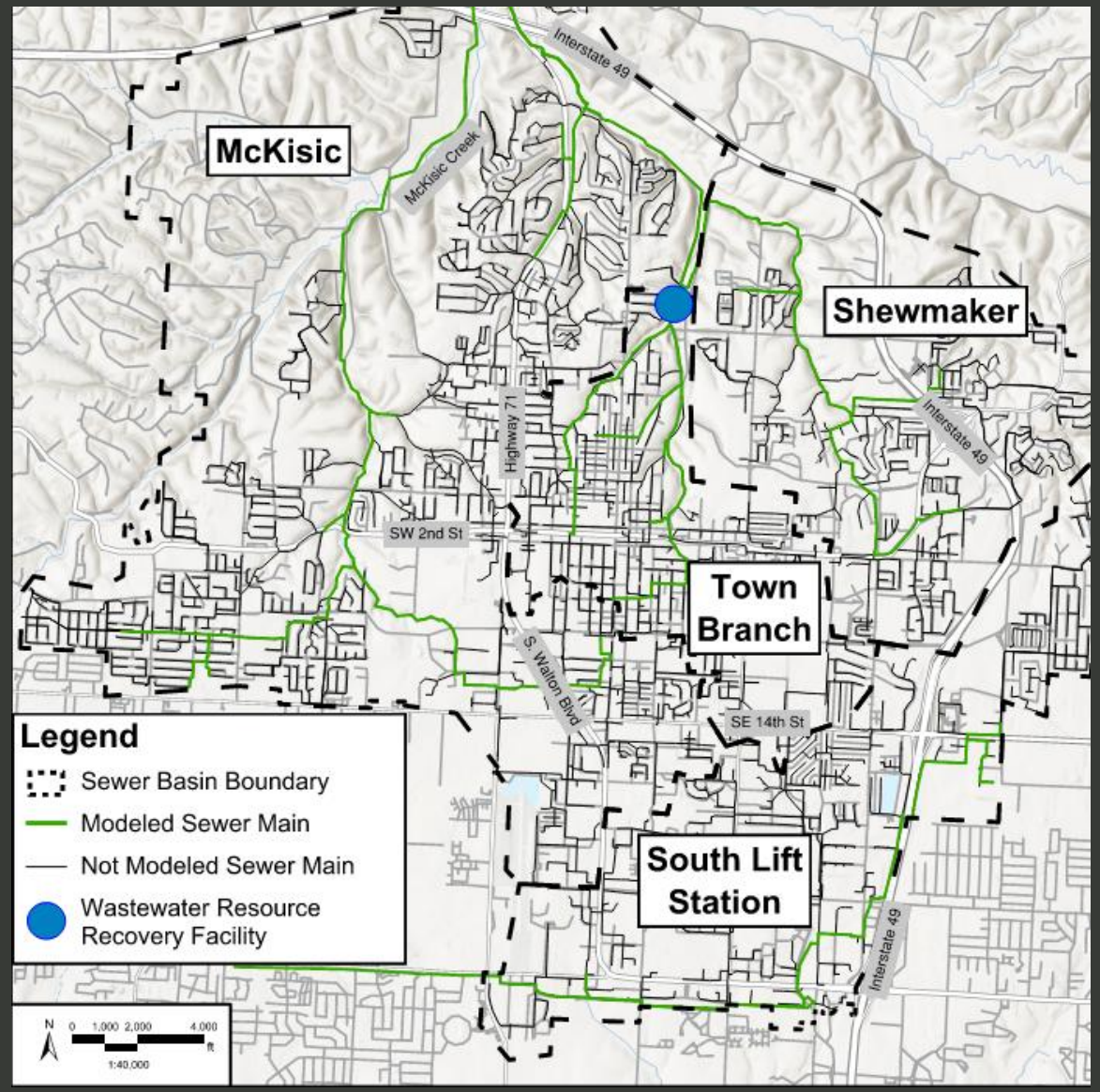
Bentonville Sewer Collection Analysis and Peak Flow Management Program

Chris Dougherty, PE

olsson

Background, Part I Study

- **Long term flow monitoring:**
  - September 2020 – June 2021
  - 27 Flow Meters total
- **Creation of Study Basins**
- **Creation of Hydraulic Model**
- **Part 1 Recommendations:**
  - Field investigation of high I/I Subbasins
  - Model Future Scenarios to develop Capital Improvement Recommendations

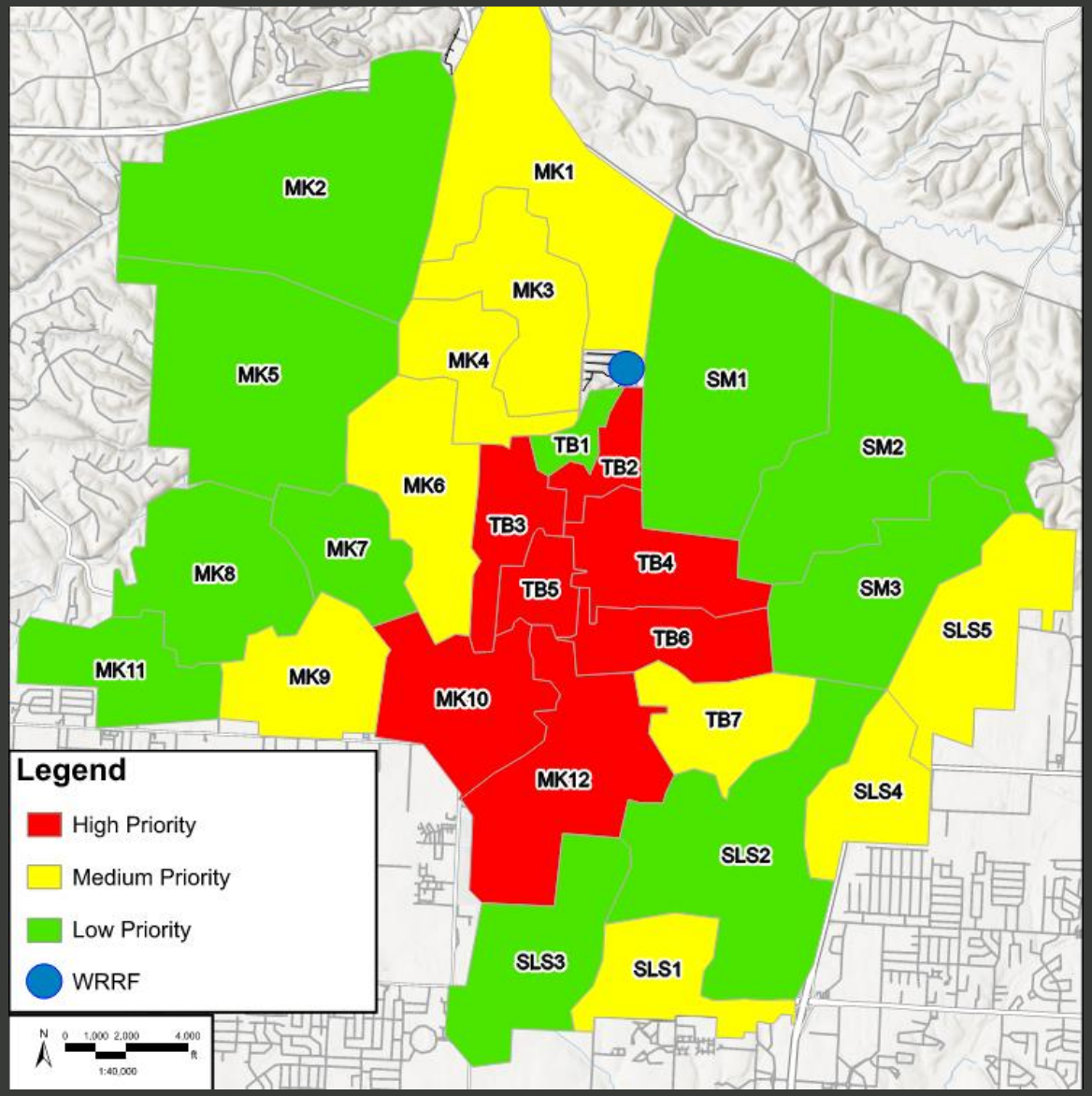


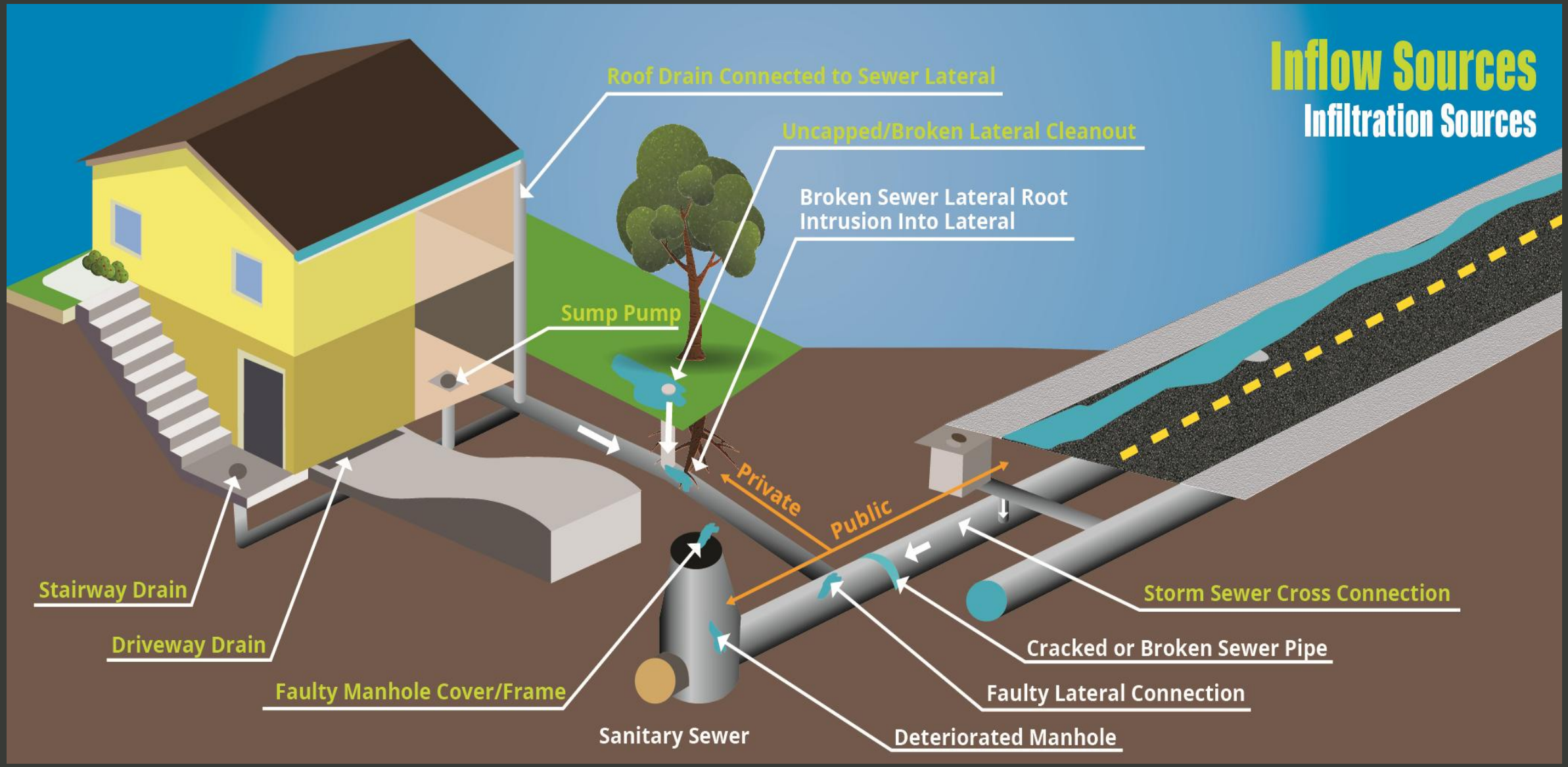
I/I Severity by Sub-basin

Sub-basins were prioritized by:

- Peak I/I Flow Rates
- Quantity and Size of Existing Pipes and Manholes

- **High Priority**
  - 7 Sub-basins
- **Medium Priority**
  - 9 Sub-basins
- **Low Priority**
  - 11 Sub-basins





Sources of Infiltration/Inflow

Sanitary Sewer Evaluation Survey (SSES)

SSES Field Testing Included:

- 19,886 LF CCTV
- 166,100 LF Acoustic sounding
- 209,000 LF Smoke testing
- 1,330 Manhole Inspections
- 537 in Part 1
- 793 in Part 2

Recommended Rehabilitation Methods:

- Lining defective pipes
- Lining MHs
- Replace/Reset MH Frame/Riser
- Bench/Invert/Pipe Seal Rehab
- Point Repairs

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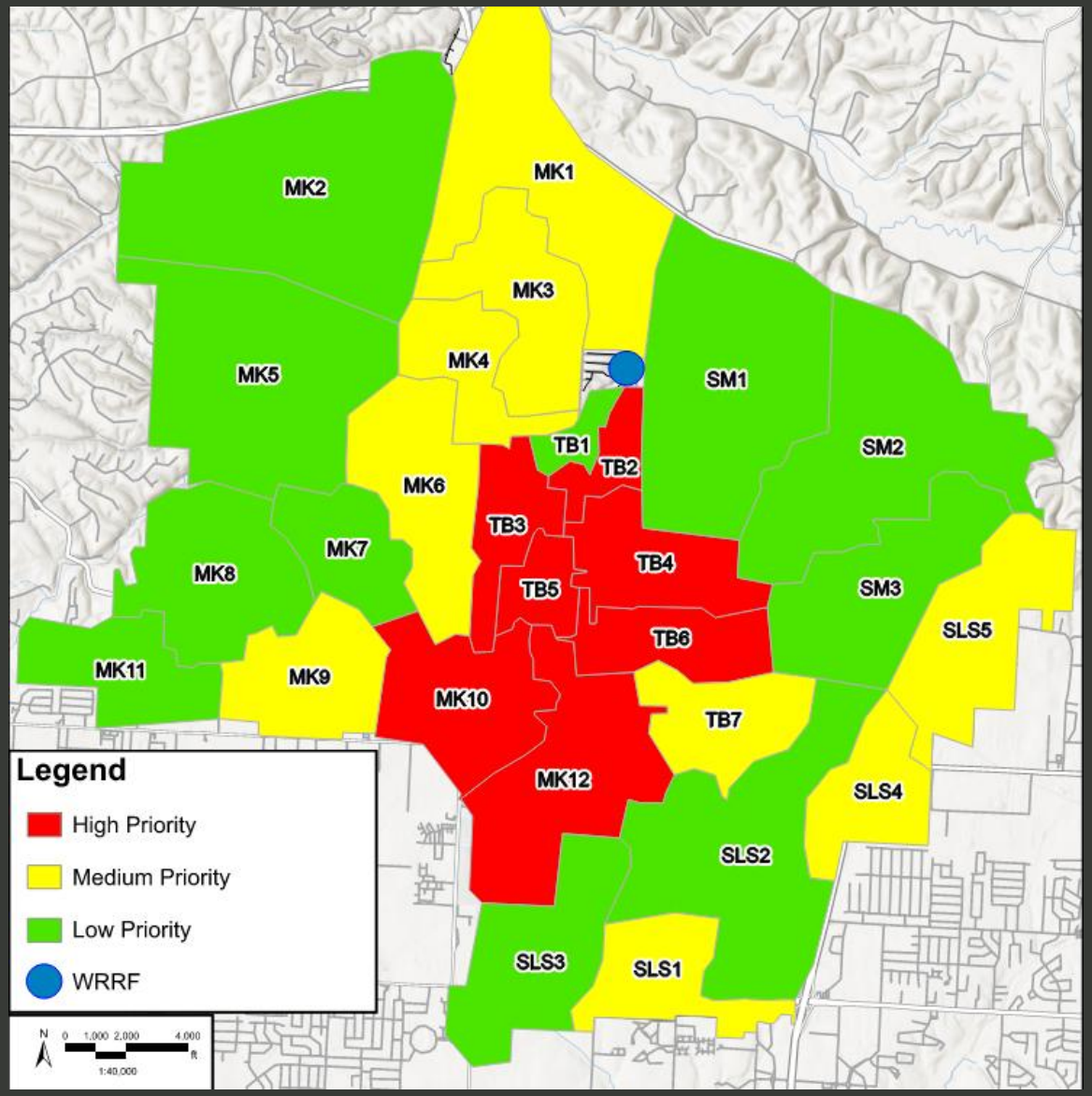
Sub-basins were prioritized by:

- Peak I/I Flow Rates
- Quantity & Size of Existing Pipes and Manholes

Priority	High	Medium	Low
Number of Sub-basins	7	9	11

Source Type	Quantity	Flow Rate (gpm)	% GPM of Total
Public-Sector[1]	743	805	61%
Private-Sector	168	514	39%
Total	**911**	**1,319**	**100%**

[1]Not all sources recommended for rehabilitation



I/I Severity & Quantification

Private I/I Sources

Recommended Private I/I Abatement Program

- 514 GPM Flow Reduction
- $232,000 Estimated Cost includes 20% contingency

Inflow/Infiltration Source	Quantity	Flow Rate (gpm)
Area Drain	3	6.55
Downspout	1	13.19
Foundation Drain	4	16.69
Grease Trap	2	2.00
Septic	2	15.00
Service Lateral	39	76.85
Storm Ditch – Service Lateral	1	2.29
Uncapped Cleanout	116	381.17
Total	**168**	**513.74**

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Inflow/Infiltration Source	Quantity	Flow Rate (gpm)
Manhole	653	327.84
Main Sewer	82	270.69
Fountain Drain	1	15.00
Storm Ditch – Mainline	5	120.30
Storm Ditch – Storm Inlet	2	71.65
Total	**743**	**805.48**

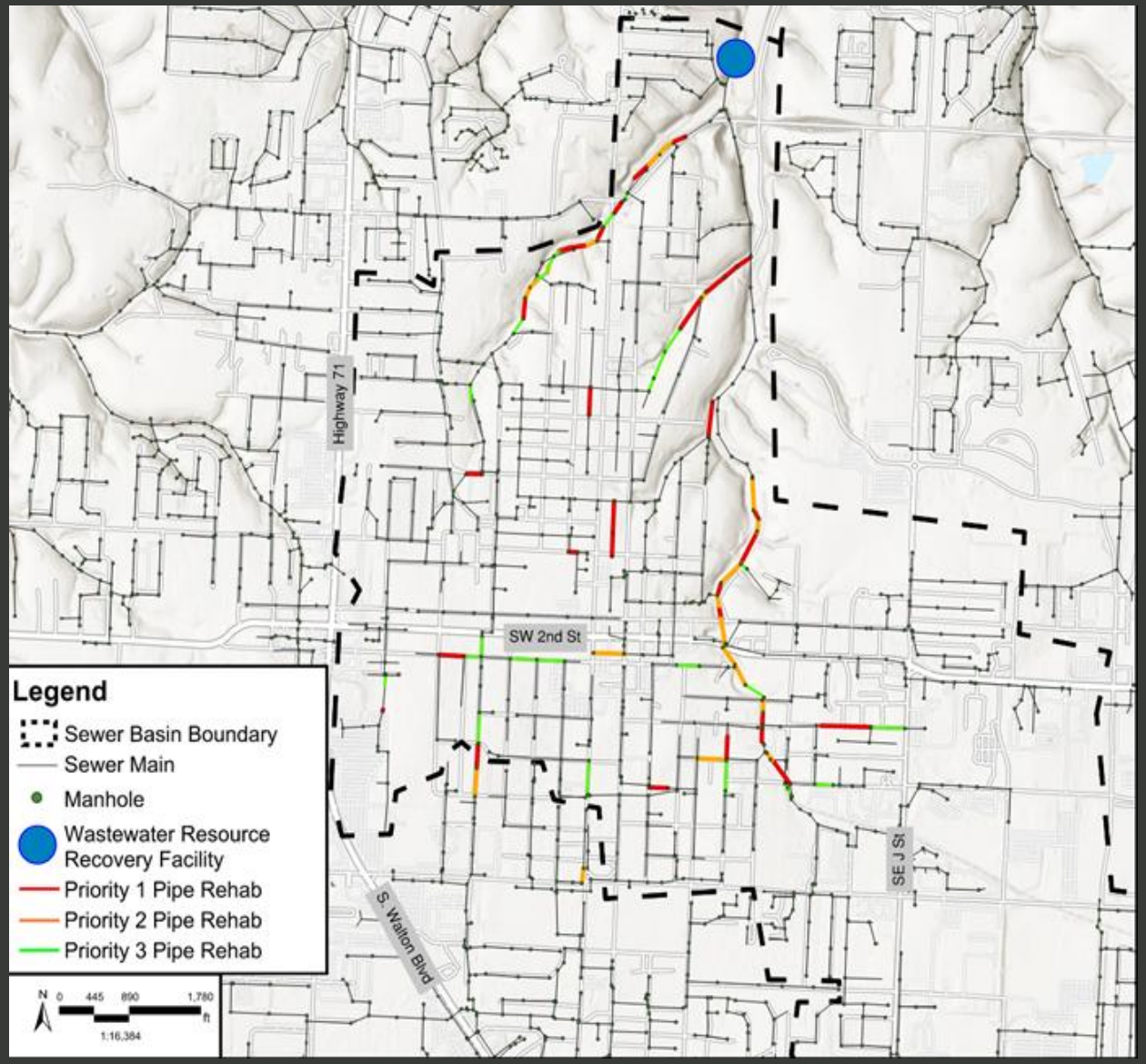
Public I/I Sources

Recommended Public I/I Rehabilitation

- 432 GPM Flow Reduction
- $3,888,000 Estimated Cost including 30% contingency on manholes and 20% contingency on Main Sewer

Priority	LF	Est. Flow Reduction (GPM)	Cost Estimate[1]
1	7,200	135	$1,074,000
2	4,300	84	$470,000
Total	**11,500**	**219**	**$1,544,000**

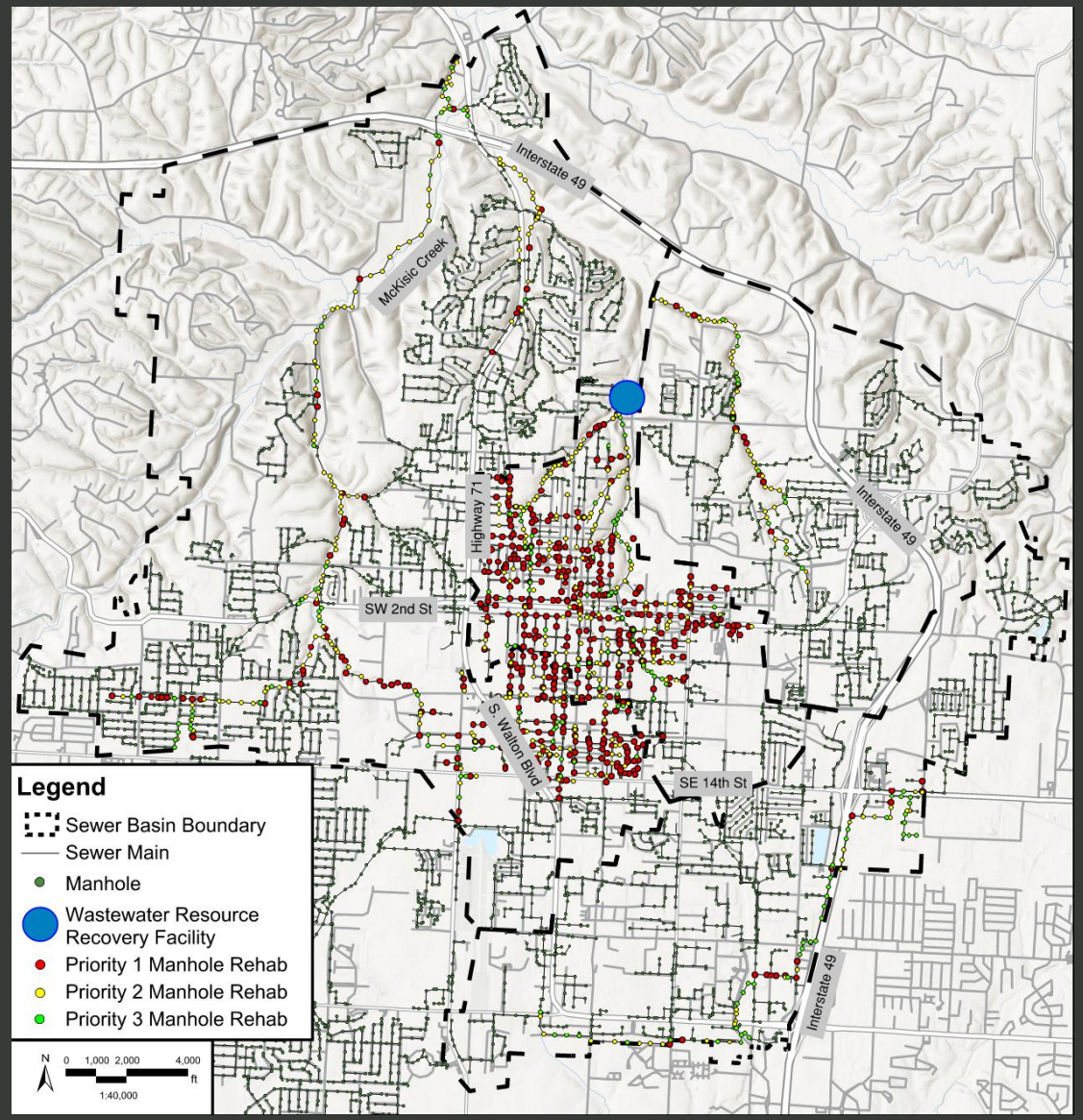
[1] *Cost includes a 20% contingency that includes engineering, administration fees, inspections and construction overages.*



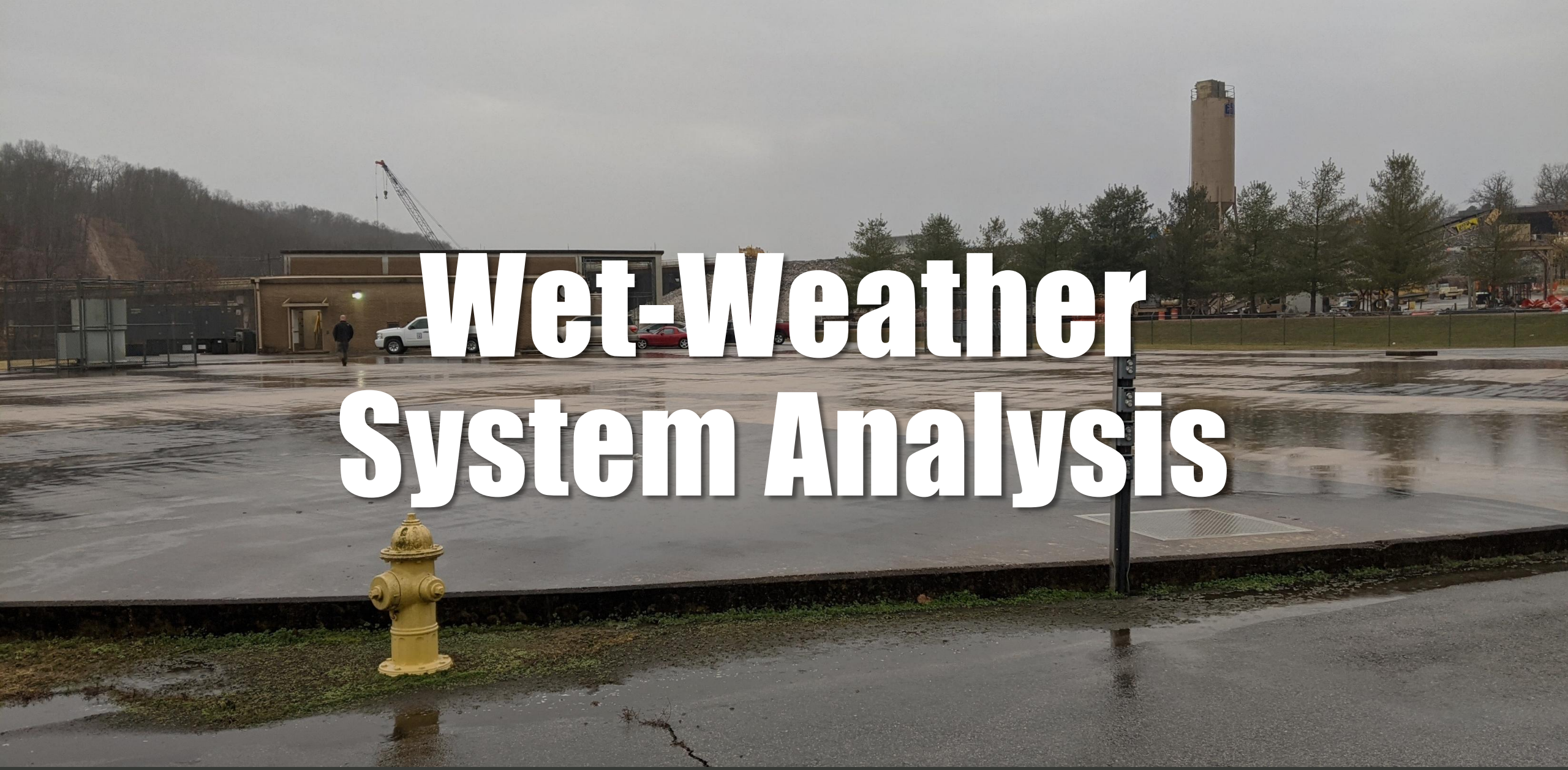
Sewer Pipe Rehabilitation

Priority	Quantity	Flow Reduction (GPM)	Cost Estimate[1]
1	182	125	$1,075,000
2	220	88	$1,269,000
Total	**402**	**213**	**$2,344,000**

[1] *Cost includes a 20% contingency that includes engineering, administration fees, inspections and construction overages.*



Manhole Rehabilitation



Wet-Weather System Analysis

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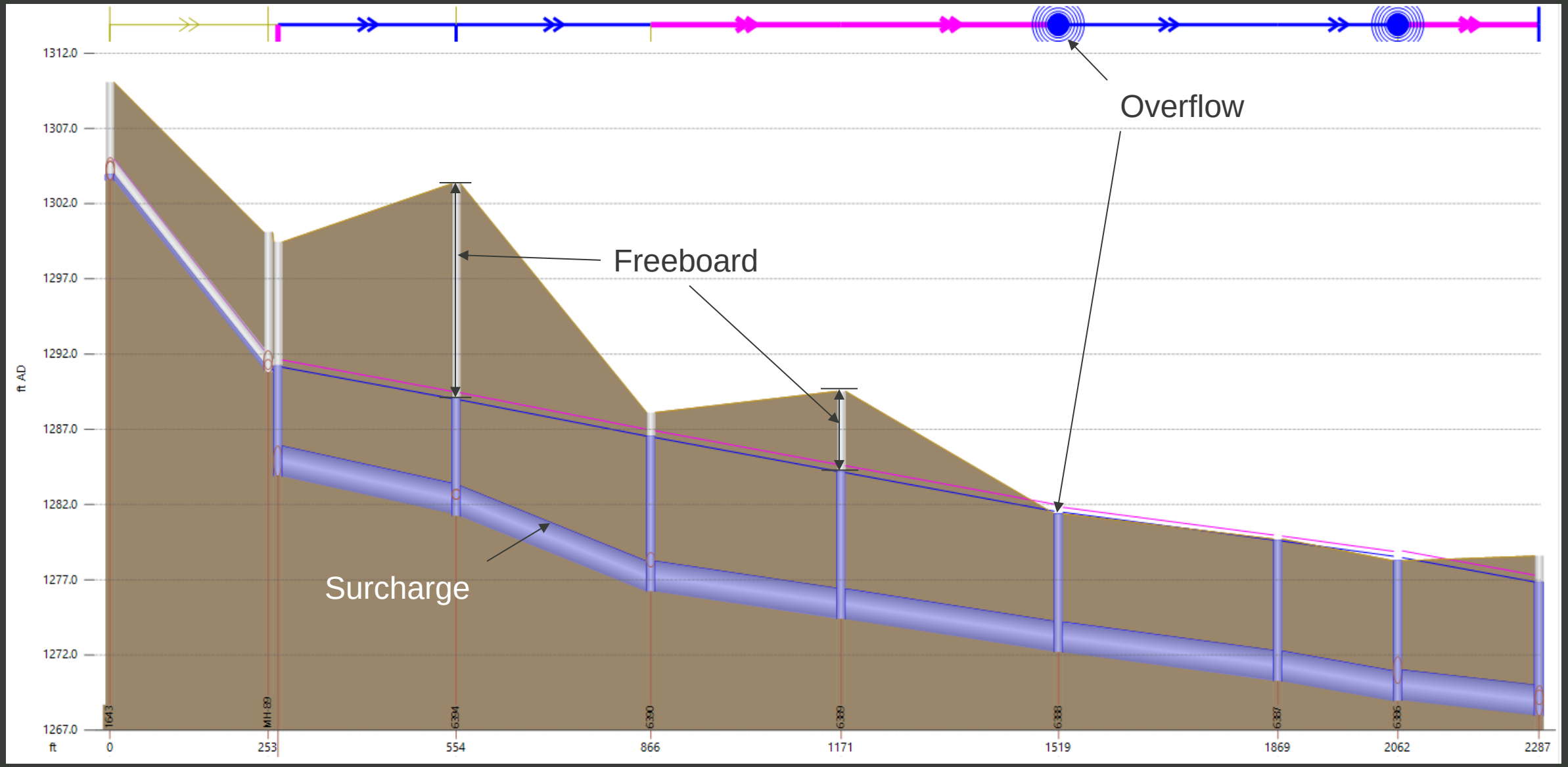

Pipe Surcharging, Manhole Freeboard, & Overflows

Ultimate Buildout Projections

- Plan Bentonville's Future Land Use Map (FLUM) used for Ultimate Buildout Conditions
- Residential Population and Commercial Population were used to develop future wastewater flows for Ultimate Buildout conditions
- No additional industrial flow is included in projections

PLAN BENTONVILLE

Population	Quantity	GPCD	Total Flow, MGD	To WRRF, MGD	To NACA, MGD
Commercial	149,654	30	4.5	2.8	1.7
Residential	116,510	65	7.6	5.3	2.3
		Total	**12.1**	**8.1**	**4.0**
		2023 Total Flow	3.3	2.5	0.8
		Percent Increase	**+270%**	**+230%**	**+390%**

THE CITY OF WATER B UTILITIES BENTONVILLE

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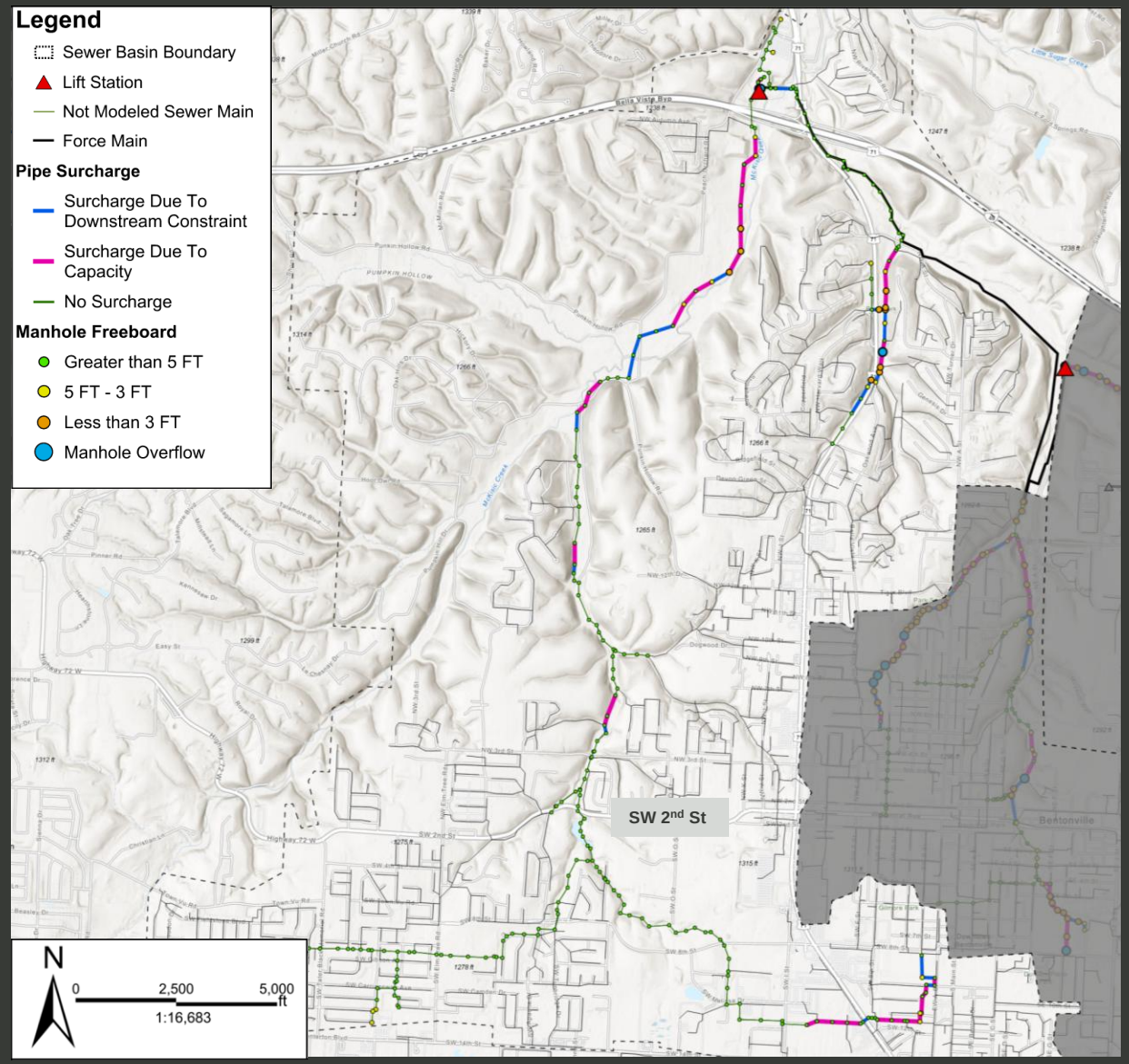
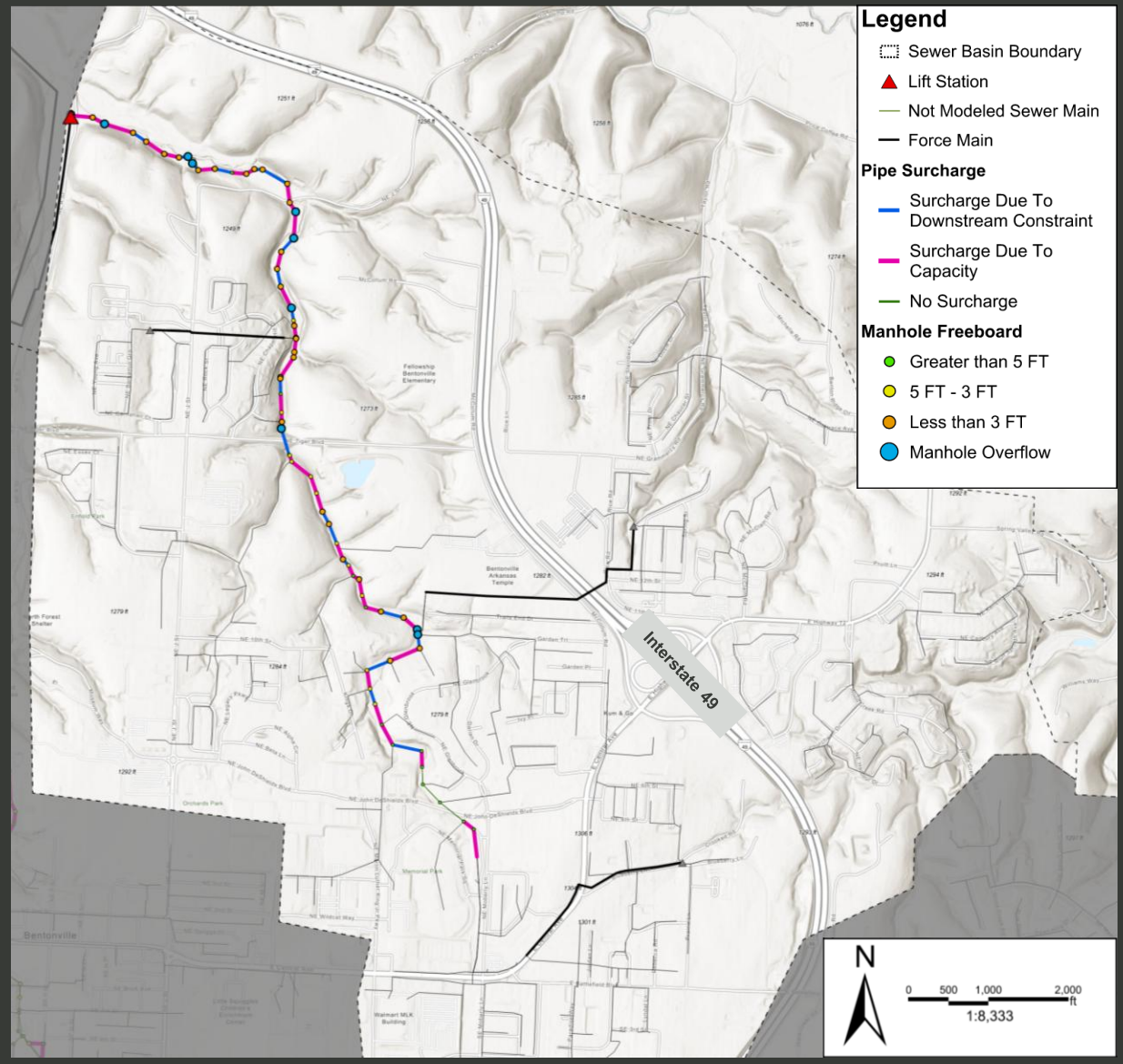
Condition	Existing		Ultimate Buildout	
	MH	Pipe, LF	MH	Pipe, LF
Pipes Surcharged due to Downstream Constraint	20	2,764	26	7,018
Pipes Surcharged due to Capacity	11	3,891	43	12,312
Overflows	0	-	3	-
Manhole Freeboard 0’-3’	5	-	11	-
Manhole Freeboard 3’-5’	11	-	20	-



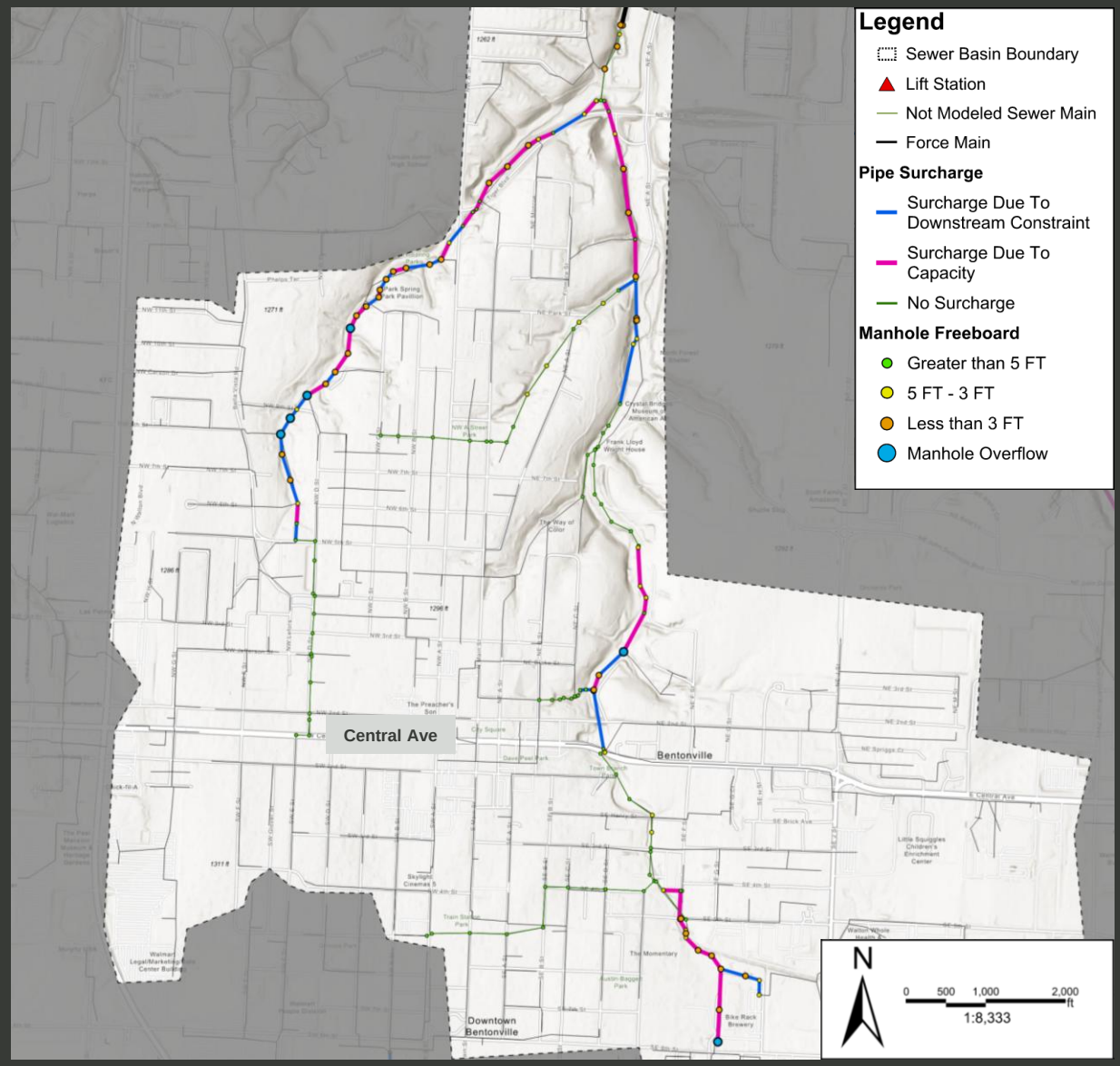
McKisic Basin Under Wet-Weather Flow

Condition	Existing		Ultimate Buildout	
	MH	Pipe, LF	MH	Pipe, LF
Pipes Surcharged due to Downstream Constraint	30	3,432	25	4,361
Pipes Surcharged due to Capacity	22	5,779	40	8,131
Overflows	3	-	10	-
Manhole Freeboard 0’-3’	18	-	32	-
Manhole Freeboard 3’-5’	17	-	22	-



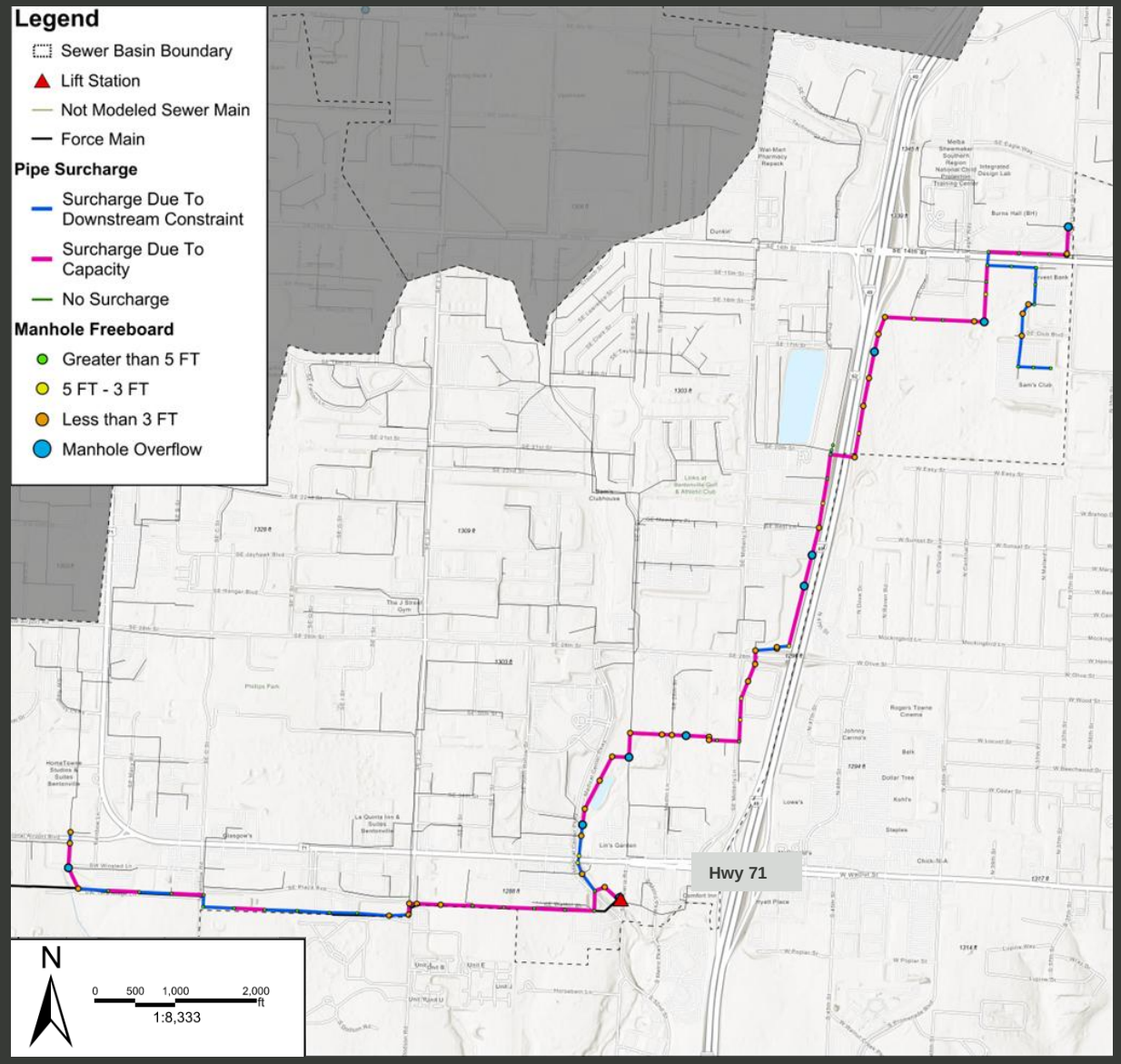
Shewmaker Basin Under Wet-Weather Flow

Condition	Existing		Ultimate Buildout	
	MH	Pipe, LF	MH	Pipe, LF
Pipes Surcharged due to Downstream Constraint	31	4,384	34	5,967
Pipes Surcharged due to Capacity	24	4,997	41	7,707
Overflows	3	-	6	-
Manhole Freeboard 0’-3’	27	-	32	-
Manhole Freeboard 3’-5’	29	-	32	-



Town Branch Basin Under Wet-Weather Flow

Condition	Existing		Ultimate Buildout	
	MH	Pipe, LF	MH	Pipe, LF
Pipes Surcharged due to Downstream Constraint	52	6,009	33	7,225
Pipes Surcharged due to Capacity	27	14,579	60	16,594
Overflows	0	-	11	-
Manhole Freeboard 0’-3’	3	-	35	-
Manhole Freeboard 3’-5’	8	-	20	-



South Lift Station Basin Under Wet-Weather Flow

Capital Improvement Recommendations

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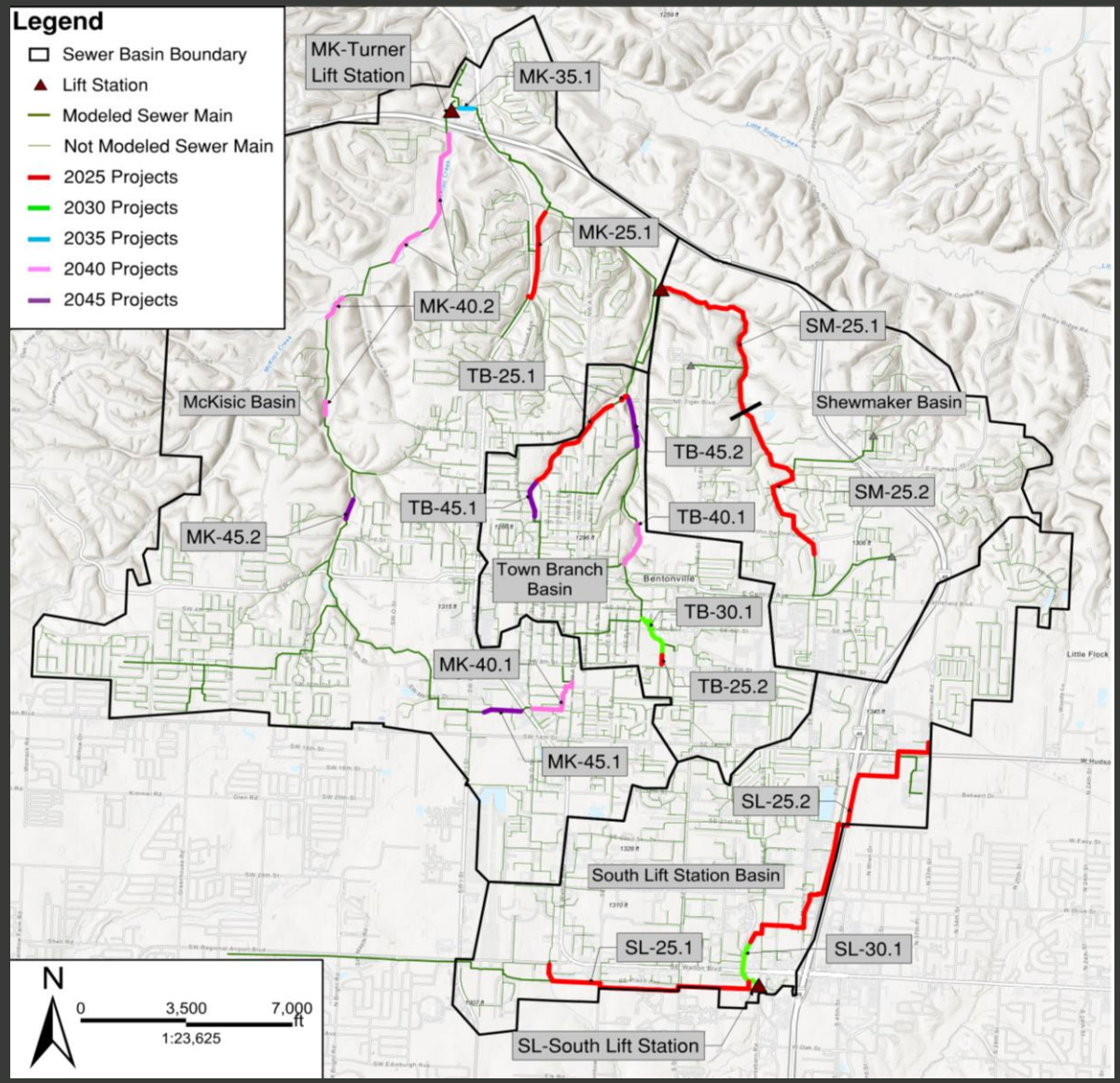
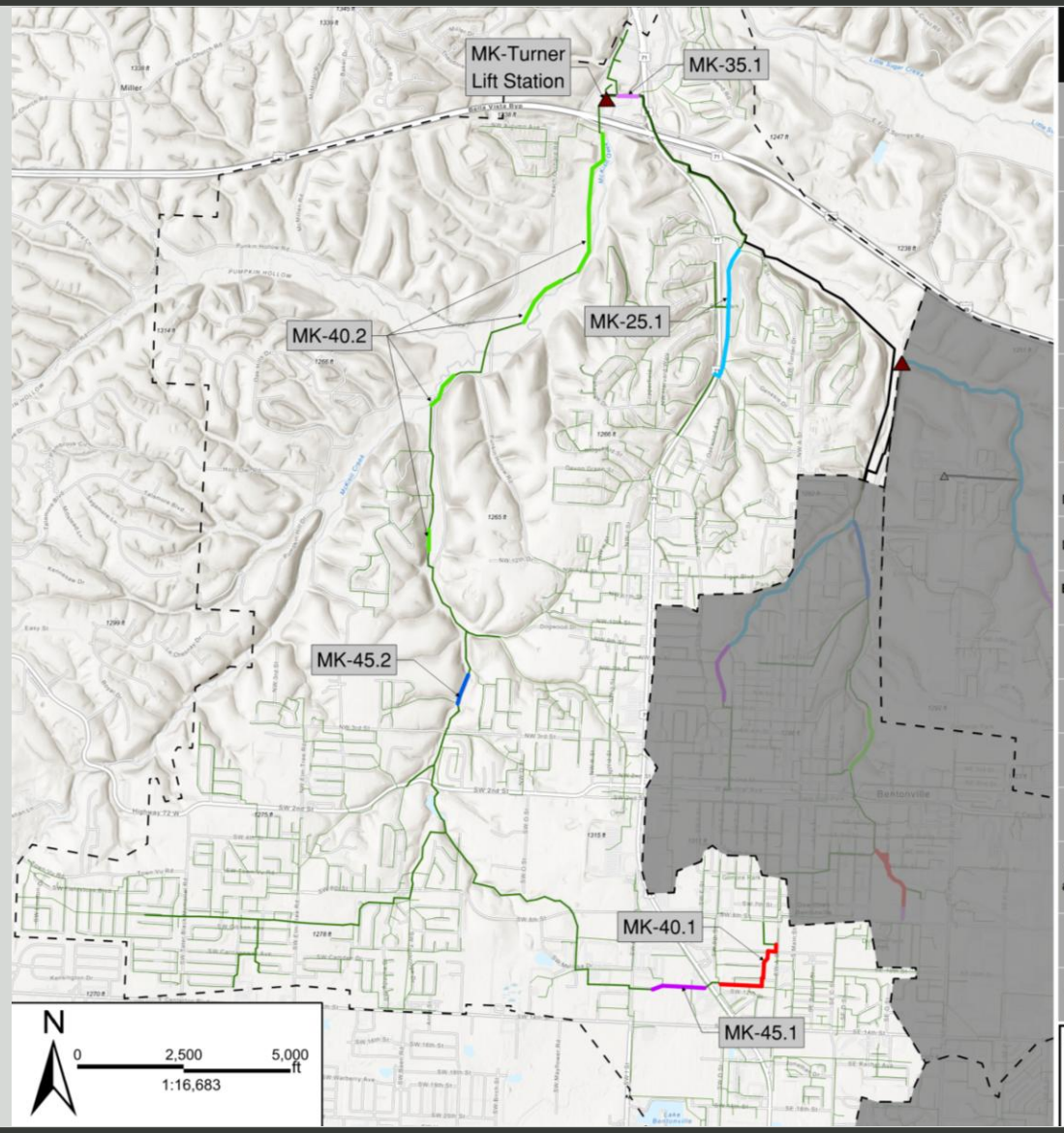
Summary of System Capacity Improvements

Capacity Improvements Included:

- 17 Projects Upsizing Existing Gravity Sewer Lines
- 1 Project increasing Storage at South Lift Station
- 2 Projects Improving Pumping Capacity at Lift Stations
  - South Lift Station
  - Turner Lift Station





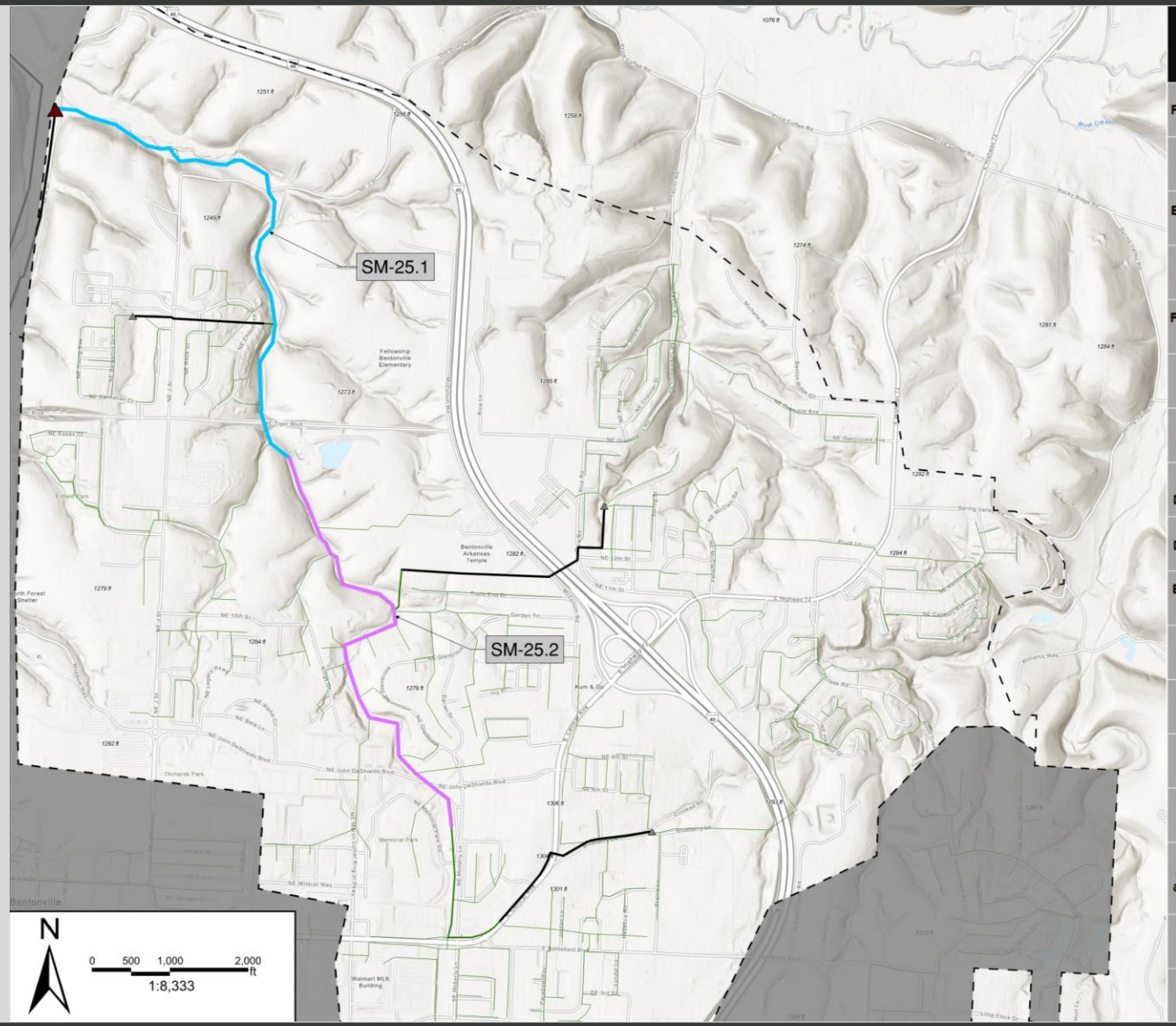
Project ID	MK-25.1	MK-Turner Lift Station[9]	MK-35.1	MK-40.1	MK-40.2	MK-45.1	MK-45.2	Basin Total
Projected Horizon	2025	2025	2035	2040	2040	2045	2045	
Total Length (Feet)	3,167	-	462	2,214	6,179	1,237	717	
Existing Diameter (Inch)	8/10	-	18	12	24	18	24	
Proposed Diameter (Inch)	12	-	24	18	30	24	30	
Dry Weather Flow Trigger (MGD)[1]	0.02	-	0.29	0.11	0.99	0.38	0.90	
Limiting Upstream Manhole ID[2]	319-3604	-	236-6811	403-9	276-3918	403-6576	360-3002	
80% of Full Pipe Capacity (MGD)[3]	0.216	-	2.112	0.584	4.096	1.832	3.928	
Initiation/Pre-Design (Months)[4]	3	3	3	3	3	3	3	
Design (Months)[5]	6	3	5	5	10	5	5	
Bid/ Construction (Months)[6]	9	8	6	7	14	6	6	
Total Duration (Months)	18	14	14	15	27	14	14	
Construction Subtotal	$ 2,893,000	$ 410,000	$ 1,000,000	$ 2,484,000	$ 7,990,000	$ 5,642,000	$ 1,065,000	$ 21,484,000
Easement	$ 79,175	-	$ 11,550	$ 55,350	$ 154,475	$ 30,925	$ 17,925	$ 349,400
Contingency	$ 668,000	$ 95,000	$ 231,000	$ 573,000	$ 1,844,000	$ 1,302,000	$ 246,000	$ 4,959,000
Design, Acquisition, Bid, and Construction Services	$ 434,000	$ 74,000	$ 150,000	$ 373,000	$ 1,199,000	$ 846,000	$ 160,000	$ 3,236,000
Total Project Cost[7]	$ 3,327,000	$ 484,000	$ 1,150,000	$ 2,857,000	$ 9,189,000	$ 6,488,000	$ 1,225,000	$ 24,720,000
Escalated Total Project Cost[8]	$ 3,852,000	$ 561,000	$ 1,874,000	$ 5,940,000	$ 19,104,000	$ 17,215,000	$ 3,251,000	$ 51,797,000

[1] When the dry weather flow equals this value the recommended improvements should considered.
[2] The ID of the upstream manhole for the pipe with lowest capacity.
[3] 80% of the full pipe capacity for the pipe with lowest capacity.
[4] Assumed at 3 Months
[5] Calculated at 1 Month per 800 feet of Improvement (or a Minimum of 5 Months)
[6] Calculated at 1 Month per 600 feet of Improvement (or a Minimum of 6 Months)
[7] Total project costs (including Design, Acquisition, Bid, and Construction Services) in 2025 dollars.
[8] Total project costs (including Design, Acquisition, Bid, and Construction Services) escalated at a rate of 5% per year to the projected project horizon.
[9] Improvements include upsizing four lift station pumps to 15hp.

Legend

- Sewer Basin Boundary
- Lift Station
- Modeled Sewer Main
- Not Modeled Sewer Main
- Forcemain
- Projects are color coded by Project ID

McKisic Improvements



Project ID	SM-25.1	SM-25.2	Basin Total[9]
Projected Horizon	2025	2025	
Total Length (Feet)	6,915	6,449	
Existing Diameter (Inch)	12/18	10/12	
Proposed Diameter (Inch)	24	18	
Peak Flow Trigger (MGD)[1]	0.13	0.14	
Limiting Upstream Manhole ID[2]	320-4863	362-4720	
80% of Full Pipe Capacity (MGD)[3]	0.608	0.664	
Initiation/Pre-Design (Months)[4]	3	3	
Design (Months)[5]	11	11	
Bid/ Construction (Months)[6]	15	14	
Total Duration (Months)	29	28	
Construction Subtotal	$ 8,869,000	$ 6,343,000	$ 15,212,000
Easement	$ 172,875	$ 161,225	$ 334,100
Contingency	$ 2,047,000	$ 1,464,000	$ 3,511,000
Design, Acquisition, Bid, and Construction Services	$ 1,330,000	$ 951,000	$ 2,281,000
Total Project Cost[7]	$ 10,199,000	$ 7,294,000	$ 17,493,000
Escalated Total Project Cost[8]	$ 11,807,000	$ 8,444,000	$ 20,251,000

Legend

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- Modeled Sewer Main
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- Forcemain
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[1] When the dry weather flow equals this value the recommended improvements should considered.
[2] The ID of the upstream manhole for the pipe with lowest capacity.
[3] 80% of the full pipe capacity for the pipe with lowest capacity.
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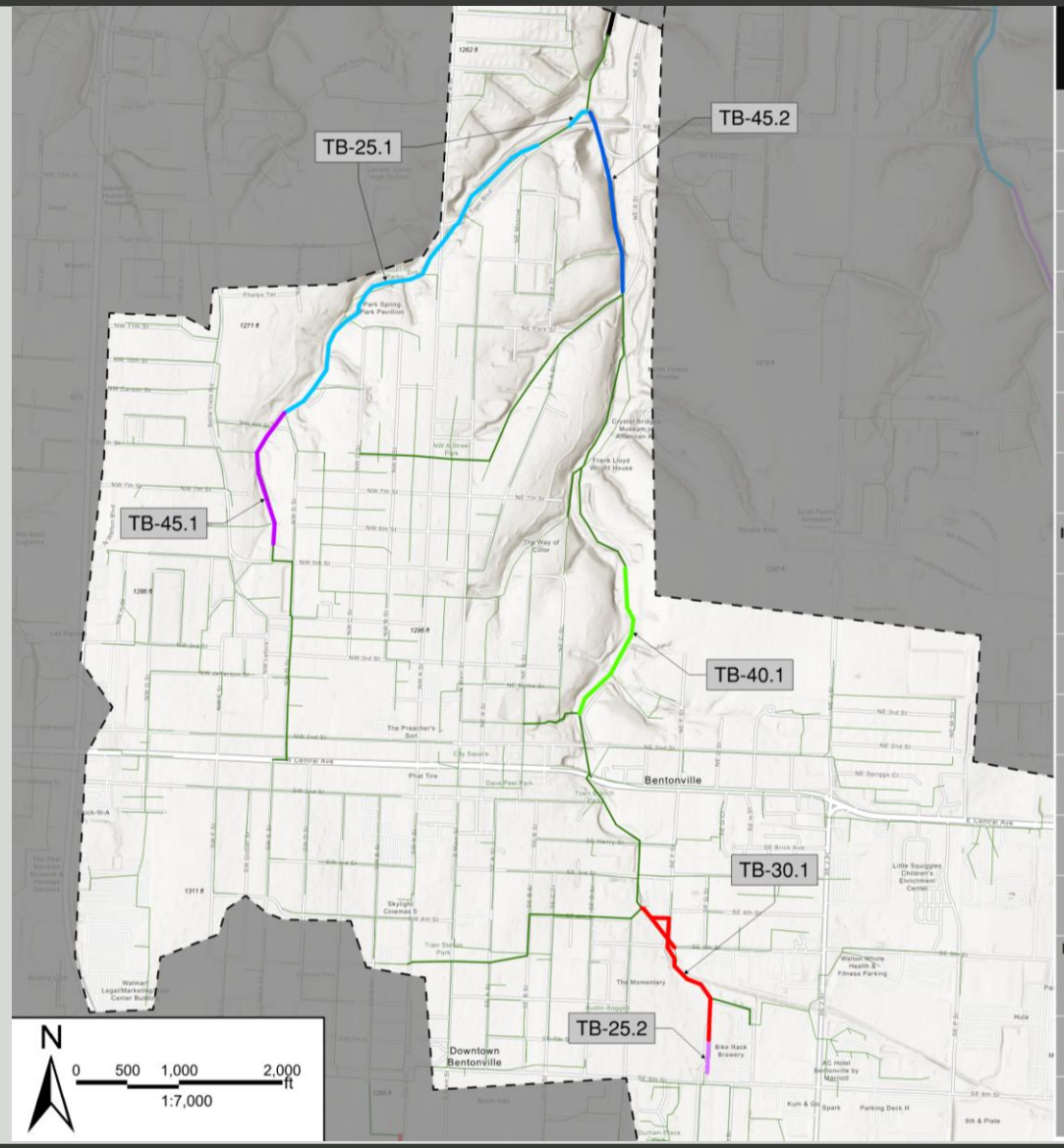
[8] Total project costs (including Design, Acquisition, Bid, and Construction Services) escalated at a rate of 5% per year to the projected project horizon.
[9] Shewmaker Lift Station Improvements are needed but are not included with this report. Improvements to LS are being analyzed as part of a separate study.

Shewmaker Improvements



Project ID	TB-25.1	TB-25.2	TB-30.1	TB-40.1	TB-45.1	TB-45.2	Basin Total
Projected Horizon	2025	2025	2030	2040	2045	2045	
Total Length (Feet)	4,019	317	2,043	1,595	1,378	1,780	
Existing Diameter (Inch)	12	12	12/15	18	12	24	
Proposed Diameter (Inch)	18	18	18	24	18	30	
Peak Flow Trigger (MGD)[1]	0.25	0.12	0.22	0.15	0.34	1.39	
Limiting Upstream Manhole ID[2]	319-3414	404-210	404-226	362-442	361-379	320-3374	
80% of Full Pipe Capacity (MGD)[3]	1.312	0.592	1.056	0.752	1.696	7.496	
Initiation/Pre-Design (Months)[4]	3	3	3	3	3	3	
Design (Months)[5]	8	5	5	5	5	5	
Bid/ Construction (Months)[6]	10	6	7	6	6	6	
Total Duration (Months)	21	14	15	14	14	14	
Construction Subtotal	$ 4,758,000	$ 547,000	$ 2,982,000	$ 1,730,000	$ 1,638,000	$ 2,698,000	$ 14,353,000
Easement	$ 100,475	$ 7,925	$ 51,075	$ 39,875	$ 34,450	$ 44,500	$ 278,300
Contingency	$ 1,098,000	$ 126,000	$ 688,000	$ 399,000	$ 378,000	$ 623,000	$ 3,312,000
Design, Acquisition, Bid, and Construction Services	$ 714,000	$ 82,000	$ 447,000	$ 260,000	$ 246,000	$ 405,000	$ 2,154,000
Total Project Cost[7]	$ 5,472,000	$ 629,000	$ 3,429,000	$ 1,990,000	$ 1,884,000	$ 3,103,000	$ 16,507,000
Escalated Total Project Cost[8]	$ 6,335,000	$ 729,000	$ 4,377,000	$ 4,138,000	$ 4,999,000	$ 8,234,000	$ 28,812,000

Legend

- Sewer Basin Boundary
- Lift Station
- Modeled Sewer Main
- Not Modeled Sewer Main
- Forcemain
- Projects are color coded by Project ID

[1] When the dry weather flow equals this value the recommended improvements should considered.
[2] The ID of the upstream manhole for the pipe with lowest capacity.
[3] 80% of the full pipe capacity for the pipe with lowest capacity.
[4] Assumed at 3 Months
[5] Calculated at 1 Month per 800 feet of Improvement (or a Minimum of 5 Months)
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[7] Total project costs (including Design, Acquisition, Bid, and Construction Services) in 2025 dollars.
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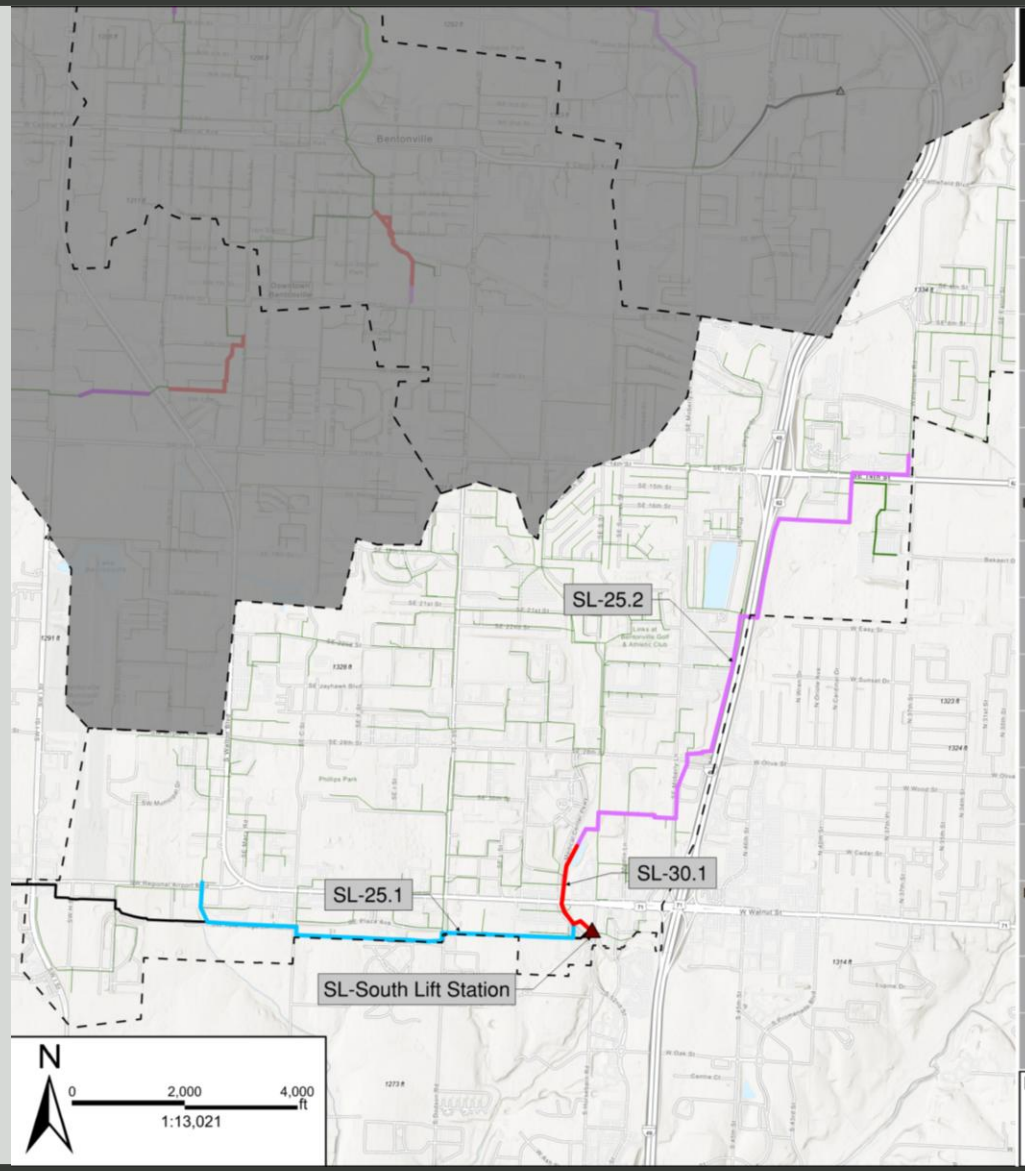
Town Branch Improvements



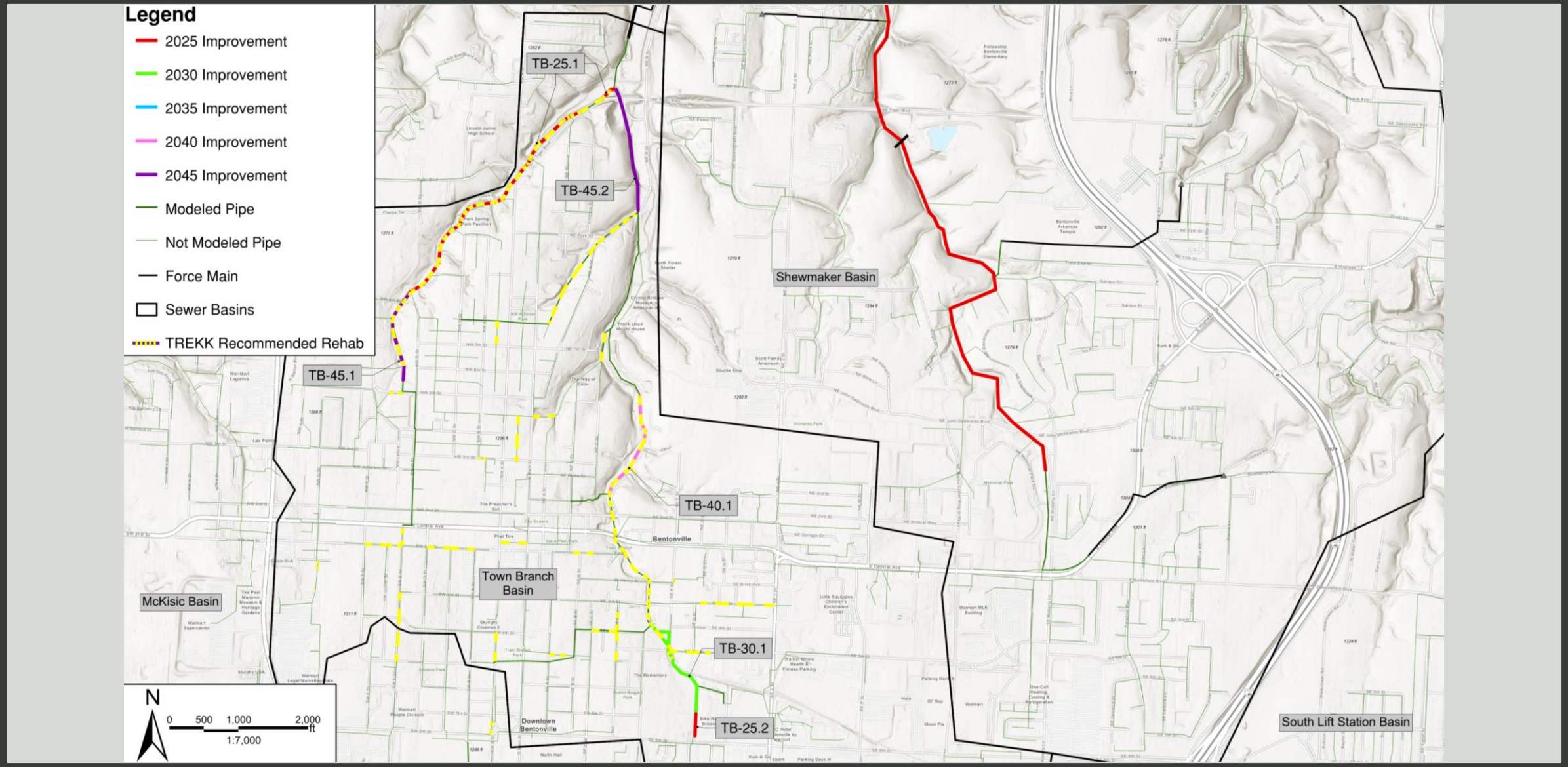
Project ID	SL-25.1	SL-25.2	SL-South Lift Station Option 1[9]	SL-South Lift Station Option 2, Part 1[10]	SL-30.1	SL-South Lift Station Option 2, Part 2[11]	Basin Total[12]
Projected Horizon	2025	2025	2025	2025	2030	2035	
Total Length (Feet)	7,633	11,916	18,300	-	1,872	-	
Existing Diameter (Inch)	12	8/12/18	-	-	18	-	
Proposed Diameter (Inch)	18/24	18/24	24	-	24/30	-	
Peak Flow Trigger (MGD)[1]	0.11	0.06	-	-	0.56	-	
Limiting Upstream Manhole ID[2]	486-1188	405-5310	-	-	486-5074	-	
80% of Full Pipe Capacity (MGD)[3]	0.528	0.304	-	-	2.248	-	
Initiation/Pre-Design (Months)[4]	3	3	3	3	3	3	
Design (Months)[5]	12	17	15	12	5	8	
Bid/ Construction (Months)[6]	16	23	18	15	7	12	
Total Duration (Months)	31	43	36	30	15	23	
Construction Subtotal	$ 12,206,000	$ 15,157,000	$ 40,949,000	$ 25,542,000	$ 3,068,000	$ 4,778,000	$ 60,751,000
Easement	$ 190,825	$ 297,900	$ 7,101,000	$ 8,712,000	$ 46,800	-	$ 9,247,525
Contingency	$ 2,817,000	$ 3,498,000	$ 9,450,000	$ 5,894,000	$ 708,000	$ 1,103,000	$ 14,020,000
Design, Acquisition, Bid, and Construction Services	$ 1,831,000	$ 2,274,000	$ 7,371,000	$ 4,598,000	$ 460,000	$ 860,000	$ 10,023,000
Total Project Cost[7]	$ 14,037,000	$ 17,431,000	$ 48,320,000	$ 30,140,000	$ 3,528,000	$ 5,638,000	$ 70,774,000
Escalated Total Project Cost[8]	$ 16,250,000	$ 20,179,000	$ 55,937,000	$ 34,891,000	$ 4,503,000	$ 9,184,000	$ 85,007,000

[1] *When the dry weather flow equals this value the recommended improvements should considered.*
[2] *The ID of the upstream manhole for the pipe with lowest capacity.*
[3] *80% of the full pipe capacity for the pipe with lowest capacity.*
[4] *Assumed at 3 Months*
[5] *Calculated at 1 Month per 800 feet of Improvement (or a Minimum of 5 Months)*
[6] *Calculated at 1 Month per 600 feet of Improvement (or a Minimum of 6 Months)*
[7] *Total project costs (including Design, Acquisition, Bid, and Construction Services) in 2025 dollars.*
[8] *Total project costs (including Design, Acquisition, Bid, and Construction Services) escalated at a rate of 5% per year to the projected project horizon.*
[9] *Not included in cost totals. Improvements include a new lift station and 24" forcemain.*
[10] *Improvements include a 1 MG Flow Equalization Tank.*
[11] *Improvements include upsizing three lift station pumps to 55hp.*
[12] *Includes the SL-South Lift Station Option 2, Part 1 & Part 2 project costs.*

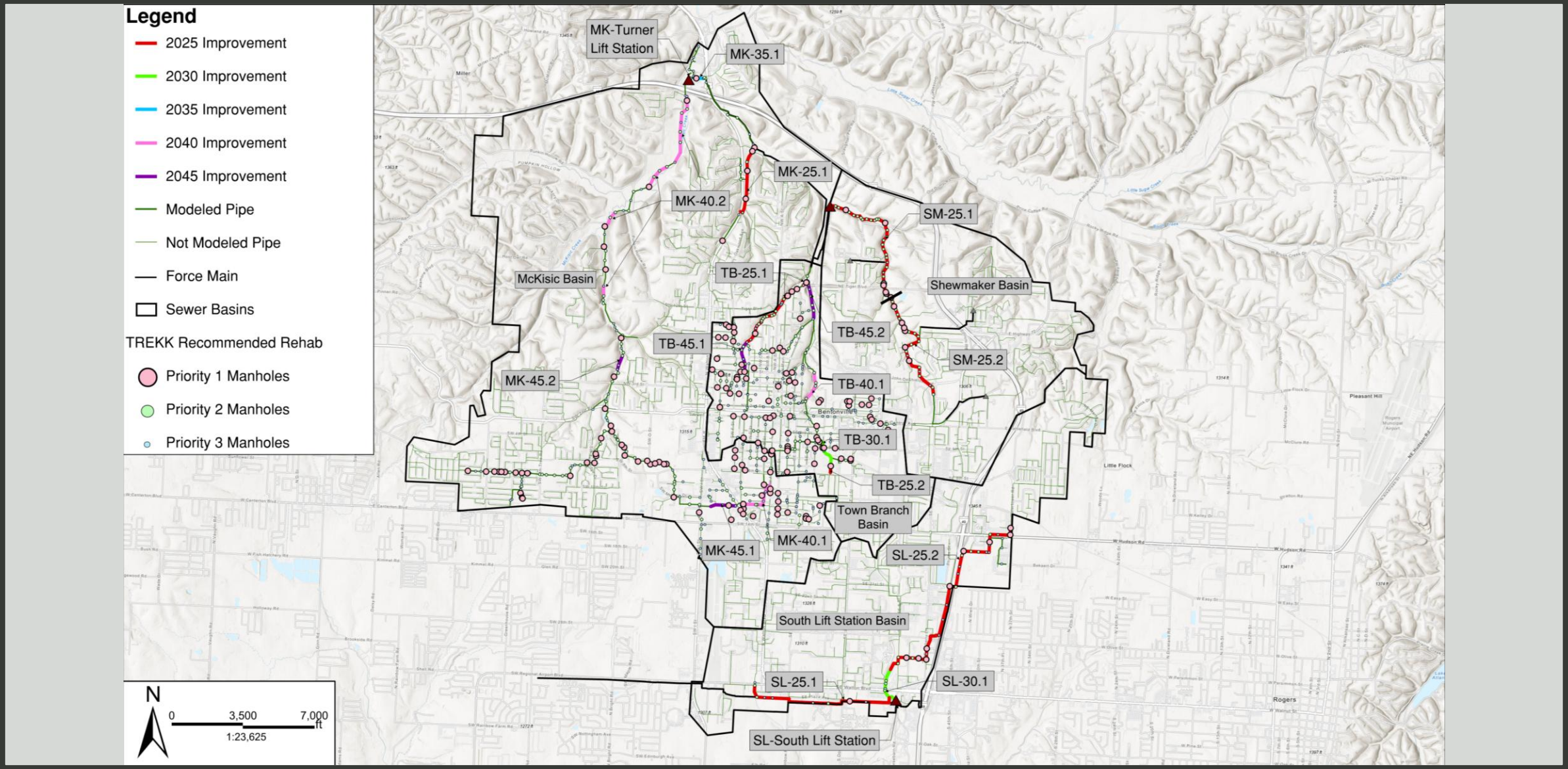
Legend

- Sewer Basin Boundary
- Lift Station
- Modeled Sewer Main
- Not Modeled Sewer Main
- Forcemain
- Projects are color coded by Project ID

South Lift Station Improvements



Capital Improvement/Rehab Overlap



TREKK Manhole Rehab Map

Capital Improvement/Rehabilitation Overlap

Rehab Recommendations Categories:

- **Priority Level 1** – *Rehabilitate Immediately*
- **Priority Level 2** – *Needs Rehabilitation but no immediate structural concerns – clean, root cut and/or repair and monitor*
- **Priority Level 3** – *Needs periodic repair and monitoring, continue to gauge deterioration*

Capacity Improvements Projected in 2025

- Priority Level 1 and 2 Rehab Recommendations Excluded
  - 1,800 LF of Sewer Pipe Rehab Exclusions
  - 88 Manhole Rehab Exclusions

Capacity Improvements Projected in 2030

- Priority Level 2 Rehab Recommendations Excluded
  - 110 LF of Sewer Pipe Rehab Exclusions
  - 5 Manhole Rehab Exclusions

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Improvement	Estimated Cost		
	No Exclusions	With Capacity Exclusions	No Overlap
Private-Sector I/I Abatement Program[1]	$232,000	$232,000	$232,000
Part 1 MH Rehabilitation (Priority 1 and 2)[2]	$1,670,000	$1,208,000	$1,044,000
Part 2 MH Rehabilitation (Priority 1 and 2)[2]	$674,000	$674,000	$674,000
Pipeline Rehabilitation (Priority 1 and 2)[1]	$1,544,000	$1,365,000	$1,105,000
Total	**$4,120,000**	**$3,479,000**	**$3,055,000**

Estimated Horizon	Total LF	Estimated Cost[3]
2025	40,400	$103,034,000[4]
2030	3,900	$8,880,000
2035	460	$11,058,000
2040	10,000	$29,182,000
2045	5,100	$33,699,000
Total	**59,200**	**$181,802,000**

[1] *Cost includes a 20% contingency that includes engineering, administration fees, inspections and construction overages.*

[2] *Cost includes a 30% contingency that includes engineering, administration fees, inspections and construction overages.*

[3] *Total project costs escalated at a rate of 5% per year to the projected project horizon.*

[4] *Total project costs escalated at a rate of 5% per year to 2028.*

Recommendations Summary


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