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TECHNICAL MEMORANDUM

To: Mr. Jim Stanley, Director of Public Service
City of Circleville, Ohio

From: Mr. Tyler Burton
Strand Associates, Inc.®

Date: September 19 , 2025

Re: Sewer Regionalization Study

Introduction

The City of Circleville, Ohio (City) is experiencing increased development along the east side of the City, most of which is currently unsewered. Development in this area will require new sewers, generating additional wastewater that must be conveyed west to the existing wastewater treatment plant (WWTP) for treatment and discharge into the Scioto River.

This memorandum summarizes the preliminary engineering evaluation for a trunk sewer within and outside the City to the WWTP. The trunk sewer plan included a capacity analysis of the existing network and capacity needs for future development.

The preliminary trunk sewer alignments were determined using Light Detection and Ranging data in conjunction with geographical information system information provided by the City for water and sanitary utilities. The preliminary trunk sewer alignment routes extend east to serve the future development areas identified by the City.

The existing and future flows to be conveyed through the trunk sewer were determined using:

- Flow metering data presented in the *Inflow and Infiltration (I/I) Reduction Plan* by Arcadis U.S., Inc.
- Design standards according to the *Ohio Environmental Protection Agency (OEPA) Green Book, 2013 edition.*
- Flow data from existing lift stations operated by the City.
- Zoning information provided by the City.

Sanitary Sewer Capacity Analysis

Anticipated Sewer Flows

Anticipated flows from future eastern development areas were estimated using zoning maps, City development plans, and OEPA Green Book standards. The zoning throughout the area is a mix of low density residential with some mixed-use developments. There are no known large use customers in the area aside from Ohio Christian University (OCU), which has its own private sanitary sewer that discharges into the City's sewer system. Based on these zoning descriptions, five dwelling units per acre was used in determining the anticipated flows in the areas to be developed. A summary of the different areas with the estimated flows are shown in Table 1.

Section Description	Area (acres)	Homes per acre	Peak Factor	ADF (gpm)	PHF (gpm)	ADF (MGD)	PHF (MGD)
Lancaster Pike–Residential	379	5	3.33	347	1,148	0.50	1.65
Lancaster Pike–Golf Course	150	N/A	4	7	15	0.01	0.02
OCU	686	5	3.33	597	1,983	0.86	2.86
Stoutsville	462	5	3.33	403	1,326	0.58	1.91
Hominy Creek	1,234	5	3.33	1,069	3,567	1.54	5.14
Total	**2,929**			**2,423**	**8,039**	**3.49**	**11.58**

MGD=million gallons per day
gpm=gallon per minute
ADF=average daily flow
PHF=peak hourly flow
N/A=not available

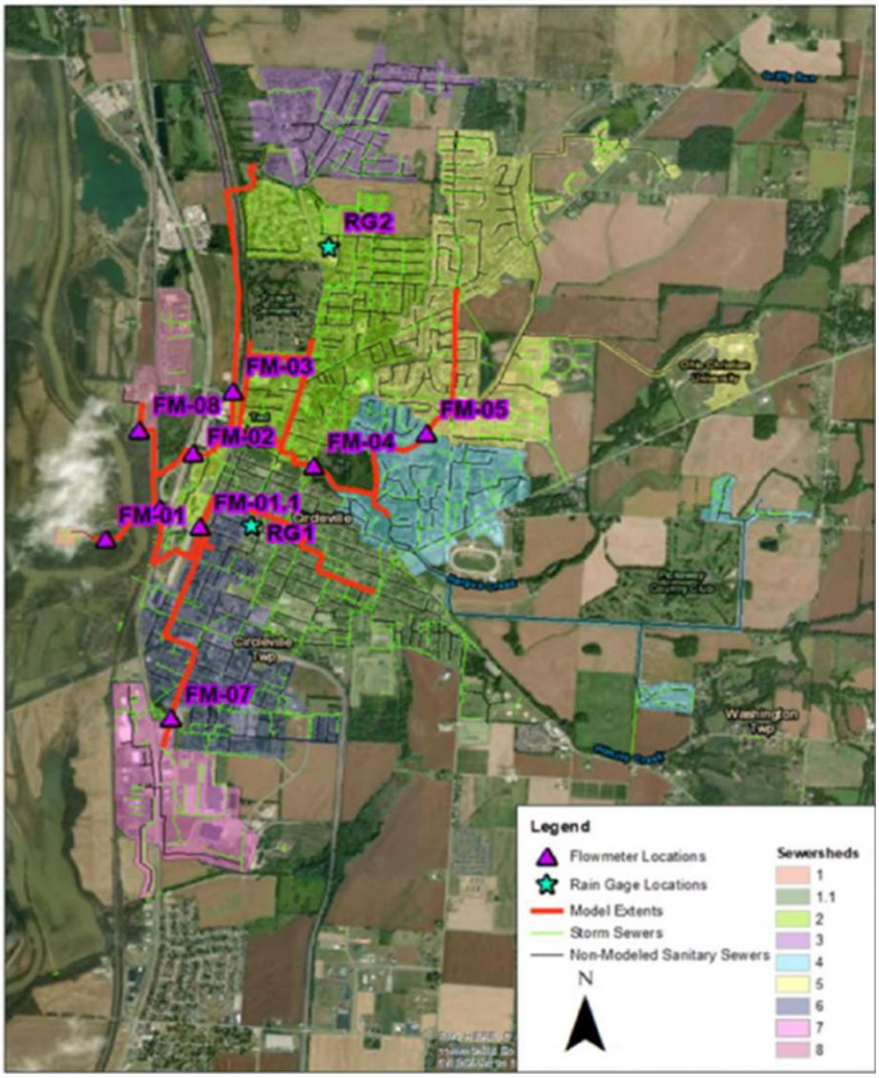
Table 1 Anticipated Peak Flows

WWTP Capacity

The existing WWTP is currently under construction to increase the average flow treatment capacity from 2.0 to 4.0 MGD. The current demand on the WWTP is 1.6 MGD and the anticipated peak flow from the new development is 3.6 MGD. The design capacity of the WWTP is 3.4 MGD to maintain an 85 percent average flow to capacity ratio, which prevents overloading at the WWTP. This means that the ADF to the WWTP can only handle 1.8 MGD of the anticipated flow from the new development.

Existing Flows

In 2020, the City completed flow metering at multiple locations throughout the sanitary sewer system. Figure 1 from the Arcadis the *Inflow and Infiltration (I/I) Reduction Plan* report shows a map of where the metering was completed relative to the WWTP.



Source: *Inflow and Infiltration (I/I) Reduction Plan* by Arcadis U.S., Inc

Figure 1 Proposed Trunk Sewer Map

The data provided from Flow Meter Nos. 2, 6, and 8 was analyzed and used to estimate sanitary flows through the existing sewered areas. The flow metering values shown in Table 2 are based on the report completed in 2021.

Flow Meter (FM) Description	Sewer Diameter (inches)	ADF (MGD)	Revised ADF (MGD)	PHF (gpm)	Theoretical Full Flow Capacity (MGD)
FM-02	48	0.31	0.64	1,480	16.3
FM-06	27	0.42	0.86	1,989	5.2
FM-08	8	0.05	0.10	231	0.5

Table 2 Existing Average and Peak Flows

The flows for Flow Meter Nos. 2, 6 and 8 would theoretically add up to the total flow at the WWTP if no I/I was in the system. Because of the metered flow rates being less than the average flow at the WWTP, the rates were increased respectively so they would total the average flow to the WWTP. PHFs were then estimated using OEPA Green Book peaking factors.

Theoretical full flow capacities were calculated using minimum slope and a minimum velocity of 2 feet per second (fps), in accordance with the OEPA Green Book. Based on these capacities, the existing infrastructure leading to the WWTP has the capacity to handle more flow from the future development.

Preliminary Trunk Sewer Planning

Based on projected flows, new preliminary trunk sewer alignments were developed to serve existing sewered and unsewered areas on the City's east side. For all trunk sewer alignments, manholes were placed at any deflections in the sewer and a maximum of 500 feet away to allow for cleaning when possible. In special cases of trenchless installation, spacing between manholes may be larger than 500 feet. When possible, trunk sewer alignments follow existing roads for ease of construction. In other cases, the trunk sewer alignments followed the natural path of Hargus Creek or Hominy Creek to use the natural drainage slope toward the Scioto River to the west. Following the creeks is also advantageous due to the open space with no existing utilities and the minimal disruption to community members. At any creek crossings, a trenchless method of installation is assumed.

Two potential preliminary trunk sewer alignments to connect the unsewered east side development to the existing system and WWTP were created, while only one would be designed and ultimately constructed. The first is the Mound Street preliminary trunk sewer alignment which follows Mound Street through between US 22 and US 23. The second is the Ted Lewis Park preliminary trunk sewer alignment, which generally parallels an existing interceptor along Hargus Creek. Both trunk sewer alignments terminate at the same spot along US-22 to connect future development trunk sewer alignments.

Four future development trunk sewer alignments were created that would serve the unsewered east side of the City, starting with the Lancaster Pike preliminary trunk sewer alignment connecting to the end of the Ted Lewis Park or Mound Street preliminary trunk sewer alignments. These trunk sewer alignments then follow Hargus Creek, Hominy Creek, and Stoutsville Pike as appropriate. Figure 2 shows a map of where these preliminary trunk sewer alignments are located.

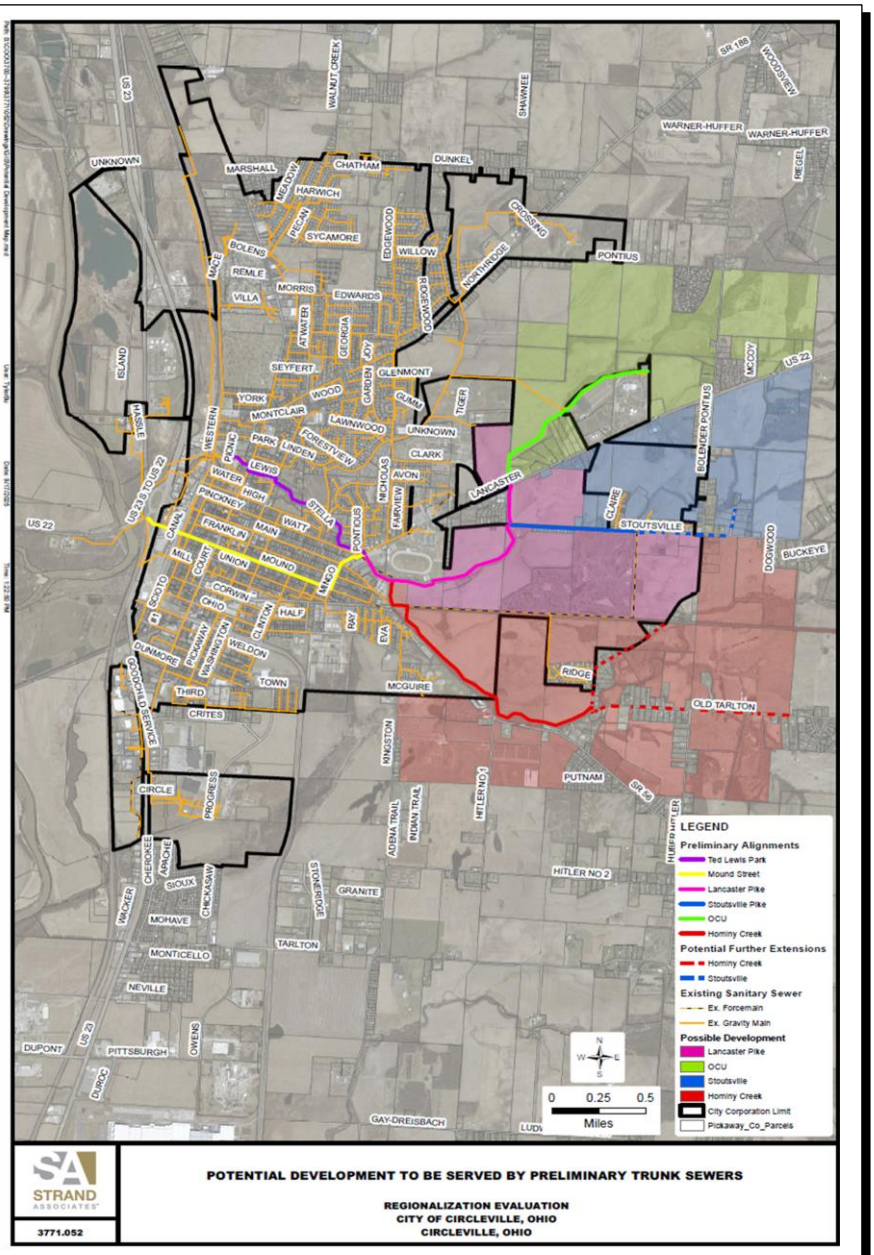


Figure 2 Proposed Preliminary Trunk Sewer Map

WWTP Connection Alignments

Mound Street

There are two alternatives to connect the proposed system to the existing WWTP. The first is the Mound Street preliminary trunk sewer alignment which runs 48-inch trunk sewers from an existing manhole located near the on ramp for US 23 South along US 22. The preliminary trunk sewer alignment then follows Mound Street, until intersecting Mingo Street, in which it continues north to US 22, and connecting to a proposed manhole near the intersection of US 22 and Pontious Lane. This trunk sewer alignment crosses under the creek near the proposed manhole and has multiple grade changes throughout, requiring the sewer to be deeper. This trunk sewer alignment also crosses US 23, which would require additional considerations during design to minimize disruptions to the highway. The trunk sewer alignment has an average slope of 0.05 percent, a minimum slope of 0.03 percent, a full flow capacity of 20.8 MGD at average slope, and an average depth of 26 feet, with a maximum manhole depth of 44 feet. The addition of a pump station before the alignment crosses Hargus Creek would allow this alignment to be shallowed up by approximately 15 feet throughout most of the trunk sewer alignment, bringing the average depth to 16 feet. No cost opinion is shown for this alignment because it would not be a feasible alternative according to the City's preferences.

Ted Lewis Park

The second alternative to connect to the existing WWTP is the Ted Lewis Park preliminary trunk sewer alignment which runs 48-inch trunk sewers from an existing manhole in Ted Lewis Park and follows along Hargus Creek to a proposed manhole near the intersection of US-22 and Pontious Lane. This trunk sewer alignment has an average slope of 0.07 percent, a minimum slope of 0.03 percent, a full flow capacity of 24.6 MGD at average slope, and an average depth of 15 feet, which is shallower than the alternative Mound Street preliminary trunk sewer alignment. This trunk sewer alignment minimizes the number of instances where the sewer would cross under the creek, which also allows the alignment to be shallower, which will reduce construction costs. Table 3 shows the preliminary cost opinion for this trunk sewer alignment. The cost opinions in this memorandum assume a 35 percent contingency to account for the rapid changes in material costs, and a 10 percent contingency for professional services including, but not limited to, engineering, legal, and right-of-way acquisition.

Item	Quantity	Unit	Unit Cost ($)	Cost ($)
48-inch pipe, open cut	5,700	LF	1,200	6,840,000
48-inch pipe, trenchless	110	LF	6,500	715,000
72-inch manhole	26	EA	16,000	416,000
Dewatering	1	LS	830,000	830,000
Maintenance of traffic (MOT)	1	LS	80,000	80,000
Clearing and grubbing	1	LS	170,000	170,000
Site restoration	1	LS	145,000	145,000
			Total	9,196,000
			10% Professional Services	920,000
			35% Contingency	3,219,000
			Cost Opinion	**13,335,000**

LF=linear feet
EA=each
SY=square yards
CY=cubic yards
LS=lump sum

Table 3 Ted Lewis Park Preliminary Cost Opinion

Conveying Additional Flow Capacity to Existing Sewer Network

The existing 18-inch sewer along the upstream end of the Ted Lewis Park preliminary trunk sewer alignment will need to be upsized and lowered; or be serviced by a pump station to allow for the connection of new development trunk sewer alignments. A pump station could connect the new development trunk sewer alignments to the existing infrastructure leading to WWTP. Or a second sewer could be added parallel to the existing sewer to carry the remaining capacity from the new development in conjunction with the pump station. The other alternative to managing the additional flow is to abandon the existing infrastructure and install a larger diameter sewer that can handle the flow from the new development and build it deep enough to be completely run by gravity, what the Mound Street and Ted Lewis Park preliminary trunk sewer alignments accomplish.

Recommendation

The recommended alternative for the City to pursue is the Ted Lewis Park preliminary trunk sewer alignment. Both the Mound Street and Ted Lewis Park preliminary trunk sewer alignments use similar trunk sewers, but the Ted Lewis Park preliminary trunk sewer alignment will be easier and more cost efficient to construct. The Mound Street preliminary trunk sewer alignment is longer, goes directly through the city, and requires deeper excavation or a pump station, which would be more costly to construct and operate. The Ted Lewis Park preliminary trunk sewer alignment is also able to connect the Lancaster Pike preliminary trunk sewer alignment at a higher elevation than Mound Street preliminary trunk sewer alignment, making all future development trunk sewer alignments shallower and easier to construct. Ted Lewis Park preliminary trunk sewer alignment is the recommended trunk sewer alignment and is used to develop plan and profile sheets for the following future development trunk sewer alignments.

Future Development

The unsewered eastern side of the City will be served by four proposed trunk sewer alignments, all of which will connect back to the end of the Ted Lewis Park preliminary trunk sewer alignment. Figure 3 shows a map of how these preliminary trunk sewer alignments will be laid out.

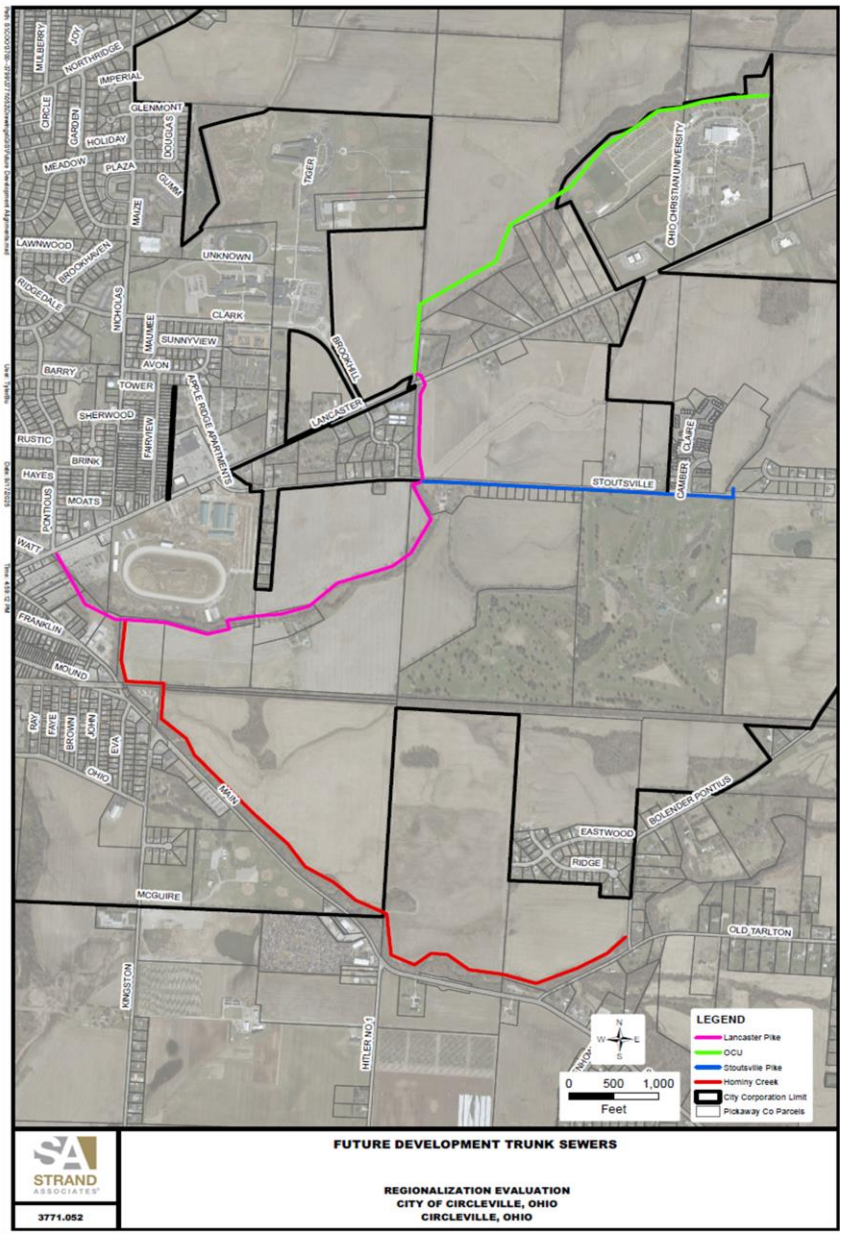


Figure 3 Future Development Preliminary Trunk Sewer Map

Lancaster Pike

The Lancaster Pike preliminary trunk sewer alignment follows Hargus Creek from a proposed manhole near the intersection of US 22 and Pontious Lane, to a proposed manhole at the northernmost intersection of US 22 and Hargus Creek. This trunk sewer alignment runs three size pipes with varying capacity.

First is a 42-inch trunk sewer starting at the end of the Ted Lewis Park preliminary trunk sewer alignment and ends at the end of the Hominy Creek preliminary trunk sewer alignment. This section of trunk sewer has an average slope of 0.20 percent, a minimum slope of 0.04 percent, a full flow capacity of 29.1 MGD at average slope, and an average depth of 17 feet.

Following is a 30-inch trunk sewer connecting to the end of the 42-inch trunk sewer and ending at the start of the Stoutsville Pike preliminary trunk sewer alignment. This section of trunk sewer has an average slope of 0.42 percent, a minimum slope of 0.34 percent, a full flow capacity of 17.2 MGD at average slope, and an average depth of 16 feet.

Finally, a 21-inch trunk sewer connects to the end of the 30-inch trunk sewer and ends at the start of the OCU preliminary trunk sewer alignment. This section of trunk sewer maintains a consistent slope of 0.11 percent, a full flow capacity of 3.4 MGD, and has an average depth of 16 feet. Table 4 shows the preliminary cost opinion for the Lancaster Pike preliminary trunk sewer alignment.

Item	Quantity	Unit	Unit Cost ($)	Cost ($)
42-inch pipe, open cut	310	LF	1,000	310,000
42-inch pipe, trenchless	890	LF	3,800	3,382,000
72-inch manhole	3	EA	16,000	48,000
30-inch pipe, open cut	4,600	LF	800	3,680,000
30-inch pipe, trenchless	110	LF	6,200	682,000
60-inch manhole	14	EA	11,000	154,000
21-inch pipe, open cut	1,200	LF	550	660,000
21-inch pipe, trenchless	210	LF	6,100	1,281,000
48-inch manhole	7	EA	10,000	70,000
Dewatering	1	LS	1,000,000	1,000,000
MOT	1	LS	25,000	25,000
Clearing and grubbing	1	LS	325,000	325,000
Site restoration	1	LS	95,000	95,000
		Total		11,712,000
		10% Professional Services		1,172,000
		35% Contingency		4,100,000
		Cost Opinion		**16,984,000**

Table 4 Lancaster Pike Preliminary Cost Opinion

OCU

The OCU preliminary trunk sewer alignment runs an 18-inch trunk sewer from the intersection of US 22 and Hargus Creek, and continues along Hargus Creek, through the OCU campus, ending near where Hargus Creeks meets the City limits. This trunk sewer alignment has an average slope of 0.50 percent, a minimum slope of 0.45 percent, a full flow capacity of 4.8 MGD at average slope, and an average depth of 15 feet. Table 5 shows the preliminary cost opinion for this trunk sewer alignment.

Item	Quantity	Unit	Unit Cost ($)	Cost ($)
18-inch pipe, open cut	5,600	LF	400	2,240,000
18-inch pipe, trenchless	160	LF	4,200	672,000
48-inch manhole	16	EA	10,000	160,000
Dewatering	1	LS	340,000	340,000
Clearing and grubbing	1	LS	270,000	270,000
Site restoration	1	LS	70,000	70,000
		Total		3,752,000
		10% Professional Services		376,000
		35% Contingency		1,314,000
		Cost Opinion		**5,442,000**

Table 5 OCU Preliminary Cost Opinion

Stoutsville Pike

The Stoutsville Pike preliminary trunk sewer alignment runs a 21-inch trunk sewer from the intersection of Stoutsville Pike and Hargus Creek and continues along Stoutsville Pike, ending near the City Lift Station No. 7. This trunk sewer alignment has an average slope of 0.73 percent, a minimum slope of 0.25 percent, a full flow capacity of 8.8 MGD at average slope, and an average depth of 14 feet. Table 6 shows the preliminary cost opinion for this trunk sewer alignment.

Item	Quantity	Unit	Unit Cost ($)	Cost ($)
21-inch pipe, open cut	3,300	LF	550	1,815,000
21-inch pipe, trenchless	320	LF	2,500	800,000
48-inch manhole	9	EA	10,000	90,000
Dewatering	1	LS	290,000	290,000
Clearing and grubbing	1	LS	165,000	165,000
Site restoration	1	LS	42,000	42,000
		Total		3,202,000
		10% Professional Services		321,000
		35% Contingency		1,121,000
		Cost Opinion		**4,644,000**

Table 6 Stoutsville Pike Preliminary Cost Opinion

Hominy Creek

The Hominy Creek preliminary trunk sewer alignment runs a 30-inch trunk sewer from the intersection of Hominy Creek and Hargus Creek, continuing along the natural path of Hominy Creek. This alignment has an average slope of 0.56 percent, a minimum slope of 0.34 percent, a full flow capacity of 19.8 MGD at an average slope, and an average depth of 13 feet. Table 7 shows the preliminary cost opinion for this trunk sewer alignment.

Item	Quantity	Unit	Unit Cost ($)	Cost ($)
30-inch pipe, open cut	8,600	LF	800	6,880,000
60-inch manhole	23	EA	11,000	253,000
Dewatering	1	LS	760,000	760,000
Clearing and grubbing	1	LS	390,000	390,000
Site restoration	1	LS	100,000	100,000
			Total	8,383,000
			10% Professional Services	839,000
			35% Contingency	2,935,000
			Cost Opinion	**12,157,000**

Table 7 Hominy Creek Preliminary Cost Opinion

Additional Considerations

The City is motivated by planned developments along Stoutsville Pike and Lancaster Pike to design and construct the Lancaster Pike preliminary trunk sewer alignment as well as the Stoutsville Pike preliminary trunk sewer alignment ahead of the design and construction of the Ted Lewis Park preliminary trunk sewer alignment. As planned in this preliminary stage, the Lancaster Pike preliminary trunk sewer alignment is approximately 22 feet deep where it is proposed to connect to the Ted Lewis Park preliminary trunk sewer alignment. The existing 18-inch trunk sewer in this area is approximately 12 feet deep as observed in the field. To facilitate the design and construction of the Lancaster Pike and Stoutsville Pike preliminary trunk sewer alignments, it is proposed that a lift station be implemented at the downstream end of the Lancaster Pike preliminary trunk sewer alignments to allow the Lancaster Pike and Stoutsville Pike preliminary trunk sewer alignments to be designed with the intent to connect to the Ted Lewis Park preliminary trunk sewer alignment in the future upon being constructed. Based on the *Inflow and Infiltration Plan* completed by Arcadis in 2021, flow meter FM-04, which was located on North Pickaway Street, south of Lewis Avenue, on a 24-inch sanitary sewer, yielded an average daily flow of 0.26 MGD. Using a peaking factor of 3.33 in accordance with the OEPA Green Book, it was assumed that approximately 0.87 MGD of PHF is experienced by the 18-inch sanitary sewer that extends east to Lancaster Pike. Using the Manning's Equation; it was determined that, at a minimum velocity of 2 fps, an 18-inch sanitary sewer has a capacity of 1.91 MGD. Given the calculated capacity and assumed PHF rate, the existing 18-inch sewer has approximately 1.0 MGD of capacity remaining to convey flows from the proposed trunk sewer extensions on the east side of the City. Therefore, a lift station capable of conveying flows up to 1.0 MGD PHF and 0.33 MGD of ADF should be designed to convey flows from proposed trunk sewer extensions to the east of the City. Figure 3 shows a potential location for this lift station. At this planning stage, the preliminary OPCC for the lift station is approximately $2,000,000.

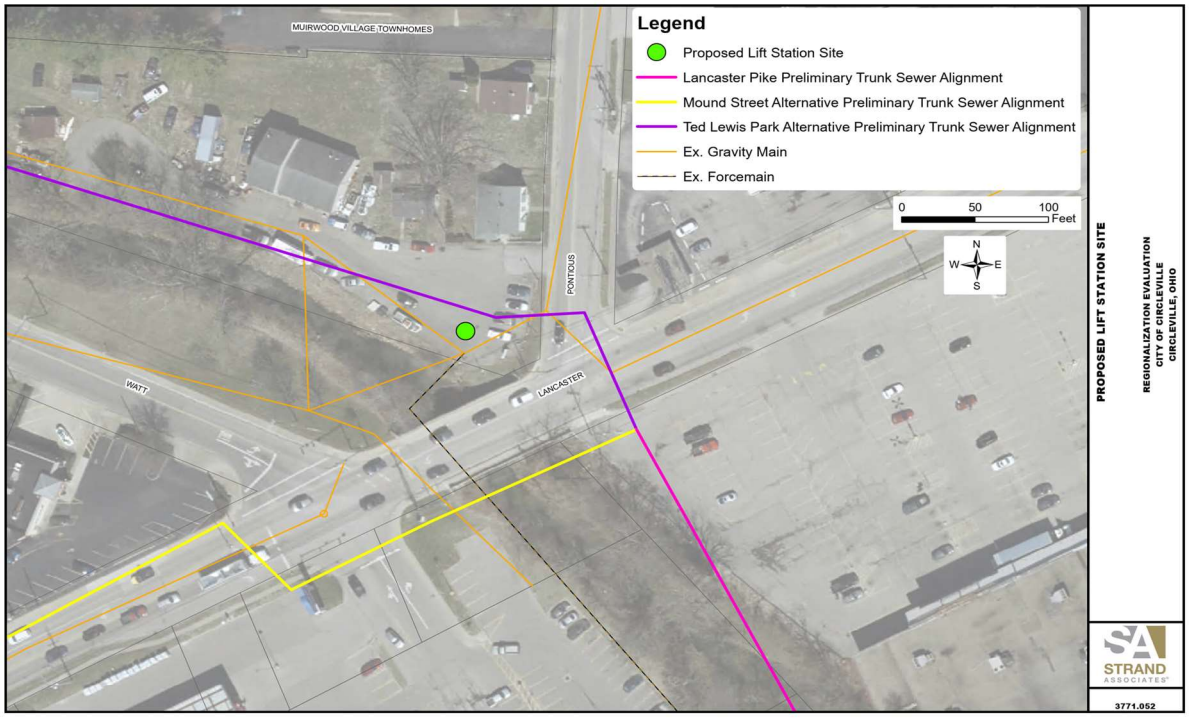


Figure 4 Lift Station Location

Regionalization Evaluation

In accordance with the Regionalization Evaluation criteria listed in the Project Planning and Regionalization Evaluation guidance listed on the OEPA Department of Environmental Financial Assistance Water Pollution Control Loan Fund Web site, the City operates the largest WWTP within a 10-mile radius of the extents of the City's existing sanitary sewer system with an average design flow of 4.0 MGD and located approximately 3.3 miles from the furthest extent of the City's sanitary sewer system. The following are the the next largest water treatment facilties within a 10-mile radius of the City's system

- The Village of Ashville's Water Resource Recovery Facility (OEPA National Pollutant Discharge Elimination System [NPDES] Permit No. 4PC00103*BD) with an average design flow of 0.8 MGD located approximately 6 miles north of the north extent of the City's sanitary sewer system.
- The Village of South Bloomfield's WWTP (Ohio EPA NPDES Permit No. 4PC00101*ED) with an average design flow of 0.5 MGD located approximately 6.5 miles north of the north extent of the City's sanitary sewer system.
- The Earnhardt Hill Regional Water and Sewer District WWTP (OEPA NPDES Permit No. 4PQ00002*HD) with an average design flow 0.3 MGD located approximately 4.5 miles south of the south extent of the City's sanitary sewer system.

The Circle Hill Subdivision WWTP (OEPA NPDES Permit No. 4PG00013*ID) operated by the Pickaway County Commissioners (County) with an average design flow of 0.03 MGD has potential to be regionalized into the City's sewer system through the design and construction of the Hominy Creek preliminary trunk sewer alignment discussed previously. As discussed, four preliminary trunk sewer alignments have been reviewed to extend sewer service to unsewered areas outside of the City. Preliminary pipe sizes have been determined for these trunk sewer alignments to carry flow from the anticipated service areas. These extensions also provide the opportunity to eliminate existing home sewage treatment systems within the unsewered areas the preliminary trunk sewer alignments are intended to serve. The City contacted the County in 2024 regarding regionalizing existing package plants operated by the County on the east side of the city into the City's sanitary sewer system. However, the County has recently regionalized two of its package plants to the northeast of the City into one WWTP. The potential shared cost savings of operator employment, billing and collections, and reduced operation and maintenance costs for running one facility versus two was not evaluated because it is not applicable to this project. With regards to sanitary sewer rate structure, the City is currently reviewing and updating its sewer rate structure to support costs for future sewer extensions.

Conclusion

Moving forward, the City plans to complete the design of the Ted Lewis Park, Lancaster Pike, Stoutsville Pike, and OCU preliminary trunk sewer alignments, with the intent of first implementing Lancaster Pike and Stoutsville Pike preliminary trunk sewer alignments to account for the upcoming development demands. The Hominy Creek preliminary trunk sewer alignment does not have the demand or interest to complete design at this point. Overall, the design of these trunk sewer alignments would include approximately 22,600 feet of proposed trunk sewer, 75 manholes, and an estimated probable construction cost of $43,000,000.

Enclosures:

Appendices

Appendix A–Proposed Trunk Sewer Alignment Plan and Profile Sheets

Appendix B–Proposed Trunk Sewer Alignment Maps

Appendix C–Lift Station Location