

DRAFT TECHNICAL MEMORANDUM



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To: Tim Beasley
Senior Engineer
Raleigh Water
One Exchange Plaza
Raleigh, NC 27601

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Crosland Southeast
801 East Boulevard
Charlotte, NC 28203

Date: December 28, 2022

From: Greg Fields, PE
Brian Oschwald, PE

Proj. No.: CSE2201

Subject: Wallbrook Development
Gravity Sewer Capacity Evaluation

Section 1 - Background

Crosland Southeast and Wallbrook Landco LLC are planning a land development project in Rolesville, North Carolina. The development will include retail, commercial, and multi-family units with a total area of approximately 52 acres near the intersection of Main Street and Burlington Mills Road. The wastewater generated from the Wallbrook Development will be conveyed by new and existing 8- through 18-inch gravity sewer through the development and along Virginia Water Drive, Trillick Court, and cross country toward US Highway 401.

The City of Raleigh has concerns regarding the downstream sewer capacity due to the additional wastewater being generated. The City requested a gravity sewer capacity evaluation be performed for the gravity sewer from the proposed development, starting on S. Main Street and continuing southeast for approximately 5,100 linear feet (LF) to a point before the gravity crosses under Highway 401 Bypass.

Wallbrook Landco LLC has contracted with HIGHFILL to prepare the gravity sewer capacity evaluation.

1.1 Data Acquisition and Historical Documents

The following data was provided for the purposes of this evaluation:

- Villages of Rolesville Plan and Profile Sanitary Sewer Outfalls As Built Survey – prepared by Priest, Craven & Associates, Inc. – dated July 26, 2002.
- Rim and Invert Survey of the manholes within the evaluation area – performed by CMP Land Surveyors – dated February 18, 2022, June 6, 2022, and September 30, 2022.
- GIS Data – provided by the City of Raleigh – received on August 31, 2022.
- Existing Sewer Basin Flowrate Tabulation – provided by McAdams – dated June 8, 2021 and sent to HIGHFILL on February 8, 2022.
- Erosion Control / Mass Grading / Sanitary Sewer Relocation Plans for Wallbrook – provided by Ark Consulting – dated July 22, 2022.

- Site Data and Estimated Daily Wastewater Flowrates – provided by Ark Consulting – dated April 20, 2022.

1.2 Initial Gravity Sewer Improvements

The mass grading and erosion control plans for the first lot to be developed conflict with the four most upstream segments of existing gravity sewer, just south of S. Main Street. To continue to provide sewer service during initial construction these segments of sewer will be re-routed through the development and tie into existing gravity sewer where Virginia Water Drive dead ends into the development. As the development progresses, the gravity sewer will be re-routed through the proposed residential development and cross an Unnamed Tributary to Wall Creek to tie into the existing gravity sewer between SMH169376 and SMH169377. As evaluated and described within, further sewer improvements are proposed downstream of this initial tie in.

Section 2 - Wastewater Flow Development

2.1 Existing Wastewater Flows

The existing wastewater flows for the sewer basin were determined using metered flow data provided by the City of Raleigh to McAdams. The data is included in Appendix A. For sub-basins that were not metered, the existing flows were calculated using the unit flow rate for single family residential properties as outlined in the 2014 City of Raleigh Handbook (250 GPD/unit). These flows were peaked using a peaking factor of 2.5.

The existing wastewater flows are summarized in Table 2.1. A detailed summary of the existing wastewater flows are included as attachments and in Appendix B.

Table 2.1 – Summary of Existing Wastewater Flows

Tributary to Node:	Description	Existing Flow (GPD)
A	• Tributary from west of S. Main Street	456,480
	• Area 1	21,024
	Subtotal	477,504
B	• From Node A	477,504
C	• From Node B	477,504
D	• From Node C	477,504
	• Area 2	100,656
	• Flow tributary to Area 2	679,680
	Subtotal	1,257,840
E	• From Node D	1,257,840
	• Area 3	49,104
	Subtotal	1,306,944

Tributary to Node:	Description	Existing Flow (GPD)
F	• From Node E	1,306,944
	• Area 4	8,928
	Subtotal	1,315,872
G	• From Node F	1,315,872
	• Area 5	23,904
	Subtotal	1,339,776
H	• From Node G	1,339,776
	• Area 6	106,375
	• Area 7	25,000
	Subtotal	1,474,151
	Total	1,474,151

2.2 Proposed Wastewater Flows

The proposed wastewater flows were provided by the developer, can be viewed in detail in Appendix A, and are summarized in Table 2.2. A detailed summary of the proposed wastewater flows are included as attachments and in Appendix B.

Table 2.2 – Summary of Estimated Proposed Flows Tributary to Node B

Description	Acres or Units	Flowrate (GPD)	Peak Flowrate (GPD)
Wallbrook	Lot 1	10.9	19,620
	Lot 5	5.1	9,180
	Lot 6	120 (units)	30,000
	Lot 7	2.7	4,860
	Lot 8	5.4	9,720
Paris Tract	Lot 9	2.0	3,600
	Lot 10	3.5	6,300
	Lot 11	1.6	2,880
MBW Tract	Lot 12	5.2	9,360

Description		Acres or Units	Flowrate (GPD)	Peak Flowrate (GPD)
MBW Tract	Lot 13	1.5	2,700	6,750
Total			98,220	245,550

Section 3 - Sewer Capacity Evaluation

For this evaluation, the sewer capacity was determined by using the Manning’s equation for full pipe flow, which incorporates the pipe diameter, the existing pipe slope, and a Manning’s “n-value” of 0.013. A rim and invert survey was performed throughout the study area to determine pipe slopes. Per the City of Raleigh Development Handbook, the calculated peak flow should not exceed 50% capacity of the pipe at full pipe flow.

The sewer capacity evaluation included three scenarios:

- 1) Existing Flows through Existing Pipes
- 2) Existing and Proposed Flows through Existing Pipes
- 3) Existing and Proposed Flows through Proposed Pipes

A summary of the worst case pipe capacity from Node to Node is included in Table 3.1. A detailed capacity of the three evaluations is shown in Figures 1-3 and in Appendix B.

Table 3.1 – Summary of Sewer Capacity Evaluation

Tributary to Node:	Upstream SSMH ID	Downstream SSMH ID	Ex. Flow through Ex. Pipe	Ex. & Prop. Flows through Ex. Pipe	Ex. & Prop. Flows through Upsized Pipe
B to C	169377	152615	93%	141%	48%
C to D	111997	187382	119%	145%	49%
D to E	187382	142684	107%	130%	44%
E to F	154111	152073	106%	128%	43%
G to End	122295	121589	90%	108%	37%

Section 4 - Summary and Recommendation

4.1 Summary

The capacity evaluation of the existing gravity sewer illustrates that it does not have available capacity to convey the flow. As determined by the capacity evaluations, the following sewer upgrades are proposed to

convey the flows and remain below 50% pipe capacity. The specific locations of these improvements are shown on Figure 3, along with the resulting capacities.

Table 4.1 – Summary of Sewer Improvements

Gravity Sewer Location	Sewer Length (feet)
Proposed 12-inch Gravity Sewer through Wallbrook	2,350
Existing Gravity Sewer Upsize from 8- to 12-inch (Virginia Water Drive)	900
Existing Gravity Sewer Upsize from 12- to 18-inch (south of Trillick Court)	1,000
Total	4,250

4.2 Recommendation

The developer plans to install the proposed 12-inch gravity sewer through the Wallbrook Development and upsize existing 8-inch to 12-inch sewer along Virginia Water Drive. The gravity sewer segments south of Trillick Court that are over capacity are recommended to be upsized from 12-inch to 18-inch. Finally, the capacity of four existing sewer segments south of Trillick Court are between 50-65% with the existing and proposed flows. Those sewer segments may be considered by the City for a fee in-lieu payment rather than upsizing.

Attachments:

- Figure 1 – Existing Basin
- Figure 2 – Capacity of Existing Sewer Lines
- Figure 3 – Capacity of Upsized Downstream Gravity Sewer

Appendix A – Site Data & Estimated Daily Flowrates and 2021-06-08 Sewage Generation Exhibit by McAdams and City of Raleigh

Appendix B – Wastewater Flowrate Tabulation and Capacity Evaluation

Wallbrook Offsite Utility Improvements

Crosland Southeast Project No. CSE2201

Figure 1 Existing Basin

Legend

- Ex. Sewer Manhole
- Proposed Manhole
- Ex. Gravity Sewer
- Proposed Gravity Sewer
- Ex. Force Main
- ▭ Parcels

Subject Gravity Sewer Diameter

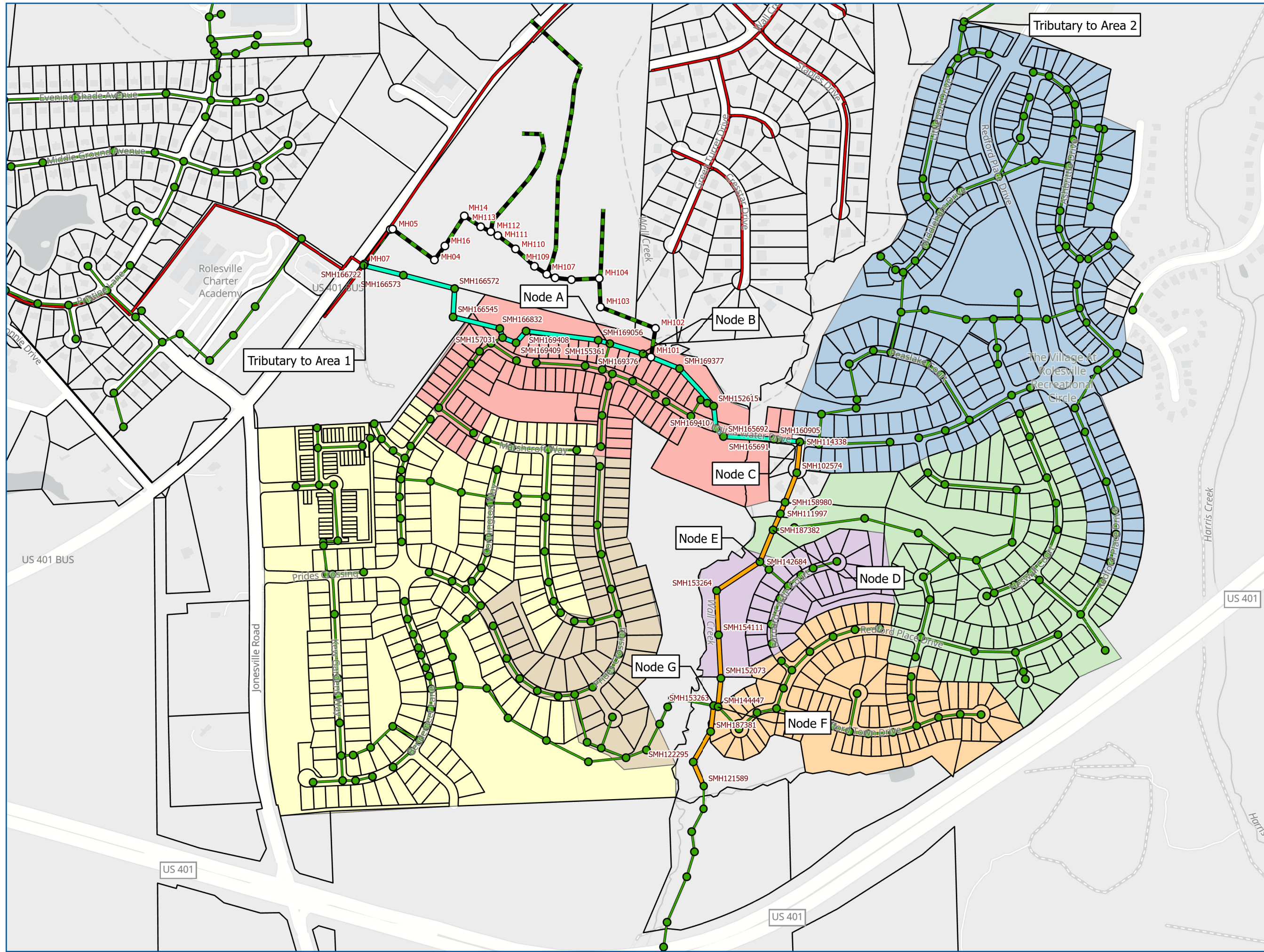
- 8-inch
- 12-inch

Sub-Basins

- Area 1
- Area 2
- Area 3
- Area 4
- Area 5
- Area 6
- Area 7

Raleigh GIS Manhole ID

SMH123456

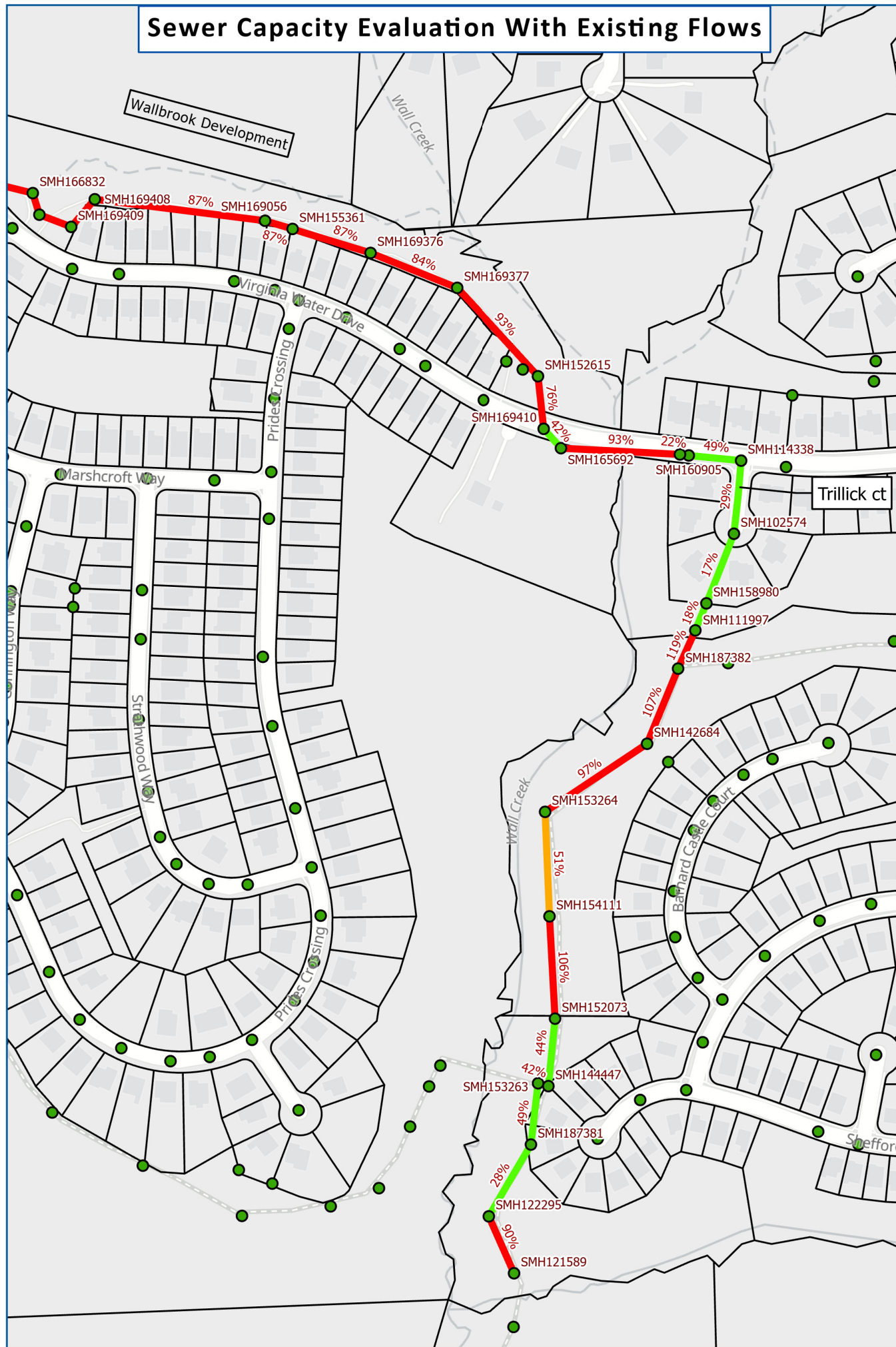


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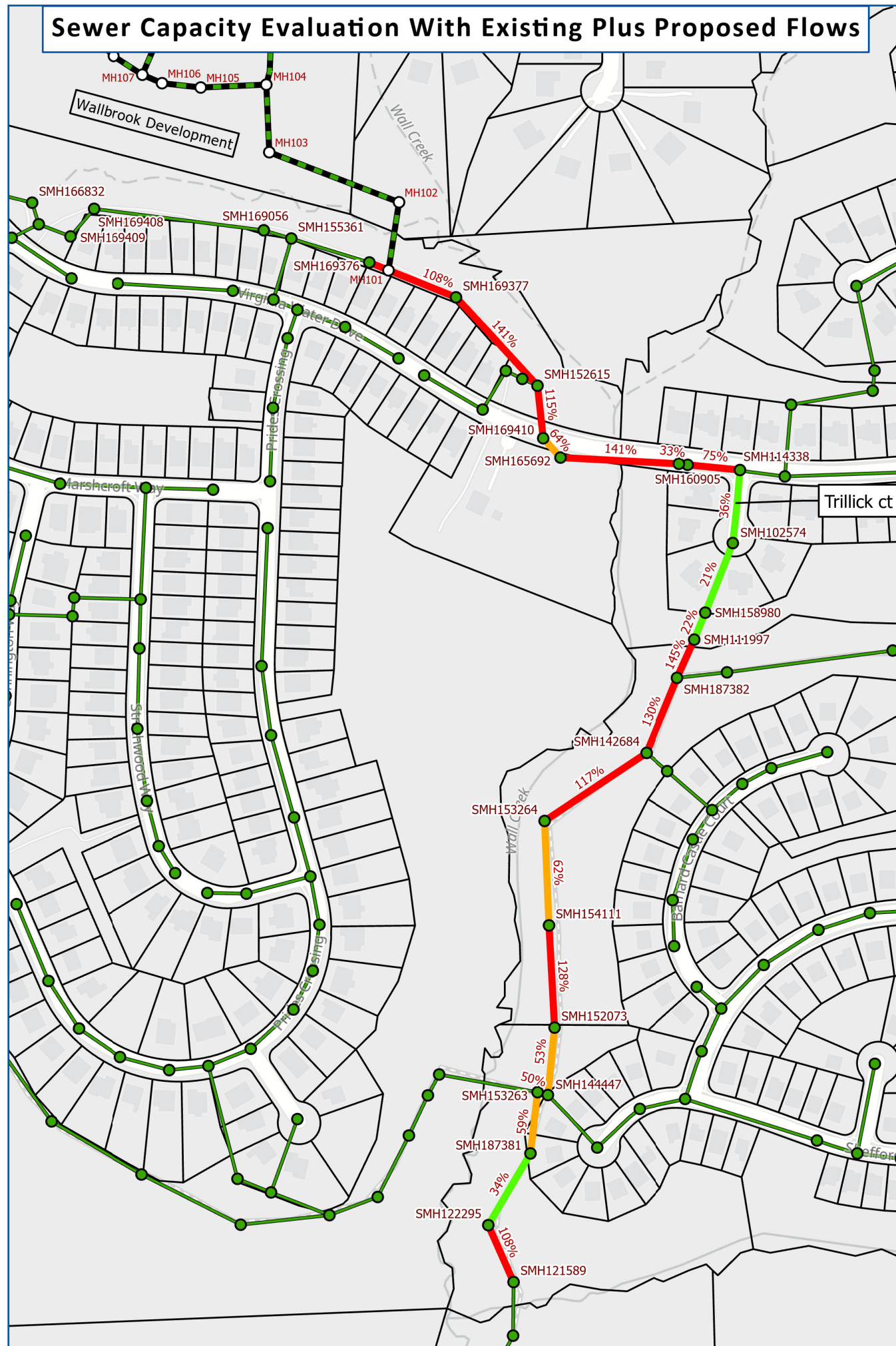


0 200 400 Feet

Sewer Capacity Evaluation With Existing Flows



Sewer Capacity Evaluation With Existing Plus Proposed Flows



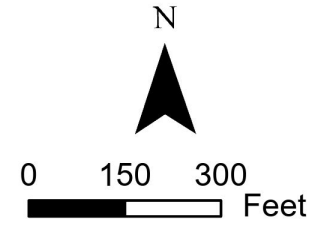
Wallbrook Offsite Utility Improvements

Crosland Southeast Project No. CSE2201

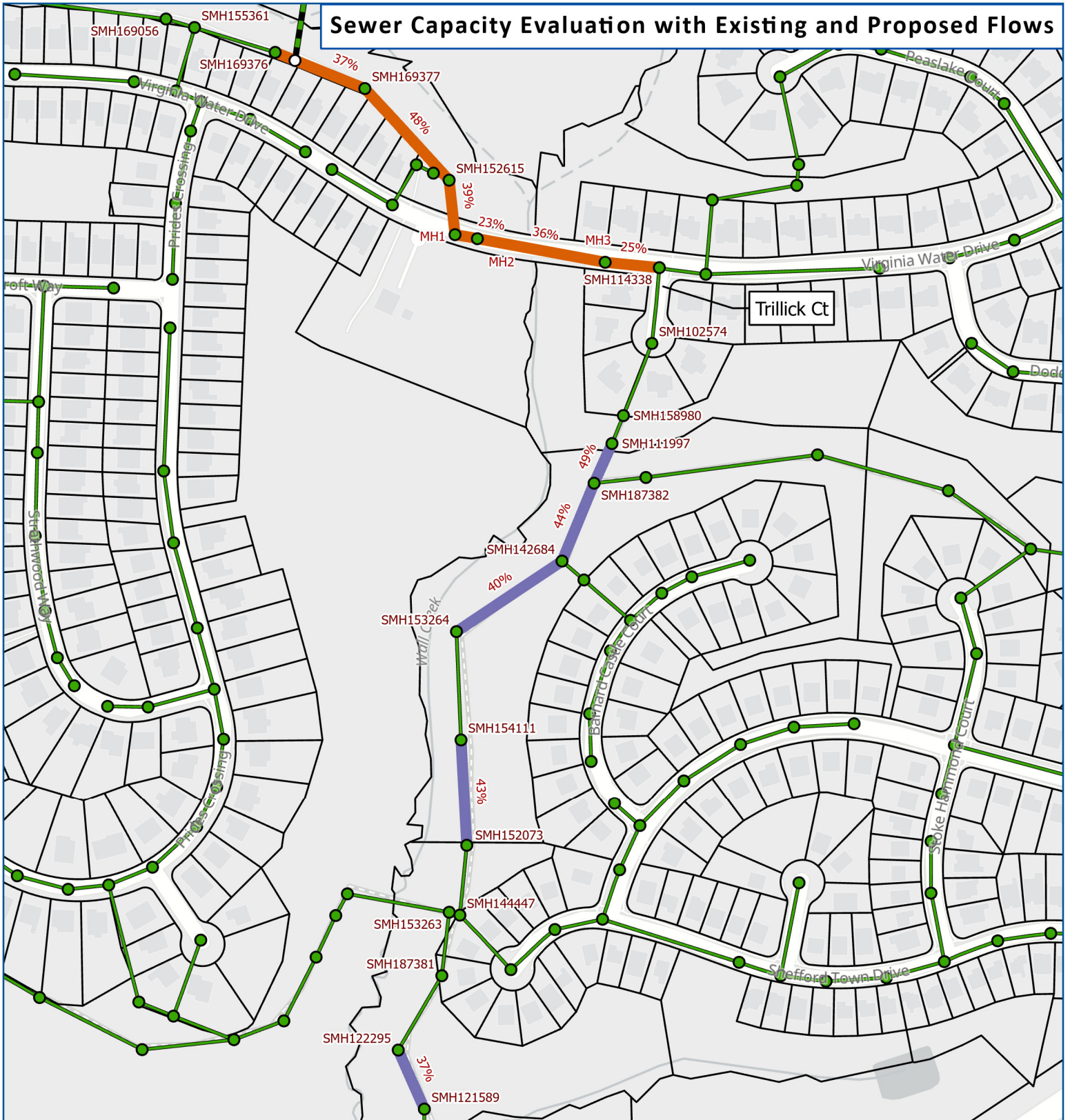
Figure 2
Capacity of Existing Sewer Lines

- Legend**
- Proposed Manholes
 - Proposed Gravity Sewer
 - Ex. Sewer Manhole
 - ▭ Parcels
- Sewer Capacity**
- Light Green: < 50%
 - Yellow: 50-65%
 - Red: > 65%

Raleigh GIS Manhole ID
SMH123456



Sewer Capacity Evaluation with Existing and Proposed Flows



**Wallbrook Offsite
Utility Improvements**

**Crosland Southeast
Project No. CSE2201**

**Figure 3
Capacity of Upsized
Downstream Gravity Sewer**

Legend

- Proposed Manholes
 - Ex. Sewer Manhole (117)
 - Ex. Gravity Sewer
 - Proposed Gravity Sewer
 - Parcels
 - Upsized Sewer
 - 8 to 12-inch
 - 12 to 18-inch
- Raleigh GIS Manhole ID
SMH123456



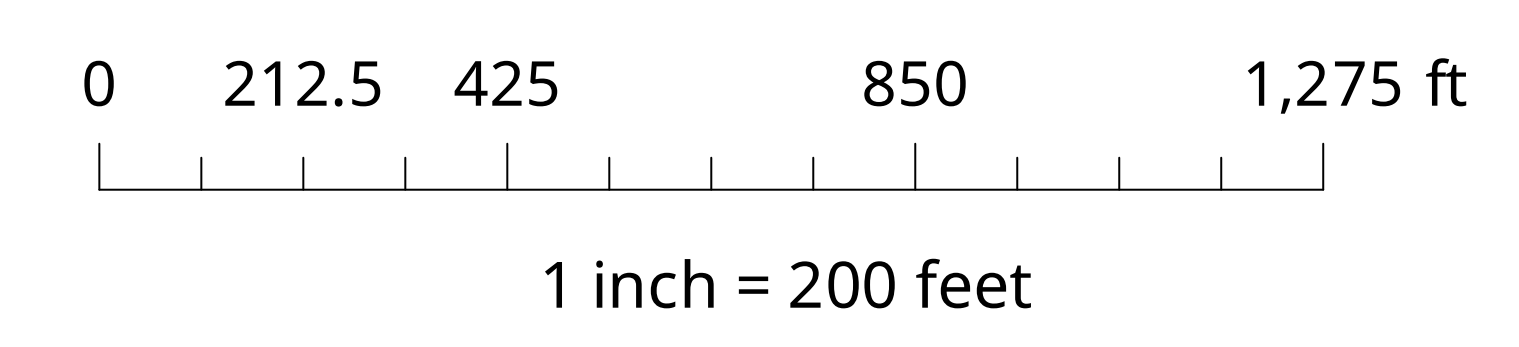
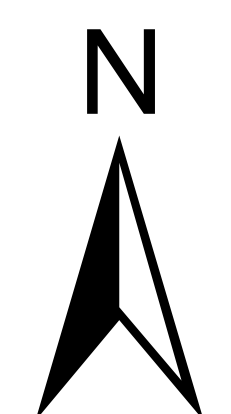
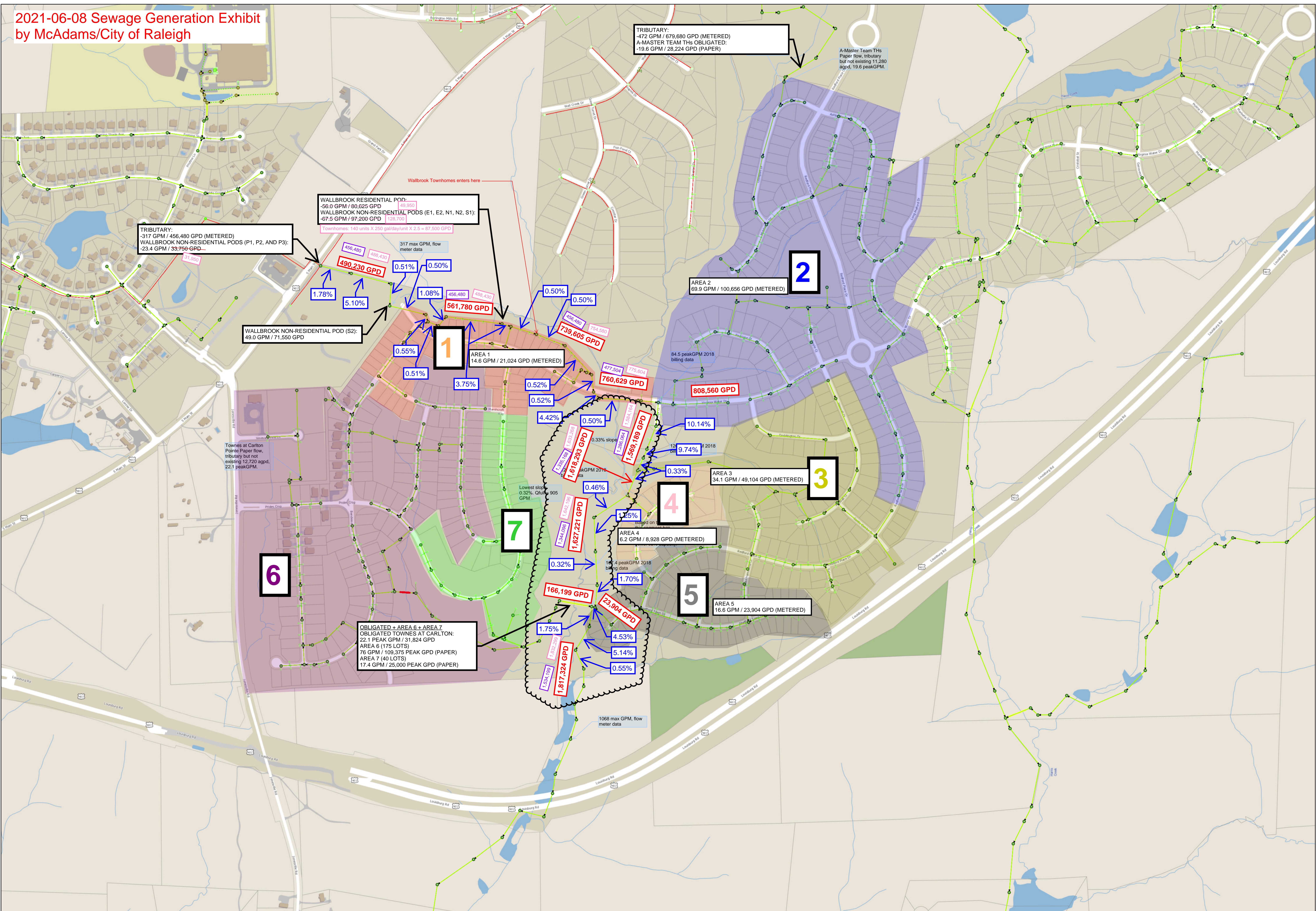
N

0 150 300 Feet

Appendix A

Site Data & Estimated Daily Flowrates and 2021-06-08 Sewage Generation Exhibit
by McAdams and City of Raleigh

**2021-06-08 Sewage Generation Exhibit
by McAdams/City of Raleigh**



Disclaimer
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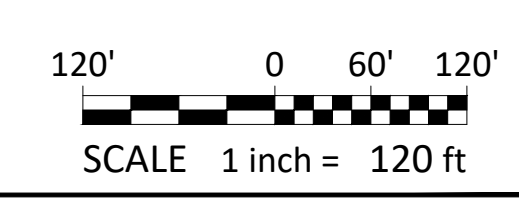
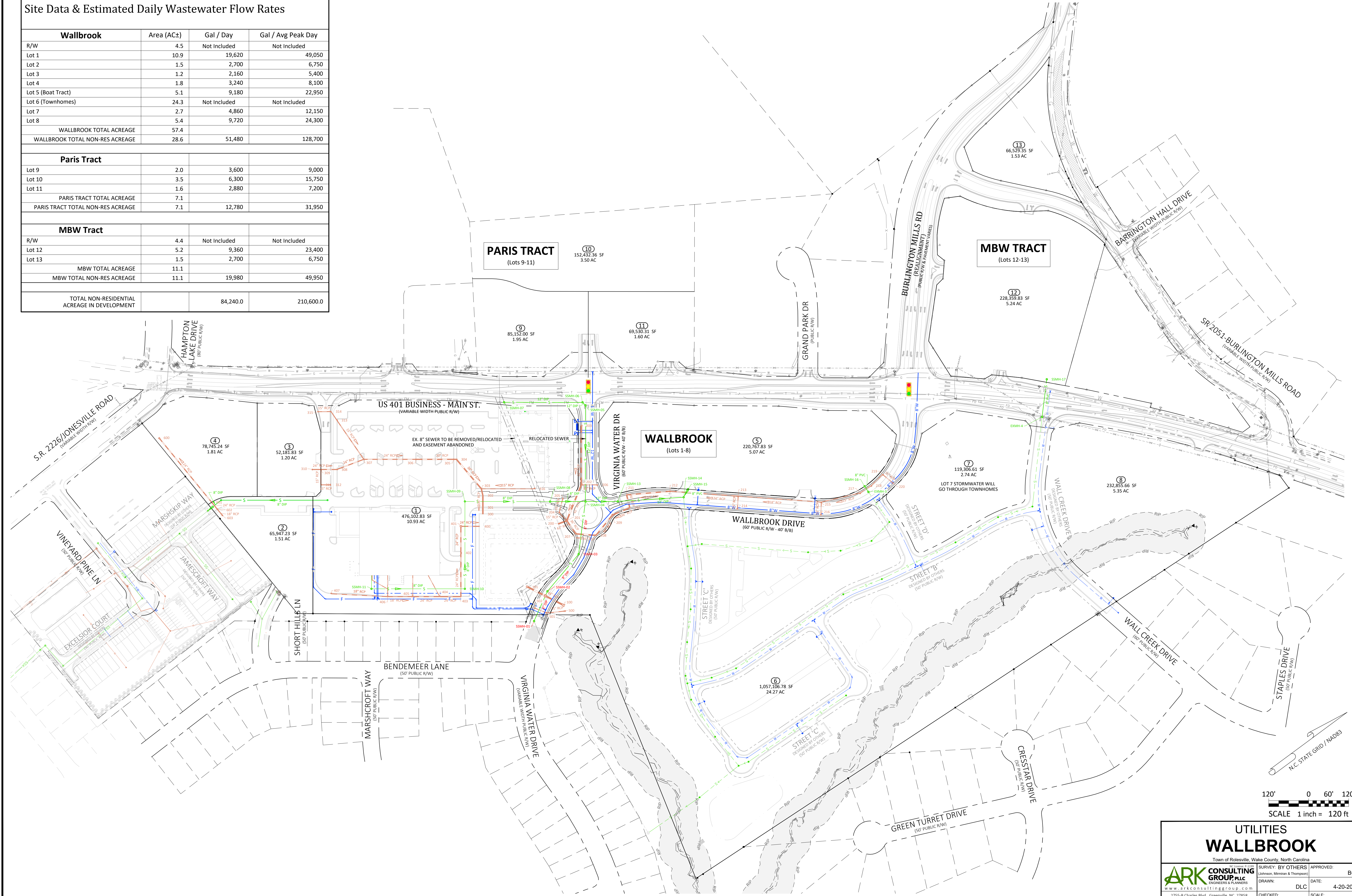
Site Data & Estimated Daily Wastewater Flow Rates

Wallbrook	Area (AC±)	Gal / Day	Gal / Avg Peak Day
R/W	4.5	Not included	Not included
Lot 1	10.9	19,620	49,050
Lot 2	1.5	2,700	6,750
Lot 3	1.2	2,160	5,400
Lot 4	1.8	3,240	8,100
Lot 5 (Boat Tract)	5.1	9,180	22,950
Lot 6 (Townhomes)	24.3	Not included	Not included
Lot 7	2.7	4,860	12,150
Lot 8	5.4	9,720	24,300
WALLBROOK TOTAL ACREAGE	57.4		
WALLBROOK TOTAL NON-RES ACREAGE	28.6	51,480	128,700

Paris Tract	Area (AC±)	Gal / Day	Gal / Avg Peak Day
Lot 9	2.0	3,600	9,000
Lot 10	3.5	6,300	15,750
Lot 11	1.6	2,880	7,200
PARIS TRACT TOTAL ACREAGE	7.1		
PARIS TRACT TOTAL NON-RES ACREAGE	7.1	12,780	31,950

MBW Tract	Area (AC±)	Gal / Day	Gal / Avg Peak Day
R/W	4.4	Not included	Not included
Lot 12	5.2	9,360	23,400
Lot 13	1.5	2,700	6,750
MBW TOTAL ACREAGE	11.1		
MBW TOTAL NON-RES ACREAGE	11.1	19,980	49,950

TOTAL NON-RESIDENTIAL ACREAGE IN DEVELOPMENT	Area (AC±)	Gal / Day	Gal / Avg Peak Day
	84,240.0		210,600.0



UTILITIES
WALLBROOK

Town of Rolesville, Wake County, North Carolina

<p>ARK CONSULTING GROUP, P.L.C. ENGINEERS & PLANNERS www.arkconsultinggroup.com 2755-B Charles Blvd., Greenville, NC 27858 (252) 558-8888</p>	SURVEY BY OTHERS (Johnson, Merriman & Thompson)	APPROVED:	BCF	
	DRAWN:	DATE:	4-20-2022	
	CHECKED:	SCALE:	1" = 120'	

11-20-2022 11:20 AM
 PROJECT: WALLBROOK - SEWER LINES, STORMWATER, AND UTILITIES
 DRAWING: WALLBROOK - UTILITIES
 SCALE: 1" = 120'
 DATE: 4-20-2022
 DRAWN BY: DLO
 CHECKED BY:

Appendix B

Wastewater Flowrate Tabulation and Capacity Evaluation
Opinion of Probable Construction Cost

Appendix A

Wallbrook Downstream Gravity Sewer Evaluation

Existing Flow thru Existing Pipes

Sub-Basin ID	Metered Flow	Peaked Flow	Sub-Basin Peak Flow (GPD)	Cumulative Peak Flow (GPD)	Line Size (inches)	Length (ft.)	Upstream SSMH	Downstream SSMH	Pipe Slope from Survey	100% Capacity (GPD)	Percentage of 100% Capacity at Existing Peak Flow
Tributary	X		456,480								
Area 1	X		21,024								
Node A				477,504	8	219	169376	169377	0.73	667,302	72%
Node B				477,504	8	282	169377	152615	0.43	512,147	93%
				477,504	8	124	152615	169410	0.65	629,677	76%
				477,504	8	61	169410	165692	2.10	1,131,802	42%
				477,504	8	279	165692	165691	0.43	512,147	93%
				477,504	8	21	165691	160905	8.01	2,210,432	22%
				477,504	8	123	160905	114338	1.53	966,065	49%
Tributary to Area 2	X		679,680								
Area 2	X		100,656								
Node C				1,257,840	12	172	160905	102574	3.46	4,283,271	29%
				1,257,840	12	176	102574	158980	10.11	7,321,720	17%
				1,257,840	12	68	158980	111997	9.43	7,071,204	18%
				1,257,840	12	98	111997	187382	0.21	1,055,230	119%
Area 3	X		49,104								
Node D				1,306,944	12	191	187382	142684	0.28	1,218,475	107%
Area 4	X		8,928								
Node E				1,315,872	12	287	142684	153264	0.35	1,362,296	97%
				1,315,872	12	245	153264	154111	1.25	2,574,498	51%
				1,315,872	12	240	154111	152073	0.29	1,240,042	106%
				1,315,872	12	158	152073	144447	1.71	3,011,172	44%
Area 5	X		23,904								
Node F				1,339,776	12	26	144447	153263	1.96	3,223,781	42%
Area 6 (175 lots X 250 gal/lot/day X 2.5 PF)		X	109,375								
Area 7 (40 lots X 250 gal/lot/day X 2.5 PF)		X	25,000								
Node G				1,474,151	12	144	153263	187381	1.70	3,002,355	49%
				1,474,151	12	195	187381	122295	5.07	5,184,913	28%
				1,474,151	12	146	122295	121589	0.51	1,644,457	90%

Over 50% Capacity

Appendix A
 Wallbrook Downstream Gravity Sewer Evaluation
 Existing and Proposed Flow thru Existing Pipes

Sub-Basin ID	Metered Flow	Peaked Flow	Sub-Basin Flow (GPD)	Cumulative Flow (GPD)	Line Size (inches)	Pipe Length	Upstream SSMH	Downstream SSMH	Pipe Slope from Survey	100% Capacity (GPD)	Percentage of 100% Capacity at Existing + Proposed Flow
Tributary	X		456,480								
Paris Tract		X	31,950								
Wallbrook Lot 1		X	49,050								
Wallbrook Lot 5		X	22,950								
MBW Tract		X	30,150								
Wallbrook Lot 6 (120 THs X 250 gal/day/unit X 2.5 PF)		X	75,000								
Wallbrook Lot 7		X	12,150								
Wallbrook Lot 8		X	24,300								
Area 1	X		21,024								
Node A				723,054	8	219	169376	169377	0.73	667,302	108%
Node B				723,054	8	282	169377	152615	0.43	512,147	141%
				723,054	8	124	152615	169410	0.65	629,677	115%
				723,054	8	61	169410	165692	2.10	1,131,802	64%
				723,054	8	279	165692	165691	0.43	512,147	141%
				723,054	8	21	165691	160905	8.01	2,210,432	33%
				723,054	8	123	160905	114338	1.53	966,065	75%
Tributary to Area 2	X		679,680								
Obligated to Area 2			28,224								
Area 2	X		100,656								
Node C				1,531,614	12	172	114338	102574	3.46	4,283,271	36%
				1,531,614	12	176	102574	158980	10.11	7,321,720	21%
				1,531,614	12	71	158980	111997	9.43	7,071,204	22%
				1,531,614	12	98	111997	187382	0.21	1,055,230	145%
Area 3	X		49,104								
Node D				1,580,718	12	191	187382	142684	0.28	1,218,475	130%
Area 4	X		8,928								
Node E				1,589,646	12	287	142684	153264	0.35	1,362,296	117%
				1,589,646	12	245	153264	154111	1.25	2,574,498	62%
				1,589,646	12	240	154111	152073	0.29	1,240,042	128%
				1,589,646	12	159	152073	144447	1.71	3,011,172	53%
Area 5	X		23,904								
Node F				1,613,550	12	25	144447	153263	1.96	3,223,781	50%
Obligated		X	31,824								
Area 6 (175 lots X 250 gal/lot/day X 2.5 PF)		X	109,375								
Area 7 (40 lots X 250 gal/lot/day X 2.5 PF)		X	25,000								
Node G				1,779,749	12	145	153263	187381	1.70	3,002,355	59%
				1,779,749	12	195	187381	122295	5.07	5,184,913	34%
				1,779,749	12	146	122295	121589	0.51	1,644,457	108%

Over 50% Capacity

Appendix A
 Wallbrook Downstream Gravity Sewer Evaluation
 Existing + Proposed Flow thru Proposed Pipe Upgrades

Sub-Basin ID	Metered Flow	Peaked Flow	Sub-Basin Flow (GPD)	Cumulative Flow (GPD)	Line Size (inches)	Length (ft)	Upstream SSMH	Downstream SSMH	Pipe Slope from Design Drawings/Survey	100% Capacity (GPD)	Percentage of 100% Capacity at Existing Flow	Recommended Pipe Upsize (inches)	100% Capacity with Upsize (GPD)	Percentage of 100% Capacity with Upsized Pipe
Tributary	X		456,480											
Paris Tract		X	31,950											
				488,430	12	--	MH07	MH06	2.00	3,256,511	15%			
				488,430	12	--	MH06	MH05	1.90	3,174,054	15%			
				488,430	12	--	MH05	MH04	2.40	3,567,329	14%			
Wallbrook Lot 1		X	49,050											
				537,480	12	--	MH04	MH16	0.60	1,783,664	30%			
				537,480	12	--	MH16	MH14	0.60	1,783,664	30%			
				537,480	12	--	MH14	MH113	0.60	1,783,664	30%			
Wallbrook Lot 5		X	22,950											
				560,430	12	--	MH113	MH112	0.57	1,738,501	32%			
				560,430	12	--	MH112	MH111	0.67	1,884,842	30%			
				560,430	12	--	MH111	MH110	2.90	3,921,358	14%			
				560,430	12	--	MH110	MH109	1.90	3,174,054	18%			
				560,430	12	--	MH109	MH107	0.68	1,898,856	30%			
MBW Tract		X	30,150											
Wallbrook Lot 6 (120 THs X 250 gal/day/unit X 2.5 PF)		X	75,000											
Wallbrook Lot 7		X	12,150											
Wallbrook Lot 8		X	24,300											
				702,030	12	--	MH107	MH106	0.60	1,783,664	39%			
				702,030	12	--	MH106	MH105	0.66	1,870,723	38%			
				702,030	12	--	MH105	MH104	0.91	2,196,637	32%			
				702,030	12	--	MH104	MH103	1.16	2,480,085	28%			
				702,030	12	--	MH103	MH102	1.04	2,348,303	30%			
				702,030	12	--	MH102	MH101	0.60	1,783,664	39%			
				702,030	12	--	MH101	MH100	0.53	1,676,391	42%			
Area 1	X		21,024											
Node A				723,054	12	219	169376	169377	0.73	1,967,428	37%			
Node B				723,054	12	282	169377	152615	0.43	1,509,982	48%			
				723,054	12	124	152615	169410/MH1	0.65	1,856,497	39%			
				723,054	12	89	169410/MH1	MH2	1.80	3,089,397	23%			
				723,054	12	258	MH2	160905/MH3	0.78	2,033,690	36%			
				723,054	12	124	160905/MH3	114338	1.53	2,848,284	25%			
Tributary to Area 2	X		679,680											
Obligated to Area 2			28,224											
Area 2	X		100,656											
Node C				1,531,614	12	172	114338	102574	3.46	4,283,271	36%			
				1,531,614	12	176	102574	158980	10.11	7,321,720	21%			
				1,531,614	12	71	158980	111997	9.43	7,071,204	22%			
				1,531,614	12	98	111997	187382	0.21	1,055,230	145%	18	3,111,171	49%
Area 3	X		49,104											
Node D				1,580,718	12	191	187382	142684	0.28	1,218,475	130%	18	3,592,471	44%
Area 4	X		8,928											
Node E				1,589,646	12	287	142684	153264	0.35	1,362,296	117%	18	4,016,504	40%
				1,589,646	12	245	153264	154111	1.25	2,574,498	62%			
				1,589,646	12	240	154111	152073	0.29	1,240,042	128%	18	3,656,059	43%
				1,589,646	12	159	152073	144447	1.71	3,011,172	53%			
Area 5 (Metered)	X		23,904											
Node F				1,613,550	12	25	144447	153263	1.96	3,223,781	50%			
Obligated		X	31,824											
Area 6 (175 lots X 250 gal/lot/day X 2.5 PF)		X	109,375											
Area 7 (40 lots X 250 gal/lot/day X 2.5 PF)		X	25,000											
Node G				1,779,749	12	145	153263	187381	1.70	3,002,355	59%			
				1,779,749	12	195	187381	122295	5.07	5,184,913	34%			
				1,779,749	12	146	122295	121589	0.51	1,644,457	108%	18	4,848,409	37%

Pipes requiring upsize
 Between 50% and 65% Capacity
 Over 65% Capacity