NAISMITH VALLEY INTERCEPTOR SEWER

Preliminary Design Report

B&V PROJECT NO. 199920

PREPARED FOR

City of Lawrence

15 FEBRUARY 2019

City of Lawrence

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1.0 Introduction

The City of Lawrence (City) hired Black & Veatch (B&V) to provide engineering services in connection with design of the Naismith Valley Interceptor Sewer and abandonment of Pump Station 8. The purpose of the project is to design a gravity flow interceptor that conveys the sanitary flows from the project area to the Lower Naismith Valley Interceptor and Pump Station 10 (south of 29th Terrace and Missouri Street).

Under existing conditions, the northern half of the project area's sanitary flows are conveyed to Pump Station 8. Flows from Pump Station 8 are conveyed to the Kaw River Wastewater Treatment Plant. When the northern half of the project area's sanitary flows are greater than the capacity of Pump Station 8, the excess flows are conveyed south through a relief sewer located at Naismith Drive and 23rd Street. The relief sewer travels south and becomes the Naismith Valley Interceptor which collects the sanitary flows from the southern portion of the project area and conveys them to the Lower Naismith Valley Interceptor. The Lower Naismith Valley Interceptor is an existing sewer that flows by gravity to either Pump Station 10 which conveys the sewer flows to the Wakarusa Wastewater Treatment Plant or to Pump Station 5 which conveys the sewer flows to the Kansas River Wastewater Treatment Plant.

The project area is in south Lawrence and consists of primarily single family residential and multi-family residential along with some commercial and park areas. The area includes Naismith Creek that conveys flow north to south through Naismith Valley Park as seen in Figure 1.

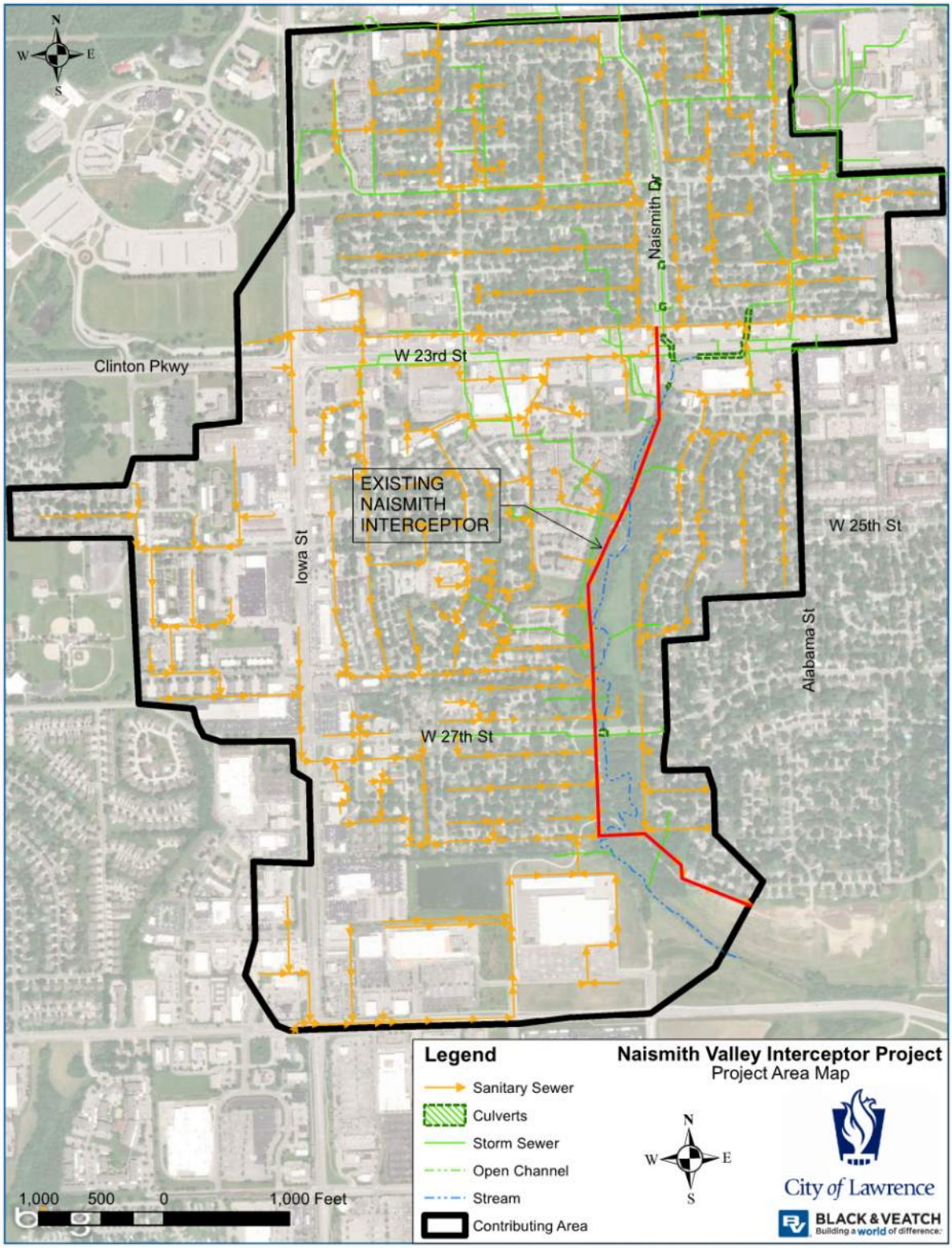

Figure 1 – Naismith Valley Interceptor Project Area

2.0 Existing Data

Previous reports and projects have been completed within the project area. This section lists the pertinent documents to provide a history of the work conducted, data collected, and the design standards that were followed. A summary of each is provided below.

2.1 SUMMARY OF EXISTING DATA

The following data, provided by the City of Lawrence, was reviewed and utilized for the Basis of Design:

- Existing System Investigations (See Section 3.0 Existing System Investigations)
- 2003 Wastewater Master Plan
- 2006 CIP Projects Evaluation Projects Report
- 2012 Wastewater Master Plan
- GIS Data
- Flow Monitoring Data and Evaluations
- Population and Planning Data
- Geotechnical Reports
    - Lower Naismith Valley Interceptor Sewer (2017)
    - 23rd Street, Ousdahl Road to Alabama Street Waterline Replacement (2017)
    - Proposed Pump Station No. 10 (2013)
- As-Built Drawings

2.2 DESIGN STANDARDS

Preliminary design of the Naismith Interceptor was completed in accordance with Section 5500 of the *City of Lawrence Design Criteria* dated January 2018 For sewers larger than 18" diameter, the slopes and sizes were designed to meet requirements from the *Recommended Standards for Wastewater Facilities* dated 2014 (10 State Standards) and Kansas Department of Health and Environment (KDHE) *Minimum Standards of Design for Water Pollution Control Facilities* dated 1978.

2.3 PREVIOUS CONSTRUCTION PROJECTS

An inventory of existing water, sewer, and storm sewer projects within the project area was done. The as-built drawings were obtained for those projects that were available. A list of as-built drawings reviewed are:

- Lower Naismith Valley Interceptor Sewer (2017)
- 23rd and Naismith Storm Box Extension (1955)
- 1997 Carolina Street Storm Sewer Improvements, Phase 1 and Phase 2 (1997)
- Sewerage and Lift Station Improvements, Pump Station 8 (1954)
- Contract No. 16 Sanitary Sewer Improvements (1967)

These drawings were reviewed to determine location, depth, and utility information to verify existing conditions and confirm elevations to avoid conflicts. In addition, invert information was reviewed from the plans to confirm existing sewer elevations.

2.4 ENVIRONMENTAL INFORMATION

To assess the likelihood that sources of environmental impact are located near the proposed interceptor sewer corridor, Black & Veatch reviewed the state and federal databases required under the ASTM E1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process 2013. The EDR provides comprehensive information from the review of the databases to ASTM-specified minimum search distances. A complete list of databases searched is provided in the EDR report. Review of the EDR report indicates the primary potential source of environmental contamination near the sewer corridor is leaking underground storage tanks (LUST) sites. Several spills were also noted in close proximity to the corridor.

2.4.1 LUST Sites

Records indicate 31 LUST sites within a one-half mile radius of the sewer corridor. Six sites are within the corridor north of 23rd Street that could impact construction activities depending on the final sewer alignment. Another eight sites are located on property adjacent to or upgradient of the corridor. Based on the EDR report, groundwater is encountered around 12 feet and flow is to the west and southwest.

The 15 LUST sites of potential concern are listed in Table 1. The table includes the relative location of the site to the corridor and the status of the site. Figure 2 shows the location of the LUST sites with the greatest potential to impact sewer construction.

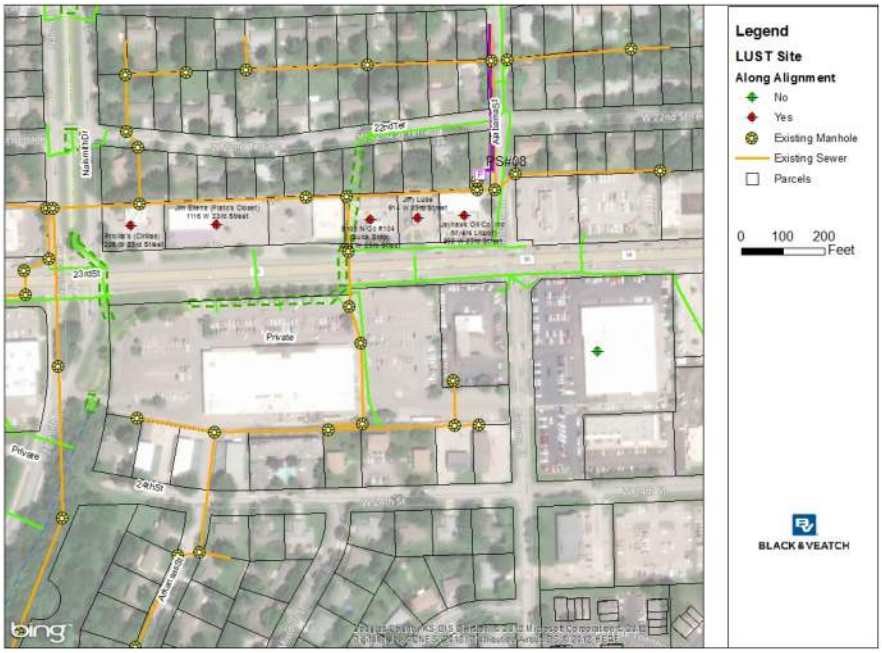

Figure 2 – LUST Sites in Close Proximity to Proposed Sewer Corridor

Table 1 – LUST Sites in Close Proximity to Proposed Sewer Corridor

Site Name	Address	Location of Site	Site Status
Jiffy Lube	914 W. 23rd St	Within Project Area	Closed
Jayhawk Oil Co. INC (Aqueous Vapor/Myers Liquor)	902 W 23rd St	Within Project Area	Closed-soil/groundwater impacts limited to UST basins
Jim Ellena (Plato's Closet)	1116 W 23rd St	Within Project Area	Closed
Shop N Go #104 (Quick Stop)	1000 W 23rd St	Within Project Area	Open- ongoing monitoring, heavily impacted soil encountered during storm sewer work and left in-place
Pricillia's (Cirillas)	1206 W. 23rd Street	Within Project Area	Open- soil/groundwater impacts limited to UST basins
Laird Noller Ford, Lawrence	23rd & Alabama	Upgradient, east of Project Area	Closed
Gregg Tire Co	814 W 23rd St	Upgradient, east of Project Area	Open-ongoing monitoring
Boston Market	600 W 23rd St	Upgradient, east of Project Area	Closed
550 W 23rd St	550 W 23rd St	Upgradient, east of Project Area	Closed
Dunkin Doughnuts	521 W 23rd St	Upgradient, east of Project Area	Closed
Louisiana-Purchase Shopping Center	2233 Louisiana St	Upgradient, east of Project Area	Open-ongoing monitoring
Louisiana BP	2301 Louisiana St	Upgradient, east of Project Area	Closed
USD #497 Lawrence	2145 Louisiana St	Upgradient, east of Project Area	Closed
USD #497 Lawrence	2017 Louisiana St	Upgradient, east of Project Area	Closed
Former Junes Gulf Service	1401 West 23rd St	Downgradient, west of Project Area	Open-ongoing monitoring

Based on this review, the LUST sites with the greatest potential to impact sewer construction are Jiffy Lube, Jayhawk Oil Co INC., Shop N GO #104, and Pricillia's. Additional Field work will need to

be done to confirm the groundwater and soil conditions where excavation is anticipated on these sites.

2.4.2 Spill Sites

EDR records indicate three spill sites within the sewer corridor area. BP Amoco, 2301 Louisiana spill indicated 5 gallons of fuel spilled in 2004, the site was closed one day after it was recorded. Two spills were recorded at 1015 W 23rd St, a motor vehicle diesel fuel leak in 1989 and a transformer failure leak in 2006. Both spill sites were closed on the same day they were reported. There are no other spill sites within a half mile of the corridor.

2.4.3 Recommendations for Further Assessment

Additional assessment of the LUST sites is necessary to determine how and to what extent they will impact the proposed sewer alignment. This in turn will allow a soil and water management plan to be prepared and implemented during construction.

2.5 EXISTING GEOTECHNICAL INFORMATION

Existing geotechnical information for projects within the area was collected and reviewed. This geotechnical information was used to determine the anticipated soil conditions to aid in determining construction methods and to aid in determining costs for the open cut and trenchless construction. Additional geotechnical information along the proposed Naismith Interceptor Sewer will be collected during Final Design to assist with the development of construction documents.

Based on a review of the geotechnical information available the soil along the alignment is a variety of clay soils. This will allow for typical construction methods. In addition groundwater was observed at depths of 7.5 to 17 feet in depth. If this is consistent along the alignment this may have an impact on construction cost and production due to potential dewatering. It is anticipated dewatering can be done by sump pumps located within the trench.

2.6 EXISTING UTILITIES

Various utilities may need to be relocated and/or rebuilt due to the proposed interceptor project. Existing utilities in the project area were identified and proposed sewer alignments were selected to minimize conflicts with the existing utilities. Based upon received information, the utilities that are confirmed to be located in the project area that could be affected by the construction activities are:

- Water Mains (City of Lawrence)
- Storm Sewers (City of Lawrence)
- Gas Lines (Black Hills and Southern Star Energy)
- Overhead and underground Power (Westar Energy)
- Traffic Lights (City of Lawrence)
- Fiber Lines (City of Lawrence, Verizon)

Utility information request will be sent to the following utility providers, which are provided in the City's Utility Contact List, to confirm if they have utilities located in the project area:

- Westar Energy (Electric)
- Black Hills Energy (Gas)
- Southern Star Energy (Gas)
- Midco (Cable)
- AT&T (Cable)

3.0 Existing System Investigations

The sewer system in the project area consists of sanitary sewers and storm sewers as seen in Figure 1. Sewer flows from the north and east section of the project area flow by gravity to Pump Station 8 where a forcemain conveys flows to Kaw River WWTP. If the flows exceed Pump Station 8's capacity, then the excess flows are conveyed south through a relief sewer. The west section of the project area is collected in this relief sewer and flows by gravity to the Pump Station 10 and is conveyed to the Wakarusa WWTP.

3.1 FLOW AND RAINFALL MONITORING

Flow and rainfall monitoring was conducted throughout the City as part of previous studies. Flow data from Pump Station 8 for 2017 was provided as well as flow data for the overflow line upstream of Pump Station 8 for 2017. The City also provided estimated flow rates for the interceptor sewer developed from the 2003 and 2012 Master Plans. The monitoring information was used to estimate project area flows in the capacity evaluation.

3.2 CCTV INSPECTIONS

CCTV inspections were provided by the City for the some of the sewers in the project area. Sewers that were connected to the proposed alignment were reviewed for existing conditions and potential repairs. Table 2 lists the sewers that were reviewed and any repair recommendations associated with those lines. Any open cut repairs are suggested to be completed as part of the Naismith Interceptor Project. Any CIPP repairs are recommended to be included in another project dedicated to CIPP rehabilitation.

Table 2 – CCTV Inspection Review

US Manhole	DS Manhole	Diameter	Length	Material	Repair Recommendations
NW121319-103	NW121319-104	8	381	VCP	CIPP Lining
NW121319-122	NW121319-112	8	186	RPM	No Repairs
NW121319-126	NW121319-110	8	308	RPM	No Repairs
NW121319-131	SW121319-075	8	276	VCP	No Repairs
SE011319-018	SE011319-019	10	310	VCP	Line Needs Full Replacement
SE011319-024	SE011319-023	8	136	VCP	No Repairs
SE011319-033	SE011319-019	8	62	VCP	No Repairs
SE011319-089	SW011319-090	15	14	VCP	No Repairs
SW011319-090	NE121319-116	15	379	CAS	No Repairs
SW121319-062	SW121319-061	8	204	VCP	No Repairs
SW121319-070	SW121319-067	8	249	VCP	Point Repair at DS MH

3.3 MANHOLE INSPECTIONS

Manhole inspections were provided by the City for the sanitary manholes in the project area. Manholes within the project area that were adjacent to the work were reviewed to determine if any repairs are needed. A summary of the manholes reviewed and the recommendations are provided in Table 3.

Table 3 – Manhole Repair Recommendations

Manhole ID	Diameter	Material	Repair Recommendations
SE011319-021	4	Brick	Replace Frame and Cover
SE011319-018	4	Brick	Replace Frame and Cover
SE011319-022	4	Brick	No Repairs
SE011319-023	4	Brick	Replace Frame and Cover
SE011319-089	4	Brick	No Repairs
SE011319-033	4	Brick	No Repairs
SW011319-090	4	Brick	No Repairs

The repairs recommended for manhole rehabilitation are to replace 3 manhole frames and covers. This is due to potential I/I from a perforated cover and evidence of infiltration around the frame. These defects are not structural and do not require immediate repair.

3.4 DATA GAP ANALYSIS

This section summarizes the additional data needs required for final design. A list of the additional data needed for final design is provided below:

- Geotechnical borings every 500’ are recommended along the proposed alignment to determine what soil materials will be expected during sewer installation and trenchless construction.
- Sub-surface utility exploration (SUE) is needed along the proposed pipeline alignments to determine the horizontal and vertical location of key existing utilities.
- Basement survey to determine the elevation of laterals that will need reconnection at 907 and 915 W 22nd Terrace/
- Topographic survey of the proposed alignment will be required to develop construction documents.
- Ownership/Encumbrance investigation along the alignment will need to be completed.
- Acquiring additional environmental monitoring reports from the LUST sites along the proposed alignment. A review of this information will confirm if additional sampling and testing will be required to determine if contaminated soil or groundwater will be encountered during construction.

4.0 Stakeholder Coordination

Coordination with stakeholders will be required moving forward into final design. Below are some stakeholders that have been identified that will require coordination with:

- Local Businesses
    - There are multiple local businesses along 23rd Street that will potentially be impacted by this project. Coordination and involvement with these businesses could help minimize conflicts and impacts to the project's schedule. Public outreach will be performed once the detailed alignment is selected and notifications and coordination with these businesses will be done during detailed design.
- Parks Department
    - A majority of the new sewer will be located within Naismith Valley Park. Coordination and involvement with the Parks and Recreation Department is critical to a successful project. An initial coordination meeting was held with the Parks and Recreation Department and their primary concerns are:
        - Tree Removal along the trail
        - Closure of the trail
    - To address these concerns, the final alignment will be staked and a walk through completed to discuss potential alignment adjustments to minimize tree removal when practical.
    - Construction sequencing will be specified in the contract documents to minimize impacts related to trail closure. Potential sequencing may allow for the portion of the trail south of 27th street to be closed first and the main portion of the trail from 27th to 23rd street to be closed during winter months when trail use is at its lowest.
- Utilities
    - As discussed in Section 2.6 Existing Utilities, water and fiber utilities have been confirmed to be in the project area. Other utilities such as gas and power are known to be in the area, but confirmation of size and location is needed. Coordinating with the local utilities is required to confirm utility locations and minimize conflicts with proposed alignments. Higher level SUE investigations will be completed when conflicts are expected between utilities and proposed improvements.
        - The project team has conducted some utility coordination efforts with public works (stormwater) and Verizon (fiber) during preliminary design of the alignment alternatives. These utility coordination efforts

are summarized in the utility coordination log provided in Appendix A – Utility Coordination Log.

- During final design, the project team will reach out to all utilities in Lawrence to confirm which utilities have infrastructure within the project limits. All coordination efforts will be recorded in the utility coordination log.

- Permitting
  - As a part of final design, the project team will develop a list of permits likely to be required for the Naismith Valley Interceptor project. The permit list will be reviewed by the City and submission responsibilities will be identified. Coordination with appropriate agencies may be required to ensure all requirements are being met prior to final submission.

5.0 Risk Management Analysis

A risk assessment was performed and a risk register was developed to identify the potential risks for the proposed work. A risk strategy was developed for the project based on the risk register. The Risk Register, including mitigation strategy, is presented in Table 4.

Table 4 – Risk Register

Risk Name	Activity Impacted	Mitigation Strategy
Assumptions of flow rates	Design	Project Team will identify any field evidence of hydraulic events that raise questions concerning assumptions used for flow rate calculations. A thorough review of the 2003 Master Plan, 2012 Master Plan update, Pump Station 8 flow data, relief sewer flow data, and inflow and infiltration rates for the area was performed to confirm the expected flow rates.
Noise & Vibration Complaints	Construction	Contract Documents to include appropriate contractual language to address working hours. Crack monitoring will be required on existing structures within 100' of the construction limits. Vibration monitoring will be considered based on the condition and land use of the properties along the alignment.
Damaged Private Property	Public Affairs	The Project Documents will include language to address any potential damage to private property. Pre-construction video and photos of the alignment will be done to document preconstruction conditions and assist with any damage claims. In addition, the survey will be done to document any private property within the area of construction that would be of a concern. Any private fencing, landscaping, or structures will be supported or removed and replaced to pre-construction condition or better. Vibration monitoring may be recommended
Public Reaction to Street Closings and Construction	Public Affairs	Historical projects and approaches to traffic control were reviewed. Also, coordination with stakeholders was conducted during alignment selection. The direction was given that open cut construction in 23rd street will not be allowed due to recent improvements. This will limit the impact on traffic disruptions on 23rd Street. Trenchless technologies are being reviewed to select the most feasible method for installing the sewer across 23rd Street. In addition, avoiding construction along the frontage of the businesses on 23rd street is being considered to reduce impacts to businesses and any closure of any lanes of traffic on 23rd Street.

Risk Name	Activity Impacted	Mitigation Strategy
Unanticipated Waste Remediation	Construction	A thorough EDR review and geotechnical investigations will determine if any unanticipated wastes are expected along the alignment. In addition, institutional knowledge will be obtained from City staff to determine if any unknown or unexpected conditions may arise during excavation.
Local Business Impacts	Public Affairs	Coordination with location businesses to discuss access, construction hours, and construction sequencing. This information will be input into the contract documents and the construction sequencing. Local impacts on bus routes, traffic patterns, and traffic related to the University of Kansas classes, football games, and basketball games will be considered during construction phasing.
Groundwater Issues During Construction	Construction	A complete geotechnical investigation will be done on the proposed alignment that will document existing soil and groundwater conditions and potential construction impacts. A review of the Lower Naismith borings indicate that groundwater is expected to be relatively shallow and will be encountered during construction. This will be confirmed through geotechnical investigations. Appropriate language will be added to the drawings and contract documents to ensure the contractor is aware of the groundwater conditions that are to be expected and that dewatering is subsidiary to other bid items.
Utility Locations	Design	Ensure complete and accurate subsurface utility exploration is completed and all utilities within the area provide responses. An initial review of potential utility conflicts has been done for the preliminary design. During detailed design all utilities within Lawrence will be contacted to confirm no utility conflicts exist. In addition, subsurface utility exploration including potholing of critical crossings will be performed.
Easement Acquisition	Public Affairs, Design, And Construction	Several easements will be required to be obtained to install the interceptor sewer. Construction of the sewer within private easements is also a risk. Risks associated with condemnation or delaying construction. Following the selection of the preferred alignment the easement requirements will be prepared and presented to the City for approval. The City will begin preliminary discussions with property owners to determine easement costs and official requirements.

6.0 Environmental & Permitting Considerations

The City of Lawrence is proposing work on its sanitary sewer infrastructure in the area along Naismith Creek, from 23rd Street south to and beyond West 27th Street in Naismith Valley Park. A site walkthrough was conducted on the afternoon of December 5, 2018 to review potential environmental considerations to anticipate permitting implications.

6.1 SITE 1 – WEST OF DILLON'S PARKING LOT

The first site investigated was Naismith Creek, situated between Naismith Drive and the Dillon's parking lot. Naismith Creek appears to be a perennial flowing stream, with an ordinary high-water mark (OHWM) width ranging from 10-12 feet. The banks of the creek consist of grouted concrete riprap from the toe to the top of bank. The stream appears to have an intact bedrock base. At the upstream extent of this reach to the north, an 18-inch drop was found exiting a box culvert at 23rd Street. Downstream, a box culvert controls grade in this reach.

Dominant vegetation included Johnson grass *Sorghum halepense,* with Siberian elm *Ulmus pumila* shrubs, and a mature 12-inch DBH Siberian elm near the Dillon's parking lot. Some sedimentation on the concrete apron of the upstream box culvert was found colonized with opportunistic cattails *Typha latifolia* on some sediment deposits on the concrete. Bush honeysuckle *Lonicera maackii* also was found at this site. A perpendicular pipe crossing is proposed here.

Figure 3 – Photo of Proposed Location of Perpendicular Crossing of Naismith Creek, Looking West from Dillon's Parking Lot

6.2 SITE 2 – ENCASED SANITARY CROSSING AT 45 DEGREE ANGLE

The next site investigated was an encased sanitary crossing downstream of Site 1. The crossing was holding channel grade, but stream flows were directed at the west high bank due to the angle of crossing. There was a one-foot drop in grade across the sanitary crossing. Due to the angle of the sewer crossing it would be recommended to remove this encased sewer after construction of the new sewer. Bed materials consisted of broken concrete stones, cobble, sand, and silt. A fence at the top of the nearly vertical bank is next to a paved recreation trail there. The stream was shaded with mature trees, but roots were undercut and banks failing. Bush honeysuckle *Lonicera maackii* was extensive throughout this reach.

Figure 4 – Photo Looking Upstream, North at Sanitary Encased Crossing

Figure 5 – Photo Looking Downstream at West Bank, Railing in Upper Left Corner of Image

6.3 SITE 3 – PAVESTONE RETAINING WALL

The third site consisted of an area with a constructed pavestone wall along the west bank, with a wood rail fence at the top along a paved trail. The wall should be assessed for integrity, upstream and downstream tie-ins to the bank as well, if any of it is to remain. Gabions have potential to be utilized to replace the wall if it requires reconstruction. From an ecological and permitting perspective, there would be no impacts to utilizing this for replacement.

Figure 6 – Photo of Pavestone Wall, Looking South Along Fence, Trail

6.4 SITE 4 – ENCASED SANITARY CROSSING AT >45 DEGREE ANGLE

This site consisted of an encased sanitary crossing at greater than a 45 degree angle. From a stream morphology perspective, the location and angle of this sanitary crossing benefits steam direction by directing flow into a meander to the east. The outside bend is armored with rock that appears to be locked in place. If possible, this grade control should be left in place, with little disturbance recommended.

Vegetation here was similar to other reaches, with significant bush honeysuckle *Lonicera maackii* shrubs, and winter creeper blanketing the ground. Establishing native vegetation in areas containing winter creeper would be difficult without a lengthy eradication program prior.

Figure 7 – Photo of Sanitary Encasement Looking Upstream, North

Figure 8 – Photo of Sanitary Encasement Looking Downstream, South

6.5 SITE 5 – OPEN AREA NORTH OF 27TH AND WEST OF THE TRAIL

This area consisted of mowed and maintained fescue turfgrass with a few trees scattered throughout. The elevation of the trail was slightly higher than part of the parkland and has resulted in an area of poor drainage just to the west of the trail with standing water at the time of the visit. Some weedy vegetation including smartweed appeared to be colonizing part of the perimeter of the ponded area. If this area of poor drainage were left to succeed naturally, it is possible that a wetland could form in this isolated area, with anaerobic conditions modifying the soil chemistry, and subsequent colonization of hydrophytic vegetation. The area was otherwise cut off from a direct hydrologic connection to Naismith Creek. It is possible that this area could become a

wetland in the future, but it is unlikely that it could be ruled jurisdictional by the United States Army Corp of Engineers (USACE) under Section 404 of the Clean Water Act. Regardless, if the area is ruled a jurisdictional wetland, and the acreage was large enough (greater than 1/10 acre) to meet reporting thresholds, a nationwide permit (NWP) 12 for utility line activities would cover the work. If a NWP 12 is required, the site would need to be restored to pre-construction contours, and the top portion of the soil profile replaced after the pipeline is installed.

Figure 9 – Photo of Low Ponded Area West of Trail, Looking North

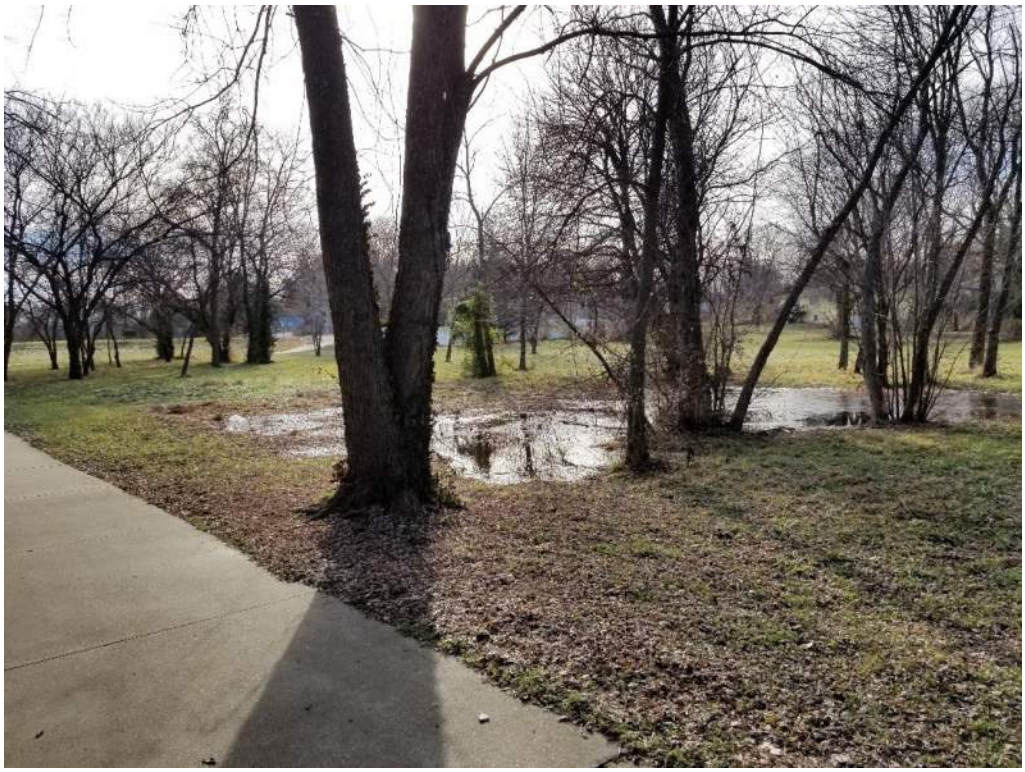

Figure 10 – Photo of Low Ponded Area West of Trail, Looking Southwest

6.6 SITE 6 – SEWER CROSSING SOUTH OF 27TH STREET

This large sanitary encasement is proposed to be removed. Geology of this area appeared to consist of sand and silt, without rock layers. The shrub layer, like other areas, was almost entirely dominated by bush honeysuckle *Lonicera maackii* and groundcover winter creeper *Euonymus fortunei* smothering native vegetation.

Figure 11 – Photo Looking Downstream At large Encasement, South

Figure 12 – Photo Looking Upstream At large Encasement, North

Figure 13 – Photo of Waterline Crossing, Possibly Abandoned, Not on City Mapping, Looking Southeast

6.7 SITE 7 – PROPOSED CREEK CROSSING

This area is a proposed crossing from a manhole west of the creek, crossing to the east, following an overhead power line easement. A roadway crossing of the creek is holding grade upstream with a box culvert, with an 18-inch drop in grade at the downstream extent. If possible, crossing the creek upstream (north) of the box culvert would afford protection from downcutting with this existing grade control.

The creek is a mud base with weathered shale at this location. Stream banks are 6-7 feet high, vertical side slopes, with significant bush honeysuckle *Lonicera maackii* and groundcover winter creeper *Euonymus fortunei* throughout this reach.

Figure 14 – Photo Looking Upstream from Proposed Crossing, North

Figure 15 – Photo Looking Downstream from Proposed Crossing, South

6.8 ENVIRONMENTAL & PERMITTING CONCLUSIONS AND RECOMMENDATIONS

It is anticipated the project will be eligible for a Nation Wide Permit (NWP) 12 for Utility Line Activities. A review of desktop materials, as well as another site visit to confirm previous observations and to finalize crossing impacts would be necessary for permit preparation. In addition to coordination with USACE for a NWP, contact with U.S. Fish and Wildlife Service (USFWS), Kansas Department of Wildlife, Parks, and Tourism (KDWP&T), Kansas Historical Society – State Historic Preservation Office (KSHS-SHPO), and the Kansas Department of Agriculture – Division of Water Resources (KDA-DWR) would likely be necessary.

7.0 Capacity Evaluation

A capacity evaluation was conducted to determine the necessary capacity of the proposed interceptor sewer to convey flow tributary to Pump Station 8 and flow currently conveyed through the existing Naismith Valley Interceptor Sewer. The capacity evaluation included reviews of existing information including the 2003 Master Plan, 2006 CIP Project Evaluation, 2012 Wastewater Master Plan, City Design Standards and City provided flow monitoring data.

The project area was divided into 18 contributing basins, see Figure 16. Each basin's design flow was calculated based on total acreage of the development, weighted average density, per capita usage, and estimated infiltration and inflow in accordance with Section 5500 of the *City of Lawrence Design Criteria* dated January 2018. During the review of zoning designations and limits it was discovered that basin Q1 had approximately 25 acres of existing open space on the Kansas University campus that could be used as Multi-Dwelling Residential. This area was classified as Multi-Dwelling Residential in the flow calculations as a conservative precaution.

The City provided flow monitoring data that included sewer flow and rainfall monitoring conducted throughout the City as part of ongoing flow metering. The City also provided I/I coefficients for multiple basins to be used to calculate the design flow rate for the interceptor sewer. The Naismith Valley Interceptor project area is located within the basin referred to as Flow Monitoring Site 9. The Pump Station 8 tributary area makes up approximately 1/3 of the Site 9 tributary area with the other 2/3 of the area consisting of older infrastructure. Flow Monitoring Site 9 had a higher I/I coefficient than other areas of the City. The City believes the older infrastructure that makes up a majority of the tributary area to Site 9 that is not within the project area is contributing to a majority of the I/I flows. The City also provided the I/I coefficient for Site 4. The City indicated the area tributary to Site 4 is a similar style, and age of home and has similar zoning as well. Design flows for the project area were developed using the City Design Standard, Site 4, and Site 9 coefficients. Flows for each coefficient are presented in Table 5.

As indicated by the flow rates both of the I/I coefficients for these sites are substantially higher than the coefficients provided in the City's Design Standards. Given this information as well as a review of the Pump Station 8 and the relief sewer flow data and discussion with the city it was determined to use the average of the I/I coefficient (K Value) for Sites 4 and 9. Design flows for the contributing basins based on the different K values is given in Table 5.

Pipe sizes (ranging from 15-inch to 36-inch) for the proposed alignments were determined based on calculated flows and pipe slopes and utilized to develop the preliminary profiles in Figure 17 through 21. The slopes used in the proposed alignments meet the minimum design requirements provided in Section 5500 of the *City of Lawrence Design Criteria* dated January 2018 and for larger diameter sewers the minimum slopes from the *Recommended Standards for Wastewater Facilities* dated 2014 (10 State Standards).

Table 5 – Basin Design Flows

SS Watershed	Area (ac)	Using K Values from Design Criteria Spreadsheet	Using Site 4 K Values	Using Site 9 K Values	Site 4 and 9 Average K Values
		Q (MGD)	Q (MGD)	Q (MGD)	Q (MGD)
K Values		**0.0030**	**0.0049**	**0.0116**	**0.0082**
Q1	199	1.35	1.76	3.46	2.61
Q2	81	0.62	0.82	1.58	1.19
Q3	23	0.15	0.25	0.51	0.38
Q4	6	0.04	0.07	0.14	0.10
Q5	7	0.05	0.08	0.16	0.12
Q6	10	0.07	0.11	0.23	0.17
Q7	28	0.22	0.31	0.63	0.47
Q8	3	0.01	0.03	0.06	0.05
Q9	9	0.05	0.09	0.19	0.14
Q10	10	0.06	0.10	0.21	0.15
Q11	9	0.06	0.09	0.18	0.13
Q12	4	0.02	0.04	0.09	0.07
Q13	215	1.29	1.80	3.62	2.70
Q14	10	0.08	0.11	0.22	0.16
Q15	77	0.56	0.72	1.44	1.07
Q16	6	0.05	0.06	0.14	0.10
Q17	62	0.46	0.62	1.26	0.94
Q18	15	0.08	0.14	0.08	0.22
Flows at Pump Station 8 (MGD)		**3.1**	**4.1**	**8.1**	**6.1**
Flows Downstream of PS 8 (MGD)		**5.2**	**7.2**	**14.2**	**10.8**

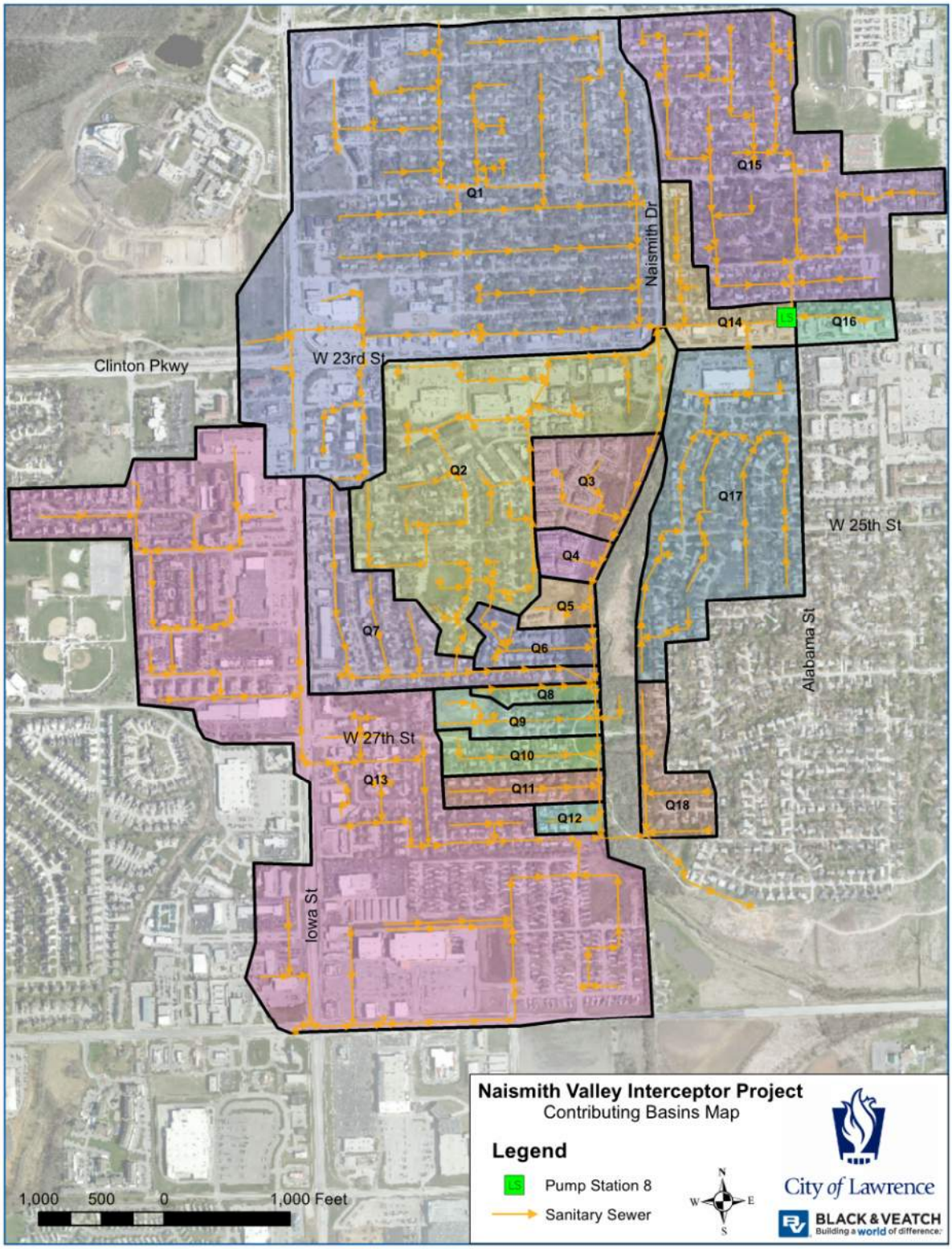

Figure 16 – Map of Contributing Basins for Naismith Valley Interceptor

8.0 Alignment Alternatives

An alternative alignment screening was conducted to develop potential alignment alternatives for review by the City. GIS was utilized to perform an initial screening of potential alignments. GIS information was provided by the City to evaluate utility impacts, construction depth, right-of-way needs, and constructability. Site visits were also conducted to assist in identifying potential risks and conflicts. The key risks, conflicts, and design details are noted below.

- During the Kickoff Meeting with the City on September 12th, the City stated that open-cut construction within 23rd Street is not an option. Therefore, all alignment alternatives include trenchless construction to cross 23rd Street. Alignment A also includes additional use of trenchless construction to cross under existing storm sewer conduits on the north side of 23rd Street.

- During site visits it was discovered that the existing sewer was exposed at all three locations where the sewer crosses Naismith Creek. The proposed alignment alternatives include relocating the sewer and abandoning the exposed crossings. Any new crossing of the creek will include protection as part of design.

Five alignment alternatives (Alignments A, B, C, D, and E) were developed during the screening and were reviewed with the City during the alignment screening workshop. The preliminary plan and profile of each alignment is shown in Figure 17 through 21.

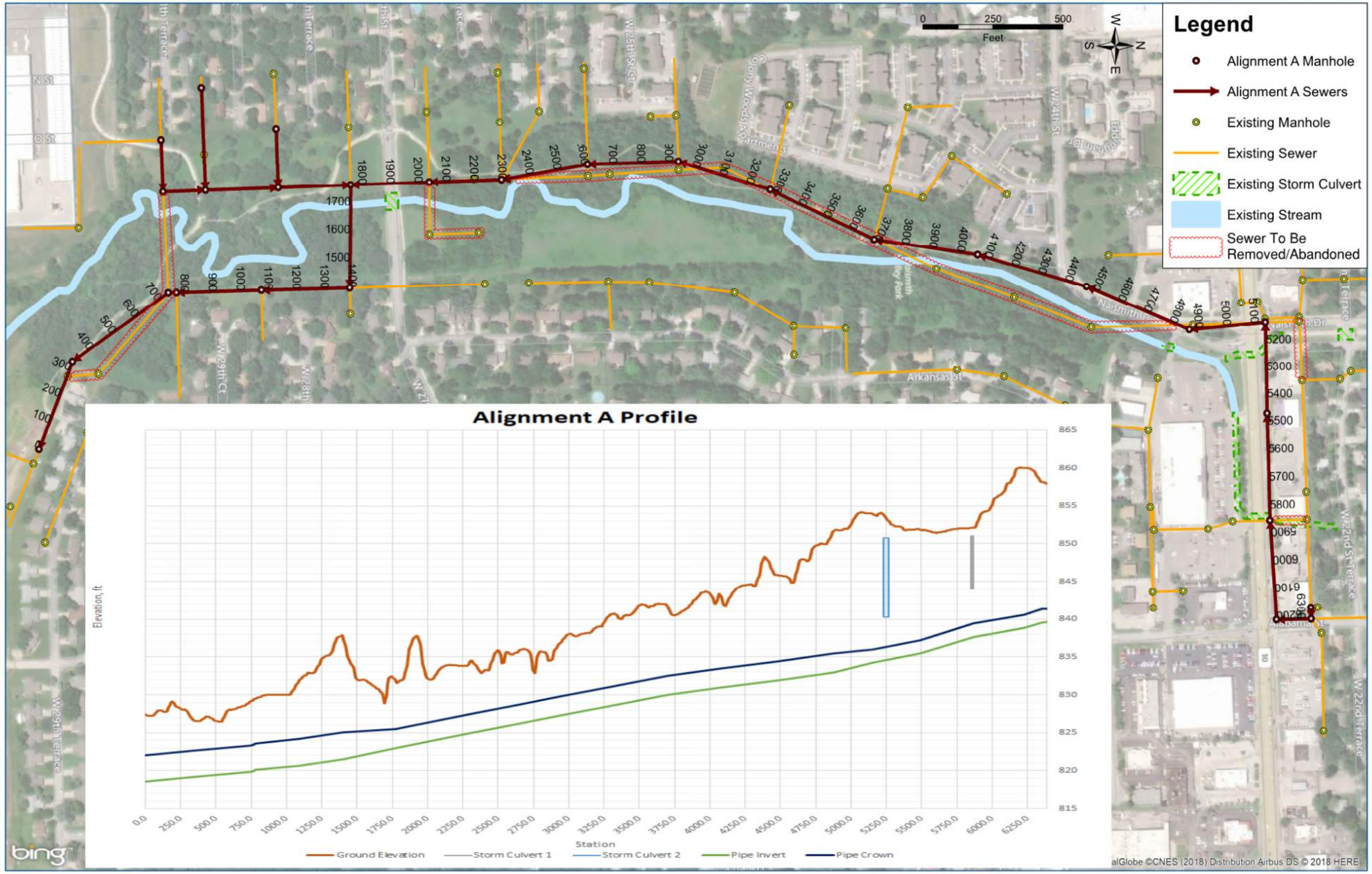

Figure 17 – Alignment Alternative A Plan and Profile

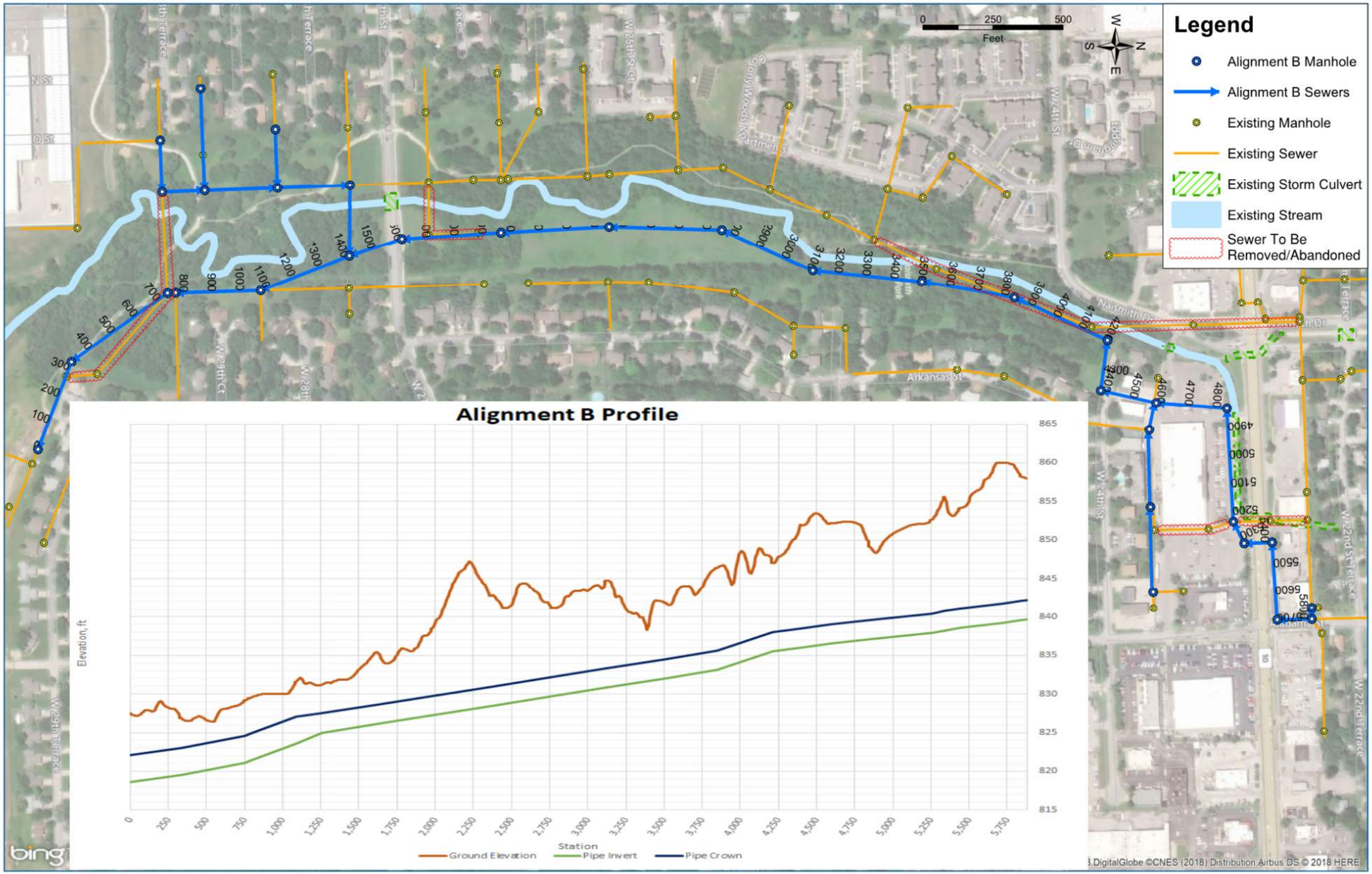

Figure 18 – Alignment Alternative B Plan and Profile

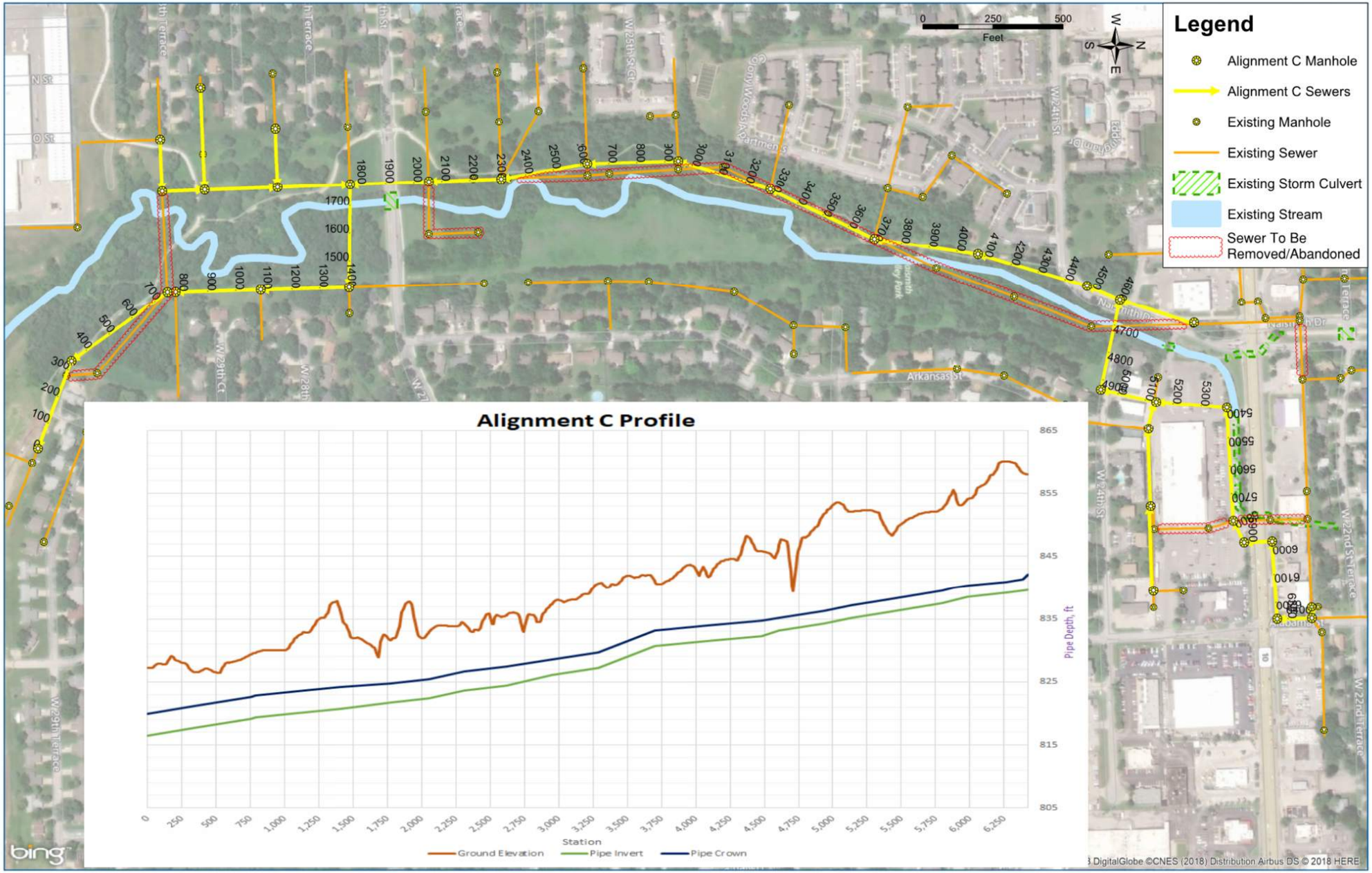

Figure 19 – Alignment Alternative C Plan and Profile

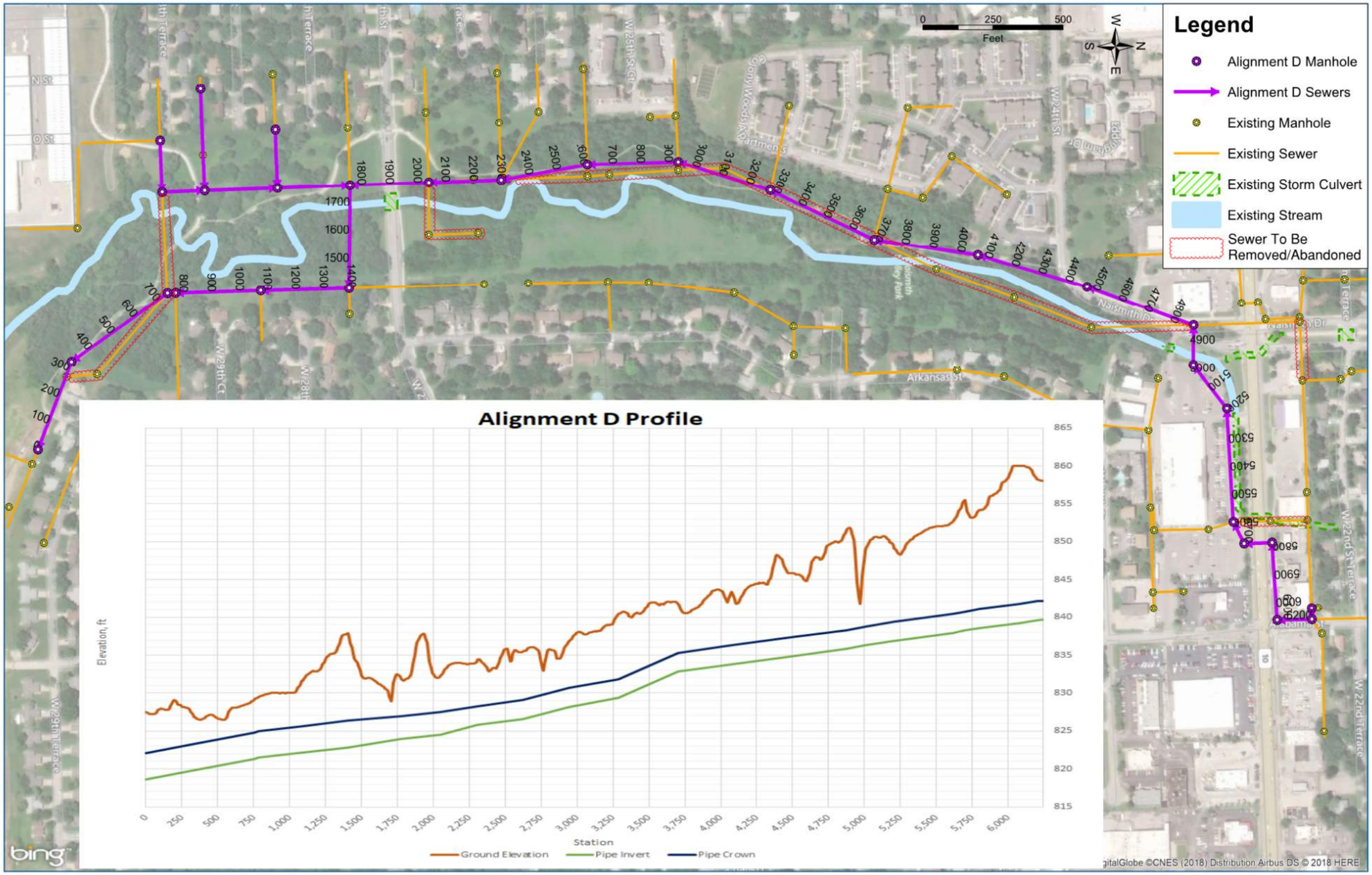

Figure 20 – Alignment Alternative D Plan and Profile

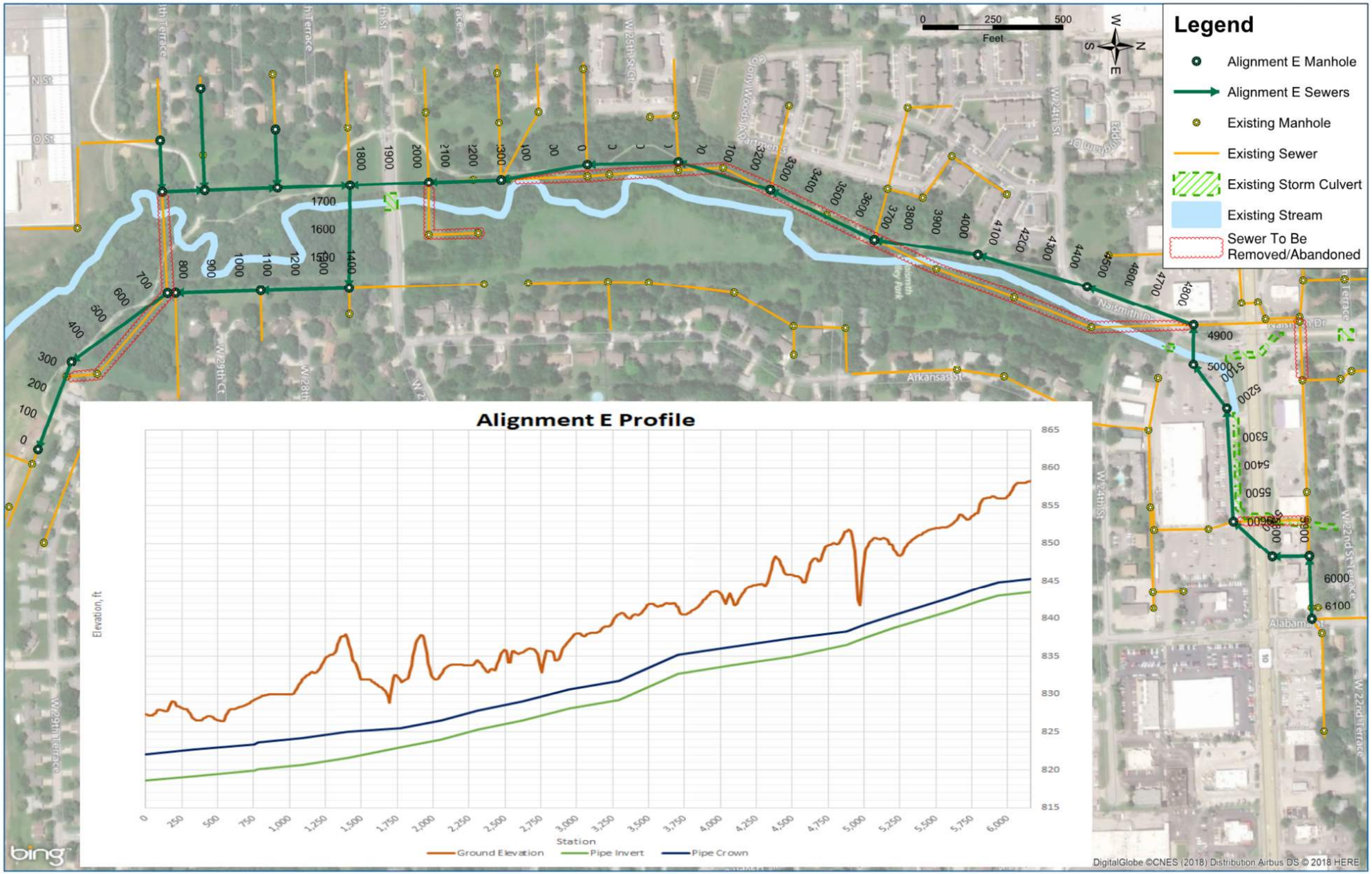

Figure 21 – Alignment Alternative E Plan and Profile

8.1 ALTERNATIVE ALIGNMENT REVIEW

An alignment screening workshop meeting was conducted with the City on November 6, 2018. The purpose of the meeting was to evaluate the alignment alternatives based on the criteria below:

- Potential risks associated with each alignment
- Land acquisition and easement concerns
- Operation and maintenance concerns
- City design and pipe material preferences
- Institutional knowledge (utility conflicts at risk)
- Additional desired system modifications (abandon pipe segments)
- Pump Station 8 abandonment
- Project sequencing concerns
- Additional ancillary items

During the alignment screening workshop, advantages and disadvantages for each alignment were identified and discussed, see Table 6.

Table 6 – Alignment Screening Advantages and Disadvantages

Pipeline Alignment	Advantages	Disadvantages
Alignment A	• Proposed pipe is located within existing City Easements • Eliminates existing Interceptor Creek Crossings • Eliminate aerial crossing north of 23rd Street • Minimizes total length of new sewer	• Increased sewer depth due to storm sewer conflicts • Additional trenchless construction due to storm sewer crossings • Maximum disruption of businesses on 23rd Street • Disruption of park trail including walking path and trees Impacts street light and intersection at 23rd street and Alabama
Alignment B	• Minimal Disruption for Park Trail including walking path and trees·Eliminates Existing Interceptor Creek Crossings • Eliminates Sewer on East Side of Dillon's Property • Minimizes disruption of Businesses on 23rd Street	• Maximum total length of new sewers and size of new sewers • Additional Realignment of Sewer South of Dillon's Property • Construction required between Apartment Buildings • Maximum number of easements • Does Not Eliminate Aerial Crossing North of 23rd Street • Difficult Access for sewer installation and sewer maintenance in the future • Impacts street light and intersection at 23rd street and Alabama
Alignment C	• Eliminate Aerial Crossing North of 23rd Street • Eliminates Existing Interceptor Creek Crossings • Eliminates Sewer on East Side of Dillon's Property • Minimizes disruption of Businesses on 23rd Street	• Additional Realignment of Sewer South of Dillon's Property • Construction required between Apartment Buildings • Maximum number of easements needed • Disruption of park trail including walking path and trees • Impacts street light and intersection at 23rd street and Alabama
Alignment D	• Eliminate Aerial Crossing North of 23rd Street • Eliminates Existing Interceptor Creek Crossings • Minimizes disruption of Businesses on 23rd Street • Minimizes number of easements required	• Disruption of park trail including walking path and trees • Increased depth of proposed sewers • Impacts street light and intersection at 23rd street and Alabama
Alignment E	• Eliminate Aerial Crossing North of 23rd Street • Eliminates Existing Interceptor Creek Crossings • Minimizes disruption of Businesses on 23rd Street • Minimizes Sewer depth of construction and pipe size	• Second highest easement needs • Disruption of park trail including walking path and trees •

The City expressed concerns with the costs for the easements for Alignments B, C, D, and E. To account for these concerns, the cost estimate for easements have been included in the Opinion of Probable Construction Costs (OPCC) for all the alignment alternatives in Table 7.

Table 7 - Opinion of Probable Construction Costs for Proposed Alignments

	Alignment A	Alignment B	Alignment C	Alignment D	Alignment E
Description	**Cost**	**Cost**	**Cost**	**Cost**	**Cost**
Site Preparation & Removals	$ 538,651	$ 440,642	$ 559,471	$ 545,878	$ 542,761
Pavements	$ 406,879	$ 369,452	$ 489,441	$ 492,414	$ 466,441
Sewer Construction	$ 1,528,273	$ 1,520,367	$ 1,679,444	$ 1,511,965	$ 1,478,869
Trenchless Sewer Construction	$ 558,836	$ 181,990	$ 152,188	$ 152,188	$ 124,464
Plantings and Erosion Control	$ 205,534	$ 207,365	$ 217,304	$ 203,850	$ 202,783
Sewer Rehabilitation	$ -	$ 186,684	$ -	$ -	$ -
Miscellaneous Items (PS Demo, Creek crossing)	$ 135,000	$ 100,000	$ 185,000	$ 185,000	$ 185,000
Subtotal	**$ 3,373,200**	**$ 3,006,600**	**$ 3,282,900**	**$ 3,091,300**	**$ 3,000,400**
General Requirements (10% of direct costs)	$ 338,000	$ 301,000	$ 329,000	$ 310,000	$ 301,000
Subtotal	**$ 3,711,200**	**$ 3,307,600**	**$ 3,611,900**	**$ 3,401,300**	**$ 3,301,400**
Contingency (30% of direct costs)	$ 1,012,000	$ 902,000	$ 985,000	$ 928,000	$ 901,000
Easement (Dillon's Property)		$ 50,000	$ 50,000	$ 50,000	$ 50,000
Total	**$ 4,723,200**	**$ 4,259,600**	**$ 4,646,900**	**$ 4,379,300**	**$ 4,252,400**

At the conclusion of the alignment screening workshop, Black & Veatch recommended to move forward with conducting business case evaluations for Alignments A and E. The City decided to move forward with developing business case evaluations for Alignments A and E.

8.2 PIPE MATERIAL REVIEW

A pipe material review was completed to determine which material would provide the best product for sizes greater than 18" diameter. Poly vinyl chloride (PVC) pipes will be specified for all pipes equal or less than 18" diameter. The factors considered in the pipe material review were costs, availability, constructability/familiarity with local contractors and operations staff, and corrosion resistance. Appendix B includes a table of the pros and cons of each pipe material.

During the pipe material review, the team requested and received material costs from manufacturers for the different materials, see Table 8. For all sizes reviewed, Polypropylene Pipe (SaniTite from ADS) was the cheapest option.

Table 8 – Summary of Different Pipe Material Costs

Pipeline Material	Diameter (in)	Length (ft)	Unit Cost ($/ft)	Cost ($)	Total Cost ($)
Reinforced Concrete Pipe (RCP, Class III, No Liner Included)	18"	860	$21	$18,060	$245,300
	24"	3,380	$33	$111,540	
	36"	1,780	$65	$115,700	
Ductile Iron Pipe (DIP, Ceramic Epoxy Liner Included)	18"	860	$41	$35,260	$432,620
	24"	3,380	$57	$192,660	
	36"	1,780	$115	$204,700	
Poly Vinyl Chloride Pipe (PVC) - Solid Wall	18"	860	$19	$16,340	$279,180
	24"	3,380	$33	$111,540	
	36"	1,780	$85	$151,300	
Poly Vinyl Chloride Pipe (PVC) - Profile Wall	18"	860	-	-	$227,240
	24"	3,380	$33	$111,540	
	36"	1,780	$65	$115,700	
High-Density Polyethylene Pipe (HDPE)	18"	860	$20	$17,372	$282,022
	24"	3,380	$36	$121,004	
	36"	1,780	$81	$143,646	
Fiber Reinforced Thermosetting Resin Pipe (FRP)	18"	860	$50	$43,000	$344,600
	24"	3,380	$55	$185,900	
	36"	1,780	$65	$115,700	
Polypropylene Pipe (Sanitite)	18"	860	$11	$9,374	$136,698
	24"	3,380	$18	$59,150	
	36"	1,780	$38	$68,174	

Based on the pipe material review, it is recommended to design the interceptor utilizing PVC – Solid Wall for the entirety of the project as it is a durable, low cost material, is available in all sizes, provides corrosion resistance, and is a material local contractors and operations staff are very familiar with. It is also recommended to provide a bid alternate for the contractor to supply FRP or polypropylene pipe for diameters 18" and larger.

8.3 CONSTRUCTION METHODS

Trenchless construction will be required due to recent pavement improvements on 23rd Street and to minimize traffic impacts during construction. An evaluation was conducted to identify the advantages and disadvantages of trenchless construction options. The evaluation included reviewing jack and bore, pilot tube, and directional drilling technology. A summary of the advantages and disadvantages for each trenchless technology is provided below.

Table 9 – Advantages and Disadvantages of Trenchless Construction Technologies

Trenchless Technology	Advantages	Disadvantages
Jack & Bore	• Typically most cost effective option • Boring distance well within limits for this technology • Abundant equipment and contractors to complete work	• Requires large shafts/pits
Pilot Tube	• Requires small shafts/pits • Boring distance well within limits for this technology	• Typically more expensive than Jack & Bore • Limited equipment available • Specialized construction and limited number of contractors qualified
Directional Drilling	• Distance well within limits for this technology • Doesn't require shafts or pits	• Vertical and horizontal tolerances unlikely to be adequate for this project • Will require long layout area for fusing and HDPE feeding • Could use PVC but joint provides less quality than fused joint

In conclusion, it is recommended to provide language and details in the drawings and specifications that allow for the use of jack and bore construction. Further discussion will be conducted to determine if project drawings and specifications should include language to allow for the contractor to use the pilot tube method during construction.

9.0 Business Case Evaluations

Following the Alignment Alternative Workshop, business case evaluations were performed on alignment alternatives A and E. The business case evaluations included multiple criteria, see below in Table 10. Once the criteria were determined, a weighting system was determined for each factor. Table 10 presents the weighting factors for each criterion. Note that these scores are relative to each other and comprise a percentage of the weighting. Therefore, a rating of 0.20 implies that the factor makes up 20% of the overall weighting and is twice as important as a factor that has a rating of 0.10. The B&V team forwarded the initial criteria and weighting system to the City staff for review and received feedback from the City. B&V updated the criteria and weighting system, based on feedback from the City, to be used for the analysis. After the criterion are weighted, the benefit values are determined for each alignment based on the definitions presented in following sections.

Table 10 – Business Case Evaluation Criteria and Weighting

Non-Cost Criteria	Weight
Reduced Easement Acquisition	0.15
Reduced Pavement and Traffic Impacts	0.25
Constructability	0.20
Long Term Operations and Maintenance	0.15
Reduced Utility Impacts	0.10
Positive Business and Stakeholder Relations	0.15
TOTAL	1.00

9.1 REDUCED EASEMENT ACQUISITION

Easement acquisition for a Public Works project can be politically sensitive for the City of Lawrence. Therefore, from a societal and political standpoint, easement acquisitions are deemed undesirable. For the Naismith Valley Interceptor Project, the anticipated easement needs would be needed on commercial properties along 23rd Street. The Alignments were ranked on a scale from 1(least favorable) through 5 (most favorable) in regard to minimizing the number of easements required.

9.2 REDUCED PAVEMENT AND TRAFFIC IMPACTS

The proposed sewer alignments have potential traffic impacts to 23rd Street, Alabama Street, Naismith Drive, and 27th Street. Closures on 23rd Street were deemed not an option by the City as it is a principal arterial and any closures would cause major impacts. Alabama Street, Naismith Drive, and 27th Street are collectors that may require closures during construction. The Alignments were ranked on a scale from 1(least favorable) through 5 (most favorable) regarding minimizing the amount of pavement and traffic impacts.

9.3 CONSTRUCTABILITY

Constructability included many factors that make the sewer easier for a contractor to build. This includes site access, ample area for stockpiling soil, pipe laydown, and equipment, sewer depth, and other factors. Alignments that cross the existing storm sewer boxes along 23rd street will increase risk and difficulty of construction and therefore are ranked less favorable.

The Alignments were ranked on a scale from 1(least favorable) through 5 (most favorable) regarding minimizing the major constructability issues.

9.4 LONG TERM OPERATIONS AND MAINTENANCE

Manhole access, depth to the sewer, and additional infrastructure to maintain were included as factors to impact long term operations and maintenance. The Alignments will be ranked on a scale from 1(least favorable) through 5 (most favorable) regarding minimizing additional or increased operations and maintenance.

9.5 REDUCED UTILITY IMPACTS

Relocation of utilities can be expensive with the direct cost (if in a City right-of-way) incurred by the Utility Company. If the Utility has a dedicated easement, then the City will bear the burden of the relocation. The Alignments will be ranked on a scale from 1(least favorable) through 5 (most favorable) regarding minimizing utility impacts whether incurred by the City of the Utility.

9.6 POSITIVE BUSINESS AND STAKEHOLDER RELATIONS

Public Relations are an important component when considering a project of this magnitude located in a residential area on a major arterial (23rd Street). Regarding the Naismith Valley Interceptor project, several factors were considered which will affect how the public will be impacted and react (positively and negatively) to the project. Several public relation factors are associated with large construction projects and include the following specific items:

- Proximity of alignment to apartments or other businesses
- Access during construction
- Overall disruption and perceived disruption to properties

The Alignments were ranked on a scale from 1 (least favorable) through 5 (most favorable) regarding maximizing positive public relations.

9.7 BUSINESS CASE EVALUATION RESULTS

Each alignment and its criterion were given a score which was then multiplied by the weighting factor for that criterion to determine an overall benefit score for each alignment. The individual scores for each alignment for each criterion are presented in Table 11. The overall scores for Alignments A and E are shown in Figure 22. The overall score presents each alignment's benefit score determined by the analysis. As seen below, Alignment E produced the highest benefit score of 3.45.

Table 11 – Business Case Evaluation Scoring

Criteria:	Easement Acquisition	Pavement and Traffic Impacts	Constructability	Long Term Operations and Maintenance	Utility Impacts	Business and Stakeholder Relations
Scoring Methodology Descriptions:	Reduction in the amount of easement required to be obtained for the project	Reduction in traffic impacts on public streets (does not include pavement on private property)	Ranking of the difficulty and risks associated with construction of each alignment	Accessibility of manholes length of sewers in the ground, stream crossings, depth of sewers.	Reduction in impacts to existing utilities	Ranks the impact to businesses during construction and stakeholders
Alignment A	4.0	2.0	2.0	3.0	1.0	1.0
Alignment E	2.0	4.0	4.0	4.0	3.0	3.0

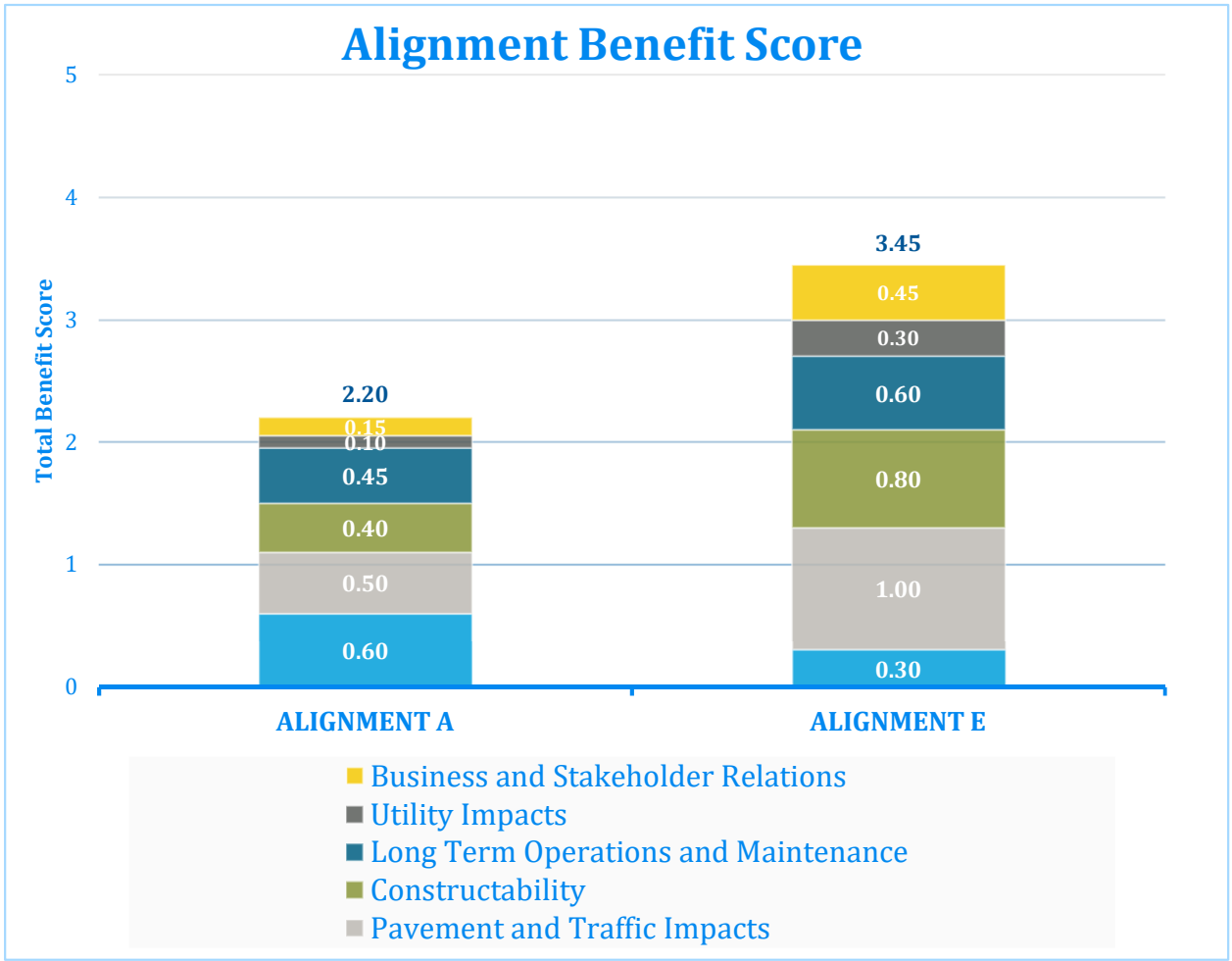

Figure 22 – Alignment Benefit Scores

10.0 Opinion of Probable Costs

Development of the preliminary design OPCC was completed by developing unit costs for the standard bid items included within the construction documents. The unit costs for each standard bid item were developed using RS Means construction cost data and recent bid tabs from similar projects in the region. All cost estimates were prepared in November 2018 dollars which corresponds to ENR CCI 11417.

The unit cost for each item includes all costs incurred by the contractor. The general requirements and contingency percentage markups do not include markups on land disposal fees or indirect costs. The General Requirements contingency includes erosion control, mobilization/demobilization, permitting, the Stormwater Pollution Prevention Plan (SWPPP), Maintenance Allowance, and the Environmental Allowance.

Based on the Alignment Review workshop and discussions with the City the preliminary design OPCC for Alignment A and E were updated to develop a more accurate cost. These costs are updated to reflect both Alignment A and E being behind Myers Liquor store to avoid impacts to the 23rd and Alabama intersection and to keep the pipe more shallow. The additional easement at Jiffy Lube was included as well. These costs are presented in Table 12 and Table 13.

Table 12 – Alignment A Preliminary Opinion of Probable Construction Cost

	Alignment A
Description	**Cost**
Site Preparation & Removals	523,000
Pavements	396,000
Sewer Construction	1,529,000
Trenchless Sewer Construction	559,000
Plantings and Erosion Control	168,000
Miscellaneous Items (PS Demo)	100,000
Subtotal	**3,275,000**
General Requirements (10% of direct costs)	328,000
Subtotal	**3,603,000**
Contingency (30% of direct costs)	983,000
Easements	15,000
Total	**4,601,000**

Table 13 – Alignment E Preliminary Opinion of Probable Construction Cost

	Alignment E
Description	**Cost**
Site Preparation & Removals	529,000
Pavements	467,000
Sewer Construction	1,479,000
Trenchless Sewer Construction	125,000
Plantings and Erosion Control	165,000
Miscellaneous Items (PS Demo, Creek crossing)	150,000
Subtotal	2,915,000
General Requirements (10% of direct costs)	292,000
Subtotal	3,207,000
Contingency (30% of direct costs)	875,000
Easements	58,000
Total	**4,140,000**

11.0 Conclusions and Recommendations

Based on the alternative alignment screening Alignment E stood out as the preferred alignment and following that with a business case analysis Alignment E produced the highest benefit score. Alignment E also provided the lowest opinion of probable construction cost. Given this information a walkthrough with the City Staff was done in December 2018. During this walkthrough it was clear due to the cost, constructability, and overall business case evaluation that Alignment E is the preferred alignment. It is recommended to move forward into detailed design of an Alignment E gravity flow interceptor that conveys flows from the project area to the Lower Naismith Valley Interceptor, thus allowing for the removal of Pump Station 8.

The next steps for detailed design of the Naismith Valley Sewer are to perform field investigations including Survey, Geotechnical Borings, SUE Investigation, and any environmental testing that may be required. In addition, critical path steps are to identify and begin preparation of all easement information that will be required for the proposed alignment. Utility coordination will be critical to determine the exact location of any conflicts and to allow for proper design of the interceptor. The 6-inch gas line and associated easement within the park is associated with critical path items as well.

Stakeholder coordination with businesses that will be affected, homeowners along the alignment, public works department, Lawrence Transit Department, Public Works, Stormwater, and others will need to be determined early in detailed design to allow for input into the contract documents.

Appendix A – Utility Coordination Log

Naismith Valley Interceptor
Utility Coordination Log

Company	Contact	Address	Phone	Email	Date of Initial Contact	Response Received (Yes/No) (Date)	Facilities in Project Area (Yes/No)	Received Map of Utilities (Yes/No)	Date of Utility Kick-Off Meeting	Discussion/Notes
City of Lawrence (Water)	Andy Ensz	PO Box 708 Lawrence, KS, 66044	785-832-7812	aensz@lawrenceks.org	8/22/2018	Yes 8/24/2018	Yes	Yes	Need to Schedule	Received GIS Information for Water Mains in Project Area.
City of Lawrence (Stormwater)	Matt Bond	PO Box 708 Lawrence, KS, 66044	785-862-3142	mbond@lawrenceks.org	10/1/2018	Yes 10/2/2018	Yes	No	Need to Schedule	Received As-Built Drawings of Storm Sewers Along 23rd Street.
Westar Energy (Electric)	Aaron Spreer	746 E 27th St Lawrence, KS, 66046	785-865-4850	aaron.spreer@westarenergy.com				No	Need to Schedule	
Black Hills Energy (Gas)	Carmen Shultz	601 N Iowa St Lawrence, KS, 66044	785-832-3917	carmen.shultz@blackhillscorp.com				No	Need to Schedule	
Southern Star Energy (Gas)	Marcus Jauregui	20031 207th St Tonganoxie, KS, 66086	913-416-0653	marcus.jauregui@sscgp.com				No	Need to Schedule	
Midco (Communications)	Richard Parnell	1470 N 1823 Rd Lawrence, KS, 66047	785-840-5979	richard.parnell@midco.com				No	Need to Schedule	
AT&T (Communications)	Curtis Calderwood	220 SE 6th Ave, Room 360 Topeka, KS 66603	785-276-6140	cc6178@att.com				No	Need to Schedule	
Verizon (Communications)	John Mueller Tom Wolf	10740 Nall Avenue Overland Park, KS 66211	913-344-2908	John.Mueller@VerizonWireless.com Tom.Wolf@VerizonWireless.com	10/1/2018	Yes 10/1/2018	Yes	No	Need to Schedule	Verizon has a 2.4" conduit (96ct fiber) on the north side of 23rd Street with an approximate depth of 42"

Appendix B – Pipe Materials Pros and Cons

Pipe Material Advantages and Disadvantages

Pipeline Material	Advantages	Disadvantages	Corrosion Protection	Repairs
Reinforced Concrete Pipe (RCP)	• Rigid pipe with high strength • Design may be optimized to meet project specific load requirements • Extensive local installations	• Heavier than DIP, PVC, HDPE and FRP • Additional corrosion protection may be required • Available in 24" diameter and larger	• Typically required	• Typically requires manufacturer field services. • Could stock typical repair sleeves and adapters.
Ductile Iron Pipe (DIP)	• Semi-flexible pipe with high strength • Extensive local installations	• Need for corrosion protection	• Corrosion protection (bonded joints, anodes, test lead stations) may be required in certain corrosive soils.	• Not readily field repairable. • Could stock pipe repair “shorts” and sleeves.
Poly Vinyl Chloride Pipe (PVC) - Solid Wall	• No need for corrosion protection • Full range of diameters • Extensive local installations	• Lower loading limits than concrete and metallic pipe • Heavier than PVC - Profile Wall	• Typically not required unless metallic fittings and appurtenances are used.	• Can be cut and repaired with new sections of pipe and restrained couplings.
Poly Vinyl Chloride Pipe (PVC) - Profile Wall	• No need for corrosion protection • Lighter than Solid Wall PVC	• Available in 30" diameter and larger • Lower loading limits than concrete and metallic pipe • Limited installation history	• Typically not required unless metallic fittings and appurtenances are used.	• Can be cut and repaired with new sections of pipe and restrained couplings.
High Density Polyethylene Pipe (HDPE)	• No need for corrosion protection • Standard installation assembly is restrained • Leak free system • Anticipated 100yr life cycle	• Available in 18" diameter and larger • Limited installation history • Lower loading limits than concrete and metallic pipe • Requires significant layout area for installation	• Typically not required	• Can be cut and new sections heat welded in; contractors or pipe suppliers will have welding equipment.
Fiber Reinforced Thermosetting Resin Pipe (FRP)	• No need for corrosion protection • Full range of diameters • Extensive local installations	• Lower loading limits than concrete and metallic pipe • Only one of the two primary manufacturers offers a restrained joint	• Typically not required	• Field fiberglass repair layups, or repair sleeves are available.
Polypropylene Pipe	• No need for corrosion protection • Lightweight Material • Full range of diameters	• Limited installation history • Lower loading limits than concrete and metallic pipe • Pipe may require more attention during bedding and backfill.	• Typically not required	• Can be cut and repaired with new sections of pipe and restrained couplings.