Kimley»Horn

TECHNICAL MEMORANDUM

To: Hector Colon, P.E., City of Ocala

From: Savannah Smith, P.E., Kimley-Horn and Associates, Inc.
Alan Garri, P.E., Kimley-Horn and Associates, Inc.

Date: December 14, 2022

RE: ***NW Ocala Wastewater Modeling***
Kimley-Horn Project No: 142371041

INTRODUCTION

The City of Ocala (City) utility service area encompasses 78 square miles within central Marion County, Florida. The wastewater collection system consists of nine master lift stations, 125 lift stations, 44 private lift stations, 375 miles of gravity main, and 95 miles of force main. The collection system transports wastewater flows to either Water Reclamation Facility (WRF) No. 2 or WRF No. 3 where advanced treatment is provided. The City is anticipating future growth throughout the northwest quadrant of the service area shown in **Figure 1**. This growth is due to multiple planned developments coming online including the following:

1) Heath Preserve – 141-acre residential development located on SW 44th Avenue
2) Champion Run RV Park – 55-acre RV park located north of US Highway 27 on NW 44th Avenue
3) Ocala 75 Logistics Park – 124-acre industrial development located west of I-75 along NW 11th Street.
4) Cottages of Ocala – Proposed apartments on a 23-acre parcel located at US Highway 27 and SW 44th Avenue.
5) Foxwood Farms – Existing 91-acre mobile home park with approximately 275 units located south of US Highway 27 near the intersection of US Highway 27 and NW 44th Avenue.

These future developments are expected to connect to the City's wastewater collection system and contribute increasing wastewater flows over the next several years as they are developed and built out. Additionally, the Foxwood Farms neighborhood community is planned to redirect wastewater flow from the existing private package plant which currently serves the neighborhood to the City's wastewater collection system.

In response to the anticipated wastewater flows in northwest Ocala, the City requested that Kimley-Horn and Associates, Inc (Kimley-Horn) evaluate the available capacity of the City's existing wastewater infrastructure in the northwest study area and identify the improvements required to accommodate the future wastewater flows. See **Figure 1** for a map of the existing northwest Ocala wastewater system. The purpose of this Technical Memorandum is to document the alternatives evaluated and summarize the improvements required to achieve the necessary wastewater capacity. The proposed alternatives include:

1) **Alternative 1:** Existing wastewater system configuration (no change). See **Figure 4**.

2) **Alternative 2:** LS 132 and LS 87 flows are redirected to the existing 12-inch gravity main on SW 1st Lane and gravity flow to LS 83. These flows are no longer repumped by LS 79. See **Figure 6**.

3) **Alternative 3:** LS 132 flows are sent to LS 87 and repumped. These flows are then redirected to the existing 12-inch gravity main on SW 1st Lane and gravity flow to LS 83. These flows are no longer repumped by LS 79. See **Figure 8**.

4) **Alternative 4:** LS 92 and LS 81 flows are sent to LS 132 and repumped. LS 86 and LS 138 flow directions are reversed and routed to LS 132 where they are repumped. LS 132 and LS 87 flows manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. In this alternative, flows from LS 92, LS 81, LS 86, and LS 138 are no longer directed east across I-75 to LS 89. See **Figure 10**.

5) **Alternative 5:** LS 92 and LS 81 flows are sent to LS 132 and repumped. LS 86 and LS 138 flow directions are reversed and routed to LS 132 where they are repumped. LS 132 and LS 87 flows manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. LS 78 flows also manifold into the force main from LS 89 to LS 83 along SR 40. In this alternative, flows from LS 92, LS 81, LS 86, LS 138, and LS 78 are no longer directed east across I-75 to LS 89. See **Figure 12**.

FLOW PROJECTIONS

DISCUSSION

The existing average daily flow (ADF) base demand was developed using historical SCADA data provided by the City for each of the lift stations. To determine the additional wastewater capacity required, the projected flows were evaluated for the northwest quadrant of the City's service area. Identifying, quantifying, and locating these future wastewater flows allows for proper analysis and planning of capital improvements that can efficiently and cost-effectively be implemented to service existing and new customers. Projected flows are anticipated to occur in one of two ways:

1) Growth within the areas currently served by the City resulting from new connections in areas where infrastructure exists (existing and infill demands). To establish infill growth, parcels located within 200 feet of existing utility infrastructure were selected and considered infill areas.

2) Increased demands from the physical expansion of the utility system to add new customers to the network driven by new development. The projected buildout flows from the following developments were included per the City's direction:

   a) Heath Preserve

   b) Champion Run RV Park

   c) Ocala 75 Logistics Park

   d) Cottages of Ocala Apartment Complex

   e) Foxwood Farms

See **Figure 2** for a map of the infill parcels evaluated. See **Figure 3** for a map of the planned developments included in this analysis.

ASSUMPTIONS

The following assumptions were made during the capacity evaluation of the City's wastewater collection system:

1) A level of service (LOS) for residential wastewater flows of 275 gallons per day (gpd) per equivalent dwelling unit (EDU) was used.

2) A level of service of 0.8 gpd per square foot of commercial building space was used. This LOS was calculated in the *City of Ocala Wastewater System Master Plan, August 2019*.

3) For undeveloped commercial and industrial parcels without an existing site plan, 30% of the total parcel area was assumed to be developed.

4) The units at the Cottages of Ocala Apartment Complex will be single family homes.

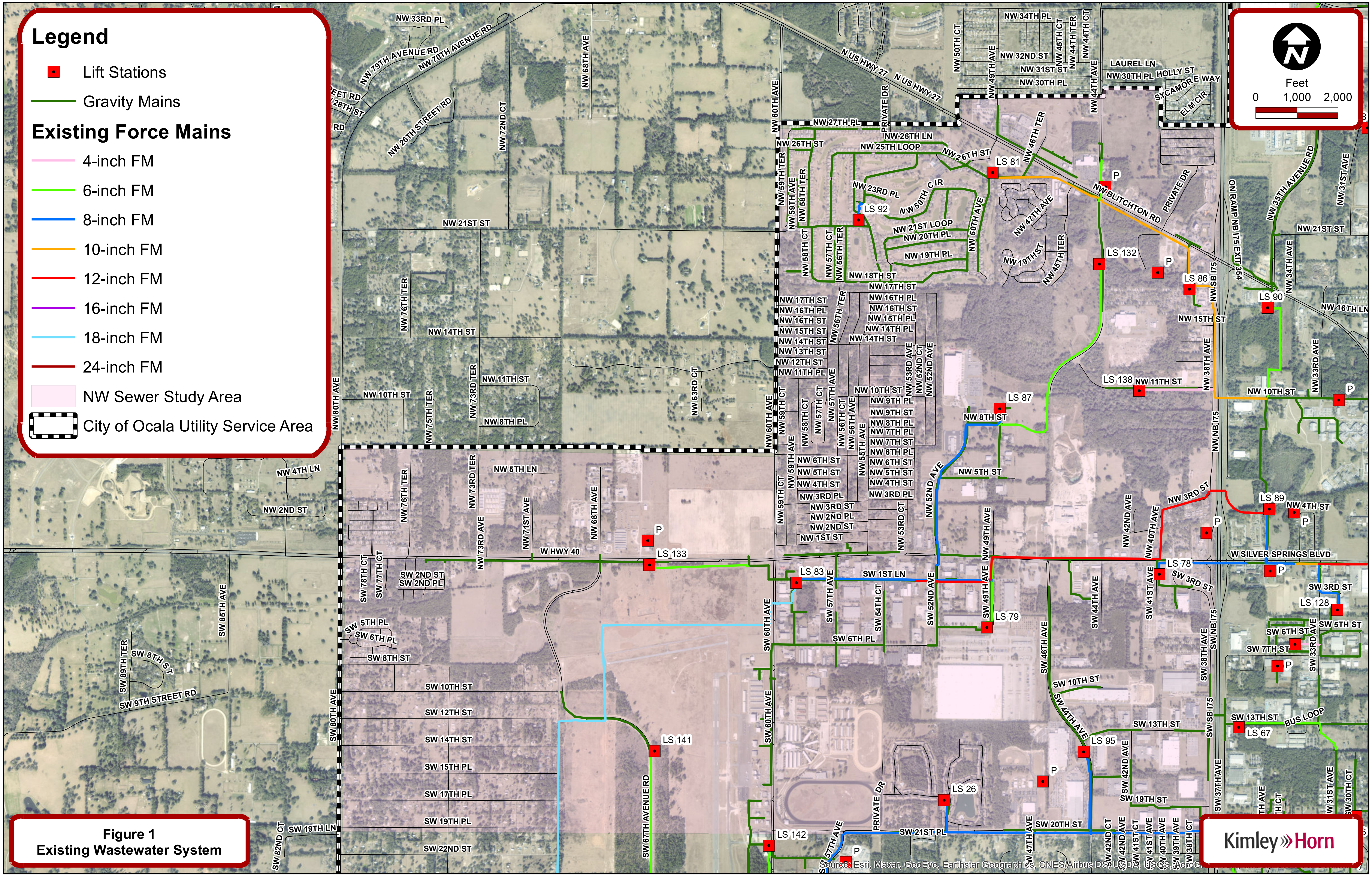


Figure 1
Existing Wastewater System

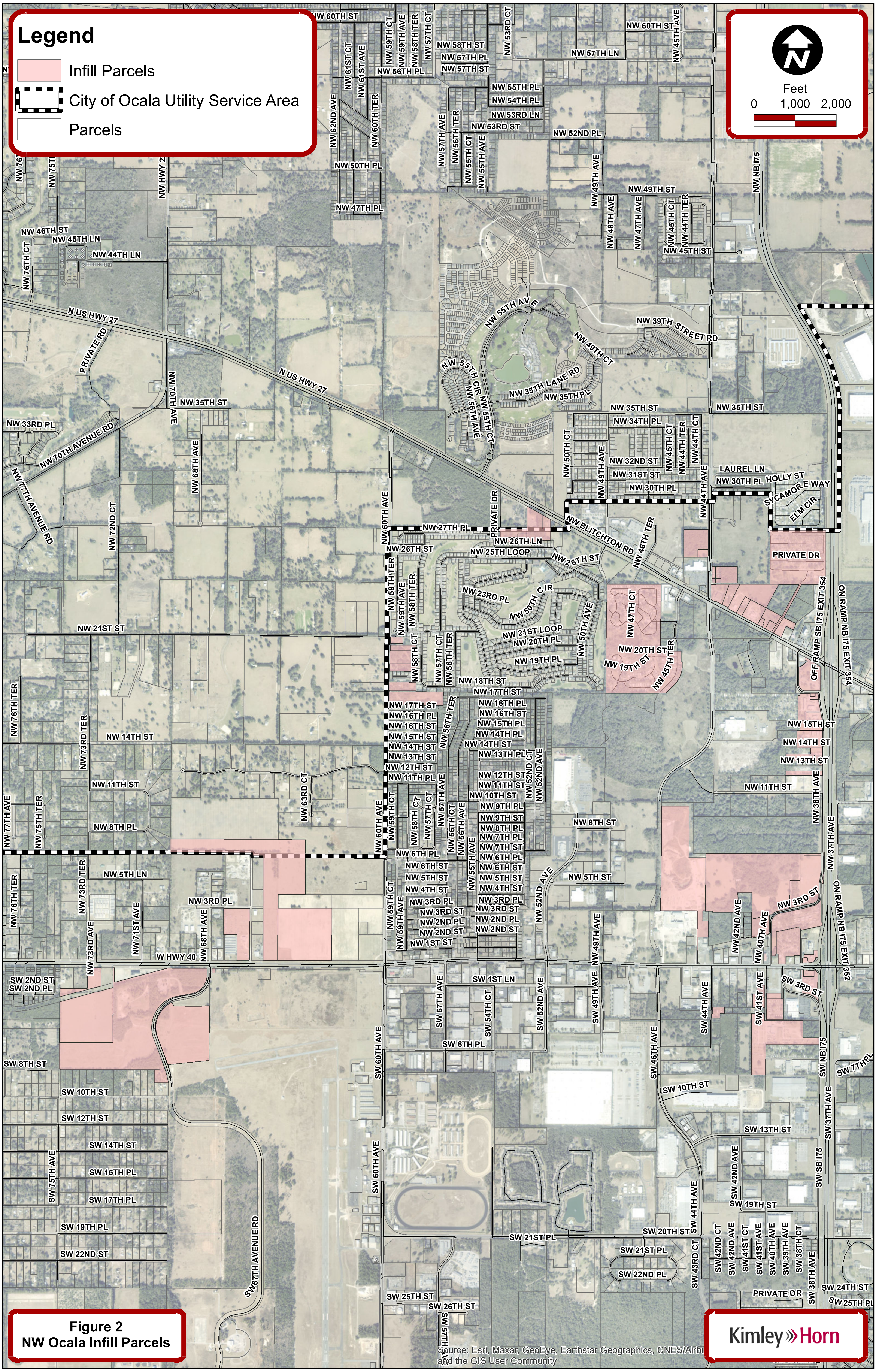


Figure 2
NW Ocala Infill Parcels

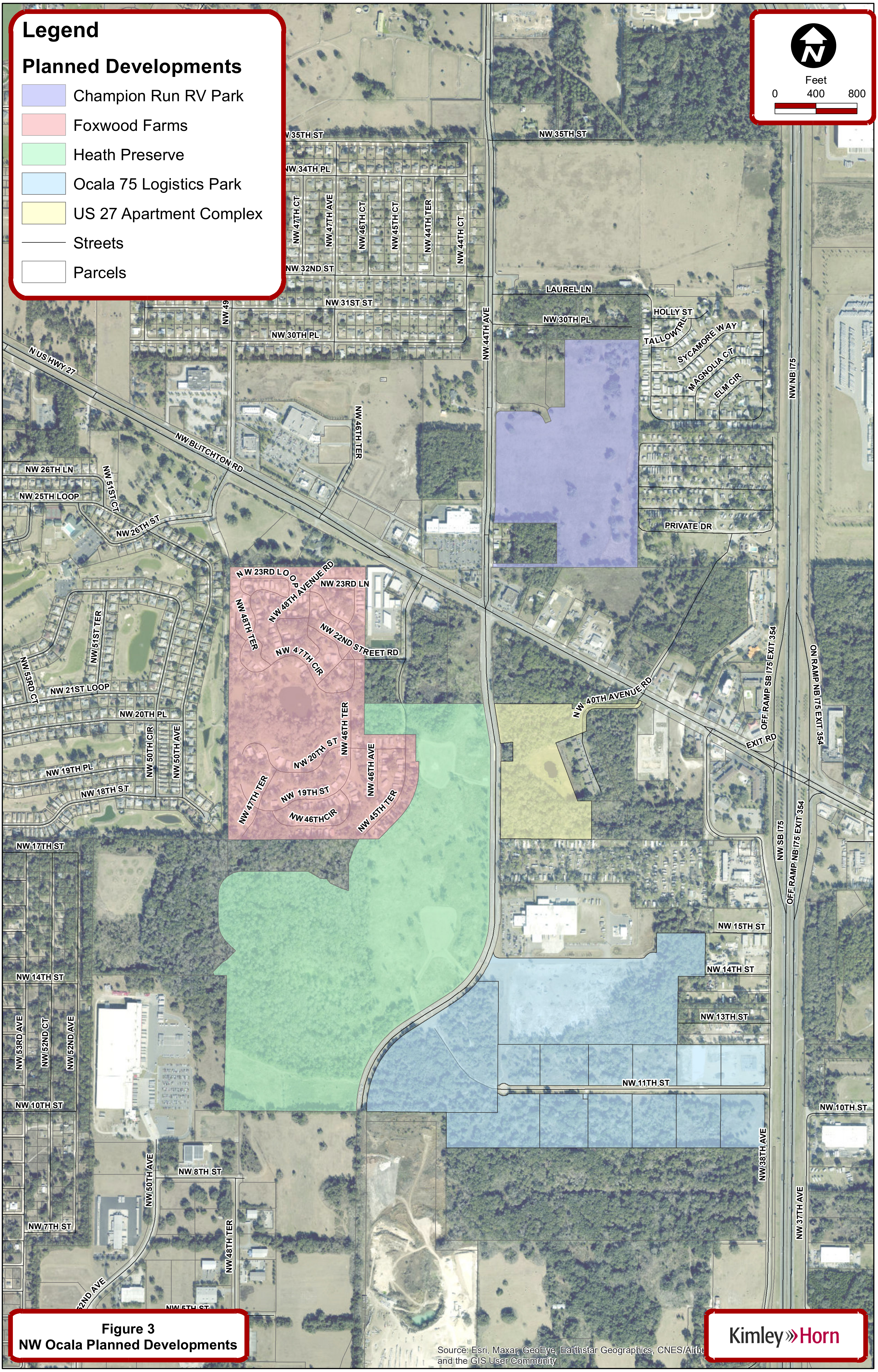


Figure 3
NW Ocala Planned Developments

METHODOLOGY FOR ESTIMATING FLOWS

To determine the capacity the City's northwest wastewater collection system, the ADF and peak hour flow (PHF) were estimated. The ADF for each lift station was developed using historical SCADA data from January 2022 to April 2022. The projected average day buildout flow for the planned developments was calculated using the following methodology:

1) Residential flows from Heath Preserve and the Cottages of Ocala Apartment Complex were calculated by multiplying the LOS by the total estimated units.

2) Industrial flow from the Ocala 75 Logistics Park was calculated by multiplying the City's LOS by the assumed building area square footage for the combined development parcels.

3) Mixed usage flow from the Champion Run RV Park was provided to Kimley-Horn by the City.

4) Residential flow from Foxwood Farms was based on the permitted capacity of the private wastewater treatment package plant (FLA012664) currently serving the neighborhood.

The estimated flows of the planned developments are shown in **Table 1**.

Table 1: Planned Developments ADF					
Development	**Quantity**	**Quantity Units**	**Level of Service**	**Level of Service Units**	**Average Daily Flow (gpd)**
Heath Preserve	237	EDU	275	gpd/EDU	65,175
Cottages of Ocala Apartment Complex	112	EDU	275	gpd/EDU	30,800
Champion Run RV Park (LS 161)	1	RV Park	71,325	gpd	71,325
Ocala 75 Logistics Park	3,447,012	SF	0.08	gpd/SF	275,761
Foxwood Farms	1	Package Plant	N/A	N/A	60,000

Infill flows were calculated for unoccupied parcels located within 200 feet of existing wastewater collection infrastructure**.** The 10-year projected flow generation was determined based on the future land use for each parcel. For residential land uses, the Southwest Florida Water Management District (SWFWMD) population projections were used to calculate the 10-year parcel population. Using the Marion County population density of 2.39 people/EDU from the US Census data, the total EDUs for each parcel was calculated. The ADF was then estimated using the City's residential LOS of 275 gpd/EDU. For commercial and industrial land uses, projected flows were calculated by multiplying the LOS by the estimated building area per parcel. The infill ADF is shown below in **Table 2**.

Table 2: Infill ADF					
Land Use	**Quantity**	**Quantity Units**	**Level of Service**	**Level of Service Units**	**Average Daily Flow (gpd)**
Residential	101	EDU	275	gpd/EDU	27,775
Commercial/ Industrial	4,769,559	SF	0.08	gpd/SF	381,564

Both the planned developments and infill parcels were classified into their respective sewer shed. A sewer shed is defined as a group of parcels that contribute flow to a dedicated lift station utilizing the wastewater collection infrastructure surrounding that lift station. The total ADF for each lift station is summarized below in **Table 3**.

Table 3: Total ADF per Sewer Shed				
Lift Station	**Existing ADF (gpm)**	**10-Year Infill ADF (gpm)**	**Planned Development ADF (gpm)**	**Total ADF per Sewer Shed (gpm)**
LS132	3.2		116.2	119.4
LS138	0.2	2.3	191.5	194.0
LS78	11.2	57.4		68.6
LS86	31.7	2.0		33.7
LS87	2.8			2.8
LS92	23.3	8.0		31.3
LS79	8.8			8.8
LS81	39.3	0.3	41.7	81.3
LS89	47.9	35.4		83.3
LS83	177.5	170.6		348.1

Four lift stations currently repump flow from upstream lift stations in addition to their dedicated sewer shed flows. These lift stations and their adjusted total ADF are summarized below in **Table 4**.

Table 4: Total ADF per Lift Station		
Lift Station	**Contributing Lift Stations**	**Total ADF per Lift Station (gpm)**
LS132	LS 161	119.4
LS138	-	194.0
LS78	-	68.6
LS86	-	33.7
LS87	-	2.8
LS92	-	31.3
LS79	LS 132, 87, 161	130.9
LS81	LS 92	112.6
LS89	LS 92, 81, 86, 138, 78	492.1
LS83	LS 92, 81, 86, 138, 89, 78, 79, 132, 87, 161	971.1

SUMMARY OF PROJECTED FLOWS

The projected population served by each lift station was estimated by dividing the projected lift station ADF by the per capita flow. The projected population for each sewer shed was used to calculate a unique peaking factor for each lift station using the Fair and Geyer equation (**Equation 1**) from *"Water Supply and Wastewater Disposal"; Fair, G.M. and Geyer, J.C.* The peak hour flow (PHF) for each lift station was determined by multiplying the lift station ADF by the peaking factor corresponding to that lift station.

Equation 1: $$Peaking\ Factor = \frac{18+\sqrt{P}}{4+\sqrt{P}} \qquad (P = Population\ in\ thousands)$$

A summary of the ADF and PHF for each lift station evaluated as part of this analysis is provided below in **Table 5**.

Table 5: Total PHF per Sewer Shed			
Lift Station	**Total ADF per Lift Station (gpm)**	**Peaking Factor**	**Total PHF per Lift Station (gpm)**
LS132	119.4	3.68	439.4
LS138	194.0	3.52	682.9
LS78	68.6	3.84	263.4
LS86	33.7	4.01	135.1
LS87	2.8	4.34	12.2
LS92	31.3	4.03	126.1
LS79	130.9	3.65	477.8
LS81	112.6	3.70	416.6
LS89	492.1	3.16	1,555.0
LS83	971.1	2.87	2,787.1

CAPACITY EVALUATION

The hydraulic model developed as part of the *City of Ocala Wastewater System Master Plan, August 2019* was used to evaluate each alternative identified previously. The projected flows were assigned to their respective lift stations throughout the northwest portion of the City's wastewater collection system in the model. Five different physical configurations of the City's lift stations and force mains were modeled to analyze the impacts of the planned future development on the City's existing wastewater infrastructure and understand the capacity improvements necessary to service this future demand. Each alternative was evaluated using projected peak hour flows and was modeled using a steady state analysis.

ALTERNATIVE 1: EXISTING CONFIGURATION

Alternative 1 models the projected peak hour wastewater flows summarized in **Table 5**. In this alternative, no change was made to the City's existing wastewater system. A schematic showing the sewer layout and connectivity of this model alternative is provided in **Figure 4**. Alternative 1 was modeled under three scenarios to understand the hydraulic deficiencies in the system and analyze potential improvements.

SCENARIO 1

Scenario 1 models the existing lift station configuration with the projected peak hour flows. The results of this scenario are summarized below in **Table 6**.

Table 6: Alternative 1, Scenario 1 Results

Pump	Flow (gpm)	Head (ft)	Projected PHF Inflow (gpm)	Pumping Deficiency (gpm)	Diameter of Discharge FM (ID)	Velocity (fps)
LS 132	79.6	82.83	439.4	-359.8	6.0	0.8
LS 138	160.8	69.74	682.9	-522.1	4.0	4.4
LS 78	379.8	26,51	263.4	116.4	8.0	2.4
LS 86	310.7	55.479	135.1	175.6	4.0	7.9
LS 87	411.5	61.78	12.2	399.3	8.0	2.6
LS 92	189.8	27.83	126.1	63.7	6.0	2.2
LS 79	408.7	35.19	477.8	-69.1	6.0	4.6
LS 81	593.4	64.47	416.6	176.8	10.0	2.4
LS 89	708.3	122.86	1,555.0	-846.7	12.0	2.0
LS 83	4,128.7	105.14	2,787.1	1,341.6	18.0	5.2

The results of Scenario 1 demonstrate that LS 132, LS 138, LS 79, and LS 89 have insufficient pumping capacity compared to the projected inflows. The pumps at these lift stations will need to be resized to meet the projected peak hourly inflows.

SCENARIO 2

Scenario 2 models the lift station configuration with the following improvements:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 79 to 477.8 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm

The results of this scenario are shown below in **Table 7**.

Table 7: Alternative 1, Scenario 2 Results				
Pump	**New Flow (gpm)**	**New Head (ft)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 138	682.9	490.38	4.0	17.43
LS 89	1,555.0	439.38	12.0	4.41

The results of **Scenario 2** demonstrate that although the upsized pumps at LS 132, LS 138, LS 79, and LS 89 allow the system to meet the required flows, LS 138, and LS 89 experience significantly high head conditions. Additionally, the velocity through the force main from LS 138 exceeds the maximum allowable velocity of 8.0 fps. It is recommended that the force mains from LS 138 and LS 89 be upsized.

SCENARIO 3

Scenario 3 models the system from Scenario 2 with the following additional improvements:

- Upsize the force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The model results for Scenario 3 are summarized in **Table 8** below.

Table 8: Alternative 1, Scenario 3 Results				
Pump	**New Diameter of Discharge FM (ID)**	**New Velocity (fps)**	**New Flow (gpm)**	**New Head (ft)**
LS 138	8.0	4.36	682.9	62.12
LS 89	12.0	4.41	1,555.0	157.61

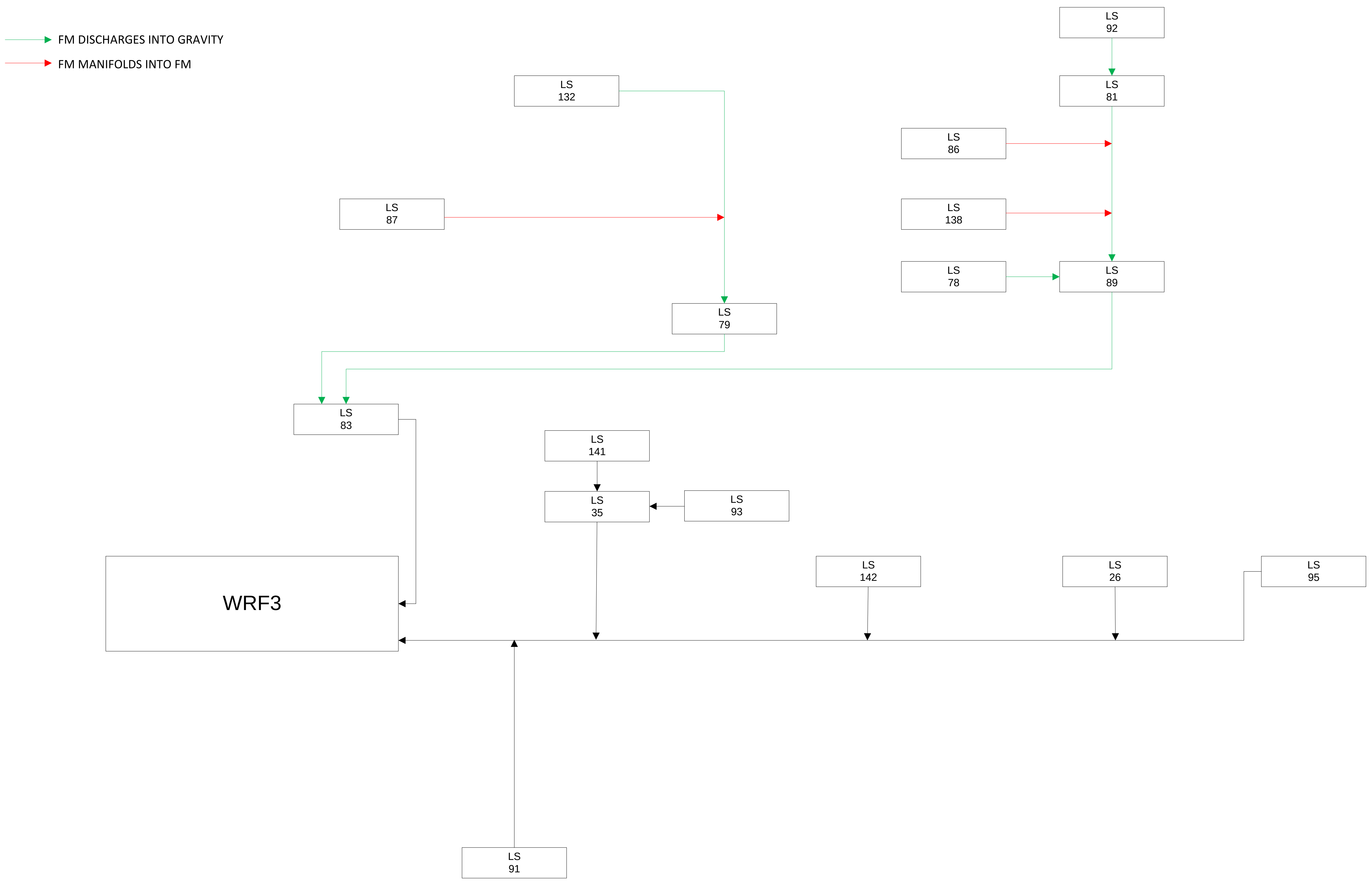
The model results indicate that the upsized force mains successfully reduced the head from LS 138 and LS 89. Furthermore, the force mains are meeting cleansing velocity. No further improvements are necessary for this alternative.

ALTERNATIVE 1 SUMMARY

In this alternative, four lift stations (LS 132, LS 138, LS 79, and LS 89) have insufficient pumping capacity and will require improvements. Furthermore, two force mains will need to be upsized to accommodate the increase in pressure from the upsized pumps. The recommended improvements for ***Alternative 1*** are listed below:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 79 to 477.8 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The estimated total cost of these improvements is approximately **$4,841,000**. A detailed breakdown of the costs is provided in **Appendix A**. A map of the proposed improvements is shown in **Figure 5**.



CITY OF OCALA
NW WASTEWATER MODEL ALTERNATIVE 1

FIGURE 4

OCTOBER 2022

SCALE: NTS

PROJECT: 142371041

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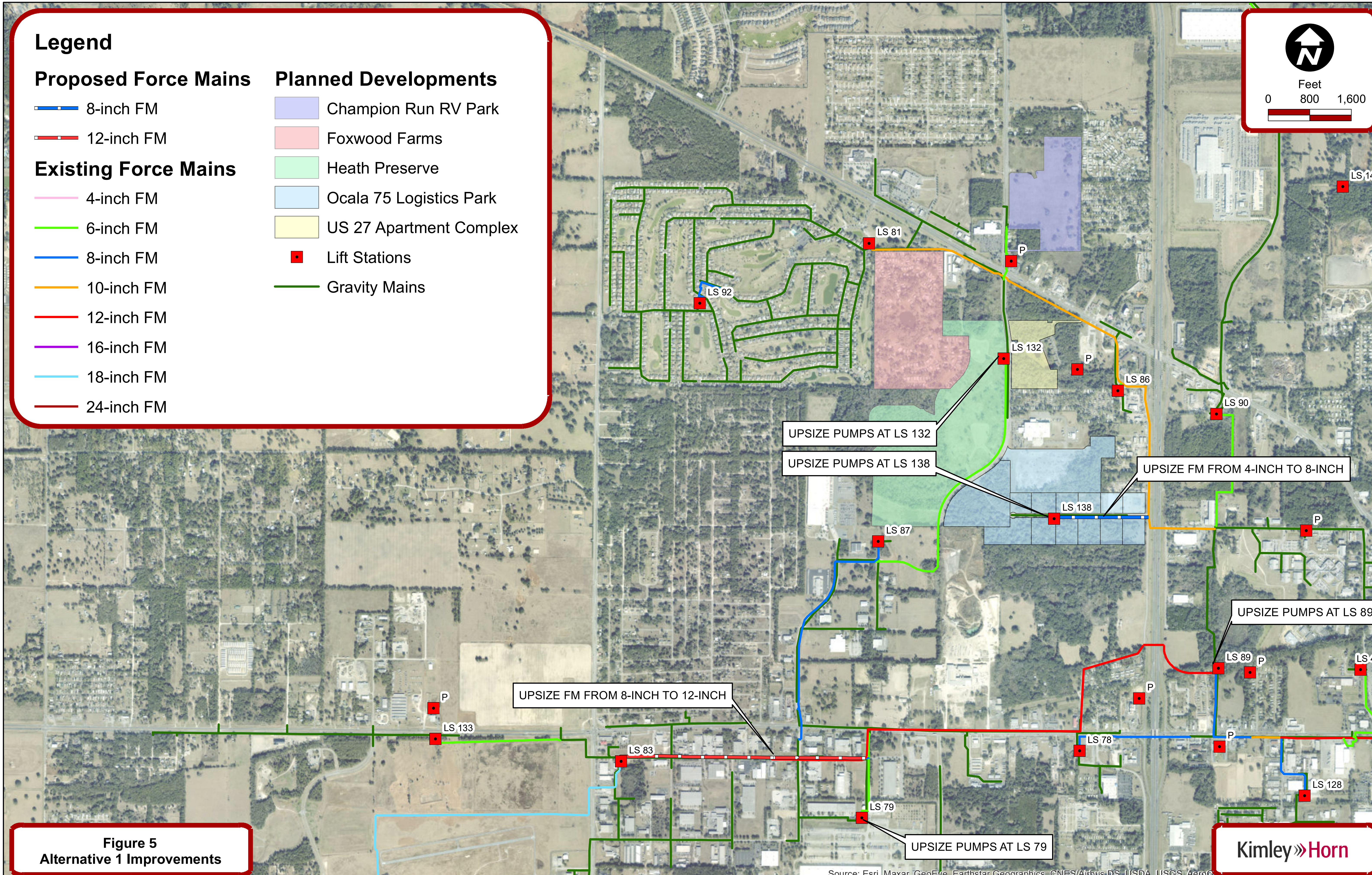


Figure 5
Alternative 1 Improvements

ALTERNATIVE 2: LS 87 AND LS 132 REDIRECTED TO LS 83

Alternative 2 models the projected peak hour wastewater flows summarized below in **Table 9**. In this alternative, flows from LS 132 and LS 87 are redirected to the existing 12-inch gravity main on SW 1st Lane where they gravity flow to LS 83. These flows are no longer repumped by LS 79. A schematic showing the sewer layout and connectivity of this model alternative is provided in **Figure 6**. ***Alternative 2*** was modeled under three scenarios to understand the hydraulic deficiencies in the system and analyze potential improvements.

Table 9: Alternative 2 ADF and PHF

Lift Station	Contributing Inflow	Total ADF per Lift Station (gpm)	Peaking Factor	Total ADF per Lift Station (gpm)
LS132	LS 161	119.4	3.68	439.4
LS138	-	194.0	3.52	682.9
LS78	-	68.6	3.84	263.4
LS86	-	33.7	4.01	135.1
LS87	-	2.8	4.34	12.2
LS92	-	31.3	4.03	126.1
LS79[1]	-	8.8	4.23	37.2
LS81	LS 92	112.6	3.70	416.6
LS89	LS 92, 81, 86, 138, 78	492.1	3.16	1,555.0
LS83	LS 92, 81, 86, 138, 89, 78, 79, 132, 87, 161	971.1	2.87	2,787.1

[1] Projected LS inflow varies from existing configuration inflow

SCENARIO 1

Scenario 1 models the physical lift station configuration of ***Alternative 2*** with the peak hour flows in **Table 9**. The results of this scenario are shown below in **Table 10**.

Table 10: Alternative 2, Scenario 1 Results

Pump	Flow (gpm)	Head (ft)	Projected PHF Inflow (gpm)	Pumping Deficiency (gpm)	Diameter of Discharge FM (ID)	Velocity (fps)
LS 132	81.2	82.77	439.4	-358.2	6.0	0.8
LS 138	160.8	69.77	682.9	-522.1	4.0	4.1
LS 78	379.8	26.51	263.4	116.4	8.0	2.4
LS 86	310.7	55.48	135.1	175.6	4.0	7.9

Table 10: Alternative 2, Scenario 1 Results						
Pump	**Flow (gpm)**	**Head (ft)**	**Projected PHF Inflow (gpm)**	**Pumping Deficiency (gpm)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 87	413.3	61.58	12.2	401.1	8.0	2.6
LS 92	189.8	27.83	126.1	63.7	6.0	2.2
LS 79	408.7	35.92	37.2	371.5	6.0	4.6
LS 81	593.4	64.47	416.6	176.8	10.0	2.4
LS 89	708.3	122.86	1,555.0	-846.7	12.0	2.0
LS 83	4,128.7	105.14	2,787.1	1,341.6	18.0	5.2

The results of Scenario 1 demonstrate that LS 132, LS 138, and LS 89 have insufficient pumping capacity compared to the projected inflows. The pumps at these lift stations will need to be resized to meet the projected peak hourly inflows.

SCENARIO 2

Scenario 2 models the lift station configuration with the following improvements:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm

The results of this scenario are shown below in **Table 11**.

Table 11: Alternative 2, Scenario 2 Results				
Pump	**New Flow (gpm)**	**New Head (ft)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 138	682.9	490.38	4.0	17.43
LS 89	1,555.0	439.38	12.0	4.41

The results of ***Scenario 2*** demonstrate that although the upsized pumps at LS 132, LS 138, and LS 89 allow the system to meet the required flows, LS 138 and LS 89 experience significantly high head conditions. Additionally, the velocity through the force main from LS 138 exceeds the maximum allowable velocity of 8.0 fps. It is recommended that the force mains from LS 138 and LS 89 be upsized.

SCENARIO 3

Scenario 3 models the system in ***Scenario 2*** with the following additional improvements:

- Upsize the force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The model results for Scenario 3 are summarized in **Table 12** below.

Table 12: Alternative 2, Scenario 3 Results				
Pump	**New Diameter of Discharge FM (ID)**	**New Velocity (fps)**	**New Flow (gpm)**	**New Head (ft)**
LS 138	8.0	4.36	682.9	62.12
LS 89	12.0	4.41	1,555.0	157.61

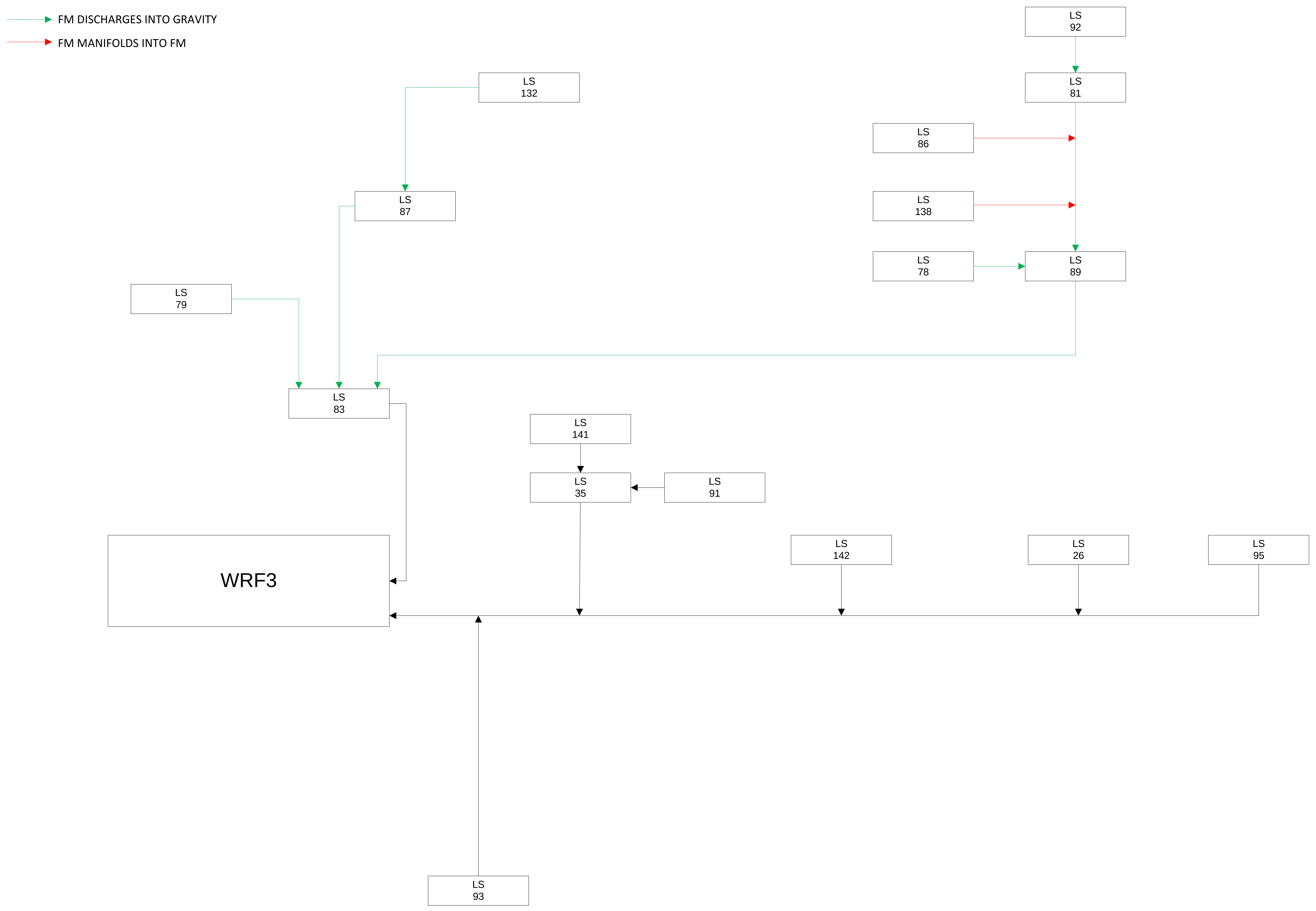
The model results indicate that the upsized force mains successfully reduced the head from LS 138 and LS 89. Furthermore, the force mains are meeting cleansing velocity. No further improvements are necessary for this alternative.

ALTERNATIVE 2 SUMMARY

In this alternative, three lift stations (LS 132, LS 138, and LS 89) have insufficient pumping capacity and will require improvements. Furthermore, two force mains will need to be upsized to accommodate the increase in pressure from the upsized pumps. The recommended improvements for ***Alternative 2*** are listed below:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm.
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The estimated total cost of these improvements is approximately **$4,738,000**. A detailed breakdown of this total is provided in **Appendix A**. A map of the proposed improvements is shown in **Figure 7**.



CITY OF OCALA
NW WASTEWATER MODEL ALTERNATIVE 2

FIGURE 6

OCTOBER 2022

SCALE: NTS

PROJECT: 142371041

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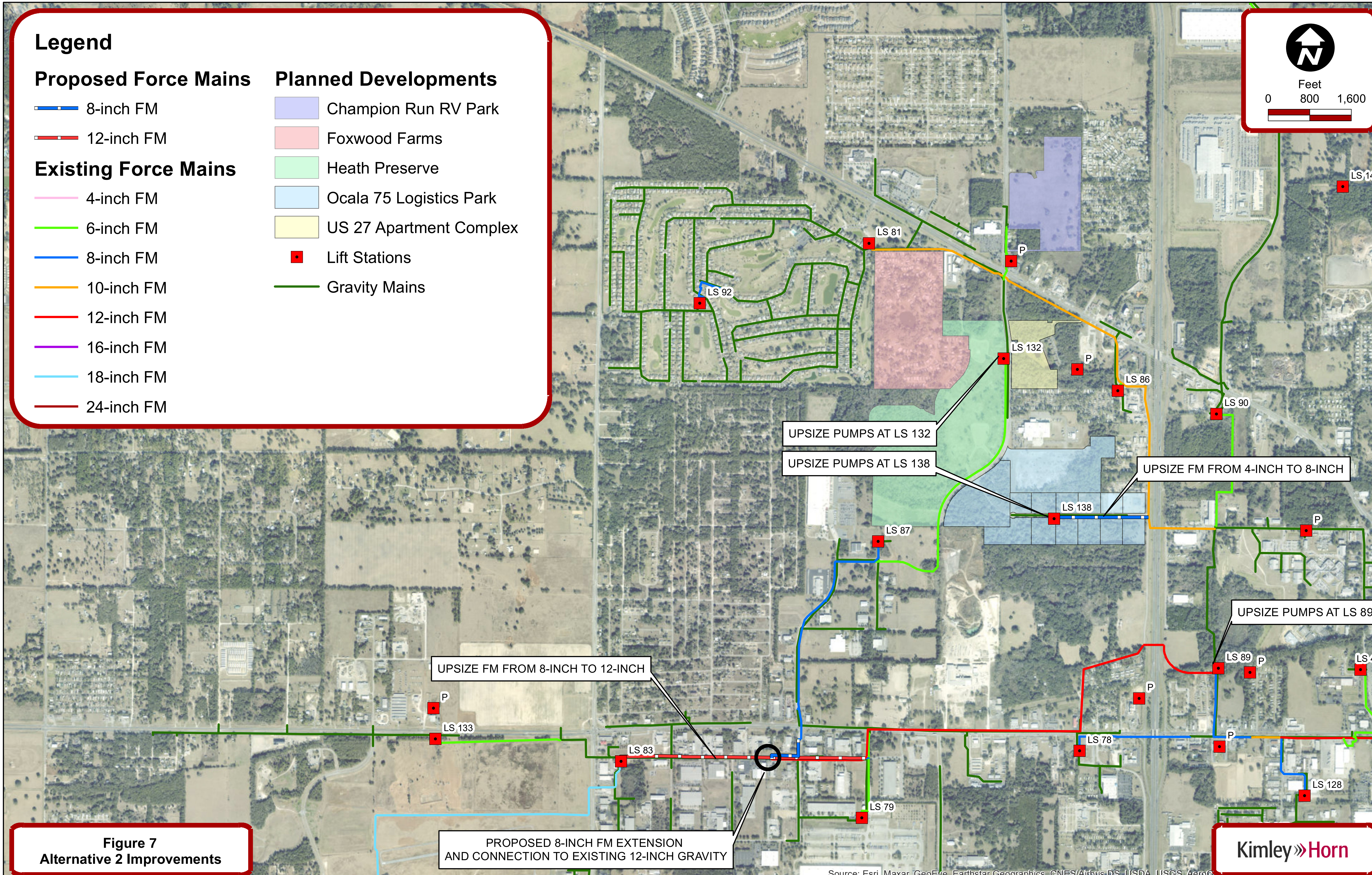


Figure 7
Alternative 2 Improvements

ALTERNATIVE 3: LS 132 FLOWS REPUMPED BY LS 87, COMBINED FLOWS REDIRECTED TO LS 83

Alternative 3 models the projected peak hour wastewater flows summarized below in **Table 13**. In this alternative, flows from LS 132 are sent to LS 87. These combined flows are then pumped at LS 87 and redirected to the existing 12-inch gravity main on SW 1st Lane where they gravity flow to LS 83. These flows are no longer repumped by LS 79. A schematic showing the sewer layout and connectivity of this model alternative is provided in **Figure 8**. ***Alternative 3*** was modeled under three scenarios to understand the hydraulic deficiencies in the system and analyze potential improvements.

Table 13: Alternative 3 ADF and PHF				
Lift Station	**Contributing Inflow**	**Total ADF per Lift Station (gpm)**	**Peaking Factor**	**Total ADF per Lift Station (gpm)**
LS132	LS 161	119.4	3.68	439.4
LS138	-	194.0	3.52	682.9
LS78	-	68.6	3.84	263.4
LS86	-	33.7	4.01	135.1
LS87[1]	LS 132, 161	122.2	3.67	448.5
LS92	-	31.3	4.03	126.1
LS79[1]	-	8.8	4.23	37.2
LS81	LS 92	112.6	3.70	416.6
LS89	LS 92, 81, 86, 138, 78	492.1	3.16	1,555.0
LS83	LS 92, 81, 86, 138, 89, 78, 79, 132, 87, 161	971.1	2.87	2,787.1

[1] *Projected LS inflow varies from existing configuration inflow*

SCENARIO 1

Scenario 1 models the physical lift station configuration of ***Alternative 3*** with the peak hour flows in **Table 13**. The results of this scenario are shown below in **Table 14**.

Table 14: Alternative 3, Scenario 1 Results						
Pump	**Flow (gpm)**	**Head (ft)**	**Projected PHF Inflow (gpm)**	**Pumping Deficiency (gpm)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 132	285.7	64.92	439.4	-153.7	6.0	2.9
LS 138	160.8	69.77	682.9	-522.1	4.0	4.1
LS 78	379.8	26.52	263.4	116.4	8.0	2.4

Table 14: Alternative 3, Scenario 1 Results						
Pump	**Flow (gpm)**	**Head (ft)**	**Projected PHF Inflow (gpm)**	**Pumping Deficiency (gpm)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 86	310.7	55.48	135.1	175.6	4.0	7.9
LS 87	451.6	57.23	448.5	3.1	8.0	2.9
LS 92	189.8	27.83	126.1	63.7	6.0	2.2
LS 79	408.7	36.19	37.2	371.5	6.0	4.6
LS 81	593.4	64.47	416.6	176.8	10	2.4
LS 89	708.3	122.86	1,555.0	-846.7	12.0	2.0
LS 83	4,128.7	105.14	2,787.1	1,341.6	18.0	5.2

The results of ***Scenario 1*** demonstrate that LS 132, LS 138, and LS 89 have insufficient pumping capacity compared to the projected inflows. The pumps at these lift stations will need to be resized to meet the projected peak hourly inflows.

SCENARIO 2

Scenario 2 models the lift station configuration with the following improvements:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm

The results of this scenario are shown below in **Table 15**.

Table 15: Alternative 3, Scenario 2 Results				
Pump	**New Flow (gpm)**	**New Head (ft)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 138	682.9	490.38	4.0	17.43
LS 89	1,555.0	439.38	12.0	4.41

The results of ***Scenario 2*** demonstrate that although the upsized pumps at LS 132, LS 138, and LS 89 allow the system to meet the required flows, LS 138 and LS 89 experience significantly high head conditions. Additionally, the velocity through the force main from LS 138 exceeds the maximum allowable velocity of 8.0 fps. It is recommended that the force mains from LS 138 and LS 89 be upsized.

SCENARIO 3

Scenario 3 models the system in Scenario 2 with the following additional improvements:

- Upsize the force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The model results for Scenario 3 are summarized in **Table 16** below.

Table 16: Alternative 3, Scenario 3 Results				
Pump	**New Diameter of Discharge FM (ID)**	**New Velocity (fps)**	**New Flow (gpm)**	**New Head (ft)**
LS 138	8.0	4.36	682.9	62.12
LS 89	12.0	4.41	1,555.0	157.61

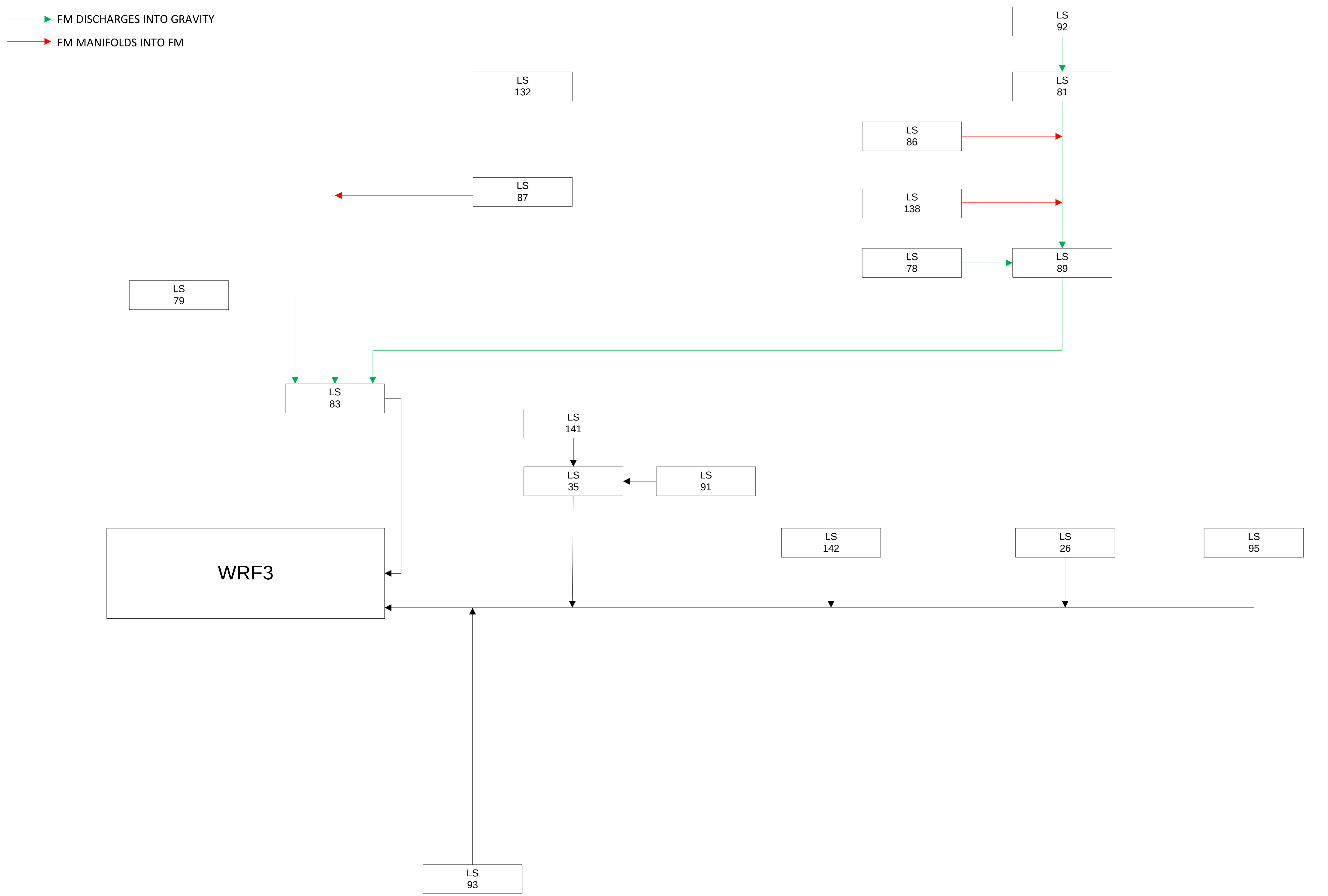
The model results indicate that the upsized force mains successfully reduced the head from LS 138 and LS 89. Furthermore, the force mains are meeting cleansing velocity. No additional improvements are necessary for this alternative.

ALTERNATIVE 3 SUMMARY

In this alternative, three lift stations (LS 132, LS 138, and LS 89) have insufficient pumping capacity and will require improvements. Furthermore, two force mains will need to be upsized to accommodate the increase in pressure from the upsized pumps. The recommended improvements for ***Alternative 3*** are listed below:

- Upsize the pumping capacity of LS 132 to 439.4 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 89 to 1,555.0 gpm
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches
- Extend the existing 8-inch force main to existing 12-inch gravity sewer on SW 1st Ave

The estimated total cost of these improvements is approximately **$4,875,000**. A detailed breakdown of this total is provided in **Appendix A**. A map of the proposed improvements is shown in **Figure 9**.



CITY OF OCALA
NW WASTEWATER MODEL ALTERNATIVE 3

FIGURE 8

OCTOBER 2022

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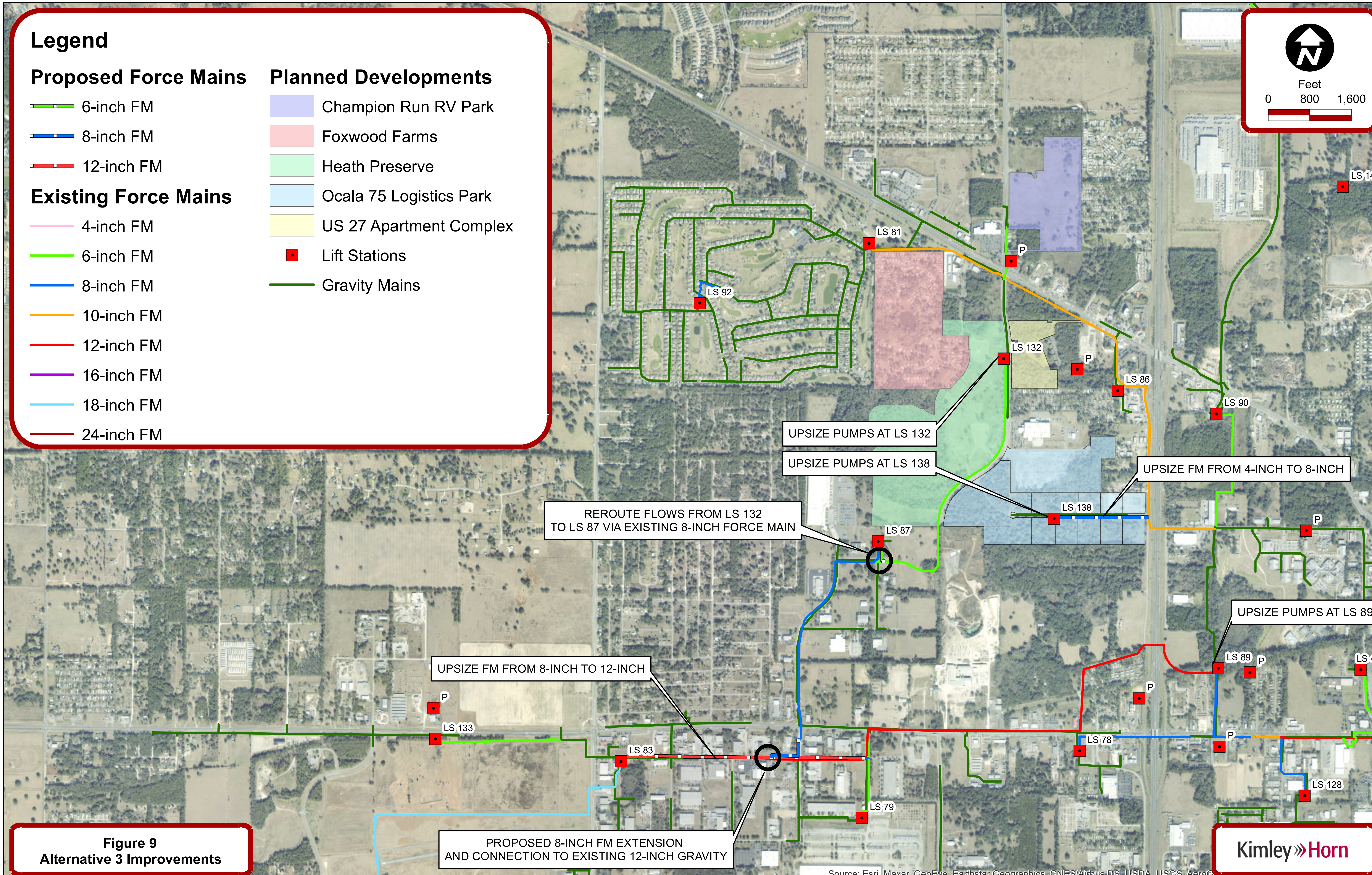


Figure 9
Alternative 3 Improvements

ALTERNATIVE 4: FLOWS FROM LS 92/LS 81/LS86/LS 138 REDIRECTED TO LS 132 AND PUMPED DIRECTLY TO LS 83

Alternative 4 models the projected peak hour wastewater flows summarized below in **Table 17.** In this alternative, flows from LS 92 and LS 81 are redirected to LS 132. The force main flow directions from LS 86 and LS 138 are reversed and these flows are rerouted to LS 132. The combined flows pumped by LS 132 and LS 87 manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. In this alternative, flows from LS 92, LS 81, LS 86, and LS 138 are no longer directed east across I-75 to LS 89. A schematic showing the sewer layout and connectivity of this model alternative is provided in **Figure 10**. Alternative 4 was modeled under three scenarios to understand the hydraulic deficiencies in the system and analyze potential improvements.

Table 17: Alternative 4 ADF and PHF				
Lift Station	**Contributing Inflow**	**Total ADF per Lift Station (gpm)**	**Peaking Factor**	**Total ADF per Lift Station (gpm)**
LS132[1]	LS 92,81,86,138, 161	459.6	3.19	1,466.1
LS138	-	194.0	3.52	682.9
LS78	-	68.6	3.84	263.4
LS86	-	33.7	4.01	135.1
LS87	-	2.8	4.34	12.2
LS92	-	31.3	4.03	126.1
LS79[1]	-	8.8	4.23	37.2
LS81	LS 92	112.6	3.70	416.6
LS89[1]	LS 78	151.9	3.60	546.8
LS83	LS 92, 81, 86, 138, 89, 78, 79, 132, 87, 161	971.1	2.87	2,787.1
[1] Projected LS inflow varies from existing configuration inflow				

SCENARIO 1

Scenario 1 models the physical lift station configuration of ***Alternative 4*** with the peak hour flows in **Table 17**. Due to the significant increase in flows sent to LS 132, this lift station deadheads, and flow results were unable to be recorded for this scenario. Additionally, LS 138 is unable to pump the projected flows. It is recommended that the pumps are upsized for these two lift stations.

SCENARIO 2

Scenario 2 models the lift station configuration with the following improvements:

- Upsize the pumping capacity of LS 132 to 1,466.1 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm

Due to the significant increase in head pressure throughout the force main extending from LS 132 to the force main along SW 1st Lane from LS 89, the pumps at LS 89 deadhead. Furthermore, the velocities in the force mains from LS 132 and 138 exceed the maximum allowable standard of 8 fps. It is recommended that the force main from LS 132 and the force main from LS 89 be upsized to reduce the generated head conditions.

Table 18: Alternative 4, Scenario 2				
Pump	**New Flow (gpm)**	**New Head (ft)**	**Diameter of Discharge FM (ID)**	**Velocity (fps)**
LS 132	1,466.1	989.50	6.0	15.08
LS 138	682.9	509.66	4.0	17.43

SCENARIO 3

Scenario 3 models the lift stations in ***Scenario 2*** with the following additional improvements:

- Upsize the 6-inch force main from LS 132 to 12-inches
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main from LS 89 on SW 1st Ln to 12-inches

The modeling results are shown below in **Table 19**.

Table 19: Alternative 3, Scenario 3 Results				
Pump	**New Diameter of Discharge FM (ID)**	**New Velocity (fps)**	**New Flow (gpm)**	**New Head (ft)**
LS 132	12.0	4.16	1,466.1	154.79
LS 138	8.0	4.36	682.9	81.40
LS 89	12.0	2.24	791.0	118.90

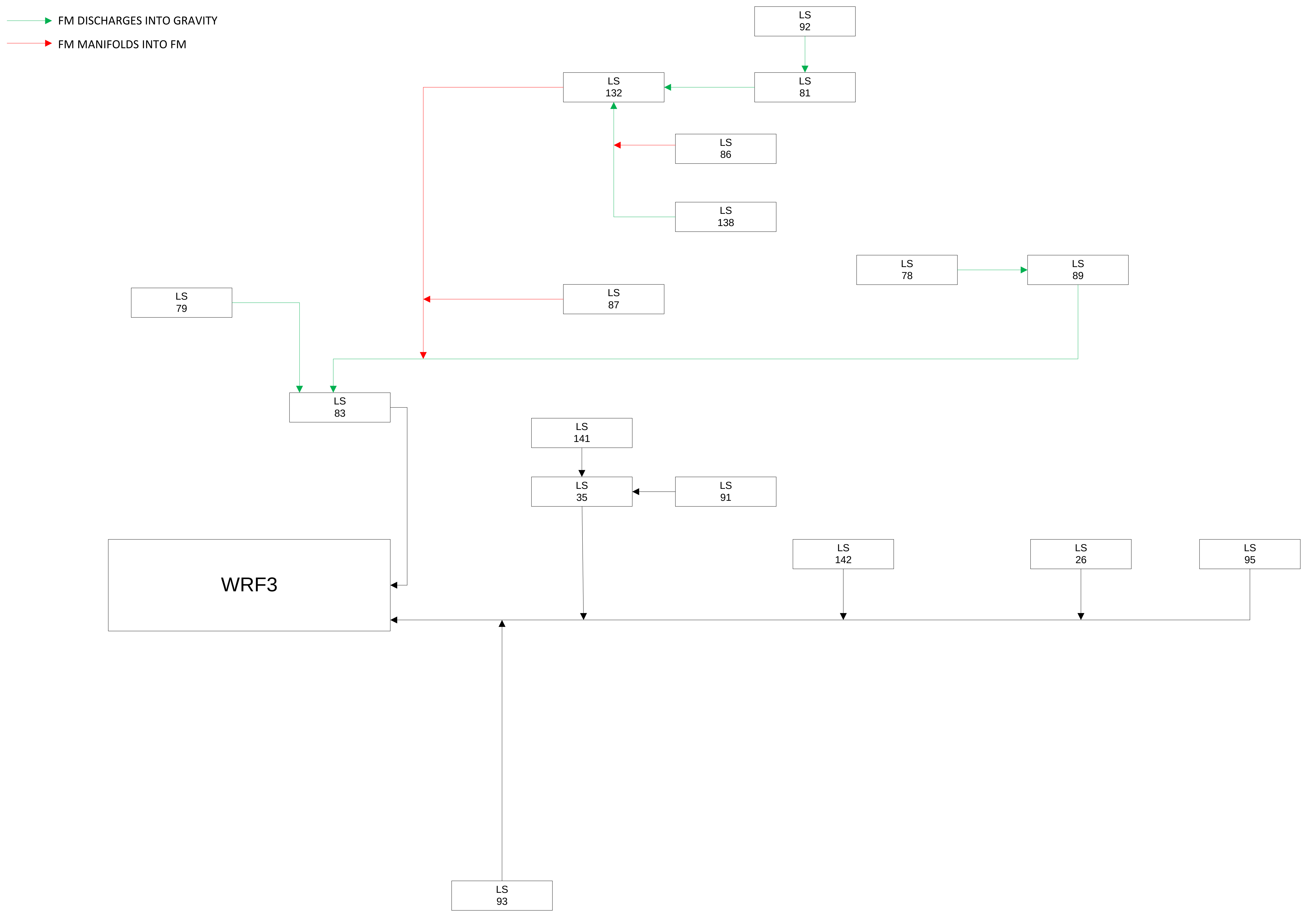
These results demonstrate that upsizing the force mains from LS 132, LS 138, and LS 89 successfully alleviates the system's hydraulic deficiencies. The pumps are no longer deadheading and have sufficient pumping capacity. Additionally, the velocities in the force mains are below the maximum allowable velocity of 8 fps. No further improvements are required.

ALTERNATIVE 4 SUMMARY

In ***Alternative 4***, two lift stations (LS 132 and LS 138) have insufficient pumping capacity and will require improvements. Furthermore, three force mains will need to be upsized to accommodate the increase in pressure from the upsized pumps. The recommended improvements for ***Alternative 4*** are listed below:

- Upsize the pumping capacity of LS 132 to 1,466.1 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the 6-inch force main from LS 132 to 12-inches
- Upsize the 8-inch force main from LS 132 to 12-inches
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches

The estimated total cost of these improvements is approximately **$7,948,000**. A detailed breakdown of this total is provided in **Appendix A**. A map of the proposed improvements is shown in **Figure 11**.



CITY OF OCALA
NW WASTEWATER MODEL ALTERNATIVE 4

FIGURE 10

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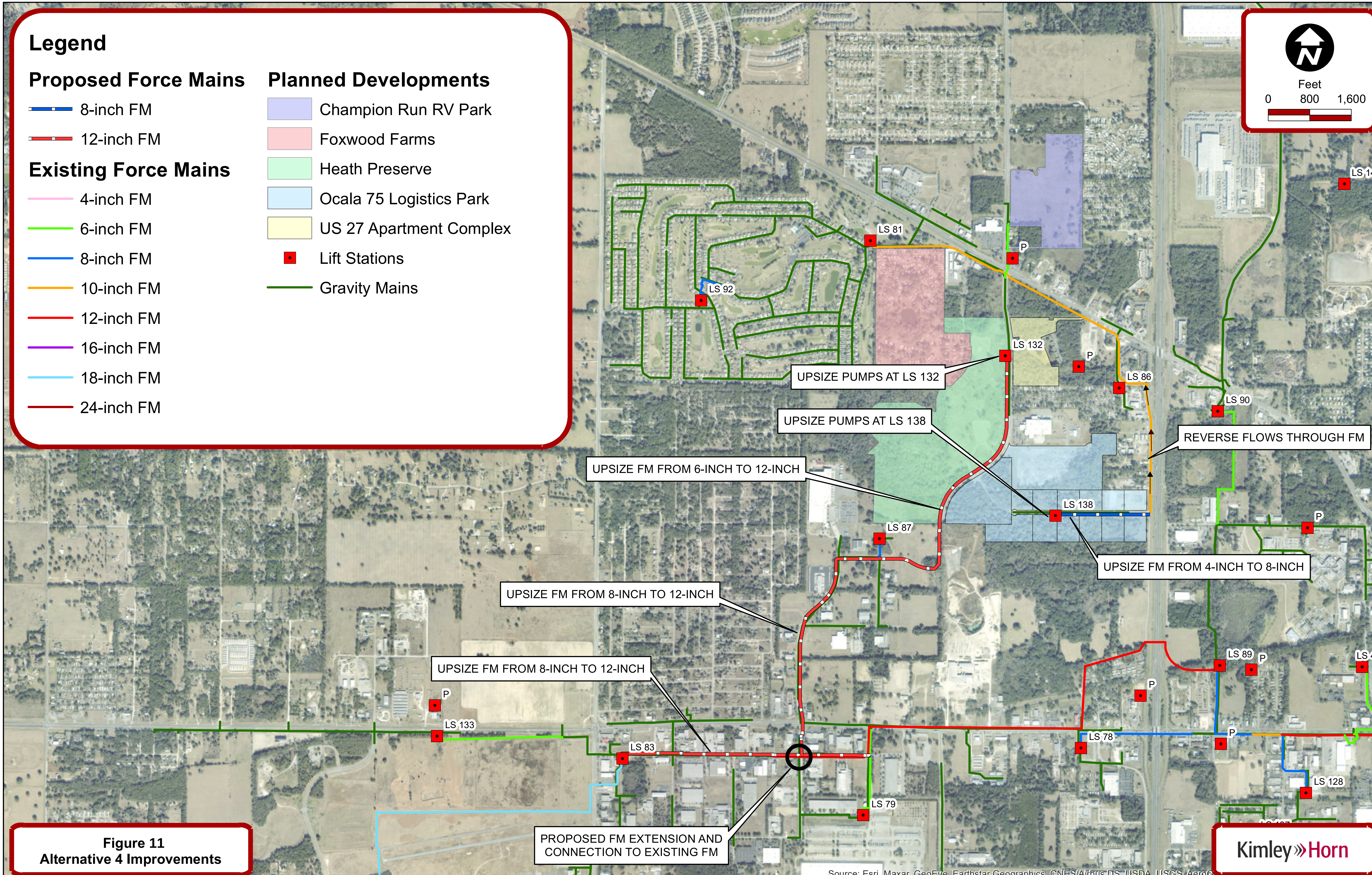


Figure 11
Alternative 4 Improvements

ALTERNATIVE 5: FLOWS FROM LS 92/LS 81/LS86/LS 138/LS78 REDIRECTED TO LS 132 AND PUMPED DIRECTLY TO LS 83

Alternative 5 models the projected peak hour wastewater flows summarized below in **Table 20.** In this alternative, flows from LS 92 and LS 81 are redirected to LS 132. The force main flow directions from LS 86 and LS 138 are reversed and these flows are rerouted to LS 132. The combined flows pumped by LS 132 and LS 87 manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. Additionally, LS 78 flows are redirected to manifold into the force main from LS 89 to LS 83 along SR 40. In this alternative, flows from LS 92, LS 81, LS 86, LS 138, and LS 78 are no longer directed east across I-75 to LS 89. A schematic showing the sewer layout and connectivity of this model alternative is provided in **Figure 12**. ***Alternative 5*** was modeled under three scenarios to understand the hydraulic deficiencies in the system and analyze potential improvements.

Table 20: Alternative 5 ADF and PHF				
Lift Station	**Contributing Inflow**	**Total ADF per Lift Station (gpm)**	**Peaking Factor**	**Total ADF per Lift Station (gpm)**
LS132[1]	LS 92,81,86,138, 161	459.6	3.19	1,466.1
LS138	-	194.0	3.52	682.9
LS78	-	68.6	3.84	263.4
LS86	-	33.7	4.01	135.1
LS87	-	2.8	4.34	12.2
LS92	-	31.3	4.03	126.1
LS79[1]	-	8.8	4.23	37.2
LS81	LS 92	112.6	3.70	416.6
LS89[1]	-	83.3	3.79	315.7
LS83	LS 92, 81, 86, 138, 89, 78, 79, 132, 87, 161	971.1	2.87	2,787.1

[1] *Projected LS inflow varies from existing configuration inflow*

SCENARIO 1

Scenario 1 models the physical lift station configuration of ***Alternative 5*** with the peak hour flows in **Table 20**. Due to the significant increase in flows sent to LS 132, this lift station deadheads, and flow results were unable to be recorded for this scenario. LS 78 also deadheads due to the significant head pressure it must pump against and is unable to satisfy the projected flow requirements. Additionally, LS 138 is unable to pump the projected flows. It is recommended that the pumps are upsized for these three lift stations.

SCENARIO 2

Scenario 2 models the lift station configuration with the following improvements:

- Upsize the pumping capacity of LS 132 to 1,466.1 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 78 to 263.4 gpm

The results of ***Scenario 2*** are summarized below in **Table 21**.

Due to the significant increase in head throughout the force main from LS 132 that manifolds into the force main from LS 89, the pumps at LS 89 deadhead. Furthermore, the velocities in the force mains from LS 132 and 138 exceed the recommended 8 fps. It is recommended that the force main from LS 132 and the force main from LS 89 be upsized to reduce the head conditions.

Table 21: Alternative 5, Scenario 2 Results

Pump	New Flow (gpm)	New Head (ft)	Diameter of Discharge FM (ID)	Velocity (fps)
LS 132	1,466.1	988.50	6.0	15.08
LS 138	682.9	509.66	4.0	17.43
LS 78	263.4	130.93	8.0	1.68

SCENARIO 3

Scenario 3 models the lift stations in ***Scenario 2*** with the following additional improvements:

- Upsize the 6-inch force main from LS 132 to 12-inches
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main from LS 89 on SW 1st Ln to 12-inches

The modeling results are shown below in **Table 22**.

Table 22: Alternative 3, Scenario 3 Results

Pump	New Diameter of Discharge FM (ID)	New Velocity (fps)	New Flow (gpm)	New Head (ft)
LS 132	12.0	4.16	1,466.1	160.35
LS 138	8.0	4.36	682.9	81.40
LS 89	12.0	2.84	1,002.2	107.03

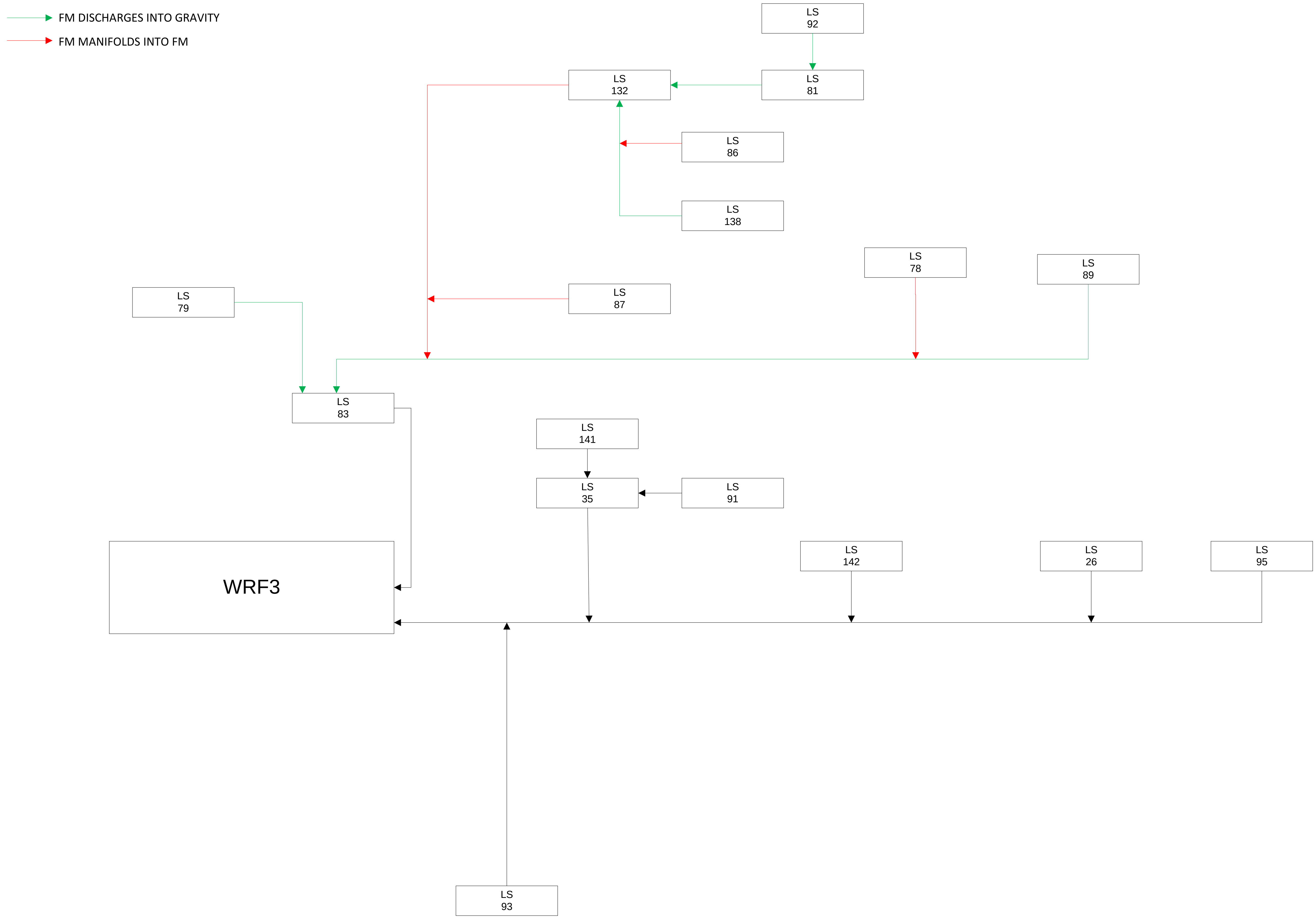
These results demonstrate that upsizing the force mains from LS 132, LS 138, and LS 89 successfully alleviates the system's hydraulic deficiencies. The pumps are no longer deadheading and have sufficient pumping capacity. Additionally, the velocities in the force mains are below the maximum allowable velocity of 8 fps. No further improvements are required.

ALTERNATIVE 5 SUMMARY

In ***Alternative 5***, three lift stations (LS 132, LS 138, and LS 78) have insufficient pumping capacity and will require improvements. Furthermore, three force mains will need to be upsized to accommodate the increase in pressure from the upsized pumps. The recommended improvements for ***Alternative 5*** are listed below:

- Upsize the pumping capacity of LS 132 to 1,466.1 gpm
- Upsize the pumping capacity of LS 138 to 682.9 gpm
- Upsize the pumping capacity of LS 78 to 263.4 gpm
- Upsize the 6-inch force main from LS 132 to 12-inches
- Upsize the 8-inch force main from LS 132 to 12-inches
- Upsize the 4-inch force main from LS 138 to 8-inches
- Upsize the 8-inch force main on SW 1st Ave to 12-inches
- Construct 8-inch force main to manifold flows from LS 78 to 12-inch force main from LS 89

The estimated total cost of these improvements is approximately **$9,215,000**. A detailed breakdown of this total is provided in **Appendix A**. A map of the proposed improvements is shown in **Figure 13**.



CITY OF OCALA
NW WASTEWATER MODEL ALTERNATIVE 5

FIGURE 12

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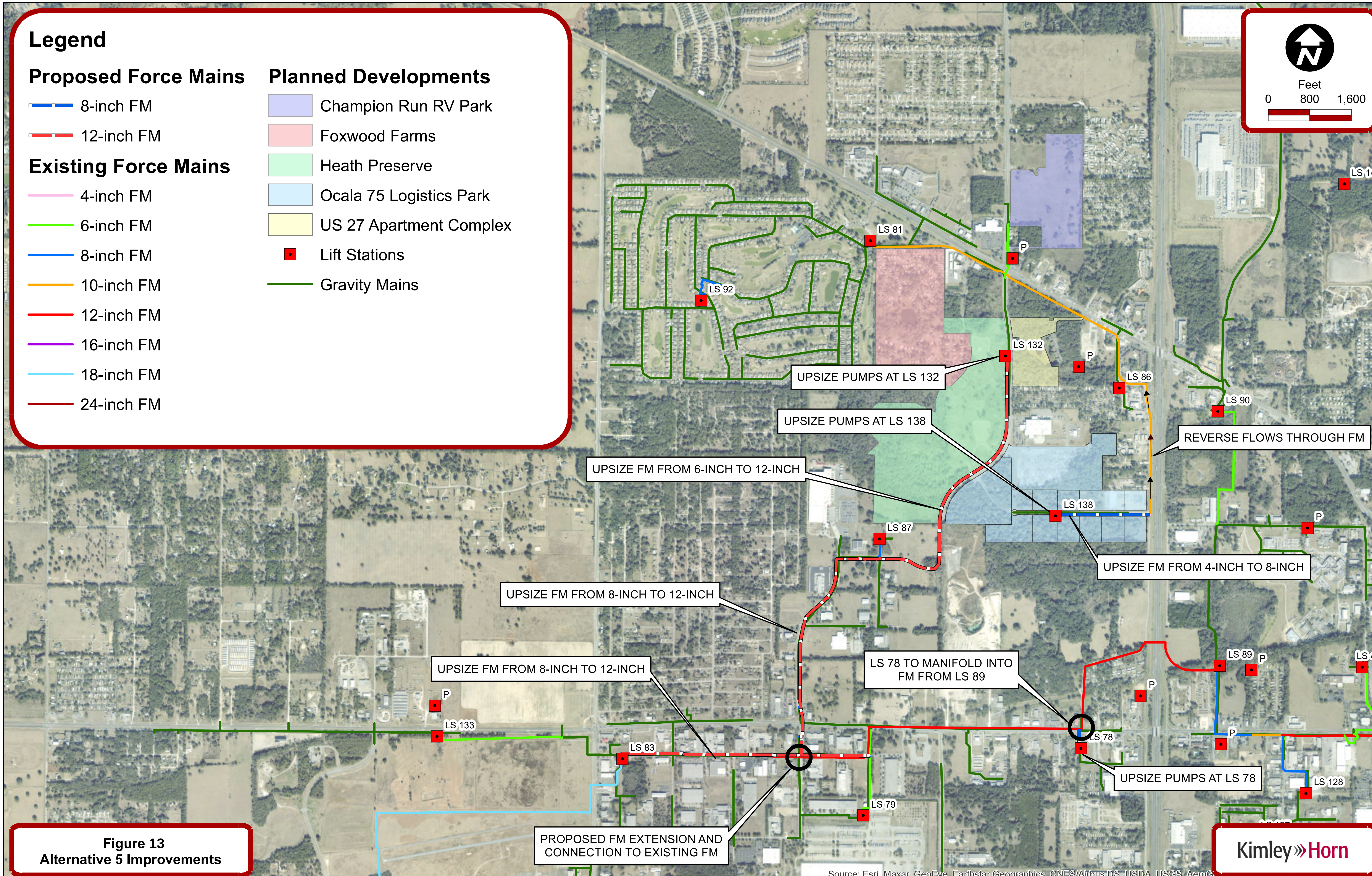

Figure 13
Alternative 5 Improvements

SUMMARY

The proposed alternatives evaluated include:

1) ***Alternative 1*:** Existing wastewater system configuration (no change).

2) ***Alternative 2*:** LS 132 and LS 87 flows are redirected to the existing 12-inch gravity main on SW 1st Lane and gravity flow to LS 83. These flows are no longer repumped by LS 79.

3) ***Alternative 3*:** LS 132 flows are sent to LS 87 and repumped. These flows are then redirected to the existing 12-inch gravity main on SW 1st Lane and gravity flow to LS 83. These flows are no longer repumped by LS 79.

4) ***Alternative 4*:** LS 92 and LS 81 flows are sent to LS 132 and repumped. LS 86 and LS 138 flow directions are reversed and routed to LS 132 where they are repumped. LS 132 and LS 87 flows manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. In this alternative, flows from LS 92, LS 81, LS 86, and LS 138 are no longer directed east across I-75 to LS 89.

5) ***Alternative 5*:** LS 92 and LS 81 flows are sent to LS 132 and repumped. LS 86 and LS 138 flow directions are reversed and routed to LS 132 where they are repumped. LS 132 and LS 87 flows manifold into the existing force main from LS 89 to LS 83 on SW 1st Lane. LS 78 flows also manifold into the force main from LS 89 to LS 83 along SR 40. In this alternative, flows from LS 92, LS 81, LS 86, LS 138, and LS 78 are no longer directed east across I-75 to LS 89.

The model results demonstrate that all five alternatives will satisfy the future wastewater flows projected within the northwest quadrant of the City's utility service area. **Table 23** below summarizes the estimated costs associated with each alternative. Detailed cost breakdowns are included in **Appendix A**.

Table 23: Cost Estimates	
Alternative 1	**$4,841,000**
Alternative 2	**$4,738,000**
Alternative 3	**$4,875,000**
Alternative 4	**$7,948,000**
Alternative 5	**$9,215,000**

APPENDIX A – Cost Estimates

ENGINEERS OPINION OF PROBABLE COST FOR NW Ocala Wastewater Model Alternative 1 Improvements						
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**		**AMOUNT**
1	Replace LS 132 (includes new pumps, electrical panel, electrical service and wetwell)	1	LS	$	959,000	959,000.00
2	Replace LS 138 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$	1,080,000	1,080,000.00
3	Upsize pumps at LS 79	1	LS	$	72,000	72,000.00
4	Upgrade LS 89 (includes new pumps, electrical panel, and electrical service)	1	LS	$	115,000	115,000.00
5	Upsize 4-inch FM to 8-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	1,950	LF	$	162	316,192.50
6	Upsize 8-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	4,900	LF	$	172	843,045.00
7	Engineering design and permitting (10%)	1	LS	$	338,524	338,523.75
8	Contingency (30%)	1	LS	$	1,117,128	1,117,128.38
					TOTAL	**$ 4,841,000.00**

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

ENGINEERS OPINION OF PROBABLE COST
FOR
NW Ocala Wastewater Model
Alternative 2 Improvements

ITEM	DESCRIPTION	QUANTITY		UNIT PRICE	AMOUNT
1	Replace LS 132 (includes new pumps, electrical panel, electrical service and wetwell)	1	LS	$ 959,000	959,000.00
2	Replace LS 138 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$ 1,080,000	1,080,000.00
3	Upgrade LS 89 (includes new pumps, electrical panel, and electrical service)	1	LS	$ 115,000	115,000.00
4	Upsize 4-inch FM to 8-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	1,950	LF	$ 162	316,192.50
5	Upsize 8-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	4,900	LF	$ 172	843,045.00
6	Engineering design and permitting (10%)	1	LS	$ 331,324	331,323.75
7	Contingency (30%)	1	LS	$ 1,093,368	1,093,368.38
				TOTAL	**$ 4,738,000.00**

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ENGINEERS OPINION OF PROBABLE COST FOR NW Ocala Wastewater Model Alternative 3 Improvements						
ITEM	**DESCRIPTION**	**QUANTITY**		**UNIT PRICE**		**AMOUNT**
1	Replace LS 132 (includes new pumps, electrical panel, electrical service and wetwell)	1	LS	$	959,000	959,000.00
2	Replace LS 138 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$	1,080,000	1,080,000.00
3	Upgrade LS 89 (includes new pumps, electrical panel, and electrical service)	1	LS	$	115,000	115,000.00
4	Upsize 4-inch FM to 8-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	1,950	LF	$	162	316,192.50
5	Extend 8-inch FM to existing 12-inch gravity main on SW 1st Ave (includes valves, fittings, and appurtenances)	900	LF	$	107	96,147.00
6	Upsize 8-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	4,900	LF	$	172	843,045.00
7	Engineering design and permitting (10%)	1	LS	$	340,938	340,938.45
8	Contingency (30%)	1	LS	$	1,125,097	1,125,096.89
					TOTAL	**$ 4,875,000.00**

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ENGINEERS OPINION OF PROBABLE COST
FOR
NW Ocala Wastewater Model
Alternative 4 Improvements

ITEM	DESCRIPTION	QUANTITY		UNIT PRICE		AMOUNT
1	Replace LS 132 (includes new pumps, electrical panel, electrical service and wetwell)	1	LS	$	1,469,000	1,469,000.00
2	Replace LS 138 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$	1,080,000	1,080,000.00
3	Upsize 4-inch FM to 8-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	1,950	LF	$	162	316,192.50
4	Upsize 6-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	5,900	LF	$	172	1,015,095.00
5	Upsize 8-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	9,750	LF	$	172	1,677,487.50
6	Engineering design and permitting (10%)	1	LS	$	555,778	555,777.50
7	Contingency (30%)	1	LS	$	1,834,066	1,834,065.75
					TOTAL	**$ 7,948,000.00**

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

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ENGINEERS OPINION OF PROBABLE COST
FOR
NW Ocala Wastewater Model
Alternative 5 Improvements

ITEM	DESCRIPTION	QUANTITY		UNIT PRICE		AMOUNT
1	Replace LS 132 (includes new pumps, electrical panel, electrical service and wetwell)	1	LS	$	1,469,000	1,469,000.00
2	Replace LS 138 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$	1,080,000	1,080,000.00
3	Replace LS 78 (includes new pumps, electrical electrical panel, electrical servicem and wetwell)	1	LS	$	872,000	872,000.00
4	Upsize 4-inch FM to 8-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	1,950	LF	$	162	316,192.50
5	Upsize 6-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	5,900	LF	$	172	1,015,095.00
6	Upsize 8-inch FM to 12-inch FM (includes valves, fittings, appurtenances, and removal of existing pipe)	9,750	LF	$	172	1,677,487.50
7	Construct 8-inch force main to manifold flows from LS 78 to 12-inch force main from LS 89 (includes valves, fittings, and appurtenances)	150	LF	$	107	16,024.50
8	Engineering design and permitting (10%)	1	LS	$	642,978	642,977.50
9	Contingency (30%)	1	LS	$	2,126,633	2,126,633.10
					TOTAL	**$ 9,215,000.00**

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.