2020 Sanitary Sewer

Master Plan Update

May 2020

City of West Jordan
8000 South Redwood Road
West Jordan, Utah 84008

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Master Plan Update

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Prepared for:
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EXECUTIVE SUMMARY

The City of West Jordan (City) has completed the 2019 Sanitary Sewer Master Plan Update (Plan). This Plan targeted the following items:

- Data Collection – Incorporate updated survey data for new developments.
- Update Existing Model – Update the InfoSWMM hydraulic model based on new survey data and include current sanitary sewer flows. Create calibrated model to utilize in the future.
- Evaluate Buildout Scenario – Create a buildout scenario that will identify capacity issues that the City will need to prepare for.
- Capital Improvement Plan (CIP) – Prepare a CIP to be used by City staff for future planning purposes.

Previous master plans studied the sewer trunk lines in arterial roads, groundwater infiltration, and provided survey and model data for the major roads. The 2012 Master Plan provided comprehensive survey and modeling data for each manhole and pipe throughout the City including individual neighborhoods. This Plan provides an updated existing model that included the areas that have developed since 2012, an estimate of future growth based on the City's Land Use Plan, and the required sewer capacity to meet the per capita wastewater demand for this growth. The location and size of new pipelines were studied, modeled, and mapped, as were improvements to the existing sewer system under the CIP.

A Geographical Information System (GIS) based computer model (InfoSWMM) was used to evaluate the existing and future pipe collection systems. The computer model incorporates Global Positioning System (GPS) surveyed manhole and pipe elevation data collected by the City for each manhole and pipe in the City's sewer system. The current West Jordan population density from census data, and the current land use map were used to evaluate sewer usage per person for existing residential areas and to project future sewer use in undeveloped areas. Water use records from water meters were used to estimate existing commercial and industrial sewer usage. The existing sewer model was calibrated by comparing observed flows in several locations throughout the City with model output data for each location, model flows calibrated to within +/- 5% of the observed flows.

EXISTING SYSTEM EVALUATION

The results of the existing system evaluation indicate that most of the system is currently functioning within established capacity criteria. However, a few pipelines have reached or are approaching capacity. The areas requiring improvements are shown in Figure 6-1. The observed deficiencies are as follows:

- **1300 West** - The 1300 West 10-inch pipeline from 8600 South to 8200 South then south of 9000 South is at capacity, due in large part to infiltration from groundwater into the sewer laterals, pipes, connections, and manholes.
- **Grizzly Way -** The 12-inch pipeline in Grizzly Way from Swift Water Way to 7800 South is at capacity because of the large area that has developed upstream of this location.

- **Campus View Drive** - The 8-inch and 10-inch diameter pipe in Campus View Drive is at capacity due mainly to the high-density residential development that is in the area.

There are various other isolated short segments of pipes (shown as red in Figure 6-1) throughout the system model that may be experiencing capacity problems or may have invert elevation or pipe size data that needs to be updated. These localized areas need to be investigated further with field monitoring to confirm if they are problem areas.

FUTURE SYSTEM EVALUATION

Generally, the location of the buildout collection pipelines was based on the previous modeling and master plan which were in proposed roads from the Master Transportation Plan. Figure 6-2 shows proposed locations and sizes of future pipelines to serve the undeveloped areas.

Future wastewater demands were projected for buildout using the City's 2018 Land Use Map zoning designations (Figure 2-1) along with the most recent General Plan. The City of West Jordan Planning Department utilizes the estimates of residential dwelling unit densities and occupancy rates (people per household). While an approximate population number could be determined from this data, the buildout scenario used in this master plan update simply utilizes the densities, occupancy rates and the approved land use map to calculate future wastewater demands. Therefore, no specific population number is used within this update.

Buildout Capacity

There are some areas in the existing collection system that will not provide adequate capacity for the projected buildout flows as shown in Figure 6-2. The observed projected deficiencies in the collection system at buildout are as follows:

- **90th South/Old Bingham Highway -** The main trunk line in 90th South starting in Old Bingham Highway near 4600 West to Redwood Road varies in size and does not have adequate capacity. The 21-inch pipeline from Redwood Road to Jordan River Parkway is also approaching the 0.75 depth of flow to diameter of pipe (d/D) ratio level of service. In discussion with city staff it was also decided to include this section of the collection system since there are going to be improvements done along 9000 South and it would be economical to complete this upsizing at that time.
- **7800 South (West) -** The 7800 South 15-inch pipeline between Mountain View Corridor and Highland Loops Road is over capacity.
- **Wells Park Road -** The pipes in Wells Park Road in the industrial park require additional capacity to provide the appropriate level of service as growth occurs.
- **Jordan River Parkway -** Approximately 1,300 feet of existing 24-inch pipeline under Jordan River Parkway between 9000 South and 8800 South does not have enough slope to carry future flows.
- **Bagley Park Road** - The pipe in Bagley Park Road in the industrial park is nearing capacity and are deteriorating due to age.

- **7800 South (East)** - The existing 36-inch pipeline in 7800 South from 1300 West to 1200 West needs to be replaced due to inadequate slopes that limit the capacity of the existing pipeline.
- **7000 South** - The 7000 South 12-inch and 15-inch pipelines from Bangerter Highway to 3200 West are nearing capacity and are deteriorating due to age.

There are other segments of pipes shown as red in Figure 6-2. These are identified as existing deficiencies in Figure 6-1, may have invert elevation or pipe size data that needs to be updated or should be monitored as the City continues to grow.

CAPITAL IMPROVEMENT PLAN (CIP)

To accommodate future growth, relief improvements need to be constructed in portions of the existing system. The recommended improvements are presented in Figure 7-1 and listed in Table ES-1.

Table ES-1: Capital Improvements Projects Summary List

Major Trunkline Area	New Master Plan Priority	Project Description	Budget Estimate
8050 South	1	1300 West	$1,191,000
9000 South	2	1300 West	$757,000
9000 South	3	9000 South	$4,485,000
7800 South	4	7800 South	$1,358,000
9000 South	5	9000 South	$4,677,000
9000 South	6	9000 South	$4,074,000
9000 South	7	9000 South	$2,536,000
9000 South	8	Old Bingham Highway	$4,474,000
9000 South	9	Hawley Park/9580 South	$2,362,000
9000 South	10	Wells Park Road	$3,674,000
9000 South	11	Jordan River Parkway	$962,000
9000 South	12	Bagley Park Drive	$1,554,000
7800 South	13	Grizzly Way	$713,000
7800 South	14	Grizzly Way	$617,000
7800 South	15	7800 South	$594,000
7000 South	16	7000 South	$1,515,000
7000 South	17	Campus View Drive, Cobble Ridge Drive, Jordan Landing Boulevard	$1,645,000
			$37,188,000

The project numbers within Figure 7-1 correspond to the projects listed in Table 7-1. The projects are prioritized for incorporation into a capital facilities plan. Refer to Appendix D for the detailed CIP list.

OTHER RECOMMENDATIONS

As part of ongoing operations and maintenance, it is recommended that the City continue to investigate the sources of inflow and infiltration (I&I) to the sanitary sewer piping collection system. A study using field monitoring, CCTV, and field inspection of each lateral, pipe, and manholes in the areas where infiltration is shown to exist may reveal areas where pipes or manholes can be repaired which can reduce large I&I flows.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION AND BACKGROUND

The City of West Jordan (City) sanitary sewer collection system consists of approximately 365 miles of pipe, and approximately 7,039 manholes. Wastewater is collected with a gravity drainpipe system and conveyed from the west side to the east side of the City with metered discharge points at 9000 South, 8050 South, 7800 South, and 7000 South. Major collection trunk lines run west to east on 9000 South, 7800 South, and 7000 South. Additional collector trunk lines on the west side of the City are in the New Bingham Highway and the Old Bingham Highway, which discharge into the 7800 South trunk line. Each major discharge is connected to a regional trunk line that flows south to north along the Jordan River and into the South Valley Water Reclamation Facility (SVWRF) located at 7495 South 1300 West, West Jordan. The City is a member owner agency of the SVWRF and has purchased capacity up to 18.5 million gallons per day (mgd).

Much of the east side of the City consists of established neighborhoods, commercial, and industrial areas. Heavy and light industrial sectors are in the southwest quadrant of the City. The west side of the City beyond 5600 West is experiencing continuing residential and commercial growth with large swaths of land yet to be developed. The previous Sanitary Sewer Master Plan from 2012 provided a detailed, in-depth evaluation of every existing pipeline in the City, incorporating flows from neighborhood sewers and routing these to the collector and major collector pipes. The current study expands the 2012 Sanitary Sewer Master Plan to include development that has taken place since the completion of the 2012 study. Future infrastructure requirements are shown throughout the City, along major trunk lines on the west side where development is not complete.

This Sanitary Sewer Master Plan Update is divided into the following tasks:

1) Updating the Sanitary Sewer Model in InfoSWMM to include all current pipes, manholes, and accurate wastewater loading calculations from each connection.
2) Evaluating the existing system (2019) to determine current capacity and system deficiencies.
3) Evaluating the existing system under future wastewater loading to show the need for existing system improvements that are necessary through buildout, as part of an overall Capital Facilities Plan.
4) Evaluating the need and location for new facilities to accommodate future new growth and development on the west side and interior of the City.

A state-of-the-art computer modeling software (InfoSWMM by Innovyze) running in a Geographic Information System (GIS) based environment was used in conjunction with the City's General Land Use Plan to simulate current and future sanitary sewer system capacity.

2 LAND USE PLANNING AND POPULATION

2.1 EXISTING POPULATION ESTIMATES AND LAND USE

The City's most current GIS parcel data, aerial photographs, and 2018 Land Use Map (Figure 2-1) were used to identify residential, commercial, industrial, and light industrial areas of the City. See Appendix A for the large-scale figure.

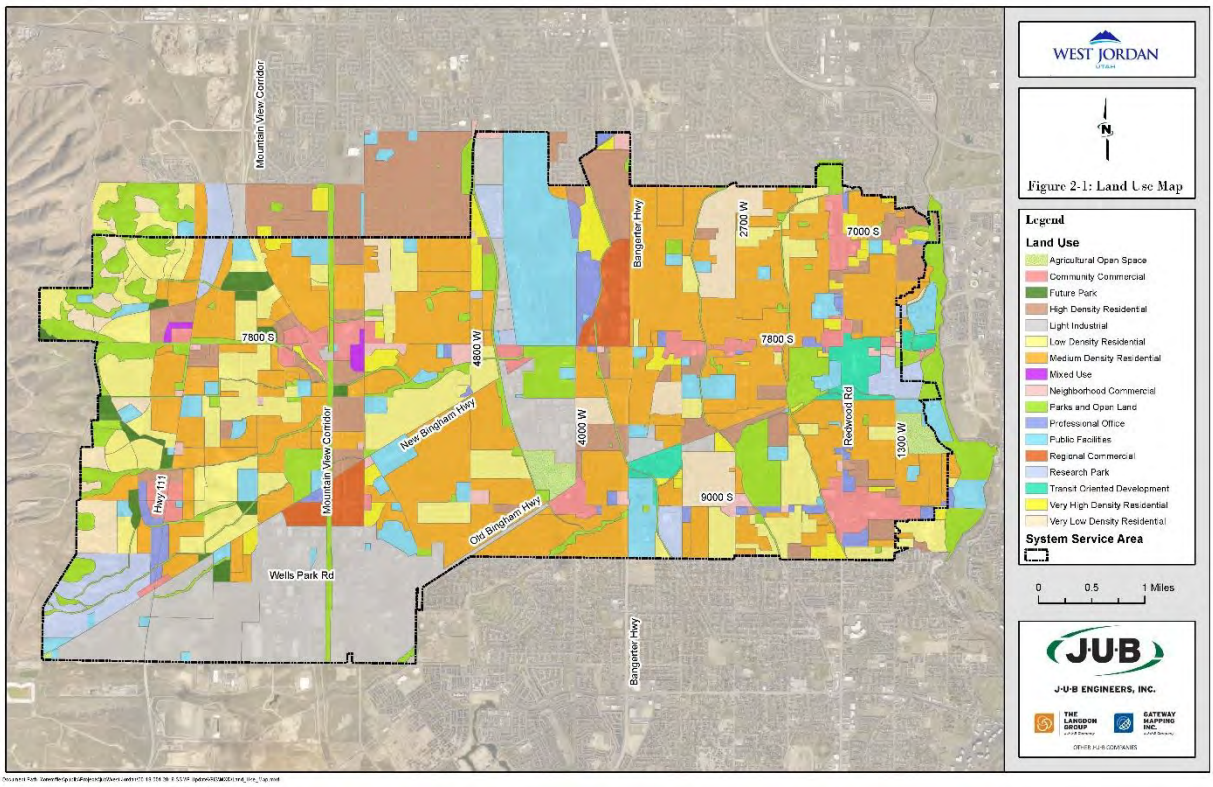


Figure 2-1: 2018 Land Use Map

The wastewater flows from these areas were then individually assigned to the wastewater model. The 2018 population estimate used information from the University of Utah Kem C. Gardner Institute for residential dwelling unit densities and occupancy rates (people per household). The current citywide residential dwelling units per acre is 1.66. The City population for 2018 from the University of Utah Kem C. Gardner Institute was 111,719.

Tables 2.1 and 2.2 provide residential density ranges that are found in the most recent City General Plan. The performance-based overlay district allows increases in density when a developer adds amenities such as extra open space, playgrounds, or upgrades to building facades.

Table 2-1: Residential Density Ranges

Density Designation	Current Density Range (Dwelling Units Per Acre)
Very Low Density	Up to 2.0
Low Density	1 to 3
Medium Density	3.1 to 5.0
High Density	5.1 to 10
Very High Density	10.1 and up

Table 2-2: Residential Density for the Performance Based Overlay District

Density Designation	Density Range (Dwelling Units Per Acre)
Very Low Density	Up to 2.0
Low Density	1 to 3.5
Medium Density	3.1 to 7.6
High Density	5.1 to 14.1
Mixed Use	0-25

2.2 FUTURE POPULATION ESTIMATES & LAND USE

Future wastewater demands were projected for buildout using the City's 2018 Land Use Map zoning designations (Figure 2-1) along with the most recent General Plan. The City of West Jordan Planning Department utilizes the estimates of residential dwelling unit densities shown above and occupancy rates (people per household). While an approximate population number can be determined from this data, the buildout scenario used in this master plan update utilizes the densities, occupancy rates and the approved land use map to calculate future wastewater demands. Therefore, no specific population number is used within this update.

3 COLLECTION SYSTEM FACILITIES

3.1 COLLECTION SYSTEM

The City's collection system service area (Figure 3-1) is approximately 7.5 square miles and services 24,275 connections, of which there are 22,714 residential, and 1,561 non-residential connections.

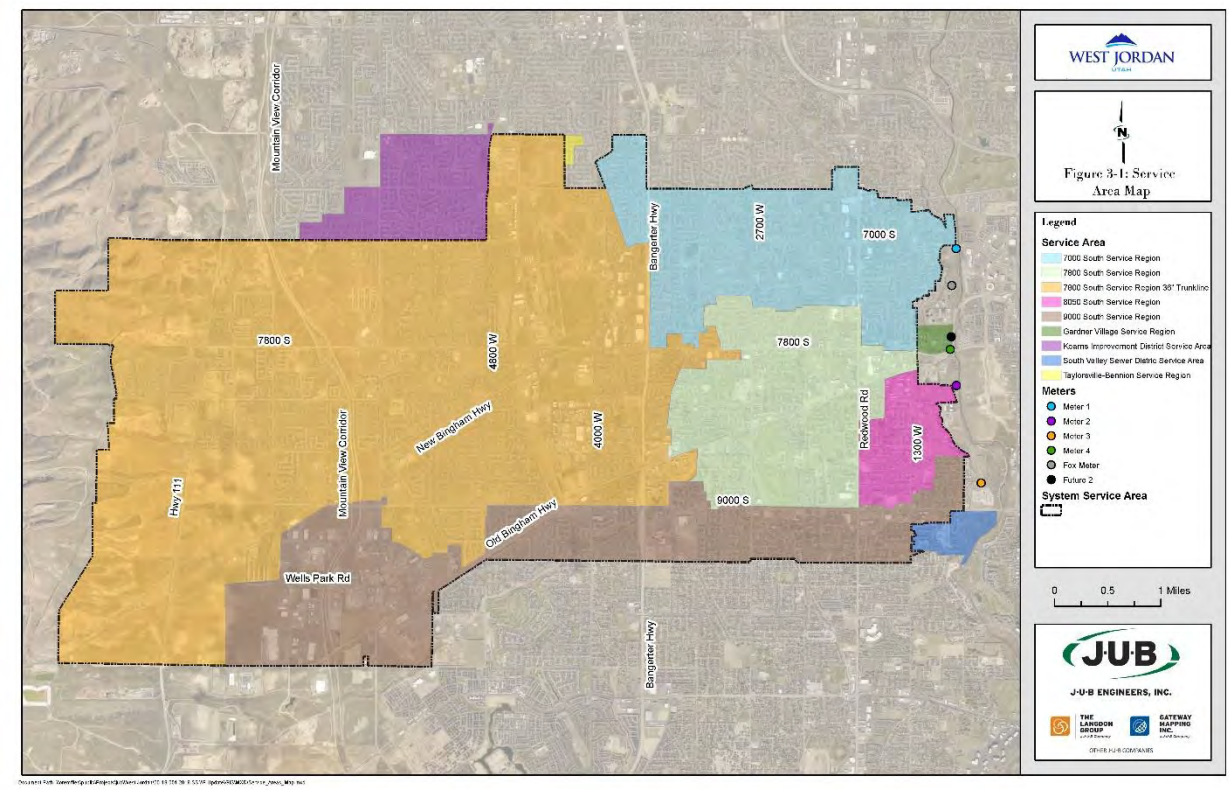


Figure 3-1: Existing Service Area Map

The collection system contains 335 miles of pipeline ranging in diameter from 8 inches to 36 inches, 7,039 manholes, and three private pump stations (Figure 3-2). Over the years the existing collection system has been constructed of various pipe materials that were typically used at the time of construction. The following table (Table 3-1) and figures (Figure 3-3 and Figure 3-4) summarize and illustrate the pipe materials and installation year of pipe within the collection system. A large-scale figure of each of these maps can found be in Appendix A.

Table 3-1: Pipe Material and Installation Year Collection System Summary

Pipe Material		Installation Year	
CIPP	7,182 ft	**Prior to 1970**	52,636 ft
Clay	207,465 ft	**1970-1989**	457,763 ft
Concrete	387,300 ft	**1990-1999**	386,473 ft
HDPE	16,360 ft	**2000-2009**	314,362 ft
PVC	939,176 ft	**2010-Current**	150,764 ft
Slip Lined	3,323 ft		

It should be noted that the full 365 miles of pipeline is not included in the summary data above. Within the reference data that was used to calculate the lengths above, various segments of pipe were not labeled with a material or date of installation. Therefore, additional analysis should be completed by the City to determine the exact numbers to supplement the information in the table above.

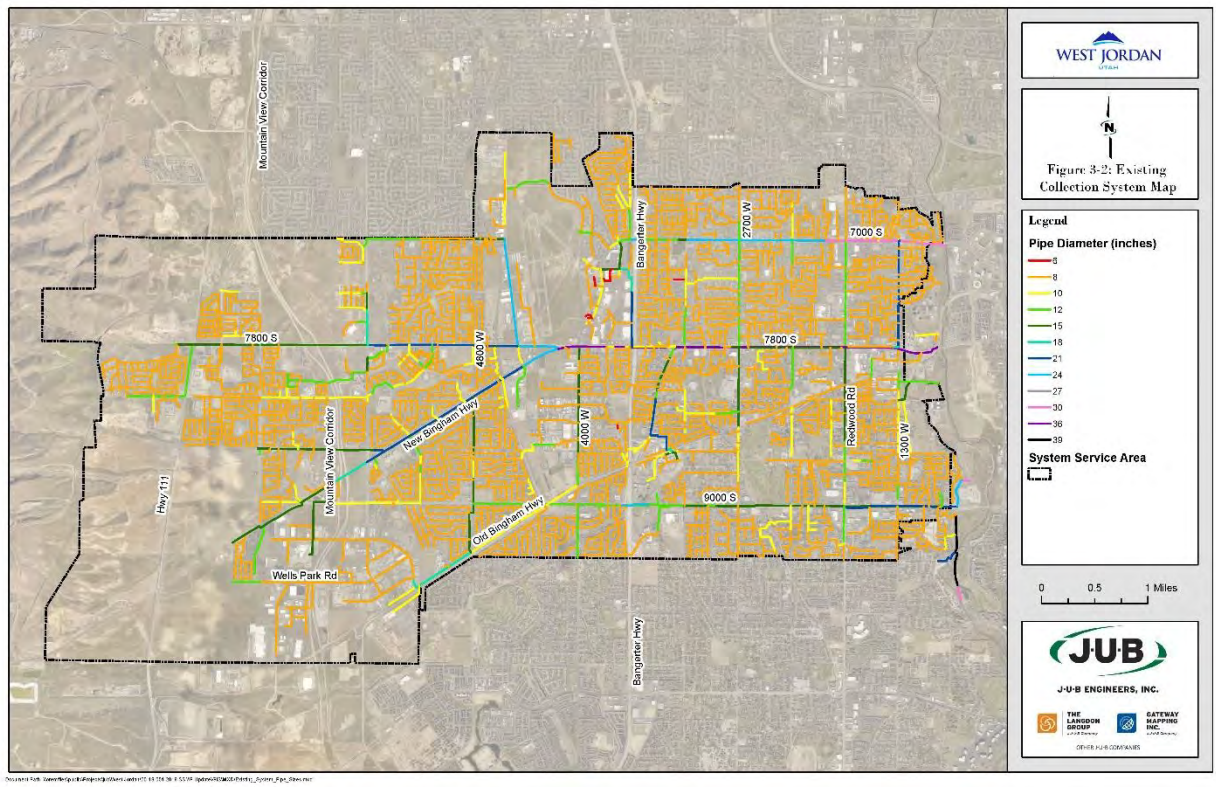


Figure 3-2: Existing Collection System Based on Pipe Size

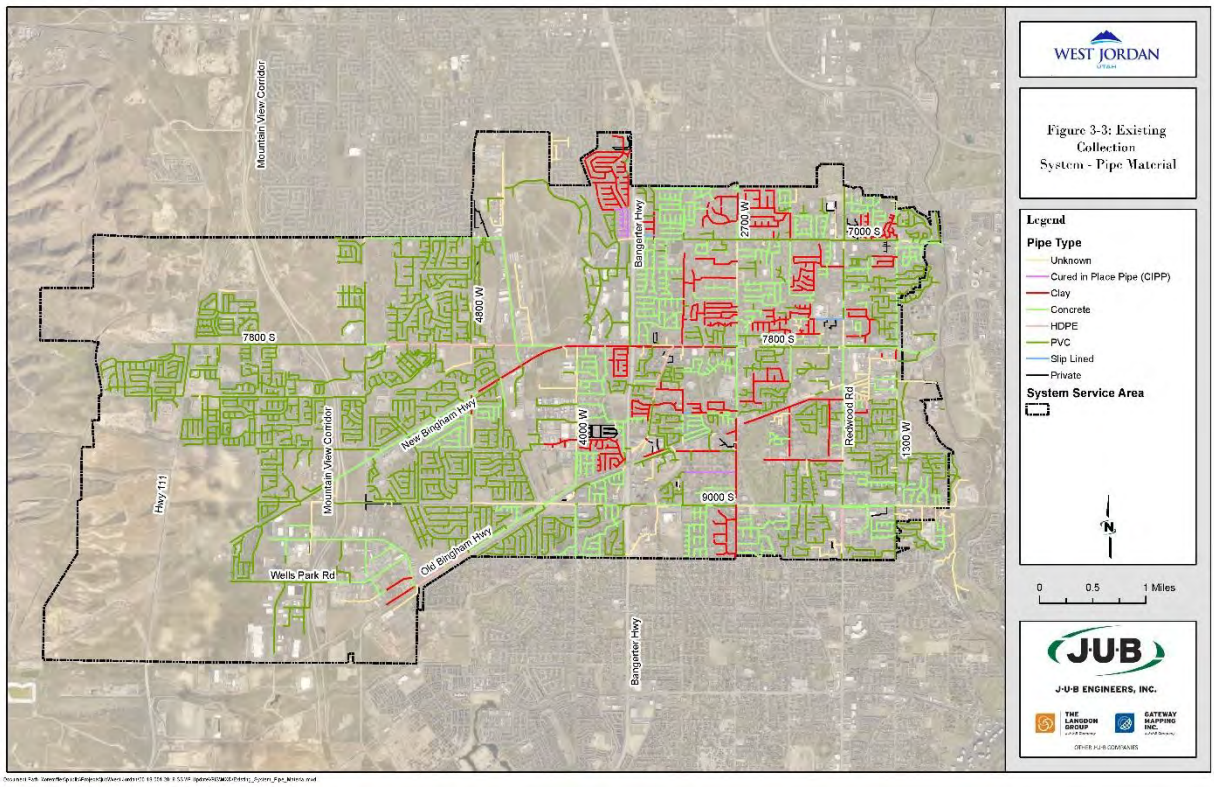


Figure 3-3: Existing Collection System Based on Pipe Material

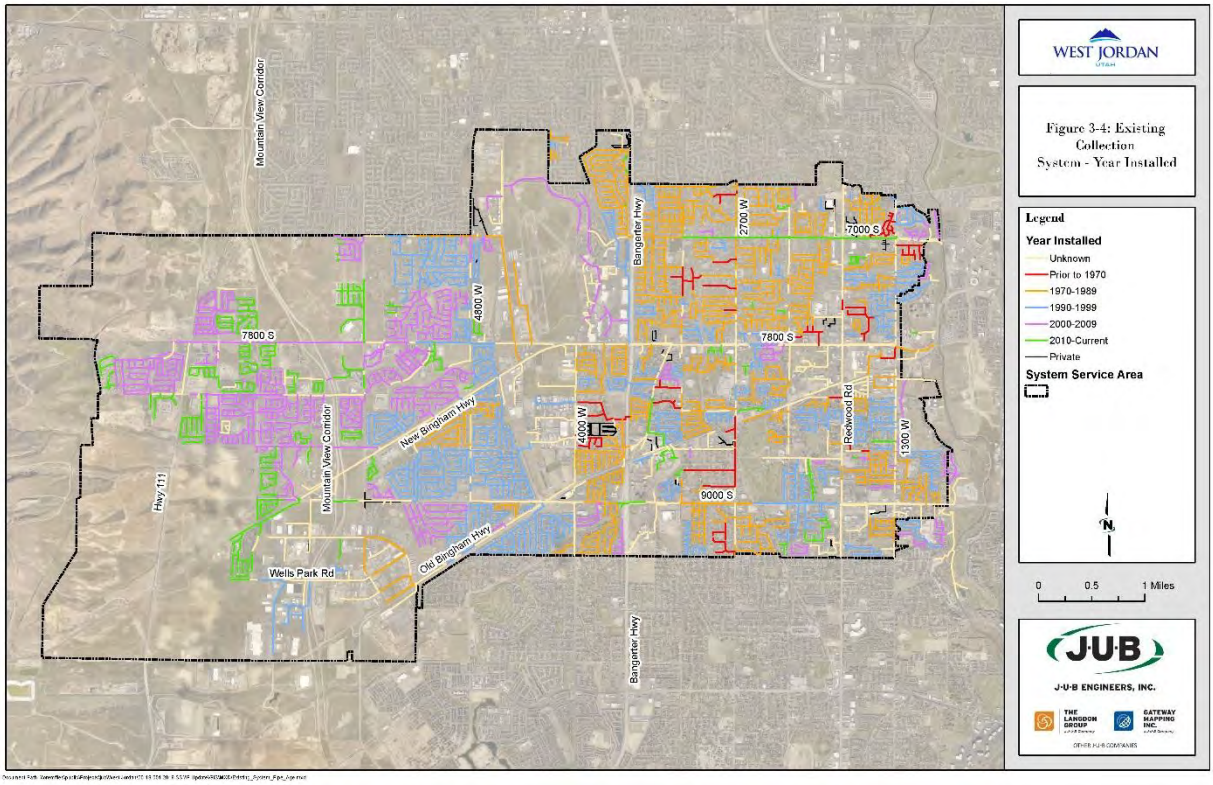


Figure 3-4: Existing Collection System Based on Installation Year

The collection system conveys flow from the west side of the City at the base of the Oquirrh Mountains by gravity to the eastern City boundary on the west side of the Jordan River. The pipelines in the original areas of the City are constructed primarily of vitrified clay pipe (VCP) and some concrete pipe. Pipelines in roads and subdivisions built after the late 1970s are constructed primarily of plastic pipe. The primary trunk sewer, which transports wastewater to the SVWRF at 7495 South 1300 West, is a 48" diameter pipeline running south to north on the west side of the Jordan River bottoms. City trunk lines with discharge meters at the primary trunk sewer are located at 7000 South, 7800 South, 8050 South, and 9000 South. Other metering locations are shown on the Service Area Map in Appendix A.

3.2 LIFT STATIONS

The City does not currently operate or maintain any public lift stations, as the only prior City owned lift station at 1220 West 8660 South was removed in 2011 and replaced with a gravity flow sewer system in 1220 West. In 2012, there were three existing private lift stations located at 1) Navigator Park on Airport Road and 6800 South, 2) the former 84 Lumber site on Airport Road and 6600 South, and 3) Spring Hollow Subdivision at Triumph Lane and 7000 South. In recent years, the City completed a gravity sewer flow pipe system in Airport road and connected it to the newly constructed sewer pipe across the South Valley Regional Airport to eliminate private lift station 1 described above. The Spring Hollow lift station will remain in place indefinitely as the discharge outfall is lower than the trunk line pipe at the east end of the City.

4 FLOW MONITORING *(REFER TO APPENDIX E)*

This 2019 model update did not use any temporary flow meters but instead utilized data from the existing permanent flow meters located as shown in Figure 3-2 *to obtain data to calibrate to. Refer to Chapter 5 for current flow metering and model calibration information. 2012 flow monitoring information can be found in Appendix E.*

5 COLLECTION SYSTEM MODELING

5.1 HYDRAULIC MODEL UPDATE

The existing computer model was updated to simulate the current and future sanitary sewer collection system using Innovyze's InfoSWMM sewer modeling software. Data for all trunk lines, pipes, and sewer manholes were obtained from the 2012 sewer master plan study and from current GIS data, both of which were provided by the City. Manhole inverts and pipe depths were field verified by the City as needed.

The model includes all pipes within the City with a diameter of 8-inches or greater, and all associated manholes, diversion structures, and lift stations. The pipeline length and diameter data, connectivity of upstream and downstream manholes, and existing or future status were included in the model database. The pipeline slopes in the hydraulic model are calculated based on invert elevations and pipe length. A Manning's "n" value of 0.013 was used for all pipes, based on a typical roughness value for a vitrified clay pipe. Figure 3-2 presents the City's collection system in the hydraulic model, which includes every existing pipe and respective pipe diameter sizes.

During the model update process, it is common to complete minor interpolations or assumptions due to incomplete or inaccurate data. This was done for a small number of manholes and pipes and is documented in Appendix B as "GIS Data/Model Adjustments Summary (Interpolation).

From the completion of the 2012 master plan to the commencement of the 2019 master plan, new development occurred within the City, particularly on the west side of the City. Much of the growth consisted of residential developments. Due to the residential units being clustered together in developments, the residential flows were added to the model manually by visually assigning the flow for each residential unit to the nearest sewer manhole.

Non-residential flows were added to the model based on data provided by the City. While some of the non-residential connections for which the City provided flow, data were already included in the model from 2012, others occupied newly developed areas or replaced non-residential connections that were included in the 2012 sewer master plan study. To avoid repetition of any non-residential flow within the model, the non-residential flow data from 2012 was completely removed from the model before adding the newly provided non-residential flow data from the City.

To add the new non-residential flows to the existing model scenario, a GIS point layer was added to the model, with each point representing a non-residential connection. The location of each point was based upon the address that was provided with the non-residential flow data from the City. Each point contained the calculated flow data associated with the non-residential connection. Using the flow allocation tool, each non-residential flow was assigned to the upstream manhole of the nearest pipe. Following allocation, a visual inspection of the assigned manholes was completed.

A total of approximately 27,500 separate demand loads were entered into the model between the 2012 and 2019 sewer master plan studies.

5.2 2019 CALIBRATED MODEL

5.2.1 Permanent Flow Meter Data

Model calibration is a crucial component of the hydraulic modeling effort. The model must be calibrated to match flow metering data to ensure the most accurate results possible.

The City has permanent flow meters near the bottom of the collection system on major trunk lines. Data from these meters was analyzed for the period of January 1, 2019 to June 2, 2019. Table 5-1 provides a summary of the data for the four major meters during the selected time period, including the average flow, maximum flow, and peaking factor. The 7800 South trunk line is the largest of the main trunk lines within the City, and thus carries the highest flow.

Table 5-1: Permanent Flow Meter Data Summary (Jan. 1, 2019 – June 2, 2019)

Meter Location	Avg. Observed Flow (mgd)	Max. Observed Flow (mgd)	Observed Peaking Factor
West Jordan 1 - 7000 South	1.50	2.72	1.82
West Jordan 2 - 8050 South	0.60	1.00	1.67
West Jordan 3 - 9000 South	1.32	2.29	1.74
West Jordan 4 - 7800 South	5.13	14.01	2.73

Graphs 1-4 in Appendix B show the detailed flow meter data during this five-month time period.

5.2.2 Base Flows

The flows graphed in Appendix B include wastewater loading base flows. Base flows are generated from routine water usage by residential, commercial, business, and industrial users, as well as groundwater infiltration into the collection system during times of dry weather.

5.2.3 Residential Dry Weather Flows

Existing residential dry weather flows are best measured by using winter water meter records. In the 2012 Sanitary Sewer Master Plan, average residential water usage was calculated at 66 gallons per capita per day (gpcd). This was based upon measured sanitary sewer flows, total population, total number of households, and the average number of people per household according to 2010 census data. The calculated average residential water usage of 66 gpcd correlates closely with estimates by the American Water Works Association (AWWA), as well as average residential water usage of neighboring cities. For the 2019 calibration purposes, 66 gpcd was again used throughout the model for all residential connections in conjunction with 3.78 people per household as determined from 2010 census data.

5.2.4 Non-Residential Flow

Non-residential flows were calculated based on 2018-2019 winter water meter data provided by the City. Because meter readings were taken by the City only once per month, average daily flows were calculated for each non-residential connection by dividing the total flow between meter readings by the number of days between meter readings. Throughout the data, some meter reading corrections were made by the City, which resulted in the billed water usage differing slightly from the meter readings. To ensure the most accurate calculations possible, billed water usage was used in place of the meter readings in the average daily flow calculations for non-residential connections.

After calculating the average daily flow for each of the non-residential connections for the winter months, it was determined the overall average daily flow for February 2019 was the highest of the winter months. As a result, the average daily flows from February 2019 were used in the model for the non-residential connections. Each non-residential connection within the model was assigned a unique average daily flow based upon the calculated February 2019 average daily flows. The peak non-residential flows occurred during the same month as the overall peak flows measured by the permanent meters.

5.2.5 Diurnal Flow Patterns and Peaking Factors

Base flows typically vary throughout the day with weekday residential peak flows occurring in the morning and in the evening. The heaviest residential use is generally seen on Saturday and Sunday. Commercial base flows typically start in the morning around 8:00 a.m. with peaks occurring around late morning/early afternoon and again around late afternoon/evening. Industrial and light industrial flows can have sporadic evening peaks, but generally have base flows during the workday with afternoon peaks. The system experiences higher weekend flows than weekday flows; therefore, the model was calibrated to the weekend flows.

Because the highest flows were governed by the residential users on Saturday and Sunday, the model was setup to mimic these high flow patterns instead of a typical weekday pattern, which was observed to be much lower in flow. The unit diurnal curve allows the InfoSWMM software to quantify the flow throughout the day for the various types of land use activities. The diurnal curve patterns that were used in the model are shown in Figure 5-1.

Figure 5-1: Diurnal Curves for Residential, Commercial, Industrial and Light Industrial Users

5.2.5.1 Residential Peak Hour Adjustment

To begin the calibration process, model results for the 7000 South, 8050 South, 9000 South, and 7800 South meter areas were compared to the corresponding meter data provided by the City as discussed in Section 5.2.1. For each of the meter areas, the model peak occurred later than the peak from the meter data. Because residential flow makes up much of the flow in the City, the first step in calibration consisted of adjusting the residential diurnal curve. The peak of the residential diurnal curve was adjusted until it lined up correctly with the observed peak from the meter data.

5.2.5.2 Other Diurnal Curve Adjustments

Some of the diurnal flow patterns for the calibrated model were refined slightly. Following the adjustments to the residential diurnal curve, adjustments were made to diurnal curve assignments. When the model was first run, the diurnal curve for commercial flows was assigned to the flows generated in the southwest corner of the City that flow down the 9000 South trunk line to the 9000 South meter. While the curve from the model flows peaked around the same time as the curve from the meter flow data, the shape of the two curves did not agree with one another. Following discussion with the City, the diurnal curve for this area of the City was changed from commercial to light industrial. Changing the assigned diurnal curve to the light industrial curve led to the shape of the model flow curve more closely matching the flow curve from the meter data.

The peaking factor is defined as the daily peak flow divided by the daily average flow. Table 5-2 and Figure 5.1 show the hourly flow patterns that are multiplied by the average demand to create hourly and peak flow values, correlating with actual metered flow data.

Table 5-2: Model Hourly Flow Patterns Multiplied by the Average Demand

Hour	Model Residential Pattern	Model Commercial Pattern	Model Industrial Pattern	Model Light Industrial Pattern
1	0.60	0.81	0.50	0.90
2	0.55	0.54	0.50	0.90
3	0.55	0.05	0.50	0.90
4	0.55	0.04	0.60	0.90
5	0.55	0.04	0.60	0.90
6	0.55	0.04	0.70	0.90
7	0.85	0.04	1.10	0.90
8	1.25	0.04	1.25	1.20
9	1.45	0.05	1.30	1.20
10	1.55	0.81	1.30	1.20
11	1.45	1.34	1.40	1.20
12	1.40	1.77	1.60	1.20
13	1.30	1.61	1.70	1.20
14	1.25	1.72	1.70	1.20
15	1.20	1.72	1.50	1.20
16	1.15	1.45	1.30	0.90
17	1.15	1.24	1.20	0.90
18	1.10	1.61	1.10	0.90
19	1.10	1.88	1.00	0.90
20	1.05	1.61	0.80	0.90
21	1.00	1.61	0.70	0.90
22	1.00	1.45	0.60	0.90
23	0.85	1.72	0.50	0.90
24	0.55	0.81	0.50	0.90

5.2.6 Dry Weather Calibration

In sanitary sewer modeling the peak flows are critical when planning collection system improvements because the collection system components must be adequately sized to convey the peak flows. The data from the permanent meters was evaluated to select a dry day that produced the highest peak flows through the collection system which occurred on February 23, 2019. This flow data was primarily used in calibrating the model to match existing dry weather flows. The flow recorded by the permanent flow meters is shown in calibration graphs labeled as "Flow Meter" by a solid blue line. These graphs are shown in Figure 5-2 and Appendix B. Other flows are shown on the graphs which are explained in the following sub-sections of the report.

With all adjustments to the diurnal curves complete, the model was run, and the model flow curves were analyzed. Following the model run, the model flow curves were compared against the meter data to complete calibration. It was found that the model data closely matched the meter data.

5.2.7 Additional Flows

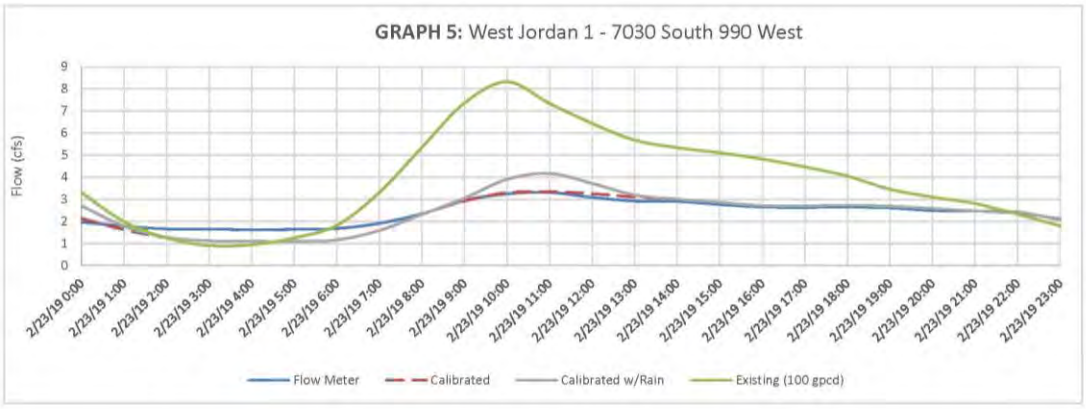
Various conditions can cause increases in the peak flows that the collection system must convey beyond dry weather flow. For example, Thanksgiving has historically created larger peak flows than other days of the year in the West Jordan sewer collection system. Weather events also affect flows in the system. Once the dry weather calibration was complete, additional flows were added to the calibrated model to account for various conditions that occur and create higher peak flows.

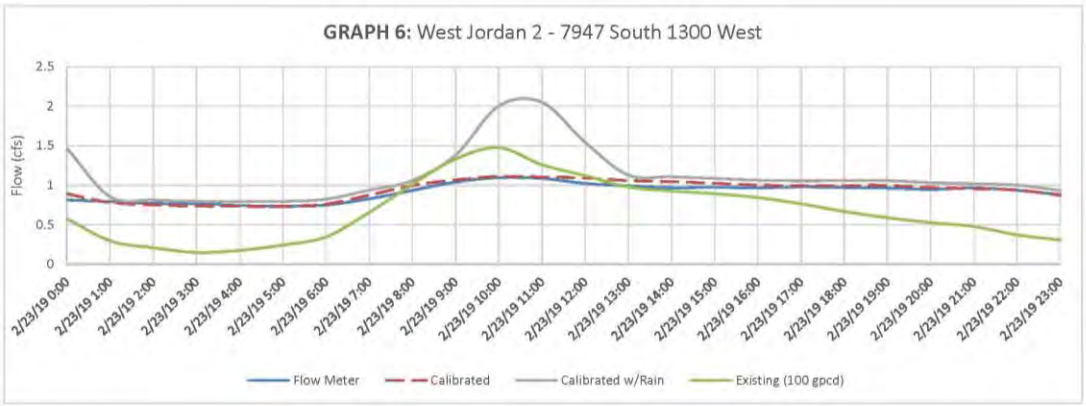
When reviewing the meter data through June 2019, the base flows at the 8050 South meter began to increase beginning around June 10. Between June 10 and June 30, the base flows increased by approximately 0.062 cfs. This increase in base flow was attributed to irrigation infiltration from canals. To account for irrigation infiltration from canals in the 8050 South meter area, 0.062 cfs was divided among and added to all the sewer manholes within that meter area. After running the model with external infiltration and irrigation infiltration added to the manholes, the model flows closely matched the flow meter data. These results are shown in the calibration graphs labeled as "Calibrated" in Figure 5-2 and Appendix B with the dashed red line.

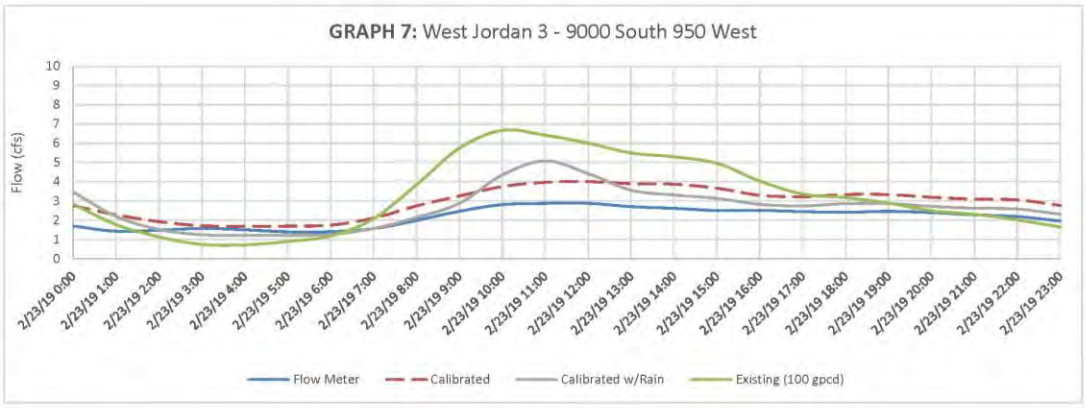
Within the permanent flow meter period, a significant rain event occurred on March 24. This rain event was roughly a 3-hour storm with a peak of 0.85 inches. The flows increased significantly in the collection system because of this rain event. Based on staff input, a 100-year 3-hour storm was added to the flows in the calibrated model at the peak hours. This was based on a proportional adjustment from the 3-hour storm event that occurred on March 24. These results are shown in the calibration graphs labeled as "Calibration w/Rain" in Figure 5-2 and Appendix B with the grey line.

5.3 EXISTING SYSTEM MODEL

Once a calibrated model is complete it also prudent to consider the state guidelines for collection system design. There are many factors that affect the peak flows in a collection system. Because of this fact, the Utah Administrative Code (UAC) R317 outlines a design criterion for sanitary sewer flows of 100 gpcd with a peaking factor of 2.5 for all sewer interceptors. These flows were compared with calibrated model flows and are shown as "Existing (100 gpcd)" in green in the calibration graphs in Figure 5-2 below and Appendix B.


GRAPH 5: West Jordan 1 - 7030 South 990 West
Flow (cfs)
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)


GRAPH 6: West Jordan 2 - 7947 South 1300 West
Flow (cfs)
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)


GRAPH 7: West Jordan 3 - 9000 South 950 West
Flow (cfs)
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)

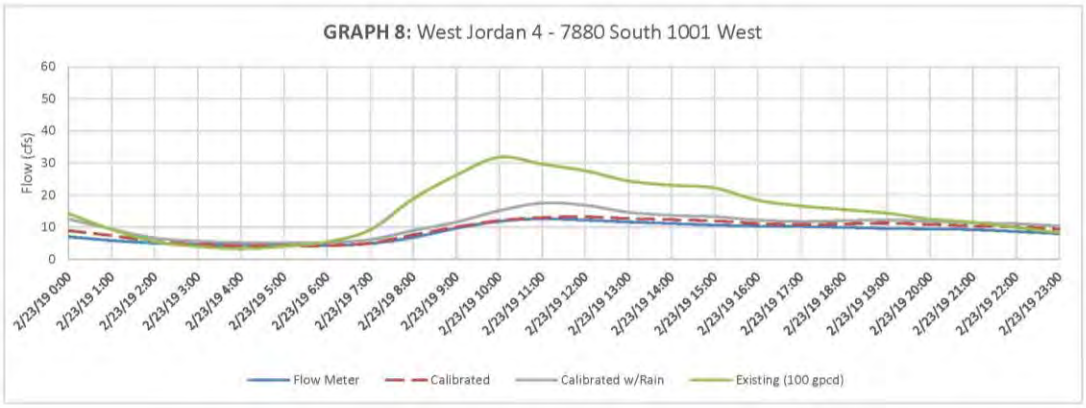


Figure 5-2: Flow Meter Calibration Graphs

It was determined by the City to establish the Level of Service (LOS) based on the UAC R317 design criterion for the existing sanitary sewer system. The existing flow in the calibration graphs represent the flows that could occur in the collection system based on the LOS the City has established for sizing its sewer collection pipes.

5.4 BUILDOUT SYSTEM MODEL

A buildout model was created to determine the pipe sizes that will be needed to serve the city in the future as development occurs. Buildout is defined as the condition when all the area to be served by the collection system has developed to the densities planned in the current land use plan. During the writing of this report, some significant development and modified land uses were proposed for the SW quadrant of the City. These were not taken into consideration for the buildout model but instead were included in separate model scenarios that are included in Appendix C for reference.

5.4.1 Future Flow Allocations

Approved land use and population estimates are the basis for developing the quantity of baseflow generated within the City. The type of land use in an area will affect the volume and characteristic of the baseflow being generated. Adequately estimating the quantity of this wastewater is an important process in maintaining and sizing collection system facilities, both for existing conditions and future developments.

All future flows were added to the future buildout model using the flow allocation tool based on the different land use types for existing undeveloped parcels. This was accomplished by first creating a new GIS layer in which City parcel data was merged with City land use data so that each parcel was divided into different land use types. A second GIS layer was then created in which a point was assigned to each land use type within each parcel. Each of the assigned points contained data about the land use that it represented such as land use type, total area, total ERUs, and a calculated flow based on land use type and ERUs. Following the creation of these GIS layers, flows were assigned to the nearest future manhole using the flow allocation tool.

5.4.2 Future Residential Flow

The number of people per household was updated from 3.78 in the 2012 calibrated model to 3.41 based on 2018 data from the Kem C. Gardner Institute of the University of Utah. Future residential flows for the different land use areas were calculated based on the planned future ERUs per acre, the corresponding acreage of the undeveloped land, 3.41 people per ERU. The future contribution per capita is based on the established LOS as defined in Section 5.3 of 100 gpcd with a peaking factor of 2.5. Maintaining consistency in LOS between the existing system and future service provides the City a reliable pattern for that LOS and integrity in the development of an Impact Fee Facility Plan (IFFP).

The future ERUs per acre were calculated based on the high dwelling units per acre that were established by the City, the number of people per household for different residential densities, and 3.41 people per ERU as shown in Table 5-3. Following the calculation of the future residential flows based on land use, the future flows were assigned to the nearest future sewer manholes within the model. This method of flow distribution provides accurate, site specific future wastewater loading estimates.

Table 5-3: Future Flow for Residential, Commercial and Industrial Areas

Land Use	Low Dwelling Units per Acre (du/ac)	High Dwelling Units per Acre (du/ac)	People per House (pph)	Gallons per Capita per Day (gpcd)	Residential Future Sewer Use per Parcel (gpd)	Commercial Sewer Use (gpd/ac)	Residential Sewer use for Future Development (gpd/ac)	Future ERUs Per Acre[1]
Very Low Density Residential	1	2	3.41	100	341		682	**2.00**
Low Density Residential	2	3.5	3.41	100	341		1,194	**3.50**
Medium Density Residential	4.51	7.6	3.41	100	341		2,592	**7.60**
High Density Residential	9	14.1	2.64	100	264		3,722	**10.92**
Very High Density Residential	12	24	2.64	100	264		6,336	**18.58**
Mixed Use	0	25	2.64	100	264	2,450	6,600	**19.35**
Town Center	14	30	2.25	100	225	1,225	6,750	**19.79**
Neighborhood Commercial						850		**2.49**
Community Commercial						850		**2.49**
Regional Commercial						850		**2.49**
Professional Office[2]						850		**2.49**
Light Industrial						1,230		**3.61**
Public Facilities[2]						1,260		**3.70**
Agricultural Open Space[2]						0		**0.00**
Future Park[2]						0		**0.00**
Research Park[2]						1230		**3.61**
Parks and Open Land[2]						0		**0.00**
Transit Oriented Development[2]	12	24	2.64	100	251		6,017	**18.58**

This table correlates with Table 2.4 of the 2012 Master Plan Report
1 – Based on "High Dwelling Units per Acre" and 3.41 people per ERU
2 – Land uses not included in the 2012 Master Plan Report

5.4.3 Future Non-Residential Flow

Future non-residential wastewater discharges in undeveloped portions of the City are difficult to forecast because each type of non-residential connection consumes and discharges different amounts of water. Future flows for the different non-residential land use areas were calculated based on the commercial sewer use in gallons per day per acre in Table 5-3, and the acreage of the undeveloped land. There is typically a strong correlation between future non-residential sewer loading and water usage. Therefore, as detailed water usage can be forecast in future planning, the more accurate the results are for future non-residential sewer loading projections.

A summary of the residential and non-residential flow projections for the existing system and City buildout are shown in Table 5-4.

Table 5-4: Existing and Buildout Average Flows for Residential and Non-Residential Areas

Planning Year	Residential Flow (MGD)	Non-Residential Flow (MGD)	Total WWTP Flow (MGD)
Existing 2019	11.79	3.32	15.11
Buildout	15.90	6.45	22.35

6 SANITARY SEWER CAPACITY ANALYSIS

6.1 INTRODUCTION

A capacity analysis of the modeled collection system was performed after completion of the calibration and establishment of the level of service. The capacity analysis identifies areas in the collection system where flow restrictions occur or where pipe capacity is insufficient to pass the peak flows. Pipes that do not have enough capacity to pass the peak flows can produce backwater effects in the collection system and potentially cause unwanted sanitary sewer overflows (SSO's). Maximum flow over full pipe flow or depth of flow over diameter of pipe (d/D) are accurate methods of predicting how much pipe capacity is remaining in the system, and if a pipe needs to be upgraded. A full pipe has a d/D value of 1.0 and has no reserve capacity, while a pipe flowing half full has a d/D value of 0.5 and has some reserve capacity. Table 6.1 provides the recommended d/D values and minimum pipe slopes for pipe design.

Table 6-1: Design Slope Parameters

Pipe Diameter (inches)	Maximum Allowed depth/Diameter d/D	Minimum Pipe Slope
8	0.50	0.40 %
10	0.55	0.28 %
12	0.60	0.22 %
15	0.65	0.15 %
18	0.75	0.12 %
21	0.75	0.10 %
24	0.75	0.10 %
27	0.75	0.10 %
30	0.75	0.10 %
36	0.80	0.10 %

Ten State Standards allows for pipe slopes less than 0.10% (S=0.0010). However, practical construction tolerances do not warrant lesser slopes.

For the update of this report it was determined that the City would allow a maximum d/D of 0.75 in the existing system. This is often referred to as the level of service that the City will provide. Once an existing pipe exceeds this level of service it is considered deficient and may need to be replaced.

6.2 COLLECTION SYSTEM PERFORMANCE

The City's collection system was analyzed using projected loads. The capacity of the collection system was assessed for both the existing condition and buildout condition under the current West Jordan Land Use Plan. As mentioned previously, when flow in a pipeline reaches a d/D ratio of 0.75, the pipeline is considered at full capacity. New sewers (parallel or replacement) are recommended to relieve these deficient pipelines.

The following scenarios were modeled to evaluate the system d/D capacity of every pipeline in the City:

- Existing System Analysis (Figure 6-1)
  - 100 gallons per capita per day (gpcd) loading with Inflow and Infiltration;
- Buildout System Analysis
  - Current West Jordan land use at the time this report was written with the existing pipe system along with potential future new pipes and associated loading;

Additional scenarios were also completed in the process of this master plan update. These were provided as a planning tool for city staff to better understand the effect on the overall collection system of various growth patterns. These scenarios ranged from increased density options, specific developments, industrial expansion and other alternatives. Figures were created as a brief summary of these scenarios and are provided in Appendix C for future reference. The buildout system analysis did not include any of these scenarios but instead only included the approved land use at the time of this update.

6.2.1 Existing System Analysis

The existing system was analyzed using the state recommended 100 gpcd. This was utilized as the current level of service to be consistent with future loading. The existing piping system capacity is generally adequate under these conditions; however, there are a few areas that need relief due to over-capacity or that are approaching capacity. Modeled system capacity for each pipe in the model are presented in Figure 6-1 (See Appendix A for the large-scale figure). The observed deficiencies are as follows:

- **1300 West** - The 1300 West 10-inch pipeline from 8600 South to 8200 South then south of 9000 South is at capacity, due in large part to infiltration from groundwater into the sewer laterals, pipes, connections, and manholes.
- **Grizzly Way -** The 12-inch pipeline in Grizzly Way from Swift Water Way to 7800 South is at capacity because of the large area that has developed upstream of this location.
- **Campus View Drive** - The 8-inch and 10-inch diameter pipe in Campus View Drive is at capacity due mainly to the high-density residential development that is in the area.

There are various other isolated short segments of pipes (shown as red in Figure 6-1) throughout the system model that may be experiencing capacity problems or may have invert elevation or pipe size data that needs to be updated. These localized areas need to be investigated further with field monitoring to confirm if they are problem areas.

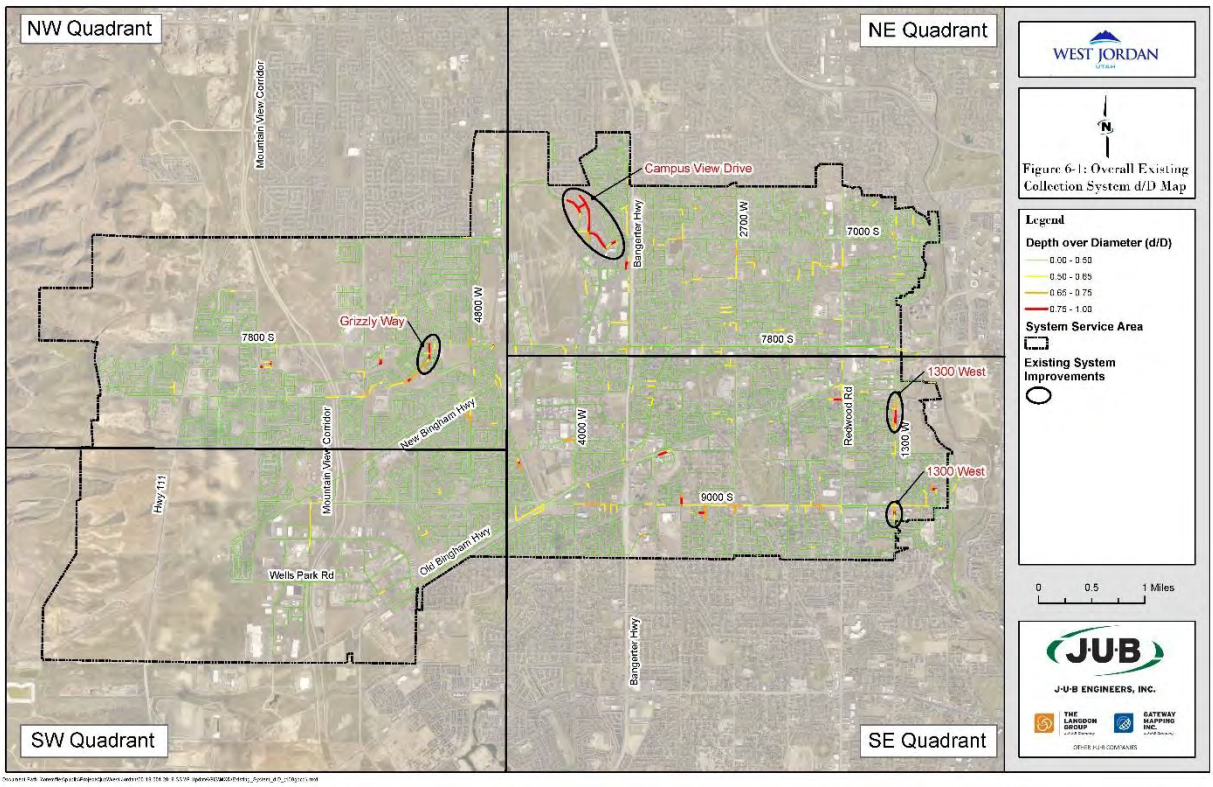


Figure 6-1: Existing System Capacity Analysis

6.2.2 Buildout System Analysis

The InfoSWMM model was used to calculate future flows and assigned the flows to the appropriate pipes. New pipes were added to the western portion of the City in potential future road locations, and pipes were sized to accommodate the predicted flow from the City's Land Use Map. The capacity analysis is shown in Figure 6-2 (See Appendix A for the large-scale figure) and the observed deficiencies are as follows:

- **90th South/Old Bingham Highway -** The main trunk line in 90th South starting in Old Bingham Highway near 4600 West to Redwood Road varies in size and does not have adequate capacity. The 21-inch pipeline from Redwood Road to Jordan River Parkway is also approaching the 0.75 depth of flow to diameter of pipe (d/D) ratio level of service. In discussion with city staff it was also decided to include this section of the collection system since there are going to be improvements done along 9000 South and it would be economical to complete this upsizing at that time.
- **7800 South (West) -** The 7800 South 15-inch pipeline between Mountain View Corridor and Highland Loops Road is over capacity.
- **Wells Park Road -** The pipes in Wells Park Road in the industrial park require additional capacity to provide the appropriate level of service as growth occurs.
- **Jordan River Parkway -** Approximately 1,300 feet of existing 24-inch pipeline under Jordan River Parkway between 9000 South and 8800 South does not have enough slope to carry future flows.

- **<u>Bagley Park Road</u>** - The pipe in Bagley Park Road in the industrial park is nearing capacity and are deteriorating due to age.
- **<u>7800 South (East)</u>** - The existing 36-inch pipeline in 7800 South from 1300 West to 1200 West needs to be replaced due to inadequate slopes that limit the capacity of the existing pipeline.
- **<u>7000 South</u>** - The 7000 South 12-inch and 15-inch pipelines from Bangerter Highway to 3200 West are nearing capacity and are deteriorating due to age.

There are other segments of pipes shown as red in Figure 6-2. These are identified as existing deficiencies in Figure 6-1, may have invert elevation or pipe size data that needs to be updated or should be monitored as the City continues to grow.

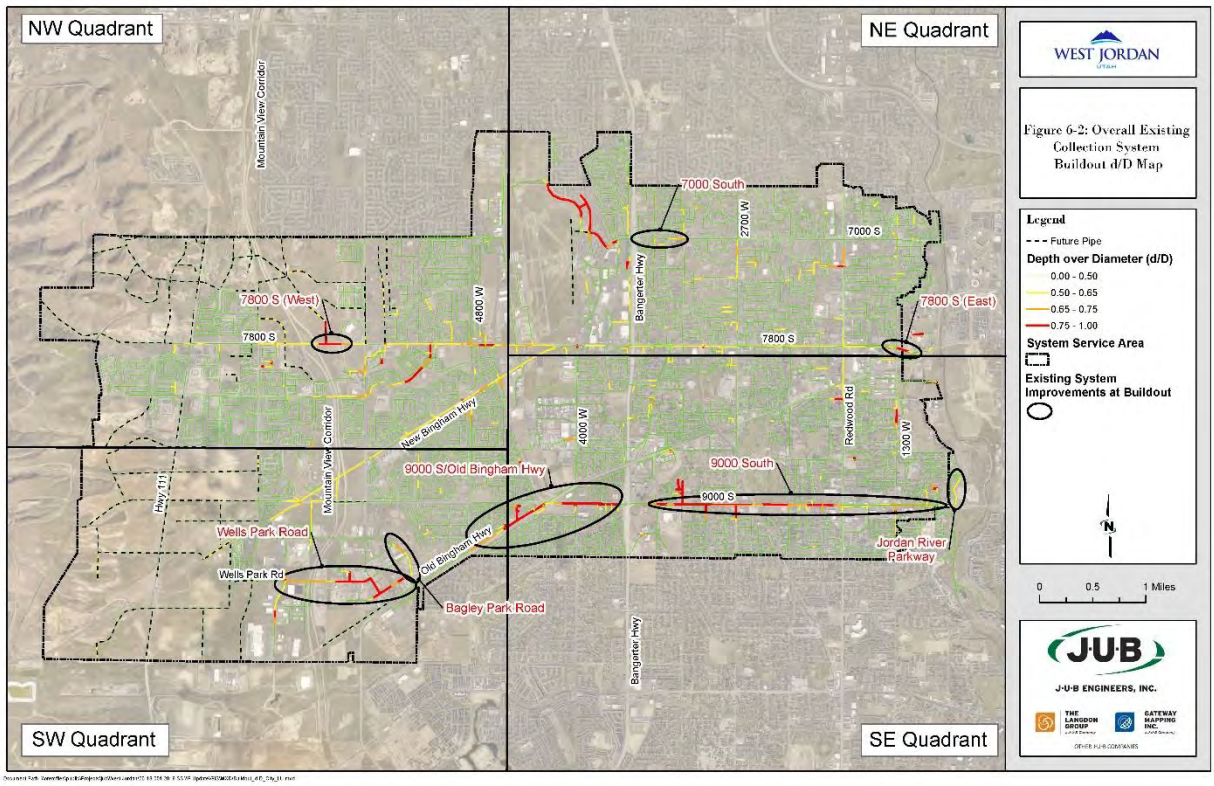


Figure 6-2: Buildout System Capacity Analysis

7 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

7.1 INTRODUCTION

The capacity analysis, described in Chapter 6, sets the foundation for the capital improvement program (CIP). The CIP focuses on alleviating the collection system capacity deficiencies. The intent of the CIP is to serve as a working document, which the City can follow to update the capacity deficient sections of the collection system.

7.2 CAPITAL IMPROVEMENT PROGRAM

When fully implemented, the CIP illuminates hydraulic capacity deficiencies in the collection system to convey peak flows to the wastewater treatment plant (WWTP). This section provides a discussion of the sewer replacement criteria, modeling assumptions, cost criteria and the recommended improvements included in the CIP.

7.2.1 CIP Criteria

7.2.1.1 Sewer Replacement Criteria

When additional capacity is required, existing sewers can be replaced or paralleled or possibly pipe burst. For the purposes of this master plan update, it was assumed that a deficient existing sewer will be replaced with a larger diameter pipeline at the same slope as the existing pipeline, unless otherwise noted. The decision to replace or parallel the existing pipeline should be made during the predesign effort for each improvement. During the predesign effort, the existing sewer should be closed circuit televised (CCTV) to determine its structural condition. If severely deteriorated, the existing sewer should be replaced. If moderately deteriorated, the existing sewer can be rehabilitated by slip lining, pipe bursting, or inversion lining with a parallel sewer constructed to convey the excess flow.

Except for pipe bursting, a rehabilitated sewer has less hydraulic capacity because of a reduction in cross-sectional area and this loss in existing capacity needs to be accounted for when sizing the parallel sewer. With pipe bursting, the existing pipe diameter can be increased by pulling a larger pipe through the existing pipe, causing it to burst. This system works well for trunk lines as they typically have fewer lateral connections, and it requires very little road repair when compared to open trenching.

7.2.1.2 Modeling and Analysis Assumptions

The CIP is based on several assumptions:

- The hydraulic grade line (level of service) is to be maintained below a depth to diameter ratio of 0.75.
- Residential loads were set at 100 gpcd with a peaking factor of 2.5 based on UAC R317-3

- Future residential, commercial, and industrial loads are based on the calculated loads per acre set forth in Table 5-3 in Chapter 5.

7.2.2 Planning Level Cost Criteria

The planning level capital cost estimate used in developing the CIP is based upon unit costs presented in Appendix D for each project. These unit costs are based on construction bids received from recently completed sanitary sewer projects. The following assumptions were made, and specific items included in the unit costs are as follows:

- "Typical" field conditions assumed with construction in stable soil at an average depth of eleven feet to invert of pipe.
- Included pipe and pipe bedding.
- Manholes and appurtenances.
- Trench excavation based on a 10-20' depth and including backfill.
- Roadway asphalt repair 4-inches thick for city roads and 8-inches thick for UDOT roads.
- Asphalt repair widths of 20 feet.
- Minor dewatering and shoring.
- Contractor overhead and profit.

To develop total CIP project costs, an additional 25% was added for engineering, administrative, legal fees, and municipal staff time along with 25% construction contingency. These percentages account for many unknowns that should be resolved during the design process, which in turn decreases these percentages prior to bidding.

7.3 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM AND PRIORITIZATION PLAN

The CIP needs to be phased in over time to provide the City with an affordable approach for implementation based on when the improvements are needed. The recommended improvements are summarized in Table 7.1 and illustrated in Figure 7.1 on the following pages (See Appendix A for the large-scale figure). Each project is prioritized in Table 7.1 for incorporation into a capital facilities plan. Appendix D contains large project cost breakdown sheets that are listed by priority number. Many of the major project improvements will depend on how the City develops in the future.

Table 7-1: Capital Improvements Projects Summary List

Major Trunkline Area	New Master Plan Priority	Project Description	Budget Estimate
8050 South	1	1300 West	$1,191,000
9000 South	2	1300 West	$757,000
9000 South	3	9000 South	$4,485,000
7800 South	4	7800 South	$1,358,000
9000 South	5	9000 South	$4,677,000
9000 South	6	9000 South	$4,074,000
9000 South	7	9000 South	$2,536,000
9000 South	8	Old Bingham Highway	$4,474,000
9000 South	9	Hawley Park/9580 South	$2,362,000
9000 South	10	Wells Park Road	$3,674,000
9000 South	11	Jordan River Parkway	$962,000
9000 South	12	Bagley Park Drive	$1,554,000
7800 South	13	Grizzly Way	$713,000
7800 South	14	Grizzly Way	$617,000
7800 South	15	7800 South	$594,000
7000 South	16	7000 South	$1,515,000
7000 South	17	Campus View Drive, Cobble Ridge Drive, Jordan Landing Boulevard	$1,645,000
			$37,188,000

Additional description can be found in Chapter 6 and in Appendix D in the detailed cost estimates.

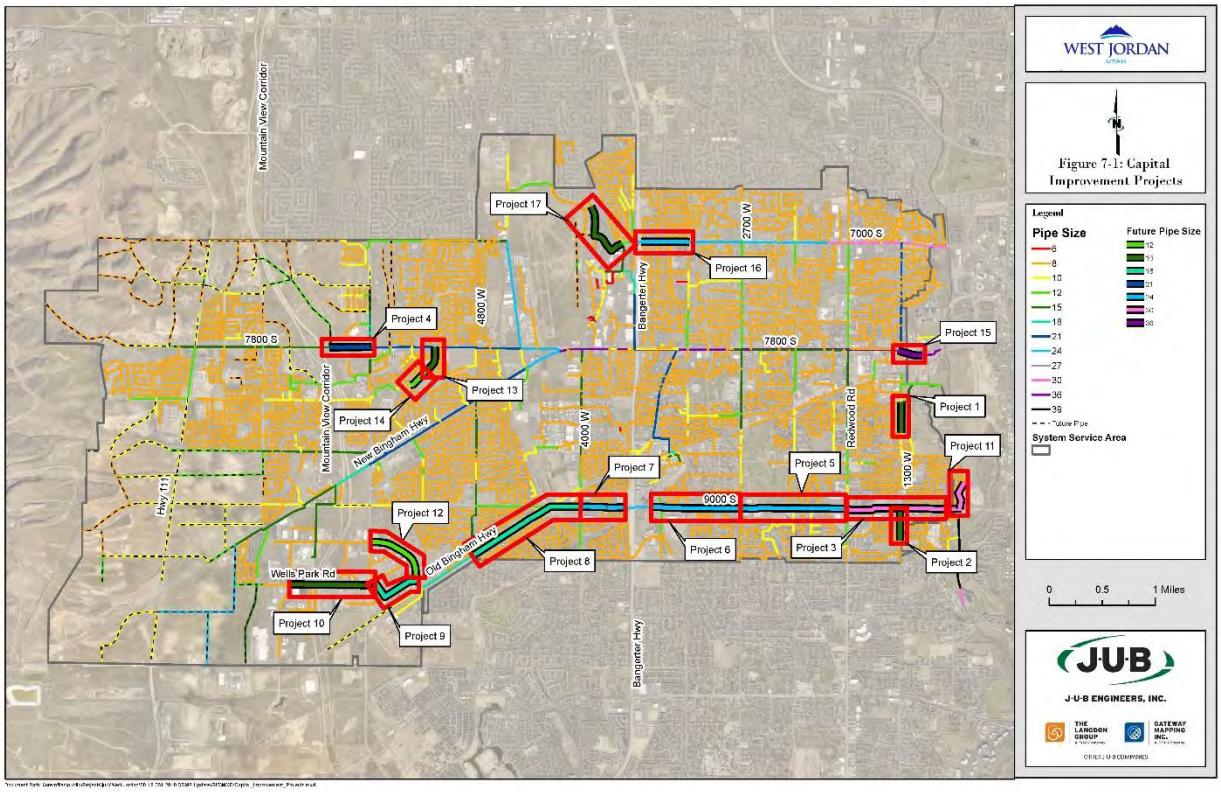


Figure 7-1: Capital Improvement Projects

The following figure, Figure 7-2, illustrates if all improvements were completed on the CIP list. The major deficiencies are resolved with only minor capacity concerns being left within the collection system. These minor capacity concerns weren't significant enough to warrant a full project and should be watched in the coming years. This will allow the city to allocate funds to the more critical infrastructure areas first and then address these minor projects if growth and need necessitate it.

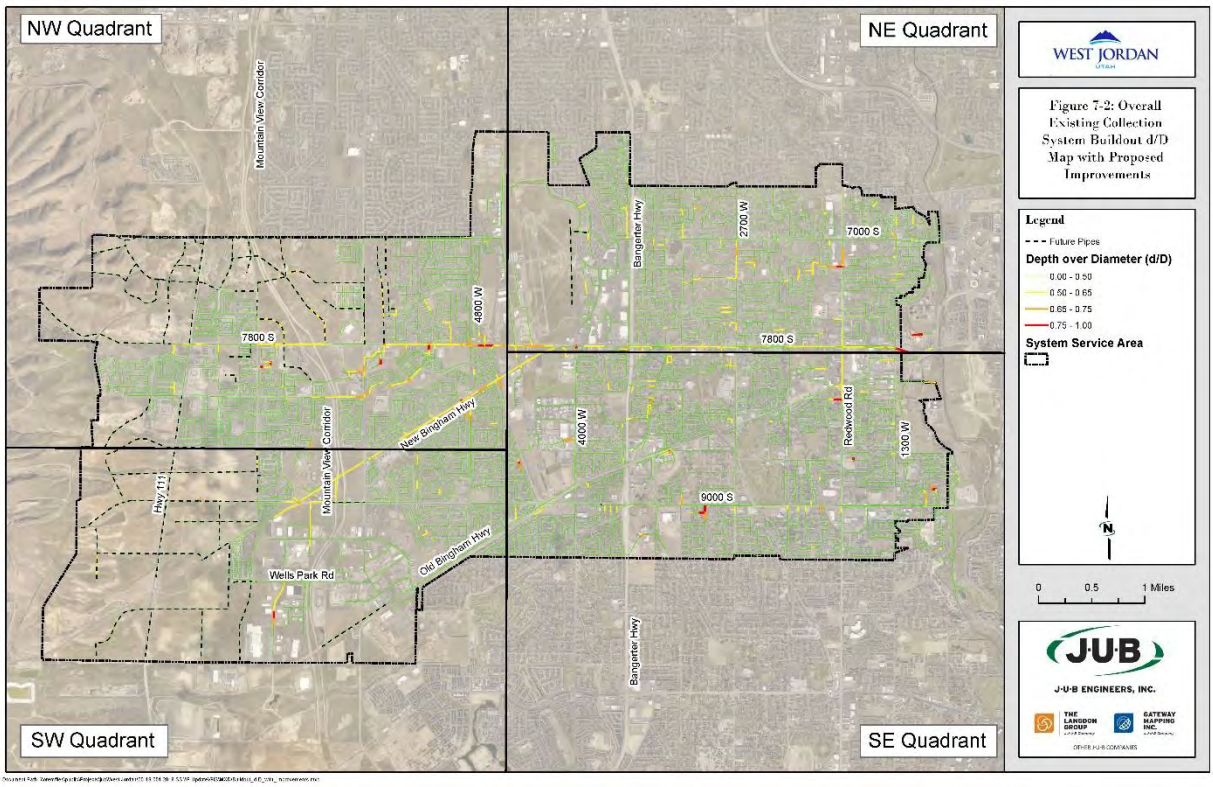


Figure 7-2: Existing Collection System with All Proposed CIP Completed

7.4 OTHER RECOMMENDATIONS

As part of ongoing operations and maintenance, it is recommended that the City investigate the sources of inflow and infiltration to the piping distribution system. Because no less than three separate engineering studies have shown the presence of significant I&I in the trunk lines, the presence of I&I is not likely to be refuted. The portion of the study that remains is detailed field monitoring, CCTV, and field inspection of each lateral, pipe, and manhole in the areas where infiltration is shown to exist. There may be areas where pipes or manholes can be repaired which can reduce large I&I flows.

General operational projects are also included in Appendix D that have come from discussion with City staff. These are separate from capital projects but are a necessary part of maintaining and operating a sanitary sewer collection system. These projects should be prioritized, and a plan put in place to complete these in the coming years.

Future updates to this study are necessary as developments and infrastructure projects are completed citywide, and to address proposed land use changes. A 5-year interval is recommended for updating this Master Plan.

7.5 POTENTIAL REVENUE/FUNDING SOURCES

Section 302 (2) of the Impact Fee Act requires the City to "generally consider all revenue sources, including impact fees and anticipated dedication of system improvements, to finance the impacts on system improvements." By doing so, the City ensures fair and equitable treatment among users and concludes whether impact fees are the most appropriate method to fund the growth.

There are several potential revenue sources to consider including:

- Grants
- Bonds
- Impact Fees
- Anticipated or Accepted Dedications of System Improvements

7.5.1 Grants

Impact fees may not reimburse projects funded through grants. No grants have been included in the project costs. If grants are received, costs will be adjusted accordingly.

7.5.2 Bonds

The City could issue bonds in the future in order to fund their sewer system. No bonds are planned and therefore no costs associated with bond issuance have been included in the calculation of impact fees.

7.5.3 Impact Fees

Because of the growth anticipated to occur in the City, impact fees are a viable means of allowing new development to pay for the impacts that it places on the existing system. An Impact Fee Facility Plan (IFFP) should be developed in accordance with legal guidelines so that an Impact Fee Analysis for the sewer system may be prepared and the City may charge impact fees. This will prevent existing users from subsidizing new growth.

7.5.4 Anticipated or Accepted Dedications of System Improvements

Any item that a developer funds, must be included in the IFFP if a credit against impact fees is to be issued, and must be agreed upon with the City before construction of the improvements.

APPENDIX A

Large Scale Figures

WEST JORDAN
UTAH

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Figure 2-1: Land Use Map

Legend

Land Use

- Agricultural Open Space
- Community Commercial
- Future Park
- High Density Residential
- Light Industrial
- Low Density Residential
- Medium Density Residential
- Mixed Use
- Neighborhood Commercial
- Parks and Open Land
- Professional Office
- Public Facilities
- Regional Commercial
- Research Park
- Transit Oriented Development
- Very High Density Residential
- Very Low Density Residential

System Service Area

0 0.5 1 Miles

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GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

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WEST JORDAN
UTAH

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Figure 3-1: Service Area Map

Legend

Service Area

- 7000 South Service Region
- 7800 South Service Region
- 7800 South Service Region 36" Trunkline
- 8050 South Service Region
- 9000 South Service Region
- Gardner Village Service Region
- Kearns Improvement District Service Area
- South Valley Sewer Distric Service Area
- Taylorsville-Bennion Service Region

Meters

- Meter 1
- Meter 2
- Meter 3
- Meter 4
- Fox Meter
- Future 2

System Service Area

0 0.5 1 Miles

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WEST JORDAN
UTAH

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Figure 3-2: Existing Collection System Map

Legend

Pipe Diameter (inches)

- 6
- 8
- 10
- 12
- 15
- 18
- 21
- 24
- 27
- 30
- 36
- 39

System Service Area

0 0.5 1 Miles

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WEST JORDAN
UTAH

Figure 3-3: Existing Collection System - Pipe Material

Legend

Pipe Type

- Unknown
- Cured in Place Pipe (CIPP)
- Clay
- Concrete
- HDPE
- PVC
- Slip Lined
- Private

System Service Area

N

0 0.5 1 Miles

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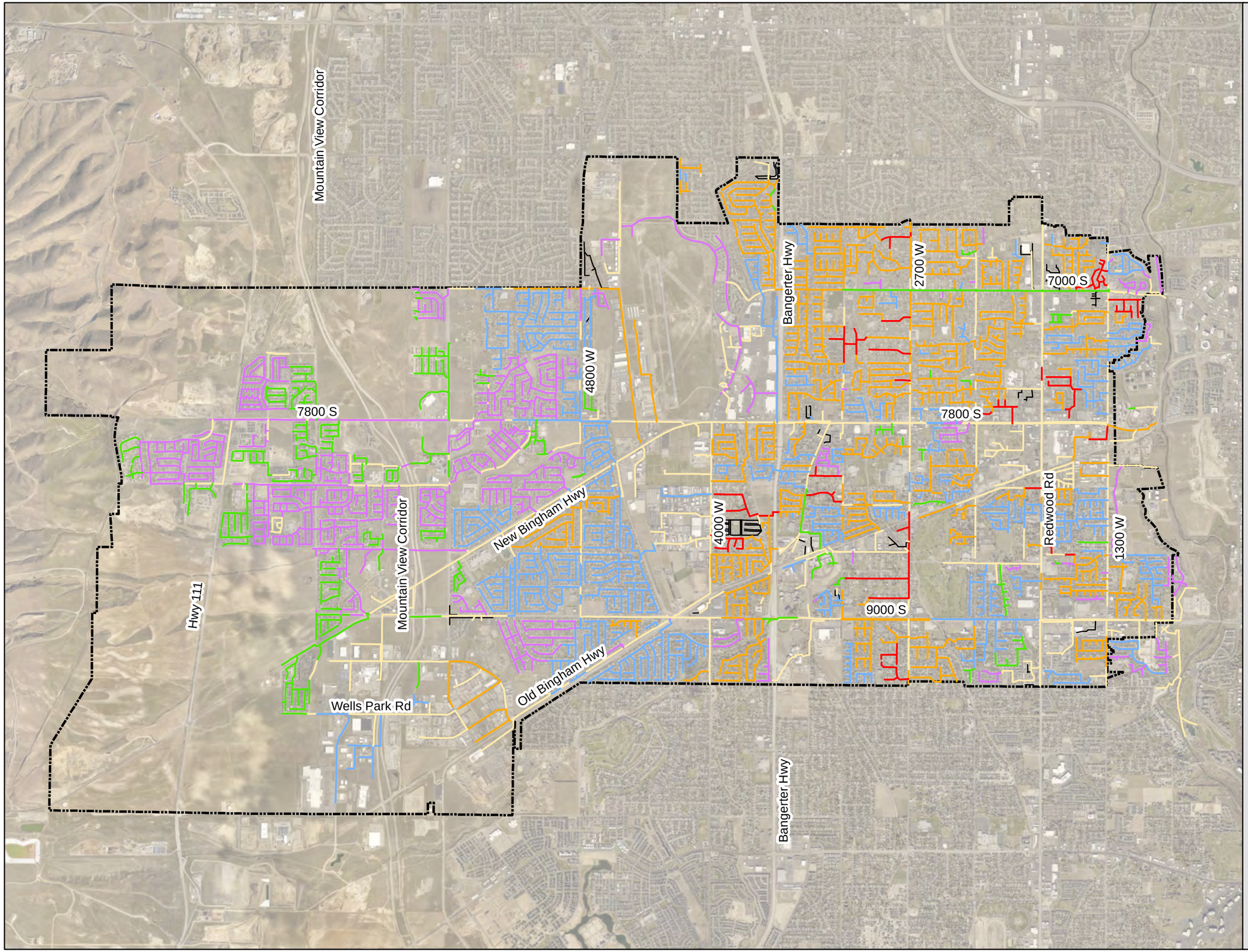

WEST JORDAN
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Figure 3-4: Existing Collection System - Year Installed

Legend

Year Installed

- Unknown
- Prior to 1970
- 1970-1989
- 1990-1999
- 2000-2009
- 2010-Current
- Private

System Service Area

N

0 0.5 1 Miles

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NW Quadrant

NE Quadrant

SW Quadrant

SE Quadrant

Mountain View Corridor

Campus View Drive

Bangerter Hwy

2700 W

7000 S

Grizzly Way

4800 W

7800 S

7800 S

1300 West

New Bingham Hwy

Mountain View Corridor

4000 W

Redwood Rd

1300 W

1300 West

Hwy 111

9000 S

Old Bingham Hwy

Wells Park Rd

Bangerter Hwy

WEST JORDAN
UTAH

N

Figure 6-1: Overall Existing Collection System d/D Map

Legend

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

Existing System Improvements

0 0.5 1 Miles

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WEST JORDAN
UTAH

Figure 6-1A: Existing Collection System d/D Map - NW Quadrant

Legend

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

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WEST JORDAN
UTAH

Figure 6-1B: Existing Collection System d/D Map - NE Quadrant

Legend

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

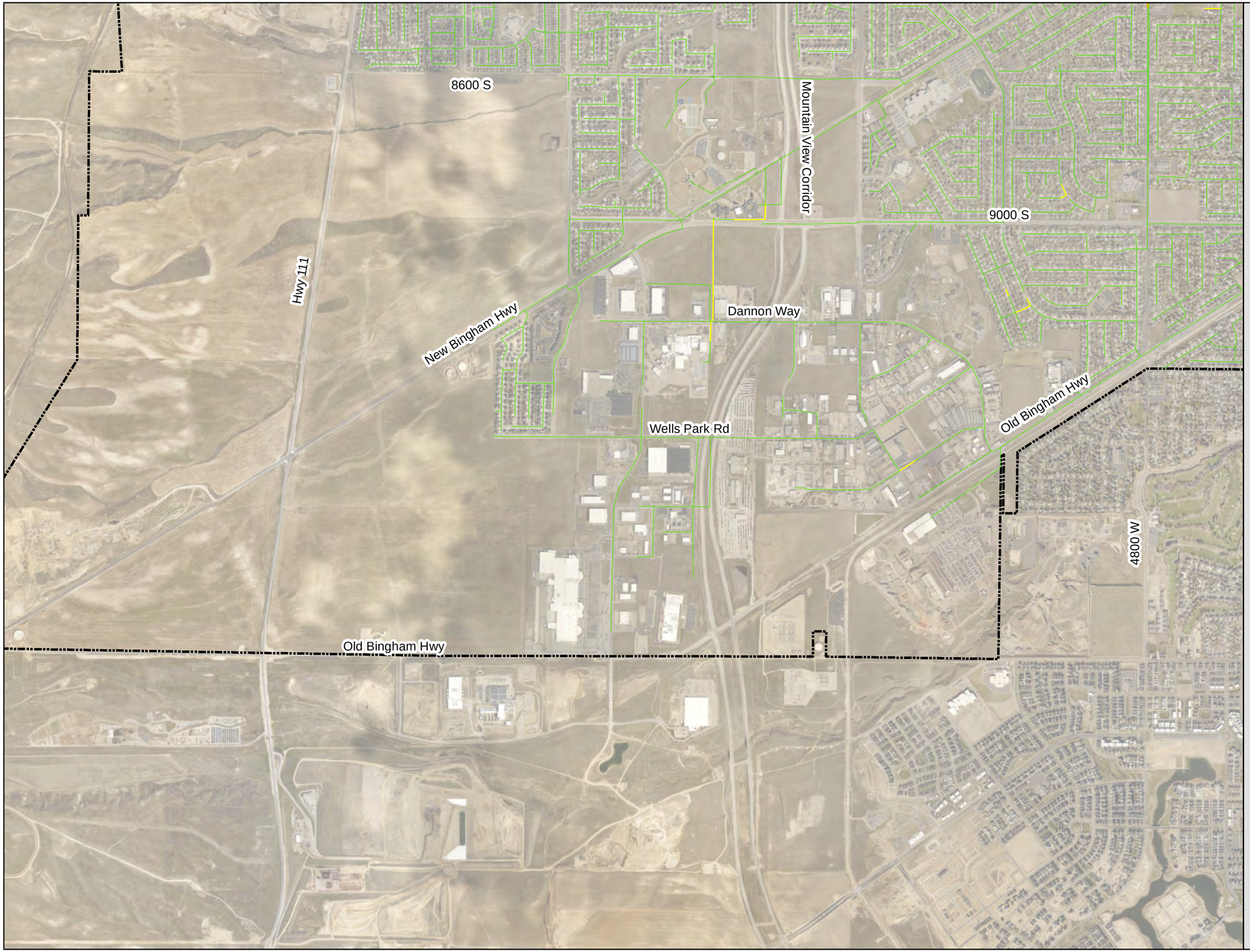
J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

Document Path: \\oremfiles\public\Projects\jub\West Jordan\50-18-051 2018 SSMP Update\GIS\MXD\Existing_System_d-D_(100gpcd)-NE_Quadrant.mxd



WEST JORDAN
UTAH

Figure 6-1C: Existing Collection System d/D Map - SW Quadrant

Legend

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

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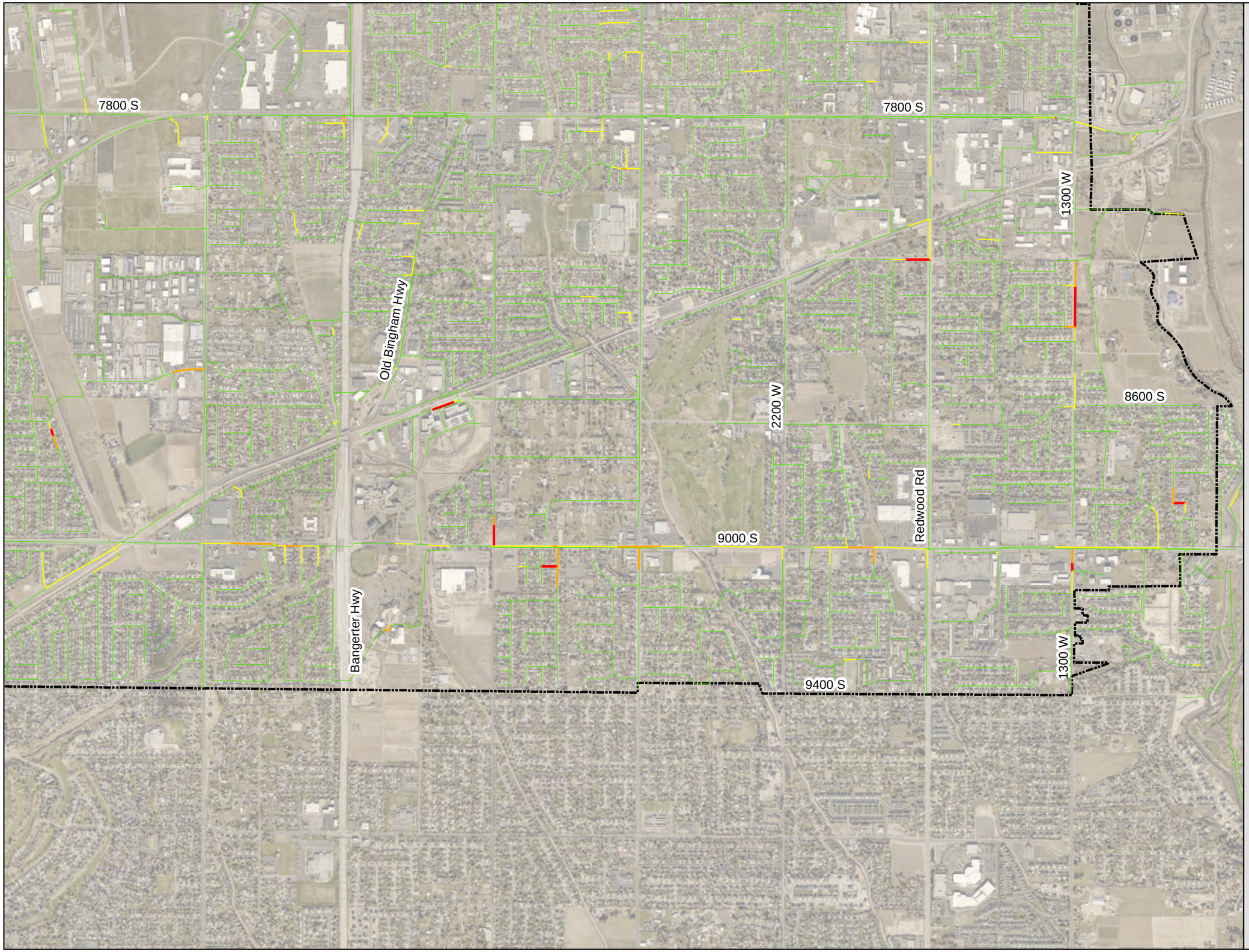

WEST JORDAN
UTAH

Figure 6-1D: Existing Collection System d/D Map - SE Quadrant

Legend

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

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NW Quadrant

NE Quadrant

SW Quadrant

SE Quadrant

Mountain View Corridor

7000 South

2700 W

7000 S

Bangerter Hwy

7800 S (West)

7800 S (East)

4800 W

7800 S

New Bingham Hwy

4000 W

Redwood Rd

1300 W

Mountain View Corridor

9000 S/Old Bingham Hwy

9000 South

9000 S

Hwy 111

Wells Park Road

Wells Park Rd

Old Bingham Hwy

Jordan River Parkway

Bagley Park Road

Bangerter Hwy

WEST JORDAN
UTAH

Figure 6-2: Overall Existing Collection System Buildout d/D Map

Legend

- - - Future Pipe

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

Existing System Improvements at Buildout

N

0 0.5 1 Miles

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WEST JORDAN
UTAH

Figure 6-2A: Existing Collection System Buildout d/D Map - NW Quadrant

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

7000 S
7800 S
8600 S
Airport Rd
Mountain View Corridor
5600 W
4800 W
Hwy 111
New Bingham Hwy

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OTHER J-U-B COMPANIES

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WEST JORDAN
UTAH

Figure 6-2B: Existing Collection System Buildout d/D Map - NE Quadrant

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

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OTHER J-U-B COMPANIES

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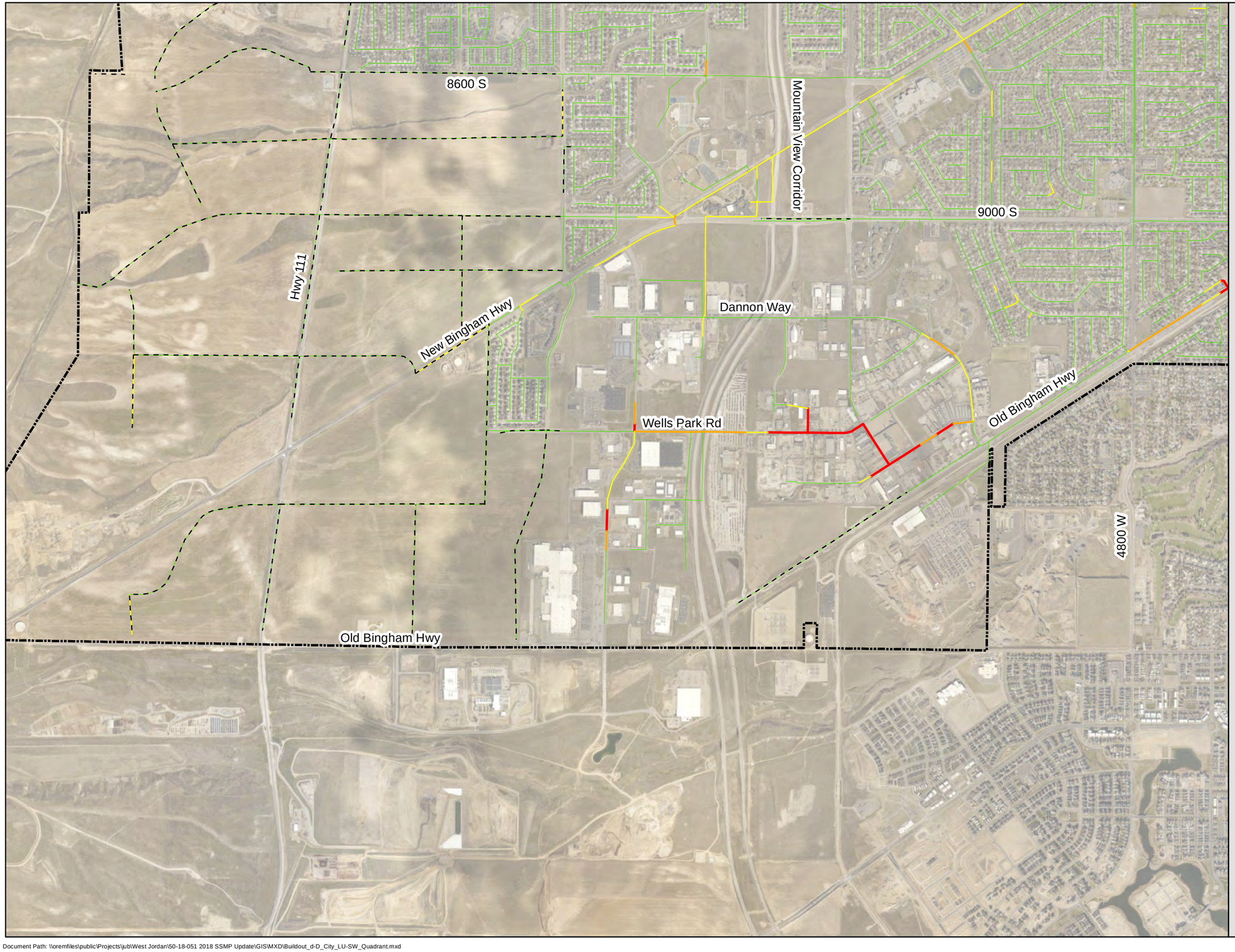

WEST JORDAN
UTAH

Figure 6-2C: Existing Collection System Buildout d/D Map - SW Quadrant

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

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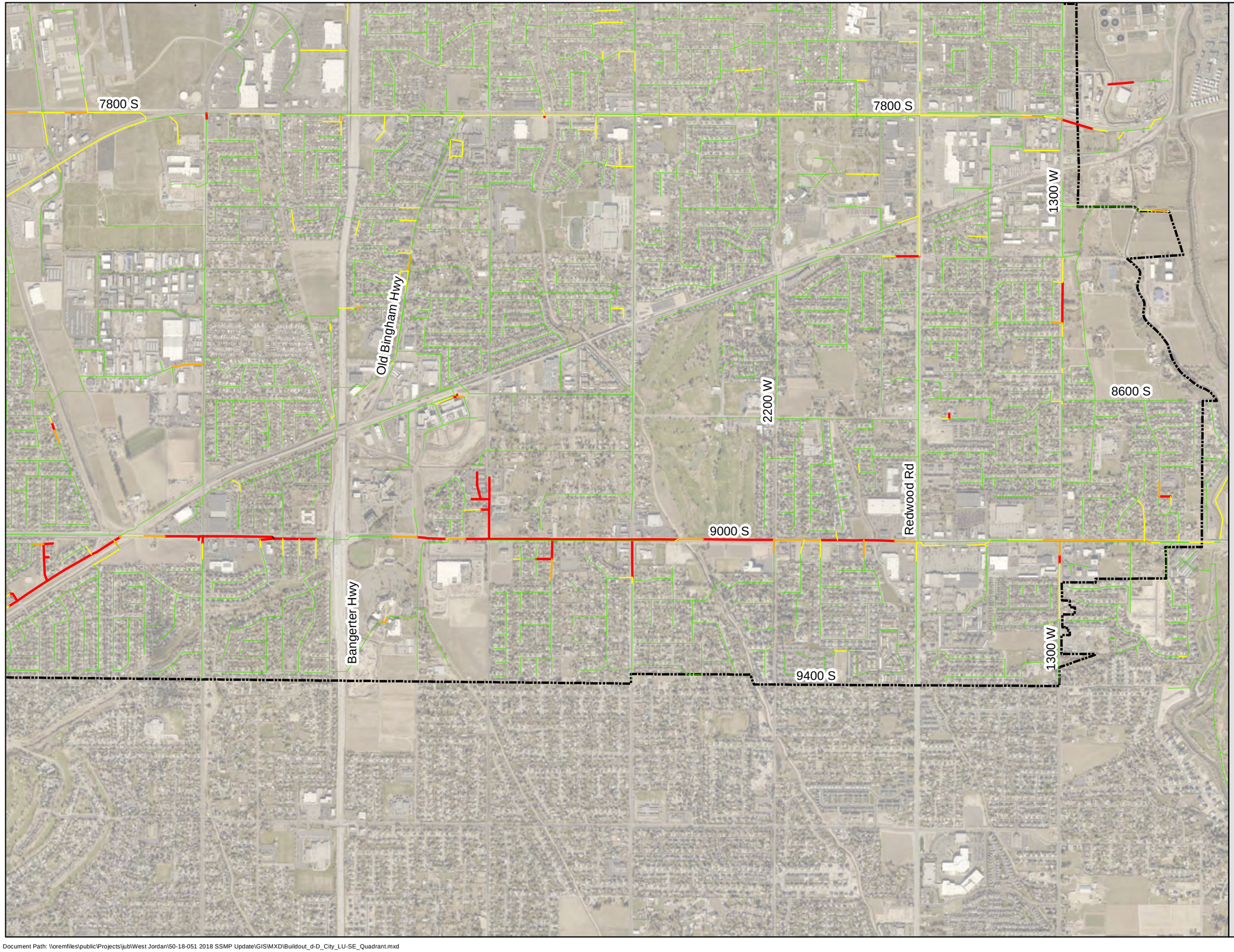

WEST JORDAN
UTAH

Figure 6-2D: Existing Collection System Buildout d/D Map - SE Quadrant

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

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OTHER J-U-B COMPANIES

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WEST JORDAN
UTAH

N

Figure 7-1: Capital Improvement Projects

Legend

Pipe Size

- 6
- 8
- 10
- 12
- 15
- 18
- 21
- 24
- 27
- 30
- 36
- 39
- Future Pipe

Future Pipe Size

- 12
- 15
- 18
- 21
- 24
- 30
- 36

System Service Area

0 0.5 1 Miles

J-U-B

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OTHER J-U-B COMPANIES

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NW Quadrant

NE Quadrant

SW Quadrant

SE Quadrant

Mountain View Corridor

Bangerter Hwy

2700 W

7000 S

4800 W

7800 S

7800 S

New Bingham Hwy

Mountain View Corridor

4000 W

Redwood Rd

1300 W

Hwy 111

9000 S

Old Bingham Hwy

Wells Park Rd

Bangerter Hwy

WEST JORDAN
UTAH

Figure 7-2: Overall Existing Collection System Buildout d/D Map with Proposed Improvements

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.5 1 Miles

J-U-B

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GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

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WEST JORDAN
UTAH

Figure 7-2A: Existing Collection System Buildout d/D Map with Proposed Improvements - NW Quadrant

Legend

- - - Future Pipes

Depth over Diamter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

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WEST JORDAN
UTAH

Figure 7-2B: Existing Collection System Buildout d/D Map with Proposed Improvements - NE Quadrant

Legend

- - - Future Pipes

Depth over Diameter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

Airport Rd
Bangerter Hwy
2700 W
7000 S
3200 W
2200 W
Redwood Rd
1300 W
7800 S
New Bingham Hwy
4000 W
Bangerter Hwy

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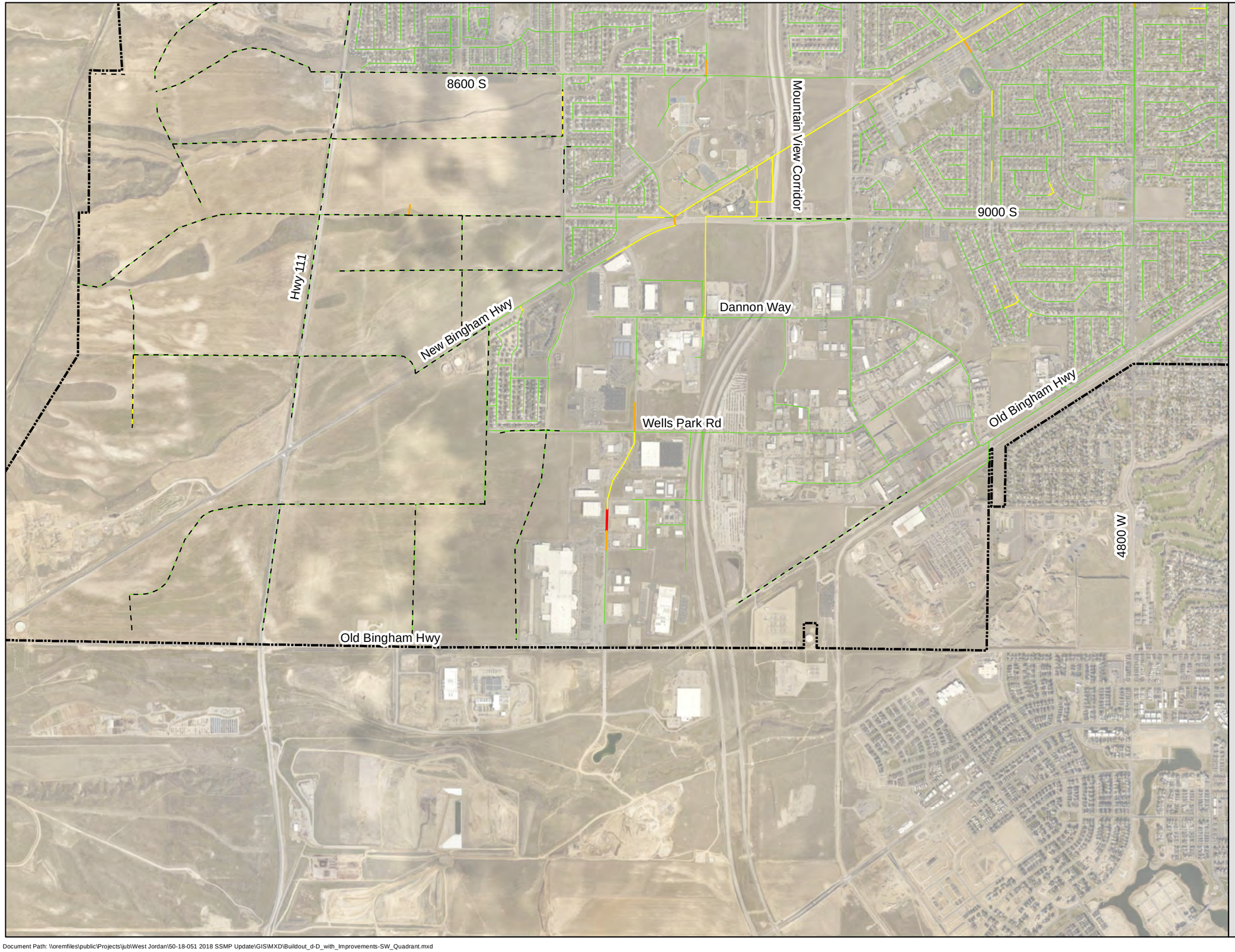

WEST JORDAN
UTAH

Figure 7-2C: Existing Collection System Buildout d/D Map with Proposed Improvements - SW Quadrant

Legend

- - - Future Pipes

Depth over Diamter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

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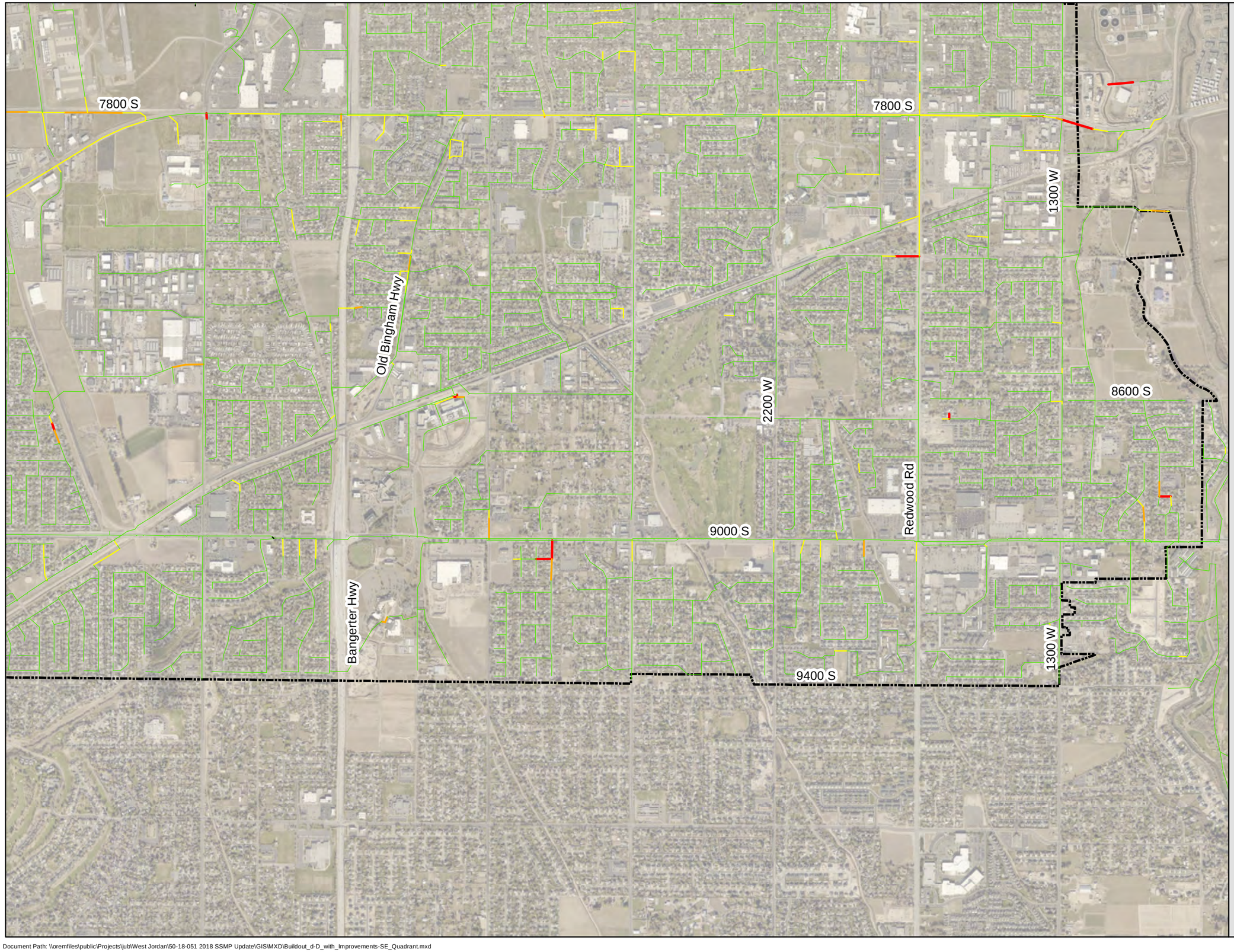

WEST JORDAN
UTAH

Figure 7-2D: Existing Collection System Buildout d/D Map with Proposed Improvements - SE Quadrant

Legend

- - - Future Pipes

Depth over Diamter (d/D)

- 0.00 - 0.50
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 1.00

System Service Area

N

0 0.25 0.5 Miles

J-U-B

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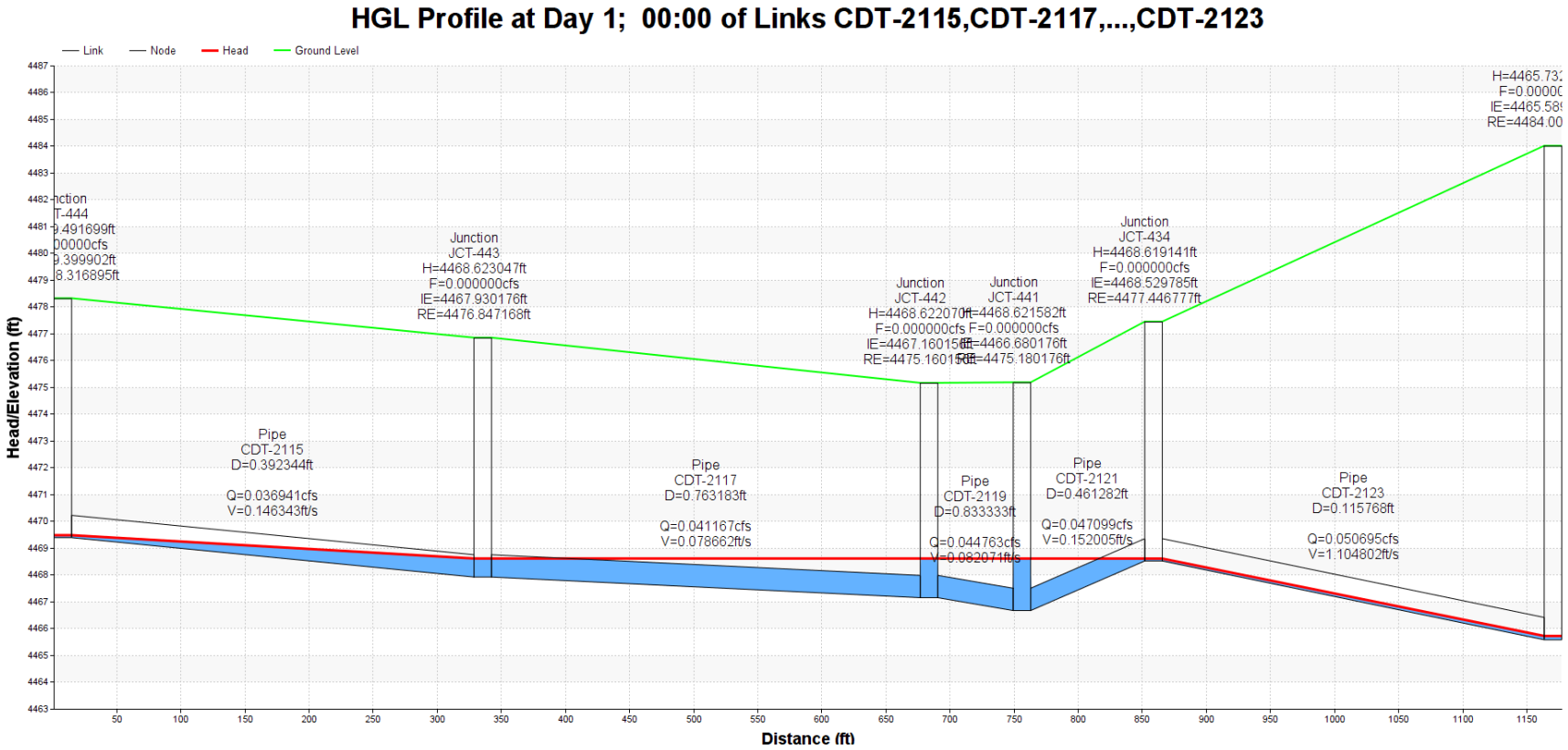
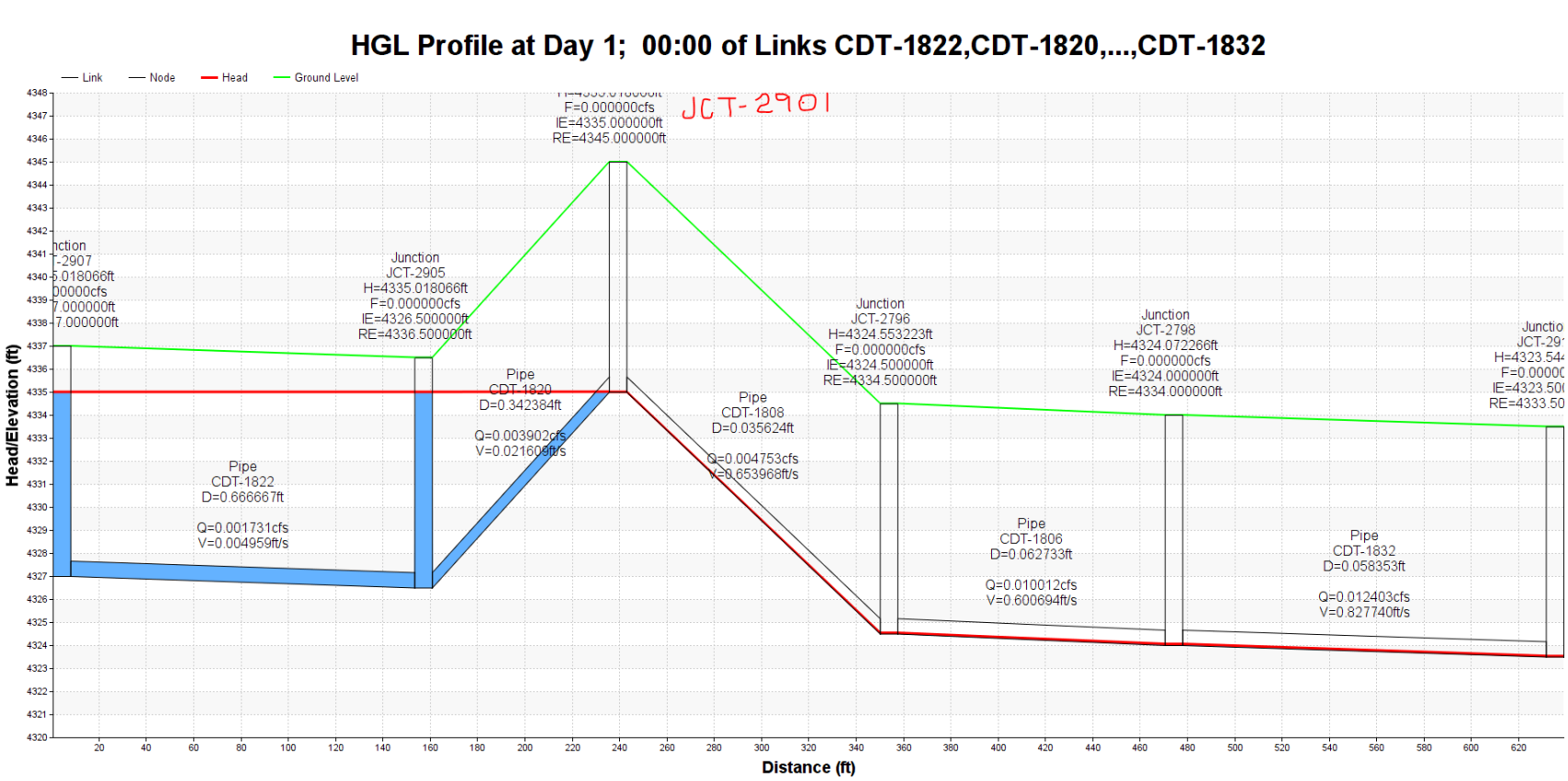
APPENDIX B

Model Adjustments, Permanent Flow Meter Data and Model Calibration Graphs

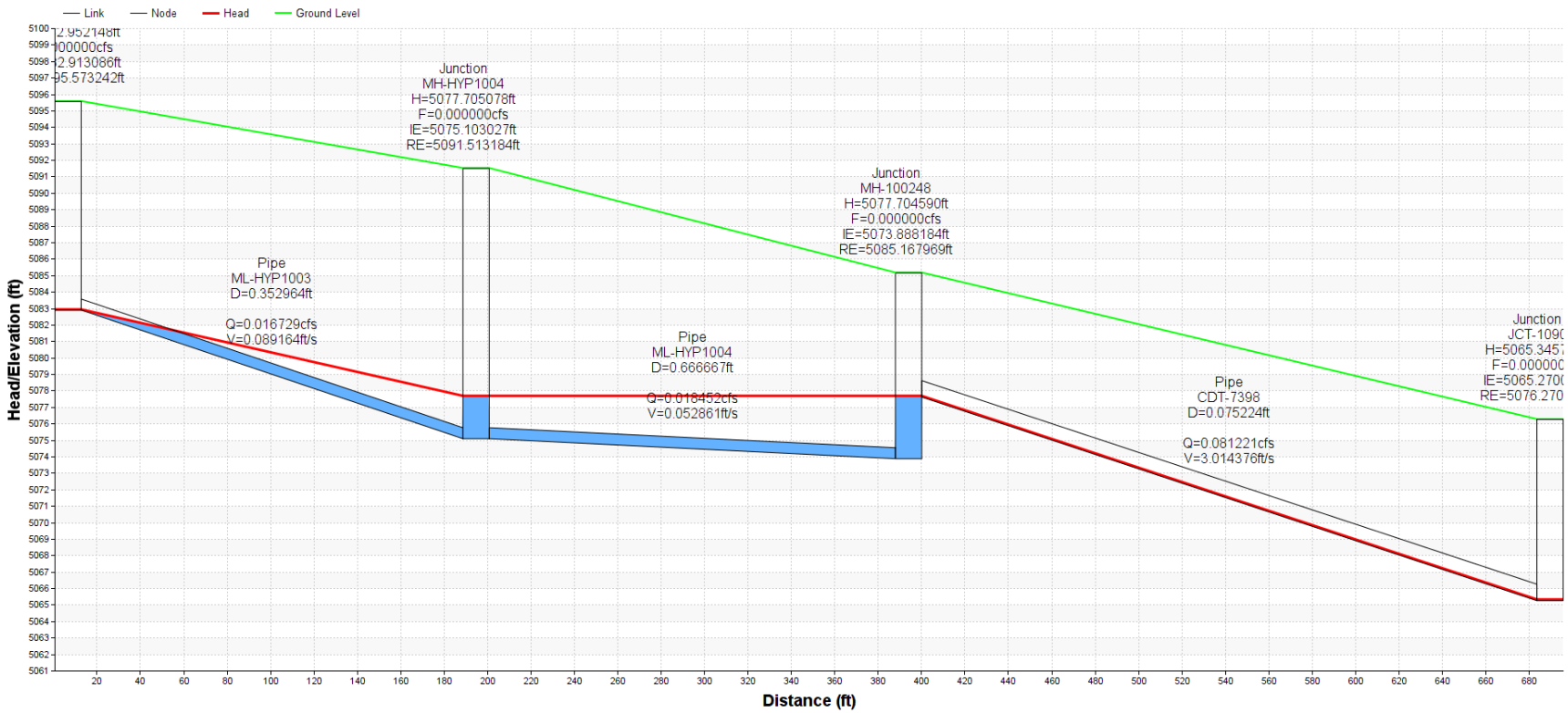
GIS DATA/MODEL ADJUSTMENTS SUMMARY (INTERPOLATION)



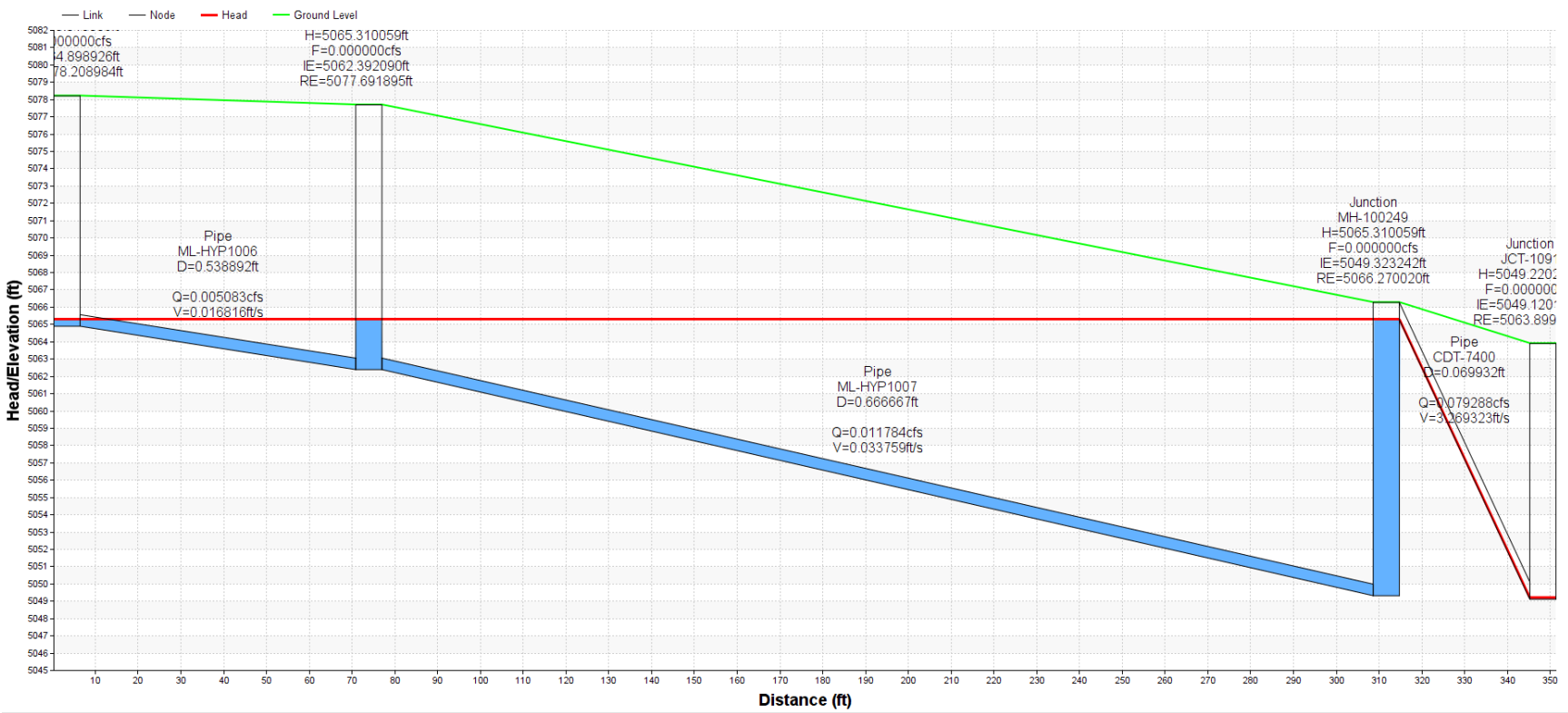
0 Manhole JCT-434 invert elevation changed from 4468.53 to 4465.95



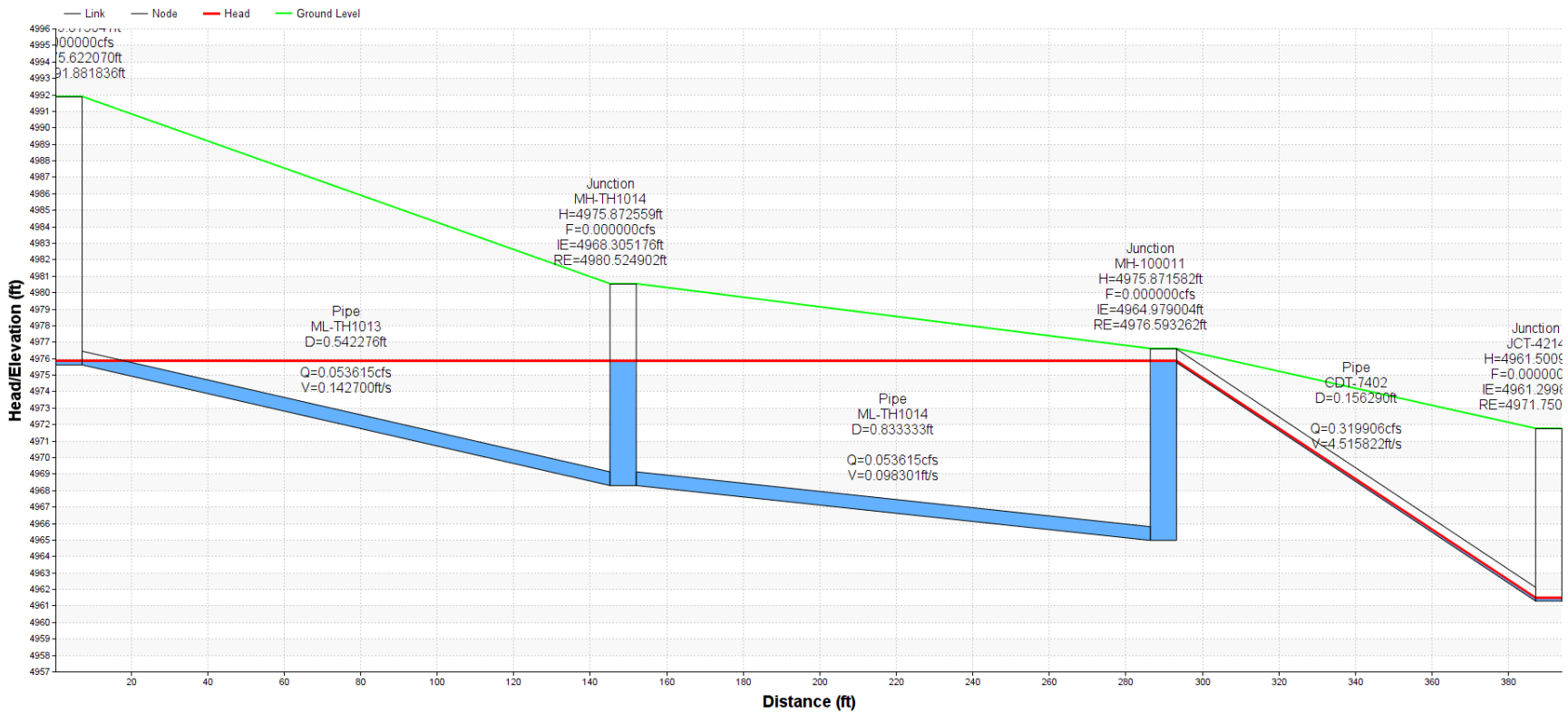
1 Manhole JCT-2901 invert elevation changed from 4335.0 to 4326.24



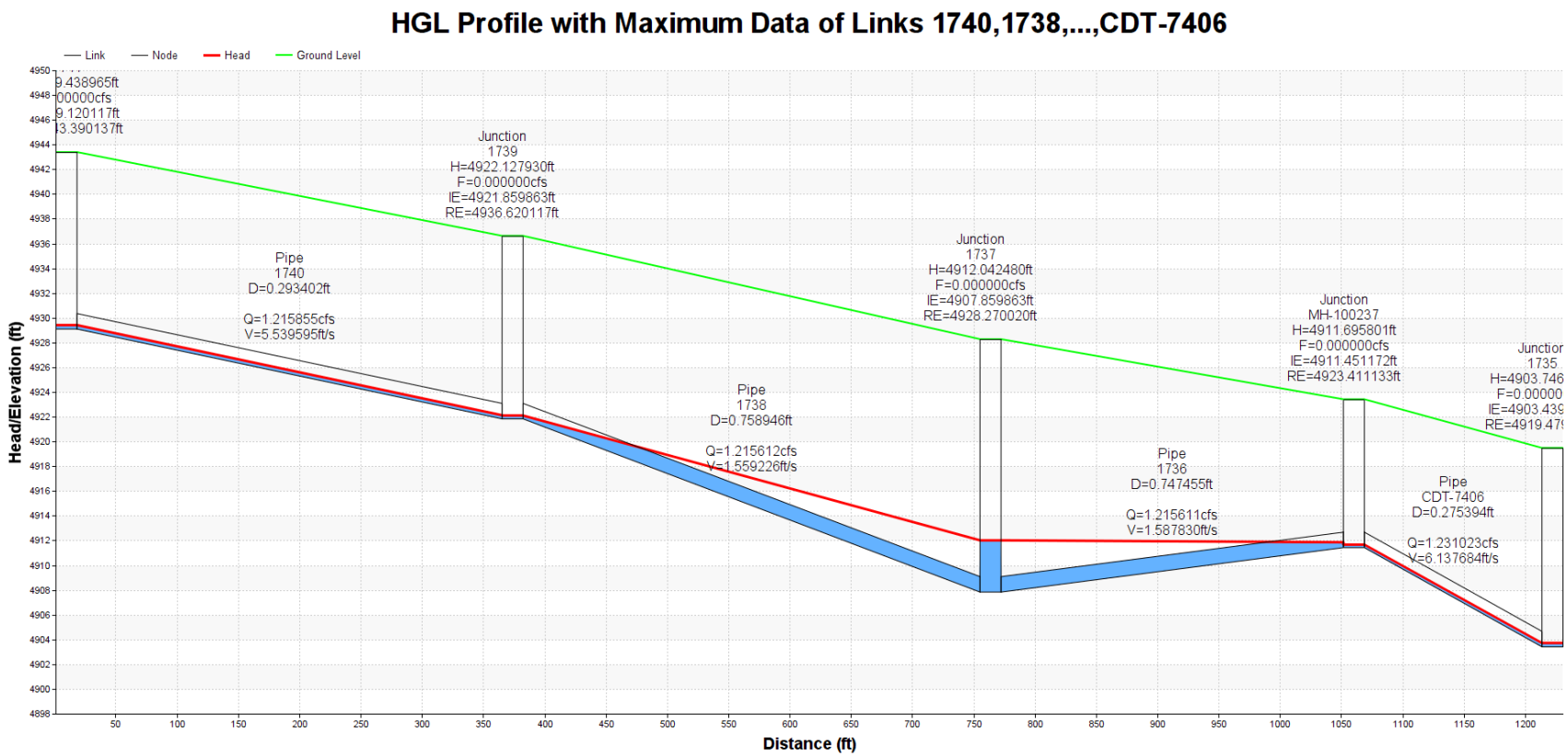
2 CORRECTED INVERTS OF PIPES GOING INTO MANHOLE



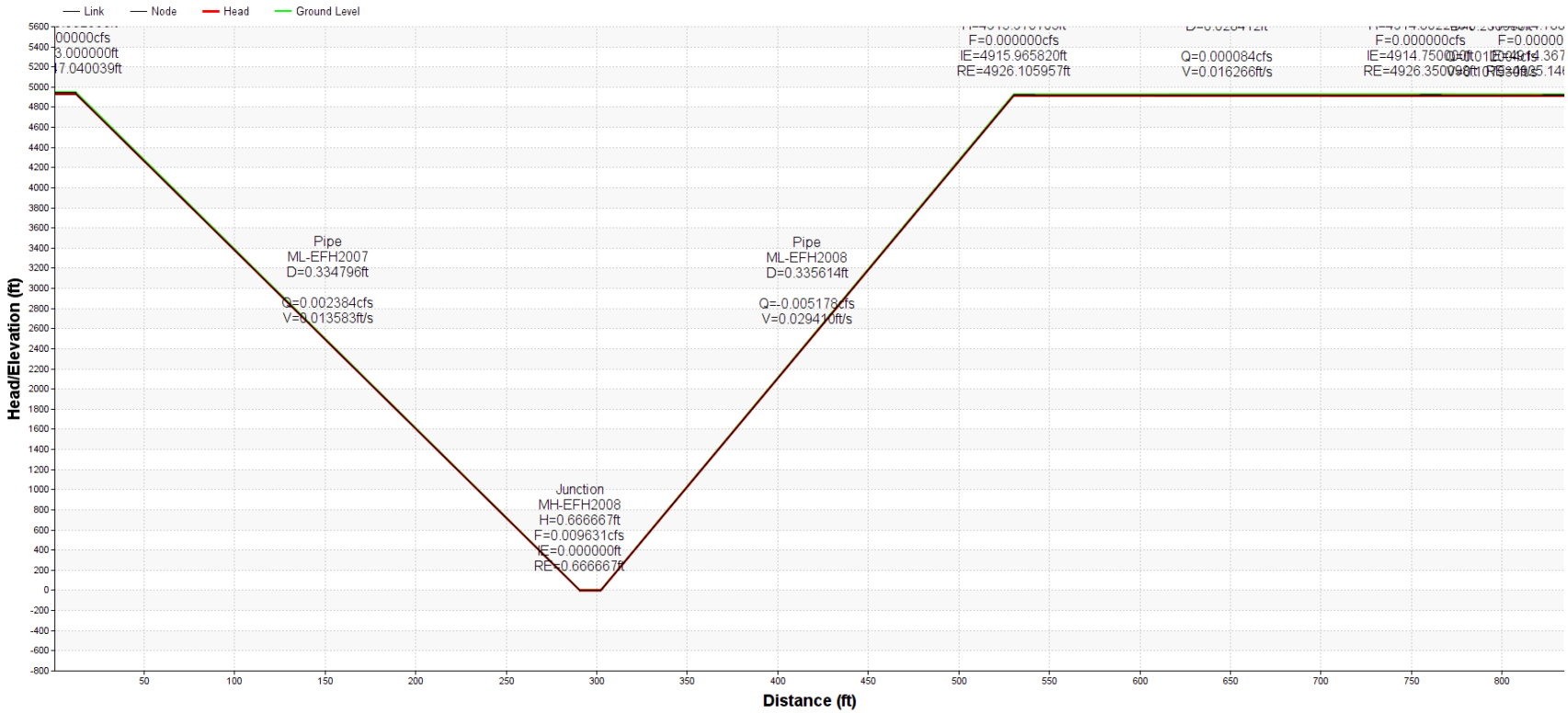
3 CORRECTED INVERTS OF PIPES INTO MANHOLE



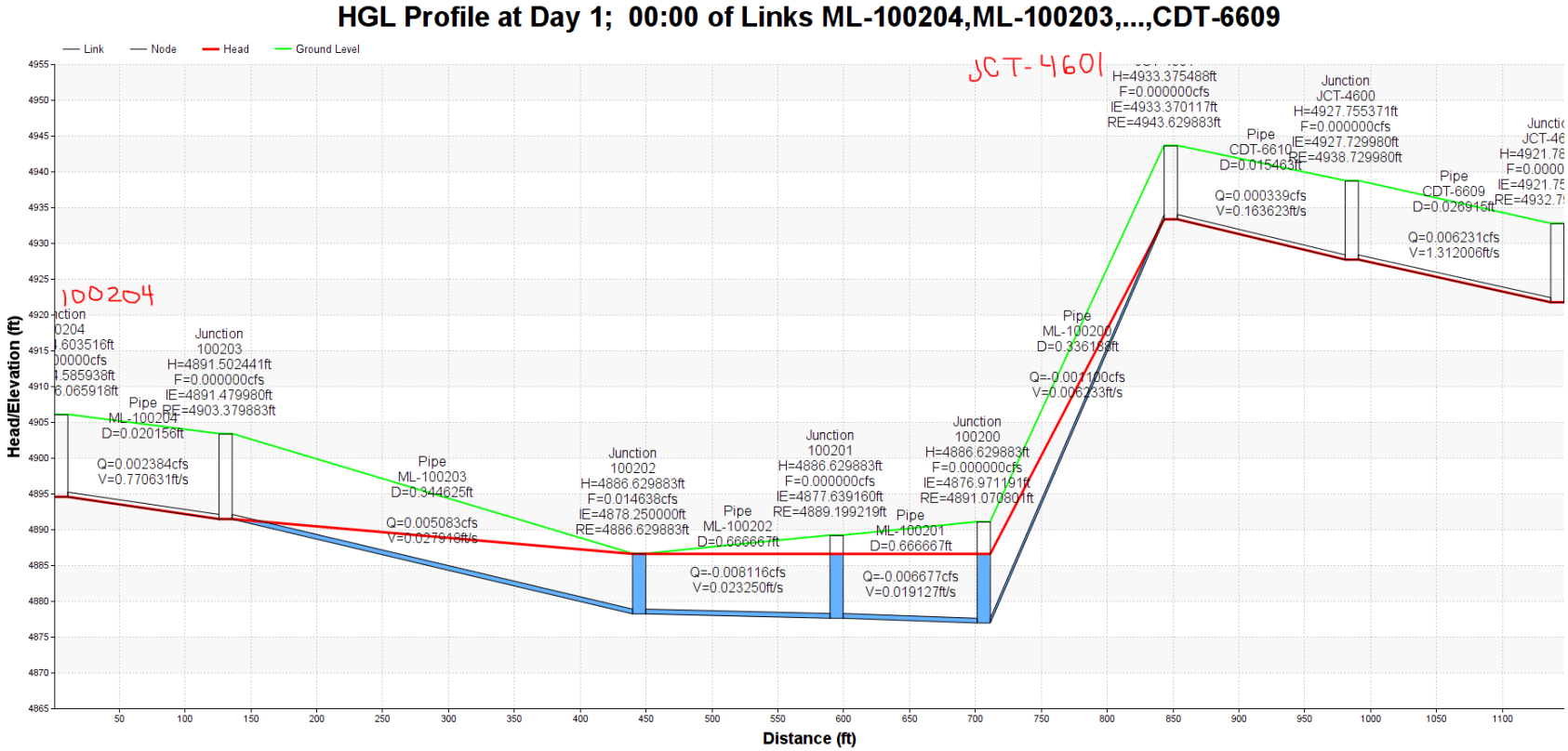
4 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE

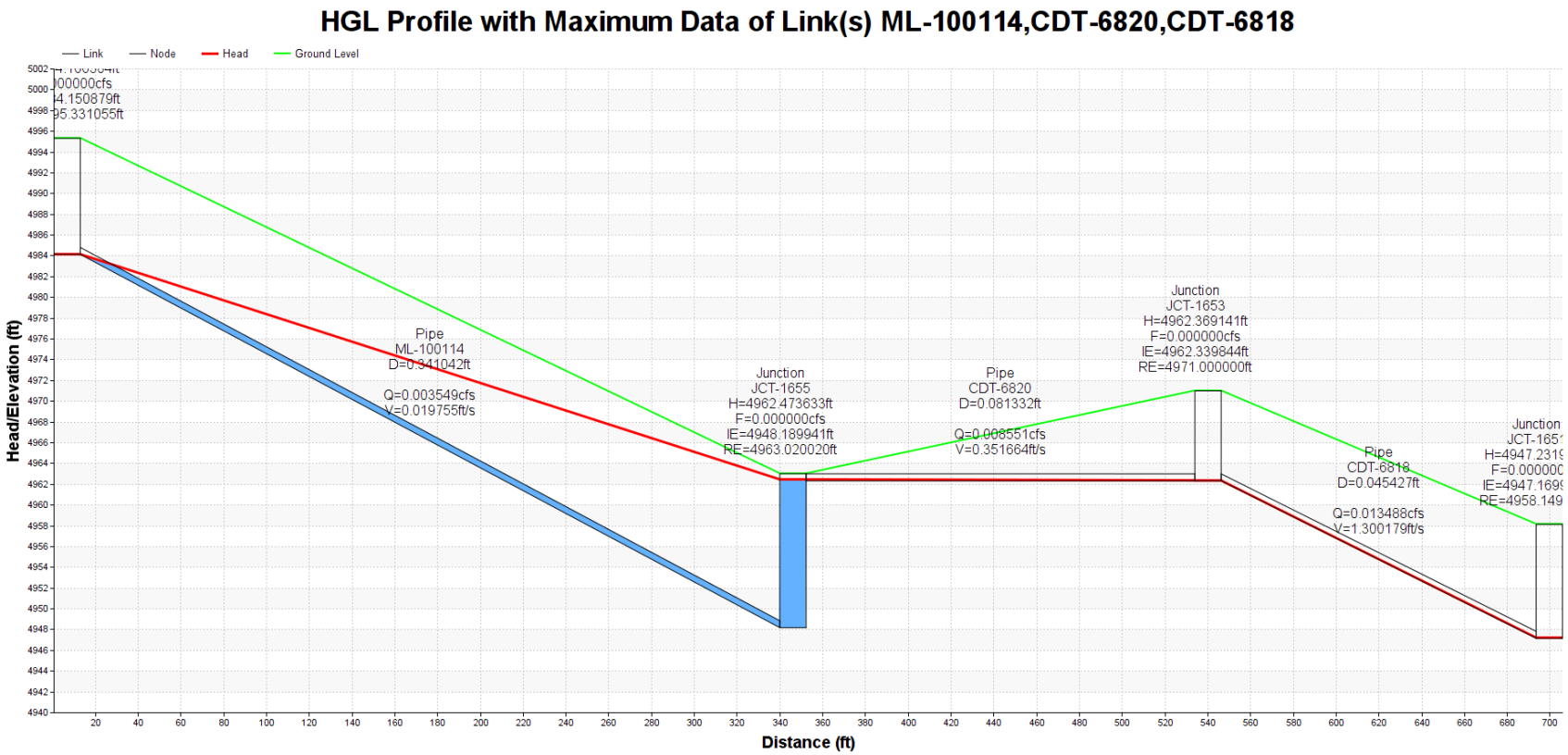


5 Manhole MH-100237 invert elevation changed from 4911.451 to 4904.83

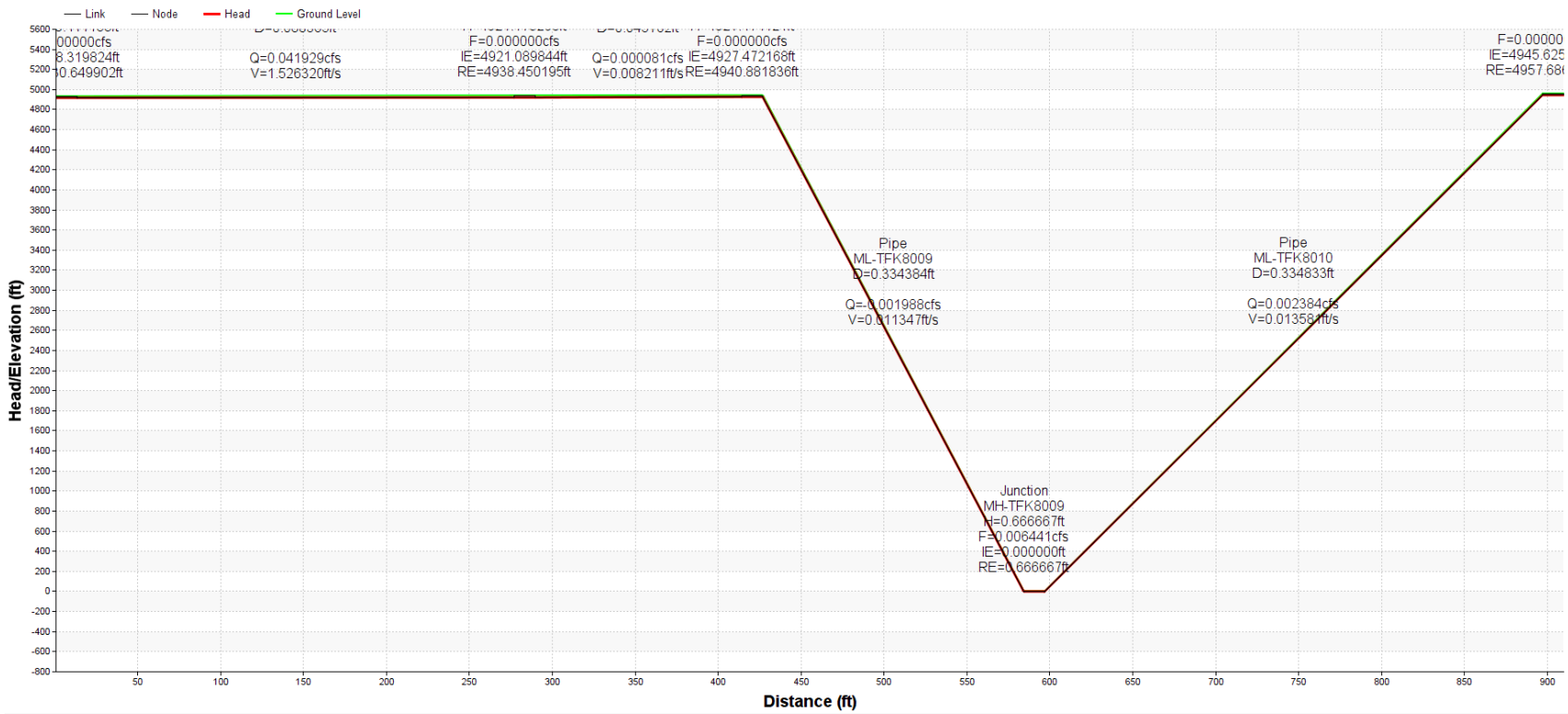


6 Manhole MH-EFH2008 invert elevation changed from 0 to 4923.64 and max depth changed from 0 to 10

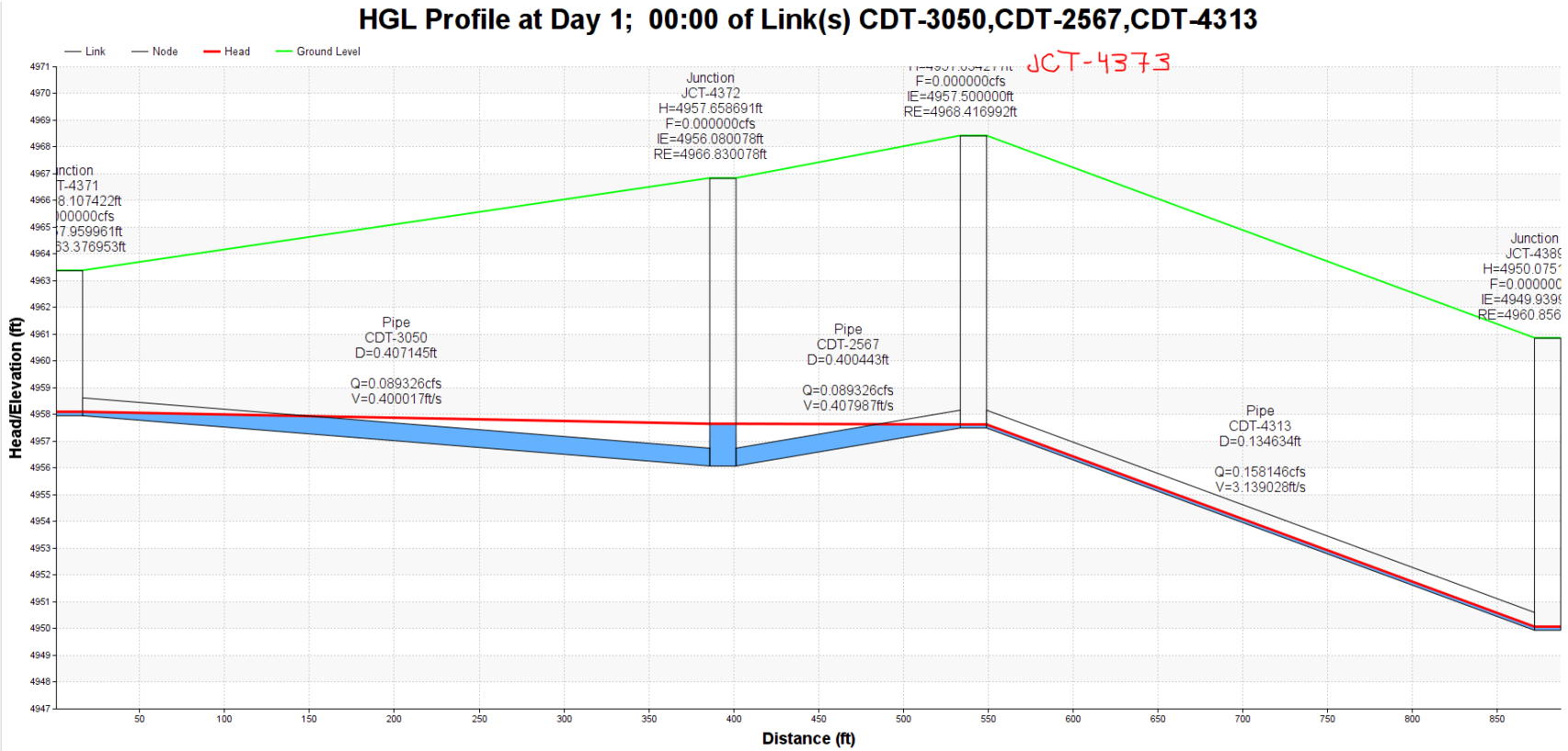

HGL Profile at Day 1; 00:00 of Links ML-100204,ML-100203,...,CDT-6609
Link
Node
Head
Ground Level
JCT-4601
100204
Junction
100203
H=4891.502441ft
F=0.000000cfs
IE=4891.479980ft
RE=4903.379883ft
Pipe
ML-100204
D=0.020156ft
Q=0.002384cfs
V=0.770631ft/s
Pipe
ML-100203
D=0.344625ft
Q=0.005083cfs
V=0.027918ft/s
Junction
100202
H=4886.629883ft
F=0.014638cfs
IE=4878.250000ft
RE=4886.629883ft
Pipe
ML-100202
D=0.666667ft
Q=-0.008116cfs
V=0.023250ft/s
Junction
100201
H=4886.629883ft
F=0.000000cfs
IE=4877.639160ft
RE=4889.199219ft
Pipe
ML-100201
D=0.666667ft
Q=-0.006677cfs
V=0.019127ft/s
Junction
100200
H=4886.629883ft
F=0.000000cfs
IE=4876.971191ft
RE=4891.070801ft
Pipe
ML-100200
D=0.336182ft
Q=-0.001100cfs
V=0.006233ft/s
H=4933.375488ft
F=0.000000cfs
IE=4933.370117ft
RE=4943.629883ft
Pipe
CDT-6610
D=0.015463ft
Q=0.000339cfs
V=0.163623ft/s
Junction
JCT-4600
H=4927.755371ft
F=0.000000cfs
IE=4927.729980ft
RE=4938.729980ft
Pipe
CDT-6609
D=0.026915ft
Q=0.006231cfs
V=1.312006ft/s
Head/Elevation (ft)
Distance (ft)



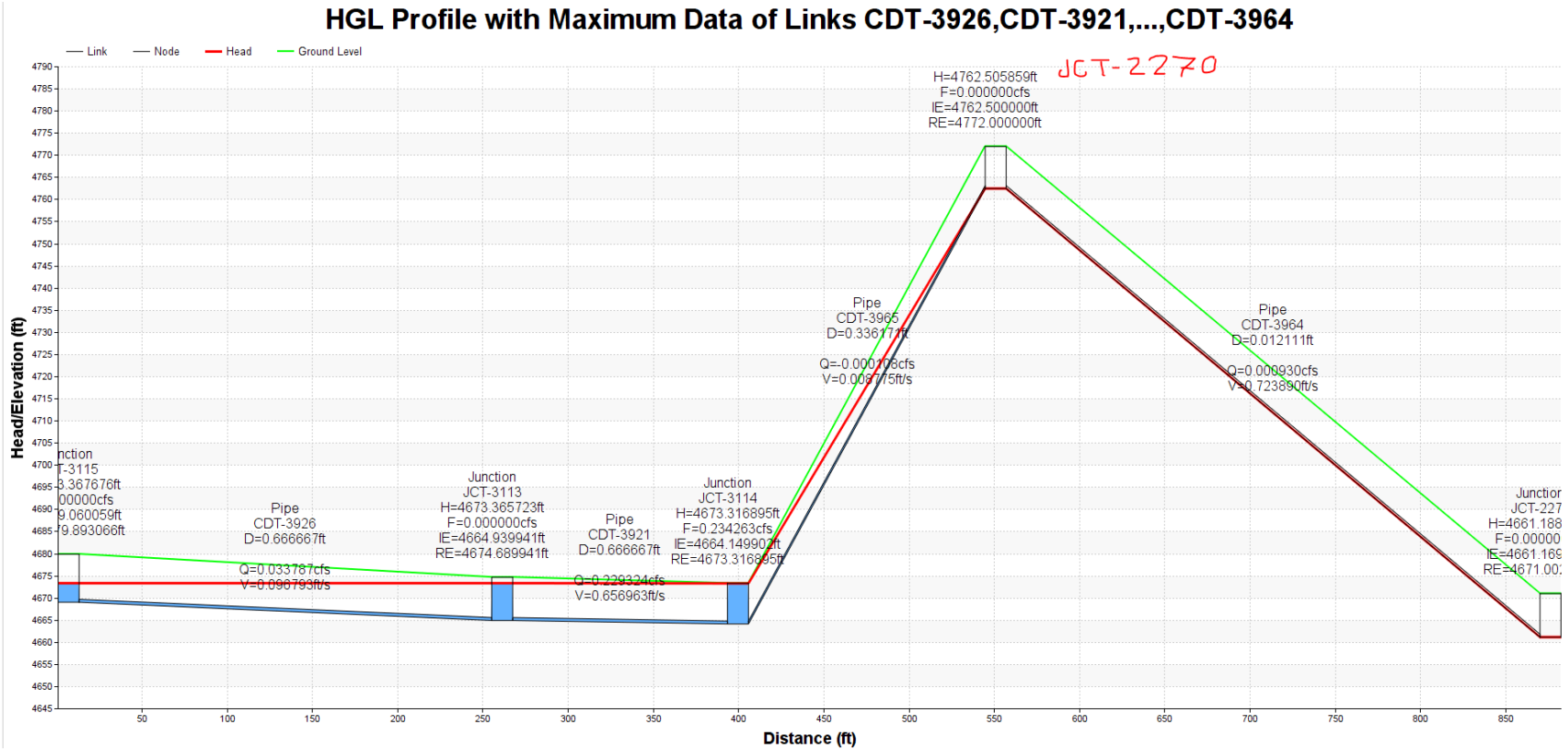
8 Manhole JCT-1653 invert elevation changed from 4962.34 to 4947.63



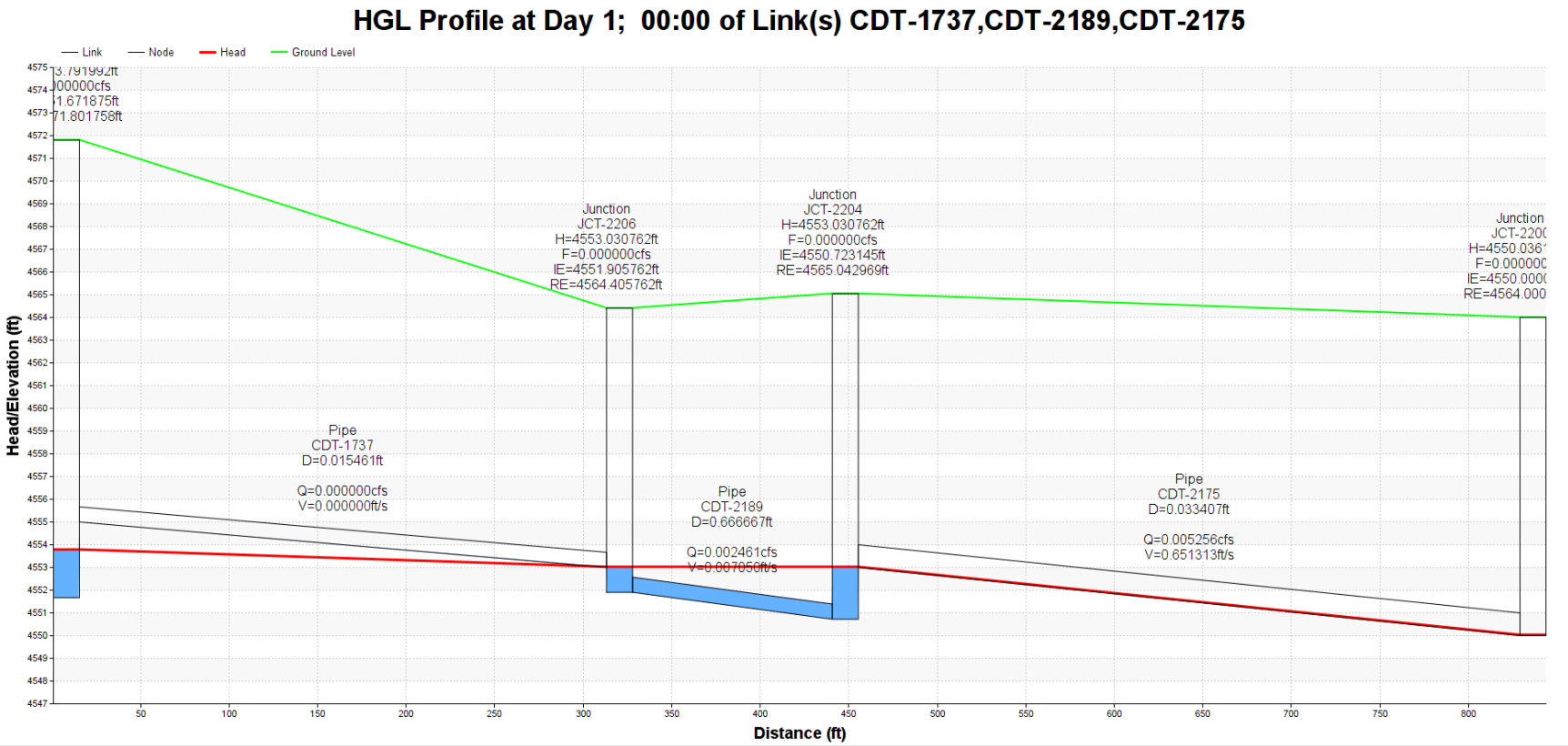
9 Manhole MH-TFK8009 invert elevation changed from 0 to 4933.72 and max depth changed from 0 to 12



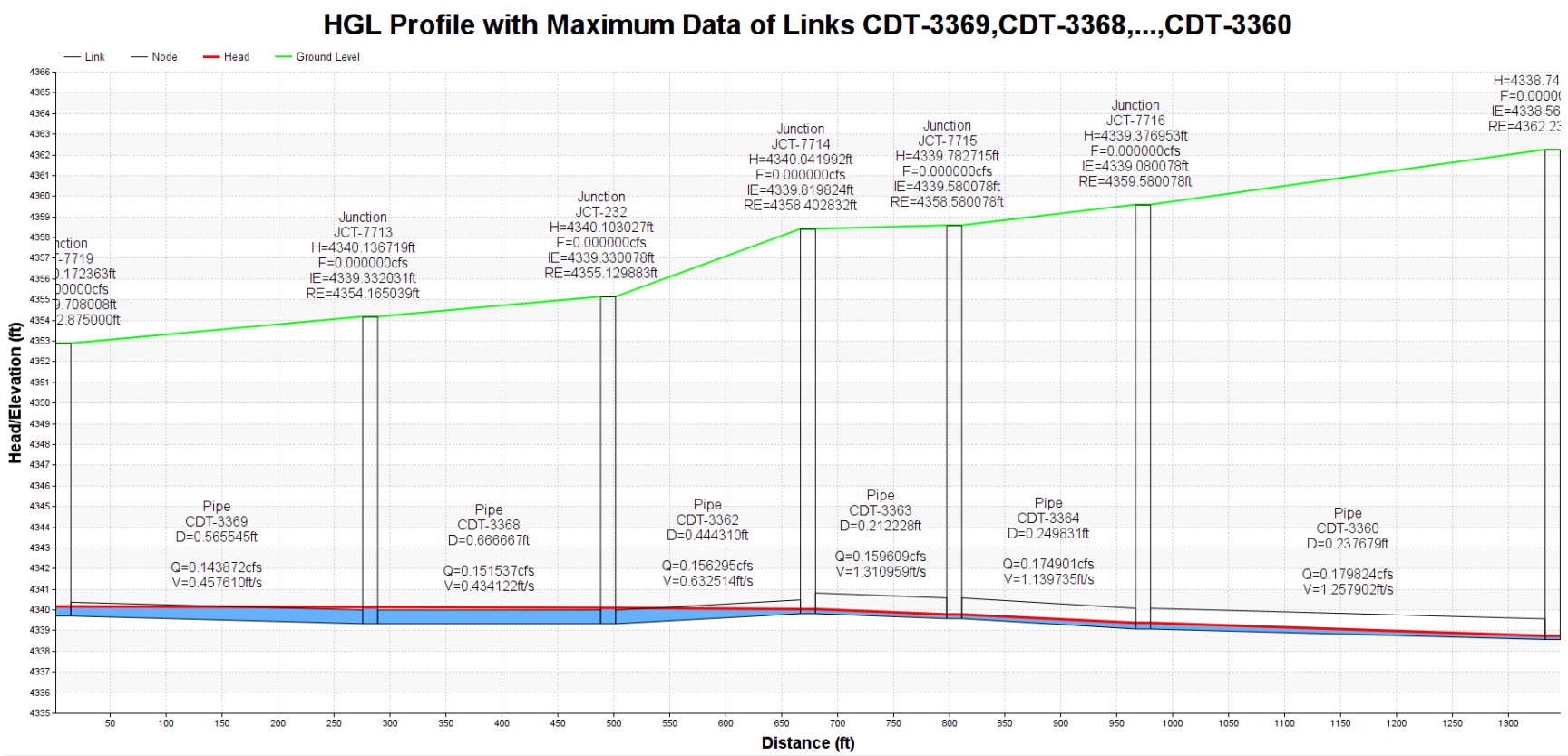
10 Manhole JCT-4373 invert elevation changed from 4957.5 to 4955.41



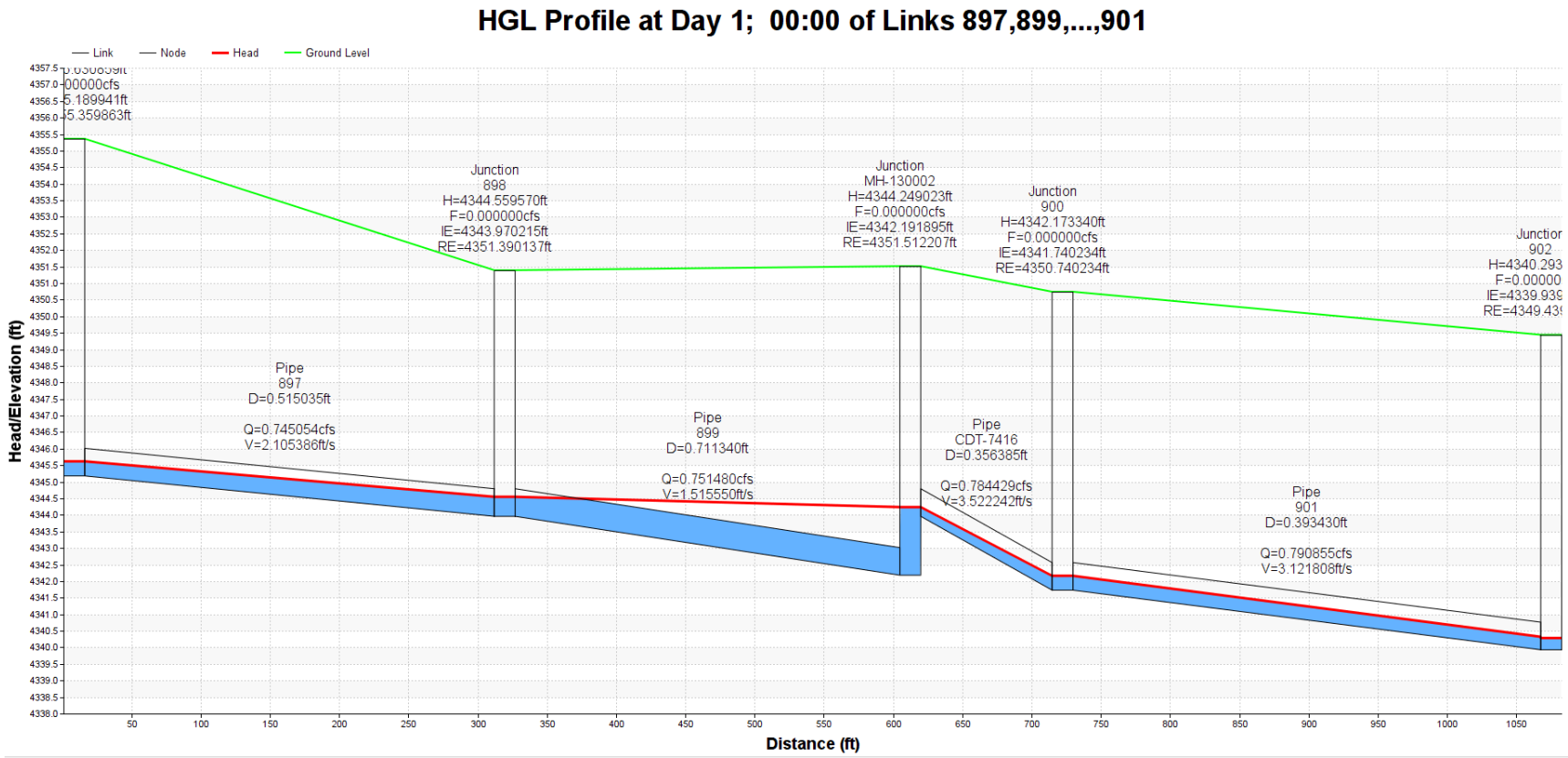
11 Manhole JCT-2270 invert elevation changed from 4762.5 to 4663.28



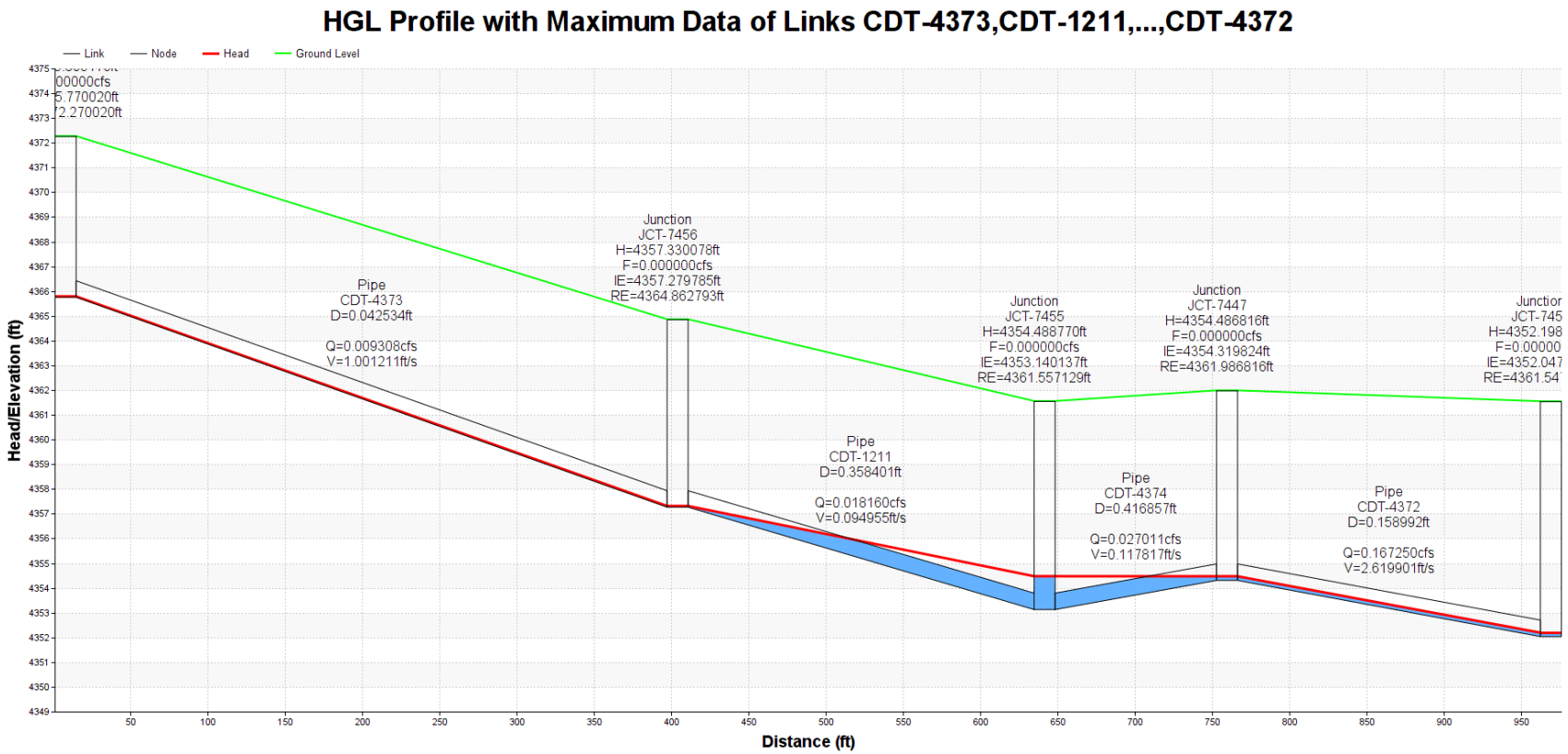
12 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE



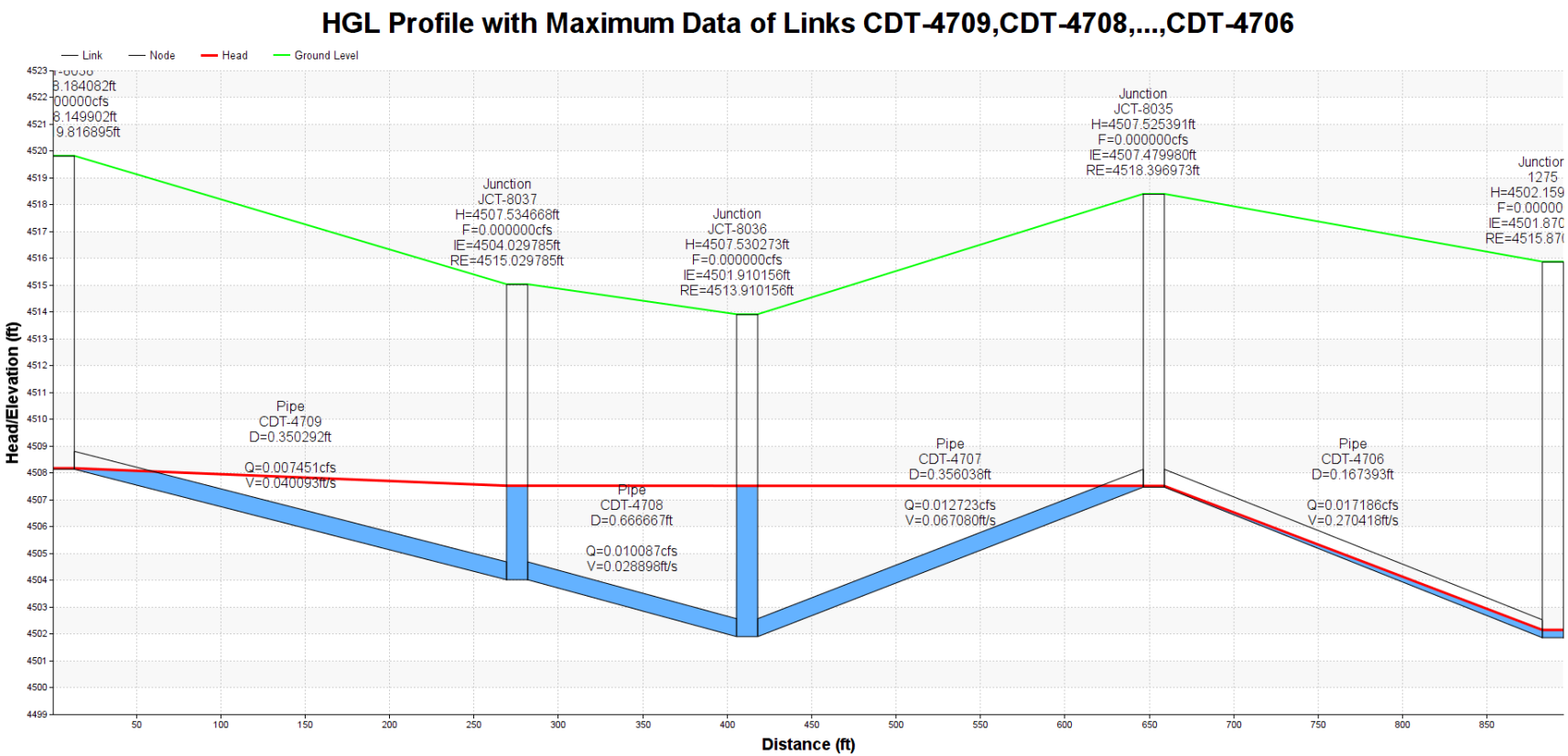
13 Manhole JCT-7714 invert elevation changed from 4339.82 to 4339.24 and JCT-7715 invert elevation changed from 4339.58 to 4339.17



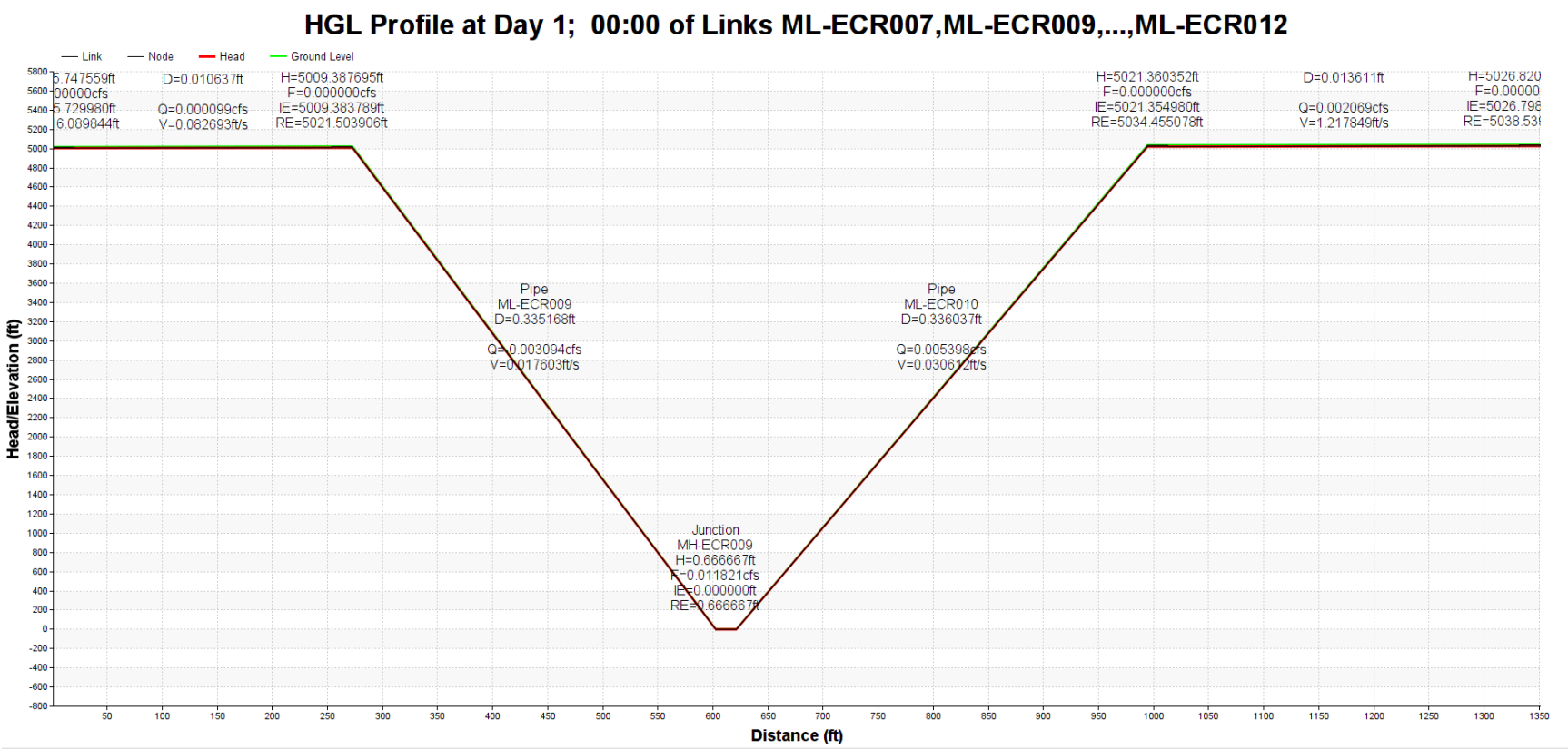
14 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE



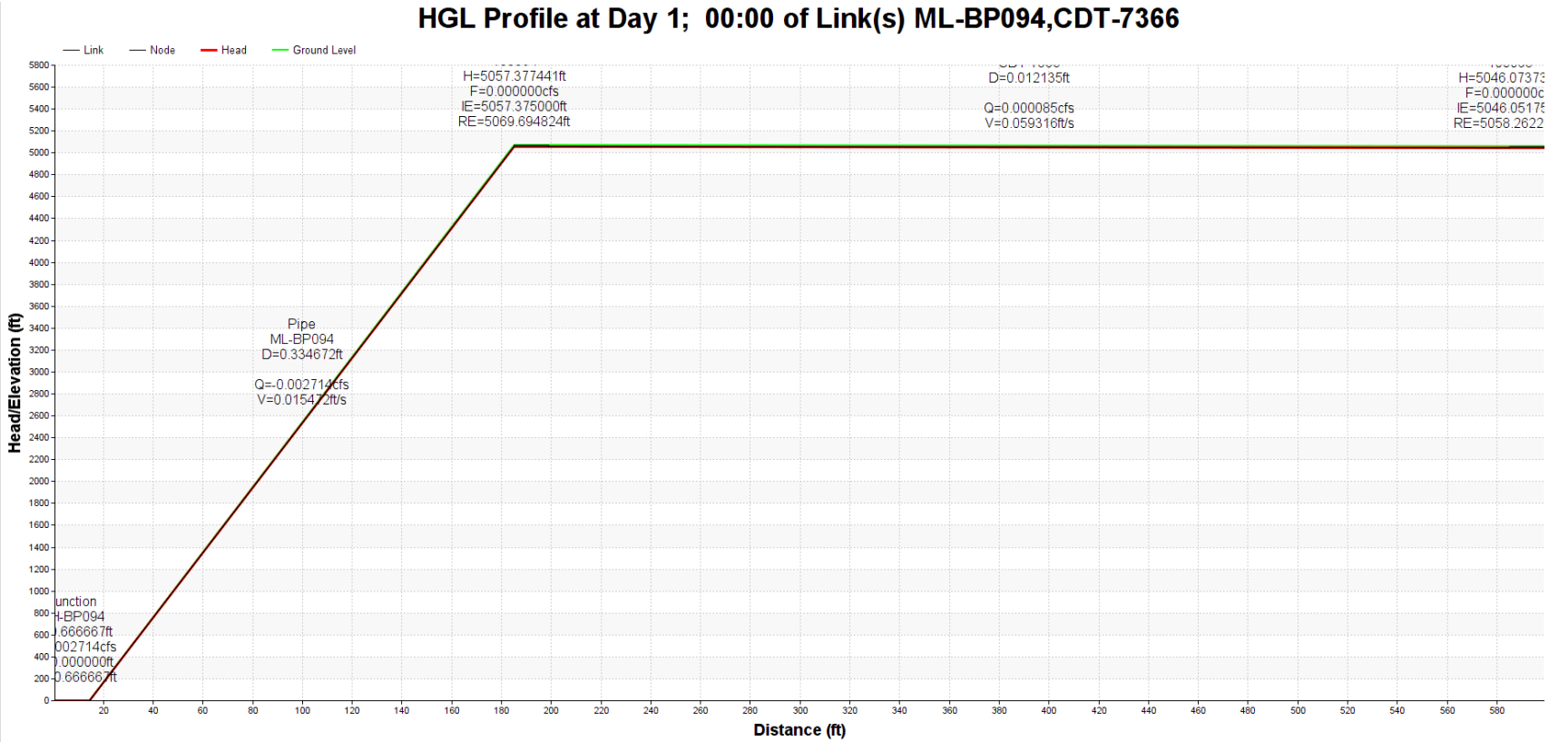
15 Manhole JCT-7447 invert elevation changed from 4354.32 to 4352.76



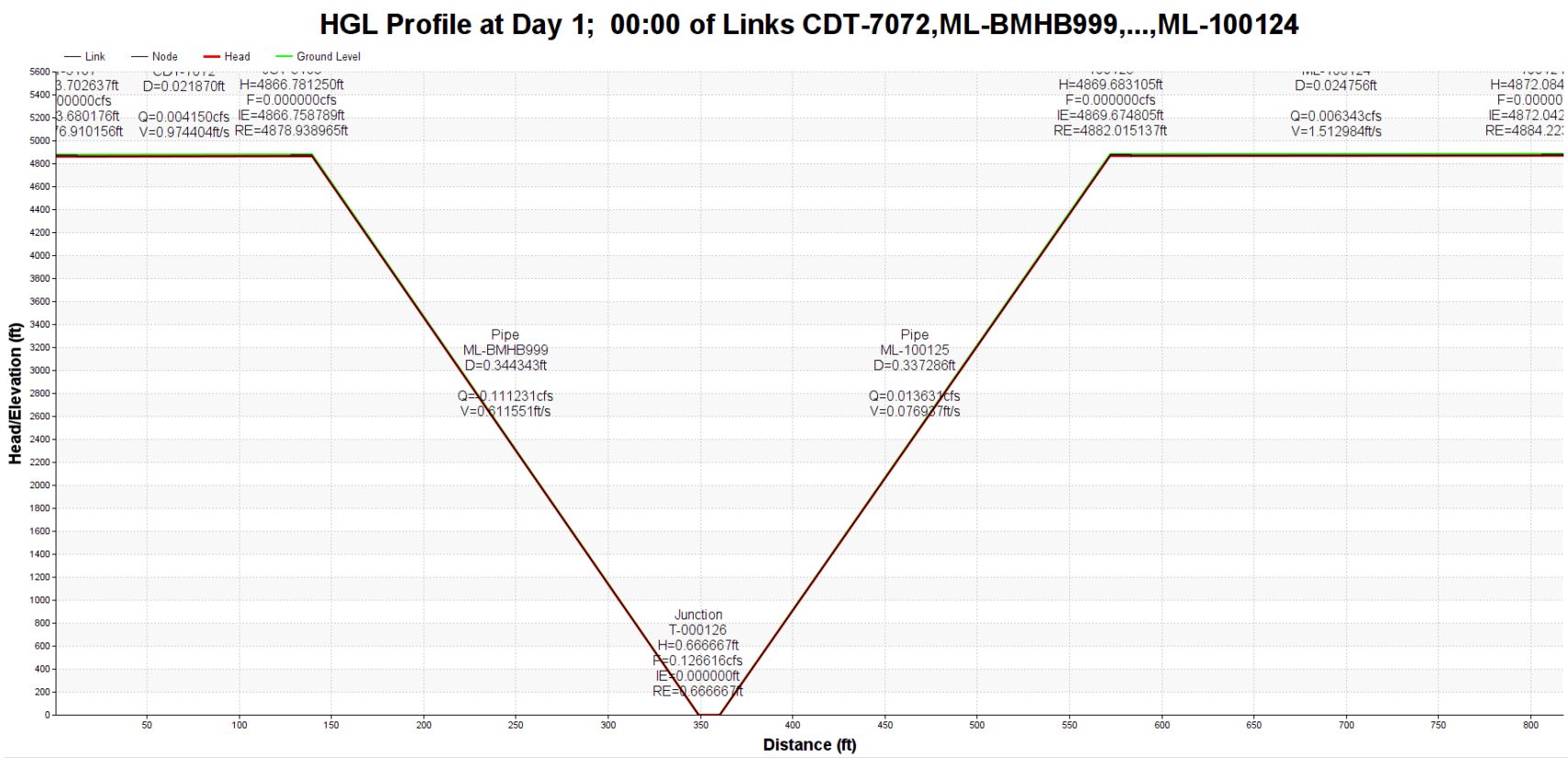
16 Manhole JCT-8035 invert elevation changed from 4507.48 to 4501.89



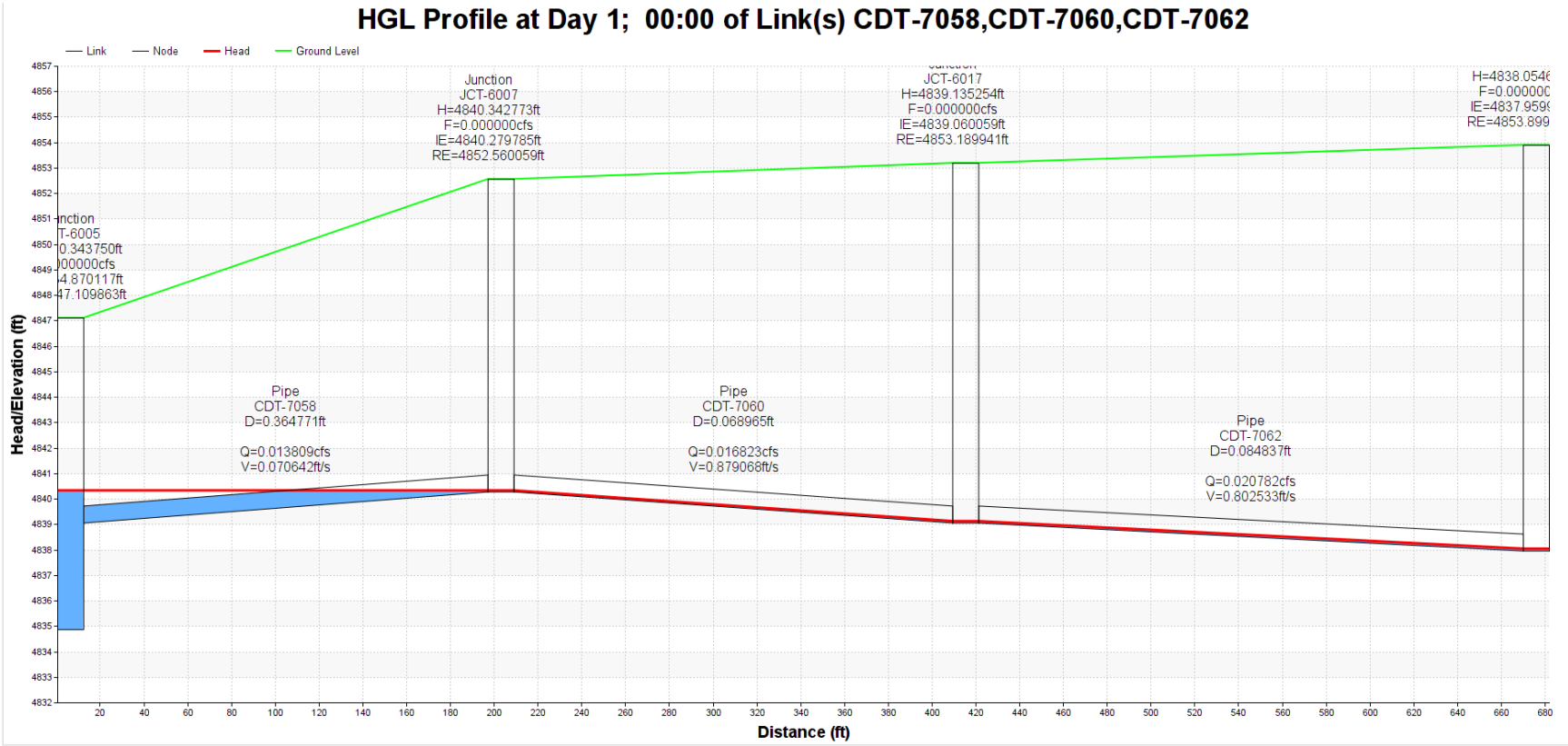
19 Manhole MH-ECR009 invert elevation changed from 0 to 5015 and max depth changed from 0 to 13



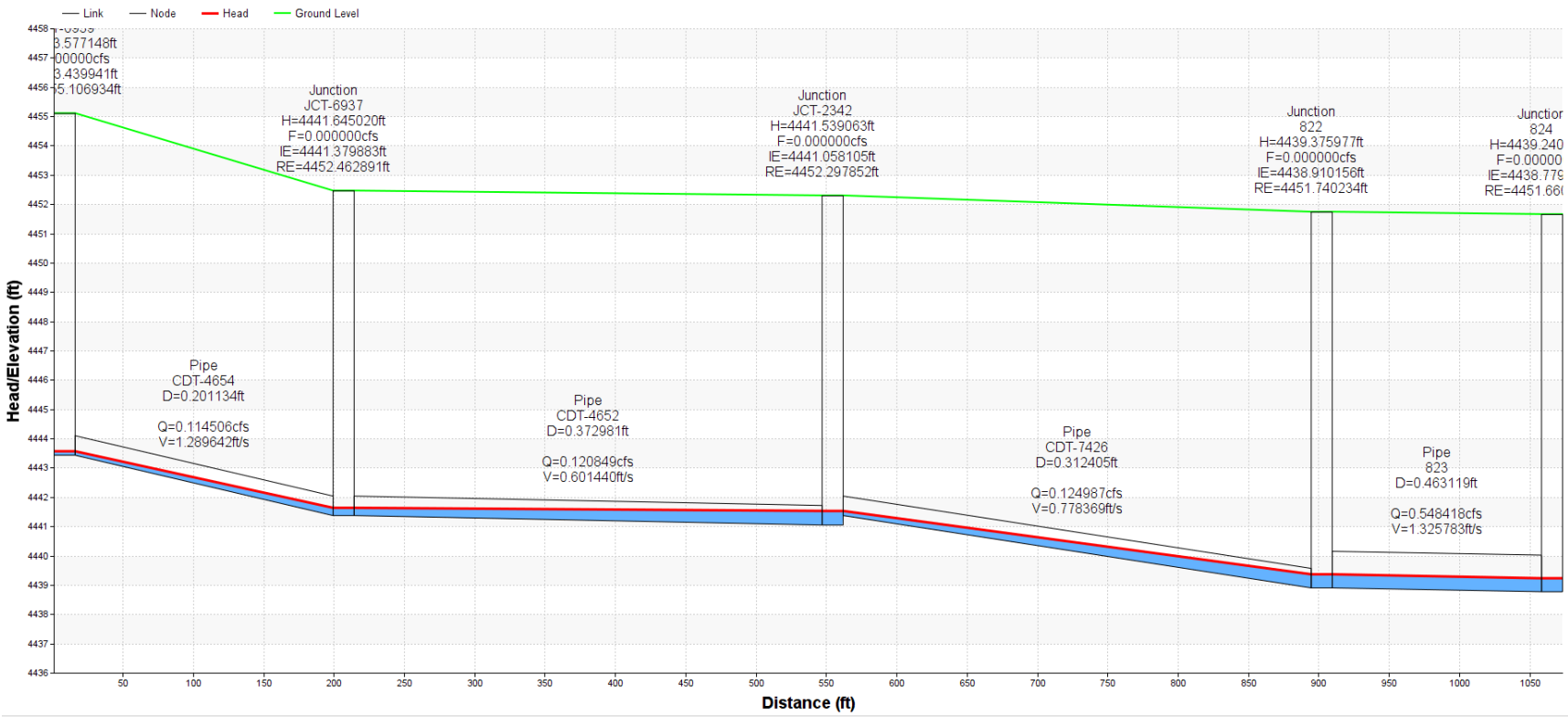
20 Manhole MH-BP094 invert elevation changed from 0 to 5062.35 and max depth changed from 0 to 13



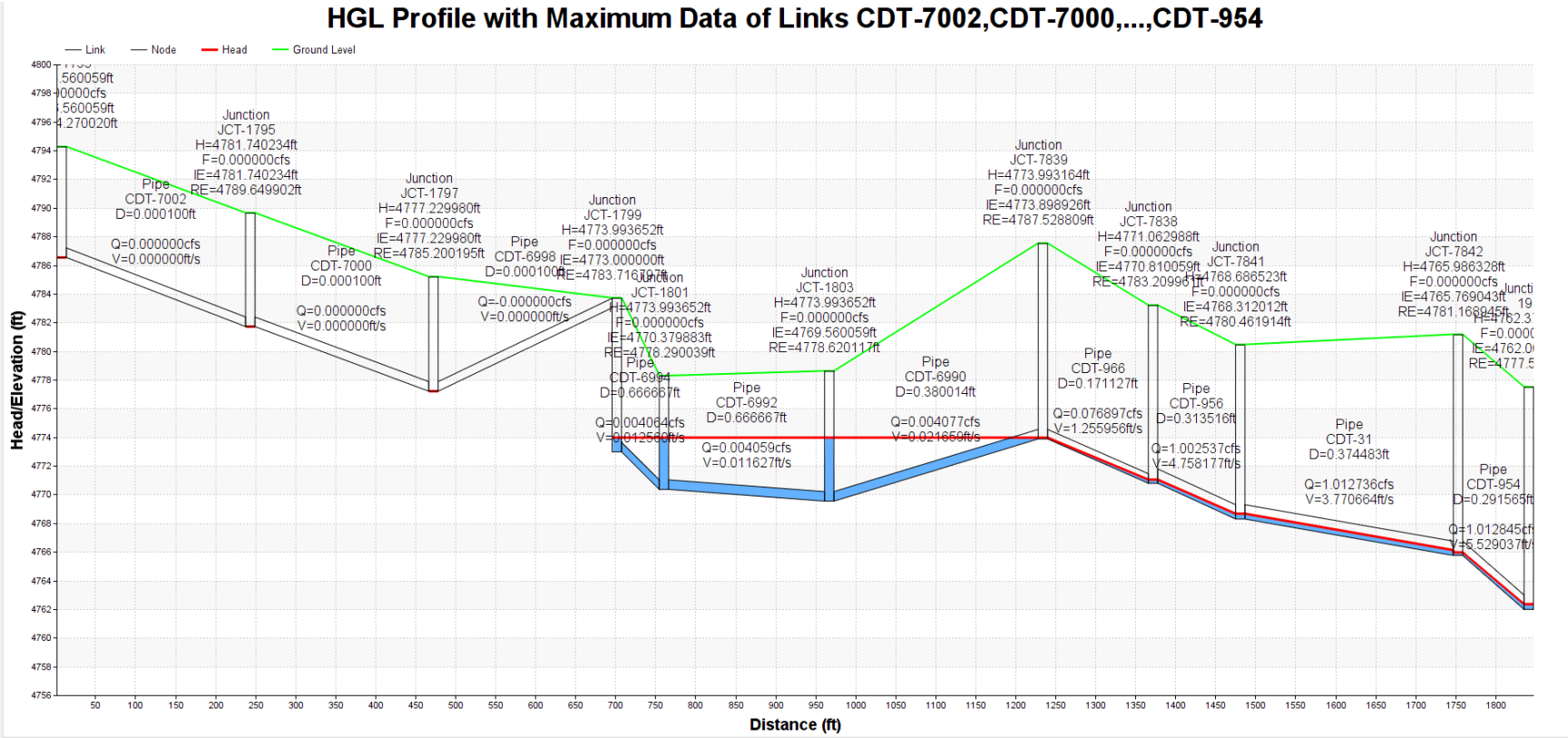
23 Manhole T-000126 invert elevation changed from 0 to 4868.21 and max depth changed from 0 to 12

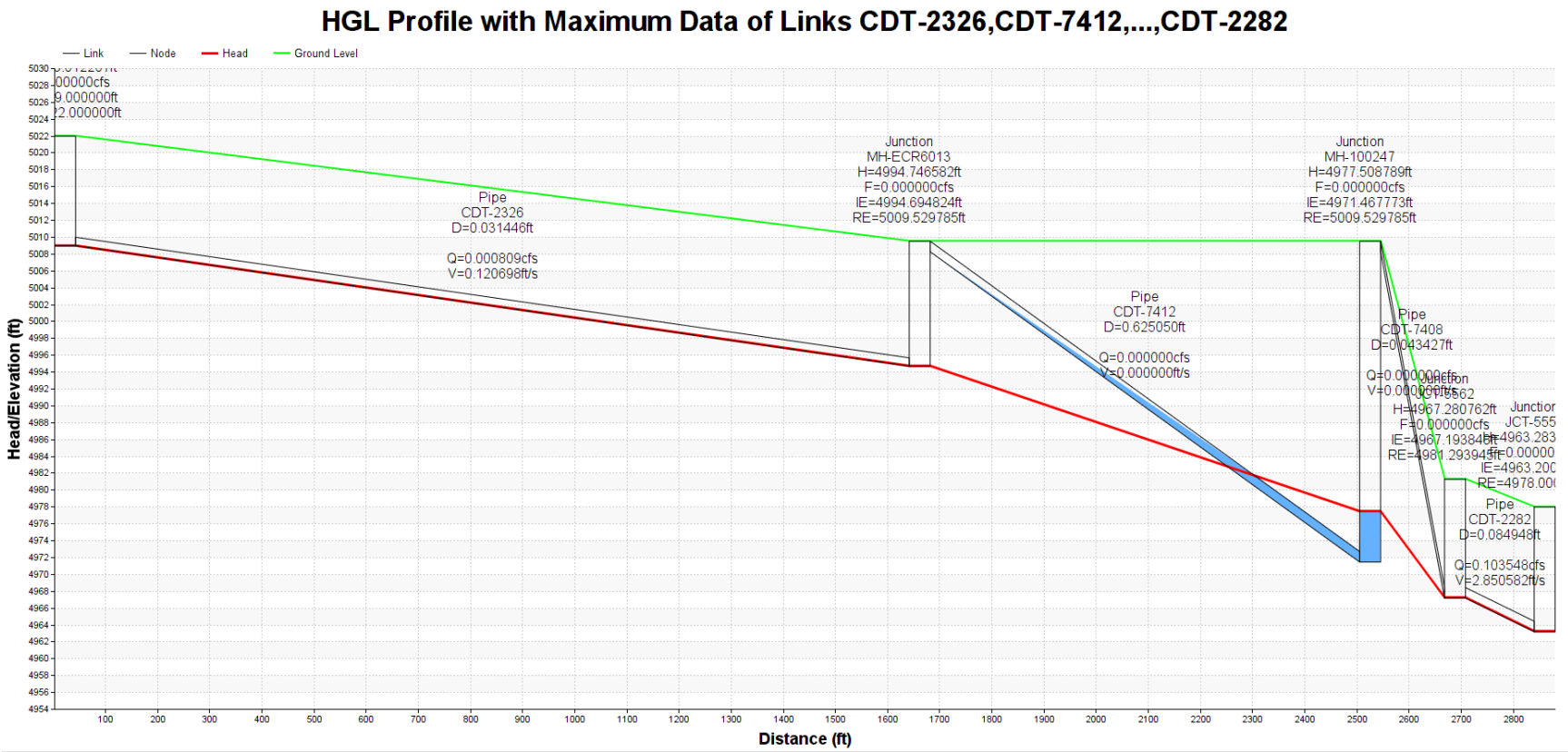


24 Manhole JCT-6005 invert elevation changed from 4834.87 to 4841.4

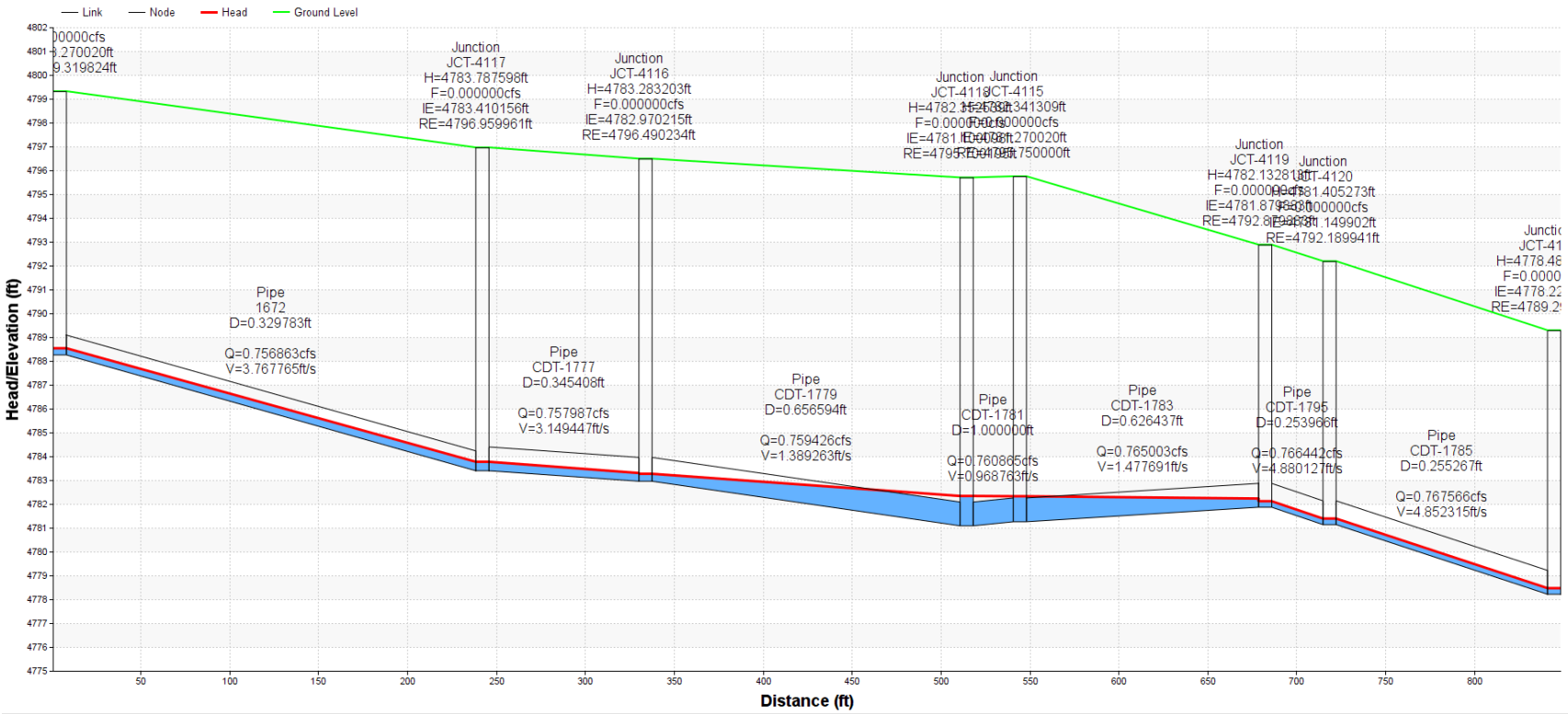


28 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE


HGL Profile with Maximum Data of Links CDT-7002,CDT-7000,...,CDT-954
Link
Node
Head
Ground Level
Head/Elevation (ft)
Distance (ft)
Junction
JCT-1795
H=4781.740234ft
F=0.000000cfs
IE=4781.740234ft
RE=4789.649902ft
Pipe
CDT-7002
D=0.000100ft
Q=0.000000cfs
V=0.000000ft/s
Junction
JCT-1797
H=4777.229980ft
F=0.000000cfs
IE=4777.229980ft
RE=4785.200195ft
Pipe
CDT-7000
D=0.000100ft
Q=0.000000cfs
V=0.000000ft/s
Pipe
CDT-6998
D=0.000100ft
Q=-0.000000cfs
V=0.000000ft/s
Junction
JCT-1799
H=4773.993652ft
F=0.000000cfs
IE=4773.000000ft
Junction
JCT-1801
H=4773.993652ft
F=0.000000cfs
IE=4770.379883ft
RE=4778.290039ft
Pipe
CDT-6994
D=0.666667ft
Q=0.004064cfs
Pipe
CDT-6992
D=0.666667ft
Q=0.004059cfs
V=0.011627ft/s
Junction
JCT-1803
H=4773.993652ft
F=0.000000cfs
IE=4769.560059ft
RE=4778.620117ft
Pipe
CDT-6990
D=0.380014ft
Q=0.004077cfs
V=0.021659ft/s
Junction
JCT-7839
H=4773.993164ft
F=0.000000cfs
IE=4773.898926ft
RE=4787.528809ft
Pipe
CDT-966
D=0.171127ft
Q=0.076897cfs
V=1.255956ft/s
Junction
JCT-7838
H=4771.062988ft
F=0.000000cfs
IE=4770.810059ft
Junction
JCT-7841
IE=4768.312012ft
RE=4780.461914ft
Pipe
CDT-956
D=0.313516ft
Q=1.002537cfs
V=4.758177ft/s
Pipe
CDT-31
D=0.374483ft
Q=1.012736cfs
V=3.770664ft/s
Junction
JCT-7842
H=4765.986328ft
F=0.000000cfs
IE=4765.769043ft
Pipe
CDT-954
D=0.291565ft



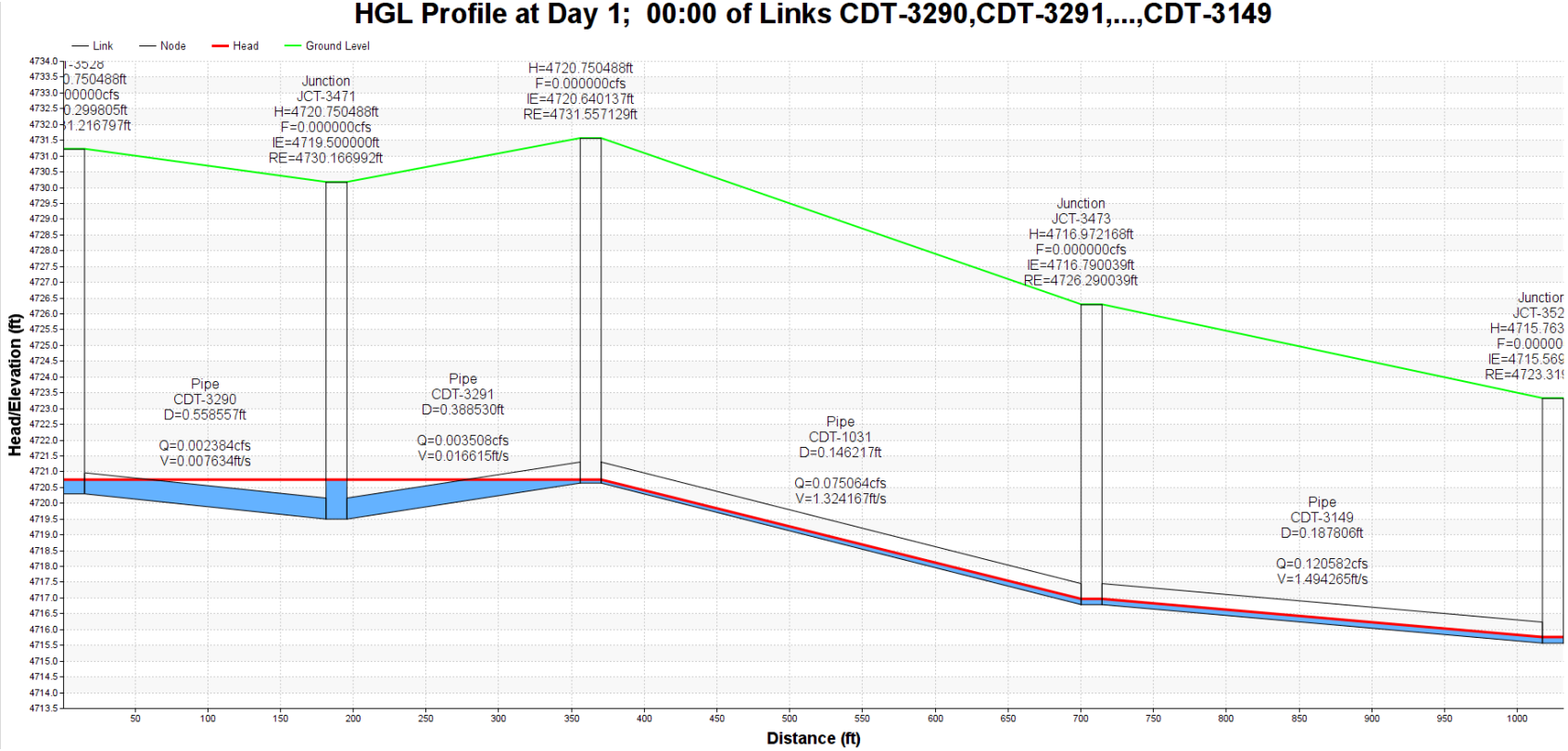
31 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE



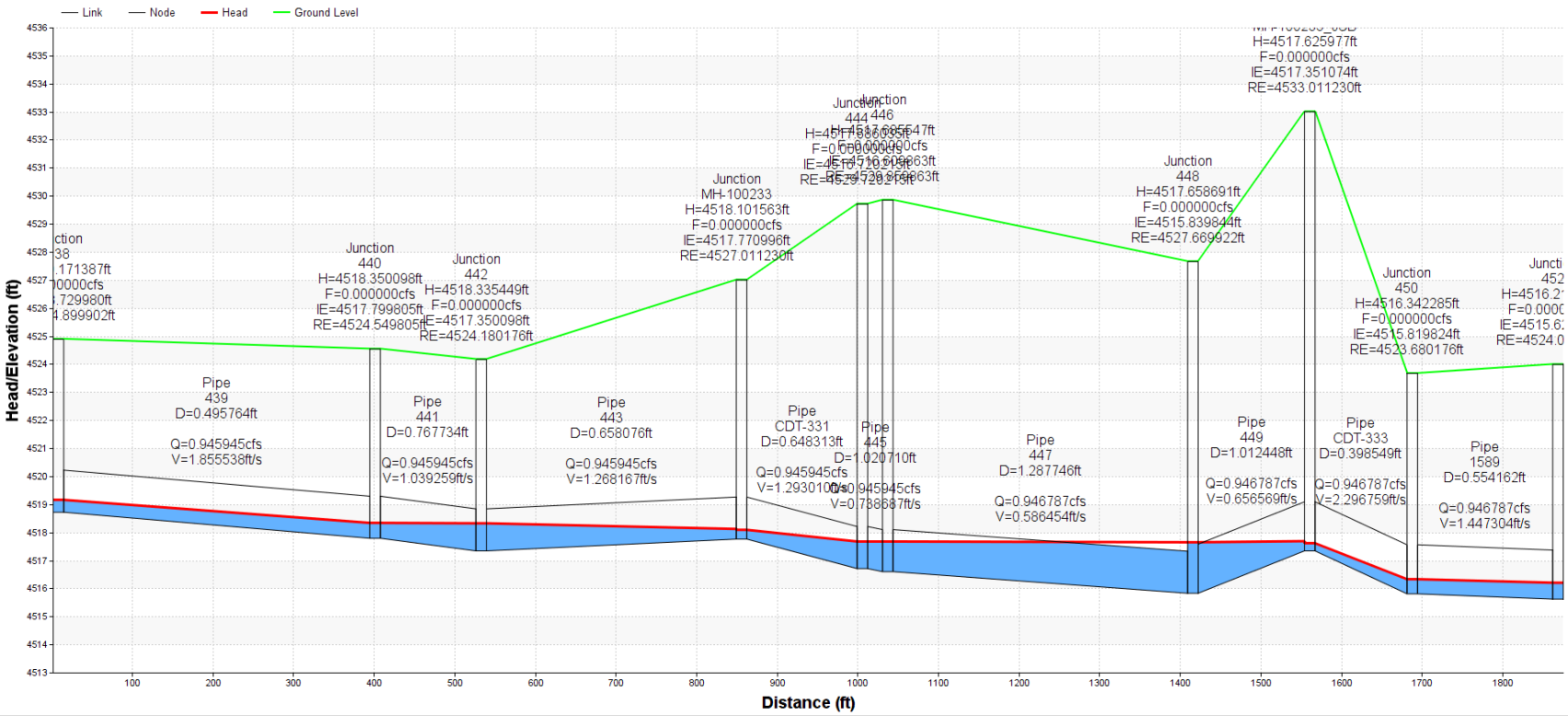
32 Manhole JCT-4115 invert elevation changed from 4781.27 to 4780.88

JCT-4119 invert elevation changed from 4781.88 to 4779.63

JCT-4120 invert elevation changed from 4781.15 to 4779.36

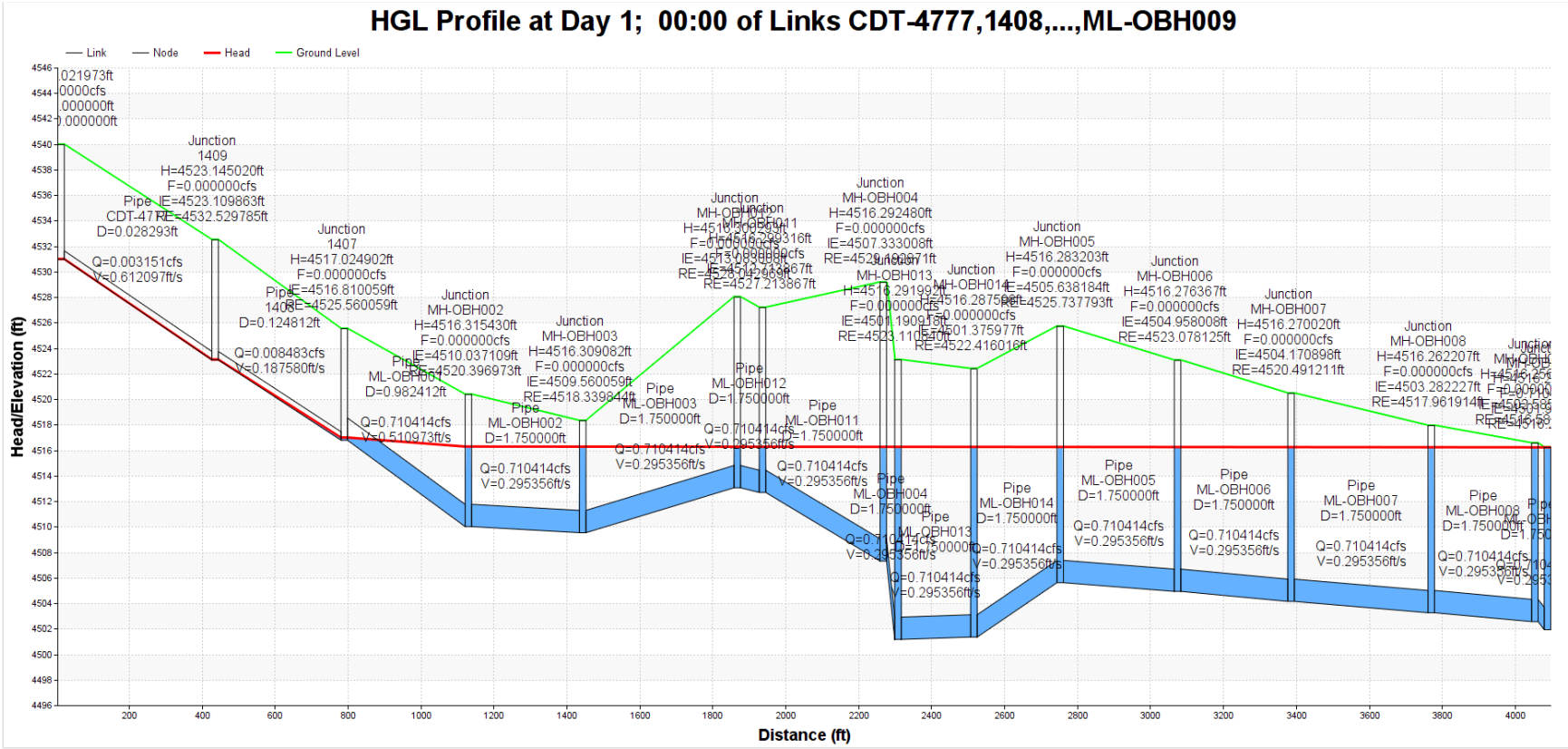


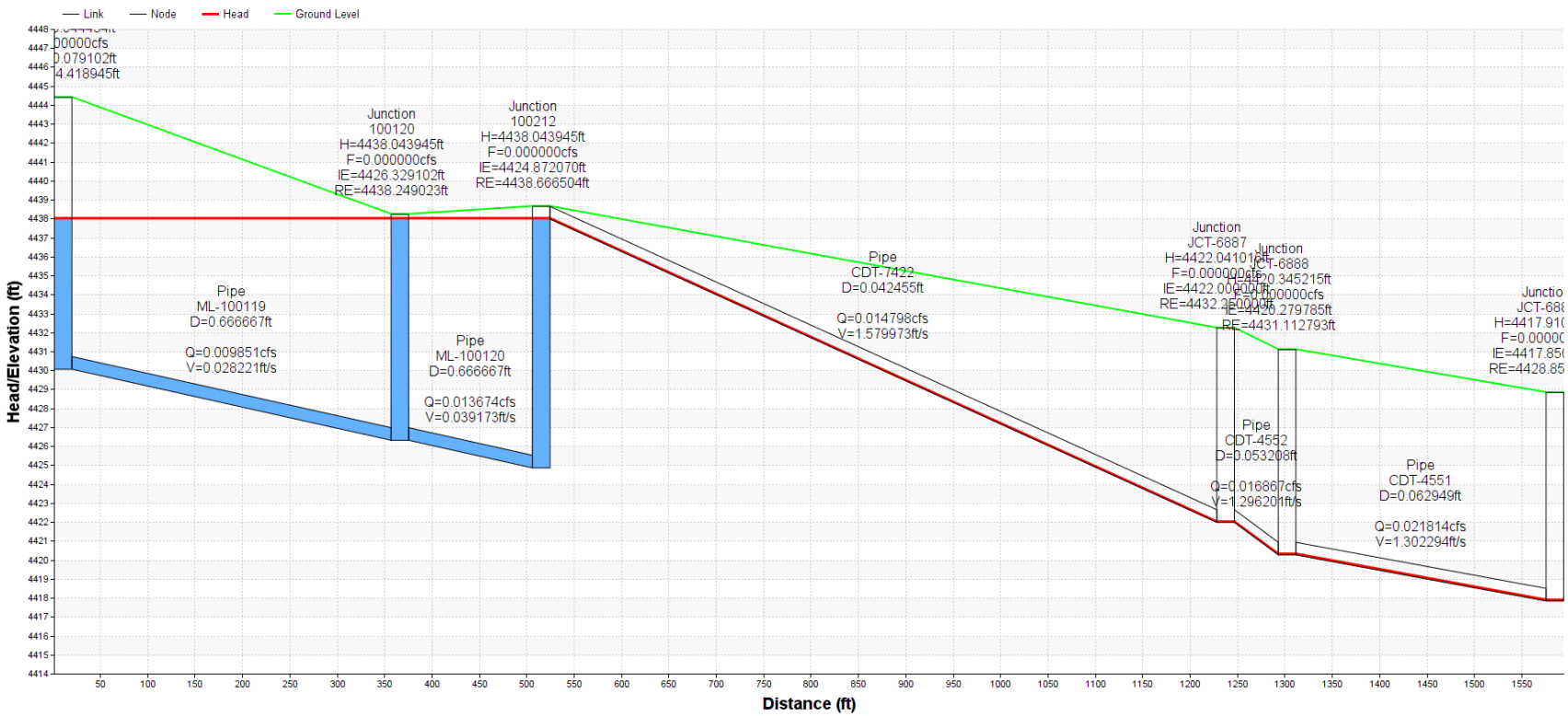
33 Manhole JCT-3472 invert elevation changed from 4720.64 to 4718.61



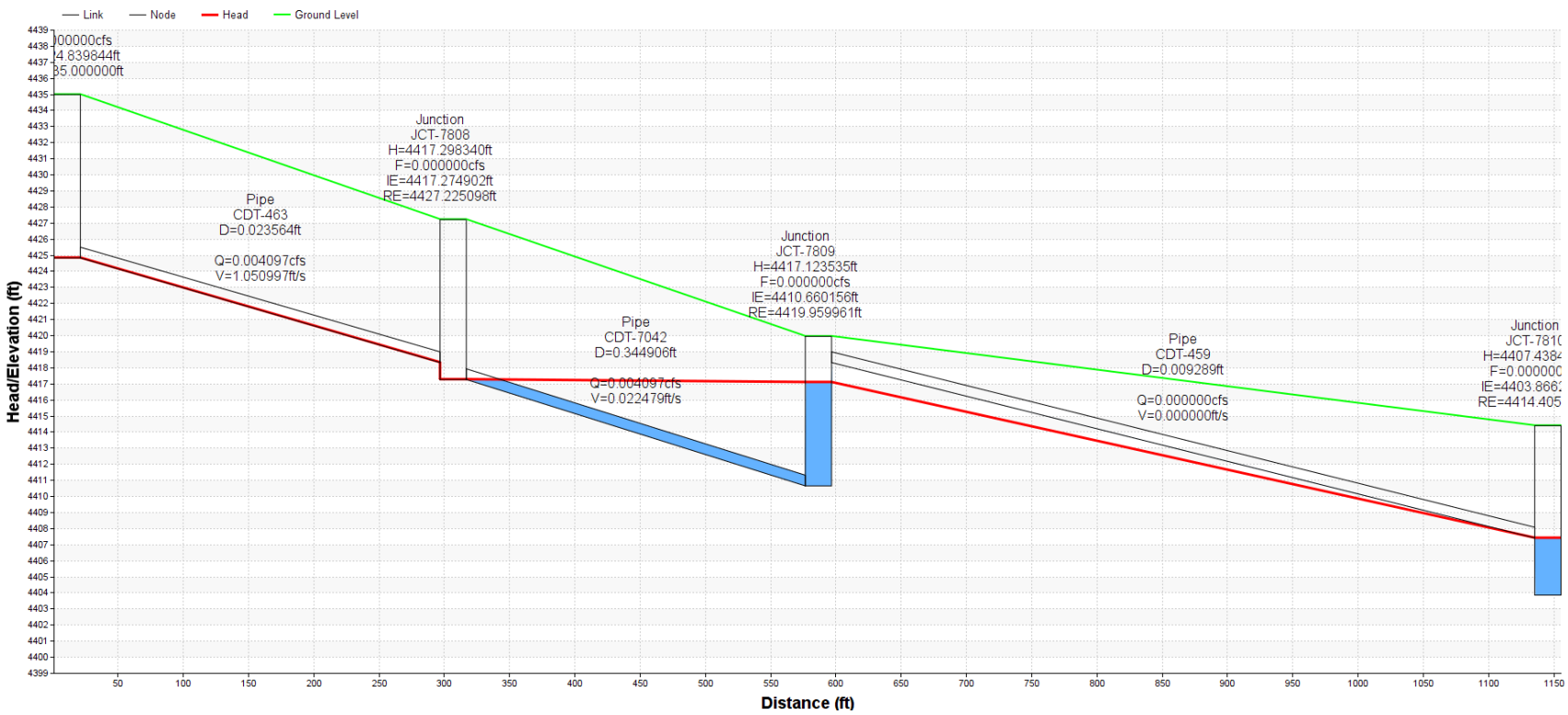
35 Manhole MH-100233 invert elevation changed from 4517.77 to 4517.01

MH-100233_JUB invert elevation changed from 4517.351 to 4515.83

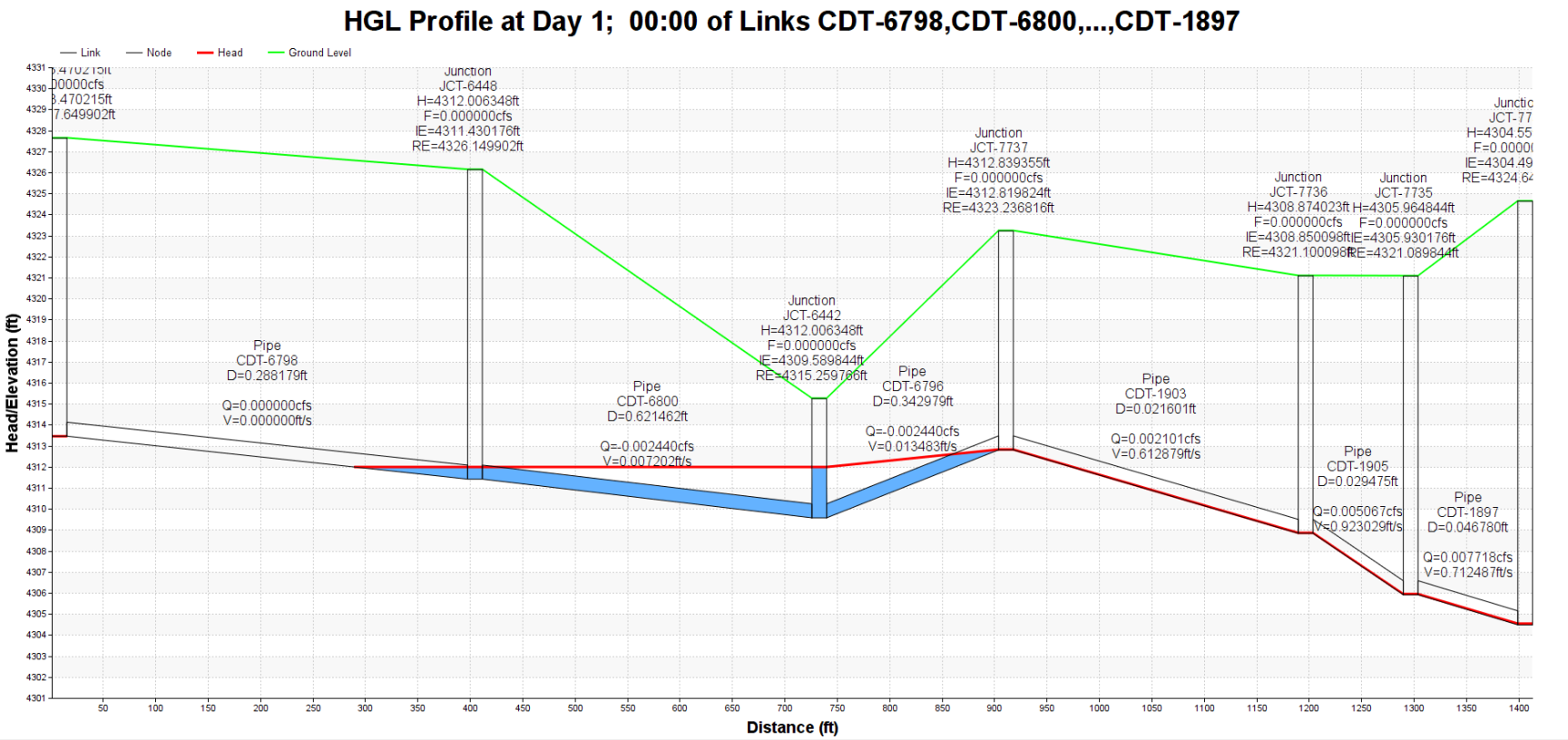

HGL Profile at Day 1; 00:00 of Links CDT-4777,1408,...,ML-OBH009
Link
Node
Head
Ground Level
Head/Elevation (ft)
Distance (ft)
Junction 1409
H=4523.145020ft
F=0.000000cfs
Pipe CDT-47
IE=4523.109863ft
RE=4532.529785ft
D=0.028293ft
Q=0.003151cfs
V=0.612097ft/s
Junction 1407
H=4517.024902ft
F=0.000000cfs
Pipe 1408
IE=4516.810059ft
RE=4525.560059ft
D=0.124812ft
Q=0.008483cfs
V=0.187580ft/s
Junction MH-OBH002
H=4516.315430ft
F=0.000000cfs
IE=4510.037109ft
Pipe ML-OBH001
RE=4520.396973ft
D=0.982412ft
Q=0.710414cfs
V=0.510973ft/s
Junction MH-OBH003
H=4516.309082ft
F=0.000000cfs
IE=4509.560059ft
RE=4518.339844ft
Pipe ML-OBH002
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH003
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Junction MH-OBH004
H=4516.292480ft
F=0.000000cfs
IE=4507.333008ft
RE=4529.192871ft
Junction MH-OBH013
H=4516.291992ft
F=0.000000cfs
IE=4501.190918ft
RE=4523.110840ft
Junction MH-OBH014
H=4516.287598ft
F=0.000000cfs
IE=4501.375977ft
RE=4522.416016ft
Pipe ML-OBH012
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH011
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH004
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH013
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH014
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Junction MH-OBH005
H=4516.283203ft
F=0.000000cfs
IE=4505.638184ft
RE=4525.737793ft
Junction MH-OBH006
H=4516.276367ft
F=0.000000cfs
IE=4504.958008ft
RE=4523.078125ft
Junction MH-OBH007
H=4516.270020ft
F=0.000000cfs
IE=4504.170898ft
RE=4520.491211ft
Junction MH-OBH008
H=4516.262207ft
F=0.000000cfs
IE=4503.282227ft
RE=4517.961914ft
Pipe ML-OBH005
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH006
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH007
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s
Pipe ML-OBH008
D=1.750000ft
Q=0.710414cfs
V=0.295356ft/s



37 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE

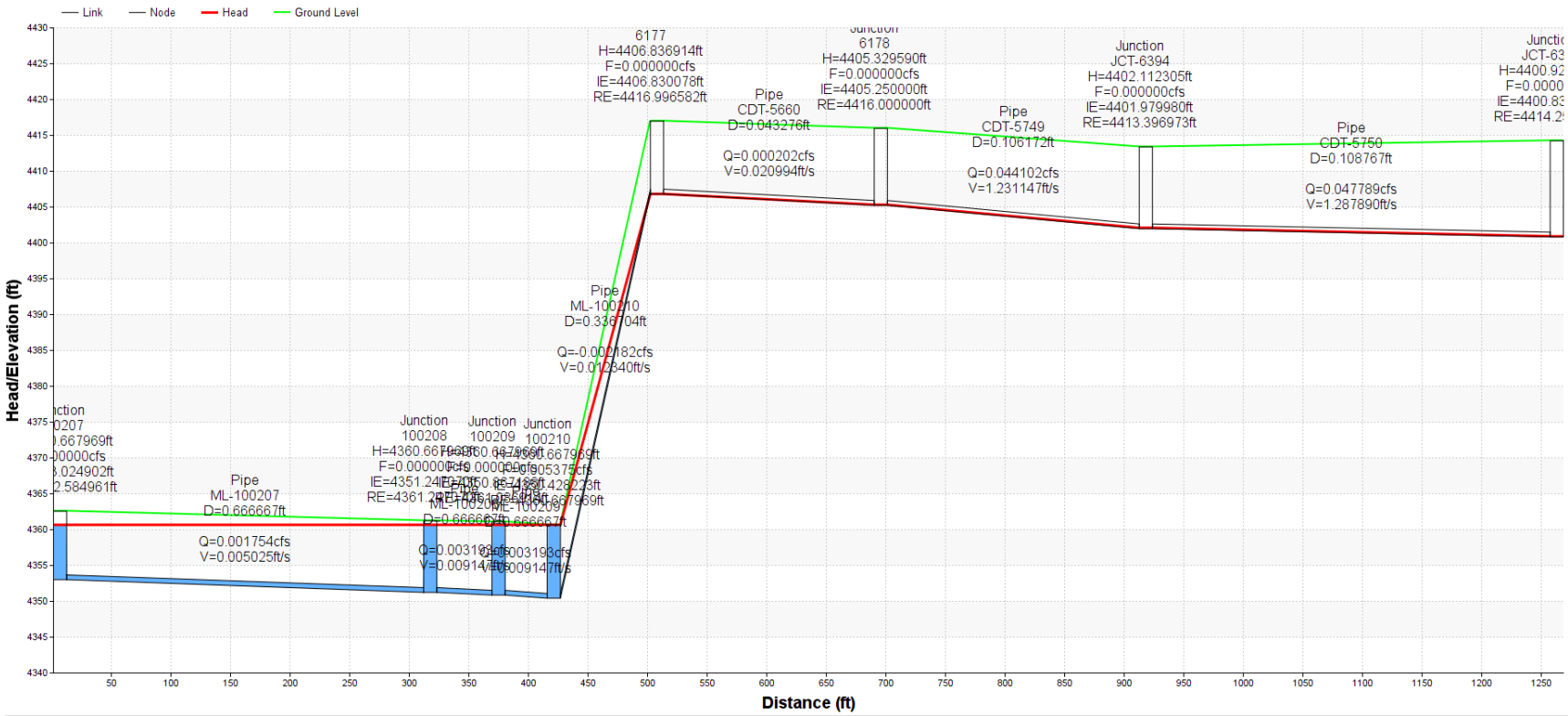


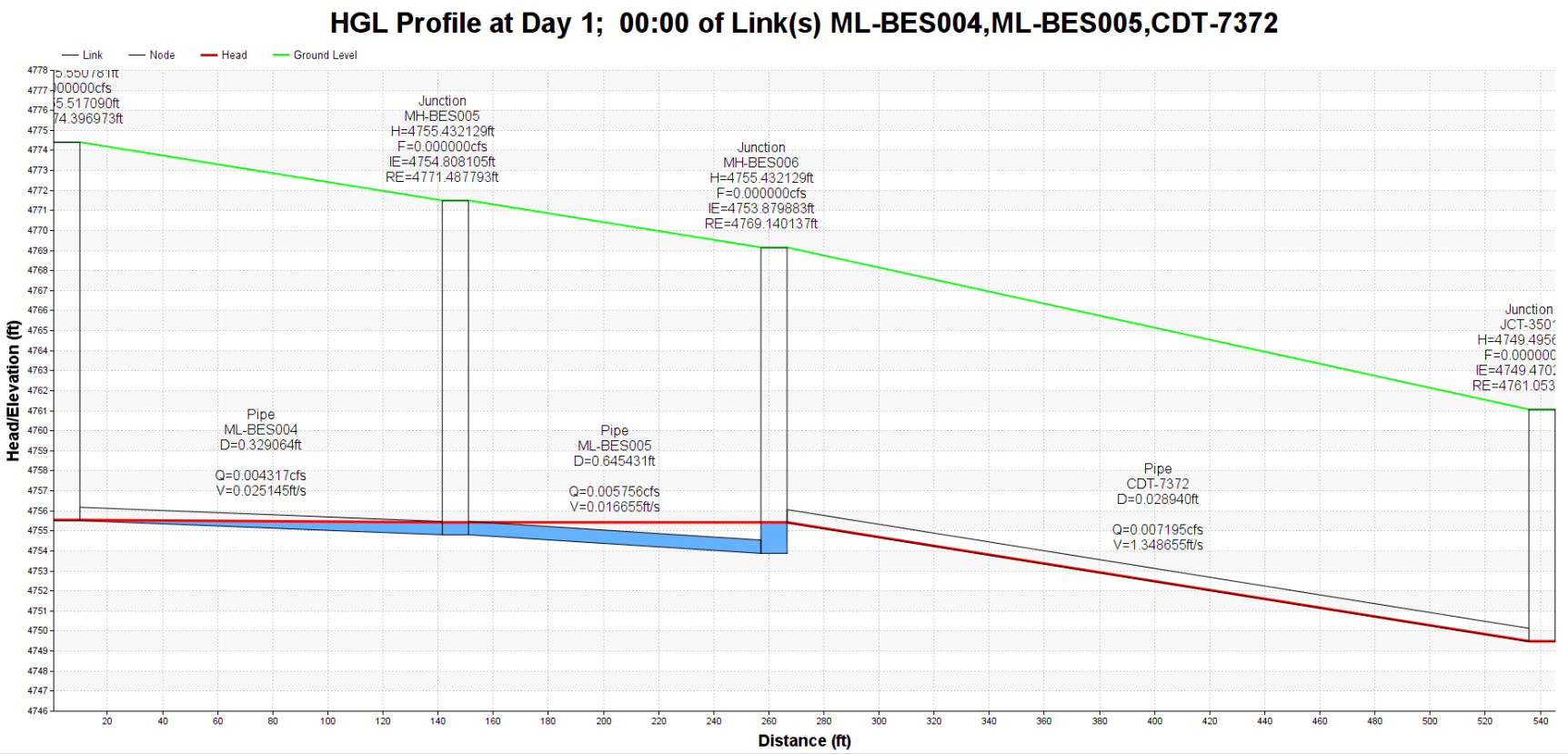
38 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE



39 Manhole JCT-7737 invert elevation changed from 4312. 82 to 4308.44

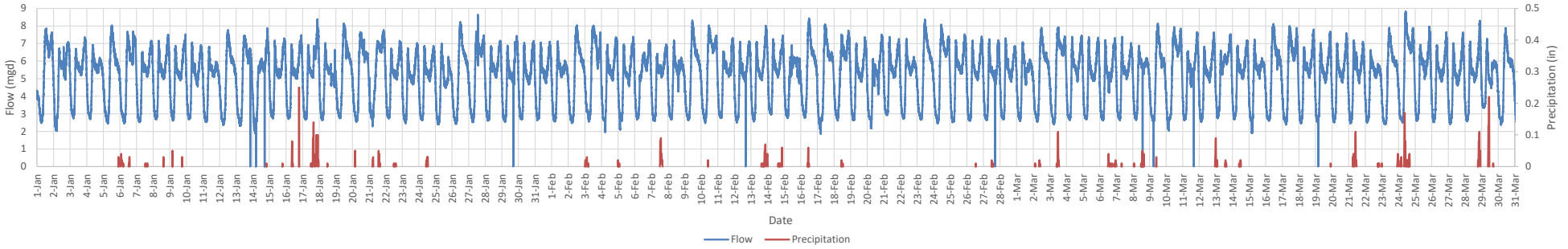
JCT-7736 invert elevation changed from 4308.85 to 4306.53


HGL Profile at Day 1; 00:00 of Links ML-100207,ML-100208,...,CDT-5750
Link
Node
Head
Ground Level
Head/Elevation (ft)
Distance (ft)
6177
H=4406.836914ft
F=0.000000cfs
IE=4406.830078ft
RE=4416.996582ft
Pipe
CDT-5660
D=0.043276ft
Q=0.000202cfs
V=0.020994ft/s
6178
H=4405.329590ft
F=0.000000cfs
IE=4405.250000ft
RE=4416.000000ft
Pipe
CDT-5749
D=0.106172ft
Q=0.044102cfs
V=1.231147ft/s
Junction
JCT-6394
H=4402.112305ft
F=0.000000cfs
IE=4401.979980ft
RE=4413.396973ft
Pipe
CDT-5750
D=0.108767ft
Q=0.047789cfs
V=1.287890ft/s
Pipe
ML-100210
D=0.336704ft
Junction
100208
Junction
100209
Junction
100210
Pipe
ML-100207
D=0.666667ft
Q=0.001754cfs
V=0.005025ft/s

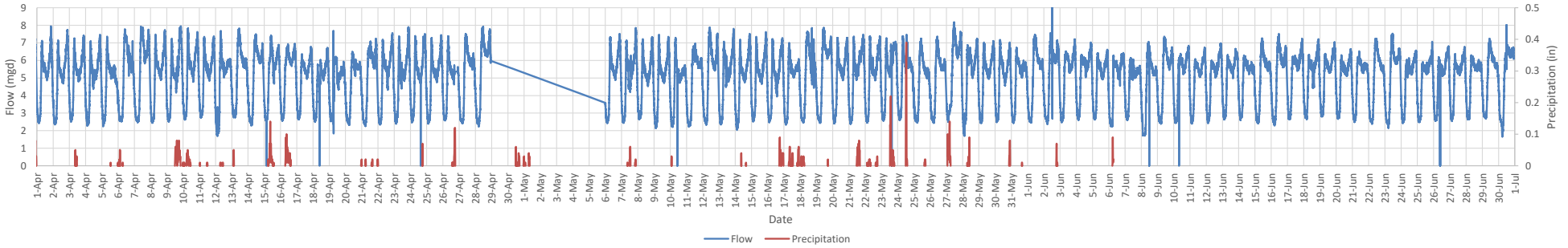


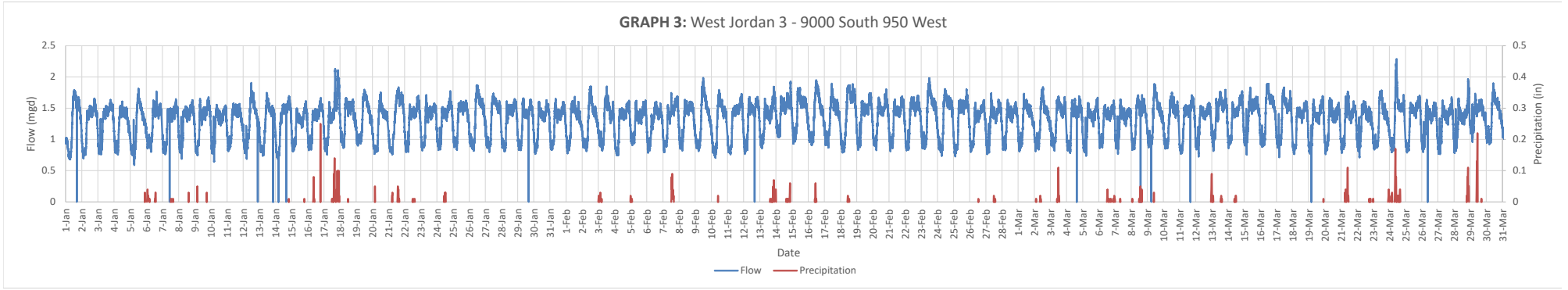
42 CORRECTED INVERTS OF PIPES TO MATCH MANHOLE

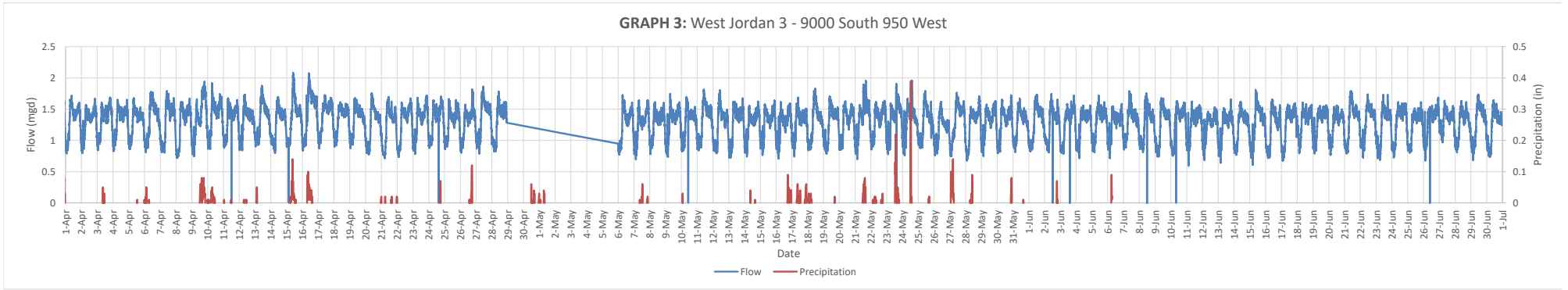
GRAPH 4: West Jordan 4 - 7880 South 1001 West

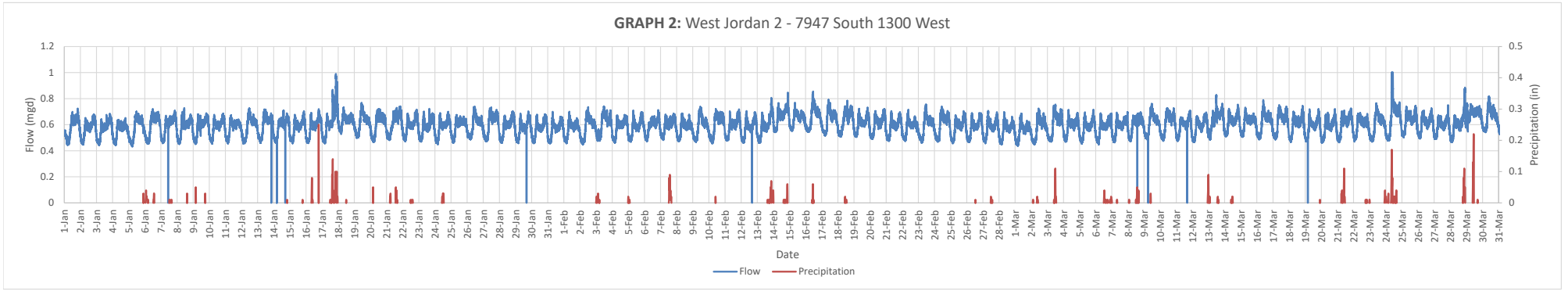


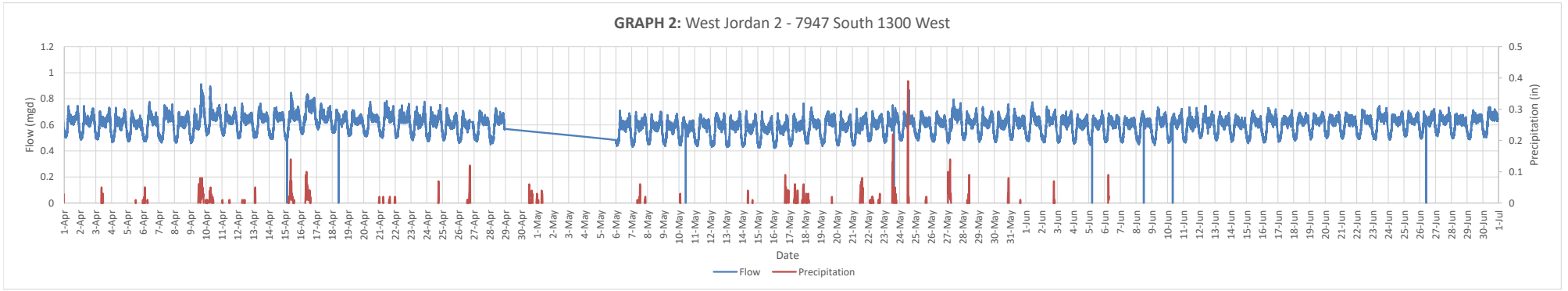
GRAPH 4: West Jordan 4 - 7880 South 1001 West

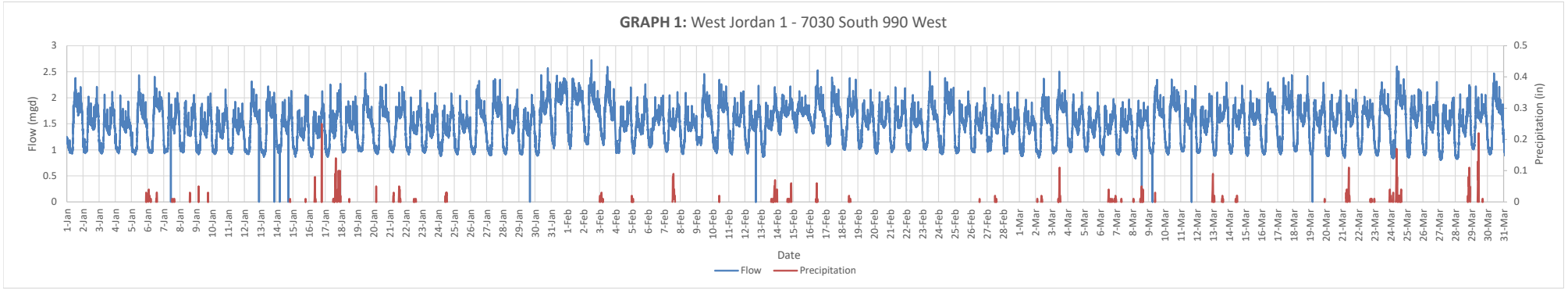


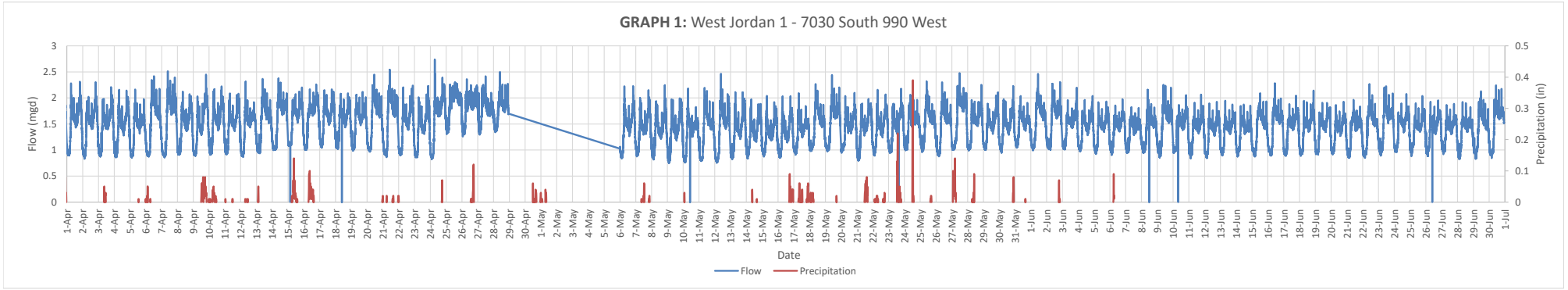

GRAPH 3: West Jordan 3 - 9000 South 950 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation

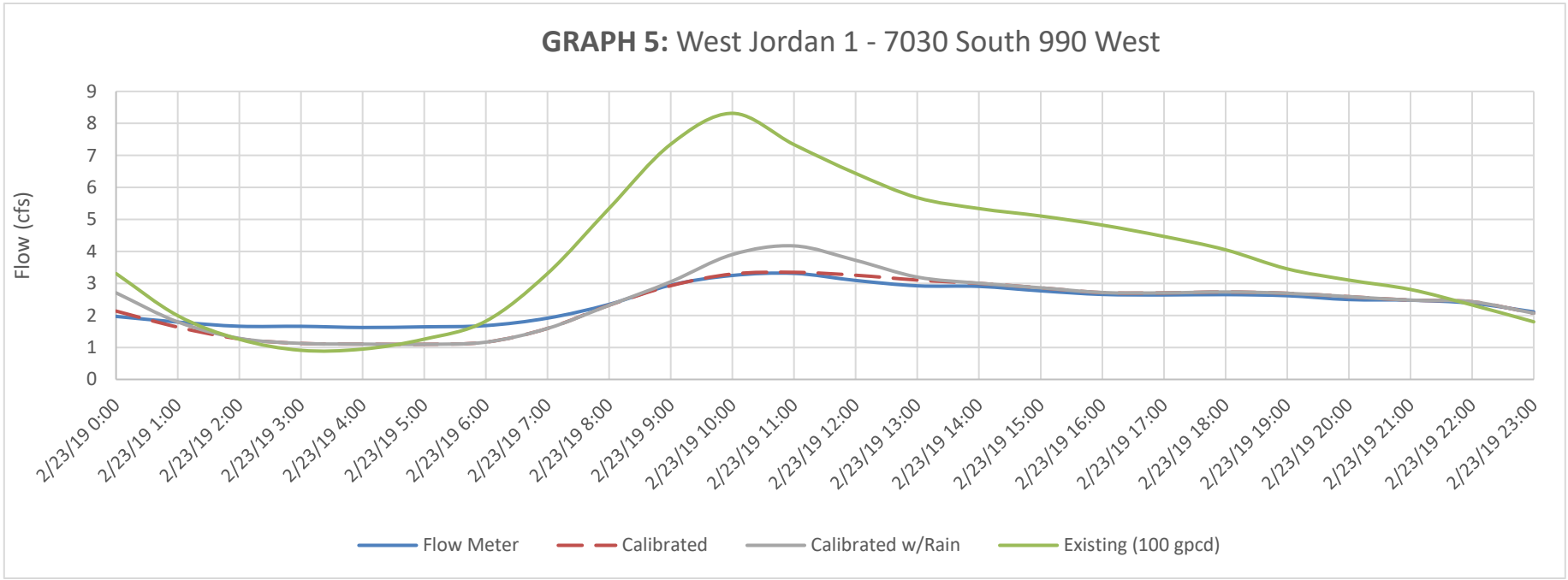

GRAPH 3: West Jordan 3 - 9000 South 950 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation

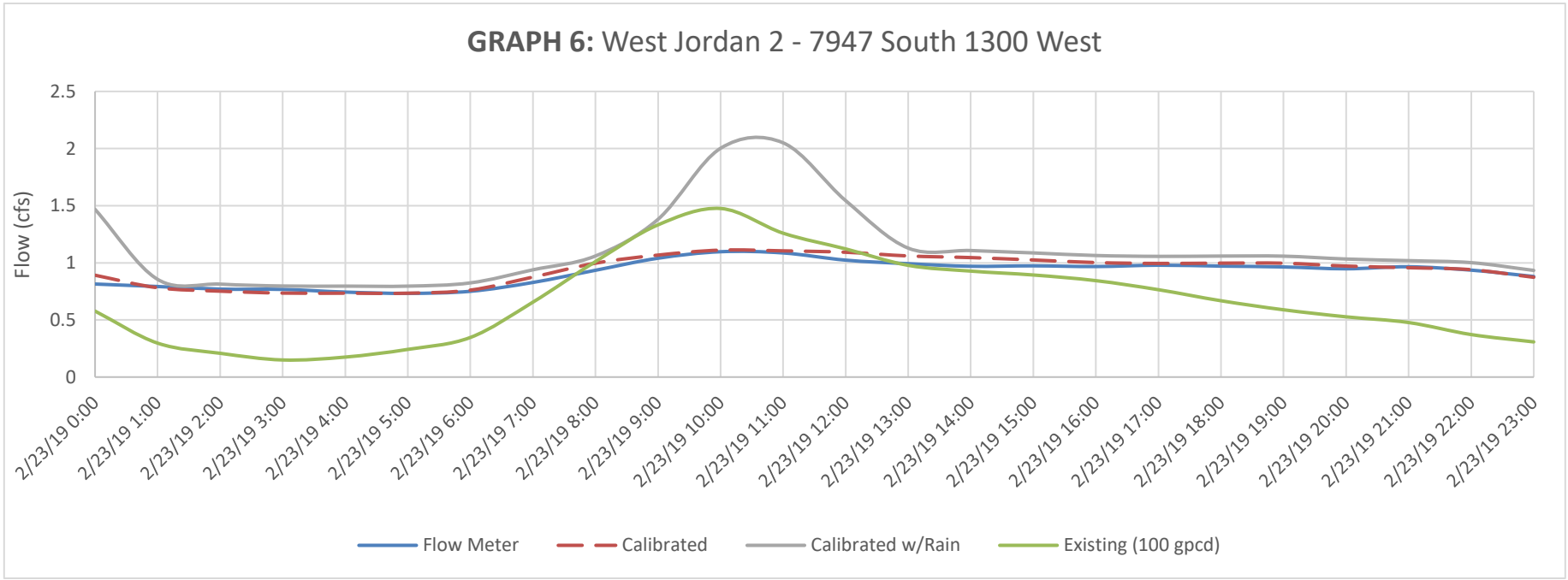

GRAPH 2: West Jordan 2 - 7947 South 1300 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation

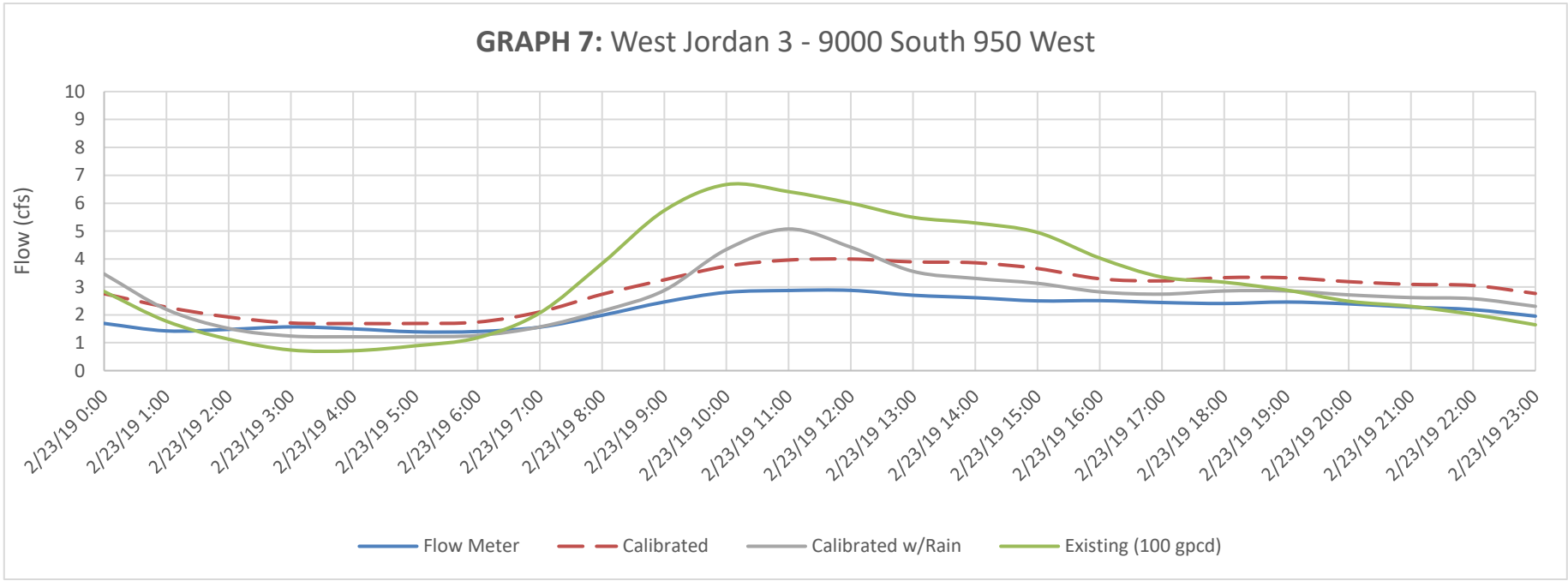

GRAPH 2: West Jordan 2 - 7947 South 1300 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation


GRAPH 1: West Jordan 1 - 7030 South 990 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation

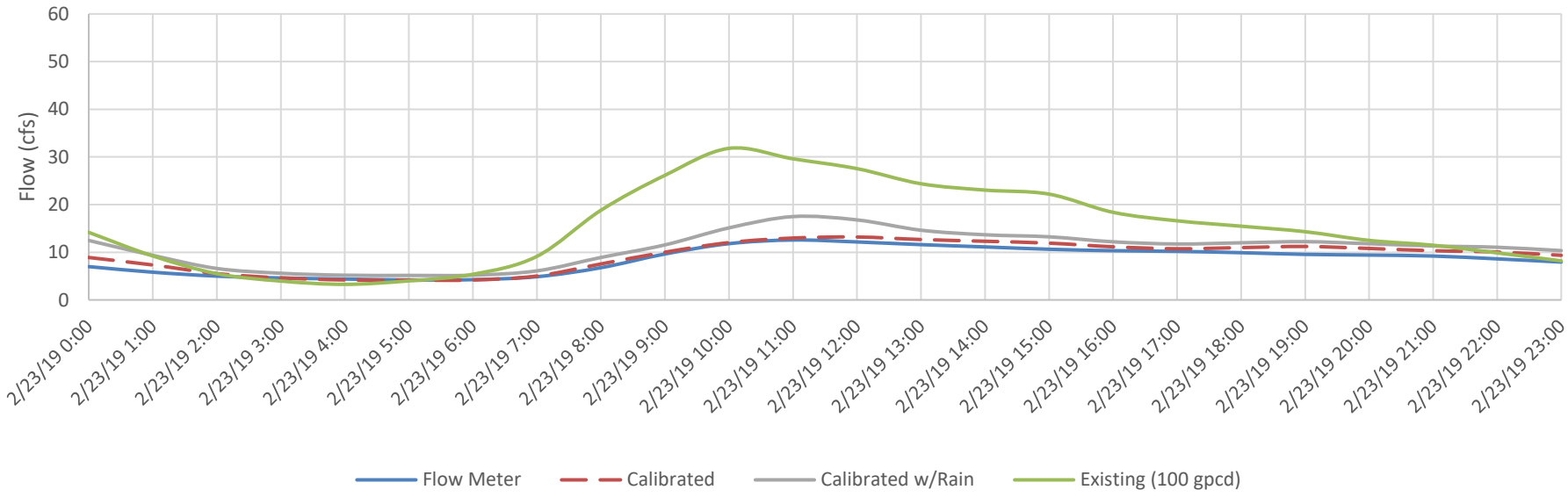

GRAPH 1: West Jordan 1 - 7030 South 990 West
Flow (mgd)
Precipitation (in)
Date
Flow
Precipitation


GRAPH 5: West Jordan 1 - 7030 South 990 West
Flow (cfs)
9
8
7
6
5
4
3
2
1
0
2/23/19 0:00
2/23/19 1:00
2/23/19 2:00
2/23/19 3:00
2/23/19 4:00
2/23/19 5:00
2/23/19 6:00
2/23/19 7:00
2/23/19 8:00
2/23/19 9:00
2/23/19 10:00
2/23/19 11:00
2/23/19 12:00
2/23/19 13:00
2/23/19 14:00
2/23/19 15:00
2/23/19 16:00
2/23/19 17:00
2/23/19 18:00
2/23/19 19:00
2/23/19 20:00
2/23/19 21:00
2/23/19 22:00
2/23/19 23:00
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)


GRAPH 6: West Jordan 2 - 7947 South 1300 West
Flow (cfs)
2.5
2
1.5
1
0.5
0
2/23/19 0:00
2/23/19 1:00
2/23/19 2:00
2/23/19 3:00
2/23/19 4:00
2/23/19 5:00
2/23/19 6:00
2/23/19 7:00
2/23/19 8:00
2/23/19 9:00
2/23/19 10:00
2/23/19 11:00
2/23/19 12:00
2/23/19 13:00
2/23/19 14:00
2/23/19 15:00
2/23/19 16:00
2/23/19 17:00
2/23/19 18:00
2/23/19 19:00
2/23/19 20:00
2/23/19 21:00
2/23/19 22:00
2/23/19 23:00
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)


GRAPH 7: West Jordan 3 - 9000 South 950 West
Flow (cfs)
10
9
8
7
6
5
4
3
2
1
0
2/23/19 0:00
2/23/19 1:00
2/23/19 2:00
2/23/19 3:00
2/23/19 4:00
2/23/19 5:00
2/23/19 6:00
2/23/19 7:00
2/23/19 8:00
2/23/19 9:00
2/23/19 10:00
2/23/19 11:00
2/23/19 12:00
2/23/19 13:00
2/23/19 14:00
2/23/19 15:00
2/23/19 16:00
2/23/19 17:00
2/23/19 18:00
2/23/19 19:00
2/23/19 20:00
2/23/19 21:00
2/23/19 22:00
2/23/19 23:00
Flow Meter
Calibrated
Calibrated w/Rain
Existing (100 gpcd)

GRAPH 8: West Jordan 4 - 7880 South 1001 West



APPENDIX C

2012 Flow Monitoring Results (Chapter 4 from 2012 Master Plan)

4 FLOW MONITORING

4.1 INTRODUCTION

As part of the hydraulic modeling calibration effort, temporary flow meters were installed to measure dry weather and wet weather flows in the collection system. Monitored flow was recorded every fifteen minutes using the City of West Jordan's Flo-Dar meters. These records of actual collection system flows where then correlated with the flows in the hydraulic model. The City has permanent flow meters to record the discharges to South Valley Water Reclamation Facility (SVWRF) at 7000 South, 7800 South, 8050 South and 9000 South trunklines. These flow meters are located at the east end of the City trunklines and also accumulate flow data every 15 minutes. Additional flow monitors were placed in strategic locations throughout the City to obtain localized flow information. Flow monitoring results at the City's permanent meters and temporary meter locations are discussed below.

4.2 COLLECTION SYSTEM FLOW MONITORING

A total of six temporary flow meters were installed throughout the collection system during 2010 and 2011. These monitors are in addition to the four permanent monitors located at the east end of the City's trunklines. During flow monitoring, pipeline flow (cfs), depth, and velocity data were collected at each flow meter in 15-minute intervals using Flo-Dar® meters. The monitors were left in place for periods over one week in order to capture the differences in weekday and weekend flows. Flow monitoring data was compared to data from the hydraulic model for calibration.

The location of the flow meters divided the collection system into five representative uses or differentiations in trunklines. Appendix B contains graphs of the results of each monitoring station. Table 4.1 presents the location of the flow meters and targeted sewer areas. Flow monitoring occurred during dry weather and is used as the base flow. It should be noted that modeled flow for the 7800 South 4300 West 24-inch trunkline (Appendix B) compared closely to actual monitored flow, and the flow confirms residential daily sewer use of 66 gallons per person per day, as presented in section 2.3.1. This pipe flow does not contain any contributions from groundwater infiltration or rainfall inflow (see section 4.3 for further discussions of inflow and infiltration), which is important for a baseline residential flow for incorporation into the model, and to predict infiltration and inflow rates above the base flow.

4.2.1 Overall Flow Monitoring Results

The average daily flow for the Year 2010 began at 7.8 mgd, increased after the summer to 8.3 mgd, and increased in November to 8.5 mgd. For the Year 2011, the average daily flow ranged from 8.5 mgd on dry weather weeks to 8.7 mgd on wet weather weeks. Weekend flows were typically higher than weekday flows at 9.2 mgd, with peak flows at 12.5 mgd, Thanksgiving Day having the highest flows of the year with a peak instantaneous flow of 15.2 mgd.

Table 4.1. Existing and Buildout Flow Monitoring:
A Comparison of Measured Average and Peak Flows for Residential, Commercial, and Industrial Areas to Modeled Flow.

Meter Location	Primary Land Use and Trunkline Delineation	Average Flow Observed (mgd)	Max Flow & Peaking Factor	Dates	Average Sewer Model Flow (mgd)	Model Max Flow, & Peaking Factor	Model Average Flow Percent Accuracy	Future Average and Max Flow Model Estimates (mgd)
Bagley Park Road and Old Bingham Highway	Industrial Segment prior to Old Bingham Highway	0.12	0.31 PF 2.58	Jan. 26 – Feb 4 2011	0.11	Max 0.21 PF 1.9	92%	Avg. 0.81 Max 2.1
5250 West Old Bingham Highway 18”	Industrial Area with Meat Packing Plant	0.18	0.42 PF 2.33	Jan. 26 – Feb 4 2011	0.19	Max 0.35 PF 1.84	106%	Avg. 0.91 Max 2.5
9000 South 2450 West 15” trunkline	Residential & Fairchild Semiconductor	1.17	1.59 PF 1.36	Aug 11 2010	0.96	Max 1.55 PF 1.61	82%	Avg. 1.97 Max 3.04
7800 South 4300 West 24” trunkline	Residential & Airport Road Light Industrial	1.25	2.22 PF 1.78	Jan 13 – Jan 18 2012	1.3	Max 2.1 PF 1.62	104%	Avg. 5.1 Max 8.2
4100 W. New Bingham Highway 24” trunkline	West side Residential, Industrial, and Light Industrial areas	1.35	1.98 PF 1.47	Jan 13 – Jan 20 2012	1.19	Max 1.89 PF 1.58	88%	Avg. 4.5 Max 7.1
Old Bingham Hwy 7900 S	Mixed Use High Density, Residential, and Light Industrial	0.18	0.31 PF 1.72	8/21/2010	0.35	Max 0.55 PF 1.57	190%	Avg. 1.0 Max 1.62

4.3 INFLOW AND INFILTRATION

4.3.1 Infiltration

Infiltration occurs when existing sewer lines undergo material and joint degradation and deterioration as well as when sewer lines are poorly designed and constructed. (Figure 4.1). Infiltration is groundwater entering the pipes or manholes through cracks, breaks, lids, faulty seals, plant root instructions, improperly aligned or seated joints and manhole walls. Because infiltration is directly influenced by groundwater fluctuations, the volume of infiltration entering a sewer system is generally expected to fluctuate from season to season with typically larger volumes anticipated in the spring and smaller volumes anticipated in the winter. Irrigation canals also raise the height of the groundwater table in the surrounding areas, and contribute to increased infiltration in localized areas down gradient of the canals.

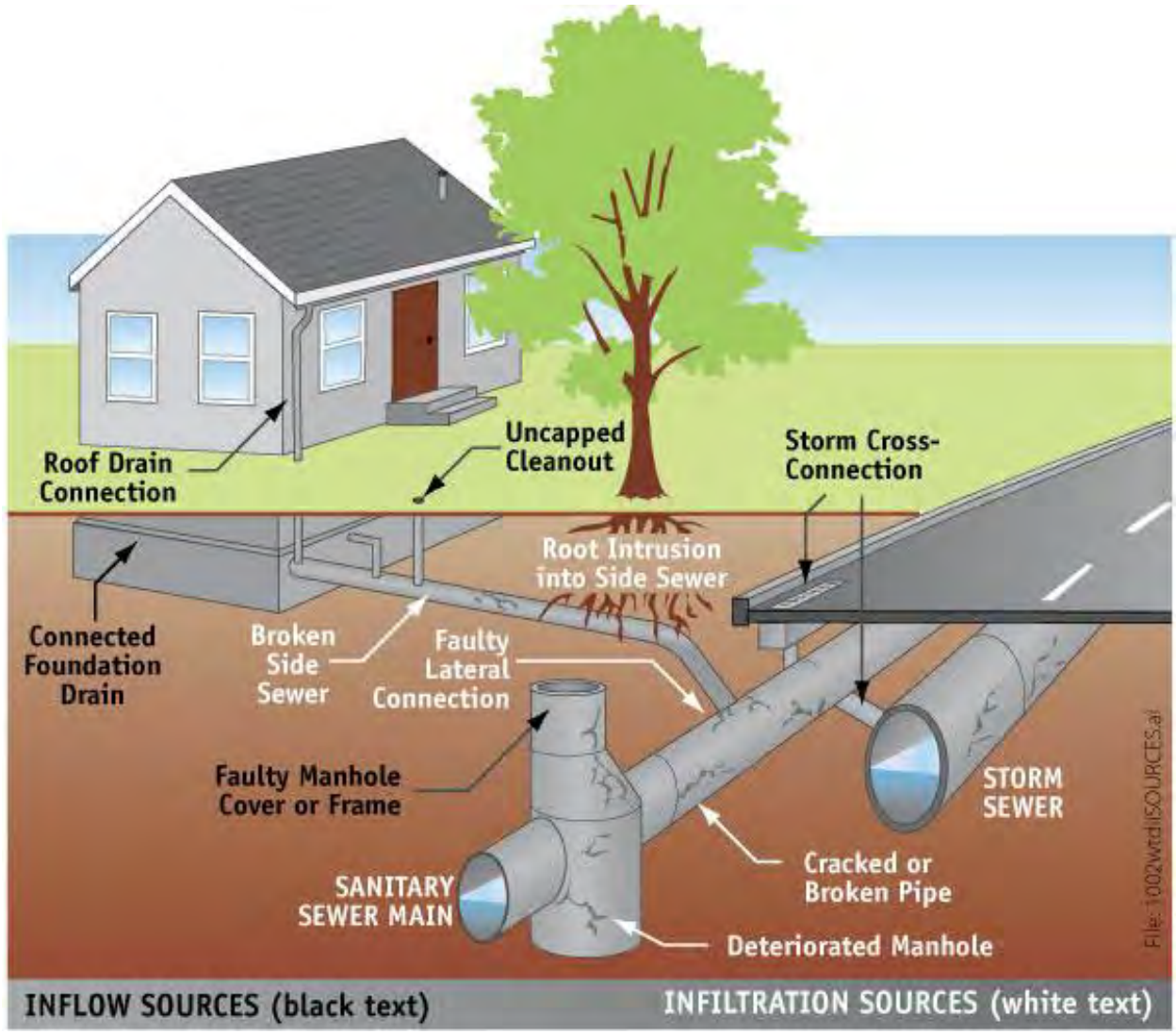


Image Courtesy of King County Website

Figure 4.1: Inflow and Infiltration Sources

4.3.2 Inflow

Inflow is extraneous water discharged into a sewer system from sources such as sump pumps, roof leaders, cellar/foundation drains, surface drains, drains from springs and swampy areas, manhole covers, catch basins, cross-connections from storm drains, cooling water discharges, leaking tide gates, and other inlets. Inflow differs from infiltration in that it is the result of direct connections of extraneous flow sources into the collection system and, generally, is not linked to fluctuations in the groundwater table.

4.3.3 Inflow and Infiltration Effects

Extraneous water from infiltration and inflow (I&I) sources reduces the capacity and capability of sewer systems and treatment facilities to transport and treat domestic and industrial wastewaters. The adverse effects of I&I in the collection system are that they increase both the flow volume and peak flows in the system, causing it to operate at or above its capacity. Because of the additional flow volume, costly pipe size increases may be necessary in the future as the reserved pipe capacity for future growth is used for infiltration and inflow. Excess flows contribute to increased wear of the system and are costly as the City pays a fee for each gallon discharged to the South Valley Water Reclamation Facility for treatment, currently $1.30 per 1000 gallons based on 8.5 mgd, or $4,000,000 annually. Excess I&I water is treated at SVWRF with additional treatment systems that would not be necessary if I&I water were prevented from entering the municipal system. If too much I&I enters the collection system, sanitary sewer overflows may occur.

4.4 INFILTRATION STUDY

Infiltration rates into the sewer system vary in the City based on the groundwater table depth and proximity to irrigation canals. Five major irrigation canals run south to north and either pass through or terminate in the eastern half of the City of West Jordan. The pipelines where low infiltration occurs are generally located west of 4000 West as the groundwater table is deeper and canals are not present. West Jordan also receives groundwater recharge flow from a secondary recharge area located on the east side of the Oquirrh Mountain Range. Due to the slope of the land from west to east, groundwater is conveyed west from the Oquirrh Mountains to the Jordan River, creating higher groundwater levels in the eastern portion of the City. Recent video footage of the 1300 West sewer pipe shows significant flow increases and in some cases pipe submersion due to infiltration from 9400 South to 8600 South. Potholing at 8680 South and 1250 West in May 2011 showed the groundwater elevation at 9 feet below the ground surface, submerging the majority of the sewer system in this area under the groundwater. Wastewater operations personnel reported in 2011 that visual observations of the 1300 West Sewer trunkline show the pipe at capacity for most of the length due to groundwater infiltration.

4.4.1 Historical Infiltration and Inflow Studies and Results

A 1992 infiltration study, *City of West Jordan Sewer System Infiltration Study, CRS, 1992*, concluded that “most infiltration occurring within the City of West Jordan is situated east of

2200 West; with the bulk of infiltration actually occurring east of 1700 West. At several locations throughout the City, existing sanitary sewer lines either pass near or beneath these irrigation canals. During the heavy irrigation season, leakage from these canals completely saturates the surrounding soils." Manholes experiencing infiltration next to the canals were located at 7962 South 3800 West, 6939 South 2200 West, 7269 South 2944 West, 8435 South 2700 West, and 7800 south 3725 West. Infiltration above 120 gallons per minute was observed in manholes in the areas of 1300 West, 1500 West, and Redwood Road. Since this study, the Redwood road trunk line pipe was lined with a continuous pvc liner to reduce infiltration; however, older neighborhood pipes and lateral connections still contribute infiltration water to the trunkline.

The City's 2003 Sanitary Sewer Master Plan, *2003 Sanitary Sewer Model & Capital Facilities Plan, JUB, 2003*, incorporated infiltration into the pipes in Redwood Road and 1300 West at a rate of 412 gallons per acre per day (gpad). The report indicated that during monitoring, the flow meters registered one significant storm event that contributed a relatively small amount of inflow and infiltration to the system. Estimates of inflow were 0 gpad on the West side of the City to 70 gpad on the east side.

4.4.2 Current Infiltration Study and Results

The City conducted an infiltration study out of necessity to bring the sewer model into calibration, as it was observed that the sewer discharge rates from residences were significantly less in the model than what was observed at the trunkline meters for 7000 south and 8050 South. Both inflow and infiltration were observed in the flow monitoring graphs from SVWRF and from the observations of City personnel. Therefore, flow data was collected to quantify infiltration rates.

Infiltration volume is typically measured as the low point of the daily wastewater flow graph, minus the known flows during that time period. In 2010 the City experienced one of the wettest years on record, which saturated the soils and led to increased infiltration. Appendix C shows graphs of West Jordan Sewer Meters for each of the four major trunklines for a dry weather week in August 23, during the years 2009, 2010, 2011, and 2012, with full irrigation canals. These yearly comparisons show that the most infiltration occurred in 2011, after record precipitation in 2010 led to increases in groundwater recharge from the Oquirrh Mountains. The graphs show that 7000 South and 8050 South trunklines are affected the most by higher levels of groundwater; 9000 South has moderate levels of infiltration; and 7800 South is influenced the least from infiltration. Figure 3.1 shows the manholes where infiltration was applied to the model, actual locations where infiltration is present need to be investigated.

Increases in dry weather infiltration were also observed when comparing sewer flows with the irrigation canals full on October 8, 2010 (8.363 mgd) to October 22nd 2010 (7.988 mgd), when the irrigation flows were reduced and the ground was not as saturated (Table 4.2). These results show that the canals likely contribute 375,000 gallons per day in infiltration to the sewer flows.

Table 4.2. Observed Flow Results and Infiltration Rates

Meter	Dry Weather Flow Daily Average Dec 12 2010	Dry Weather Flow Daily Average Dec 26 2010	Wet Weather Flow Daily Average Dec 19 2010	Dry Weather Flow Daily Average Oct 22 2010	Irrigation Season Dry Weather Flow Daily Average Oct 8 2010	Wet Weather Flow Daily Average Oct 30	Dry Weather Flow Daily Average Nov 15 2011	Irrigation Season Dry Weather Flow Daily Average Aug 23 2011	Wet Weather Flow Daily Average Nov 1 2011
7000 South	2.669	2.804	2.719	2.435	2.518	2.612	2.396	2.663	2.525
7800 South	4.193	3.938	4.325	3.624	3.912	4.155	4.017	4.238	4.368
8050 South	0.455	0.45	0.45	0.444	0.476	0.469	0.524	0.744	0.551
9000 South	1.57	1.586	1.596	1.485	1.457	1.565	1.488	1.572	1.39
Total	8.887	8.778	9.090	7.988	8.363	8.801	8.425	9.217	8.834

Note: All flows are in Millions of Gallons per Day

In order to further define the areas contributing infiltration to the 7000 South trunkline, flow monitors were placed in 7000 S from 3200 West to 1450 West, on both pipelines. Appendix C presents the field monitoring graphs along 7000 South in 2012. Differences in the calibrated model flow without infiltration, and based on the number of residences and water meter use records, were compared to field measured flows to calculate the amount of infiltration in each segment of the trunklines in 7000 South, 8050 South and 9000 South, see Table 4.3.

Table 4.3. Calculated Infiltration Assigned to 7000 South, 8050 South, and 9000 South

Location	Modeled Average Dry Weather Flow Without Infiltration (mgd)	Actual Average Dry Weather Flow (mgd)	Assigned Infiltration (gpad)
7000 S west of 3200 W	0.33	0.36	0
7000 S between 3100 W 15” Pipe west of Utah Lake Canal	0.42	0.38	0
7000 S between 3100 W 15” Pipe east of Utah Lake Canal	0.42	0.473	865
7000 S 2637 W 10” Pipe North Side	0.07	0.23	865
7000 S 2637 W 12” Pipe South Side	0.58	1.21	910
7000 S 2300 W 10” Pipe North Side	0.08	0.35	215
7000 S 2300 W 12” Pipe South Side	0.68	1.33	160
7000 S 2160 W 12” Combined Pipe	0.84	1.11	190
7000 S 1550 W 12” Pipe South Side	1.16	1.53	145
7000 S 1400 W 15” Pipe North Side	0.094	0.2	980

8050 S areas east of Redwood Road	0.27	0.75	1030
9000 S areas east of canal at 2300 W	1.42	1.7	635

Gpad = gallons per acre per day. MGD = millions of gallons per day

The results of the infiltration study as represented in Table 4.3 and on the graphs in Appendix C show the highest infiltration areas located east of Redwood Road with an average of 1,005 gallons per acre day (gpad). Areas that contribute infiltration to the 7000 S trunklines are located near the canals from 3100 West to 2637 West with infiltration as high as 910 gpad. Infiltration continues along the 7000 S trunkline from 2637 S to approximately Redwood Road at an average rate of 175 gpad. East of Redwood Road, the infiltration rate is 980 gpad. End of pipe infiltration results show 37% of the 7000 South trunkline flow is from infiltration. In the 8050 South trunkline and areas by the canals on the 7000 S trunkline, the model shows as much as 64% of the flow is attributed to infiltration during 2011, when comparing calculated sewer flows based on water meter records to actual flows. The 9000 South end of the trunkline results show that 16.5% of the flow is from infiltration. The 7800 South trunkline infiltration results were not quantified as part of the study; however, they are projected to be less than 200 gpad based on the amount of commercial areas with shallow sewer pipes that contribute to the trunkline.

4.5 RAINFALL MONITORING

Inflow volume can be quantified by observing peak flow data during storm events and comparing this to monitoring data of the same area during dry weather. The City experienced unusually high precipitation amounts in 2010 with record breaking storm events. Changes in wastewater flows were monitored during storms by using the primary trunkline flow meters located at 7000 South, 7800 South, 8050 South, and 9000 South, see Table 4.4.

Table 4.4. Wet Weather Combined Inflow and Infiltration Monitoring Results.

Area	Rainfall (inches)	Daily Average Flow (MGD) without Rainfall Dec 12-18, 2010	Daily Average Flow (MGD) with Rainfall Dec 19-22, 2010	MGD Difference	Percent Difference
7000 South					
19-Dec	0.59	2.80	2.72	-0.08	0
20-Dec	0.36	2.79	2.75	-0.05	0
21-Dec	0.32	2.74	2.73	-0.01	0
22-Dec	0.63	2.74	2.87	0.13	4.7%
7800 South					
19-Dec	0.59	3.94	4.32	0.39	4.7%
20-Dec	0.36	4.02	4.37	0.35	8.7%
21-Dec	0.32	3.94	4.12	0.19	4.5%
22-Dec	0.63	3.95	4.52	0.58	14.4%
8050 South					
19-Dec	0.59	0.45	0.45	0.00	0
20-Dec	0.36	0.44	0.50	0.05	13.6%
21-Dec	0.32	0.44	0.49	0.05	11.4%
22-Dec	0.63	0.45	0.54	0.09	20%

9000 South					
19-Dec	0.59	1.59	1.60	0.01	0.6%
20-Dec	0.36	1.64	1.67	0.04	1.8%
21-Dec	0.32	1.64	1.61	-0.03	0
22-Dec	0.63	1.56	1.75	0.19	12.2%

Note: A 3.8% flow increase was observed on 7000 South during the October 2010 storm events

Table 4.4 data shows the difference of wet weather flow monitoring for each trunkline as calculated by subtracting monitored dry weather flow from wet weather flow. It was observed that 7000 South does not appear to have significant increases in flow; however, the results actual indicate that saturated soils in the area already contribute significant levels of infiltration and the extra inflow from rainfall is less pronounced. The 7800 South trunkline shows localized flow increases after a storm event. The data for the 8050 South trunkline show significant increases in flow during wet weather, while 9000 South increases are present, but less pronounced.

Dry weather monitoring curves from previous weeks were overlaid with wet weather flows to observe changes in the average flow and determine the amount of inflow proportional to the storm event, (see wet weather flow comparison graphs in Appendix D). Storm events occurred on October 23-26, 2010 with record setting precipitation of 0.84 inches on the 25th, according to the National Weather Service Forecast Office website for the Salt Lake City area, (see Table 4.5). Another series of storms occurred from December 19-22, 2010; and in November 2011.

High inflows (other than on the Christmas holiday) were observed on Wednesday December 22 with 0.63 inches of rainfall. This storm contributed on average an additional 980,000 gallons per day (215 gpad) of total discharge for the City when compared with Wednesday December 29, 2010. The storm on October 23, 2010 measured 0.23 inches of rainfall and contributed on average an additional 130,000 gallons per day (29 gpad) when compared to November 6, 2010, the closest Saturday without rainfall inflow.

Table 4.5. Rainfall Summary and Average Daily Total Flows

Date	Daily Rainfall Volume (inches)	Average Metered Flow (mgd)	Peak Metered Flow (mgd)		Date	Daily Rainfall Volume (inches)	Average Metered Flow (mgd)	Peak Metered Flow (mgd)
Th 10/21/2010	0	8.19	11.2		Tu 12/21/2010	0.32	8.95	10.75
Fr 10/22/2010	0	7.96	10.4		W 12/22/2010	0.63	9.68	11.78
Sa 10/23/2010	0.26	8.58	12.49		Th 12/24/2010	0	9.4	12.3
Su 10/24/2010	0.18	78th Meter Malfunction	78th Meter Malfunction		Fr 12/25/2010	0	9.46	14.64*
M 10/25/2010	0.84	78th Meter Malfunction	78th Meter Malfunction		W 12/29/2011	0	8.7	11.12
Tu 10/26/2010	0.32	78th Meter Malfunction	78th Meter Malfunction		Tu 11/1/2011	0.31	8.84	11.37
W 10/27/2010	0.03	8.65	11.67		Fr 11/4/2011	0.27	8.23	10.03
Th 10/28/2010	0	8.52	11.40		Sa 11/5/2011	0.24	9.15	13.18
Fr 10/29/2010	0	8.45	11.04		Sa 11/12/2011	0.18	8.65	12.66
Sa 10/30/2010	0.29	8.8	12.98		Su 11/13/2011	0.11	9.02	12.92

Su 10/31/2010	0	8.94	12.96		M 11/14/2011	0	8.52	11.6
Sa 11/6/2010	0	8.45	12.50		Fr 11/18/2011	0.30	8.22	10.95
Su 12/19/2010	0.59	9.09	13.17		M 11/21/2011	0.13	8.75	12.47
M 12/20/2010	0.36	9.23	11.54		T 11/22/2011	0	8.58	10.9

Note: All flow results are in million gallons per day (mgd)

*Christmas Day has the 2nd highest peak flow of the year at 14.64 mgd.

Thanksgiving has the highest peak flow at 15.2 mgd.

APPENDIX D

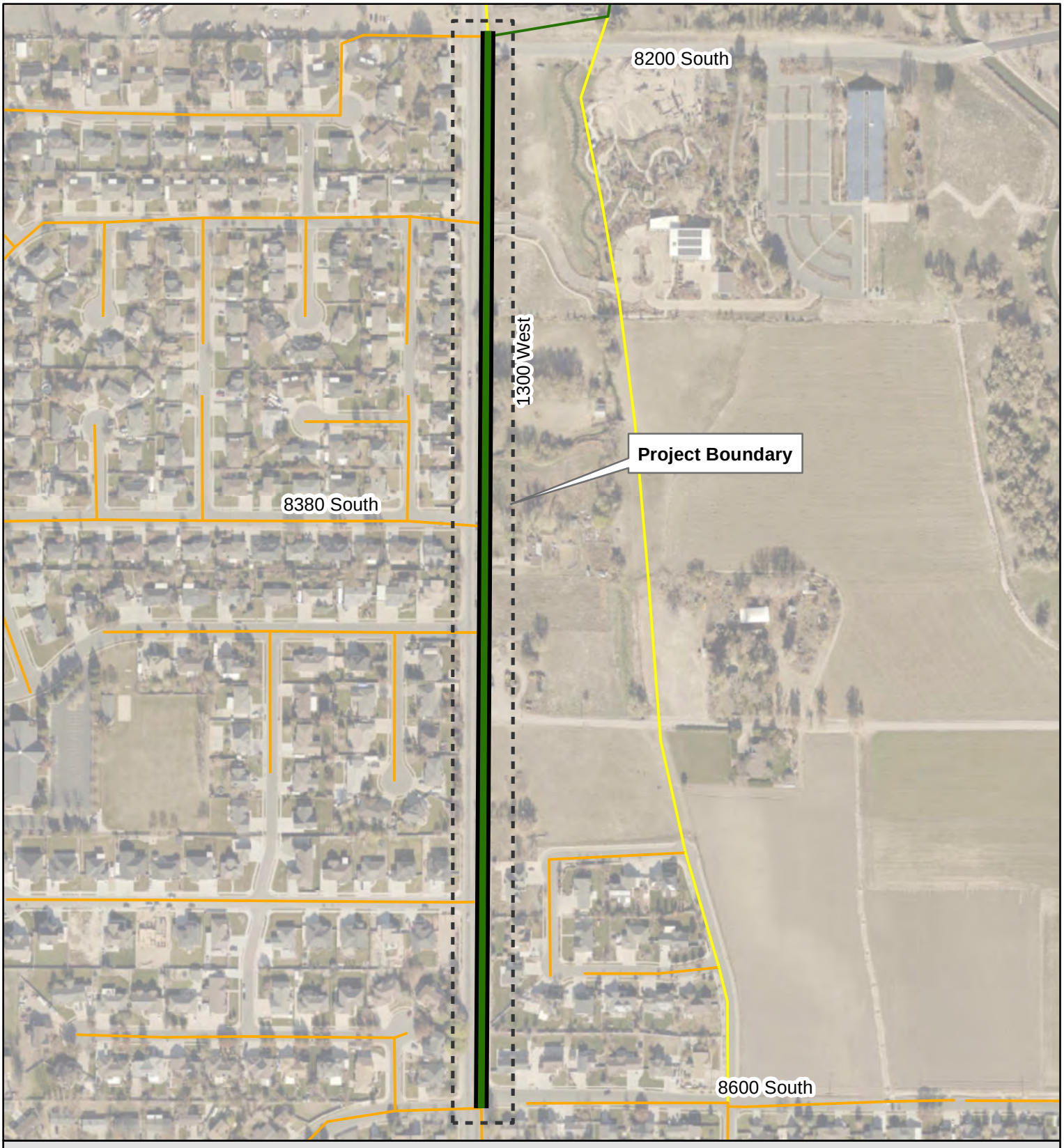
Additional Modeling Scenarios and Growth Analysis

APPENDIX E

Capital Improvement Plan Projects and Costs

Master Plan Sewer Projects													
Major Trunkline Area	**New Master Plan Priority**	**Old Master Plan ID**	**Old Master Plan Priority**	**Project Description**	**Location**	**Existing Facility**	**Future Pipe Size (in)**	**Pipe Length (LF)**	**Existing Peak Flow (cfs)**	**Future Peak Flow (cfs)**	**Budget Estimate**	**% Flow Existing Users**	**% Flow Future Users**
8050 South	1		4b	1300 West	1300 West from 8600 South to 8200 South	10	15	2,470	1.15	1.15	$1,191,000	100%	0%
9000 South	2			1300 West	1300 West from 9000 South to 9220 South	8	15	1,500	0.39	0.39	$757,000	100%	0%
9000 South	3		22	9000 South	9000 South from Redwood Road to Jordan River Parkway	21	30	5,750	5.81	9.03	$4,485,000	64%	36%
7800 South	4		New	7800 South	7800 South from between Mountain View Corridor and Highlands Loop Road to 5600 West	15	21	1,960	2.86	8.31	$1,358,000	34%	66%
9000 South	5			9000 South	2700 West to Redwood Road	15	24	5,280	4.50	7.32	$4,677,000	61%	39%
9000 South	6			9000 South	About 3500 West to 2700 West	12, 15	24	4,400	3.06	4.65	$4,074,000	66%	34%
9000 South	7			9000 South	4000 West to 3695 West	12	24	2,110	2.47	4.02	$2,536,000	61%	39%
9000 South	8			Old Bingham Highway	4800 West to 4000 West	10	18	6,020	1.34	3.00	$4,474,000	45%	55%
9000 South	9			Hawley Park/9580 South	Wells Park to Bagley Park	8	18	2,680	0.50	1.52	$2,362,000	33%	67%
9000 South	10		20, 21, 25	Wells Park Road	Prosperity to Hawley Park	8	15	4,290	0.35	1.35	$3,674,000	26%	74%
9000 South	11		22	Jordan River Parkway	Jordan River Parkway from 9000 South to 8800 South	24	30	1,360	6.82	10.06	$962,000	68%	32%
9000 South	12		New	Bagley Park Road	Bagley Park Drive from 5600 West to 9580 South	8	12	3,430	0.22	0.51	$1,554,000	43%	57%
7800 South	13		Removed	Grizzly Way	Grizzly Way from Swift Water Way to 7800 South	12	15	1,280	2.52	2.74	$713,000	92%	8%
7800 South	14		New	Grizzly Way	Grizzly Way from approx. Big Spring Drive to Swift Water Way	10	12	1,220			$617,000		
7800 South	15		New	7800 South	7800 South from 1300 West to 1200 West	36	36	720	32.60	55.23	$594,000	59%	41%
7000 South	16		23	7000 South	7000 South from Bangerter Highway to 3200 West	12, 15	24	2,380	1.71	3.82	$1,515,000	45%	55%
7000 South	17		13	Campus View Drive, Cobble Ridge Drive, Jordan Landing Boulevard	Campus View Drive from Watkins Way to Cobble Ridge Drive Cobble Ridge Drive from Campus View Drive to Jordan Landing Boulevard Jordan Landing Boulevard from Cobble Ridge Drive to Jordan Village Road	8, 10	12	3,320	1.56	1.92	$1,645,000	81%	19%
											$37,188,000		
Operational Sewer Projects													
7800 South	1		7c	Sky View Estates Sbd, Remove pipe behind homes from 3200 W to the canal and reconnect pipe to 3200 W Meadow Green, 1000' pipe & repair 3-way manhole	3100 W 8250 S	10	8	1,000			$142,000	100%	0%
9000 South	2		8b	Twin Oaks & Tamar Streets- relay pipe, poor slope	1350 W 8780 S	8	10	1,500	0.18	0.18	$245,000	100%	0%
7800 South	3		9a	Jordan Landing Behind Wal-Mart - Line 5 Manholes	Jordan Landing/W. Bangerter Hwy	NA	NA	NA			$37,000	100%	0%
9000 South	4		18	Dannon Way concrete pipe slip lining & 7 Manholes	Dannon Factory to Hawley Park Rd.	8	8	2,750			$350,000	100%	0%
9000 South	5		15a	Mountain Meadow Upsize 500 LF pipe	8870 S 1095 W	8	10	500	0.17	0.17	$69,000	100%	0%
7000 South	6		15b	2200 W Upsize 530 LF Pipe	2200 W 8100 S	8	10	530	0.1	0.1	$73,000	100%	0%
9000 South	7		19a	Dannon Way, slip line pipe & 11 manholes	Hawley Park Rd to Axel Park Rd.	8	8	3,450			$477,000	100%	0%
9000 South	8		19b	Sunleaf-10" pipe upsize	4300 W, 8780 S to 8660 S	8	10	603	0.22	0.22	$146,000	100%	0%
9000 South	9			Bagley Industrial park pipeline upgrade 26,200’ pipe to upgrade				26,200				100%	0%
	10			Sky View Estates easement exchange 600’ of new sewer main and a better easement line with no manhole located in residential yard.				600				100%	0%
	11			Meadow Green Farms Easement line 1900’ of new sewer main 800’ of this will be with better easement line placement. This will eliminate 2,300’ of easement line located in back yards.				1,900				100%	0%
	12			Troester/Bridal Acres Pipe upsize/upgrade project 3,400’ pipe to upgrade				3,400				100%	0%
	13			Bateman farms 2 easement line elimination 170’ of new sewer main and 4 private lateral reconnected to the new main.				170				100%	0%

	14			Jordan Oaks Estates to Pheasant Run Estates Easement line elimination 250’ of new sewer main to redirect the sewer flows away from easement.				250				100%	0%



WEST JORDAN
UTAH

PROJECT 1:
1300 West

Future Pipe Size		Existing Pipe Size			
12	18	6	10	24	
15	21	8	12	27	
	24		15	30	
	30		18	36	
	36		21	39	

0 170 340 Feet

N

J-U-B ENGINEERS, INC.

THE LANGDON GROUP | GATEWAY MAPPING INC.

OTHER J-U-B COMPANIES

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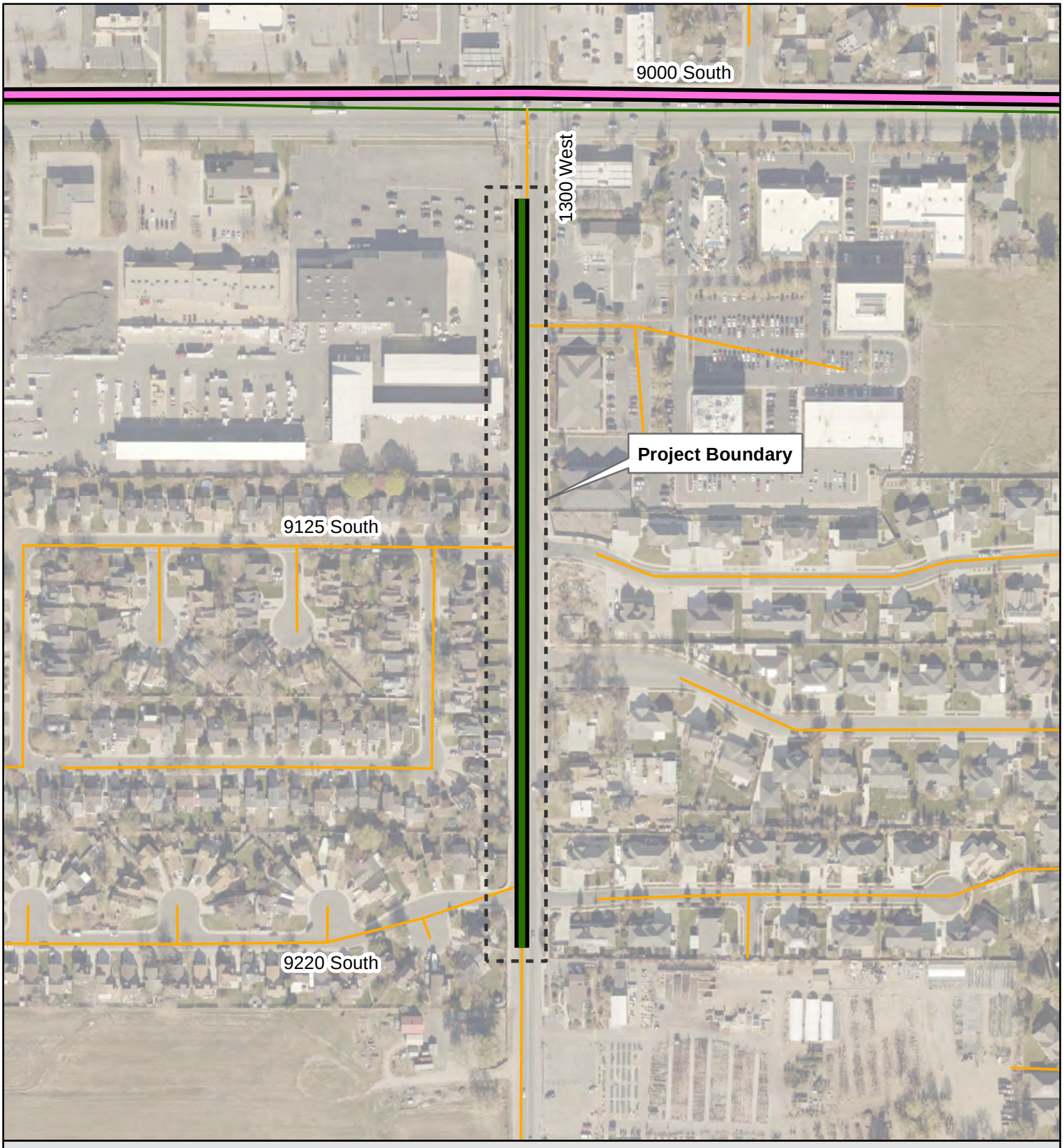
OPINION OF PROBABLE COST

Name: 1300 West
Number: 1
Desc: 1300 West from 8600 South to 8200 South

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 66,140	$ 66,140
2	Traffic Control (approx 10%)	LS	1	$ 66,140	$ 66,140
				SUBTOTAL	**$ 132,280**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF	2,470	$ 40	$ 98,800
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	2,470	$ 10	$ 24,700
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 135,500**
Trench Excavation and Backfill					
14	10-20 feet	LF	2,470	$ 100	$ 247,000
				SUBTOTAL	**$ 247,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	2,470	$ 80	$ 197,600
				SUBTOTAL	**$ 197,600**
Manholes					
17	60" Manhole (10-20 ft. depth)	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 42,000**
Crossings/Borings					
18	Irrigation Canal or Railroad (Boring)	EA		$ 150,000	$ -
19	Major Arterial Crossing (Boring)	EA		$ 250,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
20	Lateral Connections (estimate)	EA	3	$ 1,100	$ 3,300
21	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 39,300**
			CONSTRUCTION SUBTOTAL		**$ 793,680**
	Construction Contingency		25%		$ 198,420
	Engineering, Administration, Legal, etc.		20%		$ 158,736
	City Staff Time		5.0%		$ 39,684
				TOTAL COSTS	**$ 1,191,000**



WEST JORDAN
UTAH

PROJECT 2:
1300 West

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 130 260 Feet

N

J·U·B ENGINEERS, INC.

THE LANGDON GROUP

GATEWAY MAPPING INC.

OTHER J-U-B COMPANIES

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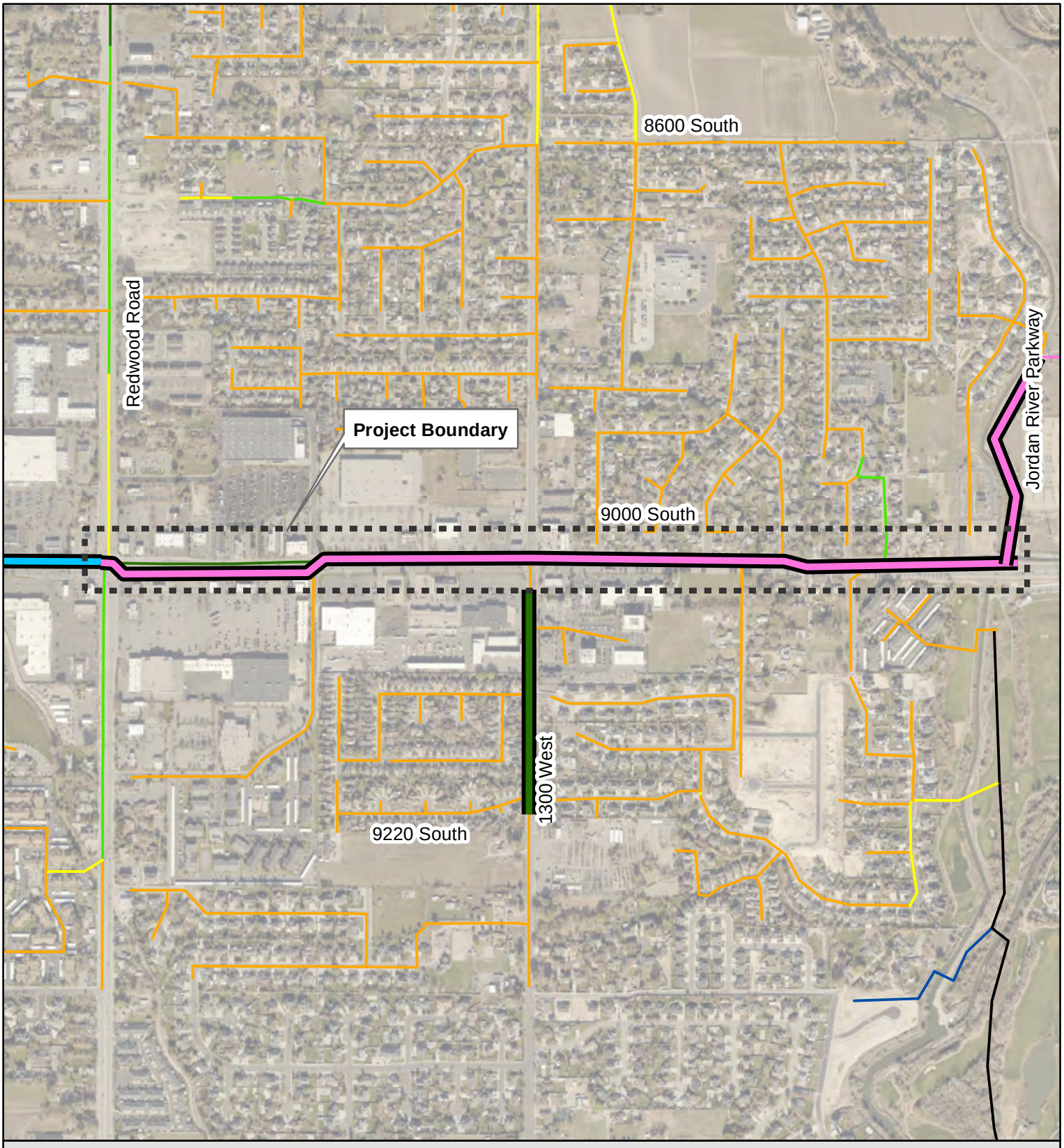
OPINION OF PROBABLE COST

Name: 1300 West
Number: 2
Desc: 1300 West from 9000 South to 9220 South

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 42,030	$ 42,030
2	Traffic Control (approx 10%)	LS	1	$ 42,030	$ 42,030
				SUBTOTAL	**$ 84,060**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF	1,500	$ 40	$ 60,000
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	1,500	$ 10	$ 15,000
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 87,000**
Trench Excavation and Backfill					
14	10-20 feet	LF	1,500	$ 100	$ 150,000
				SUBTOTAL	**$ 150,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	1,500	$ 80	$ 120,000
				SUBTOTAL	**$ 120,000**
Manholes					
17	60" Manhole (10-20 ft. depth)	EA	4	$ 6,000	$ 24,000
				SUBTOTAL	**$ 24,000**
Crossings/Borings					
18	Irrigation Canal or Railroad (Boring)	EA		$ 150,000	$ -
19	Major Arterial Crossing (Boring)	EA		$ 250,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
20	Lateral Connections (estimate)	EA	3	$ 1,100	$ 3,300
21	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 39,300**
			CONSTRUCTION SUBTOTAL		**$ 504,360**
	Construction Contingency		25%		$ 126,090
	Engineering, Administration, Legal, etc.		20%		$ 100,872
	City Staff Time		5.0%		$ 25,218
				TOTAL COSTS	**$ 757,000**



WEST JORDAN
UTAH

PROJECT 3:
9000 South

Future Pipe Size		Existing Pipe Size		
12	18	6	10	24
15	21	8	12	27
	24		15	30
	30		18	36
	36		21	39

0 425 850 Feet

N

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OPINION OF PROBABLE COST

Name: 9000 South
Number: 3
Desc: 9000 South from Redwood Road to Jordan River Parkway

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 249,150	$ 249,150
2	Traffic Control (approx 10%)	LS	1	$ 249,150	$ 249,150
				SUBTOTAL	**$ 498,300**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF	5,750	$ 115	$ 661,250
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	5,750	$ 25	$ 143,750
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 817,000**
Trench Excavation and Backfill					
14	10-20 feet	LF	5,750	$ 120	$ 690,000
				SUBTOTAL	**$ 690,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	5,750	$ 130	$ 747,500
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 747,500**
Manholes					
17	60" Manhole (10-20 ft. depth)	EA	15	$ 6,000	$ 90,000
				SUBTOTAL	**$ 90,000**
Crossings/Borings					
18	Irrigation Canal or Railroad (Boring)	EA	1	$ 75,000	$ 75,000
19	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 75,000**
Miscellaneous					
20	Lateral Connections (estimate)	EA		$ 1,100	$ -
21	Bypass Pumping	Days	60	$ 1,200	$ 72,000
				SUBTOTAL	**$ 72,000**
			CONSTRUCTION SUBTOTAL		**$ 2,989,800**
	Construction Contingency		25%		$ 747,450
	Engineering, Administration, Legal, etc.		20%		$ 597,960
	City Staff Time		5.0%		$ 149,490
				TOTAL COSTS	**$ 4,485,000**

WEST JORDAN
UTAH

PROJECT 4:
7800 South

Future Pipe Size		Existing Pipe Size			
12	18	6	10	24	
15	21	8	12	27	
	24		15	30	
	30		18	36	
	36		21	39	

0 170 340 Feet

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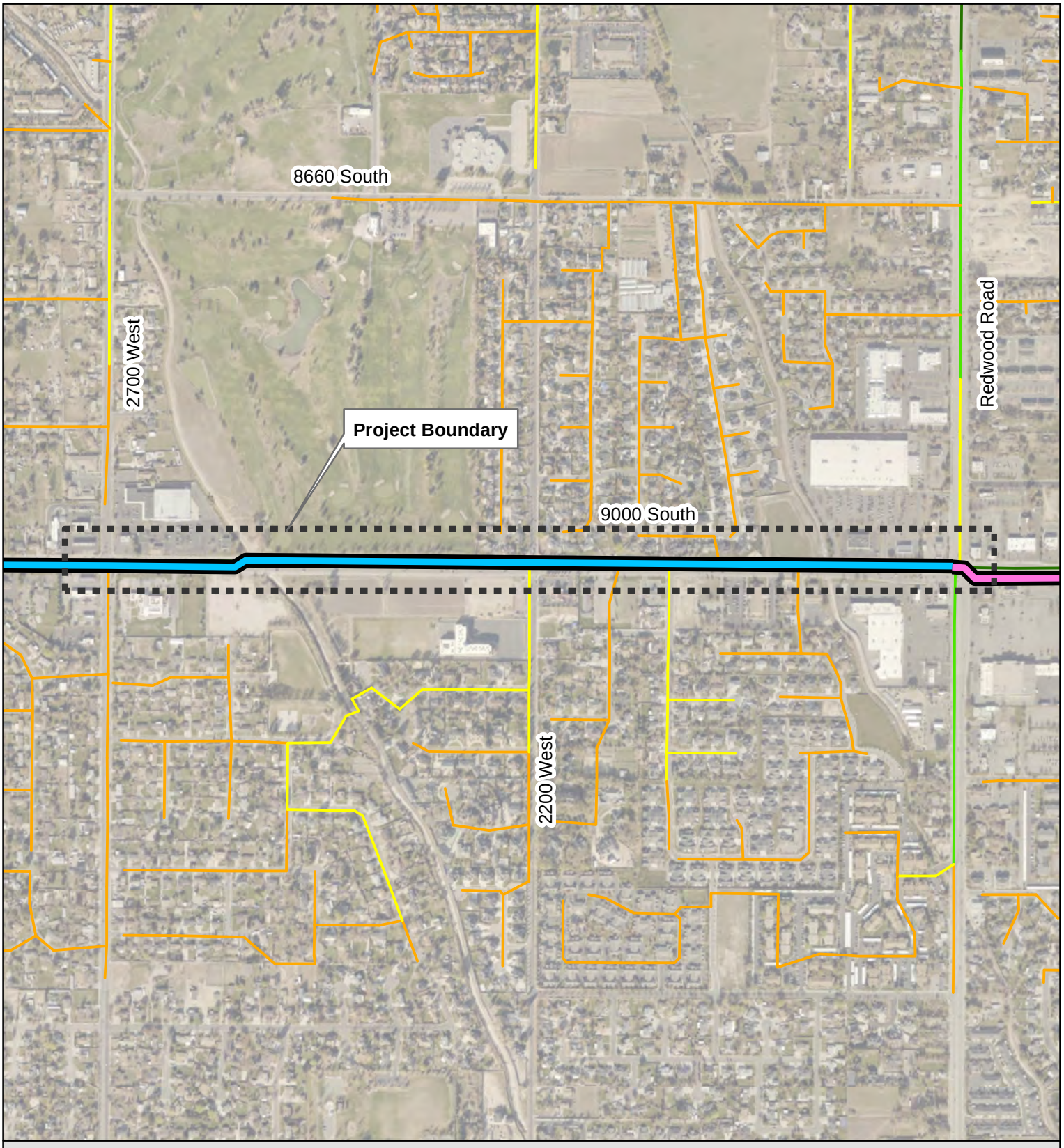
OPINION OF PROBABLE COST

Name: 7800 South
Number: 4
Desc: 7800 South from between Mountain View Corridor and Highlands Loop Road to

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 75,420	$ 75,420
2	Traffic Control (approx 10%)	LS	1	$ 75,420	$ 75,420
				SUBTOTAL	**$ 150,840**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF	1,960	$ 70	$ 137,200
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	1,960	$ 25	$ 49,000
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 198,200**
Trench Excavation and Backfill					
14	10-20 feet	LF	1,960	$ 120	$ 235,200
				SUBTOTAL	**$ 235,200**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	1,960	$ 130	$ 254,800
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 254,800**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	5	$ 6,000	$ 30,000
				SUBTOTAL	**$ 30,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 36,000**
			CONSTRUCTION SUBTOTAL		**$ 905,040**
	Construction Contingency		25%		$ 226,260
	Engineering, Administration, Legal, etc.		20%		$ 181,008
	City Staff Time		5.0%		$ 45,252
				TOTAL COSTS	**$ 1,358,000**



WEST JORDAN
UTAH

PROJECT 5:
9000 South

Future Pipe Size		Existing Pipe Size			
12	18	6	10	24	
15	21	8	12	27	
	24		15	30	
	30		18	36	
	36		21	39	

0 425 850 Feet

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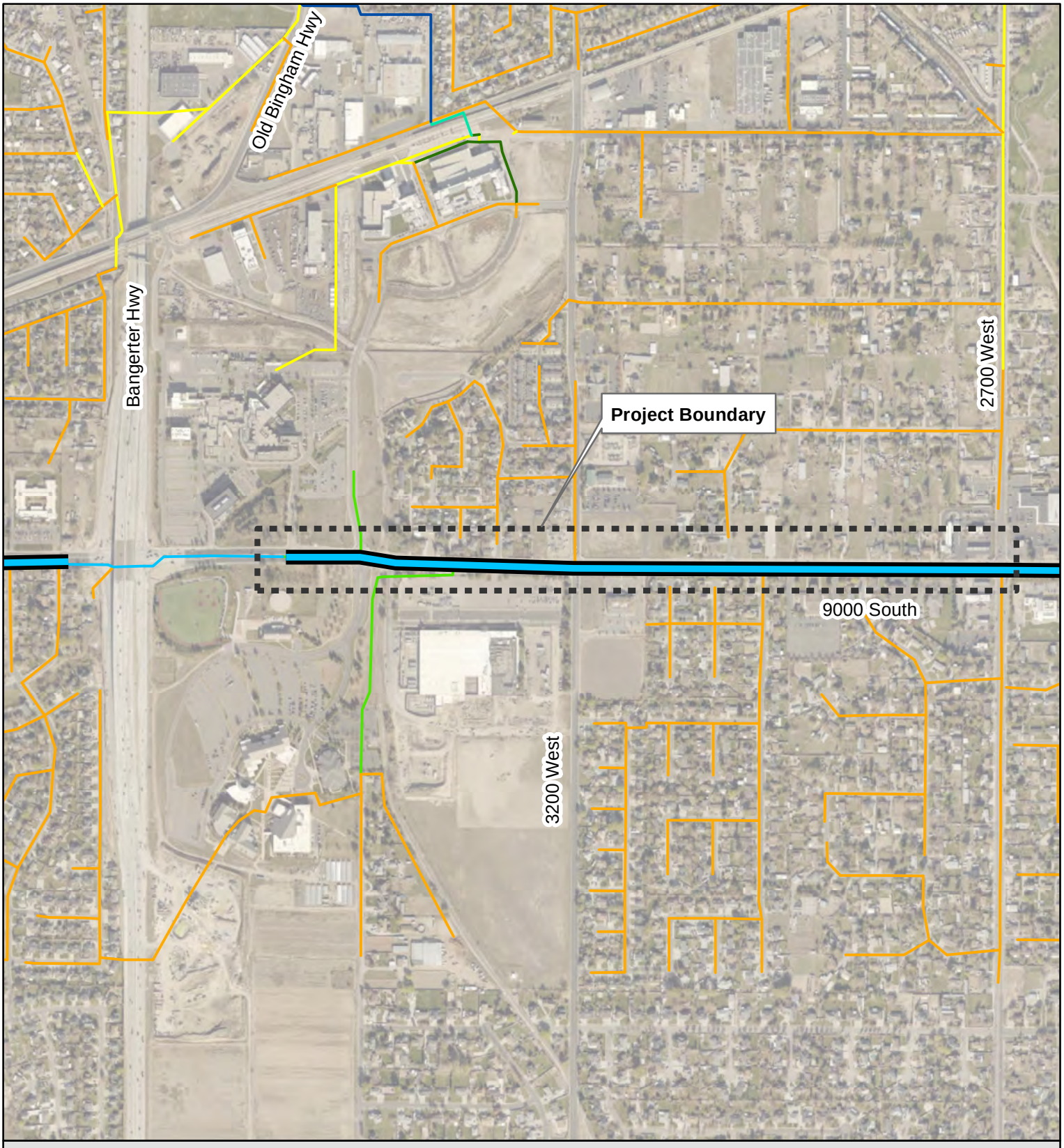
OPINION OF PROBABLE COST

Name: 9000 South
Number: 5
Desc: 2700 West to Redwood Road

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 259,830	$ 259,830
2	Traffic Control (approx 10%)	LS	1	$ 259,830	$ 259,830
				SUBTOTAL	**$ 519,660**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF	5,280	$ 85	$ 448,800
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	5,280	$ 25	$ 132,000
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 622,800**
Trench Excavation and Backfill					
14	10-20 feet	LF	5,280	$ 120	$ 633,600
				SUBTOTAL	**$ 633,600**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	5,280	$ 130	$ 686,400
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 686,400**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	14	$ 6,000	$ 84,000
				SUBTOTAL	**$ 84,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 75,000	$ 375,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 375,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
				CONSTRUCTION SUBTOTAL	**$ 3,117,960**
	Construction Contingency		25%		$ 779,490
	Engineering, Administration, Legal, etc.		20%		$ 623,592
	City Staff Time		5.0%		$ 155,898
				TOTAL COSTS	**$ 4,677,000**



WEST JORDAN
UTAH

PROJECT 6:
9000 South

Future Pipe Size			Existing Pipe Size		
12	18	30	6	10	24	30
15	21	36	8	12	27	36
	24			15	30	39
				18	36	
				21		

0 425 850 Feet

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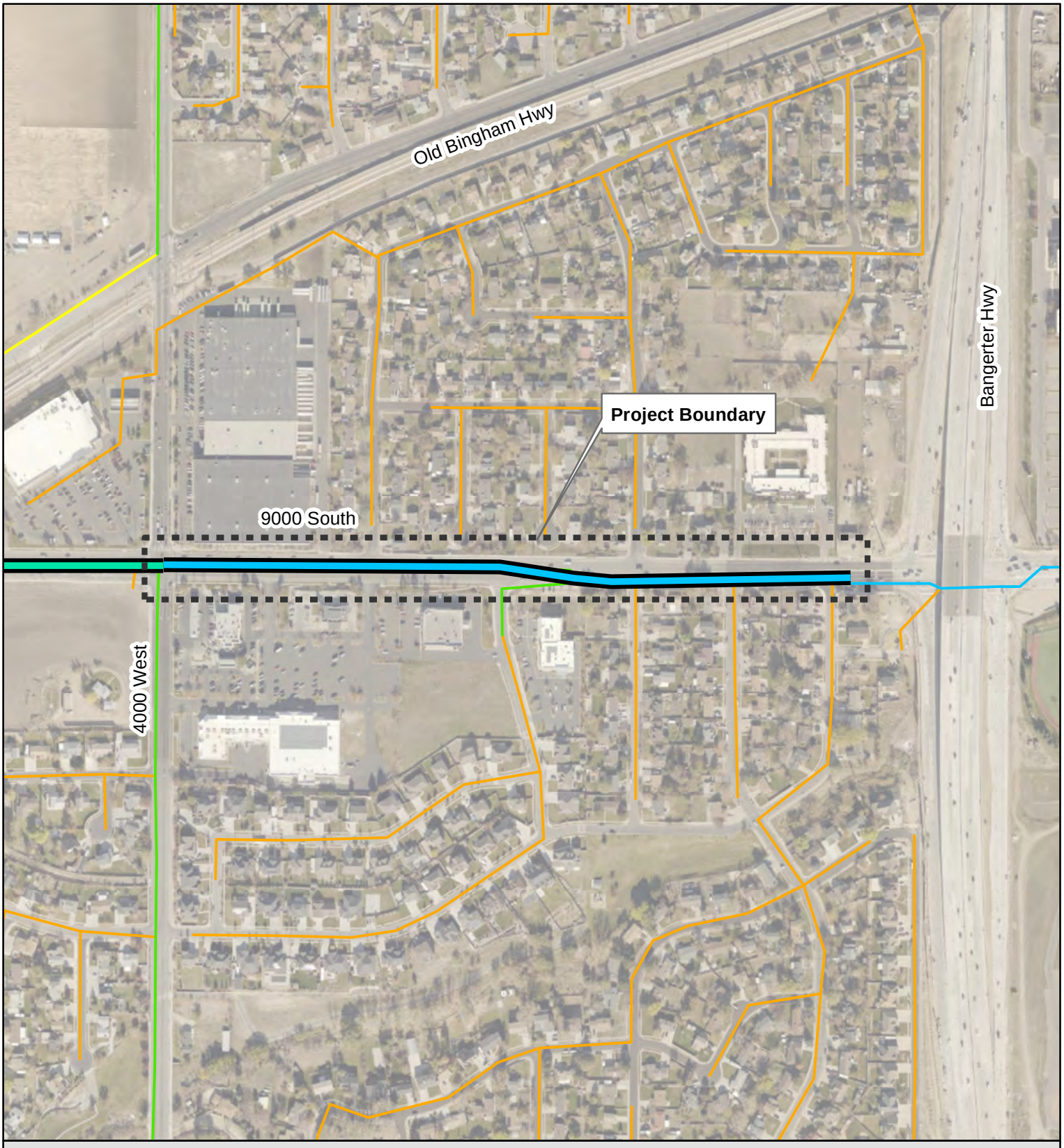
OPINION OF PROBABLE COST

Name: 9000 South
Number: 6
Desc: About 3500 West to 2700 West

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 226,350	$ 226,350
2	Traffic Control (approx 10%)	LS	1	$ 226,350	$ 226,350
				SUBTOTAL	**$ 452,700**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF	4,400	$ 85	$ 374,000
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	4,400	$ 25	$ 110,000
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 526,000**
Trench Excavation and Backfill					
14	10-20 feet	LF	4,400	$ 120	$ 528,000
				SUBTOTAL	**$ 528,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	4,400	$ 130	$ 572,000
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 572,000**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	11	$ 6,000	$ 66,000
				SUBTOTAL	**$ 66,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 75,000	$ 375,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 375,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
				CONSTRUCTION SUBTOTAL	**$ 2,716,200**
	Construction Contingency		25%		$ 679,050
	Engineering, Administration, Legal, etc.		20%		$ 543,240
	City Staff Time		5.0%		$ 135,810
				TOTAL COSTS	**$ 4,074,000**



WEST JORDAN
UTAH

PROJECT 7:
9000 South

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 210 420 Feet

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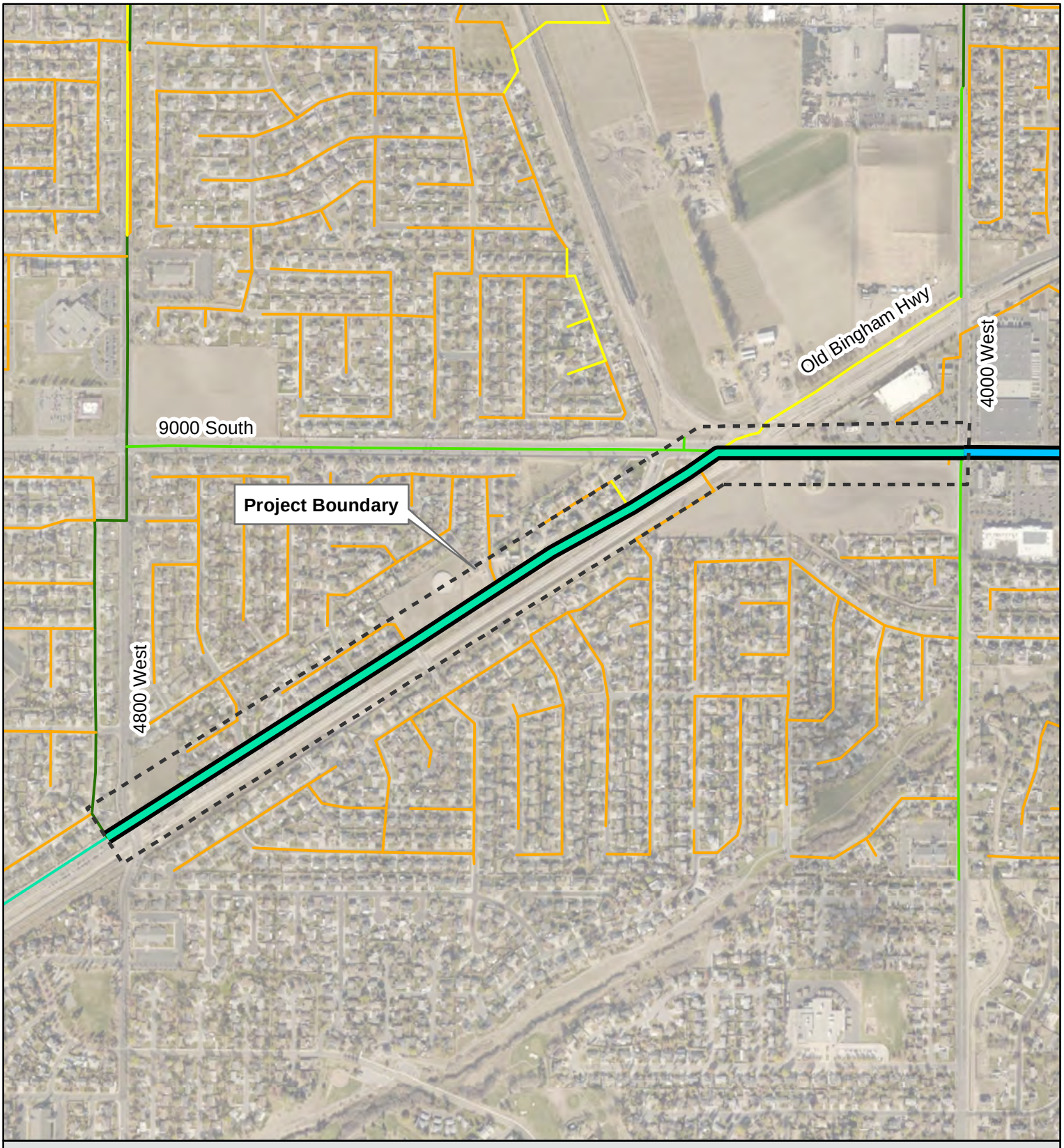
OPINION OF PROBABLE COST

Name: 9000 South
Number: 7
Desc: 4000 West to 3695 West

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 140,910	$ 140,910
2	Traffic Control (approx 10%)	LS	1	$ 140,910	$ 140,910
				SUBTOTAL	**$ 281,820**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF	2,110	$ 85	$ 179,350
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	2,110	$ 25	$ 52,750
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 274,100**
Trench Excavation and Backfill					
14	10-20 feet	LF	2,110	$ 120	$ 253,200
				SUBTOTAL	**$ 253,200**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	2,110	$ 130	$ 274,300
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 274,300**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	6	$ 6,000	$ 36,000
				SUBTOTAL	**$ 36,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 75,000	$ 375,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 375,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
				CONSTRUCTION SUBTOTAL	**$ 1,690,920**
	Construction Contingency		25%		$ 422,730
	Engineering, Administration, Legal, etc.		20%		$ 338,184
	City Staff Time		5.0%		$ 84,546
				TOTAL COSTS	**$ 2,536,000**



WEST JORDAN
UTAH

PROJECT 8:
Old Bingham Hwy

Future Pipe Size

- 12
- 15
- 18
- 21
- 24
- 30
- 36

Existing Pipe Size

- 6
- 8
- 10
- 12
- 15
- 18
- 21
- 24
- 27
- 30
- 36
- 39

0 425 850 Feet

N

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OPINION OF PROBABLE COST

Name: Old Bingham Highway
Number: 8
Desc: 4800 West to 4000 West

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 248,540	$ 248,540
2	Traffic Control (approx 10%)	LS	1	$ 248,540	$ 248,540
				SUBTOTAL	**$ 497,080**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF	6,020	$ 55	$ 331,100
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	6,020	$ 10	$ 60,200
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 433,300**
Trench Excavation and Backfill					
14	10-20 feet	LF	6,020	$ 100	$ 602,000
				SUBTOTAL	**$ 602,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF	6,020	$ 130	$ 782,600
16	City Asphalt Patch (20 ft wide)	LF		$ 80	$ -
				SUBTOTAL	**$ 782,600**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	16	$ 6,000	$ 96,000
				SUBTOTAL	**$ 96,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 75,000	$ 375,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 375,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
			CONSTRUCTION SUBTOTAL		**$ 2,982,480**
	Construction Contingency		25%		$ 745,620
	Engineering, Administration, Legal, etc.		20%		$ 596,496
	City Staff Time		5.0%		$ 149,124
				TOTAL COSTS	**$ 4,474,000**

WEST JORDAN
UTAH

PROJECT 9:
Hawley Park Rd

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 210 420 Feet

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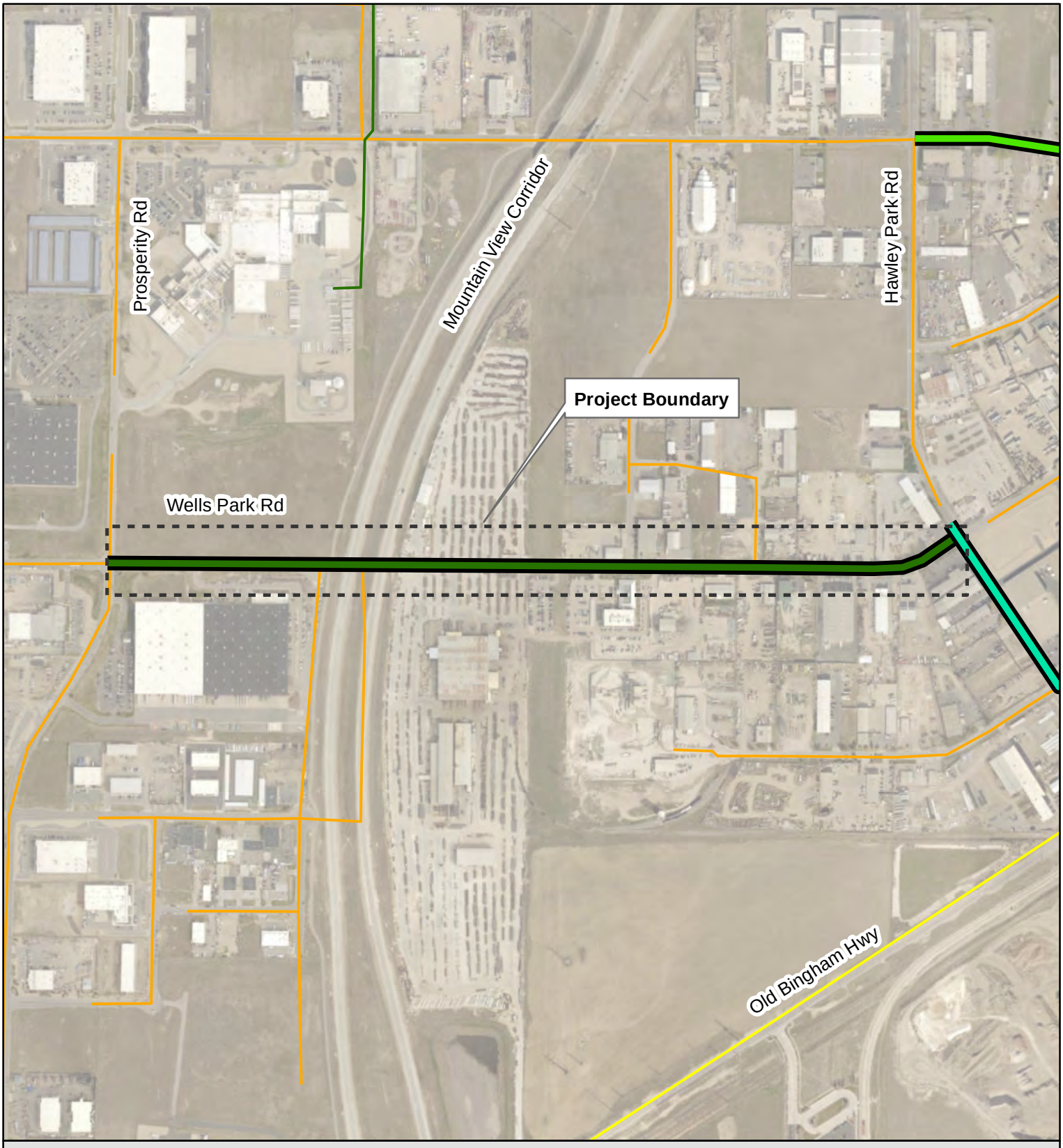
OPINION OF PROBABLE COST

Name: Hawley Park/9580 South
Number: 9
Desc: Wells Park to Bagley Park

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 131,210	$ 131,210
2	Traffic Control (approx 10%)	LS	1	$ 131,210	$ 131,210
				SUBTOTAL	**$ 262,420**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF	2,680	$ 55	$ 147,400
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	2,680	$ 10	$ 26,800
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 216,200**
Trench Excavation and Backfill					
14	10-20 feet	LF	2,680	$ 100	$ 268,000
				SUBTOTAL	**$ 268,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	2,680	$ 80	$ 214,400
				SUBTOTAL	**$ 214,400**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 42,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 75,000	$ 375,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 375,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
			CONSTRUCTION SUBTOTAL		**$ 1,574,520**
	Construction Contingency		25%		$ 393,630
	Engineering, Administration, Legal, etc.		20%		$ 314,904
	City Staff Time		5.0%		$ 78,726
				TOTAL COSTS	**$ 2,362,000**



WEST JORDAN
UTAH

PROJECT 10:
Wells Park Rd

Future Pipe Size			Existing Pipe Size		
12	18	30	6	10	24
15	21	36	8	12	27
	24			15	30
				18	36
				21	39

0 350 700 Feet

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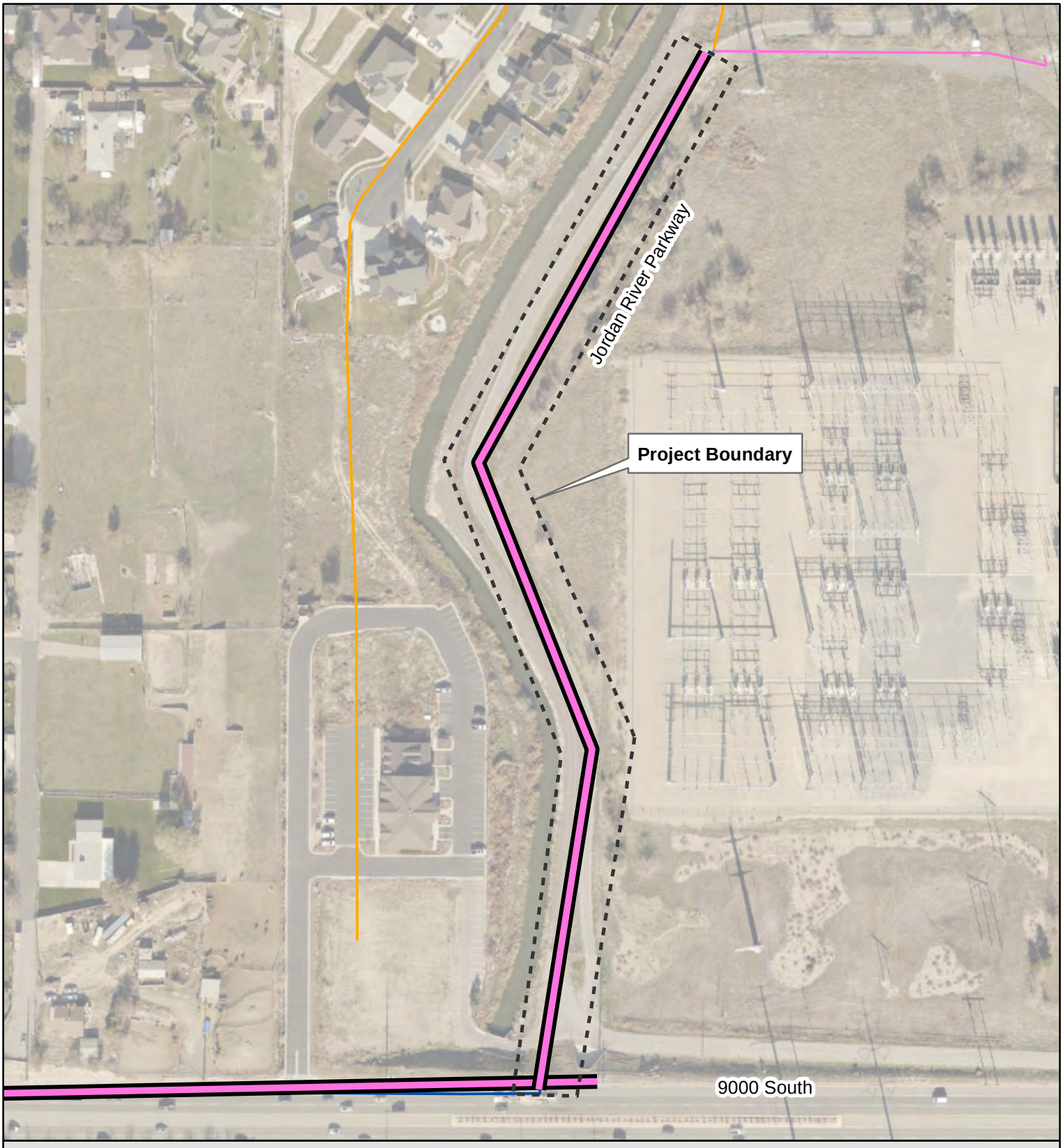
OPINION OF PROBABLE COST

Name: Wells Park Road
Number: 10
Desc: Prosperity to Hawley Park

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 204,120	$ 204,120
2	Traffic Control (approx 10%)	LS	1	$ 204,120	$ 204,120
				SUBTOTAL	**$ 408,240**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF	4,290	$ 40	$ 171,600
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	4,290	$ 10	$ 42,900
13	Connect to Existing	EA	7	$ 6,000	$ 42,000
				SUBTOTAL	**$ 256,500**
Trench Excavation and Backfill					
14	10-20 feet	LF	4,290	$ 100	$ 429,000
				SUBTOTAL	**$ 429,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	4,290	$ 80	$ 343,200
				SUBTOTAL	**$ 343,200**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	11	$ 6,000	$ 66,000
				SUBTOTAL	**$ 66,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	5	$ 150,000	$ 750,000
18	Major Arterial Crossing (Boring)	EA		$ 250,000	$ -
				SUBTOTAL	**$ 750,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA	15	$ 1,100	$ 16,500
20	Bypass Pumping	Days	150	$ 1,200	$ 180,000
				SUBTOTAL	**$ 196,500**
				CONSTRUCTION SUBTOTAL	**$ 2,449,440**
	Construction Contingency		25%		$ 612,360
	Engineering, Administration, Legal, etc.		20%		$ 489,888
	City Staff Time		5.0%		$ 122,472
				TOTAL COSTS	**$ 3,674,000**



WEST JORDAN
UTAH

PROJECT 11:
Jordan River Pkwy

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 85 170 Feet

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OPINION OF PROBABLE COST

Name: Jordan River Parkway
Number: 11
Desc: Jordan River Parkway from 9000 South to 8800 South

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 53,440	$ 53,440
2	Traffic Control (approx 10%)	LS	1	$ 53,440	$ 53,440
				SUBTOTAL	**$ 106,880**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF	1,360	$ 115	$ 156,400
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	1,360	$ 25	$ 34,000
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 202,400**
Trench Excavation and Backfill					
14	10-20 feet	LF	1,360	$ 120	$ 163,200
				SUBTOTAL	**$ 163,200**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	1,360	$ 80	$ 108,800
				SUBTOTAL	**$ 108,800**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	4	$ 6,000	$ 24,000
				SUBTOTAL	**$ 24,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 36,000**
			CONSTRUCTION SUBTOTAL		**$ 641,280**
	Construction Contingency		25%		$ 160,320
	Engineering, Administration, Legal, etc.		20%		$ 128,256
	City Staff Time		5.0%		$ 32,064
				TOTAL COSTS	**$ 962,000**

WEST JORDAN
UTAH

PROJECT 12: Bagley Park Rd

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 170 340 Feet

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OPINION OF PROBABLE COST

Name: Bagley Park Road
Number: 12
Desc: Bagley Park Drive from 5600 West to 9580 South

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 86,346	$ 86,346
2	Traffic Control (approx 10%)	LS	1	$ 86,346	$ 86,346
				SUBTOTAL	**$ 172,692**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF	3,430	$ 32	$ 109,760
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	3,430	$ 10	$ 34,300
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 156,060**
Trench Excavation and Backfill					
14	10-20 feet	LF	3,430	$ 100	$ 343,000
				SUBTOTAL	**$ 343,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	3,430	$ 80	$ 274,400
				SUBTOTAL	**$ 274,400**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	9	$ 6,000	$ 54,000
				SUBTOTAL	**$ 54,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 36,000**
			CONSTRUCTION SUBTOTAL		**$ 1,036,152**
	Construction Contingency		25%		$ 259,038
	Engineering, Administration, Legal, etc.		20%		$ 207,230
	City Staff Time		5.0%		$ 51,808
				TOTAL COSTS	**$ 1,554,000**

WEST JORDAN
UTAH

PROJECT 13:
Grizzly Way

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 85 170 Feet

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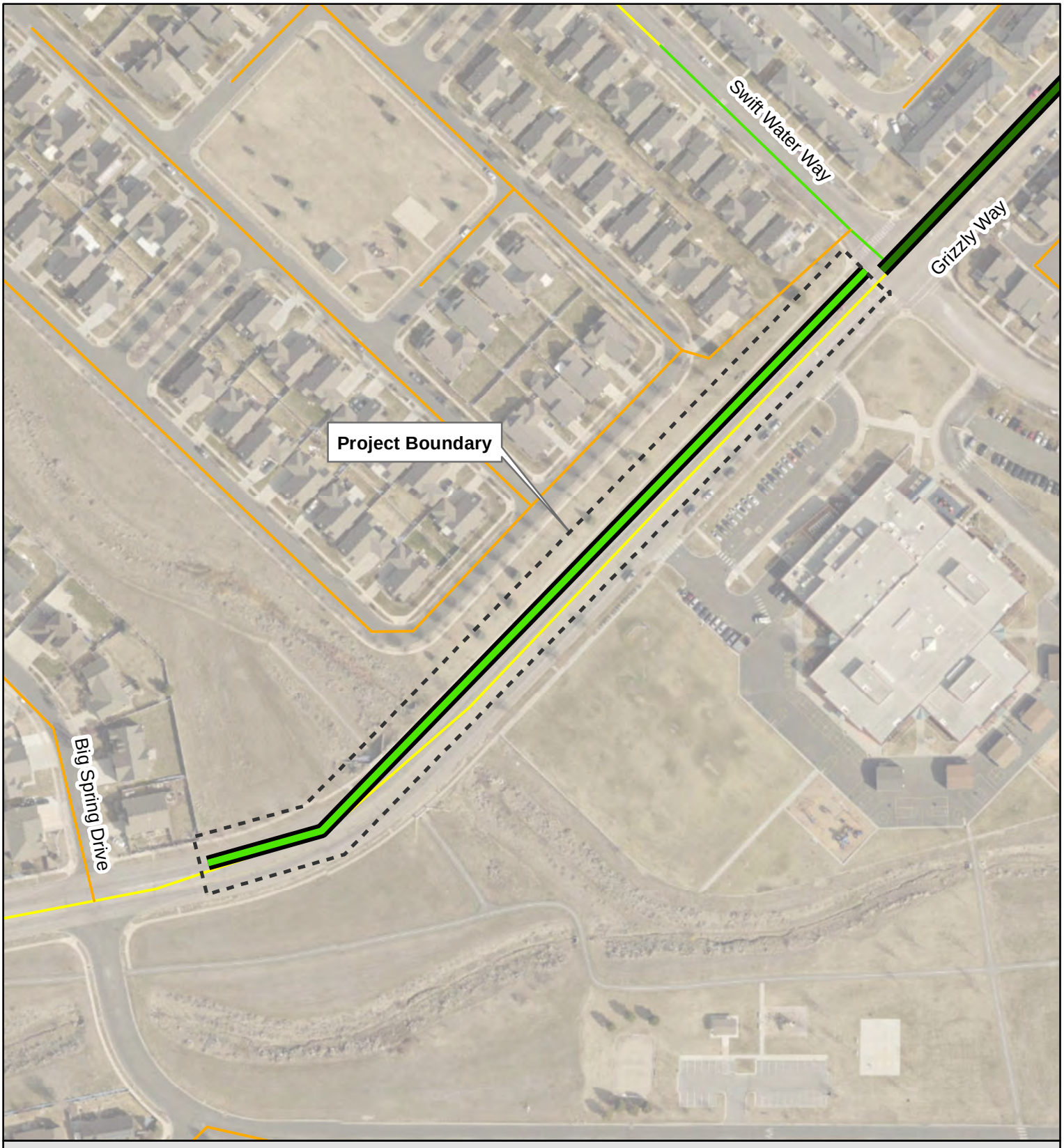
OPINION OF PROBABLE COST

Name: Grizzly Way
Number: 13
Desc: Grizzly Way from Swift Water Way to 7800 South

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 39,610	$ 39,610
2	Traffic Control (approx 10%)	LS	1	$ 39,610	$ 39,610
				SUBTOTAL	**$ 79,220**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF	1,280	$ 40	$ 51,200
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	1,280	$ 10	$ 12,800
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 76,000**
Trench Excavation and Backfill					
14	10-20 feet	LF	1,280	$ 100	$ 128,000
				SUBTOTAL	**$ 128,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	1,280	$ 80	$ 102,400
				SUBTOTAL	**$ 102,400**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	4	$ 6,000	$ 24,000
				SUBTOTAL	**$ 24,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA	27	$ 1,100	$ 29,700
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 65,700**
			CONSTRUCTION SUBTOTAL		**$ 475,320**
	Construction Contingency		25%		$ 118,830
	Engineering, Administration, Legal, etc.		20%		$ 95,064
	City Staff Time		5.0%		$ 23,766
				TOTAL COSTS	**$ 713,000**



WEST JORDAN
UTAH

PROJECT 14: Grizzly Way

Future Pipe Size		Existing Pipe Size	
12	18	6	10
15	21	8	12
	24		15
	30		18
	36		21
			24
			27
			30
			36
			39

0 85 170 Feet

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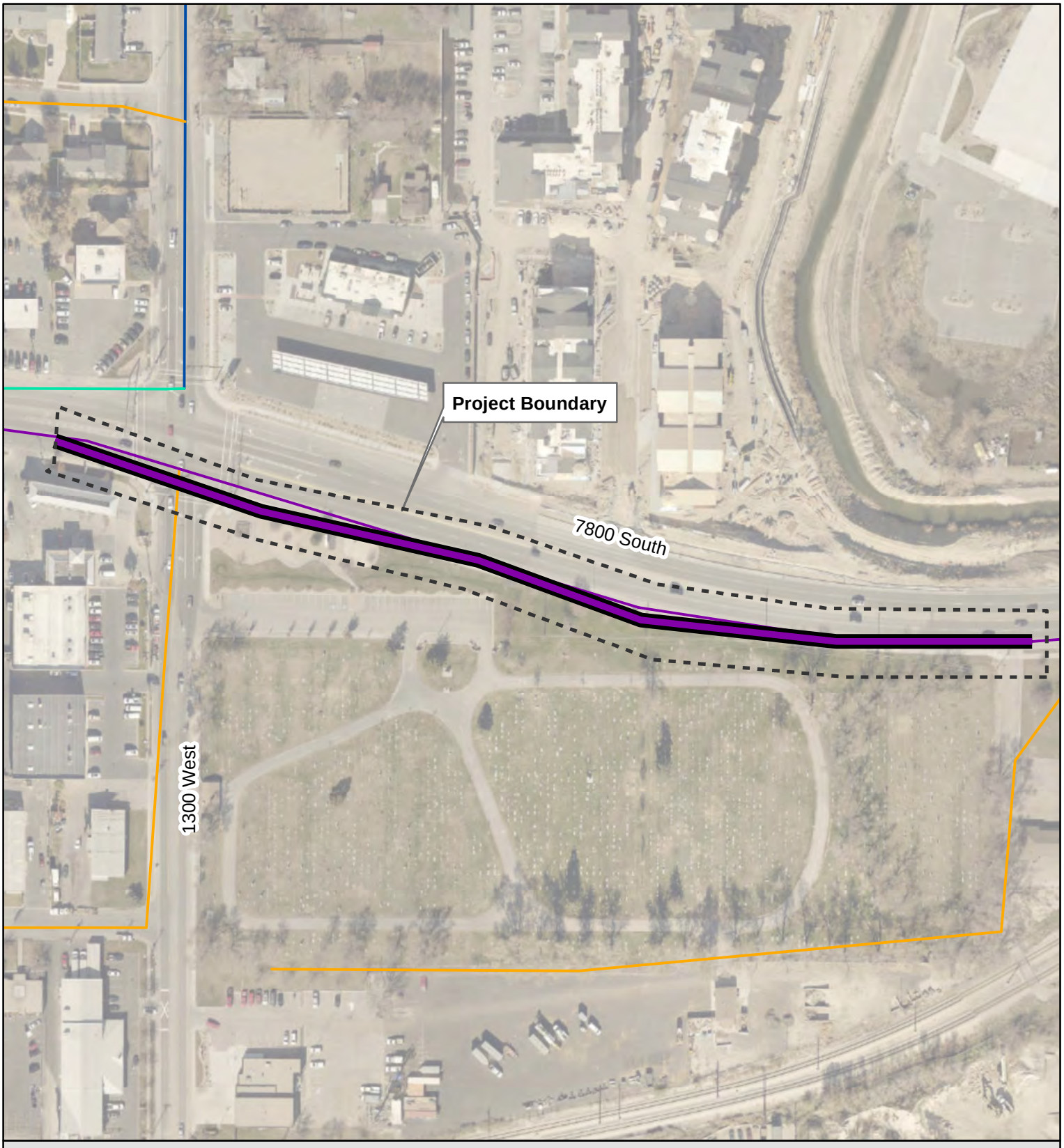
OPINION OF PROBABLE COST

Name: Grizzly Way
Number: 14
Desc: Grizzly Way from approx. Big Spring Drive to Swift Water Way

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 34,284	$ 34,284
2	Traffic Control (approx 10%)	LS	1	$ 34,284	$ 34,284
				SUBTOTAL	**$ 68,568**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF	1,220	$ 32	$ 39,040
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	1,220	$ 10	$ 12,200
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 63,240**
Trench Excavation and Backfill					
14	10-20 feet	LF	1,220	$ 100	$ 122,000
				SUBTOTAL	**$ 122,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	1,220	$ 80	$ 97,600
				SUBTOTAL	**$ 97,600**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	4	$ 6,000	$ 24,000
				SUBTOTAL	**$ 24,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 36,000**
			CONSTRUCTION SUBTOTAL		**$ 411,408**
	Construction Contingency		25%		$ 102,852
	Engineering, Administration, Legal, etc.		20%		$ 82,282
	City Staff Time		5.0%		$ 20,570
				TOTAL COSTS	**$ 617,000**



WEST JORDAN
UTAH

PROJECT 15:
7800 South

Future Pipe Size			Existing Pipe Size		
12	18	30	6	10	24
15	21	36	8	12	27
	24			15	30
				18	36
				21	39

0 85 170 Feet

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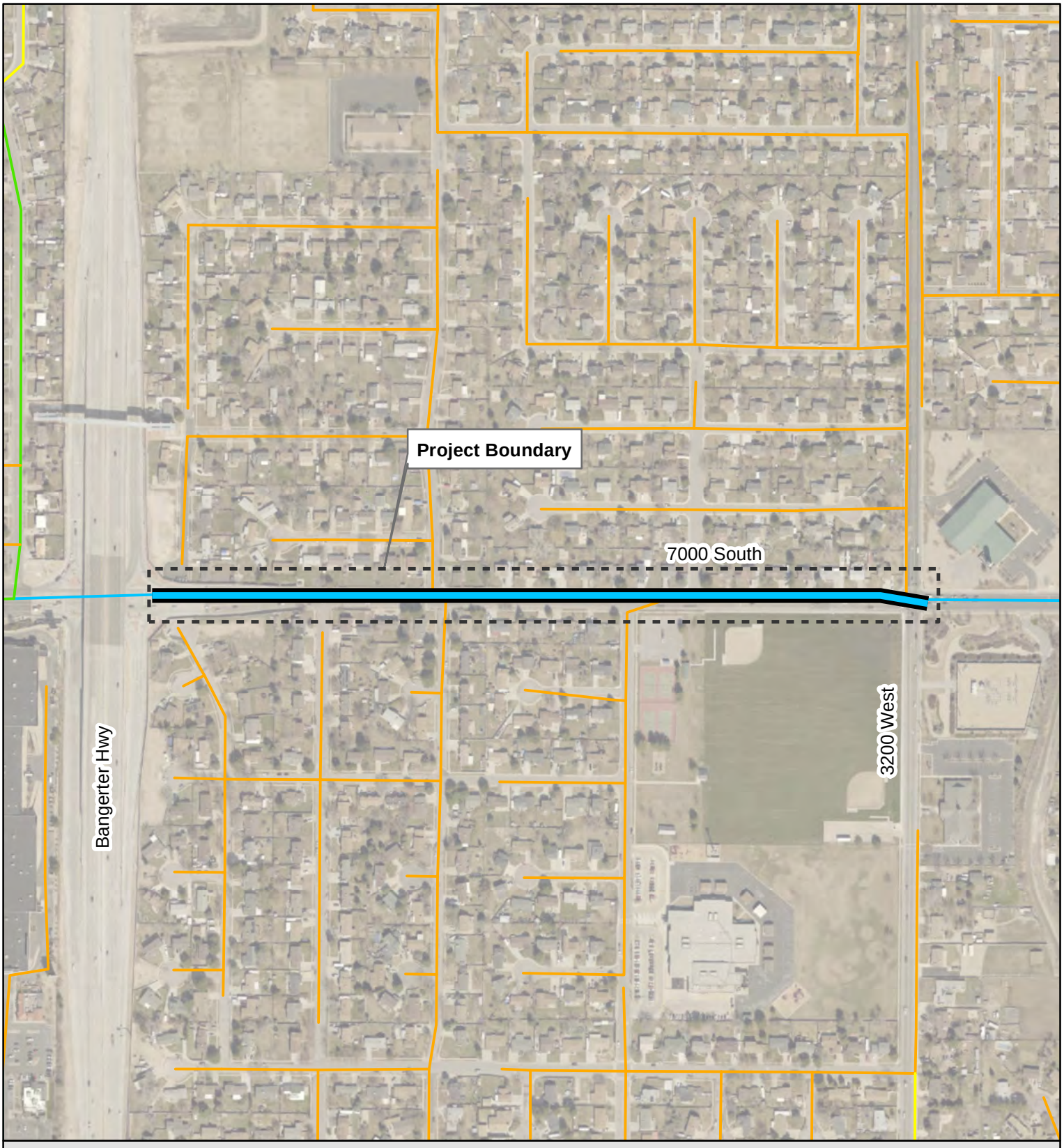
OPINION OF PROBABLE COST

Name: 7800 South
Number: 15
Desc: 7800 South from 1300 West to 1200 West

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 33,000	$ 33,000
2	Traffic Control (approx 10%)	LS	1	$ 33,000	$ 33,000
				SUBTOTAL	**$ 66,000**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF	720	$ 160	$ 115,200
12	Dewatering - Minor	LF	720	$ 30	$ 21,600
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 148,800**
Trench Excavation and Backfill					
14	10-20 feet	LF	720	$ 130	$ 93,600
				SUBTOTAL	**$ 93,600**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	720	$ 80	$ 57,600
				SUBTOTAL	**$ 57,600**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 12,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	15	$ 1,200	$ 18,000
				SUBTOTAL	**$ 18,000**
			CONSTRUCTION SUBTOTAL		**$ 396,000**
	Construction Contingency		25%		$ 99,000
	Engineering, Administration, Legal, etc.		20%		$ 79,200
	City Staff Time		5.0%		$ 19,800
				TOTAL COSTS	**$ 594,000**



WEST JORDAN
UTAH

PROJECT 16:
7000 South

Future Pipe Size		Existing Pipe Size			
12	18	6	10	24	
15	21	8	12	27	
	24		15	30	
	30		18	36	
	36		21	39	

0 215 430 Feet

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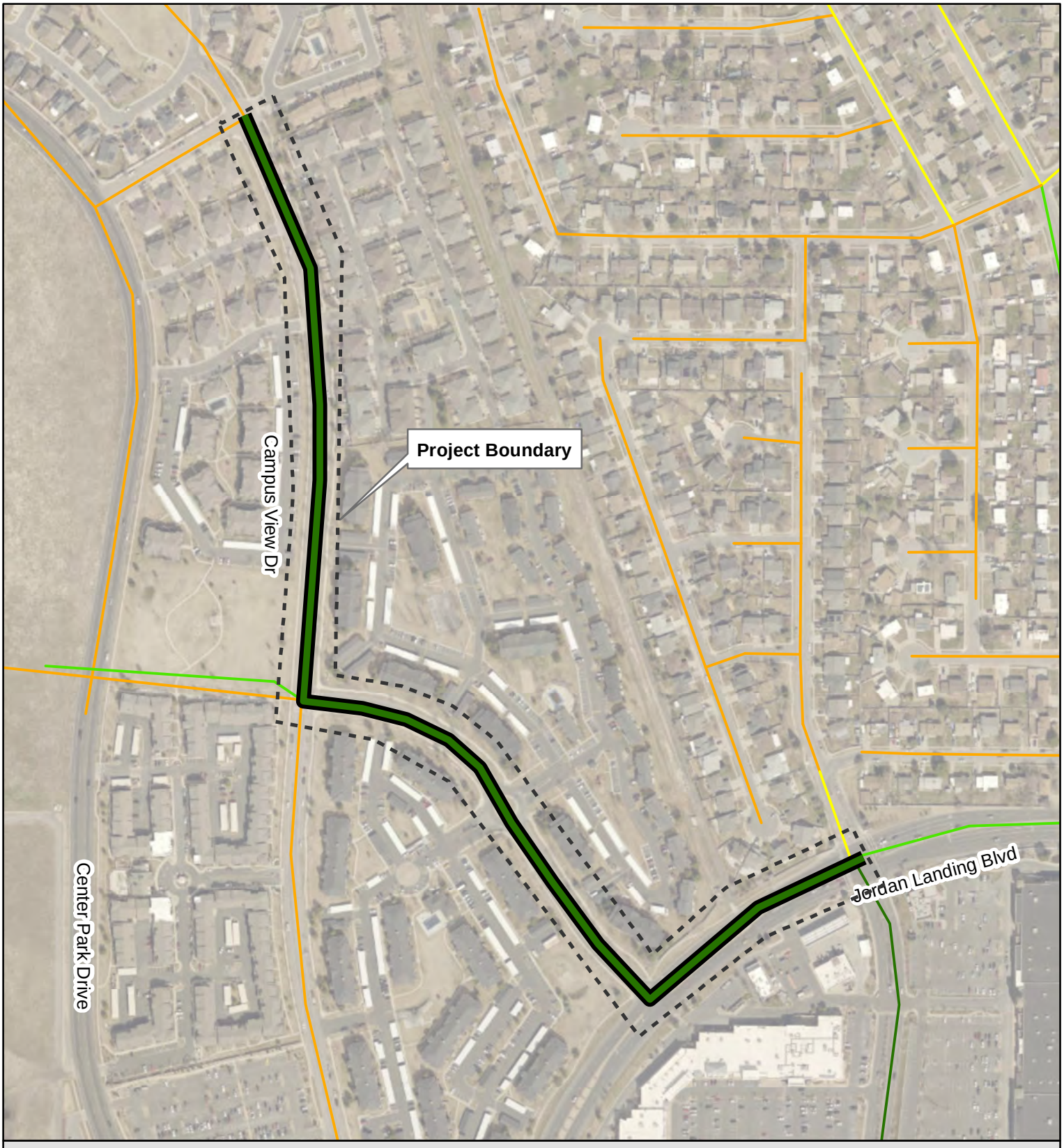
OPINION OF PROBABLE COST

Name: 7000 South
Number: 16
Desc: 7000 South from Bangerter Highway to 3200 West

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 84,160	$ 84,160
2	Traffic Control (approx 10%)	LS	1	$ 84,160	$ 84,160
				SUBTOTAL	**$ 168,320**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF		$ 32	$ -
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF	2,380	$ 85	$ 202,300
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	2,380	$ 25	$ 59,500
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 273,800**
Trench Excavation and Backfill					
14	10-20 feet	LF	2,380	$ 120	$ 285,600
				SUBTOTAL	**$ 285,600**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	2,380	$ 80	$ 190,400
				SUBTOTAL	**$ 190,400**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	6	$ 6,000	$ 36,000
				SUBTOTAL	**$ 36,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA		$ 75,000	$ -
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ -**
Miscellaneous					
19	Lateral Connections (estimate)	EA	18	$ 1,100	$ 19,800
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 55,800**
			CONSTRUCTION SUBTOTAL		**$ 1,009,920**
	Construction Contingency		25%		$ 252,480
	Engineering, Administration, Legal, etc.		20%		$ 201,984
	City Staff Time		5.0%		$ 50,496
				TOTAL COSTS	**$ 1,515,000**



WEST JORDAN
UTAH

PROJECT 17:
Campus View

Future Pipe Size		Existing Pipe Size			
12	18	6	10	24	
15	21	8	12	27	
	24		15	30	
	30		18	36	
	36		21	39	

0 170 340 Feet

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J·U·B ENGINEERS, INC.

THE LANGDON GROUP

GATEWAY MAPPING INC.

OTHER J-U-B COMPANIES

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OPINION OF PROBABLE COST

Name: Campus View Drive, Cobble Ridge Drive, Jordan Landing Boulevard
Number: 17
Desc: 12-inch on Campus View Drive from Watkins Way to Cobble Ridge Drive; Cobble

Item No.	Description	Unit	Quantity	Unit Price	Total
General					
1	Mobilization (approx. 10%)	LS	1	$ 91,404	$ 91,404
2	Traffic Control (approx 10%)	LS	1	$ 91,404	$ 91,404
				SUBTOTAL	**$ 182,808**
Gravity Sewer Pipe					
3	8-inch PVC Pipe & Bedding	LF		$ 24	$ -
4	10-inch PVC Pipe & Bedding	LF		$ 27	$ -
5	12-inch PVC Pipe & Bedding	LF	3,320	$ 32	$ 106,240
6	15-inch PVC Pipe & Bedding	LF		$ 40	$ -
7	18-inch PVC Pipe & Bedding	LF		$ 55	$ -
8	21-inch PVC Pipe & Bedding	LF		$ 70	$ -
9	24-inch PVC Pipe & Bedding	LF		$ 85	$ -
10	30-inch PVC Pipe & Bedding	LF		$ 115	$ -
11	36-inch PVC Pipe & Bedding	LF		$ 160	$ -
12	Dewatering - Minor	LF	3,320	$ 10	$ 33,200
13	Connect to Existing	EA	2	$ 6,000	$ 12,000
				SUBTOTAL	**$ 151,440**
Trench Excavation and Backfill					
14	10-20 feet	LF	3,320	$ 100	$ 332,000
				SUBTOTAL	**$ 332,000**
Surface Repair					
15	UDOT Asphalt Patch (20 ft wide)	LF		$ 130	$ -
16	City Asphalt Patch (20 ft wide)	LF	3,320	$ 80	$ 265,600
				SUBTOTAL	**$ 265,600**
Manholes					
16	60" Manhole (10-20 ft. depth)	EA	9	$ 6,000	$ 54,000
				SUBTOTAL	**$ 54,000**
Crossings/Borings					
17	Irrigation Canal or Railroad (Boring)	EA	1	$ 75,000	$ 75,000
18	Major Arterial Crossing (Boring)	EA		$ 150,000	$ -
				SUBTOTAL	**$ 75,000**
Miscellaneous					
19	Lateral Connections (estimate)	EA		$ 1,100	$ -
20	Bypass Pumping	Days	30	$ 1,200	$ 36,000
				SUBTOTAL	**$ 36,000**
			CONSTRUCTION SUBTOTAL		**$ 1,096,848**
	Construction Contingency		25%		$ 274,212
	Engineering, Administration, Legal, etc.		20%		$ 219,370
	City Staff Time		5.0%		$ 54,842
				TOTAL COSTS	**$ 1,645,000**

Pipes with d/D greater than or equal to 0.75 (red pipes on d/D map) that are not included as CIPs

Pipe ID	Location	Pipe Size
ML-100202	Lake Powell Road - between Annandale Way and Strada Crest Way	8
ML-100201	Lake Powell Road - between Annandale Way and Strada Crest Way	8
CDT-4283	South Prosperity Way / 6200 West - near Boeing	8
CDT-7390	7800 South and 5490 West	8
CDT-31	7801 South and 5490 West	12
CDT-6992	Bedrock Flats Lane	8
CDT-6994	Bedrock Flats Lane	8
341	Grizzly Way	12
343	Grizzly Way	12
345	Grizzly Way	12
347	Grizzly Way	12
353	Grizzly Way	10
355	Grizzly Way	10
357	Grizzly Way	10
359	Grizzly Way	10
52	7800 South and 4690 West	21
CDT-2252	New Bingham Highway - south of 4800 West	10
1264	New Bingham Highway and 4800 West	15
CDT-5096	8260 South and 4800 West	8
CDT-4056	Copper Pot Lane	8
1210	7800 South and 4000 West	15
Multiple	Old Bingham Highway - between 7800 South and 8600 South	Various
CDT-3738	9000 South and 3200 West	8
CDT-3745	9000 South and 3200 West	8
CDT-3744	9000 South and 3200 West	8
CDT-3704	South Edenbrook Way and 9000 South	8
CDT-1158	7800 South and Elk Ridge Drive	8
ML-100207	7550 South and 2230 West	8
ML-100208	7550 South and 2230 West	8
ML-100209	7550 South and 2230 West	8
1706	Redwood Road - near Deseret Industries	8
1016	7800 South - near outlet	36
CDT-1148	7800 South - near outlet	36
859	Sugar Factory Road and Redwood Road	8
ML-EGF001	8660 South and Eggli Farms Circle	8
CDT-3435	1300 West - near 9000 South	8
CDT-3368	8870 South and 1095 West	8
CDT-6890	Near power station	24

d/D	Comment
1	Datum issue
1	Datum issue
0.789	Less slope (0.56%) than surrounding pipes
0.779	Appears to be at capacity
0.754	Appears to be at capacity
1	Incorrect invert elevations
1	Incorrect invert elevations
1	Watch (appears to be at capacity)
1	Watch (appears to be at capacity)
1	Watch (appears to be at capacity)
0.845	Watch (appears to be at capacity)
0.762	Watch (appears to be at capacity)
0.794	Watch (appears to be at capacity)
0.916	Watch (appears to be at capacity)
0.752	Watch (appears to be at capacity)
0.856	Watch (appears to be at capacity)
0.793	Appears to be at capacity
0.821	Flat slope; appears to be at capacity
0.829	Appears to be at capacity
0.975	Incorrect invert elevations
0.826	Appears to be at capacity
Various	Incorrect invert elevations
0.765	Incorrect invert elevations
1	Incorrect invert elevations
1	Incorrect invert elevations
0.835	Incorrect invert elevations
0.78	May not be an existing pipe
1	Datum issue
1	Datum issue
1	Datum issue
0.787	Appears to be at capacity
0.751	Flat slope for pipe size
0.899	Flat slope for pipe size
0.81	Appears to be at capacity
1	Incorrect invert elevations
0.871	Incorrect invert elevations
0.769	Flat slope; appears to be at capacity
0.755	Near capacity