SANITARY SEWER

IMPACT FEE FACILITIES PLAN

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APPENDIX

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EXECUTIVE SUMMARY

This Impact Fee Facility Plan (IFFP) is a document that considers the sanitary sewer **collection** needs, limited aspects of wastewater **treatment**, and treated effluent **disposal** within the Wolf Creek Water and Sewer Improvement District (WCWSID) boundary through buildout. The primary purpose of this plan is to identify projects that are growth related, or in other terms, impact fee eligible. Projects needed to address existing capacity deficiencies will also be identified. It is recommended where improvements are needed both at present to correct deficiencies and will also need further improvement to handle buildout conditions, that new sewer lines be constructed to buildout sizes. The IFFP will be completed following the requirements of Section 11-36a of Utah code, including level of service and excess capacity. The Impact Fee Analysis (IFA) will be completed in a separate document.

SYSTEM GROWTH

A hydraulic model of the existing and proposed future pipelines has been created to determine peak flows for existing and buildout conditions. The existing condition model consists of Equivalent Residential Units (ERUs) active at the time of the study. The buildout condition model consists of existing and future ERUs, based on platted parcels and current development master plans within the District boundary.

The number of existing ERUs reported by the District at the time of the study is 1,114. This consists of 1,099 domestic and 15 commercial units.

It is projected that 2,441 ERUs will be served by WCWSID at buildout. Only future development within the existing WCWSID boundary was considered in the projected ERUs.

Peak flows were determined for each condition using existing and projected ERUs and then modeled to determine capacity usage in pipelines. Peak flows were based on 100 gallons per capita per day, 3 persons per household and a peaking factor of 2.5. The modeled flows closely reflect realized flows and are considered accurate.[1]

[1] SCADA data available for the year 2020 indicates that the actual peak flow during the year (March) was 12% higher than the value calculated for use in the model. However, it appears that the peak flow is present due to inflow and infiltration of snowmelt and surface water (I&I). If the second highest peak (during the dry month of July when peak flows are more likely not affected by I&I), the recorded peak flow was 12% lower than the value calculated for use in the model. The District's efforts to reduce or eliminate illegal discharges of roof drains, trench drains and sump drains have been met with success and it is anticipated that continued efforts will meet with success to drastically reduce I&I to the point where the calculated peak flows as mentioned in the body of this paragraph are substantially equal to actual peak flow rates.

HISTORICAL DATA

Miscellaneous historical data are shown in the following table for informational reference.

Table T-1, Miscellaneous Statistics, 2010-2021[2]

Year	Domestic	Commercial	Total ERUs
2021	1099	15	1114
2020	1084	15	1096
2019	1062	15	1077
2018	1014	15	1029
2017	965	15	980
2016	946	13	959
2015	943	13	956
2014	938	13	951
2013	932	13	945
2012	928	13	941
2011	923	13	936
2010	918	15	933

LEVEL OF SERVICE

The **collection** system pipes, for both existing and future conditions, were evaluated using the depth to diameter ratio (d/D) under the design flow conditions. Pipe capacity is determined by d/D values. Pipes with d/D values less than the level of service value are considered to have excess capacity. Pipes found to have d/D values at or above the level of service will be considered for replacement. The design parameters for each ERU and the District's desired level of service are listed in Table T-2.

Table T-2, Design Parameters and Level of Service

Description	Value
Design Sewer Flow Allowance per ERU (gpd)	300
Design Flow Peaking Factor	2.5
Sewer collection system Level of Service, Maximum Acceptable Depth (d) to Diameter (D) Ratio for Peak Flow conditions, (d/D)	0.75

[2] Connection data provided by WCWSID Office Manager, October 8, 2021.

The SCADA system is an integral part of the wastewater **treatment** plant's operation. It has had a useful life of over 10 years and its replacement is anticipated to also have a useful life of over 10 years. The District's SCADA equipment is a public facility eligible for application of the impact fee law.[3]

Treated effluent **disposal** is currently accomplished by either land application during the high-demand irrigation season, or through infiltration in rapid infiltration basins adjacent to the treatment plant. WCWSID desires to raise the level of service in the category of treated effluent disposal. The District plans to construct a 90-AF pond near the Bridges development to collect treated effluent year-round for the benefit of disposal through land application during the irrigation season. A pump station and transmission line will also need to be constructed and are shown in concept on Map CP2 in the appendix, collectively referred to as the Bridges Pond project, Project 5. The Bridges Pond project is discussed in further detail in the District's Secondary Water IFFP. The reader is referred to the Secondary Water System IFFP.

Constructing the Bridges Pond will primarily benefit the secondary water system. Thus, most of the costs (90%) of said improvements are attributed to the secondary water system and will be paid through collection of secondary water impact fees.

RECOMMENDED SYSTEM IMPROVEMENTS

Collection System - The current WCWSID service area was divided into 4 main trunk lines and the system was evaluated. Most of the District has a relatively steep slope and has adequate capacity. The 4 main trunk lines modeled converge at the low end of the system and eventually flow to the treatment plant in one main line. Flows from the four trunk lines converge on the west side of Wolf Creek Drive and continue to the treatment plant on Willow Brook Lane. The existing system at the lower end is inadequately sized to provide the desired level of service for existing connections, requiring improvements at present. Additional improvements are needed to accommodate buildout conditions. The recommended projects (1 through 4) are shown in table T-3 on the following page.

The wastewater **treatment** plant requires a new SCADA system. The District has received bids to supply the needed replacements. A portion of the cost of a new SCADA system will be covered by existing ERUs through user fees and the District's general operating funds. Future ERUs will pay for a portion through impact fees. The recommended SCADA replacement is shown as Project 6 in table T-3 on the following page.

Ten percent of the benefit of the Bridges Pond is attributable to the **disposal** portion of the sanitary sewer system. Establishing this year-round level of service for treated effluent disposal will be new to the District and the cost of establishing the level of service for existing ERUs on the sanitary sewer system cannot be paid for through the collection of impact fees. The cost of providing the year-round level of service to future ERUs, however, is impact fee eligible. The recommended Bridges Pond is shown as Project 5 in table T-3 on the following page.

Note that sequence and timing of implementation of the recommended projects will be determined based on sequence and location of development and other factors determined by the District.

[3] Per Utah Code, 11-36a-102(17).

Table T-3, Recommended Improvement Projects

Project	Priority	Description	Estimated Total Project Cost	Impact Fee Eligible Portion
1	**2**	Project 1 – 10" and 12" lines in Willow Brook Lane and Bypass The Villages	$324,916	$193,581
2	**3**	Project 2 – Upsize pipes 90 and 92 at the bottom of The Villages	$129,629	$62,374
3	**4**	Project 3 – 10" line in Creek View Drive and Willow Brook Lane	$962,550	100%
4	**5**	Project 4 – Upsize Pipe 36 crossing Wolf Creek Drive to 12"	$191,086	$107,516
5	**6**	Bridge Pond – Impact Fee Eligible column shows that portion of costs attributable to benefitting the sewer system that may be paid for through impact fees (10% of total project cost is attributable to benefitting the sewer system and 53.9% of that 10% is impact fee eligible)	$5,321,595	$286,834
6	**1**	SCADA system replacement - Portion of costs (53.9%) attributable to future ERUs that may be paid for through impact fees	$200,000	$107,800

CERTIFICATION of Compliance with Utah State Code (11-36a-306(1)):

To the extent the following items are addressed in the IFFP dated January 2022, Gardner Engineering certifies that the following impact fee facilities plan:

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

CHAPTER 1

INTRODUCTION

Gardner Engineering has been retained by Wolf Creek Water and Sewer Improvement District (WCWSID, District) to help prepare an Impact Fee Facilities Plan (IFFP) for the District's sanitary sewer system. The primary purpose of this plan is to identify projects that are growth related or impact fee eligible. Projects needed to address existing capacity deficiencies will also be identified. It is recommended that new sewer lines be constructed to buildout sizes. The IFFP will be completed following the requirements of Section 11-36a of Utah code, including level of service and excess capacity. The Impact Fee Analysis (IFA) will be included in a separate document.

Future growth within the District boundary has been estimated based on current development master plans. Revisions to this document may be necessary if major changes to planning or development occur.

Tasks

The following are general tasks to complete the IFFP:

Task 1: Existing system mapping

Task 2: Identify future development (current master planning and platted open lots)

Task 3: Hydraulic model of main trunk lines (existing and buildout conditions)

Task 4: Identify needed improvements to serve existing and future development

Task 5: Prepare IFFP document summarizing results of model and recommended improvement.

DEFINITIONS

CFS	Cubic feet per second
d/D	depth of flow / Diameter of Pipe Ratio
ERU	Equivalent Residential Units
GPD	gallons per day
gpdpc	gallons per day per capita
MGD	Million gallons per day
I & I	Infiltration and Inflow
IFFP	Impact Fee Facilities Plan
WCWSID	Wolf Creek Water and Sewer Improvement District

CHAPTER 2

EXISTING SYSTEM

The existing WCWSID boundary was evaluated in this document. The existing **collection** system mapping was completed by field survey and information provided by the District Manager. Existing system mapping is included in the appendix as Sheet SM1. The existing system consists of primarily of 8" sewer lines with some 10" sewer lines. Much of the developed area within the District is on the hillside and sloping towards the treatment plant. Most of the existing sewer lines have relatively steep slopes and capacity is not an issue. In the lower areas of the system, nearer the treatment plant, the slopes are flatter with decreased capacity. Visual representations of the existing system main trunk line pipes and manholes included in the hydraulic model created for analysis of the system's capacity are included as SM2 and SM3 in the appendix (manholes are referred to as "Structures" in the model).

There are three existing sewer lift stations within the existing sanitary sewer system. Two of them serve Phases 2 and 6 of the Eagle Ridge subdivision and the third services the Ridge Townhomes. The District manager indicated that all lift stations operate properly.

WCWSID is currently working to identify and address inflow and infiltration (I&I) issues on the existing system. The District will continue to repair damaged pipes and manholes and work to eliminate illegal connections from sumps, roof drains, and foundation drains. This IFFP does not include evaluation of I&I. The district currently can only meter sewer flows as they enter the treatment plant. Additional metering in specific areas would be needed to complete a detailed study of I&I.

The existing WCWSID **treatment** plant is located at 4820 East Willow Brook Lane. The Membrane Bioreactor sewer facility was constructed in 2008 to replace a sewer lagoon system. The plant is designed to treat waste from 2,500 ERUs. The current plant capacity is sized to serve all planned development within the existing WCWSID boundary. The plant site includes 2 backup storage ponds that can be used if the plant is temporarily inoperable or flows exceed the plant's treatment capacity.

The plant's activities are electronically monitored and controlled through use of a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system needs to be replaced, as it has become technologically outdated and is becoming obsolete. Additional evaluation of the treatment plant was not within the scope of this IFFP.

Once treated to appropriate water quality, the treated effluent exits the plant for **disposal**. Treated effluent is currently disposed of by either infiltration or land application. Infiltration occurs in rapid infiltration basins located adjacent to the treatment plant. Land application occurs during periods of high irrigation demand by pumping the treated effluent to a pond on the 9th Hole, then the treated effluent gets re-pumped into the secondary water system. Land application occurs only during the irrigation season. A redundant method of disposal by land application is being considered by the District: year-round storage of treated effluent for use during the irrigation season as a supplement to other sources of water for the secondary system. The reader is referred to the District's Secondary Water System IFFP for additional discussion of this method of treated effluent disposal.

CHAPTER 3

FUTURE GROWTH

The service area was evaluated using existing and buildout conditions. The existing condition has been evaluated using the number of existing sewer customers[4], a.k.a existing Equivalent Residential Units (ERUs). An ERU is a unit of measurement used to refer to the sanitary sewer waste of both residential and non-residential development. The number of existing ERUs reported by the District at the time of the study is 1,114. This consists of 1,099 residential and 15 non-residential units.

There are a number of lots within the District boundary that have been platted but are not currently sewer customers contributing flows to the system. These platted-but-unbuilt lots are considered in the buildout condition analysis.

There are several areas within the WCWSID boundary that have been master planned but are not yet platted with lots. In 2014, Weber County reviewed a proposed development master plan for the Wolf Creek Resort. Information from that master plan was used to add future, unplatted developments to the number of platted-but-unbuilt lots[5] to establish a future, "buildout" condition. It is estimated that an additional 1,305 ERUs will be added to the WCWSID sanitary sewer system before buildout. Buildout ERUs are summarized on Map SM5 in the appendix.

The total number of estimated ERUs that will be served by the sewer treatment plant at buildout is 2,441. The sewer treatment plant is designed to treat waste from 2,500 ERUs.

Dry weather sewer flows are flows from regular water usage from sewer customers. As mentioned in Chapter 2, above, the effects of I&I flows were not evaluated in this study. The District recognizes that I&I flows have a real impact on the sanitary sewer system's operation and continues efforts to minimize or eliminate sources of I&I. Dry weather flows were used as the contributing flows from the estimated ERUs in both the existing and buildout modeled conditions.

State Code requires that sewer systems be designed based on an annual average daily rate of flow of 100 gallons per capita per day unless there are data to indicate otherwise. This flow rate includes some allowance already for infiltration and inflow. The latest census data indicates an average household size of 3 people[6]. The flow was modeled using a peaking factor of 2.5 to account for estimated peaks experienced each day. The modeled peak flows closely match the realized peak flows (refer to Footnote 1 on Page S-1). Table 3-1, below, shows the diurnal curve[7] from which the modeled peaking factor was derived.

[4] It is significant to note that "existing" ERUs are physical units connected to the system at present.
[5] Indicated by a comparative review of the most recent publicly available aerial photography in the area and Weber County' s plat maps.
[6] https://www.census.gov/quickfacts/webercountyutah; accessed 2022-01-10.
[7] City of Saratoga Springs, Sewer Capital Facilities Plan, May 2014, Page 4-3.

Table 3-1, Diurnal Curve Used in Modeling the Sanitary Sewer System

HYDRAULIC MODEL TIME PATTERN	
HOUR	RATIO OF AVERAGE DAY FLOW
0	0.80
1	0.60
2	0.40
3	0.30
4	0.20
5	0.25
6	0.30
7	0.45
8	0.64
9	1.10
10	1.70
11	2.50
12	2.00
13	1.60
14	1.40
15	1.25
16	1.10
17	1.05
18	1.15
19	1.33
20	1.09
21	0.97
22	0.90
23	0.92
24	0.80

CHAPTER 4

COLLECTION SYSTEM HYDRAULIC MODEL

A computer model of the WCWSID system was developed to determine peak flows from the existing and future conditions. The modeling software used for this study was Autodesk Storm and Sanitary Analysis. Storm and Sanitary Analysis is an extension of Autodesk Civil 3D. The existing sewer mapping has historically been maintained in Civil 3D. Plan and profile data for the sewer system was imported into the analysis software to evaluate sewer flow conditions. For the purposes of this study, 4 major trunk lines were evaluated. These lines represent the main sewer flow for Wolf Creek Water and Sewer Improvement District. The major sewer mains and manholes (referred to in the model as Structures) included in the hydraulic model are shown in the appendix as Maps SM2 and SM3. Information on the physical characteristics of the pipes included in the model were collected and assembled by Gardner Engineering. Manhole rim elevations and inverts were collected by Gardner Engineering survey crew. Please refer to the model run results on Table 1 in the Appendix for data modeled for existing conditions.

Estimated flows for both existing and buildout conditions were added to the model based on ERUs for each scenario. The existing system flows were added to the model at structure locations. Engineering judgement was used to reduce the number of manholes and pipes included in the model. Where slopes were clearly steep and the number of injecting ERUs were low, no pipes and manholes were modeled but flows from future development were instead added to major trunk lines as applicable.

CHAPTER 5

CAPACITY ANALYSIS

After development of the model, a capacity analysis of the system was completed. The analysis is used to identify areas in the system where peak flows exceed the pipe capacity level of service.

LEVEL OF SERVICE

The **collection** system, for both existing and future conditions, were evaluated based on the following level of service. The level of service used is listed in Table T-2. Pipes were evaluated using the depth to diameter ratio (d/D) under the design flow conditions. Pipe capacity is determined by d/D values. Pipes with d/D values less than the level of service value are considered to have excess capacity. Pipes found to have d/D values at or above the level of service will be considered for replacement.

Table T-2, Level of Service

Description	Value
Design Sewer Flow Allowance per ERU (gpd)	300
Design Flow Peaking Factor	2.5
Maximum Allowable Depth to Diameter Ratio for Peak Flow conditions for new design	0.75

The SCADA system is an integral part of the **treatment** plant's operation. It has had a useful life of over 10 years and its replacement is anticipated to also have a useful life of over 10 years. The District's SCADA equipment is a public facility eligible for application of the impact fee law.[8]

Treated effluent **disposal** is currently accomplished by either land application during the high-demand irrigation season, or through infiltration in rapid infiltration basins adjacent to the treatment plant. WCWSID desires to raise the level of service in the category of treated effluent disposal. The District plans to construct a 90-AF pond near the Bridges development to collect treated effluent year-round for the benefit of disposal through land application during the irrigation season. A pump station and transmission line will also need to be constructed and are shown in concept on Map CP1 in the appendix. Establishing this year-round level of service for treated effluent disposal will be new to the District and the cost of establishing the level of service for existing users cannot be paid for or reimbursed through the collection of sewer impact fees. The benefits, costs and impact fees related to this method of disposal are further discussed under the heading **Disposal** on Page 5-6.

CAPACITY ANALYSIS

Future development cannot pay to correct existing deficiencies in public utilities through the collection of impact fees. Existing deficiencies in the sewer **collection** system were identified through use of the hydraulic model established in the previous chapter. Note that pipes modeled to carry existing peak flows at depths of flow greater than the acceptable d/D level[9] have been highlighted in Table 1 in the Appendix. The pipes identified in Table 1 were then increased in size until existing peak flows were carried at an acceptable d/D level. The pipes needed to correct existing deficiencies were then included

[8] Per Utah Code, 11-36a-102(17).
[9] Acceptable flow depth = d/D < 75%. Refer to Table T-2, above.

in the model and the results of running the model with the existing ERU loading plus the upsized pipes is shown in Table 2, to show that existing flow capacity deficiencies in the model were corrected with the upsized pipes.

Future development will be required to install new facilities as needed to extend sewer collection service to new areas. Future connections will use excess capacity in existing facilities and, in cases where existing facilities are not adequately sized to carry flows at 75% flow depth, the facilities will need to be upsized for buildout conditions.

Excess Capacity (CFS)[10] available for utilization by future connections in existing (or upsized, as described on the previous page) pipes was calculated as the difference between Design Flow 75% Capacity and Peak Flow (CFS). Table 2 in the Appendix shows the Excess Capacity (CFS) available for utilization by future connections in each analyzed Main Trunkline pipe section in terms of Equivalent ERU.

The same process of determining deficiencies in the existing system was also employed to determine deficiencies between the improved existing system and the buildout conditions. The deficiencies are identified in Table 3. Necessary improvements were then incorporated into the model and Table 4 presents the model run output that demonstrates that buildout flow capacity deficiencies in the model were corrected with the upsized pipes.

Trunk Line 1

Trunk Line 1 (represented with a bold yellow line on Maps SM2-5 and CP1&2 in the Appendix) is relatively steep and consists of large enough pipes above the point where waste from Trunk Line 2 flows into it, that there are no deficiencies under either existing or buildout conditions.

Below the intersection of Trunk Line 2, there are both existing and buildout condition deficiencies. The existing condition deficiencies are highlighted on Table 1, shown corrected in Table 2 in the Appendix, and described below. Buildout condition deficiencies are highlighted on Table 3, shown corrected in Table 4 in the Appendix, and described below. Please refer to Map SM2 in the Appendix for a representation of model pipe locations.

Existing Deficiencies:

1. After Trunk Line 3 intercepts Trunk Line 1 below The Villages, **Pipes 90 and 92** are undersized for existing flows, as can be seen in the highlighted rows of Table 1 in the Appendix. The existing 8" pipes need to be 10" for existing conditions. As shown in Table 2, the Excess Capacity in Pipes 90 and 92 after being upsized to correct the existing deficiency is 437 ERUs. The calculated capacities of 10" lines, given the slopes of Pipes 90 and 92 is 1,088 ERUs[11] at the standard 75% flow depth. Based on the total and excess capacities, approximately (437 ERUs excess capacity / 1,088 ERU capacity at 75% flow depth) 40% of the 10" line capacity would benefit future users.

2. **Pipe 91** is undersized for existing ERUs, as noted on Table 1 in the Appendix. The existing 8" pipe needs to be 10" for existing conditions. As shown in Table 2, the Excess

[10] Capitalized terms in this and Chapter refer to column headings in Tables 1-4 in the Appendix.
[11] The Manning equation was used to calculate the flow passed by a 10" pipe with n=0.013, at 0.40% slope and a 75% flow depth, and the resulting flow was converted to Equivalent ERUs.

Capacity in Pipe 91 after being upsized to correct the existing deficiency is 838 ERUs. The calculated capacity of a 10" line, given the slope of Pipes 91 is 1,970 ERUs at the standard 75% flow depth. Based on the total and excess capacities, approximately (838 ERUs excess capacity / 1,970 ERU capacity at 75% flow depth) 40%[12] of the 10" line capacity would benefit future users.

Buildout Deficiencies:

3. **Pipes 8-10** below Trunk Line 2 along Creek View Drive need to be upsized to carry buildout flows. One hundred percent of the capacity required in Pipes 8-10 would benefit future connections. **Pipe 93** in Willow Brook Lane, below Creek View Drive would necessarily be upsized to prevent a reduction in pipe size as waste flows downhill. One hundred percent of the capacity increase resulting from the Pipe 93 size increase would be due to future users requiring the upsize of Pipes 8-10. Upsizing of Pipes 8-10 and 93 is collectively referred to as Project 3.

4. Pipes through the Villages would also need to be upsized for buildout flows, but an alternative improvement is preferred by the District. The preferred alternative will avoid the acute angles of pipes in the Villages: **Project 1.** Project 1 would divert flows from Patio Springs and points above, as well as flows from Wolf Lodge into a new line in Willow Brook Lane. Project 1 is visually presented on Sheet CP-1 in the Appendix and is highlighted in the model output on Tables 2-4 in the Appendix. It is identified with Priority 2 after the SCADA system, because the Project would address not only the existing deficiency in Pipe 91 (Pipe 91 transmits flow from all customers into the final manhole before entering the treatment plant and is therefore critical to the entire District for immediate implementation), but would also redirect a significant portion of the District's wastewater flows *around* the multiple sharp angles in the pipes' flow paths present in The Villages development. Thus, Project 1 would correct the existing deficiency in Pipe 91 and provide immediate operational improvements while preparing for the buildout needs of the other pipes in the Project. The benefit of Project 1 is shared between existing and future users, and is addressed in the calculation of project costs, included as Page 24 in the Appendix.

5. **Pipes 90-92** will need to be upsized further to meet buildout flows. Future users will utilize all the Excess Capacity identified in 1. and 2., above, plus additional capacity will be needed. The additional capacity provided by upsizing beyond what is needed at present will entirely be required by future customers.

[12] 43% calculated value, rounded down to 40% for the convenience of matching the excess capacities of Pipes 90 and 92.

Trunk Line 2

Trunk Line 2 (represented with a bold blue-green line on Maps SM2-5 and CP1&2 in the Appendix) is relatively steep and consists of large enough pipes that there are no identified deficiencies in flow capacity.

Trunk Line 3

Trunk Line 3 (represented with a bold blue line on Maps SM2-5 and CP1&2 in the Appendix) is relatively steep and consists of large enough pipes above the point where waste from Powder Canyon and Moose Hollow enter the collection system (on the east side Wolf Creek Drive, Structure 38 in the model, refer to Maps SM4 and SM5 in the Appendix), that there are no deficiencies under either existing or buildout conditions.

Below Structure 38, there are both existing and buildout condition deficiencies. The identified existing condition deficiency is highlighted on Table 1, shown corrected in Table 2 in the Appendix, and described below. The identified buildout condition deficiency is highlighted on Table 3, shown corrected in Table 4 in the Appendix, and described below. Please refer to Map SM2 in the Appendix for a representation of model pipe locations.

Existing Deficiency:

6. Below the point where Powder Canyon and Moose Hollow enter the collection (Structure 38), **Pipe 36** in Trunk Line 3 is undersized for existing flows, as can be seen in the highlighted row of Table 1 in the Appendix. The existing 8" pipe needs to be 10" for existing conditions. As shown in Table 2, the Excess Capacity in Pipe 36 after being upsized to correct the existing deficiency is 455 ERUs. The calculated capacity of a 10" pipe, given the slope of Pipe 36 is 1,047 ERUs[13] at the standard 75% flow depth. Based on the total and excess capacities, approximately (455 ERUs excess capacity / 1,047 ERU capacity at 75% flow depth) 40%[14] of the 10" line capacity would benefit future users.

Buildout Deficiency:

7. **Pipe 36** will need to be upsized further to meet buildout flows. Future users will utilize all the Excess Capacity identified in 6., above, plus additional capacity will be needed. The additional capacity provided by upsizing beyond what is needed at present will entirely be required by future customers.

Trunk Line 4

Trunk Line 4 (represented with a bold green line on Maps SM2-5 and CP1&2 in the Appendix) is relatively steep and consists of large enough pipes that there are no identified deficiencies in flow capacity. Trunk Line 4 has adequate capacity through buildout.

[13] The Manning equation was used to calculate the flow passed by a 10" pipe with n=0.013, at 0.37% slope and a 75% flow depth, and the resulting flow was converted to Equivalent ERUs.
[14] 43% calculated value, rounded down to 40% for the convenience of matching the excess capacities of Pipes 90 and 92.

Treatment

The SCADA system in the treatment plant is an integral cog in the treatment plant's operations. Changes in technology have made many components of the system unserviceable and therefore obsolete.

Disposal

Treated effluent disposal is currently accomplished by either land application during the high-demand irrigation season, or through infiltration in rapid infiltration basins adjacent to the treatment plant. WCWSID desires to raise the level of service in the category of treated effluent disposal. Doing so will serve two primary purposes, 1) provide a significant source of additional water to the secondary system for use during the irrigation season, and 2) provide a year-round redundant means of disposal.

CAPACITY ANALYSIS SUMMARY

The capacity analysis identifies the needed system improvements. Chapter 6 includes a detailed description of the recommended projects. Below is a summary of the analysis and recommended improvements on each trunk line modeled.

Trunk Line 1

Pipes 8 - 10, and 93, identified as **Project 3** on Map CP1 in the Appendix, need to be upsized to 10" to carry buildout flows. No upsizing in these pipes is necessary for existing customers. A detailed cost estimate for Project 3 is included as Page 26 in the Appendix.

Pipes 90 and 92 must be upsized to 10" to carry existing flows and must be upsized to 12" to carry buildout flows. When the District upsizes Pipes 90 and 92, the installed pipes should be the size identified for buildout conditions. Upsizing Pipes 90 and 92 is collectively referred to as **Project 2** which project is shown on Map CP1 in the Appendix. A detailed cost estimate for Project 2 is included as Page 25 in the Appendix. The value of the 10" pipe capacity needed at present is not impact fee eligible, so Page 25 includes both a total project cost estimate and an impact fee eligible project cost.

Pipe 91 must be upsized to 10" to carry existing flows and must be upsized to 12" to carry buildout flows. As an alternative to upsizing lines through The Villages, WCWSID is considering the construction of lines in Willow Brook Lane to replace the 8" capacity in The Villages and route all upstream flows around the acute angles present in the sewer lines through The Villages. Upsizing Pipe 91, the installation of new lines in Willow Brook Lane, and the installation of a pipe to divert upstream flows around The Villages are collectively referred to as **Project 1,** which project is shown on Map CP1 in the Appendix. A detailed cost estimate for Project 1 is included as Page 24 in the Appendix. The value of the new 8" lines that would redirect or replace 8" capacity through The Villages is not impact fee eligible, nor is the value of the 10" Pipe 91 capacity needed at present, so Page 24 includes both a total project cost estimate and an impact fee eligible project cost.

Trunk Line 2

Trunk Line 2 has adequate capacity through buildout.

Trunk Line 3

Pipe 36 must be upsized to 10" to carry existing flows and must be upsized to 12" to carry buildout flows. When the District upsizes Pipe 36, the installed pipe should be the size identified for buildout conditions. Upsizing Pipe 36 is referred to as **Project 4** which project is shown on Map CP1 in the Appendix. A detailed cost estimate for Project 4 is included as Page 27 in the Appendix. The value of the 10" pipe capacity needed at present is not impact fee eligible, so Page 27 includes both a total project cost estimate and an impact fee eligible project cost.

Trunk Line 4

Trunk Line 4 has adequate capacity through buildout.

Treatment

The SCADA system in the treatment plant must be replaced due to changes in technology making the system increasingly obsolete. Replacement must be done to maintain the level of service for future users that existing users have: an operating wastewater treatment plant.

Disposal

It is estimated that the majority (90%) of the new Bridges Pond and related pump station and transmission line will benefit the secondary system, while approximately 10% of the projects' benefits will be for the sanitary sewer system.

CHAPTER 6

RECOMMENDED IMPROVEMENTS

The capacity analysis identified areas where additional capacity is needed for both existing and future buildout conditions. To develop cost estimates, it is assumed that deficient pipes will be replaced with the necessary upsized lines. At the time of specific project design and construction, alternative options shall be evaluated such as parallel lines or improved alignments. The following recommended projects are shown in the Appendix as Maps CP1 and CP2.

Project 1

Pipe 91 in Trunk Line 1 will need to be upsized to 12" to support future growth (identified as Pipe 1C on Map CP1). It is also recommended that instead of upsizing lines through the Villages PRUD, a new 8" line in Wolf Lodge Drive (identified as Pipe 1A) and 10" lines be installed in Willow Brook Lane (identified as Pipes 1B) connecting pipes 93 and 91. This will bypass pipes 94-99 through the subdivision. Pipe 94 will be abandoned. Table 6-1 includes the estimated impact fee eligible costs for the proposed Project 1. A detailed project cost estimate is presented on Page 24 of the Appendix.

Table 6-1

Project 1	Description	Estimated Cost
Total Cost	Project 1 – Willow Brook Lane/The Villages Bypass	$324,916
	Project 1 – Willow Brook Lane/The Villages Bypass: Impact Fee Eligible Costs	$193,581

Project 2

The model indicates that the pipes below The Villages, running between Wolf Creek Drive and Willow Brook Lane (Pipes 92 and 90) will surcharge under existing conditions and is undersized. This section of pipe needs to be upsized to a 10" for existing conditions. We recommend that this pipe be upsized to a 12" to handle the anticipated flows under the future buildout condition. The cost for this project has been divided into total project cost and impact fee eligible cost. The impact fee eligible cost is the total project cost less the material cost for the 10" pipe that is needed for existing conditions. The table below gives an estimated cost of this project. A detailed project cost estimate is presented on Page 25 of the Appendix.

Table 6-2

Project 2	Description	Estimated Cost
Total Cost	Project 2 – Upsize Pipes 92 and 90 to 12" at bottom of The Villages	$129,629
Impact Fee Eligible	Project 2 – Portion of Total Cost	$62,374

Project 3

Pipes 8, 9, 10, and 93 will need to be upsized to 10" to support future growth. The pipes running in Creek View Drive are around 20 feet deep and the upsizing of said lines is not the District's preferred method of increasing capacity. However, efforts to secure an off-roadway easement to allow shallower bury depths have proven unsuccessful to date. It is assumed that these pipes will be upsized. This project is 100% impact fee eligible. A detailed project cost estimate is presented on Page 26 of the Appendix.

Table 6-3

Project 3	Description	Estimated Cost
	Project 3 – 10" line in Creek View Drive and Willow Brook Lane	$962,550

Project 4

Pipe 36 on Trunk Line 3 runs under Wolf Creek Drive. The existing pipe can physically carry flows from existing ERUs, but existing flows would be above the standard 75% flow depth for determining pipeline capacity. Thus, Pipe has reached its capacity and a 10" pipe capacity is needed at present. A 12" pipe capacity is needed for buildout conditions. It is recommended that this section be upsized to 12" to handle future flows. Table 6-4 includes a summary of the estimated cost for the proposed 12" sewer under Wolf Creek Drive. A detailed project cost estimate is presented on Page 27 of the Appendix.

Table 6-4

Project 4	Description	Estimated Cost
Total Cost	Project 4 – Upsize Wolf Creek Drive crossing to 12" (Pipe 36)	$191,086
Impact Fee Eligible	Project 4 – Portion of Total Cost	$107,516

Project 5

The Bridges Pond and associated pump station and pipeline costs have been developed in the District's Secondary Water System IFFP and are restated here in Table 6-5. As indicated in Chapter 5, it is estimated that 10% of the total project costs are attributable to benefits received by the Sanitary Sewer System, and of that 10%, 53.9%[15] is impact fee eligible.

Table 6-5

Project 5	Description	Estimated Cost
Total Cost	Total Cost (Bridges Pond, pump facility, transmission line)	$5,321,595
Portion attributable to sewer	Estimated 10% of total cost benefits sewer system	$532,160
Impact Fee Eligible	Portion (53.9%) of costs attributable to benefitting the sewer system that may be paid for through impact fees	$286,834

[15] 1,114 existing ERUs / 2,419 buildout ERUs = 46.1% of the attributable project cost is to establish the *Treated Effluent Disposal* level of service to existing users and cannot be paid for through impact fees. The remaining 53.9% of the applicable project cost is to maintain the established level of service for future users and *is* impact fee eligible.

Project 6

The SCADA system in the wastewater treatment plant is becoming obsolete after 13 years of useful life and must be replaced to maintain the level of service that is provided to existing users. It is anticipated that the needed replacement SCADA system will likewise have a useful life of over 10 years. That portion of the SCADA system replacement that will serve existing users is not impact fee eligible. The table below gives an estimated cost of this project, based on bids received by District.

Table 6-6

Project 6	Description	Estimated Cost
Total Cost	Total Cost to replace the existing, unsupportable SCADA system	$200,000
IF eligible	Portion (53.9%) of costs attributable to benefitting the sewer system that may be paid for through impact fees	$107,800

---End of IFFP---

Appendix

KEY

- EXISTING SANITARY SEWER
- EXISTING PRESSURIZED SANITARY SEWER
- FUTURE SANITARY SEWER
- FUTURE PRESSURIZED SANITARY SEWER
- WOLF CREEK IMPROVEMENT DISTRICT

SEWER LINES ARE 8" PVC UNLESS OTHERWISE NOTED
PRESSURIZED SEWER LINES ARE 4" UNLESS OTHERWISE NOTED

Proposed Sewer Lift Station

EAGLE RIDGE DR

10" PVC

10" PVC

10" PVC

PATIO SPRINGS DR

WILLOW BROOK LN

WOLF CREEK DR

CREEK VIEW DR

2" Poly High Pressure

Sewer Lift Station

SEWER TREATMENT PLANT

ELKRIDGE TRAIL

ELKHORN DRIVE

4"

0' 250' 500' 1000' 1500'

Scale in Feet
1" = 500'

SCALE: 1" = 500'
DATE: 10-12-21
DESIGN: KAH
DRAWN: KAH
CHECKED: RC

REVISIONS

DATE	DESCRIPTION

DWG:

SEWER MASTER PLAN
OVERALL SEWER SYSTEM
WOLF CREEK IMPROVEMENT DISTRICT
EDEN, WEBER, UTAH

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SM1

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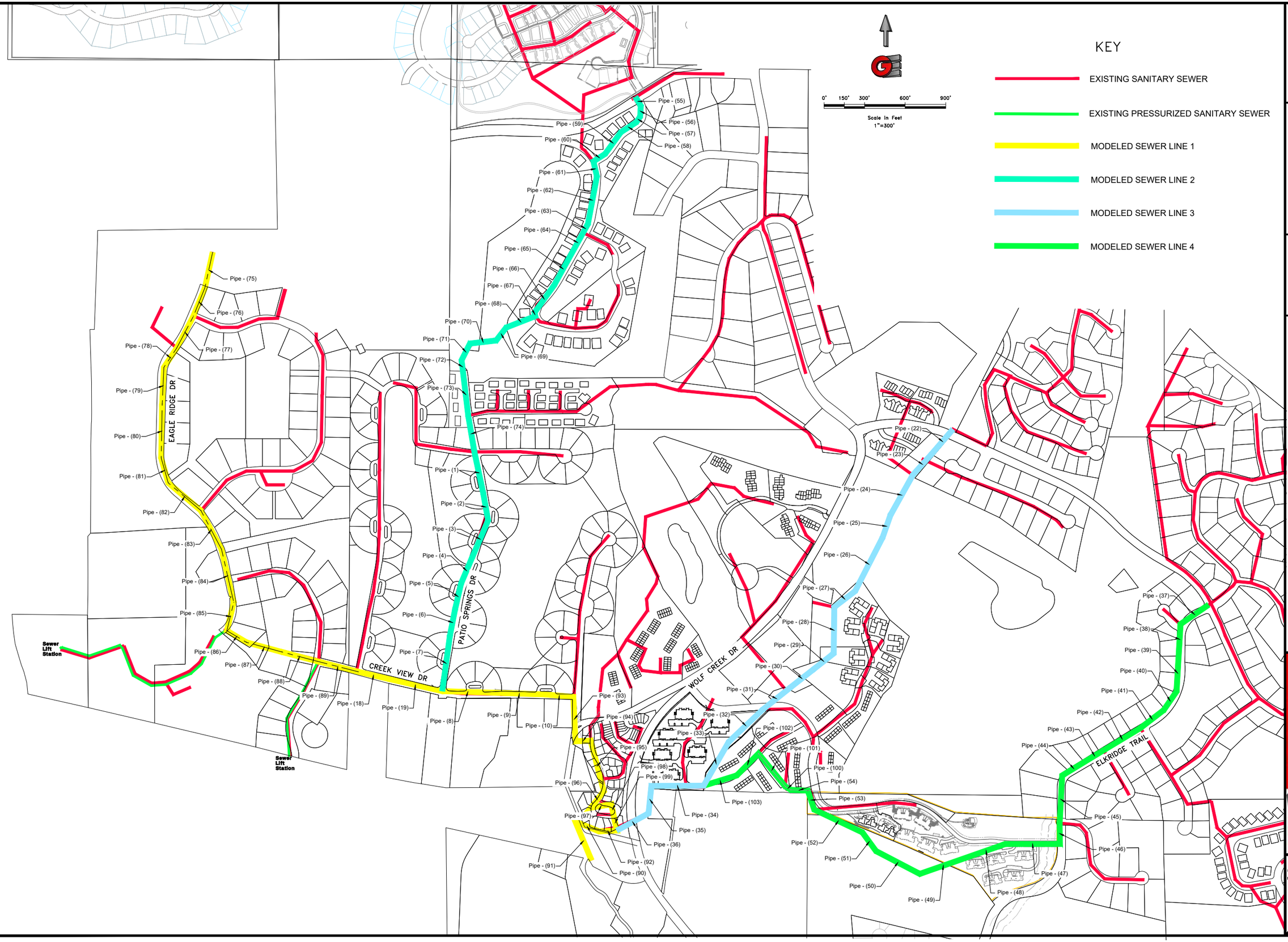

SEWER MODEL

EXISTING SEWER SYSTEM

WOLF CREEK IMPROVEMENT DISTRICT

EDEN, WEBER, UTAH

SCALE:	1"=300'
DATE:	10-12-21
DESIGN:	KAH
DRAWN:	KAH
CHECKED:	RC

REVISIONS

DATE	DESCRIPTION

DWG:

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MUNICIPAL - LAND SURVEYING
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SM2

KEY

- EXISTING SANITARY SEWER
- EXISTING PRESSURIZED SANITARY SEWER
- MODELED TRUNK LINE 1
- MODELED TRUNK LINE 2
- MODELED TRUNK LINE 3
- MODELED TRUNK LINE 4

STRUCTURE - (58)
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STRUCTURE - (4)
STRUCTURE - (5)
STRUCTURE - (6)
STRUCTURE - (7)
STRUCTURE - (8)
STRUCTURE - (2)
10" PVC
10" PVC
10" PVC
Sewer Lift Station
2" Poly High Pressure

0' 250' 500' 1000' 1500'
Scale In Feet
1" = 500'

REVISIONS		
DATE	DESCRIPTION	

SCALE 1" = 500'
DATE 10-12-21
DESIGN KAN
DRAWN KAN
CHECKED RC
DWG:

SEWER MODEL EXISTING STRUCTURES
EXISTING SEWER SYSTEM
WOLF CREEK IMPROVEMENT DISTRICT
EDEN, WEBER, UTAH

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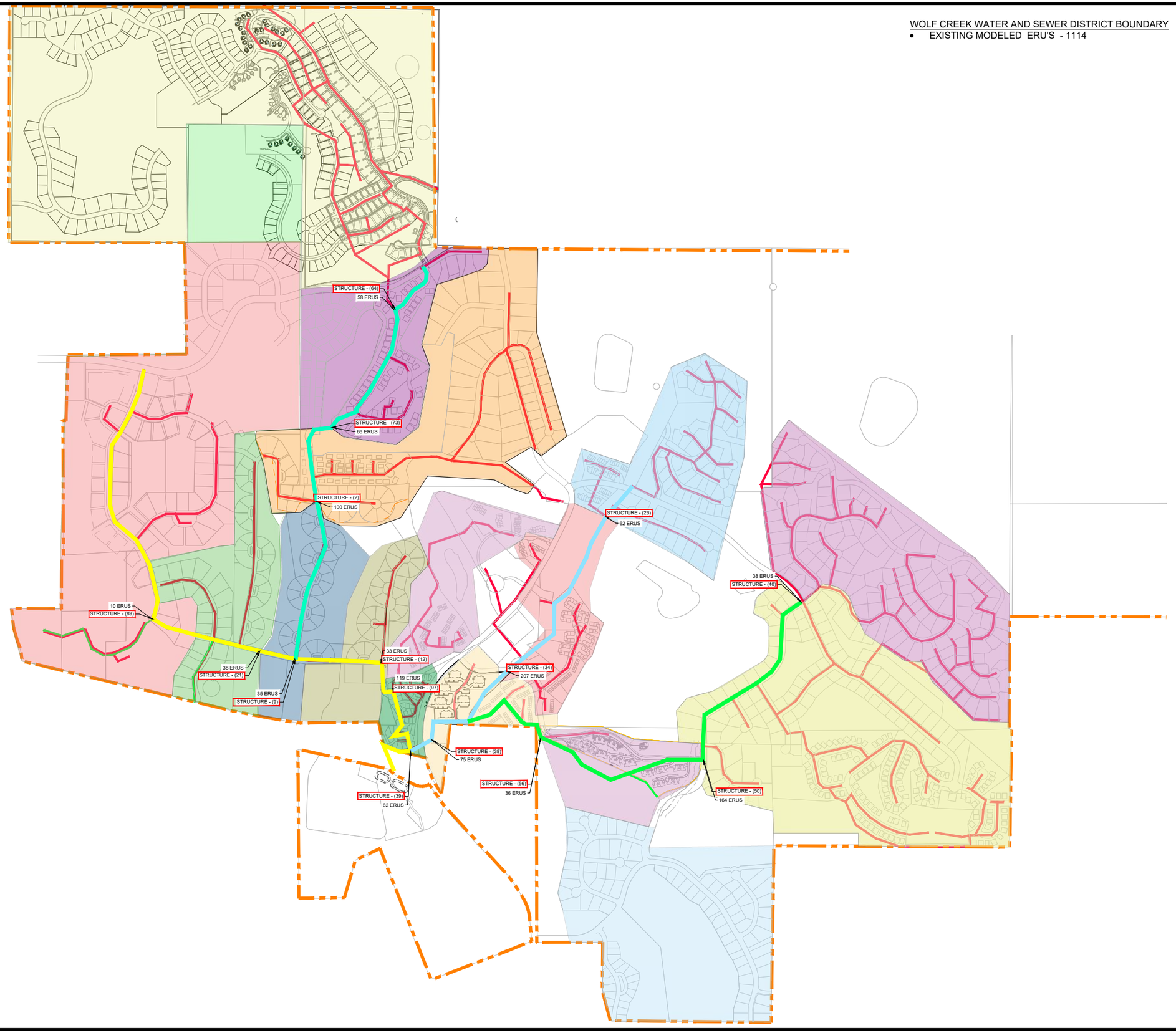
SM3

WOLF CREEK WATER AND SEWER DISTRICT BOUNDARY
- EXISTING MODELED ERU'S - 1114



Location of Modeled injected flows

trunk line 1	ERU	Q cfs*
Structure - (12)	33	0.015
Structure - (9)	35	0.016
Structure - (39)	62	0.029
Structure - (21)	38	0.018
Structure - (97)	119	0.055
Structure - (89)	10	0.005
	297	0.138

trunk line 2	ERU	Q cfs*
Structure - (2)	100	0.056
Structure - (73)	66	0.031
Structure - (64)	58	0.027
	224	0.114

trunk line 3	ERU	Q cfs*
Structure - (26)	62	0.029
Structure - (38)	75	0.035
Structure - (27)	11	0.005
Structure - (34)	207	0.096
	355	0.165

trunk line 4	ERU	Q cfs*
Structure - (56)	36	0.017
Structure - (40)	38	0.018
Structure - (50)	164	0.076
	238	0.111

Total Existing	1114	0.528

*The CFS value shown in this table is the average daily flow. The diurnal curve shown on Table 3-1 of the IFFP was then applied to this average value.

0' 250' 500' 1000' 1500'

Scale in Feet
1" = 500'

SCALE 1" = 500'
DATE 10-12-21
DESIGN KAN
DRAWN KAN
CHECKED RC
DWG:

REVISIONS

DATE	DESCRIPTION

INJECTED EXISTING FLOWS

SEWER SYSTEM

WOLF CREEK IMPROVEMENT DISTRICT

EDEN, WEBER, UTAH

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SM4

WOLF CREEK WATER AND SEWER DISTRICT BOUNDARY
- EXISTING MODELED ERU'S - 1114
- TOTAL BUILD OUT ERU'S - 2441

KEY

- EXISTING SANITARY SEWER
- EXISTING PRESSURIZED SANITARY SEWER
- FUTURE SANITARY SEWER
- FUTURE PRESSURIZED SANITARY SEWER
- MODELED TRUNK LINE 1
- MODELED TRUNK LINE 2
- MODELED TRUNK LINE 3
- MODELED TRUNK LINE 4

STRUCTURE - (64)
FROM BRIDGES 153
HIDDEN OAKS 20
TOTAL 173 ERUS

231 ERUS
FROM THE BRIDGES
22 FUTURE ERUS
TOTAL 253 ERUS
STRUCTURE - (78)

STRUCTURE - (75)
FROM BRIDGES 31 ERUS
EDEN ESCAPE 31
FUTURE EAGLE CREST 56
TOTAL 118

STRUCTURE - (73)
FAIRWAYS
44 ERUS

STRUCTURE - (2)
FAIRWAY OAKS/PATIO SPRINGS
WOLFCREEK
120 ERUS

THE RETREAT
WOLF RIDGE PH 3&4
WOLF STAR
104 ERUS
STRUCTURE - (26)

PARCEL 10
80 ERU'S
STRUCTURE - (27)

HIGHLANDS
141 ERUS
STRUCTURE - (40)

EAGLE RIDGE 41 ERUS
FUTURE ERUS 19
TOTAL ERUS 60
STRUCTURE - (89)

RESORT HOTEL
257 ERUS
STRUCTURE - (33)

PATIO SPRINGS
33 ERUS
STRUCTURE - (12)

EAGLE RIDGE/PATIO HOMES
46 ERUS
STRUCTURE - (21)

STRUCTURE - (34)
TIMESHARE
CASCADE
MOOSE HOLLOW
140 ERUS

WOLF LODGE 209 ERUS
STRUCTURE - (97)

PATIO SPRINGS 35 ERUS
STRUCTURE - (9)

STRUCTURE - (38)
POWDER CANYON/
MOOSE HOLLOW
168 ERUS

STRUCTURE - (56)
THE RIDGE 48 ERUS

STRUCTURE - (39)
WOLF CREEK VILLAGES 62 ERUS

STRUCTURE - (50)
ELK HORN
TRAPPERS RIDGE
253 ERUS

EAGLE'S LANDING
97 ERU'S

Location of Modeled injected flows		
trunk line 1		
	ERU	Q cfs*
Structure - (12)	33	0.015
Structure - (9)	35	0.016
Structure - (39)	62	0.029
Structure - (21)	46	0.021
Structure - (97)	209	0.097
Structure - (89)	60	0.028
Structure - (78)	253	0.118
	698	0.324
trunk line 2		
	ERU	Q cfs*
Structure - (2)	120	0.056
Structure - (73)	44	0.020
Structure - (75)	118	0.055
Structure - (64)	173	0.080
	455	0.211
trunk line 3		
	ERU	Q cfs*
Structure - (26)	104	0.048
Structure - (27)	80	0.037
Structure - (33)	257	0.119
Structure - (34)	140	0.065
Structure - (38)	168	0.078
	749	0.348
trunk line 4		
	ERU	Q cfs*
Structure - (56)	48	0.022
Structure - (40)	141	0.066
Structure - (50)	253	0.118
	442	0.205
total existing	2344	1.089
+97 Pumped	2441	1.134

*The CFS value shown in this table is the average daily flow. The diurnal curve shown on Table 3-1 of the IFFP was then applied to this average value.

0' 250' 500' 1000' 1500'
Scale in Feet
1" = 500'

SCALE 1" = 500'
DATE 10-12-21
DESIGN KAN
DRAWN KAN
CHECKED RC
DWG:

REVISIONS
DATE | DESCRIPTION

INJECTED FUTURE FLOWS
SEWER SYSTEM
WOLF CREEK IMPROVEMENT DISTRICT
EDEN, WEBER, UTAH

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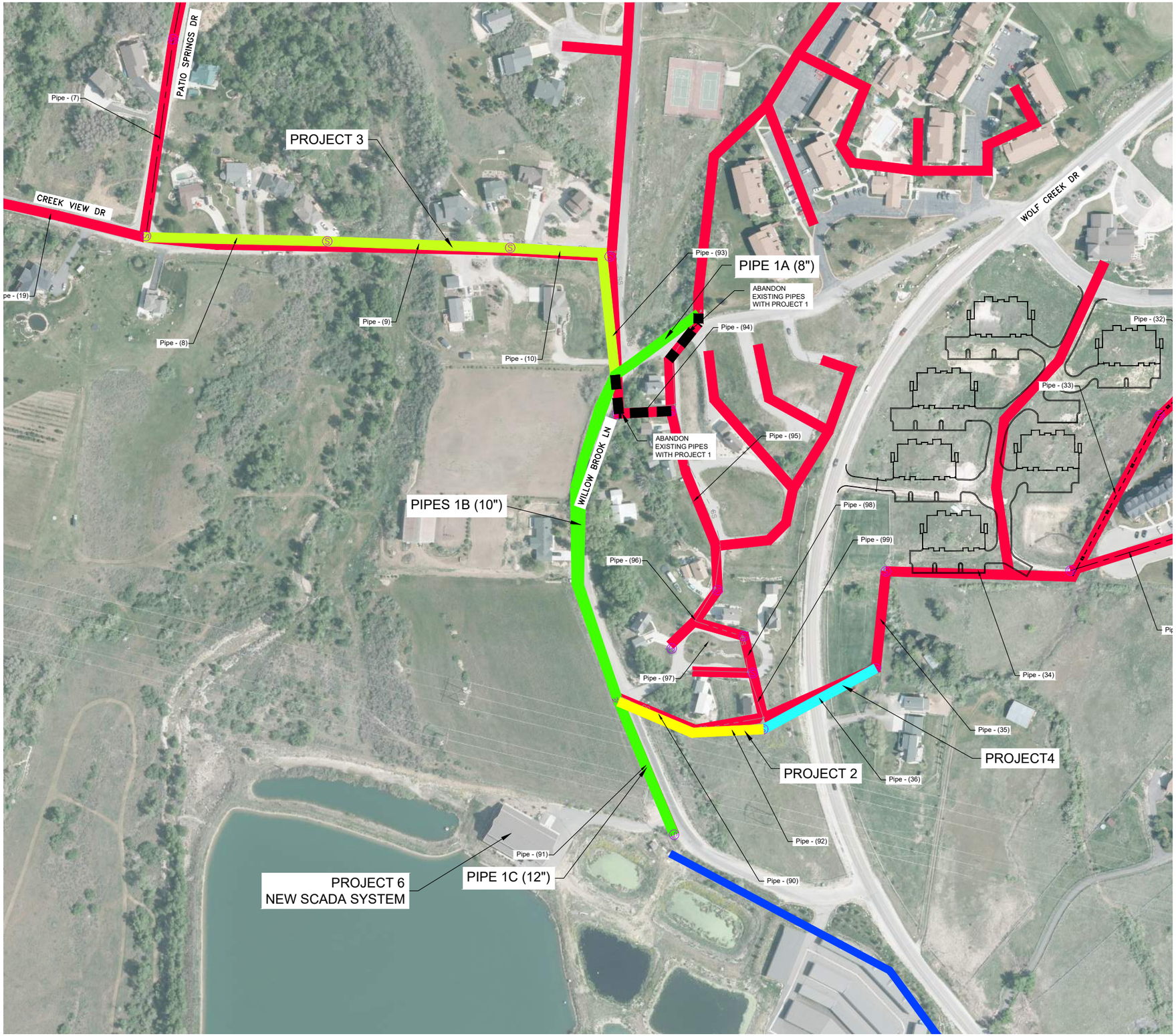
SM5



PROJECT 1
PIPE 1A - INSTALL 171 FEET OF 8" SEWER
PIPE 1B- INSTALL 780 FEET OF 10" SEWER
PIPE 1C - INSTALL 276 FEET OF 12" SEWER
- 8 NEW MANHOLES

PROJECT 2
- INSTALL 322 FEET OF 12" SEWER

PROJECT 3
- INSTALL 1204 FEET OF 10" SEWER
- 5 NEW MANHOLES

PROJECT 4
- INSTALL 268 FEET OF 12" SEWER

EXISTING SEWER

NOTE:
PROJECT 1 - ABANDON PIPE 94 (ROUTES TRUNK LINES 1 AND 2 TO TREATMENT PLANT)

0' 50' 100' 200' 300'
Scale in Feet
1" = 100'

SCALE 1" = 100'
DATE 10-26-21
DESIGN KAN
DRAWN KAN
CHECKED RC

REVISIONS
DATE | DESCRIPTION

DWG:

CONSTRUCTION PROJECTS
UPSIZE SEWER LINE
WOLF CREEK IMPROVEMENT DISTRICT
EDEN, WEBER, UTAH

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CP1
2

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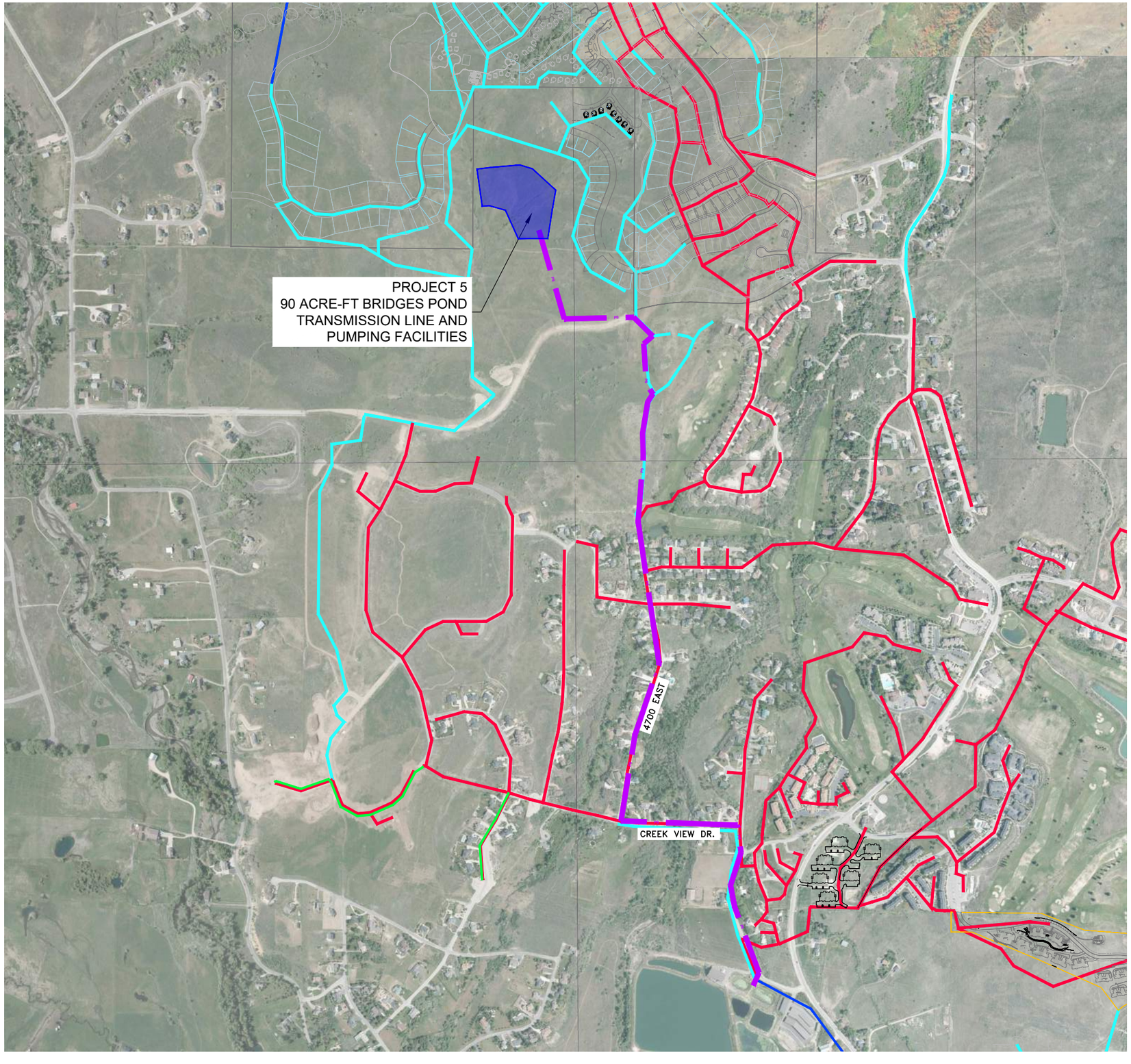

KEY

- EXISTING SANITARY SEWER
- EXISTING PRESSURIZED SANITARY SEWER
- FUTURE SANITARY SEWER
- FUTURE PRESSURIZED SANITARY SEWER
- PROJECT 5 - INSTALL NEW 6" REUSE LINE

0' 200' 400' 800' 1200'

Scale in Feet
Custom

SCALE: Custom
DATE: 10-12-21
DESIGN: KAN
DRAWN: KAN
CHECKED: RC
DWG:

REVISIONS

DATE	DESCRIPTION

CONSTRUCTION PROJECTS

UPSIZE SEWER LINE

WOLF CREEK IMPROVEMENT DISTRICT

EDEN, WEBER, UTAH

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CP2
2

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Table 1 - Existing ERUs with Existing Infrastructure Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (1)	Structure - (2)	Structure - (3)	315.66	5188.61	5173.74	4.7100	8.00	0.0130	0.29	2.40	0.22	2.11	1816
Pipe - (10)	Structure - (11)	Structure - (12)	208.64	5113.45	5112.88	0.2700	8.00	0.0130	0.38	0.57	0.56	0.19	167
Pipe - (100)	Structure - (102)	Structure - (103)	46.81	5171.21	5163.71	16.0200	8.00	0.0130	0.28	4.42	0.16	4.14	3569
Pipe - (101)	Structure - (103)	Structure - (104)	315.36	5154.97	5142.32	4.0100	8.00	0.0130	0.28	2.21	0.23	1.93	1665
Pipe - (102)	Structure - (104)	Structure - (105)	227.46	5142.32	5125.91	7.2100	8.00	0.0130	0.28	2.97	0.20	2.69	2315
Pipe - (103)	Structure - (105)	Structure - (36)	256.85	5125.91	5100.92	9.7300	8.00	0.0130	0.28	3.45	0.18	3.17	2729
Pipe - (18)	Structure - (20)	Structure - (21)	226.69	5133.48	5120.11	5.9000	8.00	0.0130	0.01	2.68	0.05	2.67	2304
Pipe - (19)	Structure - (21)	Structure - (9)	408.88	5120.11	5118.13	0.4800	8.00	0.0130	0.06	0.77	0.18	0.71	608
Pipe - (2)	Structure - (3)	Structure - (4)	201.49	5173.74	5165.54	4.0700	8.00	0.0130	0.29	2.23	0.23	1.94	1671
Pipe - (22)	Structure - (24)	Structure - (25)	237.53	5385.41	5356.94	11.9900	8.00	0.0130	0.00	3.83	0.00	3.83	3297
Pipe - (23)	Structure - (25)	Structure - (26)	212.78	5356.94	5324.91	15.0500	8.00	0.0130	0.00	4.29	0.00	4.29	3694
Pipe - (24)	Structure - (26)	Structure - (27)	339.92	5324.91	5288.09	10.8300	8.00	0.0130	0.08	3.64	0.09	3.56	3064
Pipe - (25)	Structure - (27)	Structure - (28)	174.20	5288.09	5271.82	9.3400	8.00	0.0130	0.09	3.38	0.11	3.29	2832
Pipe - (26)	Structure - (28)	Structure - (29)	446.81	5271.82	5236.43	7.9200	8.00	0.0130	0.09	3.11	0.11	3.02	2602
Pipe - (27)	Structure - (29)	Structure - (30)	193.84	5236.43	5225.01	5.8900	8.00	0.0130	0.09	2.68	0.12	2.59	2233
Pipe - (28)	Structure - (30)	Structure - (31)	343.12	5225.01	5197.31	8.0700	8.00	0.0130	0.09	3.14	0.11	3.05	2627
Pipe - (29)	Structure - (31)	Structure - (32)	189.59	5197.31	5187.22	5.3200	8.00	0.0130	0.09	2.55	0.12	2.46	2118
Pipe - (3)	Structure - (4)	Structure - (5)	301.42	5165.54	5151.61	4.6200	8.00	0.0130	0.29	2.37	0.22	2.08	1797
Pipe - (30)	Structure - (32)	Structure - (33)	220.14	5187.22	5163.74	10.6700	8.00	0.0130	0.09	3.61	0.10	3.52	3032
Pipe - (31)	Structure - (33)	Structure - (34)	259.43	5163.74	5147.39	6.3000	8.00	0.0130	0.09	2.77	0.12	2.68	2312
Pipe - (32)	Structure - (34)	Structure - (35)	346.66	5147.39	5120.73	7.6900	8.00	0.0130	0.33	3.06	0.21	2.73	2356
Pipe - (33)	Structure - (35)	Structure - (36)	374.27	5120.73	5100.92	5.2900	8.00	0.0130	0.33	2.54	0.23	2.21	1905
Pipe - (34)	Structure - (36)	Structure - (37)	386.25	5100.92	5091.61	2.4100	8.00	0.0130	0.61	1.72	0.39	1.11	952
Pipe - (35)	Structure - (37)	Structure - (38)	203.94	5091.61	5083.20	4.1200	8.00	0.0130	0.60	2.24	0.34	1.64	1415
Pipe - (36)	Structure - (38)	Structure - (39)	267.45	5083.20	5082.21	0.3700	8.00	0.0130	0.69	0.67	0.77	-0.02	-15
Pipe - (37)	Structure - (40)	Structure - (41)	251.41	5414.09	5384.20	11.8900	8.00	0.0130	0.05	3.81	0.07	3.76	3240
Pipe - (38)	Structure - (41)	Structure - (42)	226.84	5384.20	5363.03	9.3300	8.00	0.0130	0.05	3.37	0.08	3.32	2865
Pipe - (39)	Structure - (42)	Structure - (43)	272.87	5363.03	5328.06	12.8200	8.00	0.0130	0.05	3.96	0.07	3.91	3366
Pipe - (4)	Structure - (5)	Structure - (6)	205.89	5151.61	5145.60	2.9200	8.00	0.0130	0.29	1.89	0.25	1.60	1377
Pipe - (40)	Structure - (43)	Structure - (44)	167.40	5328.06	5307.72	12.1500	8.00	0.0130	0.05	3.85	0.07	3.80	3276
Pipe - (41)	Structure - (44)	Structure - (45)	215.57	5307.72	5278.76	13.4300	8.00	0.0130	0.05	4.05	0.07	4.00	3446
Pipe - (42)	Structure - (45)	Structure - (46)	317.78	5278.76	5253.08	8.0800	8.00	0.0130	0.05	3.14	0.08	3.09	2663
Pipe - (43)	Structure - (46)	Structure - (47)	160.91	5253.08	5250.39	1.6700	8.00	0.0130	0.05	1.43	0.12	1.38	1187
Pipe - (44)	Structure - (47)	Structure - (48)	199.78	5250.39	5225.19	12.6100	8.00	0.0130	0.05	3.92	0.07	3.87	3338
Pipe - (45)	Structure - (48)	Structure - (49)	352.90	5225.19	5195.91	8.3000	8.00	0.0130	0.05	3.18	0.08	3.13	2700

Table 1 - Existing ERUs with Existing Infrastructure Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (46)	Structure - (49)	Structure - (50)	154.05	5195.91	5192.88	1.9700	8.00	0.0130	0.05	1.55	0.11	1.50	1293
Pipe - (47)	Structure - (50)	Structure - (51)	403.04	5192.88	5190.88	0.5000	8.00	0.0130	0.25	0.78	0.36	0.53	458
Pipe - (48)	Structure - (51)	Structure - (52)	301.21	5190.88	5189.33	0.5100	8.00	0.0130	0.24	0.79	0.36	0.55	473
Pipe - (49)	Structure - (52)	Structure - (53)	369.74	5189.33	5187.54	0.4800	8.00	0.0130	0.24	0.77	0.36	0.53	453
Pipe - (5)	Structure - (6)	Structure - (7)	197.89	5145.60	5136.46	4.6200	8.00	0.0130	0.29	2.37	0.22	2.08	1797
Pipe - (50)	Structure - (53)	Structure - (54)	364.85	5187.54	5185.83	0.4700	8.00	0.0130	0.24	0.76	0.37	0.52	446
Pipe - (51)	Structure - (54)	Structure - (55)	171.15	5185.83	5185.15	0.4000	8.00	0.0130	0.24	0.70	0.38	0.46	395
Pipe - (52)	Structure - (55)	Structure - (56)	394.33	5185.15	5183.72	0.3600	8.00	0.0130	0.24	0.66	0.39	0.42	364
Pipe - (53)	Structure - (56)	Structure - (57)	148.03	5183.72	5182.97	0.5100	8.00	0.0130	0.28	0.79	0.39	0.51	439
Pipe - (54)	Structure - (57)	Structure - (102)	125.31	5182.97	5171.77	8.9400	8.00	0.0130	0.28	3.30	0.19	3.02	2605
Pipe - (55)	Structure - (58)	Structure - (59)	78.09	5353.65	5351.44	2.8300	8.00	0.0130	0.00	1.86	0.00	1.86	1602
Pipe - (56)	Structure - (59)	Structure - (60)	79.76	5351.44	5348.36	3.8600	8.00	0.0130	0.00	2.17	0.00	2.17	1871
Pipe - (57)	Structure - (60)	Structure - (61)	50.67	5348.36	5345.34	5.9600	8.00	0.0130	0.00	2.70	0.00	2.70	2324
Pipe - (58)	Structure - (61)	Structure - (62)	134.87	5345.34	5335.93	6.9800	8.00	0.0130	0.00	2.92	0.00	2.92	2515
Pipe - (59)	Structure - (62)	Structure - (63)	199.52	5335.93	5318.38	8.8000	8.00	0.0130	0.00	3.28	0.00	3.28	2824
Pipe - (6)	Structure - (7)	Structure - (8)	196.20	5136.46	5132.78	1.8800	8.00	0.0130	0.29	1.51	0.28	1.22	1056
Pipe - (60)	Structure - (63)	Structure - (64)	102.43	5318.38	5310.20	7.9900	8.00	0.0130	0.00	3.12	0.00	3.12	2691
Pipe - (61)	Structure - (64)	Structure - (65)	113.82	5310.20	5305.60	4.0400	8.00	0.0130	0.07	2.22	0.11	2.15	1853
Pipe - (62)	Structure - (65)	Structure - (66)	359.27	5305.60	5289.81	4.4000	8.00	0.0130	0.07	2.32	0.11	2.25	1937
Pipe - (63)	Structure - (66)	Structure - (67)	75.66	5289.81	5285.25	6.0300	8.00	0.0130	0.07	2.71	0.11	2.64	2278
Pipe - (64)	Structure - (67)	Structure - (68)	161.58	5285.25	5276.06	5.6900	8.00	0.0130	0.07	2.64	0.11	2.57	2211
Pipe - (65)	Structure - (68)	Structure - (69)	282.17	5276.06	5259.23	5.9600	8.00	0.0130	0.07	2.70	0.11	2.63	2264
Pipe - (66)	Structure - (69)	Structure - (70)	246.38	5259.23	5245.93	5.4000	8.00	0.0130	0.07	2.57	0.11	2.50	2152
Pipe - (67)	Structure - (70)	Structure - (71)	27.43	5245.93	5243.26	9.7400	8.00	0.0130	0.07	3.45	0.09	3.38	2911
Pipe - (68)	Structure - (71)	Structure - (72)	230.76	5243.26	5232.46	4.6800	8.00	0.0130	0.07	2.39	0.11	2.32	1999
Pipe - (69)	Structure - (72)	Structure - (73)	121.35	5232.46	5229.86	2.1400	8.00	0.0120	0.07	1.75	0.13	1.68	1449
Pipe - (7)	Structure - (8)	Structure - (9)	415.38	5132.78	5118.13	3.5300	8.00	0.0130	0.29	2.08	0.24	1.79	1539
Pipe - (70)	Structure - (73)	Structure - (74)	195.39	5229.86	5227.92	0.9900	8.00	0.0130	0.15	1.10	0.23	0.95	818
Pipe - (71)	Structure - (74)	Structure - (75)	137.73	5227.92	5220.42	5.4500	8.00	0.0130	0.15	2.58	0.15	2.43	2093
Pipe - (72)	Structure - (75)	Structure - (76)	97.58	5220.42	5216.57	3.9500	8.00	0.0130	0.15	2.20	0.17	2.05	1763
Pipe - (73)	Structure - (76)	Structure - (77)	316.37	5216.57	5198.54	5.7000	8.00	0.0130	0.15	2.64	0.15	2.49	2144
Pipe - (74)	Structure - (77)	Structure - (2)	271.52	5198.54	5188.61	3.6600	8.00	0.0130	0.15	2.11	0.17	1.96	1692
Pipe - (75)	Structure - (78)	Structure - (79)	269.75	5168.38	5167.51	0.3200	10.00	0.0130	0.00	1.13	0.00	1.13	977
Pipe - (76)	Structure - (79)	Structure - (80)	227.13	5167.51	5158.75	3.8600	10.00	0.0130	0.00	3.94	0.00	3.94	3392
Pipe - (77)	Structure - (80)	Structure - (81)	266.01	5158.75	5142.32	6.1800	10.00	0.0130	0.00	4.98	0.00	4.98	4291

Table 1 - Existing ERUs with Existing Infrastructure Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (78)	Structure - (81)	Structure - (82)	171.03	5142.32	5141.53	0.4600	10.00	0.0130	0.00	1.36	0.00	1.36	1171
Pipe - (79)	Structure - (82)	Structure - (83)	272.69	5141.53	5140.84	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (8)	Structure - (9)	Structure - (10)	379.03	5118.13	5115.44	0.7100	8.00	0.0130	0.38	0.93	0.42	0.55	475
Pipe - (80)	Structure - (83)	Structure - (84)	398.23	5140.84	5139.85	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (81)	Structure - (84)	Structure - (85)	190.37	5139.85	5139.27	0.3000	10.00	0.0130	0.00	1.10	0.00	1.10	945
Pipe - (82)	Structure - (85)	Structure - (86)	317.93	5139.27	5138.63	0.2000	10.00	0.0130	0.00	0.90	0.00	0.90	772
Pipe - (83)	Structure - (86)	Structure - (87)	323.79	5138.63	5137.85	0.2400	10.00	0.0130	0.00	0.98	0.00	0.98	846
Pipe - (84)	Structure - (87)	Structure - (88)	402.79	5137.85	5136.84	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (85)	Structure - (88)	Structure - (89)	216.08	5136.84	5136.24	0.2800	10.00	0.0130	0.00	1.06	0.00	1.06	913
Pipe - (86)	Structure - (89)	Structure - (90)	168.63	5136.24	5135.57	0.4000	10.00	0.0130	0.01	1.27	0.07	1.26	1083
Pipe - (87)	Structure - (90)	Structure - (91)	272.44	5135.57	5135.23	0.1200	10.00	0.0130	0.01	0.69	0.08	0.68	589
Pipe - (88)	Structure - (91)	Structure - (92)	268.23	5135.23	5134.27	0.3600	10.00	0.0130	0.01	1.20	0.07	1.19	1027
Pipe - (89)	Structure - (92)	Structure - (20)	316.39	5134.27	5133.48	0.2500	10.00	0.0130	0.01	1.00	0.08	0.99	855
Pipe - (9)	Structure - (10)	Structure - (11)	382.52	5115.44	5113.45	0.5200	8.00	0.0130	0.38	0.80	0.46	0.42	359
Pipe - (90)	Structure - (93)	Structure - (94)	191.40	5081.69	5080.92	0.4000	8.00	0.0130	0.82	0.70	0.93	-0.12	-104
Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	8.00	0.0130	0.82	1.26	0.55	0.44	383
Pipe - (92)	Structure - (39)	Structure - (93)	129.91	5082.21	5081.69	0.4000	8.00	0.0130	0.82	0.70	1.00	-0.12	-104
Pipe - (93)	Structure - (12)	Structure - (96)	328.91	5112.88	5110.92	0.6000	8.00	0.0130	0.42	0.86	0.47	0.44	376
Pipe - (94)	Structure - (96)	Structure - (97)	112.47	5110.92	5110.26	0.5900	8.00	0.0130	0.42	0.85	0.47	0.43	369
Pipe - (95)	Structure - (97)	Structure - (98)	387.03	5110.26	5092.55	4.5800	8.00	0.0130	0.56	2.36	0.32	1.80	1555
Pipe - (96)	Structure - (98)	Structure - (99)	155.20	5092.55	5088.49	2.6200	8.00	0.0130	0.56	1.79	0.37	1.23	1059
Pipe - (97)	Structure - (99)	Structure - (100)	153.41	5088.49	5087.36	0.7400	8.00	0.0130	0.56	0.95	0.52	0.39	336
Pipe - (98)	Structure - (100)	Structure - (101)	79.59	5087.36	5085.05	2.9000	8.00	0.0130	0.56	1.88	0.36	1.32	1139
Pipe - (99)	Structure - (101)	Structure - (39)	119.36	5085.05	5082.21	2.3800	8.00	0.0130	0.56	1.70	0.37	1.14	986

Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	8.00	0.0130	1.32	1.26	0.78	-0.06	-48
Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	10.00	0.0130	1.32	2.29	0.52	0.97	838

See Table 1 Page 4 for notes concerning highlighted rows

Cell: J31
Note: Dan White:
Pipe 36 can physically carry existing flows, but not at the design flow capacity of less than 75%, and so must be upsized to carry flows at the desired level of service.

Cell: J91
Note: Dan White:
Pipe 90: Since the upstream Pipe 92 can only pass 0.82 CFS, that's all that Pipe 90 receives in the model. The reduced flow from Pipe 92 of 0.82 CFS is still over the 75% capacity of Pipe 90, so it was tagged as over capacity.

Cell: J92
Note: Dan White:
Pipe 91: This pipe only receives what can pass through Pipe 92 and 90. Pipe 91 appears to be within capacity in this table because Pipe 92 is only allowed in the model to pass its physical capacity of 0.82 cfs. See the two shaded Pipe 91 lines at the bottom of the table for analysis if Pipes 92 and 90 are upsized to handle existing flows

Cell: J93
Note: Dan White:
Pipe 92: Pipe 92 can't pass all the flow coming to it. It receives 1.32 CFS (from Pipes 99 and 36, plus an injection at structure 39) and can only pass 0.82 CFS.

Cell: J102
Note: Dan White:
Pipe 91 with 92 and 90 upsized: If Pipes 90 and 92 could pass all existing flows to pipe 91, this row of data shows that an 8" Pipe 91 would carry existing flows but not within the standard 75% capacity, so it needs to be upsized to a 10". See also Table 2.

Cell: J103
Note: Dan White:
If 90 and 92 could pass all existing flows to pipe 91, it would take a 10" Pipe 91 to pass existing flows with the 75% capacity standard.

Table 2 - Existing ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (1)	Structure - (2)	Structure - (3)	315.66	5188.61	5173.74	4.7100	8.00	0.0130	0.29	2.40	0.22	2.11	1816
Pipe - (10)	Structure - (11)	Structure - (12)	208.64	5113.45	5112.88	0.2700	8.00	0.0130	0.38	0.57	0.56	0.19	167
Pipe - (100)	Structure - (102)	Structure - (103)	46.81	5171.21	5163.71	16.0200	8.00	0.0130	0.28	4.42	0.16	4.14	3569
Pipe - (101)	Structure - (103)	Structure - (104)	315.36	5154.97	5142.32	4.0100	8.00	0.0130	0.28	2.21	0.23	1.93	1665
Pipe - (102)	Structure - (104)	Structure - (105)	227.46	5142.32	5125.91	7.2100	8.00	0.0130	0.28	2.97	0.20	2.69	2315
Pipe - (103)	Structure - (105)	Structure - (36)	256.85	5125.91	5100.92	9.7300	8.00	0.0130	0.28	3.45	0.18	3.17	2729
Pipe - (18)	Structure - (20)	Structure - (21)	226.69	5133.48	5120.11	5.9000	8.00	0.0130	0.01	2.68	0.05	2.67	2304
Pipe - (19)	Structure - (21)	Structure - (9)	408.88	5120.11	5118.13	0.4800	8.00	0.0130	0.06	0.77	0.18	0.71	608
Pipe - (2)	Structure - (3)	Structure - (4)	201.49	5173.74	5165.54	4.0700	8.00	0.0130	0.29	2.23	0.23	1.94	1671
Pipe - (22)	Structure - (24)	Structure - (25)	237.53	5385.41	5356.94	11.9900	8.00	0.0130	0.00	3.83	0.00	3.83	3297
Pipe - (23)	Structure - (25)	Structure - (26)	212.78	5356.94	5324.91	15.0500	8.00	0.0130	0.00	4.29	0.00	4.29	3694
Pipe - (24)	Structure - (26)	Structure - (27)	339.92	5324.91	5288.09	10.8300	8.00	0.0130	0.08	3.64	0.09	3.56	3064
Pipe - (25)	Structure - (27)	Structure - (28)	174.20	5288.09	5271.82	9.3400	8.00	0.0130	0.09	3.38	0.11	3.29	2832
Pipe - (26)	Structure - (28)	Structure - (29)	446.81	5271.82	5236.43	7.9200	8.00	0.0130	0.09	3.11	0.11	3.02	2602
Pipe - (27)	Structure - (29)	Structure - (30)	193.84	5236.43	5225.01	5.8900	8.00	0.0130	0.09	2.68	0.12	2.59	2233
Pipe - (28)	Structure - (30)	Structure - (31)	343.12	5225.01	5197.31	8.0700	8.00	0.0130	0.09	3.14	0.11	3.05	2627
Pipe - (29)	Structure - (31)	Structure - (32)	189.59	5197.31	5187.22	5.3200	8.00	0.0130	0.09	2.55	0.12	2.46	2118
Pipe - (3)	Structure - (4)	Structure - (5)	301.42	5165.54	5151.61	4.6200	8.00	0.0130	0.29	2.37	0.22	2.08	1797
Pipe - (30)	Structure - (32)	Structure - (33)	220.14	5187.22	5163.74	10.6700	8.00	0.0130	0.09	3.61	0.10	3.52	3032
Pipe - (31)	Structure - (33)	Structure - (34)	259.43	5163.74	5147.39	6.3000	8.00	0.0130	0.09	2.77	0.12	2.68	2312
Pipe - (32)	Structure - (34)	Structure - (35)	346.66	5147.39	5120.73	7.6900	8.00	0.0130	0.33	3.06	0.21	2.73	2356
Pipe - (33)	Structure - (35)	Structure - (36)	374.27	5120.73	5100.92	5.2900	8.00	0.0130	0.33	2.54	0.23	2.21	1905
Pipe - (34)	Structure - (36)	Structure - (37)	386.25	5100.92	5091.61	2.4100	8.00	0.0130	0.61	1.72	0.39	1.11	952
Pipe - (35)	Structure - (37)	Structure - (38)	203.94	5091.61	5083.20	4.1200	8.00	0.0130	0.60	2.24	0.34	1.64	1415
Pipe - (36)	Structure - (38)	Structure - (39)	267.45	5083.20	5082.21	0.3700	10.000	0.0130	0.69	1.22	0.51	0.53	455
Pipe - (37)	Structure - (40)	Structure - (41)	251.41	5414.09	5384.20	11.8900	8.00	0.0130	0.05	3.81	0.07	3.76	3240
Pipe - (38)	Structure - (41)	Structure - (42)	226.84	5384.20	5363.03	9.3300	8.00	0.0130	0.05	3.37	0.08	3.32	2865
Pipe - (39)	Structure - (42)	Structure - (43)	272.87	5363.03	5328.06	12.8200	8.00	0.0130	0.05	3.96	0.07	3.91	3366
Pipe - (4)	Structure - (5)	Structure - (6)	205.89	5151.61	5145.60	2.9200	8.00	0.0130	0.29	1.89	0.25	1.60	1377
Pipe - (40)	Structure - (43)	Structure - (44)	167.40	5328.06	5307.72	12.1500	8.00	0.0130	0.05	3.85	0.07	3.80	3276
Pipe - (41)	Structure - (44)	Structure - (45)	215.57	5307.72	5278.76	13.4300	8.00	0.0130	0.05	4.05	0.07	4.00	3446
Pipe - (42)	Structure - (45)	Structure - (46)	317.78	5278.76	5253.08	8.0800	8.00	0.0130	0.05	3.14	0.08	3.09	2663
Pipe - (43)	Structure - (46)	Structure - (47)	160.91	5253.08	5250.39	1.6700	8.00	0.0130	0.05	1.43	0.12	1.38	1187
Pipe - (44)	Structure - (47)	Structure - (48)	199.78	5250.39	5225.19	12.6100	8.00	0.0130	0.05	3.92	0.07	3.87	3338
Pipe - (45)	Structure - (48)	Structure - (49)	352.90	5225.19	5195.91	8.3000	8.00	0.0130	0.05	3.18	0.08	3.13	2700

Table 2 - Existing ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (46)	Structure - (49)	Structure - (50)	154.05	5195.91	5192.88	1.9700	8.00	0.0130	0.05	1.55	0.11	1.50	1293
Pipe - (47)	Structure - (50)	Structure - (51)	403.04	5192.88	5190.88	0.5000	8.00	0.0130	0.25	0.78	0.36	0.53	458
Pipe - (48)	Structure - (51)	Structure - (52)	301.21	5190.88	5189.33	0.5100	8.00	0.0130	0.24	0.79	0.36	0.55	473
Pipe - (49)	Structure - (52)	Structure - (53)	369.74	5189.33	5187.54	0.4800	8.00	0.0130	0.24	0.77	0.36	0.53	453
Pipe - (5)	Structure - (6)	Structure - (7)	197.89	5145.60	5136.46	4.6200	8.00	0.0130	0.29	2.37	0.22	2.08	1797
Pipe - (50)	Structure - (53)	Structure - (54)	364.85	5187.54	5185.83	0.4700	8.00	0.0130	0.24	0.76	0.37	0.52	446
Pipe - (51)	Structure - (54)	Structure - (55)	171.15	5185.83	5185.15	0.4000	8.00	0.0130	0.24	0.70	0.38	0.46	395
Pipe - (52)	Structure - (55)	Structure - (56)	394.33	5185.15	5183.72	0.3600	8.00	0.0130	0.24	0.66	0.39	0.42	364
Pipe - (53)	Structure - (56)	Structure - (57)	148.03	5183.72	5182.97	0.5100	8.00	0.0130	0.28	0.79	0.39	0.51	439
Pipe - (54)	Structure - (57)	Structure - (102)	125.31	5182.97	5171.77	8.9400	8.00	0.0130	0.28	3.30	0.19	3.02	2605
Pipe - (55)	Structure - (58)	Structure - (59)	78.09	5353.65	5351.44	2.8300	8.00	0.0130	0.00	1.86	0.00	1.86	1602
Pipe - (56)	Structure - (59)	Structure - (60)	79.76	5351.44	5348.36	3.8600	8.00	0.0130	0.00	2.17	0.00	2.17	1871
Pipe - (57)	Structure - (60)	Structure - (61)	50.67	5348.36	5345.34	5.9600	8.00	0.0130	0.00	2.70	0.00	2.70	2324
Pipe - (58)	Structure - (61)	Structure - (62)	134.87	5345.34	5335.93	6.9800	8.00	0.0130	0.00	2.92	0.00	2.92	2515
Pipe - (59)	Structure - (62)	Structure - (63)	199.52	5335.93	5318.38	8.8000	8.00	0.0130	0.00	3.28	0.00	3.28	2824
Pipe - (6)	Structure - (7)	Structure - (8)	196.20	5136.46	5132.78	1.8800	8.00	0.0130	0.29	1.51	0.28	1.22	1056
Pipe - (60)	Structure - (63)	Structure - (64)	102.43	5318.38	5310.20	7.9900	8.00	0.0130	0.00	3.12	0.00	3.12	2691
Pipe - (61)	Structure - (64)	Structure - (65)	113.82	5310.20	5305.60	4.0400	8.00	0.0130	0.07	2.22	0.11	2.15	1853
Pipe - (62)	Structure - (65)	Structure - (66)	359.27	5305.60	5289.81	4.4000	8.00	0.0130	0.07	2.32	0.11	2.25	1937
Pipe - (63)	Structure - (66)	Structure - (67)	75.66	5289.81	5285.25	6.0300	8.00	0.0130	0.07	2.71	0.11	2.64	2278
Pipe - (64)	Structure - (67)	Structure - (68)	161.58	5285.25	5276.06	5.6900	8.00	0.0130	0.07	2.64	0.11	2.57	2211
Pipe - (65)	Structure - (68)	Structure - (69)	282.17	5276.06	5259.23	5.9600	8.00	0.0130	0.07	2.70	0.11	2.63	2264
Pipe - (66)	Structure - (69)	Structure - (70)	246.38	5259.23	5245.93	5.4000	8.00	0.0130	0.07	2.57	0.11	2.50	2152
Pipe - (67)	Structure - (70)	Structure - (71)	27.43	5245.93	5243.26	9.7400	8.00	0.0130	0.07	3.45	0.09	3.38	2911
Pipe - (68)	Structure - (71)	Structure - (72)	230.76	5243.26	5232.46	4.6800	8.00	0.0130	0.07	2.39	0.11	2.32	1999
Pipe - (69)	Structure - (72)	Structure - (73)	121.35	5232.46	5229.86	2.1400	8.00	0.0120	0.07	1.75	0.13	1.68	1449
Pipe - (7)	Structure - (8)	Structure - (9)	415.38	5132.78	5118.13	3.5300	8.00	0.0130	0.29	2.08	0.24	1.79	1539
Pipe - (70)	Structure - (73)	Structure - (74)	195.39	5229.86	5227.92	0.9900	8.00	0.0130	0.15	1.10	0.23	0.95	818
Pipe - (71)	Structure - (74)	Structure - (75)	137.73	5227.92	5220.42	5.4500	8.00	0.0130	0.15	2.58	0.15	2.43	2093
Pipe - (72)	Structure - (75)	Structure - (76)	97.58	5220.42	5216.57	3.9500	8.00	0.0130	0.15	2.20	0.17	2.05	1763
Pipe - (73)	Structure - (76)	Structure - (77)	316.37	5216.57	5198.54	5.7000	8.00	0.0130	0.15	2.64	0.15	2.49	2144
Pipe - (74)	Structure - (77)	Structure - (2)	271.52	5198.54	5188.61	3.6600	8.00	0.0130	0.15	2.11	0.17	1.96	1692
Pipe - (75)	Structure - (78)	Structure - (79)	269.75	5168.38	5167.51	0.3200	10.00	0.0130	0.00	1.13	0.00	1.13	977
Pipe - (76)	Structure - (79)	Structure - (80)	227.13	5167.51	5158.75	3.8600	10.00	0.0130	0.00	3.94	0.00	3.94	3392
Pipe - (77)	Structure - (80)	Structure - (81)	266.01	5158.75	5142.32	6.1800	10.00	0.0130	0.00	4.98	0.00	4.98	4291

Table 2 - Existing ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (78)	Structure - (81)	Structure - (82)	171.03	5142.32	5141.53	0.4600	10.00	0.0130	0.00	1.36	0.00	1.36	1171
Pipe - (79)	Structure - (82)	Structure - (83)	272.69	5141.53	5140.84	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (8)	Structure - (9)	Structure - (10)	379.03	5118.13	5115.44	0.7100	10.00	0.0130	0.38	1.69	0.42	1.31	1127
Pipe - (80)	Structure - (83)	Structure - (84)	398.23	5140.84	5139.85	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (81)	Structure - (84)	Structure - (85)	190.37	5139.85	5139.27	0.3000	10.00	0.0130	0.00	1.10	0.00	1.10	945
Pipe - (82)	Structure - (85)	Structure - (86)	317.93	5139.27	5138.63	0.2000	10.00	0.0130	0.00	0.90	0.00	0.90	772
Pipe - (83)	Structure - (86)	Structure - (87)	323.79	5138.63	5137.85	0.2400	10.00	0.0130	0.00	0.98	0.00	0.98	846
Pipe - (84)	Structure - (87)	Structure - (88)	402.79	5137.85	5136.84	0.2500	10.00	0.0130	0.00	1.00	0.00	1.00	863
Pipe - (85)	Structure - (88)	Structure - (89)	216.08	5136.84	5136.24	0.2800	10.00	0.0130	0.00	1.06	0.00	1.06	913
Pipe - (86)	Structure - (89)	Structure - (90)	168.63	5136.24	5135.57	0.4000	10.00	0.0130	0.01	1.27	0.07	1.26	1083
Pipe - (87)	Structure - (90)	Structure - (91)	272.44	5135.57	5135.23	0.1200	10.00	0.0130	0.01	0.69	0.08	0.68	589
Pipe - (88)	Structure - (91)	Structure - (92)	268.23	5135.23	5134.27	0.3600	10.00	0.0130	0.01	1.20	0.07	1.19	1027
Pipe - (89)	Structure - (92)	Structure - (20)	316.39	5134.27	5133.48	0.2500	10.00	0.0130	0.01	1.00	0.08	0.99	855
Pipe - (9)	Structure - (10)	Structure - (11)	382.52	5115.44	5113.45	0.5200	8.00	0.0130	0.38	0.80	0.46	0.42	359
Pipe - (90)	Structure - (93)	Structure - (94)	191.40	5081.69	5080.92	0.4000	10.000	0.0130	0.76	1.27	0.75	0.51	437
Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	10.000	0.0130	1.32	2.29	0.52	0.97	838
Pipe - (92)	Structure - (39)	Structure - (93)	129.91	5082.21	5081.69	0.4000	10.000	0.0130	0.76	1.27	0.75	0.51	437
Pipe - (93)	Structure - (12)	Structure - (96)	328.91	5112.88	5110.85	0.6200	8.000	0.0130	0.42	0.87	0.47	0.45	388
Pipe - (95)	Structure - (97)	Structure - (98)	387.03	5110.26	5092.55	4.5800	8.000	0.0130	0.00	2.36	0.00	2.36	2038
Pipe - (96)	Structure - (98)	Structure - (99)	155.20	5092.55	5088.49	2.6200	8.000	0.0130	0.00	1.79	0.00	1.79	1541
Pipe - (97)	Structure - (99)	Structure - (100)	153.41	5088.49	5087.36	0.7400	8.000	0.0130	0.00	0.95	0.00	0.95	819
Pipe - (98)	Structure - (100)	Structure - (101)	79.59	5087.36	5085.05	2.9000	8.000	0.0130	0.00	1.88	0.00	1.88	1621
Pipe - (99)	Structure - (101)	Structure - (39)	119.36	5085.05	5082.21	2.3800	8.000	0.0130	0.00	1.70	0.00	1.70	1469
PIPE-123	SSMH8	Structure - (94)	258.91	5088.05	5080.62	2.8700	10.00	0.0130	0.56	3.39	0.26	2.83	2442
PIPE-127	SSMH14	SSMH10	198.00	5108.51	5101.00	3.7900	10.00	0.0130	0.56	3.90	0.24	3.34	2878
PIPE-128	Structure - (96)	SSMH14	45.00	5110.72	5105.41	11.8000	10.00	0.0130	0.56	6.88	0.22	6.32	5447
PIPE-129	SSMH10	SSMH8	253.00	5100.90	5093.70	2.8500	10.00	0.0130	0.56	3.38	0.26	2.82	2432
NP-1	Structure - (97A)	Structure - (96)	216.77	5123.68	5110.92	5.8900	8.00	0.0130	0.14	2.68	0.15	2.54	2190

Pipe - (36)	Must upsize from	8.00	to	10.00	to adequately serve existing ERUs
Pipe - (90)	Must upsize from	8.00	to	10.00	to adequately serve existing ERUs
Pipe - (91)	Must upsize from	8.00	to	10.00	to adequately serve existing ERUs. 8" is surcharged 10" is >75% d/D.
Pipe - (92)	Must upsize from	8.00	to	10.00	to adequately serve existing ERUs
Project 1 is needed to prevent the need to upsize through The Villages.					

See Table 2 Page 4 for notes concerning highlighted rows

Cell: H31
Note: Dan White:
Pipe 36 needs to be upsized to 10" to carry existing flows at less than the established 75% flow depth

Cell: H91
Note: Dan White:
Pipe 90 needs to be upsized to 10" to carry existing flows

Cell: J91
Note: Dan White:
Pipe 90: Note that peak flow is less than the initial "existing" scenario, because in this model run, Project 1 has been installed to take all Trunkline 1 flows and all of the Wolf Lodge flows

Cell: H92
Note: Dan White:
Pipe 91 needs to be 10" to carry existing flows

Cell: J92
Note: Dan White:
Pipe 91: note that this flow IS the same as the initial "existing" conditions run, even after adding Project 1 to the model, because it is the last pipe in the model and still captures all modeled flows, regardless of the path taken to get to it.

Cell: H93
Note: Dan White:
Pipe 92 needs to be 10" to carry existing flows

Cell: J93
Note: Dan White:
Pipe 92: Note that peak flow is less than the initial "existing" scenario, because in this model run, Project 1 has been installed to take all Trunkline 1 flows and all of the Wolf Lodge flows

Cell: A100
Note: Dan White:
Pipes 123, 127, 128, 129, 97A were created in the model to represent Project 1.

Table 3 - Buildout ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (1)	Structure - (2)	Structure - (3)	315.66	5188.61	5173.74	4.7100	8.00	0.0130	0.57	2.40	0.32	1.83	1575
Pipe - (10)	Structure - (11)	Structure - (12)	208.64	5113.45	5112.88	0.2700	8.00	0.0130	0.68	0.57	1.00	-0.11	-91
Pipe - (100)	Structure - (102)	Structure - (103)	46.81	5171.21	5163.71	16.0200	8.00	0.0130	0.51	4.42	0.22	3.91	3371
Pipe - (101)	Structure - (103)	Structure - (104)	315.36	5154.97	5142.32	4.0100	8.00	0.0130	0.51	2.21	0.31	1.70	1467
Pipe - (102)	Structure - (104)	Structure - (105)	227.46	5142.32	5125.91	7.2100	8.00	0.0130	0.51	2.97	0.27	2.46	2117
Pipe - (103)	Structure - (105)	Structure - (36)	256.85	5125.91	5100.92	9.7300	8.00	0.0130	0.51	3.45	0.25	2.94	2530
Pipe - (18)	Structure - (20)	Structure - (21)	226.69	5133.48	5120.11	5.9000	8.00	0.0130	0.37	2.68	0.24	2.31	1994
Pipe - (19)	Structure - (21)	Structure - (9)	408.88	5120.11	5118.13	0.4800	8.00	0.0130	0.42	0.77	0.50	0.35	298
Pipe - (2)	Structure - (3)	Structure - (4)	201.49	5173.74	5165.54	4.0700	8.00	0.0130	0.57	2.23	0.33	1.66	1430
Pipe - (22)	Structure - (24)	Structure - (25)	237.53	5385.41	5356.94	11.9900	8.00	0.0130	0.00	3.83	0.00	3.83	3297
Pipe - (23)	Structure - (25)	Structure - (26)	212.78	5356.94	5324.91	15.0500	8.00	0.0130	0.00	4.29	0.00	4.29	3694
Pipe - (24)	Structure - (26)	Structure - (27)	339.92	5324.91	5288.09	10.8300	8.00	0.0130	0.12	3.64	0.12	3.52	3030
Pipe - (25)	Structure - (27)	Structure - (28)	174.20	5288.09	5271.82	9.3400	8.00	0.0130	0.21	3.38	0.16	3.17	2729
Pipe - (26)	Structure - (28)	Structure - (29)	446.81	5271.82	5236.43	7.9200	8.00	0.0130	0.21	3.11	0.17	2.90	2498
Pipe - (27)	Structure - (29)	Structure - (30)	193.84	5236.43	5225.01	5.8900	8.00	0.0130	0.21	2.68	0.18	2.47	2130
Pipe - (28)	Structure - (30)	Structure - (31)	343.12	5225.01	5197.31	8.0700	8.00	0.0130	0.21	3.14	0.17	2.93	2524
Pipe - (29)	Structure - (31)	Structure - (32)	189.59	5197.31	5187.22	5.3200	8.00	0.0130	0.21	2.55	0.19	2.34	2015
Pipe - (3)	Structure - (4)	Structure - (5)	301.42	5165.54	5151.61	4.6200	8.00	0.0130	0.57	2.37	0.32	1.80	1555
Pipe - (30)	Structure - (32)	Structure - (33)	220.14	5187.22	5163.74	10.6700	8.00	0.0130	0.21	3.61	0.16	3.40	2929
Pipe - (31)	Structure - (33)	Structure - (34)	259.43	5163.74	5147.39	6.3000	8.00	0.0130	0.51	2.77	0.28	2.26	1950
Pipe - (32)	Structure - (34)	Structure - (35)	346.66	5147.39	5120.73	7.6900	8.00	0.0130	0.67	3.06	0.30	2.39	2063
Pipe - (33)	Structure - (35)	Structure - (36)	374.27	5120.73	5100.92	5.2900	8.00	0.0130	0.67	2.54	0.33	1.87	1612
Pipe - (34)	Structure - (36)	Structure - (37)	386.25	5100.92	5091.61	2.4100	8.00	0.0130	1.19	1.72	0.58	0.53	453
Pipe - (35)	Structure - (37)	Structure - (38)	203.94	5091.61	5083.20	4.1200	8.00	0.0130	1.19	2.24	0.49	1.05	907
Pipe - (36)	Structure - (38)	Structure - (39)	267.45	5083.20	5082.21	0.3700	10.00	0.0130	1.42	1.22	0.92	-0.20	-174
Pipe - (37)	Structure - (40)	Structure - (41)	251.41	5414.09	5384.20	11.8900	8.00	0.0130	0.17	3.81	0.14	3.64	3136
Pipe - (38)	Structure - (41)	Structure - (42)	226.84	5384.20	5363.03	9.3300	8.00	0.0130	0.17	3.37	0.14	3.20	2762
Pipe - (39)	Structure - (42)	Structure - (43)	272.87	5363.03	5328.06	12.8200	8.00	0.0130	0.17	3.96	0.13	3.79	3262
Pipe - (4)	Structure - (5)	Structure - (6)	205.89	5151.61	5145.60	2.9200	8.00	0.0130	0.57	1.89	0.36	1.32	1136
Pipe - (40)	Structure - (43)	Structure - (44)	167.40	5328.06	5307.72	12.1500	8.00	0.0130	0.17	3.85	0.14	3.68	3172
Pipe - (41)	Structure - (44)	Structure - (45)	215.57	5307.72	5278.76	13.4300	8.00	0.0130	0.17	4.05	0.13	3.88	3343
Pipe - (42)	Structure - (45)	Structure - (46)	317.78	5278.76	5253.08	8.0800	8.00	0.0130	0.17	3.14	0.15	2.97	2560
Pipe - (43)	Structure - (46)	Structure - (47)	160.91	5253.08	5250.39	1.6700	8.00	0.0130	0.17	1.43	0.22	1.26	1084
Pipe - (44)	Structure - (47)	Structure - (48)	199.78	5250.39	5225.19	12.6100	8.00	0.0130	0.17	3.92	0.13	3.75	3234
Pipe - (45)	Structure - (48)	Structure - (49)	352.90	5225.19	5195.91	8.3000	8.00	0.0130	0.17	3.18	0.15	3.01	2596

Table 3 - Buildout ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (46)	Structure - (49)	Structure - (50)	154.05	5195.91	5192.88	1.9700	8.00	0.0130	0.17	1.55	0.21	1.38	1190
Pipe - (47)	Structure - (50)	Structure - (51)	403.04	5192.88	5190.88	0.5000	8.00	0.0130	0.48	0.78	0.52	0.30	260
Pipe - (48)	Structure - (51)	Structure - (52)	301.21	5190.88	5189.33	0.5100	8.00	0.0130	0.47	0.79	0.52	0.32	275
Pipe - (49)	Structure - (52)	Structure - (53)	369.74	5189.33	5187.54	0.4800	8.00	0.0130	0.47	0.77	0.53	0.30	255
Pipe - (5)	Structure - (6)	Structure - (7)	197.89	5145.60	5136.46	4.6200	8.00	0.0130	0.57	2.37	0.32	1.80	1555
Pipe - (50)	Structure - (53)	Structure - (54)	364.85	5187.54	5185.83	0.4700	8.00	0.0130	0.47	0.76	0.54	0.29	248
Pipe - (51)	Structure - (54)	Structure - (55)	171.15	5185.83	5185.15	0.4000	8.00	0.0130	0.46	0.70	0.56	0.24	206
Pipe - (52)	Structure - (55)	Structure - (56)	394.33	5185.15	5183.72	0.3600	8.00	0.0130	0.46	0.66	0.58	0.20	175
Pipe - (53)	Structure - (56)	Structure - (57)	148.03	5183.72	5182.97	0.5100	8.00	0.0130	0.51	0.79	0.56	0.28	240
Pipe - (54)	Structure - (57)	Structure - (102)	125.31	5182.97	5171.77	8.9400	8.00	0.0130	0.51	3.30	0.26	2.79	2407
Pipe - (55)	Structure - (58)	Structure - (59)	78.09	5353.65	5351.44	2.8300	8.00	0.0130	0.00	1.86	0.00	1.86	1602
Pipe - (56)	Structure - (59)	Structure - (60)	79.76	5351.44	5348.36	3.8600	8.00	0.0130	0.00	2.17	0.00	2.17	1871
Pipe - (57)	Structure - (60)	Structure - (61)	50.67	5348.36	5345.34	5.9600	8.00	0.0130	0.00	2.70	0.00	2.70	2324
Pipe - (58)	Structure - (61)	Structure - (62)	134.87	5345.34	5335.93	6.9800	8.00	0.0130	0.00	2.92	0.00	2.92	2515
Pipe - (59)	Structure - (62)	Structure - (63)	199.52	5335.93	5318.38	8.8000	8.00	0.0130	0.00	3.28	0.00	3.28	2824
Pipe - (6)	Structure - (7)	Structure - (8)	196.20	5136.46	5132.78	1.8800	8.00	0.0130	0.57	1.51	0.40	0.94	814
Pipe - (60)	Structure - (63)	Structure - (64)	102.43	5318.38	5310.20	7.9900	8.00	0.0130	0.00	3.12	0.00	3.12	2691
Pipe - (61)	Structure - (64)	Structure - (65)	113.82	5310.20	5305.60	4.0400	8.00	0.0130	0.20	2.22	0.19	2.02	1741
Pipe - (62)	Structure - (65)	Structure - (66)	359.27	5305.60	5289.81	4.4000	8.00	0.0130	0.20	2.32	0.19	2.12	1825
Pipe - (63)	Structure - (66)	Structure - (67)	75.66	5289.81	5285.25	6.0300	8.00	0.0130	0.20	2.71	0.18	2.51	2166
Pipe - (64)	Structure - (67)	Structure - (68)	161.58	5285.25	5276.06	5.6900	8.00	0.0130	0.20	2.64	0.18	2.44	2099
Pipe - (65)	Structure - (68)	Structure - (69)	282.17	5276.06	5259.23	5.9600	8.00	0.0130	0.20	2.70	0.18	2.50	2152
Pipe - (66)	Structure - (69)	Structure - (70)	246.38	5259.23	5245.93	5.4000	8.00	0.0130	0.20	2.57	0.18	2.37	2040
Pipe - (67)	Structure - (70)	Structure - (71)	27.43	5245.93	5243.26	9.7400	8.00	0.0130	0.20	3.45	0.16	3.25	2799
Pipe - (68)	Structure - (71)	Structure - (72)	230.76	5243.26	5232.46	4.6800	8.00	0.0130	0.20	2.39	0.19	2.19	1887
Pipe - (69)	Structure - (72)	Structure - (73)	121.35	5232.46	5229.86	2.1400	8.00	0.0130	0.20	1.62	0.23	1.42	1220
Pipe - (7)	Structure - (8)	Structure - (9)	415.38	5132.78	5118.13	3.5300	8.00	0.0130	0.57	2.08	0.34	1.51	1298
Pipe - (70)	Structure - (73)	Structure - (74)	195.39	5229.86	5227.92	0.9900	8.00	0.0130	0.25	1.10	0.31	0.85	732
Pipe - (71)	Structure - (74)	Structure - (75)	137.73	5227.92	5220.42	5.4500	8.00	0.0130	0.25	2.58	0.20	2.33	2007
Pipe - (72)	Structure - (75)	Structure - (76)	97.58	5220.42	5216.57	3.9500	8.00	0.0130	0.39	2.20	0.27	1.81	1556
Pipe - (73)	Structure - (76)	Structure - (77)	316.37	5216.57	5198.54	5.7000	8.00	0.0130	0.39	2.64	0.25	2.25	1937
Pipe - (74)	Structure - (77)	Structure - (2)	271.52	5198.54	5188.61	3.6600	8.00	0.0130	0.43	2.11	0.29	1.68	1451
Pipe - (75)	Structure - (78)	Structure - (79)	269.75	5168.38	5167.51	0.3200	10.00	0.0130	0.31	1.13	0.33	0.82	709
Pipe - (76)	Structure - (79)	Structure - (80)	227.13	5167.51	5158.75	3.8600	10.00	0.0130	0.31	3.94	0.18	3.63	3124

Table 3 - Buildout ERUs with Improvements needed at Present Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (77)	Structure - (80)	Structure - (81)	266.01	5158.75	5142.32	6.1800	10.00	0.0130	0.30	4.98	0.16	4.68	4033
Pipe - (78)	Structure - (81)	Structure - (82)	171.03	5142.32	5141.53	0.4600	10.00	0.0130	0.30	1.36	0.30	1.06	912
Pipe - (79)	Structure - (82)	Structure - (83)	272.69	5141.53	5140.84	0.2500	10.00	0.0130	0.30	1.00	0.35	0.70	605
Pipe - (8)	Structure - (9)	Structure - (10)	379.03	5118.13	5115.44	0.7100	8.00	0.0130	1.03	0.93	0.91	-0.10	-85
Pipe - (80)	Structure - (83)	Structure - (84)	398.23	5140.84	5139.85	0.2500	10.00	0.0130	0.30	1.00	0.36	0.70	605
Pipe - (81)	Structure - (84)	Structure - (85)	190.37	5139.85	5139.27	0.3000	10.00	0.0130	0.30	1.10	0.34	0.80	687
Pipe - (82)	Structure - (85)	Structure - (86)	317.93	5139.27	5138.63	0.2000	10.00	0.0130	0.30	0.90	0.38	0.60	513
Pipe - (83)	Structure - (86)	Structure - (87)	323.79	5138.63	5137.85	0.2400	10.00	0.0130	0.30	0.98	0.36	0.68	587
Pipe - (84)	Structure - (87)	Structure - (88)	402.79	5137.85	5136.84	0.2500	10.00	0.0130	0.30	1.00	0.35	0.70	605
Pipe - (85)	Structure - (88)	Structure - (89)	216.08	5136.84	5136.24	0.2800	10.00	0.0130	0.30	1.06	0.35	0.76	655
Pipe - (86)	Structure - (89)	Structure - (90)	168.63	5136.24	5135.57	0.4000	10.00	0.0130	0.37	1.27	0.35	0.90	773
Pipe - (87)	Structure - (90)	Structure - (91)	272.44	5135.57	5135.23	0.1200	10.00	0.0130	0.37	0.69	0.42	0.32	279
Pipe - (88)	Structure - (91)	Structure - (92)	268.23	5135.23	5134.27	0.3600	10.00	0.0130	0.37	1.20	0.36	0.83	717
Pipe - (89)	Structure - (92)	Structure - (20)	316.39	5134.27	5133.48	0.2500	10.00	0.0130	0.37	1.00	0.40	0.63	544
Pipe - (9)	Structure - (10)	Structure - (11)	382.52	5115.44	5113.45	0.5200	8.00	0.0130	0.94	0.80	1.00	-0.14	-123
Pipe - (90)	Structure - (93)	Structure - (94)	191.40	5081.69	5080.92	0.4000	10.00	0.0130	0.84	1.27	0.56	0.43	368
Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	10.00	0.0130	1.32	2.29	0.60	0.97	838
Pipe - (92)	Structure - (39)	Structure - (93)	129.91	5082.21	5081.69	0.4000	10.00	0.0130	0.84	1.27	0.56	0.43	368
Pipe - (93)	Structure - (12)	Structure - (96)	328.91	5112.88	5101.85	3.3500	10.00	0.0130	0.73	3.67	0.45	2.94	2530
Pipe - (95)	Structure - (97)	Structure - (98)	387.03	5110.26	5092.55	4.5800	8.00	0.0130	0.00	2.36	0.00	2.36	2038
Pipe - (96)	Structure - (98)	Structure - (99)	155.20	5092.55	5088.49	2.6200	8.04	0.0130	0.00	1.81	0.00	1.81	1562
Pipe - (97)	Structure - (99)	Structure - (100)	153.41	5088.49	5087.36	0.7400	8.00	0.0130	0.00	0.95	0.00	0.95	819
Pipe - (98)	Structure - (100)	Structure - (101)	79.59	5087.36	5085.05	2.9000	8.00	0.0130	0.00	1.88	0.00	1.88	1621
Pipe - (99)	Structure - (101)	Structure - (39)	119.36	5085.05	5082.21	2.3800	8.00	0.0130	0.00	1.70	0.00	1.70	1469
PIPE-123	SSMH8	Structure - (94)	258.91	5088.05	5082.64	2.0900	10.00	0.0150	0.96	2.51	0.41	1.55	1336
PIPE-127	SSMH14	SSMH10	198.00	5108.51	5101.00	3.7900	10.00	0.0150	0.96	3.38	0.35	2.42	2085
PIPE-128	Structure - (96)	SSMH14	45.00	5110.72	5108.41	5.1300	10.00	0.0150	0.97	3.93	0.32	2.96	2553
PIPE-129	SSMH10	SSMH8	253.00	5100.90	5093.70	2.8500	10.00	0.0150	0.96	2.93	0.38	1.97	1698
NP-1	SSMH-97A	Structure - (96)	171.67	5123.68	5110.91	7.4400	8.00	0.0130	0.24	3.01	0.18	2.77	2390

Cell: J8
Note: Dan White:
Pipe 10 receives 1.03 CFS at buildout and can only pass the 0.68 CFS shown here. Pipe 10 is surcharging under buildout ERUs and must be up upsized to handle BO flows. See Table 4.

Cell: H31
Note: Dan White:
Pipe 36 needs to be upsized to 10" to carry existing flows at less than the established 75% flow capacity. 10" is not sufficient for buildout flows as flow depth at the buildout number of ERUs exceeds the 75% flow capacity. See improvements identified in Table 4.

Cell: J79
Note: Dan White:
Pipe 8: the existing 8" is over capacity at buildout flows. See Table 4 for required improvements.

Cell: J90
Note: Dan White:
Pipe 9 does not have the capacity to pass the flow coming to it from Pipe 8. Pipe 9 is surcharged at the 0.94 cfs shown here. Pipe 9 should be upgraded to handle BO flows and is corrected on Table 4.

Cell: J91
Note: Dan White:
Pipe 90 is restricted in this model run from "seeing" all the flows that should be coming to it, because of the restriction in Pipe 36. The undersized pipes are all corrected in the next run, and required improvements are identified on Table 4.

Cell: J92
Note: Dan White:
Pipe 91 is restricted in this model run from "seeing" all the flows that should be coming to it, because of the restrictions in Pipes 9 and 36. The undersized pipes are all corrected in the next run, and required improvements are identified on Table 4.

Cell: J93
Note: Dan White:
Pipe 92 is restricted in this model run from "seeing" all the flows that should be coming to it, because of the restriction in Pipe 36. The undersized pipes are all corrected in the next run, and required improvements are identified on Table 4.

Cell: A100
Note: Dan White:
Pipes 123, 127, 128, 129, 97A were created in the model to represent Project 1.

Table 4 - Buildout ERUs with Improvements needed for Buildout Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (1)	Structure - (2)	Structure - (3)	315.66	5188.61	5173.74	4.7100	8.00	0.0130	0.57	2.40	0.32	1.83	1575
Pipe - (10)	Structure - (11)	Structure - (12)	208.64	5113.45	5112.88	0.2700	10.00	0.0130	1.03	1.04	0.74	0.01	9
Pipe - (100)	Structure - (102)	Structure - (103)	46.81	5171.21	5163.71	16.0200	8.00	0.0130	0.51	4.42	0.22	3.91	3371
Pipe - (101)	Structure - (103)	Structure - (104)	315.36	5154.97	5142.32	4.0100	8.00	0.0130	0.51	2.21	0.31	1.70	1467
Pipe - (102)	Structure - (104)	Structure - (105)	227.46	5142.32	5125.91	7.2100	8.00	0.0130	0.51	2.97	0.27	2.46	2117
Pipe - (103)	Structure - (105)	Structure - (36)	256.85	5125.91	5100.92	9.7300	8.00	0.0130	0.51	3.45	0.25	2.94	2530
Pipe - (18)	Structure - (20)	Structure - (21)	226.69	5133.48	5120.11	5.9000	8.00	0.0130	0.37	2.68	0.24	2.31	1994
Pipe - (19)	Structure - (21)	Structure - (9)	408.88	5120.11	5118.13	0.4800	8.00	0.0130	0.42	0.77	0.50	0.35	298
Pipe - (2)	Structure - (3)	Structure - (4)	201.49	5173.74	5165.54	4.0700	8.00	0.0130	0.57	2.23	0.33	1.66	1430
Pipe - (22)	Structure - (24)	Structure - (25)	237.53	5385.41	5356.94	11.9900	8.00	0.0130	0.00	3.83	0.00	3.83	3297
Pipe - (23)	Structure - (25)	Structure - (26)	212.78	5356.94	5324.91	15.0500	8.00	0.0130	0.00	4.29	0.00	4.29	3694
Pipe - (24)	Structure - (26)	Structure - (27)	339.92	5324.91	5288.09	10.8300	8.00	0.0130	0.12	3.64	0.12	3.52	3030
Pipe - (25)	Structure - (27)	Structure - (28)	174.20	5288.09	5271.82	9.3400	8.00	0.0130	0.21	3.38	0.16	3.17	2729
Pipe - (26)	Structure - (28)	Structure - (29)	446.81	5271.82	5236.43	7.9200	8.00	0.0130	0.21	3.11	0.17	2.90	2498
Pipe - (27)	Structure - (29)	Structure - (30)	193.84	5236.43	5225.01	5.8900	8.00	0.0130	0.21	2.68	0.18	2.47	2130
Pipe - (28)	Structure - (30)	Structure - (31)	343.12	5225.01	5197.31	8.0700	8.00	0.0130	0.21	3.14	0.17	2.93	2524
Pipe - (29)	Structure - (31)	Structure - (32)	189.59	5197.31	5187.22	5.3200	8.00	0.0130	0.21	2.55	0.19	2.34	2015
Pipe - (3)	Structure - (4)	Structure - (5)	301.42	5165.54	5151.61	4.6200	8.00	0.0130	0.57	2.37	0.32	1.80	1555
Pipe - (30)	Structure - (32)	Structure - (33)	220.14	5187.22	5163.74	10.6700	8.00	0.0130	0.21	3.61	0.16	3.40	2929
Pipe - (31)	Structure - (33)	Structure - (34)	259.43	5163.74	5147.39	6.3000	8.00	0.0130	0.51	2.77	0.28	2.26	1950
Pipe - (32)	Structure - (34)	Structure - (35)	346.66	5147.39	5120.73	7.6900	8.00	0.0130	0.67	3.06	0.30	2.39	2063
Pipe - (33)	Structure - (35)	Structure - (36)	374.27	5120.73	5100.92	5.2900	8.00	0.0130	0.67	2.54	0.33	1.87	1612
Pipe - (34)	Structure - (36)	Structure - (37)	386.25	5100.92	5091.61	2.4100	8.00	0.0130	1.19	1.72	0.58	0.53	453
Pipe - (35)	Structure - (37)	Structure - (38)	203.94	5091.61	5083.20	4.1200	8.00	0.0130	1.19	2.24	0.49	1.05	907
Pipe - (36)	Structure - (38)	Structure - (39)	267.45	5083.20	5082.21	0.3700	12.00	0.0130	1.39	1.98	0.58	0.59	510
Pipe - (37)	Structure - (40)	Structure - (41)	251.41	5414.09	5384.20	11.8900	8.00	0.0130	0.17	3.81	0.14	3.64	3136
Pipe - (38)	Structure - (41)	Structure - (42)	226.84	5384.20	5363.03	9.3300	8.00	0.0130	0.17	3.37	0.14	3.20	2762
Pipe - (39)	Structure - (42)	Structure - (43)	272.87	5363.03	5328.06	12.8200	8.00	0.0130	0.17	3.96	0.13	3.79	3262
Pipe - (4)	Structure - (5)	Structure - (6)	205.89	5151.61	5145.60	2.9200	8.00	0.0130	0.57	1.89	0.36	1.32	1136
Pipe - (40)	Structure - (43)	Structure - (44)	167.40	5328.06	5307.72	12.1500	8.00	0.0130	0.17	3.85	0.14	3.68	3172
Pipe - (41)	Structure - (44)	Structure - (45)	215.57	5307.72	5278.76	13.4300	8.00	0.0130	0.17	4.05	0.13	3.88	3343
Pipe - (42)	Structure - (45)	Structure - (46)	317.78	5278.76	5253.08	8.0800	8.00	0.0130	0.17	3.14	0.15	2.97	2560
Pipe - (43)	Structure - (46)	Structure - (47)	160.91	5253.08	5250.39	1.6700	8.00	0.0130	0.17	1.43	0.22	1.26	1084
Pipe - (44)	Structure - (47)	Structure - (48)	199.78	5250.39	5225.19	12.6100	8.00	0.0130	0.17	3.92	0.13	3.75	3234
Pipe - (45)	Structure - (48)	Structure - (49)	352.90	5225.19	5195.91	8.3000	8.00	0.0130	0.17	3.18	0.15	3.01	2596

Table 4 - Buildout ERUs with Improvements needed for Buildout Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (46)	Structure - (49)	Structure - (50)	154.05	5195.91	5192.88	1.9700	8.00	0.0130	0.17	1.55	0.21	1.38	1190
Pipe - (47)	Structure - (50)	Structure - (51)	403.04	5192.88	5190.88	0.5000	8.00	0.0130	0.48	0.78	0.52	0.30	260
Pipe - (48)	Structure - (51)	Structure - (52)	301.21	5190.88	5189.33	0.5100	8.00	0.0130	0.47	0.79	0.52	0.32	275
Pipe - (49)	Structure - (52)	Structure - (53)	369.74	5189.33	5187.54	0.4800	8.00	0.0130	0.47	0.77	0.53	0.30	255
Pipe - (5)	Structure - (6)	Structure - (7)	197.89	5145.60	5136.46	4.6200	8.00	0.0130	0.57	2.37	0.32	1.80	1555
Pipe - (50)	Structure - (53)	Structure - (54)	364.85	5187.54	5185.83	0.4700	8.00	0.0130	0.47	0.76	0.54	0.29	248
Pipe - (51)	Structure - (54)	Structure - (55)	171.15	5185.83	5185.15	0.4000	8.00	0.0130	0.46	0.70	0.56	0.24	206
Pipe - (52)	Structure - (55)	Structure - (56)	394.33	5185.15	5183.72	0.3600	8.00	0.0130	0.46	0.66	0.58	0.20	175
Pipe - (53)	Structure - (56)	Structure - (57)	148.03	5183.72	5182.97	0.5100	8.00	0.0130	0.51	0.79	0.56	0.28	240
Pipe - (54)	Structure - (57)	Structure - (102)	125.31	5182.97	5171.77	8.9400	8.00	0.0130	0.51	3.30	0.26	2.79	2407
Pipe - (55)	Structure - (58)	Structure - (59)	78.09	5353.65	5351.44	2.8300	8.00	0.0130	0.00	1.86	0.00	1.86	1602
Pipe - (56)	Structure - (59)	Structure - (60)	79.76	5351.44	5348.36	3.8600	8.00	0.0130	0.00	2.17	0.00	2.17	1871
Pipe - (57)	Structure - (60)	Structure - (61)	50.67	5348.36	5345.34	5.9600	8.00	0.0130	0.00	2.70	0.00	2.70	2324
Pipe - (58)	Structure - (61)	Structure - (62)	134.87	5345.34	5335.93	6.9800	8.00	0.0130	0.00	2.92	0.00	2.92	2515
Pipe - (59)	Structure - (62)	Structure - (63)	199.52	5335.93	5318.38	8.8000	8.00	0.0130	0.00	3.28	0.00	3.28	2824
Pipe - (6)	Structure - (7)	Structure - (8)	196.20	5136.46	5132.78	1.8800	8.00	0.0130	0.57	1.51	0.40	0.94	814
Pipe - (60)	Structure - (63)	Structure - (64)	102.43	5318.38	5310.20	7.9900	8.00	0.0130	0.00	3.12	0.00	3.12	2691
Pipe - (61)	Structure - (64)	Structure - (65)	113.82	5310.20	5305.60	4.0400	8.00	0.0130	0.20	2.22	0.19	2.02	1741
Pipe - (62)	Structure - (65)	Structure - (66)	359.27	5305.60	5289.81	4.4000	8.00	0.0130	0.20	2.32	0.19	2.12	1825
Pipe - (63)	Structure - (66)	Structure - (67)	75.66	5289.81	5285.25	6.0300	8.00	0.0130	0.20	2.71	0.18	2.51	2166
Pipe - (64)	Structure - (67)	Structure - (68)	161.58	5285.25	5276.06	5.6900	8.00	0.0130	0.20	2.64	0.18	2.44	2099
Pipe - (65)	Structure - (68)	Structure - (69)	282.17	5276.06	5259.23	5.9600	8.00	0.0130	0.20	2.70	0.18	2.50	2152
Pipe - (66)	Structure - (69)	Structure - (70)	246.38	5259.23	5245.93	5.4000	8.00	0.0130	0.20	2.57	0.18	2.37	2040
Pipe - (67)	Structure - (70)	Structure - (71)	27.43	5245.93	5243.26	9.7400	8.00	0.0130	0.20	3.45	0.16	3.25	2799
Pipe - (68)	Structure - (71)	Structure - (72)	230.76	5243.26	5232.46	4.6800	8.00	0.0130	0.20	2.39	0.19	2.19	1887
Pipe - (69)	Structure - (72)	Structure - (73)	121.35	5232.46	5229.86	2.1400	8.00	0.0130	0.20	1.62	0.23	1.42	1220
Pipe - (7)	Structure - (8)	Structure - (9)	415.38	5132.78	5118.13	3.5300	8.00	0.0130	0.57	2.08	0.34	1.51	1298
Pipe - (70)	Structure - (73)	Structure - (74)	195.39	5229.86	5227.92	0.9900	8.00	0.0130	0.25	1.10	0.31	0.85	732
Pipe - (71)	Structure - (74)	Structure - (75)	137.73	5227.92	5220.42	5.4500	8.00	0.0130	0.25	2.58	0.20	2.33	2007
Pipe - (72)	Structure - (75)	Structure - (76)	97.58	5220.42	5216.57	3.9500	8.00	0.0130	0.39	2.20	0.27	1.81	1556
Pipe - (73)	Structure - (76)	Structure - (77)	316.37	5216.57	5198.54	5.7000	8.00	0.0130	0.39	2.64	0.25	2.25	1937
Pipe - (74)	Structure - (77)	Structure - (2)	271.52	5198.54	5188.61	3.6600	8.00	0.0130	0.43	2.11	0.29	1.68	1451
Pipe - (75)	Structure - (78)	Structure - (79)	269.75	5168.38	5167.51	0.3200	10.00	0.0130	0.31	1.13	0.33	0.82	709
Pipe - (76)	Structure - (79)	Structure - (80)	227.13	5167.51	5158.75	3.8600	10.00	0.0130	0.31	3.94	0.18	3.63	3124
Pipe - (77)	Structure - (80)	Structure - (81)	266.01	5158.75	5142.32	6.1800	10.00	0.0130	0.30	4.98	0.16	4.68	4033

Table 4 - Buildout ERUs with Improvements needed for Buildout Model Results

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Design Flow 0.75% Capacity (cfs)	Max Flow Depth / Total Depth Ratio	Excess Capacity (cfs)	Equivalent ERU
Pipe - (78)	Structure - (81)	Structure - (82)	171.03	5142.32	5141.53	0.4600	10.00	0.0130	0.30	1.36	0.30	1.06	912
Pipe - (79)	Structure - (82)	Structure - (83)	272.69	5141.53	5140.84	0.2500	10.00	0.0130	0.30	1.00	0.35	0.70	605
Pipe - (8)	Structure - (9)	Structure - (10)	379.03	5118.13	5115.44	0.7100	10.00	0.0130	1.03	1.69	0.53	0.66	567
Pipe - (80)	Structure - (83)	Structure - (84)	398.23	5140.84	5139.85	0.2500	10.00	0.0130	0.30	1.00	0.36	0.70	605
Pipe - (81)	Structure - (84)	Structure - (85)	190.37	5139.85	5139.27	0.3000	10.00	0.0130	0.30	1.10	0.34	0.80	687
Pipe - (82)	Structure - (85)	Structure - (86)	317.93	5139.27	5138.63	0.2000	10.00	0.0130	0.30	0.90	0.38	0.60	513
Pipe - (83)	Structure - (86)	Structure - (87)	323.79	5138.63	5137.85	0.2400	10.00	0.0130	0.30	0.98	0.36	0.68	587
Pipe - (84)	Structure - (87)	Structure - (88)	402.79	5137.85	5136.84	0.2500	10.00	0.0130	0.30	1.00	0.35	0.70	605
Pipe - (85)	Structure - (88)	Structure - (89)	216.08	5136.84	5136.24	0.2800	10.00	0.0130	0.30	1.06	0.35	0.76	655
Pipe - (86)	Structure - (89)	Structure - (90)	168.63	5136.24	5135.57	0.4000	10.00	0.0130	0.37	1.27	0.35	0.90	773
Pipe - (87)	Structure - (90)	Structure - (91)	272.44	5135.57	5135.23	0.1200	10.00	0.0130	0.37	0.69	0.42	0.32	279
Pipe - (88)	Structure - (91)	Structure - (92)	268.23	5135.23	5134.27	0.3600	10.00	0.0130	0.37	1.20	0.36	0.83	717
Pipe - (89)	Structure - (92)	Structure - (20)	316.39	5134.27	5133.48	0.2500	10.00	0.0130	0.37	1.00	0.40	0.63	544
Pipe - (9)	Structure - (10)	Structure - (11)	382.52	5115.44	5113.45	0.5200	10.00	0.0130	1.03	1.44	0.59	0.41	357
Pipe - (90)	Structure - (93)	Structure - (94)	191.40	5081.69	5080.92	0.4000	12.00	0.0130	1.46	2.06	0.59	0.60	517
Pipe - (91)	Structure - (94)	Out-1Pipe - (91)	311.68	5080.62	5076.54	1.3100	12.00	0.0130	2.76	3.73	0.60	0.97	835
Pipe - (92)	Structure - (39)	Structure - (93)	129.91	5082.21	5081.69	0.4000	12.00	0.0130	1.45	2.06	0.59	0.61	526
Pipe - (93)	Structure - (12)	Structure - (96)	328.91	5112.88	5101.85	3.3500	10.00	0.0130	1.06	3.67	0.57	2.61	2246
Pipe - (95)	Structure - (97)	Structure - (98)	387.03	5110.26	5092.55	4.5800	8.00	0.0130	0.00	2.36	0.00	2.36	2038
Pipe - (96)	Structure - (98)	Structure - (99)	155.20	5092.55	5088.49	2.6200	8.00	0.0130	0.00	1.79	0.00	1.79	1541
Pipe - (97)	Structure - (99)	Structure - (100)	153.41	5088.49	5087.36	0.7400	8.00	0.0130	0.00	0.95	0.00	0.95	819
Pipe - (98)	Structure - (100)	Structure - (101)	79.59	5087.36	5085.05	2.9000	8.00	0.0130	0.00	1.88	0.00	1.88	1621
Pipe - (99)	Structure - (101)	Structure - (39)	119.36	5085.05	5082.21	2.3800	8.00	0.0130	0.00	1.70	0.00	1.70	1469
PIPE-123	SSMH8	Structure - (94)	258.91	5088.05	5082.64	2.0900	10.00	0.0150	1.30	2.51	0.49	1.21	1043
PIPE-127	SSMH14	SSMH10	198.00	5108.51	5101.00	3.7900	10.00	0.0150	1.30	3.38	0.41	2.08	1792
PIPE-128	Structure - (96)	SSMH14	45.00	5110.72	5108.41	5.1300	10.00	0.0150	1.30	3.93	0.37	2.63	2268
PIPE-129	SSMH10	SSMH8	253.00	5100.90	5093.70	2.8500	10.00	0.0150	1.30	2.93	0.44	1.63	1405
NP-1	SSMH-97A	Structure - (96)	171.67	5123.68	5110.91	7.4400	8.00	0.0130	0.24	3.01	0.18	2.77	2390
Pipe - (10)	Must upsize from	8.00	to	10.00	to adequately serve buildout ERUs								
Pipe - (36)	Must upsize from	10.00	to	12.00	to adequately serve buildout ERUs				Upsize from 8" to 10" needed for existing conditions				
Pipe - (8)	Must upsize from	8.00	to	10.00	to adequately serve buildout ERUs								
Pipe - (9)	Must upsize from	8.00	to	10.00	to adequately serve buildout ERUs								
Pipe - (90)	Must upsize from	10.00	to	12.00	to adequately serve buildout ERUs				Upsize from 8" to 10" needed for existing conditions				
Pipe - (91)	Must upsize from	10.00	to	12.00	to adequately serve buildout ERUs				Upsize from 8" to 10" needed for existing conditions				
Pipe - (92)	Must upsize from	10.00	to	12.00	to adequately serve buildout ERUs				Upsize from 8" to 10" needed for existing conditions				

WOLF CREEK WATER AND SEWER IMPROVEMENT DISTRICT
COST ESTIMATE

PROJECT 1
10" and 12" LINES IN WILLOW BROOK LANE and BYPASS THE VILLAGES

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
1	INSTALL NEW 8" DR 18 C900 PVC PIPE (Pipe 1A)	171	LF	$110.00	$18,810.00
2	INSTALL NEW 10" DR 18 C900 PVC PIPE (Pipes 1B)	780	LF	$130.00	$101,400.00
3	INSTALL NEW 12" DR 18 C900 PVC PIPE (Pipe 91 on Map SM2, Pipe 1C on Map CP1)	276	LF	$150.00	$41,400.00
4	MANHOLE	8	EA	$7,500.00	$60,000.00
5	BY PASS PUMPING	1	LS	$10,000.00	$10,000.00
6	ABANDON EXISTING 8"	322	LF	$20.00	$6,440.00
7	CONNECT TO EXISTING MANHOLE	3	EA	$1,500.00	$4,500.00
8	ROAD BASE	160	TON	$25.00	$4,002.00
9	ASPHALT TRENCH PATCH	411	TON	$170.00	$69,806.25
10	2" MINUS GRANULAR BACKFILL	640	TON	$25.00	$16,008.00
11	Pipe Zone Back Fill	636	TON	$22.00	$13,992.00
12	Traffic control	1	LS	$20,000.00	$20,000.00
				SUB TOTAL	$246,148.25
				12% ENGINEERING	$29,537.79
				20% CONTINGENCY	$49,229.65
				TOTAL ESTIMATED PROJECT COST	$324,915.69

IMPACT FEE ELIGIBLE PORTION (marginal cost of pipe plus 1/2 of other costs)

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
2	Pipes 1B - PIPE COST DIFFERENCE BETWEEN 8" NEEDED AT PRESENT TO REPLACE THE 8" CAPACITY THROUGH THE VILLAGES AND 10" NEEDED FOR BUILDOUT: DR 18 C900 PVC PIPE	780	LF	$32.50	$25,350.00
3	Pipe 1C - an upsize from 8" to 10" is needed at present. 60% of capacity of 10" line is to remedy existing deficiencies. 40% of 10" capacity is for future connections, thus 40% of the cost of the 10" line needed at present is impact fee eligible.	276	LF	$52.00	$14,352.00
3	Pipe 1C - PIPE COST DIFFERENCE BETWEEN 10" NEEDED FOR EXISTING CONDITIONS AND 12" NEEDED FOR BUILDOUT	276	LF	$37.50	$10,350.00
4	MANHOLE	8	EA	$3,750.00	$30,000.00
5	BY PASS PUMPING	1	LS	$5,000.00	$5,000.00
6	ABANDON EXISTING 8"	322	LF	$10.00	$3,220.00
7	CONNECT TO EXISTING MANHOLE	3	EA	$750.00	$2,250.00
8	ROAD BASE	160	TON	$12.50	$2,001.00
9	ASPHALT TRENCH PATCH	411	TON	$85.00	$34,903.13
10	2" MINUS GRANULAR BACKFILL	640	TON	$12.50	$8,004.00
11	Pipe Zone Back Fill	636	TON	$11.00	$6,996.00
12	Traffic control	1	LS	$10,000.00	$10,000.00
				SUB TOTAL	$152,426.13
				6% ENGINEERING	$18,291.14
				15% CONTINGENCY	$22,863.92
				IMPACT FEE ELIGIBLE PORTION OF PROJECT COST	$193,581.18

WOLF CREEK WATER AND SEWER IMPROVEMENT DISTRICT
COST ESTIMATE

PROJECT 2
UPSIZE PIPES 90 and 92 AT THE BOTTOM OF THE VILLAGES

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
1	INSTALL NEW 12" DR 18 C900 PVC PIPE	322	LF	$150.00	$48,300.00
2	BY PASS PUMPING	1	LS	$10,000.00	$10,000.00
3	ABANDON EXISTING 8"	322	LF	$20.00	$6,440.00
4	CONNECT TO EXISTING MANHOLE	2	EA	$3,000.00	$6,000.00
5	Pipe Zone Back Fill	187	TON	$22.00	$4,114.00
6	2" MINUS GRANULAR BACKFILL	934	TON	$25.00	$23,350.00
				SUB TOTAL	$98,204.00
				12% ENGINEERING	$11,784.48
				20% CONTINGENCY	$19,640.80
				TOTAL ESTIMATED PROJECT COST	$129,629.28

IMPACT FEE ELIGIBLE PORTION (marginal cost of pipe plus 1/2 of other costs)

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
3	An upsize from 8" to 10" is needed at present. 60% of capacity of 10" line is to remedy existing deficiencies. 40% of 10" capacity is for future connections, thus 40% of the cost of the 10" line needed at present is impact fee eligible. See Project 1 for 10" pipe cost estimate.	322	LF	$52.00	$16,744.00
1	PIPE COST DIFFERENCE BETWEEN 10" NEEDED AT PRESENT AND 12" NEEDED FOR BUILDOUT: DR 18 C900 SEWER PIPE	322	LF	$37.50	$12,075.00
2	BY PASS PUMPING	1	LS	$5,000.00	$5,000.00
3	ABANDON EXISTING 8"	322	LF	$10.00	$3,220.00
4	CONNECT TO EXISTING MANHOLE	2	EA	$1,500.00	$3,000.00
5	Pipe Zone Back Fill	187	TON	$11.00	$2,057.00
6	2" MINUS GRANULAR BACKFILL	934	TON	$12.50	$11,675.00
				SUB TOTAL	$53,771.00
				6% ENGINEERING	$3,226.26
				10% CONTINGENCY	$5,377.10
				IMPACT FEE ELIGIBLE PORTION OF PROJECT COST	$62,374.36

WOLF CREEK WATER AND SEWER IMPROVEMENT DISTRICT
COST ESTIMATE

PROJECT 3

12" LINE IN CREEK VIEW DRIVE AND WILLOW BROOK LANE

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
1	INSTALL NEW 12" DR 18 C900 PVC PIPE	1204	LF	$200.00	$240,800.00
2	5' DIAMETER MANHOLE	5	EA	$8,000.00	$40,000.00
3	ABANDON EXISTING 8"	1204	LF	$20.00	$24,080.00
4	BY PASS PUMPING	1	LS	$10,000.00	$10,000.00
5	CONNECT TO EXISTING MANHOLE	2	EA	$3,000.00	$6,000.00
6	ASPHALT TRENCH PATCH	861	TON	$170.00	$146,346.20
7	ROAD BASE	1514	TON	$25.00	$37,850.00
8	Pipe Zone Back Fill	699	TON	$22.00	$15,378.00
9	2" MINUS GRANULAR BACKFILL	7550	TON	$25.00	$188,750.00
10	Traffic Control	1	LS	$20,000.00	$20,000.00
				SUB TOTAL	$729,204.20
				12% ENGINEERING	$87,504.50
				20% CONTINGENCY	$145,840.84
				TOTAL CONSTRUCTION COST	$962,549.54

WOLF CREEK WATER AND SEWER IMPROVEMENT DISTRICT
COST ESTIMATE

PROJECT 4

UPSIZE PIPE (36) CROSSING WOLF CREEK DRIVE

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
1	INSTALL NEW 12" DR 18 C900 PVC PIPE	268	LF	$150.00	$40,200.00
2	BY PASS PUMPING	1	LS	$10,000.00	$10,000.00
3	ABANDON EXISTING 8"	268	LF	$20.00	$5,360.00
4	CONNECT TO EXISTING MANHOLE	2	EA	$1,500.00	$3,000.00
5	ROAD BASE	41	TON	$25.00	$1,025.00
6	ASPHALT TRENCH PATCH	32	TON	$170.00	$5,440.00
7	24" STEEL CASING	66	LF	$800.00	$52,800.00
8	2" MINUS GRANULAR BACKFILL	777	TON	$25.00	$19,430.00
9	Pipe Zone Back Fill	195	TON	$22.00	$4,290.00
10	Traffic control	1	LS	$20,000.00	$20,000.00
				SUB TOTAL	$141,545.00
				15% ENGINEERING	$21,231.75
				20% CONTINGENCY	$28,309.00
				TOTAL CONSTRUCTION COST	$191,085.75

IMPACT FEE ELIGIBLE PORTION (marginal cost of pipe plus 1/2 of other costs)

ITEM	DESCRITPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL
3	An upsize from 8" to 10" is needed at present. 60% of capacity of 10" line is to remedy existing deficiencies. 40% of 10" capacity is for future connections, thus 40% of the cost of the 10" line needed at present is impact fee eligible. See Project 1 for 10" pipe cost estimate.	268	LF	$52.00	$13,936.00
3	PIPE COST DIFFERENCE BETWEEN 10" NEEDED AT PRESENT AND 12" NEEDED FOR BUILDOUT: DR 18 C900 PVC PIPE	268	LF	$37.50	$10,050.00
4	BY PASS PUMPING	1	LS	$5,000.00	$5,000.00
5	ABANDON EXISTING 8"	268	LF	$10.00	$2,680.00
6	CONNECT TO EXISTING MANHOLE	2	EA	$750.00	$1,500.00
7	ROAD BASE	41	TON	$12.50	$512.50
8	ASPHALT TRENCH PATCH	32	TON	$85.00	$2,720.00
9	24" STEEL CASING	66	LF	$400.00	$26,400.00
10	2" MINUS GRANULAR BACKFILL	777	TON	$12.50	$9,715.00
11	Pipe Zone Back Fill	195	TON	$11.00	$2,145.00
12	Traffic control	1	LS	$10,000.00	$10,000.00
				SUB TOTAL	$84,658.50
				6% ENGINEERING	$10,159.02
				15% CONTINGENCY	$12,698.78
				IMPACT FEE ELIGIBLE PORTION OF PROJECT COST	$107,516.30

Wolf Creek Water and Sewer Improvement District					
Preliminary Estimate of Probable Construction Cost, 90-AF Bridges Pond					
Item #	**Items**	**QTY**	**Unit**	**Unit Cost**	**Total**
Exploration					
1	Geotechnical	1	LS	$82,500.00	$82,500.00
Site Preparation					
2	Mobilization and Demobilization	1	LS	$52,800.00	$52,800.00
3	Surveying	1	LS	$19,800.00	$19,800.00
4	Clearing, Grubbing	51,600	SY	$1.38	$70,950.00
5	Excavation and Preparation	182,040	CY	$3.58	$650,793.00
6	Storm Water Pollution Prevention	1	LS	$13,200.00	$13,200.00
Facility Construction					
7	Pond Access Road	1,200	TON	$19.80	$23,760.00
8	Pumping Facilities to pump into distribution system	1	LS	$200,000.00	$200,000.00
9	Re-vegetation	1	LS	$13,200.00	$13,200.00
10	Embankment (Structural Fill import)	34,392	CY	$8.25	$283,734.00
11	10^-7 cm/s or better lining system	17,040	CY	$16.50	$281,160.00
12	Protection Layer (Rounded Cobble 6"minus-12" deep)	11,312	CY	$33.00	$373,307.73
13	Dam Face Riprap	4,525	CY	$33.00	$149,323.09
14	Inlet / Outlet Control Structure	1	EA	$66,000.00	$66,000.00
15	Outlet Piping and Appurtenances	1	LS	$26,400.00	$26,400.00
16	12" Transmission Line	2,800		$106.70	$298,760.00
CONSTRUCTION SUBTOTAL					$2,605,687.83
Engineering and Contingency					
17	Engineering (12% of Construction Costs)	1	LS	$312,682.54	$312,682.54
18	Contingencies (20% of Construction Costs)	1	LS	$521,137.57	$521,137.57
					$833,820.10
Pond Total					**$3,439,507.93**
				$/AC-FT	**$38,216.75**

Wolf Creek Water and Sewer Improvement District					
Preliminary Estimate of Probable Construction Cost, Pump Station and Reuse Line					
IDENTIFIED AS PROJECT NUMBER 5 IN SEWER IFFP					
Item #	**Items**	**QTY**	**Unit**	**Unit Cost**	**Total**
1	8" C-900 DR18 PVC waterline	7,934	LF	$90.00	$714,060.00
2	8" Gate Valve	4	EA	$2,500.00	$10,000.00
3	Saw Cut Asphalt (Length in oil)	4,830	LF	$1.50	$7,245.00
3	4" Asphalt (avg 10'W)	1,208	TON	$150.00	$181,200.00
4	Trench Backfill (avg 3'D x 5'W)	8,034	TON	$19.50	$156,663.00
5	Base Course (avg 8"D x 10'W)	5,367	TON	$20.00	$107,340.00
6	Sand Bedding (avg 2.25'D x 3.5'W)	4,218	TON	$25.00	$105,450.00
7	300 GPM x 227' TDH duplex pumpstation	1	LS	$200,000.00	$200,000.00
CONSTRUCTION SUBTOTAL					$1,481,958.00

Engineering and Contingency					
8	Engineering (12% of Construction Costs)	1	LS	$177,834.96	$177,834.96
9	Contingencies (15% of Construction Costs)	1	LS	$222,293.70	$222,293.70
					$400,128.66
PROJECT TOTAL					**$1,882,086.66**
	90-AF Bridges Pond:			**$/AC-FT**	**$20,912.07**