2018 WASTEWATER COLLECTION SYSTEM
MASTER PLAN

Submitted To

Submitted By

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
SPECIALIZING IN CIVIL ENGINEERING FOR
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# CITY OF HUTCHINS
## 2018 WASTEWATER COLLECTION SYSTEM MASTER PLAN

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MASTER PLAN MAP
1. GENERAL

The City of Hutchins’ 2018 Wastewater Collection System Master Plan Study is a hydraulic evaluation of the existing wastewater collection system and a determination of the required improvements to convey the ultimate flows upon Buildout. This report summarizes the findings of the study, and it reflects contributions by the City staff for the configuration of the buildout system.

1.1 Purpose

This is the first wastewater master plan for the City of Hutchins. Master planning is based on the fully-developed planning area, termed ‘buildout’. This wastewater master plan outlines the major objectives for the wastewater system to provide service for the buildout wastewater flows. The master plan promotes an organized and efficient wastewater collection system.

1.2 Scope

The objectives required by this project were accomplished through the following scope of services.

- Historical Data Collection
- Limited Field Survey of Existing Collection System
- Hydraulic Model Creation & Limited Calibration to Existing System Flows
- Lift Station Evaluation Study (Separate Cover)
- Natural Drainage Basin Analysis
- Meetings with City Staff to Discuss Configuration Options
- Hydraulic Model Scenario Development: Ultimate Configuration & Flows
- Budgetary Cost & Timeline Estimation

1.3 Planning Area

The planning area for the City’s wastewater collection system includes the area within the City Limits and additional area in the extraterritorial jurisdiction (ETJ), including State of Texas properties. Roughly 6,790-acres of the 8,965-acre planning area were determined to be developable or developed. The City’s planning area includes a large swath of the Trinity River waterway that was not considered in the Study.

The topographical elevations in the planning area range from 580-feet above mean sea level to approximately 390-feet, near the shoreline of the River.
2. POPULATION, LAND USE & FLOWS

The City of Hutchins is situated at the intersection of IH-45 and IH-20. The Interstate Highways make Hutchins an ideal location for commercial and industrial uses. Areas surrounding the City are developing, and it is expected that Hutchins will rapidly develop after years of historically slow growth. Industrial developments which recognize the City’s position as a transportation center will likely continue to develop in Hutchins.

The City’s existing and future Land Use Maps, developed by Bannister Engineering, LLC for the 2016 Impact Fee Report, were utilized to calculate flow generation in the master plan. Bannister Engineering also derived the buildout population projection for Hutchins’ planning area of 11,244-people, which was utilized for the master plan.

2.1 Existing Land Use

Today, approximately 1,800-acres of the developable 6,790-acres are developed (27%). The developed land area is approximately 20-percent Residential, 67-percent Industrial, 9-percent Commercial and 4-percent Prison. The 2018 population was estimated to be approximately 5,700-people and was determined to include the State Prison inmate population of approximately 2,200-people.

2.2 Buildout Land Use

According to the City’s Future Land Use Map, approximately 5,060-acres will ultimately be developed. The developed land area will be approximately 18-percent Residential, 64-percent Industrial, 16-percent Commercial and 2-percent Prison. The projected buildout population is 11,244-people and includes the inmate population of 2,200. The Future Land Use Map shows a significant portion of the future residential area to be located south of Dowdy Ferry Road, near the Trinity River shoreline, and it shows most of the currently vacant land area to become light-industrial.

2.3 Average Wastewater Flows

Monthly flow totals, metered at the City of Dallas Point-of-Entry meter station for the 12-months in 2016, were obtained from the City. The Average (dry-weather) Daily Flow Rate (ADF) for the City was approximately 0.60-MGD. It should be noted that the design of wastewater conveyance facilities is not based on average flow rates, and designs must be based on peak flow rates. Calculations for Peak Wet-Weather Flow (PWWF) rates include a peaking factor, applied to the ADF, and also include an additional allowance for Inflow and Infiltration (I&I).
2.3.1 Existing Land Use Flow Assumptions
The metered average daily flow rate (ADF), 0.60-MGD, provided by the City, was compared to the existing land uses and population of the City. The ADF was divided among the existing users, on a per-person and a per-acre basis, resulting in flow rate assumptions. The assumptions can be used to project flow responses to additional development.

The Average-Rate Flow Assumptions for the existing system were as follows:
- Residential: 80-gallons per person (capita) per day (gpcd)
- Commercial: 350-gallons per acre per day (gpad)
- Industrial: 200-gpad
- Prison: 2,200-gpad (approximately 65-gpcd per inmate)

The resulting ADF, used by the Hydraulic model, was 0.78-MGD, compared to the 0.60-MGD ADF that was observed by the DWU meter station, in 2016.

2.3.2 Buildout Land Use Flow Assumptions
For the buildout hydraulic model scenario, design flow assumptions were increased to match those observed in other communities, based on the expectation that the existing development will continue to expand and also to densify.

The Average-Rate Flow Assumptions for the buildout system were as follows:
- Residential: 90-gpcd
- Commercial: 1,300-gpad (Office/Retail/Public: 1,500-gpad, Town Center: 1,700-gpad)
- Industrial: 1,000-gpad (2,500-gpad for Heavy Industrial)
- Prison: 2,200-gpad

The resulting Buildout ADF, used by the Hydraulic model, was 5.92-MGD.
2.3.3 Rainfall-Derived Inflow & Infiltration (I&I)

A second load set was applied to the hydraulic model to simulate the flow response to rainfall that enters the wastewater collection system. According to the ASCE Manuals and Reports on Engineering Practice No. 36, wastewater collection systems which serve community populations between 1,000 and 10,000 people commonly observe maximum flows that are approximately 300-percent of the ADF due to precipitation that enters collection systems. A maximum flow rate that is 300-percent of the ADF is termed to have a Wet-Weather Peaking Factor (WWPF) of 3.

Maximum flow periods most commonly follow intense rainfall events. An intense storm is one where a large volume of rainfall occurs over a short duration. These storms allow surface water to accumulate and flow over the ground surface and into the wastewater collection system via openings in the system, which is termed Inflow. Persistent rainfall causes ground saturation, and the ground water also penetrates the system, termed Infiltration. If observed flow in a sewer were plotted, the Inflow volume relates to a rapid spike in flow, and the Infiltration volume is shown by an elevated flow rate that slowly diminishes over a period that is often several days.

The City has not performed flow monitoring investigations. Electronic devices can be installed in manholes at specific locations to capture the actual fluctuations in flow rates. Due to the lack of flow monitoring data, the hydraulic model wet-weather loads were applied with a typical storm distribution for all areas. The peak of the 6-hour storm load was aligned with the morning peak of the diurnal curve pattern, applied to the ADF, to simulate a maximum flow scenario.

The 5-year/ 60-minute storm for Dallas County was applied to the model. The total precipitation was 2.24-inches over the 1-hour period. In the model, 100-percent of the total rainfall occurs at 7 a.m., when the user loads are also elevated. Of the total rainfall volume, 2.50-percent was assumed to enter into the collection system, correlating to approximately 1,500-gallons per developed acre, per day.

Modeled System Results:

- Existing Model ADF = 0.78-MGD, PWWF = 3.49-MGD, WWPF = 4.47
- Buildout Model ADF = 5.92-MGD, PWWF = 17.07-MGD, WWPF = 2.88

Inflow and Infiltration rates closer to 600-gpad are used more typically for service areas with new construction, assuming newly constructed lines are of higher-quality materials, have fewer openings and are constructed with better inspection methods for completed work.
3. EXISTING WASTEWATER COLLECTION SYSTEM

The City of Hutchins’ wastewater collection system consists of approximately thirty-one (31) miles of sanitary sewer pipeline, generally ranging from 6-inch to 21-inch in diameter. The collection system also includes Seven (7) lift stations with force mains that range from 4-inch to 12-inch in diameter. Wastewater treatment is provided by the Dallas Water Utilities (DWU) at the Southside Wastewater Treatment Facility, located near the east bank of the Trinity River, adjacent to the City’s eastern planning boundary line. The following sections describe the City’s existing Lift Stations and Wastewater Collection Lines, and briefly discuss the Master Plan proposals which affect each. Section 2.5 includes a map of the existing collection system.

3.1 Existing Lift Stations

The City operates and maintains seven (7) lift stations. The three primary lift stations are: Dallas, Cleveland Road and Sikes. The remaining four (4) lift stations were constructed to serve individual developments. The four lift stations, serving individual developments, are not discussed in this section and include; Trout Road, Skyline, Millers Ferry and Goode Road.

Wastewater lift stations are regulated by the Texas Commission on Environmental Quality (TCEQ), and the requirements are outlined by Chapter 217, Subchapter C, of the Texas Administrative Code. During the creation of the Master plan, the City engaged us to investigate the three major lift stations in the system, including the assessment for compliance with the TCEQ requirements. For the evaluation, the lift stations were field tested for pumping capacity through draw-down tests. The findings showed that the FIRM pumping capacity (defined by the TCEQ as the Lift Station capacity with the largest pump on standby) of each lift station tested was less than the calculated theoretical peak flows to each.

Cycle Times and Detention times were also calculated, based on the measured discharge rates. All Cycle times were determined to be adequate, based on the wet well float settings, however none of the stations had detention times greater than the TCEQ minimum detention time; 20-minutes. Due to the short detention times calculated for the time of power failure to the first overflow in the upstream system, it is recommended to install standby generators with automatic transfer switches on-site for each station.

The three lift stations that were included in the Lift Station Assessment Study are described in more detail in the following sections. Appendix-A includes findings from the Lift Station Study, including land use and flow calculations, pumping rate field measurements and cycle and detention time calculations.
3.1.1 Dallas Lift Station
The Dallas Lift Station, today, receives all of wastewater flow generated by the City. All other lift stations in the system are upstream of this station. Situated near the northern planning boundary line, the site is adjacent to Interstate Highway 20 (IH-20) right-of-way and the Trinity River. The Dallas Lift Station site is the location of the abandoned wastewater treatment facility for the City (Imhoff Tank). A second lift station wet well exists on-site today that was taken out of service.

The Dallas Lift Station wet well is 12-feet by 12-feet and 23.5-feet deep. Two pumps are installed, and the FIRM Capacity measured was 1.96-Million Gallons per Day (MGD). The 12-inch diameter force main runs east from the station, crossing the Trinity River, and discharges to a DWU wastewater meter station, located southwest of the intersection of IH-20 and Dowdy Ferry Road. The Meter Station is the Point of Entry (P.O.E.) to the City of Dallas Wastewater System, and it is currently the only P.O.E. for the City.

The TCEQ requirements establish an acceptable range of force main velocities; 3-feet per second (fps) to 6-fps. The existing 12-inch diameter force main therefore has a defined range of capacities which is 1.52-MGD at the minimum 3-fps and 3.05-MGD at the upper limit of velocity; 6-fps. The measured discharge rate of the Dallas Lift station was within the range, producing a 3.9-fps velocity which is adequate for the transport of solids, and was not too rapid to cause damage to the forcemain system or to induce friction head losses that lessen pumping efficiency.

In the future, the Dallas Lift Station may activate the existing secondary wet well and utilize up to four (4) pumps. Pump selection will be dependent on the need for a secondary force main, that would be operated in parallel, or would replace the existing 12-inch force main altogether. Additional force main capacity is warranted for lift station capacity requirements above 3.05-MGD. Today, the theoretical peak wastewater flow to the lift station is 3.59-MGD, however the City has not reported overflows due to pumping capacity deficiencies. Implementation of the Master Plan will partially relieve flow to the Dallas Lift Station, and the timing of development and Master Plan implementation will determine the needs at the Dallas Lift Station.

3.1.2 Cleveland Road Lift Station
Today, a large portion of the City drains via the 18-inch diameter sewer along Cleveland Road. The Cleveland Road Lift Station is situated on the south side of Cleveland Road and on the eastern end, near the Trinity River. The area is relatively flat, topographically, and the Lift station is required to lift the flow only a short distance. The vertical lift of the water surface is also relatively small, and a vacuum release valve is installed in the valve vault of this station because a portion of the forcemain volume expels by gravity.
The Cleveland Lift Station has two pumps installed that are different models. Only one of the pumps could be field tested, resulting in a 1.67-MGD capacity. Through the 8-inch diameter force main, a velocity of 7.4-fps was induced by pumping. Although this is above the TCEQ recommended maximum, it was considered acceptable for this force main. It should be noted that excessive turbulence exists in the receiving downstream manhole.

The Master Plan shows the Cleveland Road Lift Station to be abandoned in the future. The Master Plan proposes the southerly-flowing ‘Shoreline’ Trunk Sewer, which is to be installed after the construction of the proposed ‘Southern’ Lift Station and Force Main. The Shoreline sewer will intercept the Cleveland Road flows and divert the flow away from the northern Dallas Lift Station and towards the proposed Southern Lift Station.

3.1.3 Sikes Lift Station
The Sikes Lift Station is situated approximately one half-mile south of the Cleveland Lift Station. Sikes Lift Station is located in the floodplain and may not be accessible during significant rain events. The wet well top slab is elevated approximately 3-feet, and it was determined to be above the 100-year flood water surface elevation. The Lift Station was positioned in the floodplain so that it could serve two (2) natural drainage basins. Flow to Sikes Lift Station is conveyed, therefore, by two trunk sewers, named herein as the ‘North Sikes’ and the ‘South Sikes’ trunk sewers. A topographical ridge, generally along Dowdy Ferry Road, divides the North Sikes and the South Sikes natural drainage basins.

Sikes Lift Station pumping capacity measured 0.66-MGD with one pump running. During the field investigations, one of the two pumps was not functioning. The installed pumps are vertical lift pumps, rather than submersible, which require suction to prime and engage pumping.

Sikes Lift Station force main is 8-inch in diameter. The force main runs northerly, along a strip of land with perennial water bodies on both sides. The force main discharges to the Rawlins Sewer at the east end of Cleveland Road, approximately the same location of the Cleveland Road Lift Station discharge. The combined flow discharged by Cleveland Road and Sikes lift stations (1.67-MGD & 0.66-MGD) totals 2.33-MGD, which exceeds the 1.32-MGD capacity of the Rawlins sewer (15-inch sewer on 0.10% grade).

The Master Plan proposes to abandon the Sikes Lift Station with the installation of the proposed Southern Lift Station and proposed Shoreline Trunk Sewer. The Shoreline Trunk Sewer will intercept the North Sikes and the South Sikes Trunk Sewers near the floodplain boundary and will convey the flow southerly to the proposed Southern Lift Station.
3.2 Existing Trunk Sewers

Trunk sewers are generally defined as those primary sewers which typically follow a natural drainage course, such as a creek or river. Topography dictates the natural drainage basins, being bound by topographical ridges, or high-points. Topographical ridge boundaries may still be crossed by sewers, usually by installing the pipes at greater depths to ‘cut-through’ a hill or ridge, and sewers that cross natural basin divides are referred to as interceptor sewers or relief sewers. Systems that are in the early stages of development, which lack trunk sewer infrastructure may use lift stations or interceptor sewers to extend the system in order to serve an area.

The existing collection system uses an interceptor sewer along Main Street to divert flow from the natural drainage paths of the City’s southern natural drainage basins, towards the northern Cleveland Road Sewer, and existing development east of Main Street (at lower elevation) is served by lift stations which pump northerly, towards the Dallas Lift Station.

The existing trunk sewers are discussed in more detail in the following sections, which are presented in geographical order from north to south.

3.2.1 Dallas Basin Sewers (Langdon, Prison & Rawlins)

The most northern drainage basin is not well defined topographically, being relatively flat along the width of the basin. Two (2) trunk sewers serve the basin, the ‘Langdon’ Road Sewer and the ‘Prison’ Sewer.

The Langdon Sewer is mostly 12-inch pipe, but it varies in size and capacity along the route. This Master Plan proposes the replacement of approximately 1,100-feet of 6-inch pipe, to 10-inch diameter, to improve capacity of a railroad crossing, east of IH-45.

The Prison Sewer is 10-inch in diameter, and was thought to be constructed to serve the State of Texas detention centers. Field survey reported that the Prison sewer was dry upon inspection, meaning no flow was observed.

Near the floodplain boundary of the Trinity River is the, previously discussed, Rawlins Sewer. It is a 15-inch diameter, vitrified clay tile pipe sewer that was constructed in 1968 with the same project that installed the Sikes Lift Station and Force Main, as well as the South Sikes Trunk Sewer. The Rawlins Sewer is situated along the River-side of a closed landfill, and its location creates challenges for future connections to the Sewer. The primary function of the Rawlins Sewer is to convey the discharged flow of the Cleveland Road and the Sikes Lift Stations.
3.2.2 Cleveland Road Trunk Sewer

Today, nearly all of the development west of Main Street is served by the 18-inch diameter Cleveland Road Trunk Sewer, which conveys flow to the Cleveland Road Lift Station. Millers Ferry and Goode Road Lift Station service areas also contribute to the Cleveland Road flows, in the current configuration. The 18-inch diameter Main Street Interceptor sewer, installed at depths greater than 25-feet in places, conveys flow across basin divides to a 21-inch diameter sewer, which connects to the western end of the Cleveland Road Trunk Sewer. The upstream 21-inch diameter sewer has a capacity in the range of 6.0-MGD, based on limited survey, and it acts like a funnel, rapidly injecting flow to the Cleveland Road Trunk Sewer, which has a capacity in the range of 2.5-MGD. Topography is steep along the 21-inch sewer and flattens out considerably along the Cleveland Road Sewer.

3.2.3 Sikes Sewers

Two trunk sewers, separated by a steep ridge along Dowdy Ferry Road, convey flow to the existing Sikes Lift Station. The North Sikes Trunk Sewer is 10-inch and 8-inch diameter, and it generally follows Nichols Drive to serve a residential service area, including Meadow Brook Drive. The service area for the North Sikes Trunk Sewer is approximately 300-acres.

The South Sikes Trunk Sewer is 10-inch diameter, vitrified clay tile pipe. It was constructed in 1968 with the Sikes Lift Station and Rawlins sewer. This trunk sewer extends along Rawlins Creek, which crosses Dowdy Ferry near Michael Street, to serve the Skyline Estates development. In addition, two lift stations; Trout Road and Skyline, pump flow towards the South Sikes Trunk Sewer, and are include in the service area for the interim period.

The South Sikes Trunk Sewer follows the Rawlins Creek, which is a well-defined surface waterway which collects runoff from area west of Main Street. The Creek crosses IH-45, the Railroad and Main Street just south of the Quail Run development. The natural drainage basin for the Trunk Sewer, being the same as that for the watershed, extends west of the Main Street Interceptor.
3.3 Existing Collection System Summary

The Dallas Lift Station, located in the north of the City, conveys all of the wastewater flow generated by the City. Two other primary lift stations, Cleveland Road and Sikes, pump flow, generated by more southerly service areas, to the 15-inch Rawlins Sewer, which conveys the flow northerly, to the Dallas Lift Station. The series of lift stations move the flow northerly and across the Trinity River to the City of Dallas Point-of-Entry, at the meter station. City of Dallas collection system directs the flow back south to the Southside Wastewater Treatment Facility.

The Main Street Interceptor Sewer collects flow from area west of Main Street, and transports the flow across basin divides, to the North. The Main Street interceptor flows are then conveyed by the Cleveland Road Trunk Sewer and the Cleveland Road Lift Station.

3.4 Existing Collection System Capacity Deficiencies

Three primary lift stations were determined to require improvements, based on the theoretical peak flows calculated and the measured pumping capacities. Several of the trunk sewers lack capacity to convey existing peak flows. The existing Collection System Capacity Deficiencies include:

- Dallas, Cleveland Road & Sikes Lift Stations (FIRM Pumping Capacity, Detention time)
- Rawlins 15-inch Sewer (3.12-MGD peak flow/ 1.32-MGD Capacity)
- Cleveland Road 18-inch Trunk Sewer (2.33-MGD peak flow/ 2.50-MGD Capacity)
- West Palestine Street 6-inch Sewer (conveys 12-inch Lancaster-Hutchins Rd. Sewer flows)
- Langdon Road 6 and 8-inch Railroad Crossing (proposed upstream residential loads)
3.5 Existing Collection System Map

FIGURE 1
City of Hutchins Existing Wastewater Collection System & Service Area Basins

LEGEND
- WASTEWATER PLANNING AREA
- AREA SERVED BY DALLAS LIFT STATION ONLY*
- CLEVELAND ROAD LIFT STATION SERVICE AREA
- SIKES LIFT STATION SERVICE AREA

*The Dallas Lift Station Service Area includes all shaded areas.
4. HYDRAULIC MODEL

The hydraulic wastewater model is an important tool for understanding the interaction of flows within the sewer network. It is useful for assessing capacities of existing and proposed lines and facilities. The model iteratively calculates the hydraulic grade line (HGL) for timesteps set in the model. Functions of the software can plot the profile of the HGL water surface within the collection network, and can predict where in the system the HGL elevation exceeds a surface manhole rim elevation (a modeled overflow).

The hydraulic model was created in InfoSewer Pro Suite 7.6, running on the ArcGIS 10.4.1 platform. Three model scenarios were created; Existing (2018), 10-year (2028) and Buildout. Each scenario includes unique loads that are applied to the system at manholes.

4.1 Resources

The model was created with georeferenced shapefiles for sewer lines and manholes that were provided by the City. Two collection lines that were not included in the files were added to the model; the 12-inch Lancaster-Hutchins Road Sewer and the 15-inch West Wintergreen Road Sewer. The Wintergreen line was added with the use of construction plans, however, construction plans were not readily provided for any other major collection line, with the exception of the 15-inch Rawlins Sewer and 10-inch South Sikes Sewer. Where provided, flowline and manhole rim elevations from as-built construction plans were applied to the model lines and facilities.

Due to the lack of historical records, the survey crew of Birkhoff, Hendricks & Carter was dispatched over several weeks to collect additional rim and flowline elevation data at specified manholes. Fifty-four (54) manholes were field surveyed throughout the system, of which, most of the manholes were opened and depth to flowlines were measured.

2-Foot topographical contour shapefiles were purchased from North Central Texas Council of Governments (NCTCOG), which were used to determine the remainder of the manhole rim elevations applied to the model.

Several full-sized construction plan-sets were provided by the City for the Lift Stations. Plans were received for each of the lift stations, with one exception; Skyline Lift Station. As mentioned, the three primary lift stations (Dallas, Cleveland and Sikes) were each visited, measured dimensionally and measured for pumping capacity. Those field measurements were utilized in the model.

The City provided to us a table of daily recordings of the pump-run hour meters for the three major lift stations. Paired with the measured pump discharge rates, the average daily flow estimates were generally confirmed by the measurements.
4.2 Model Creation Method

The digital collection system was created in the software by importing the City’s existing sewer line and manhole shapefiles. The files did not include elevation data. Known elevation data was input and attributed to each component. Pipe sizes were taken from other working maps provided by the City. Flowlines were calculated between known points, based on feasible and required depths of pipe below ground surface. Drop manholes were incorporated into the flowline information at certain locations where excessive depths or slopes were encountered.

Lift stations and force mains were also created in the model. The pumping capacities were applied where known.

The City’s parcels were delineated into Sub-Basins, each encompassing land uses. Land use composition was extracted for each individual sub-basin, and used to calculate the average daily flow rates, using the flow assumptions. Sixty-five (65) Sub-Basins were each analyzed for the Buildout model scenario. The total ADF calculated for each sub-basin was distributed evenly among the manholes in each sub-basin and applied to the model.

The Diurnal Curve pattern, shown by Figure 2, was added to the model, and it was linked to the ADF loads to apply the daily variation in usage rates. The Diurnal Curve values are unitless, meaning the average peaking factor for the 24-hour period is 1. Considering an example ADF of 1.00-MGD, the model would inject the flow rate 1.74-MGD at 7 a.m. and 0.65-MGD at 3 p.m., averaging 1.00-MGD daily.
The storm distribution Hydrograph pattern, shown by Figure 3, was also added to the model, and it was linked to the secondary, base storm loads to apply the time-dependent variation of I&I entering the system. The hydrograph applies variation of the total rainfall-derived inflow loads within the model. The hydrograph peaking factors are unitless and reach a peak factor of 1.0 at 7 a.m., and therefore, 100-percent of the base storm loads applied are injected to the model at 7 a.m., being the same hour of peaking for the diurnal curve, applied to the ADF user load.

As discussed, the base storm loads, which are multiplied by this time-step pattern, were derived with a percentage of total rainfall. 2.50-percent of the total rainfall volume was selected for the amount of I&I that enters the system. To illustrate, if one inch of rainfall falls on one acre of land, the volume of total rainfall is one inch-acre, equating approximately 27,150-gallons of precipitation. 2.50-percent of the volume, 679-gallons per acre in total, enters the system. The design storm used for the model was the 5-year/60-minute storm for Dallas County, for which total precipitation value is 2.24-inches, over a one-hour duration. The calculation example above references a 1-inch storm, and the rate 679-gallons per acre can be extended to the 2.24-inch design storm for an I&I rate of 1,520-gallons per acre (per hour). Peaked with the hydrograph pattern, the maximum I&I rate applied to the model was 1,520-gallons per acre, per hour (at 7 a.m.).
4.3 Model Analysis

The model was used to analyze the system in a variety of ways. First, the flowline information developed was used to assess feasibility of the proposed facilities. Previously, there was little flowline information known for the collection system, and the model was an organizational tool to construct and document the elevations and dimensions of the lines and facilities. With the data organized, manual calculation analysis was combined with the model data for the conceptual design of proposed lines and facilities.

Queries were developed in the model software to output the locations of manholes that experience surcharging and overflow. Those queries were tested throughout the load development process to distinguish if the model was correctly presenting the surcharges or overflows that were, reportedly, experienced in the field.

The model reports peak flows in each line segment, as well as for the lift stations. Maximum flow outputs are used for the sizing of lift stations and force mains. The wastewater collection system operates as a network where each line segment conveys different amounts of flow at differing velocities.

The model was run for various configurations. Facilities can be “turned-on or off”, and they can be modeled under various loads. For example, the Existing system configuration was tested using the buildout loads. **Figure 4** shows a model-generated profile of the 15-inch Rawlins Sewer at 5 a.m., just prior to conveying a peak flow of 7.55-MGD. (Note that the upstream, Cleveland Road and Sikes Lift Station pumps are set to pump the inflow as required.)

![FIGURE 4 - Sample Model Generated Profile (Rawlins Sewer Capacity Deficiency)](image-url)
A model simulation was run for the existing collection system configuration with buildout flows to predict the locations of overflow. **Figure 5** shows the Manholes which overflowed in Red.

**FIGURE 5** – Sanitary Sewer Overflow Manhole Locations (Existing System, Buildout Flows)
4.4 Model Results

The model outputs are summarized in Table 1 for the major lift stations and trunk sewers, for both the existing system and the buildout system.

**TABLE 1 - Facility Maximum Flows**

<table>
<thead>
<tr>
<th>Existing Lift Station</th>
<th>Pipe ID</th>
<th>Existing (2018)</th>
<th>Buildout</th>
<th>Notes</th>
</tr>
</thead>
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<td>Dallas Lift Station</td>
<td>1000</td>
<td>3.49</td>
<td>3.16</td>
<td>Service Area Reduced</td>
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<tr>
<td>Cleveland Road Lift Station</td>
<td>2102</td>
<td>1.90</td>
<td></td>
<td>Abandoned</td>
</tr>
<tr>
<td>Sikes Lift Station</td>
<td>3200</td>
<td>0.93</td>
<td></td>
<td>Abandoned</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Existing Trunk Sewer</th>
<th>Pipe ID</th>
<th>Existing (2018)</th>
<th>Buildout</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>Rawlins Trunk Sewer</td>
<td>1300</td>
<td>2.86</td>
<td>0.74</td>
<td>Service Area Reduced</td>
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<tr>
<td>Cleveland Road Trunk Sewer</td>
<td>2105</td>
<td>1.90</td>
<td>2.64</td>
<td>Service Area Reduced</td>
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<tr>
<td>North Sikes Trunk Sewer</td>
<td>3104</td>
<td>0.14</td>
<td>0.47</td>
<td>Trout Road &amp; Skyline LS removed from Service Area</td>
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<tr>
<td>Existing South Sikes Trunk Sewer</td>
<td>3203</td>
<td>0.74</td>
<td>0.70</td>
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<tr>
<td>Main Street Interceptor Sewer (Upstream of Quail Run Development)</td>
<td>2411</td>
<td>0.68</td>
<td>4.11</td>
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<tr>
<td>West Wintergreen Rd. Sewer at Main St.</td>
<td>2507</td>
<td>0.13</td>
<td>2.24</td>
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<tr>
<td>Lancaster-Hutchins Rd. Sewer at Palestine St.</td>
<td>2312</td>
<td>0.36</td>
<td>1.71</td>
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</table>

<table>
<thead>
<tr>
<th>Proposed Facility</th>
<th>Pipe ID</th>
<th>Existing (2018)</th>
<th>Buildout</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Rawlins Creek Trunk Sewer to Main St.</td>
<td>8040</td>
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<td>6.32</td>
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<tr>
<td>Rawlins Creek Trunk Sewer Extension</td>
<td>8050</td>
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<td>Lancaster-Hutchins Connector Sewer</td>
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<td>Trout-Skyline Trunk Sewer</td>
<td>8073</td>
<td>Proposed 0.85</td>
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<td>Millers-Goode Trunk Sewer</td>
<td>8080</td>
<td>Proposed 2.30</td>
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<tr>
<td>Shoreline Sewer (sec-1, upper)</td>
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<td>Shoreline Sewer (sec-2)</td>
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<tr>
<td>Shoreline Sewer (sec-3, lower)</td>
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<tr>
<td>Southern Lift Station</td>
<td>8060 + 8061</td>
<td>Proposed</td>
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</tbody>
</table>

**Total System:** | 3.49 | 17.08 |
5. MASTER PLAN CAPITAL IMPROVEMENTS

The existing system is at or near capacity thru most of the trunk system, lift stations and force mains. The system in place conveys all wastewater north of the Dallas Lift Station, which then conveys the wastewater to the City of Dallas treatment facilities to the south. Several plans were reviewed to convey wastewater and the plan presented eliminates most lift stations and allows flow to gravity along natural drainage basins. The plan conveys a majority of the flow to the south and then pumps it to the City of Dallas treatment facility thru a new major lift station. The Master Plan maintains the Dallas Lift Station, which will primarily serve the prison and county facilities. The cost to realign the sewer system is equivalent to reconstruction and enlarging the existing collection system, but eliminates six lift stations, leaving two major lift stations to convey flow. The operation and maintenance cost to operate two lift stations versus seven lift stations is a significant cost savings.

5.1 Proposed Facilities

The Master Plan defines major lift stations, interceptors and trunk lines required at buildout. It should be noted that engineering design will be required to confirm alignments, diameters and slopes.

The following sections describe the proposed Master Plan Capital Improvements.

5.1.1 Southern Lift Station

It was determined that a new lift station, located south of Dowdy Ferry Road and near the Trinity River floodplain boundary, could serve the majority of the City. The flow carried by the existing Cleveland Road, the North Sikes and the South Sikes trunk sewers will be intercepted and conveyed by the proposed Shoreline Trunk Sewer to the proposed Southern Lift Station. Proposed Trout Road-Skyline and Goode Road-Millers Ferry trunk sewers will convey the flow generated in the southern planning area to the proposed Southern Lift Station.

The buildout peak flow calculated for the proposed Southern Lift Station is 13.9-MGD.

A 16-inch diameter force main to the City of Dallas treatment facility is proposed for the initial phase to convey up to 5.4 MGD. For ultimate buildout, a second force main must be installed. A future parallel 20-inch diameter force main is envisioned.
5.1.2 Shoreline Interceptor Sewer

The proposed Shoreline Interceptor Sewer will collect and divert flow conveyed by three existing trunk sewers; Cleveland Road, North Sikes and South Sikes. The proposed Shoreline Sewer flows southerly, and discharges to the wet well of the proposed Southern Lift Station. The installation of the Shoreline Interceptor, Southern Lift Station and Force Main will allow for abandonment of Cleveland Road and Sikes Lift Stations.

In total, approximately 6,475-linear feet (LF) of 33-inch, 27-inch and 24-inch line is required to convey 10.3 MGD. The alignment generally abuts the floodplain boundary as it traverses southerly.

5.1.3 Trunk Sewer

The re-configuration of the collection system requires trunk sewers along natural drainage basins that flow from west to east. As the trunk lines are constructed, the smaller lift stations can be abandoned by transferring flow from the wet well to the trunk line. The following trunk lines are envisioned:

- **Rawlins Creek Trunk**: 7,400 linear feet of 21-inch diameter line to connect the existing 18-inch Main Street Interceptor to the proposed Shoreline Interceptor.

- **Rawlins Creek Trunk Extension**: 6,100 linear feet of 12-inch diameter line that is located between Lancaster Hutchins and Main Street.

- **Trout Road-Skyline Trunk**: 2,860 linear feet of 10-inch diameter line that will eliminate the Trout Road Lift Station and the Skyline Lift Station.

- **Goode Road-Miller Ferry Trunk**: Consist of approximately 5,700 linear feet of 10-inch line and 4,550 linear feet of 12-inch line. This trunk will eliminate the Goode Road Lift Station and the Millers Ferry Lift Station.