

APPENDIX F: One-Page Summary Reports for Recommended Flood Mitigation Projects and Details (Scope of Work, Components, Benefits, No Negative Impacts Assessment)

Flood Mitigation Project (FMP)



Title **Spring Meadows Estates Detention Pond Design**

ID# **033000007** Sponsor **03003577**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

Pond redesign and reconstruction to lower normal pool elevation to be below inlets upstream. Increase storage capacity and design outlet works to increase level of service to 100-yr storm event.

Watershed HUC# (if known) **120301060406,120301060408,12030106040** Emergency Need? **No**

Drainage area (mi² est.) **0**

Associated FME's **-** County **Dallas**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **18** # of structures **9** Critical facilities **0**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **0**

Number of low water crossings **0** Historical road closures **0**

100-Year Flood Risk Reduction

Population removed from 100-yr **18** # of structures removed from 100-yr **9**

Critical facilities removed from 100-yr **0** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **1** Low water crossings removed from 100-yr **0**

Other benefits **No** Reduction in # of road closures over 10 years **0**

Impacts

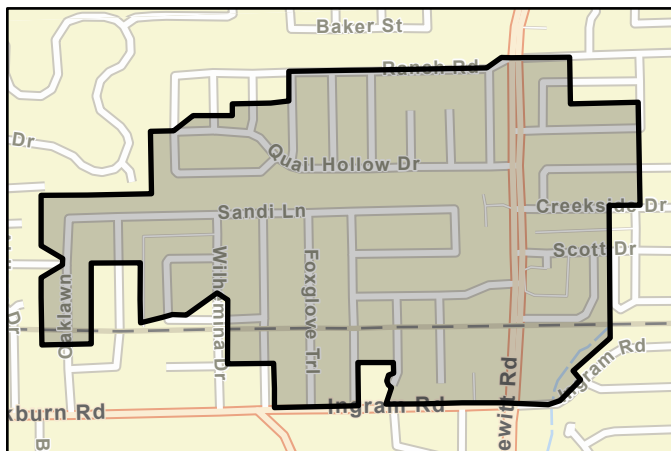
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$1,868,000** % Nature-Based **0** BCR **0**

Recurring costs **131000** Issues **-**



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title **West Irving Creek Phases 2, 3, and 4**

ID# **033000008** Sponsor **03002563**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

Reconstruction of 2.5+ miles of shallow, trapezoidal, concrete channel to deeper, vertical-walled channel to increase capacity & relieve historical flooding issues. Other improvements: reconstruct 15 road crossings, wastewater mains, detention, & WQ ponds

Watershed HUC# (if known) **120301020706** Emergency Need? **No**

Drainage area (mi² est.) **1**

Associated FME's **-** County **Dallas**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **1,180** # of structures **256** Critical facilities **1**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **5**

Number of low water crossings **8** Historical road closures **61**

100-Year Flood Risk Reduction

Population removed from 100-yr **1,151** # of structures removed from 100-yr **252**

Critical facilities removed from 100-yr **1** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **5** Low water crossings removed from 100-yr **1**

Other benefits **Public Recreation, Water Quality** Reduction in # of road closures over 10 years **44**

Impacts

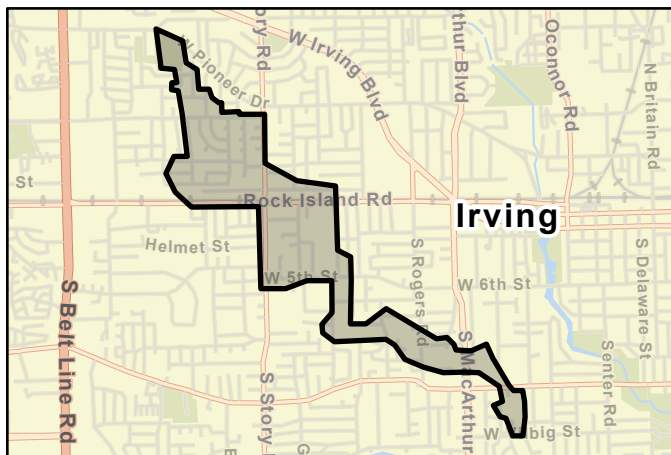
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$98,746,000** % Nature-Based **0** BCR **0**

Recurring costs **7355000** Issues **-**



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title Arlington VC(A)-1 Drainage and Erosion Improvements

ID# 033000016 Sponsor 03003362

RFPG recommend? Yes Reason for Recommendation Action aligns with goals and meets TWDB guidance

Project Description

Arlington VC(A)-1 Drainage and Erosion Improvements; unfunded FIF #13646
 This project includes improving the drainage in a residential area with an undersized bridge and severe erosion issues.

Watershed HUC# (if known) 120301020506,120301020405 Emergency Need? No
 Drainage area (mi² est.) 1
 Associated FME's - County Tarrant
 Associated FMS's - Associated FMP's -

Existing 100-Year Flood Risk

Flood risk type: Riverine? Yes Coastal? No Local? No Playa? No Other? No
 Population at risk 474 # of structures 118 Critical facilities 0
 Farm/Ranch land impacted (acres) 0 Roadway(s) impacted (length) 0
 Number of low water crossings 3 Historical road closures 37

100-Year Flood Risk Reduction

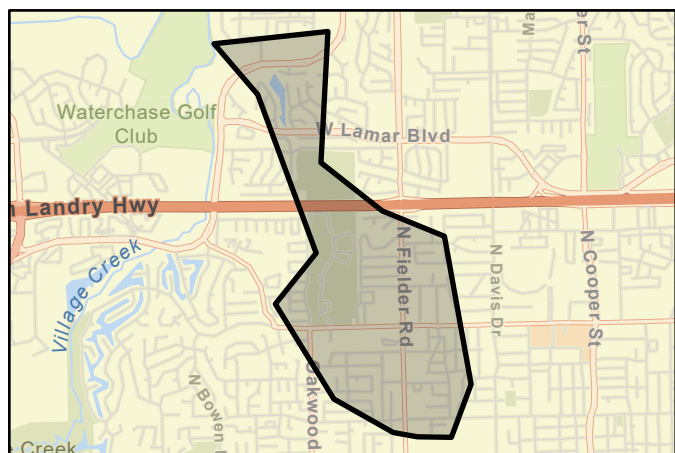
Population removed from 100-yr 24 # of structures removed from 100-yr 9
 Critical facilities removed from 100-yr 0 Farm/Ranch land removed from 100-yr (acres) 0
 Road removed from 100-yr (miles) 1 Low water crossings removed from 100-yr 0
 Other benefits No Reduction in # of road closures over 10 years 3

Impacts

Negative impacts? No Negative impacts description N/A
 Water supply contributions? No Water supply contribution description -

Estimated Cost

Project Cost \$2,601,000 % Nature-Based 0 BCR 0
 Recurring costs 181000 Issues -



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title **Lancaster/Foch Area Mitigation**

ID# **033000030** Sponsor **03002831**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

To decrease the flooding depths near the Norwood/Bledsoe/Crockett intersections, a storm drain alternative was developed. The storm drain system would run along Foch Street and then through Trinity Park to the river.

Watershed HUC# (if known) **120301020105,120301020307** Emergency Need? **No**

Drainage area (mi² est.) **0**

Associated FME's **-** County **Tarrant**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **4,575** # of structures **44** Critical facilities **0**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **1**

Number of low water crossings **1** Historical road closures **59**

100-Year Flood Risk Reduction

Population removed from 100-yr **3,272** # of structures removed from 100-yr **10**

Critical facilities removed from 100-yr **0** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **1** Low water crossings removed from 100-yr **0**

Other benefits **No** Reduction in # of road closures over 10 years **1**

Impacts

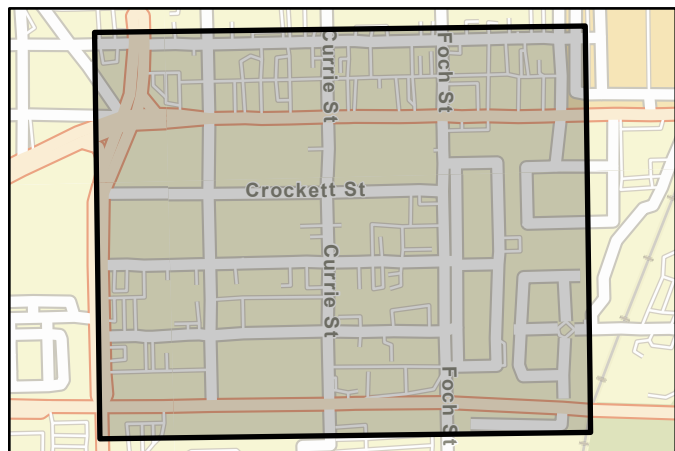
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$11,771,000** % Nature-Based **0** BCR **0**

Recurring costs **783000** Issues **-**



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title **Linwood Park Flood Mitigation (University Drive)**

ID# **033000031** Sponsor **03002831**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

To mitigate the flooding depths in the Linwood Park area, a storm drain would outfall to the West Fork Trinity River.

Watershed HUC# (if known) **120301020105,120301020307** Emergency Need? **No**

Drainage area (mi² est.) **1**

Associated FME's **-** County **Tarrant**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **11,372** # of structures **313** Critical facilities **0**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **5**

Number of low water crossings **1** Historical road closures **81**

100-Year Flood Risk Reduction

Population removed from 100-yr **6,882** # of structures removed from 100-yr **204**

Critical facilities removed from 100-yr **0** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **3** Low water crossings removed from 100-yr **0**

Other benefits **No** Reduction in # of road closures over 10 years **0**

Impacts

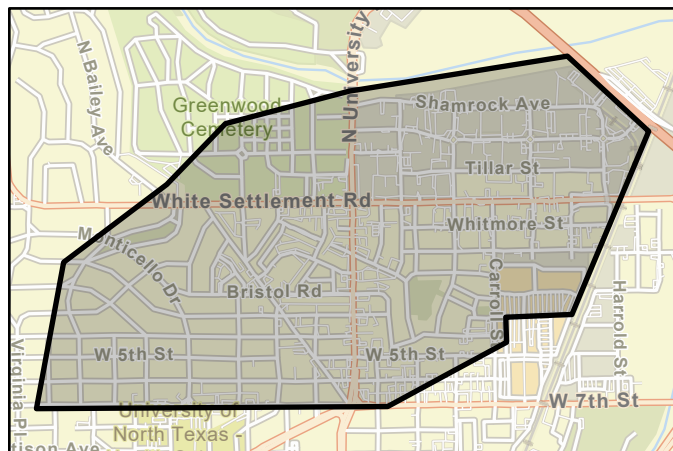
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$50,523,000** % Nature-Based **0** BCR **0**

Recurring costs **3358000** Issues **-**



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title **Sunnyvale Urban Flooding Reduction Improvements - Area 1**

ID# **033000033** Sponsor **03002565**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

Proposed alternatives to reduce roadway overtopping's during the 100-year ultimate storm such as culvert and ditch improvements.

Watershed HUC# (if known) **120301060501,120301060503** Emergency Need? **No**

Drainage area (mi² est.) **0**

Associated FME's **-** County **Dallas**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **56** # of structures **14** Critical facilities **1**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **0**

Number of low water crossings **0** Historical road closures **7**

100-Year Flood Risk Reduction

Population removed from 100-yr **56** # of structures removed from 100-yr **14**

Critical facilities removed from 100-yr **1** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **1** Low water crossings removed from 100-yr **0**

Other benefits **No** Reduction in # of road closures over 10 years **7**

Impacts

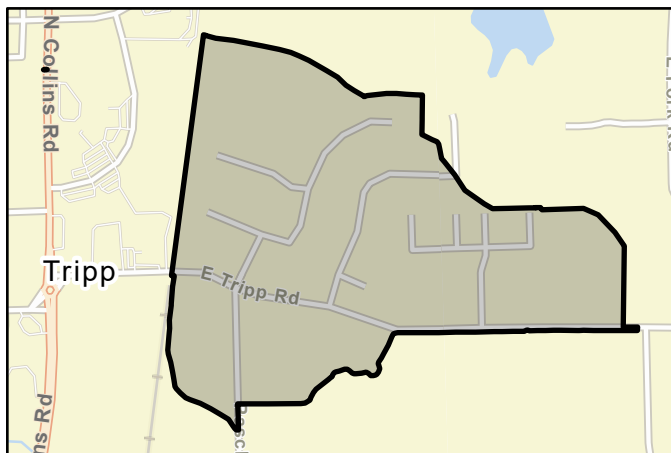
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$4,560,000** % Nature-Based **0** BCR **0**

Recurring costs **310000** Issues **-**



FMP area



Regional view of FMP area

Flood Mitigation Project (FMP)



Title **Sunnyvale Urban Flooding Reduction Improvements - Area 2**

ID# **033000036** Sponsor **03002565**

RFPG recommend? **Yes** Reason for Recommendation **Action aligns with goals and meets TWDB guidance**

Project Description

Proposed alternatives to reduce roadway overtopping's during the 100-year ultimate storm such as culvert, ditch and storm drain improvements.

Watershed HUC# (if known) **120301060503** Emergency Need? **No**

Drainage area (mi² est.) **0**

Associated FME's **-** County **Dallas**

Associated FMS's **-** Associated FMP's **-**

Existing 100-Year Flood Risk

Flood risk type: Riverine? **Yes** Coastal? **No** Local? **No** Playa? **No** Other? **No**

Population at risk **113** # of structures **35** Critical facilities **1**

Farm/Ranch land impacted (acres) **0** Roadway(s) impacted (length) **1**

Number of low water crossings **0** Historical road closures **8**

100-Year Flood Risk Reduction

Population removed from 100-yr **113** # of structures removed from 100-yr **32**

Critical facilities removed from 100-yr **1** Farm/Ranch land removed from 100-yr (acres) **0**

Road removed from 100-yr (miles) **1** Low water crossings removed from 100-yr **0**

Other benefits **No** Reduction in # of road closures over 10 years **8**

Impacts

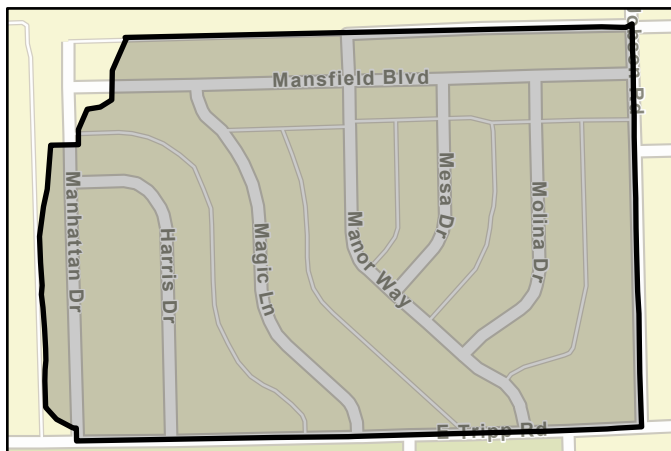
Negative impacts? **No** Negative impacts description **N/A**

Water supply contributions? **No** Water supply contribution description **-**

Estimated Cost

Project Cost **\$5,701,000** % Nature-Based **0** BCR **0**

Recurring costs **388000** Issues **-**



FMP area



Regional view of FMP area

Table 5.3.1: No Negative Impact Determination for Potentially Feasible FMPs

FMP ID	FMP Name	Hydraulic Model Type	No Negative Impact Requirements (100-yr Flood Event)*						FMP Meets ALL No Negative Impacts Requirements from Exhibit C Section 3.6.A	FMP Meets No Negative Impacts Requirements based on Engineering Judgement**
			Increase in inundation in areas beyond the public right-of-way, project property, or easement	Increases in inundation of storm drains, channels, and roadways beyond design capacity	Max. Increase in 1D WSE < 0.05 ft	Max. Increase in 2D WSE < 0.35ft	Max. Increase in Peak Discharge < 0.5%			
033000007	Spring Meadows Estates Detention Pond Design	2D	✔ N	✔ N	N/A	✔ -3.80	✔ -8.4%	✔ Y	-	
033000008	West Irving Creek Phases 2, 3, and 4	1D/2D	✔ N	✔ N	✘ 1.05	✘ 1.05	✘ 18.9%	✘ N	✔ Increase in peak discharge is fully contained within the proposed channel and do not impact adjacent properties. Rise in WSE is in public park area and Sponsor has accepted this condition. Other alternatives were tested to avoid increase in WSE, but it would result in loss of park function.	
033000016	Arlington VC(A)-1 Drainage and Erosion Improvements	1D/2D	✔ N	✔ N	✘ 0.31	N/A	✔ 0.3%	✘ N	✔ The only rise in WSE within the FMP area occurs at the Sylvan Dr crossing (+0.31 ft). Yet, this rise is fully contained within the roadway right-of-way.	
033000030	Lancaster/Foch Area Mitigation (Trail Drive)	2D	✔ N	✔ N	N/A	✔ -2.08	✘ 155.2%	✘ N	✔ The proposed project would connect to the existing storm drain system and reduce the overall flow across the project study area. However, this improvement results in an increase (approx. 620 cfs) in peak discharge at the outfall into the Clear Fork Trinity River. The elevation of the Clear Fork Trinity River floodplain must be considered when evaluating the hydraulic grade line along the proposed storm drain system. The Lancaster/Foch FMP area of interest is less than 0.25 square miles, but the contributing drainage area is close to 3 square miles -- which is a small fraction of the overall 90 square mile watershed of the Clear Fork Trinity River. Moreover, "with such a large difference between contributing areas, it is unlikely that there will be peak-on-peak conditions for the flood hydrographs of the Trinity River and the proposed storm drain system." (page 6 of the SWS 081 - Task Order 1 Lancaster/Foch Area Flood Mitigation)	

*TWDB Technical Guidance - Exhibit C Section 3.6.A

** Additional details regarding nature of impacts and reasoning for accepting impacts based on engineering judgment is included in individual project descriptions.

FMP ID	FMP Name	Hydraulic Model Type	No Negative Impact Requirements (100-yr Flood Event)*					FMP Meets ALL No Negative Impacts Requirements from Exhibit C Section 3.6.A	FMP Meets No Negative Impacts Requirements based on Engineering Judgement**
			Increase in inundation in areas beyond the public right-of-way, project property, or easement	Increases in inundation of storm drains, channels, and roadways beyond design capacity	Max. Increase in 1D WSE < 0.05 ft	Max. Increase in 2D WSE < 0.35ft	Max. Increase in Peak Discharge < 0.5%		
033000031	Linwood Park Flood Mitigation (University Drive)	2D	✔ N	✔ N	N/A	✔ -2.91	✘ 175.7%	✘ N	<p>✔ The proposed project would intercept the existing storm drain system and reduce flow across University Drive from 2,000 cfs to 200 cfs (90% reduction). However, this improvement results a significant increase (approx. 1,853 cfs) in peak discharge at the outfall to the West Fork of the Trinity River. This increase is due to the timing in which flow arrives to the outfall location. The stormwater volume discharging to the West Fork of the Trinity remains the same. The observed increase in peak discharge will not necessarily coincide with the 100-year peak flow at the West Fork of the Trinity at this outfall. A timing analysis (i.e. hydrologic analysis) may be required to ultimately determine if there is an increase to the 100-year peak discharge and WSELs at the West Fork.</p> <p>To that effect, the Linwood Park Flood Mitigation report indicates that the proposed condition includes "a storm drain discharge point into the West Fork Trinity River. Although the new relief storm drain would replace the existing, smaller storm drain at the outfall point, there will likely need to be coordination with the US Army Corps of Engineers (USACE) regarding discharge into the West Fork as the river is controlled by the levee system (potential Section 408 permitting). The discharge will also need to be coordinated with the Tarrant Regional Water District (TRWD)" (page 5 of Linwood Area Final Report Compiled 2017-0808).</p>
033000033	Sunnyvale Urban Flooding Reduction Improvements – Area 1	1D/2D	✔ N	✔ N	N/A	✔ 0.00	✘ 34.1%	✘ N	<p>✔ Although there are noticeable increases in peak flow at the downstream outfall of the project, the increases to the 100-yr inundation boundary are minimal and do not affect any structures downstream. In most areas, the inundation has been reduced due to proposed drainage infrastructure and building inundation has been greatly reduced. Sheet flow that used to leave Tribb Road and flow south, has been concentrated to flow in the proposed channels.</p>
033000036	Sunnyvale Urban Flooding Reduction Improvements - Area 2	1D/2D	✔ N	✔ N	N/A	✔ 0.00	✘ 15.3%	✘ N	<p>✔ Although there are noticeable increases in peak flow at the downstream outfall of the project, the increases to the 100-yr inundation boundary are minimal and do not affect any structures downstream. In most areas, the inundation has been reduced due to proposed drainage infrastructure and building inundation has been greatly reduced. Flow is now concentrated to the east of Jobson Road and to the south of Tribb Road where there are no affected structures.</p>

*TWDB Technical Guidance - Exhibit C Section 3.6.A

** Additional details regarding nature of impacts and reasoning for accepting impacts based on engineering judgment is included in individual project descriptions.

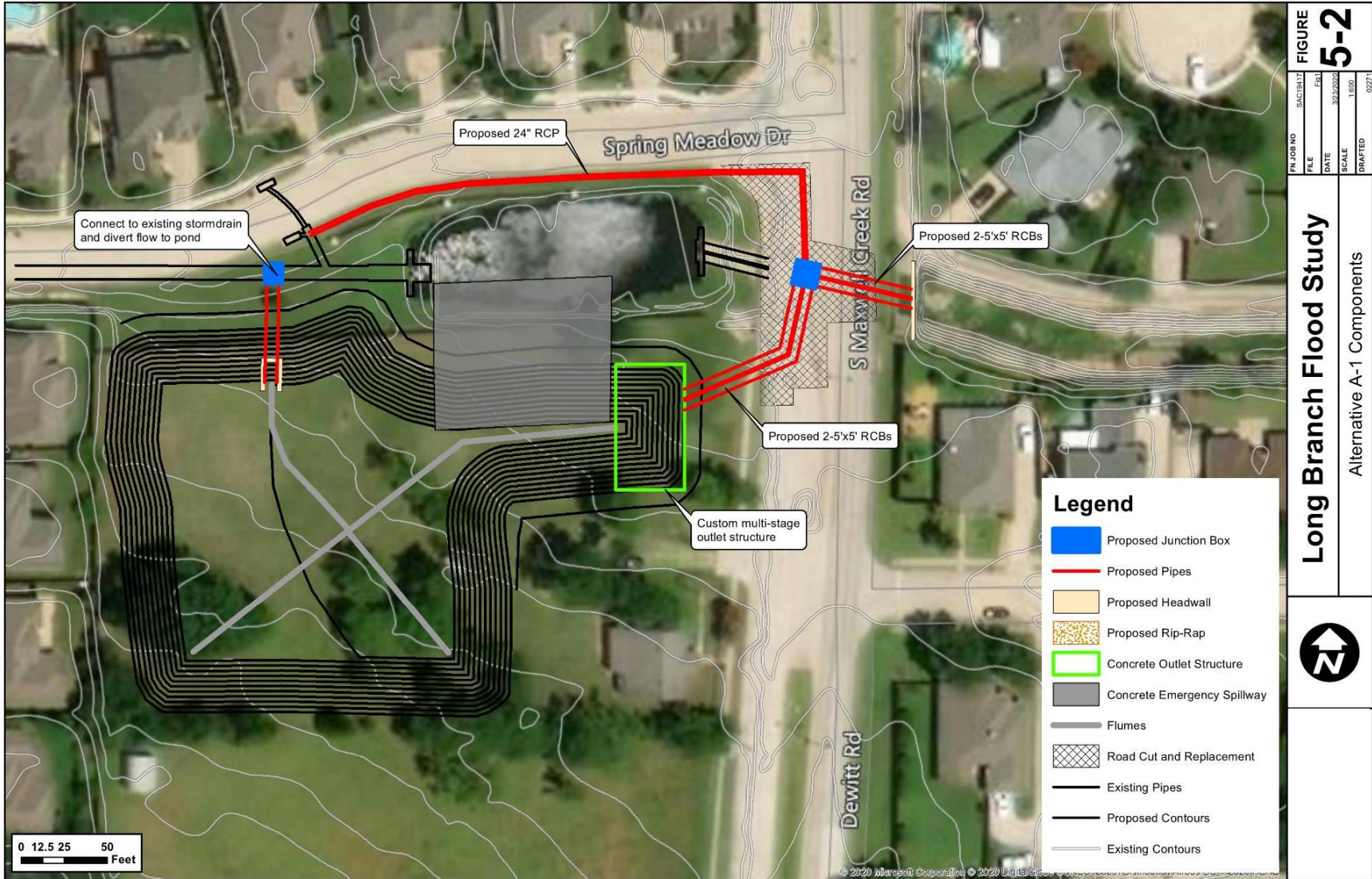
Spring Meadows Estates Detention Pond Design (FMP 033000007)

The Spring Meadows Estates Detention Pond Design project was generated from the Long Branch Flood Study performed by Freese and Nichols, Inc. in 2020. The proposed project aims to mitigate flooding along the intersection of Spring Meadow Dr and Dewitt Rd in the City of Sachse. This area experiences frequent flooding and creates a considerable safety concern. The primary source of flooding for this area is the overflow from the existing Spring Meadows Estates retention pond. This pond was originally designed as a dry detention pond, but it is currently functioning as a wet pond which effectively eliminates its ability to store floodwaters.

A HEC-RAS 2D model was created for this study to evaluate existing and proposed conditions. The main component of this project is the design and construction of an off-line dry detention pond next to the existing pond that will provide a 100-year LOS (see **Figure 5.3.1**). A diversion structure would be required to redirect runoff from the existing storm drain system into the new pond. The new pond would be approximately 12 ft deep and would provide approximately 10 ac-ft of storage. Pond outlet works would be designed to control the 2-year and 100-year design storm events and would discharge to an existing concrete lined channel via 2-5'x5' RCBs. An additional 24-in RCP is required to reroute runoff from two inlets on Spring Meadows Dr and connect them to the proposed 2-5'x5' RCB's downstream. This project will require acquisition of a portion of the parcel south of the existing pond.

Following the implementation of the proposed improvements, an estimated 0.34 miles of roadway and 9 residential structures would be completely removed from the 100-year floodplain. This correlates to an estimated 18 individuals removed from the 100-year flood risk. Based on the comparative assessment performed for this FMP, this project meets all no negative impacts requirements (see **Table 5.3.1**).

Figure 5.3.1: Spring Meadows Estates Detention Pond Design - Project Components (FMP 03300007)



West Irving Creek Phases 2, 3, and 4 (FMP 033000008)

The West Irving Creek FMP was generated from the Flood Infrastructure Fund application #13792. The City of Irving experiences significant flooding within the West Irving Creek watershed, so this project identifies several elements to alleviate the flooding in the area.

A HEC-RAS 1D/2D model was created to analyze existing flooding conditions, develop flood mitigation alternatives, and evaluate the impacts of the proposed improvements. The West Irving Creek channel improvements project consists of reconstruction of over 2.5 miles of shallow trapezoidal concrete channel as deeper vertical walled channel to increase capacity and relieve historical flooding issues (see **Figure 5.3.2**). The vertical walled channels allow the project to remain within a similar footprint as the existing channel to minimize easement needs and impacts to private properties while meeting the flood carrying capacity goals of the project. The channel improvements will also require the reconstruction of 15 road crossings and several miles of wastewater main. In conjunction with the channel improvements, upstream detention improvements will be made as well as the implementation of water quality ponds to reduce pollutant load in the channel and to provide amenity to the adjoining neighborhoods. These improvements will mitigate flood events associated with the 1% annual chance flood (100-year LOS).

The estimated flood risk reduction benefits following the implementation of West Irving Creek FMP include the removal of an estimated 5 miles of roadway and 252 structures from the 100-year floodplain, 230 of which are residential structures. This correlates to an estimated 1,151 individuals removed from the 100-year flood risk. Additionally, 6 structures would have reduced area within the 100-year floodplain but would not be fully removed from flood risk following these improvements. One critical facility and 1 low water crossing would also be removed from the 100-year floodplain.

Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the West Irving Creek FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**).

Increases in peak discharge are expected at the downstream areas of the improved channel due to the significant increase in channel capacity. However, these increases are fully contained within the proposed channel and do not cause any adverse impact to adjacent properties. There is one area within the project's zone of influence that would experience an increase of approximately 1 foot in water surface elevation, but this is a public park area with no insurable structures (see **Figure 5.3.3**). Based on these factors, the RFPG considers that the West Irving Creek FMP conforms to the no negative impacts requirements.

The park areas within the project limits include Shady Grove Trail Park, Markwood Park, and Wyche Park, as well the Dallas College Irving Center, a college campus with a large open space along the channel alignment. Under Existing Conditions, the flooding seen between Tipton Road and Rogers Road is controlled by backwater from Markwood Park and the Dallas College Irving Center campus. While the proposed channel was designed to have 100-year capacity, this area will continue to flood unless the backwater is mitigated. In addition to the backwater, thirteen structures near the Markwood Park and Dallas College Irving Center are within the existing 100-year floodplain limits.

The West Irving Creek Drainage Improvements Comprehensive Planning Study (FNI, 2022) describes the alternatives that were considered for this public park area as part of the project design (Section 3.3.1). Multiple grading alternatives were presented to the City Parks Department, and after discussion it was decided that some alternatives would not be feasible for construction while others would be investigated further during the design phase of the project.

The first alternative involved grading out a bench above the Ordinary High Water Mark (OHWM). This option resulted in the greatest WSE decreases, but grading would result in the removal of Markwood Park and it would no longer be usable as a park area. The second alternative involved deepening the channel. This option would cause moderate impact to Markwood Park, but it would conflict with existing sewer lines in the park and require more extensive environmental permitting as grading would occur below the OHWM. Both alternatives were discarded by the City since they would cause negative impacts on Markwood Park.

Three additional alternatives were investigated in order to find solutions that would not have negative impacts on the park areas. These alternatives investigated options for grading out a bench in the Dallas College Irving Center Campus above the OHWM. These would provide greater capacity and storage and would also allow the majority of the existing open space in the Dallas College Irving Center campus to remain in use. In Markwood Park, various levels of grading and modifications were considered. Through evaluation of these alternatives, it was determined that grading in the Dallas College Irving Center campus provides significant benefits and is necessary in order for any changes within Markwood Park to be beneficial. Coordination and communication with Dallas College Irving Center on the proposed grading along the natural channel will be required in order to address concerns and ensure agreement on the proposed improvements.

After discussion with the City, it was decided that a decision regarding the potential alternatives for improvements in Markwood Park would be made at a later point in the design. The improvements in the Dallas College Irving Center campus will remove six structures from the 100-year floodplain, and the finalized Markwood Park improvements will not impact the design of the upstream channel. Further evaluation of the Markwood Park alternatives will be performed and discussed with the City and the US Army Corps of Engineers (USACE), and the final alternative will be selected as part of the detailed design phase of the project.

Figure 5.3.2: West Irving Creek Phases 2, 3, and 4 - Project Components (FMP 033000008)

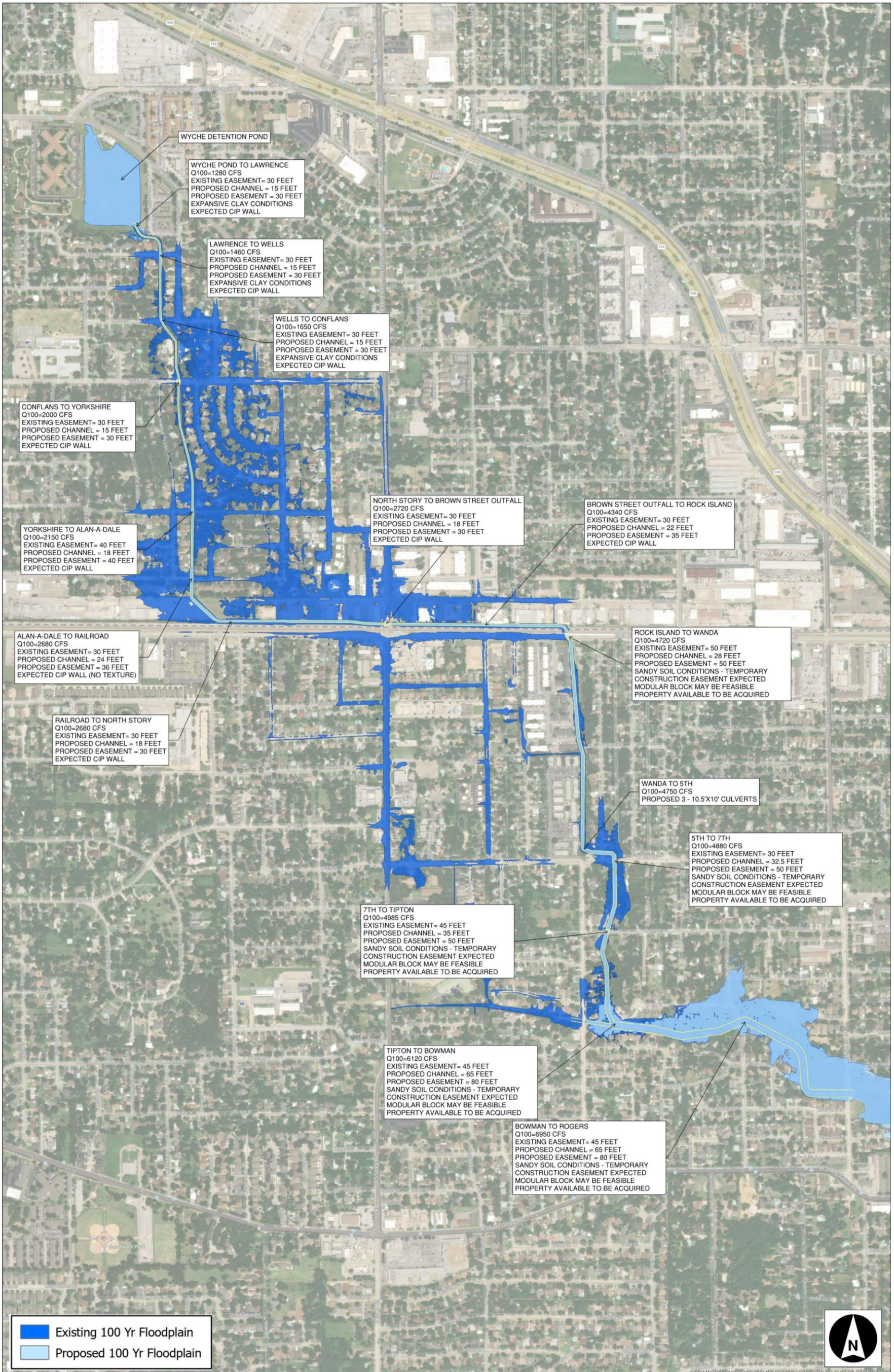


Figure 5.3.3: Existing and Post-Project Floodplain in affected Parks Areas (FMP 033000008)



Arlington VC(A)-1 (FMP 033000016)

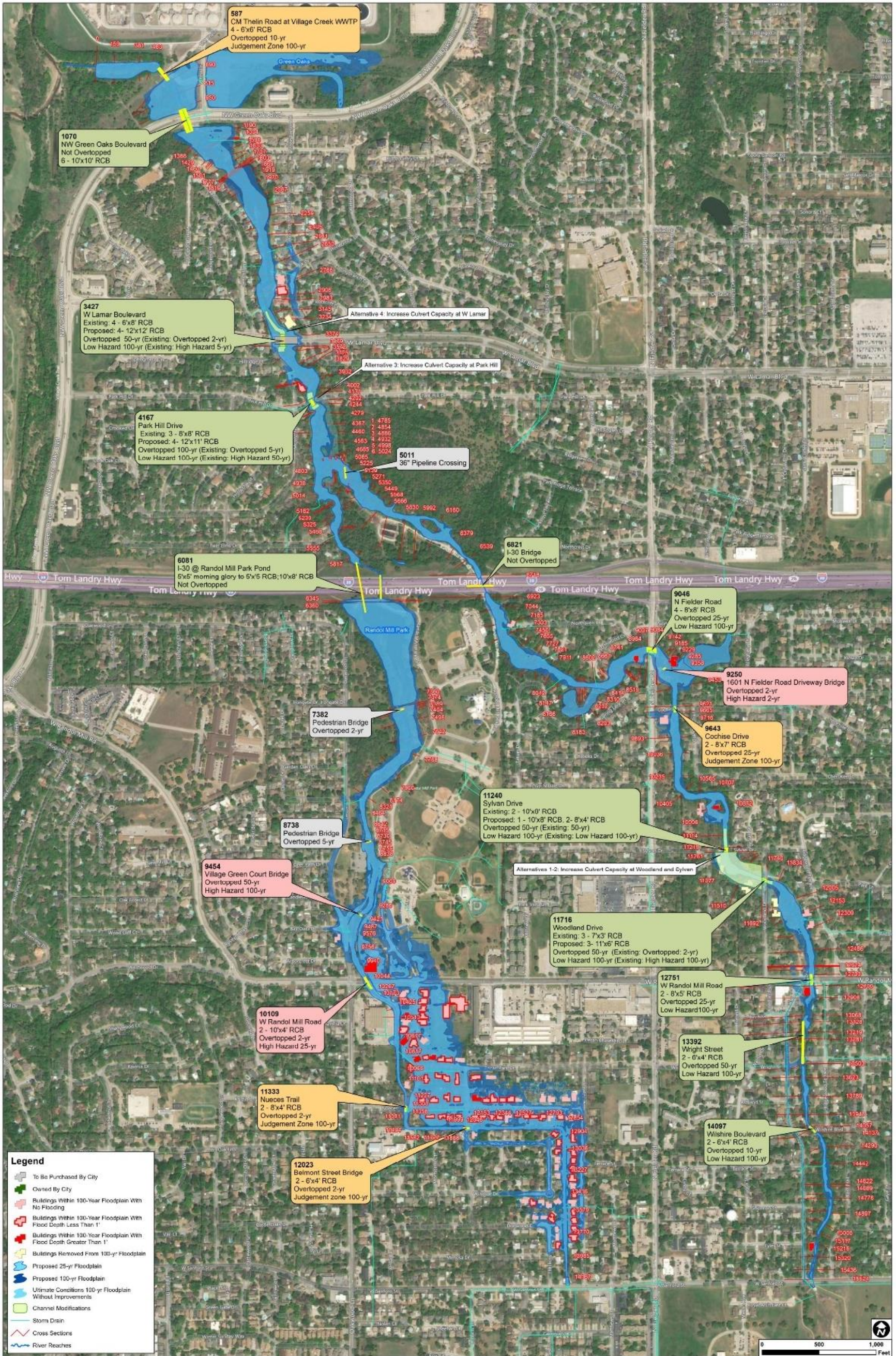
The Arlington VC(A)-1 FMP, developed from the unfunded Flood Infrastructure Fund application #13646, proposes options for drainage and erosion improvements. The proposed project includes improvements to four low-capacity crossings at Woodland Drive, Sylvan Drive, Park Hill Drive, and West Lamar Boulevard (see **Figure 5.3.4**). HEC-HMS and HEC-RAS models were created to analyze the impact that the proposed improvements would have based on ultimate land use conditions. A stream assessment was also performed and identified erosion risk alternatives to improve the stability of the stream bed and banks.

The proposed project will provide a minimum of a 25-year LOS (4% annual chance flood event). The LOS for the four crossings mentioned above range from 25-year to 100-year. However, flood risk reduction benefits are expected for all crossings up to the 100-year event.

Following the implementation of these drainage and erosion improvements, an estimated 0.16 mile of roadway and 9 structures would be removed from the 100-year floodplain, 3 of which are residential structures. This correlates to an estimated 24 individuals removed from the 100-year flood risk. Additionally, 29 structures would have reduced area within the 100-year floodplain but would not be fully removed from flood risk following these improvements.

Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the Arlington VC(A)-1 FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**). Model results show a 0.31 ft rise at the Sylvan Dr crossing, but this minor rise is fully contained within the roadway right-of-way and does not impact insurable structures such as residential and commercial buildings.

Figure 5.3.4: Arlington VC(A)-1 – Project Components (FMP 03300016)



Stream VC(A)-1 Watershed Study
Alternatives Workmap

Lancaster/Foch Area Mitigation (FMP 033000030)

The Lancaster/Foch Area Mitigation FMP is sponsored by the City of Fort Worth. Alternatives¹ were evaluated to provide storm drain relief along Norwood Street between West 7th Street and Lancaster Avenue, at the Lancaster Avenue/Bledsoe Street intersection, and the Lancaster Avenue/Currie Street intersection. This is primarily a commercial area in downtown Fort Worth.

A 2D ICM model was developed to analyze the storm drain trunk lines and identify the deficiencies in the system. The proposed project includes a 6'x6' box section along Norwood Street north of Lancaster Avenue and a 12'x10' box section along the remainder of the relief system length to convey the 100-year discharge (see **Figure 5.3.5**).

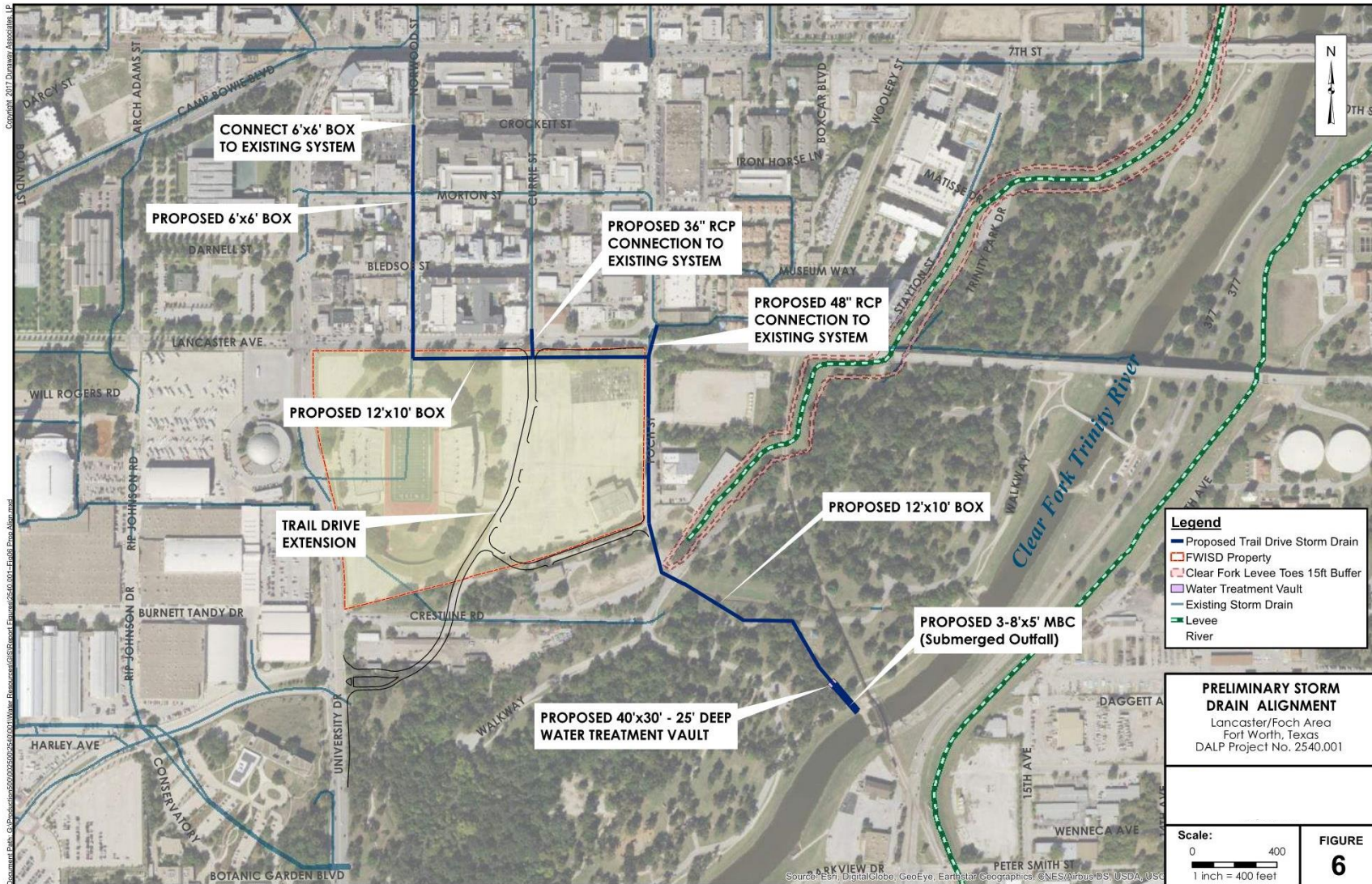
Following the implementation of these mitigation measures, an estimated 0.49 mile of roadway and 10 structures (commercial and public properties) would be removed from the 100-year floodplain. This correlates to an estimated 3,272 individuals removed from the 100-year flood risk. Additionally, 23 structures would have reduced area within the 100-year floodplain but would not be fully removed from flood risk following these improvements.

Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the Lancaster/Foch Area Mitigation FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**).

The proposed project would connect to the existing storm drain system and reduce the overall flow across the project study area. However, this improvement results in an increase (approx. 620 cfs) in peak discharge at the outfall into the Clear Fork Trinity River. The Lancaster/Foch FMP area of interest is less than 0.25 square miles, but the contributing drainage area is close to 3 square miles, which is a small fraction of the overall 90 square mile watershed of the Clear Fork Trinity River. With such a large difference between contributing areas, it is unlikely that there will be peak-on-peak conditions for the flood hydrographs of the Clear Fork Trinity River and the proposed storm drain system (see page 6 of the *SWS 081 - Task Order 1 Lancaster/Foch Area Flood Mitigation* report). Therefore, it is anticipated that this increase in peak discharge would not have a significant impact on the peak water surface elevations for the Clear Fork Trinity River. A timing analysis (i.e. hydrologic analysis) may be required to ultimately determine if there is an increase to the 100-year peak discharge and water surface elevations at the Clear Fork Trinity River.

¹ SWS 081 - Task Order 1 Lancaster/Foch Area Flood Mitigation, Dunaway, August 2017.

Figure 5.3.5: Lancaster/Foch Area Mitigation - Project Components (FMP 033000030)



Linwood Park Flood Mitigation (FMP 033000031)

The City of Fort Worth completed a flood mitigation study for the Linwood Park area in 2017². This study identified approximately 2,000 cfs of stormwater is generated by the area west of University Drive. Therefore, storm drain improvements west of University Drive are necessary to reduce the amount of runoff that reaches the Linwood Park area. Alternatives were identified to reduce the potential for inundation during the 100-year storm event.

An ICM model was created to evaluate the existing storm drain network and potential mitigation alternatives for multiple storm events. One branch of the proposed storm drain system would begin at Belle Place and run along West 7th Street, following three residential streets before turning east on Bristol Road and intersecting the line on University Drive. The storm drain would then run along University Drive to the West Fork Trinity River. A second feeder system would extend east from University Drive along Bristol Road, then turn south on Templeton Drive and extend south along Norwood Street to just north of West 7th Street (see **Figure 5.3.6**).

Following the implementation of these improvements, an estimated 3.32 miles of roadway and 204 structures would be removed from the 100-year floodplain, 123 of which are residential structures. Additionally, 239 structures would have reduced area within the 100-year floodplain but would not be fully removed from flood risk following these improvements. This correlates to an estimated 6,882 individuals removed from the 100-year flood risk.

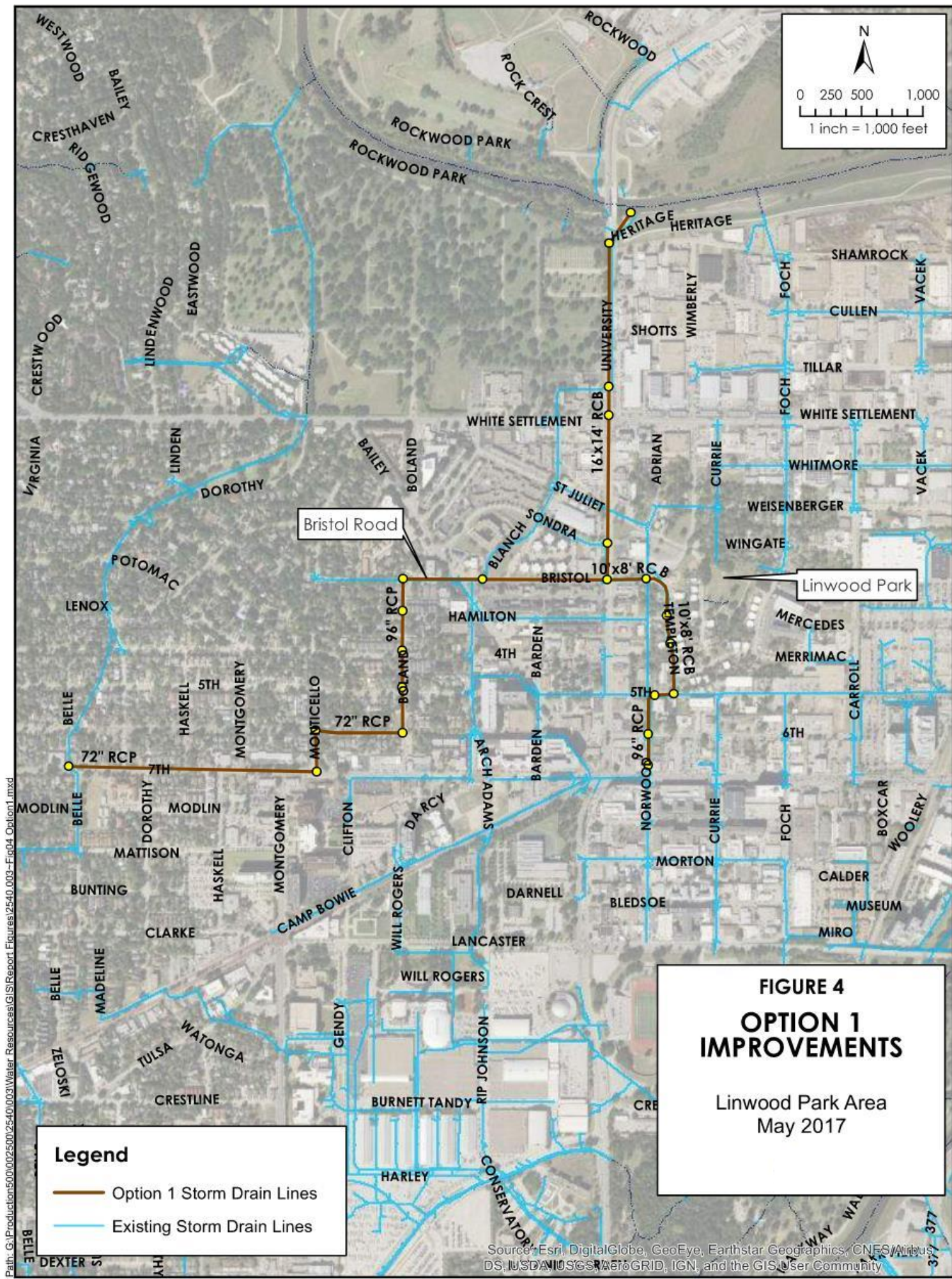
Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the Linwood Park Flood Mitigation FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**).

The proposed project would intercept the existing storm drain system and reduce flow across University Drive from 2,000 cfs to 200 cfs (90% reduction). However, this improvement results a significant increase (approx. 1,853 cfs) in peak discharge at the outfall to the West Fork of the Trinity River. This increase is due to the timing in which flow arrives to the outfall location. The stormwater volume discharging to the West Fork of the Trinity remains the same. The observed increase in peak discharge will not necessarily coincide with the 100-year peak flow at the West Fork of the Trinity at this outfall. A timing analysis (i.e. hydrologic analysis) may be required to ultimately determine if there is an increase to the 100-year peak discharge and water surface elevations at the West Fork.

To that effect, the Lindwood Park Flood Mitigation report indicates that although the new relief storm drain would replace the existing, smaller storm drain at the outfall point, there will likely need to be coordination with the US Army Corps of Engineers (USACE) regarding discharge into the West Fork as the river is controlled by the levee system (potential Section 408 permitting). The discharge will also need to be coordinated with the Tarrant Regional Water District (TRWD) (page 5 of Linwood Area Final Report Compiled 2017-0808).

² SWS 081 - Task Order 3 Linwood Park Flood Mitigation, Dunaway, August 2017.

Figure 5.3.6: Linwood Park Flood Mitigation - Project Components (FMP 033000031)



Sunnyvale Urban Flooding Reduction Improvements – Area 1 (FMP 033000033)

The City of Sunnyvale completed a stormwater masterplan for the Long Creek watershed in 2018³. This study identified alternatives for local area improvements to reduce the potential for inundation during the ultimate conditions 100-year storm event. This FMP pertains to Area 1, which includes the Sunnyvale Middle and High School, portions of the Deer Creek neighborhood, and the ditch and culvert system along Tripp Road from Collins Street to East Fork Road. The ditch and culvert system along Tripp Road is undersized for the 100-year event, causing potential flooding to the road and neighboring structures. Causes for flooding along Tripp Road include not only the size of the culverts and ditches, but also the grades. Some of the systems have negative slopes or are filled with sediment. Portions of Tripp Road experience significant flooding, with upwards of 3 feet of inundation at the cross culvert from the Deer Creek detention pond.

An ICM model was created to model the performance of existing stormwater infrastructure, identify areas of inundation, and develop alternatives to mitigate flooding risks. The proposed improvements for Area 1 include an alternative ditch and culvert system for Tripp Road, which was sized to contain the 100-year ultimate flows within the right-of-way and under the driveways. Proposed improvements also include increasing existing ditch, culvert, and pipe sizes, adjusting inlet sizes and parameters for inlets receiving runoff from the school, and adjusting flowlines to establish a positive slope for the system. Channel geometry was selected to fit within the estimated right-of-way. Where capacity issues necessitated culvert sizes larger than 24-in, a multiple-barrel culvert or wider box culvert was proposed to avoid constructability issues related to the residential driveways (see **Figure 5.3.7**).

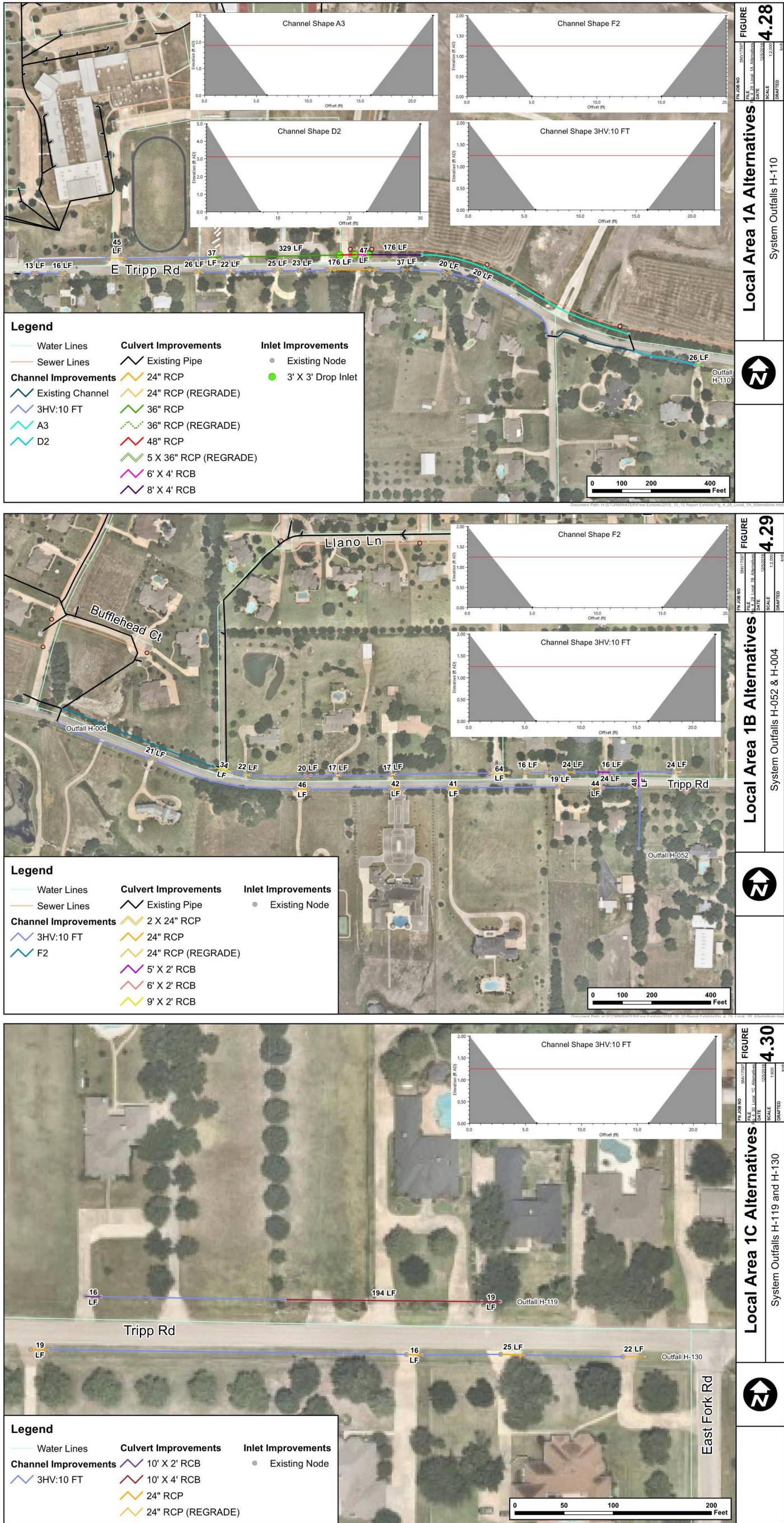
Following the implementation of these local area improvements, an estimated 0.32 mile of roadway and 14 structures would be removed from the 100-year floodplain, 9 of which are residential structures. This correlates to an estimated 56 individuals removed from the 100-year flood risk.

Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the Sunnyvale Urban Flooding Reduction Improvements – Area 1 FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**).

Although there are noticeable increases in peak flow at the downstream outfall of the project, the increases to the 100-year inundation boundary are minimal and do not affect any structures downstream. In most areas, the inundation has been reduced due to proposed drainage infrastructure and building inundation has been greatly reduced. Sheet flow that used to leave Tribb Road and flow south, has been concentrated to flow in the proposed channels.

³ Town of Sunnyvale Stormwater Masterplan, Freese and Nichols, Inc., November 2018.

Figure 5.3.7: Urban Flooding Reduction Improvements – Area 1 – Project Components (FMP 033000033)



Sunnyvale Urban Flooding Reduction Improvements – Area 2 (FMP 033000036)

The City of Sunnyvale completed a stormwater masterplan for the Long Creek watershed in 2018⁴. This study identified alternatives for local area improvements to reduce the potential for inundation during the ultimate conditions 100-year storm event. This FMP pertains to Area 2, which includes storm drainage infrastructure along Tripp Road and Jobson Road adjacent to and including Sunnyvale Estates neighborhood. The ditch and culvert system along Tripp Road is undersized for the 100-year event, causing structure inundation and road overtopping. Causes for flooding along Tripp Road include not only the size of the culverts and ditches, but also the grades. Some of the systems have negative slopes or have very flat slopes which greatly reduce the channel capacity.

An ICM model was created to model the performance of existing stormwater infrastructure, identify areas of inundation, and develop alternatives to mitigate flooding risks. Proposed improvements include increasing existing ditch, culvert, and pipe sizes, and adjusting flowlines to establish a positive slope for the system. Channel geometry was selected to fit within the estimated right-of-way. An additional parallel 60" RCP and an additional 42" RCP are proposed for the two existing culvert crossings at Jobson Road to reduce inundation depths at Jobson Road (see **Figure 5.3.8**).

Following the implementation of these local area improvements, an estimated 0.8 mile of roadway and 32 structures would be removed from the 100-year floodplain, all of which are residential structures. This correlates to an estimated 113 individuals removed from the 100-year flood risk.

Based on the comparative assessment performed for this FMP, the proposed project does not meet all no negative impacts requirements as established in the *TWDB Technical Guidance (Exhibit C Section 3.6.A)*. However, the Trinity RFPG considers that the Sunnyvale Urban Flooding Reduction Improvements – Area 2 FMP conforms to the no negative impacts requirements based on professional engineering judgment (see **Table 5.3.1**).

Although there are noticeable increases in peak flow at the downstream outfall of the project, the increases to the 100-year inundation boundary are minimal and do not affect any structures downstream. In most areas, the inundation has been reduced due to proposed drainage infrastructure and building inundation has been greatly reduced. Flow is now concentrated to the east of Jobson Road and to the south of Tribb Road where there are no affected structures.

⁴ Town of Sunnyvale Stormwater Masterplan, Freese and Nichols, Inc., November 2018.

Figure 5.3.8: Urban Flooding Reduction Improvements – Area 2– Project Components (FMP 033000036)

