

Date: November 25, 2020
To: Comprehensive Plan Review Committee Members
From: Christina Day, AICP, Director of Planning
Subject: Density Examples and Infrastructure Information

Questions were raised at recent Comprehensive Plan Review Committee meetings about providing examples of various densities and the capacity of Plano's infrastructure. Staff has prepared the supporting information below.

1. Density Examples

Residential density can be defined and calculated differently, including both gross and net density. Gross density includes street right-of-ways and common and open space areas. Net density, in comparison, includes only the individual housing lots in the calculation, and as such, is typically 50-70% higher than a gross density calculation. Plano's Zoning Ordinance defines residential density using net density, as follows:

The number of individual residential living units per acre of the site or lot on which they are located. Calculation of residential density shall be based on the net size of the property, exclusive of public and private street right-of-way, street easements, and park and open space accessible to the public.

Examples of the net density of various housing developments in Plano are attached to this memo.

The CPRC has discussed density and some examples of density at various times in the past. For the Committee's reference, please find the information here:

- [Density introduction](#) – January 22, 2020, CPRC meeting
- [Density examples](#) – February 4, 2020, CPRC meeting
- [Housing types examples](#) – March 3, 2020, CPRC meeting
- [Density comparisons with other cities](#) – August 28, 2020, CPRC memorandum
- [Housing menu report with density examples](#) – November 10, 2020, CPRC meeting

2. Infrastructure Capacity

Plano's Public Works and Engineering Departments provided the information below regarding infrastructure capacity.

Wastewater System

Plano's Public Works Department contracted with Freese and Nichols, Inc. to evaluate and analyze the city's current wastewater system to measure existing performance, identify deficiencies, and determine improvements needed to meet projected future conditions. The

Executive Summary of the draft Wastewater Modeling Services Report from October 2020 is attached to this memo and the full report is [available online here](#).

The City of Plano is finishing its wastewater master plan. The plan will provide for a build-out (with a population of 322,173, estimated at 2038), and future employment growth of 333,382, estimated at 2038. These numbers are conservative (on the high side) from a modeling perspective, but it is better to have excess capacity rather than not enough.

The NTMWD provides our wastewater treatment. They are in the process of the design and then construction of a new regional wastewater treatment plant northeast of McKinney. This treatment plants will meet the needs of the service area. The District is not planning to expand the Rowlett Creek plant in Plano for normal flow; however, they are modifying the plant to handle peak flows related to wet weather.

Storm Sewer – Drainage System

The City of Plano regulations require developers to construct their storm drainage based on a 100-yr fully-developed conditions, not just the capacity needed at the time of development. Per the [City's Storm Drainage Manual](#), drainage and floodway easements shall be provided for all open channels. Easements shall encompass all areas lower than a ground elevation defined as being the highest of the following: one (1) foot above the calculated water surface elevation based on a design storm whose frequency is 100 years, fully developed or the top of the high bank, whichever is higher. This ensures disturbance to creeks is at a minimum. Also, City of Plano standards require all new structures be constructed two (2) feet above the ultimate 100-yr water surface elevation. When developing along a major creek within the City of Plano, the developer must submit a Flood Study to the City showing the 100-yr water surface elevation based on both current land-use and future land-use assumptions.

The City of Plano is a member of the National Flood Insurance Program (NFIP) and participates in the Community Rating System (CRS), which is administered by Federal Emergency Management Agency (FEMA). The CRS program is a voluntary incentive program, which recognizes and encourages community floodplain management activities which exceed the minimum NFIP requirements. More information: www.plano.gov/303/Floodplain-Information.

Roads

The vast majority of the roads shown on the Thoroughfare Plan Map have been constructed. There simply is very limited areas that lanes can be added to alleviate traffic congestion. The [2045 Metropolitan Transportation Plan \(NCTCOG\)](#) predicts a growth of 77% between 2017 and 2045. Adding additional lanes will not relieve traffic congestion. [Traffic volumes collected in 2017](#) show the “hotspots” within the City. However, the majority of congestion on the arterial system is a result of capacity issues at intersections. The City has sixteen (16) intersections currently beginning or about to begin capacity improvements (see attached Improving Plano Map). There are another 10-15 locations currently being evaluated or in design. These locations are determined by our High Accident Location (HAL) or High Accident Road Segments (HARS) program. This program is fluid and intersections are evaluated on a yearly basis by transportation engineers.

Water System

Our water system, for showers, toilet flushes, and watering lawns, was designed for a lot more usage than we see today. Our all-time peak day was on September 4, 2000, at 136.1 Million Gallons. There have been only 4 days in the past ten years that have exceeded 130 Million Gallons. During the water restrictions of 2011-15, our goal was based on the 2010-11 water year

of 23.6 Billion Gallons. We have not exceeded that amount since then. The highest year was 2016-17 at 22.2 Billion Gallons. The City of Plano has more than enough water capacity to meet the demand at buildout.

The North Texas Municipal Water District (NTMWD) sells us water on a wholesale basis. They are constructing a new reservoir which will meet the regional needs for over 20 years.

Trash

The Environmental Waste Services Division is prepared to meet the needs for trash, recycling, yard waste pickup and other services into the future. For every 1,000 homes we need one additional route (driver and truck), the cost of which is generally covered by fees for service from those property owners. Commercial and multifamily trash service is provide through a contract with Republic Services.

The North Texas Municipal Water District provides the transfer stations and the landfill necessary for trash disposal. The landfill has over 40 years of capacity. The District is working with the City of Frisco to build a fourth transfer station in northern Frisco to meet capacity requirements for their member cities.

Additional information regarding transportation can be found in the [April 17, 2020, CPRC memorandum](#), specifically question 2, which provides links to various past presentations regarding pavement management and both departments.

Dwelling Units per Acre (DUA) Density Examples

Densities for the following subdivisions were calculated using the density definition from the City of Plano Zoning Ordinance, which defines residential density as “the number of individual residential living units per acre of the site or lot on which they are located. Calculation of residential density shall be based on the net size of the property, exclusive of public and private street right-of-way, street easements, and park and open space accessible to the public.”

*** Densities are not representative of the entire subdivisions and will vary from lot to lot.*

Subdivision Details

Street View

Aerial View

Subdivision Name:
Dallas North Estate 9

Location:
[2217 Westlake Dr.](#)

DUA: 4.17



Subdivision Name:
Trails of Glenwoods

Location:
[6420 Academy Ln.](#)

DUA: 4.46



Subdivision Name:
Madison Estates

Location:
[2600 Van Buren Dr.](#)

DUA: 9.84



Subdivision Name:
Avilla Premier

Location: [3409 Premier Dr.](#)

DUA: 11.12



Dwelling Units per Acre (DUA) Density Examples

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*** Densities are not representative of the entire subdivisions and will vary from lot to lot.*

Subdivision Details

Street View

Aerial View

Subdivision Name:

Pasquinellis Westbrook at Ridgeview

Location:

[3273 Judge Holland Ln.](#)

DUA: 11.6



Subdivision Name:

Oak Point Estates

Location:

[6213 Texana Way](#)

DUA: 13.27



Subdivision Name:

Garden Gate Apartments

Location:

[1201 Legacy Dr.](#)

DUA: 16.03



Subdivision Name:

Rice Field

Location:

[2217 Westlake Dr.](#)

DUA: 16.13



Dwelling Units per Acre (DUA) Density Examples

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*** Densities are not representative of the entire subdivisions and will vary from lot to lot.*

Subdivision Details

Street View

Aerial View

Subdivision Name:

Icon at Legacy West

Location:

[6121 Echelon Way](#)

DUA: 18.35



Subdivision Name:

Evergreen at Plano

Location:

[600 Independence Pkwy.](#)

DUA: 21.73



Subdivision Name:

Aura One90

Location:

[680 Executive Dr.](#)

DUA: 33.26



Subdivision Name:

Savannah at Gateway

Location:

[401 Shiloh Rd](#)

DUA: 40.99



Dwelling Units per Acre (DUA) Density Examples

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*** Densities are not representative of the entire subdivisions and will vary from lot to lot.*

Subdivision Details

Street View

Aerial View

Subdivision Name:

Windrose Tower

Location:

[7901 Windrose Ave.](#)

DUA: 45.26



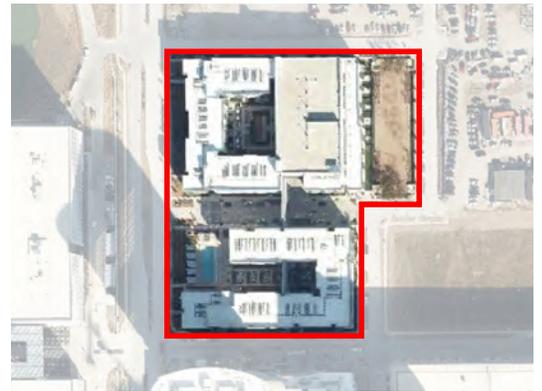
Subdivision Name:

Windsor Metro West

Location:

[8055 Windrose Ave.](#)

DUA: 64.17



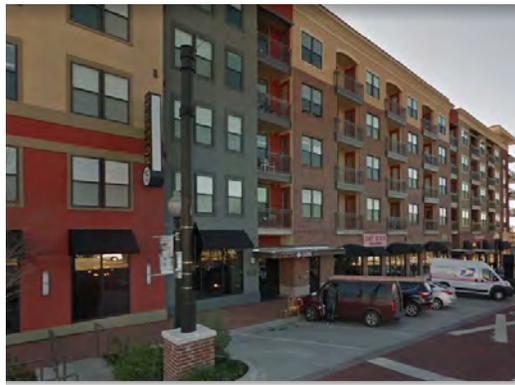
Subdivision Name:

Junction 15

Location:

[930 E 15th St.](#)

DUA: 95.41



Subdivision Name:

LVL29 Apartments

Location:

[6000 Columbus Ave.](#)

DUA: 155.49



DRAFT

**WASTEWATER
MODELING SERVICES**

Prepared for:

City of Plano

October 2020



Prepared by:

FREESE AND NICHOLS, INC.
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817-735-7300

DRAFT
**WASTEWATER
MODELING SERVICES**

Prepared for:

City of Plano

DRAFT	DRAFT
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City of Plano

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

This report presents the analysis approach, findings, and results of the Wastewater Modeling Services performed by Freese and Nichols, Inc. (FNI) for the City of Plano. The goal of this project was to evaluate and analyze the systems to measure existing performance, identify deficiencies, and determine improvements needed to meet projected future conditions. Historical wastewater usage was reviewed to establish trends and project demands and flows for the system evaluations. Based on the evaluations, a phased 20-year Community Investment Program (CIP) was developed for the collection system. The recommended improvements will serve as a basis for the design, construction, and financing of lines and facilities required to meet Plano’s future system needs. The major elements of the scope of this project include:

- Population Wastewater Flow Projections for 5-Year, 10-Year, and 20-year Conditions
- Wastewater Hydraulic Model Development and Calibration
- Hydraulic Capacity Analysis and Capacity CIP
- Wastewater System Risk-Based Assessment and Rehabilitation CIP
- Comprehensive Community Investment Program

2.0 EXISTING WASTEWATER COLLECTION SYSTEM

The City of Plano’s wastewater service area covers approximately 77 square miles and consists of 14 major sewer basins. Portions of the City’s collection system such as interceptors, lift stations, and the Rowlett Creek Wastewater Treatment Plant (WWTP) is owned and operated North Texas Municipal Water District (NTMWD). **Table ES-1** gives a summary of the length of pipe and ownership within the City’s wastewater system.

Table ES-1 Wastewater System Summary

	City of Plano	NTMWD
Gravity Line		
Length (miles)	1,005	23
Diameter (in)	3 - 54	4 - 54
Force Main		
Length (miles)	4	28
Diameter (in)	2 - 36	8 - 48

3.0 TEMPORARY FLOW MONITORING

Flow monitoring data was used to examine the existing dry and wet weather flows, evaluate the effects of rainfall on the wastewater collection system, and provide real-world data to calibrate the hydraulic model for evaluating the capacity of the system to transport peak flows. The system was evaluated using 24 temporary flow meters and four temporary rain gauges installed throughout the collection system for 89 days beginning March 18, 2018 and ending on June 14, 2018. The locations were strategically selected to allow the temporary flow meters to monitor the system’s performance during rain events to identify rainfall-dependent inflow and infiltration (RDII) and provide data for hydraulic model calibration. During this time, NTMWD was conducting separate flow monitoring at 50 locations throughout the City. These flow monitors were evaluated by NTMWD and are not included in this analysis but were available during the hydraulic model calibration. Collected rainfall data was examined along with the flow monitoring data to select rainfall events of varying magnitudes and peak intensities to facilitate wet weather calibration.

4.0 POPULATION AND WASTEWATER FLOWS

Population and land use are important elements in the analysis of wastewater systems. Wastewater flows depend on the residential population and commercial development served by the system. An analysis of historical and projected populations, along with land use, provides the basis for projecting future flows. The projected population and employment population for each planning year for the City are shown in **Table ES-2**.

Table ES-2 Projected Population by Basin

Year	Population	Employment
2018	285,210	226,682
2023	292,999	253,893
2028	300,788	281,105
2038	316,366	335,529

Wastewater flows were projected for existing (2018), 2023, 2028, and 2038 conditions. The evaluation of historical data provided a basis for determining the design criteria used to project wastewater flows. **Table ES-3** summarizes the wastewater flows for each planning year.

Table ES-3 Projected Wastewater Flows

Basin	2018		2023		2028		2038	
	Average Day Flow (MGD)	Peak Wet Weather Flow (MGD)	Average Day Flow (MGD)	Peak Wet Weather Flow (MGD)	Average Day Flow (MGD)	Peak Wet Weather Flow (MGD)	Average Day Flow (MGD)	Peak Wet Weather Flow (MGD)
Cottonwood Creek	0.63	2.46	0.64	2.49	0.65	2.53	0.66	2.60
Indian Creek	2.21	8.43	2.57	9.87	2.93	11.31	3.65	14.19
North Dallas Trunk	1.32	4.06	1.63	4.96	1.93	5.86	2.54	7.65
Pitman Creek	2.04	9.03	2.12	9.35	2.20	9.67	2.36	10.30
Plano Parkway	0.83	1.93	0.97	2.18	1.12	2.42	1.40	2.91
Plano East	0.15	0.40	0.17	0.48	0.20	0.56	0.25	0.72
Prairie Creek	0.87	3.25	0.89	3.32	0.91	3.39	0.95	3.53
Ridgewood Creek	1.11	4.44	1.15	4.58	1.18	4.72	1.25	4.99
Rowlett Creek	2.21	7.52	2.50	8.67	2.79	9.81	3.37	12.11
Russell Creek	2.61	10.40	2.67	10.64	2.73	10.88	2.84	11.35
Spring Creek	4.78	16.36	5.04	17.28	5.30	18.20	5.82	20.04
White Rock Creek Up	4.34	15.16	4.80	16.99	5.26	18.81	6.18	22.47
White Rock Creek Low	4.31	16.79	4.53	17.67	4.75	18.56	5.19	20.32
Young Branch	0.73	1.79	0.80	2.07	0.87	2.34	1.01	2.90
Total	28.14	102.01	30.48	110.53	32.81	119.05	37.48	136.09

5.0 WASTEWATER MODEL DEVELOPMENT AND CALIBRATION

As part of the Project, FNI developed a hydraulic model to be used as a tool for evaluating the wastewater collection system using the *InfoWorks ICM* software by *Innovyze*. *InfoWorks ICM* combines a relational database with geographic analysis to provide a single environment that integrates asset planning with hydraulic modeling. The software makes use of engineering equations and mathematical algorithms to determine the flows and velocities that would occur in a collection system under a specified set of conditions.

The dynamic hydraulic model is capable of evaluating the impact of wastewater flow generation on the collection system over time. This capability allows the user to model and evaluate system performance over time due to changing flow characteristics from both domestic and variable wet weather field conditions. These conditions include various infiltration and inflow rates throughout the system in response to varying weather and environmental conditions, allowing more accurate modeling results.

6.0 WASTEWATER SYSTEM CAPACITY ANALYSIS

Following model calibration for both dry and wet weather storm events, the next step in the Wastewater Modeling Services process was to use the wastewater system hydraulic model to evaluate the existing system under existing flows and future flows and evaluate alternatives to address modeled capacity deficiencies. The existing system was evaluated under the 5-year, 24-hour design storm (5.4 inches) identified in NTMWD's Regional Hydraulic Model Protocol to determine areas where the model predicted surcharging or overflows. Mapping was developed to show areas where the capacity of the system is exceeded by the loading upstream.

Hydraulic analyses were conducted to identify deficiencies in the wastewater system and establish a CIP to reinforce the existing system and convey projected wastewater flows through the 20-year planning period. Various combinations of improvements and modifications were investigated to determine the most appropriate approach for conveying projected flows.

7.0 WASTEWATER SYSTEM RISK BASED ANALYSIS

In addition to the capacity analysis, FNI developed a risk-based assessment (RBA) for the City's wastewater system gravity mains. The goal of the RBA program is to develop a more proactive approach to maintaining the City's wastewater gravity lines through effective rehabilitation and renewal. Overall risk is calculated as the product of an asset's condition (the likelihood of failure) and its criticality (the consequence of failure). FNI conducted a desktop RBA to assign condition and criticality scores to each wastewater gravity line. Once the risk of each asset was determined, a high-level decision process was used to assign a specific action to each asset to help identify renewal projects that improve the reliability of the wastewater system. The overall risk was scored from 0 to 100 where 0 is a very low risk and 100 is very high. The results of the risk scoring are shown in **Table ES-4**.

Table ES-4 Gravity Main Risk Scoring Results

Risk Grade	Length (mi)	% of System
Very Low	843.41	83.94%
Low	142.66	14.20%
Medium	16.34	1.63%
High	1.86	0.19%
Very High	0.48	0.04%
Total	1,004.75	100.00%

A decision tree was developed to identify wastewater candidate assets for renewal. The recommended improvements help to mitigate the overall risk of the wastewater collection system by improving the condition. Rehabilitation actions for each asset in the collection system include:

- Contract Inspection
- High Priority Rehabilitation
- In-House Inspection
- Moderate Priority Replacement
- Point Repair Initiative
- Replacement
- Small Diameter Lining
- Small Diameter Rehabilitation/Replace

8.0 COMPREHENSIVE COMMUNITY INVESTMENT PROGRAM

A comprehensive wastewater CIP was developed for the City of Plano to address existing deficiencies in the system, as well as provide capacity for future loading in the wastewater collection system. CIP projects were analyzed and phased into the planning period in which they become hydraulically necessary. Costs were calculated for the recommended improvements. The costs include an allowance for engineering, surveying, and contingencies. **Table ES-5** summarizes the cost of the wastewater system CIP by planning period for the City of Plano. Detailed project descriptions, drivers, and estimated costs are provided in **Appendix A**.

Table ES-5 Wastewater System Community Investment Program Costs

Planning Period	Estimated Project Cost
Short-Term CIP	\$270,249,600
Intermediate-Term CIP	\$164,152,000
Long-Term CIP	\$46,185,900
TOTAL	\$480,587,500

InsidePlano



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IMPROVING PLANO

Construction can be disruptive, but the end result is a better Plano. Here are major intersection projects underway in the City of Plano over the next six months.

(Start and completion dates are estimated.)

INTERSECTION IMPROVEMENTS

1. Park and Coit
Start 9/20 Completion 1/21
2. Park and Custer
Start 11/20 Completion 4/21
3. Park and Alma
Start 4/21 Completion 7/21
4. Park and K
Start 1/21 Completion 5/21
5. Park and Jupiter
Start 9/20 Completion 12/20
6. Parker and Coit
Start 10/20 Completion 3/21
7. Parker and Alma
Start 10/20 Completion 3/21
8. Plano Parkway and Executive
Start 5/20 Completion 10/21
9. Plano Pkwy and Independence
Start 5/20 Completion 10/21
10. Plano Pkwy and Parkwood
Start 5/20 Completion 10/21
11. Headquarters and Legacy
Start 5/20 Completion 10/21
12. Legacy and Independence
Start 12/20 Completion 5/21
13. Legacy and Custer
Start 12/20 Completion 6/21
14. Legacy and K
Start 12/20 Completion 7/21
15. Legacy and Parkwood
Start 12/20 Completion 8/21
16. Coit and Mapleshade
Start 12/20 Completion 8/21

FOR PROJECT DETAILS, PLEASE VISIT PLANO.GOV/CIP



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