Future Sanitary Sewer System Costs

INTRODUCTION

Moab City (City) is in need of a new wastewater treatment plant. As part of the planning process for the plant improvements, the City has retained Bowen Collins & Associates (BC&A) to prepare a sewer rate study. The purpose of this study will be to help the City develop a sustainable rate plan to finance construction of the new plant and its subsequent operation. As part of this plan, it will be important to fairly distribute costs among the various users of the plant. The purpose of this memorandum is to examine the different types of future users that will benefit from the plant and calculate an appropriate cost share for each.

This memorandum, originally completed on October 28, 2015, has been updated to reflect additional information obtained since that time. The additional information driving the update can be grouped into four categories:

1. **Moab City O&M Budget:** An updated Moab City O&M budget has been made available to BC&A. The cost share model has updated to reflect that budget.
2. **Impact Fees:** In the original memorandum, impact fees were estimated based on information available at the time. Since October 2015, a new impact fee study has been completed and a new impact fee structure has been established. The cost share model has been updated to reflect those proposed impact fees.
3. **Wastewater Treatment Plant Costs:** Since October 2015, the wastewater treatment plant has been designed and bid. Thus, construction costs are now known and the loan interest rate is now known. The upfront cash contribution amounts of each entity dedicated to construction capital costs for the new wastewater treatment plant was not finalized in October 2015. The initial investment amounts have now been tentatively agreed upon.

4. **Updated Connection and Flow Data** – The original memo was based on connection and flow data from 2014. To best reflect actual connections at the time of the potential treatment plant capacity agreement, all data was updated to reflect connections in August of 2016.

PROPOSED COST SHARE APPROACH

BC&A has analyzed the expected future costs associated with Moab City’s wastewater system. This includes construction and future operation of the new wastewater treatment plant as well as the other operating and capital costs of the system. BC&A also met with and interviewed personnel from Moab City and Spanish Valley Water & Sewer Improvement District (SVW&SID) to gain insight into their priorities regarding how the system will be used and operated. Based on our discussions, we have identified the following objectives for division of future costs associated with operation of the wastewater system:

1. Moab City wants to maintain ownership of the new treatment plant.
2. The division of costs between entities should be as fair as possible based on the actual cost of service to each entity.
3. The final cost division should be as easy as possible to implement and administer.

Based on these objectives, BC&A has assembled a proposed cost share approach for the Moab City wastewater system. The major components of the proposed approach are summarized in Table 1. The approach is discussed in detail in the following sections.

Capital Costs

There are two types of costs that must be divided between those who are using the system, capital costs and operation & maintenance costs. This section discusses capital costs. Capital costs can further be divided into treatment costs and collection system costs.

Treatment. While not the only item of importance in this discussion, construction of a new treatment plant is the largest single issue that will affect future costs for Moab City. Construction of the plant will include two types of capacity:

- **Replacement of Existing Capacity** – The existing Moab City plant currently provides treatment for up to 1.17 million gallons per day (mgd) of wastewater during the peak month of the year. There are also additional users that are currently constructing homes and businesses that will add additional flow to the plant increasing the total committed capacity to 1.19 mgd. Since the old plant will be abandoned, the new plant must have capacity to continue to serve these existing users. It is proposed that the portion of plant costs used to replace existing capacity be divided among existing users based on their actual use of committed capacity at the time the plant is constructed. In dividing these costs, several items should be considered:
 - **Treatment Equivalency** – When it comes to treatment capacity, it is not adequate to look at the portion of flow used by each entity only. The strength of wastewater must also be considered. This is especially true in Moab. The Moab plant has historically had a significant portion of its capacity used to receive septage from the several campgrounds and recreational areas in the vicinity of the City. This is expected to continue in the future. The strength of wastewater coming from

**Table 1
Proposed Cost Share Matrix**

| Cost Category | Capital Costs | | | | Operations and Maintenance | |
|--|--|--|---|---|--|---|
| Cost Area | Treatment | | Collection | | Treatment | Collection |
| Type of Costs | Replacement of Existing Capacity | Construction of Capacity for Future Users | Replacement of Existing Capacity | Construction of Capacity for Future Users | System O&M | System O&M |
| How costs will be paid for? | Cash on Hand and/or Use Charges** | Impact Fees | Use Charges | Impact Fees | Use Charges | Use Charges |
| What is the basis of total costs? | Portion of new treatment plant costs required to serve existing users | Portion of new treatment plant costs available to serve future users | Annual collection system rehabilitation and replacement budget (1% system replacement) | Projected costs of construction | Annual treatment O&M per Moab budget | Annual collection O&M per Moab budget |
| How are costs divided? | Proportional use of plant capacity based on treatment ERUs. The number of treatment ERUs are calculated based on the formula established for each type of user in the ERU study (to be based on peak month flow and strength). | Not divided between entities. Capacity is distributed based on a "first come, first serve" basis. As a result, the owner of the facility (Moab City) would carry all initial costs of this capacity, but would also receive all future revenue from related impact fees. | Proportional use of Moab collection facilities based on flow ERUs. This will be calculated in two steps: 1. Use of each pipe calculated based on proportional flow ERUs conveyed in the pipe. 2. Contribution of each pipe to the overall system weighted by length times flow capacity of pipeline assuming State minimum slope (estimate of required O&M effort). | Same as treatment capital costs for future capacity. | Proportional use of plant capacity based on treatment ERUs | Same as collection capital costs for existing capacity. |
| When are costs divided? | Calculated only once based on existing use of capacity. | N/A | Recalculated with each rate study (approximately once every 3 to 5 years). | N/A | Recalculated annually. | Same as collection capital costs for existing capacity. |
| Notes | 1. Applies to initial 20-year period to pay for the new plant only. After the plant has been paid for, a treatment rehab and replacement budget will need to be established and costs split similar to treatment O&M. | None. | 1. The number of flow ERUs are calculated based on the formula established for each type of user in the ERU study (to be based on peak month flow only). 2. ERU study to be updated periodically. | 1. Collection impact fees will need to be calculated for at least two service areas. One for Moab only facilities and one for joint facilities. Only the joint facility fee will apply to users outside the City and be remitted to Moab. | 1. ERU study to be updated periodically. | Same as collection capital costs for existing capacity. |

** Each entity will be asked to contribute cash on hand for some minimum percentage of their share of existing treatment costs (i.e. all entities contribute at least xx% of their portion of costs). This money can come from impact fees (pending results of legal review) or other reserves. The purpose of this contribution will be to minimize the amount of borrowing required by Moab City to construct the plant. If desired, each entity will also be allowed to contribute additional cash on hand to reduce their total liability for this cost category. If additional cash on hand is contributed, the entity's portion of the remaining bond costs will be reduced correspondingly.

septage is 40 to 50 times greater than that of typical domestic wastewater and has a significant impact on the treatment process. To account for the full range of issues affecting treatment costs, BC&A would propose defining treatment demand for each entity (including septage) in terms of a treatment based equivalent resident unit (treatment ERU). This process is discussed in detail in a memorandum that has been included in the appendix of this report. Once the number of treatment ERUs has been defined for each entity, this can be used to calculate the proportionate use of existing capacity to be replaced.

- **Cash vs. Bonding** – This cost category represents a large one-time expenditure for each entity. As a result, each entity will have some decisions to make regarding how to pay for their portion. To minimize the amount of bonding the City has to incur, each entity is planning to contribute cash on hand for a portion of their share of existing treatment costs. Moab City and SVW&SID have tentatively agreed to make upfront contributions in the amounts of \$1,320,595 and \$800,000, respectively. This money could come from impact fee balances (pending results of legal review) or other reserves. The remaining portion of each entity’s cost liability will be put into a bond and paid for over time through annual user charges. If desired, each entity could be allowed to contribute additional cash on hand to reduce their total liability for this cost category. If additional cash on hand is contributed, the entity’s portion of the remaining bond costs would be reduced correspondingly.
- **Rehabilitation and Replacement** – It should be noted that this proposed cost share is for the initial construction costs of the treatment plant only. Since the plant will be brand new, this should represent the only required capital costs at the plant for the next several years. As the plant ages, however, a treatment plant rehabilitation and replacement budget will eventually need to be established. When this occurs, costs can be divided as discussed for treatment O&M (to be discussed later).
- **Construction of Capacity for Future Users** – The new treatment plant is expected to have a peak month, average day capacity of 1.75 mgd. This means that when the plant is completed, it is expected that there will be approximately 0.56 mgd of capacity available for future users. It is not anticipated that any entities will be reserving this future capacity in the treatment plant. Instead, future capacity will be distributed on a “first come, first serve” basis to be paid for through impact fees. Since Moab City will maintain ownership of the plant, it is expected that Moab City will be responsible to carry all debt associated with future capacity. However, this also means that Moab City will receive all future impact fees associated with treatment, regardless of where the fees are collected.

It should be noted that this concept applies to both individual lot owners as well as other entities. For example, there are a large group of potential customers in San Juan County that currently have sewer service through septic systems. There has been some discussion of this group bringing their wastewater to Moab City. If this were to occur, Moab would require an agreement with San Juan County that would include the payment of impact fees sufficient to secure the capacity in the plant required to serve the new users.

Collection. As with treatment, collection system capital costs will also include two types of capacity:

- **Replacement of Existing Capacity** – Sewer system collection pipelines have a finite lifespan and eventually need to be replaced. Paying for these costs becomes the responsibility of all who use capacity in the pipelines. It is proposed that these costs be divided using the following principles:
 - **Flow Equivalency** – BC&A would propose defining flow demand for each entity in terms of a flow based equivalent resident unit (flow ERU). This process is discussed in detail in a memorandum that has been included in the appendix of this report. In short, the flow ERU would be based on peak month projected flow for various types of users. This is in contrast to the alternative approach of defining flow based on average annual volume. Peak month flow is deemed a fairer basis of cost sharing than annual volume because the collection system must be sized based on peak flows.
 - **Use of Facilities** – While Moab customers generally benefit from the entire collection system, the same is not true for other entities. SVW&SID only uses capacity in a relatively small number of Moab’s trunk lines to convey its wastewater to the plant. To account for this difference in the use of Moab collection facilities, it is proposed that the portion of use be calculated in two steps:
 1. The percent usage of each pipe can be calculated based on proportional flow ERUs conveyed in the pipe (e.g. if SVW&SID has 400 ERUs in a pipe that is conveying 1,000 total ERUs, it would be assigned 40% of that pipe’s capacity).
 2. Once the capacity used in each pipeline is calculated, the second step is to calculate the contribution of each pipe to the overall system. This can be done by looking at a weighted use of capacity for all pipes in the system. It is proposed that the pipelines contribution to the system be weighted by the length of each pipe times its flow capacity assuming State minimum slope. Flow capacity is considered representative of the overall required maintenance effort associated with each pipe. Using the State minimum slope allows the system to be analyzed given limitations relative to actual pipe slope data.
 - **Annual Costs** – There are two possible approaches for determining collection system replacement costs. One approach would be to look at each replacement project individually and then determine the exact cost to each entity depending on which pipelines are being replaced. In addition to being extremely complicated, this approach has the added disadvantage of resulting in uneven costs for entities outside of Moab City. In some years, these entities may have no costs as the City focuses its efforts on replacement of pipelines serving only Moab City customers. In other years costs, the outside entities could be hit with extremely high costs when a major trunk line needed to be replaced. This creates problems for outside entities on two fronts. First, it makes it very difficult to set consistent sewer rates. Second, if the entity does not have enough money to fund a large project, it will be difficult to bond for the project since it is owned and will be constructed by Moab City.

What appears to be a better approach is to charge a fixed amount to each outside entity based on their expected average annual portion of collection system replacement costs. In this case, Moab would collect the amount for each entity on a consistent basis and then spend the money as needed. If bonding was required for

particularly large projects, it could all be handled by Moab internally. The proposed budget amount would be initially set at 1% of the Moab system replacement value. Each entity would pay a portion of this based on its percent use of the overall system as discussed previously. The proposed budget equates to an average life span of 100 year for sewer system collection components. This is likely longer than can realistically be expected, but is a good rule of thumb for system renewal when asset management data is limited.

- **Periodic Recalculation** – It is expected that the system value and each entity’s use of the system will slowly change over time. As a result, it will be important to periodically re-examine each of these elements. It is proposed that these items be recalculated with each rate study (assumed to be once every 3 to 5 years)
- **Construction of Capacity for Future Users** – Although not specifically identified at this time, it is expected that some additional pipeline projects will need to be constructed for the purpose of accommodating flow from future users. Similar to the treatment plant, it is not anticipated that any entities will be reserving future capacity in these pipelines. Instead, future capacity will be distributed on a “first come, first serve” basis to be paid for through impact fees. Since Moab City will maintain ownership of the pipeline, it is expected that Moab City will be responsible to carry all costs associated with future pipeline capacity. However, this also means that Moab City will receive all future impact fees associated with collection capacity inside the Moab City system, regardless of where the impact fees are collected.
This does not mean that other entities cannot have their own collection impact fee. However, their fee will need to be separate from that collected for capacity inside the Moab collection system.

Operation and Maintenance Costs

The second major category of costs in the Moab City wastewater system is operation and maintenance (O&M) costs. As with capital costs, operation and maintenance costs can be divided into treatment costs and collection system costs.

Treatment. It is proposed that operation and maintenance costs at the treatment plant be divided based on treatment equivalency as defined previously in the section regarding treatment capital costs. The only difference between capital costs and O&M costs is that O&M costs will be reexamined on an annual basis. Each year the total O&M budget will be updated to reflect actual costs and the cost share will be updated to reflect the growth for each entity during the previous year.

It should be emphasized that, under this approach, all entities would be charged a fixed amount each month based on the number and type of customers connected to the system. This is in contrast to a variable approach in which the amount charged each month is based on metered flow and strength. BC&A carefully considered both of these approaches. Ultimately charging a fixed amount each month was selected for the recommended approach because of several advantages:

- **Equitable Distribution of Costs** – The basis of the fixed charge will be the treatment ERUs per entity as discussed above. These ERUs represent the expected demand of customers during peak demand periods. The great majority of sewer system costs are most closely tied to peak capacities. Peak demands determine the sizing of all capital equipment which, in turn, determines most maintenance costs. Peak demands also establish staffing costs, the

largest single expenditure associated with O&M. In contrast, O&M costs associated with the volume of wastewater produced are comparatively small (power consumption and some chemical costs). Given the two alternatives, charging based on peak demand is much more reflective of the true cost of service for each entity.

- **Revenue Stability** – Fixed charges mean that revenue from outside entities will be consistent from month to month. This will help Moab City to plan and manage its annual budget. It also simplifies budgeting for outside entities since they can plan on a consistent expense for treatment from month to month.
- **Simplicity** – Fixed charges are extremely easy to calculate and administer. All that is necessary is to keep track of the number and type of new connections each year so that ERU values for each entity can be updated annually. In contrast, charging variable rates requires accurate flow metering that all parties agree on. Depending on how the rates are structured, it may also require frequent sampling of wastewater from each entity to assign strength values. These additional complications can add significantly to the bottom line cost of operating the system.

Collection. It is proposed that operation and maintenance costs for the collection system be divided in the same manner as defined previously in the section regarding collection replacement capital costs for existing capacity.

CALCULATED COST SHARE BASED ON PROPOSED APPROACH

Based on the approach described above, BC&A has assembled a cost share model for the Moab City wastewater system. The full, detailed model is contained in the appendix of this report. The following sections highlight the major results of the model. It should be noted that the model includes a year by year projection of shared system costs. This is a projection based on the best available information regarding development patterns. The actual cost share between entities will depend on actual system growth and may vary slightly from the results shown here.

Equivalent Residential Units

There are currently three types of users of the Moab City system:

- Moab City customers
- Customers from Spanish Valley Water & Sewer Improvement District (SVW&SID)
- Septage Haulers

Based on historic water use records, existing ERUs connected to the Moab sewer system (or ERUs for which capacity has been committed, i.e. projects that have already paid an impact fee but are not yet connected) are as summarized in Table 2.

**Table 2
Existing ERUs**

| Customer Category | Flow | | | Treatment | | |
|-------------------------------|--------------|--------------|-----------|--------------|--------------|--------------|
| | Moab | SVW&SID | Septage | Moab | SVW&SID | Septage |
| Residential – Single Family | 1,768 | 1,963 | | 1,768 | 1,963 | |
| Residential – Multifamily | 230 | 75 | | 230 | 75 | |
| Overnight Accommodations | 1,980 | 113 | | 1,980 | 113 | |
| Commercial/Retail | 603 | 94 | | 603 | 94 | |
| Office | 113 | 39 | | 113 | 39 | |
| Restaurant | 396 | 19 | | 893 | 43 | |
| Schools | 29 | 22 | | 29 | 22 | |
| Gas Station/Convenience Store | 88 | 93 | | 88 | 93 | |
| RV/Campground | 142 | 213 | | 285 | 426 | |
| Other | 118 | 76 | 38 | 118 | 76 | 1,372 |
| Total | 5,467 | 2,707 | 38 | 6,107 | 2,944 | 1,372 |
| Percent of Total | 66.6% | 33.0% | 0.5% | 58.6% | 28.2% | 13.2% |

As can be seen in the table, Moab is responsible for approximately 2/3rds of the flow to the treatment with the other 1/3rd coming from SVW&SID. Septage is an insignificant contributor to overall flow. However, when strength is considered, septage is using 13.2 percent of the total treatment capacity.

In addition to these existing customers, the model includes the following expected future users of the Moab City system:

- USU – USU is currently exploring plans for further development of facilities for its Extension in Moab. Over the planning period (next 20 years), this is expected to add an average day flow of 144,500 gallons per day (166,175 gpd average day, peak month) to the total flow into Moab City. It is expected that USU will be a retail customer of SVW&SID and will add to their total flow.
- San Juan County – Development in San Juan County is all currently on septic systems. At some point in the future, it is expected that additional capacity will be desired and that all development (both existing and future) will be brought to Moab’s system. For the purpose of this analysis, it has been assumed that San Juan will have approximately 265 flow ERUs connecting to the system in 2020. If San Juan connects, it is expected that the County will be a new wholesale customer (i.e. not a retail customer of either Moab or SVW&SID).

Based on the new customers described above and projected growth rates for existing customers, projected ERUs to be connected to the Moab sewer system are as summarized in Table 3.

**Table 3
Projected ERUs – 2035**

| Year | Flow | | | | Treatment | | | |
|------|-------|----------|---------|----------|-----------|----------|---------|----------|
| | Moab | SVW&SID* | Septage | San Juan | Moab | SVW&SID* | Septage | San Juan |
| 2017 | 5,467 | 2,707 | 38 | 0 | 6,107 | 2,944 | 1,372 | 0 |
| 2022 | 5,774 | 3,259 | 47 | 277 | 6,450 | 3,590 | 1,687 | 301 |
| 2027 | 6,099 | 3,907 | 55 | 308 | 6,813 | 4,354 | 2,002 | 334 |
| 2032 | 6,442 | 4,588 | 64 | 342 | 7,196 | 5,152 | 2,316 | 372 |
| 2035 | 6,657 | 5,014 | 69 | 365 | 7,436 | 5,649 | 2,505 | 397 |

*Includes projected flows from USU Extension.

Use of Moab Wastewater Collection System

As discussed previously, customers outside of Moab City will only use a portion of the wastewater collection system. Following the procedure discussed above, SVW&SID’s current weighted use of the Moab Collection System is summarized in Table 4.

**Table 4
SVW&SID’s Current Weighted Use of Moab’s Collection System**

| Size (in) | Total Length (ft) | Weighted Capacity* (ft-cfs) | SVW&SID Proportional Use of Capacity | SVW&SID Weighted Capacity* | Moab Weighted Capacity* |
|--|-------------------|-----------------------------|--------------------------------------|----------------------------|-------------------------|
| 6 | 37,658 | 14,981 | 0.0% | - | 14,981 |
| 8 | 99,656 | 76,368 | 1.3% | 1,006 | 75,362 |
| 9 | 729 | 695 | 0.0% | - | 695 |
| 10 | 11,071 | 12,869 | 7.1% | 910 | 11,959 |
| 12 | 7,857 | 13,165 | 76.6% | 10,090 | 3,075 |
| 15 | 3,601 | 9,032 | 14.1% | 1,277 | 7,756 |
| 18 | 10,106 | 36,874 | 22.1% | 8,139 | 28,735 |
| 21 | 1,125 | 5,653 | 0.0% | - | 5,653 |
| 24 | 745 | 4,782 | 49.3% | 2,359 | 2,423 |
| 30 | 1,050 | 10,401 | 35.0% | 3,636 | 6,765 |
| 3 (Force Main) | 2,536 | 871 | 0.0% | - | 871 |
| 4 (Force Main) | 827 | 505 | 0.0% | - | 505 |
| Total | 176,960 | 186,197 | | 27,417 | 158,780 |
| SVW&SID Current Use of Collection System | | | | | 14.7% |
| SVW&SID Current Portion of Total Flow | | | | | 31.4% |
| SVW&SID Proportional Use of Collection System Capacity | | | | | 46.9% |

*Weighted capacity based on total length times the capacity of each pipeline at the State minimum slope. Capacity for force mains based on velocity of 7 ft/sec.

As is summarized in the table, SVW&SID only uses 14.7 percent of the collection system capacity, even though it accounts for 31.4 percent of the total flow. This means that SVW&SID’s use of the collection system is only 46.9 percent of its proportional contribution of flow.

Cost Share Model Results

Results from the cost share model are summarized in Tables 5 through 7. Tables 5 and 6 provide a summary of the percent of cost associated with each entity over time for collection and treatment costs, respectively. Table 7 provides the projected cost share for the new treatment plant assuming completion of the plant in 2018.

**Table 5
Projected Cost Share - Collection System Costs***

| Year | Moab | SVW&SID** | Septage | San Juan |
|------|-------|-----------|---------|----------|
| 2017 | 84.5% | 15.5% | 0% | 0% |
| 2022 | 82.3% | 16.3% | 0% | 1.4% |
| 2027 | 80.9% | 17.7% | 0% | 1.4% |
| 2032 | 79.7% | 18.8% | 0% | 1.4% |
| 2035 | 79.2% | 19.4% | 0% | 1.4% |

*Projected future costs are estimates based on current growth projections. Actual cost share will be recalculated as described in this memorandum based on actual system growth and development.

**Includes projected flows from USU Extension.

**Table 6
Projected Cost Share - Treatment Costs***

| Year | Moab | SVW&SID** | Septage | San Juan |
|------|-------|-----------|---------|----------|
| 2017 | 58.6% | 28.2% | 13.2% | 0% |
| 2022 | 53.6% | 29.8% | 14.0% | 2.5% |
| 2027 | 50.4% | 32.2% | 14.8% | 2.5% |
| 2032 | 47.9% | 34.3% | 15.4% | 2.5% |
| 2035 | 46.5% | 35.3% | 15.7% | 2.5% |

*Projected future costs are estimates based on current growth projections. Actual cost share will be recalculated as described in this memorandum based on actual system growth and development.

**Includes projected flows from USU Extension.

**Table 7
Projected Cost Share - Treatment Plant Construction Costs**

| Entity | Total Cost | Portion of Total |
|---------------|--------------|------------------|
| Moab | \$6,243,364 | 38.25% |
| SVW&SID | \$3,009,737 | 18.44% |
| Septage | \$2,557,307 | 15.69% |
| San Juan | \$0 | 0% |
| Future Growth | \$4,510,188 | 27.63% |
| Total | \$16,320,595 | 100% |

As can be seen in the tables, the current model shows costs slowly shifting away from Moab City and onto other users. This is the result of higher projected growth rates for development outside of the City. However, as noted above, the values contained in these tables are only projections based on estimated of future development patterns. The actual cost share between entities in future years will depend on actual system growth and may vary slightly from the results show here. In future

years, it is expected that the projections in the rate model will be replaced with actual values for each entity to more accurately calculate the appropriate cost share and corresponding rates.

Approximate Wastewater Rates

The primary focus of this memorandum has been the development of cost share calculations to divide costs between the several entities. It does include the information to perform a comprehensive rate study and calculate detail rates for each entity. However, based on information provided by each entity regarding historic rates and annual revenues, it is possible to estimate approximate monthly rates for each of the entities as shown in Tables 8. The monthly rates estimated in Table 8 take into account the initial capital investment that each entity has agreed to pay towards construction of the wastewater treatment plant and assumes securing a loan for the remaining capital costs.

**Table 8
Approximate Residential Future Wastewater Rates – Moab Portion of Bill Only**

| Year | Moab (\$/month) | SVW&SID (\$/month) | Septage (\$/gallon) |
|----------|-----------------|--------------------|---------------------|
| Historic | \$16.90 | \$7.70 | \$0.09 |
| 2020 | \$35.16 | \$14.10 | \$0.20 |
| 2025 | \$36.81 | \$14.43 | \$0.19 |
| 2030 | \$39.20 | \$15.09 | \$0.18 |
| 2035 | \$41.99 | \$16.00 | \$0.18 |

It should be emphasized that these costs are for the Moab City portion of each bill only. For Moab residents, this represents their full sewer bill. For other entities, however, there will be additional costs for the operation and maintenance of their individual collection systems.

In both of the tables, it is noted that the amount of increase from year to year is not consistent between entities. There are even decreases in some cases. This is a result of the differing growth rates between entities and their ratio of treatment plant costs to other costs. For example, in the case of septage customers, all of their costs are associated with treatment and they have a higher than average projected growth rate. As a result, the projected growth allows the initial construction costs of the plant to be distributed over an increasing number of users over time. This results in a small decrease in the cost per customer over time. Conversely, treatment costs in Moab are a much smaller portion of total costs and it has the lowest expected growth rate. This means that inflation associated with collection system and other costs overshadows any reduction in treatment plant payments and the overall rate increases gradually over time.

CONCLUSIONS AND RECOMMENDATIONS

This memorandum provides a proposed approach to sharing costs in the Moab wastewater system, including construction of a new treatment plant. It is recommended that Moab City review the proposed approach with all potential stakeholders in the treatment project to collect input and finalize the approach. This will become the basis for a final agreement between the various entities. Specific items that should be reviewed and agreed upon should include:

1. Moab continued ownership of treatment plant
2. First come, first serve policy for future capacity
3. ERU calculation policy – Both flow and treatment based

4. Use of fixed monthly charges to each entity based on flow and treatment ERUs instead of variable monthly charges based on volume and strength measurements
5. Final agreement on cash contributions toward initial treatment plant construction costs to be contributed by each entity
6. How septage will fund its required portion of treatment plant construction costs (initial payment vs. incorporated into future rates)

Once the cost share principles discussed in this memorandum are finalized and adopted, BC&A will be able to calculate specific rates for Moab City customers in greater detail.

Appendix A
ERU Calculation Memorandum



TECHNICAL MEMORANDUM # 1

TO: Rebecca Davidson
Moab City

COPIES: File

FROM: Keith Larson P.E.
Jeff Beckman P.E.
Bowen, Collins & Associates
154 East 14000 South
Draper, Utah 84020

DATE: September 21, 2016

PROJECT: Sewer Rate Study

SUBJECT: Residential Equivalent Study

INTRODUCTION

Bowen Collins & Associates (BC&A) has been retained by Moab City (City) to do a study on equivalent residential units (ERUs) for the City. An ERU is the typical water use amount for a single family residence measured in gallons per day or gallons per month. This represents the average flow and strength of wastewater for a residential connection to the City.

The purpose of this study is to create a basis for the City to relate flow from larger non-residential customers to the flow of an average residential connection or ERU. By defining the flow of all the different customer types in terms of ERUs, the City will be able to equally allocate the costs of service in the sewer system to the various system users. This memorandum examines the basis of an ERU in the City and proposes a method of ERU calculation for different customer types.

ERU DEFINITION

The definition of an ERU should be defined based on the average characteristics of a single family residential connection. Based on water use records for 2016, the average residential connection had indoor water use of approximately 4,400 gallons during the peak month of the year. Historically, the City has used an expected domestic wastewater concentration of 300 mg/L when calculating Biological Oxygen Demand (BOD) loading and 280 mg/L when calculating Total Suspended Solids (TSS) loading.

Based on this information, the following definitions and equations are proposed to calculate the number of ERUs for different customer types. To accurately reflect the impact of customers on both collection and treatment facilities, ERUs will be defined in terms of both flow and strength. Fractional ERU values are rounded up to the next whole number.

ERU Definition Based on Flow

(1) $1 \text{ ERU}_{\text{flow}} = 4,400 \text{ gal/month}$

ERU Definition Based on BOD

(2) $1 \text{ ERU}_{\text{BOD}} = 300 \text{ mg/L} \times (8.345 \times 10^{-6} \text{ lbs L/mg gal}) \times 4,400 \text{ gal/month}$

$1 \text{ ERU}_{\text{BOD}} = 11.0 \text{ lbs/month}$

ERU Definition Based on TSS

(3) $1 \text{ ERU}_{\text{TSS}} = 280 \text{ mg/L} \times (8.345 \times 10^{-6} \text{ lbs L/mg gal}) \times 4,400 \text{ gal/month}$

$1 \text{ ERU}_{\text{TSS}} = 10.3 \text{ lbs/month}$

Equation to Calculate ERU Value Based on Flow

(4) $\# \text{ of ERU}_{\text{flow}} = \frac{\text{Customer Flow gal/month}}{4,400 \text{ gal/month per RE}}$

Equation to Calculate ERU Value Based on BOD

(5) $\# \text{ of ERU}_{\text{BOD}} = \frac{\text{BOD}_{\text{conc}} \text{ mg/L} \times (8.345 \times 10^{-6}) \times \text{Cust. Flow gal/month}}{11.0 \text{ lbs/month per ERU}}$

Equation to Calculate ERU Value Based on TSS

(6) $\# \text{ of ERU}_{\text{TSS}} = \frac{\text{TSS}_{\text{conc}} \text{ mg/L} \times (8.345 \times 10^{-6}) \times \text{Customer Flow gal/month}}{10.3 \text{ lbs/month per ERU}}$

Equation to Calculate Number of Treatment ERUs Based on Cost Weighted Average of: Flow, BOD, & TSS

(7) $\# \text{ of Treatment ERU}_{\text{Wt Ave}} = (\text{ERU}_{\text{flow}} \times 33.3\%) + (\text{ERU}_{\text{BOD}} \times 33.3\%) + (\text{ERU}_{\text{TSS}} \times 33.3\%)$

The cost weighted average approach described above takes the estimated percentage spent by the City on treatment based on total flow, BOD, and TSS and calculates a weighted ERU value. For this study, costs have been divided evenly between the three categories¹.

¹ To develop a more refined estimate of actual costs would require a full cost-of-service analysis of the detailed design of the new treatment plant and its subsequent operation costs. Since this data will not be available for several years, the costs have been approximated as shown. These are believed to be relatively accurate estimates based on costs as observed at other established plants. A cost analysis of the Central Valley Water Reclamation Facility in Salt Lake City, Utah calculated costs at 30% flow, 31% BOD, and 39% TSS. A similar analysis of the Timpanogos Wastewater Treatment Plant in Pleasant Grove, Utah calculated costs at 56% flow, 24% BOD, and 20% TSS. While costs will vary from plant to plant depending on the treatment process used and the quality of wastewater being received, the estimate contained here seems reasonable in the absence of additional data.

CUSTOMER ERU CATEGORIES

Based on the City’s current customer billing types, BC&A would propose ten different customer categories for defining ERUs as identified in Table 1.

**Table 1
Proposed ERU Customer Categories**

| Customer Category | Notes |
|-------------------------------|---|
| Residential – Single Family | Includes typical single family residential along with trailers, town homes, duplexes, and large multifamily (see below). |
| Residential – Multifamily | Includes all apartments and condos up to a maximum size of 1,500 square feet per unit. All larger multifamily to be grouped with single family residential. |
| Overnight Accommodations | Any overnight accommodations with sewer service including hotels, motels, and bed & breakfasts. |
| Commercial/Retail Office | |
| Restaurant | Any business whose primary function is to prepare and serve food (including fast food). |
| Schools | |
| Gas Station/Convenience Store | |
| RV/Campground | |
| Other | Any development that is not adequately represented by one of the categories above. Could include medical, churches, car washes, laundromats, etc. |

ERU CATEGORY CALCULATIONS

For the proposed customer categories listed above, BC&A has developed a recommended definition for both Flow ERUs and Treatment ERUs as summarized in Table 2. Definitions for Flow ERUs in this table are based on historic flow data as available from 2016 water use records for Moab City customers. Flow equivalency has been based on estimated peak month indoor water use as approximated from April 2016 water use.

Because water quality data is not readily available for the various Moab City customer categories, Treatment ERUs have been based on data collected as part of a detailed water quality study completed by BC&A for Mt. Olympus Improvement District completed in 2012. Historical data used to assemble the results are contained in Appendix A.

**Table 2
Proposed ERU Definitions by Customer Category**

| Customer Type | Flow Only Definition 1 ERU = | Treatment Definition 1 ERU = |
|-------------------------------|---|---|
| Residential – Single Family | 1 residence | 1 residence |
| Residential – Multifamily | 1.8 units | 1.8 units |
| Overnight Accommodations | 1.2 units | 1.2 units |
| Commercial/Retail | 6,500 ft ² | 6,500 ft ² |
| Office | 4,000 ft ² | 4,000 ft ² |
| Restaurant | 10.6 Seats | 4.7 Seats |
| Schools | 15 Students | 15 Students |
| Gas Station/Convenience Store | 3,600 ft ² | 3,600 ft ² |
| RV/Campground | By Study | By Study |
| Other | By Study | By Study |

It is recommended that the definitions proposed in Table 2 be used to calculate the number of Flow and Treatment ERUs in the Moab, Spanish Valley Water & Sewer Improvement District, and other systems. This can be accomplished as outlined in Equation (8).

Equation to Calculate Number of ERUs Based on ERU Definition

$$(8) \text{ Number of ERUs} = \frac{\text{Customer Facility Size (ft}^2, \text{ \# seats, etc.)}}{\text{ERU Definition}}$$

Moab Historical Water Use by Customer Category (2016)

Residential – Single Family

| | Connections | Units | Quantity (Peak Month) - kgals | Peak Month Indoor Water consumption kgals | Peak Month Indoor Water consumption gpd | ERUs |
|----------------------------|-------------|-------------|-------------------------------------|---|---|---------------|
| 1 Residential | 1365 | 1368 | 6019.2 | 4.40 | 144.7 | 1368.0 |
| 2 Residential | 11 | 18 | 79.2 | 4.40 | 144.7 | 18.0 |
| Trailer Courts | 12 | 349 | 1490.5 | 4.27 | 140.4 | 338.8 |
| Trailer Court/House | 1 | 3 | 30.0 | 10.00 | 328.8 | 6.8 |
| Trailer Court/2 Apts/House | 2 | 22 | 108.0 | 4.91 | 161.4 | 24.5 |
| County Residential | 12 | 12 | 52.8 | 4.40 | 144.7 | 12.0 |
| Total | 1403 | 1772 | 7779.741787 | 4.39 | 144.3 | 1768.1 |

Residential – Multifamily

| | | | | | | |
|------------------|-----------|------------|-------------|------------|-------------|--------------|
| House/Apartments | 8 | 16 | 39.1 | 2.4 | 80.4 | 8.9 |
| Apartments | 77 | 398 | 972.9 | 2.4 | 80.4 | 221.1 |
| Total | 85 | 414 | 1012 | 2.4 | 80.4 | 230.0 |

Overnight Accommodations

| | | | | | | |
|-----------------------|-----------|--------------------|--------------------|------------|--------------|---------------|
| Hotel/Motel/B&B | 64 | 2393.1 | 8774.9 | 3.7 | 120.5 | 1994.3 |
| Bed & Breakfast 52.94 | 2 | 2 | 2.0 | 1.0 | 32.9 | 0.5 |
| Restaurant Correction | -5 | -5 | -64.9 | -13.0 | -426.7 | -14.8 |
| Total | 61 | 2390.142857 | 8711.957143 | 3.6 | 119.8 | 1980.0 |

Commercial/Retail

| | | | | | | |
|--------------------------------|------------|------------|--------------------|---------------|----------------|--------------|
| Business/House | 6 | 11 | 104.0 | 9.5 | 310.8 | 23.6 |
| Business | 138 | 138 | 3277.2 | 23.7 | 780.8 | 744.8 |
| Business - 4 month water usage | 6 | 7 | 22.3 | 3.2 | 104.6 | 5.1 |
| County Business | 1 | 1 | 6.0 | 6.0 | 197.3 | 1.4 |
| 2 Commercial | 1 | 2 | 2.0 | 1.0 | 32.9 | 0.5 |
| Restaurant Correction | -9 | -9 | -132.2 | -14.7 | -482.9 | -30.0 |
| RV/Campground Correction | -3 | -3 | -626.1 | -208.7 | -6861.4 | -142.3 |
| Total | 140 | 147 | 2653.209368 | -180.0 | -5918.0 | 603.0 |

Office

| | | | | | | |
|-----------------------|-----------|-----------|--------------|-------------|--------------|--------------|
| Office Space Rental | 24 | 24 | 556.0 | 23.2 | 761.6 | 126.4 |
| Restaurant Correction | -4 | -4 | -57.8 | -14.5 | -475.1 | -13.1 |
| Total | 20 | 20 | 498.2 | 24.9 | 819.0 | 113.2 |

Restaurant

| | | | | | | |
|--|-----------|-----------|---------------|-------------|---------------|--------------|
| Restaurant/Bar | 23 | 23 | 1461.0 | 63.5 | 2088.4 | 332.0 |
| Restaurant/Bar Billed Under Other Categories | 20 | 20 | 281.3 | 14.1 | 462.4 | 63.9 |
| Total | 43 | 43 | 1742.3 | 40.5 | 1332.1 | 396.0 |

Schools

| | | | | | | |
|-------------------------------|-----------|-----------|------------|------------|--------------|-------------|
| School | 7 | 7 | 97.0 | 13.9 | 455.6 | 22.0 |
| School - 4 month winter usage | 6 | 6 | 31.0 | 5.2 | 169.9 | 7.0 |
| Total | 13 | 13 | 128 | 9.8 | 323.7 | 29.1 |

Gas Station/Convenience Store

| | | | | | | |
|-------------------------------|----------|----------|--------------|-------------|---------------|-------------|
| Gas Station/Convenience Store | 6 | 6 | 411.4 | 68.6 | 2254.4 | 93.5 |
| Restaurant Correction | -2 | -2 | -26.4 | -13.2 | -434.0 | -6.0 |
| Total | 4 | 4 | 385.0 | 96.3 | 3164.6 | 87.5 |

RV/Campground

| | | | | | | |
|---------------------------------------|----------|----------|--------------|--------------|---------------|--------------|
| RV/Campground Billed Other Categories | 3 | 3 | 626.1 | 208.7 | 6861.4 | 142.3 |
| Total | 3 | 3 | 626.1 | 208.7 | 6861.4 | 142.3 |

Other

| | | | | | | |
|--------------------------------|-----------|-----------|------------|-------------|--------------|--------------|
| Church | 1 | 1 | 1.0 | 1.0 | 32.9 | 0.2 |
| Church - 4 months Winter Usage | 8 | 8 | 57.0 | 7.1 | 234.2 | 13.0 |
| Govt - 4 month winter usage | 3 | 3 | 10.0 | 3.3 | 109.6 | 2.3 |
| Medical Office | 4 | 4 | 21.0 | 5.3 | 172.6 | 4.8 |
| Hospital | 3 | 3 | 431.0 | 143.7 | 4723.3 | 98.0 |
| Total | 19 | 19 | 520 | 27.4 | 899.8 | 118.2 |

Totals

| | | | | | | |
|------------------------------------|-------------|--------------------|--------------------|------------|--------------|---------------|
| Residential – Single Family | 1403 | 1772 | 7779.741787 | 4.4 | 144.3 | 1768.1 |
| Other | 388 | 3053.142857 | 16276.79508 | 5.3 | 175.3 | 3699.3 |
| Total | 1791 | 4825.142857 | 24056.53687 | 5.0 | 163.9 | 5467.4 |

SVW&SID Historical Water Use by Customer Category (2016, including committed but not yet connected)

Residential – Single Family

| | Connections | Units | Quantity (Peak Month) - kgals | Peak Month Indoor Water consumption kgals | Peak Month Indoor Water consumption gpd | ERUs |
|---------------|-------------|--------|-------------------------------------|---|---|--------|
| Residential | 1851 | 1851 | 8144.4 | 4.4 | 144.7 | 1851.0 |
| Trailer Court | 8 | 112.0 | 493 | 4.4 | 144.7 | 112.0 |
| Total | 1859 | 1963.0 | 8637.4 | 4.4 | 144.7 | 1963.0 |

Residential – Multifamily

| | | | | | | |
|-------|----|-----|-----|-----|------|------|
| All | 16 | 135 | 330 | 2.4 | 80.4 | 75.0 |
| Total | 16 | 135 | 330 | 2.4 | 80.4 | 75.0 |

Overnight Accommodations

| | | | | | | |
|-------|---|-------|-----|-----|-------|-------|
| All | 6 | 135.5 | 497 | 3.7 | 120.5 | 113.0 |
| Total | 6 | 135.5 | 497 | 3.7 | 120.5 | 113.0 |

Commercial/Retail

| | | | | | | |
|-------|----|----|--------|-----|-------|------|
| All | 60 | 60 | 414.25 | 6.9 | 227.0 | 94.1 |
| Total | 60 | 60 | 414.25 | 6.9 | 227.0 | 94.1 |

Office

| | | | | | | |
|-------|----|----|-------|------|-------|------|
| All | 17 | 17 | 170.4 | 10.0 | 329.5 | 38.7 |
| Total | 17 | 17 | 170.4 | 10.0 | 329.5 | 38.7 |

Restaurant

| | | | | | | |
|-------|---|---|----|------|-------|------|
| All | 3 | 3 | 83 | 27.7 | 909.6 | 18.9 |
| Total | 3 | 3 | 83 | 27.7 | 909.6 | 18.9 |

Schools

| | | | | | | |
|-------|---|---|----|------|--------|------|
| All | 2 | 2 | 95 | 47.5 | 1561.6 | 21.6 |
| Total | 2 | 2 | 95 | 47.5 | 1561.6 | 21.6 |

Gas Station/Convenience Store

| | | | | | | |
|-------|---|---|-----|-------|--------|------|
| All | 3 | 3 | 410 | 136.7 | 4493.2 | 93.2 |
| Total | 3 | 3 | 410 | 136.7 | 4493.2 | 93.2 |

RV/Campground

| | | | | | | |
|-------|---|-----|-----|-----|------|-------|
| All | 7 | 430 | 938 | 2.2 | 71.7 | 213.2 |
| Total | 7 | 430 | 938 | 2.2 | 71.7 | 213.2 |

Other

| | | | | | | |
|-------|----|----|-------|------|-------|------|
| All | 25 | 25 | 334.6 | 13.4 | 440.0 | 76.0 |
| Total | 25 | 25 | 334.6 | 13.4 | 440.0 | 76.0 |

Totals

| | | | | | | |
|-----------------------------|------|-------------|----------|-----|-------|--------|
| Residential – Single Family | 1859 | 1963.045455 | 8637.4 | 4.4 | 144.7 | 1963.0 |
| Other | 139 | 810.5454545 | 3272.25 | 4.0 | 132.7 | 743.7 |
| Total Connections | 1998 | 2773.590909 | 11909.65 | 4.3 | 141.2 | 2706.7 |

Appendix B
Cost Share Model

Moab City Wastewater System - Cost Share Model

| | Projected Year | | | | | | | | | | | | | | | | | | | | |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | FYE 2015 | FYE 2016 | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 | FYE 2023 | FYE 2024 | FYE 2025 | FYE 2026 | FYE 2027 | FYE 2028 | FYE 2029 | FYE 2030 | FYE 2031 | FYE 2032 | FYE 2033 | FYE 2034 | FYE 2035 |
| Moab Sewer Flows (MGD) | 0.77 | 0.78 | 0.79 | 0.80 | 0.81 | 0.82 | 0.83 | 0.84 | 0.85 | 0.85 | 0.86 | 0.87 | 0.88 | 0.89 | 0.90 | 0.91 | 0.92 | 0.93 | 0.94 | 0.95 | 0.96 |
| GWSSA Sewer Flows (MGD) | 0.38 | 0.38 | 0.39 | 0.40 | 0.41 | 0.42 | 0.42 | 0.43 | 0.44 | 0.45 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | 0.51 | 0.52 | 0.53 | 0.54 | 0.55 | 0.56 |
| USU Sewer Flows (MGD) | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 | 0.11 | 0.12 | 0.13 | 0.14 | 0.15 | 0.16 | 0.166175 |
| San Juan Sewer Flows (MGD) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Septage Sewer Flows (MGD) | 0.004992 | 0.005244 | 0.005496 | 0.005748 | 0.006000 | 0.006252 | 0.006504 | 0.006756 | 0.007009 | 0.007261 | 0.007513 | 0.007765 | 0.008017 | 0.008269 | 0.008521 | 0.008773 | 0.009025 | 0.009277 | 0.009529 | 0.009781 | 0.010033 |
| Committed Sewer Flows - Peak Month, Ave. Day (MGD) | 1.16 | 1.17 | 1.19 | 1.21 | 1.23 | 1.30 | 1.33 | 1.35 | 1.38 | 1.41 | 1.44 | 1.47 | 1.50 | 1.53 | 1.56 | 1.59 | 1.62 | 1.66 | 1.69 | 1.72 | 1.75 |
| Moab Flow ERUs | 5,349 | 5,408 | 5,467 | 5,527 | 5,588 | 5,649 | 5,712 | 5,774 | 5,838 | 5,902 | 5,967 | 6,033 | 6,099 | 6,166 | 6,234 | 6,303 | 6,372 | 6,442 | 6,513 | 6,584 | 6,657 |
| GWSSA Flow ERUs | 2,602 | 2,654 | 2,707 | 2,761 | 2,816 | 2,873 | 2,930 | 2,989 | 3,049 | 3,109 | 3,172 | 3,235 | 3,300 | 3,366 | 3,433 | 3,502 | 3,572 | 3,643 | 3,716 | 3,790 | 3,866 |
| USU Flow ERUs | 0 | 0 | 0 | 0 | 68 | 135 | 203 | 270 | 338 | 405 | 473 | 540 | 608 | 675 | 743 | 810 | 878 | 945 | 1,013 | 1,080 | 1,148 |
| San Juan Flow ERUs | 0 | 0 | 0 | 0 | 0 | 265 | 271 | 277 | 283 | 289 | 295 | 301 | 308 | 314 | 321 | 328 | 335 | 342 | 350 | 357 | 365 |
| Septage Flow ERUs | 34 | 36 | 38 | 40 | 41 | 43 | 45 | 47 | 48 | 50 | 52 | 54 | 55 | 57 | 59 | 61 | 62 | 64 | 66 | 68 | 69 |
| Total Flow ERUs | 7,985 | 8,098 | 8,212 | 8,328 | 8,513 | 8,966 | 9,160 | 9,357 | 9,555 | 9,756 | 9,958 | 10,163 | 10,370 | 10,579 | 10,790 | 11,003 | 11,219 | 11,437 | 11,657 | 11,880 | 12,105 |
| Moab Treatment ERUs | 5,975 | 6,041 | 6,107 | 6,174 | 6,242 | 6,311 | 6,380 | 6,450 | 6,521 | 6,593 | 6,666 | 6,739 | 6,813 | 6,888 | 6,964 | 7,040 | 7,118 | 7,196 | 7,275 | 7,355 | 7,436 |
| GWSSA Treatment ERUs | 2,830 | 2,886 | 2,944 | 3,003 | 3,063 | 3,124 | 3,187 | 3,250 | 3,315 | 3,382 | 3,449 | 3,518 | 3,589 | 3,660 | 3,734 | 3,808 | 3,885 | 3,962 | 4,041 | 4,122 | 4,205 |
| USU Treatment ERUs | 0 | 0 | 0 | 0 | 85 | 170 | 255 | 340 | 425 | 510 | 595 | 680 | 765 | 850 | 935 | 1,020 | 1,105 | 1,190 | 1,275 | 1,360 | 1,445 |
| San Juan Treatment ERUs | 0 | 0 | 0 | 0 | 0 | 288 | 295 | 301 | 307 | 314 | 321 | 328 | 335 | 342 | 349 | 357 | 364 | 372 | 380 | 388 | 397 |
| Septage Treatment ERUs | 1,246 | 1,309 | 1,372 | 1,435 | 1,498 | 1,561 | 1,624 | 1,687 | 1,750 | 1,813 | 1,876 | 1,939 | 2,002 | 2,065 | 2,127 | 2,190 | 2,253 | 2,316 | 2,379 | 2,442 | 2,505 |
| Total Treatment ERUs | 10,051 | 10,236 | 10,423 | 10,612 | 10,888 | 11,454 | 11,740 | 12,029 | 12,319 | 12,611 | 12,906 | 13,203 | 13,503 | 13,805 | 14,109 | 14,416 | 14,725 | 15,037 | 15,351 | 15,668 | 15,987 |
| Moab Growth Rate | - | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% |
| GWSSA Growth Rate | - | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% | 2.0% |
| USU Growth Rate | - | NA | NA | NA | #DIV/0! | 100.0% | 50.0% | 33.3% | 25.0% | 20.0% | 16.7% | 14.3% | 12.5% | 11.1% | 10.0% | 9.1% | 8.3% | 7.7% | 7.1% | 6.7% | 6.3% |
| San Juan Growth Rate | - | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% | 2.1% |
| Septage Growth Rate | - | 5.0% | 4.8% | 4.6% | 4.4% | 4.2% | 4.0% | 3.9% | 3.7% | 3.6% | 3.5% | 3.4% | 3.2% | 3.1% | 3.0% | 3.0% | 2.9% | 2.8% | 2.7% | 2.6% | 2.6% |
| Overall % Growth from Previous Year | - | 1.41% | 1.41% | 1.41% | 2.22% | 5.31% | 2.17% | 2.15% | 2.12% | 2.10% | 2.08% | 2.06% | 2.03% | 2.02% | 2.00% | 1.98% | 1.96% | 1.94% | 1.93% | 1.91% | 1.90% |
| Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$210,000 | \$217,781 | \$401,000 | \$415,863 | \$432,965 | \$457,454 | \$476,141 | \$495,532 | \$515,654 | \$536,534 | \$558,201 | \$580,683 | \$604,011 | \$628,217 | \$653,333 | \$679,393 | \$706,433 | \$734,489 | \$763,598 | \$793,801 | \$825,137 |
| O&M - Treatment | \$315,000 | \$327,353 | \$583,000 | \$720,775 | \$751,768 | \$793,870 | \$827,597 | \$862,581 | \$898,869 | \$936,509 | \$975,550 | \$1,016,045 | \$1,058,048 | \$1,101,615 | \$1,146,802 | \$1,193,670 | \$1,242,281 | \$1,292,699 | \$1,344,991 | \$1,399,225 | \$1,455,473 |
| Capital Expenditures - Collection (R&R) | \$492,325 | \$512,673 | \$450,000 | \$463,500 | \$477,405 | \$491,727 | \$506,479 | \$521,673 | \$537,324 | \$553,443 | \$570,047 | \$587,148 | \$604,762 | \$622,905 | \$641,592 | \$660,840 | \$680,665 | \$701,085 | \$722,118 | \$743,781 | \$766,095 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$83,891 | \$85,067 | \$122,043 | \$263,813 | \$127,503 | \$128,818 | \$130,153 | \$131,509 | \$132,886 | \$134,285 | \$135,707 | \$137,150 | \$138,617 | \$140,106 | \$141,620 | \$143,157 | \$144,719 | \$146,305 | \$147,917 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$14,200,000 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | (\$14,200,000) | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 |
| Total Expenditures | \$1,017,325 | \$1,057,807 | \$1,517,891 | \$2,484,039 | \$2,583,015 | \$2,805,698 | \$2,736,554 | \$2,807,438 | \$2,880,834 | \$2,956,829 | \$3,035,518 | \$3,116,996 | \$3,201,362 | \$3,288,721 | \$3,379,178 | \$3,472,844 | \$3,569,833 | \$3,670,264 | \$3,774,260 | \$3,881,947 | \$3,993,457 |
| Allocation of Collection Costs | | | | | | | | | | | | | | | | | | | | | |
| Moab | 84.7% | 84.6% | 84.5% | 84.5% | 84.1% | 82.9% | 82.6% | 82.3% | 82.0% | 81.7% | 81.5% | 81.2% | 80.9% | 80.7% | 80.5% | 80.2% | 80.0% | 79.8% | 79.6% | 79.4% | 79.2% |
| GWSSA (Including USU) | 15.3% | 15.4% | 15.5% | 15.5% | 15.9% | 15.7% | 16.0% | 16.3% | 16.6% | 16.9% | 17.2% | 17.4% | 17.7% | 17.9% | 18.1% | 18.4% | 18.6% | 18.8% | 19.0% | 19.2% | 19.4% |
| San Juan | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% |
| Septage | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Total | 100% |
| Allocation of Treatment Costs | | | | | | | | | | | | | | | | | | | | | |
| Moab | 59.4% | 59.0% | 58.6% | 58.2% | 57.3% | 55.1% | 54.3% | 53.6% | 52.9% | 52.3% | 51.6% | 51.0% | 50.5% | 49.9% | 49.4% | 48.8% | 48.3% | 47.9% | 47.4% | 46.9% | 46.5% |
| GWSSA (Including USU) | 28.2% | 28.2% | 28.2% | 28.3% | 28.9% | 28.8% | 29.3% | 29.8% | 30.4% | 30.9% | 31.3% | 31.8% | 32.2% | 32.7% | 33.1% | 33.5% | 33.9% | 34.3% | 34.6% | 35.0% | 35.3% |
| San Juan | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% |
| Septage | 12.4% | 12.8% | 13.2% | 13.5% | 13.8% | 13.6% | 13.8% | 14.0% | 14.2% | 14.4% | 14.5% | 14.7% | 14.8% | 15.0% | 15.1% | 15.2% | 15.3% | 15.4% | 15.5% | 15.6% | 15.7% |
| Total Costs | 100% |

Moab City Wastewater System - Cost Share Model

| | Projected Year | | | | | | | | | | | | | | | | | | | | |
|---|------------------|------------------|--------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | FYE 2015 | FYE 2016 | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 | FYE 2023 | FYE 2024 | FYE 2025 | FYE 2026 | FYE 2027 | FYE 2028 | FYE 2029 | FYE 2030 | FYE 2031 | FYE 2032 | FYE 2033 | FYE 2034 | FYE 2035 |
| Moab Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$177,926 | \$184,325 | \$339,040 | \$351,234 | \$364,216 | \$379,177 | \$393,213 | \$407,764 | \$422,849 | \$438,487 | \$454,699 | \$471,503 | \$488,924 | \$506,981 | \$525,699 | \$545,102 | \$565,213 | \$586,060 | \$607,667 | \$630,064 | \$653,278 |
| O&M - Treatment | \$187,254 | \$193,177 | \$341,580 | \$419,345 | \$430,983 | \$437,379 | \$449,746 | \$462,561 | \$475,837 | \$489,589 | \$503,831 | \$518,579 | \$533,850 | \$549,660 | \$566,027 | \$582,968 | \$600,503 | \$618,651 | \$637,433 | \$656,869 | \$676,981 |
| Capital Expenditures - Collection (R&R) | \$417,130 | \$433,915 | \$380,469 | \$391,468 | \$401,600 | \$407,585 | \$418,267 | \$429,275 | \$440,619 | \$452,306 | \$464,348 | \$476,753 | \$489,532 | \$502,695 | \$516,253 | \$530,216 | \$544,597 | \$559,407 | \$574,658 | \$590,362 | \$606,533 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$83,891 | \$85,067 | \$122,043 | \$263,813 | \$127,503 | \$128,818 | \$130,153 | \$131,509 | \$132,886 | \$134,285 | \$135,707 | \$137,150 | \$138,617 | \$140,106 | \$141,620 | \$143,157 | \$144,719 | \$146,305 | \$147,917 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$4,922,769 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | (\$4,922,769) | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 | \$299,038 |
| Total Moab Expenditures | \$782,309 | \$811,417 | \$1,144,979 | \$1,546,151 | \$1,617,881 | \$1,786,992 | \$1,687,767 | \$1,727,456 | \$1,768,496 | \$1,810,930 | \$1,854,802 | \$1,900,160 | \$1,947,051 | \$1,995,525 | \$2,045,633 | \$2,097,430 | \$2,150,971 | \$2,206,313 | \$2,263,515 | \$2,322,639 | \$2,383,748 |
| GWSSA Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$32,074 | \$33,456 | \$61,960 | \$64,629 | \$68,748 | \$71,934 | \$76,328 | \$80,899 | \$85,655 | \$90,604 | \$95,753 | \$101,111 | \$106,686 | \$112,486 | \$118,521 | \$124,799 | \$131,332 | \$138,128 | \$145,199 | \$152,554 | \$160,207 |
| O&M - Treatment | \$88,683 | \$92,303 | \$164,665 | \$203,953 | \$217,347 | \$228,308 | \$242,605 | \$257,467 | \$272,920 | \$288,986 | \$305,693 | \$323,067 | \$341,135 | \$359,925 | \$379,468 | \$399,793 | \$420,934 | \$442,922 | \$465,792 | \$489,581 | \$514,323 |
| Capital Expenditures - Collection (R&R) | \$75,195 | \$78,758 | \$69,531 | \$72,032 | \$75,805 | \$77,324 | \$81,191 | \$85,166 | \$89,254 | \$93,459 | \$97,785 | \$102,237 | \$106,818 | \$111,535 | \$116,391 | \$121,391 | \$126,542 | \$131,846 | \$137,311 | \$142,942 | \$148,743 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$2,209,737 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | (\$2,209,737) | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 | \$102,207 |
| Total GWSSA Expenditures | \$195,953 | \$204,518 | \$296,157 | \$442,821 | \$464,107 | \$479,774 | \$502,331 | \$525,740 | \$550,036 | \$575,257 | \$601,439 | \$628,622 | \$656,846 | \$686,153 | \$716,587 | \$748,191 | \$781,014 | \$815,104 | \$850,510 | \$887,284 | \$925,480 |
| San Juan Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$0 | \$0 | \$0 | \$0 | \$0 | \$6,343 | \$6,600 | \$6,869 | \$7,150 | \$7,443 | \$7,749 | \$8,068 | \$8,402 | \$8,749 | \$9,113 | \$9,492 | \$9,888 | \$10,301 | \$10,732 | \$11,182 | \$11,653 |
| O&M - Treatment | \$0 | \$0 | \$0 | \$0 | \$0 | \$19,990 | \$20,768 | \$21,581 | \$22,430 | \$23,317 | \$24,244 | \$25,212 | \$26,223 | \$27,279 | \$28,382 | \$29,534 | \$30,737 | \$31,993 | \$33,306 | \$34,676 | \$36,108 |
| Capital Expenditures - Collection (R&R) | \$0 | \$0 | \$0 | \$0 | \$0 | \$6,818 | \$7,021 | \$7,232 | \$7,451 | \$7,678 | \$7,913 | \$8,158 | \$8,412 | \$8,675 | \$8,949 | \$9,233 | \$9,527 | \$9,832 | \$10,149 | \$10,478 | \$10,819 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Total San Juan Expenditures | \$0 | \$0 | \$0 | \$0 | \$0 | \$33,151 | \$34,390 | \$35,682 | \$37,031 | \$38,438 | \$39,906 | \$41,438 | \$43,036 | \$44,704 | \$46,443 | \$48,258 | \$50,151 | \$52,126 | \$54,187 | \$56,337 | \$58,579 |
| Septage Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| O&M - Treatment | \$39,063 | \$41,873 | \$76,755 | \$97,478 | \$103,438 | \$108,193 | \$114,478 | \$120,972 | \$127,682 | \$134,616 | \$141,782 | \$149,188 | \$156,841 | \$164,751 | \$172,926 | \$181,376 | \$190,108 | \$199,133 | \$208,460 | \$218,099 | \$228,061 |
| Capital Expenditures - Collection (R&R) | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$2,557,307 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | (\$2,557,307) | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 | \$143,864 |
| Total Septage Expenditures | \$39,063 | \$41,873 | \$76,755 | \$241,341 | \$247,302 | \$252,057 | \$258,342 | \$264,836 | \$271,546 | \$278,480 | \$285,646 | \$293,051 | \$300,705 | \$308,615 | \$316,790 | \$325,239 | \$333,972 | \$342,996 | \$352,324 | \$361,963 | \$371,925 |
| Future Growth Expenditures | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| O&M - Treatment | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Collection (R&R) | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Collection Expansion | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Capital Expenditures - Treatment | \$0 | \$0 | \$4,510,188 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Debt Service | \$0 | \$0 | (\$4,510,188) | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 |
| Total Future Growth Expenditures | \$0 | \$0 | \$0 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 |
| Check: Expenditures = Total? | \$0 | \$0 | \$0 | \$0 | \$0 | (\$0) | \$0 | \$0 | (\$0) | \$0 | \$0 | (\$0) | (\$0) | \$0 |
| Impact Fees (Moab) | | | | | | | | | | | | | | | | | | | | | |
| Income - Collection | \$ - | \$ - | \$ 83,891 | \$ 85,067 | \$ 122,043 | \$ 263,813 | \$ 127,503 | \$ 128,818 | \$ 130,153 | \$ 131,509 | \$ 132,886 | \$ 134,285 | \$ 135,707 | \$ 137,150 | \$ 138,617 | \$ 140,106 | \$ 141,620 | \$ 143,157 | \$ 144,719 | \$ 146,305 | \$ 147,917 |
| Income - Treatment | \$ 37,864 | \$ 37,864 | \$ 104,678 | \$ 106,427 | \$ 205,960 | \$ 539,535 | \$ 216,737 | \$ 218,767 | \$ 220,834 | \$ 222,938 | \$ 225,081 | \$ 227,263 | \$ 229,485 | \$ 231,747 | \$ 234,050 | \$ 236,396 | \$ 238,784 | \$ 241,216 | \$ 243,693 | \$ 246,214 | \$ 248,782 |
| Expenditures - Collection | \$0 | \$0 | \$ 83,891 | \$ 85,067 | \$ 122,043 | \$ 263,813 | \$ 127,503 | \$ 128,818 | \$ 130,153 | \$ 131,509 | \$ 132,886 | \$ 134,285 | \$ 135,707 | \$ 137,150 | \$ 138,617 | \$ 140,106 | \$ 141,620 | \$ 143,157 | \$ 144,719 | \$ 146,305 | \$ 147,917 |
| Expenditures - Treatment | \$0 | \$0 | \$0 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 | \$253,725 |
| Net Impact Fees | \$ - | \$ - | \$ 104,678 | \$ (147,297) | \$ (47,765) | \$ 285,810 | \$ (36,988) | \$ (34,958) | \$ (32,891) | \$ (30,786) | \$ (28,644) | \$ (26,462) | \$ (24,240) | \$ (21,978) | \$ (19,674) | \$ (17,329) | \$ (14,941) | \$ (12,509) | \$ (10,032) | \$ (7,510) | \$ (4,942) |

Moab City Wastewater System - Cost Share Model

| | Projected Year | | | | | | | | | | | | | | | | | | | | |
|---|----------------|----------------|----------------|----------------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | FYE 2015 | FYE 2016 | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 | FYE 2023 | FYE 2024 | FYE 2025 | FYE 2026 | FYE 2027 | FYE 2028 | FYE 2029 | FYE 2030 | FYE 2031 | FYE 2032 | FYE 2033 | FYE 2034 | FYE 2035 |
| Cost Per ERU | | | | | | | | | | | | | | | | | | | | | |
| Moab | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$33.27 | \$34.09 | \$62.02 | \$63.55 | \$65.18 | \$67.12 | \$68.85 | \$70.62 | \$72.43 | \$74.29 | \$76.20 | \$78.16 | \$80.16 | \$82.22 | \$84.33 | \$86.49 | \$88.70 | \$90.98 | \$93.30 | \$95.69 | \$98.14 |
| O&M - Treatment | \$31.34 | \$31.98 | \$55.93 | \$67.92 | \$69.04 | \$69.31 | \$70.49 | \$71.71 | \$72.97 | \$74.26 | \$75.59 | \$76.95 | \$78.36 | \$79.80 | \$81.28 | \$82.80 | \$84.37 | \$85.97 | \$87.62 | \$89.31 | \$91.04 |
| Capital Expenditures - Collection (R&R) | \$77.99 | \$80.24 | \$69.59 | \$70.83 | \$71.87 | \$72.15 | \$73.23 | \$74.34 | \$75.48 | \$76.63 | \$77.82 | \$79.03 | \$80.26 | \$81.53 | \$82.81 | \$84.13 | \$85.47 | \$86.84 | \$88.24 | \$89.66 | \$91.11 |
| Capital Expenditures - Collection Expansion | \$0.00 | \$0.00 | \$15.34 | \$15.39 | \$21.84 | \$46.70 | \$22.32 | \$22.31 | \$22.29 | \$22.28 | \$22.27 | \$22.26 | \$22.25 | \$22.24 | \$22.24 | \$22.23 | \$22.23 | \$22.22 | \$22.22 | \$22.22 | \$22.22 |
| Capital Expenditures - Treatment | \$0.00 | \$0.00 | \$806.09 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Debt Service | \$0.00 | \$0.00 | (\$806.09) | \$48.43 | \$47.91 | \$47.39 | \$46.87 | \$46.36 | \$45.86 | \$45.36 | \$44.86 | \$44.38 | \$43.89 | \$43.41 | \$42.94 | \$42.48 | \$42.01 | \$41.56 | \$41.10 | \$40.66 | \$40.21 |
| Net Impact Fees | \$0.00 | \$0.00 | (\$17.14) | \$23.86 | \$7.65 | (\$45.29) | \$5.80 | \$5.42 | \$5.04 | \$4.67 | \$4.30 | \$3.93 | \$3.56 | \$3.19 | \$2.83 | \$2.46 | \$2.10 | \$1.74 | \$1.38 | \$1.02 | \$0.66 |
| Total Moab Expenditures | \$143 | \$146 | \$186 | \$290 | \$283 | \$257 | \$288 | \$291 | \$294 | \$297 | \$301 | \$305 | \$308 | \$312 | \$316 | \$321 | \$325 | \$329 | \$334 | \$339 | \$343 |
| GWSSA | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$12.33 | \$12.61 | \$22.89 | \$23.41 | \$23.84 | \$23.92 | \$24.36 | \$24.82 | \$25.30 | \$25.78 | \$26.27 | \$26.78 | \$27.30 | \$27.84 | \$28.38 | \$28.94 | \$29.52 | \$30.10 | \$30.70 | \$31.32 | \$31.95 |
| O&M - Treatment | \$31.34 | \$31.98 | \$55.93 | \$67.92 | \$69.04 | \$69.31 | \$70.49 | \$71.71 | \$72.97 | \$74.26 | \$75.59 | \$76.95 | \$78.36 | \$79.80 | \$81.28 | \$82.80 | \$84.37 | \$85.97 | \$87.62 | \$89.31 | \$91.04 |
| Capital Expenditures - Collection (R&R) | \$28.90 | \$29.68 | \$25.69 | \$26.09 | \$26.29 | \$25.71 | \$25.92 | \$26.13 | \$26.36 | \$26.59 | \$26.83 | \$27.08 | \$27.34 | \$27.60 | \$27.87 | \$28.15 | \$28.44 | \$28.73 | \$29.04 | \$29.35 | \$29.67 |
| Capital Expenditures - Collection Expansion | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Capital Expenditures - Treatment | \$0.00 | \$0.00 | \$750.59 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Debt Service | \$0.00 | \$0.00 | (\$750.59) | \$34.04 | \$32.47 | \$31.03 | \$29.70 | \$28.47 | \$27.33 | \$26.26 | \$25.27 | \$24.35 | \$23.48 | \$22.66 | \$21.89 | \$21.17 | \$20.49 | \$19.84 | \$19.23 | \$18.64 | \$18.09 |
| Total GWSSA Expenditures | \$73 | \$74 | \$105 | \$151 | \$152 | \$150 | \$150 | \$151 | \$152 | \$153 | \$154 | \$155 | \$156 | \$158 | \$159 | \$161 | \$163 | \$165 | \$167 | \$169 | \$171 |
| San Juan | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$23.92 | \$24.36 | \$24.82 | \$25.30 | \$25.78 | \$26.27 | \$26.78 | \$27.30 | \$27.84 | \$28.38 | \$28.94 | \$29.52 | \$30.10 | \$30.70 | \$31.32 | \$31.95 |
| O&M - Treatment | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$69.31 | \$70.49 | \$71.71 | \$72.97 | \$74.26 | \$75.59 | \$76.95 | \$78.36 | \$79.80 | \$81.28 | \$82.80 | \$84.37 | \$85.97 | \$87.62 | \$89.31 | \$91.04 |
| Capital Expenditures - Collection (R&R) | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$25.71 | \$25.92 | \$26.13 | \$26.36 | \$26.59 | \$26.83 | \$27.08 | \$27.34 | \$27.60 | \$27.87 | \$28.15 | \$28.44 | \$28.73 | \$29.04 | \$29.35 | \$29.67 |
| Capital Expenditures - Collection Expansion | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Capital Expenditures - Treatment | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Debt Service | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Total San Juan Expenditures | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$119 | \$121 | \$123 | \$125 | \$127 | \$129 | \$131 | \$133 | \$135 | \$138 | \$140 | \$142 | \$145 | \$147 | \$150 | \$153 |
| Septage | | | | | | | | | | | | | | | | | | | | | |
| O&M - Collection | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| O&M - Treatment | \$31.34 | \$31.98 | \$55.93 | \$67.92 | \$69.04 | \$69.31 | \$70.49 | \$71.71 | \$72.97 | \$74.26 | \$75.59 | \$76.95 | \$78.36 | \$79.80 | \$81.28 | \$82.80 | \$84.37 | \$85.97 | \$87.62 | \$89.31 | \$91.04 |
| Capital Expenditures - Collection (R&R) | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Capital Expenditures - Collection Expansion | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Capital Expenditures - Treatment | \$0.00 | \$0.00 | \$1,863.56 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Debt Service | \$0.00 | \$0.00 | (\$1,863.56) | \$100.24 | \$96.03 | \$92.16 | \$88.59 | \$85.28 | \$82.21 | \$79.36 | \$76.70 | \$74.21 | \$71.87 | \$69.68 | \$67.62 | \$65.68 | \$63.84 | \$62.11 | \$60.47 | \$58.91 | \$57.43 |
| Total Septage Expenditures | \$31 | \$32 | \$56 | \$168 | \$165 | \$161 | \$159 | \$157 | \$155 | \$154 | \$152 | \$151 | \$150 | \$149 | \$149 | \$148 | \$148 | \$148 | \$148 | \$148 | \$148 |
| Cost Per ERU/month | | | | | | | | | | | | | | | | | | | | | |
| Moab | \$ 11.88 | \$ 12.19 | \$ 15.48 | \$ 24.16 | \$ 23.62 | \$ 21.45 | \$ 23.96 | \$ 24.23 | \$ 24.51 | \$ 24.79 | \$ 25.09 | \$ 25.39 | \$ 25.71 | \$ 26.03 | \$ 26.37 | \$ 26.72 | \$ 27.07 | \$ 27.44 | \$ 27.82 | \$ 28.21 | \$ 28.62 |
| GWSSA | \$ 6.05 | \$ 6.19 | \$ 8.71 | \$ 12.62 | \$ 12.64 | \$ 12.50 | \$ 12.54 | \$ 12.59 | \$ 12.66 | \$ 12.74 | \$ 12.83 | \$ 12.93 | \$ 13.04 | \$ 13.16 | \$ 13.29 | \$ 13.42 | \$ 13.57 | \$ 13.72 | \$ 13.88 | \$ 14.05 | \$ 14.23 |
| San Juan | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | \$ 9.91 | \$ 10.06 | \$ 10.22 | \$ 10.39 | \$ 10.55 | \$ 10.72 | \$ 10.90 | \$ 11.08 | \$ 11.27 | \$ 11.46 | \$ 11.66 | \$ 11.86 | \$ 12.07 | \$ 12.28 | \$ 12.50 | \$ 12.72 |
| Septage Cost Per Gallon | | | | | | | | | | | | | | | | | | | | | |
| Septage | \$ 0.033 | \$ 0.034 | \$ 0.060 | \$ 0.180 | \$ 0.202 | \$ 0.197 | \$ 0.194 | \$ 0.191 | \$ 0.188 | \$ 0.186 | \$ 0.183 | \$ 0.182 | \$ 0.180 | \$ 0.179 | \$ 0.177 | \$ 0.176 | \$ 0.176 | \$ 0.175 | \$ 0.175 | \$ 0.174 | \$ 0.174 |
| Average Cost Per Resident/Month - Note: These are approximate values only based on historic report of average residential costs. Actual rates will be calculated as part of the detailed rate study. | | | | | | | | | | | | | | | | | | | | | |
| Moab | \$17.43 | \$ 17.89 | \$ 22.71 | \$ 35.46 | \$ 34.66 | \$ 31.47 | \$ 35.16 | \$ 35.55 | \$ 35.96 | \$ 36.37 | \$ 36.81 | \$ 37.26 | \$ 37.72 | \$ 38.20 | \$ 38.69 | \$ 39.20 | \$ 39.72 | \$ 40.26 | \$ 40.82 | \$ 41.40 | \$ 41.99 |
| GWSSA | \$6.80 | \$ 6.96 | \$ 9.79 | \$ 14.19 | \$ 14.21 | \$ 14.05 | \$ 14.10 | \$ 14.16 | \$ 14.24 | \$ 14.33 | \$ 14.43 | \$ 14.54 | \$ 14.66 | \$ 14.80 | \$ 14.94 | \$ 15.09 | \$ 15.26 | \$ 15.43 | \$ 15.61 | \$ 15.80 | \$ 16.00 |

APPENDIX B
PROJECTED NON-RATE REVENUE
AND REVENUE REQUIREMENTS

Table B1
Moab City - Sewer Rate Study
Non-Rate Revenue (Including Impact Fees)

Assumed Inflation Rate = 3.0%

| Item | Projected FYE 2017 | Projected FYE 2018 | Projected FYE 2019 | Projected FYE 2020 | Projected FYE 2021 | Projected FYE 2022 |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <i>Operations Non-Rate Revenue</i> | | | | | | |
| GWSSA Sewer Sales | \$296,157 | \$442,821 | \$464,107 | \$512,925 | \$536,720 | \$561,422 |
| Special Services | \$1,500 | \$1,562 | \$1,626 | \$1,692 | \$1,762 | \$1,834 |
| Septage Sales | \$76,755 | \$241,341 | \$247,302 | \$252,057 | \$258,342 | \$264,836 |
| Sewer Connections | \$8,000 | \$8,328 | \$8,669 | \$9,025 | \$9,395 | \$9,780 |
| Total Operations Non-Rate Revenue | \$382,412 | \$694,052 | \$721,704 | \$775,699 | \$806,219 | \$837,871 |
| <i>Non-Operations Non-Rate Revenue</i> | | | | | | |
| Impact Fees | \$188,569 | \$191,494 | \$328,003 | \$402,869 | \$410,987 | \$414,332 |
| Finance Charges & Other Income | \$22,400 | \$23,318 | \$24,274 | \$25,270 | \$26,306 | \$27,384 |
| Total Non-Operations Non-Rate Revenue | \$210,969 | \$214,813 | \$352,278 | \$428,138 | \$437,293 | \$441,716 |
| Total Non-Rate Revenue | \$593,381 | \$908,865 | \$1,073,982 | \$1,203,837 | \$1,243,511 | \$1,279,587 |

Table B2
Moab City - Sewer Rate Study
Revenue Requirements
Cash Basis

| Item | Projected FYE 2017 | Projected FYE 2018 | Projected FYE 2019 | Projected FYE 2020 | Projected FYE 2021 | Projected FYE 2022 |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <i>Sewer Treatment Expenses</i> | | | | | | |
| General | \$190,000 | \$196,745 | \$203,729 | \$210,962 | \$218,451 | \$226,206 |
| Salaries & Wages | \$138,579 | \$193,499 | \$200,368 | \$207,481 | \$214,846 | \$222,473 |
| Employee Benefits | \$104,702 | \$123,419 | \$127,800 | \$132,337 | \$137,035 | \$141,900 |
| Overtime | \$8,000 | \$8,284 | \$8,578 | \$8,883 | \$9,198 | \$9,524 |
| Subscriptions & Memberships | \$4,600 | \$4,763 | \$4,932 | \$5,107 | \$5,289 | \$5,477 |
| Travel | \$2,500 | \$2,589 | \$2,681 | \$2,776 | \$2,874 | \$2,976 |
| Office Expenses & Supplies | \$2,000 | \$2,071 | \$2,145 | \$2,221 | \$2,299 | \$2,381 |
| Equipment Supplies & Maintenance | \$50,500 | \$52,293 | \$54,149 | \$56,071 | \$58,062 | \$60,123 |
| Building Supplies & Maintenance | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| Utilities & Telephone | \$57,700 | \$109,748 | \$113,644 | \$117,679 | \$121,856 | \$126,182 |
| Equipment & Property Rental | \$2,500 | \$2,589 | \$2,681 | \$2,776 | \$2,874 | \$2,976 |
| Fuel | \$12,000 | \$12,426 | \$12,867 | \$13,324 | \$13,797 | \$14,287 |
| Shipping/Freight | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| <i>Sewer Collections Expenses</i> | | | | | | |
| Capital Lease | \$21,600 | \$22,367 | \$23,161 | \$23,983 | \$24,834 | \$25,716 |
| Salaries & Wages | \$139,798 | \$144,761 | \$149,900 | \$155,221 | \$160,732 | \$166,438 |
| Employee Benefits | \$95,910 | \$99,315 | \$102,840 | \$106,491 | \$110,272 | \$114,186 |
| Overtime | \$6,000 | \$6,213 | \$6,434 | \$6,662 | \$6,898 | \$7,143 |
| Subscriptions & Memberships | \$1,560 | \$1,615 | \$1,673 | \$1,732 | \$1,794 | \$1,857 |
| Travel | \$2,700 | \$2,796 | \$2,895 | \$2,998 | \$3,104 | \$3,215 |
| Office Expenses & Supplies | \$1,500 | \$1,553 | \$1,608 | \$1,665 | \$1,725 | \$1,786 |
| Equipment Supplies & Maintenance | \$30,000 | \$31,065 | \$32,168 | \$33,310 | \$34,492 | \$35,717 |
| Building Supplies & Maintenance | \$2,000 | \$2,071 | \$2,145 | \$2,221 | \$2,299 | \$2,381 |
| Utilities & Telephone | \$6,100 | \$6,317 | \$6,541 | \$6,773 | \$7,013 | \$7,262 |
| Equipment Rental | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| Fuel | \$8,000 | \$8,284 | \$8,578 | \$8,883 | \$9,198 | \$9,524 |
| Professional & Technical Services | \$33,500 | \$34,689 | \$35,921 | \$37,196 | \$38,516 | \$39,884 |
| Education | \$6,350 | \$6,575 | \$6,809 | \$7,051 | \$7,301 | \$7,560 |
| Freight | \$1,500 | \$1,553 | \$1,608 | \$1,665 | \$1,725 | \$1,786 |
| Special Departmental Supplies | \$39,500 | \$40,902 | \$42,354 | \$43,858 | \$45,415 | \$47,027 |
| Total O&M | \$984,099 | \$1,134,035 | \$1,174,293 | \$1,215,980 | \$1,259,147 | \$1,303,847 |
| <i>Debt Service</i> | | | | | | |
| Potential 2017 Treatment Plant Loan | \$0 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 |
| Potential 2019 South Trunk Loan | \$0 | \$0 | \$0 | \$73,133 | \$73,133 | \$73,133 |
| Total Debt Service | \$0 | \$798,834 | \$798,834 | \$871,967 | \$871,967 | \$871,967 |
| <i>Expansion and Replacement</i> | | | | | | |
| Collection - Rehabilitation & Replacement | \$0 | \$0 | \$0 | \$655,227 | \$285,684 | \$695,130 |
| Loaned Treatment Plant Capital Costs | \$3,900,000 | \$10,300,000 | \$0 | \$0 | \$0 | \$0 |
| Non-Loaned Treatment Plant Capital Costs | \$1,320,595 | \$0 | \$0 | \$0 | \$0 | \$0 |
| New South Trunk Pipeline | \$0 | \$300,000 | \$1,800,000 | \$0 | \$0 | \$0 |
| Replace 400 East Trunk Pipeline | \$0 | \$0 | \$0 | \$0 | \$389,200 | \$0 |
| Sewer Lift Station Pump | \$8,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| SCADA Upgrades | \$40,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Building Project | \$100,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Sewer Master Plan | \$70,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Loan Proceeds | (\$3,900,000) | (\$10,300,000) | (\$1,300,000) | \$0 | \$0 | \$0 |
| Transfer to/(from) Reserve Fund | (\$991,082) | (\$138,512) | \$15,310 | \$33,392 | \$83,458 | \$72,862 |
| Total Capital Outlays | \$547,513 | \$161,488 | \$515,310 | \$688,619 | \$758,342 | \$767,992 |
| Total Revenue Requirements | \$1,531,612 | \$2,094,357 | \$2,488,437 | \$2,776,566 | \$2,889,456 | \$2,943,806 |
| LESS: | | | | | | |
| Operations Non-Rate Revenue | \$382,412 | \$694,052 | \$721,704 | \$775,699 | \$806,219 | \$837,871 |
| Non-Operations Non-Rate Revenue | \$210,969 | \$214,813 | \$352,278 | \$428,138 | \$437,293 | \$441,716 |
| Net Revenue Requirements | \$ 938,231 | \$ 1,185,492 | \$ 1,414,456 | \$ 1,572,729 | \$ 1,645,944 | \$ 1,664,219 |

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CONSULTING ENGINEERS

SEWER RATE COST OF SERVICE ANALYSIS

May 2017

Prepared by:



**Bowen Collins
& Associates, Inc.**
CONSULTING ENGINEERS

Prepared for:

CITY OF
MOAB
UTAH

SEWER RATE COST OF SERVICE ANALYSIS

May 2017

Prepared for:



Prepared by:



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EXECUTIVE SUMMARY

INTRODUCTION

Earlier this year, Moab City updated its sewer rates based upon a sewer rate report issued by Bowen, Collins & Associates, Inc. in February 2017. Due to various constraints, primarily related to the anticipated construction timing of the new WWTP, that report was limited in its analysis to a relatively simple revenue needs approach.

The purpose of this report is to present recommended updates to Moab City's (City) sewer rates based a more detailed cost of service analysis. This analysis will calculate detailed rates for FYE 2018 to FYE 2022. Implementing the recommendations contained in this report will help Moab City keep its sewer system adequately funded to maintain its current infrastructure and continue to provide dependable service to its customers based upon a sewer rate structure that is more equitable than the revenue needs approach previously adopted.

COST-OF-SERVICE SEWER RATE ANALYSIS

The primary objective of this sewer rate analysis is to establish fair and equitable rates that will be sufficient to meet revenue requirements for the City. To accomplish this goal, this analysis focused on six major tasks:

- 1. Projecting Growth:** In FYE 2016, the Moab City sewer system was composed of approximately 2,489 individual accounts comprising 5,468 residential equivalent residential units (ERUs). Based on Moab City water reclamation facility planning information, the estimated total population growth rate for the next six years was estimated to be approximately 1.1% for all customers.
- 2. Calculating Revenue Requirements:** Total revenue requirements for the City were projected for the next several years. Those requirements included operations and maintenance costs, capital improvement costs, facilities rehabilitation/replacement costs, and debt service. Revenue generated outside of sewer rates (impact fees, sewer sales to SVW&SID, septage sales, finance charges, etc.) was deducted from the total to give the net revenue requirement to be recovered from service charges.
- 3. Comparing Revenue to Required Revenue:** Once revenue requirements were projected, it was possible to compare required revenue to revenue projections.
- 4. Developing a Funding Plan to Meet Projected Needs:** In order for the City to meet projected expenditures and maintain its reserve fund at acceptable levels, it is important that revenue be sufficient to accommodate future projects. This study utilized the plan from the February 2017 sewer rate study to maintain the City's reserve fund and establish funding levels appropriate to provide the desired level of service in the wastewater system.
- 5. Allocating Costs to Customers:** This analysis generally followed the design cost-causative procedure recommended by the Water Environment Federation (WEF), American Society of Civil Engineers (ASCE), and American Public Works Association (APWA). The essential principle of this method is that sewer rates should be recovered from customers in proportion to the cost of serving customers.

As part of this analysis, some significant changes in the City's billing structure have been recommended to better reflect the actual cost of serving different types of customers. These changes include:

- **Multi-unit and Large Meter Based Rates** - Instead of charging the same base rate to all accounts regardless of size, it is proposed that base rates be proportional to potential use of capacity in the system. To implement this principle, it is proposed that multi-unit accounts (including overnight accommodations) be based on the size and number of units per account and that larger commercial accounts be charged based on their water meter size.
 - **Strength Based Volume Rates for Restaurants and Fast Food** – It is also proposed that restaurants and fast food eateries be charged higher volume charges based on their higher strength wastewater.
6. **Calculating Final Sewer Rates:** Using the recommended billing structure, sewer rates were calculated to recover the allocated cost-of-service based on operation and maintenance costs, debt service, and capital improvement costs.

The recommended sewer rates shown in Table ES-1 reflect a multiple year rate schedule (using the recommended billing structure) needed to meet the cost of capital improvements and system renewal.

RECOMMENDATIONS

It is recommended that the service charges summarized in Table ES-1 be adopted by Moab City. The proposed rates should be re-evaluated in approximately five years to ensure that the City's revenue requirements and goals for customer equity are being met.

**Table ES-1
Calculated/Recommended Rates**

| Monthly Base Rate | Existing FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---|----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Single Family | \$14.40 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| Multifamily 1st Unit (2 Bedrooms or Larger) | \$19.10 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Multifamily 1st Unit (1 Bedroom or Smaller) | \$19.10 | \$14.60 | \$15.80 | \$17.00 | \$16.55 | \$16.55 |
| + Charge per each additional unit | - | \$1.60 | \$4.10 | \$5.50 | \$6.40 | \$6.40 |
| Overnight Accommodations: 1st Unit Condo, 2 Bedrooms or Larger | \$19.10 | \$16.40 | \$20.45 | \$23.25 | \$23.85 | \$23.85 |
| + Charge per each additional unit | - | \$3.40 | \$8.80 | \$11.75 | \$13.65 | \$13.65 |
| Overnight Accommodations: 1st Unit Condo, 1 Bedroom or Smaller | \$19.10 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Overnight Accommodations: 1st Unit Hotel/Motel (No Kitchen) | \$19.10 | \$15.25 | \$17.40 | \$19.15 | \$19.10 | \$19.10 |
| + Charge per each additional unit | - | \$2.20 | \$5.75 | \$7.65 | \$8.90 | \$8.90 |
| Restaurant/Fast Food and Other Non-Residential: 1-inch or smaller water meter | \$19.10 | \$19.10 | \$19.10 | \$21.30 | \$21.55 | \$21.55 |
| 1.5-inch water meter | - | \$19.10 | \$21.75 | \$24.40 | \$24.80 | \$24.80 |
| 2-inch water meter | - | \$24.25 | \$29.30 | \$32.95 | \$33.75 | \$33.75 |
| 3-inch water meter | - | \$69.60 | \$84.75 | \$95.90 | \$99.65 | \$99.65 |
| 4-inch water meter | - | \$86.40 | \$105.25 | \$119.25 | \$124.10 | \$124.10 |
| 5-inch water meter | - | \$125.60 | \$153.20 | \$173.65 | \$181.05 | \$181.05 |
| 6-inch water meter | - | \$170.45 | \$207.95 | \$235.80 | \$246.10 | \$246.10 |
| 8-inch water meter | - | \$232.25 | \$283.55 | \$321.65 | \$335.95 | \$335.95 |

| Volume Rate (\$/kgal) | Existing FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|------------------------------|----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Residential | \$1.70 | \$1.70 | \$1.70 | \$1.82 | \$1.90 | \$1.90 |
| Multifamily | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Overnight Accommodations | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Restaurant/Fast Food | \$1.85 | \$2.22 | \$2.66 | \$3.20 | \$3.41 | \$3.41 |
| Other Non-Residential | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |

SEWER RATE COST OF SERVICE ANALYSIS

INTRODUCTION

The purpose of this rate study is to present recommended updates to Moab City's (City) sewer rates based a cost of service analysis. This analysis will calculate detailed rates for FYE 2018 to FYE 2022 and present a longer term finance plan to achieve the City's primary objectives of:

- Maintain high quality and reliable sewer service at affordable prices for customers;
- Sustain stable revenue generation adequate to fund system needs;
- Minimize the City's long-term costs by avoiding further debt where possible; and
- Equitably charge each customer based on their actual cost of service.

Implementing the recommendations contained in this report will help Moab City keep its sewer system adequately funded to maintain its current infrastructure and continue to provide dependable service to its customers based upon a more equitable sewer rate structure.

BACKGROUND

Earlier this year, Moab City updated its sewer rates based upon two sewer rate reports issued by Bowen, Collins & Associates, Inc. (BC&A). The original report, completed in October of 2016, was updated in February 2017 to account for higher than expected construction costs associated with the proposed wastewater treatment plant (WWTP) to be constructed in the near future. Due to various constraints, primarily related to the anticipated construction timing of the new WWTP, those reports calculated rates based upon a relatively simple revenue needs approach. Those reports recommended that the City revisit their rate structure based on cost-of-service principles as soon as reasonably possible. The rate study completed in February 2017 for Moab City is included in Appendix B. Table 1 shows the recommended annual revenue increases needed to meet the requirements of the City's sewer system as described in that previous rate study.

Table 1
Recommended Annual Revenue Increases for the 10-Year Budget Plan

| Year | Rate Revenue Increase |
|----------|-----------------------|
| FYE 2018 | 20% |
| FYE 2019 | 20% |
| FYE 2020 | 12% |
| FYE 2021 | 4.5% |
| FYE 2022 | 0%* |
| FYE 2023 | 0%* |
| FYE 2024 | 0%* |
| FYE 2025 | 0%* |
| FYE 2026 | 0%* |

* No significant increase expected, but small annual adjustments may be needed to account for inflation or other issues.

Table 2 shows the previously calculated rate structure recently adopted by the City. As the February 2017 report was limited to a revenue needs analysis, the rates adopted by the City were calculated by simply multiplying the City's existing rate structure by the percent increases identified in Table 1.

Table 2
Adopted Rates to Meet Projected Revenue Needs

| Monthly Base Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|-------------------|----------|----------|----------|----------|----------|----------|
| Residential | \$14.40 | \$17.28 | \$20.74 | \$23.22 | \$24.27 | \$24.27 |
| Commercial | \$19.10 | \$22.92 | \$27.50 | \$30.80 | \$32.19 | \$32.19 |

| Volume Rate | Existing | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|-------------|----------|----------|----------|----------|----------|----------|
| Residential | \$1.70 | \$2.04 | \$2.45 | \$2.74 | \$2.87 | \$2.87 |
| Commercial | \$1.85 | \$2.22 | \$2.66 | \$2.98 | \$3.12 | \$3.12 |

| | | | | | | |
|----------------------------------|---------|---------|---------|---------|---------|---------|
| Average Monthly Residential Bill | \$21.88 | \$26.26 | \$31.51 | \$35.29 | \$36.88 | \$36.88 |
|----------------------------------|---------|---------|---------|---------|---------|---------|

The following sections of this report examine more closely the actual cost of service for different types of customers and recommended rates to improve rate equity between users of Moab City's sanitary sewer system.

10-YEAR BUDGET PLAN

A 10-year budget plan is a critical component of the analysis to determine a cost of service rate structure. The budget plan outline in the February 2017 sewer rate study was used to determine the revenue requirements shown in Table 1. For additional detail on overall budgeting, the reader should reference the February 2017 report. The following cost of service analysis is based on that original budget plan.

DETAILED RATE CALCULATION

With an overall revenue plan in place, the next step in the rate calculation process is a detailed cost-of-service rate analysis. This analysis focuses on four major tasks:

1. **Projecting Sewer Use:** Future sewer sales were estimated by examining current use patterns and by projecting sewer system growth for the next several years.
2. **Calculating Revenue Requirements:** Total revenue requirements of the system were projected for the next several years based on the budget plan outlined in the February 2017 report. Non-rate revenue (including impact fee, septage sales, etc.) was deducted from the total to give the net revenue requirement to be recovered from rate payers.
3. **Cost Allocation:** This analysis generally follows the design cost-causative procedure recommended by the Water Environment Federation (WEF), American Society of Civil

Engineers (ASCE), and American Public Works Association (APWA)¹. The essential principle of this method is that wastewater revenue should be recovered from classes of customers in proportion to the cost of serving those customers. All sewer connections have been grouped into five customer classes resulting in a standard rate for each class.

4. **Wastewater Rate Design:** Wastewater rates were calculated to recover the allocated cost-of-service based on operation and maintenance costs, capital improvement costs, and debt service costs.

The remainder of this report details the results of each of these four major tasks. Detailed rate tables from the model used to develop the rate recommendations are located in Appendix A.

KEY ASSUMPTIONS

The results presented in this report are based on the following assumptions:

1. The Moab City sewer operating fund will continue to be a self-funding enterprise fund.
2. The study follows the basic recommended methodologies of the joint publication, "Financing and Charges for Wastewater Systems". Only the "cash basis" approach has been used to allocate costs to users.
3. This wastewater rate study is based on projections of future wastewater production and projected system operation, maintenance, and improvement costs. These projections are based on current economic conditions and wastewater use patterns. Because conditions may change over time, it is recommended that the City review the wastewater rates periodically and adjust them as needed to provide a revenue stream that will adequately fund operation and maintenance costs as well as needed rehabilitation and replacement projects. It is also recommended that a comprehensive review and updating of wastewater rates be undertaken in three to five years so that the basic analytical foundations of this study can be re-evaluated.

PROJECTING WASTEWATER PRODUCTION

Historic Indoor Water Use

In FYE 2016, the City provided sewer service to approximately 2,489 accounts composed of approximately 5,468 flow ERUs. The City has historically separated accounts into two classes as described below:

- **Single Family Residential** – This class represents all the single family residential customers connected into the Moab City sewer system. Based on information provided to BC&A, this customer class currently accounts for approximately 32% of all ERUs in the system. Each residential unit is assumed to be 1 ERU by the City. The strength of wastewater flows is not differentiated within this class.
- **Commercial** – This class of customers contains all other customers. The strength of wastewater flows is not differentiated within this class. The City historically tracks commercial subclasses in four categories as follows: multifamily, overnight accommodations, restaurant/fast food, and other non-residential.

¹Water Environment Federation, American Society of Civil Engineers, and American Public Works Association. Financing and Charges for Wastewater Systems, 1984.

For the purposes of this study, BC&A would propose using the same five general customer classifications the City has developed. Moab City does not meter sewage flows for individual customers. Lacking direct information on flow rates, BC&A estimated the typical sewer flow rates based on indoor water meter data obtained from Moab City for FYE 2015. The number of accounts in each customer class, along with their estimated sewer flows in FYE 2015, is summarized in Table 3.

Table 3
2015 Account and Sewer Use Summary

| Customer Class | Number of Accounts in 2015 | Number of ERUs in 2015 | 2015 Sewer Flows (kgal) | Average Monthly Flows/ERU (kgal) |
|--------------------------|----------------------------|------------------------|-------------------------|----------------------------------|
| Residential | 1,753 | 1,753 | 91,073 | 4.3 |
| Multifamily | 409 | 227 | 12,070 | 4.4 |
| Overnight Accommodations | 60 | 1,958 | 81,618 | 3.5 |
| Restaurant/Fast Food | 43 | 392 | 18,877 | 4.0 |
| Other Non-Residential | 197 | 1,078 | 48,297 | 3.7 |
| Total | 2,462 | 5,409 | 251,935 | - |

Projected Growth

There is a relatively large amount of area within Moab City that is undeveloped. Therefore, a reasonable amount of growth is expected. The basis of the growth projected to occur was taken from Moab City's recent water reclamation facility planning efforts. The growth rate was applied to the number of existing ERUs and accounts. Overall historic growth has generally been relatively moderate. The projected growth rates and number of ERUs by customer type are summarized in Table 4.

Table 4
Projected System Growth (ERUs)

| Customer Class | FYE 2016 | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Residential | 1,772 | 1,791 | 1,811 | 1,831 | 1,851 | 1,872 | 1,892 |
| Multifamily | 230 | 233 | 235 | 238 | 240 | 243 | 246 |
| Overnight Accommodations | 1,980 | 2,002 | 2,024 | 2,046 | 2,069 | 2,091 | 2,114 |
| Restaurant/Fast Food | 396 | 400 | 405 | 409 | 414 | 418 | 423 |
| Other Non-Residential | 1,090 | 1,102 | 1,114 | 1,126 | 1,139 | 1,151 | 1,164 |
| Total | 5,468 | 5,528 | 5,589 | 5,650 | 5,713 | 5,775 | 5,839 |
| % System Growth | | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% |

Projected Sewer Flows

Future sewer demands were projected by multiplying the average use per ERU in FYE 2015 from Table 3 by the projected number of ERUs in Table 4. Using this methodology, the projected growth in total sewer flows are shown in Table 5.

Table 5
Projected Growth in Sewer Flows

| Customer Class | Use per ERU/Year | Flow Amount (kgal) | | | | | | |
|--------------------------|------------------|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | | FYE 2016 | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 52.0 | 92,075 | 93,062 | 94,101 | 95,140 | 96,180 | 97,271 | 98,310 |
| Multifamily | 53.1 | 12,203 | 12,362 | 12,468 | 12,627 | 12,733 | 12,892 | 13,052 |
| Overnight Accommodations | 41.7 | 82,516 | 83,433 | 84,349 | 85,266 | 86,225 | 87,142 | 88,100 |
| Restaurant/Fast Food | 48.2 | 19,085 | 19,277 | 19,518 | 19,711 | 19,952 | 20,145 | 20,386 |
| Other Non-Residential | 44.8 | 48,828 | 49,366 | 49,903 | 50,441 | 51,023 | 51,561 | 52,143 |
| Total | - | 254,706 | 257,500 | 260,341 | 263,186 | 266,113 | 269,011 | 271,991 |

Infiltration and Inflow

Infiltration and inflow is the intrusion of groundwater or storm water into the sewer system through cracked pipes, broken and offset joints, improper connections, leaky manholes, etc. In areas with aging sewer lines and high groundwater, infiltration can actually be the largest component of flow being conveyed in the sewer. Infiltration is very difficult to measure because it varies across the service area based on climate conditions, water table levels, pipe diameter, and pipe condition. Because of the difficulty of identifying the source and quantity of infiltration, Moab City does not bill sewer accounts for infiltration directly. Thus, infiltration and inflow are not included in the rate model.

Strength Characteristics

Strength characteristics of wastewater are generally used to scale the cost of treatment between different users. For example, an industrial connection may produce stronger wastewater than a residential connection, thus meriting a higher sewer rate to cover the increased treatment cost. The only historical data regarding wastewater strength available to BC&A were measurements taken at the wastewater treatment plant. 300 mg/L of biochemical oxygen demand (BOD) and 280 mg/L of total suspended solids (TSS) were recorded for the combined wastewater stream entering the WWTP. Those values were assumed to be the approximate average strength of all connections. Flow strength per connection has not been monitored in detail by the City. However, based on previous residential equivalence studies conducted by BC&A of similar entities, restaurant and fast food customers have higher wastewater strength characteristics. Correspondingly, the projected strength of wastewater from these customers has been updated in the rate model. The strength portion of the rate model may provide further value to the City if it has any individual customers in the future that merit additional consideration of strength. Table

A7 of Appendix A shows the BOD and TSS values that were used in the rate model for each customer class.

CALCULATING REVENUE REQUIREMENTS

There are two methods for determining a water utility’s revenue requirements. One is called the Cash Basis of revenue requirements. The other method is called the Utility Basis of revenue requirements. The revenue requirements for each approach are summarized on the next page.

| <u>Cash Basis</u> | <u>Utility Basis</u> |
|-------------------------------------|-------------------------------------|
| Operation and Maintenance Costs | Operation and Maintenance Cost |
| Plus: Debt Service | Plus: Depreciation |
| Cash-Financed Capital Outlays | Return on Investment |
| Taxes (if applicable) | Taxes (if applicable) |
| <u>Net Additions to Reserves</u> | <hr/> |
| Total Requirements | Total Requirements |
| Less: <u>Non-Rate Revenues</u> | Less: <u>Non-Rate Revenues</u> |
| Equals: Net Requirements from Rates | Equals: Net Requirements from Rates |

The cash basis of revenue requirements is based on the actual cash expenditures of the system. Its goal is to make sure revenues match the cash needs of the system. In public utilities, this method generally matches the budgetary expenditures for the period. It has the additional advantage of being more understandable to most ratepayers and more directly meets any debt service coverage requirements that the system might need to comply with.

The utility basis approach simulates the financial requirements of private sector companies. It ensures that revenue requirements reflect the depreciation incurred by the system, as well as a return on the investment in rate base by system owners. In the municipal utility setting, the utility basis is most often used when there is significant utility service to customers outside the jurisdictional boundaries of the system owners. It allows the system owners (i.e., City customers) to earn a return from the investments to serve the customers outside the City.

Approximately one third of flows treated by Moab City originate outside the City’s jurisdictional boundaries. For these flows, the utility basis could be well suited to calculate revenue requirements. However, because this rate study does not seek to determine retail rates for users outside the City, the utility basis is less applicable. For customers inside Moab City, the cash basis is the preferred method for these circumstances. Due to its previously stated advantages, rates in this study were developed under the cash basis only.

Impact Fee Revenue

The projected annual revenue from impact fees is based on the projected number of new ERUs. The impact fee revenue also includes the revenue obtained from new development outside of Moab City that is routing flow into Moab for treatment (such as SVW&SID). For this analysis, it has been assumed that the City’s impact fee rates will be as discussed in the *2016 Moab Sewer Impact Fee Analysis*. If Moab City adopts impact fees other than those recommended, the rates calculated in this report will need to be adjusted accordingly. The projected impact fee revenue is

generally expected to increase gradually over the next six years following system growth and City projections, as shown in Table 6. The exception to the gradual trend are some larger increases between FYE 2018 and FYE 2020 that occur as new capacity at the treatment plant opens up opportunity for additional connections from San Juan County and elsewhere.

Table 6
Projected Impact Fee Revenue

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--|------------------|------------------|------------------|------------------|------------------|------------------|
| Projected Collections Impact Fee Revenues | \$83,891 | \$85,067 | \$122,044 | \$144,637 | \$147,367 | \$148,681 |
| Projected Treatment Impact Fee Revenues | \$104,678 | \$106,427 | \$205,960 | \$258,232 | \$263,620 | \$265,651 |
| Projected Total Impact Fee Revenues | \$188,569 | \$191,494 | \$328,003 | \$402,869 | \$410,987 | \$414,332 |

Non-Rate Revenue

The projected non-rate revenue for the City is summarized in Table 7. The projected revenue amounts are based on a 3% inflation rate and the ERU growth rates shown in Table 4. This non-rate revenue is the net income from activities not associated with Moab City sewer sales. It includes sewer rate collection penalty fees and interest, sales to SVW&SID, septage sales, impact fees, and other income. As shown in the table, impact fees, SVW&SID sewer sales, and septage sales account for the vast majority of the total non-rate revenue. There is a large increase shown in FYE 2018 in association with new rates calculated as part of the February 2017 Rate Study. Increases thereafter are relatively modest and correspond with inflation and system growth.

Table 7
Projected Non-Rate Revenue

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------------|------------------|------------------|--------------------|--------------------|--------------------|--------------------|
| SVW&SID Sewer Sales | \$296,157 | \$442,821 | \$464,107 | \$512,925 | \$536,720 | \$561,422 |
| Special Services | \$1,500 | \$1,562 | \$1,626 | \$1,692 | \$1,762 | \$1,834 |
| Septage Sales | \$76,755 | \$241,341 | \$247,302 | \$252,057 | \$258,342 | \$264,836 |
| Sewer Connections | \$8,000 | \$8,328 | \$8,669 | \$9,025 | \$9,395 | \$9,780 |
| Impact Fees | \$188,569 | \$191,494 | \$328,003 | \$402,869 | \$410,987 | \$414,332 |
| Finance Charges & Other Income | \$22,400 | \$23,318 | \$24,274 | \$25,270 | \$26,306 | \$27,384 |
| Total | \$593,381 | \$908,865 | \$1,073,982 | \$1,203,837 | \$1,243,511 | \$1,279,587 |

Moab City Expenditures

The projected City expenditures for the planning period are summarized in Table 8. Included in the table are the projected total costs for the three major categories of expenditures: operations and maintenance, debt service, and capital expenditures. These categories are discussed in more detail in following sections.

Table 8
Projected Revenue Requirements

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| O&M | \$984,099 | \$1,134,035 | \$1,174,293 | \$1,215,980 | \$1,259,147 | \$1,303,847 |
| Debt Service | \$0 | \$798,834 | \$798,834 | \$877,592 | \$877,592 | \$877,592 |
| Capital Outlays | \$547,513 | \$114,069 | \$481,747 | \$673,591 | \$758,684 | \$768,400 |
| Total Expenditures | \$1,531,612 | \$2,046,937 | \$2,454,874 | \$2,767,163 | \$2,895,423 | \$2,949,840 |

Operation and Maintenance Costs: The projected operation and maintenance costs for Moab City were based on the City's budgeted amount for FYE 2017 and are discussed in more detail in the February 2017 sewer rate study. A detailed list of O&M costs is included as part of the rate model in Appendix A.

Debt Service Costs: These are the costs paid toward the loans taken out or expected to be taken out by the City in the near future and are discussed in more detail in the February 2017 sewer rate study. A detailed list of loan payments is included as part of the rate model in Appendix A.

Capital Improvement Costs: These are the costs for constructing new facilities within Moab City. This can include completely new facilities or replacement of existing facilities. In years where capital expenditures for rehabilitation and replacement of the existing infrastructure do not occur, or are less than the amount budgeted, the rate revenue will be transferred to the City's savings fund which will be stored to pay for future improvements. If major improvement projects are needed before the fund has been sufficiently built up, the City will likely need to utilize a bond for a portion of that future project's cost.

It should be noted that the FYE 2017 Moab City budget identified four recommended potential improvement projects outside of those already discussed previously. As the project costs range from only approximately \$8,000 to \$100,000, it was assumed that these projects could be funded through the funds annually set aside for rehabilitation and replacement as previously described. The capital improvement projects and the recommended timing of their construction is shown in Table A11 of Appendix A. The expenditures of this category are discussed in more detail in the February 2017 Sewer Rate Study.

COST ALLOCATIONS

A key step in a cost-causative wastewater rate analysis is the allocation of costs to customer service characteristics. The allocation approach used in this study reflects the basic approaches recommended by WPCF, ASCE, and APWA.

Customer Service Characteristics

This approach recommends the allocation of costs into one of four cost allocation categories:

- **Volume Costs** – Volume costs refer to costs that are determined by the volume of wastewater generated in the system.
- **Capacity Costs** – Capacity costs are typically costs determined by the peak wastewater production of system users. Although peak flows are not billed for directly (in part because there is no presently installed way to monitor them), there is a component of the system that allows each customer the opportunity to intermittently discharge peak flows. As a result, each customer should be paying for their potential to discharge at peak rates into the system, even though this capacity may be rarely used. This category would include such items as the design and construction of major trunk lines since they are sized based on peak flow rates.
- **Strength Costs** – Strength costs are those costs determined by BOD or TSS concentrations of the wastewater.
- **Customer Related Costs** – Customer related costs are those costs that are independent of the quantity or quality of wastewater generated. This category is mostly limited to administrative services such as the cost of generating and sending out bills each month.

Detailed cost divisions have been completed in the sewer rate model (see Tables A12 through A16 of Appendix A). In each case, these allocations are based on professional engineering judgment and knowledge of system operations. Table A12 provides a division by cost allocation category for O&M expenditures. Table A13 lists the cost allocations for City assets and the overall allocated percentage amounts to each division. Using those overall allocation percentages, allocations were determined for debt service, capital outlays, and all non-rate revenue in Table A15 of Appendix A.

Using the percentages assigned to each budget category, the system revenue costs are distributed among the customer service classes to produce a total revenue requirement for each customer service characteristic. Table A16 of Appendix A shows that total cost allocation for each customer class and service characteristic.

CALCULATED COST-OF-SERVICE RATES

Following the recommended cost-of-service methodology, required rates to satisfy the City's projected revenue requirements were calculated as summarized in Table 9.

Table 9
Calculated Cost-of-Service Rates

| Monthly Account Base Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|-----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| All Users | \$7.16 | \$8.65 | \$9.74 | \$10.19 | \$10.18 |
| Monthly ERU Base Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| All Users | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |
| | | | | | |
| Volume Rate (\$/kgal) | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| <i>Volume Component</i> | | | | | |
| <i>All Users</i> | \$0.79 | \$0.87 | \$0.90 | \$0.93 | \$0.94 |
| <i>Strength Component</i> | | | | | |
| <i>Restaurant/Fast Food Users</i> | \$1.66 | \$2.06 | \$2.37 | \$2.48 | \$2.48 |
| <i>All Other Users</i> | \$0.64 | \$0.80 | \$0.92 | \$0.97 | \$0.96 |
| Total Volume Rate | | | | | |
| Restaurant/Fast Food Users | \$2.45 | \$2.93 | \$3.27 | \$3.41 | \$3.41 |
| All Other Users | \$1.44 | \$1.67 | \$1.82 | \$1.90 | \$1.90 |

Like existing City rates, this calculation includes developing a monthly base rate for each user plus a set rate per 1,000 gallons of actual indoor water used each month. However, a number of modifications to the existing City rate structure are recommended.

- Monthly Base Rate** – Historically, monthly base rates have been the same for each account, regardless of the size of connection. Based on cost-of-service, it is recommended that the monthly base rate be separated into a monthly account base rate and a monthly ERU base rate. The base rate is divided into those two categories to more equitably capture the varying situations of capacity reservation within the sewer system. Each user would be charged a monthly account base rate to cover costs associated with simply being connected into the system (such as administrative costs for monthly billings). In addition, each user would also pay a monthly base rate dependent upon the user's number of ERUs to reserve capacity in the system as previously described in the cost allocation section. A main point of that section is that the capacity reservation is primarily due to the standard practice of sizing sewer trunk lines and other facilities based on the maximum expected peak flows for each user. Customers with higher peak flows require dedicating a larger portion of sewer system capacity to adequately serve them even if they do not frequently utilize the full capacity (and correspondingly cannot be captured through volume rates). Equity between customers is improved by correspondingly charging a higher base rate for the increased capacity dedication.

Where this change will likely have the greatest effect in Moab is on overnight accommodations. Historically, Moab has only charged hotels a single base rate that is very similar to what a single residential unit pays. Thus, a residential connection pays \$14.40 per month for the ability to connect to the sewer system and a hotel (or any other type of non-residential user) only pays a little bit more at \$19.10 per month. This is true

regardless of the size of non-residential connection. While a resident and a hotel do have roughly the same amount of billing and administrative costs, the hotel's need for available capacity can be many more times that of a single home. Thus, paying essentially the same base rate does not effectively reflect the cost of service for each customer.

It is sometimes argued that larger customers do pay more for service through increased volume charges. However, as noted above, the revenue that is collected through volume charges only reflects the costs associated with actual volume related expenditures. They do not reflect the costs of available capacity. To be most consistent with cost of service principles, capacity related costs should not be collected through volume charges, but through base charges associated with expected maximum capacity needs.

- Wastewater Strength Component** – As shown in Table A15 of Appendix A, the strength category accounts for approximately 18% of sewer system annual revenue requirements. To improve equity of rates, wastewater strength should be factored into the rates. For the customers in the City's system, there is no existing practical way of measuring wastewater strength for individual customers on a regular basis. Apart from the "restaurant/fast food" and "other non-residential" customer classifications shown in Table 3, the remaining three customer classifications are expected to produce relatively similar BOD and TSS concentrations so the extra effort to capture the differences may not be warranted. The "restaurant/fast food" classification is expected to have a relatively higher BOD and TSS from the standard based on past sampling of similar entities. As the "other non-residential" classification covers a wide range of customer types, it is much more difficult to determine strength characteristics without further sampling.

To be more equitable for the other customer classifications (which should have much lower wastewater strength), the rate model utilized higher BOD and TSS concentrations for the 'restaurant/fast food' classification and lower concentrations (based off historical sampling of the total combined influent into the WWTP) for the remaining four classifications to calculate the cost-of-service for the strength component of the volume rate. The cost-of-service information contained in this report may be used as a basis to calculate equitable rates if Moab City ever has a request to provide service to an industrial or other high strength user or would like to conduct thorough wastewater strength sampling of additional customer classifications.

RECOMMENDED FUTURE RATES

The cost-of-service rates summarized above provide a good basis for developing recommended rates for the system. However, to fairly and efficiently administer the rates, it is useful to further define the rate structure by customer class.

For monthly base rates, all customer classes will be calculated by adding the monthly account base rate (from Table 9) to the monthly ERU base rate (also from Table 9) multiplied by the flow ERUs associated with the account. For customer classifications where multiple units may exist under a single account, such as a motel, the first unit will be charged the account base rate but each additional unit will be charged a monthly base rate dependent only on the ERU base rate. This will ensure the City only charges these types of customers once per month to cover the monthly account base rate portion of the bill. For the calculation of flow ERUs per account, the following is recommended:

- **Single Family** – In the case of single family customers, the number of flow ERUs per account is simply one.
- **Multifamily** – For multifamily customers, it is recommended that the flow ERUs associated with each account be based on the per unit values defined in Table 10 of the *2016 Moab Sewer Impact Fee Analysis* (IFA). This customer class includes two subcategories:
 - 2 Bedrooms or Larger = 1.0 ERUs per unit
 - 1 Bedroom or Smaller = 0.56 ERUs per unit
- **Overnight Accommodations** – For this category of customers, it is also recommended that the flow ERUs associated with each account be based on the per unit values defined in Table 10 of the *2016 Moab Sewer Impact Fee Analysis*. This customer class includes three subcategories:
 - Condo (2 bedroom and larger) = 1.2 ERUs per unit
 - Condo (1 bedroom and smaller) = 1.0 ERUs per unit
 - Hotel/Motel = 0.78 ERUs per unit
- **Restaurant/Fast Foot and Other Non-Residential** – For this category of customers, it is recommended that the flow ERUs associated with each account be based on the AWWA equivalent meter ratio (determined by the actual size of the water meter serving the customer). Table 10 shows the equivalent meter ratio per meter size. This equivalent meter ratio rate structure will allow the City to more fairly charge for the capacity reservation as the water meter size is typically directly related to flow capacity. This will result in a generally consistent monthly rate for each commercial customer. As shown in Table 11, entities with 1-inch and smaller meters (approximately equal in size to that of the typical single family residence) will be charged the same monthly rate as a single family residence.

Table 10
AWWA Equivalent Water Meter Ratios

| Customer Class | Meter Size (Inches) | | | | | | | |
|--------------------------|---------------------|-------|-----|-----|------|------|------|------|
| | 1 and smaller | 1 1/2 | 2 | 3 | 4 | 6 | 8 | 10 |
| AWWA Equiv. Meter Ratios | 1.0 | 1.3 | 2.1 | 7.9 | 10.0 | 15.0 | 20.7 | 28.6 |

Based on the methodology described above, the recommended wastewater rates necessary to meet projected revenue requirements for the next five years are summarized in Table 11.

Table 11
Calculated/Recommended Monthly Rates

| Monthly Base Rate | Existing FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---|----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Single Family | \$14.40 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| Multifamily 1st Unit (2 Bedrooms or Larger) | \$19.10 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Multifamily 1st Unit (1 Bedroom or Smaller) | \$19.10 | \$14.60 | \$15.80 | \$17.00 | \$16.55 | \$16.55 |
| + Charge per each additional unit | - | \$1.60 | \$4.10 | \$5.50 | \$6.40 | \$6.40 |
| Overnight Accommodations: 1st Unit Condo, 2 Bedrooms or Larger | \$19.10 | \$16.40 | \$20.45 | \$23.25 | \$23.85 | \$23.85 |
| + Charge per each additional unit | - | \$3.40 | \$8.80 | \$11.75 | \$13.65 | \$13.65 |
| Overnight Accommodations: 1st Unit Condo, 1 Bedroom or Smaller | \$19.10 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Overnight Accommodations: 1st Unit Hotel/Motel (No Kitchen) | \$19.10 | \$15.25 | \$17.40 | \$19.15 | \$19.10 | \$19.10 |
| + Charge per each additional unit | - | \$2.20 | \$5.75 | \$7.65 | \$8.90 | \$8.90 |
| Restaurant/Fast Food and Other Non-Residential: 1-inch or smaller water meter | \$19.10 | \$19.10 | \$19.10 | \$21.30 | \$21.55 | \$21.55 |
| 1.5-inch water meter | - | \$19.10 | \$21.75 | \$24.40 | \$24.80 | \$24.80 |
| 2-inch water meter | - | \$24.25 | \$29.30 | \$32.95 | \$33.75 | \$33.75 |
| 3-inch water meter | - | \$69.60 | \$84.75 | \$95.90 | \$99.65 | \$99.65 |
| 4-inch water meter | - | \$86.40 | \$105.25 | \$119.25 | \$124.10 | \$124.10 |
| 5-inch water meter | - | \$125.60 | \$153.20 | \$173.65 | \$181.05 | \$181.05 |
| 6-inch water meter | - | \$170.45 | \$207.95 | \$235.80 | \$246.10 | \$246.10 |
| 8-inch water meter | - | \$232.25 | \$283.55 | \$321.65 | \$335.95 | \$335.95 |

| Volume Rate (\$/kgal) | Existing FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|------------------------------|----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Residential | \$1.70 | \$1.70 | \$1.70 | \$1.82 | \$1.90 | \$1.90 |
| Multifamily | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Overnight Accommodations | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Restaurant/Fast Food | \$1.85 | \$2.22 | \$2.66 | \$3.20 | \$3.41 | \$3.41 |
| Other Non-Residential | \$1.85 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |

It should be noted that the recommended sewer rates shown in Table 11 reflect a multiple year transition from current rates to the cost of service rates identified in Table 9. Typically, it is desirable for rate changes to occur gradually over several years to avoid shocking customers with a sudden rate increase. Thus, the changes to the rate payment calculation method (additional unit

charges, wastewater strength charges, meter size charges, etc.) have all been phased in gradually to minimize potential impacts to any given customer. Based upon the customer information and assumptions supplied by Moab City, the recommended rates are projected to be overall revenue neutral compared to the calculated rates identified in the February 2017 Rate Study.

As shown in the table, cost of service rates under the proposed plan would be fully implemented (along with required increases to meet expected revenue needs) by FYE 2021. No further changes in rates are currently shown in FYE 2022. Typically, after the initial few years of rate growth to bring rates in line with budgetary needs, the rates will subsequently need to be grown just to keep pace with inflation. This is not the case for Moab City rates primarily because loan payments remain steady while the predicted system and customer growth rates produce excess revenue to roughly offset inflation during the period analyzed. This projection should be revisited in the next rate study completed in 3 to 5 years.

RECOMMENDATIONS

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

Adopt Recommended Rates: It is recommended that Moab City adopt the rates summarized in Table 11. These increases are needed to meet immediate operation and maintenance needs and to fund capital expenditures to meet the City's longer-term system investment goals. The recommended rates will improve cost sharing fairness among the various customer classes within Moab City's sanitary sewer system. In addition to a general increase in rates, this includes two major changes from existing rates:

- **Multi-unit and Large Meter Based Rates** - Instead of charging the same base rate to all accounts regardless of size, it is proposed that base rates be proportional to potential use of capacity in the system. To implement this principle, it is proposed that multi-unit accounts (including overnight accommodations) be based on the size and number of units per account and that larger commercial accounts be charged based on their water meter size.
- **Strength Based Volume Rates for Restaurants and Fast Food** – It is also proposed that restaurants and fast food eateries be charged higher volume charges based on their higher strength wastewater.

Consider a Multiple Year Rate Schedule: If at all possible, it is recommended that the City adopt the full multiple year rate schedule through FYE 2022. By adopting a multiple year rate schedule, the City can program the desired increases to the rates consistent with the results of this report and provide longer notice to customers. If it is necessary to make revisions in the future, the rate structure can always be modified.

Continue Volumetric Billing Practices: It is recommended that the City continue the practice of billing the residential volumetric rates based on the average winter water usage rate during the months of November through February while billing all other classifications based on their actual monthly water usage.

Update This Rate Study Periodically: After the implementation of any major change to the rate structure, we would suggest that the City monitor customer responses and system revenue for a period to two to three years. Following this initial observation period, the rates should be re-

examined to determine if there should be any subsequent rate adjustments. A comprehensive review of this rate study should also be performed in three to five years. The projections, assumptions, and data contained in this report may need to be revised over time. For these reasons, it is prudent to update the rates to ensure they are sufficient to meet system requirements, as well as maintain cost-of-service equity in charges to customers.

APPENDIX A
DETAILED RATE TABLES

**Table A1
Moab City - Sewer Rate Study
Historic Indoor Water Use**

| Customer Class | FYE 2014 | | | | FYE 2015 | | | | FYE 2016 | | | | Use/Acct. (kgal/year) | Use/Acct. (kgal/month) |
|--------------------------|----------------|--------------|--------------|--------------------|----------------|--------------|--------------|--------------------|----------------|--------------|--------------|---------------------|--------------------------|---------------------------|
| | Use (kgal) | Flow ERUs | Accounts | Use per ERU (kgal) | Use (kgal) | Flow ERUs | Accounts | Use per ERU (kgal) | Use (kgal) | Flow ERUs | Accounts | Use/ERU (kgal/year) | | |
| Residential | 90,082 | 1,734 | 1,734 | 52.0 | 91,073 | 1,753 | 1,753 | 52.0 | 92,075 | 1,772 | 1,772 | 52.0 | 52.0 | 4.3 |
| Multifamily | 11,939 | 225 | 405 | 53.1 | 12,070 | 227 | 409 | 53.1 | 12,203 | 230 | 414 | 53.1 | 29.5 | 2.5 |
| Overnight Accommodations | 80,730 | 1,937 | 60 | 41.7 | 81,618 | 1,958 | 60 | 41.7 | 82,516 | 1,980 | 61 | 41.7 | 1,352.7 | 112.7 |
| Restaurant/Fast Food | 18,672 | 387 | 42 | 48.2 | 18,877 | 392 | 43 | 48.2 | 19,085 | 396 | 43 | 48.2 | 443.8 | 37.0 |
| Other Non-Residential | 47,772 | 1,066 | 195 | 44.8 | 48,297 | 1,078 | 197 | 44.8 | 48,828 | 1,090 | 199 | 44.8 | 245.4 | 20.4 |
| Total | 249,194 | 5,350 | 2,435 | 46.6 | 251,935 | 5,409 | 2,462 | 46.6 | 254,706 | 5,468 | 2,489 | 46.6 | 102.3 | 8.5 |

**Table A2a
Moab City - Sewer Rate Study
Projected Flow ERUs**

| Customer Class | Year | Number of ERUs | | | | | |
|--------------------------|-----------------|----------------|--------------|--------------|--------------|--------------|--------------|
| | | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| | % Growth | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% |
| Residential | | 1,791 | 1,811 | 1,831 | 1,851 | 1,872 | 1,892 |
| Multifamily | | 233 | 235 | 238 | 240 | 243 | 246 |
| Overnight Accommodations | | 2,002 | 2,024 | 2,046 | 2,069 | 2,091 | 2,114 |
| Restaurant/Fast Food | | 400 | 405 | 409 | 414 | 418 | 423 |
| Other Non-Residential | | 1,102 | 1,114 | 1,126 | 1,139 | 1,151 | 1,164 |
| Total | | 5,528 | 5,589 | 5,650 | 5,713 | 5,775 | 5,839 |

**Table A2b
Moab City - Sewer Rate Study
Projected Accounts**

| Customer Class | Year | Number of Accounts | | | | | |
|--------------------------|-----------------|--------------------|--------------|--------------|--------------|--------------|--------------|
| | | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| | % Growth | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% | 1.10% |
| Residential | | 1,791 | 1,811 | 1,831 | 1,851 | 1,871 | 1,892 |
| Multifamily | | 419 | 424 | 429 | 434 | 439 | 444 |
| Overnight Accommodations | | 62 | 63 | 64 | 65 | 66 | 67 |
| Restaurant/Fast Food | | 43 | 43 | 43 | 43 | 43 | 43 |
| Other Non-Residential | | 201 | 203 | 205 | 207 | 209 | 211 |
| Total | | 2,516 | 2,544 | 2,572 | 2,600 | 2,628 | 2,657 |

**Table A3
Moab City - Sewer Rate Study
Projected Annual Indoor Water Use**

| Customer Class | Avg. Use/ERU/year | Amount (kgal) | | | | | |
|--------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 52.0 | 93,062 | 94,101 | 95,140 | 96,180 | 97,271 | 98,310 |
| Multifamily | 53.1 | 12,362 | 12,468 | 12,627 | 12,733 | 12,892 | 13,052 |
| Overnight Accommodations | 41.7 | 83,433 | 84,349 | 85,266 | 86,225 | 87,142 | 88,100 |
| Restaurant/Fast Food | 48.2 | 19,277 | 19,518 | 19,711 | 19,952 | 20,145 | 20,386 |
| Other Non-Residential | 44.8 | 49,366 | 49,903 | 50,441 | 51,023 | 51,561 | 52,143 |
| Total | | 257,500 | 260,341 | 263,186 | 266,113 | 269,011 | 271,991 |

**Table A4
Moab City - Sewer Rate Study
Projected Total Wastewater Flow**

| Customer Class | Amount (mgd) | 2016 | | | | | |
|--------------------------|--------------|-------------|-------------|-------------|-------------|-------------|----------|
| | | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.30 | |
| Multifamily | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | |
| Overnight Accommodations | 0.26 | 0.26 | 0.26 | 0.27 | 0.27 | 0.27 | |
| Restaurant/Fast Food | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | |
| Other Non-Residential | 0.15 | 0.15 | 0.16 | 0.16 | 0.16 | 0.16 | |
| Total | 0.79 | 0.80 | 0.81 | 0.82 | 0.83 | 0.84 | |

Moab Portion of Peak Month Flow at Treatment Plant (mgd) = **0.78**

Table A5
Moab City - Sewer Rate Study
Peaking Factors

| Customer Class | Est. Peak Hour Factor |
|--------------------------|-----------------------|
| Residential | 2.50 |
| Multifamily | 2.50 |
| Overnight Accommodations | 2.50 |
| Restaurant/Fast Food | 2.50 |
| Other Non-Residential | 2.50 |

Table A6
Moab City - Sewer Rate Study
Projected Flow Peaking Characteristics

| Customer Class | Estimated Peak Hour (mgd) | | | | | |
|--------------------------|---------------------------|-------------|-------------|-------------|-------------|-------------|
| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 0.64 | 0.64 | 0.65 | 0.66 | 0.67 | 0.67 |
| Multifamily | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| Overnight Accommodations | 0.57 | 0.58 | 0.58 | 0.59 | 0.60 | 0.60 |
| Restaurant/Fast Food | 0.13 | 0.13 | 0.14 | 0.14 | 0.14 | 0.14 |
| Other Non-Residential | 0.34 | 0.34 | 0.35 | 0.35 | 0.35 | 0.36 |
| Total | 1.76 | 1.78 | 1.80 | 1.82 | 1.84 | 1.86 |

| Customer Class | Peak Hour Excess Over Average Day (mgd) | | | | | |
|--------------------------|---|-------------|-------------|-------------|-------------|-------------|
| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 0.38 | 0.39 | 0.39 | 0.40 | 0.40 | 0.40 |
| Multifamily | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Overnight Accommodations | 0.34 | 0.35 | 0.35 | 0.35 | 0.36 | 0.36 |
| Restaurant/Fast Food | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| Other Non-Residential | 0.20 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 |
| Total | 1.06 | 1.07 | 1.08 | 1.09 | 1.11 | 1.12 |

Table A7
Moab City - Sewer Rate Study
Strength

| Customer Class | BOD' (mg/L) | TSS' (mg/L) |
|---------------------------|-------------|-------------|
| Residential | 300 | 280 |
| Multifamily | 300 | 280 |
| Overnight Accommodations | 300 | 280 |
| Restaurant/Fast Food | 1,167 | 323 |
| Other Non-Residential | 300 | 280 |
| Approximate Cost Division | 50% | 50% |

'Based on historic sampling data from Moab and the 2012 Mount Olympus Residential Equivalence Study.

Table A8
Moab City - Sewer Rate Study
Projected Strength Characteristics

| Customer Class | BOD (lbs/year) | | | | | |
|--------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 261,228 | 264,145 | 267,062 | 269,979 | 273,042 | 275,959 |
| Multifamily | 34,700 | 34,998 | 35,445 | 35,743 | 36,190 | 36,636 |
| Overnight Accommodations | 234,198 | 236,771 | 239,345 | 242,035 | 244,609 | 247,300 |
| Restaurant/Fast Food | 210,497 | 213,128 | 215,233 | 217,864 | 219,969 | 222,600 |
| Other Non-Residential | 138,571 | 140,080 | 141,589 | 143,224 | 144,733 | 146,367 |
| Total | 879,194 | 889,122 | 898,674 | 908,845 | 918,543 | 928,862 |

| Customer Class | TSS (lbs/year) | | | | | |
|--------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 243,813 | 246,535 | 249,258 | 251,980 | 254,839 | 257,562 |
| Multifamily | 32,387 | 32,665 | 33,082 | 33,360 | 33,777 | 34,194 |
| Overnight Accommodations | 218,585 | 220,987 | 223,389 | 225,900 | 228,302 | 230,813 |
| Restaurant/Fast Food | 58,261 | 58,989 | 59,572 | 60,300 | 60,883 | 61,611 |
| Other Non-Residential | 129,333 | 130,741 | 132,150 | 133,676 | 135,084 | 136,610 |
| Total | 682,379 | 689,917 | 697,451 | 705,216 | 712,885 | 720,790 |

| Customer Class | Weighted Average (lbs/year) | | | | | |
|--------------------------|-----------------------------|----------------|----------------|----------------|----------------|----------------|
| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
| Residential | 252,521 | 255,340 | 258,160 | 260,980 | 263,941 | 266,761 |
| Multifamily | 33,544 | 33,832 | 34,264 | 34,552 | 34,984 | 35,415 |
| Overnight Accommodations | 226,392 | 228,879 | 231,367 | 233,968 | 236,456 | 239,057 |
| Restaurant/Fast Food | 134,379 | 136,059 | 137,403 | 139,082 | 140,426 | 142,106 |
| Other Non-Residential | 133,952 | 135,411 | 136,870 | 138,450 | 139,909 | 141,489 |
| | - | - | - | - | - | - |
| Total | 780,787 | 789,520 | 798,063 | 807,031 | 815,714 | 824,826 |

Table A9
Moab City - Sewer Rate Study
Impact Fee Revenue

| Size of Meter | Projected FYE 2017 | Projected FYE 2018 | Projected FYE 2019 | Projected FYE 2020 | Projected FYE 2021 | Projected FYE 2022 |
|---------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Collections Impact Fee | \$83,891 | \$85,067 | \$122,044 | \$144,637 | \$147,367 | \$148,681 |
| Treatment Impact Fee | \$104,678 | \$106,427 | \$205,960 | \$258,232 | \$263,620 | \$265,651 |
| Total Impact Fee Revenue | \$188,569 | \$191,494 | \$328,003 | \$402,869 | \$410,987 | \$414,332 |

Table A10
Moab City - Sewer Rate Study
Non-Rate Revenue (Including Impact Fees)

| Assumed Inflation Rate = 3.0% | | | | | | |
|--|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Item | Projected FYE 2017 | Projected FYE 2018 | Projected FYE 2019 | Projected FYE 2020 | Projected FYE 2021 | Projected FYE 2022 |
| <i>Operations Non-Rate Revenue</i> | | | | | | |
| GWSSA Sewer Sales | \$296,157 | \$442,821 | \$464,107 | \$512,925 | \$536,720 | \$561,422 |
| Special Services | \$1,500 | \$1,562 | \$1,626 | \$1,692 | \$1,762 | \$1,834 |
| Septage Sales | \$76,755 | \$241,341 | \$247,302 | \$252,057 | \$258,342 | \$264,836 |
| Sewer Connections | \$8,000 | \$8,328 | \$8,669 | \$9,025 | \$9,395 | \$9,780 |
| Total Operations Non-Rate Revenue | \$382,412 | \$694,052 | \$721,704 | \$775,699 | \$806,219 | \$837,871 |
| <i>Non-Operations Non-Rate Revenue</i> | | | | | | |
| Impact Fees | \$188,569 | \$191,494 | \$328,003 | \$402,869 | \$410,987 | \$414,332 |
| Finance Charges & Other Income | \$22,400 | \$23,318 | \$24,274 | \$25,270 | \$26,306 | \$27,384 |
| Total Non-Operations Non-Rate Revenue | \$210,969 | \$214,813 | \$352,278 | \$428,138 | \$437,293 | \$441,716 |
| Total Non-Rate Revenue | \$593,381 | \$908,865 | \$1,073,982 | \$1,203,837 | \$1,243,511 | \$1,279,587 |

Table A11
Moab City - Sewer Rate Study
Revenue Requirements
Cash Basis

| Item | Projected FYE 2017 | Projected FYE 2018 | Projected FYE 2019 | Projected FYE 2020 | Projected FYE 2021 | Projected FYE 2022 |
|-------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <i>Sewer Treatment Expenses</i> | | | | | | |
| General | \$190,000 | \$196,745 | \$203,729 | \$210,962 | \$218,451 | \$226,206 |
| Salaries & Wages | \$138,579 | \$193,499 | \$200,368 | \$207,481 | \$214,846 | \$222,473 |
| Employee Benefits | \$104,702 | \$123,419 | \$127,800 | \$132,337 | \$137,035 | \$141,900 |
| Overtime | \$8,000 | \$8,284 | \$8,578 | \$8,883 | \$9,198 | \$9,524 |
| Subscriptions & Memberships | \$4,600 | \$4,763 | \$4,932 | \$5,107 | \$5,289 | \$5,477 |
| Travel | \$2,500 | \$2,589 | \$2,681 | \$2,776 | \$2,874 | \$2,976 |
| Office Expenses & Supplies | \$2,000 | \$2,071 | \$2,145 | \$2,221 | \$2,299 | \$2,381 |
| Equipment Supplies & Maintenance | \$50,500 | \$52,293 | \$54,149 | \$56,071 | \$58,062 | \$60,123 |
| Building Supplies & Maintenance | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| Utilities & Telephone | \$57,700 | \$109,748 | \$113,644 | \$117,679 | \$121,856 | \$126,182 |
| Equipment & Property Rental | \$2,500 | \$2,589 | \$2,681 | \$2,776 | \$2,874 | \$2,976 |
| Fuel | \$12,000 | \$12,426 | \$12,867 | \$13,324 | \$13,797 | \$14,287 |
| Shipping/Freight | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| <i>Sewer Collections Expenses</i> | | | | | | |
| Capital Lease | \$21,600 | \$22,367 | \$23,161 | \$23,983 | \$24,834 | \$25,716 |
| Salaries & Wages | \$139,798 | \$144,761 | \$149,900 | \$155,221 | \$160,732 | \$166,438 |
| Employee Benefits | \$95,910 | \$99,315 | \$102,840 | \$106,491 | \$110,272 | \$114,186 |
| Overtime | \$6,000 | \$6,213 | \$6,434 | \$6,662 | \$6,898 | \$7,143 |
| Subscriptions & Memberships | \$1,560 | \$1,615 | \$1,673 | \$1,732 | \$1,794 | \$1,857 |
| Travel | \$2,700 | \$2,796 | \$2,895 | \$2,998 | \$3,104 | \$3,215 |
| Office Expenses & Supplies | \$1,500 | \$1,553 | \$1,608 | \$1,665 | \$1,725 | \$1,786 |
| Equipment Supplies & Maintenance | \$30,000 | \$31,065 | \$32,168 | \$33,310 | \$34,492 | \$35,717 |
| Building Supplies & Maintenance | \$2,000 | \$2,071 | \$2,145 | \$2,221 | \$2,299 | \$2,381 |
| Utilities & Telephone | \$6,100 | \$6,317 | \$6,541 | \$6,773 | \$7,013 | \$7,262 |
| Equipment Rental | \$5,000 | \$5,178 | \$5,361 | \$5,552 | \$5,749 | \$5,953 |
| Fuel | \$8,000 | \$8,284 | \$8,578 | \$8,883 | \$9,198 | \$9,524 |
| Professional & Technical Services | \$33,500 | \$34,689 | \$35,921 | \$37,196 | \$38,516 | \$39,884 |
| Education | \$6,350 | \$6,575 | \$6,809 | \$7,051 | \$7,301 | \$7,560 |
| Freight | \$1,500 | \$1,553 | \$1,608 | \$1,665 | \$1,725 | \$1,786 |
| Special Departmental Supplies | \$39,500 | \$40,902 | \$42,354 | \$43,858 | \$45,415 | \$47,027 |
| Total O&M | \$984,099 | \$1,134,035 | \$1,174,293 | \$1,215,980 | \$1,259,147 | \$1,303,847 |
| <i>Debt Service</i> | | | | | | |
| Potential 2017 Treatment Plant Loan | \$0 | \$798,834 | \$798,834 | \$798,834 | \$798,834 | \$798,834 |
| Potential 2019 South Trunk Loan | \$0 | \$0 | \$0 | \$78,758 | \$78,758 | \$78,758 |
| Total Debt Service | \$0 | \$798,834 | \$798,834 | \$877,592 | \$877,592 | \$877,592 |

| Item | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| <i>Expansion and Replacement</i> | | | | | | |
| Collection - Rehabilitation & Replacement | \$0 | \$0 | \$0 | \$669,941 | \$300,839 | \$710,741 |
| Loaned Treatment Plant Capital Costs | \$3,900,000 | \$10,300,000 | \$0 | \$0 | \$0 | \$0 |
| Non-Loaned Treatment Plant Capital Costs | \$1,320,595 | \$0 | \$0 | \$0 | \$0 | \$0 |
| New South Trunk Pipeline | \$0 | \$300,000 | \$1,800,000 | \$0 | \$0 | \$0 |
| Replace 400 East Trunk Pipeline | \$0 | \$0 | \$0 | \$0 | \$389,200 | \$0 |
| Sewer Lift Station Pump | \$8,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| SCADA Upgrades | \$40,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Building Project | \$100,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Sewer Master Plan | \$70,000 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Loan Proceeds | (\$3,900,000) | (\$10,300,000) | (\$1,400,000) | \$0 | \$0 | \$0 |
| Transfer to/(from) Reserve Fund | (\$991,082) | (\$185,931) | \$81,747 | \$3,649 | \$68,644 | \$57,660 |
| Total Capital Outlays | \$547,513 | \$114,069 | \$481,747 | \$673,591 | \$758,684 | \$768,400 |
| Total Revenue Requirements | \$1,531,612 | \$2,046,937 | \$2,454,874 | \$2,767,163 | \$2,895,423 | \$2,949,840 |
| LESS: | | | | | | |
| Operations Non-Rate Revenue | \$382,412 | \$694,052 | \$721,704 | \$775,699 | \$806,219 | \$837,871 |
| Non-Operations Non-Rate Revenue | \$210,969 | \$214,813 | \$352,278 | \$428,138 | \$437,293 | \$441,716 |
| Net Revenue Requirements | \$ 938,231 | \$ 1,138,073 | \$ 1,380,892 | \$ 1,563,326 | \$ 1,651,912 | \$ 1,670,252 |

Table A12
Moab City - Sewer Rate Study
Cost Allocation Percentages to Service Characteristics

| Item | Volume | Capacity | Strength | Customer | Total |
|-----------------------------------|--------|----------|----------|----------|-------|
| <i>Sewer Treatment Expenses</i> | | | | | |
| General | 30% | 40% | 15% | 15% | 100% |
| Salaries & Wages | 30% | 40% | 15% | 15% | 100% |
| Employee Benefits | 30% | 40% | 15% | 15% | 100% |
| Overtime | 30% | 40% | 15% | 15% | 100% |
| Subscriptions & Memberships | 10% | 0% | 10% | 80% | 100% |
| Travel | 10% | 0% | 10% | 80% | 100% |
| Office Expenses & Supplies | 10% | 0% | 10% | 80% | 100% |
| Equipment Supplies & Maintenance | 30% | 35% | 20% | 15% | 100% |
| Building Supplies & Maintenance | 30% | 45% | 10% | 15% | 100% |
| Utilities & Telephone | 50% | 15% | 20% | 15% | 100% |
| Equipment & Property Rental | 40% | 25% | 20% | 15% | 100% |
| Fuel | 30% | 25% | 30% | 15% | 100% |
| Shipping/Freight | 30% | 25% | 30% | 15% | 100% |
| <i>Sewer Collections Expenses</i> | | | | | |
| Capital Lease | 40% | 30% | 0% | 30% | 100% |
| Salaries & Wages | 30% | 50% | 0% | 20% | 100% |
| Employee Benefits | 40% | 40% | 0% | 20% | 100% |
| Overtime | 40% | 40% | 0% | 20% | 100% |
| Subscriptions & Memberships | 20% | 10% | 0% | 70% | 100% |
| Travel | 20% | 10% | 0% | 70% | 100% |
| Office Expenses & Supplies | 0% | 0% | 0% | 100% | 100% |
| Equipment Supplies & Maintenance | 40% | 45% | 0% | 15% | 100% |
| Building Supplies & Maintenance | 40% | 45% | 0% | 15% | 100% |
| Utilities & Telephone | 40% | 30% | 0% | 30% | 100% |
| Equipment Rental | 50% | 35% | 0% | 15% | 100% |
| Fuel | 50% | 35% | 0% | 15% | 100% |
| Professional & Technical Services | 40% | 45% | 0% | 15% | 100% |
| Education | 50% | 20% | 0% | 30% | 100% |
| Freight | 50% | 35% | 0% | 15% | 100% |
| Special Departmental Supplies | 40% | 30% | 0% | 30% | 100% |

Table A13
Moab City - Sewer Rate Study
Fixed Assets Allocations to Service Characteristics

| Item | Percent | | | | | | Allocated Amount | | | | |
|-----------------------------|---------------------|--------|----------|----------|----------|-------|--------------------|---------------------|--------------------|--------------------|---------------------|
| | Assets | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total |
| Collection System (20 year) | \$9,031,460 | 5% | 75% | 0% | 20% | 100% | \$451,573 | \$6,773,595 | \$0 | \$1,806,292 | \$9,031,460 |
| Treatment Plant | \$12,504,000 | 10% | 35% | 35% | 20% | 100% | \$1,250,400 | \$4,376,400 | \$4,376,400 | \$2,500,800 | \$12,504,000 |
| Total | \$21,535,460 | | | | | | \$1,701,973 | \$11,149,995 | \$4,376,400 | \$4,307,092 | \$21,535,460 |
| Percent | | | | | | | 7.9% | 51.8% | 20.3% | 20.0% | 100.0% |

Table A14
Moab City - Sewer Rate Study
Allocation of O&M Costs to Service Characteristics

| Item | FYE 2017 | | | | | FYE 2018 | | | | | FYE 2019 | | | | | FYE 2020 | | | | | FYE 2021 | | | | | FYE 2022 | | | | |
|-----------------------------------|------------------|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|------------------|--------------------|
| | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total |
| <i>Sewer Treatment Expenses</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| General | \$57,000 | \$76,000 | \$28,500 | \$28,500 | \$190,000 | \$59,024 | \$78,698 | \$29,512 | \$29,512 | \$196,745 | \$61,119 | \$81,492 | \$30,559 | \$30,559 | \$203,729 | \$63,289 | \$84,385 | \$31,644 | \$31,644 | \$210,962 | \$65,535 | \$87,380 | \$32,768 | \$32,768 | \$218,451 | \$67,862 | \$90,482 | \$33,931 | \$33,931 | \$226,206 |
| Salaries & Wages | \$41,574 | \$55,432 | \$20,787 | \$20,787 | \$138,579 | \$58,050 | \$77,399 | \$29,025 | \$29,025 | \$193,499 | \$60,110 | \$80,147 | \$30,055 | \$30,055 | \$200,368 | \$62,244 | \$82,992 | \$31,122 | \$31,122 | \$207,481 | \$64,454 | \$85,939 | \$32,227 | \$32,227 | \$214,846 | \$66,742 | \$88,989 | \$33,371 | \$33,371 | \$222,473 |
| Employee Benefits | \$31,411 | \$41,881 | \$15,705 | \$15,705 | \$104,702 | \$37,026 | \$49,368 | \$18,513 | \$18,513 | \$123,419 | \$38,340 | \$51,120 | \$19,170 | \$19,170 | \$127,800 | \$39,701 | \$52,935 | \$19,851 | \$19,851 | \$132,337 | \$41,111 | \$54,814 | \$20,555 | \$20,555 | \$137,035 | \$42,570 | \$56,760 | \$21,285 | \$21,285 | \$141,900 |
| Overtime | \$2,400 | \$3,200 | \$1,200 | \$1,200 | \$8,000 | \$2,485 | \$3,314 | \$1,243 | \$1,243 | \$8,284 | \$2,573 | \$3,431 | \$1,287 | \$1,287 | \$8,578 | \$2,665 | \$3,553 | \$1,332 | \$1,332 | \$8,883 | \$2,759 | \$3,679 | \$1,380 | \$1,380 | \$9,198 | \$2,857 | \$3,810 | \$1,429 | \$1,429 | \$9,524 |
| Subscriptions & Memberships | \$460 | \$0 | \$460 | \$3,680 | \$4,600 | \$476 | \$0 | \$476 | \$3,811 | \$4,763 | \$493 | \$0 | \$493 | \$3,946 | \$4,932 | \$511 | \$0 | \$511 | \$4,086 | \$5,107 | \$529 | \$0 | \$529 | \$4,231 | \$5,289 | \$548 | \$0 | \$548 | \$4,381 | \$5,477 |
| Travel | \$250 | \$0 | \$250 | \$2,000 | \$2,500 | \$259 | \$0 | \$259 | \$2,071 | \$2,589 | \$268 | \$0 | \$268 | \$2,145 | \$2,681 | \$278 | \$0 | \$278 | \$2,221 | \$2,776 | \$287 | \$0 | \$287 | \$2,299 | \$2,874 | \$298 | \$0 | \$298 | \$2,381 | \$2,976 |
| Office Expenses & Supplies | \$200 | \$0 | \$200 | \$1,600 | \$2,000 | \$207 | \$0 | \$207 | \$1,657 | \$2,071 | \$214 | \$0 | \$214 | \$1,716 | \$2,145 | \$222 | \$0 | \$222 | \$1,777 | \$2,221 | \$230 | \$0 | \$230 | \$1,840 | \$2,299 | \$238 | \$0 | \$238 | \$1,905 | \$2,381 |
| Equipment Supplies & Maintenance | \$15,150 | \$17,675 | \$10,100 | \$7,575 | \$50,500 | \$15,688 | \$18,302 | \$10,459 | \$7,844 | \$52,293 | \$16,245 | \$18,952 | \$10,830 | \$8,122 | \$54,149 | \$16,821 | \$19,625 | \$11,214 | \$8,411 | \$56,071 | \$17,419 | \$20,322 | \$11,612 | \$8,709 | \$58,062 | \$18,037 | \$21,043 | \$12,025 | \$9,018 | \$60,123 |
| Building Supplies & Maintenance | \$1,500 | \$2,250 | \$500 | \$750 | \$5,000 | \$1,553 | \$2,330 | \$518 | \$777 | \$5,178 | \$1,608 | \$2,413 | \$536 | \$804 | \$5,361 | \$1,665 | \$2,498 | \$555 | \$833 | \$5,552 | \$1,725 | \$2,587 | \$575 | \$862 | \$5,749 | \$1,786 | \$2,679 | \$595 | \$893 | \$5,953 |
| Utilities & Telephone | \$28,850 | \$8,655 | \$11,540 | \$8,655 | \$57,700 | \$54,874 | \$16,462 | \$21,950 | \$16,462 | \$109,748 | \$56,822 | \$17,047 | \$22,729 | \$17,047 | \$113,644 | \$58,839 | \$17,652 | \$23,536 | \$17,652 | \$117,679 | \$60,928 | \$18,278 | \$24,371 | \$18,278 | \$121,856 | \$63,091 | \$18,927 | \$25,236 | \$18,927 | \$126,182 |
| Equipment & Property Rental | \$1,000 | \$625 | \$500 | \$375 | \$2,500 | \$1,036 | \$647 | \$518 | \$388 | \$2,589 | \$1,072 | \$670 | \$536 | \$402 | \$2,641 | \$1,110 | \$694 | \$555 | \$416 | \$2,776 | \$1,150 | \$719 | \$575 | \$431 | \$2,874 | \$1,191 | \$744 | \$595 | \$446 | \$2,976 |
| Fuel | \$3,600 | \$3,000 | \$3,600 | \$1,800 | \$12,000 | \$3,728 | \$3,107 | \$3,728 | \$1,864 | \$12,426 | \$3,860 | \$3,217 | \$3,860 | \$1,930 | \$12,867 | \$3,997 | \$3,331 | \$3,997 | \$1,999 | \$13,324 | \$4,139 | \$3,449 | \$4,139 | \$2,070 | \$13,797 | \$4,286 | \$3,572 | \$4,286 | \$2,143 | \$14,287 |
| Shipping/Freight | \$1,500 | \$1,250 | \$1,500 | \$750 | \$5,000 | \$1,553 | \$1,294 | \$1,553 | \$777 | \$5,178 | \$1,608 | \$1,340 | \$1,608 | \$804 | \$5,361 | \$1,665 | \$1,388 | \$1,665 | \$833 | \$5,552 | \$1,725 | \$1,437 | \$1,725 | \$862 | \$5,749 | \$1,786 | \$1,488 | \$1,786 | \$893 | \$5,953 |
| <i>Sewer Collections Expenses</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Capital Lease | \$8,640 | \$6,480 | \$0 | \$6,480 | \$21,600 | \$8,947 | \$6,710 | \$0 | \$6,710 | \$22,367 | \$9,264 | \$6,948 | \$0 | \$6,948 | \$23,161 | \$9,593 | \$7,195 | \$0 | \$7,195 | \$23,983 | \$9,934 | \$7,450 | \$0 | \$7,450 | \$24,834 | \$10,286 | \$7,715 | \$0 | \$7,715 | \$25,716 |
| Salaries & Wages | \$41,939 | \$69,899 | \$0 | \$27,960 | \$139,798 | \$43,428 | \$72,380 | \$0 | \$28,952 | \$144,761 | \$44,970 | \$74,950 | \$0 | \$29,980 | \$149,900 | \$46,566 | \$77,611 | \$0 | \$31,044 | \$155,221 | \$48,219 | \$80,366 | \$0 | \$32,146 | \$160,732 | \$49,931 | \$83,219 | \$0 | \$33,288 | \$166,438 |
| Employee Benefits | \$38,364 | \$38,364 | \$0 | \$19,182 | \$95,910 | \$39,726 | \$39,726 | \$0 | \$19,863 | \$99,315 | \$41,136 | \$41,136 | \$0 | \$20,568 | \$102,840 | \$42,597 | \$42,597 | \$0 | \$21,298 | \$106,491 | \$44,109 | \$44,109 | \$0 | \$22,054 | \$110,272 | \$45,675 | \$45,675 | \$0 | \$22,837 | \$114,186 |
| Overtime | \$2,400 | \$2,400 | \$0 | \$1,200 | \$6,000 | \$2,485 | \$2,485 | \$0 | \$1,243 | \$6,213 | \$2,573 | \$2,573 | \$0 | \$1,287 | \$6,434 | \$2,665 | \$2,665 | \$0 | \$1,332 | \$6,662 | \$2,759 | \$2,759 | \$0 | \$1,380 | \$6,898 | \$2,857 | \$2,857 | \$0 | \$1,429 | \$7,143 |
| Subscriptions & Memberships | \$312 | \$156 | \$0 | \$1,092 | \$1,560 | \$323 | \$162 | \$0 | \$1,131 | \$1,615 | \$335 | \$167 | \$0 | \$1,171 | \$1,673 | \$346 | \$173 | \$0 | \$1,212 | \$1,732 | \$359 | \$179 | \$0 | \$1,256 | \$1,794 | \$371 | \$186 | \$0 | \$1,300 | \$1,857 |
| Travel | \$540 | \$270 | \$0 | \$1,890 | \$2,700 | \$559 | \$280 | \$0 | \$1,957 | \$2,796 | \$579 | \$290 | \$0 | \$2,027 | \$2,895 | \$600 | \$300 | \$0 | \$2,099 | \$2,998 | \$621 | \$310 | \$0 | \$2,173 | \$3,104 | \$643 | \$321 | \$0 | \$2,250 | \$3,215 |
| Office Expenses & Supplies | \$0 | \$0 | \$0 | \$1,500 | \$1,500 | \$0 | \$0 | \$0 | \$1,553 | \$1,553 | \$0 | \$0 | \$0 | \$1,608 | \$1,608 | \$0 | \$0 | \$0 | \$1,665 | \$1,665 | \$0 | \$0 | \$0 | \$1,725 | \$1,725 | \$0 | \$0 | \$0 | \$1,786 | \$1,786 |
| Equipment Supplies & Maintenance | \$12,000 | \$13,500 | \$0 | \$4,500 | \$30,000 | \$12,426 | \$13,979 | \$0 | \$4,660 | \$31,065 | \$12,867 | \$14,476 | \$0 | \$4,825 | \$32,168 | \$13,324 | \$14,989 | \$0 | \$4,996 | \$33,310 | \$13,797 | \$15,522 | \$0 | \$5,174 | \$34,492 | \$14,287 | \$16,073 | \$0 | \$5,358 | \$35,717 |
| Building Supplies & Maintenance | \$800 | \$900 | \$0 | \$300 | \$2,000 | \$828 | \$932 | \$0 | \$311 | \$2,071 | \$858 | \$965 | \$0 | \$322 | \$2,145 | \$888 | \$999 | \$0 | \$333 | \$2,221 | \$920 | \$1,035 | \$0 | \$345 | \$2,299 | \$952 | \$1,072 | \$0 | \$357 | \$2,381 |
| Utilities & Telephone | \$2,440 | \$1,830 | \$0 | \$1,830 | \$6,100 | \$2,527 | \$1,895 | \$0 | \$1,895 | \$6,317 | \$2,616 | \$1,962 | \$0 | \$1,962 | \$6,541 | \$2,709 | \$2,032 | \$0 | \$2,032 | \$6,773 | \$2,805 | \$2,104 | \$0 | \$2,104 | \$7,013 | \$2,905 | \$2,179 | \$0 | \$2,179 | \$7,262 |
| Equipment Rental | \$2,500 | \$1,750 | \$0 | \$750 | \$5,000 | \$2,589 | \$1,812 | \$0 | \$777 | \$5,178 | \$2,681 | \$1,876 | \$0 | \$804 | \$5,361 | \$2,776 | \$1,943 | \$0 | \$833 | \$5,552 | \$2,874 | \$2,012 | \$0 | \$862 | \$5,749 | \$2,976 | \$2,083 | \$0 | \$893 | \$5,953 |
| Fuel | \$4,000 | \$2,800 | \$0 | \$1,200 | \$8,000 | \$4,142 | \$2,899 | \$0 | \$1,243 | \$8,284 | \$4,289 | \$3,002 | \$0 | \$1,287 | \$8,578 | \$4,441 | \$3,109 | \$0 | \$1,332 | \$8,883 | \$4,599 | \$3,219 | \$0 | \$1,380 | \$9,198 | \$4,762 | \$3,334 | \$0 | \$1,429 | \$9,524 |
| Professional & Technical Services | \$13,400 | \$15,075 | \$0 | \$5,025 | \$33,500 | \$13,876 | \$15,610 | \$0 | \$5,203 | \$34,689 | \$14,368 | \$16,164 | \$0 | \$5,388 | \$35,921 | \$14,878 | \$16,738 | \$0 | \$5,579 | \$37,196 | \$15,407 | \$17,332 | \$0 | \$5,777 | \$38,516 | \$15,953 | \$17,948 | \$0 | \$5,983 | \$39,884 |
| Education | \$3,175 | \$1,270 | \$0 | \$1,905 | \$6,350 | \$3,288 | \$1,315 | \$0 | \$1,973 | \$6,575 | \$3,404 | \$1,362 | \$0 | \$2,043 | \$6,809 | \$3,525 | \$1,410 | \$0 | \$2,115 | \$7,051 | \$3,650 | \$1,460 | \$0 | \$2,190 | \$7,301 | \$3,780 | \$1,512 | \$0 | \$2,268 | \$7,560 |
| Freight | \$750 | \$525 | \$0 | \$225 | \$1,500 | \$777 | \$544 | \$0 | \$233 | \$1,553 | \$804 | \$563 | \$0 | \$241 | \$1,608 | \$833 | \$583 | \$0 | \$250 | \$1,665 | \$862 | \$604 | \$0 | \$259 | \$1,725 | \$893 | \$625 | \$0 | \$268 | \$1,786 |
| Special Departmental Supplies | \$15,800 | \$11,850 | \$0 | \$11,850 | \$39,500 | \$16,361 | \$12,271 | \$0 | \$12,271 | \$40,902 | \$16,942 | \$12,706 | \$0 | \$12,706 | \$42,354 | \$17,543 | \$13,157 | \$0 | \$13,157 | \$43,858 | \$18,166 | \$13,624 | \$0 | \$13,624 | \$45,415 | \$18,811 | \$14,108 | \$0 | \$14,108 | \$47,027 |
| Total | \$331,955 | \$377,036 | \$94,842 | \$180,266 | \$984,099 | \$388,239 | \$423,921 | \$117,959 | \$203,915 | \$1,134,035 | \$402,022 | \$438,970 | \$122,147 | \$211,154 | \$1,174,293 | \$416,293 | \$454,554 | \$126,483 | \$218,650 | \$1,215,980 | \$431,072 | \$470,691 | \$130,973 | \$226,412 | \$1,259,147 | \$446,375 | \$487,400 | \$135,622 | \$234,450 | \$1,303,847 |
| Percent | 33.7% | 38.3% | 9.6% | 18.3% | 100.0% | 34.2% | 37.4% | 10.4% | 18.0% | 100.0% | 34.2% | 37.4% | 10.4% | 18.0% | 100.0% | 34.2% | 37.4% | 10.4% | 18.0% | 100.0% | 34.2% | 37.4% | 10.4% | 18.0% | 100.0% | 34.2% | 37.4% | 10.4% | 18.0% | 100.0% |

Table A15
Moab City - Sewer Rate Study
Revenue Requirements by Service Characteristics

| Item | FYE 2017 | | | | | FYE 2018 | | | | | FYE 2019 | | | | | FYE 2020 | | | | | FYE 2021 | | | | | FYE 2022 | | | | |
|-----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-----------|-------------|
| | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total | Volume | Capacity | Strength | Customer | Total |
| O&M | \$331,955 | \$377,036 | \$94,842 | \$180,266 | \$984,099 | \$388,239 | \$423,921 | \$117,959 | \$203,915 | \$1,134,035 | \$402,022 | \$438,970 | \$122,147 | \$211,154 | \$1,174,293 | \$416,293 | \$454,554 | \$126,483 | \$218,650 | \$1,215,980 | \$431,072 | \$470,691 | \$130,973 | \$226,412 | \$1,259,147 | \$446,375 | \$487,400 | \$135,622 | \$234,450 | \$1,303,847 |
| Debt Service | \$0 | \$0 | \$0 | \$0 | \$0 | \$63,133 | \$413,597 | \$162,338 | \$159,767 | \$798,834 | \$63,133 | \$413,597 | \$162,338 | \$159,767 | \$798,834 | \$69,357 | \$454,374 | \$178,343 | \$175,518 | \$877,592 | \$69,357 | \$454,374 | \$178,343 | \$175,518 | \$877,592 | \$69,357 | \$454,374 | \$178,343 | \$175,518 | \$877,592 |
| Capital Outlays | \$43,271 | \$283,475 | \$111,265 | \$109,503 | \$547,513 | \$9,015</ | | | | | | | | | | | | | | | | | | | | | | | | |

Table A17
Moab City - Sewer Rate Study
Existing Rate and Projected Revenue at the Existing Rate

| Base Rate / Month | Existing | Accounts | ERUs | Effective Rate Per ERU |
|--------------------------|----------|----------|-------|------------------------|
| Residential | \$ 14.40 | 1,772 | 1,772 | \$ 14.40 |
| Multifamily | \$ 19.10 | 414 | 230 | \$ 34.38 |
| Overnight Accommodations | \$ 19.10 | 61 | 1,980 | \$ 0.59 |
| Restaurant/Fast Food | \$ 19.10 | 43 | 396 | \$ 2.07 |
| Other Non-Residential | \$ 19.10 | 199 | 1,090 | \$ 3.49 |

| Volume Rate / kgal | Existing | | | |
|--------------------------|----------|--|--|--|
| Residential | \$ 1.70 | | | |
| Multifamily | \$ 1.85 | | | |
| Overnight Accommodations | \$ 1.85 | | | |
| Restaurant/Fast Food | \$ 1.85 | | | |
| Other Non-Residential | \$ 1.85 | | | |

| Meter Size | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|------------|------------|------------|------------|------------|------------|
| Residential | \$ 309,485 | \$ 312,941 | \$ 316,397 | \$ 319,853 | \$ 323,482 | \$ 326,938 |
| Multifamily | \$ 96,126 | \$ 96,952 | \$ 98,189 | \$ 99,014 | \$ 100,252 | \$ 101,490 |
| Overnight Accommodations | \$ 14,137 | \$ 14,292 | \$ 14,447 | \$ 14,610 | \$ 14,765 | \$ 14,927 |
| Restaurant/Fast Food | \$ 9,955 | \$ 10,080 | \$ 10,179 | \$ 10,304 | \$ 10,403 | \$ 10,528 |
| Other Non-Residential | \$ 46,113 | \$ 46,615 | \$ 47,117 | \$ 47,661 | \$ 48,163 | \$ 48,707 |

| | FYE 2017 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|------------|------------|------------|------------|------------|------------|
| Residential | \$ 158,206 | \$ 159,972 | \$ 161,739 | \$ 163,506 | \$ 165,361 | \$ 167,127 |
| Multifamily | \$ 22,870 | \$ 23,066 | \$ 23,360 | \$ 23,557 | \$ 23,851 | \$ 24,146 |
| Overnight Accommodations | \$ 154,350 | \$ 156,047 | \$ 157,743 | \$ 159,516 | \$ 161,212 | \$ 162,985 |
| Restaurant/Fast Food | \$ 35,663 | \$ 36,109 | \$ 36,466 | \$ 36,911 | \$ 37,268 | \$ 37,714 |
| Other Non-Residential | \$ 91,327 | \$ 92,321 | \$ 93,316 | \$ 94,393 | \$ 95,388 | \$ 96,465 |

Table A18
Moab City - Sewer Rate Study
Calculated Rates (Cost of Service)

| Monthly Account Base Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---------------------------|----------|----------|----------|----------|----------|
| Residential | \$ 7.16 | \$ 8.65 | \$ 9.74 | \$ 10.19 | \$ 10.18 |
| Multifamily | \$ 7.16 | \$ 8.65 | \$ 9.74 | \$ 10.19 | \$ 10.18 |
| Overnight Accommodations | \$ 7.16 | \$ 8.65 | \$ 9.74 | \$ 10.19 | \$ 10.18 |
| Restaurant/Fast Food | \$ 7.16 | \$ 8.65 | \$ 9.74 | \$ 10.19 | \$ 10.18 |
| Other Non-Residential | \$ 7.16 | \$ 8.65 | \$ 9.74 | \$ 10.19 | \$ 10.18 |

| Monthly ERU Base Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|----------|----------|----------|----------|----------|
| Residential | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |
| Multifamily | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |
| Overnight Accommodations | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |
| Restaurant/Fast Food | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |
| Other Non-Residential | \$7.84 | \$9.58 | \$10.88 | \$11.40 | \$11.38 |

| Volume Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|----------|----------|----------|----------|----------|
| Volume Component | | | | | |
| Residential | \$ 0.79 | \$ 0.87 | \$ 0.90 | \$ 0.93 | \$ 0.94 |
| Multifamily | \$ 0.79 | \$ 0.87 | \$ 0.90 | \$ 0.93 | \$ 0.94 |
| Overnight Accommodations | \$ 0.79 | \$ 0.87 | \$ 0.90 | \$ 0.93 | \$ 0.94 |
| Restaurant/Fast Food | \$ 0.79 | \$ 0.87 | \$ 0.90 | \$ 0.93 | \$ 0.94 |
| Other Non-Residential | \$ 0.79 | \$ 0.87 | \$ 0.90 | \$ 0.93 | \$ 0.94 |

| Strength Component | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|----------|----------|----------|----------|----------|
| Residential | \$ 0.64 | \$ 0.80 | \$ 0.92 | \$ 0.97 | \$ 0.96 |
| Multifamily | \$ 0.64 | \$ 0.80 | \$ 0.92 | \$ 0.97 | \$ 0.96 |
| Overnight Accommodations | \$ 0.64 | \$ 0.80 | \$ 0.92 | \$ 0.97 | \$ 0.96 |
| Restaurant/Fast Food | \$ 1.66 | \$ 2.06 | \$ 2.37 | \$ 2.48 | \$ 2.48 |
| Other Non-Residential | \$ 0.64 | \$ 0.80 | \$ 0.92 | \$ 0.97 | \$ 0.96 |

| Total Volume Rate | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|----------|----------|----------|----------|----------|
| Residential | \$ 1.44 | \$ 1.67 | \$ 1.82 | \$ 1.90 | \$ 1.90 |
| Multifamily | \$ 1.44 | \$ 1.67 | \$ 1.82 | \$ 1.90 | \$ 1.90 |
| Overnight Accommodations | \$ 1.44 | \$ 1.67 | \$ 1.82 | \$ 1.90 | \$ 1.90 |
| Restaurant/Fast Food | \$ 2.45 | \$ 2.93 | \$ 3.27 | \$ 3.41 | \$ 3.41 |
| Other Non-Residential | \$ 1.44 | \$ 1.67 | \$ 1.82 | \$ 1.90 | \$ 1.90 |

Table A19
Moab City - Sewer Rate Study
Recommended Rates

| Monthly Base Rate | Existing FYE 2017 | Adopted 2018 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|---|-------------------|--------------|----------|----------|----------|----------|----------|
| Single Family | \$14.40 | \$17.28 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| Multifamily 1st Unit (2 Bedrooms or Larger) | \$19.10 | \$22.92 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Multifamily 1st Unit (1 Bedroom or Smaller) | \$19.10 | \$22.92 | \$14.60 | \$15.80 | \$17.00 | \$16.55 | \$16.55 |
| + Charge per each additional unit | - | - | \$1.60 | \$4.10 | \$5.50 | \$6.40 | \$6.40 |
| Overnight Accommodations: 1st Unit With Kitchen, 2 Bedrooms or Larger | \$19.10 | \$22.92 | \$16.40 | \$20.45 | \$23.25 | \$23.85 | \$23.85 |
| + Charge per each additional unit | - | - | \$3.40 | \$8.80 | \$11.75 | \$13.65 | \$13.65 |
| Overnight Accommodations: 1st Unit With Kitchen, 1 Bedroom or Smaller | \$19.10 | \$22.92 | \$15.85 | \$19.00 | \$21.30 | \$21.55 | \$21.55 |
| + Charge per each additional unit | - | - | \$2.80 | \$7.35 | \$9.80 | \$11.40 | \$11.40 |
| Overnight Accommodations: 1st Unit Hotel/Motel (No Kitchen) | \$19.10 | \$22.92 | \$15.25 | \$17.40 | \$19.15 | \$19.10 | \$19.10 |
| + Charge per each additional unit | - | - | \$2.20 | \$5.75 | \$7.65 | \$8.90 | \$8.90 |
| Restaurant/Fast Food and Other Non-Residential: 1-inch or smaller water meter | \$19.10 | \$22.92 | \$19.10 | \$19.10 | \$21.30 | \$21.55 | \$21.55 |
| 1.5-inch water meter | - | - | \$19.10 | \$21.75 | \$24.40 | \$24.80 | \$24.80 |
| 2-inch water meter | - | - | \$24.25 | \$29.30 | \$32.95 | \$33.75 | \$33.75 |
| 3-inch water meter | - | - | \$69.60 | \$84.75 | \$95.90 | \$99.65 | \$99.65 |
| 4-inch water meter | - | - | \$86.40 | \$105.25 | \$119.25 | \$124.10 | \$124.10 |
| 5-inch water meter | - | - | \$125.60 | \$153.20 | \$173.65 | \$181.05 | \$181.05 |
| 6-inch water meter | - | - | \$170.45 | \$207.95 | \$235.80 | \$246.10 | \$246.10 |
| 8-inch water meter | - | - | \$232.25 | \$283.55 | \$321.65 | \$335.95 | \$335.95 |

| Volume Rate (\$/kgal) | Existing FYE 2017 | Adopted 2018 | FYE 2018 | FYE 2019 | FYE 2020 | FYE 2021 | FYE 2022 |
|--------------------------|-------------------|--------------|----------|----------|----------|----------|----------|
| Residential | \$1.70 | \$2.04 | \$1.70 | \$1.70 | \$1.82 | \$1.90 | \$1.90 |
| Multifamily | \$1.85 | \$2.22 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Overnight Accommodations | \$1.85 | \$2.22 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |
| Restaurant/Fast Food | \$1.85 | \$2.22 | \$2.22 | \$2.66 | \$3.20 | \$3.41 | \$3.41 |
| Other Non-Residential | \$1.85 | \$2.22 | \$1.85 | \$1.85 | \$1.85 | \$1.90 | \$1.90 |

Draper, Utah Office:
154 East 14000 South
Draper, Utah 84020
Phone: (801) 495-2224
Fax: (801) 495-2225

Eagle, Idaho Office:
776 East Riverside Drive
Suite 250
Eagle, Idaho 83616
Phone: (208) 939-9561
Fax: (208) 939-9571

St. George, Utah Office:
20 North Main
Suite 107
St. George, Utah 84770
Phone: (435) 656-3299
Fax: (435) 656-2190

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Bowen Collins
& Associates, Inc.
CONSULTING ENGINEERS

APPENDIX D

2017 Flow Monitoring Summary

TECHNICAL MEMORANDUM

TO: Chuck Williams
City Engineer
City of Moab

COPIES: Eric Johanson, Obe Tejada

FROM: Jeff Beckman, Keith Larson, Ben Kirk, Andrew McKinnon

DATE: October 10, 2017

SUBJECT: 2017 Flow Monitoring Summary

JOB NO.: 130-17-04

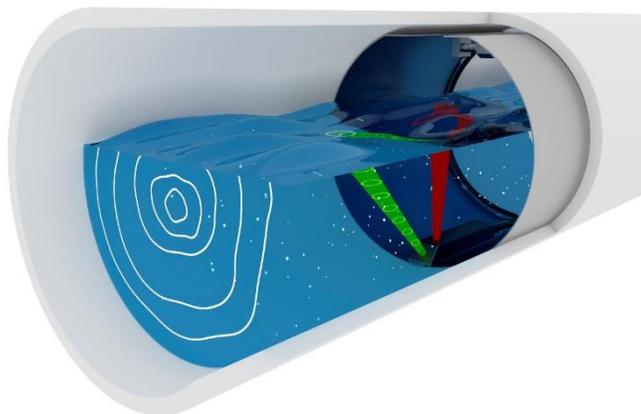
INTRODUCTION

As part of the City's Sanitary Sewer Master Plan, the City of Moab retained BC&A to perform flow monitoring to aid in calibration of the City's sanitary sewer hydraulic model. The purpose of this technical memorandum is to summarize the criteria used to select flow monitoring sites along with the results of flow monitoring.

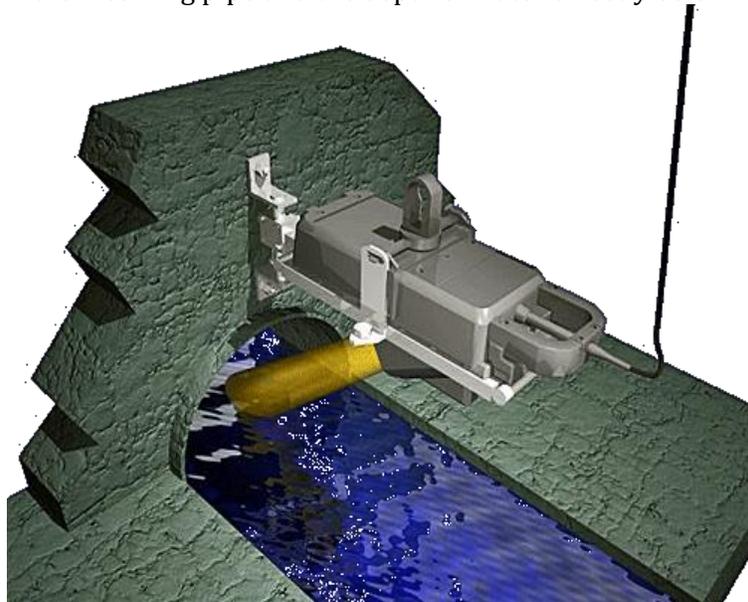
FLOW MONITORING TECHNOLOGY

Before selecting the sites for collecting flow monitoring data, BC&A reviewed various available flow monitoring technologies. The two technologies most commonly used for short-term flow monitoring (and available within the flow monitoring timing window for the study) included ultrasonic doppler velocity meters, and radar velocity meters.

- Ultrasonic Doppler Velocity Meters – This type of meter is inserted into the incoming pipe of a manhole upstream of the manhole trough with an insertion ring that expands to hug the pipe. The meter itself sits at the invert of flow and uses ultrasonic doppler waves to measure the movement of particles in the water.



- Advantages –
 - Velocity Profile - This type of meter measures the velocity of flow through most of the profile of water and represent a very good “average” velocity for flow due to the large area of measurement.
 - Calibration – Because the velocity is measured through the full profile of flow, this type of meter can be more reliable than other types of meters that do not measure the velocity through the full profile. In addition, by installing the meter inside of the incoming pipe, any poor hydraulics in the manhole that may affect flow measurements can be mitigated.
- Disadvantages –
 - Sediment and Debris – Because it sits at the invert of the pipe, there is a tendency for this type of meter to accumulate sediment or other debris. Once sediment and debris accumulates on the sensor, the velocity or depth measurements can begin to drift as the sensor is obscured. These limitations can be mitigated by frequent cleaning and re-calibration of the meter.
 - Minimum Depth – The sensors in this type of meter need a minimum depth of approximately one inch to adequately measure depth and the area of flow. This can limit the locations of where this type of meter will accurately measure flow.
- Radar Velocity Meters – This type of meter is inserted above the flow in a manhole with a radar sensor pointed up the incoming pipe. The radar sensor measures the surface velocity of water from the incoming pipe and the depth of water directly below it in the manhole.



- Advantages –
 - Non-Contact - Because it is located up and out of the flow, this type of meter can be installed and left alone for longer durations without cleaning or maintenance.
 - Versatility – Because these meters will measure almost any depth, they are well suited for small collection areas.

- Disadvantages –
 - Manhole Selection – Manhole selection for monitoring flow is extremely important for this meter due to the way depth versus velocity is measured. If the slope in the manhole is significantly different than the incoming pipe that is being measured, the depth/velocity relationship used for flow measurement can be disturbed. For proper readings, the trough of the manhole selected should match the shape of the incoming pipe as much as possible (slope, size, etc) and side lateral pipes should be avoided if possible to reduce interference in the manhole depth by other incoming flow. This may limit the locations where this type of meter can be installed.

Because of concerns about sediment/debris accumulation and the limited depth in some of the trunk lines of interest, radar velocity meters were selected as the preferred monitoring technology.

SITE SELECTION

BC&A coordinated with City of Moab personnel to identify the number and locations of flow monitoring sites. A minimum of 10 sites were recommended to represent overall flow distribution and characteristics in the Moab collection system with a focus around calibrating around the main trunk line leading to the City’s wastewater treatment plant. While selection of additional sites would have obviously added more detail, the number of sites selected represented a good balance of collecting sufficient flow data to adequately represent system flow characteristics while still staying within the allowable budget of the study. Several iterations of sites were proposed to Moab collection system personnel to identify the best locations for meter installation. BC&A reviewed photos of each manhole proposed and revised the selection of specific manholes when apparent flow characteristics looked inappropriate for meter installation. In addition, during field installation, a few additional modifications were made to the selected set of metered manholes in order to find more favorable conditions for flow monitoring. A map of each of the ten sites selected is located at the end of this memo.

The following sections contain specific information on each of the selected manholes:

MH 748 (600 S Kane Creek Blvd), MH 107 (600 S Main St), and MH 417 (150 E Grand County Middle)

These three sites were selected to monitor flow coming from Grand Water and Sewer Service Agency (GWSSA). They are all located downstream of some existing GWSSA’s sewer flumes. In recent years, there have been some accuracy concerns about data from the GWSSA flumes and these flow monitors were installed to resolve any concern about existing meter accuracy.

MH 114 (50 E 100 S)

This flow monitor site represents a large portion of flow that represents primarily residential neighborhoods in the eastern portion of the City.

MH 313 (500 W 300 N), MH 205 (290 W Walnut Ln)

These two flow monitor sites monitor the flow in the main trunk line that leads to the City’s wastewater treatment plant. One is before and one is after the connection from the Moab Regional Hospital. Two sites along the trunk line were installed to make sure an accurate reading of flow was available near this critical location. Having a site before and after the hospital was intended to

identify if there were any significant differences in flow patterns before and after this large institutional connection.

100 West & Center (MH 145)

For all locations, BC&A was able identify manholes that appeared appropriate for flow monitoring except along 100 West north of Mill Creek. In all cases, the manholes between Mill Creek and Walnut Lane along 100 West appear to have poor hydraulics. Most of the manholes between Mill Creek and along 100 West have relatively large side lateral connections that may disturb flow or depth of flow in the pipe of interest. Due to the relative importance of this location, a site at Center Street was recommended because only one smaller collection area from the west was identified as influencing the depth of flow in the manhole. Even this site was recognized as a mediocre site selection, but was the best available for this important pipeline.

MH 290 (500 West 400 North)

This site monitors the flow from a 10-inch connection from the east that includes both residential and institutional uses. This site discharges into the trunk line leading to the City’s treatment plant.

MH 472 (North of Treatment Plant), MH 28 (620 N Riversand Rd)

These two sites monitor a large percentage of the area of the City that contributes flow to the City’s main trunkline from the North. Both of these flow monitors collect a portion of the City that includes a large number of overnight accommodations.

MONITORING PERIOD

One goal of flow monitoring was to calibrate the City’s sanitary sewer hydraulic model for peak wastewater production periods in the City. Spring break and “Jeep Week” in the City of Moab typically represents some of the busiest times of year for tourism in the City. As a result, BC&A measured flow during the month of April to monitor any peak flow conditions represented by a peak tourism period. Five flow meter devices were used to measure flow between March 29, 2017 and April 12, 2017 at manholes at the south end of the City (MH 748, MH 107, MH 417, MH 114, MH 205). These same flow meters were relocated on April 12th to the remaining five locations (MH 313, MH 145, MH 290, MH 472, MH 28) to measure through May 3, 2017.

“Jeep Week” fell between April 8th and April 15th in 2017. Two weeks were monitored at each site with each weekend of “Jeep Week” recorded by either set of data. Other weeks during the month included spring break tourists from the various different school districts in the area. By recording at least two weeks at each site, it was possible to measure a reliable pattern of flow at each site representative of peak day conditions (including two weekends when tourism is at its highest).

FLOW MONITORING RESULTS

Table 1 summarizes key statistics for each flow monitoring site along with an assessment of data accuracy.

**Table 1
Summary of Flow Monitoring Results**

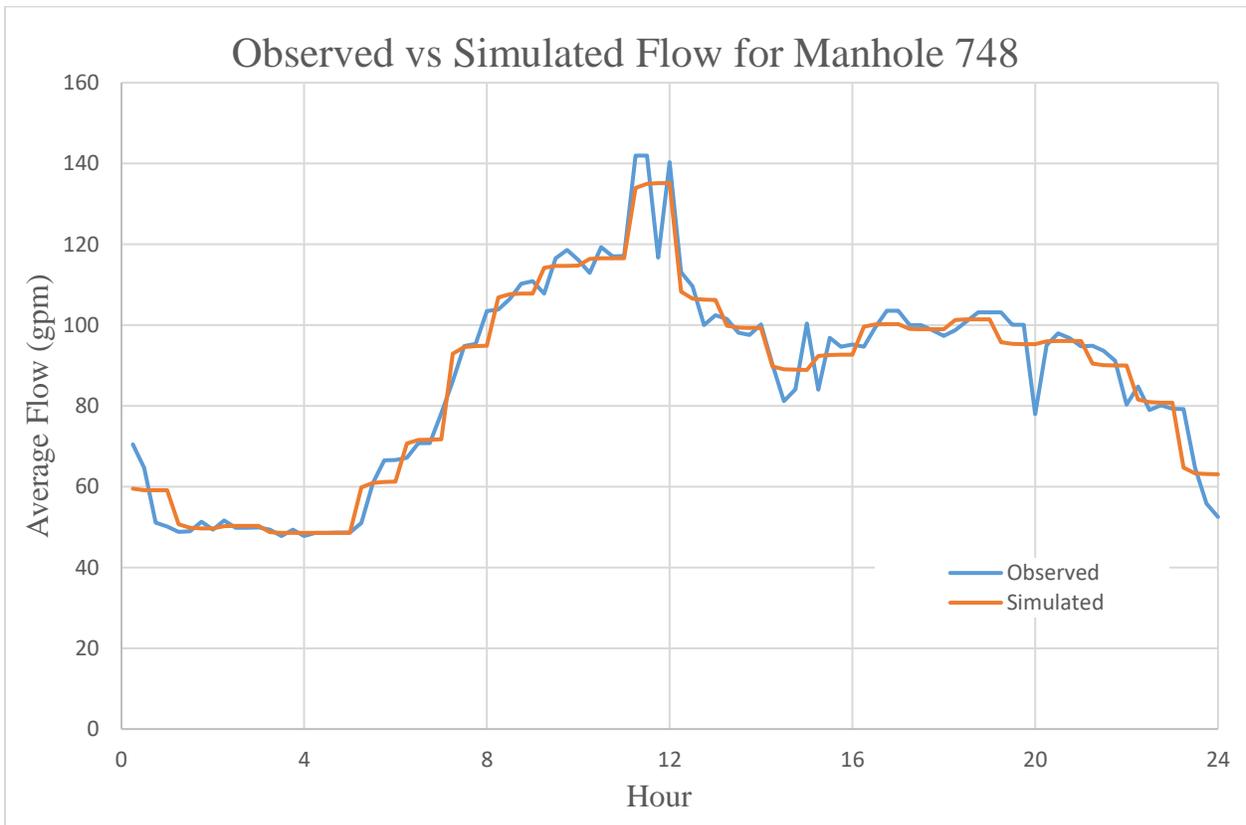
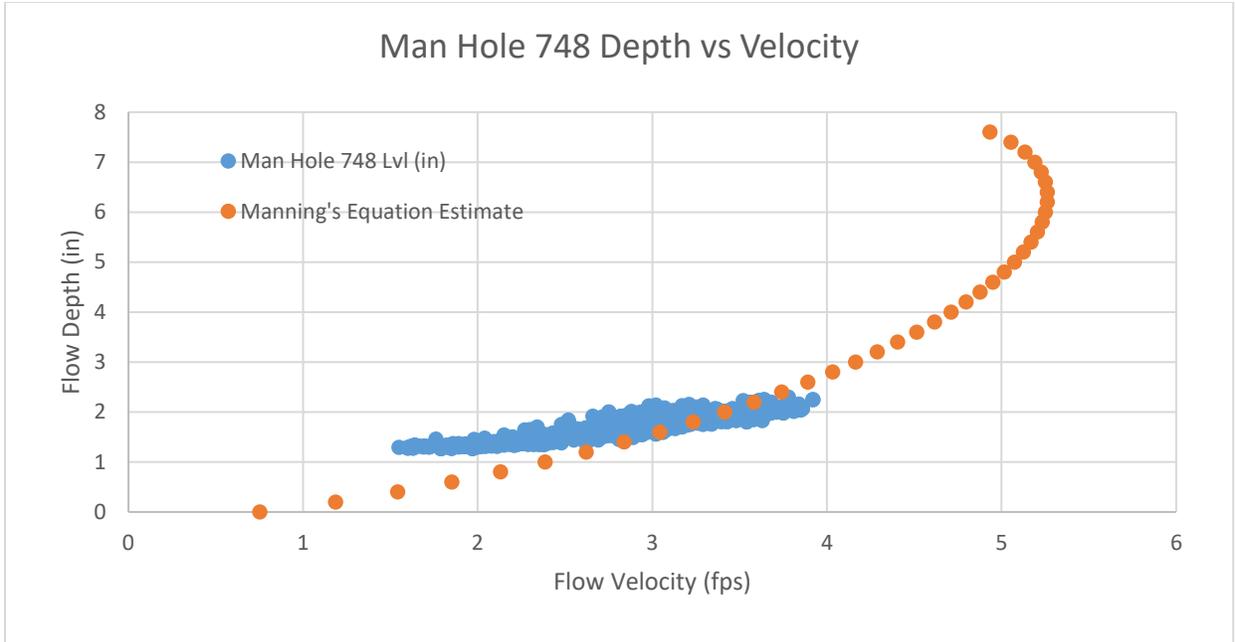
| Location | Collection Dates | Pipe Size (inch) | Average Calculated Flow (gpm) | Max Calculated Flow (gpm) | Max Depth to Diameter Ratio | Depth versus Velocity Consistency | Manning's Equation Correlation |
|------------------------------------|------------------|------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------------|--|
| MH 748 (600 S Kane Creek Blvd) | 29Mar - 12Apr | 8 | 81.4 | 142.0 | 0.29 | Good | Good |
| MH 107 (600 S Main St) | 29Mar - 12Apr | 10 | 101.2 | 177.7 | 0.25 | Good | Good |
| MH 417 (150 E Grand County Middle) | 29Mar - 12Apr | 12 | 170.9 | 417.3 | 0.37 | Good | Sediment or Backwater Effects Observed |
| MH 114 (50 E 100 S) | 29Mar - 12Apr | 10 | 95.0 | 175.4 | 0.21 | Good | Good |
| MH 205 (290 W Walnut Ln) | 29Mar - 12Apr | 18 | 592.4 | 923.6 | 0.43 | Good | Sediment or Backwater Effects Observed |
| MH 313 (500 W 300 N) | 12Apr - 3May | 18 | 713.2 | 1,310.3 | 0.38 | Good | Good |
| MH 145 (100 West & Center) | 12Apr - 3May | 15 | 679.6 | 1,004.9 | 0.90 | Poor | Very Little |
| MH 290 (500 W 400 N) | 12Apr - 3May | 10 | 50.9 | 160.1 | 0.28 | Good | Good |
| MH 472 (North of Treatment Plant) | 12Apr - 3May | 18 | 83.2 | 202.2 | 0.16 | Good | Good |
| MH 28 (620 N Riversand Rd) | 12Apr - 3May | 18 | 93.9 | 189.3 | 0.13 | Good | Good |

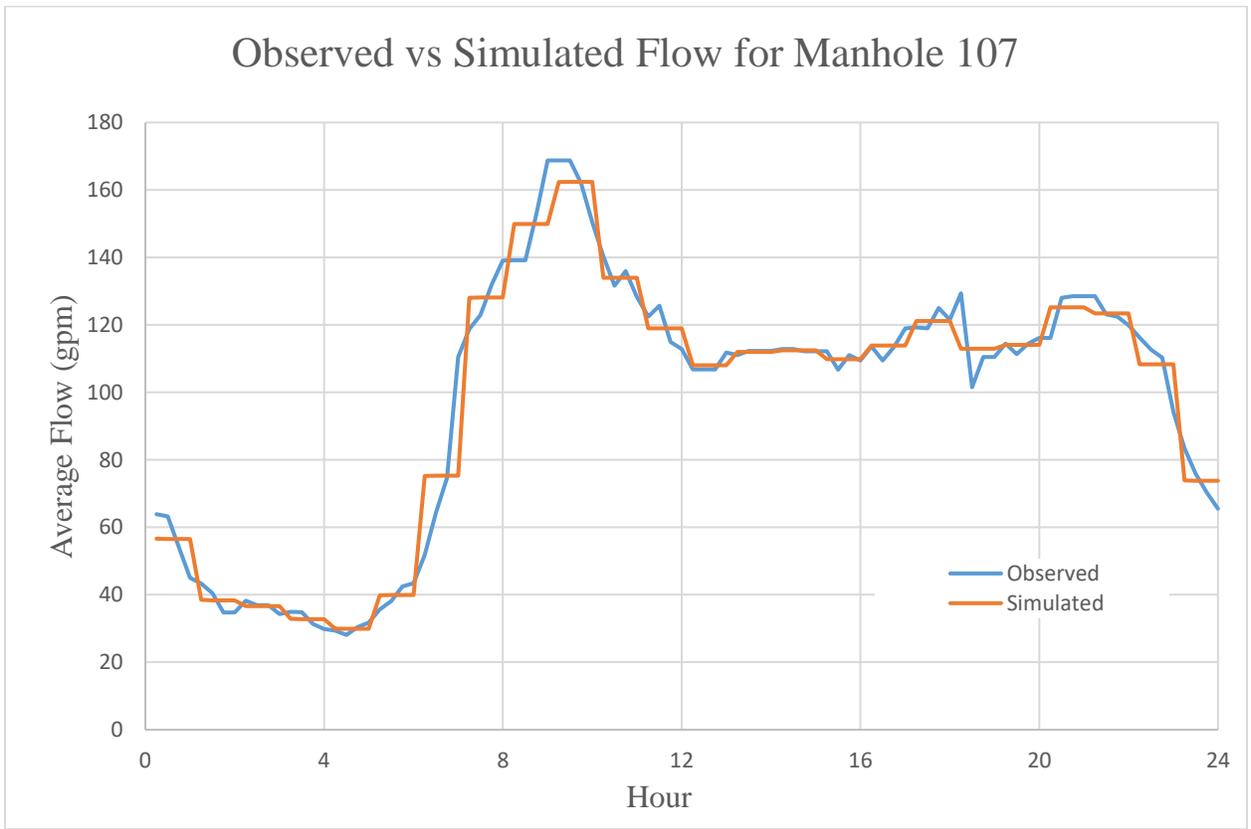
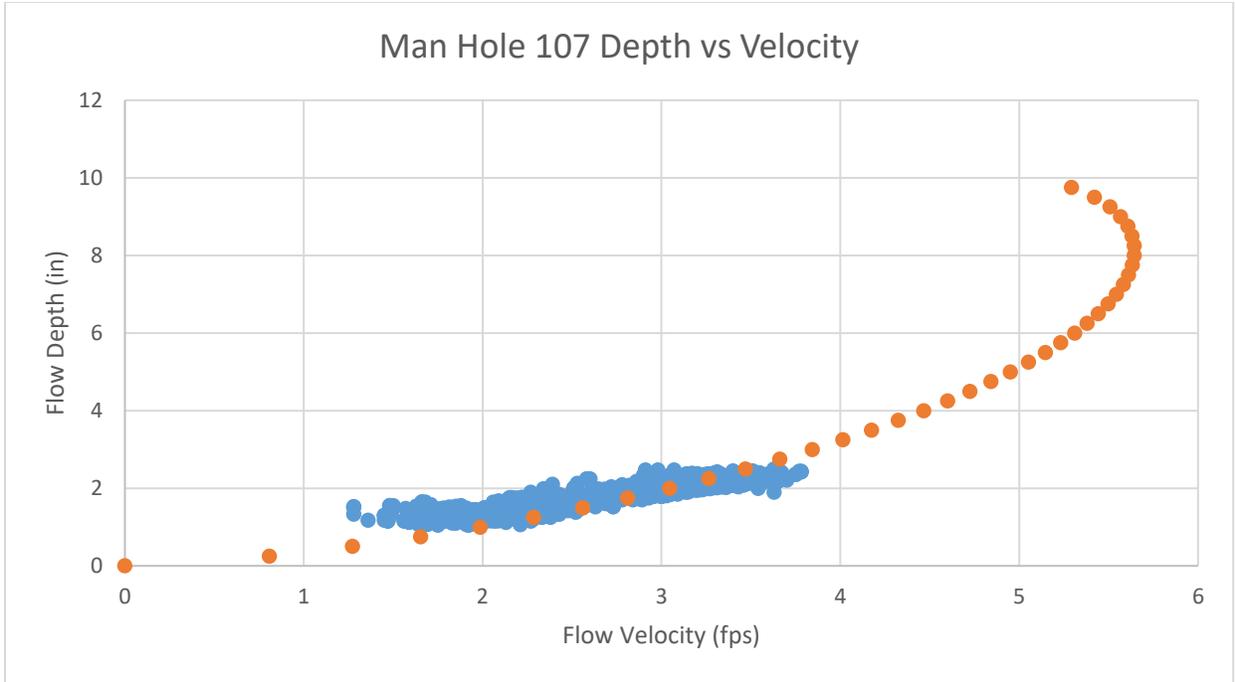
As part of the summary, an assessment of depth to velocity consistency is provided along with commentary about correlation to Manning’s equation calculation of flow.

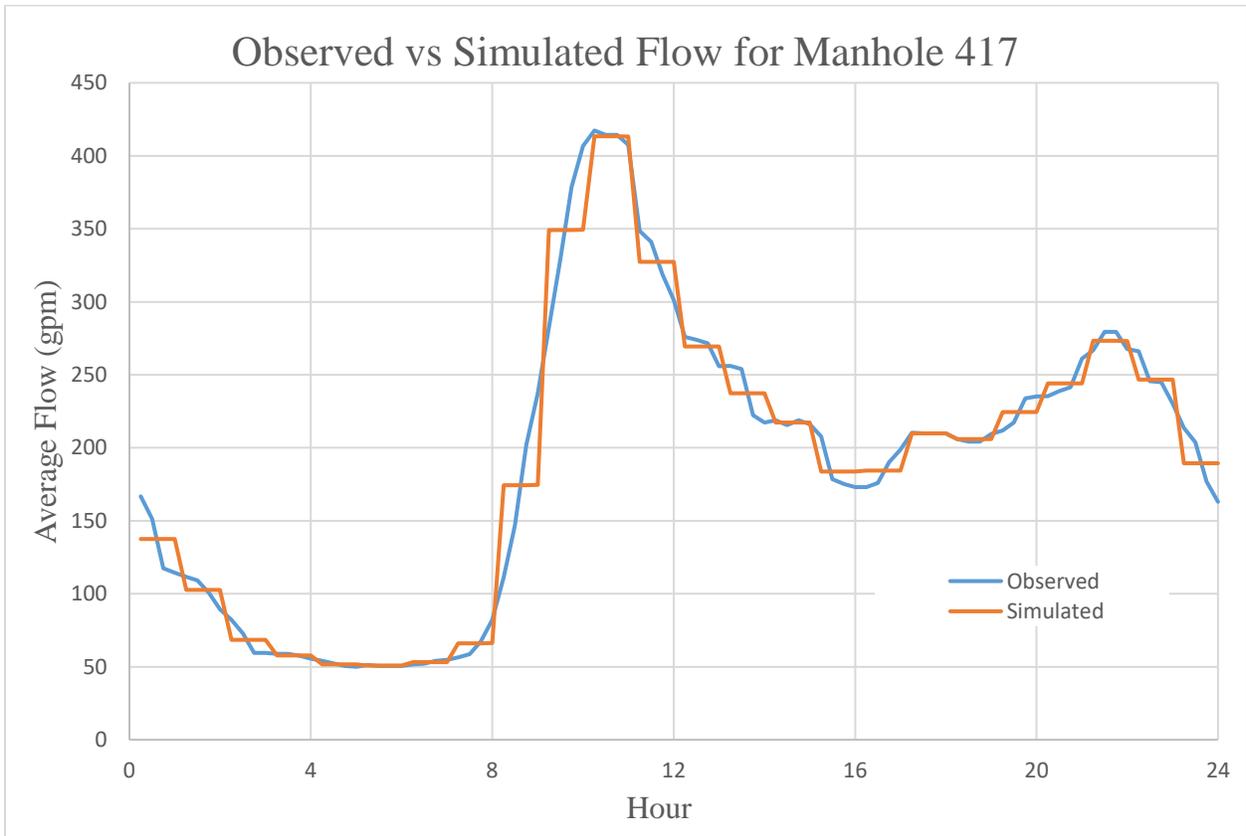
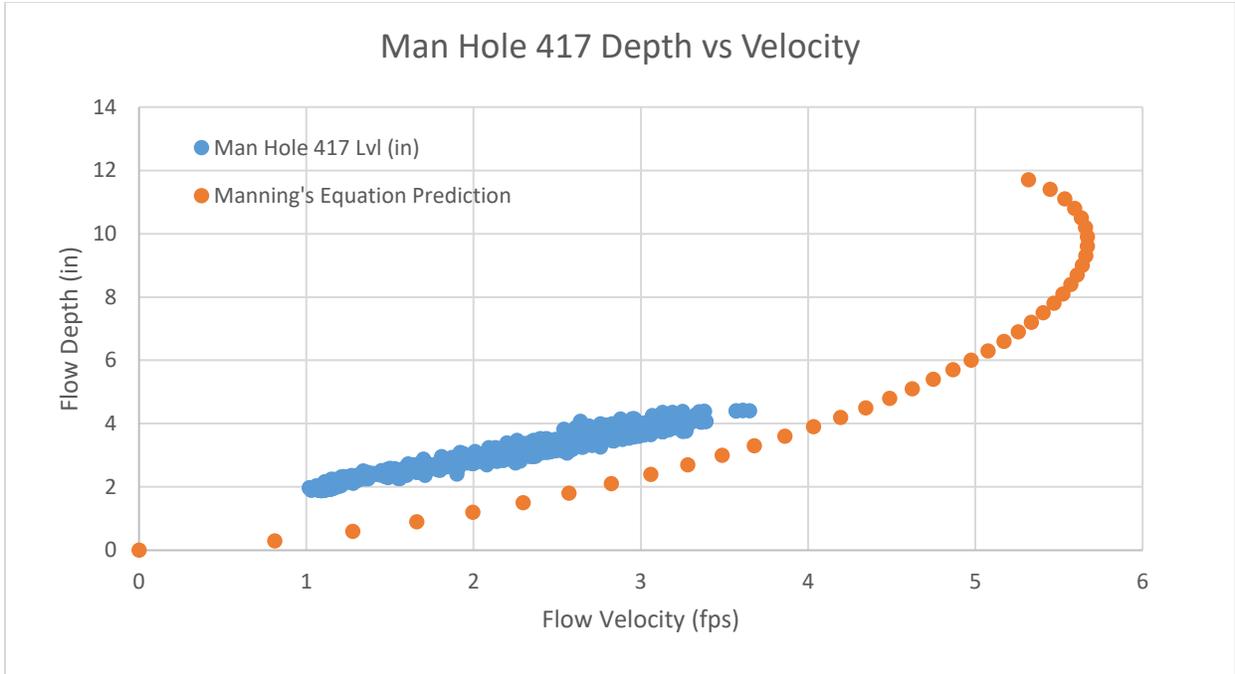
- Depth to Velocity Consistency – The consistency of depth to velocity measurements should remain the same over time for a given pipe unless changes to pipe roughness, sediment levels, debris accumulation, or backwater conditions change during the monitoring period. Scatter plots of depth versus velocity for the monitoring period can reveal how consistent the data is. Consistency is one of the most important elements in assessing the relative accuracy of a flow monitor.
- Manning’s Equation Correlation – Manning’s Equation is an empirical formula that can predict the relationship of depth, velocity, and flow for a given geometry and slope. By comparing the predicted depth versus velocity using Manning’s Equation against observed depth versus velocity, it is possible to assess how the pipe is performing compared to a theoretical clean pipe condition.

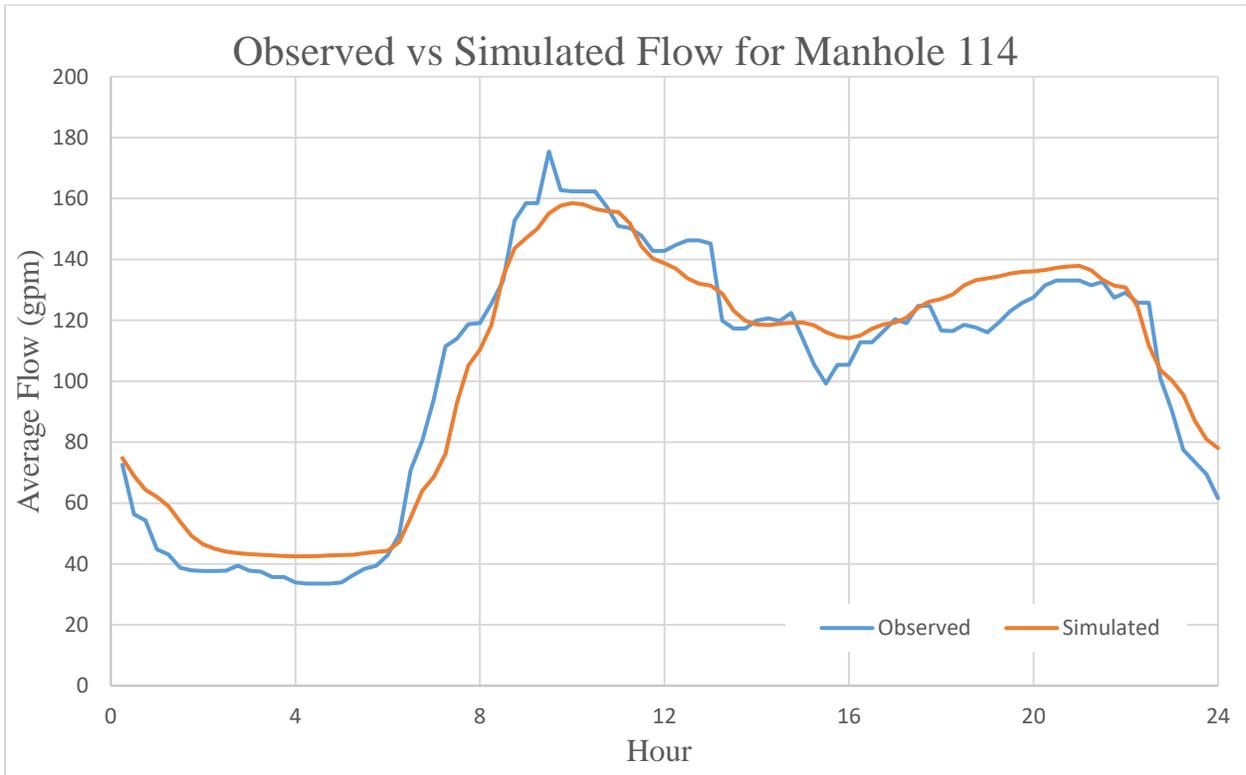
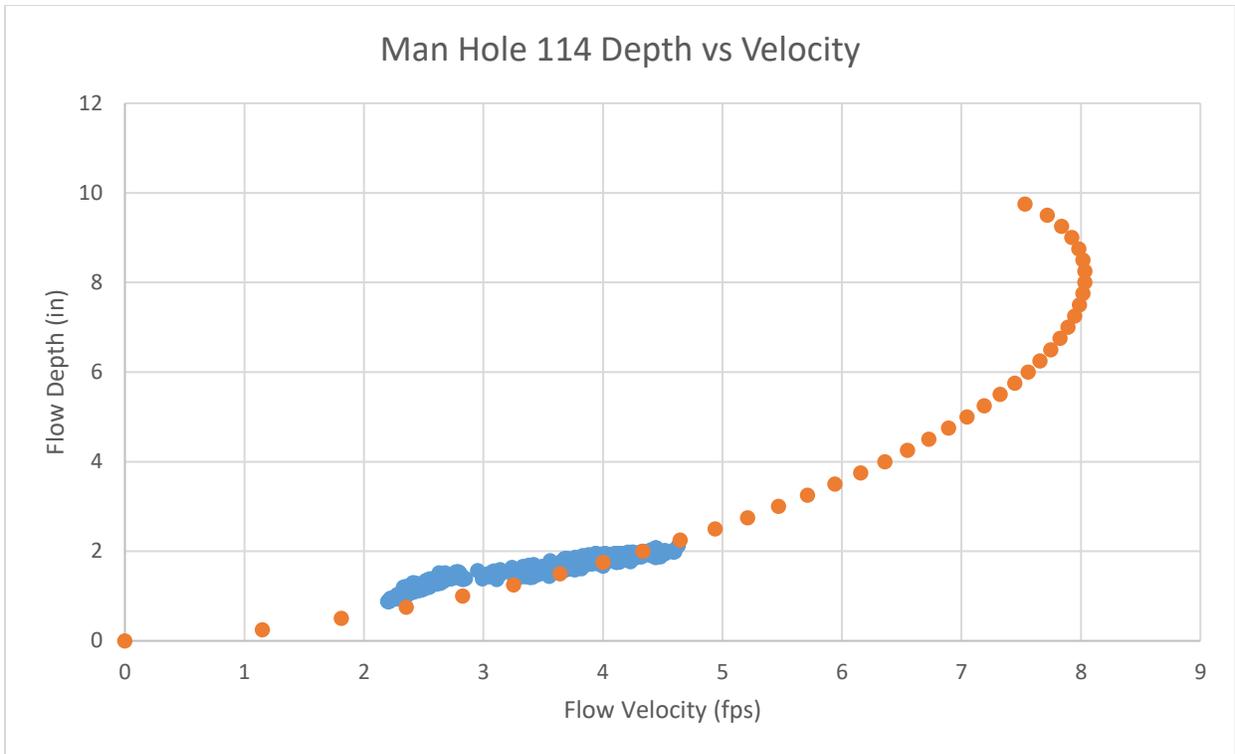
Because flows are calculated based on depth and velocity, both good consistency and good correlation to Manning's Equation boost confidence in the reliability of flow monitoring data. Inconsistencies in depth versus velocity may indicate bad data or bad hydraulics in a manhole. Good correlation with Manning's equation may boost confidence in flow monitoring data and indicate good hydraulics in the selected manhole, but is not mandatory for accurate flow monitoring results.

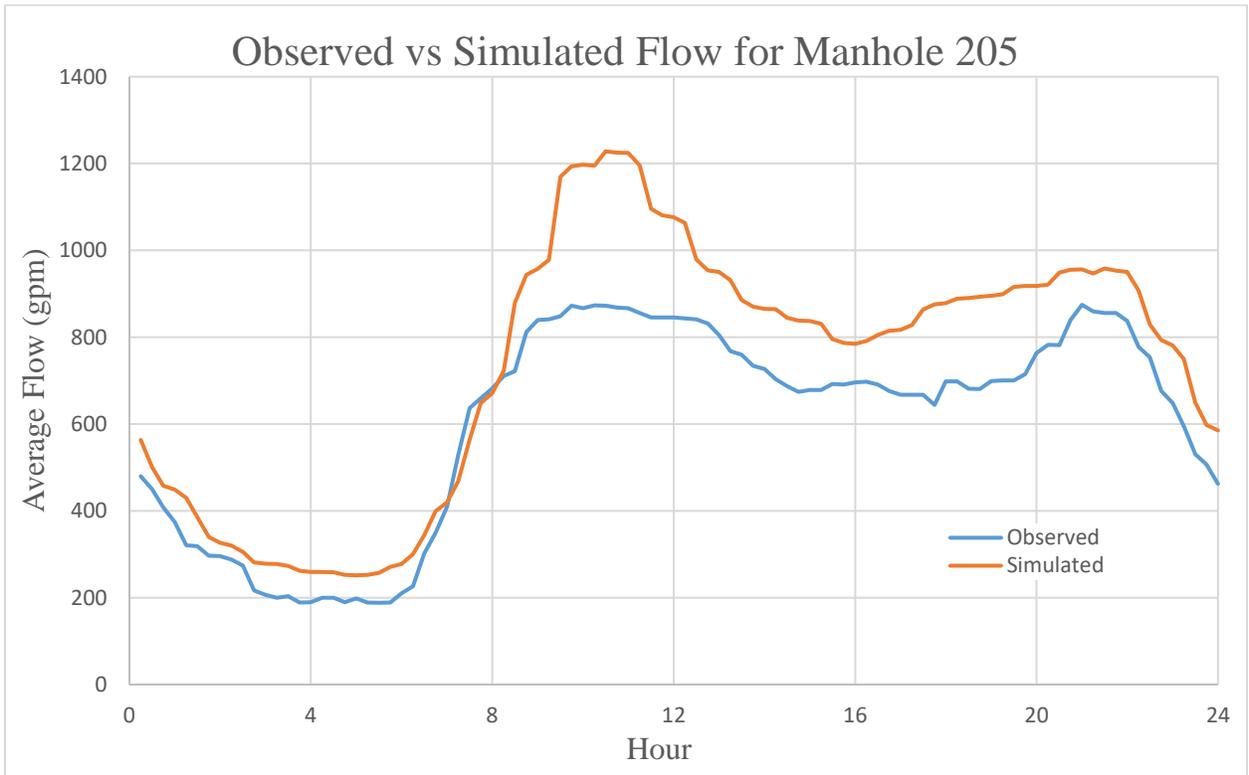
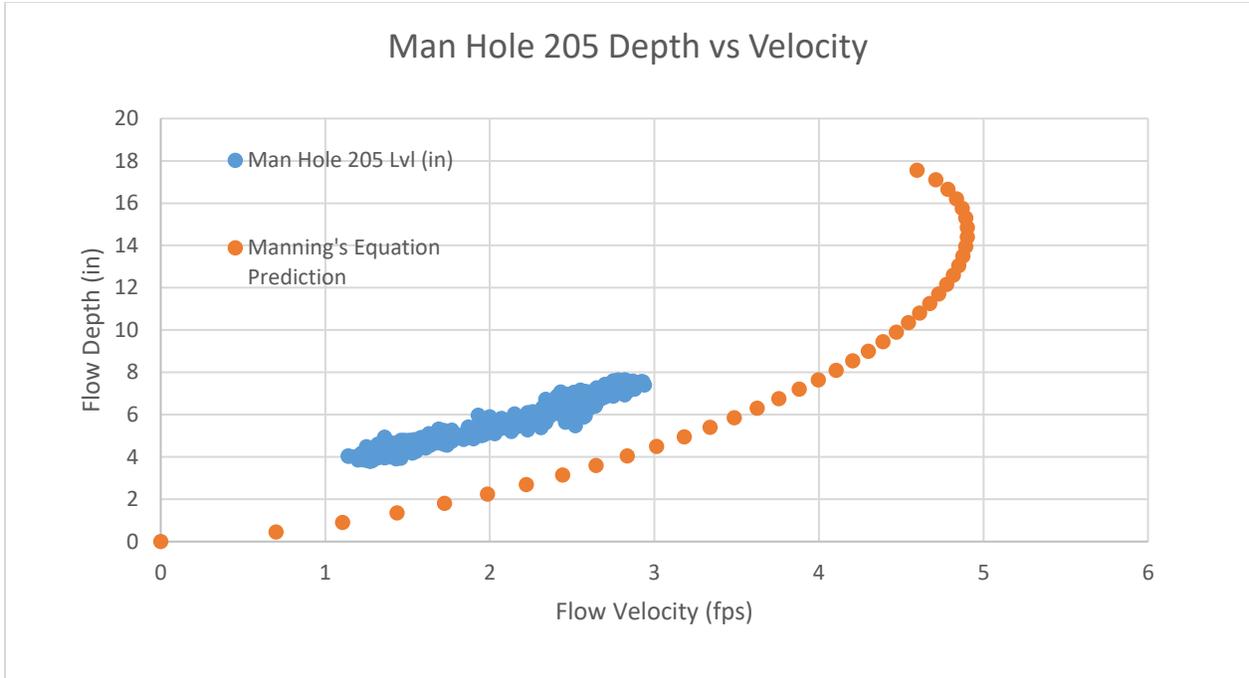
The following graphs show depth versus velocity for each of the flow monitoring sites along with the predicted Manning's Equation depth versus velocity plot. A plot of simulated flow versus observed flow also shows how the model compares to observed flows. Note that the only site with poor consistency is MH 145. Data at that site indicate that there are very poor hydraulics in that portion of the Moab collection system that could be the function of debris, roots, or poor connection hydraulics.

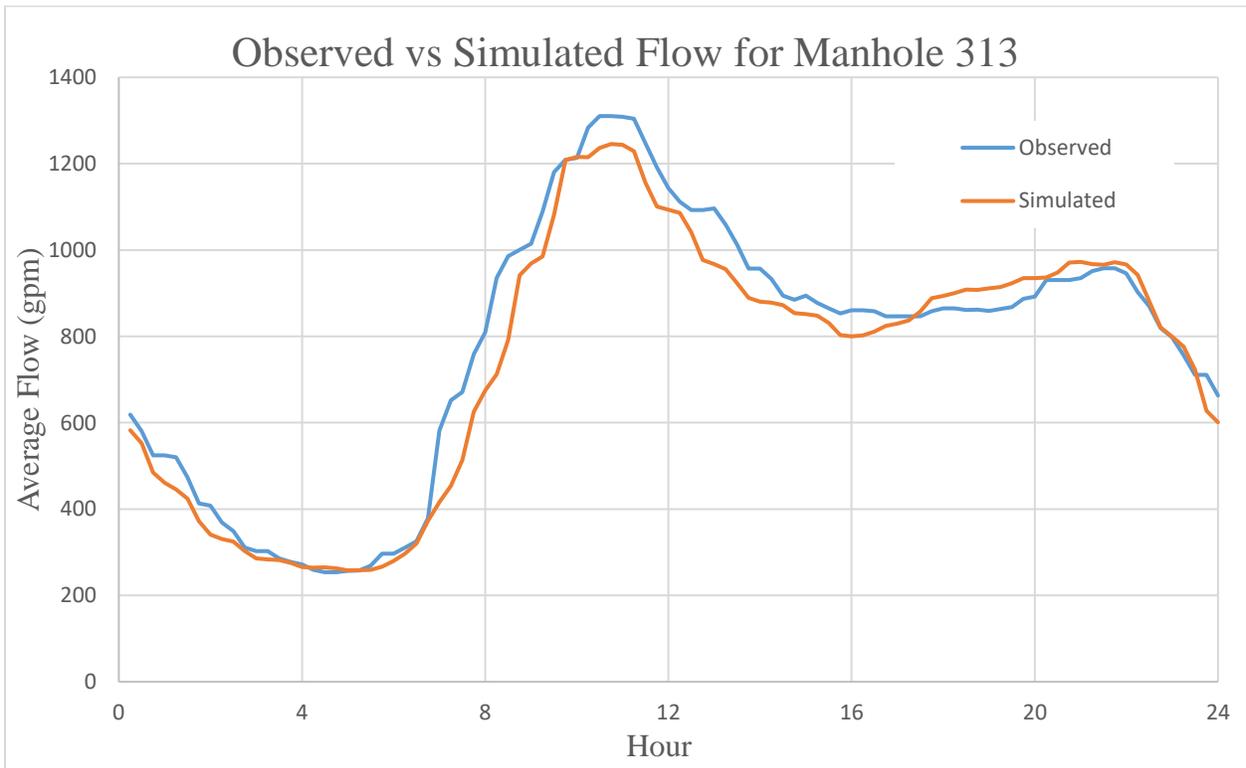
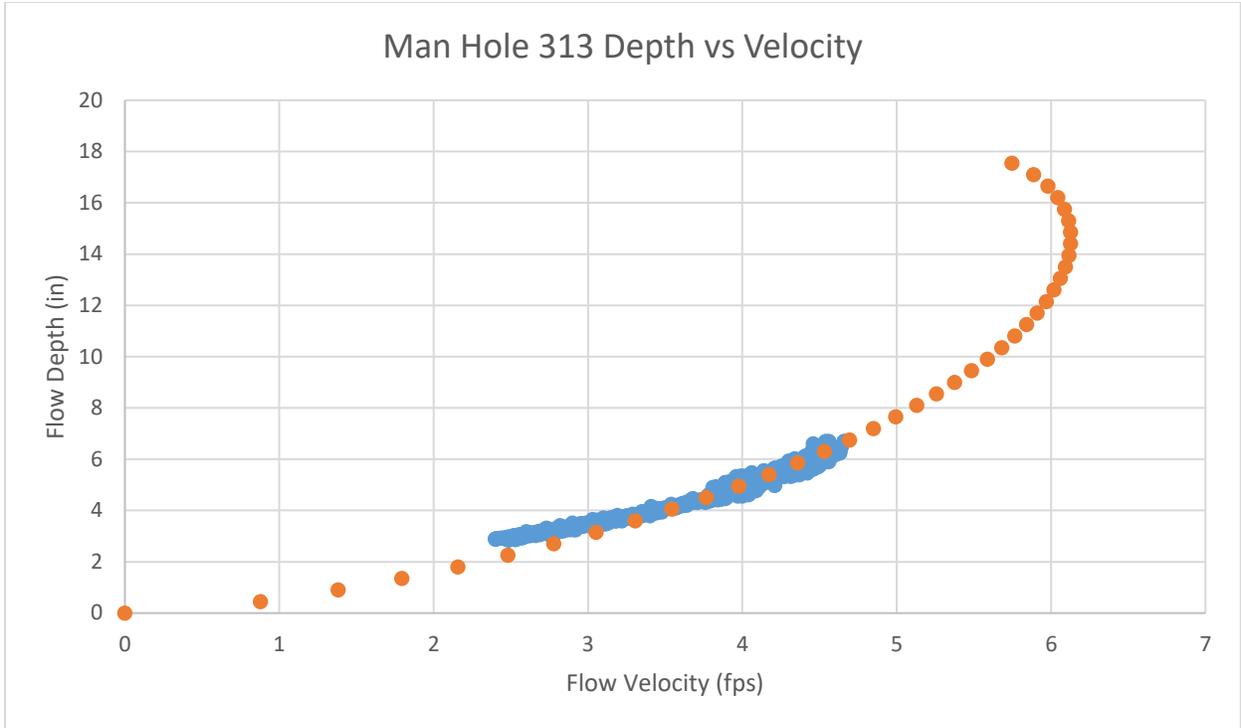


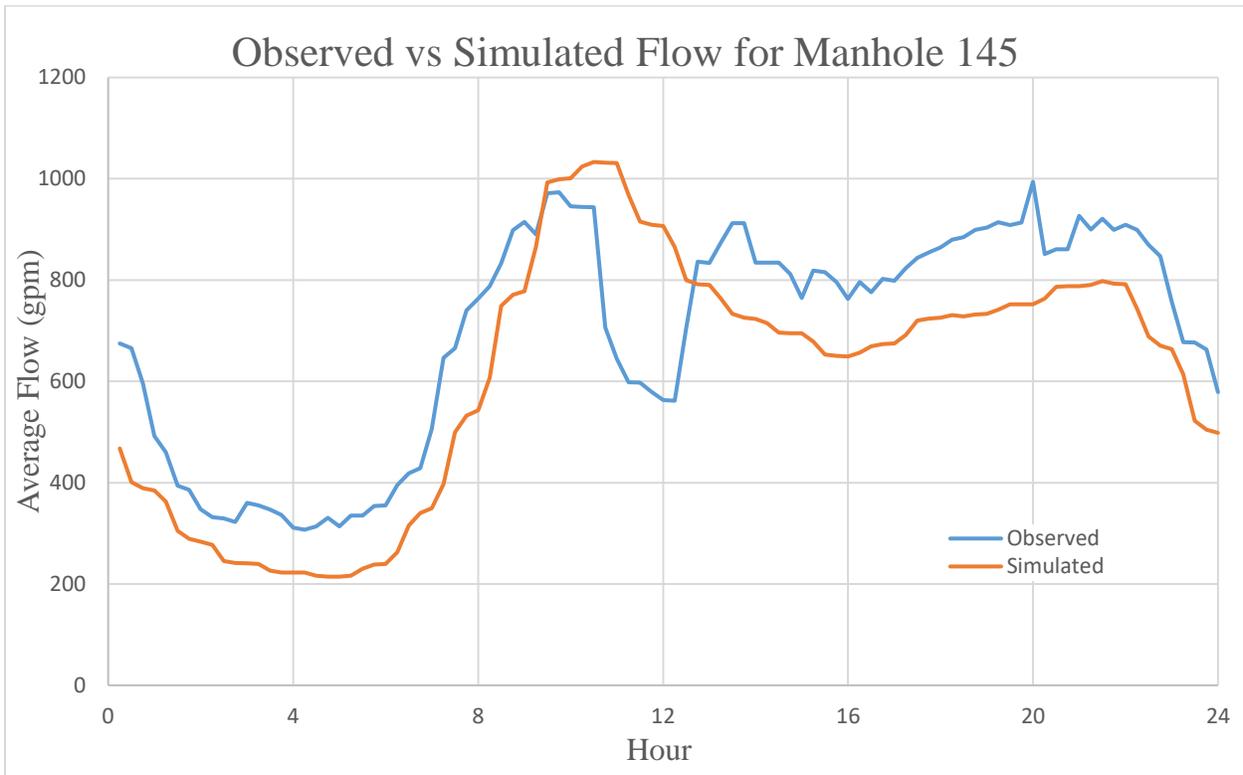
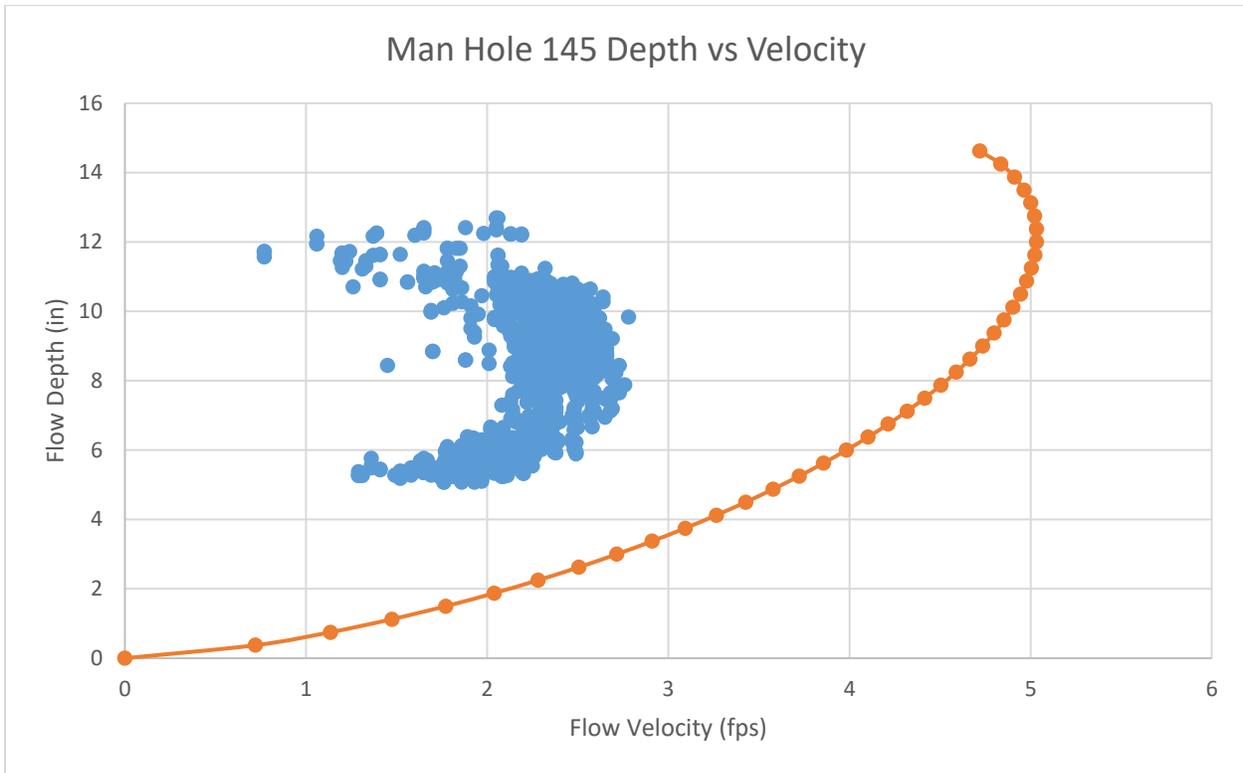


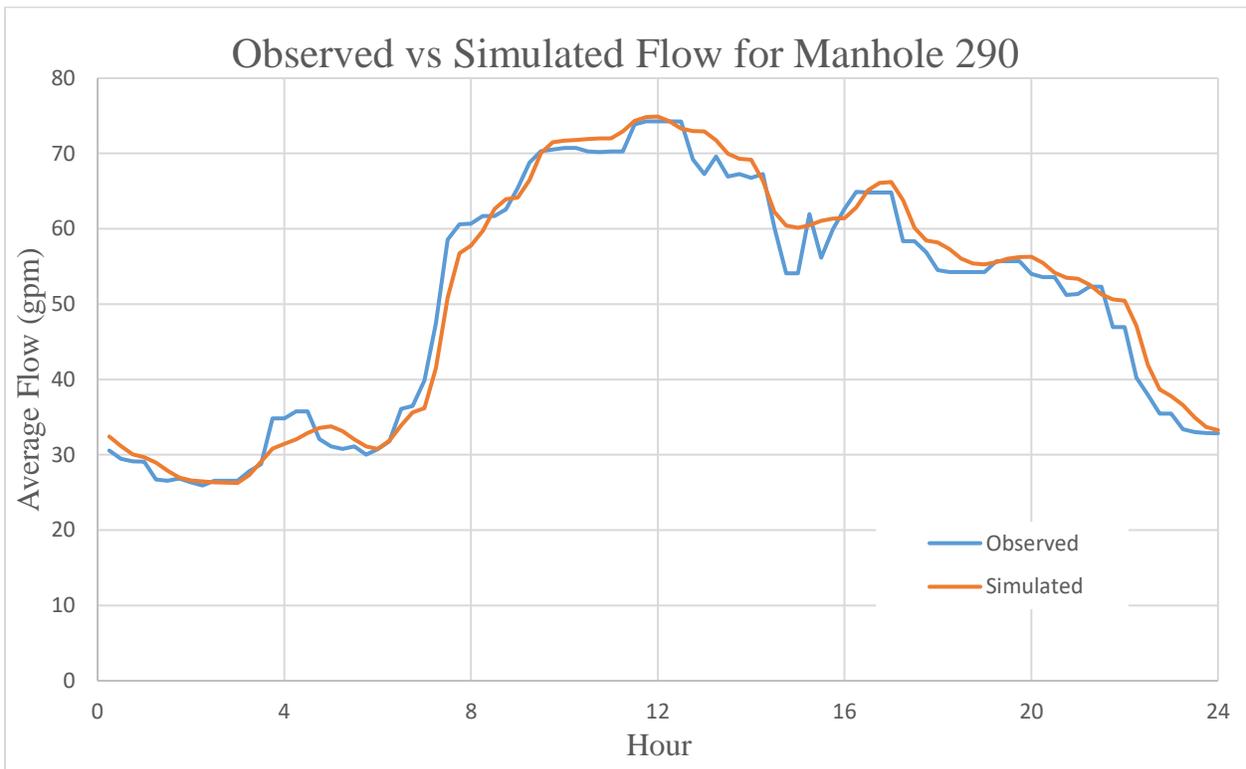
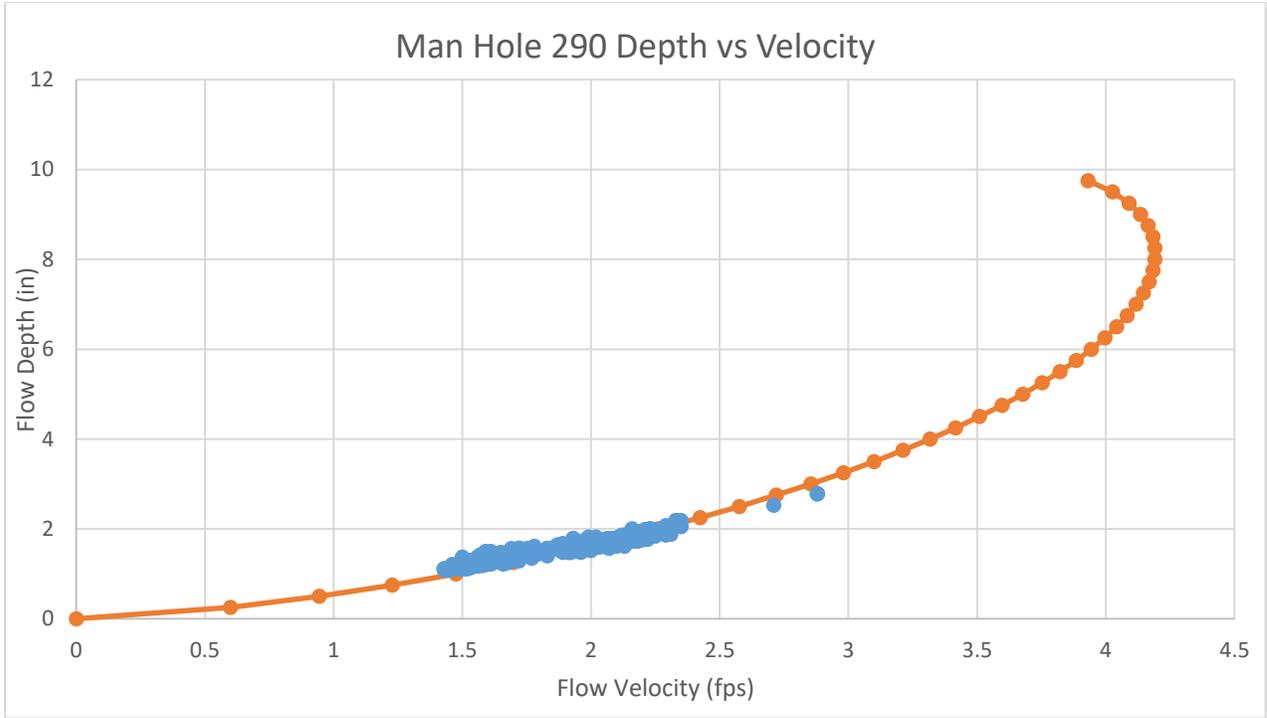


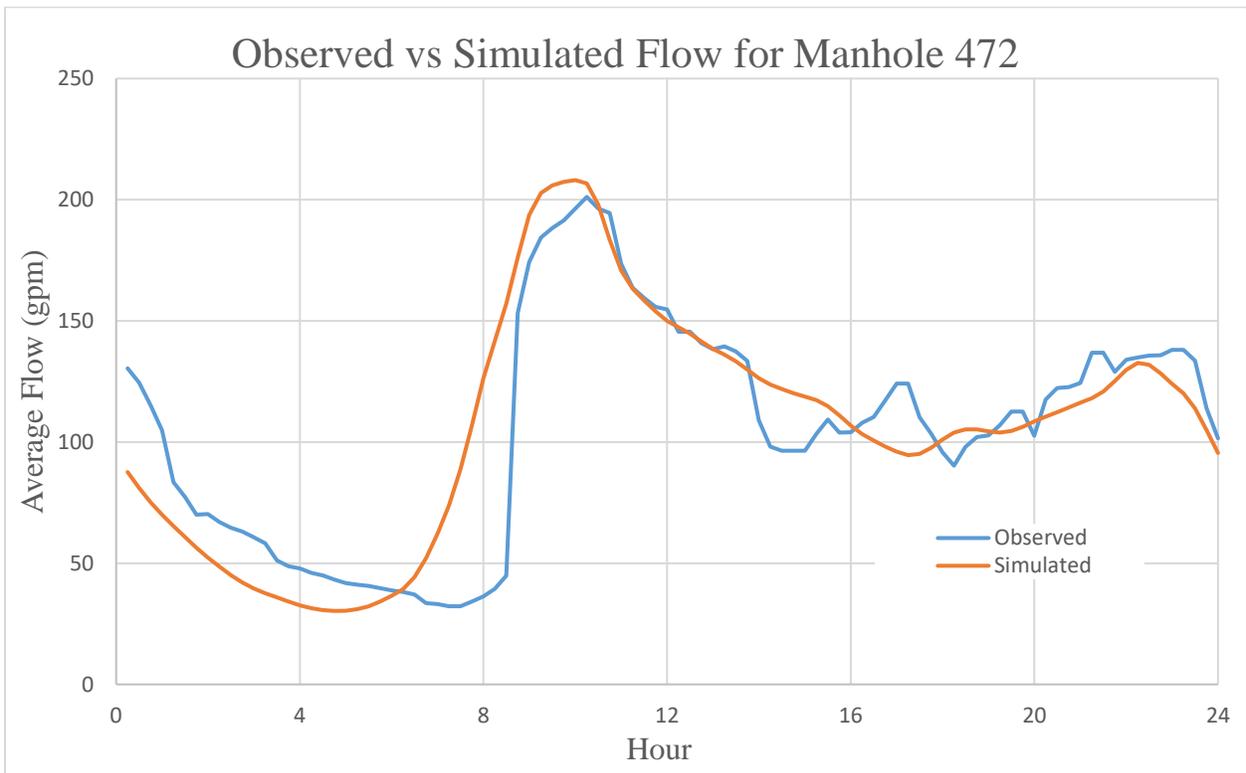
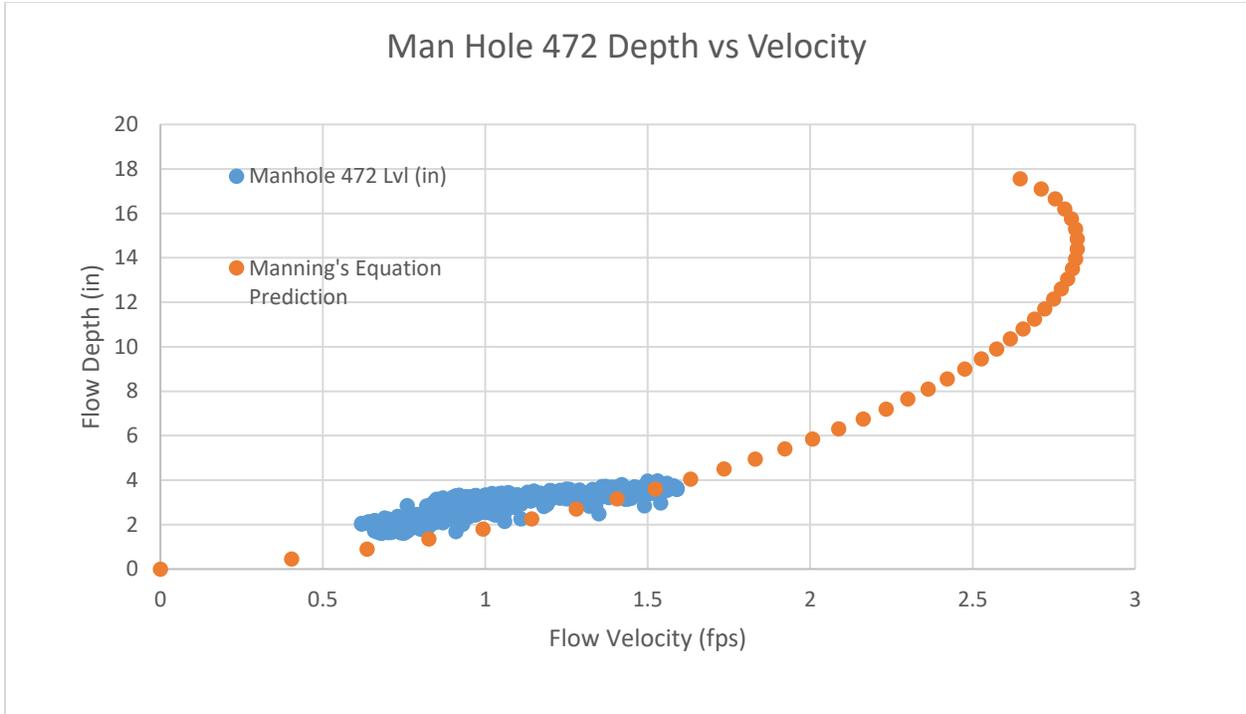


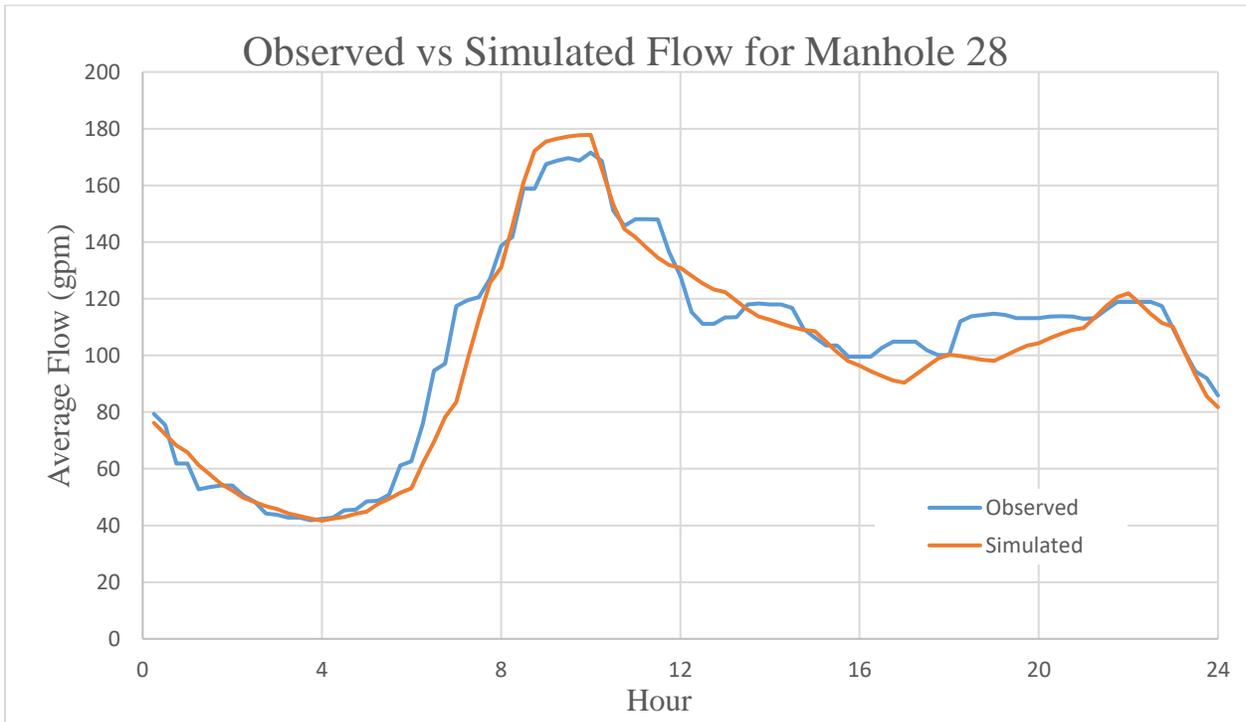
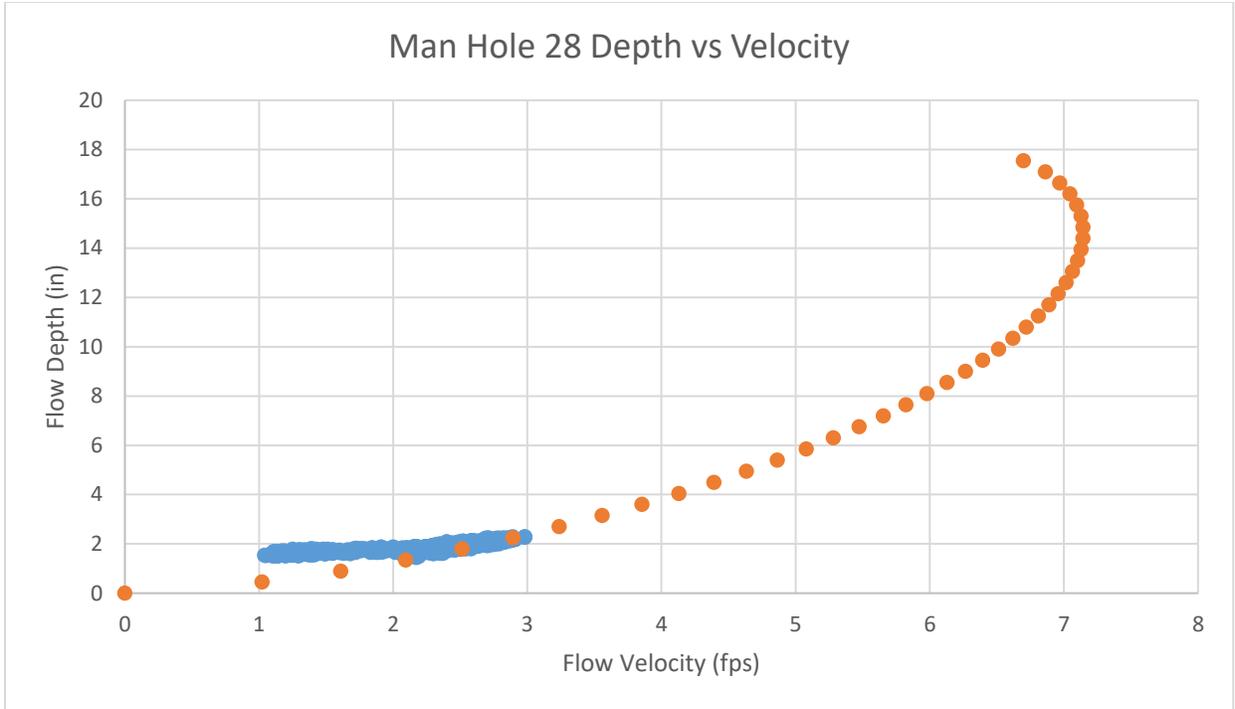








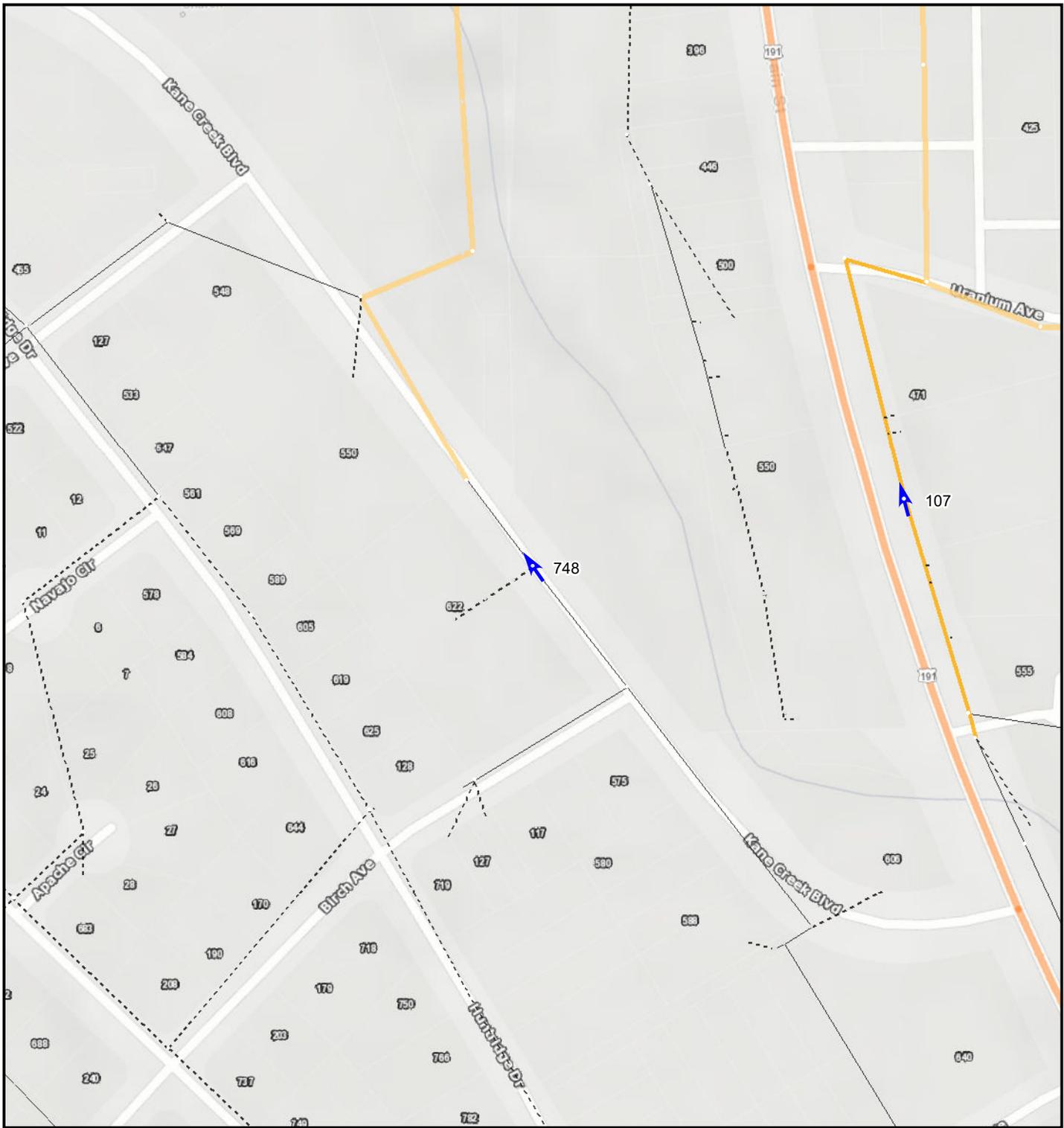




CONCLUSION

Based on the summary of flow monitoring results, the following conclusions can be made regarding the flow monitoring conducted in April 2017:

- MH 145 (100 West) – The 100 West Trunk line has very poor hydraulic conditions that could be a function of sediment, roots, debris, or poor connection hydraulics. The conditions in the pipe have led to depths that exceed the City’s design criteria for the pipe. Because of inconsistency in the relationship between depth and velocity, the reliability of flow data at this site is questionable. Observed flows from the data appear to somewhat match simulated flow data in the model. However, there is little confidence in observed flow data accuracy at this location. As a result, this flow monitor site was not used for calibration.
- MH 205 (290 W Walnut Ln) and MH 313 (500 W 300 N) – Observed flows at MH 205 do not match simulated flows in the hydraulic model as well as they do for other metered sites. This is true even though results match very well at MH 313, just a short distance away. While data consistency and correlation at MH 205 is relatively good, consistency and correlation at MH 313 are even better. As a result, flow metering result for MH 313 were considered more important to model calibration. From the shift in the data at MH 205 away from the theoretical Manning’s prediction, it appears likely that sediment or backwater is distorting the flow calculation. This manhole should be avoided for future flow monitoring or a careful assessment of sediment should be measured to adjust flow calculations appropriately.
- Data Adequacy – Outside of the two exceptions discussed above, the flow monitoring data collected appears to be accurate and adequate for calibrating the City’s sanitary sewer hydraulic model.



LEGEND

Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less

— 8"

— 10"

— 12"

— 15"

— 18"

— 21"

— 24"

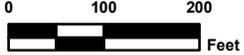
— 30"

— 36"

— 42"

⬜ Spanish Valley

NORTH: 

SCALE:  Feet

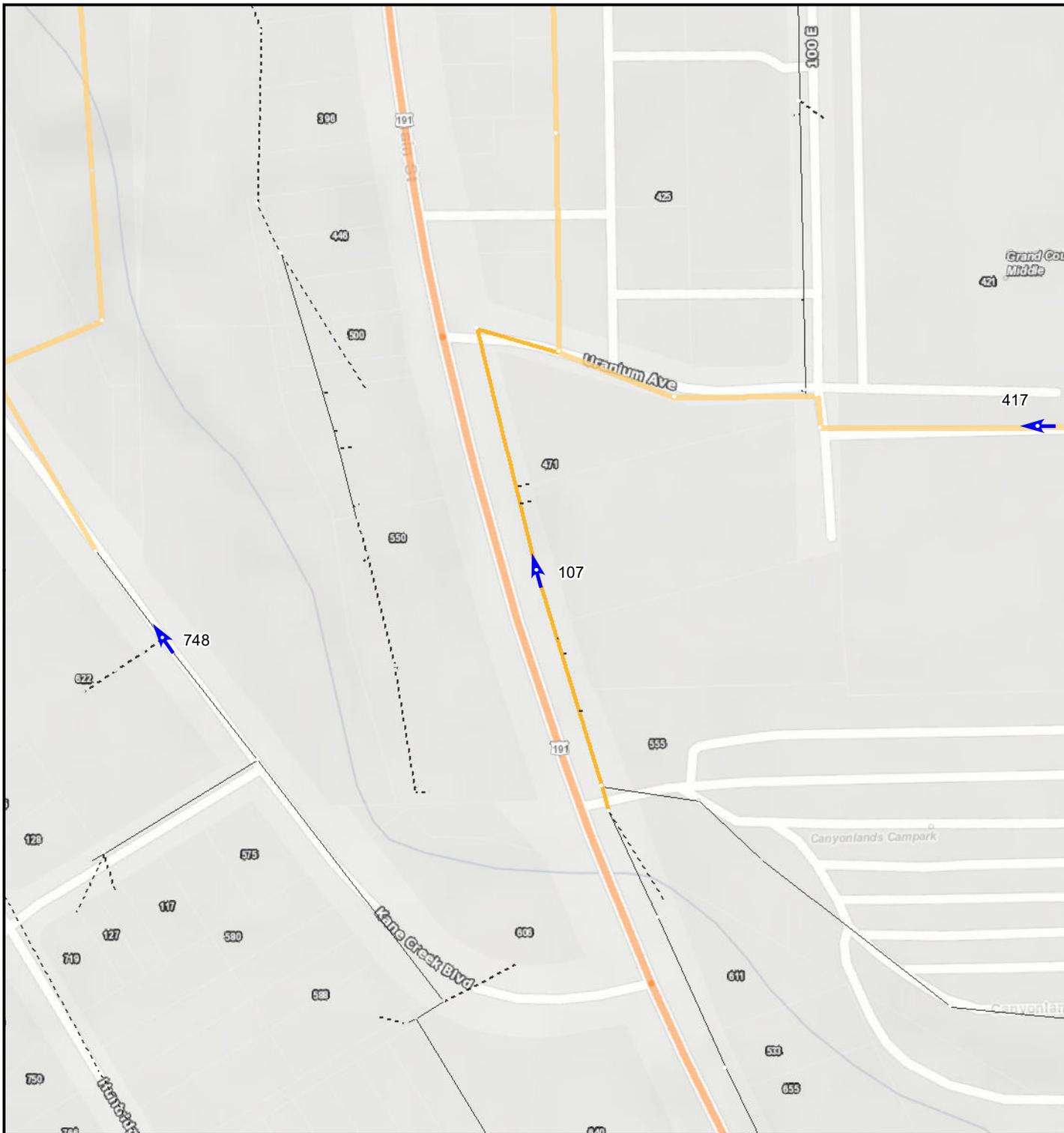
8-INCH

MOAB CITY
**SANITARY SEWER
MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
748



LEGEND

Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less
 ——— 8"
 ——— 10"
 ——— 12"
 ——— 15"
 ——— 18"
 ——— 21"
 ——— 24"
 ——— 30"
 ——— 36"
 ——— 42"

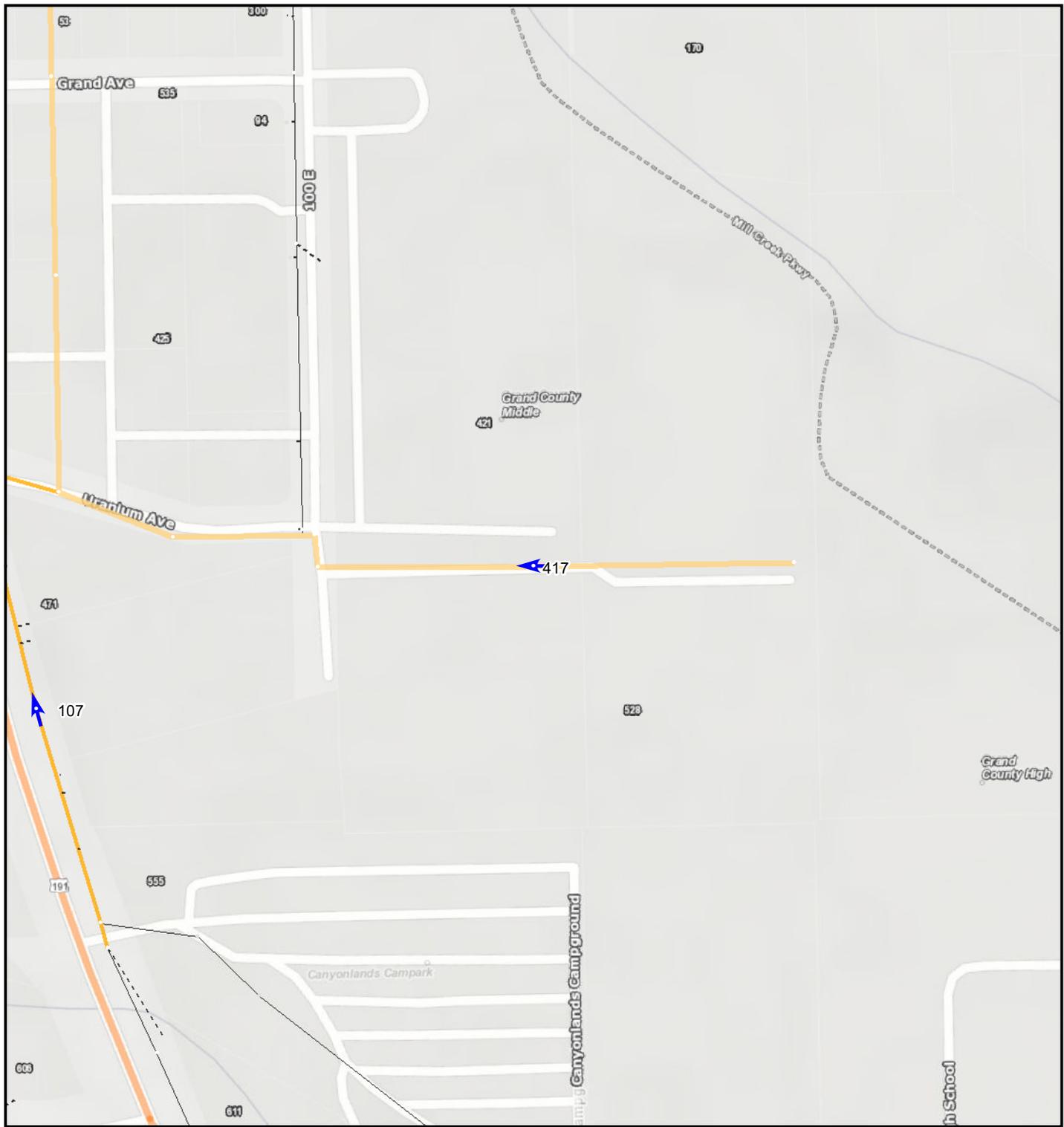
⊞ Spanish Valley

| | |
|------------|------------|
| NORTH: | SCALE: |
|------------|------------|

10-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**

| | |
|---|---|
| BOWEN COLLINS & ASSOCIATES <i>Celebrating 20 Years</i> | MANHOLE NO. <h1 style="font-size: 36px; margin: 0;">107</h1> |
|---|---|



LEGEND

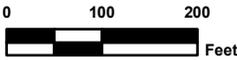
Manholes

- No Invert
- Invert
- ▲ Proposed Flow Site

----- 6" or less
 ——— 8"
 ——— 10"
 ——— 12"
 ——— 15"
 ——— 18"
 ——— 21"
 ——— 24"
 ——— 30"
 ——— 36"
 ——— 42"

▭ Spanish Valley

NORTH: 

SCALE:  Feet

12-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
417



LEGEND

Manholes

- No Invert
- Invert
- ▲ Proposed Flow Site

----- 6" or less
 ——— 8"
 ——— 10"
 ——— 12"
 ——— 15"
 ——— 18"
 ——— 21"
 ——— 24"
 ——— 30"
 ——— 36"
 ——— 42"

⊞ Spanish Valley

NORTH: 

SCALE:  Feet

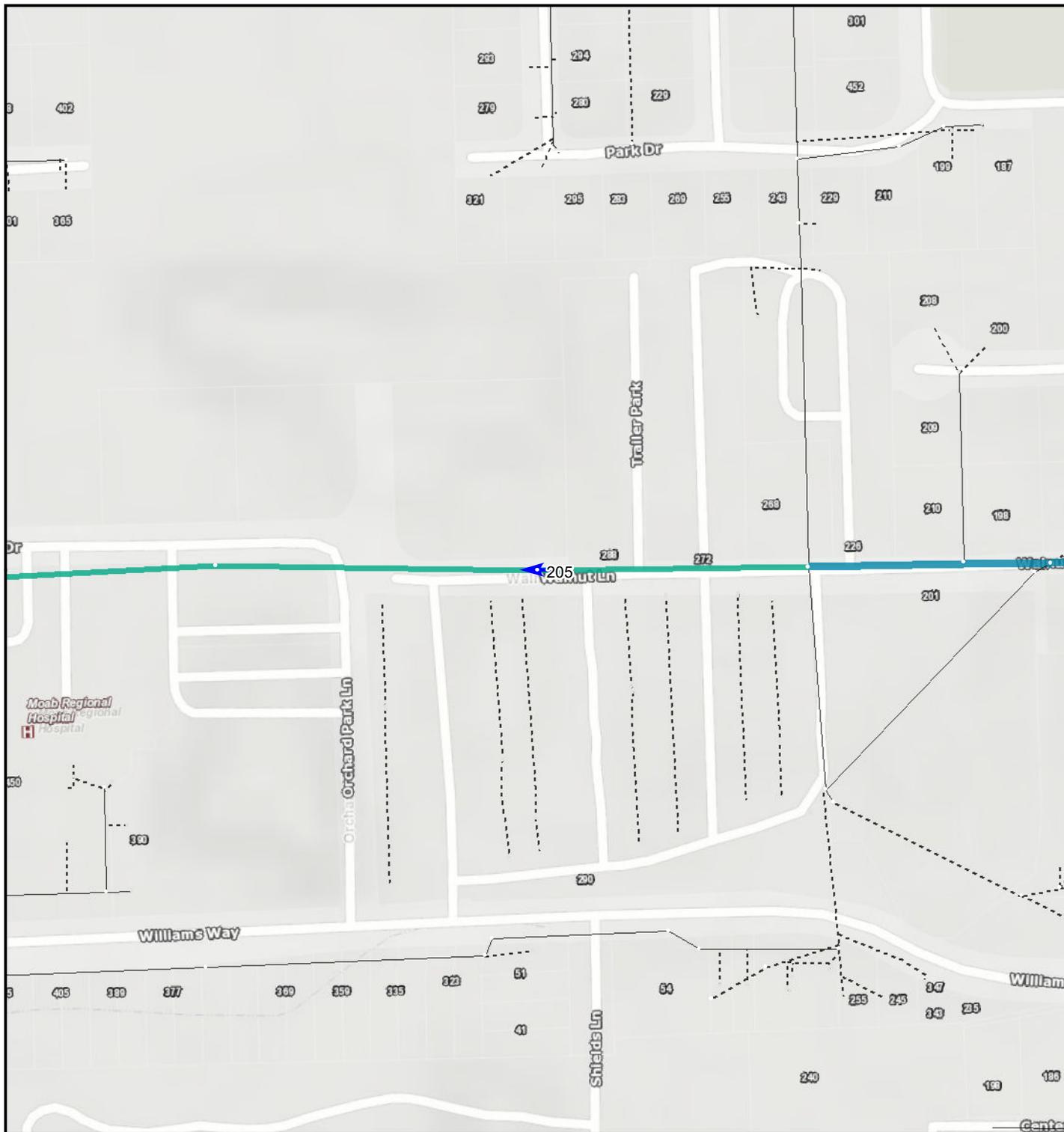
10-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
114



LEGEND

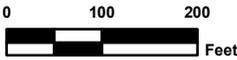
Manholes

- No Invert
- Invert
- ▲ Proposed Flow Site

----- 6" or less
 _____ 8"
 _____ 10"
 _____ 12"
 _____ 15"
 _____ 18"
 _____ 21"
 _____ 24"
 _____ 30"
 _____ 36"
 _____ 42"

 Spanish Valley

NORTH: 

SCALE:  Feet

18-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
205



LEGEND

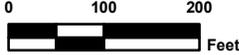
Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less
 ——— 8"
 ——— 10"
 ——— 12"
 ——— 15"
 ——— 18"
 ——— 21"
 ——— 24"
 ——— 30"
 ——— 36"
 ——— 42"

Spanish Valley

NORTH: 

SCALE:  Feet

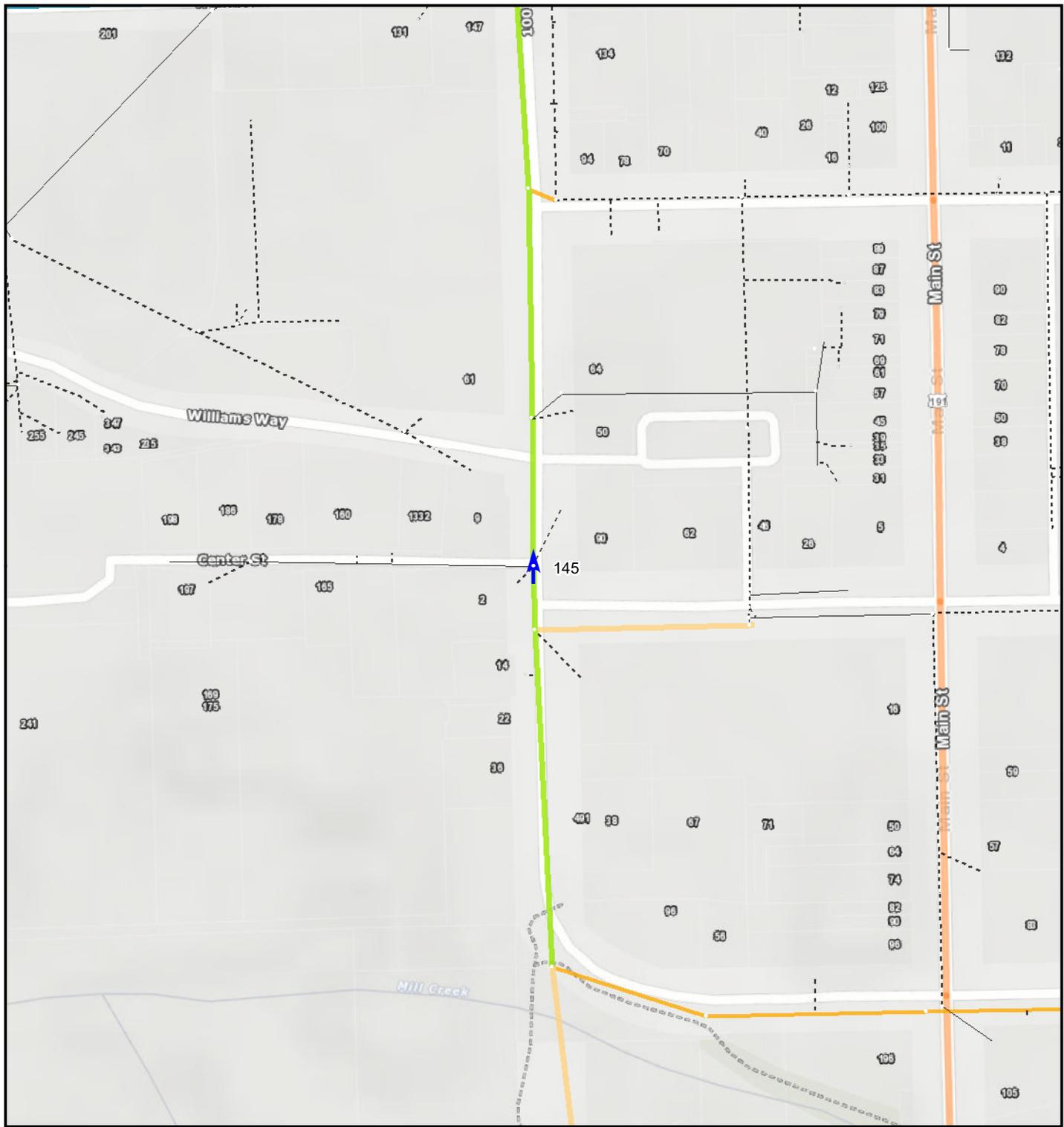
18-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
313



LEGEND

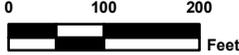
Manholes

- No Invert
- Invert
- ▲ Proposed Flow Site

----- 6" or less
 _____ 8"
 _____ 10"
 _____ 12"
 _____ 15"
 _____ 18"
 _____ 21"
 _____ 24"
 _____ 30"
 _____ 36"
 _____ 42"

▭ Spanish Valley

NORTH: 

SCALE:  Feet

15-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
145



LEGEND

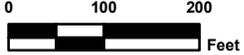
Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less
 _____ 8"
 _____ 10"
 _____ 12"
 _____ 15"
 _____ 18"
 _____ 21"
 _____ 24"
 _____ 30"
 _____ 36"
 _____ 42"

Spanish Valley

NORTH: 

SCALE:  Feet

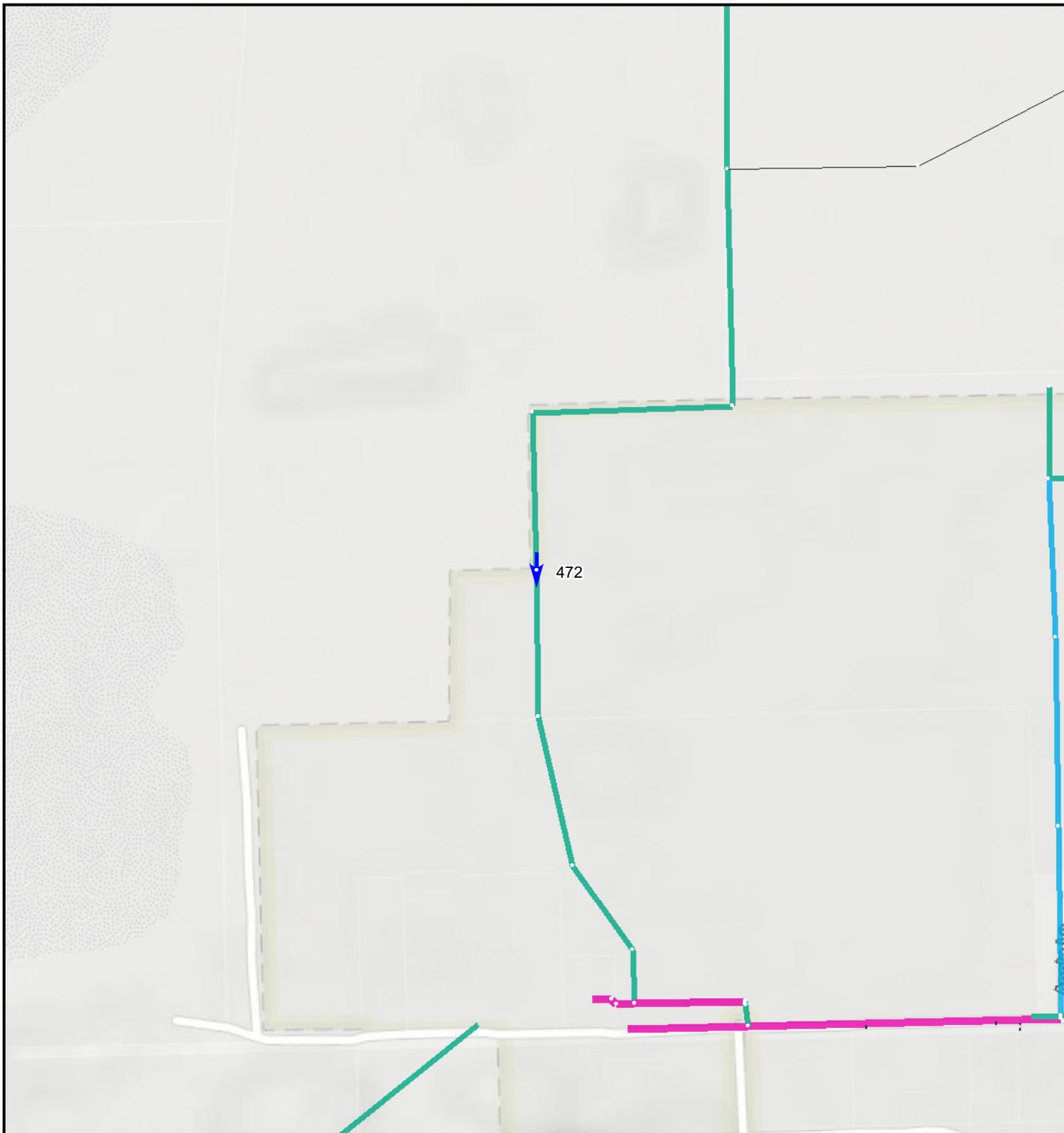
10-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
290



LEGEND

Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less
 — 8"
 — 10"
 — 12"
 — 15"
 — 18"
 — 21"
 — 24"
 — 30"
 — 36"
 — 42"

Spanish Valley

| | |
|------------|------------|
| NORTH: | SCALE: |
|------------|------------|

18-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**

| | |
|---|---|
| BOWEN COLLINS & ASSOCIATES <i>Celebrating 20 Years</i> | MANHOLE NO. <h1 style="font-size: 36px; margin: 0;">472</h1> |
|---|---|



LEGEND

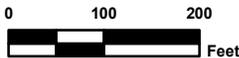
Manholes

- No Invert
- Invert
- ↑ Proposed Flow Site

----- 6" or less
 — 8"
 — 10"
 — 12"
 — 15"
 — 18"
 — 21"
 — 24"
 — 30"
 — 36"
 — 42"

 Spanish Valley

NORTH: 

SCALE:  Feet

18-INCH

MOAB CITY
**SANITARY SEWER
 MASTER PLAN**



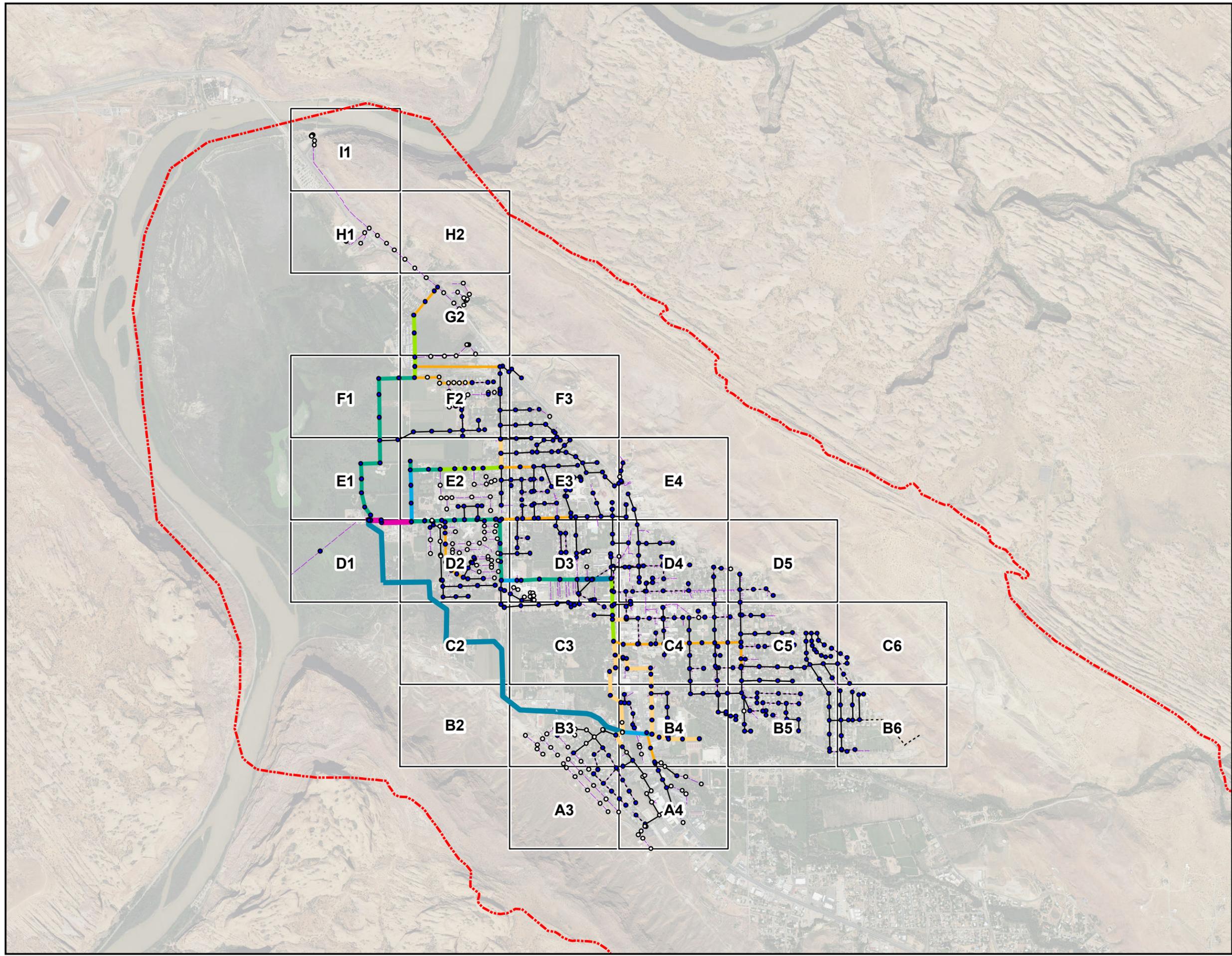
**BOWEN COLLINS
& ASSOCIATES**
Celebrating 20 Years

MANHOLE NO.
28

APPENDIX E

Model Result

Mapbook



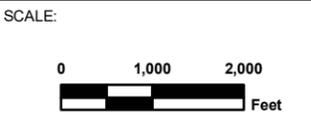
LEGEND

Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- ⬡ Spanish Valley



MAPBOOK
INDEX

CITY OF MOAB
SANITARY SEWER
MASTER PLAN

BOWEN COLLINS & ASSOCIATES
Celebrating 20 Years

FIGURE NO.
X



LEGEND

Manholes

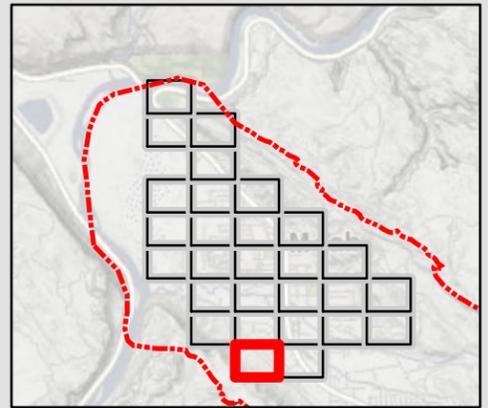
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

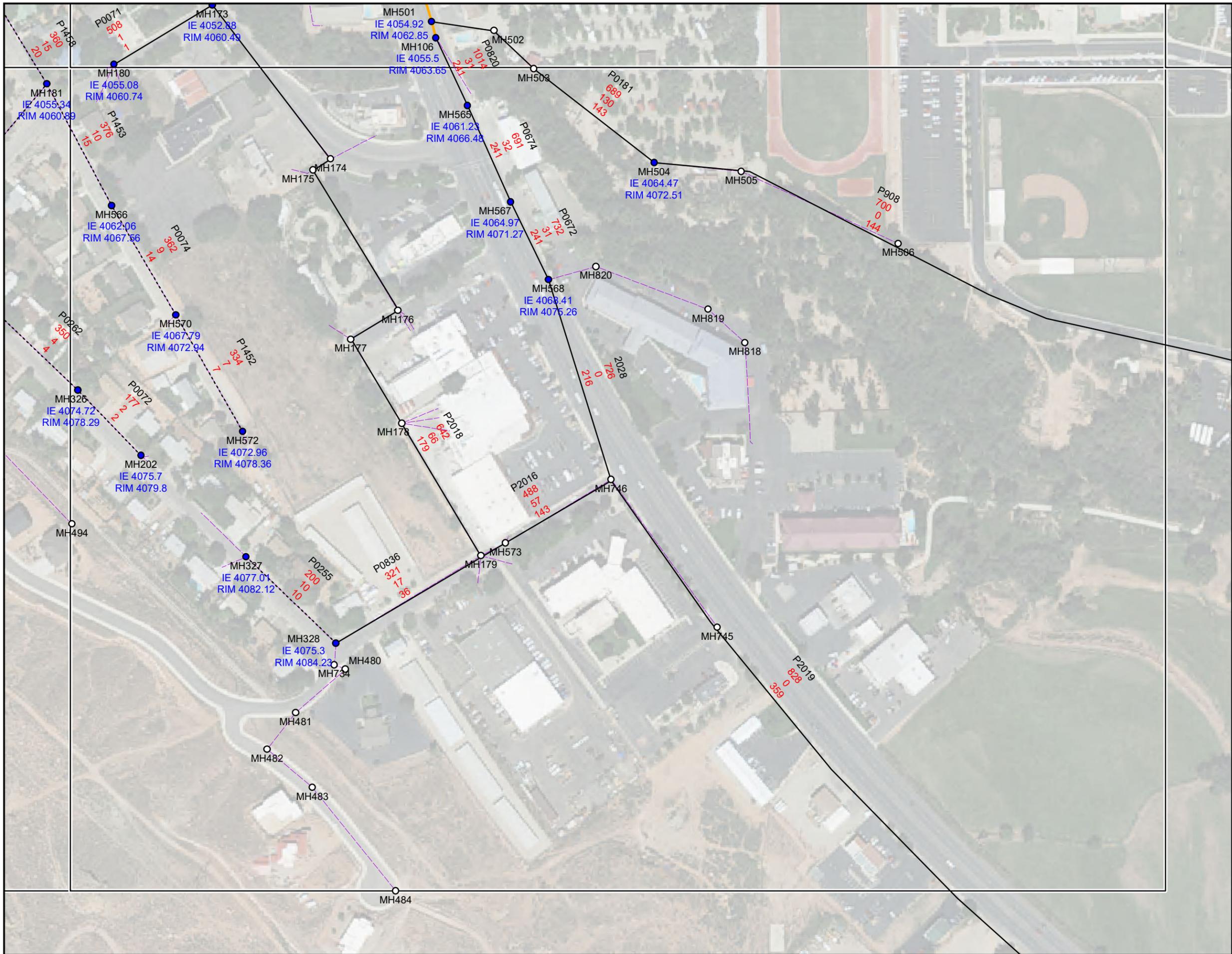
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**

FIGURE NO.
A-3



LEGEND

Manholes

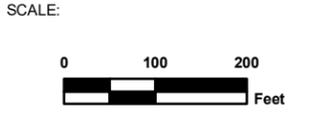
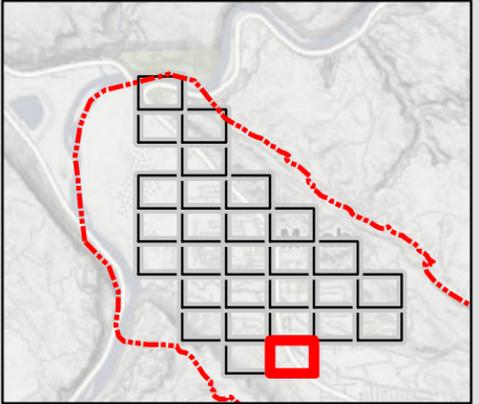
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

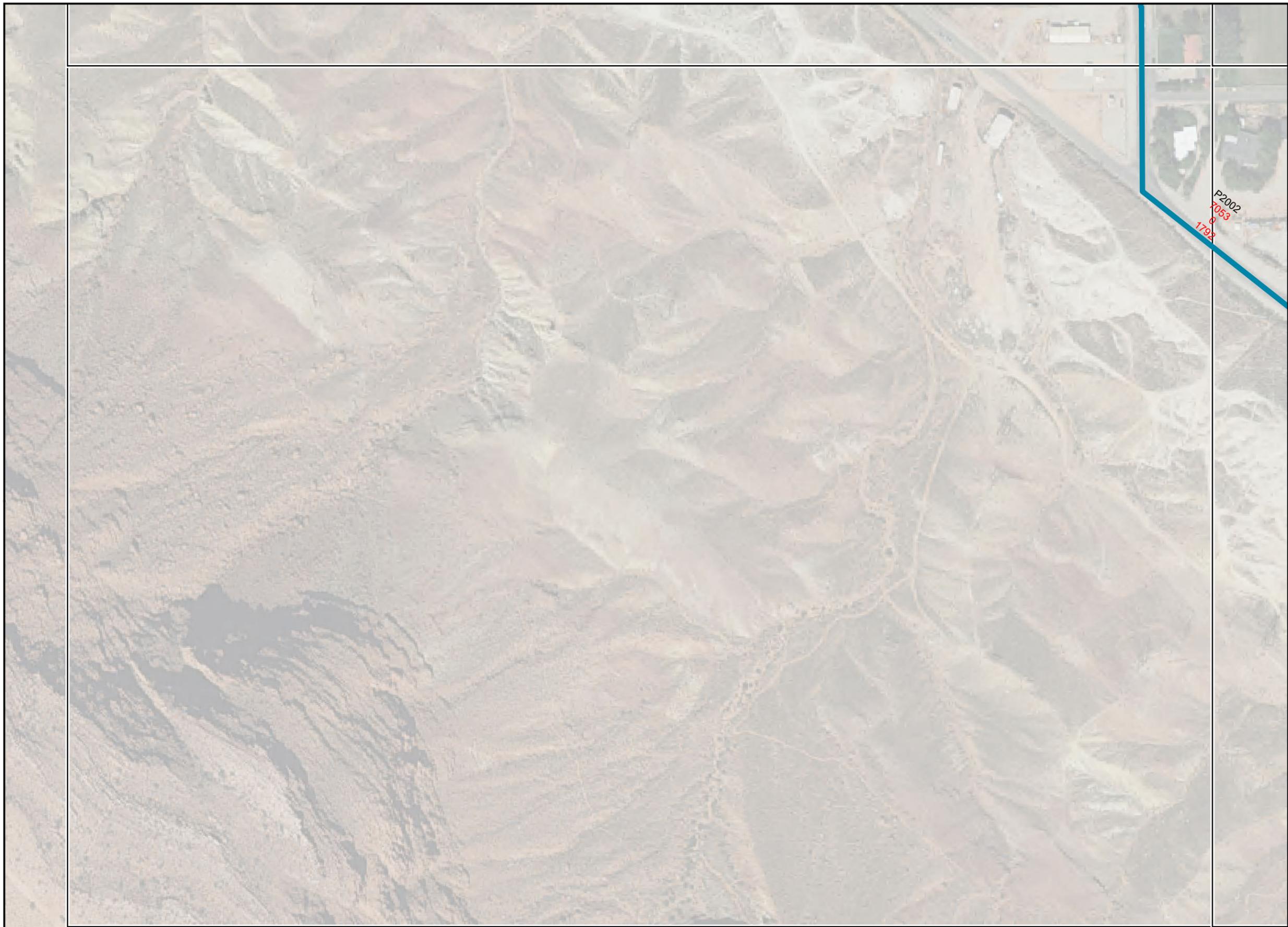


MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.
A-4



LEGEND

Manholes

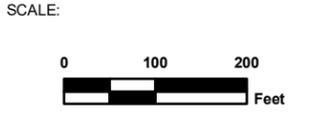
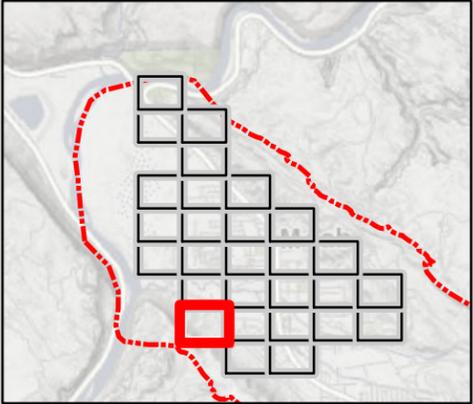
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- - - - - Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**

FIGURE NO.
B-2



LEGEND

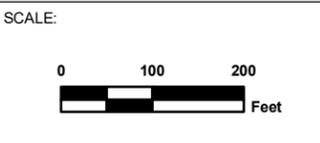
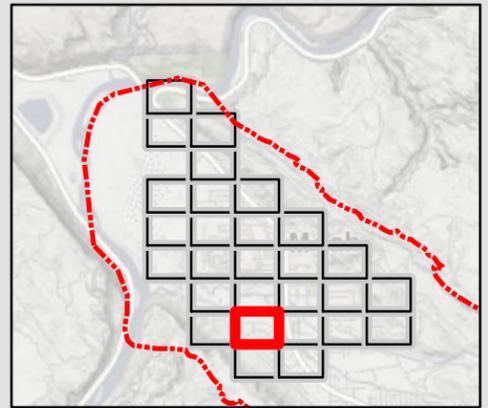
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

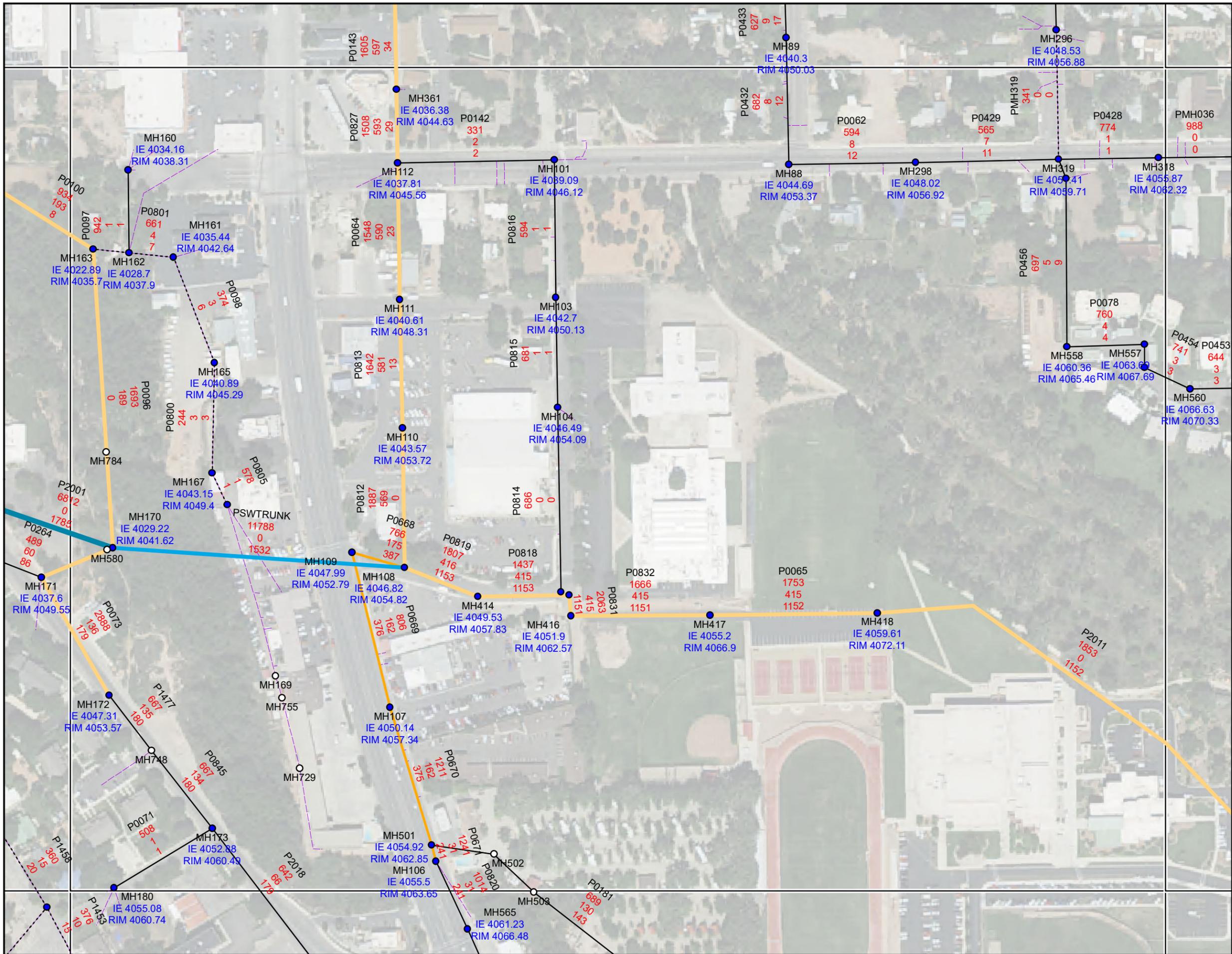


MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.
B-3



LEGEND

Manholes

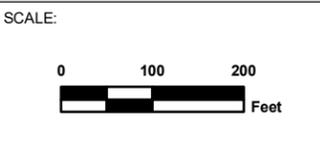
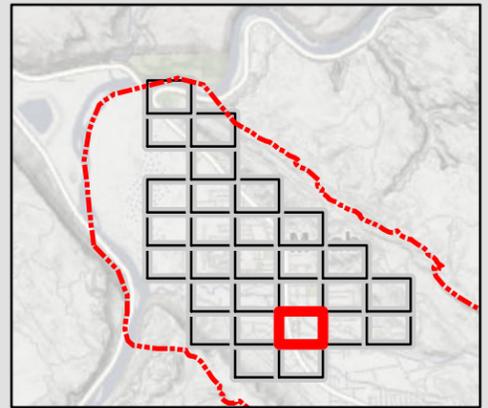
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

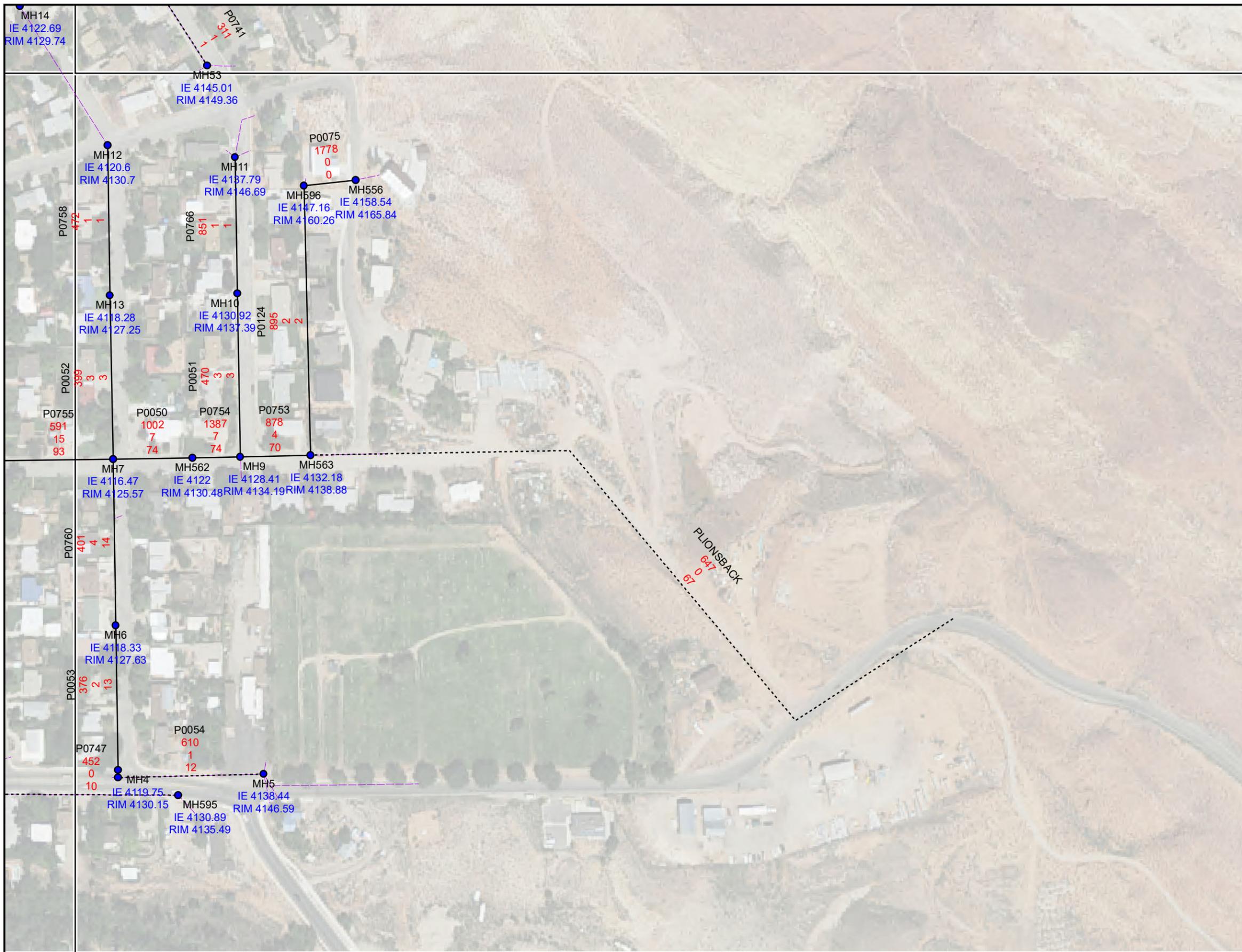


MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.
B-4



LEGEND

Manholes

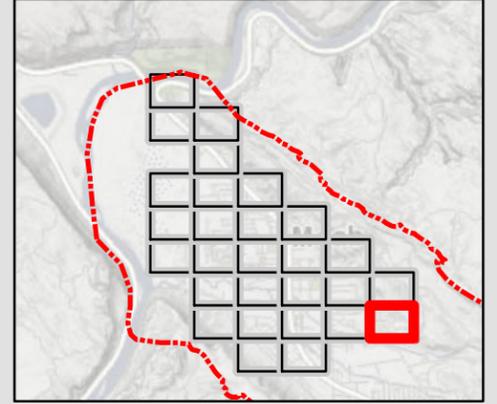
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:

SCALE:

MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**

BOWEN COLLINS & ASSOCIATES
Celebrating 20 Years

FIGURE NO.
B-6



LEGEND

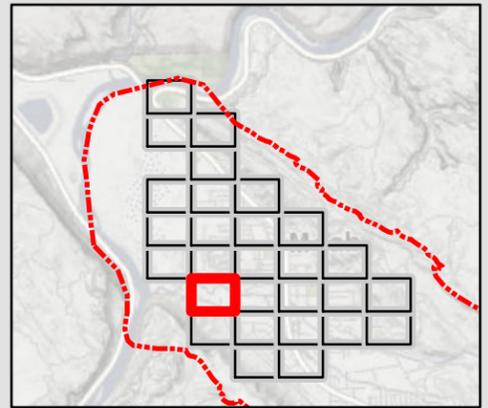
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

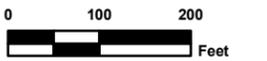
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



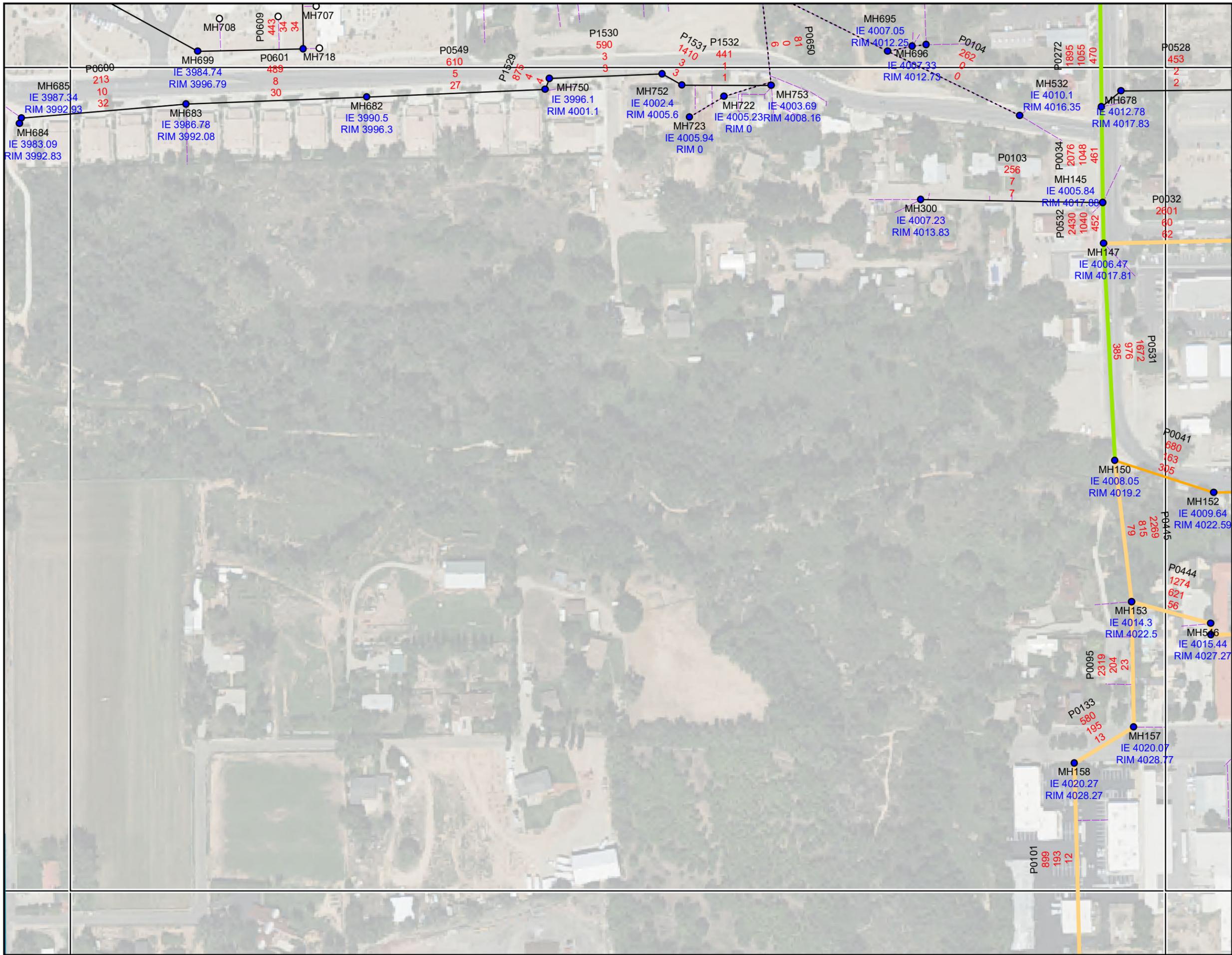
MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.

C-2



LEGEND

Manholes

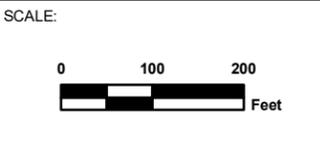
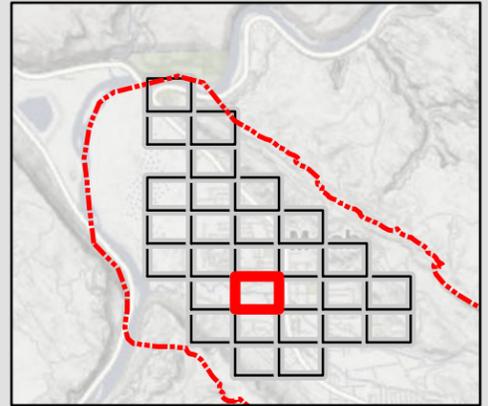
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

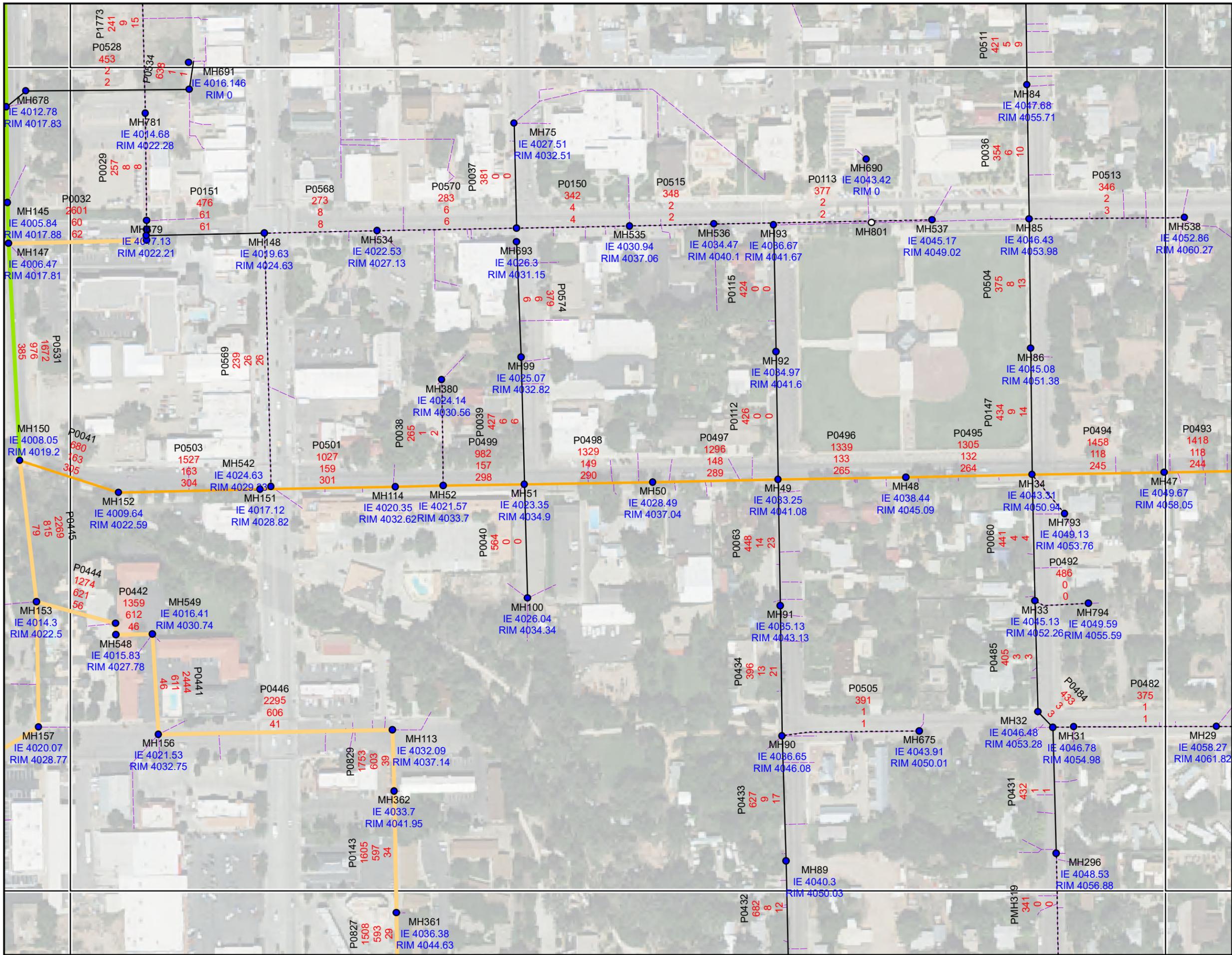
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



MAPBOOK

CITY OF MOAB SANITARY SEWER MASTER PLAN

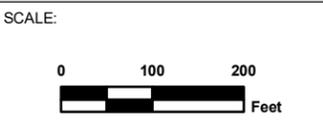
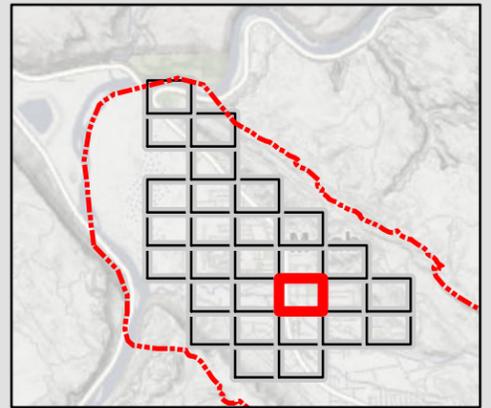
FIGURE NO.
C-3



LEGEND

- Manholes**
- No Invert
 - Invert
- Buildout Improved Pipe Diameter (inches)**
- 6" or less
 - 8"
 - 10"
 - 12"
 - 15"
 - 18"
 - 21"
 - 24"
 - 30"
 - 36"
 - 42"
 - Not Modeled
 - Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



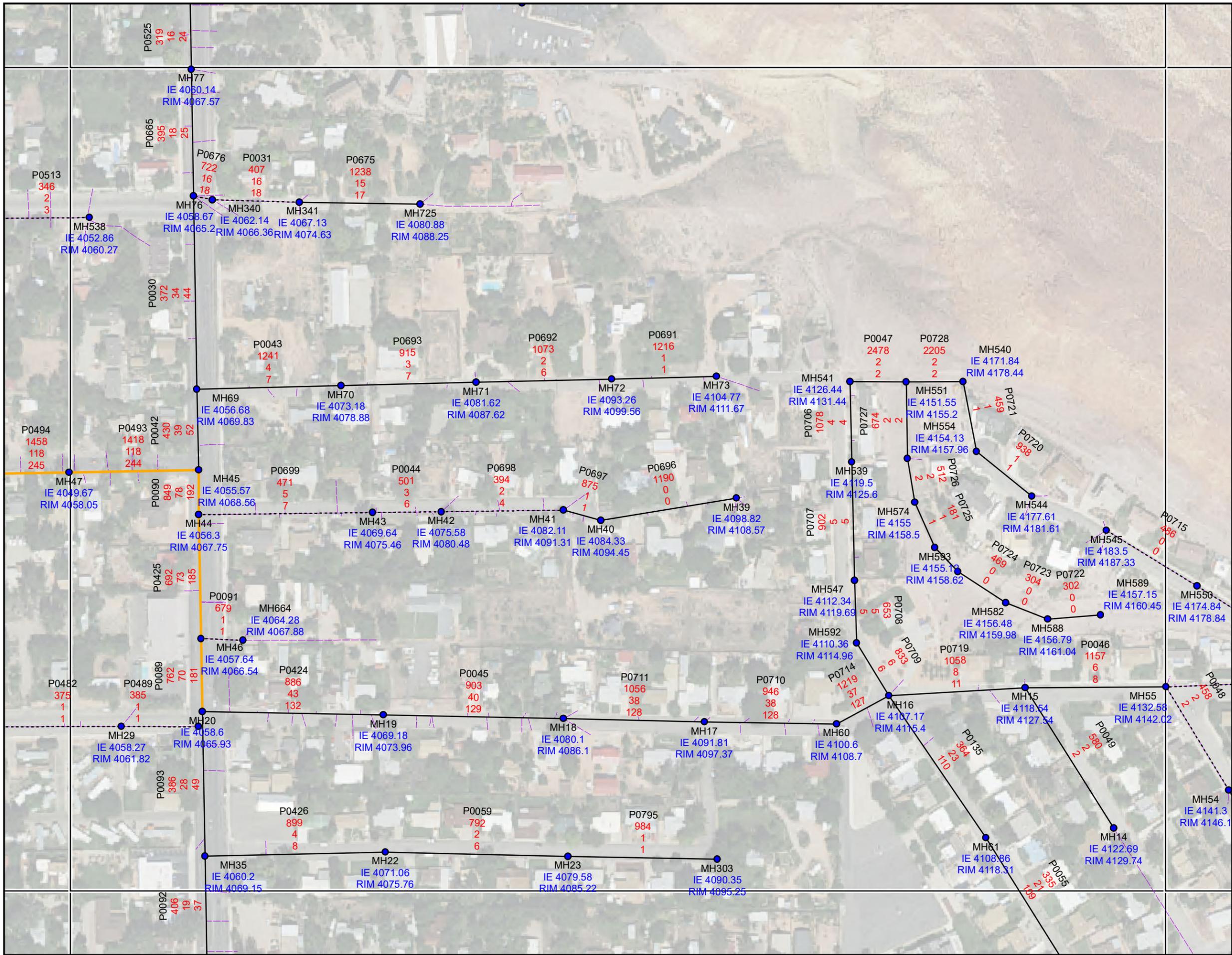
MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.

C-4



LEGEND

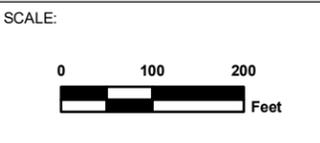
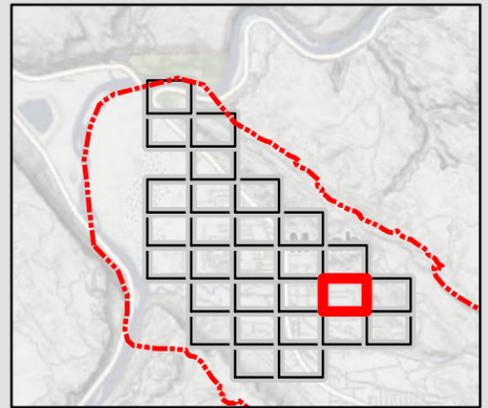
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



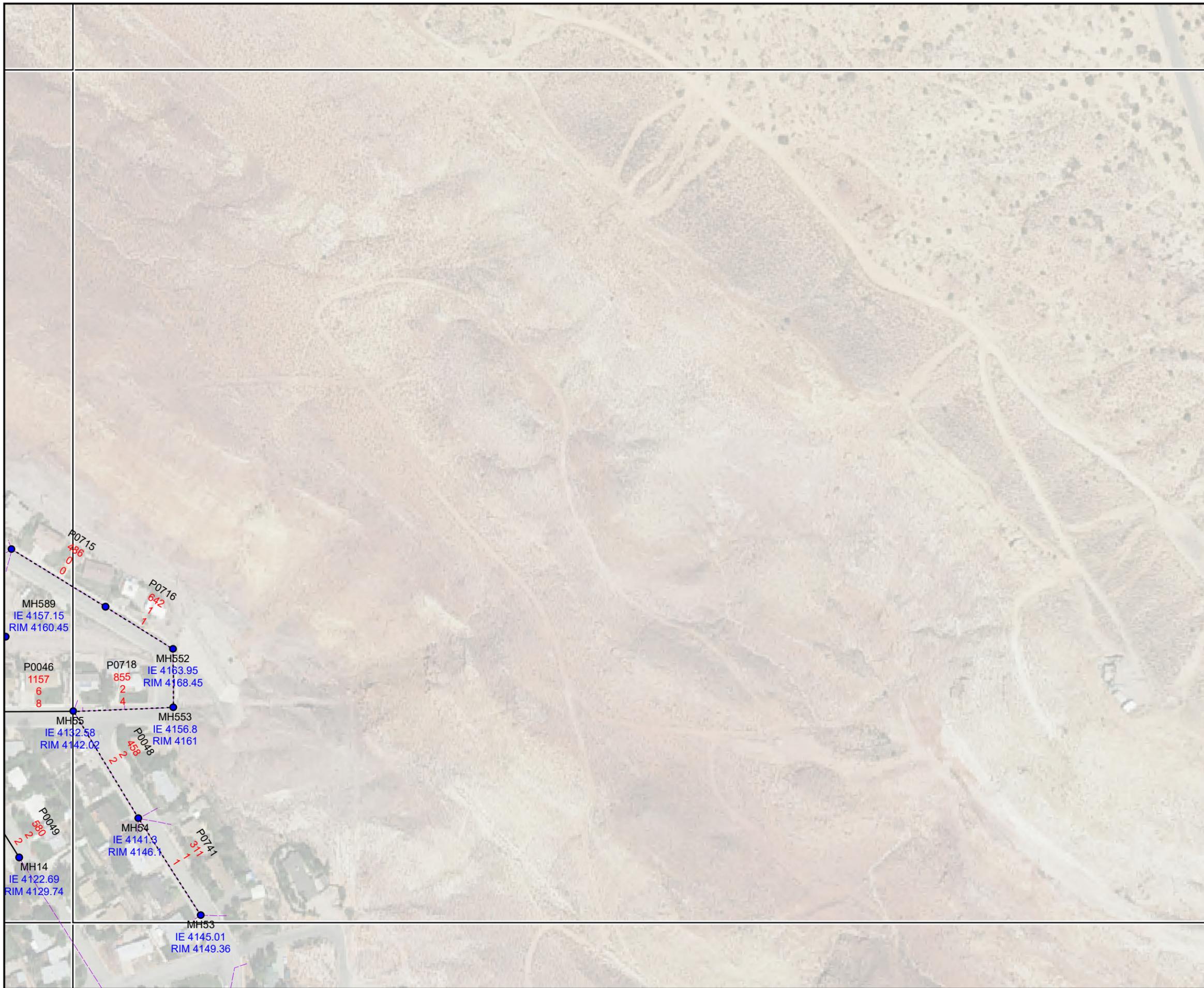
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CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.

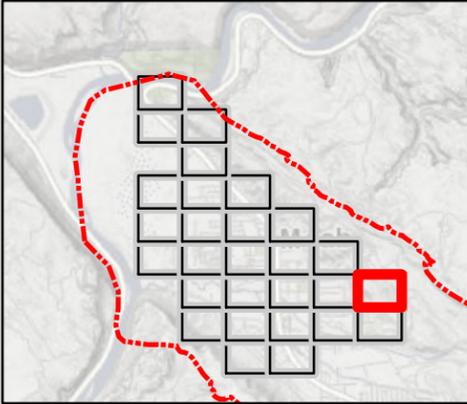
C-5



LEGEND

- Manholes**
- No Invert
 - Invert
- Buildout Improved**
- Pipe Diameter (inches)**
- 6" or less
 - 8"
 - 10"
 - 12"
 - 15"
 - 18"
 - 21"
 - 24"
 - 30"
 - 36"
 - 42"
 - Not Modeled
 - Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



MAPBOOK

CITY OF MOAB SANITARY SEWER MASTER PLAN



FIGURE NO.

C-6



| | | | | |
|--------|-------------|-------|--|-------|
| PWWTP | MH475 | P0243 | | P0239 |
| 101018 | IE 3955.5 | 4182 | | 11337 |
| 1818 | RIM 3965.1 | 1577 | | 1576 |
| 3435 | | 1154 | | 1145 |
| | MH476 | | | |
| | IE 3954.97 | | | |
| | RIM 3967.87 | | | |
| | MH220 | | | |
| | IE 3962.71 | | | |
| | RIM 3967.09 | | | |

MH770
IE 3952.49
RIM 3957.69

P2004
6003
0
1807

P2003
11055
0
1813

LEGEND

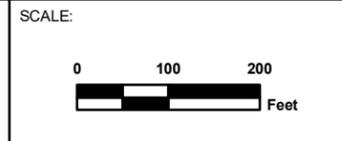
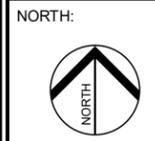
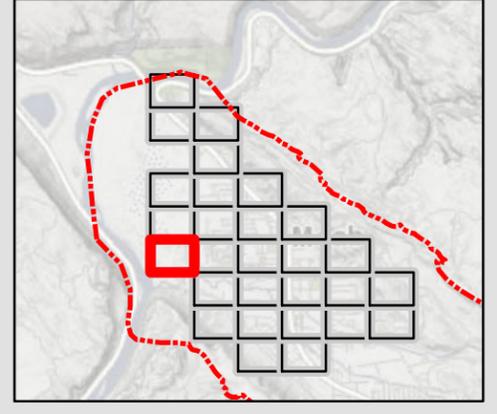
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

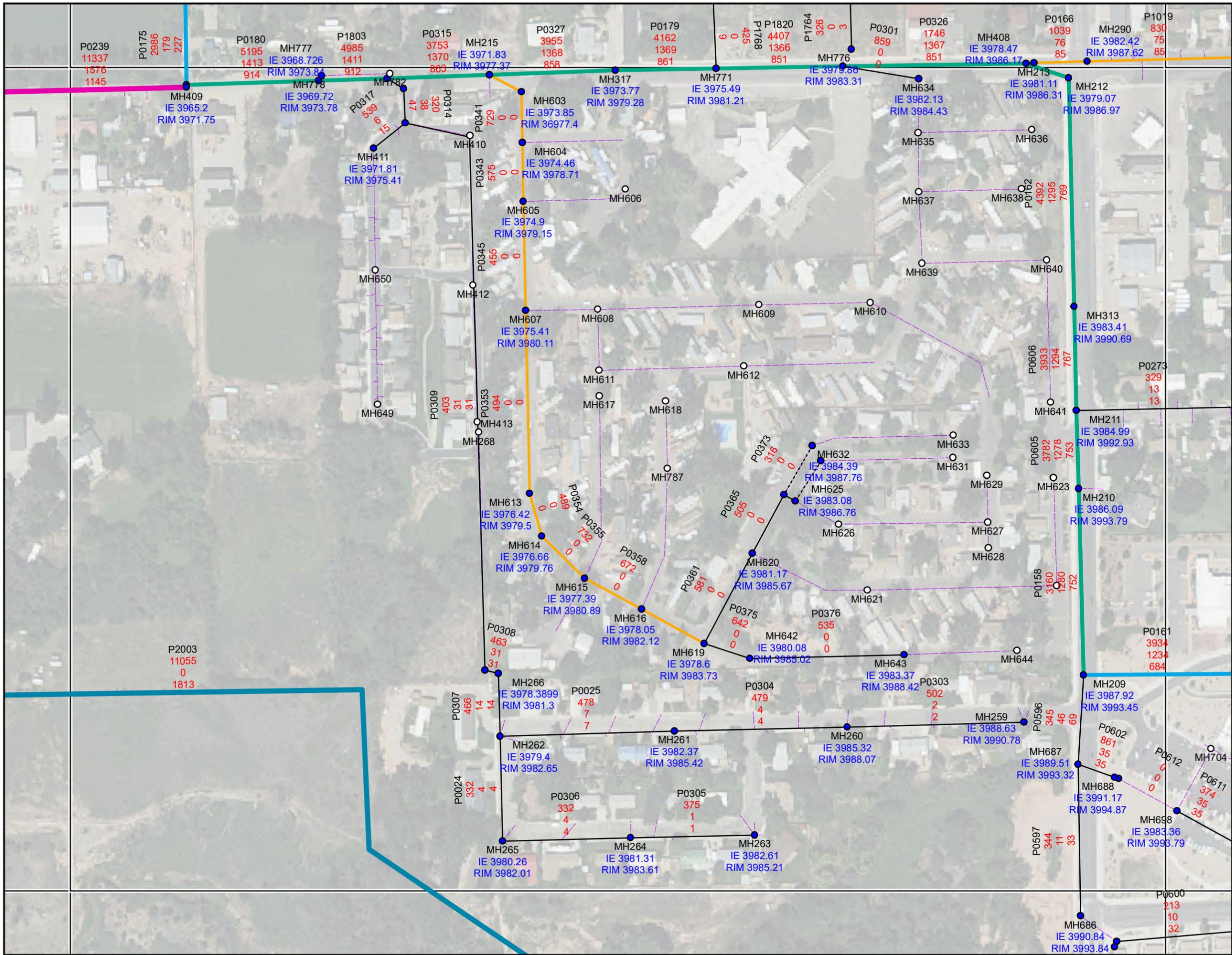
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**

FIGURE NO.
D-1



LEGEND

Manholes

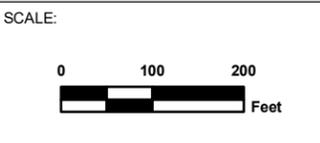
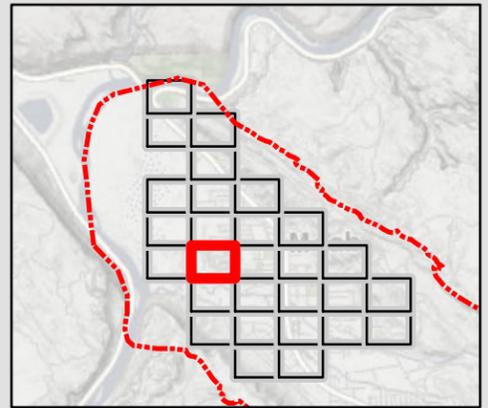
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

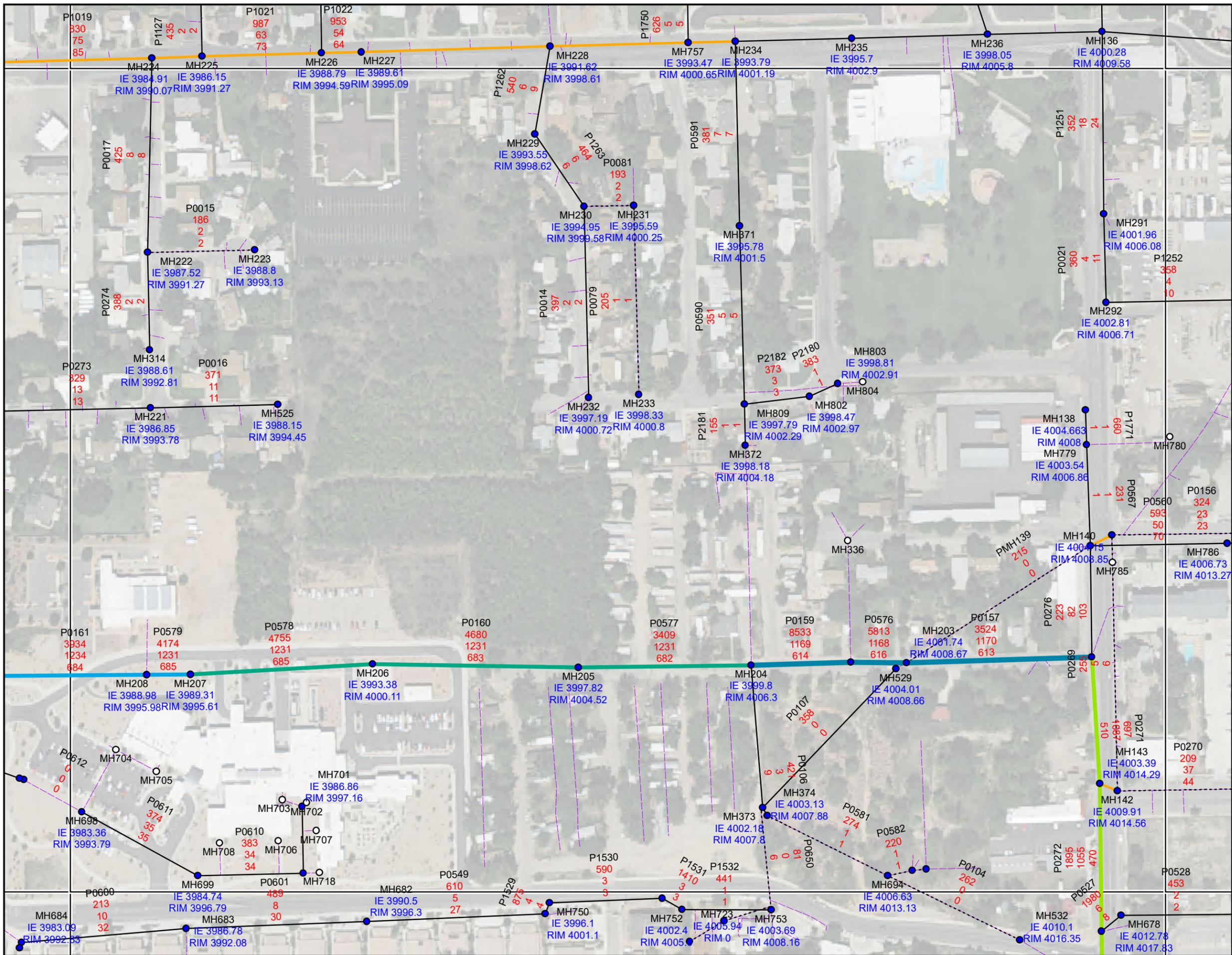


MAPBOOK

CITY OF MOAB
**SANITARY SEWER
 MASTER PLAN**



FIGURE NO.
D-2



LEGEND

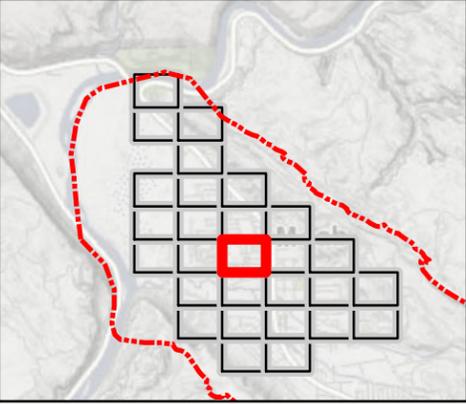
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



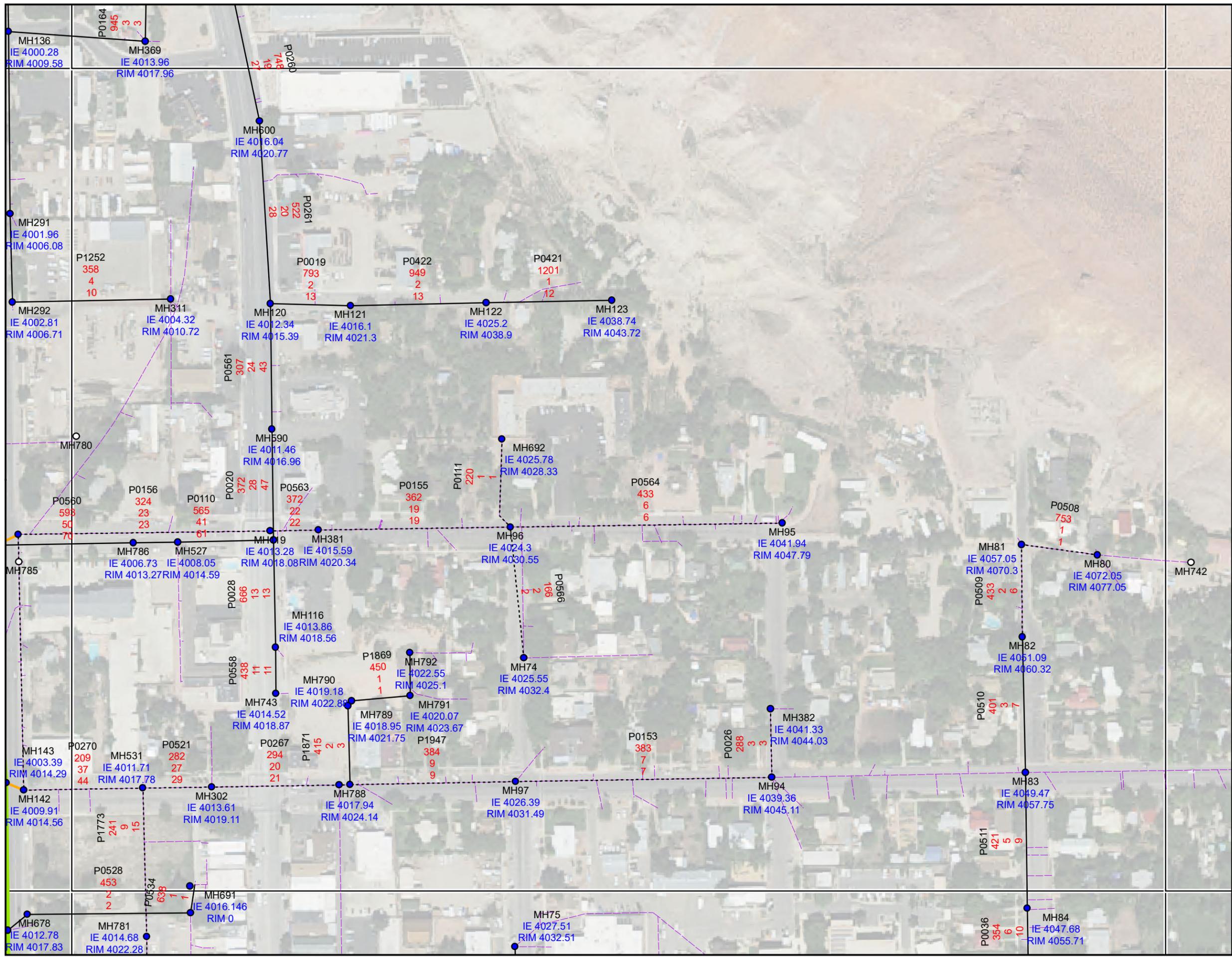
NORTH:

SCALE:

MAPBOOK

CITY OF MOAB SANITARY SEWER MASTER PLAN

FIGURE NO. **D-3**



LEGEND

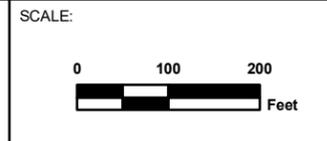
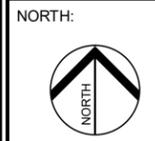
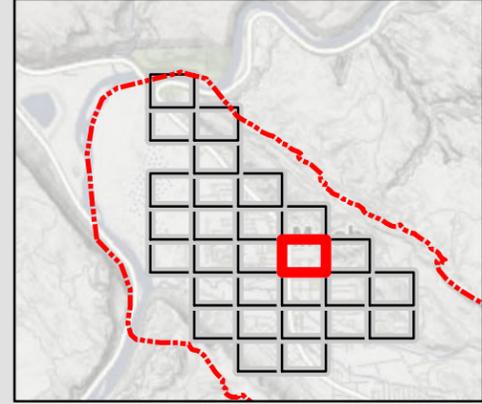
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

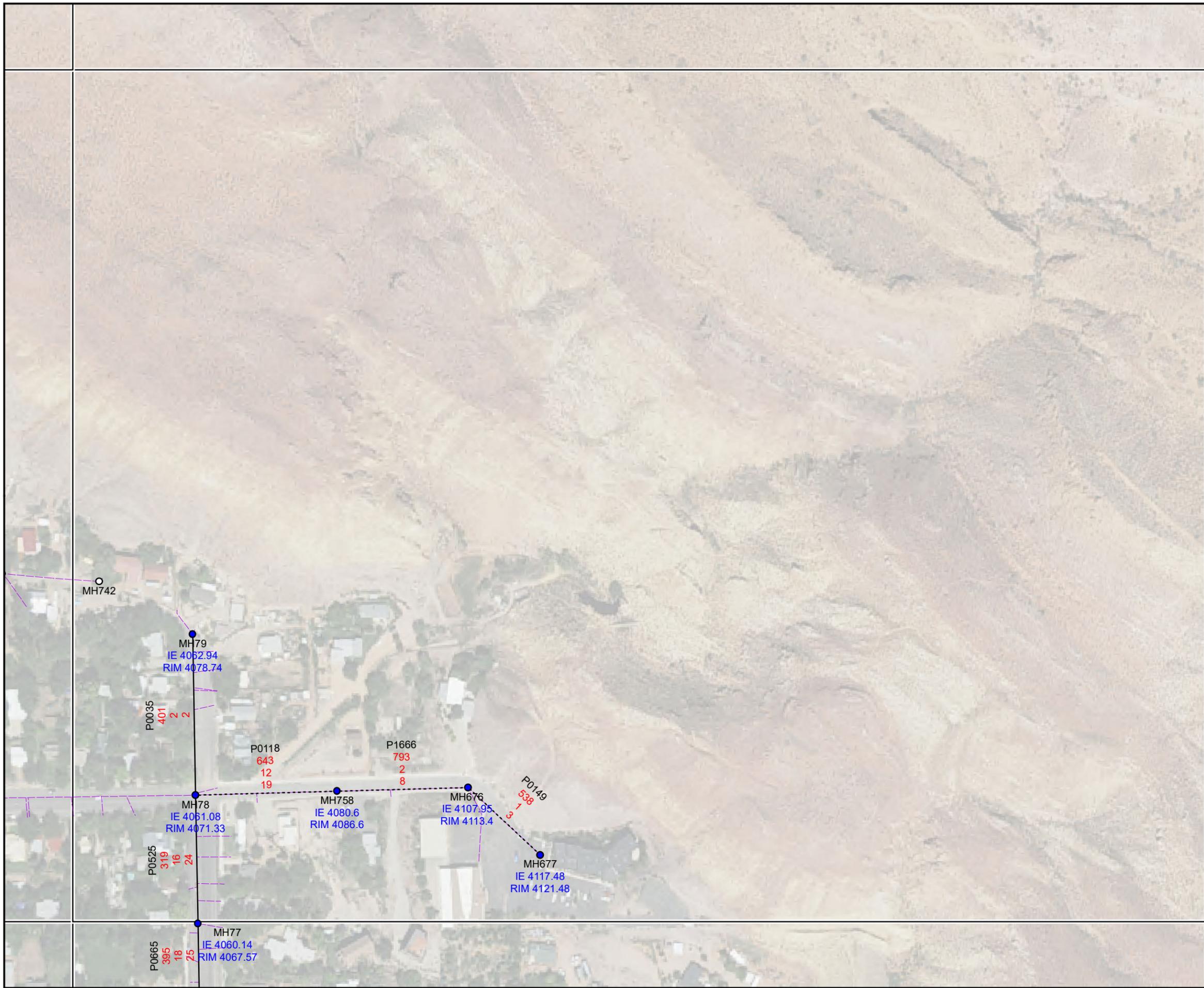


MAPBOOK

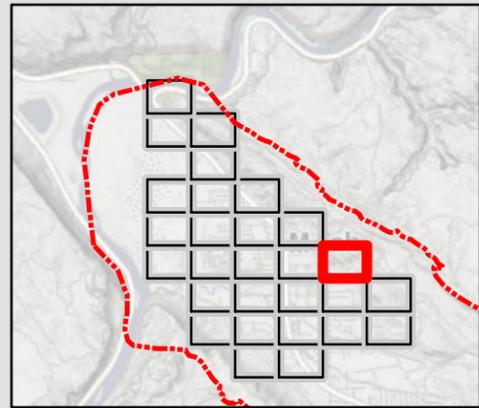
CITY OF MOAB
**SANITARY SEWER
 MASTER PLAN**



FIGURE NO.
D-4



| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



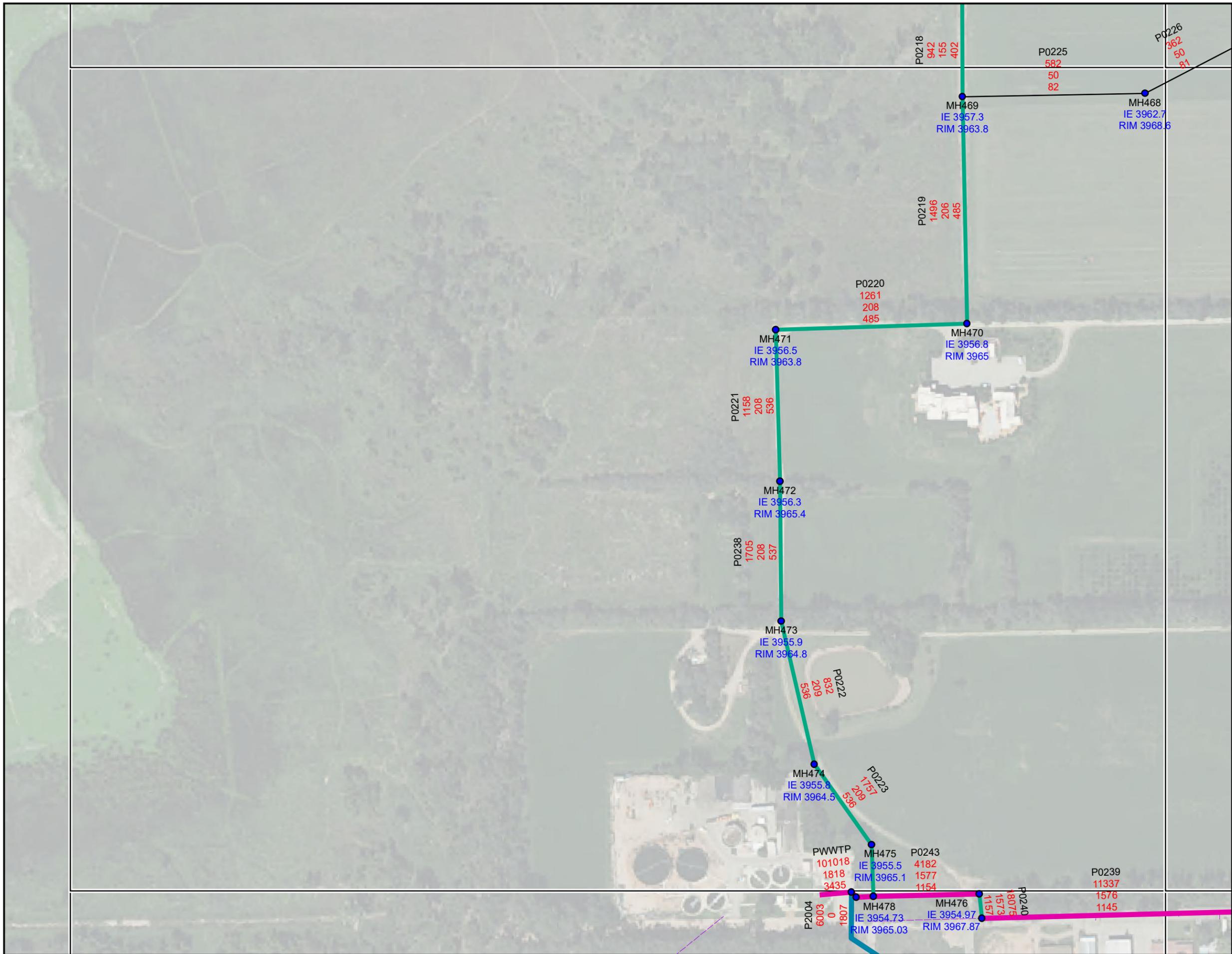
MAPBOOK

CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**



FIGURE NO.

D-5



LEGEND

Manholes

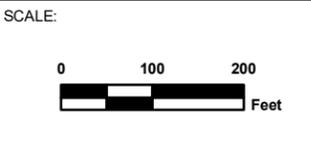
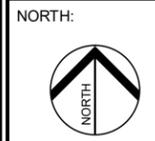
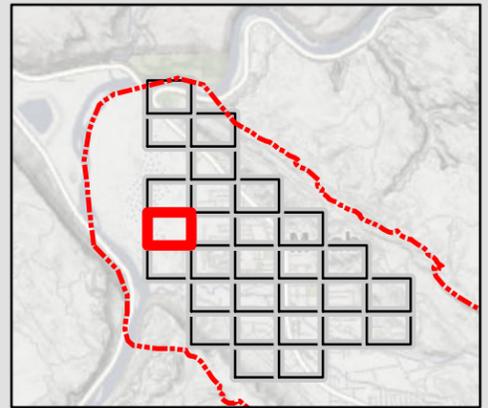
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

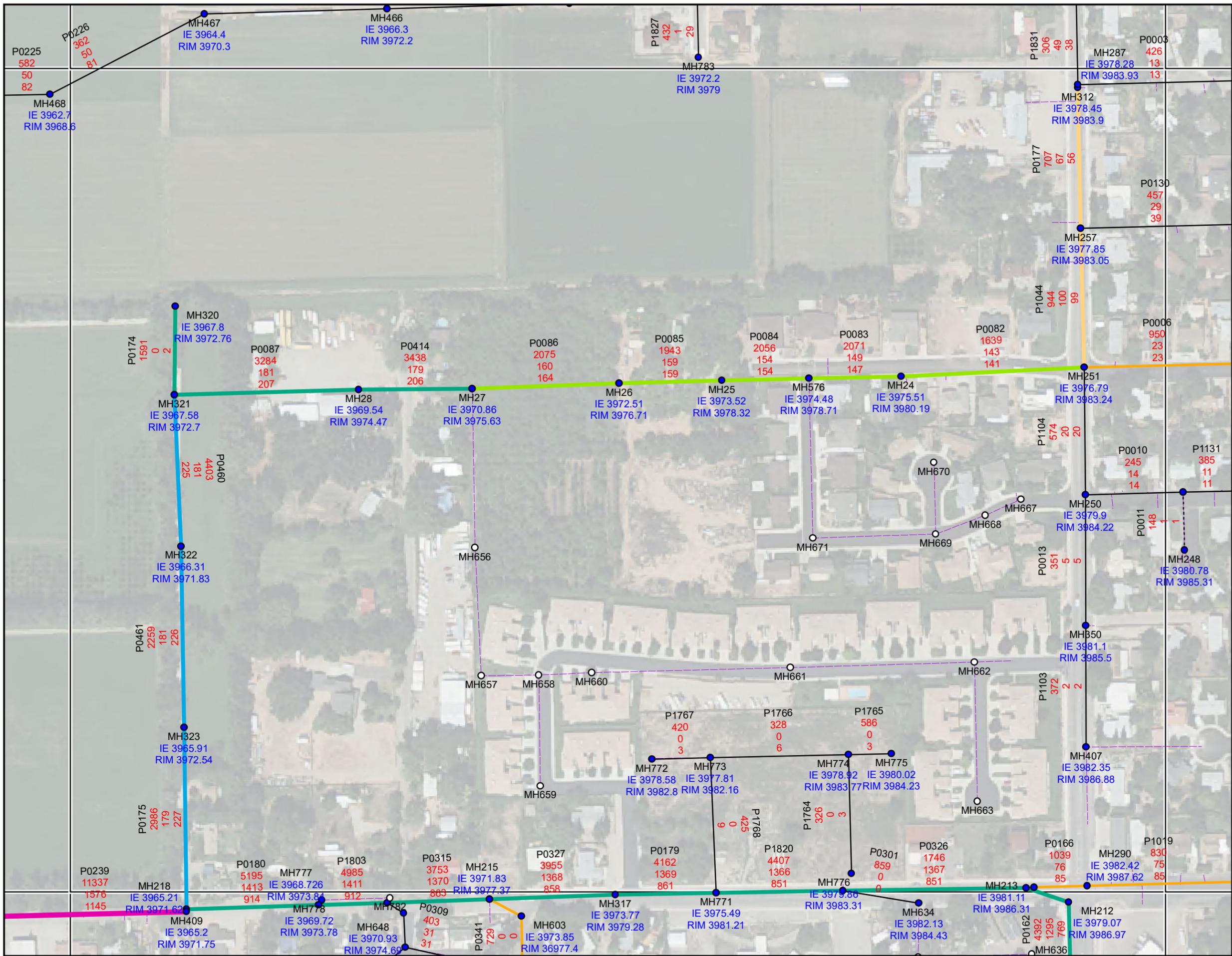


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CITY OF MOAB
**SANITARY SEWER
 MASTER PLAN**

**BOWEN COLLINS
 & ASSOCIATES**
Celebrating 20 Years

FIGURE NO.
E-1



LEGEND

Manholes

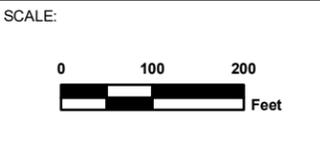
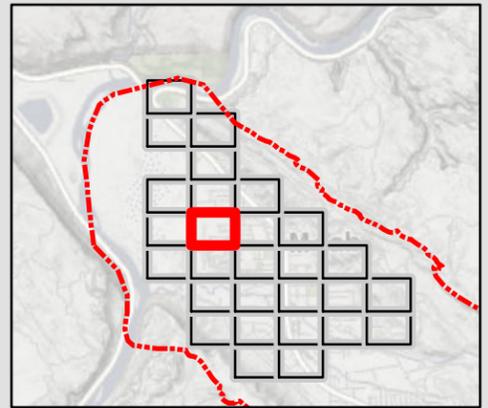
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

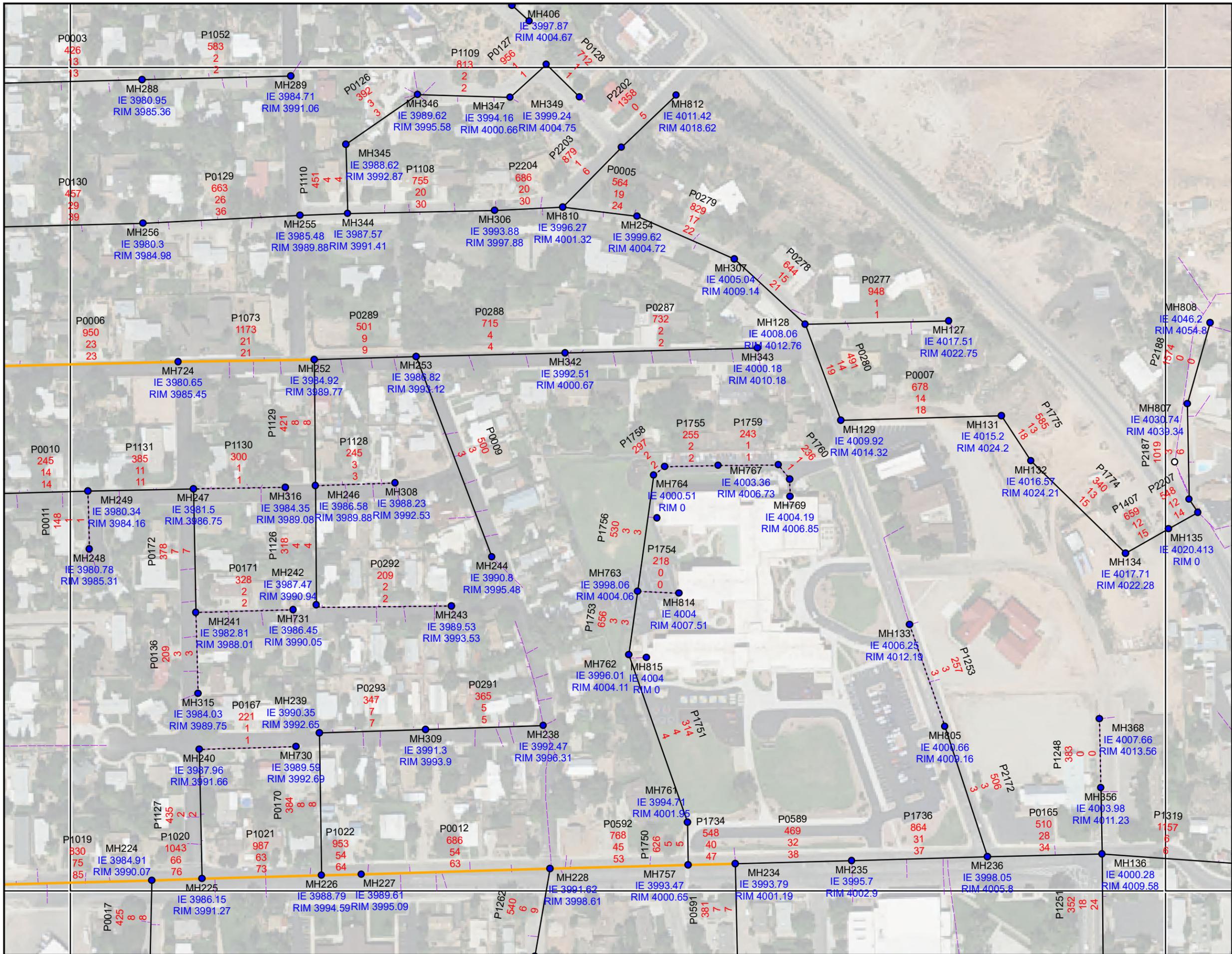


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**SANITARY SEWER
 MASTER PLAN**



FIGURE NO.
E-2



LEGEND

Manholes

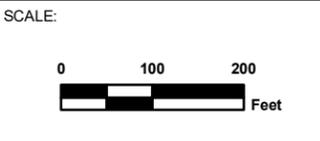
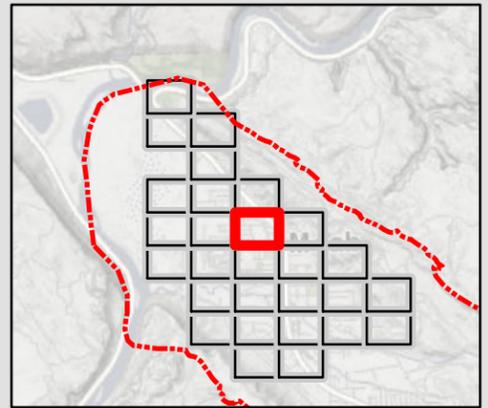
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- - - - - Not Modeled
- ▭ Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



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CITY OF MOAB
**SANITARY SEWER
 MASTER PLAN**



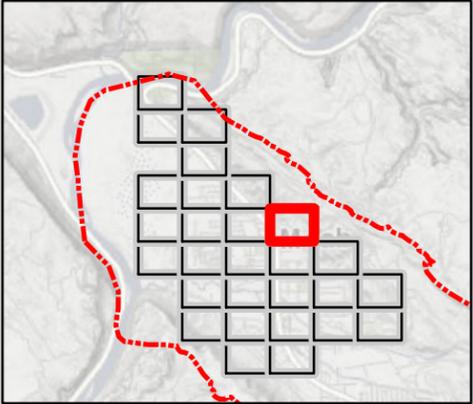
FIGURE NO.
E-3



LEGEND

- Manholes**
- No Invert
 - Invert
- Buildout Improved**
- Pipe Diameter (inches)**
- 6" or less
 - 8"
 - 10"
 - 12"
 - 15"
 - 18"
 - 21"
 - 24"
 - 30"
 - 36"
 - 42"
 - Not Modeled
 - Spanish Valley

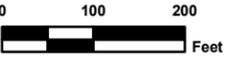
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



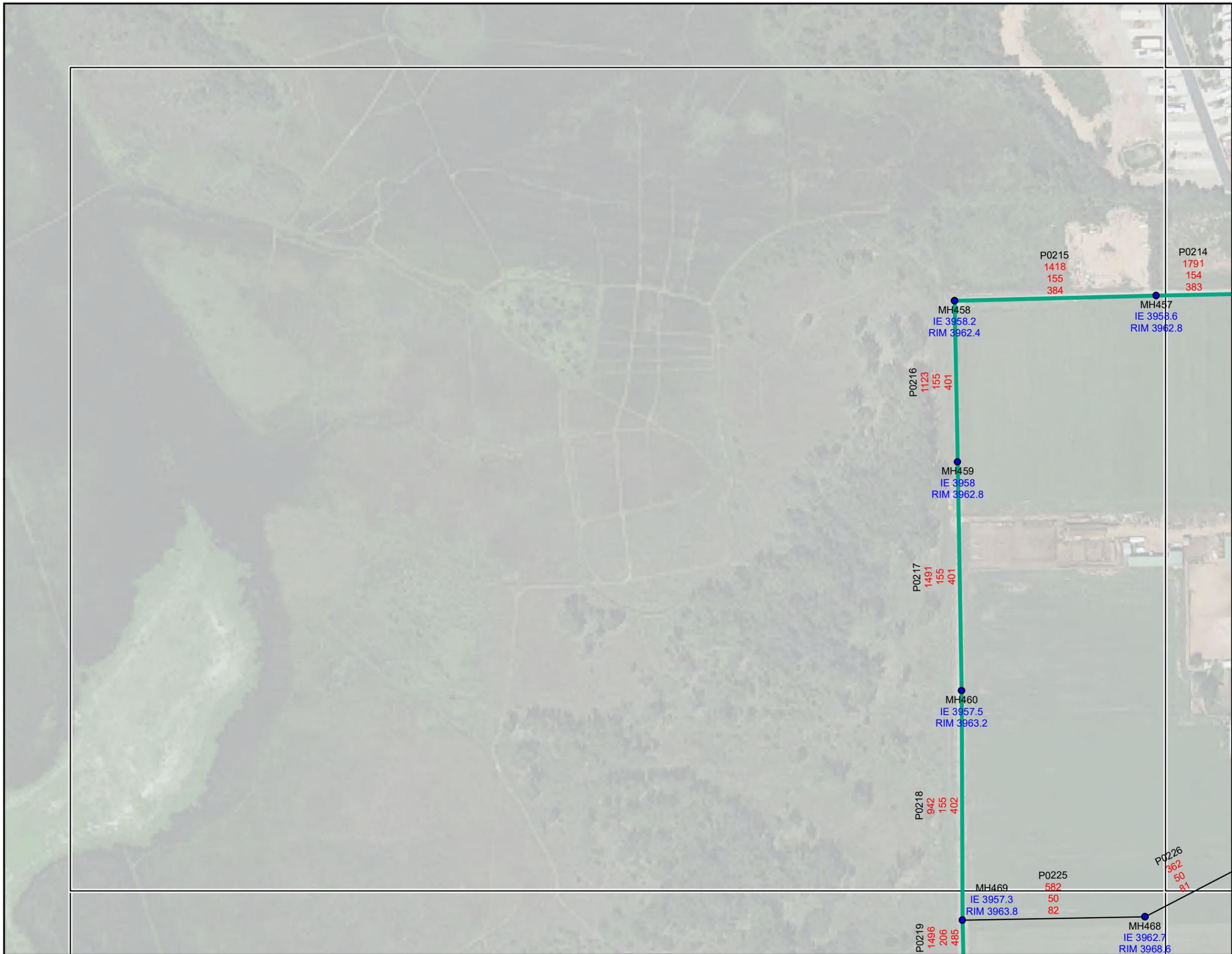
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MASTER PLAN**



FIGURE NO.

E-4



LEGEND

Manholes

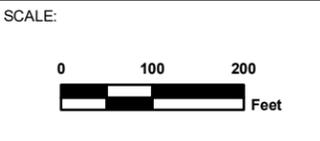
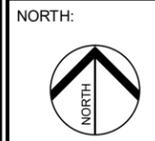
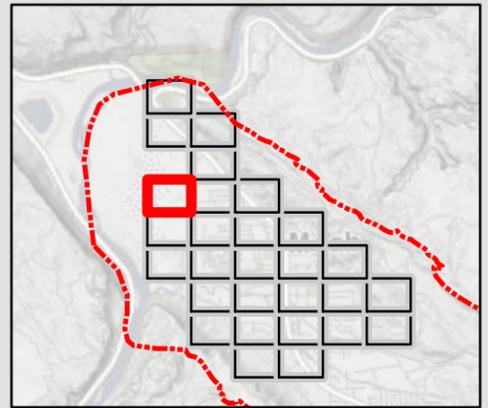
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

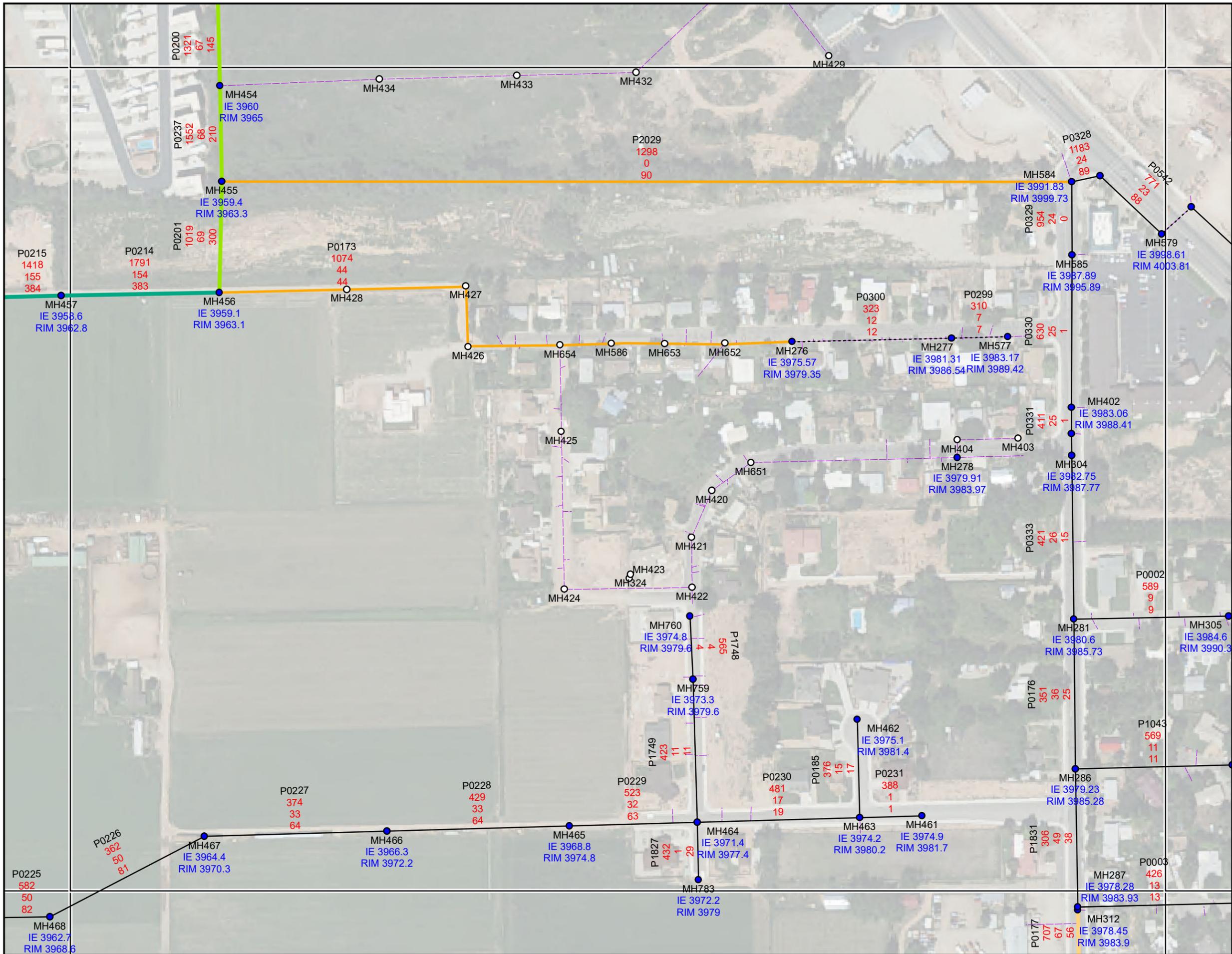


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CITY OF MOAB
**SANITARY SEWER
MASTER PLAN**

BOWEN COLLINS & ASSOCIATES
Celebrating 20 Years

FIGURE NO.
F-1



LEGEND

Manholes

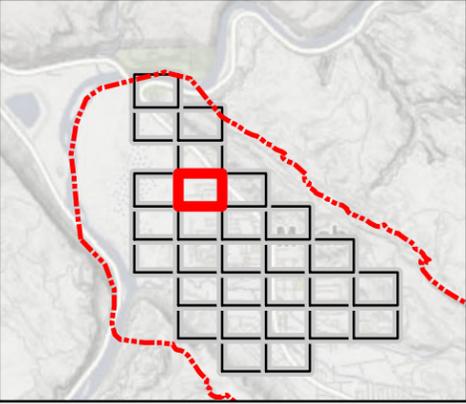
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- - - - - Not Modeled
- ▭ Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:

SCALE:

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 MASTER PLAN**

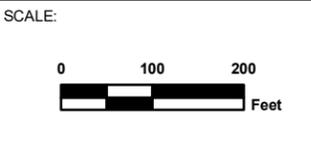
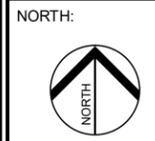
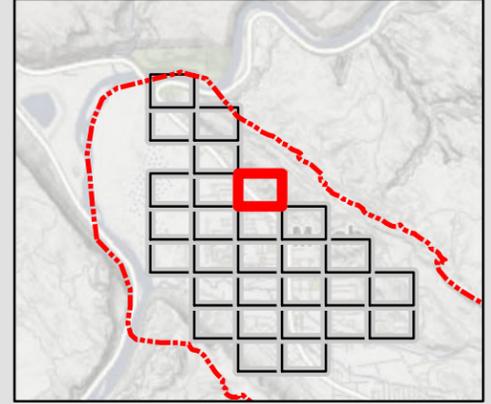
FIGURE NO.
F-2



LEGEND

- Manholes**
- No Invert
 - Invert
- Buildout Improved Pipe Diameter (inches)**
- 6" or less
 - 8"
 - 10"
 - 12"
 - 15"
 - 18"
 - 21"
 - 24"
 - 30"
 - 36"
 - 42"
 - Not Modeled
 - Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |

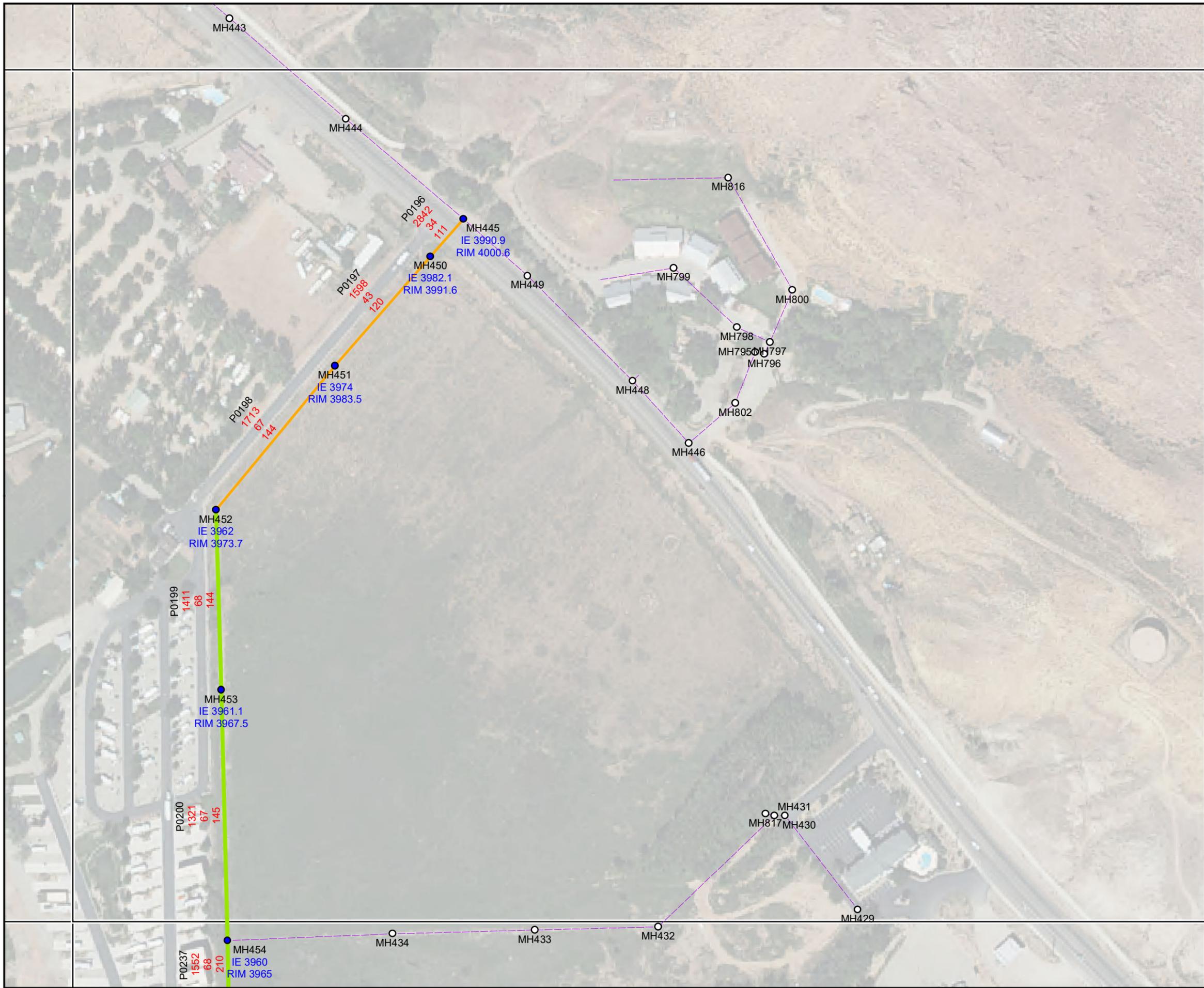


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SANITARY SEWER MASTER PLAN



FIGURE NO.
F-3



LEGEND

Manholes

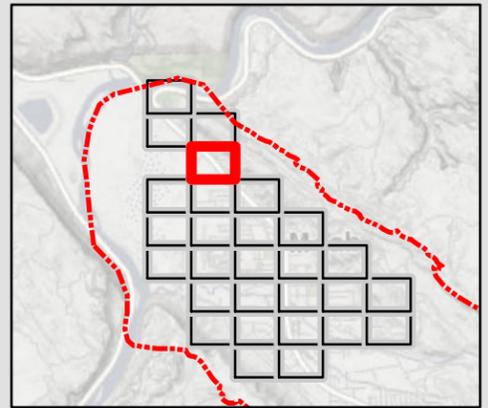
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

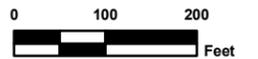
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



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MASTER PLAN**



FIGURE NO.

G-2



LEGEND

Manholes

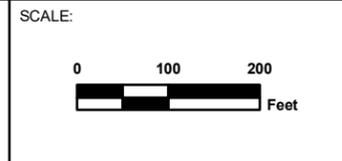
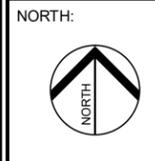
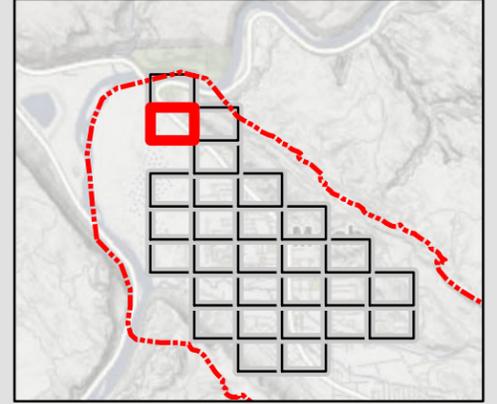
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- - - - - Not Modeled
- ▭ Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



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MASTER PLAN**

BOWEN COLLINS & ASSOCIATES
Celebrating 20 years

FIGURE NO.
H-1



LEGEND

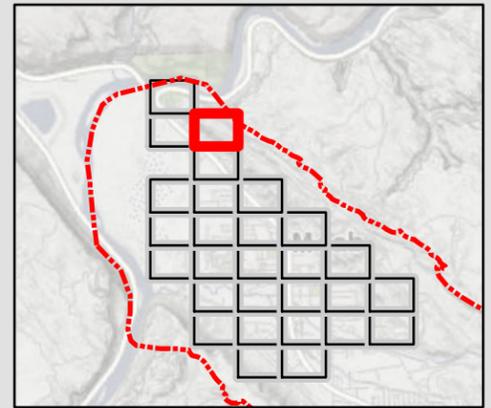
Manholes

- No Invert
- Invert

Buildout Improved Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- - - - - Not Modeled
- Spanish Valley

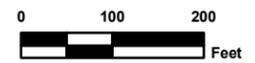
| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



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MASTER PLAN**



FIGURE NO.

H-2



LEGEND

Manholes

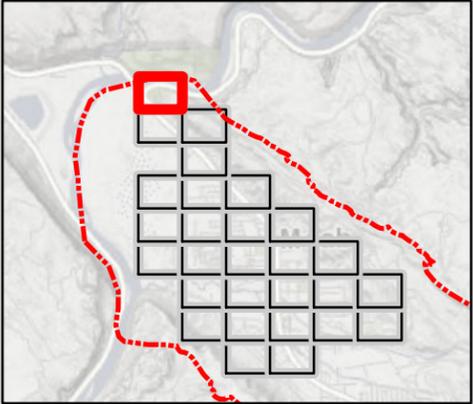
- No Invert
- Invert

Buildout Improved

Pipe Diameter (inches)

- 6" or less
- 8"
- 10"
- 12"
- 15"
- 18"
- 21"
- 24"
- 30"
- 36"
- 42"
- Not Modeled
- Spanish Valley

| MH ID | Pipe ID |
|------------------|-------------------------|
| Invert Elevation | Capacity (gpm) |
| RIM | Existing (gpm) |
| | Buildout Improved (gpm) |



NORTH:



SCALE:



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MASTER PLAN**



FIGURE NO.

I-1