1 Executive Summary

1.1 Master Plan Purpose

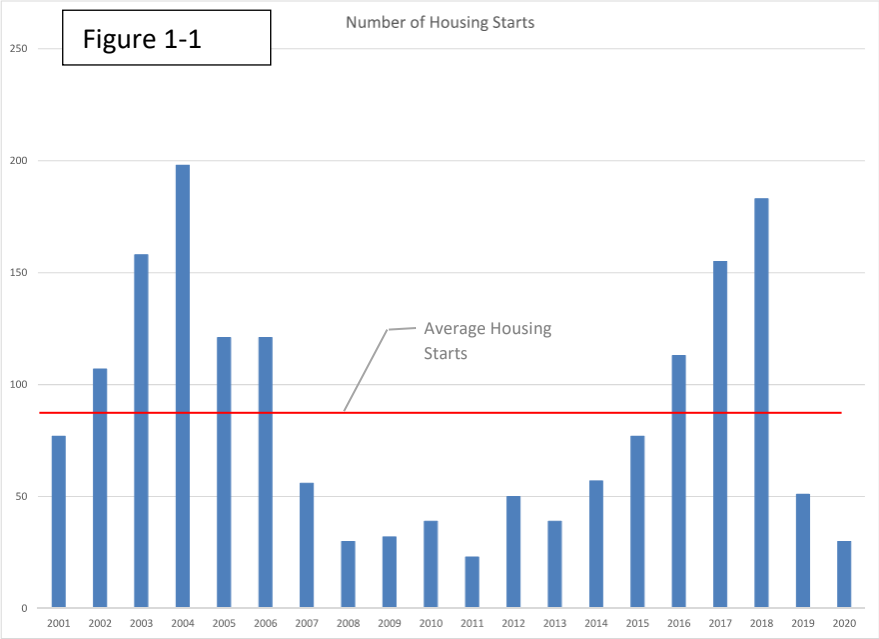
HDR Engineering Inc. was retained by the City of Smithville to prepare a Wastewater Master Plan. The Master Plan summarizes HDR's assessment of the City of Smithville's Wastewater Treatment Plant (WWTP) and collection and conveyance system, including pump stations, force mains, and major gravity interceptors. The purpose of this Master Plan is to:

- Define and prioritize wastewater infrastructure improvement needs within the next ten years related to growth and capacity upgrades and regulatory requirements
- Develop a long term, "ultimate", collection system plan that prioritizes a gravity collection system that eliminates many of the City's 36 existing pump stations and minimizes the need for future pump stations.

HDR's findings and recommendations are summarized below.

1.2 Wastewater Flow Projections

Wastewater flow is directly related to population growth and anticipated development. Historical city growth can be correlated to housing permits issued each year. Figure 1-1 summarizes building permits for residential houses in Smithville for the last 20 years.



Housing starts have fluctuated significantly with the economy, but overall have averaged 89 per year between 2001 and 2019. At an average of 2.7 persons/residence this equates to an increased population of 240 persons/year. At this average, the ten year

projected residential growth rate would be 2,400 additional residents between 2020 and 2030. This methodology was compared to recommendations from the Comprehensive Plan prepared by Stover & Associates, updated July 1, 2020. This plan projected a population growth of between 3,500 to 4,500 new residents between 2020 and 2030. For the purposes of this Master Plan, conservatively, it is assumed about 4,500 new residents will be added in the 10-year wastewater analysis.

For the ultimate scenario, it was assumed the entire City was developed according to the current zoning. In addition, the areas where projected annexation is anticipated was added to the ultimate development scenario. Residential density was assumed to match closely with current conditions, which averages 3 houses per acre and 2.7 residents per house.

Based on these criteria, the total ultimate population is shown in Table 1.

TABLE 1 PROJECTED 10 YEAR AND ULTIMATE POPULATION PROJECTIONS	Estimated Population Growth	Cumulative Population
Estimated 2020 Population	--	10,764
0-10 Year Growth	4,472	15,236
Ultimate Growth (within current City Limits)	50,278	65,514
Ultimate Growth (outside current City Limits)	12,659	78,173

It is unlikely these populations will be obtained in the foreseeable future, but for planning purposes, these projections were used to determine the ultimate wastewater flow rates. These flow rates were utilized to size the future main interceptor sewers.

1.3 Wastewater Treatment Plant

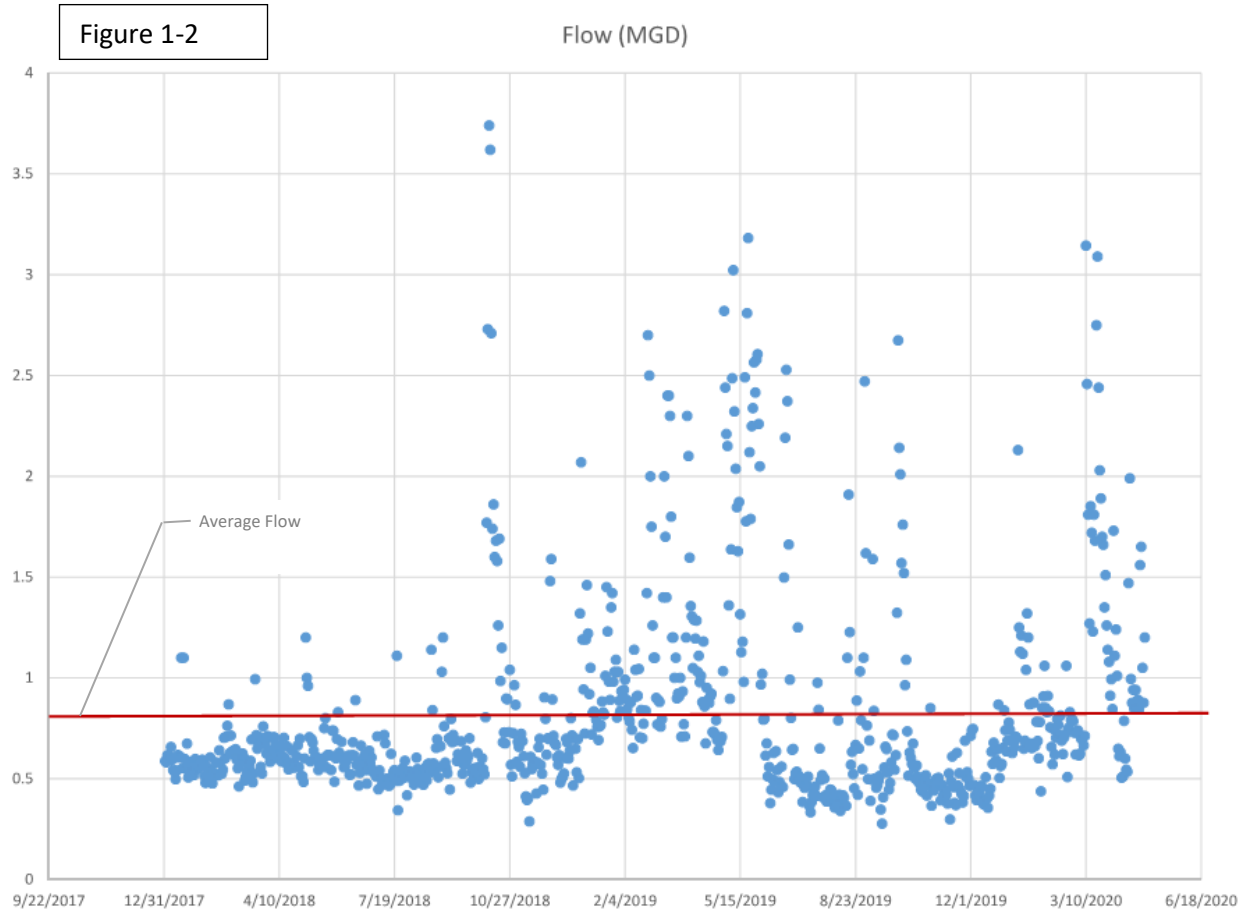
The existing wastewater treatment plant utilizes the activated sludge process using Sequencing Batch Reactor (SBR) technology. The plant was originally constructed in 1995 and replaced an existing lagoon system. An expansion was completed to increase the capacity of the WWTP to a 1.125 MGD average daily flow in 2007. The WWTP consists of an influent pump station, Headworks facility, three SBR basins,

UV disinfection, effluent pumping, two sludge digester basins, and an excess flow holding tank to store peak flows during wet weather events.

1.3.1 Existing Flows

Daily Monitoring Reports (DMRs) were analyzed to determine the current flows at the WWTP from January 2018 to May 2020. The following graph summarizes the influent flows analyzed for this facility.

Figure 1-2



Based upon the evaluation, the average daily flow and peak daily flow are as follows:

- Average Daily Flow = 0.70 mgd
- Peak Daily Flow = 3.7 mgd

1.3.2 Treatment Plant Capacity Evaluation

A summary of the hydraulic capacity of each component within the liquid train is shown in the table below.

TABLE 2 HYDRAULIC CAPACITY OF THE EXISTING WWTP COMPONENTS	
Component	Hydraulic Capacity (MGD)
Influent Pump Station	
Dry Weather Pumps	4.0
Wet Weather Pumps	5.0
Headworks	
Bar Screen	6.0
Sequencing Batch Reactors (SBRs)	
Average Daily Flow, each basin	0.375
Peak Instantaneous Flow, each basin	1.315
Total Average Daily Flow, 3 basins	1.125
Total Peak Instantaneous Flow, 3 basins	3.95
UV Disinfection	6.0
Effluent Pumping	7.9
Excess Flow Holding Tank (1.2 MG)	5.0

1.3.3 Existing and Proposed Effluent Limits

The Smithville WWTP operates under the Missouri Department of Natural Resources (MDNR) Permit Number MO-0055204 and discharges to the Little Platte River. The facility's effluent limits are based on several factors including, but not limited to, the design flow, mixing assumptions with the receiving stream, criteria designed to protect designated uses in the receiving stream, and effluent regulations. Because these factors can change over time, existing permit limits will likely differ from those in the future. Projected effluent limits for existing and future conditions are discussed below. For purposes of this document, estimated future effluent limits are projected for the year 2030.

TABLE 3 CURRENT EFFLUENT LIMITS FOR THE EXISTING SMITHVILLE WWTP			
Parameter	Daily Maximum	Weekly Average	Monthly Average
Outfall #001			
BOD_5 (mg/L)	-	45	30
TSS (mg/L)	-	45	30
NH_3 (November 1 – April 30) (mg/L)	11.5	-	3.2
NH_3 (May 1 – October 31) (mg/L)	12.4	-	5.6
Oil & Grease (mg/L)	15	-	10
Fecal Coliform (#/100ml)	-	1030	206

The most recent permit for the Smithville WWTP expired on June 30, 2020. It is anticipated that MDNR will renew this permit by the end of 2020. With the exception of ammonia, it is anticipated that permit limits will remain unchanged at permit renewal. Projected effluent limits for the renewed permit are included in the table below. However, these could potentially be increased if the City elects to pursue site-specific temperature and pH assumptions during the permit renewal period. It is recommended that the City work with MDNR during the permit review to negotiate less stringent effluent limits.

TABLE 4
ANTICIPATED EFFLUENT LIMITS FOR THE EXISTING SMITHVILLE WWTP

Parameter	Daily Maximum	Weekly Average	Monthly Average
BOD_5 (mg/L)	-	45	30
TSS (mg/L)	-	45	30
E. coli (#/100ml)	-	1030	206
Oil & Grease (mg/L)	15	-	10
pH (SU)	6-9	-	6-9
Total Phosphorus (mg/L)	*	-	*
Total Nitrogen (mg/L)	*	-	*
Ammonia as N (January) (mg/L)	8.6	-	4.7
Ammonia as N (February) (mg/L)	8.6	-	4.7
Ammonia as N (March) (mg/L)	8.6	-	4.7
Ammonia as N (April) (mg/L)	7.1	-	3.7
Ammonia as N (May) (mg/L)	7.6	-	3.3
Ammonia as N (June) (mg/L)	7.1	-	2.0
Ammonia as N (July) (mg/L)	7.1	-	1.7
Ammonia as N (August) (mg/L)	8.6	-	2.0
Ammonia as N (September) (mg/L)	7.1	-	2.3
Ammonia as N (October) (mg/L)	7.1	-	3.7
Ammonia as N (November) (mg/L)	8.6	-	4.7
Ammonia as N (December) (mg/L)	8.6	-	4.7

*Monitoring only

Potential future effluent limits for the year 2030 were projected based on an expanded design flow of 1.5 MGD. Major considerations for projecting future limits included updated ammonia criteria, potential nutrient removal requirements, and antidegradation. The 2030 potential future effluent limits are summarized in the table below.

TABLE 5
POTENTIAL FUTURE LIMITS FOR THE EXPANDED SMITHVILLE WWTP

Parameter	Daily Maximum	Weekly Average	Monthly Average
BOD_5 (mg/L)	-	15-34	10-23
TSS (mg/L)	-	15-34	10-23
E. coli (#/100ml)	-	1030	206
Oil & Grease (mg/L)	15	-	10
pH (SU)	6-9	-	6-9
Total Phosphorus (mg/L)	-	-	0.5 – 1.0
Total Nitrogen (mg/L)	-	-	8 - 10
Ammonia as N (January) (mg/L)	9.0	-	3.1
Ammonia as N (February) (mg/L)	9.0	-	3.1
Ammonia as N (March) (mg/L)	9.0	-	2.7
Ammonia as N (April) (mg/L)	4.7	-	1.5
Ammonia as N (May) (mg/L)	3.9	-	1.3
Ammonia as N (June) (mg/L)	2.0	-	0.8
Ammonia as N (July) (mg/L)	1.6	-	0.7
Ammonia as N (August) (mg/L)	2.0	-	0.8
Ammonia as N (September) (mg/L)	2.5	-	0.9
Ammonia as N (October) (mg/L)	4.6	-	1.5
Ammonia as N (November) (mg/L)	8.9	-	2.5
Ammonia as N (December) (mg/L)	9.0	-	3.1

*It is unclear at this time whether nutrient limits would apply as an average monthly or average annual limit.

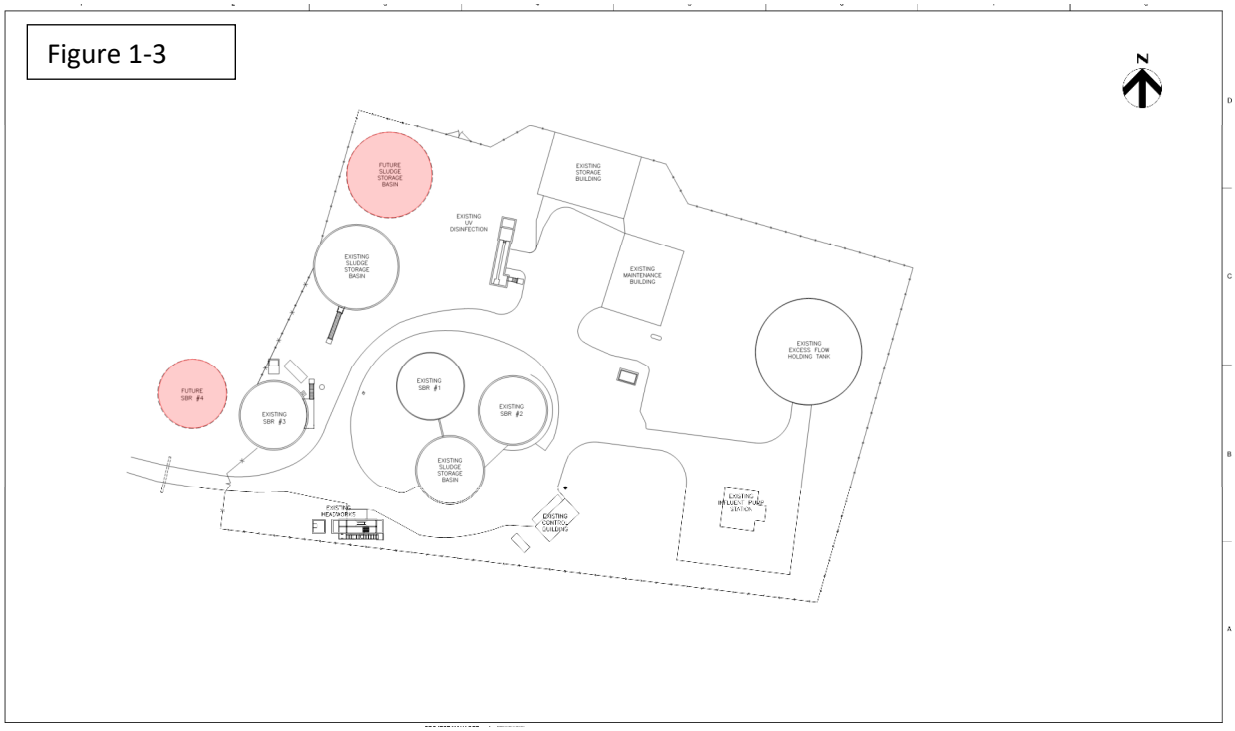
1.3.4 Future Wastewater Service

For ease of construction and cost, two phases for expansion were developed for this alternative. They are:

- Phase I – 0.375 MGD Expansion, 1.5 MGD Total Plant Capacity
- Phase II – 0.375 MGD Expansion, 2.25 MGD Total Plant Capacity

The Phase I expansion, indicated in the figure below, includes expanding the existing plant utilizing Sequencing Batch Reactor treatment technology. The land west of the existing site must be utilized for plant expansion. A fourth SBR basin is required as well as upgrades to the influent valve vault, effluent valve vault, and the addition of an additional sludge storage tank. As shown in the capacity evaluation above, the existing influent pump station, bar screen, UV disinfection, and effluent pump station have sufficient hydraulic capacity to meet the Phase I expansion.

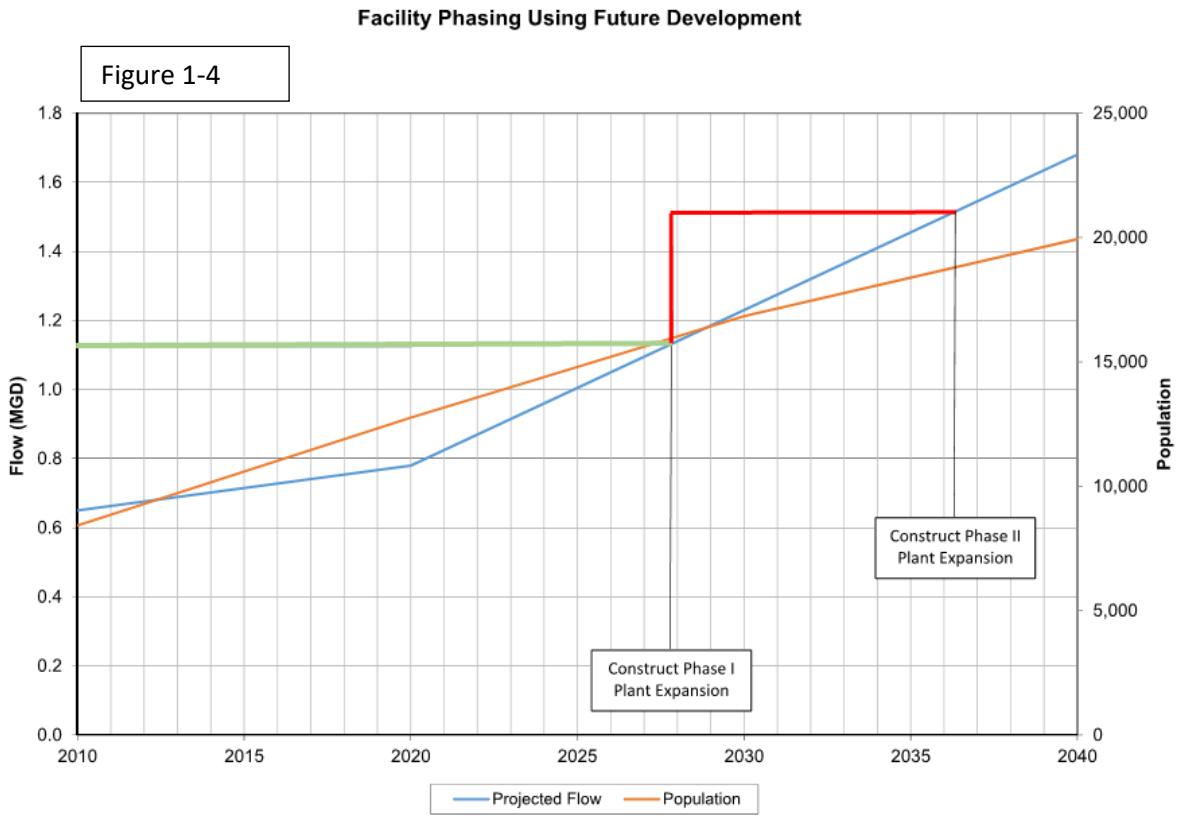
Figure 1-3



Phase II expansion will require the addition of a fifth and sixth SBR basin. Again, upgrades are required at the influent valve vault and effluent valve vault. Additional bulbs will be added to the UV equipment to increase the design capacity. One more additional sludge storage tank will need to be added to the treatment plant to increase sludge storage capacity.

The projected growth was used to determine the timing of the future expansions. As can be seen on the chart below, Phase I expansion should be completed by 2028.

Figure 1-4



The estimated capital construction costs for the Phase I expansion are approximately $2,260,000 for the liquids improvements and $1,781,000 for the solids improvements.

1.4 Wastewater Collection System

1.4.1 Pump Stations

The City of Smithville currently owns and operates 29 wastewater pump stations. The majority of these stations connect to and convey wastewater flow through one of two common force mains, the north and south. Each pump station requires frequent inspection and maintenance by City staff to ensure they are operating as intended. In addition, there are periodic operational and rehabilitation expenses required to keep them in good working order. The capacity of these pump stations and common force mains are frequently the limiting factor in allowing development to occur within the City of Smithville.

Each pump station and required maintenance needs is summarized in Table 6 below and shown on the attached Figure 1-5.

TABLE 6 SUMMARY OF EXISTING PUMP STATIONS AND REQUIRED MAINTENANCE NEEDS	Rehabilitation	Estimated Cost
Harbor Lakes	Controls, Fencing, Site Lighting	$17,000
Diamond Crest	Access Road	$10,000
Wildflower	Capacity	[1]
Rock Creek	Fencing	$5,000
Rollins Landing	Access Road, Fencing	$15,000
Greyhawke #1	Access Road	$10,000
Greyhawke #2	Access Road	$10,000
180th Street	Access Road, Fencing	$15,000
Lakeview Drive	Fencing	$5,000
Bridgeport	Controls, Access Road, Fencing	$25,000
Big Harborview	Fencing	$5,000
Campground	Located in Floodplain	[1]
Cub Cadet		[2]
Bridge Street	Structural, Fencing	$10,000
Stone Creek Villas	Controls, Access Road	$20,000
Cedar Lakes #1	Access Road, Fencing	$15,000
Cedar Lakes #2	Pump Replacement, Access Road, Fencing	$45,000
Strawberry Hill	Access Road, Fencing	$15,000
Quail Ridge	Access Road	$10,000
Harbortowne	Access Road, Fencing	$30,000
Daycare	Fencing	$5,000
Stone Bridge	Fencing	$5,000
Ashmont		[4]
Diversified Metal		[4]

McDonalds		[2]
Platte Valley		[2]
Hills of Shannon		[2]
Gerber Collision		[4]
Woods Court	Fencing	$5,000
Subtotal		**$277,000**
Contingency	*25%*	*$69,250*
Total		**$346,300**

Notes:
[1] Pump station will be replaced
[2] Decommissioned with Phase I improvements
[3] Decommissioned with Phase II improvements
[4] No rehabilitation identified

1.4.2 Interceptor Sewers

A long term goal of the City of Smithville is to more efficiently serve the community's wastewater collection needs and provide additional capacity to facilitate growth opportunities. The most efficient method to convey wastewater is through the thoughtful implementation of gravity sewers to serve the north and south portions of the City. These interceptors are long term solutions that should be constructed in phases as growth and development is proposed. Three interceptor sewers are recommended for the ultimate build out of the City, shown in the attached Figure 1-6.

- Owens Branch Interceptor to serve the area north of the Little Platte River
- First Creek Interceptor to serve the City south of Hwy 93 and west of Hwy 169
- Wilkerson Branch Interceptor to serve the area south of the Little Platte River and east of Hwy 169

0-10 Year Improvements

North Smithville

The north force main is the portion of the wastewater conveyance system with the least available capacity. The system has the capacity to convey flows from the current residential developments as well as a limited amount of anticipated future growth. Hydraulic modeling of the system indicates the remaining capacity in existing north force main is as follows in Table 7 and shown in the attached Figure 1-7.

TABLE 7 NORTH SMITHVILLE SHORT TERM DEVELOPMENT CAPACITY	Single Family Houses	Estimated Additional Population
Additional Development Capacity (no improvements)	265	716
Additional Development Capacity with Wildflower Pump Station improvements (Eagle Heights development responsibility)	320	864
Total Existing North Force Main Capacity	**585**	**1,580**

The available capacity of the north force main will accommodate approximately 33% of the anticipated 10 year citywide population growth of 4,500. Assuming half of all growth occurs in the north portion of the City, the north force main should be able to convey anticipated flows with growth for 7 years. The City should begin to plan for future capacity upgrades in the next two to three years to allow them to be designed, easements acquired, and construction completed and in service before the force main has exceeded its capacity.

Recommended capacity upgrades are to construct the portion of the Owens Branch Interceptor from the Wastewater Treatment Plant to Hillcrest Drive.

TABLE 8 OWENS BRANCH INTERCEPTOR - PHASE 1 TOTAL COST	Pipe Length (Ft.)	Pipe Size (In.)	Total Cost
Owens Branch - Phase 1	9,157	30	$6,517,000

South Smithville

The recent completion of the first phase of the Second Creek/First Creek Interceptor from the Wastewater Treatment Plant to approximately Richardson Street has reduced the length and overall operating pressures within the existing south force main. This has provided additional capacity to accommodate the flow from the Forest Oaks subdivision and anticipated development within the southern portion of the City in the near term.

Southeast Smithville

The construction of the South Booster Pump Station and South Interceptor Project, (currently in property acquisition) will provide the collection system infrastructure "backbone" to convey the majority of the anticipated flow east of Hwy 169 and south of from remaining ten year growth projections. Additional improvements in the south portion of the City to facilitate development will be limited to sewer extensions or upsizing existing pump stations and tributary lines to the South Interceptor. The cost for these projects will be development responsibility and construction costs have not been included in this Master Plan.

Southwest Smithville

There is minimal anticipated short term development in the area south of Hwy 92 and west of Hwy 192, except for the frontage of Hwy 192. The area fronting Hwy 192

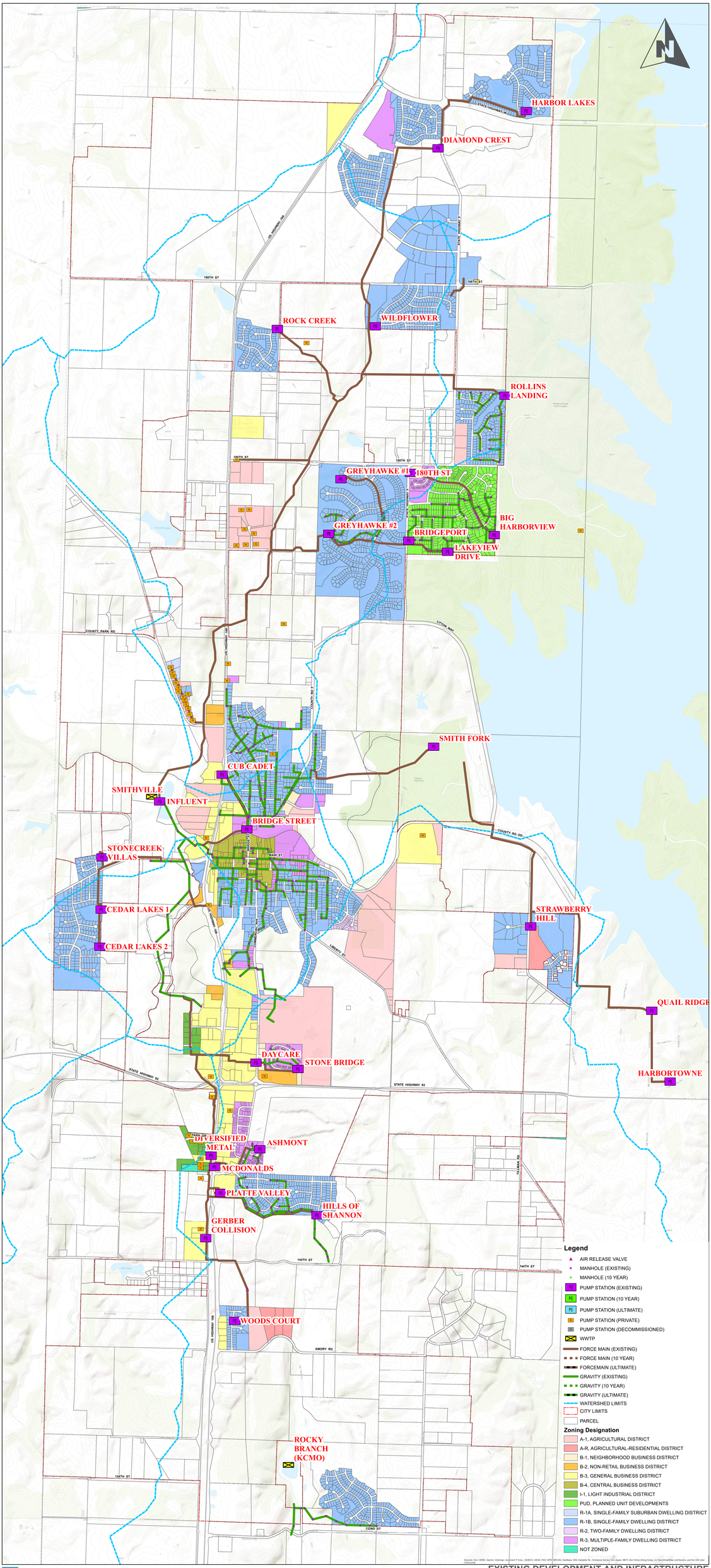
between 144th Street and Commercial Street will be served by connections to the existing south force main or a gravity extension draining east across Hwy 192. The cost for these projects will be development responsibility and construction costs have not been included in this Master Plan.

Ultimate Improvements

As mentioned previously, the ultimate wastewater collection solution is to construct three interceptor sewers to convey the majority of flow by gravity to the treatment plant. The total cost, in 2020 dollars for these projects are shown in Table 8. The timing of these improvements will have to be coordinated with potential developments.

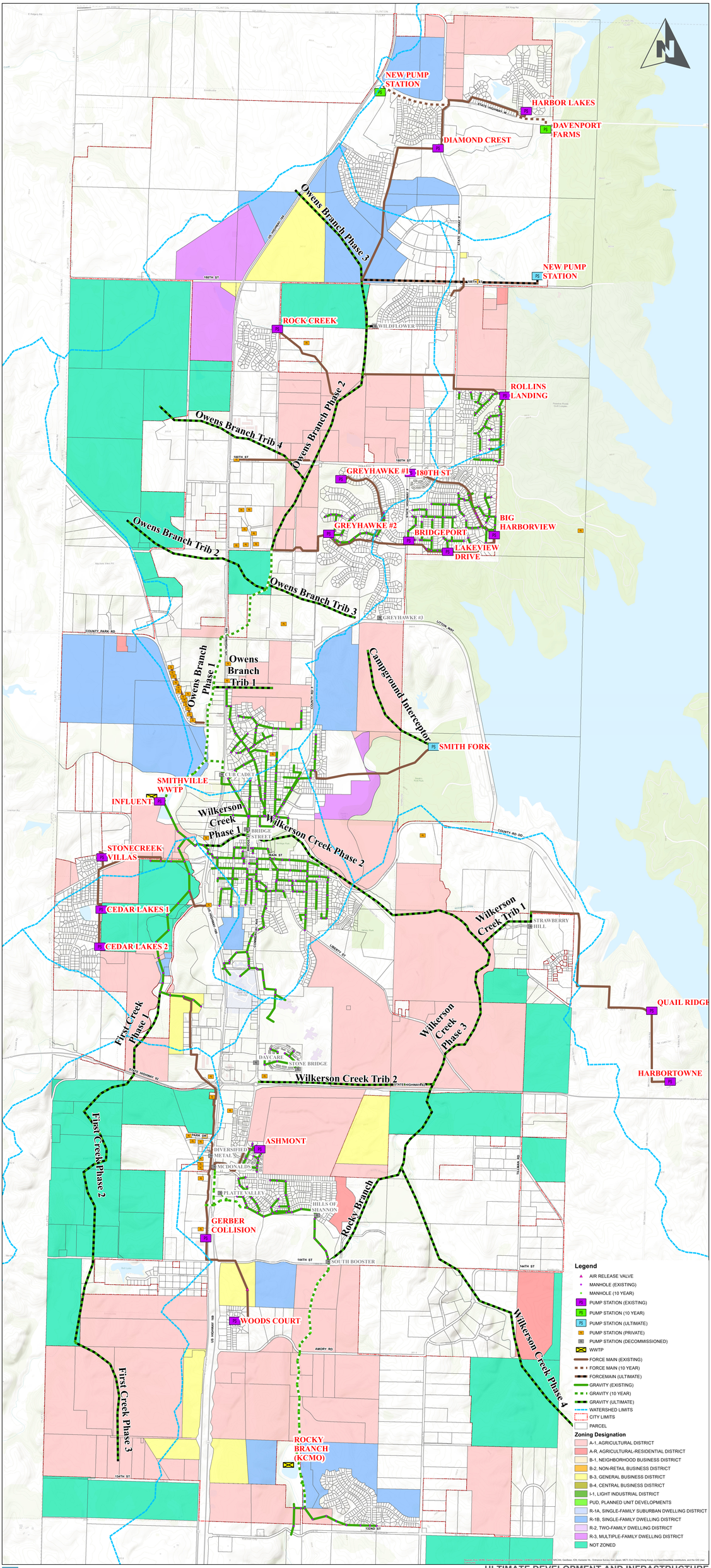
TABLE 8 Collection System Ultimate Interceptor Expansion	**Length (LF)**	**Size (IN)**	**Total Cost[1,2]**
Owens Branch Phase 2	9,075	18	$ 3,342,700
Owens Branch Phase 3	3,478	8	$ 826,000
Owens Branch Tributary 1	1,249	8	$ 297,500
Owens Branch Tributary 2	4,950	10	$ 1,471,300
Owens Branch Tributary 3	2,884	8	$ 683,900
Owens Branch Tributary 4	5,309	10	$ 1,580,800
First Creek Segment 1	2,279	21	$ 974,200
First Creek Segment 2	6,317	18	$ 2,327,300
First Creek Segment 3	9,075	10 - 18	$ 2,167,300
Wilkerson Creek Phase 1	1,373	36	$ 1,115,400
Wilkerson Creek Phase 2	8,109	36	$ 6,542,300
Wilkerson Creek Phase 3	6,580	27 - 30	$ 4,315,700
Wilkerson Creek Phase 4	10,839	21	$ 4,628,800
Wilkerson Creek Trib 1	1,638	8	$ 390,500
Wilkerson Creek Trib 2	3,686	10	$ 1,092,700
Rocky Branch Segment 1	5,938	21	$ 2,539,100
TOTAL	**80,382**		**$ 34,295,500**

Notes
1. Includes complete installation of pipes, MHs, and other ancillary structure and surface restoration.
2. Includes 20% for survey, engineering, legal, & easements and 30% contingency.



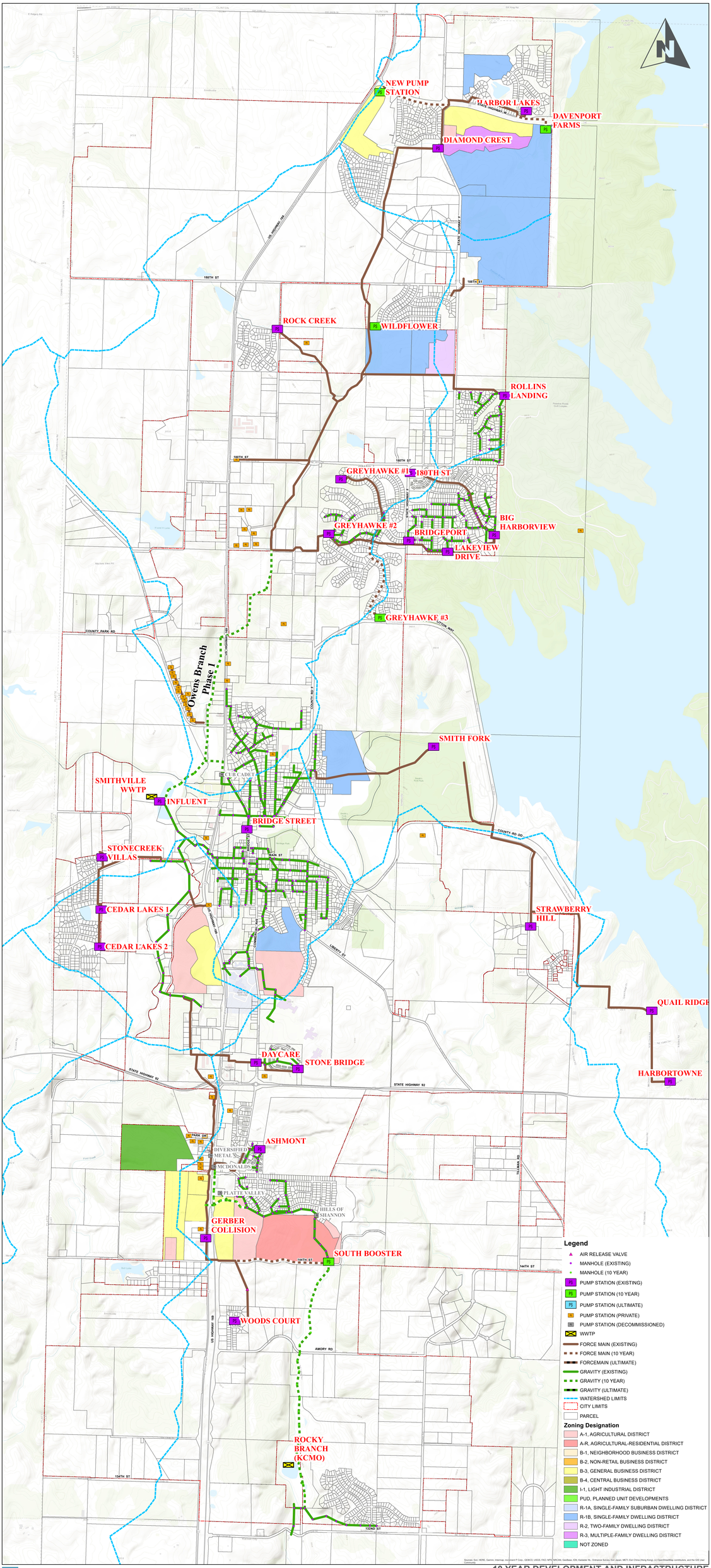
EXISTING DEVELOPMENT AND INFRASTRUCTURE
CITY OF SMITHVILLE, MISSOURI
FIGURE 1-5

SEWER MASTER PLAN



ULTIMATE DEVELOPMENT AND INFRASTRUCTURE
CITY OF SMITHVILLE, MISSOURI
FIGURE 1-6

SEWER MASTER PLAN



10 YEAR DEVELOPMENT AND INFRASTRUCTURE
CITY OF SMITHVILLE, MISSOURI
FIGURE 1-7

SEWER MASTER PLAN