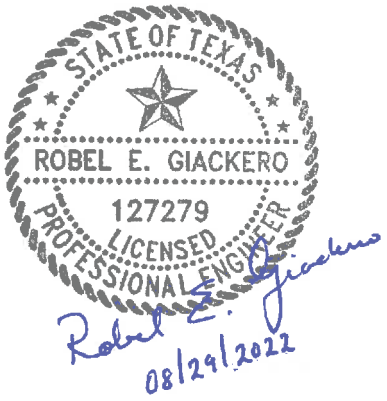
CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION

FM 1774 SANITARY SEWER EXTENSION

PRELIMINARY ENGINEERING REPORT

AEI JOB NO. 212215.30

AUGUST 2022



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CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

PRELIMINARY ENGINEERING REPORT

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I. INTRODUCTION

A. Project Description

The City of Magnolia (the "City") is located in southwestern Montgomery County, Texas, approximately 40 miles northwest of the City of Houston metropolitan area. The City provides water and wastewater services to customers within its corporate boundaries and certain customers within its extraterritorial jurisdiction (ETJ) boundaries. The City's Magnolia Economic Development Corporation (the "MEDC"), a non-profit, tax-exempt corporation, separate from any board or commission of the City, is dedicated to economic development in Magnolia. MEDC in partnership with the City of Magnolia intends to examine the opportunities to extend sanitary sewer services along the southern portion of FM 1774. The extension of services is two-fold as it provides utility service as part of the City's annexation plan and facilitates commercial development along the corridor. The portion of FM 1774 considered comprises the corridor generally between Oak Crossing and Friendship Drive. The location and vicinity maps are provided in ***Attachment A***.

B. Authorization

AEI Engineering, a Baxter & Woodman Company (AEI) was authorized by MEDC to prepare this preliminary engineering report (PER) for design of a sanitary sewer extension to serve commercial developments along FM 1774. This PER was prepared pursuant to the City of Magnolia Unified Development Code (UDC) and Title 30 Texas Administrative Code – Chapter 217 entitled "Design Criteria for Domestic Wastewater Systems" (TCEQ).

II. PROJECT DESCRIPTON AND CONDITIONS

As previously noted, the portion of FM 1774 considered generally lies between Oak Crossing and Friendship Drive. The northern end of the sanitary sewer extension near Oak Crossing was selected as this is where the City's existing sanitary sewer terminates. The southern end for the FM 1774 sanitary sewer extension was selected to be near a 4.6 acre vacant tract, immediately southeast of its intersection with Friendship Drive, within the City's ETJ, just outside the city corporate limits. The 4.6-acre vacant site is bound by FM 1774 to the northeast, Friendship Drive to the northwest, a commercial development to the southwest, and Lakes of Magnolia subdivision and vacant land to the southeast. A location map and vicinity map can be found in ***Attachment A***. The City currently has a 12-inch water line near the northwest corner of the site available to serve the tract. However, sanitary sewer collection service is not available at this tract.

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for panel 48339C0480G dated August 18, 2014, the area near the vicinity of the site lies in the unshaded zone "X" outside the 500-year floodplain as shown in ***Attachment B***. Natural ground elevations at the site range from 259 to 263 feet.

III. PROPOSED IMPROVEMENTS

To provide sewer service to tracts along FM 1774, extending a gravity sanitary sewer line from the existing City system was considered. However, due to significant variation in the

natural ground elevation along FM 1774, adequate depth of cover while maintaining sanitary sewer minimum design slope cannot be achieved. A lift station with a force main will be necessary to convey wastewater from the tract to the existing collection system.

A. Lift Station Site

The lift station site, planned to be approximately 0.07 acres, will be located near the northeast corner of the 4.6-acre tract, fronting FM 1774. There is no record that the tract has been platted. Therefore, the lift station site will need to be platted per City requirements. The land for the lift station can be negotiated to be dedicated or granted to the City of Magnolia whereby the owner of the land retains the fee simple ownership while the City receives the right to use the land for a lift station. As an alternate, the land can be purchased.

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for panel 48339C0480G dated August 18, 2014, the lift station site lies in the unshaded zone "X" outside the 500-year floodplain as shown in ***Attachment B***. Natural ground elevations at the proposed site range from 259 to 260 feet.

B. Drainage

Texas Department of Transportation's (TxDOT) drainage area map for the FM 1774 road widening project indicates that drainage from sites abutting FM 1774's right-of-way (ROW), up to 150 feet from the ROW, have been considered as contributing drainage areas and discharge from the 150-foot strip is accounted for in TxDOT's drainage plan. Therefore, runoff from the lift station site will entirely flow to TxDOT's drainage system along FM 1774. The weighted runoff coefficient for the lift station site will be kept the same or less than the runoff coefficient used in TxDOT's drainage area map. Therefore, the site impervious area will be limited to approximately 60% or less. Site specific TxDOT design requirements related to the tie-in will be coordinated during final design. Should the location of the lift station site be moved to another location within the 4.6-acre tract, outside the 150-foot strip abutting FM 1774, then stormwater detention will be required. A detention system will increase the footprint of the lift station site.

C. Lift Station Configuration

The lift station will be located inside a secured fenced area per TCEQ requirements. The wet well will be located near the southwest corner of the site, allowing operations and maintenance vehicles full access into the site. An elevated equipment slab adjacent to the wet well will support discharge piping, valves, and the force main discharge header. An emergency back-up generator with 48-hour fuel tank will be located near the southeast corner of the site. The lift station control panel will be located underneath a weather canopy, adjacent to generator. A preliminary site layout is included in ***Attachment C***.

D. Instrumentation and Controls

The lift station will be equipped with an instrumentation/control package designed to provide local automatic and unattended pump control, remote monitoring of the wet

well liquid level, and communications for failures such as power outages and various pump failures. The package will consist of: electro-mechanical relay logic for automatic pump control utilizing radar level transmitter for elevation detection with submersible transducer and floats as a backup detection, a programmable microprocessor for telemetry only, and a cellular communications based auto dialer. The package can be designed to allow for future addition of SCADA controls for compatibility, should the City of Magnolia acquire a SCADA system. As previously noted, the site is out of the 100-year and 500-year flood elevations. As such, all electrical and instrumentation equipment panels will be above the 100-year and 500-year flood plain elevations.

E. Design Alternatives

The lift station and force main will be designed to meet UDC and TCEQ regulations and standards. There are currently no plans for the 4.6-acre tract or other tracts in the immediate vicinity. Two options for lift station capacities were evaluated for this study. Alternate 1 is for a lift station with capacity to serve the other tracts in the immediate vicinity based on an estimated development capacity. Alternate 2 is a lift station with capacity to serve nearby potential developments along the FM 1774 corridor.

1. Alternate 1

i. Design Criteria

An area density design criteria of 10 equivalent single-family connections (ESFC) per acre was used establishing approximately 47 ESFCs for the 4.6-acre tract. The TCEQ defines the sewer usage per ESFC as 300 gallons per day (gpd) average daily flow. Therefore, the average daily flow to the lift station from the tract is estimated to be 14,100 gpd (47 ESFCs x 300 gpd/ESFC) or 10 gallons per minute (gpm). TCEQ rules require when a peak flow cannot be measured, a peaking flow multiplier of 4 x the average daily flow should be used for peak determination. Therefore, the peak flow to the lift station is estimated to be 56,400 gpd (14,100 x 4) or 40 gpm.

ii. Hydraulic Design

The lift station will be a duplex (two-pump) lift station. The two (2) pumps will be submersible, non-clog pumps with vortex impellers. The minimum diameter for a force main shall be 4 inches in diameter and be designed for a discharge velocity ranging between 3 to 8 feet per second (fps), per the TCEQ. The submersible pumps will need a minimum pumping capacity of 131 gpm to maintain the minimum velocity of 3 fps. Therefore, the design flow is adjusted from 40 gpm to 131 gpm (or from 56,400 gpd to 188,640 gpd). This PER, hereafter, will refer to the 131 gpm (188,640 gpd) as the design peak flow for Alternate 1. It should be noted that a 131-gpm pumping capacity can serve up to 157 ESFCs without modification to any of the 4-inch diameter piping. Therefore, the lift station is capable of serving the estimated 47 ESFCs up to 157 ESFCs.

Isolation plug valves will be installed horizontally on the discharge piping of each submersible pump, as well as swing check valves upstream of the isolation valves. A combination air release/air vacuum valve will be installed on each pump discharge upstream of the check valve, as well as the most downstream point of the discharge piping. Preliminary pump and system curves, and design calculations are included in ***Attachments D and E***, respectively.

iii. Wet Well Design

The wet well will be a circular design, 6 feet in diameter and 16 feet deep, designed for 188,640 gallons per day (gpd). The wet well vent is sized at 4 inches, the smallest size allowed by the TCEQ. The velocity through the vent will be less than 201 feet per minute, which meets TCEQ's maximum allowable air velocity of 600 feet per minute. Preliminary calculations are included in ***Attachment F***.

The wet well volume will accommodate the minimum cycle time of six (6) minutes. Because the lift station site is upstream in the sanitary system and the site location will be isolated from populated areas, odor control was not considered in the scope of this project. Once development plans are established, odor control can be re-evaluated if deemed necessary.

2. Alternate 2

i. Design Criteria

An estimate of a wet weather peak flow of 200 gpm or 288,000 gpd was used for this alternate. A 200-gpm capacity was selected to keep the total head within a range that provides for more selection of pumps from manufacturers. A larger pump capacity allows pumps to avoid clogging and maintenance. A 200 gpm peak flow equates to an average flow 50 gpm (200 gpm ÷ peak factor of 4), or 72,000 gpd. A lift station with an average flow capacity of 72,000 gpd can serve 240 ESFCs (72,000 gpd ÷ 300 gpd/ESFC).

ii. Hydraulic Design

The lift station will be a duplex (two-pump) lift station. The two (2) pumps will be submersible, non-clog pumps with vortex impellers. The minimum diameter for a force main shall be 4 inches in diameter and be designed for a discharge velocity ranging between 3 to 8 feet per second (fps), per the TCEQ. Submersible pumps with a capacity of 200 gpm (288,000 gpd) were selected for Alternate 2. The pump capacity will maintain the minimum discharge velocity of 3fps and generally operate around 4fps. A 200 gpm capacity was selected to keep the total head within a range that provides for more selection of pumps from manufacturers.

Isolation plug valves will be installed horizontally on the discharge piping of each submersible pump, as well as swing check valves upstream of the isolation valves. A combination air release/air vacuum valve will be installed on each pump discharge upstream of the check valve, as well as the most

downstream point of the discharge piping. Preliminary pump and system curves, and design calculations are included in ***Attachments G and H***, respectively.

iii. Wet Well Design

The wet well will be a circular design, 8 feet in diameter and 24 feet deep designed for 288,000 gallons per day (gpd). The wet well vent is sized at 4 inches, the smallest size allowed by the TCEQ. The velocity through the vent will be less than 306 feet per minute, which meets TCEQ's maximum allowable air velocity of 600 feet per minute. Preliminary calculations are included in ***Attachment I***.

The wet well volume will accommodate the minimum cycle time of six (6) minutes. Because the lift station site is upstream in the sanitary system and the site location will be isolated from populated areas, odor control was not considered in the scope of this project. Once development plans are established, odor control can be re-evaluated if deemed necessary.

II. PROPOSED FORCE MAIN

A. Alignment

The City has an existing lift station at 416 Melton Street, between Oak Crossing and Sulphur Branch. Discharging the flow from the proposed new lift station to a manhole located along FM1774 that ultimately gravity flows to the Melton Street lift station was considered. However, the Melton Street Lift Station is located within the regulatory floodway zone and is known to have flooding issues. Therefore, the option of tying to the Melton Street lift station was eliminated. Another option considered was to discharge to one of the manholes located near the intersection of FM1774 and Yon Street. However, the capacity in these manholes is restricted due to all flows from the vicinity converging to an 8-inch sanitary sewer line further downstream. This option was also eliminated. The proposed force main will discharge to the 24-inch interceptor near the intersection of Nichols Sawmill Road, just south of Commerce Street.

The force main will be approximately 8,950 linear feet in length. The alignment begins at the southwest corner of the proposed lift station and runs northwest along the south side of FM 1774, mostly within a 10-foot sanitary sewer easement to be dedicated to the City or in a right-of-way (ROW) at some locations where easements are not feasible. The force main then turns southeast at Sanders Street, traverses southeast along the east side Sanders Street within the ROW, then crosses Sanders Street near Commerce Street, traverses northwest along the south side of Commerce Street within the ROW, then turns southwest to Nichols Sawmill Road. The force main will discharge to a new 4-foot diameter corrosion resistant manhole to be located along the east side of Nichols Sawmill within the ROW, approximately 50 feet southwest of its intersection with Commerce Street. Flow from the discharge manhole will gravity flow via an 8-inch diameter PVC pipe to an existing manhole

approximately 15 feet northwest from the force main discharge manhole. Alignment layout sheets of the force main are shown in ***Attachment J***.

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for panels 48339C0480G dated August 18, 2014, approximately 6,450 feet of the force main lies in the unshaded zone "X" outside the 100-year floodplain, while the remaining 2,500 feet lies within the 100-year floodplain, 500-year floodplain, or the floodway.

B. Design Considerations

The force main is designed to meet the City's and TCEQ regulations and standards. The minimum force main size per TCEQ is 4 inches in diameter. The selected force main size minimizes friction losses through the pipe while maintaining a minimum design flow velocity of 3 fps with a single pump operating. Excerpts for the preliminary calculations are shown in ***Attachment E.*** The majority of the buried portion of the force main is relatively flat, with exceptions to intermediate high points at crossings of water lines, storm sewers, or public ROW.

C. Air Release / Air Vacuum Valves

Combination air release/air vacuum valves within a manhole will be provided at each of the intermediate high points in the system. Manholes to be located within the 100-year floodplain will be bolted shut. The force main will also have gate valves spaced at no more than 2,000-foot intervals to facilitate initial testing and subsequent maintenance and repairs.

D. Surge Analysis and Recommendations

A surge pressure analysis was conducted on the force main. The results reveal the following:

- Pressure Wave = 1,506 ft/s
- Surge Pressure due to sudden stoppage = 61 psi
- Surge Pressure due to change in direction = 101 psi
- Critical Period of 11.9 seconds

The maximum force main velocity is not expected to exceed 6 fps; however due to the length of the proposed force main, a surge analysis was performed. The critical period of 11.9 seconds suggests changes in flow velocities to be characterized as "sudden". The anticipated surge pressure due to a sudden change in flow direction was calculated to be 101 psi. The minimum pressure rating of the force main pipe will be 235 psi to exceed the anticipated surge pressures due to a sudden change in direction by a factor of safety of 2.3. Additionally, combination air release/air vacuum valves will be located at intermediate high points along the force main and will help reduce surge pressures during sudden changes to flow direction and velocity, as well as eliminate air pockets. Force main surge analysis calculations are provided in ***Attachment K.***

E. Tracer Wire

A tracer wire shall be placed on the force main as required by the City. The tracer wire shall be extended to the surface at various points. The distance between points shall not exceed 1,000 feet.

F. Construction and Testing

The construction drawings will incorporate requirements for separation between existing utilities and the force main in conformance with the City's guidelines and TCEQ design criteria. The construction drawings will specify locations where restrained joints are to be installed. Hydrostatic testing of the force main is specified for the given pipe, in conformance with TCEQ design criteria.

III. PROPOSED GRAVITY SANITARY SEWER LINE

The force main will discharge to a new 4-foot diameter corrosion resistant manhole to be located along the east side of Nichols Sawmill Road, approximately 50 feet south of its intersection with Commerce Street. Flow from the discharge manhole will gravity flow via a proposed 8-inch diameter PVC SDR 26 pipe to an existing manhole approximately 15 feet northwest of the force main discharge manhole. The 8-inch diameter pipe at a minimum slope of 0.335% is designed to carry a maximum flow of 315 gpm. Therefore, the 8-inch gravity sanitary sewer line has adequate capacity to accept peak flow of 200 gpm. The gravity sanitary sewer will be core drilled and sealed into the existing manhole.

As previously noted, Alternate 2 will serve both the 4.6-acre site and other nearby developments along the FM 1774 corridor. Flow from nearby developments along FM 1774 will need to be routed to the lift station via a gravity sanitary sewer. A 12-inch diameter PVC SDR 26 gravity sanitary sewer can be extended up to approximately 3,500 linear feet northwest along FM 1774 from Friendship Drive. It is not recommended to extend the gravity line further up since adequate depth of cover while maintaining sanitary sewer minimum design slope cannot be achieved due to significant variation in the natural ground surface. The proposed 12-inch diameter pipe at a minimum slope of 0.2% is designed to carry a maximum flow of 717 gpm. A possible alignment layout for the gravity sanitary sewer along the corridor is shown in ***Attachment M***.

IV. SANITARY SEWER SYSTEM CAPACITY

Downstream of the proposed force main's discharge into the existing sanitary sewer system, flow will combine with current flows. Sanitary sewer capacity calculations for the current 24-inch gravity sewer were performed to check for capacity availability, the result of which indicate that the City has adequate capacity for the proposed additional flow. Calculations for the 24-inch interceptor capacity is shown in ***Attachment L***.

V. WASTEWATER TREATMENT PLANT CAPACITY

The City owns and operates a wastewater treatment plant (WWTP) that is currently permitted to discharge an average daily flow of 0.65 MGD. The WWTP has a phased permit with a final phase discharge capacity of 2.0 MGD. Construction of an interim phase to expand to 1.3 MGD is currently in progress. The WWTP currently treats an actual average daily flow of 0.4 MGD, approximately 61% of the permitted capacity. As shown in

the table below, at 100% design capacity of the proposed lift station, the average daily flow at the WWTP is expected to be 0.44 MGD for Alternate 1 and 0.47 MGD for Alternate 2, approximately 68% and 72% of the current capacity, respectively. Therefore, the City's WWTP has adequate capacity to handle additional flow from the proposed lift station.

	Current Average Flow (gpd) *	Flow from Lift Station (gpd)	Total Average Flow (gpd)	Current WWTP Capacity
Alternate 1	395,000	47,100	442,100	68%
Alternate 2		72,000	467,000	72%

* Average daily flow based on historical data for the past 12 months (June 2021 to May 2022).

VI. EASEMENTS

Constructing the force main within TxDOT's ROW was considered. However, constructing within a ROW typically presents additional challenges such as utility conflicts, constructability, and construction impacts. In addition, if TxDOT elects to widen FM 1774 even further, then utilities within their ROW will need to be relocated at the owner's expense. Easement acquisitions are typically costly, but considering that it will minimize and/or eliminate the aforementioned challenges and risks, constructing the force main in an easement is the preferred option.

The proposed force main and gravity sanitary sewer are planned to be constructed within a 10-foot-wide dedicated sanitary sewer easement for the majority of the alignment. There are specific areas where the property owners have conditions that will not allow an easement. In these areas, the proposed force main and gravity sanitary sewer have been routed into the public right-of-way. It should be noted that additional easements maybe required depending on sanitary sewer depth or utility conflict. The exhibit included in ***Attachment J*** shows the proposed easements.

VII. PERMITS

The project plans will be reviewed and approved by TCEQ, TxDOT, City of Magnolia, and Montgomery County. All agencies will conduct their standard review to confirm their design guidelines are met. In addition, TxDOT will require a driveway permit to tie to FM 1774 and a permit to discharge site runoff to TxDOT ROW. Montgomery County will require a Non-Structure Development Permit. During permit procurement, the County may require plan submittal to confirm that runoff will discharge only to TxDOT's ROW.

VIII. PUBLIC STREET CROSSINGS

The force main alignment crosses several public streets most of which are located within the City corporate limits, with a few crossings located within the City's ETJ. The force main will be installed at perpendicular crossings using bore and jack construction methods in an 8-inch steel casing. The gravity sanitary sewer will also be constructed in a similar manner in a 20-inch steel casing. Public street crossings will be designed to conform with the City and TCEQ guidelines.

IX. SUMMARY OF ALTERNATES

As described in this PER, the proposed lift station has capacity to serve approximately 157 ESFCs at the 4.6-acre tract and other developments in the immediate vicinity

(Alternate 1). As an alternative option (Alternate 2), the lift station capacity can be upsized, without any modification to the force main, to serve the 4.6-acre tract and other developments along the FM 1774 corridor of up to a total 240 ESFCs. The upsizing will consist of constructing a larger wet well and installing submersible pumps with a larger capacity. A 12-inch gravity sanitary sewer, up to 3,500 linear feet northwest along FM 1774, from the lift station site, will be constructed. The table below summarizes the proposed lift station and upsized capacities.

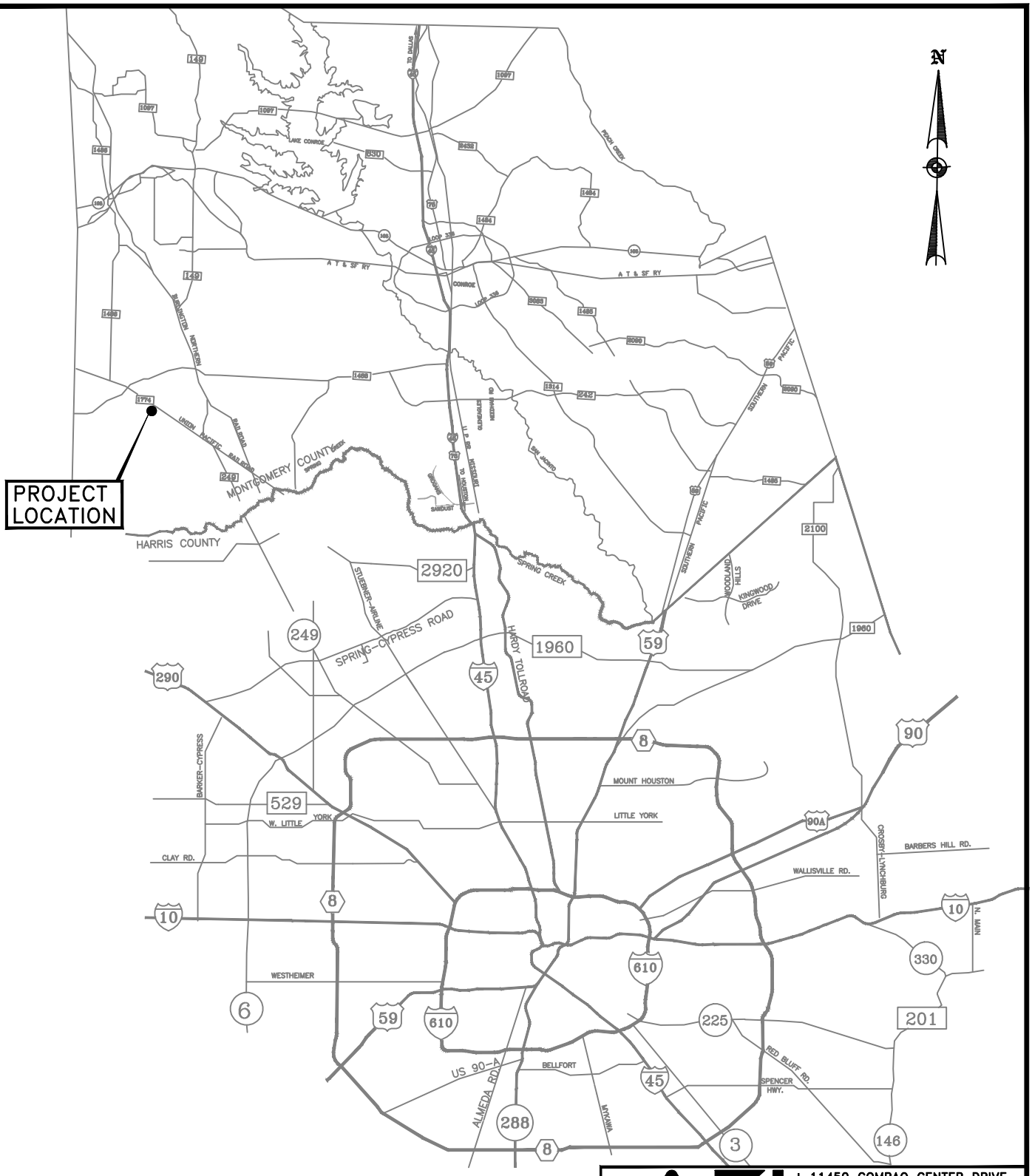
Description	Alternate 1	Alternate 2
Wet Well Diameter (ft)	6	8
Wet Well Depth (ft)	16	24
Submersible Pump (gpm)	131	200
12-inch Gravity Sanitary Sewer (linear feet)	0	3,500
ESFC	**157**	**240**

X. SUMMARY

The Magnolia Economic Development Corporation (the "MEDC") authorized AEI Engineering, a Baxter & Woodman Company (the "Engineer") to prepare this preliminary engineering report for a sanitary sewer extension to serve developments along FM 1774. Construction of a gravity sanitary sewer from Friendship Drive tying to the City of Magnolia's existing sewer facilities is not feasible. A lift station and a force main can serve the developments in the immediate vicinity. The lift station will consist of a duplex submersible lift station with a wet well diameter of 6 feet and a depth of 16 feet, a 4-inch force main approximately 8,950 feet long, and can serve approximately 157 ESFCs (Alternate 1). As an alternate, a lift station with a wet well diameter of 8 feet and a depth 24 feet, a larger capacity pump, with the same length and diameter of the force main in Alternate 1, can serve up to 240 ESFCs (Alternate 2). A 12-inch diameter gravity sanitary sewer will be extended along the FM 1774 corridor to serve commercial developments.

ATTACHMENT A

Location and Vicinity Maps



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CITY OF MAGNOLIA
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FM 1774 SANITARY SEWER EXTENSION

LOCATION MAP

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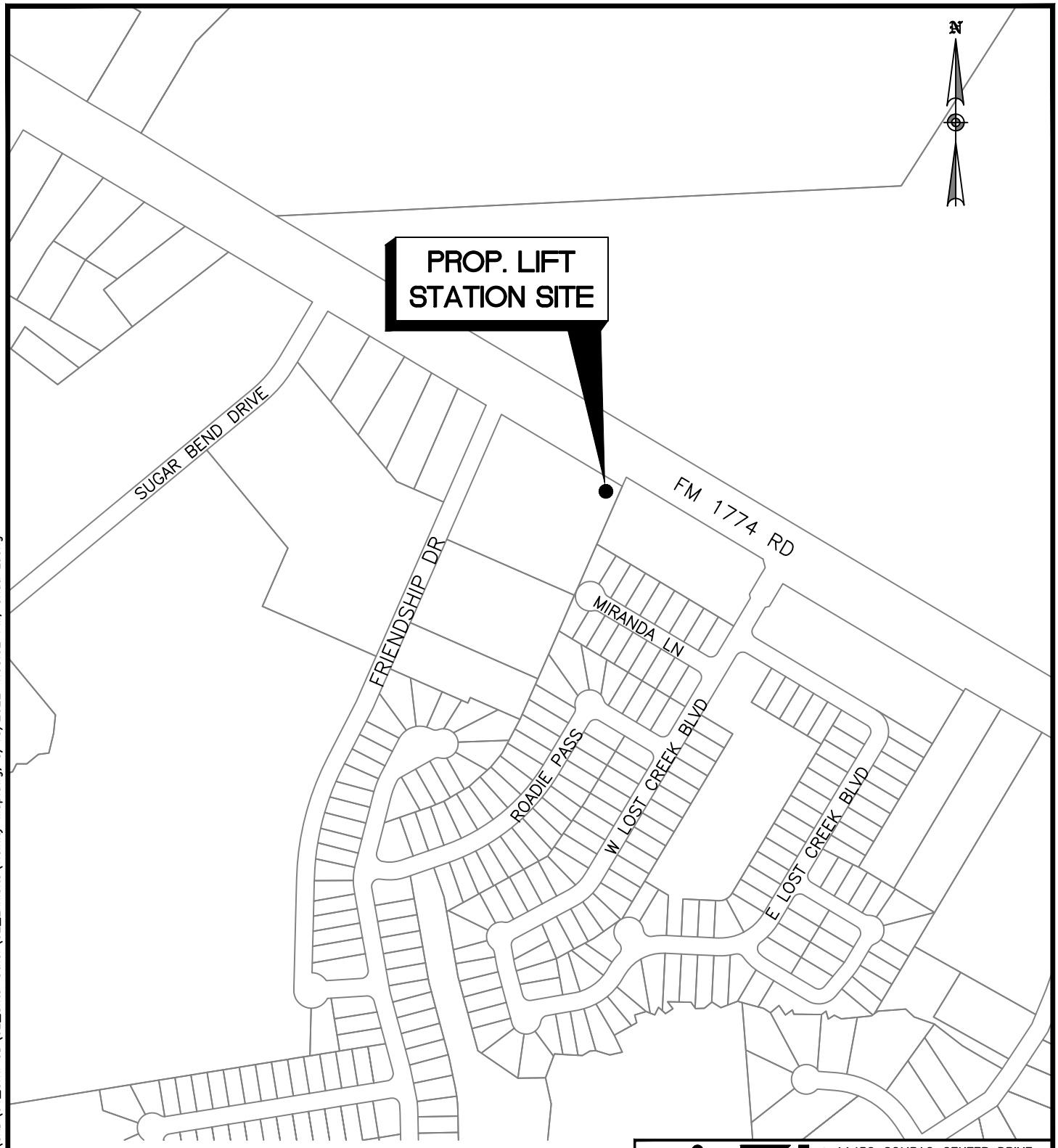

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CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

VICINITY MAP

MAY 2022

212215.30

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ATTACHMENT B

FEMA FIRMette Flood Map

National Flood Hazard Layer FIRMette

FEMA

95°43'53"W 30°11'57"N

95°43'16"W 30°11'26"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

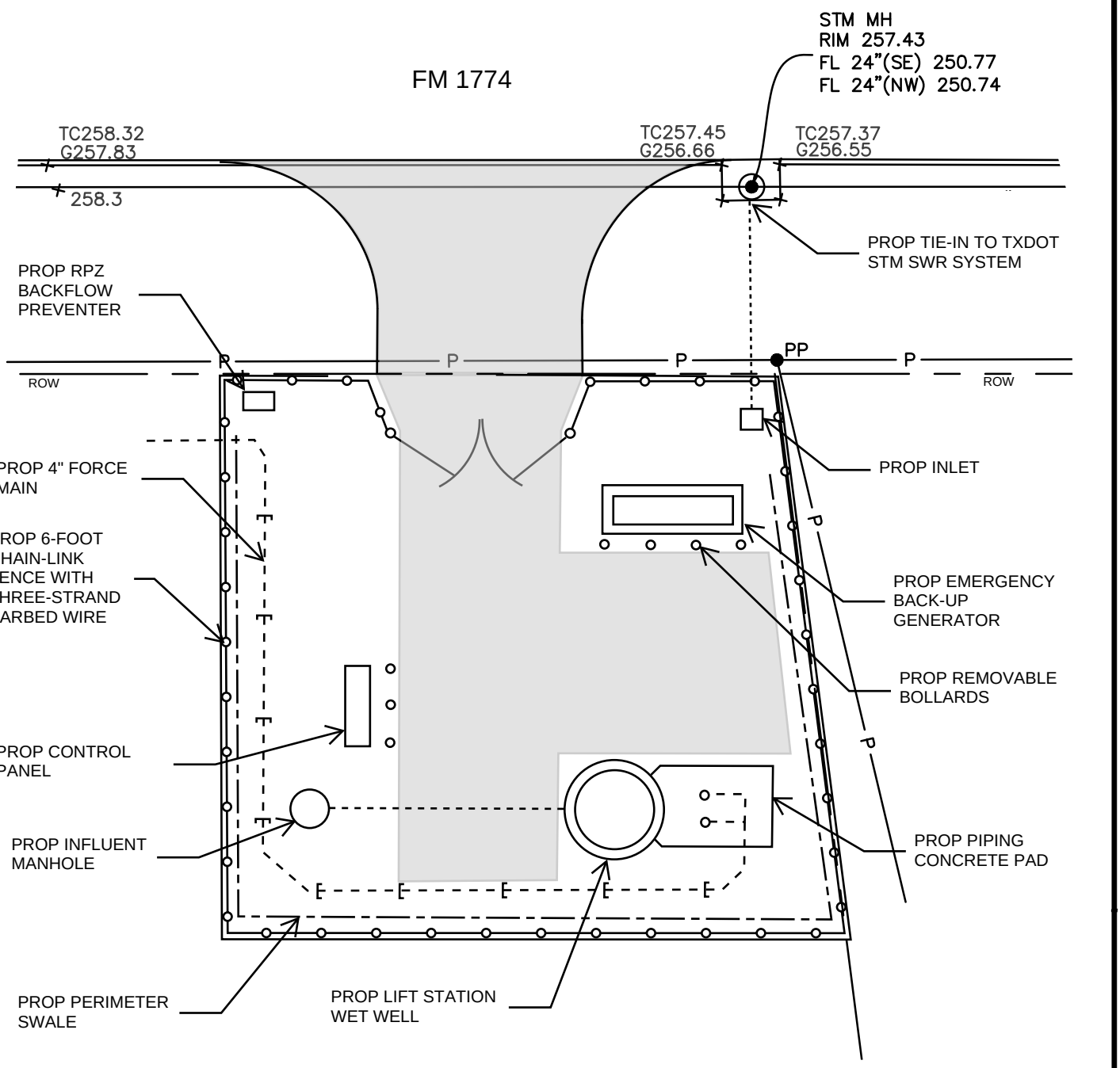
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/13/2022 at 3:18 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

ATTACHMENT C

Lift Station Site Layout



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FM 1774 SANITARY SEWER EXTENSION

LIFT STATION SITE LAYOUT

MAY 2022

212215.30

ATTACHMENT D

Pump and System Curves for Alternate 1

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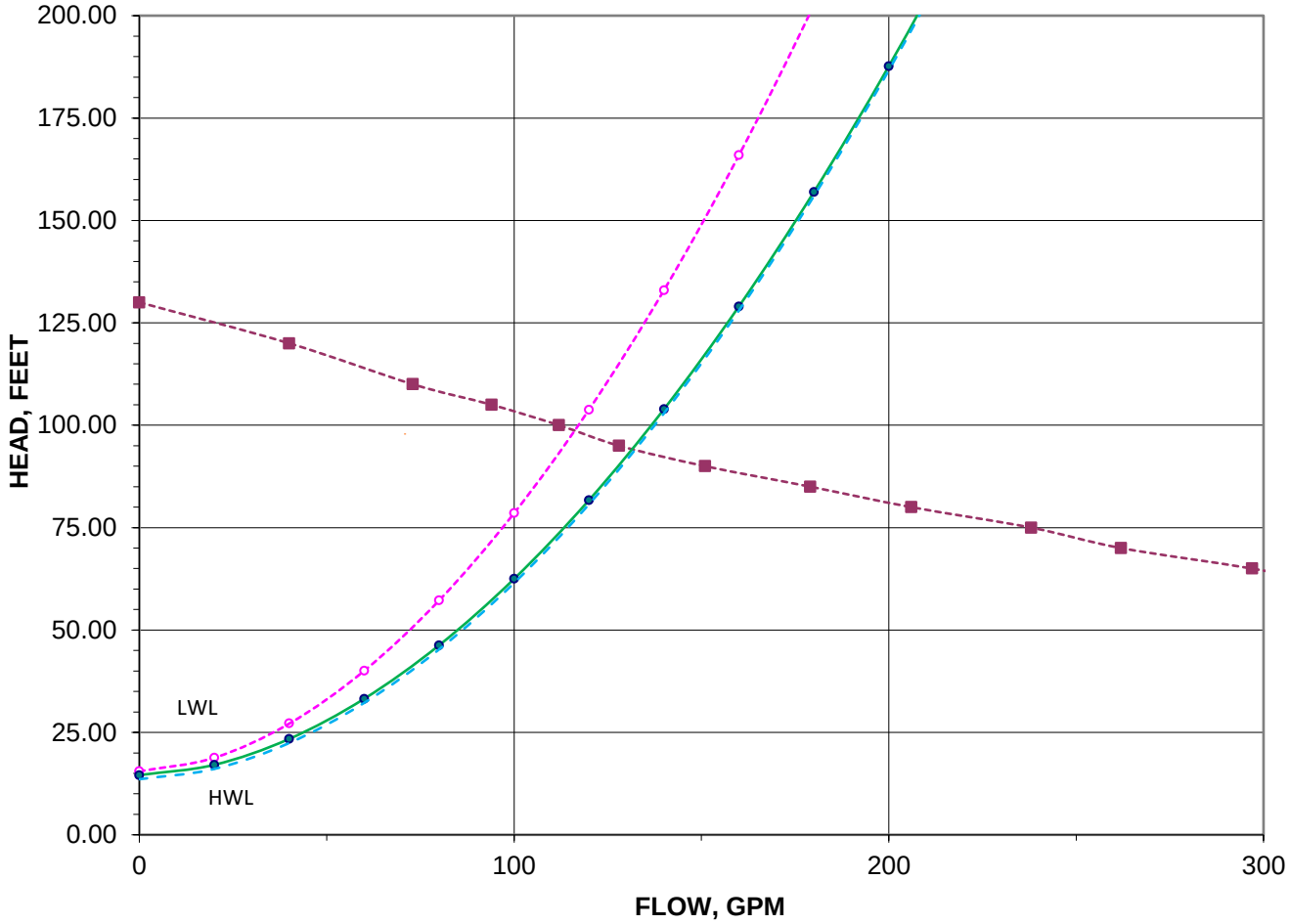
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION
SYSTEM AND PUMP CURVES

ALTERNATE 1

4" FORCE MAIN, 4" DISCHARGE PIPING



FLYGT Model No.
Concertor DP
N80-5800 -
7.5HP/2810RPM/3P

- 1 PUMP @ C=120
- LOW WATER LEVEL-1 Pump, C=120
- HIGH WATER LEVEL-1 Pump, C=140
- FLOODED LEVEL, C=140

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ATTACHMENT E

Design Calculations for Alternate 1

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

DESIGN DATA (ALTERNATE 1)

I. OPERATING DATA

Qdes =	**47,160**	gpd	32.8	gpm	0.07 cfs
Pk Factor	**4**				
Q_{peak} =	131.00		**131**	gpm - Firm Design Capacity	0.29 cfs
Total No. of Pumps			**2**		
No. of Operating Pumps			**1** @	**131** gpm - Individual Pump Capacity	
(w/ largest pump out of service)					

Elevations shown are based upon the FEMA datum NAVD 88 2001 Adjustment.

II. LIFT STATION DATA

Pump: **FLYGT PUMP, MODEL Concertor DP N80-5800, 3" IMPELLER, 7.5 HP, 2810 RPM, 4" DISCHARGE**

Wet Well Shape:

Circular:	(ft)	**Rectangular:**	
Diameter	**6.0**	Width	
		Length	
		Area	

Wet Well Data:

Equivalent Diameter	6.00
Top of Concrete Elevation	**260.00**
Ceiling of Wet Well =	257.50
FL 15-Inch Sanitary Sewer	**251.00**
Base Elevation	**243.00**
Low Rim Elev	**259.00**
Available Capacity Depth	16.00

Wet Well Elevations:

		Auto Δ ELEV.	Manual Δ ELEV.	
			1.00	
High Level Alarm	**249.43**	1.00	**1.30**	
1st Pump On	**248.43**	0.93	**1.50**	114.30
Minimum WS	**247.50**	1.00		
Low Level Alarm	**246.50**	1.04		
Pump Requirement	245.46	**29.5 in**	Min. Liquid level of pump (per Mfgr)	
Base Elevation	243.00			

III. PIPING

DISCHARGE PIPING DATA — Material: **Ductile Iron**

Above Ground Piping (No Vault) = **3.0** ft above slab (C_L)

Discharge Header Elevation = 263.00 ft

Discharge Elevation = **247.00** ft

FORCE MAIN DATA — Material: **DR 18 PVC**

SCENARIO		FM dia	Length	FM Ext. Dia	Length
1	**1**	**4**	**8950**	**0**	**0**
	2	**6**	**8950**	**0**	**0**
	3	**8**	**8950**	**0**	**0**

DESIGN DATA

	Discharge	Force Main	FM Extension	
Nominal Pipe Diameter, in	**4**	**4**	**0**	
Pipe Length, ft	20.54	**8950**	**0**	
Resistance Coefficient **(K)**	4.95	20.48		From Calculation of Minor Losses (below).
C values (Friction Factor)	**100**	**100**	**100**	
	120	**120**	**120**	
	140	**140**	**140**	

CALCULATION OF MINOR LOSSES (K)

4" DISCHARGE				4" FORCE MAIN				0" FORCE MAIN EXTENSION			
MINOR LOSSES	**Qty**	**K**	**Total K**	**MINOR LOSS**	**Qty**	**K**	**Total K**	**MINOR LOSS**	**Qty**	**K**	**Total K**
Entrance	**1**	0.5	0.5	Exit	**1**	1	1.00	Exit	**0**		
90 Deg Bend	**2**	0.51	1.02	90 Deg Bend	**6**	0.51	3.06	90 Deg Bend	**2**		
45 Deg Bend	**2**	0.27	0.54	45 Deg Bend	**26**	0.27	7.02	45 Deg Bend	**1**		
22 1/2 Deg Bend	**0**	0.18	0.00	22 1/2 Deg Bend	**8**	0.18	1.44	22 1/2 Deg Bend	**0**		
11 1/4 Deg Bend	**0**	0.14	0.00	11 1/4 Deg Bend	**8**	0.14	1.12	11 1/4 Deg Bend	**0**		
Reducer	**0**	0.3	0	Reducer	**0**	0.3	0.00	Reducer	**0**		
Gate Valve	**0**	0.14	0	Gate Valve	**6**	0.14	0.84	Gate Valve	**0**		
Swing Check Valve	**1**	0.75	0.75	Swing Check Valve	**0**	0.75	0.00	Swing Check Valve	**0**		
Plug Valve	**1**	0.031	0.031	Plug Valve	**0**	0.34	0.00	Plug Valve	**0**		
Tee, branch flow	**1**	1.02	1.02	Tee, branch flow	**0**	1.02	0.00	Tee, branch flow	**1**		
Tee, thru flow	**1**	0.34	0.34	Tee, thru flow	**0**	0.34	0.00	Tee, thru flow	**3**		
Air Release Valve	**1**	0.75	0.75	Air Release Valve	**8**	0.75	6.00	Air Release Valve	**1**		
TOTAL			**4.951**	TOTAL			**20.48**	TOTAL			

IV. STATIC HEAD AND MINOR LOSSES

	FT	
Flooded Section Static Head	13.57	
Minimum Static Head	14.57	Last Pump On
Maximum Suction Head	2.97	
Maximum Static Head	15.50	1st Pump On
Minimum Suction Head	2.97	
Total Dynamic Head (Min)	93.36	Last Pump On
Total Dynamic Head (Max)	94.29	1st Pump On

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

VELOCITIES AND CYCLE TIME CALCULATIONS (ALTERNATE 1)

V. PIPE VELOCITIES (As Determined from Flows from Chart)

		4" Discharge Ductile Iron	4" Force Main DR 18 PVC	0" FM Extension DR 18 PVC
Qmax	gpm	131	131	131
Qmin	gpm	131	131	131
Area	ft^2	0.09	0.10	#N/A
Vmax	ft/s	3.10	3.01	#N/A
Vmin	ft/s	3.10	3.01	#N/A

Qmax = flow under min head conditions, C=140
Qmin = flow under max head conditions, C=120

VI. CYCLE TIME CALCULATIONS

Vol = (Tmin x Qpc)/(4 x 7.48 gal/cf) Where T_{min} = **6** minutes
Q pc = Pump Capacity in gpm

	Force Main		Wet Well		Time	
	Q (gpm)	V (ft/s)	Δ Vol/T_{min} (ft3)	Δ H/T_{min} (ft)	On (min)	Off (min)
Active Pumps						
1 Pump @	131	3.01	26	**0.93**	1.500	4.50

Total Vertical Feet 0.93

VII. PUMP CONTROL SCHEDULE

Level Transducer			Rising Water Level		Falling Water Level	
Description	**Elev.**	**Height from Min. WS**	**Action**	**Pump Status**	**Action**	**Pump Status**
High Level Alarm	249.43	1.93	Alarm On	P1		P1
1st Pump On	248.43	0.93	1st On	P1		P1
Minimum WS	247.50	0.00	All Pumps Off		All Pumps Off	All Off
Low Level Alarm	246.50				Alarm	On
Base Elevation	243.00					

ATTACHMENT F

Ventilation Requirements for Alternate 1

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

VENTILATION REQUIREMENTS (ALTERNATE 1)

Gravity Ventilation

Maximum Design Pumping Rate =	131	gpm	
=	18	cfm	
Powered Ventilation (if utilized) =	0	cfm	
Total Required Exchange Rate =	**18**	**cfm**	
Maximum Allowable Air Velocity =	600	ft/min	(per TCEQ Standard)
Minimum Equivalent Pipe Size Required =	2.31	in	
Chosen Pipe Size =	**4**	**in**	(per TCEQ Minimum)
Requires	1	Pipes	
Resulting Air Velocity =	201	ft/min	

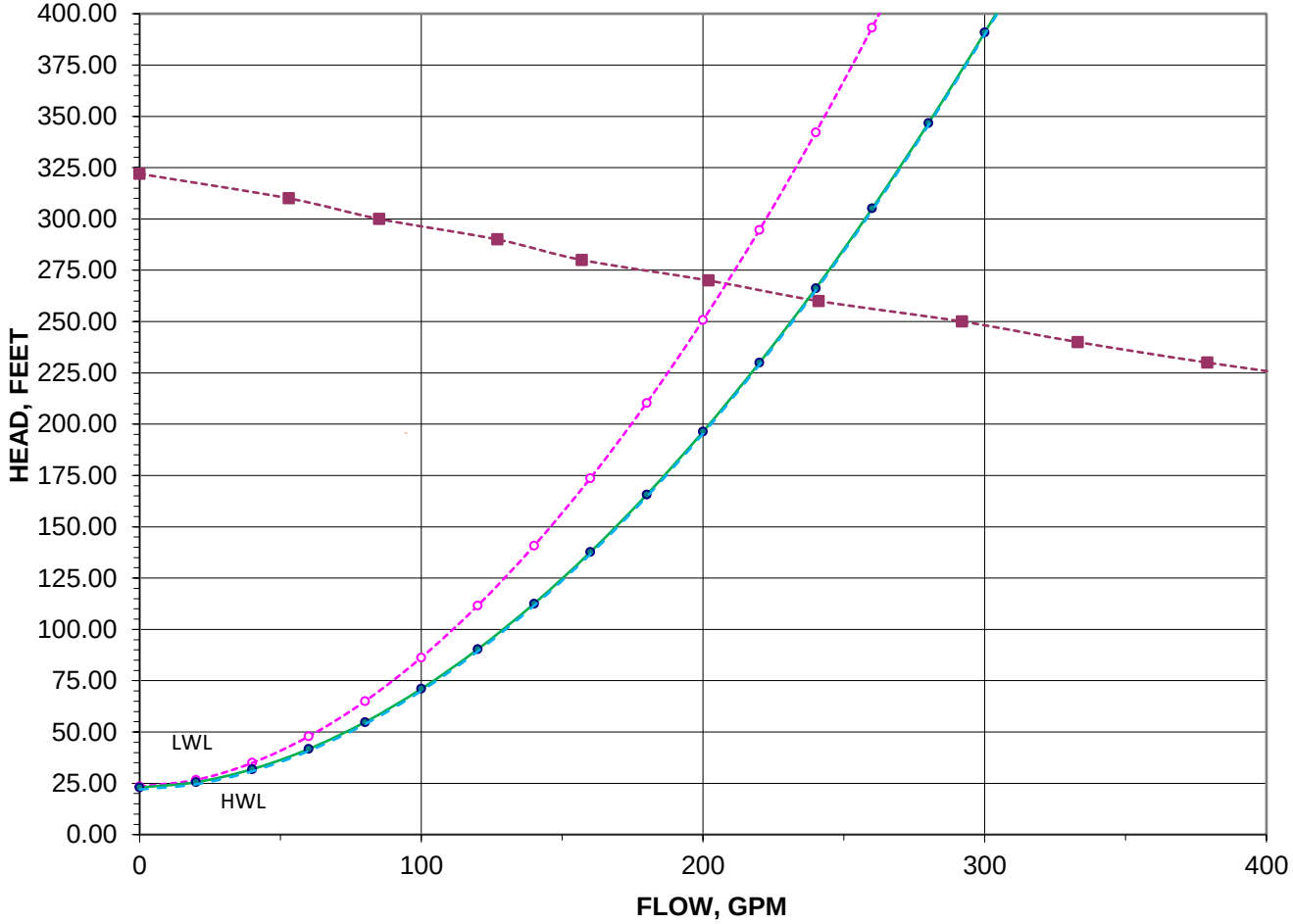
ATTACHMENT G

Pump and System Curves for Alternate 2

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION
SYSTEM AND PUMP CURVES

ALTERNATE 2

4" FORCE MAIN, 4" DISCHARGE PIPING



FLYGT Model No.
NP3171
35HP/3520RPM/3P

- 1 PUMP @ C=120
- LOW WATER LEVEL-1 Pump, C=120
- HIGH WATER LEVEL-1 Pump, C=140
- FLOODED LEVEL, C=140

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ATTACHMENT H

Design Calculations for Alternate 2

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

DESIGN DATA (ALTERNATE 2)

I. OPERATING DATA

Qdes =	**72,000**	gpd	50.0	gpm	0.11 cfs
Pk Factor	**4**				
Q_{peak} =	131.00		**200**	gpm - Firm Design Capacity	0.45 cfs
Total No. of Pumps			**2**		
No. of Operating Pumps			**1** @	**200**	gpm - Individual Pump Capacity
(w/ largest pump out of service)					

Elevations shown are based upon the FEMA datum NAVD 88 2001 Adjustment.

II. LIFT STATION DATA

Pump: **FLYGT PUMP, MODEL NP3171, 3" IMPELLER, 35 HP, 3520 RPM, 4" DISCHARGE**

Wet Well Shape:

Circular:	(ft)	**Rectangular:**
Diameter	**8.0**	Width
		Length
		Area

Wet Well Data:

Equivalent Diameter	8.00
Top of Concrete Elevation	**260.00**
Ceiling of Wet Well =	257.50
FL 15-Inch Sanitary Sewer	**244.00**
Base Elevation	**235.00**
Low Rim Elev	**259.00**
Available Capacity Depth	24.00

Wet Well Elevations:

		Auto Δ ELEV.	Manual Δ ELEV.	
			1.00	
High Level Alarm	**241.02**	1.00	**1.30**	
1st Pump On	**240.02**	0.52	**1.50**	114.30
Minimum WS	**239.50**	1.00		
Low Level Alarm	**238.50**	1.04		
Pump Requirement	237.46	**29.5 in**	Min. Liquid level of pump (per Mfgr)	
Base Elevation	235.00			

III. PIPING

DISCHARGE PIPING DATA — Material: **Ductile Iron**

Above Ground Piping (No Vault)	**3.0**	ft above slab (C_L)
Discharge Header Elevation =	263.00	ft
Discharge Elevation =	**247.00**	ft

FORCE MAIN DATA — Material: **DR 18 PVC**

SCENARIO		FM dia	Length	FM Ext. Dia	Length
1	**1**	**4**	**8950**	**0**	**0**
	2	**6**	**8950**	**0**	**0**
	3	**8**	**8950**	**0**	**0**

DESIGN DATA

	Discharge	Force Main	FM Extension	
Nominal Pipe Diameter, in	**4**	**4**	**0**	
Pipe Length, ft	29.54	**8950**	**0**	
Resistance Coefficient **(K)**	4.95	20.48		From Calculation of Minor Losses (below).
C values (Friction Factor)	**100**	**100**	**100**	
	120	**120**	**120**	
	140	**140**	**140**	

CALCULATION OF MINOR LOSSES (K)

4" DISCHARGE				4" FORCE MAIN				0" FORCE MAIN EXTENSION			
MINOR LOSSES	**Qty**	**K**	**Total K**	**MINOR LOSS**	**Qty**	**K**	**Total K**	**MINOR LOSS**	**Qty**	**K**	**Total K**
Entrance	**1**	0.5	0.5	Exit	**1**	1	1.00	Exit	**0**		
90 Deg Bend	**2**	0.51	1.02	90 Deg Bend	**6**	0.51	3.06	90 Deg Bend	**2**		
45 Deg Bend	**2**	0.27	0.54	45 Deg Bend	**26**	0.27	7.02	45 Deg Bend	**1**		
22 1/2 Deg Bend	**0**	0.18	0.00	22 1/2 Deg Bend	**8**	0.18	1.44	22 1/2 Deg Bend	**0**		
11 1/4 Deg Bend	**0**	0.14	0.00	11 1/4 Deg Bend	**8**	0.14	1.12	11 1/4 Deg Bend	**0**		
Reducer	**0**	0.3	0	Reducer	**0**	0.3	0.00	Reducer	**0**		
Gate Valve	**0**	0.14	0	Gate Valve	**6**	0.14	0.84	Gate Valve	**0**		
Swing Check Valve	**1**	0.75	0.75	Swing Check Valve	**0**	0.75	0.00	Swing Check Valve	**0**		
Plug Valve	**1**	0.031	0.031	Plug Valve	**0**	0.34	0.00	Plug Valve	**0**		
Tee, branch flow	**1**	1.02	1.02	Tee, branch flow	**0**	1.02	0.00	Tee, branch flow	**1**		
Tee, thru flow	**1**	0.34	0.34	Tee, thru flow	**0**	0.34	0.00	Tee, thru flow	**3**		
Air Release Valve	**1**	0.75	0.75	Air Release Valve	**8**	0.75	6.00	Air Release Valve	**1**		
TOTAL			**4.951**	TOTAL			**20.48**	TOTAL			

IV. STATIC HEAD AND MINOR LOSSES

	FT	
Flooded Section Static Head	21.98	
Minimum Static Head	22.98	Last Pump On
Maximum Suction Head	2.56	
Maximum Static Head	23.50	1st Pump On
Minimum Suction Head	2.56	
Total Dynamic Head (Min)	250.18	Last Pump On
Total Dynamic Head (Max)	250.70	1st Pump On

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

VELOCITIES AND CYCLE TIME CALCULATIONS (ALTERNATE 2)

V. PIPE VELOCITIES (As Determined from Flows from Chart)

		4" Discharge Ductile Iron	4" Force Main DR 18 PVC	0" FM Extension DR 18 PVC
Qmax	gpm	200	200	200
Qmin	gpm	200	200	200
Area	ft^2	0.09	0.10	#N/A
Vmax	ft/s	4.73	4.59	#N/A
Vmin	ft/s	4.73	4.59	#N/A

Qmax = flow under min head conditions, C=140
Qmin = flow under max head conditions, C=120

VI. CYCLE TIME CALCULATIONS

Vol = (Tmin x Qpc)/(4 x 7.48 gal/cf) Where T_{min} = **6** minutes
Q pc = Pump Capacity in gpm

	Force Main		Wet Well		Time	
	Q (gpm)	V (ft/s)	Δ Vol/T_{min} (ft3)	Δ H/T_{min} (ft)	On (min)	Off (min)
Active Pumps						
1 Pump @	131	3.01	26	**0.52**	1.500	4.50

Total Vertical Feet 0.52

VII. PUMP CONTROL SCHEDULE

Level Transducer			Rising Water Level		Falling Water Level	
Description	**Elev.**	**Height from Min. WS**	**Action**	**Pump Status**	**Action**	**Pump Status**
High Level Alarm	241.02	1.52	Alarm On	P1		P1
1st Pump On	240.02	0.52	1st On	P1		P1
Minimum WS	239.50	0.00	All Pumps Off		All Pumps Off	All Off
Low Level Alarm	238.50				Alarm	On
Base Elevation	235.00					

ATTACHMENT I

Ventilation Requirements for Alternate 2

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

VENTILATION REQUIREMENTS (ALTERNATE 2)

Gravity Ventilation

Maximum Design Pumping Rate =	200	gpm	
=	27	cfm	
Powered Ventilation (if utilized) =	0	cfm	
Total Required Exchange Rate =	**27**	**cfm**	
Maximum Allowable Air Velocity =	600	ft/min	(per TCEQ Standard)
Minimum Equivalent Pipe Size Required =	2.86	in	
Chosen Pipe Size =	**4**	**in**	(per TCEQ Minimum)
Requires	1	Pipes	
Resulting Air Velocity =	306	ft/min	

ATTACHMENT J

Force Main Alignment Layout

LEGEND

- WATER DISTRIBUTION LINE
- FIRE HYDRANT AND GATE VALVE
- FIRE HYDRANT
- SANITARY SEWER LINE
- SANITARY MANHOLE
- PROP FORCE MAIN
- STORM SEWER LINE
- STORM MANHOLE
- STORM INLET
- PROPOSED 10' SSE (SANITARY SEWER EASEMENT)

NTS

ACKER STREET

MELTON STREET

MELTON STREET

PROP 12" GRAVITY SANITARY SEWER

PROP 10' SSE

(4) 5X4

MATCH LINE

FM 1774

FM 1774

BETTY HALL STREET

YON STREET

COMMERCE STREET

SANDERS STREET

PROP FORCE MAIN

MAGNOLIA 6TH GRADE CAMPUS

ST MATTHIAS CATHOLIC CHURCH

MAGNOLIA VISION CENTER

ACREAGE

ACREAGE

4X3

PINE CROSSING

TIMBER RIDGE APARTMENTS

NICHOLS SAWMILL ROAD

SANDERS STREET

PURVIS STREET

ELM

SAN MH (DRY)
RIM 264.77
FL 6"(NE) 259.72
FL 24"(S) 245.65
FL 24"(NW) 245.80

PROP CORROSION RESISTANT DISCHARGE MANHOLE

SAN MH
RIM 265.44
FL 6"(N) 260.72
FL 8"(SE) 253.67
FL 12"(SE) 250.35
FL 12"(SW) 250.08
FL 4"(W) 258.57
FL 10"(NW) 250.35

SAN MH
RIM 267.00
FL 8"(NE) 253.36
FL 8"(NE) 246.68
FL 24"(SW) 245.39
FL 24"(N) 245.49

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TBPELS FIRM No. F-21783

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

PROP. FORCE MAIN ALIGNMENT SHEET 1 OF 3

APRIL 2022 212215.30

LEGEND

- WATER DISTRIBUTION LINE
- FIRE HYDRANT AND GATE VALVE
- FIRE HYDRANT
- SANITARY SEWER LINE
- SANITARY MANHOLE
- PROP FORCE MAIN
- STORM SEWER LINE
- STORM MANHOLE
- STORM INLET
- PROPOSED 10' SSE (SANITARY SEWER EASEMENT)

N

NTS

MATCH LINE

MELTON STREET

FM 1774

PROP FORCE MAIN

PROP 10' SSE

ACREAGE

OAK CROSSING

MAGNOLIA MEMORIAL GARDENS CEMETERY

MAGNOLIA FUNERAL HOME

MAGNOLIA MEMORIAL GARDENS CEMETERY

MAGNOLIA CHURCH OF CHRIST

MAGNOLIA CHURCH OF CHRIST

MAGNOLIA FAMILY PRACTICE & FAMILY DENTAL GROUP

STATE FARM & BEAR ARMS OF TEXAS

VALERO GAS STATION

MAGNOLIA BAPTIST CHURCH

LEGACY TUBULAR

BLACKWELL MINI STORAGE

REDWOOD CT

REDWOOD

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CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

PROP. FORCE MAIN ALIGNMENT
SHEET 2 OF 3

APRIL 2022

212215.30

LEGEND

- WATER DISTRIBUTION LINE
- FIRE HYDRANT AND GATE VALVE
- FIRE HYDRANT
- SANITARY SEWER LINE
- SANITARY MANHOLE
- PROP FORCE MAIN
- STORM SEWER LINE
- STORM MANHOLE
- STORM INLET
- PROPOSED 10' SSE (SANITARY SEWER EASEMENT)

N

NTS

MATCH LINE

PROP FORCE MAIN

PROP 10' SSE

PROPOSED LIFT STATION SITE

36" 36" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24"

3X3 3X3

12" 12" 12" 12" 12"

FM 1774

HANCOCK RETAIL CENTER

ABSOLUTE ZERO ORDINANCE & ANTIQUE SHOP

DAVID LANE

COLLISION REPAIR CENTER

MY MECHANIC

ACREAGE

COUNTRY AIR HVAC

MAGNOLIA YOUTH SPORTS COMPLEX

SUGAR BEND DRIVE

MAGNOLIA GLASS

MAGNOLIA ANIMAL CLINIC

DANCE CONNECTIONS

ACREAGE

ACREAGE

FRIENDSHIP DRIVE

ACREAGE (4.6 ACRE TRACT)

MIRANDA LANE

WILLOW CITY

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CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

PROP. FORCE MAIN ALIGNMENT SHEET 3 OF 3

APRIL 2022 212215.30

ATTACHMENT K

Surge Analysis Calculations

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
PROPOSED LIFT STATION DESIGN
MAY 2022

FORCE MAIN SURGE ANALYSIS

Pressure Wave

$$a = \sqrt{1 \div \left(\frac{w}{g} * \left(\frac{1}{K} + \frac{D}{e} * \frac{C_1}{E^1} \right) \right)}$$

D =	4.22	in	Pipe diameter
e =	0.29	in	Pipe wall thickness
E^1 =	61,920,000	psf	Young's Modulus of Elasticity for pipe
K =	43,200,000	psf	Bulk Modulus of Water
w/g =	1.938	slugs/cf	Mass density of water
C_1 =	0.87		Coefficient of pipe support condition
			(depends on Poisson's ratio, normally μ=0.3)
a =	**1,506**	**ft/s**	Pressure wave speed

Surge Pressure - Sudden Flow Stoppage

$$h_w = \frac{av}{g} \text{ (ft)}$$

a =	1,506	ft/s	Pressure wave speed
v =	3.01	ft/s	Max flow velocity
g =	32.2	ft/s^2	gravitational acceleration
h_w =	141	ft	pressure rise for sudden stop
	2.31		Conversion from PSI to Head (feet of water)
	61	**psi**	

Surge Pressure - Change in Flow

$$h_w = \frac{a(v2 - v1)}{g} \text{ (ft)}$$

a =	1,506	ft/s	Pressure wave speed
v2 =	8.00	ft/s	flow velocity
v1 =	3.01	ft/s	flow velocity
g =	32.2	ft/s^2	gravitational acceleration
h_w =	233	ft	pressure rise for sudden stop
	2.31		Conversion from PSI to Head (feet of water)
	101	**psi**	

Critical Period

L =	8,950	ft	Force main length	
2L/a =	**11.89**	**s**	Critical Period*	* Must not be greater than 1.5 seconds. (Assumed pump rundown time.)

Surge pressure could be a problem.

TABLE 6
Classification of Force Mains in Pumping Systems

	A	B
1. Type of System		
A. Single pipeline of uniform size	X	
B. Single pipeline of more than one size		
C. Two or more parallel lines		
D. Single or parallel system connected to a distrbution grid		
2. Profile of System		
A. Relatively flat or gradual ascending slope		
B. Steep slope (less than 20 times the pump head)		
C. Intermediate high points	X	
D. Intermediate pumps or tanks		
3. Pump Suction Conditions		
A. Suction direct from suction well	X	
B. Suction line in which the critical period (2L/a) is 1 second or less		
C. Suction line in which the critical period (2L/a) is greater than 1 second		

If the pump system contains only items in Category "A" Proceed to Table 7

If the pump system contains any items in Category "B", it is recommended that the system be referred to experts for analysis.

TABLE 7
Check List for Force Mains of Category "A" Items Only

	Yes	No
1. Is the "Critical Period" greater than 1.5 seconds?	X	
2. Is the maximum flow velocity in the force main greater than 4.0 ft/ sec?		X
3. Will any check valve in the force main close in less than the "Critical Period"?		X
4. Will the pump or motor be damaged if allow to run backwards, up to the full speed?		X
5. Is the factor of safety for the force main less than 3.5 under normal operating conditions?		X
6. Are there any automatic quick closing valves in the force main set to open/close in less than 5 seconds?		X
7. Are there any automatic valves within the pumping system that become inoperative due to the loss of pumping system pressure?		X
8. Will the pump(s) be tripped off prior to full closure of the discharge valve?		X
9. Will the pump(s) be started with the discharge valve open?		X

If the answer to any one of the above questions 1 thru 6 is yes, there is reason for concern regarding surge pressures. If two or more of the above questions 1 thru 9 are answered yes, the situation is likely to be serious and the degree of severity will be in proportion to the number of yes answers.

ATTACHMENT L

Gravity Sanitary Sewer Alignment Layout

LEGEND

- WATER DISTRIBUTION LINE
- FIRE HYDRANT AND GATE VALVE
- FIRE HYDRANT
- SANITARY SEWER LINE
- SANITARY MANHOLE
- PROP FORCE MAIN
- STORM SEWER LINE
- STORM MANHOLE
- STORM INLET
- PROPOSED 10' SSE (SANITARY SEWER EASEMENT)

NTS

MATCH LINE

MELTON STREET

FM 1774

PROP FORCE MAIN

PROP 10' SSE

PROP GRAVITY SANITARY SEWER

ACREAGE

OAK CROSSING

MAGNOLIA MEMORIAL GARDENS CEMETERY

MAGNOLIA FUNERAL HOME

MAGNOLIA MEMORIAL GARDENS CEMETERY

MAGNOLIA CHURCH OF CHRIST

MAGNOLIA CHURCH OF CHRIST

MAGNOLIA FAMILY PRACTICE & FAMILY DENTAL GROUP

STATE FARM & BEAR ARMS OF TEXAS

VALERO GAS STATION

MAGNOLIA BAPTIST CHURCH

LEGACY TUBULAR

BLACKWELL MINI STORAGE

REDWOOD CT

REDWOOD

MEADOW CROSSING

AEI ENGINEERING
a BAXTER & WOODMAN company
11450 COMPAQ CENTER DRIVE
SUITE 660
HOUSTON, TEXAS 77070
(281)350-7027
www.baxterwoodman.com
TBPELS FIRM No. F-21783

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION

PROP. GRAVITY SANITARY SEWER ALIGNMENT
SHEET 1 OF 2

APRIL 2022 212215.30

LEGEND

- WATER DISTRIBUTION LINE
- FIRE HYDRANT AND GATE VALVE
- FIRE HYDRANT
- SANITARY SEWER LINE
- SANITARY MANHOLE
- PROP FORCE MAIN
- STORM SEWER LINE
- STORM MANHOLE
- STORM INLET
- PROPOSED 10' SSE (SANITARY SEWER EASEMENT)

NTS

MATCH LINE

PROP FORCE MAIN

PROP 10' SSE

PROPOSED LIFT STATION SITE

36" 36" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24" 24"

3X3 3X3

12" 12" 12" 12"

FM 1774

PROP GRAVITY SANITARY SEWER

HANCOCK RETAIL CENTER

ABSOLUTE ZERO ORDINANCE & ANTIQUE SHOP

COLLISION REPAIR CENTER

MY MECHANIC

ACREAGE

COUNTRY AIR HVAC

MAGNOLIA YOUTH SPORTS COMPLEX

MAGNOLIA GLASS

MAGNOLIA ANIMAL CLINIC

DANCE CONNECTIONS

ACREAGE

ACREAGE

ACREAGE (4.6 ACRE TRACT)

DAVID LANE

WILLOW CITY

SUGAR BEND DRIVE

FRIENDSHIP DRIVE

MIRANDA LANE

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PROP. GRAVITY SANITARY SEWER ALIGNMENT
SHEET 2 OF 2

APRIL 2022 212215.30

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ATTACHMENT M

Sanitary Sewer System Capacity Calculations

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION
MAY 2022

SANITARY SEWER SYSTEM CAPACITY ANALYSIS

Collection System Component	Connections (ESFC's)	Allocated Sanitary Service (GPD)	Peak Factor
Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole at Commerce Street to manhole at Sarah			
Audubon Creekside North Section 1	4	1,200	
Audubon Creekside North Section 2A	47	14,100	
Audubon Creekside North Section 2B	27	8,100	
Audubon Creekside North Section 3A	33	9,900	
Audubon Creekside North Section 3B	52	15,600	
Audubon Creekside North Section 5	15	4,500	
Audubon Park Section 1	4	1,200	
Audubon Park Section 2	35	10,500	
Audubon Park Section 3	25	7,500	
Audubon Park Section 6	2	600	
Church Acres	4	1,200	
Deer Crossing Section 1	9	2,700	
Deer Crossing Section 2	10	3,000	
Deer Crossing Section 3	5	1,500	
Dogwood Patches Section 1	57	17,100	
Dogwood Patches Section 2	19	5,700	
Dogwood Patches Section 3	13	3,900	
Dogwood Patches Section 4	11	3,300	
Dogwood Patches Section 5	22	6,600	
Escondido Section 1	33	9,900	
Escondido Section 2	10	3,000	
Escondido Section 3	3	900	
Lee	13	3,900	
Magnolia Crossing	40	12,000	
Magnolia Melton	4	1,200	
Magnolia Ridge Forest Section 1	34	10,200	
Magnolia Ridge Forest Section 2	25	7,500	
Magnolia Ridge Forest Section 3	19	5,700	
Magnolia Ridge Forest Section 4	32	9,600	
Magnolia Ridge Forest Section 5	24	7,200	
Magnolia Ridge Forest Section 6	21	6,300	
Magnolia Ridge Forest Section 7	32	9,600	
Magnolia Ridge Forest Section 8	22	6,600	
Magnolia Ridge Forest Section 9	28	8,400	
Magnolia Ridge Forest Section 10	86	25,800	
Magnolia Ridge Forest Section 11	2	600	
Magnolia Ridge Forest Section 12	2	600	
Magnolia Ridge Section 4	145	43,500	
Magnolia Ridge Section 5	92	27,600	
Mill Creek Estates Section 1	139	41,700	
Mill Creek Estates Section 2	29	8,700	
Mill Creek Estates Section 3	87	26,100	
Mustang Rdige Section 1	43	12,900	
Oak Forest Terrace 320	12	3,600	
Pecan Village	10	3,000	
Rolling Hills Magnolia	6	1,800	
Windmill Estates	110	33,000	
Residential Not within Subdivision	213	63,900	
Magnolia City Hall	1	300	
Magnolia Historical Society	1	300	

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION
MAY 2022

SANITARY SEWER SYSTEM CAPACITY ANALYSIS

Magnolia Sewer Plant		1	300					
Sullivan Park/Magnolia City Hall		1	300					
Unity Park 4A EDC/4B CDC		1	300					
Love On'Em Assisted Living		16	4,800					
Magnolia Manor Apartments		16	4,800					
Magnolia Plaza Apartments		36	10,800					
Park at Walkers Landing		64	19,200					
Timber Ridge Apartments		16	4,800					
School, Church, Library, etc.		63	18,900			Calculated		Existing
Commercial		262	78,600			Peak Flow		Capacity
Proposed 4.6-acre Tract Development		47	14,100			(gpd)		(gpd)
	Total	**2,235**	**670,500**	x	4 Peak =	**2,682,000**	**<**	**10,872,589**
						Capacity Available		

Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole at Sarah to manhole approximately 230 feet south of Sarah								
						Calculated		Existing
Flow from manhole at Sarah		2,235	670,500			Peak Flow		Capacity
						(gpd)		(gpd)
	Total	**2,235**	**670,500**	x	4 Peak =	**2,682,000**	**<**	**10,872,589**
						Capacity Available		

Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole 230 feet south of Sarah to manhole at Hanks Road								
Flow from manhole 230 feet south of Sarah		2,235	670,500			Calculated		Existing
Residential Not within Subdivision		2	600			Peak Flow		Capacity
Magnolia Trail Apartments		80	24,000			(gpd)		(gpd)
	Total	**2,317**	**695,100**	x	4 Peak =	**2,780,400**	**<**	**11,165,177**
						Capacity Available		

Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole at Hanks Road to manhole at Unity Park Drive								
						Calculated		Existing
Flow from manhole at Hanks Road		2,317	695,100			Peak Flow		Capacity
						(gpd)		(gpd)
	Total	**2,317**	**695,100**	x	4 Peak =	**2,780,400**	**<**	**11,356,049**
						Capacity Available		

Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole at Unity Park Drive to manhole at Connie Avenue								
Flow from manhole at Unity Park Drive		2317	695,100			Calculated		Existing
Timberbrook Estates		81	24,300			Peak Flow		Capacity
Residential Not within Subdivision		2	600			(gpd)		(gpd)
	Total	**2,400**	**720,000**	x	4 Peak =	**2,880,000**	**<**	**11,356,049**
						Capacity Available		

CITY OF MAGNOLIA
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FM 1774 SANITARY SEWER EXTENSION
MAY 2022

SANITARY SEWER SYSTEM CAPACITY ANALYSIS

Flow through 24" Sanitary Line on Nichols Sawmill Road from manhole at Connie Avenue to manhole at approximately 550 feet south of Connie Avenue

Flow from manhole at Connie Avenue	2400	720,000				Calculated Peak Flow (gpd)		Existing Capacity (gpd)
Arnold Estates Section 1	37	11,100						
Total	**2,437**	**731,100**	x	4 Peak	=	**2,924,400**	**<**	**11,356,049**
						Capacity Available		

Flow through 30" Sanitary Line crossing Nichols Sawmill Road

Flow from manhole south of Connie Avenue	2,437	731,100				Calculated Peak Flow (gpd)		Existing Capacity (gpd)
Total	**2,437**	**731,100**	x	4 Peak	=	**2,924,400**	**<**	**10,632,572**
						Capacity Available		

Flow through 36" Sanitary Line from 30" sanitary line to WWTP

Flow from 30" sanitary line	2437	731,100						
Glen Oaks Section 1	102	30,600						
Glen Oaks Section 2	77	23,100				Calculated Peak Flow (gpd)		Existing Capacity (gpd)
Glen Oaks Section 3	124	37,200						
Glen Oaks Section 4	60	18,000						
Total	**2,800**	**840,000**	x	4 Peak	=	**3,360,000**	**<**	**20,274,010**
						Capacity Available		

Notes:
1. Peak factor of 4 based on TPDES permit.
2. See Sanitary Sewer Pipe Flow calculations for existing sanitary sewer pipe flow capacity.

CITY OF MAGNOLIA
MAGNOLIA ECONOMIC DEVELOPMENT CORPORATION
FM 1774 SANITARY SEWER EXTENSION
MAY 2022

SANITARY SEWER PIPE FLOW CAPACITY CALCULATIONS

Pipe Diameter (inches)	Slope [1]	Manning's n	Hydraulic Radius (feet)	Area [2] (feet)	Velocity (fps)	Flow (cfs)	Flow (gpm)	Flow (gpd)
8	0.335%	0.013	0.17	0.35	2.01	0.70	315	453,263
15	0.150%	0.013	0.31	1.23	2.04	2.51	1,126	1,621,352
24	0.550%	0.013	0.50	3.14	5.35	16.82	7,550	10,872,589
24	0.580%	0.013	0.50	3.14	5.50	17.28	7,754	11,165,177
24	0.600%	0.013	0.50	3.14	5.59	17.57	7,886	11,356,049
30	0.160%	0.013	0.63	4.91	3.35	16.45	7,384	10,632,572
36	0.220%	0.013	0.75	7.07	4.44	31.37	14,079	20,274,010

Notes:

1. Slope for 24", 30" and 36" sanitary sewer based on Nichols Sawmill Interceptor Sewer Replacement Phase I and Phase II project plans and/or record drawings. Slope for 8" and 15" sanitary sewer based on City of Magnolia minimum design slope.

2. Assumed that pipe can flow full.