Preliminary Report

CITY OF BEL AIRE

SEWER MASTER PLAN

PEC PROJECT NO. 35-220925-000-2564

AUGUST 2023

PREPARED BY
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1.0 Introduction

The City of Bel Aire retained the services of Professional Engineering Consultants to develop a working computer model of the City's sanitary sewer collection system and perform a detailed capacity analysis in order to prepare a plan for addressing current and projected future system deficiencies. This Sanitary Sewer Collection System Master Plan presents the information utilized to prepare the model, evaluation of the model to determine system deficiencies under current and projected future flows, and a summary of recommended system improvements.

1.1 Study Objective

The primary objective of this study is to determine sanitary sewer system improvements needed to address current system deficiencies and anticipated future conditions. This included analyzing potential flow growth and system expansion, collection piping, and pumping capabilities.

The computerized model of the collection system was developed using Autodesk Storm and Sanitary Analysis software. The model was analyzed to determine if there were adequate pipe capacities for current and future flows. This study presents an evaluation of alternatives to address current and anticipated future deficiencies. It also presents the necessary system expansion options required to serve the future growth areas. The study period for analysis of the collection system is twenty years (2043). Total project cost estimates were prepared for each recommended improvement for incorporation into the City's Capital Improvement Plan.

1.2 Scope of Study

This study includes the following elements:

- Description of the existing sanitary sewer collection system.
- Development of projected wastewater flows for a 20-year planning period based on projected development and historical wastewater flow data.
- Development of a computerized sanitary sewer model of the existing collection system with 10-inch piping and larger, and smaller piping as necessary.
- Calibration of the sanitary sewer based on field flow data collection information.
- Evaluation of the sanitary sewer model for current and projected peak flows to determine distribution system deficiencies.
- Development of system improvement alternatives and recommendations to address identified deficiencies and provide service to the growth areas.
- Development of preliminary construction cost estimates for recommended improvements.

2.0 Existing Sanitary Sewer System Overview

Figure 1 shows an overview of the City's sanitary sewer system which includes gravity lines, force mains, and lift stations. The City of Bel Aire's sanitary sewer system is split into a north drainage basin and a south drainage basin. The south drainage basin drains to a pump station located at Harding and 37th Street. The north basin drains to a lift station on 37th Street, east of Oliver Street. Both of these lift stations then pump to the Chisholm Creek Utility Authority (CCUA) wastewater treatment plant for treatment. The force mains from the lift stations combine near the intersection of Oliver Rd. and 53rd St. and are pumped to CCUA in a single 18" force main.

During times of high flow, drainage from the south drainage basin can "overflow" into an 18" gravity pipe and into the City of Wichita's sewer system. Based on flow data received from the City of Wichita, this 18" sanitary sewer line has an approximate available capacity of 1.25 MGD peak flow. The 37th lift station, 53rd lift station, and the 18" gravity pipe to Wichita are the three "discharging" locations for Bel Aire's sanitary sewer system. To get a better understanding of the overall condition of the City's sanitary sewer system, total historical flows from these three discharge locations, and projected sewer flows were determined.

3.0 Wastewater Flows

Current wastewater flows and flows for in-progress development must be determined to accurately analyze current system performance and identify improvements needed for future growth. Peak flows are typically utilized as the base demand for a sanitary sewer system.

An average flowrate is the total flow through the system in a given year evenly distributed throughout the entire year. Wastewater flows also typically follow a diurnal pattern during the day with low usage at night and peak usage in the early morning and early evening hours. The high flows during the early morning and early evening are due to the normal daily pattern of typical residential customer water use activities (showering, cooking, laundry, etc.). The highest flow observed due to this diurnal curve is referred to as the dry weather peak. In addition to this, sanitary sewer systems often experience significant inflow and infiltration (I&I). This is when rain or ground water enters the system. The peak flow rates due to I&I will be the highest flows the system has and is referred to as the wet weather peak. The wet weather peak is what is utilized for the capacity analysis of a wastewater system.

3.1 Historical Sewer Flows

The City provided historical daily flow information from 2017-2021 for both lift stations and the City of Wichita overflow meter. Using this data, total annual flow and average day flow from the City's sewer system was found by adding the daily flows from the lift stations and the overflow meter. The maximum day flows by year from both lift stations and the overflow are also provided in the table.

Table 1: Historical Sewer Flows Figure

Year	Total Annual Flow (MGY)	Average Day Flow (MGD)	Maximum Day Flow from Harding Lift Station (MGD)	Maximum Day Flow from 53rd St. Lift Station (MGD)	Maximum Day Flow from Gravity Discharge to Wichita (MGD)
2017	177.45	0.485	0.750	0.100	N/A
2018	196.18	0.537	0.825	0.112	N/A
2019	203.70	0.558	1.308	0.106	N/A
2020	211.35	0.577	1.150	0.147	0.002
2021	214.48	0.587	1.200	0.177	0.063

The approximate annual growth rate over this period is 4.91%. This growth is expected due to the steady and continual growth of the City's infrastructure. It is less than the growth rate seen with water use, which is likely due to water being utilized for irrigation purposes.

Since the City has seen significant growth over the last five years, the 2021 wastewater flows are likely a more accurate representation of the City's existing system compared to utilizing the average use of the five years.

Using the information above, the average max day factor for wastewater is 2.15.

A useful comparison when evaluating the sanitary sewer system is the percent return rate of water use. This provides an approximate percentage of water use that is returned to the wastewater system. The table below shows the City's wastewater and water use data from 2017 to 2022.

Table 2: Wastewater and Water Use

Year	Total Water Use (MG)	Total Wastewater Discharge (MG)	Percent Return Rate
2017	240.44	177.45	73.8%
2018	284.17	196.18	69.0%
2019	261.49	203.70	77.9%
2020	318.84	211.35	66.3%
2021	314.71	214.48	67.5%

The City's average percentage return rate over this period is 70.9%. This is on the lower end of the typical return rate of 65-85%. The highest percent return rate occurred in 2019 with a return rate of 77.9%. This higher return rate in 2019 has been consistent with other cities. The high number of rain events would cause an increase of I&I into the system.

3.2 Projected Wastewater Flows

Through discussions with the City and review of the City's comprehensive plan, all current and planned development areas were identified. A visual representation of the development areas is shown in Figure 2. Projections for future wastewater flows from these developments were calculated using a scenario-based approach, where scenarios were designated as follows:

- **Scenario 1:** In-Progress Development
- **Scenario 2:** Planned Development
- **Scenario 3:** Full Comprehensive Plan Growth

The projected flows were calculated using Kansas Department of Health and Environment (KDHE) assumed flowrates based on the land use. The projected average demand for each growth area is shown in Table 3.

Table 3: Projected Flows of Growth Areas

Development		Lots/Area	Units	Projected Average Day Flows (GPD)
1	Homestead Senior Living	120	Lots	34,340
2	Chapel Landing, Phase 2	40	Lots	11,447
3	Prairie Preserve	12	Lots	3,434
4	Chapel Landing 6th	50	Lots	14,308
5	Chapel Landing 3rd	86	Lots	24,610
6	Bristol Hollows	122	Lots	34,912
7	Chapel Landing 5th	113	Lots	32,336
8	Chapel Landing	58	Lots	16,597
9	Chapel Landing 4th	12	Lots	3,434
10	Chapel Landing 2nd	0	Lots	0
11	Central Park 3rd	69	Lots	19,745
12	Villas at Prestwick	36	Lots	10,302
13	Elk Creek	37	Lots	10,588
14	Courtyards at Elk Creek*	0	Lots	0
15	Elk Creek 2nd	9	Lots	2,575
16	Elk Creek 3rd	10	Lots	2,862
17	Deer Run	130	Lots	37,201
18	Rock Spring*	0	Lots	0
19	Rock Spring	23	Lots	6,582
20	Rock Spring 2nd*	0	Lots	0
21	Rock Spring 3rd	112	Lots	32,050
22	Sham Way Estate	213	Lots	60,953
23	Cedar Pass (Rock Spring 5th)	177	Lots	50,651
24	Rock Spring 4th	108	Lots	30,906
25	Skyview at Block 49	108	Lots	30,906
26	Skyview at Block 49 2nd	90	Lots	25,755
27	Skyview at Block 49 3rd	16	Acres	15,521
28	Tierra Verde	60	Acres	100,000
29	Bel Aire Industrial Park	60	Acres	200,000
30	Sunflower Commerce Park	87	Acres	145,000
31	Sunflower Commerce Park 2nd	65	Acres	108,333
32	Integra Technologies	-	-	1.2/2.4M
A1	Residential	160	Acres	155,207
A2	Commercial	40	Acres	66,667
A3	Commercial	80	Acres	133,333
A4	Light Industrial	240	Acres	400,000
A5	Commercial	320	Acres	533,333

A6	Light Industrial	160	Acres	266,667
A7	Commercial	40	Acres	66,667

**Due to the amount of lots already developed by the end of 2022, it was assumed that the demand associated with this development was already captured in the baseline demand data.*

Scenario 1 development areas represent the developments in progress of construction with individual lots expected to be developed within the next 1-2 years. The majority of these developments are residential. The City's existing flows (2022 use) and the projected flows from the Scenario 1 developments (which were calculated based on lot counts) were added together to get a total Scenario 1 flowrate. The Scenario 1 analysis will analyze the system based on this combined demand.

Scenario 2 development areas represent the developments that are planned/platted but individual lots are expected to be developed in approximately 5 years. The flows for the Scenario 2 developments are based on residential lot counts or approximate commercial/ industrial areas. In addition, Scenario 2 also includes the flow of one new 0.6-MGD wastewater user, Integra Technologies (Integra), that the City will be adding to their system. The Scenario 2 total flow and system analysis will include existing flows, Scenario 1 developments, Scenario 2 developments, and Integra (0.6-MGD user).

Scenario 3 development areas were determined based on the remaining development in the "Preferred Balanced Growth Scenario" of the City's 2018 Comprehensive Plan and upgrading Integra to a 1.2-MGD user. These areas are expected to be developed within the next 20 years. The flows for the remaining comprehensive plan growth are based on approximate areas since the majority of the development was identified as being either commercial or industrial. The Scenario 3 total flow and system analysis will include existing flows, Scenario 1 developments, Scenario 2 developments, Scenario 3 developments, and Integra (1.2-MGD user).

A max day factor of 2.15 and a peaking factor of 3 was used to convert the average demands to max day and peak demands. The peaking factor of 3 is the typical peaking factor specified by KDHE for design. These were then utilized to develop the projections give an approximate increase in flows for the next phases of infrastructure improvements for the City.

Table 4: Cumulative Projected Flows

Phase	Cumulative ADD (MGD)	Cumulative MDD (MGD)	Cumulative PHD (MGD)
1	1.18	2.54	3.55
2	2.29	4.19	5.60
3	4.55	8.32	11.11

4.0 Wastewater Flow Monitoring

PEC engaged the services of Haynes Equipment to conduct flow monitoring at six manhole locations, with the aim of gathering flow data for model calibration. Flow information was collected over a span of 34 days from April 6th to May 9th, 2023. The flows were recorded at five-minute intervals to ensure a comprehensive dataset during this period. The data from the flow monitoring, along with GIS mapping of the system, was then utilized to develop a functional model of the City's sanitary sewer system. Figure 3 shows the six-meter locations and their respective metered collection basin areas. The table below shows the average day, peak flows, and peaking factors for each meter throughout the 34-day period. It should be noted that meters 5 and 6 experienced significant I&I on several days, which will be further discussed below. Consequently, the flowrates recorded during these two days of I&I were excluded from the average and peak flowrates presented in the Figure.

Table 5: Flow Meter Monitoring Results

	Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6
Average Flowrate (gpm)	44.62	24.83	204.96	54.10788	42.49	5.99
Peak Flowrate (gpm)	122.36	177.61	416.42	75.59	104.5	29.08
Peaking Factor	2.74	4.74	2.03	1.40	2.46	4.85

Meter 6 exhibited two notable instances of I&I during rain events on April 26 and April 28. The peak flowrates recorded on April 26 and 28 were 37.73 gallons per minute (gpm) and 160.4 gpm, respectively. If we exclude these two rain event days from the calculation of the average day flowrate, the average flowrate over the 34-day period at meter 6 amounted to 5.99 gpm. This implies that on April 26, a peaking factor of 6.29 was observed, while on April 28, a peaking factor of 26.73 occurred.

For areas in Bel Aire's system where the flow meter study did not collect data, a separate method was used to determine approximate average and peak flows. The total flow of meter areas 1-6 in Figure 3 were summed and multiplied to find the total approximate monthly flow. This value was approximately 13.69 MGD of total monthly flow. The total monthly flow found in CCUA's billing records for the month of April was 14.75 MGD. Therefore, the total flow unaccounted for in the flow study is approximately 1.06 MGD. The 1.06 MGD was then distributed using house counts and applied to the model at locations where the flow was not captured with the flow monitors.

5.0 Modeling

A comprehensive base sanitary sewer model was developed using Autodesk's Storm and Sanitary software to encompass all sanitary sewer lines exceeding 8" in diameter within the City of Bel Aire's system with the addition of some critical 8" lines. Figure 4 highlights all gravity lines that were modeled using these criteria. Accurate manhole locations were determined through the utilization of GPS equipment, while depths were measured using a laser distance measurer, referencing the top of the manhole rim. These depth measurements were then used to input flowlines into the model for each manhole, particularly in cases where plans or recorded flowline elevations were unavailable. Once all flowlines were inputted, slopes were generated to determine the capacities of each pipe. In instances where negative or missing slopes were encountered, extrapolation techniques were employed, deriving flowlines and slopes from the nearest downstream and upstream manholes.

Figure 5 shows the sanitary sewer subbasins of the City's system, based on interceptor and pump station locations. By considering the counts of residential and commercial buildings, the average day flows (inflows) from the wastewater flow monitoring study were proportionally allocated to each subbasin. Furthermore, the model allowed for adjustments to the 24-hour time patterns, tailoring the hourly flows based on the average inflow at each location. Time patterns were generated at each inflow point, approximating the patterns observed in the hourly flows from the flow monitoring study. The peak flowrate at each inflow location was positioned around the time of day when the peak was typically observed in the results of the flow monitoring study. This approach aimed to create a model that accurately represents Bel Aire's actual daily flow fluctuations and available capacities.

The results for each subbasin are also included in Figure 5. The results include the full/design pipe capacity from the model, full pipe capacity using KDHE’s minimum design slope, the peak flowrate, and the peak flowrate with a 1.7 factor. The 1.7 factor was found using the max monthly flow found from the last two years of City’s sanitary sewer billing data and comparing that to the total monthly flow from April 2023 (14.75 MG). The highest flow found in the last two years was from May 2022 which was 25.31 MG. Comparing this flow to the 14.75 MG April 2023 flow resulted in a factor of 1.7. This factor was then applied to the peak flows found from the model. This was done to show peak flows that the City could potentially see during a month with high volumes of flow.

The table below shows the approximate peak flow model results to each lift station in the City’s sanitary sewer system.

Table 6: Existing Flows to Lift Stations

Location	Peak Flow (gpm)
37th St. Lift Station	516.75
53rd St. Lift Station	139.48
Rock Rd. Lift Station	126.99
Sunflower Lift Station	5.47
Webb Rd. Lift Station	10.39
Oliver Rd. Lift Station	0

6.0 Future Development

Improvements to the sanitary sewer system are required to provide service to the identified development areas. Wastewater infrastructure improvements are sized based off approximate peak flows expected from the proposed development. The tables below show these peak flows for each proposed improvement phase by location. They also include a proposed discharge/connection location for each development area. These discharge locations were chosen given the proximity to the development area and the available capacity in the pipe. For the proposed Integra development, a peak flow rate of 500 gpm was assumed for each phase.

Table 7: Phase 1 Peak Flows and Discharge Locations

Location	Peak Flow	Discharge Location
1	72	8” Gravity to Oliver LS
2	24	8” Gravity to Oliver LS
3	7	8” Gravity to Oliver LS
4	30	10” Gravity to 53rd LS
5	51	10” Gravity to 53rd LS
6	83	10” Gravity to 53rd LS
7	67	10” Gravity to 53rd LS
8	35	10” Gravity to 53rd LS
9	7	10” Gravity to 53rd LS
10	0	10” Gravity to 53rd LS
11	41	8” Gravity to 37th LS
12	21	10” Gravity to Rock Rd LS
13	22	15” Gravity to Rock Rd LS
14	0	15” Gravity to Rock Rd LS
15	5	15” Gravity to Rock Rd LS
16	6	15” Gravity to Rock Rd LS
17	78	18” Gravity to Rock Rd LS
18	0	12” Gravity to 18” Gravity to Rock Rd LS
19	14	12” Gravity to 18” Gravity to Rock Rd LS
20	0	12” Gravity to 18” Gravity to Rock Rd LS
21	67	8” Gravity to Webb Rd LS
23	106	10” Gravity to Webb Rd LS
24	64	8” Gravity to Webb Rd LS
25	64	10” Gravity to Rock Rd LS
26	54	10” Gravity to Rock Rd LS
27	32	10” Gravity to Rock Rd LS
30	303	10” Gravity to Rock Rd LS

Table 8: Phase 1 Total Future Flows to Existing Lift Stations

Location	Peak Flow (GPM)
Total Future Flow to Rock Rd LS	836
Total Future Flow to 53rd LS	1,202
Total Future Flow to Webb Rd LS	237
Total Future Flow to Oliver Rd LS	103

Table 9: Phase 2 Peak Flows and Discharge Locations

Location	Peak Flow	Discharge Location
Integra Phase 1	500	Webb/Treatment Plant
22	127	10" Gravity to Webb Rd LS
28	208	15" Gravity to Rock Rd LS
29	417	15" Gravity to Rock Rd LS
31	226	Webb/Treatment Plant

Table 10: Phase 2 Total Future Flows to Existing Lift Stations

Location	Peak Flow (GPM)
Total Future Flow to Rock Rd LS	625
Total Future Flow to Webb Rd LS	853
Total Future Flow to 53rd Rd LS	1478

Table 11: Phase 3 Peak Flows and Discharge Locations

Location	Peak Flow	Discharge Location
Integra Phase 2	500	Webb/Treatment Plant
A1	100	10" Gravity to Oliver Rd LS
A2	139	18" Gravity to 53rd LS
A3	278	To Webb Rd LS
A4	833	Webb/Treatment Plant
A5	1,111	Webb/Treatment Plant
A6	556	Webb/Treatment Plant
A7	69	Subbasin 4A

Table 12: Phase 3 Total Future Flows to Existing Lift Stations

Location	Peak Flow (GPM)
Total Future Flow to 53rd LS	3,517
Total Future Flow to Webb Rd LS/Treatment Plant	3,278

7.0 Future Improvement Options

Using the approximate peak flows in the tables in section 6.0, locations and sizes for improvements to the City's sanitary sewer infrastructure were developed. Figures 6-8 show 3 options for improvements to the sanitary sewer system to serve future growth. The proposed improvements primarily serve areas to the north and east sides of the City's limits where most of the development is expected to occur.

7.1 Improvement Option 1: All Flow to CCUA

Improvement option 1 proposes improvements to direct all flow to CCUA, as shown in Figure 6. This continues the City's current discharge method of taking all flow to CCUA. The ability of the CCUA WWTF's ability to treat this additional flow will have to be determined. The improvements consist of a 30"/24" gravity interceptor to serve areas A3-A6 and area 31. The 30"/24" interceptor would flow to a new and up-sized Webb Rd. lift station. This new lift station would be located in approximately the same location as the existing Webb Rd. lift station and would serve all existing areas served by the lift station as well as the new Integra development and the proposed 30" gravity interceptor. The peak flow to the new lift station would be approximately 4,370 gpm. The lift station would then pump through a new 16" force main and tie into the existing 53rd lift station. The 53rd St. lift station would need to be either up sized or modified to accommodate this additional flow. Included in this improvement option are a couple of smaller recommended improvements to serve areas A7 and areas 28 and 29. For area A7, a new 8" gravity extension from existing infrastructure to the west is proposed. Areas 28 and 29 have an existing 8" accessible for these areas. Using the KDHE minimum design calculations, the peak flow rate will exceed the capacity of an 8" pipe at minimum slope. It is recommended to monitor this 8" line as these areas develop to determine the need to upsize this line.

7.2 Improvement Option 2: WWTF

Improvement option 2 includes improvements to serve all proposed areas with a new 2.07 MGD treatment plant located in the approximate area shown in Figure 7. The new treatment plant would serve areas 20-20, 31-32, and A3-A6. A new 30"/24" interceptor would serve the new development to the south. A new 21" interceptor would serve the new Integra development as well as serve all the areas currently expected to be directed to the Webb Road lift station. The Webb Road lift station could then be decommissioned or removed as needed by the City. The same improvements as shown in Figure 6 for the areas A7, 28, and 29 are also shown on Figure 7.

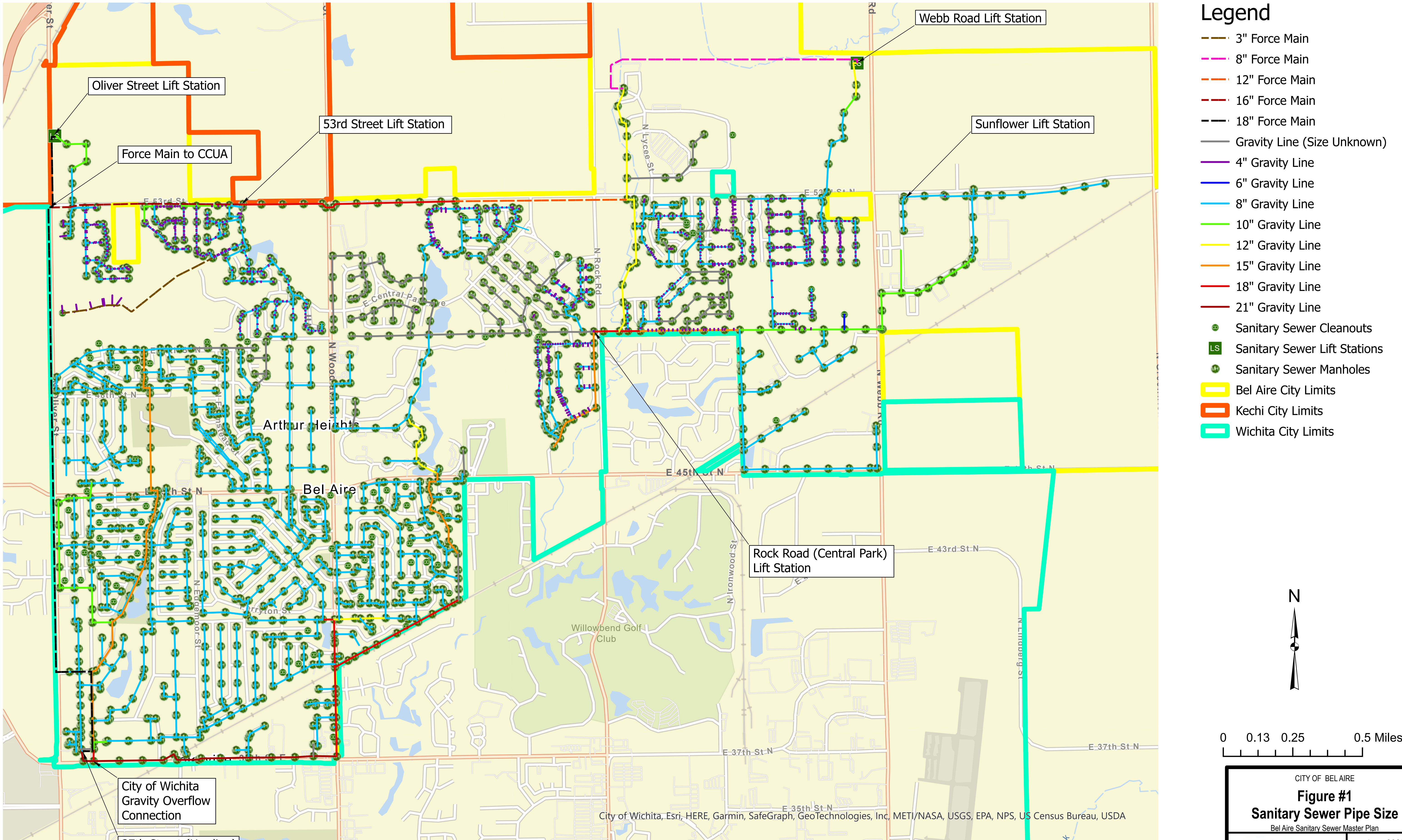
7.3 Improvement Option 3: City of Wichita Discharge Connection & CCUA

The last option proposes split flow to CCUA and the City of Wichita as shown in Figure 8. This is done to reduce the amount of additional flow that CCUA would have to be to treat. A new 1,000 gpm lift station is proposed on the east side of the new Integra location. This lift station would serve the new Integra development and pump through a new 8" force main to the City of Wichita's sanitary sewer system. The tie-in location to the City of Wichita's system is proposed to occur in the Willbend Golf Club and tie into an existing 24" gravity interceptor. The City of Wichita will need to verify the ability of the interceptor to receive this additional flow. The remaining future development areas on the east side of town would be served by a new 30"/24" interceptor that would flow to the Webb Rd. lift station. Similar to Improvement Option 1, this lift station would need to be upsized to be able to handle an approximate peak flow of 3,300 gpm. The new Webb Rd. lift station would then pump through a new 16" force main and discharge into the existing 53rd St. lift station. The 53rd St. lift station would need to be upsized and modified to accommodate this additional flow to CCUA. The CCUA will need to evaluate their ability to receive this additional flow.

8.0 Cost Estimates

Cost estimates are to be provided in the final report.

Figures



CITY OF BEL AIRE

Figure #1

Sanitary Sewer Pipe Size

Bel Aire Sanitary Sewer Master Plan

June 2023

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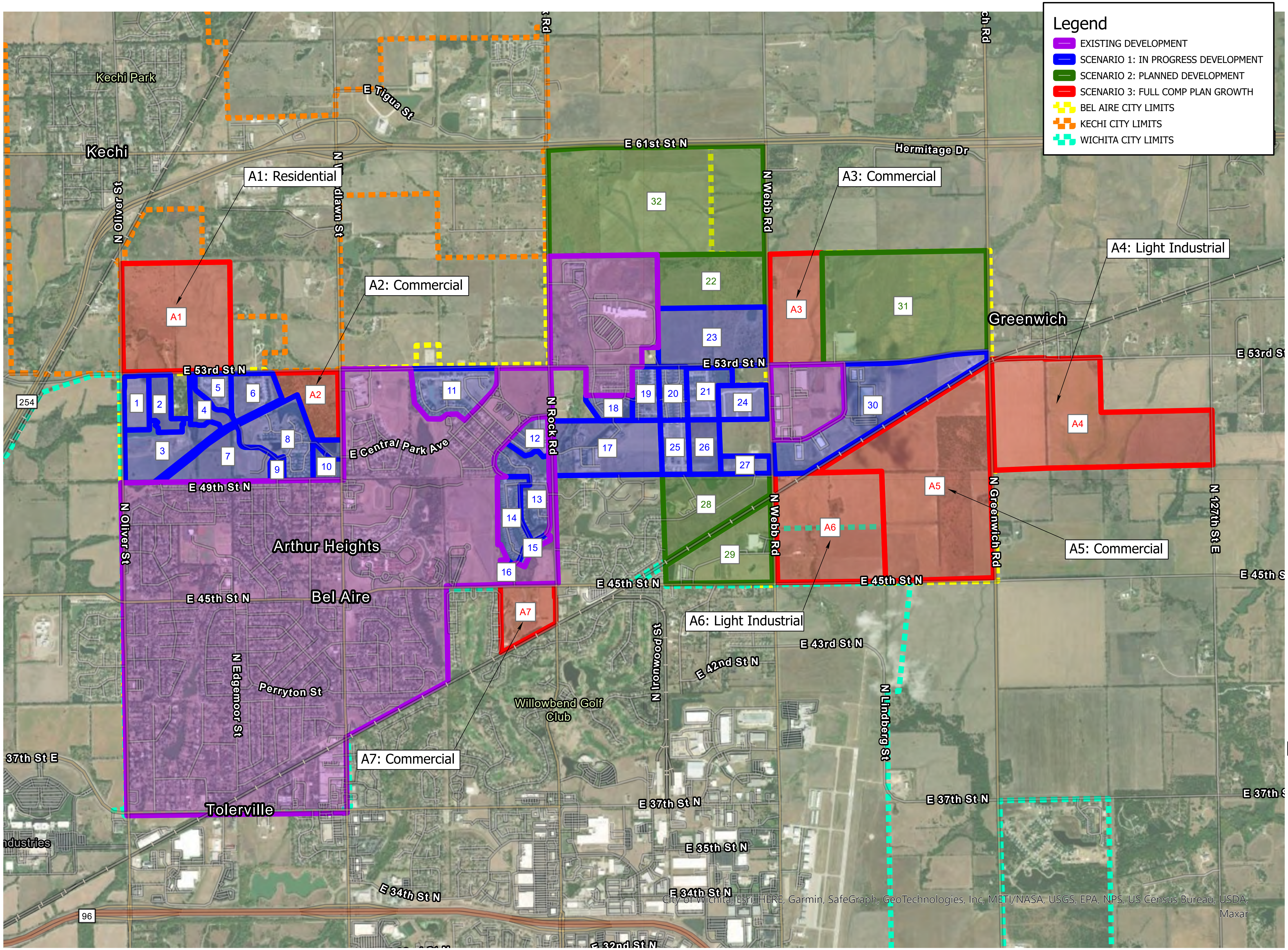

NUMBER	DEVELOPMENT NAME
1	Homstead Senior Landing
2	Chapel Landing, Phase 2
3	Prairie Preserve
4	Chapel Landing 6th
5	Chapel Landing 3rd
6	Bristol Hollows
7	Chapel Landing 5th
8	Chapel Landing
9	Chapel Landing 4th
10	Chapel Landing 2nd
11	Central Park 3rd
12	Villas at Prestwick
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14	Courtyards at Elk Creek
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16	Elk Creek 3rd
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19	Rock Spring
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22	Sham Way Estate
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24	Rock Spring 4th
25	Skyview at Block 49
26	Skyview at Block 49 2nd
27	Skyview at Block 49 3rd
28	Tierra Verde
29	Bel Aire Industrial Park
30	Sunflower Commerce Park
31	Sunflower Commerce Park 2nd
32	Integra Technologies

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Figure #2
Development Map

Bel Aire Sewer Master Plan

Bel Aire PEC

May 2023

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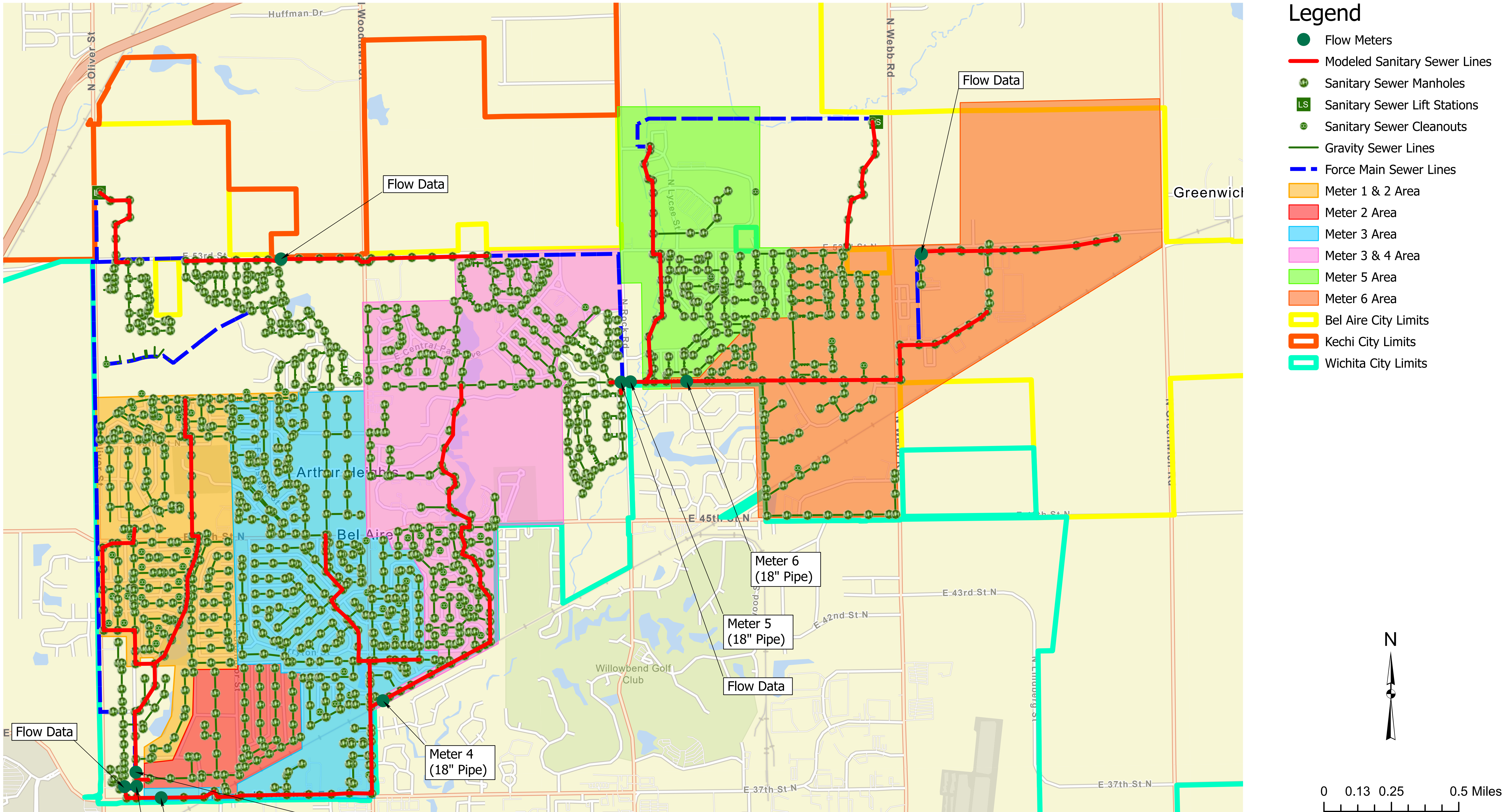

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Figure #3

Meter Location and Areas

Bel Aire Sanitary Sewer Master Plan

June 2023

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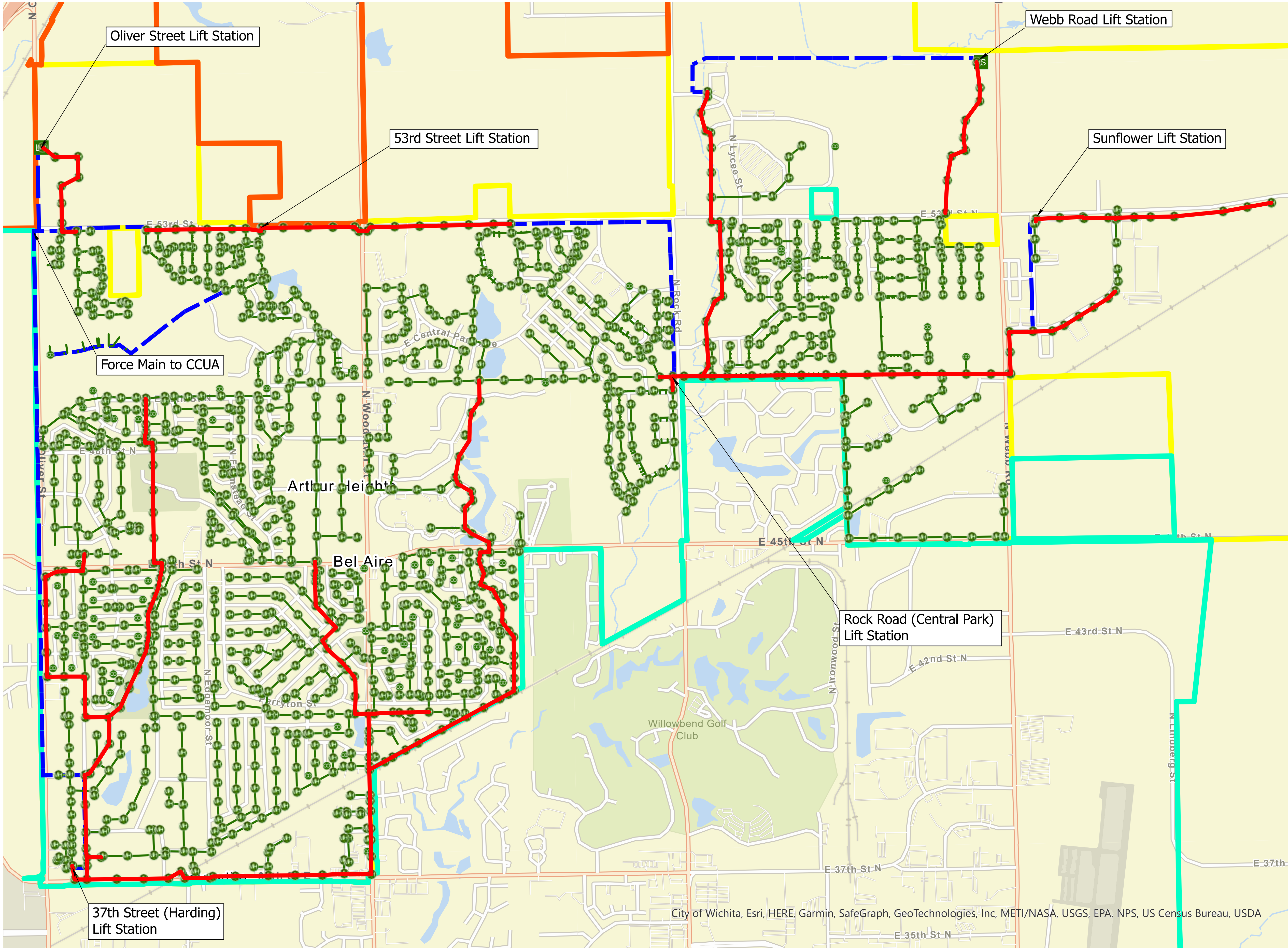

Legend

- Modeled Sanitary Sewer Lines
- Sanitary Sewer Manholes
- Sanitary Sewer Lift Stations
- Sanitary Sewer Cleanouts
- Gravity Sewer Lines
- Force Main Sewer Lines
- Bel Aire City Limits
- Kechi City Limits
- Wichita City Limits

N

0 0.13 0.25 0.5 Miles

CITY OF BEL AIRE

Figure #4

Modeled Sanitary Sewer Lines

Bel Aire Sanitary Sewer Master Plan

Bel Aire PEC

June 2023

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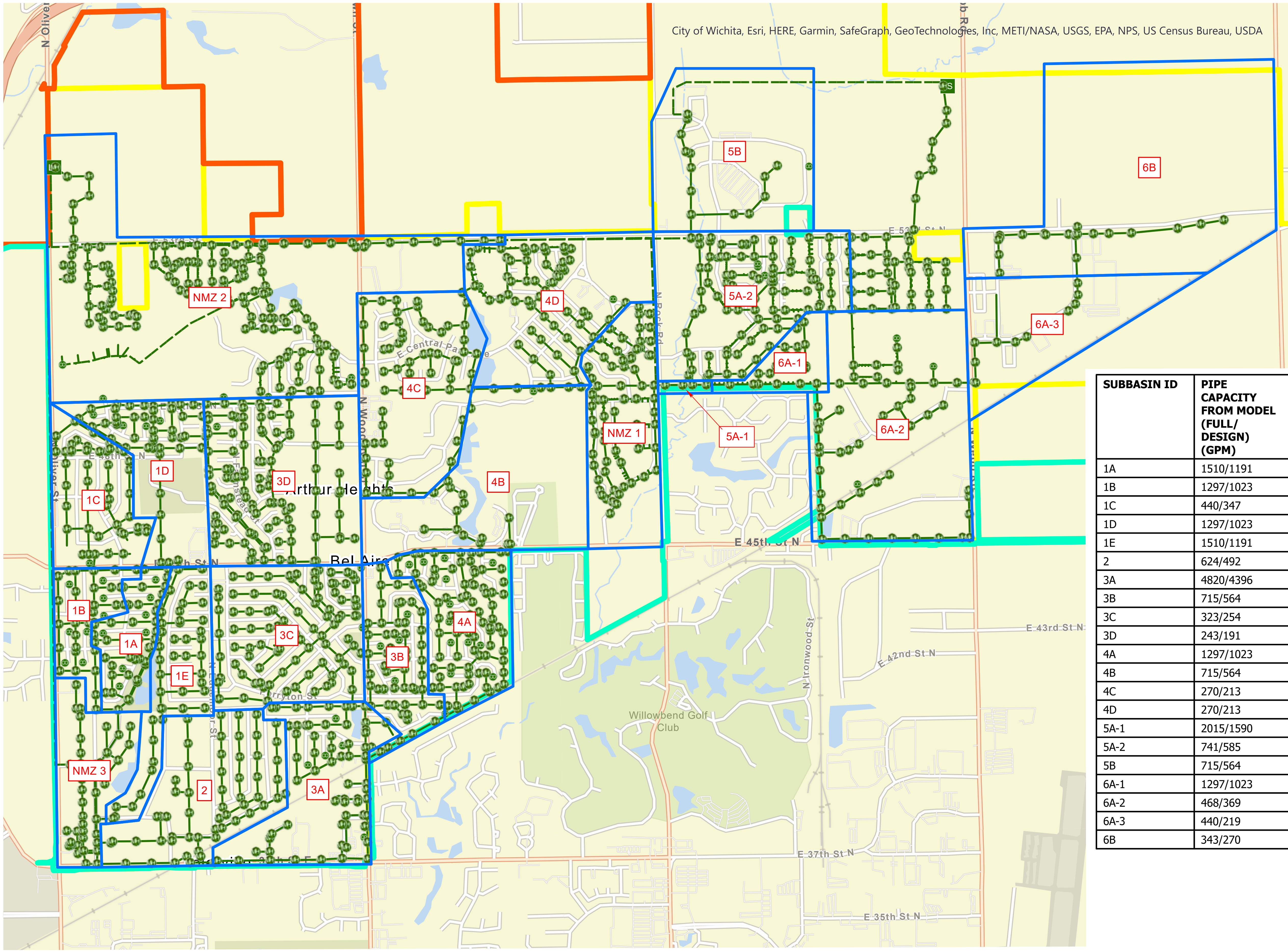

Legend

- Sanitary Sewer Basins
- Sanitary Sewer Manholes
- Sanitary Sewer Lift Stations
- Sanitary Sewer Cleanouts
- Gravity Sewer Lines
- Force Main Sewer Lines
- Bel Aire City Limits
- Kechi City Limits
- Wichita City Limits

N

0 0.13 0.25 0.5 Miles

SUBBASIN ID	PIPE CAPACITY FROM MODEL (FULL/ DESIGN) (GPM)	FULL PIPE CAPACITY USING KDHE MIN. SLOPE (GPM)	MODEL PEAK (GPM)	PEAK (WITH 1.7 FACTOR)
1A	1510/1191	1106	141	239
1B	1297/1023	1106	68	116
1C	440/347	491	26	44
1D	1297/1023	1106	25	42
1E	1510/1191	1106	141	239
2	624/492	491	130	221
3A	4820/4396	1595	518	881
3B	715/564	706	68	115
3C	323/254	344	85	145
3D	243/191	344	88	149
4A	1297/1023	1106	75	128
4B	715/564	706	46	78
4C	270/213	344	18	31
4D	270/213	344	18	31
5A-1	2015/1590	1106	94	159
5A-2	741/585	706	96	163
5B	715/564	706	24	41
6A-1	1297/1023	1106	26	44
6A-2	468/369	491	27	46
6A-3	440/219	344	32	47
6B	343/270	344	8	19

CITY OF BEL AIRE

Figure #5
Sanitary Sewer Sub Basins

Bel Aire Sanitary Sewer Master Plan

Bel Aire PEC

June 2023

Sht. 5 of 8

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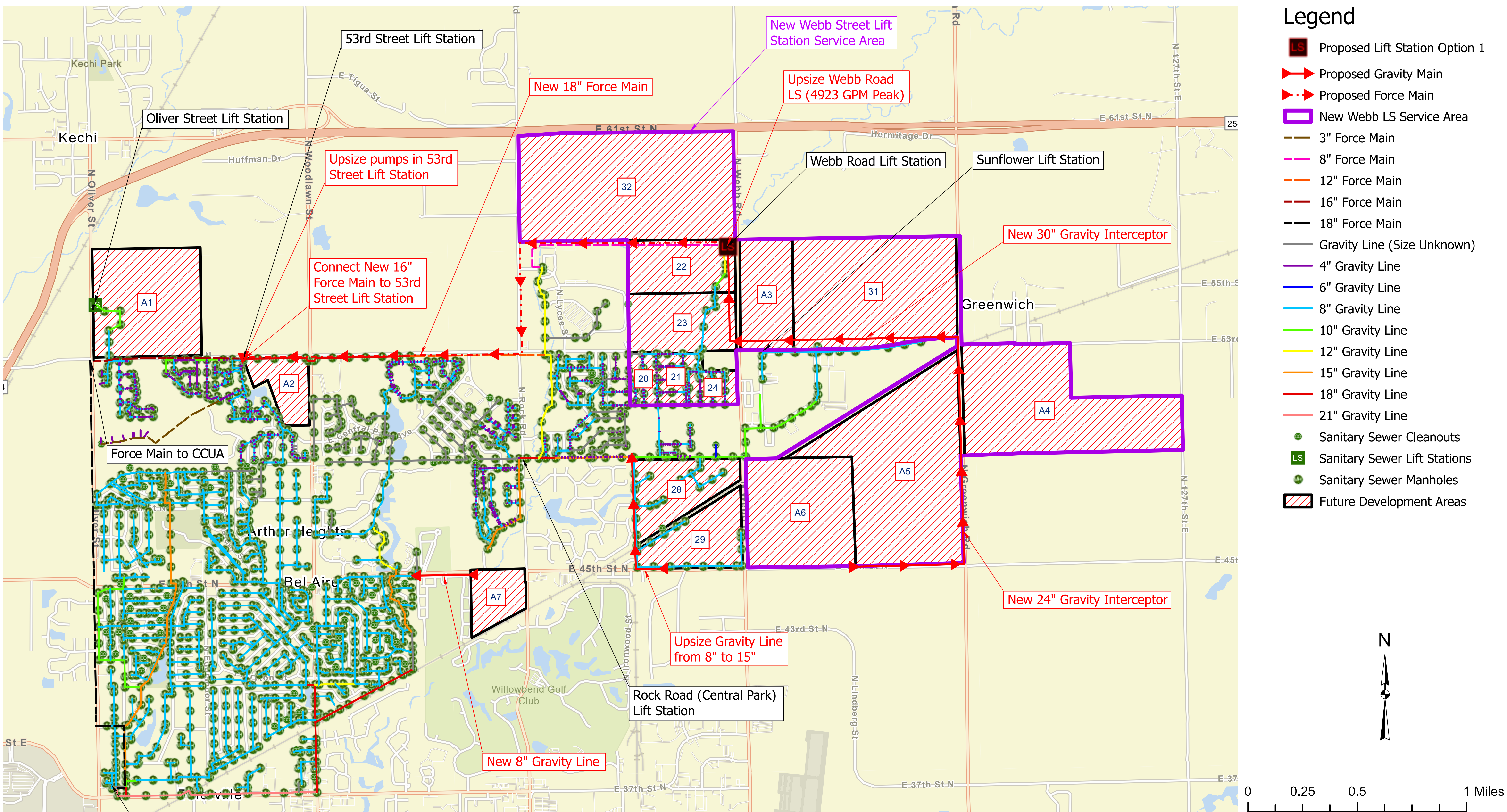

CITY OF BEL AIRE

Figure #6

Improvement Option 1

Bel Aire Sanitary Sewer Master Plan

Bel Aire | PEC

June 2023

Sht. 6 of 8

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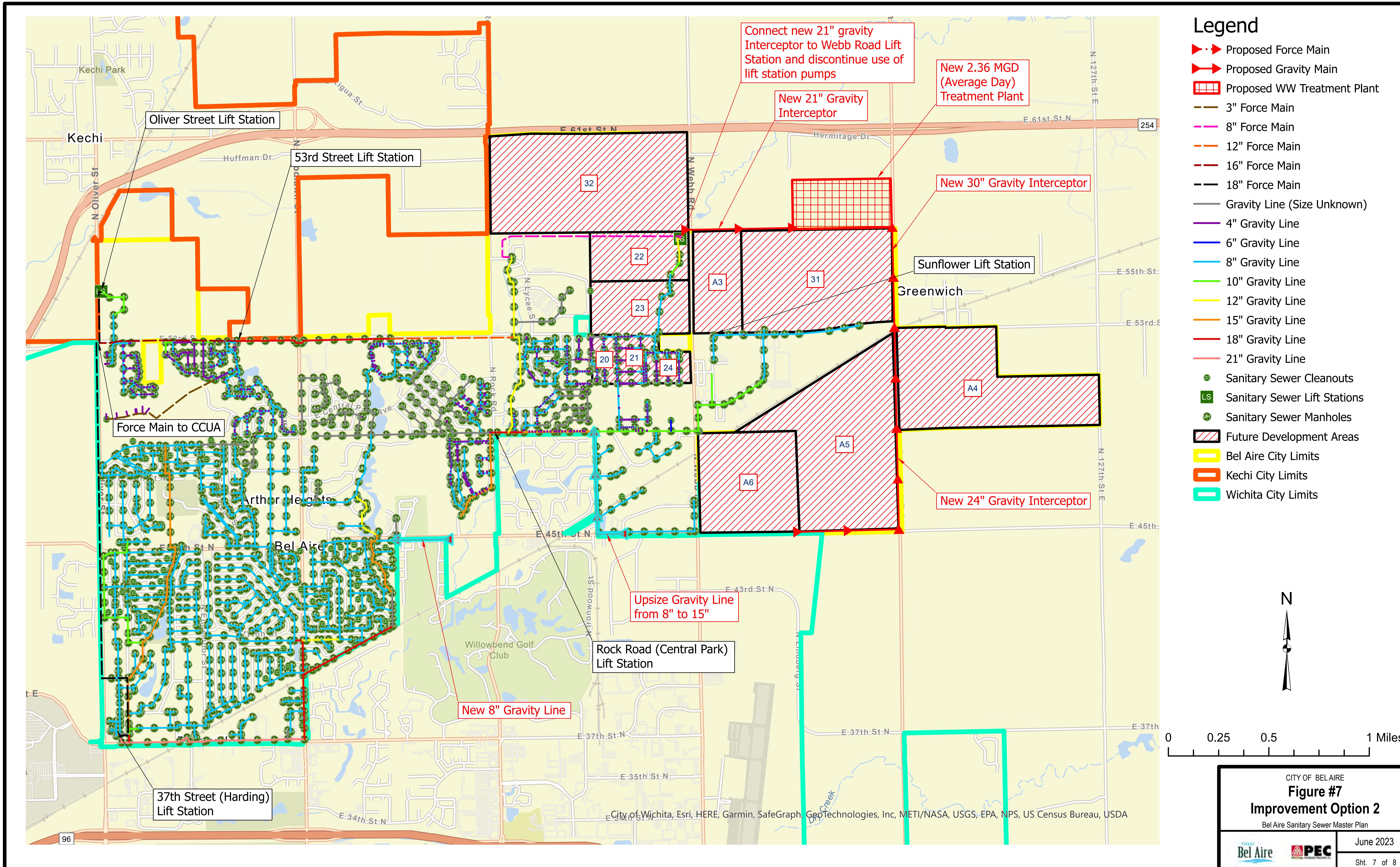

CITY OF BEL AIRE

Figure #7

Improvement Option 2

Bel Aire Sanitary Sewer Master Plan

June 2023

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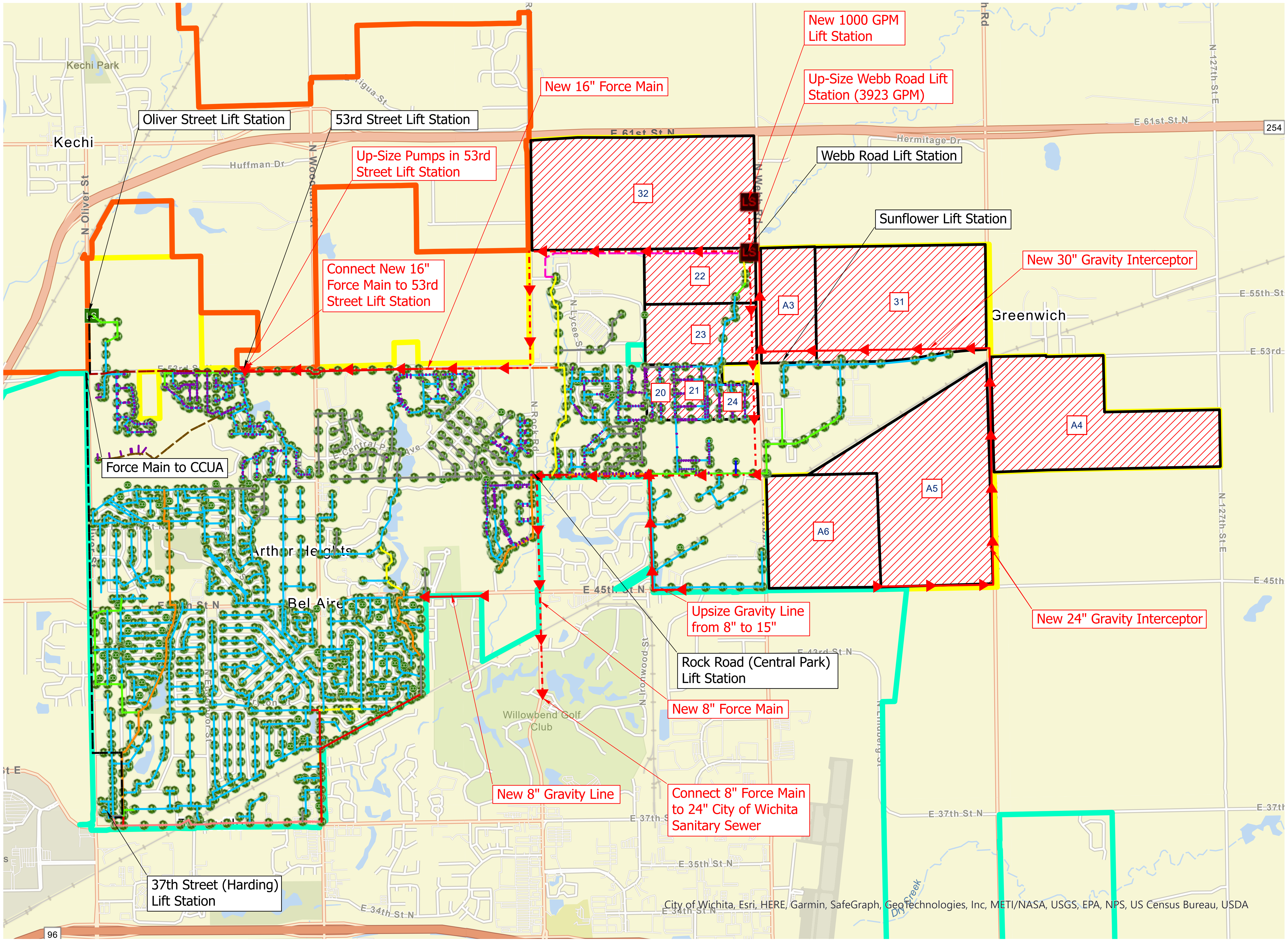

Legend

- Proposed Lift Station Option 3
- Proposed Force Main
- Proposed Gravity Main
- 3" Force Main
- 8" Force Main
- 12" Force Main
- 16" Force Main
- 18" Force Main
- Gravity Line (Size Unknown)
- 4" Gravity Line
- 6" Gravity Line
- 8" Gravity Line
- 10" Gravity Line
- 12" Gravity Line
- 15" Gravity Line
- 18" Gravity Line
- 21" Gravity Line
- Sanitary Sewer Cleanouts
- Sanitary Sewer Lift Stations
- Sanitary Sewer Manholes
- Future Development Areas
- Bel Aire City Limits
- Kechi City Limits
- Wichita City Limits

N

0 0.25 0.5 1 Miles

CITY OF BEL AIRE

Figure #8

Improvement Option 3

Bel Aire Sanitary Sewer Master Plan

June 2023

Sht. 8 of 8

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