REPORT

For

INDIAN HILLS
FEASIBILITY STUDY

Prepared for the

CITY OF GRAND PRAIRE

Firm: Lockwood, Andrews & Newnam, Inc.
Firm ID: 2614
Date: 06/12/2017

June 2017

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

PLANNING • ENGINEERING • PROGRAM MANAGEMENT

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1 Executive Summary

1.1 Purpose and Scope

The goal of the Indian Hills Feasibility Study is to support the City of Grand Prairie (the City) and McKim & Creed, Inc. in their efforts to improve the subject neighborhood drainage by developing a plan to address existing flooding and pavement ponding issues. Accomplishing this goal requires an understanding of the drainage deficiencies that currently exist within the Indian Hills region and recommending projects that are both functionally efficient and financially effective.

To achieve the goals of flooding reduction and drainage improvements, Lockwood, Andrews & Newnam, Inc (LAN) was contracted by the City and McKim & Creed, Inc. to prepare a feasibility study, rainfall on mesh 2D model of existing and proposed conditions.

The study area is located in central Grand Prairie and bounded by South Carrier Parkway to the west, Dickey Road to the south, Cherokee Trace to the north, and Southeast 4th Street to the east. Extents for the study area can be seen in Exhibit 1-Study Location Map. The neighborhood has minimal existing storm drain infrastructure and drains via sheet flow to Indian Hills Branch to the northeast and Cottonwood Creek to the east and south as seen in Exhibit 2.

1.2 Existing Conditions Analysis

Detailed 2-dimensional models were developed using Infoworks ICM in order to understand the complex drainage issues observed within the region. Two-dimensional models offer unique insight into how overland stormwater conveyance is tightly coupled to and influenced by the subsurface storm drain system and outfall channels. The performance of the stormwater infrastructure within the region was evaluated for the 100-,50-, 25-, 10-, 5-, and 2-year 24-hour storm event and found to be functionally deficient in several locations.

In general, the region is subject to wide spread roadway inundation during the 100-year, 24-hour event. Many of the roadways within the region are impassible during lesser events and subject to excessively long time-to-drain durations with long term standing water leading to poor pavement condition. The roadways have poor conveyance due to their minimal grade and are unable to convey the intended flow to outfalls.

1.3 Proposed Improvement Project

Proposed improvement projects were developed in accordance with the City design standards with the goal to meet as much of the current design criteria as possible. Retrofitting existing neighborhoods to meet current design criteria in all aspects in all areas for extreme events can be a difficult process without substantial reconstruction of the entire neighborhood. It is for this reason that this recommended improvements project seeks to meet current design criteria, but cannot meet 100-year design criteria in all areas. The improvements recommended offer a great deal of benefit over existing conditions and provide a higher level of service; however, ponding

outside the right of way still occurs in low points. An improvement project consisting of milled and re-graded roadways coupled with additional strategic storm drain and roadway re-grading on Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street aid in removing isolated low points which allows stormwater to drain as intended.

2 Introduction

2.1 Purpose and Scope

The goal of the Indian Hills Feasibility Study is to support the City and McKim and Creed, Inc. in their efforts to understand and improve the neighborhood drainage by developing a plan to address existing flooding issues within the Indian Hills region. To accomplish this goal, it requires an understanding of the existing drainage patterns and problem areas before recommending projects that are both functionally efficient and financially effective.

2.2 Location

The study area is bounded by Cherokee Trace and Indian Hills Branch to the north, Southeast 4th Street to the east, South Carrier Parkway to the west, and West Dickey Road and Cottonwood Creek to the south. The study area drains primarily via sheet flow to Cottonwood Creek as there are no roadside ditches or storm drains present within the neighborhood except a small stretch along West Dickey Road.

2.3 Floodplain Information

The FEMA Flood Insurance Rate Map (FIRM) No. 48113C0435L, Panel 435 of 725 (Effective Date July 7, 2014) indicated that the study region is not within the 100-year floodplain (Exhibit 12).

2.4 Data Collection

The primary data sources regarding the existing stormwater system in the study area came from the City provided GIS and LiDAR data. Existing storm drainage system flowlines were already populated within the feature classes.

2.5 Study Datum

Horizontal control for the study was based on the Texas State Grid Coordinate System, North Central Zone, NAD 1983. The vertical datum for the study was the North American Vertical Datum of 1988, 2001 Adjustment. The horizontal and vertical controls used are City and FEMA preferred datums.

3 Hydrology and Hydraulics

3.1 Hydrology

The built-in direct rainfall method in InfoWorks-ICM was used to simulate rainfall-runoff process which tracks and aggregates the storm water runoff generated from each 2D mesh cell. Rainfall distributions were provided by the City of Grand Prairie and inserted into the model.

Time of Concentration (Tc) was not required for direct rainfall method in the 2D models in order to create the required hydrographs. Rainfall is routed through the 2D surface according to the terrain topography and overland roughness coefficients. For InfoWorks ICM direct rainfall modeling, hydrologic and hydraulic process are coupled internally in a seamless way.

3.2 Hydraulics

The hydraulic analysis for the existing drainage system and the proposed improvements are based on simulation results obtained from 2-dimensional InfoWorks ICM models.

3.2.1 Model Development

InfoWorks-ICM V7.0-dimensional models were created in order to better understand the drainage issues observed in the study area. The models simulated the storm runoff carried by the subsurface storm drainage infrastructure and its interaction with the ground surface.

Storm drain connectivity, sizes, and flowlines were adjusted from City provided GIS in order to match City provided as-built information. Where flowline or size information was not available from as-built information, it was assumed or interpolated from surrounding pipes. In areas with no upstream or downstream information, pipe flowlines were assumed to be installed at grades sufficient to provide full flow velocities at three feet-per-second. In the model, a triangular mesh was generated to perform the analysis of the surface flows using the built-in InfoWorks mesh creation process. Elevations at the vertices of and areas within the generated mesh elements were developed from the LiDAR provided by the City. Overland roughness zones were incorporated into the 2D mesh surface to account for variations in surface roughness such as the change from concrete areas to grassed areas. Roughness zones were generate based on zoning information, aerial imagery and field visits.

Manning's Roughness parameters for conduits were established as 0.013 for precast concrete pipe.

4 Existing Conditions Results

The performance of the stormwater infrastructure within the study area was evaluated for the 100-, 50-, 25-, 10-, 5- and 2-year, 24-hour storm events. Infrastructure within the study area was found to be functionally deficient in several locations. Per the City design Standards, the 100-year, 24-hour duration storm event should contain low flow point overflows within easements.

During the 100-year, 24-hour storm event, street ponding and conveyance is expected but should comply with the above stated requirements. As shown on Exhibit 3-Existing Conditions 100-Year, 24-hour Event Ponding, there are several locations within the study corridor with stormwater infrastructure that do not conform to the desired design requirements for the 100-year, 24-hour storm event and/or ponding durations were excessively long. Ponding does not meet these specifications at Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street. In addition to ponding out of the ROW, the streets do not have proper overland conveyance and therefore water pools at the low points and is only removed by evaporation. This long term duration standing water is leading to pavement degredation and overall pavement condition issues. Evidence of this long standing water can be seen in Exhibit 17-Existing Conditions End of Storm 100 Year, 24-hour Event. The ponding present in this exhibit is at the end of the storm, approximately 12 hours after the peak rainfall occurs. The ponding in this Exhibit represents the non-cascading low points in the region that are unable to drain. Ponding depths range from no ponding to approximately 2.5 feet in the area. Generally, within the study area, the region is not entirely compliant with drainage criteria, but does not appear to be subject to roadway driven structural flooding. As shown on Exhibit 3, it does appear that there are a number of lots within the area that have inadequate drainage on site leading to ponding within yards and alleys.

During the 50-year, 24 hour event, street ponding as well as ponding outside of the right of way is prominent. Ponding for the streets such as Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, SW 5th Street, and Chickasaw Trace as are among the deepest ponded streets. Generally, the area has limited storm drains and the streets are not properly graded to adequately convey the flow downstream due to variations in vertical roadway geometry. Ponding depths range from no ponding to approximately 2.5 feet in the area Results for the existing conditions 50-year, 24 hour storm ponding can be seen in Exhibit 4.

During the 25-year, 24-hour storm event ponding is similar to that of a 50-year storm but less severe. As present in the 50-year storm, certain roads, such as Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, SW 5th Street are unable to drain due to roadway paving and topographical low points. These low points continue to hold water for long durations and rely on evaporation to completely dry. The lack of fully available curb and gutter systems further hinders the roadways performance. It appears that the region has been subject to numerous asphalt overlayments and that some gutters are not well established. Ponding depths range from no ponding to approximately 2.4 feet in the area The 25-year, 24 hour storm can be seen in Exhibit 5-Existing Conditions 25-Year, 24-hour Event Ponding.

Per the City design standards, the 10-year, 24-hour storm event should be conveyed by a combination of the subsurface storm drainage system and street ponding at or below the curb elevation. Any ponding above the curb elevation or extending beyond the ROW, for the 100-year storm event, is considered to have exceeded criteria thresholds for drainage issue identification per City criteria. There are multiple locations within the study area that significant ponding is present within the roadways for the 10-year, 24-hour storm event as shown in Exhibit 6- Existing Conditions 10-Year, 24-hour Event Ponding. Ponding is prevalent throughout many places along the region, but most extreme at Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street. Ponding dephs range from approximately 0 to 2.3 feet.

During the 5-year, 24-hour storm event, ponding is present on streets such as Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street as seen in Exhibit 7- Existing Conditions 5-Year, 24-hour Event Ponding. While ponding is present on these roads the depths are typically less than one foot and therefore are passable by car. Ponding depths range from approximately 0 to 2.3 feet.

During the 2-year, 24-hour storm event there are multiple locations within the region that ponding is present within the roadways for the 2-year, 24-hour storm event. These streets include Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street and can be seen in Exhibit 8: Existing Conditions 2-Year, 24-hour Event Ponding. Ponding depths range from approximately 0 to 2.3 feet.

The area is heavily dependent on overland flow to reach the few storm drain systems. The roads have isolated low pockets that are unable to drain by overflow means and must rely on evaporation to completely dry. A high point goes through the middle of the study area resulting in a natural drainage divide. The high point can be seen in Exhibit 2: Overall System Layout. Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street are all designed to drain south to West Dickey Road and ultimately to the outfall at Cottonwood Creek. Over time, multiple asphalt overlays have changed the geometries of the road. Concrete gutters have been overlaid and are not well established throughout the neighborhood. Due to the geometry of many of the neighborhood streets, storm water is not able to flow as intended to Cottonwood Creek and ponds on the roads for excessively long durations.

5 Proposed Improvement Options

Two types of drainage improvements are usually considered when attempting to improve drainage within a region: stormwater conveyance or detention improvements. In the case of the Indian Hills area, conveyance improvements are proposed. Conveyance improvements are necessary to move stormwater out of neighborhoods and downstream to Cottonwood Creek.

Select existing roads should be re-graded to increase conveyance to Cottonwood Creek. Proposed improvement options can be seen in Exhibit 9-Proposed Improvements. Re-grading of the roadways is defined as the re-establishment of positive roadway slopes while isolated low points and maintaining fixed elevation points at intersections. The intent is that the roadway slope will be redefined between intersections and enable positive drainage throughout the roadway system.

Shawnee Trace Re-grade:

The proposed roadway re-grade will start at the intersection of Highland Drive and Shawnee Trace and continue south along Shawnee Trace to the intersection of West Dickey Road and Shawnee Trace. It will tie in to natural ground at each of these locations and be re-graded in between these intersections with a longitudinal proposed percent slope of 0.3%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

Indian Hills Drive Re-grade:

The proposed roadway re-grade will start at the intersection of Highland Drive and Indian Hills Drive and continue south along Indian Hills Drive to the intersection of West Dickey Road and Indian Hills Drive. It will tie in to natural ground at each of these locations and be re-graded in between these intersections with a longitudinal proposed percent slope of 0.2%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

Highland Drive Re-grade:

The proposed roadway re-grade will start approximately 250 feet east of the northern boundary of the Indian Hills Re-grade improvement. The re-grade would continue south and tie back into West Dickey Road. It will tie in to natural ground at each of these locations and be re-graded in between these intersections with a longitudinal proposed percent slope of 0.3%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

Clarice Street Re-grade:

The proposed roadway re-grade will start approximately 160 feet north at the intersection of Clarice Street and Desco Street and continue south along Clarice Street to the intersection of West Dickey Road and Clarice Street. It will tie in to natural ground at each of these locations

and be re-graded in between these intersections with a longitudinal proposed percent slope of 0.3%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

Ralph Street Re-grade:

The proposed roadway re-grade will start approximately 75 feet north at the intersection of Ralph Street and Desco Street and continue south along Ralph Street to the intersection of West Dickey Road and Ralph Street. It will tie in to natural ground at each of these locations and be re-graded in between these intersections with a longitudinal proposed percent slope of 1.2%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

SW 5th Street Re-grade:

The proposed roadway re-grade should start at the intersection of SW 5th Street and Desco Street and continue south along SW 5th Street to the intersection of West Dickey Road and SW 5th Street. It will tie in to natural ground at each of these locations and be re-graded in between these intersections with a longitudinal proposed percent slope of 1.9%. The purpose is to remove the non-cascading low points in the road and allow water to drain south as intended.

Storm Drain Improvements West Dickey Road:

The proposed storm drain improvements should take place on West Dickey Road from Shawnee Trace to the outfall located 50 feet east from Southwest 3rd Street. This pipe will be an additional 36" reinforced concrete pipe that will run parallel to the existing system. Nine inlets will be added to convey the additional water flowing to Dickey Road due to the other proposed improvement projects. Currently the system on West Dickey Road is undersized due to the amount of potentially contributing flow and there is significant head loss in the system. By adding a parallel pipe system, additional capacity is available and the system will become more efficient.

Other proposed improvements were evaluated, but not ultimately recommended. These include additional storm drains along Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street. While these storm drain improvements would aid in conveyance, they do not provide the same level of benefit offered by the roadway re-grades. This is due to the fact that there are many isolated low points in the current roadways. Inlets would need to be added to every low point and would be prohibitively expensive. Another additional improvement consideration was a buyout of selected properties to turn into detention facilities. However, without removing the isolated low points the drainage issues would continue to occur. Rain gardens is another considered alternative. However, if stormwater cannot leave the isolated low points, the rain gardens would be ineffective. Therefore, these improvement alternatives were not ultimately recommended.

It is anticipated that the proposed roadway re-grades will reduce ponding within the study area. The proposed alignment also provides the flexibility for any other existing utilities upgrades, such as water lines or sanitary sewer replacement. In addition to drainage improvements, roadway re-grades would vastly improve the roadway.

In total the project consists of approximately 50,000 square yards of roadway improvements along with approximately 3,200LF of storm drain improvement projects.

Overall, the proposed improvements are very effective at reducing ponding extents, depths, and durations within the study corridor.

6 Proposed Conditions Results

Proposed roadway conditions were modeled using Infoworks ICM version 7.0 and compared to existing conditions to determine their impact.

For the 100-year, 24-hour storm a significant reduction in ponding depths, as well as ponding durations occurred. Re-grading the roadways removes the localized low points and allows proper overland flow in the area. Ponding is generally contained within the right of way with the exception of aWest Gramley Street. Overland flow is generally contained to the right of way and flows the intended direction. Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street were roads that previously relied on evaporation and now can drain south to West Dickey Road as intended. This can be seen in Exhibit 18-Proposed Conditions End of Storm 100-Yr, 24 hour event. This exhibit represents stormwater that is still present at the end of the storm, twelve hours after peak rainfall. Since the roads are now dry, it displays the benefit to the proposed roadway and storm drain improvements. In addition to shorter ponding durations these roads also have lower ponding depths as seen in Exhibit 10 Proposed 100-Year, 24-Hour Event Ponding.

During the 50-year, 24-hour storm, proposed conditions experience a reduction in ponding depths as well as durations. Roads that previously relied on evaporation to drain, such as Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street now properly convey flow south to West Dickey Road. Low points are removed allowing for intended overland flow to West Dickey Road. Ponding extents are generally contained to the right of way as seen in Exhibit 11- Proposed 50-Year, 24-Hour Event Ponding.

During the 25-year, 24-hour storm, ponding depths and durations are reduced. Typical ponding depth reductions are around 0.2 feet on roads where improvements are located, such as Shawnee Trace, Indian Hills Drive, Highland Drive, Clarice Street, Ralph Street, and SW 5th Street. As in the 100-year, and 50-year storm events, roads properly convey flow downstream to West Dickey Road as intended. Ponding values for the 25-year storm are generally less than 0.75 feet for proposed conditions as seen in Exhibit 12- Proposed 25-Year, 24-Hour Event Ponding.

During the 10-year, 24-hour storm street ponding is present but is typically less than 0.5 feet for proposed conditions. Reductions are consistent throughout the area and ranged from 0.0 feet to approximately 0.5 feet of ponding. By re-grading the roads, low points are removed and water no longer pools in these low areas. Ponding results for this storm can be seen in Exhibit 13- Proposed 10-Year, 24-Hour Event Ponding.

During the 5-year, 24-hour storm ponding is present but generally minimal in proposed conditions. As in the other design storms, the re-grading of the roads allows for proper drainage and reduces both the ponding depths and extents for the areas. Ponding results for this storm can be seen in Exhibit 14-Proposed 5-Year, 24-Hour Event Ponding.

During the 2-year, 24-hour storm ponding is reduced. Ponding extents are reduced and ponding depths are generally less than 0.25 feet. As in the other design storms, the area operates as intended with the

roadway re-grades. Re-grading the roads removes the low portions of road and improves conveyance. Ponding results for this storm can be seen in Exhibit 15- Proposed 2-Year, 24-Hour Event Ponding.

7 Opinion of Probable Construction Cost

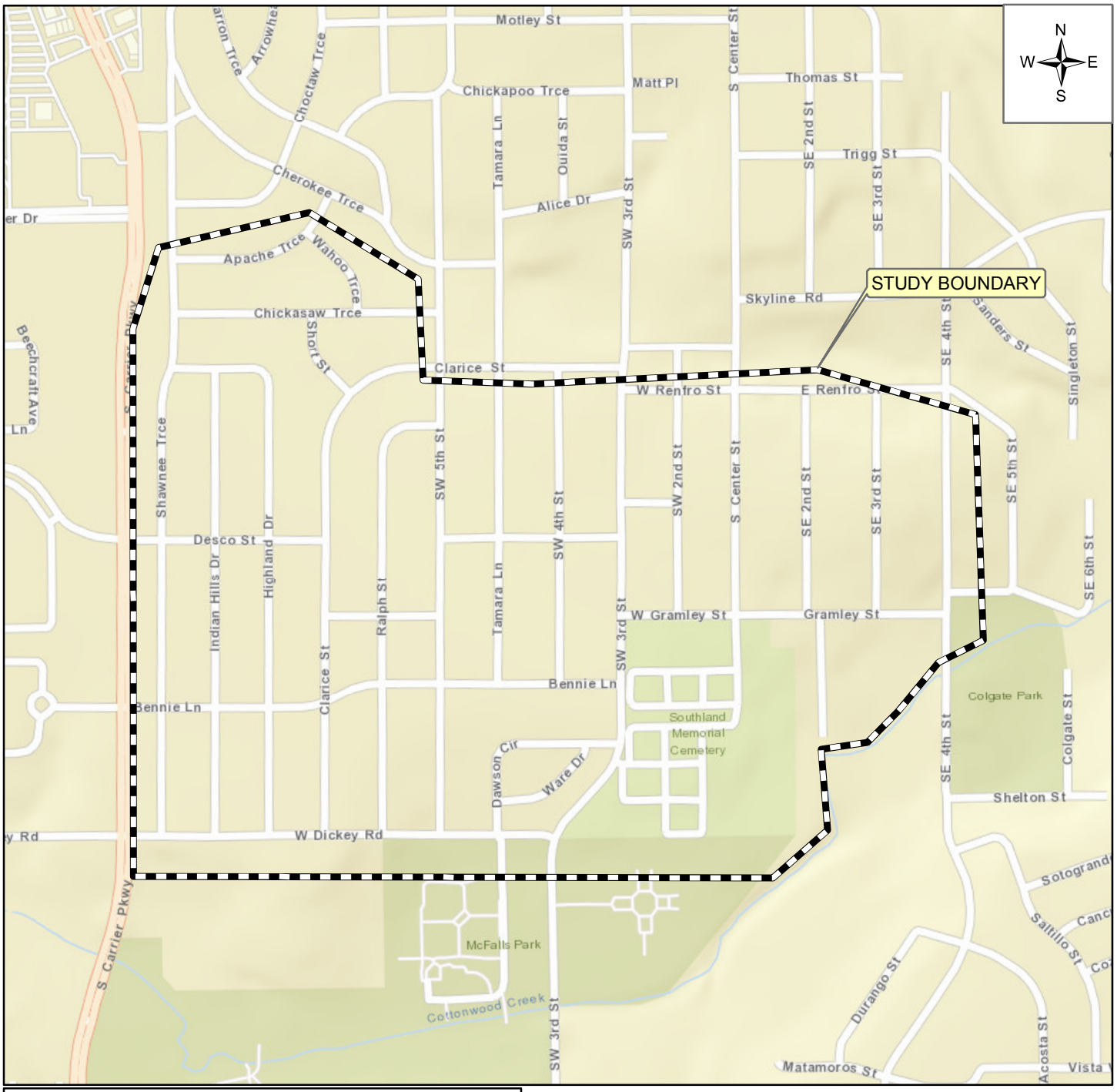
The proposed improvements are intended to provide additional conveyance capacity for much of the Indian Hills study area. Missing curbs and gutters should be reestablished as necessary. Disturbances to existing curb and gutters, sidewalks and driveways should be avoided as much as possible. Opinions of Probably Construction Cost can be found in Appendix A.

The opinion of probable construction cost for the proposed improvements projects was developed from City of Grand Prairie provided unit costs when possible and supplemented with district and state level TxDOT unit costs, engineer's estimates, and recent bids received from similar projects in the region. The total opinion of probable construction cost for the proposed project is approximate $8,310,000 which includes a 30% contingency. This cost estimate does not include costs for engineering services during construction and is subject to change based on future unit price fluctuation and design finalization.

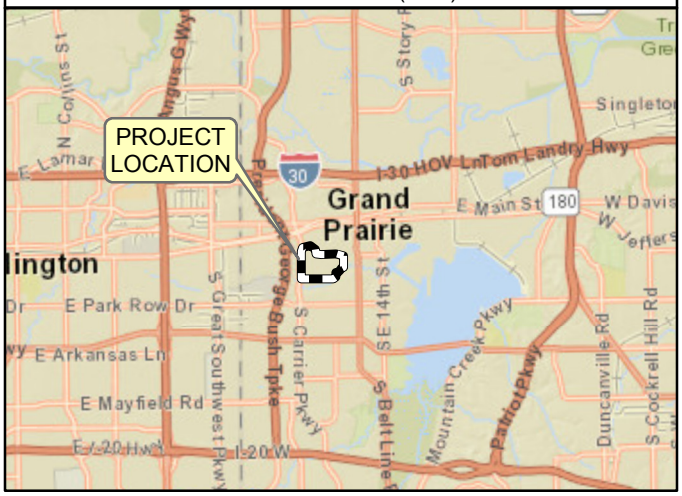
8 Conclusions and Recommendations

The Indian Hills region is served by overland flow paths and limited storm drains. This region was evaluated using a 2-dimensional Infoworks ICM model to fully understand the region's subsurface and overland flow patterns in order to identify deficiencies. The performance of the stormwater infrastructure within the Indian Hills Region was evaluated for the 100-, 50-, 25-, 10-, 5-, and 2-year, 24-hour design storms and found to be functionally deficient in several locations throughout the region.

The proposed improvements are intended to provide additional conveyance for the Indian Hills study area and reduce ponding depths and durations. The proposed improvements were developed in accordance with the City design standards and the goal to meet as much of the current design criteria as possible. In this study, the proposed improvements involve re-grading roads to better convey water south to Cottonwood Creek. These recommendations are based on GIS data, LiDAR data, and Infoworks-ICM V7.0 2-dimensional modeling results. Retrofitting existing neighborhoods to meet current design criteria in all aspects in all areas for extreme events can be a difficult process without substantial reconstruction of the entire neighborhood. By re-grading key roads in Indian Hills and adding storm drains along Dickey Road, water is able to flow as intended and ponding is reduced for all of the evaluated storms. The improvements recommended offer a great deal of benefit over existing conditions and provide a higher level of service.



VICINITY MAP (NTS)



0 400 800 1,600 Feet

CITY OF GRAND PRAIRIE

Lockwood, Andrews & Newnam, Inc.
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INDIAN HILLS
FEASIBILITY STUDY

EXHIBIT 1
PROJECT LOCATION

Map Document: N:\120\120-11987-000\9-0-Non-Projectwise_Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 1 - Project Location.mxd 5/19/2017 8:39:54 AM ELObrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
CIMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CHICKASAW TRC
CLARICE ST
BEECHCRAFT AV
SHORT ST
North Drainage
Area = ~100 Acres
RENFRO DR
S CENTER ST
SE 5TH ST
CLARICE ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
RALPH ST
SW 5TH ST
DESCO LN
DESCO ST
LONG ST
SE 2ND ST
SE 3RD ST
GRAMLEY ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
SE 4TH ST
South Drainage
Area = ~180 Acres
BENNIE LN
SE 2ND ST
24"
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
36"
39"
48"
60"
DICKEY RD
JENNIFER MCFALLS PARK
WEST
SW 3RD ST

Legend

- Drainage_Divide
- Study Area
- Inlet
- Manhole
- Outfall
- Storm Drains

Elevation (ft)

High : 548

Low : 458

0 225 450 900 Feet

CITY OF GRAND PRAIRIE INDIAN HILLS FEASIBILITY STUDY

OVERALL SYSTEM LAYOUT

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT 2

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CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
ALICE DR
TRIGG ST
SINGLETON ST
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
SHORT ST
BEECHCRAFT AV
RENFRO DR
S CENTER ST
SE 5TH ST
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
SE 2ND ST
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

- Study Area
- Storm Drains

100yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

Citywide Complaints

- BKEROSOT
- DEBRISCH
- FLDGBSNS
- FLDGGARG
- FLDGHOUS
- FLDGSTRT
- FLDGYARD
- NEBTONEB
- OTHER
- UNKNOWN
- WTRSNALY
- WTRSNDTH
- WTRSNPRK
- WTRSNSTR
- WTRSNYRD
- YdEros

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS
100-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

Lockwood, Andrews & Newnam, Inc.
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Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
3

N:\120\120-11987-000\9-0-Non-Projectwise_Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 3 - Existing Conditions 100-yr.mxd 5/19/2017 9:31:20 AM User Name: ELOBrien

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS
50-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
4

Legend

- Study Area
- Storm Drains

50yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

Citywide Complaints

- BKEROSOT
- DEBRISCH
- FLDGBSNS
- FLDGGARG
- FLDGHOUS
- FLDGSTRT
- FLDGYARD
- NEBTONEB
- OTHER
- UNKNOWN
- WTRSNALY
- WTRSNDTH
- WTRSNPRK
- WTRSNSTR
- WTRSNYRD
- YdEros

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

0 225 450 900 Feet

N

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
SKYLINE RD
SE 2ND ST
SE 3RD ST
SANDERS ST
CLARICE ST
SHORT ST
BEECHCRAFT AV
RENFRO DR
S CENTER ST
SE 5TH ST
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
GRAMLEY ST
SE 2ND ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

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CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
SHAWNEE TRC
APACHE TRC
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ALICE DR
TRIGG ST
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SHORT ST
BEECHCRAFT AV
RENFRO DR
S CENTER ST
SE 5TH ST
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST
DURANGO

Legend

- Study Area
- Storm Drains

25yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

Citywide Complaints

- BKEROSOT
- DEBRISCH
- FLDGBSNS
- FLDGGARG
- FLDGHOUS
- FLDGSTRT
- FLDGYARD
- NEBTONEB
- OTHER
- UNKNOWN
- WTRSNALY
- WTRSNDTH
- WTRSNPRK
- WTRSNSTR
- WTRSNYRD
- YdEros

0 225 450 900 Feet

N

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS -
25-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
5

N:\120120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 5 - Existing Conditions 25-yr.mxd 5/19/2017 9:44:12 AM User Name: ELObrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
ALICE DR
TRIGG ST
SINGLETON ST
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
SHORT ST
BEECHCRAFT AV
RENFRO DR
S CENTER ST
SE 5TH ST
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST
DURANG

Legend

- Study Area
- Storm Drains

10yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

Citywide Complaints

- BKEROSOT
- DEBRISCH
- FLDGBSNS
- FLDGGARG
- FLDGHOUS
- FLDGSTRT
- FLDGYARD
- NEBTONEB
- OTHER
- UNKNOWN
- WTRSNALY
- WTRSNDTH
- WTRSNPRK
- WTRSNSTR
- WTRSNYRD
- YdEros

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS -
10-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
6

N:\120\120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 6 - Existing Conditions 10-yr.mxd 5/19/2017 9:48:41 AM User Name: ELObrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CHICKASAW TRC
CLARICE ST
BEECHCRAFT AV
SHORT ST
RENFRO DR
S CENTER ST
SE 5TH ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

Study Area
Storm Drains

5yr Ponding Depth (ft)*

DEPTH2D

0.10 - 0.25
0.26 - 0.50
0.51 - 1.00
1.01 - 2.00
>2.00

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

Citywide Complaints

CODE_PRO

BKEROSOT
DEBRISCH
FLDGBSNS
FLDGGARG
FLDGHOUS
FLDGSTRT
FLDGYARD
NEBTONEB
OTHER
UNKNOWN
WTRSNALY
WTRSNDTH
WTRSNPRK
WTRSNSTR
WTRSNYRD
YdEros

0 225 450 900
Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS -
5-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
7

N:\120\120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 7 - Existing Conditions 5-yr.mxd 5/19/2017 9:55:48 AM User Name: ELObrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CHICKASAW TRC
CLARICE ST
BEECHCRAFT AV
SHORT ST
RENFRO DR
S CENTER ST
SE 5TH ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

Study Area
Storm Drains

2yr Ponding Depth (ft)*

DEPTH2D

0.10 - 0.25
0.26 - 0.50
0.51 - 1.00
1.01 - 2.00
>2.00

*Start of rainfall at 00:00
Peak Inundation at 12:10pm

Citywide Complaints

CODE_PRO

BKEROSOT
DEBRISCH
FLDGBSNS
FLDGGARG
FLDGHOUS
FLDGSTRT
FLDGYARD
NEBTONEB
OTHER
UNKNOWN
WTRSNALY
WTRSNDTH
WTRSNPRK
WTRSNSTR
WTRSNYRD
YdEros

0 225 450 900
Feet

N

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS -
2-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
8

N:\120\120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 8 - Existing Conditions 2-yr.mxd 5/19/2017 9:57:02 AM User Name: ELObrien

CONOVER DR
SHAWNEE TRC
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
ALICE DR
TRIGG ST
SINGLETON ST
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
RENFRO DR
SE 5TH ST
BEECHCRAFT AV
SHORT ST
CLARICE ST
S CENTER ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
SE 2ND ST
DAWSON CIR
WARE DR
SOUTHLAND LN
CLARICE ST
36" RCP
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

- Study Area
- Drainage_Divide
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains
- Proposed Roadway Milling and Regrading

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED IMPROVEMENTS

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
9

N:\120\120-11987-0009-0-Non-Projectwise_Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 9 - Proposed Improvements.mxd 6/12/2017 2:05:27 PM User Name: elobrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CHICKASAW TRC
CLARICE ST
BEECHCRAFT AV
SHORT ST
RENFRO DR
SE 5TH ST
S CENTER ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
GRAMLEY ST
SE 2ND ST
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

- Study Area
- Proposed Inlet
- Proposed Manhole
- Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 100yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 100yr Ponding

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

N

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS
100-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
10

N:\120\120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 10 - Proposed Conditions 100-yr.mxd 5/19/2017 10:52:26 AM User Name: ELObrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CHICKASAW TRC
CLARICE ST
BEECHCRAFT AV
SHORT ST
RENFRO DR
SE 5TH ST
S CENTER ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
SE 4TH ST
GRAMLEY ST
SE 2ND ST
BENNIE LN
DAWSON CIR
WARE DR
CLARICE ST
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

Legend

- Study Area
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 50yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 50yr Ponding

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS
50-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

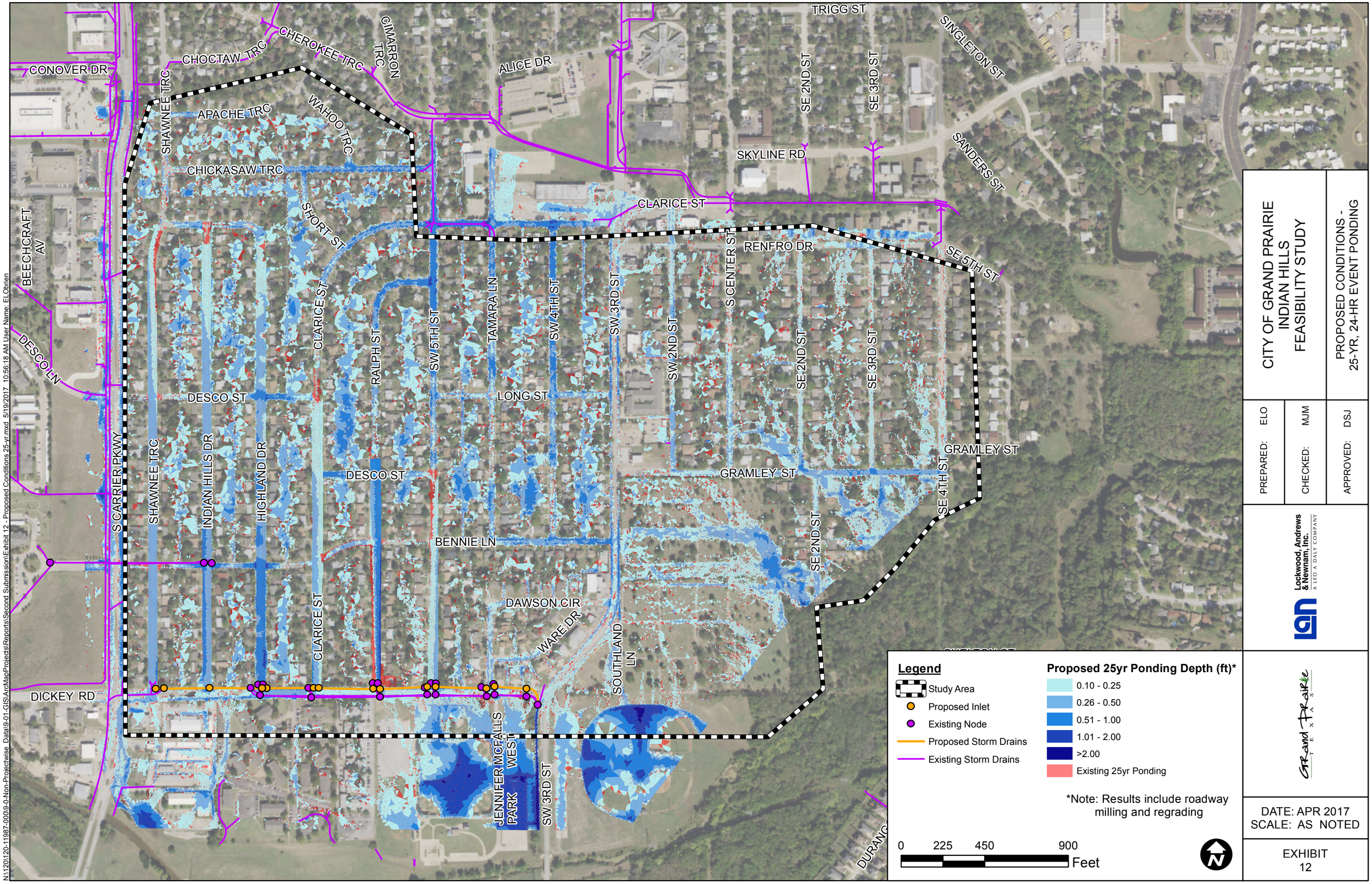
Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
11

N:\120120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 11 - Proposed Conditions 50-yr.mxd 5/19/2017 10:51:28 AM User Name: ELObrien



Legend

- Study Area
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 25yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 25yr Ponding

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS - 25-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT 12

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CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
ALICE DR
TRIGG ST
SE 2ND ST
SE 3RD ST
SINGLETON ST
SKYLINE RD
SANDERS ST
CLARICE ST
SHORT ST
BEECHCRAFT AV
RENFRO DR
S CENTER ST
SE 5TH ST
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
GRAMLEY ST
SE 2ND ST
BENNIE LN
DAWSON CIR
WARE DR
SOUTHLAND LN
CLARICE ST
DICKEY RD
JENNIFER MCFALLS PARK
WEST
SW 3RD ST
DURANG

Legend

- Study Area
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 10yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 10yr Ponding

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS -
10-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

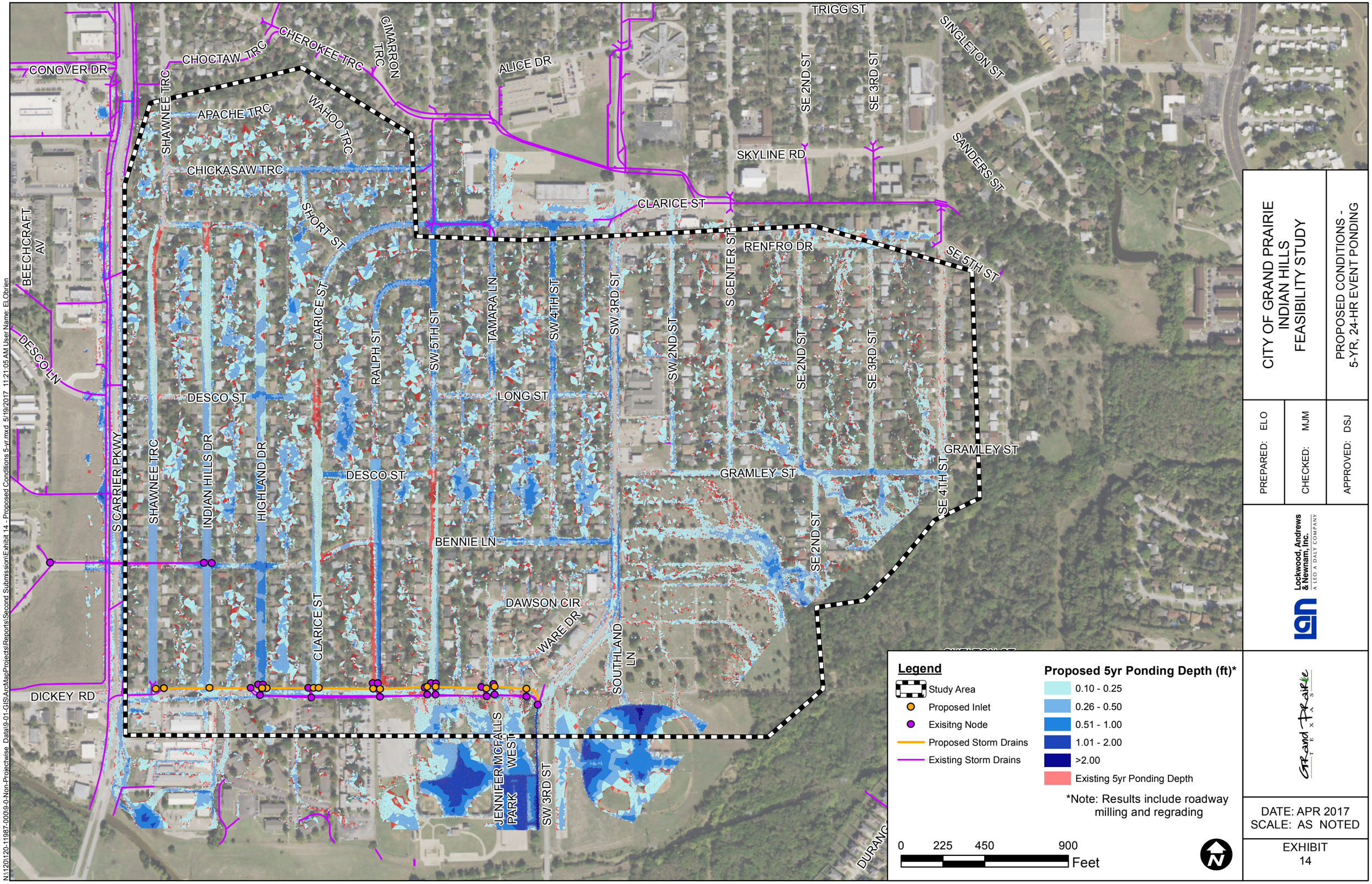
Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
13

N:\120\120-11987-00009-0-Non-Projectwise_Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 13 - Proposed Conditions 10-yr.mxd 5/19/2017 11:16:52 AM User Name: ELObrien



Legend

- Study Area
- Proposed Inlet
- Exisitng Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 5yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 5yr Ponding Depth

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS - 5-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc. A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT 14

N:\120\120-11987-000\9-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 14 - Proposed Conditions 5-yr.mxd 5/19/2017 11:21:05 AM User Name: ELObrien

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS -
2-YR, 24-HR EVENT PONDING

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
15

Legend

- Study Area
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 2yr Ponding Depth (ft)*

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00
- Existing 2yr Ponding Depth

*Note: Results include roadway milling and regrading

0 225 450 900 Feet

N

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
ALICE DR
TRIGG ST
SINGLETON ST
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
SHORT ST
BEECHCRAFT AV
RENFRO DR
SE 5TH ST
S CENTER ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
SE 2ND ST
SE 3RD ST
DESCO LN
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
BENNIE LN
SE 2ND ST
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Texas State Plane North Central Zone (FIPS zone 4202). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base Map information shown on this FIRM was provided in digital format by the North Central Texas Council of Governments (NCTCOG). This information was photogrammetrically compiled at a scale of at least 1:24,000 from aerial photography dated 2001.

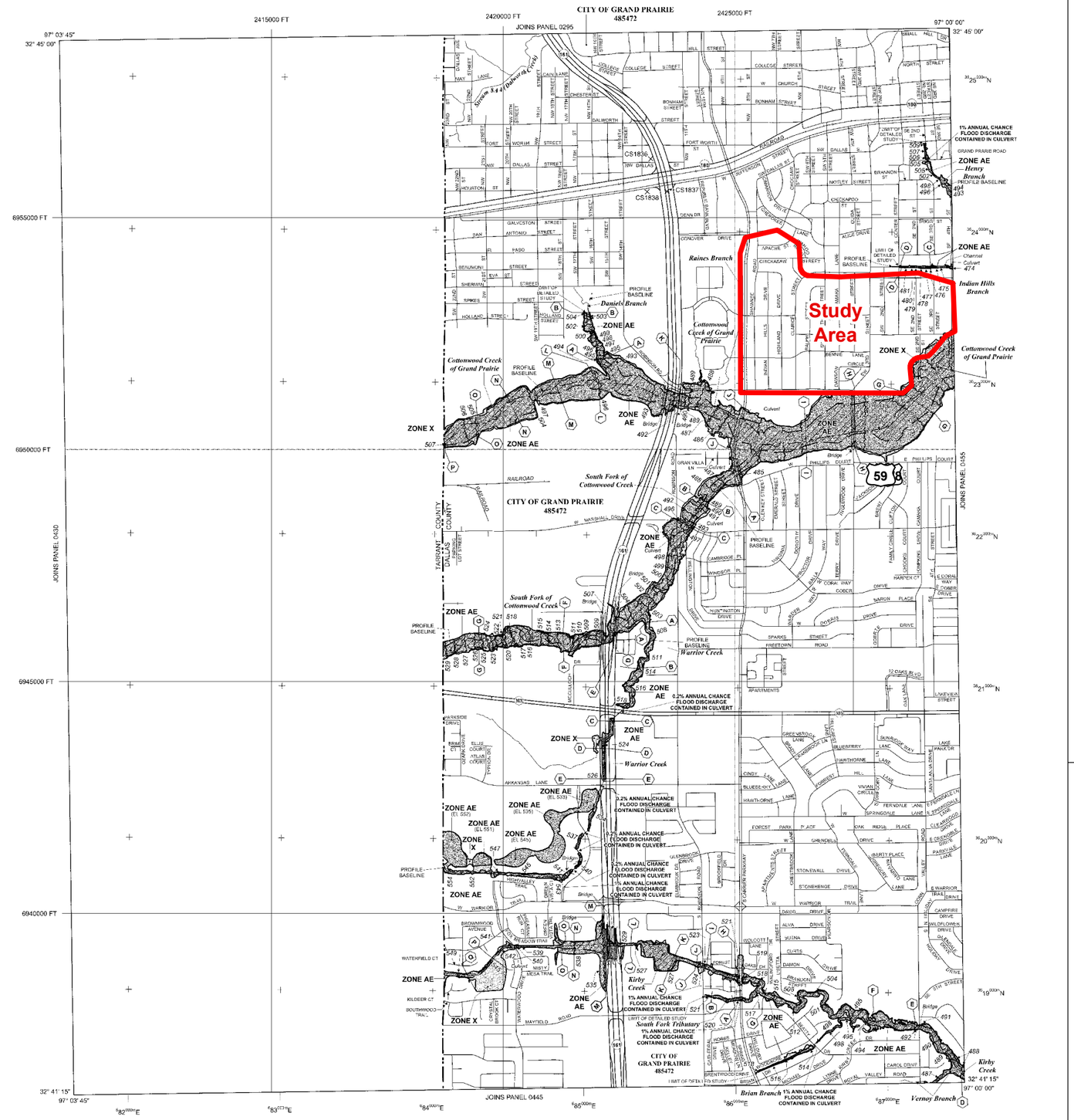
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 3100000 FT — 5000-foot ticks: Texas State Plane North Central Zone (FIPS Zone 4202), Lambert Conformal Conic projection
- 1000-meter Universal Transverse Mercator grid values, zone 14
- X — BM5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 23, 2001

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
June 16, 2005

July 7, 2014 - to change Base Flood Elevations, to change Special Flood Hazard Areas, to change floodway, to change zone designations, to reflect updated topographic information, to update map format, to update corporate limits, to add roads and road names and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0435L

FIRM

FLOOD INSURANCE RATE MAP

DALLAS COUNTY, TEXAS AND INCORPORATED AREAS

PANEL 435 OF 725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAND PRAIRIE, CITY OF	485472	0435	L

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
48113C0435L
MAP REVISED
JULY 7, 2014

Federal Emergency Management Agency

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

FEMA FIRM NO. 48113C0435L
PANEL 435 OF 725

PREPARED: ELO
CHECKED: MJM
APPROVED: DSJ

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT
16

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PRIVATE
CONOVER DR
SHAWNEE TRC
CHOCTAW TRC
CHEROKEE TRC
CIMARRON TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
SHORT ST
ALICE DR
OUIDA ST
TRIGG ST
SINGLETON ST
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
RENFRO DR
SE 5TH ST
DESCO LN
DESCO ST
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
TOM HALL DR
SW 2ND ST
S CENTER ST
SE 2ND ST
SE 3RD ST
SW 3RD ST
GRAMLEY ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
BENNIE LN
CLARICE ST
DAWSON CIR
WARE DR
SOUTHLAND LN
SE 2ND ST
SE 4TH ST
SHELTON ST
DICKEY RD
JENNIFER MCFALLS PARK WEST
DURANGO ST

Legend

- Study Area
- Existing Node
- Existing Storm Drains

Existing 100-Year End of Storm Ponding (ft)

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

*Long-term standing water 12 hours after storm ends

0 237.5 475 950 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

EXISTING CONDITIONS PONDING AT END OF STORM 100-YR, 24-HR EVENT

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT 17

N:\120\120-11987-0009-0-Non-Projectwise Data\9-01-GIS\ArcMapProjects\Reports\Second Submission\Exhibit 17 - Existing 100yr End of Storm.mxd 6/12/2017 1:40:17 PM User Name: elobrien

CONOVER DR
CHOCTAW TRC
CHEROKEE TRC
GUMARRON TRC
SHAWNEE TRC
APACHE TRC
WAHOO TRC
CHICKASAW TRC
ALICE DR
TRIGG ST
SINGLETON ST
SE 2ND ST
SE 3RD ST
SKYLINE RD
SANDERS ST
CLARICE ST
SHORT ST
RENFRO DR
SE 5TH ST
BEECHCRAFT AV
DESCO LN
CLARICE ST
RALPH ST
SW 5TH ST
TAMARA LN
SW 4TH ST
SW 3RD ST
SW 2ND ST
S CENTER ST
SE 2ND ST
SE 3RD ST
DESCO ST
LONG ST
GRAMLEY ST
SE 4TH ST
S CARRIER PKWY
SHAWNEE TRC
INDIAN HILLS DR
HIGHLAND DR
DESCO ST
GRAMLEY ST
BENNIE LN
SE 2ND ST
DAWSON CIR
CLARICE ST
WARE DR
SOUTHLAND LN
DICKEY RD
JENNIFER MCFALLS WEST PARK
SW 3RD ST
DURANG

Legend

- Study Area
- Proposed Inlet
- Existing Node
- Proposed Storm Drains
- Existing Storm Drains

Proposed 100-Year End of Storm Ponding (ft)

- 0.10 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- >2.00

*Long-term standing water 12 hours after storm ends

0 225 450 900 Feet

CITY OF GRAND PRAIRIE
INDIAN HILLS
FEASIBILITY STUDY

PROPOSED CONDITIONS PONDING AT END OF STORM 100-YR, 24-HR EVENT

PREPARED: ELO
CHECKED: MJM
APPROVED: DST

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Grand Prairie TEXAS

DATE: APR 2017
SCALE: AS NOTED

EXHIBIT 18

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APPENDIX A

Indian Hills
Construction Cost Estimate

Item #	Description	Unit	Quantity	Unit Price	Amount
	Install 10ft Inlet	EA	15	$4,690	$70,350
	Install Type B 4' Storm Manhole	EA	7	$4,100	$28,700
	Install Outfall	EA	1	$10,000	$10,000
	Install 24in RCP	LF	84	$125	$10,500
	Install 36in RCP	LF	2,123	$160	$339,720
	Concrete Pavement - (All thickness)- Remove and Replace	SY	49,556	$70	$3,468,926
	6" Subgrade (Lime Stabilized)	SY	49,556	$10	$495,561
	6" Concrete (Driveways)	SF	26,640	$10	$266,400
	Curb & Gutter, 6" Conc-Remove and Replace	LF	29,734	$30	$892,011
	Asphalt overlay	TON	5,389	$150	$808,385
Base Bid Total					**$6,390,552**
Contingency (30%)					**$1,917,166**
Construction Cost Estimate Total					**$8,310,000**

Cost Estimate does not include mobilization, traffic control, utility adjustments, installation of new or additional utilities. Cost estimate is for stormwater related items only.

Any and all estimates provided by Consultant are opinions of probable costs based on information that is reasonably available to Consultant. Client acknowledges and agrees that Consultant has no control over the cost of labor, materials, equipment or services, or the means and methods used by others in determining prices, competitive bidding, or market conditions. Client further acknowledges and understands that proposals, bids, and/or actual project costs may, and probably will vary from the estimates and opinions of probable costs provided by Consultant under the Agreement.