City of Austin, Texas

Onion Creek Floodplain Modeling and Mapping

Phase 2 – Risk Identification and Mitigation

Flood Mitigation Analyses

Executive Summary & Technical Report

November 28, 2017

Prepared by:

Halff Associates, Inc.

9500 Amberglen Blvd., Bldg. F, Suite 125

Austin, TX 78729-1102

HALFF | SMARTER SOLUTIONS

STATE OF TEXAS
CINDY J. ENGELHARDT
103496
LICENSED
PROFESSIONAL ENGINEER

TBPE Firm #312
11/28/2017

EXECUTIVE SUMMARY

Executive Summary

The Onion Creek watershed encompasses approximately 344 square miles. Onion Creek generally flows easterly, from the headwaters in Blanco County, through Hays County, to the confluence with the Colorado River in Travis County. In response to the October 2013 flood along Onion Creek, the City of Austin initiated a multi-phase study of the Onion Creek Watershed. The initial phase of this study included hydrologic and hydraulic analyses redefining flows, water surface elevations, and the floodplain along the Onion Creek and tributaries in Travis County. The flood mitigation concepts discussed in this report are the results of the second phase of this study, Risk Identification and Mitigation. In October 2015, Onion Creek once again experienced a significant flooding event which further demonstrated the importance of this evaluation. **This Onion Creek Flood Mitigation Analysis is a feasibility study. Any results from this study, including post-project flood risk, will be refined should any of the projects mentioned in this analysis be recommended for further evaluation.** This area of Onion Creek was first studied and mapped by FEMA in 1978. Since that time, several studies have been performed in this area. Flood mitigation alternatives were analyzed in this area by Loomis and Moore in 1997. The United States Army Corps of Engineers (USACE) studied Onion Creek in 2006 and again in 2013. The previous studies were reviewed and the alternatives with the best potential were further evaluated in this study.

To validate the updated hydrologic and hydraulic analyses, the study team simulated three historical events (October 2013, May 2015, and October 2015) using gage-adjusted radar rainfall and gage records provided by the City of Austin. Once validated, the updated analysis was used to redefine computed peak flows, water surface elevations, and floodplains along Onion Creek within Travis County. Based on this study, the City was able to re-evaluate flood risk within the Pinehurst and Wild Dunes neighborhoods and evaluate potential flood mitigation alternatives.

Flood Mitigation Study Area

This study focuses on flood mitigation along the portion of Onion Creek between Interstate Highway 35 (IH-35) to East Slaughter Lane. For a location map of the study area in relation to the watershed, please see Figure 1. Because of the topography of the creek and locations of the homes at risk of flooding, the flood mitigation alternatives have varying effects throughout the study area. The flood mitigation benefits vary based on location along Onion Creek for each of the flood mitigation alternatives. For this reason, the study area is often referred to as two separate locations: the Pinehurst and Wild Dunes neighborhoods. The nomenclature refers to the homes in the general areas near Pinehurst Drive and Wild Dunes Drive including homes on all streets and not only those specific streets.

Existing Conditions Flood Risk

Once the hydrologic and hydraulic analyses were updated, the potential existing condition flood risk in the Pinehurst and Wild Dunes neighborhoods was established. Flood risk in the study area was evaluated for several flood events with varying frequency (probability of occurring). No homes within the study area are estimated to be flooded during the 50-year or 2% Annual Chance

Event (ACE) or any flood events with higher frequencies. Therefore, the evaluation of flood risk in the study area focused on mitigating the 100-year or 1% ACE.

Finished floor elevations were defined based on survey for over 90% of the homes in the study area. Where survey was not available, LiDAR elevation data was utilized. The number of at risk homes and expected depth of flooding in those homes were defined by subtracting the finished floor elevation from the 1% ACE water surface elevation. When the 1% ACE water surface elevation exceeds the finish floor elevation, interior or structural flooding is likely to occur. The estimated 1% ACE depths in homes can be seen in Figure 1. There are 115 homes in the Pinehurst neighborhood and 23 in the Wild Dunes neighborhood that are estimated to experience structural flooding during the 1% ACE, for a total of 138 homes.

As you can see in Figure 1, there are more than 138 homes located within the floodplain. This means that, even though the 1% ACE floodplain surrounds the home, the flood waters are not estimated to reach above the finished floor elevation and enter into the home. There are 174 homes located within the 1% ACE floodplain in the Pinehurst neighborhood, 45 homes in the Wild Dunes neighborhood, and 7 homes in other locations within the study area, for a total of 226 homes. This total includes the 138 homes that are expected to experience interior flooding.

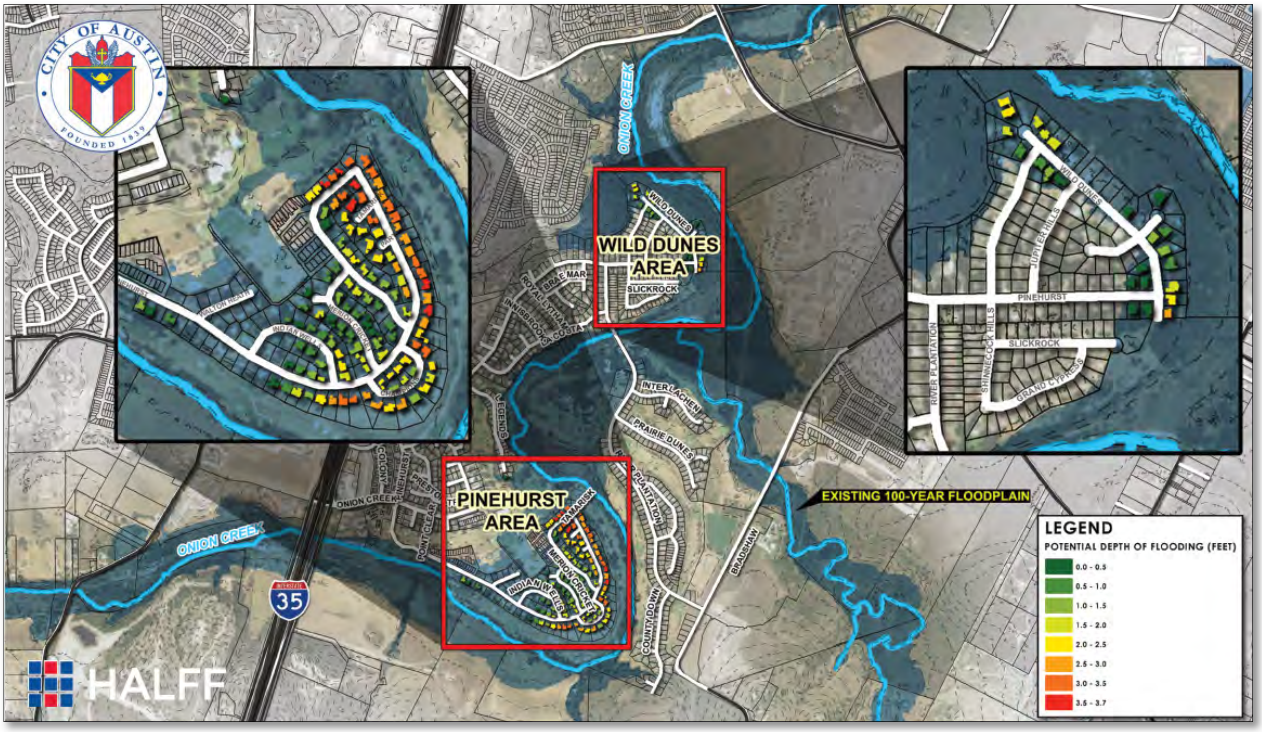


Figure 2: 1% (100-year) ACE Existing Conditions Risk of Flooding in Homes

Mitigation Goals

The overall flood mitigation objective is to eliminate the risk of interior flooding of homes along the reach of Onion Creek between IH-35 and East Slaughter Lane during the 1% ACE. In order to significantly reduce structural flooding between IH-35 and East Slaughter Lane, the flood elevations from the 1% ACE need to be reduced to levels similar to the 2% (50-year) ACE or at risk homes can be relocated out of the floodplain through the use of buyouts. A water surface elevation reduction can be accomplished using hydrologic alternatives (detention/retention ponds), hydraulic alternatives (diversions, floodwalls, channel improvements, etc.), or a combination of these alternatives. An analysis of possible flood mitigation improvements was conducted to potentially convey floodwaters within existing or proposed channel easements and roadway right-of-ways. The goal of this feasibility analysis was to identify alternatives that would either reduce the 1% ACE peak flows by approximately 30% or produce equivalent water surface elevation reductions ranging from 2 to 6 feet through the study area. When water surface elevation reduction is not feasible through the use of hydrologic or hydraulic alternatives, buyouts can be utilized to completely remove people and homes from the floodplain. When people and homes are removed from the floodplain, risk is eliminated indefinitely.

Final Flood Mitigation Alternatives

The flood mitigation analysis consisted of the development and evaluation of a variety of potential alternatives, both structural and non-structural, with the goal of protecting people and property from flooding and possibly reducing flood levels along Onion Creek between IH-35 and East Slaughter Lane within the Pinehurst and Wild Dunes neighborhoods. An extensive set of potential flood mitigation alternatives were evaluated based upon expected flood mitigation benefits, high-level engineering feasibility, and cost effectiveness of each individual alternative.

Based on the analysis, 3 stand-alone alternatives and 3 combined alternatives were selected for further engineering analysis. These six alternatives are listed below:

Stand-Alone Alternatives:

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts

Combined Alternatives:

- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modifications

These selected alternatives were chosen considering their technical feasibility, cost, and input from project stakeholders. The continued engineering analysis of these alternatives included refinement of design to maximize effectiveness. The effectiveness of each of these alternatives was evaluated based on the benefits provided relative to the updated existing condition 1% ACE flooding conditions. Highlights of these alternatives are displayed in the alternative fact sheets

located in Appendix A. After the finalization of the engineering analysis for the selected flood mitigation alternatives, each were evaluated using a project scoring criteria. Project scoring allows for all flood mitigation alternatives to be evaluated equally to ultimately identify the most favorable flood mitigation project for the Onion Creek study area.

Stand-Alone Alternatives

Centex West Regional Detention Pond – Hydrologic detention is used to temporarily impound flood waters for later release in order to reduce peak flows or to alter the timing and prevent the additive impact of tributary peak flows within a watershed. Therefore, the location of the rainfall within the watershed can have a significant impact on the true effectiveness of any regional detention alternative. This conceptual-level analysis included the identification of several potential regional detention pond locations upstream of IH-35 along Onion Creek. Compared to other regional detention alternatives that were analyzed, the Centex West pond is located relatively close to the study area, has fewer permitting challenges than other alternatives, and has significant flood mitigation benefits. Therefore this alternative was further evaluated in the final flood mitigation alternatives. The Buda/IH-35 Pond is located closer to the study area and did provide more flood mitigation benefits than the Centex West alternative, however due to exorbitant estimated project cost, significant permitting, and property acquisition this detention alternative was not selected for further analysis.

The Centex West Regional Detention Pond would utilize a portion of the active Centex quarry as an offline detention pond. The pond would be offline (flow diverted from the creek into the pond) and would, therefore, not require construction of an inline dam across Onion Creek. The diversion channel would be excavated from Onion Creek to the quarry. It would be designed to allow smaller or more frequent flood events to continue down Onion Creek while diverting and detaining only the larger or less frequent flood events. The flood waters will only be temporarily stored within the pond. The quarry would remain dry except for a period of time after significant flood events. Since this is currently an active quarry, in order to utilize it for detention, negotiations with the property owner and quarry operator would be required to allow for disruptions to mining operations during and after flood events that utilize the pond. Also agreements would need to be established regarding the property once mining operations are complete. When utilizing regional detention as a flood mitigation alternative there is a risk that if the rain falls primarily downstream of the detention pond, the pond will not be able to store a sufficient quantity of flood waters, and the study area will not see the full anticipated flood mitigation benefits.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$50,700,000** and **$40,000** respectively. The estimated time required to design and construct the pond (once funding is available) is **more than 10 years**. This flood mitigation alternative could be utilized to produce about an **11% flow reduction** of the computed 1% ACE peak flow at the Pinehurst and Wild Dunes neighborhoods. This 11% reduction in peak flow eliminates structural flooding for approximately **78 out of 138 homes** from the 1% ACE.

Channel Clearing – This alternative includes channel clearing for 126 acres of the densest areas of vegetation within the Onion Creek floodplain adjacent to the Pinehurst and Wild Dunes neighborhoods. In order to provide a flood mitigation benefit within the study area, channel clearing would require more than simply removing debris and fallen trees along Onion Creek. Although channel clearing is somewhat effective, it does not have the impact necessary to provide relief to a majority of the homes at risk in the 1% ACE floodplain compared to other flood mitigation alternatives analyzed. Since the City of Austin does not currently own easement or property along this reach of Onion Creek, easements would need to be acquired in the areas where channel clearing is proposed. Once the channel clearing is complete, great efforts would be required to maintain the "cleared" channel. The initial channel clearing and the perpetual maintenance would significantly impact the riparian corridor along Onion Creek including negative effects on water quality, creek stability, wildlife, and trees. This channel clearing alternative would remove all underbrush and more than 50% of existing trees within the dense vegetation areas, and would negatively impact heritage trees. Because of the environmental impacts, utilizing channel clearing as a flood mitigation alternative runs contrary to both the national trend in floodplain management and the City of Austin's goal of natural channel preservation.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$35,300,000** and **$448,000** respectively. The estimated time required to design and construct this alternative (once funding is available) is **2 to 5 years**. This flood mitigation alternative eliminates structural flooding for approximately **51 out of 138 homes** from the 1% ACE.

Buyouts – Property acquisition is often the most effective means of improving public safety and reducing flood damages in previously developed floodplain areas. When people and homes are removed from the floodplain, risk is eliminated permanently. The buyout option considered in this study is based on the offer of flood mitigation buyouts to homes within the study area that experience structural flooding during the 1% ACE. Such buyouts could be prioritized based on the depth of flooding and would proceed from the highest risk homes to the lowest risk as funding becomes available. The estimated cost of buyouts or property acquisition includes real estate services, appraisals, acquisition costs, relocation/moving expenses, asbestos testing/abatement, demolition, and property management. In order to avoid isolating homes, the cost estimate for this project includes estimates to offer buyouts to a handful of homes that are not at risk of structural flooding in the 1% ACE, but are located between at risk homes.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$77,500,000** and **$105,000** respectively. The estimated time required for implementation (once funding is available) is **2 years**. This flood mitigation alternative eliminates structural flooding for approximately **138 out of 138 homes** at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.

Combined Alternatives

The buyout alternative presented above is the only stand-alone alternative that would potentially mitigate the full risk of flooding in the study area during the 1% ACE flood. In order to provide this level of mitigation without relying solely on buyouts, a combination of alternatives is required.

Centex West Regional Detention Pond with Channel Modifications – This alternative includes a combination of the Centex West Regional Detention Pond, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive near the Wild Dunes neighborhood. Since the City of Austin does not currently own easement or property along this reach of Onion Creek, property acquisition would be required in the areas where channel modifications are proposed. In the areas of the proposed channel modifications, significant efforts to maintain the "cleared" channel once the project is complete will be required. Cutting into the channel would significantly impact the riparian corridor along Onion Creek negatively impacting water quality, creek stability, wildlife, and trees.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$70,200,000** and **$88,000** respectively. The estimated time required to design and construct this combined alternative (once funding is available) is **more than 10 years**. This flood mitigation alternative could be utilized to produce about an **11% flow reduction** of the computed 1% ACE peak flow at the Pinehurst and Wild Dunes neighborhoods. This combined alternative eliminates structural flooding for approximately **110 out of 138 homes** from the 1% ACE.

Pinehurst Flood Protection Wall with Buyouts – This alternative includes a flood protection wall in the Pinehurst neighborhood in combination with buyouts for the homes at risk of flooding in the 1% ACE in the Wild Dunes neighborhood. Because the flood protection wall would only provide limited flood reduction benefits to the Wild Dunes neighborhood, buyouts could be used to help meet the flood mitigation goals in this area. The purchase of 48 properties along the southeast side of Pinehurst Drive would also be required for construction of the wall. The height of the proposed wall is on average 5.5 feet, similar to the height of a standard privacy fence, with a max height of 14 feet. These dimensions include the FEMA requirements of freeboard (height above the 1% ACE water surface elevation) of at least 3 feet for the entire length of the wall, and 3.5 feet of freeboard at the upstream and downstream ends of the wall. The facade of the wall could be constructed to match current architecture in the neighborhood. The flood protection wall's alignment would also allow for the full function of the golf course as it is today. In addition, an internal drainage system would be required to drain approximately 77 acres of neighborhood drainage located behind the wall.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$59,400,000** and **$68,000** respectively. The estimated time required to design and construct this alternative (once funding is available) is **5 to 7 years**. This flood mitigation alternative eliminates structural flooding for approximately **138 out of 138 homes** at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.

Pinehurst Flood Protection Wall with Channel Modifications – This alternative includes the combination of the Pinehurst flood protection wall, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive. The Pinehurst flood protection wall is the same as the wall proposed in the combined alternative Pinehurst Flood Protection Wall with Buyouts. The River Plantation bridge improvements are the same as those included in the combined alternative with the Centex West Pond and channel modifications. The channel modifications in combination with the flood protection wall would require more conveyance and excavation than the channel modifications in combination with the Centex West Pond, because it does not experience the flow reduction benefits that the Centex West Pond would provide.

Since the City of Austin does not currently own easement or property along this reach of Onion Creek, property acquisition would be required in areas where channel modifications are proposed. In the areas of the proposed channel modifications the channel will require significant efforts to maintain the "cleared" channel once the project is complete. Cutting into the channel would significantly impact the riparian corridor along Onion Creek negatively impacting water quality, creek stability, wildlife, and trees.

The estimated project cost and annual O&M cost for this flood mitigation alternative are **$88,900,000** and **$159,000** respectively. The estimated time required to design and construct this alternative (once funding is available) is **7 to 10 years**. This flood mitigation alternative eliminates structural flooding for approximately **138 out of 138 homes** at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.

Project Scoring

Each of the flood mitigation alternatives were compared based on a set project scoring criteria. The scoring criteria cover a wide range of issues and were established based on a review of prioritization approaches used previously by the City of Austin and methods used by other municipalities and agencies. The selected criteria balance a broad range of considerations. There are seven different criteria:

- **Cost Effectiveness** – A Benefit-Cost Analysis was performed for the six flood mitigation alternatives.
- **Environmental Impacts** – The estimate of environmental impact is generally based on whether the environmental impact would be moderate or significant, and if the impact would be short-term or long-term.
- **Funding Constraints** – This criteria is based on what could be the project's funding source, the estimated time required to obtain funding, and the ability of the project to be implemented in phases.
- **Time of Implementation** – This criteria is based on what would be the time it takes to design, permit, and construct for each project. This criteria does not include the time to obtain funding.

- **Land & Easement Acquisition Required** – This criteria is based on the land or easement acquisition required for the flood mitigation alternative to be implemented.
- **Neighborhood Input** – This criteria is based on the neighborhood survey results from the Onion Creek public meeting on November 15, 2016.
- **Complexity of Permitting** – This criteria considers what permits would be required for the proposed flood mitigation projects and what is the difficulty in obtaining those permits due to other entities' involvement.

In Table 1, the results of the project scoring are summarized. The alternative that received the highest score, Buyouts, is highlighted in green. The alternative that received the lowest score, the combination of the Centex West Pond with channel modifications, is highlighted in red. The table illustrates where each alternative fell for each project scoring criteria.

Table 1. Project Scoring Results Summary

Criteria	Best ← → Worst		
Cost Effectiveness (Benefit-Cost Index)	• Wall with Buyouts	• **Buyouts** • Wall with Chl. Mods.	• Centex West Pond • Channel Clearing • **Pond with Chl. Mods.**
Environmental Impact	• **Buyouts**	• Centex West Pond • Wall with Buyouts	• Channel Clearing • **Pond with Chl. Mods.** • Wall with Chl. Mods.
Funding Constraints	• **Buyouts**	• Channel Clearing • **Pond with Chl. Mods.** • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond
Time of Implementation	• **Buyouts**	• Channel Clearing • Wall with Buyouts	• Centex West Pond • **Pond with Chl. Mods.** • Wall with Chl. Mods.
Land & Easement Acquisition	• **Buyouts**	• Channel Clearing • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond • **Pond with Chl. Mods.**
Neighborhood Input	• Centex West Pond • Channel Clearing • **Pond with Chl. Mods.**	• **Buyouts** • Wall with Chl. Mods.	• Wall with Buyouts
Complexity of Permitting	• **Buyouts**	• Channel Clearing • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond • **Pond with Chl. Mods.**

Conclusion & Recommendations

The Onion Creek Flood Mitigation Analysis allowed the City to re-evaluate flood risk within the Pinehurst and Wild Dunes neighborhoods in light of the October 2013 and 2015 floods and evaluate potential flood mitigation alternatives. There are 115 homes in the Pinehurst neighborhood and 23 in the Wild Dunes neighborhood where the estimated 1% ACE water surface elevation exceeds the finished floor elevations. The overall flood mitigation objective is to eliminate the interior flooding risk of homes during the 1% ACE within the Pinehurst and Wild Dunes neighborhoods.

Buyouts are less expensive than regional detention and have the flexibility of being implemented as funding becomes available. A Buyout program offers the shortest time of implementation and allows for prioritization of the most at risk homes. In addition to these benefits, this alternative has the least environmental impact to the Pinehurst and Wild Dunes neighborhoods. Based on the results of the analysis and the project scoring criteria, Halff recommends **Buyouts** as the preferred flood mitigation alternative.

Regional Detention could also be considered as a flood mitigation alternative for long-term and comprehensive planning. However high project cost, lack of funding, complex permitting, property acquisition, and environmental impact will all be obstacles that would need to be overcome if regional detention was ever implemented. Regional detention would also require regional partnerships between multiple jurisdictions, including coordination between Travis and Hays Counties through their recent Interlocal Agreement (ILA).

This Onion Creek Flood Mitigation Analysis is a feasibility study. Any results from this study, including post-project flood risk, will be refined should any of the projects mentioned in this analysis be recommended for further evaluation. For a more in-depth narrative of the flood mitigation analyses please refer to the *Onion Creek Flood Mitigation Analyses Technical Report*.

TECHNICAL REPORT

Table of Contents

List of Tables

List of Figures

List of Appendices

Appendix A: Fact Sheets

- Pinehurst Flood Protection Wall with Voluntary Buyouts
- Pinehurst Flood Protection Wall with Channel Modifications

Appendix B: Opinion of Probable Costs

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts
- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modification

Appendix C: Profile Comparisons

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts
- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modification

Appendix D: Floodplain Comparisons

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts
- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modification

Appendix E: Benefit-Cost Analysis (BCA)

- BCA Summary and Home Inventory (including FFE)

Appendix F: Project Scoring

- Final Alternatives Project Scoring Sheet

Appendix G: Post-Project Risk Maps

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts
- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modification

Appendix H: Digital Data (CD only)

- Shapefiles
- HEC-HMS
- HEC-RAS

Introduction

The Onion Creek watershed encompasses approximately 344 square miles. Onion Creek generally flows easterly, from the headwaters in Blanco County, through Hays County, to the confluence with the Colorado River in Travis County. In response to the October 2013 flood along Onion Creek, the City of Austin initiated a multi-phase study of the Onion Creek Watershed. The initial phase of this study included hydrologic and hydraulic analyses redefining flows, water surface elevations, and the floodplain along the Onion Creek and tributaries in Travis County. The flood mitigation concepts discussed in this report are the results of the second phase of this study, Risk Identification and Mitigation. In October 2015, Onion Creek once again experienced a significant flooding event which further demonstrated the importance of this evaluation.

This Onion Creek Flood Mitigation Analysis is a feasibility study. Any results from this study, including post-project flood risk, could be refined should any of the projects mentioned in this analysis be recommended for further evaluation.

This area of Onion Creek was first studied and mapped by the Federal Emergency Management Agency (FEMA) in 1978. Since that time, several studies have been performed in this area. Unfortunately, when the Onion Creek neighborhoods were developed in the 1970's and 1980's the Onion Creek floodplain in this area was significantly underestimated. Through further studies and improvement in the science of hydrology and hydraulics, a better estimate of the Onion Creek peak flow and floodplain extents have been defined. Similarly, many Onion Creek flood mitigation alternatives have been analyzed through studies performed by Loomis and Moore in 1997 and the United States Army Corps of Engineers (USACE) in 2006 and again in 2013. The previous studies were reviewed and the alternatives with the best potential were further evaluated in this study.

To validate the updated hydrologic and hydraulic analyses, the study team simulated three historical events (October 2013, May 2015, and October 2015) using gage-adjusted radar rainfall and gage records provided by the City of Austin. Documentation of this analysis can be found in the *Onion Creek Hydrologic and Hydraulic Technical Support Data Notebooks*. Once validated, the updated analysis was used to redefine computed peak flows, water surface elevations, and floodplains along Onion Creek within Travis County. Based on this study, the City was able to re-evaluate flood risk within the Pinehurst and Wild Dunes neighborhoods and evaluate potential flood mitigation alternatives.

Flood Mitigation Study Area

This study focuses on flood mitigation along the reach of Onion Creek between Interstate Highway 35 (IH-35) and East Slaughter Lane. These two road crossings almost bracket the study area perfectly, and make for a convenient reference for the study area location. For a location map of the study area in relation to the watershed, please see Figure 1. Because of the topography of the creek and locations of the homes at risk of flooding, the flood mitigation alternatives have varying effects throughout the study area. The flood mitigation benefits vary based on location along Onion Creek for each of the flood mitigation alternatives. For this reason, the study area is

often referred to as two separate locations: the Pinehurst and Wild Dunes neighborhoods (see Figure 2). The nomenclature refers to the homes in the general areas near Pinehurst Drive and Wild Dunes Drive including homes on all streets and not only those specific streets.

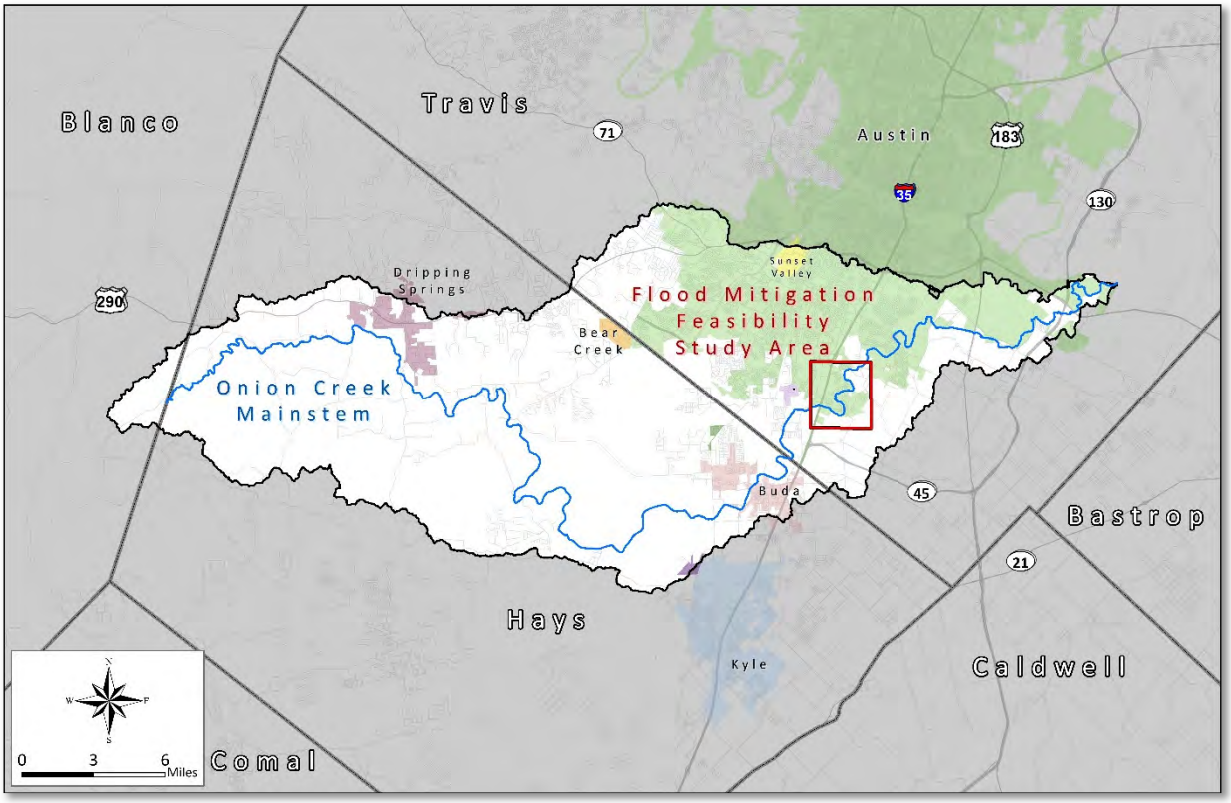


Figure 1: Flood Mitigation Study Area Location Map

Flood Mitigation Analysis Overview

The Onion Creek Flood Mitigation Analysis was a step-by-step process, where each step was influenced by the preceding analysis. This section outlines the steps that were taken during the analysis. Step 1 describes the previous phase of hydrologic and hydraulic modeling and mapping. Starting with step 2, this report describes the evolution and progression of the flood mitigation analysis associated.

1. Onion Creek Hydrologic and Hydraulics Update – As a part of the Onion Creek Floodplain Modeling and Mapping Study, the Onion Creek hydrologic and hydraulics models were updated for both existing and fully developed conditions. Hydrologic analysis is the computation of how much water (flow) enters a creek at specified locations of interest. Once the flow is established in the hydrologic model the flow is entered into the hydraulic model. Hydraulic analysis is the computation of how water (flow) travels down a creek system. Hydraulic analysis allows for the estimation of water elevations, speed, and floodplain extents along a creek. Based on these models, the FEMA regulatory water

surface elevations and floodplains were redefined along Onion Creek within Travis County. The anticipated release date for the updated Flood Insurance Rate Maps (FIRM) is late 2018 or early 2019. The updated hydrologic and hydraulics analyses are not discussed in this report. For more information about these updates, please refer to the *Onion Creek Floodplain Modeling and Mapping Survey Technical Support Data Notebook (TSDN)*, *Onion Creek Floodplain Modeling and Mapping Hydrologic TSDN*, and *Onion Creek Floodplain Modeling and Mapping Hydraulic TSDN*.

2. Existing Conditions Flood Risk – Based on the updated hydrologic and hydraulic analyses, the potential existing condition peak flows, water surface elevations, floodplain extents, and estimated flood risk in the Pinehurst and Wild Dunes neighborhoods were established.

3. Flood Mitigation Goals – Knowing the flood risk within the study area, a sensitivity analysis was performed to estimate the peak flow reduction and water surface elevation reduction required to mitigate flood risk within the study area.
    - Hydrologic (Stream Flow) Considerations – Reducing the peak flow along Onion Creek within the study area reduces water surface elevations and associated flood risks. A peak flow reduction can be simulated by modeling a proposed detention pond in the hydrologic model. The proposed condition peak flows are then run through the hydraulic model to assess the possible water surface elevation and flood risk reduction. The necessary peak flow reduction for the Onion Creek study area is discussed in the *Flood Mitigation Goals* section of this report. This section explains how a peak flow reduction can be achieved utilizing detention along the main steam of Onion Creek or along a tributary that significantly influences the peak flow along the main steam. Understanding the importance of hydrologic modeling and hydrograph timing provides explanation regarding the selection of the proposed detention ponds.
    - Hydraulic (Water Surface Elevation) Considerations – Reducing the water surface elevation along Onion Creek within the study area reduces flood risk. A hydraulic water surface elevation reduction can be achieved by increasing the flow area or conveyance of a channel within the hydraulic model. Increasing conveyance, decreases the water surface elevation and, in effect, reduces flood risk. The necessary water surface elevation reduction for the Onion Creek study area is discussed in the *Flood Mitigation Goals* section. This section explains how a water surface elevation reduction can be achieved utilizing channel improvements.

4. Preliminary Flood Mitigation Alternatives – Once the flood mitigation goals were identified, preliminary flood mitigation alternatives were analyzed. In selecting flood mitigation alternatives, a full range of structural and nonstructural measures were considered. The *Preliminary Flood Mitigation Alternatives* section outlines each of the individual alternatives that were initially analyzed. Evaluating individual flood mitigation alternatives allows for the identification of the favorable alternatives. Ultimately the preliminary analysis was used to refine or narrow the list of potential flood mitigation alternatives for further evaluation.

5. Final Flood Mitigation Alternatives – From the list of preliminary flood mitigation alternatives, a list of final flood mitigation alternatives was selected for further engineering analysis. These selected alternatives were chosen considering each alternative's technical feasibility, cost, and input from project stakeholders. The *Final Flood Mitigation Alternatives* sections outline each of the alternatives that were evaluated more in depth for this flood mitigation feasibility analysis.
6. Project Scoring – After the completion of the final flood mitigation alternatives engineering analysis, each of the selected flood mitigation alternatives were evaluated and compared to one another using a project scoring criteria established by the City of Austin. The project scoring covers a wide range of criteria: complexity of permitting, neighborhood input, land & easement acquisition, time of implementation, funding constraints, environmental impacts, and cost effectiveness. Project scoring allows for all flood mitigation alternatives to be evaluated in a consistent process to ultimately identify the most favorable flood mitigation project for the Onion Creek study area.
7. Conclusion & Recommendations – Based on the project scoring and reviewing the overall analysis, a conclusion and recommendation was established for the Onion Creek Flood Mitigation Analysis.

Existing Conditions Flood Risk

Based on the updated hydrologic and hydraulic analyses, the potential existing condition flood risk in the Pinehurst and Wild Dunes neighborhoods was established. As stated, fully developed conditions were also evaluated during the initial phase of this study. The fully developed condition hydrologic analysis was based on full build-out of the watershed rather than previous future condition analysis that evaluated a 30 year projection of development. Fully developed conditions is based on future land use provided by the City of Austin. Using the provided land use, the fully developed condition parameters of the watershed were estimated by increasing the percent of impervious cover and computing Snyder's lag times with the future land use condition. Based on the Onion Creek hydrologic results, the fully developed peak flow is less than 0.6% greater than existing conditions within the study area. This peak flow increase is reflected in a water surface elevation difference within the study area of 0.09 feet on average with a maximum difference of 0.4 feet. Considering the minimal difference between existing and fully developed conditions, this flood mitigation analysis was based on existing conditions. Using existing conditions also allows the analysis to comply with FEMA criteria, considering the Department of Homeland Security (DHS) FEMA Hazard Mitigation Assistance (HMA) programs present a critical opportunity to reduce the existing condition risk to individuals and property while simultaneously reducing reliance on federal disaster funds.

Flood risk in the study area was evaluated for several flood events with varying frequency (probability of occurring). No homes within the study area are estimated to be flooded during the 50-year or 2% Annual Chance Event (ACE) or any flood events with higher frequencies. The relationship between the flood event and annual probability of occurrence is summarized in Table 1. Therefore, the evaluation of flood risk in the study area focused on mitigating the 100-year or 1% ACE.

Table 1. Annual Probability of Frequency Flood Events

Flood Event	Probability of occuring in a year (%)
2-year	50%
5-year	20%
10-year	10%
25-year	4%
50-year	2%
100-year	1%

Field surveys and photographs, finished floor elevations, and high water marks were obtained by McGray and McGray Land Surveyors, Inc. between October 2014 and April 2015. The survey task included identifying and establishing survey control, conducting high water mark (HWM) and finished floor elevation (FFE) surveys, conducting hydraulic surveys, and obtaining photographs of high water marks. FFE survey taken by the USACE in 2005 was also utilized for this study. Finished floor elevations were defined based on survey for over 90% of the homes in the study area. Where survey was not available, LiDAR elevation data was utilized. The number of at risk homes and expected depth of flooding in those homes were defined by subtracting the finished floor elevation from the 1% ACE water surface elevation. When the 1% ACE water surface elevation exceeds the finish floor elevation, interior or structural flooding is likely to occur. The estimated 1% ACE depths in homes can be seen in Figure 2. There are 115 homes in the Pinehurst neighborhood and 23 in the Wild Dunes neighborhood that are estimated to be at risk of structural flooding during the 1% ACE, for a total of 138 homes.

As shown in Figure 2, there are more than 138 homes located within the floodplain. This means that even though the 1% ACE floodplain surrounds the home, the flood waters are not estimated to reach above the finished floor elevation and enter into the home. There are 174 homes located within the 1% ACE floodplain in the Pinehurst neighborhood, 45 homes in the Wild Dunes neighborhood, and 7 homes in other locations within the study area, for a total of 226 homes. This total includes the 138 homes that are expected to experience interior flooding.

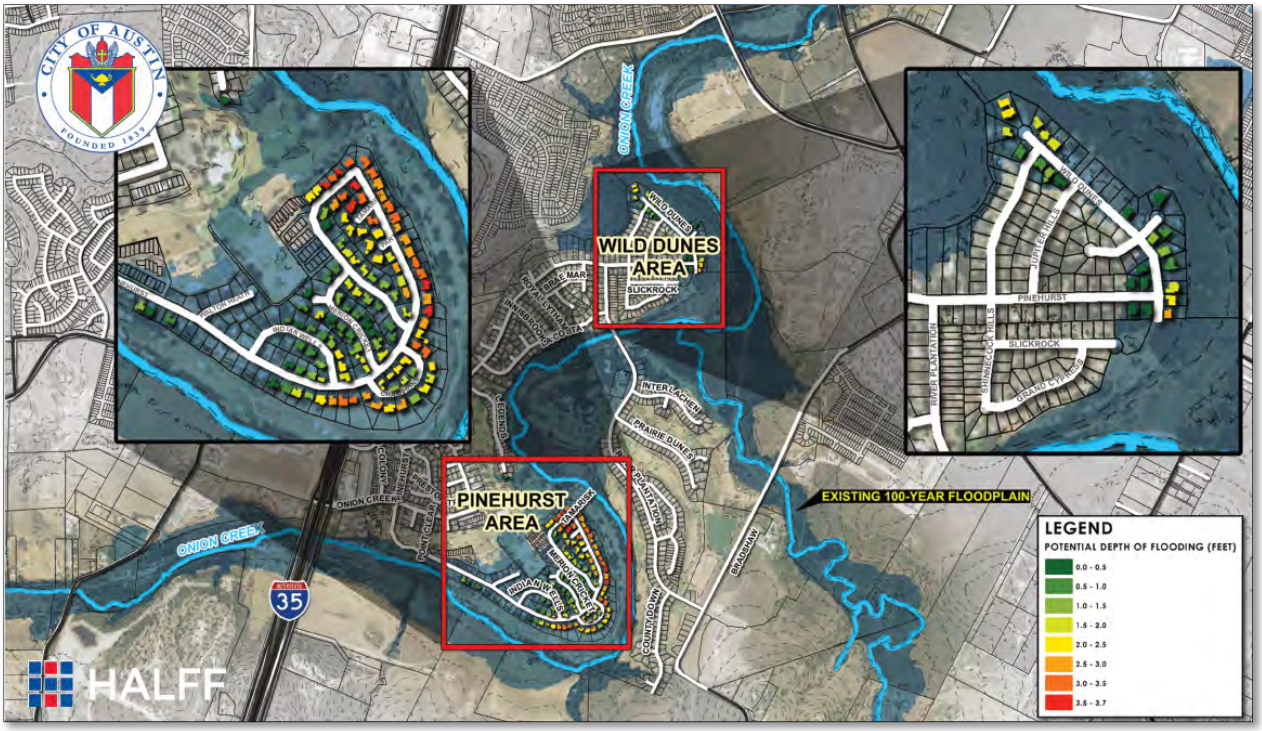


Figure 2: 1% (100-year) ACE Existing Conditions Risk of Flooding in Homes

Mitigation Goals

The overall flood mitigation objective is to eliminate the risk of interior flooding of homes along the reach of Onion Creek between IH-35 and East Slaughter Lane during the 1% ACE. As stated in a previous section, evaluation of available finished floor elevations indicated that approximately 115 homes in the Pinehurst neighborhood and 23 homes in the Wild Dunes neighborhood are estimated to experience structural flooding during the computed 1% ACE. In order to significantly reduce structural flooding between IH-35 and East Slaughter Lane, the flood elevations from the 1% ACE need to be reduced to levels similar to the 2% (50-year) ACE or at risk homes could be relocated out of the floodplain through the use of buyouts. A water surface elevation reduction could be accomplished using hydrologic alternatives (detention/retention ponds), hydraulic alternatives (diversions, floodwalls, channel improvements, etc.), or a combination of these alternatives. An analysis of possible flood mitigation improvements was conducted to potentially convey floodwaters within existing or proposed channel easements and roadway right-of-ways. The goal of this feasibility analysis was to identify alternatives that would either reduce the 1% ACE peak flows by approximately 30% or produce equivalent water surface elevation reductions ranging from 2 to 6 feet through the study area. When water surface elevation reduction is not feasible through the use of hydrologic or hydraulic alternatives, buyouts could be utilized to completely remove at-risk homes and their occupants from the floodplain. When people and homes are removed from the floodplain, risk is eliminated indefinitely.

Hydrologic (Stream Flow) Considerations

For flood mitigation, reductions in the peak flow of Onion Creek between IH-35 and East Slaughter Lane could either be achieved through the in-line or off-line detention of flood flows (peak flows) from the main stem of Onion Creek or by detention of flood flows on major tributaries that have a significant influence on the peak flow in Onion Creek. Peak flows within the study area are made up of a combination of flows from the main portion of the upstream Onion Creek watershed, and flows from Bear Creek watershed that join Onion Creek at Twin Creeks Road. The flows are also influenced by the larger Onion Creek tributaries upstream of the City of Buda. Within the study area, Rinard Creek joins Onion Creek approximately 1,200 feet downstream of River Plantation Drive, and Slaughter Creek joins Onion Creek approximately 6,500 feet downstream of Slaughter Lane.

Tributary peak flows that are close in time (coincident) to the peak of the main stem result in a significant increase to overall peak flow along Onion Creek. Onion Creek tributaries with significant drainage areas upstream of Slaughter Creek were evaluated to determine if the peak flow from the tributary coincided with the Onion Creek main stem peak flow. Detention within a coincident peaking tributary watershed could change the timing of the tributary peak and thereby reduce the total peak flow along Onion Creek. To demonstrate the impact of hydrologic timing, the hydrographs at the confluence of South Onion Creek and Rinard Creek are compared in Figure 3 below. A hydrograph is a graph that shows the quantity of flow versus time at a certain point along a creek. When the quantity of flow is at a maximum, this is known as the peak flow. As stated previously for flood mitigation the goal is to reduce peak flow along Onion Creek.

Even though Rinard Creek and Slaughter Creek join Onion Creek near the study area they do not have a significant impact on the peak flow or flood flow along Onion Creek, due to the fact the peak flows from those tributaries do not correlate to the timing of Onion Creek peak flows and ultimately do not increase the peak flow along Onion Creek. There are two tributaries upstream of the study area in the upper basin, South Onion Creek and Bear Creek, that peak at similar times to the Onion Creek main stem location near the corresponding confluence.

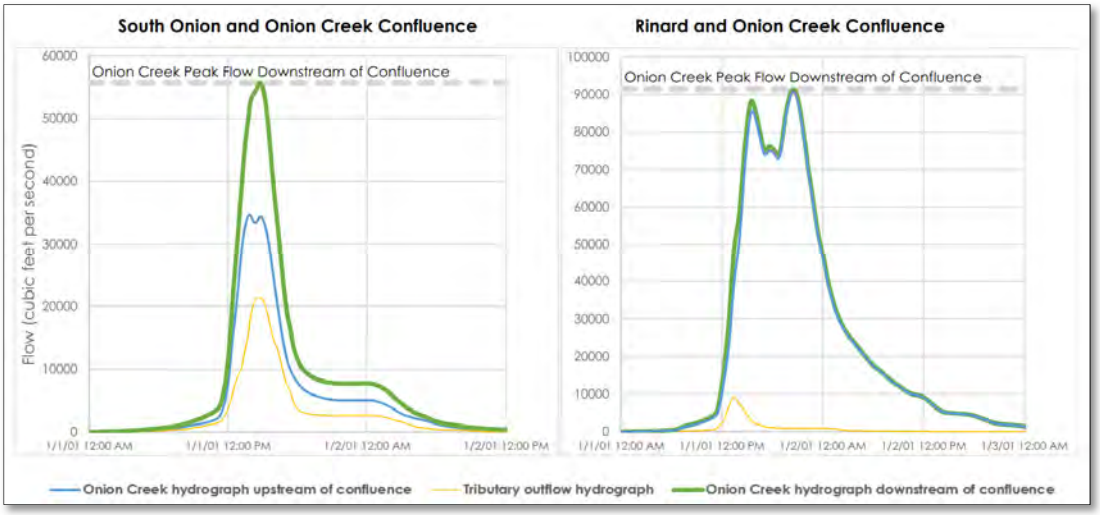


Figure 3: Hydrograph Comparison at Confluence of Onion Creek Tributaries

Because South Onion Creek has an influence on the peak flow along Onion Creek, detention along this tributary was simulated by completely disconnecting the tributary from Onion Creek within the hydrologic model. This provides an idea of the hypothetical peak flow reduction possible for detention along this tributary. Detaining South Onion Creek and Bear Creek resulted in minimal peak reductions along Onion Creek in the lower basin between IH-35 and East Slaughter Lane. Minimal peak reduction is a result of a small tributary drainage area relative to the Onion Creek drainage area. Between IH-35 and East Slaughter Lane the contributing drainage area of Onion Creek is approximately 250 square miles. The drainage areas of South Onion Creek and Bear Creek are approximately 70 square miles and 50 square miles, respectively. Based on the findings of this sensitivity analysis, most of the hydrologic flood mitigation alternatives or regional detention alternatives evaluated were focused on the Onion Creek main stem.

Hydraulic (Water Surface Elevation) Considerations

For flood mitigation, reductions in water surface elevation between IH-35 and East Slaughter Lane could be achieved by increasing the flow area or conveyance of the channel within the study area. An evaluation of the hydraulic results revealed that the computed 1% ACE water surface elevation profile has three significant localized increases in water surface elevations (head loss) between IH-35 and East Slaughter Lane, as seen in Figure 4. Such water surface increases are generally caused by inflow from large tributaries or channel constrictions where the area of a channel (conveyance) is reduced. As explained in the *Hydrologic (Stream Flow) Considerations* section, none of these localized increases in water surface elevations are caused by the inflow of Rinard Creek or Slaughter Creek due to hydrologic or hydrograph timing. Therefore, hydraulic flood mitigation alternatives were concentrated near the primary causes of the three identified flood elevation increases, such as natural changes in channel geometry or man-made constrictions caused by development and roadway crossings. Please note, the updated 1% ACE water surface elevation was used as the baseline for the hydraulic flood mitigation alternative evaluations.

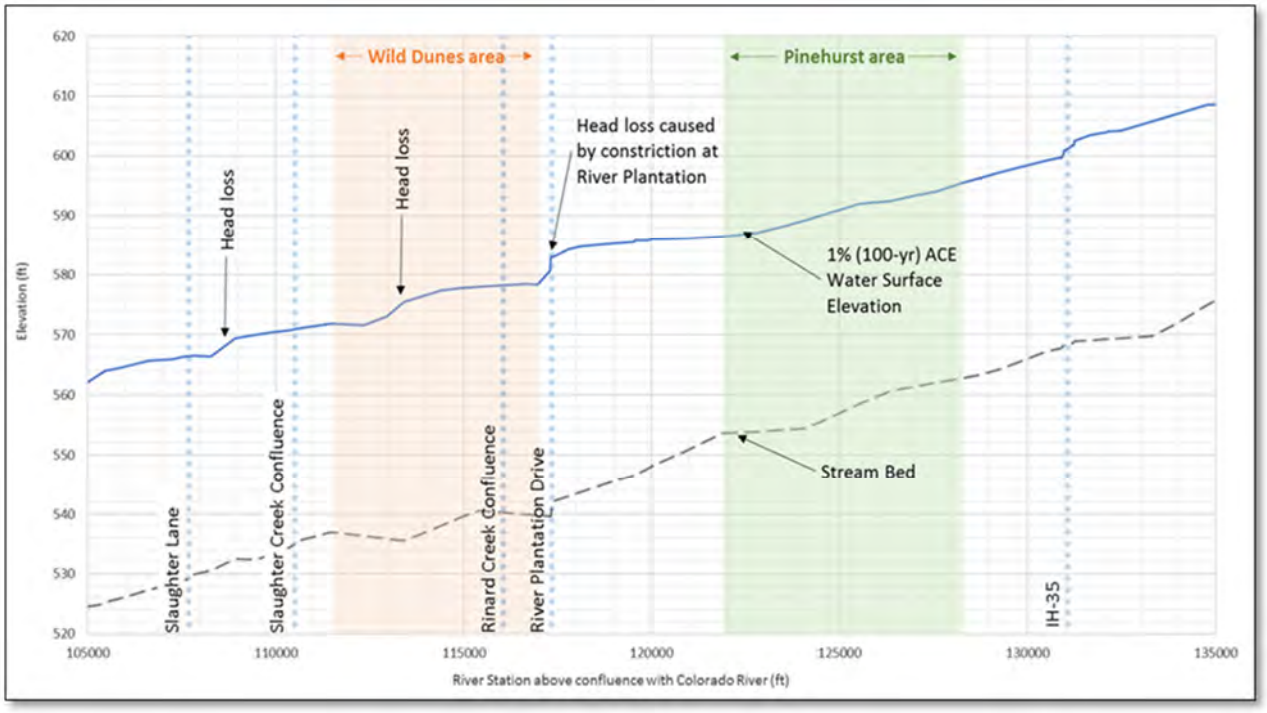


Figure 4: 1% (100-year) ACE Water Surface Elevation Profile

Preliminary Flood Mitigation Alternatives

Below is a comprehensive list of each flood mitigation alternative evaluated individually during the initial phase of the flood mitigation analysis. The alternatives are split into three categories: regional detention, hydraulic, and buyouts. The initial phase of the flood mitigation analysis was performed to observe mitigation benefits of individual alternative simulations. In response to the October 2015 flood along Onion Creek, the Austin City Council requested an accelerated conceptual evaluation of potential flood mitigation alternatives utilizing the Onion Creek draft hydrologic and hydraulic analyses. This initial flood mitigation alternatives analysis was completed and documented in a memorandum dated February 29, 2016. Following this memorandum and completion of the Onion Creek hydrologic and hydraulic analyses, these preliminary alternatives were independently re-evaluated utilizing the updated analysis. The City held a public meeting on November 15, 2016 to present their preliminary findings. A complete list of preliminary flood mitigation alternatives is displayed in Table 2. As mentioned previously, these preliminary alternatives were evaluated independent of other flood mitigation alternatives to observe mitigation benefits. Using the results from this initial analysis, the study team was able to identify favorable alternatives for further evaluation. The alternatives highlighted in dark blue were further evaluated in the final flood mitigation alternatives analysis.

Table 2: Preliminary Flood Mitigation Alternatives Summary

REGIONAL DETENTION ALTERNATIVES
Bornheim Quarry
Dripping Springs Pond
Rattlesnake Pond
Centex East Pond
Centex West Pond
IH-35/Buda Pond
HYDRAULIC MITIGATION ALTERNATIVES
Pinehurst Neighborhood Flood Protection Wall
Wild Dunes Neighborhood Flood Protection Wall
Channel Diversion
Channel Clearing
Removal of Champions Lane Constriction
Removal of Wild Dunes Court Constriction
Removal of River Plantation Drive Constriction
Pinehurst Neighborhood Channel Benching
Wild Dunes Neighborhood Channel Benching
BUYOUTS

Regional Detention Alternatives

Hydrologic detention is used to temporarily impound flood waters for later release in order to alter the timing of peak flows to prevent or reduce the additive impact of tributary peak flows within a watershed. Potential hydrologic improvements were modeled and evaluated utilizing the updated hydrologic frequency analysis. This conceptual-level analysis included the identification of several potential regional detention pond locations upstream of IH-35 along Onion Creek. Proposed ponds were located where existing topography was favorable for significant detention and feasible construction. The conceptual ponds were designed to allow the more frequent events (4% ACE and below) to bypass or pass through the pond, while detaining the less frequent events with a focus on reduction of the 1% ACE flows. The locations of the proposed ponds that were analyzed can be seen in Figure 5 below. These ponds are discussed in further detail in the following sections starting with the most upstream pond along Onion Creek moving downstream. Bornheim Quarry is the only detention alternative not located along Onion Creek, and it is listed first.

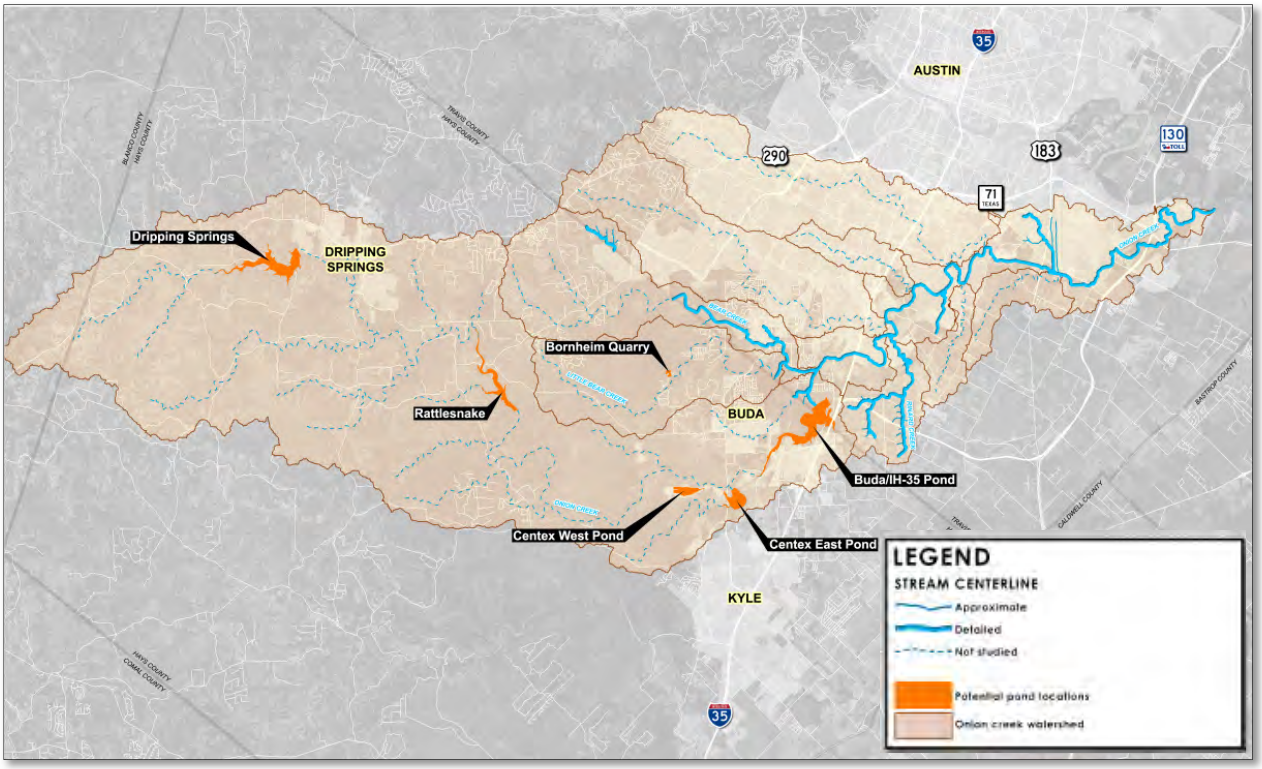


Figure 5: Regional Detention Location Map

The hydrologic simulation used to evaluate the proposed detention ponds, assumed uniform rainfall across the watershed with areal reduction. Areal reduction is applied due to the unlikelihood of uniform or consistent rainfall across large watersheds that have drainage basins greater than 10 square miles. Areal reduction of rainfall is a method used that reduces peak flow at a point based on the watershed area that drains to that point. Historical evaluation of rainfall over the Onion Creek watershed indicates that rain does not fall uniformly across the watershed validating the use of areal reduction. An example of this can be seen in Figure 6. This figure shows the rainfall distribution across the Onion Creek watershed for the October 2015 flood event. The heaviest rainfall for this storm event fell primarily downstream of the proposed pond locations. If rain falls primarily downstream of the proposed detention pond, the pond would not be able to store a sufficient quantity of flood waters, and the study area could not see the full anticipated flood mitigation benefits. Therefore, the location of the rainfall within the watershed could have a significant impact on the true effectiveness of any regional detention alternative.

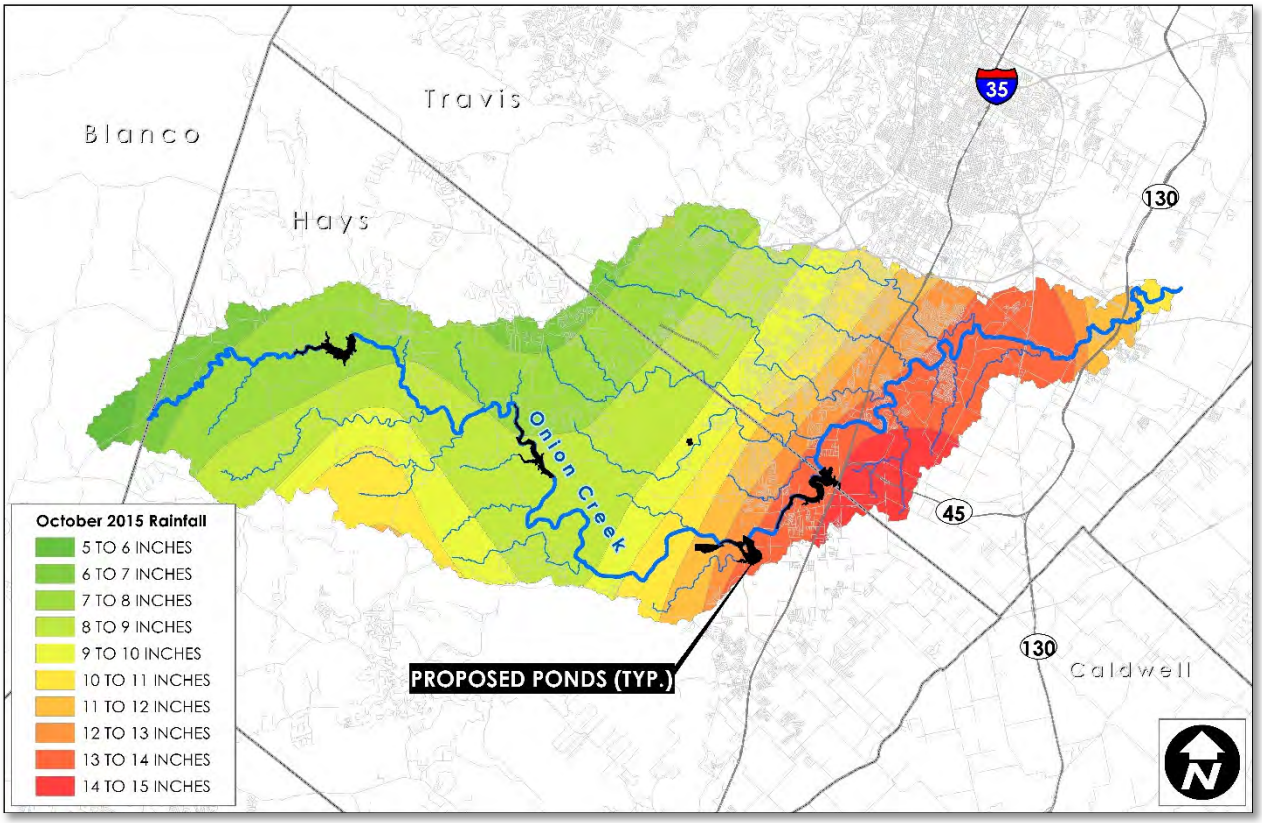


Figure 6: October 2015 Event Rainfall Distribution

Please note implementation of regional detention could require regional partnerships between multiple jurisdictions, including coordination between Travis and Hays Counties through their recent Interlocal Agreement (ILA). Regional detention ponds in combination with one another could be considered as a flood mitigation alternative for long-term and comprehensive planning. However high project cost, lack of funding, complex permitting, property acquisition, and environmental impact prolong the estimated timeline for implementation. Due to these constraints, multiple regional detention ponds in combination was not further analyzed as a viable alternative during this analysis.

Bornheim Quarry

This pond utilizes the Bornheim Quarry located along Little Bear Creek. Bornheim is no longer an active quarry and the property is owned by the City of Austin. This pond has an approximate capacity of 600 acre-feet. The quarry was modeled as an offline detention pond, meaning that instead of an inline dam across the Little Bear Creek channel, a diversion channel would be utilized to divert flood waters from Little Bear Creek into the detention pond located adjacent to the creek. The floodwaters would then be released back into Little Bear Creek at a slower rate to reduce downstream flooding. This previous quarry site is essentially a pre-excavated reservoir, ideal for flood diversion and flow reduction. However, when modeled as an off-line detention pond, the computed 1% ACE peak flow is only reduced by approximately 1.5% within the study area. This 1.5% reduction in peak flow results in a 1% ACE water surface elevation reduction of

approximately 0.4 feet within the study area. Due to the pond's location, limited storage capacity, and limited flood reduction benefits in the Pinehurst and Wild Dunes neighborhoods this pond was not further analyzed as a viable alternative.

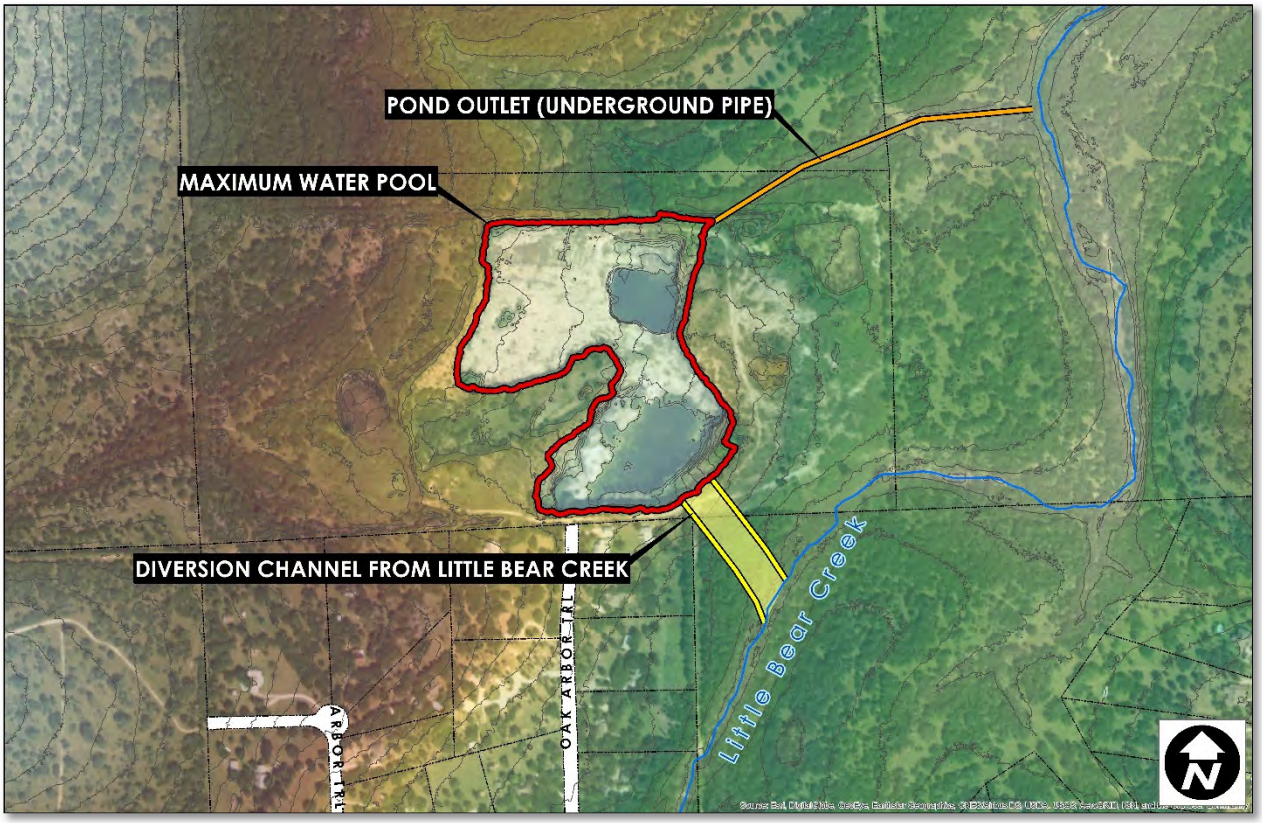


Figure 7: Preliminary Schematic of Bornheim Quarry

Dripping Springs Pond

The Dripping Springs Pond utilizes the natural topography of the Onion Creek valley just upstream of Dripping Springs, Texas near CR-190. This proposed pond is approximately 41 miles upstream from the flood mitigation study area in the upper portion of the watershed. The Dripping Springs Pond would be an inline pond that would require the construction of a large dam across Onion Creek to detain water. With a dam height well above 6 feet, this location would be subject to Texas Commission of Environmental Quality (TCEQ) dam regulations. As with the other inline ponds, the dam outlet structure would be optimized to allow the smaller, more frequent events to pass while detaining the peak of the larger, less frequent events. The Dripping Springs Pond would have an approximate capacity of 6,660 acre-feet and a surface area of 377 acres. This detention alternative results in a 1% ACE peak flow reduction of approximately 11% within the study area. This 11% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 2 feet within the study area. Precipitation would have to fall upstream of the pond in order for the flood waters to be detained, and provide flood mitigation benefits downstream. Because this pond is located very far upstream in the Onion Creek watershed and the drainage area to the pond is smaller than other proposed pond locations, there is limited area where rain

could fall to allow the pond to detain flood flow. Due to the pond's location relative to the Pinehurst and Wild Dunes neighborhoods and extensive required property acquisition, this pond was not further analyzed as a viable alternative.

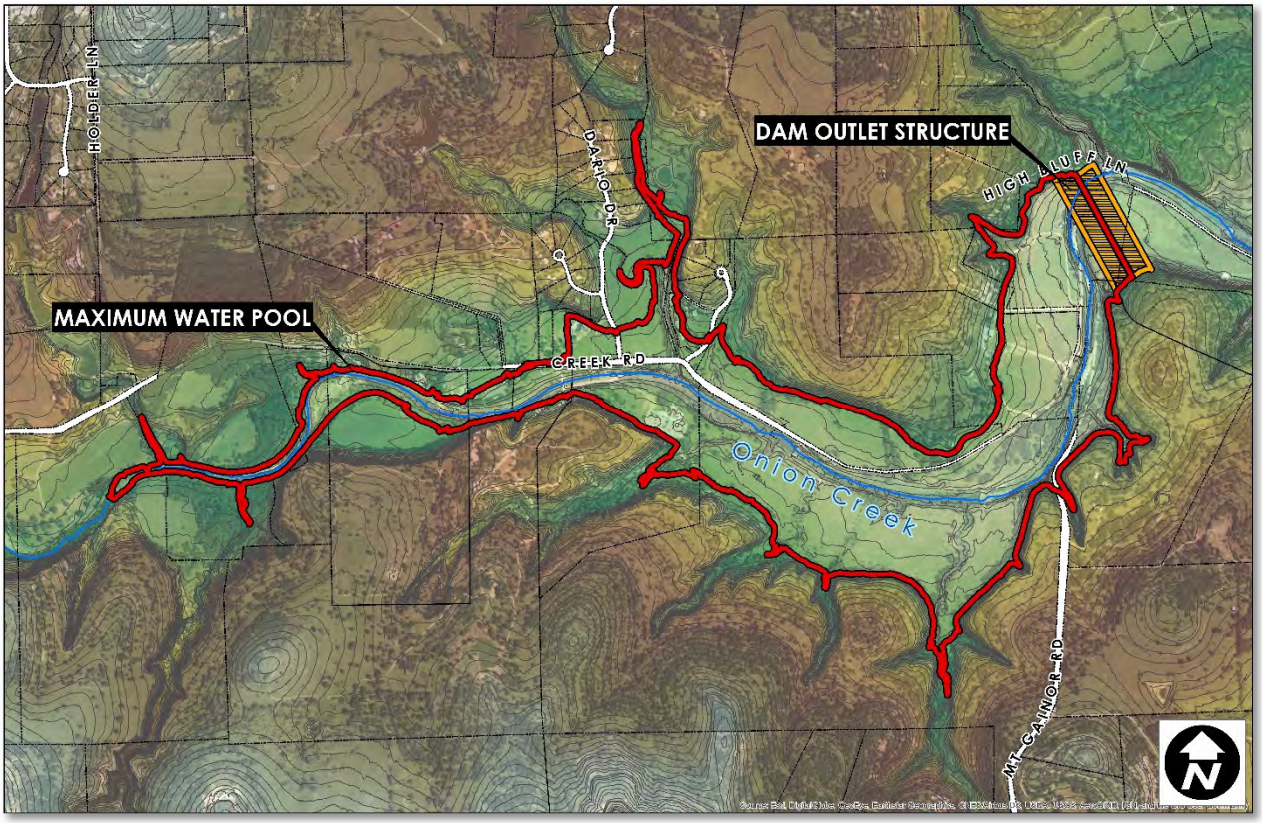


Figure 8: Preliminary Schematic of Dripping Springs Pond

Rattlesnake Pond

The Rattlesnake Pond utilizes the natural topography of the Onion Creek floodplain just downstream of Dripping Springs, Texas near RR-12. This proposed pond is approximately 27 miles upstream from the flood mitigation study area in the upper portion of the watershed. This location would require the construction of a large dam across Onion Creek to detain water. With a dam height greater than 6 feet, this location would be subject to TCEQ dam regulations. As with the other inline ponds described in this section, the Rattlesnake Pond would be designed to allow for the more frequent events to pass while detaining the less frequent events using an optimized dam outlet structure. The Rattlesnake Pond would have an approximate capacity of 3,655 acre-feet and a surface area of 254 acres. This detention alternative results in 1% ACE peak flow reduction of approximately 2% within the study area. This 2% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 0.3 feet within the study area. Similar to the Dripping Springs Pond, this pond is located very high up in the Onion Creek watershed. Drainage area is limited where precipitation could fall in order to utilize the pond for flood mitigation. Precipitation would have to fall upstream of the pond in order for the flood waters to be detained, and provide flood mitigation benefits downstream. Due to the pond's location, limited flood reduction benefits

to the Pinehurst and Wild Dunes neighborhoods, and extensive required property acquisition, this pond was not further analyzed as a viable alternative.

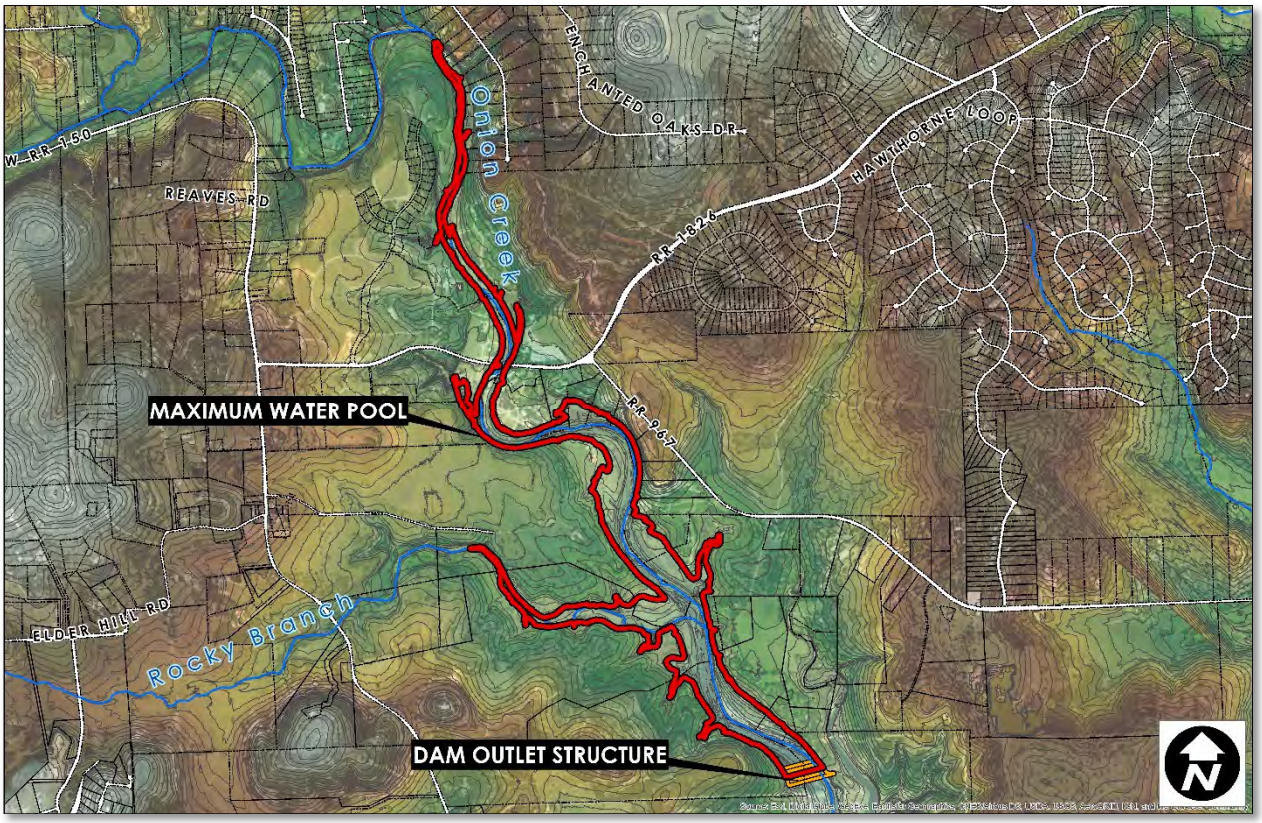


Figure 9: Preliminary Schematic of Rattlesnake Pond

Centex West Pond

The Centex West Pond would utilize the active, western portion of the Centex quarry. The existing western Centex quarry is essentially a large pre-excavated reservoir that could possibly be utilized for flood diversion and reduction. This proposed pond is approximately 12 miles upstream from the flood mitigation study area. The pond would be offline (flow diverted from the creek into the pond) and would, therefore, not require construction of an inline dam across Onion Creek. Flood waters would be diverted from Onion Creek main stem into the Centex West Pond using a diversion channel, and then released back into Onion Creek at a reduced flow rate utilizing an optimized outlet structure. The diversion channel to the pond would be designed to allow for the smaller or more frequent events to pass while diverting the larger or less frequent events to be detained in the pond. The Centex West Pond has an approximate existing capacity of 5,700 acre-feet, because this is an active quarry this capacity could increase as quarry operations progress. This pond could be utilized to produce about an 11% flow reduction of the computed 1% ACE peak flow within the study area. This 11% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 2 feet within the study area. Compared to other regional detention alternatives that were analyzed, the Centex West pond is located relatively close to the study area, has fewer permitting challenges, and has significant flood mitigation benefits.

Therefore this alternative was selected for further evaluation in the final flood mitigation alternatives analysis.

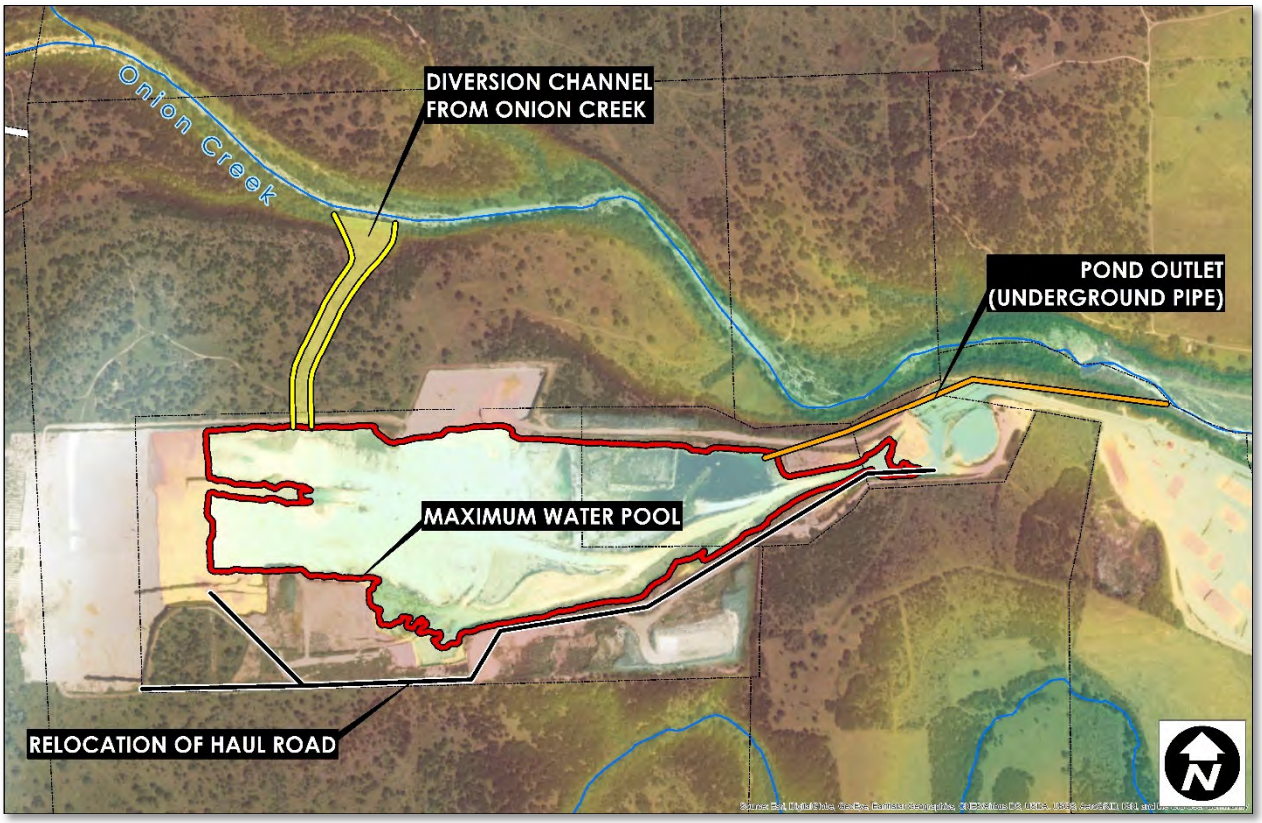


Figure 10: Preliminary Schematic of Centex West Pond

Centex East Pond

The Centex East Pond was modeled as both an inline and an offline pond. Both options would utilize the portion of the Centex quarry on the east side of the property along a tributary of Onion Creek named Mustang Branch. The existing eastern Centex quarry, most of which is no longer actively in use, is a large area with favorable topography and pre-excavated areas reasonable for detention. This proposed pond is approximately 11 miles upstream from the flood mitigation study area. Both pond configurations would have impacts to the current access road and conveyor system located in the area.

The Centex East Inline Pond configuration would require the construction of a dam across Onion Creek to detain flood water, allowing it to pond in the eastern quarry area. With a dam height greater than 6 feet, this location would be subject to TCEQ dam regulations. This inline pond would be designed to allow for the smaller or more frequent events to pass while detaining the peak of the larger or less frequent events using an optimized dam outlet structure. The Centex East Inline Pond has an approximate capacity of 4,100 acre-feet with a surface area of 335 acres. Since this pond is located just downstream of Mustang Branch, a tributary of Onion Creek, the pond would need to accommodate flows from this tributary's watershed. This detention pond results in an

estimated 5% reduction of the computed 1% ACE peak flow within the study area. This 5% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 0.6 feet within the study area. Given the minimal benefits and multiple constraints, the viability of this pond is low.

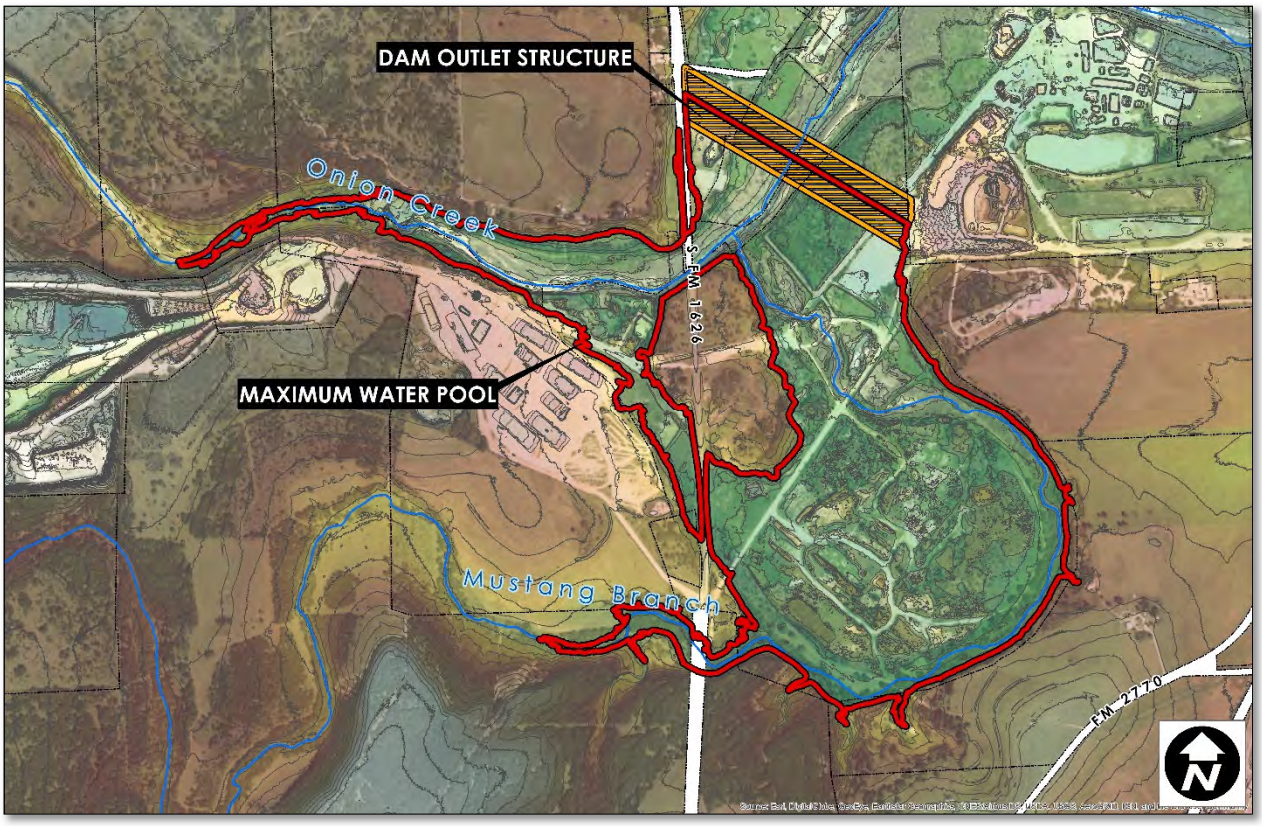


Figure 11: Preliminary Schematic of Centex East Inline Pond

The Centex East Offline Pond would divert flood waters from Onion Creek main stem into the Centex East Offline Pond using a diversion channel instead of utilizing an inline dam. The flood waters would then be released back into Onion Creek at a reduced flow rate. The Centex East Offline Pond has an approximate capacity of 2,300 acre-feet with a surface area of 224 acres. This is a smaller capacity than the Centex East Inline Pond. Since this pond is located along Mustang Branch, a tributary of Onion Creek, the pond would need to accommodate flows from this tributary's watershed. This detention pond results in an estimated 2% reduction of the computed 1% ACE peak flow within the study area. This 2% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 0.4 feet within the study area. Currently there are two planned roadway projects in the area (expansion of FM 1626 and construction of the Kyle Loop) that would impact the pond and reduce the available storage volume. Due to limited storage capacity, limited flood reduction benefits to the Pinehurst and Wild Dunes neighborhoods, and conflicts with proposed projects neither configuration of the Centex East Pond was further analyzed as a viable alternative.

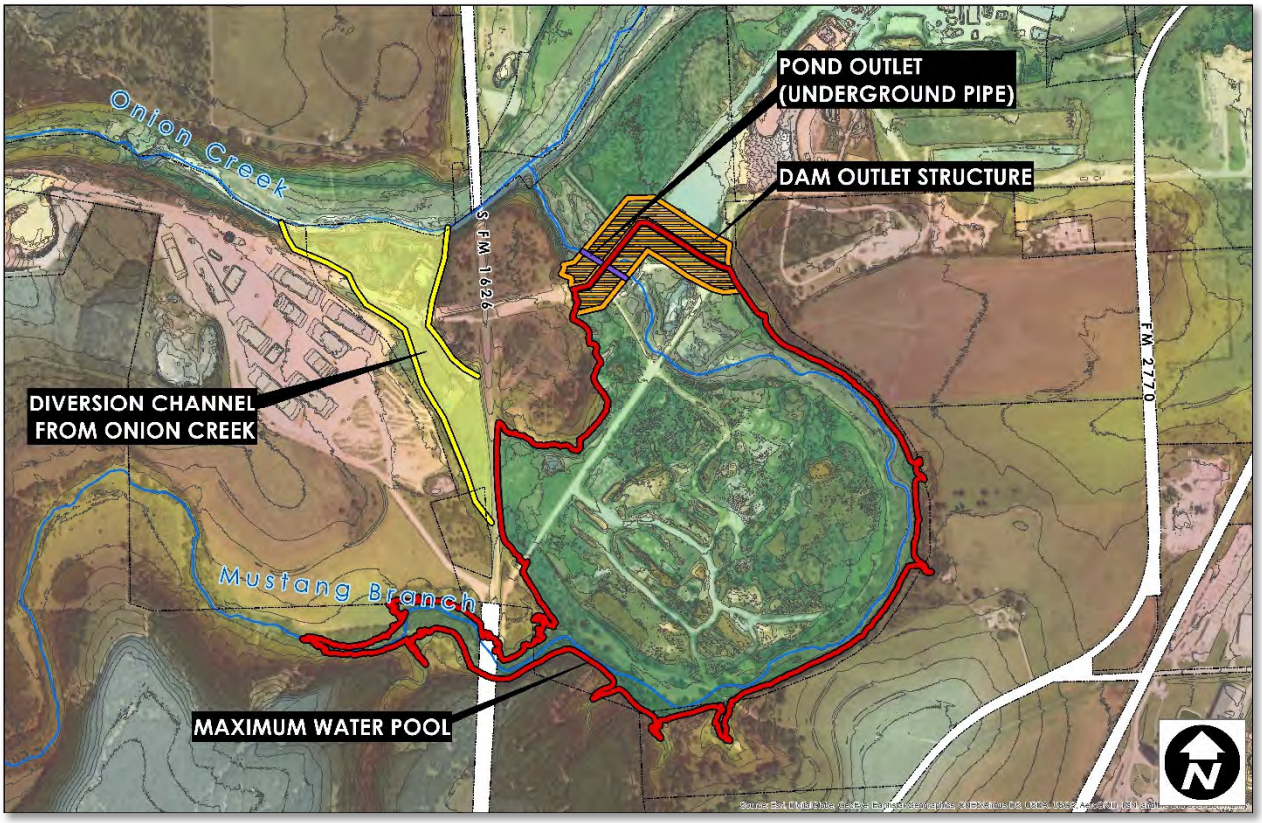


Figure 12: Preliminary Schematic of Centex East Offline Pond

IH-35/Buda Pond

The IH-35/Buda Pond would utilize the natural topography of the Onion Creek floodplain just downstream of Buda, Texas near IH-35. The pond location is approximately 4 miles upstream from the flood mitigation study area. This alternative is an inline pond and would require the construction of a large dam across Onion Creek to detain flood waters. With a dam height greater than 6 feet, this location would be subject to TCEQ dam regulations. Similar to other inline pond alternatives, this pond would be designed to allow for the more frequent events to pass while detaining the less frequent events using an optimized dam outlet structure. The IH-35/Buda Pond has an approximate capacity of 7,600 acre-feet and a surface area of 464 acres. This detention alternative results in a 1% ACE peak flow reduction of approximately 15% within the study area. This 15% reduction in peak flow results in a 1% ACE water surface elevation reduction of approximately 2 feet within the study area. This detention alternative was initially included in the final alternative analysis; however, the probable cost including property acquisition, design, materials, and construction was greater than $235 million. Extensive property acquisition would also be required for this alternative. Although this inline pond would be located closer to the study area and has the potential to produce more significant reductions in peak flow, the feasibility of constructing this large of a dam at this location along Onion Creek is minimal due to environmental and economic constraints; therefore this pond was not further analyzed as a viable

alternative. These conclusions are similar to those of the USACE Interim Feasibility Study findings for the IH-35/Buda Pond.

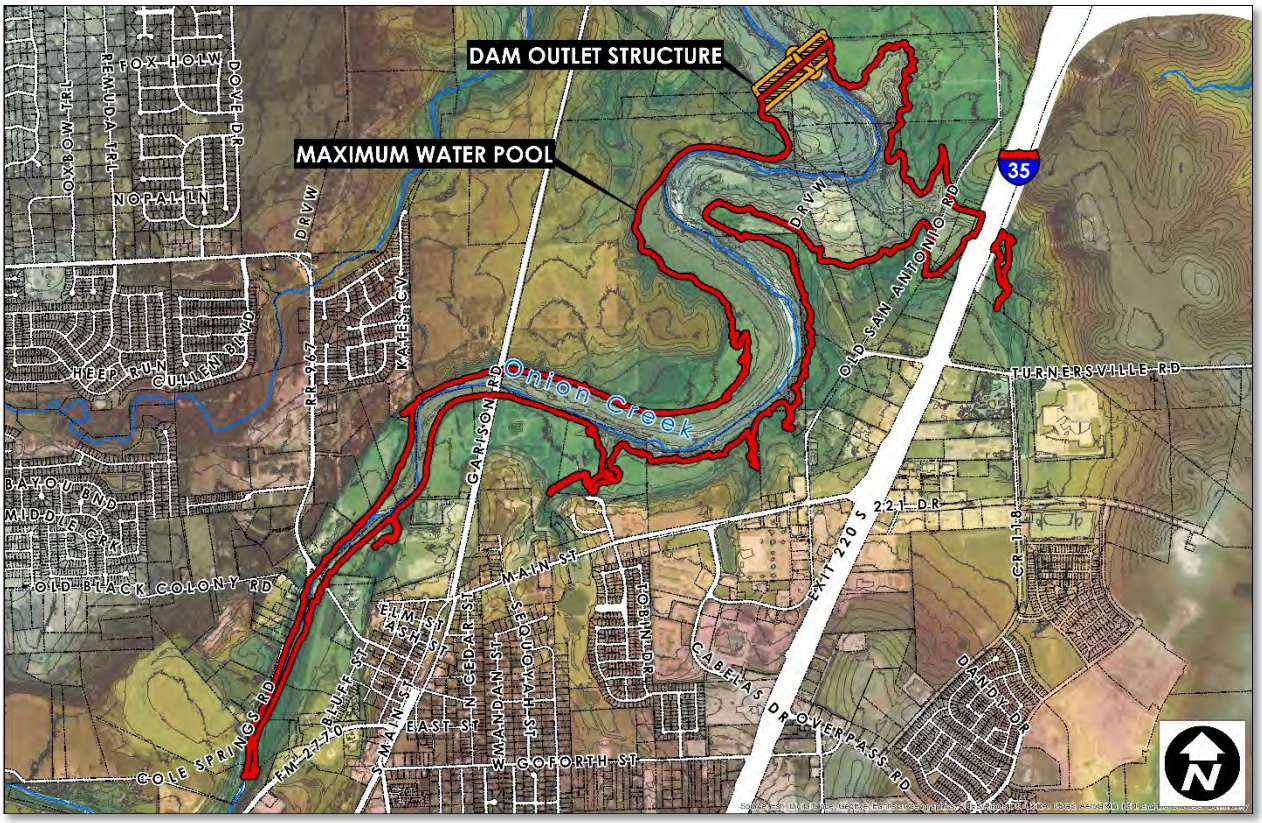


Figure 13: Preliminary Schematic of IH-35/Buda Pond

Hydraulic Mitigation Alternatives

A broad range of conceptual hydraulic alternatives were evaluated to mitigate flooding in the Pinehurst and Wild Dunes neighborhoods. These hydraulic alternatives include the construction of floodwalls, diversion channels, and channel modifications in order to reduce the computed 1% ACE water surface elevation. Any downstream adverse impacts or increases in water surface elevation associated with hydraulic alternative options would be evaluated and mitigated should any of the projects mentioned in this analysis be recommended for further evaluation. Each mitigation alternative discussed in this section was independently evaluated utilizing the updated Onion Creek hydraulic frequency analysis.

Flood Protection Wall

Flood protection walls could be effective flood protection solutions as they prevent flood waters from reaching flood prone areas. FEMA criteria require the floodwall to have a minimum freeboard (height above the 1% ACE water level) of at least 3 feet for the entire length of the wall and 3.5 feet of freeboard at the upstream and downstream tie-in locations. Floodwalls were analyzed in both the Pinehurst and Wild Dunes neighborhoods. The proposed alignments can be seen in Figure 14.

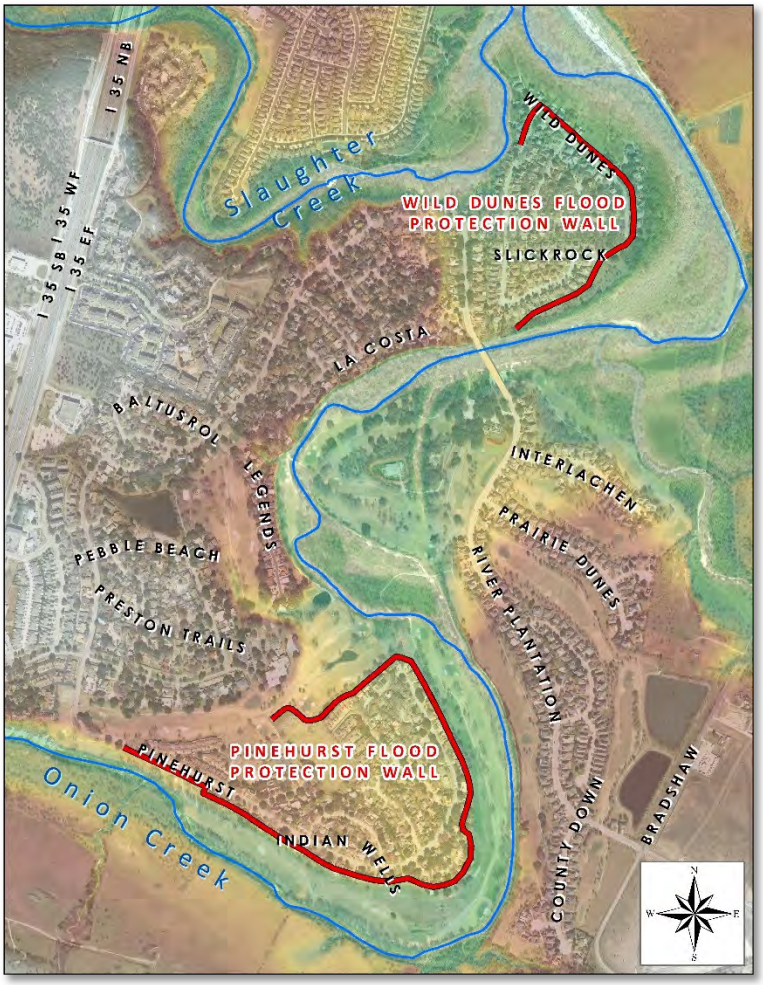


Figure 14: Pinehurst and Wild Dunes Flood Protection Wall Location Map

Floodwalls typically require substantial amounts of additional conveyance along the stream corridor because they generally reduce the conveyance of the channel. The proposed Onion Creek floodwalls were strategically located to avoid channel conveyance constriction. Additionally, floodwalls require internal drainage systems to accommodate localized rainfall and associated stormwater run-off behind the wall. Standard internal drainage systems include storm drainage networks combined with a storage facility. These systems allow for the storage of internal drainage until the water could be released to the creek.

Pinehurst Neighborhood Flood Protection Wall

Because of the location and elevation of the Pinehurst neighborhood relative to the Onion Creek floodplain, the alignment of the proposed floodwall could be located on the high point along the left channel bank generally parallel to Pinehurst Drive, Champions Lane, and a portion of the golf course for approximately 7,200 feet. The average height of the wall is estimated to be approximately 5.5 feet with a maximum height of 14 feet. Construction of a floodwall in this location would also require the acquisition of 48 homes along the southern side of Pinehurst Drive.

In addition, an internal drainage system would be required to mitigate approximately 77 acres of neighborhood run-off behind the wall. Several alignments of the flood protection wall were evaluated. If located immediately adjacent to the property line or even the existing homes, the average height and cost of the wall would significantly increase. Without the purchase of the 48 properties, construction of a floodwall would be considerably less practical. The wall would need to be located as close to the existing homes as possible in order to minimize the height. This alternative was further evaluated with the final alternatives.

Wild Dunes Neighborhood Flood Protection Wall

Due to the topography and location of the upper channel bank in the Wild Dunes neighborhood, alignment of the proposed floodwall would generally parallel Wild Dunes Drive and Shinnecock Hills Drive for approximately 3,400 feet. The average height of the wall would be approximately 5 feet with a maximum height of 12 feet. Construction of a floodwall in this location would also require the acquisition of 31 homes along the eastern side of Wild Dunes Drive and the western side of Shinnecock Hills Drive. In existing conditions, there are approximately 23 homes with finished floor elevations below the 1% ACE. In addition, an internal drainage system would also be required for neighborhood run-off behind the wall. Because the construction of the flood protection wall would require acquisition of more homes than are estimated to be flooded by the 1% ACE, the Wild Dunes Flood Protection Wall was not further analyzed as a viable alternative.

Channel Diversion

Diversions of flood water could, in some cases, be constructed to more efficiently convey flood waters across the neck of a sharp bend in a channel. This is essentially an engineered version of the natural channel migration process that forms what is called an oxbow. Caution must be used to identify and mitigate potential downstream impacts where such a diversion channel re-enters the creek and to protect the diversion so that erosion does not cause the main channel to fully migrate to the diversion channel. A 150-foot wide diversion channel was evaluated through the golf course to the north of the impacted Pinehurst homes in order to convey flood waters around the homes. See alignment in Figure 15 below. Construction of the channel diversion independent of other mitigation alternatives resulted in water surface elevation reductions near the upstream end of the diversion but had limited benefit at the downstream end where it re-enters Onion Creek due to the tail water conditions in Onion Creek. In order for this alternative to be beneficial for the entire Pinehurst neighborhood, the channel diversion would need to be coupled with significant downstream channel modifications that would reduce the tail water impacts from Onion Creek and allow the diversion to efficiently drain. This option would impact the golf course and therefore require modifications to the course alignment. Due to the physical limitations and limited flood mitigation benefits, a channel diversion was not further analyzed as a viable alternative.

Figure 15: Diversion Location Map

Channel Clearing

Reducing friction losses within a channel and the immediate overbanks could be an effective alternative to reduce flood elevations. Friction losses could be reduced by selective clearing of trees, underbrush, and other obstacles from the channel and overbanks. In order to produce a significant flood mitigation benefit within the study area, however, channel clearing would require more than removal of debris and fallen trees along Onion Creek. This channel clearing alternative would remove all underbrush and small trees in the dense vegetation areas and more than 50% of all trees with diameters equal to or greater than eight inches. This alternative could also negatively impact heritage trees. Such channel clearing would have significant environmental impacts and require high perpetual maintenance and mitigation costs. Clearing the channel also goes against FEMA's initiative, one also shared by the City of Austin, to preserve the natural character and function of creek corridors.

Decreases in roughness coefficients near the Pinehurst and Wild Dunes neighborhoods resulted in computed 1% ACE water surface elevation decreases of approximately 1.6 feet. This alternative would require significant on-going efforts to maintain the "cleared" channel and would negatively impact the riparian corridor along Onion Creek. Due to the stakeholder interest in further evaluating the possible flood mitigation benefits of channel clearing, this alternative was further evaluated with the final alternatives.

Removal of Constrictions

Increases in water surface elevation along a creek could be caused by channel constrictions that reduce the flow area of a channel. Typical man-made constrictions include encroachment of the channel due to development and roadway crossings. Increases in water surface elevations within the study area, shown graphically in Figure 4, are caused by Champions Lane, Wild Dunes Court, and the River Plantation Drive bridge. These constriction locations can be seen in Figure 16. The flood mitigation benefit of the removal of each of these constrictions were evaluated and discussed below.

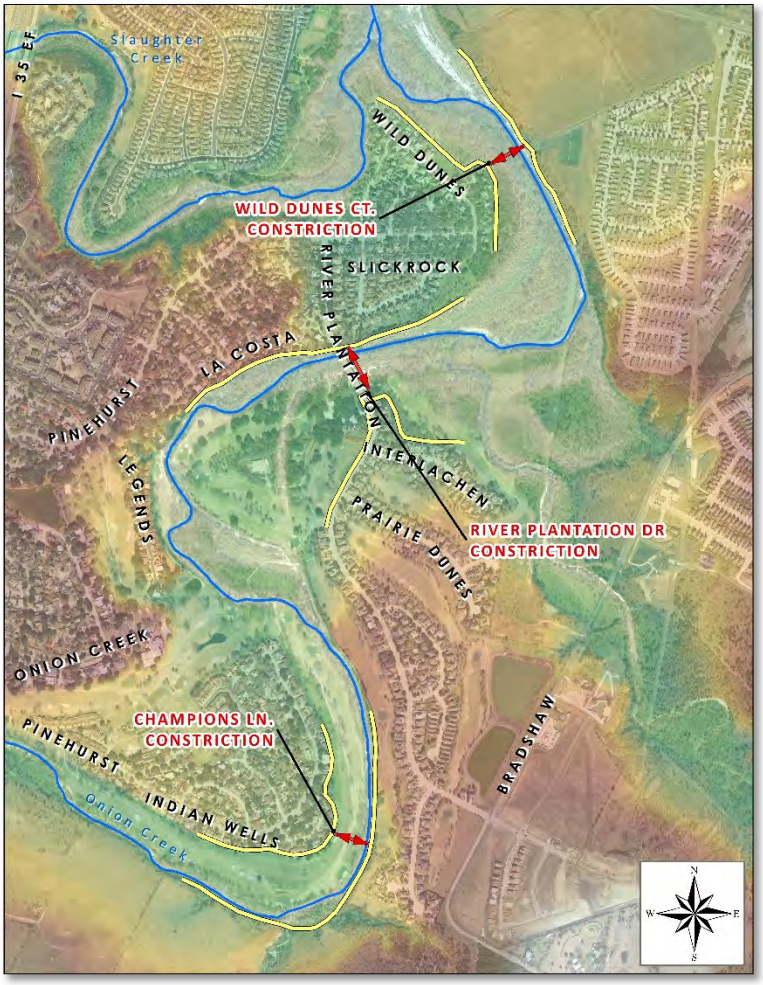


Figure 16. Channel Constrictions

Removal of Champions Lane Constriction

The properties along Champions Lane restrict the conveyance of the Onion Creek floodplain in the Pinehurst neighborhood. Channel modifications through the area along with acquisition of Champions Lane properties, was simulated to evaluate the potential benefits to water surface elevations. Removing this constriction results in a water surface elevation decrease of less than 0.1 feet. Increasing the channel capacity in the Champions Lane area does not have a significant flood mitigation benefit to the Pinehurst neighborhood because the majority of the channel

conveyance is constricted along the southern bank of Onion Creek through this bend. Therefore, this alternative was not further evaluated with the final alternatives.

Removal of Wild Dunes Court Constriction

The properties along Wild Dunes Court restrict the conveyance of the Onion Creek floodplain through the Wild Dunes neighborhood. Channel modifications along with associated acquisition of Wild Dunes Court properties, was simulated to evaluate resulting impacts to water surface elevations in this area. Increasing the channel capacity in this location does not have a significant benefit because the majority of the channel conveyance is restricted along the eastern bank of Onion Creek. Therefore, this alternative was not further evaluated with the final alternatives.

Removal of River Plantation Drive Constriction

The River Plantation Drive bridge also restricts the conveyance of Onion Creek. The evaluated River Plantation Drive improvements include excavating the channel to add flow area (conveyance) under the River Plantation Drive Bridge, as well as additional bridge spans on the south bank were the channel could be widened. Increasing the opening of this crossing not only benefits the Wild Dunes neighborhood, but also reduces the computed 1% ACE water surface elevations along River Plantation Drive and Interlachen Lane. Improvements to this crossing result in high velocities that could potentially be very erosive. This issue would be need to be resolved utilizing erosion protection in any subsequent design. This alternative was included in the combined final alternatives.

Channel Benching

Similar to constriction removal, channel benching could be used to increase the flow area (conveyance) of a channel. Channel benching was analyzed in both the Pinehurst and Wild Dunes neighborhoods. For the initial channel benching analysis, the volume of channel benching was maximized in order to estimate the maximum flood mitigation benefits possible from stand-alone channel benching. The initial locations of the channel benching can be seen in Figure 17. In the graphic the benched or flat part of the proposed channel is represented with purple, whereas the proposed sloped part of the channel is pink. To minimize USACE 404 Permitting requirements, channel benching was evaluated above Onion Creek's estimated ordinary high water elevations. Similar to the channel clearing, this alternative would require significant efforts to maintain the "cleared" channel and would negatively impact the riparian corridor along Onion Creek, negatively effecting water quality, creek stability, wildlife, and trees. Channel benching could result in high velocities that could potentially be erosive. Similar to any other mitigation alternative, any negative downstream impacts would have to be mitigated and prevented.

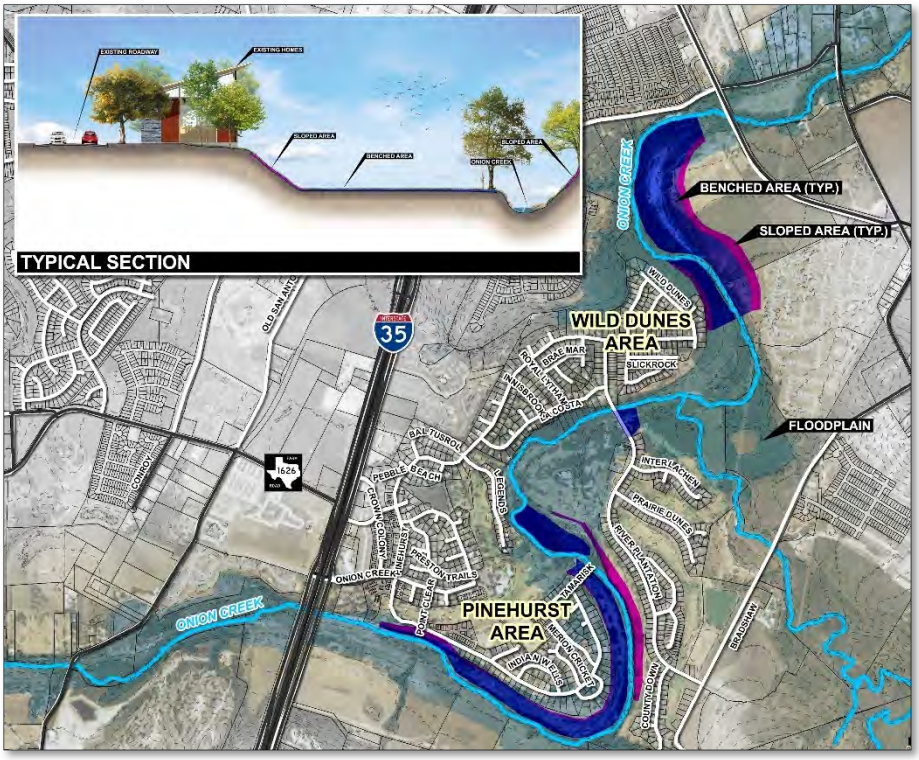


Figure 17. Channel Benching

Pinehurst Neighborhood Channel Benching

The preliminary evaluation of channel benching included a large benched section on the north side of Onion Creek parallel to Pinehurst Drive, as well as sloping of the eastern bank parallel to River Plantation Drive in the Pinehurst neighborhood. Stand-alone channel benching in the Pinehurst neighborhood would result in an approximate average decrease of 0.5 feet in computed 1% ACE water surface elevation. These channel modifications would need to be combined with the downstream channel benching discussed for the Wild Dunes neighborhood to provide significant reductions in water surface elevations. Due to the limited flood mitigation benefits and potential negative environmental impacts this channel benching in the Pinehurst neighborhood was not further evaluated as one of the final alternatives.

Wild Dunes Neighborhood Channel Benching

Channel benching in the Wild Dunes neighborhood includes a large benched section on the west side of Onion Creek parallel to Wild Dunes Drive, as well as significant channel benching of the eastern bank from Wild Dunes Drive to East Slaughter Lane. Stand-alone channel benching in the Wild Dunes neighborhood results in an approximate average decrease of 4 feet in computed 1% ACE water surface elevation. Due to the significant flood mitigation benefits, channel benching in the Wild Dunes neighborhood was further evaluated in the final alternatives. In the final alternative analysis, in order to limit the amount of proposed channel excavation, the proposed channel benching was optimized where possible while maintaining flood mitigation benefits.

Buyouts

Non-structural flood mitigation alternatives generally include floodplain management, construction and design regulations, and property buyouts. Property acquisition is often the most effective means of improving public safety and reducing flood damages in previously developed floodplain areas. When people and homes are removed from the floodplain, risk is eliminated permanently. Buyouts would have the least environmental impact to the riparian corridor because it requires no clearing or modifications within the channel. Buyouts also have the benefit of being able to be implemented as funding becomes available, whereas structural projects would require all of the funding to be in place prior to implementation. All homes that experience 1% ACE flooding above the finished floor elevation in the study area may qualify for buyouts, including 115 in the Pinehurst neighborhood and 23 in the Wild Dunes neighborhood. In order to avoid isolating homes, buyouts could include a handful of homes that are not at risk of structural flooding in the 1% ACE, but are located between at risk homes. Buyouts are further discussed in the following Final Flood Mitigation Alternatives section.

Final Flood Mitigation Alternatives

The flood mitigation analysis consisted of the development and evaluation of a variety of potential alternatives, both structural and non-structural, with the goal of protecting people and property from flooding and possibly reducing flood levels along Onion Creek between IH-35 and East Slaughter Lane within the Pinehurst and Wild Dunes neighborhoods. An extensive set of potential flood mitigation alternatives were evaluated based upon expected flood mitigation benefits, high-level engineering feasibility, and cost effectiveness of each individual alternative. Based on the analysis, 3 stand-alone alternatives and 3 combined alternatives were selected for further engineering analysis. These six alternatives are listed below:

Stand-Alone Alternatives:

- Centex West Regional Detention Pond
- Channel Clearing
- Buyouts

Combined Alternatives:

- Centex West Regional Detention Pond with Channel Modifications
- Pinehurst Flood Protection Wall with Buyouts
- Pinehurst Flood Protection Wall with Channel Modifications

These selected alternatives were chosen considering their technical feasibility, cost, and input from project stakeholders. The continued engineering analysis of these alternatives included refinement of design to maximize effectiveness. This section documents the selected alternatives including high-level conceptual illustrations and opinions of probable costs for construction and annual operation and maintenance (O&M). Highlights of these alternatives are displayed in the alternative fact sheets located in Appendix A. After the finalization of the engineering analysis for the selected flood mitigation alternatives, each were evaluated using a project scoring criteria

discussed later in this report. The City of Austin held a second public meeting on May 16, 2017 to present the final flood mitigation results and fact sheets.

The flood mitigation benefits of each of these alternatives were evaluated based on the benefits provided relative to the updated existing condition 1% ACE flooding conditions. If applicable average flow decrease within the study area and average depth decrease in the homes of the Pinehurst and Wild Dunes neighborhoods were evaluated and compared, as well as the number of homes protected from 1% ACE flood event and the average decrease in flooding depths in the area. It should be noted that a few alternatives display a smaller average depth decrease with more homes removed from flood risk, because the average depth decrease in homes was computed using only the homes that remain at risk of flooding under estimated post-project conditions. Homes that were removed from the risk of flooding under post-project conditions were not considered in this computation.

An opinion of probable cost was developed for each alternative. Unit prices for probable costs were developed using the Texas Department of Transportation (TxDOT) bid tabulations from projects within the Austin District within the last calendar year. For specific elements that were not listed within the TxDOT tabulation, unit prices were derived using recent land development and drainage projects in the Central Texas region. O&M costs were estimated in coordination with the City of Austin based on the City's current O&M costs and estimated O&M requirements for each alternative. It should be noted that these opinions of cost use standard practice and are only considered an estimate. These estimates should be refined should any of the projects mentioned in this analysis be recommended for further evaluation. Opinions of probable cost for each alternative can be found in Appendix B. Time of implementation, excluding time of funding, was also estimated and considered for each of the final alternatives.

All final alternatives, with the exception of buyouts, include modifications to the channel or changes to the timing of flows in the watershed, therefore channel routing was updated to evaluate potential downstream adverse impacts. Channel routing is the computation of storage within a channel. As the channel's geometry is modified due to natural erosion or proposed channel design the channel routing could be updated to account for the change in storage. Based on this analysis, none of the proposed alternatives displayed adverse impacts anywhere along Onion Creek. If any of these flood mitigation alternatives are implemented, no increase in water surface elevation would be permitted in any portion of the Onion Creek channel. Any increase in water surface elevation caused by the proposed project would have to be mitigated utilizing detention or other means of preventing such increases.

Water surface elevation profile comparisons are provided to visually display the water surface elevation impact of each alternative between IH-35 and East Slaughter Lane in the Pinehurst and Wild Dunes neighborhoods. A water surface elevation profile comparison to existing conditions for each alternative can be found in Appendix C. Floodplain comparison maps of the study area are provided to visually display the floodplain extent impact of each alternative. A floodplain comparison between each alternative and existing conditions is included in Appendix D.

Stand-Alone Alternatives

Centex West Regional Detention Pond

The Centex West Regional Detention Pond would utilize a portion of the active Centex quarry as an offline detention pond. This quarry would be able to detain approximately 5,700 acre-feet of Onion Creek flood waters. The surface area of the pond is approximately 135 acres, and the depth of the Centex West pond is 45 feet on average and 100 feet at its deepest point. The pond would be offline (flow diverted from the creek into the pond) and would, therefore, not require construction of an inline dam across Onion Creek. The diversion channel would be excavated from Onion Creek to the quarry. It would be designed to allow smaller or more frequent flood events to continue down Onion Creek while diverting and detaining only the larger or less frequent flood events. The diversion channel would need to be approximately 1,900 feet long, 20 feet deep, and 150 feet wide. Once the flood waters are diverted from Onion Creek into the Centex West Pond, the flood waters would be slowly released back into Onion Creek by 2 – 48" diameter underground pipes. The flood waters would only be temporarily stored within the pond. The quarry would remain dry except for a period of time after significant flood events. Erosion control structures would be required where the diversion channel outfalls into the Centex West quarry and where the outlet pipe outfalls into Onion Creek. Since this is an active quarry, additional treatment may be needed when the flood waters are released back into Onion Creek. Some sediment from the quarry could settle while the water is detained, because the invert of the outlet pipe would not be at the same elevation as the bottom of the pond. To account for the potential water treatment cost and other unknown costs, the contingency for this pond's cost estimate is higher than other alternatives. A schematic of the pond is included in Figure 18.

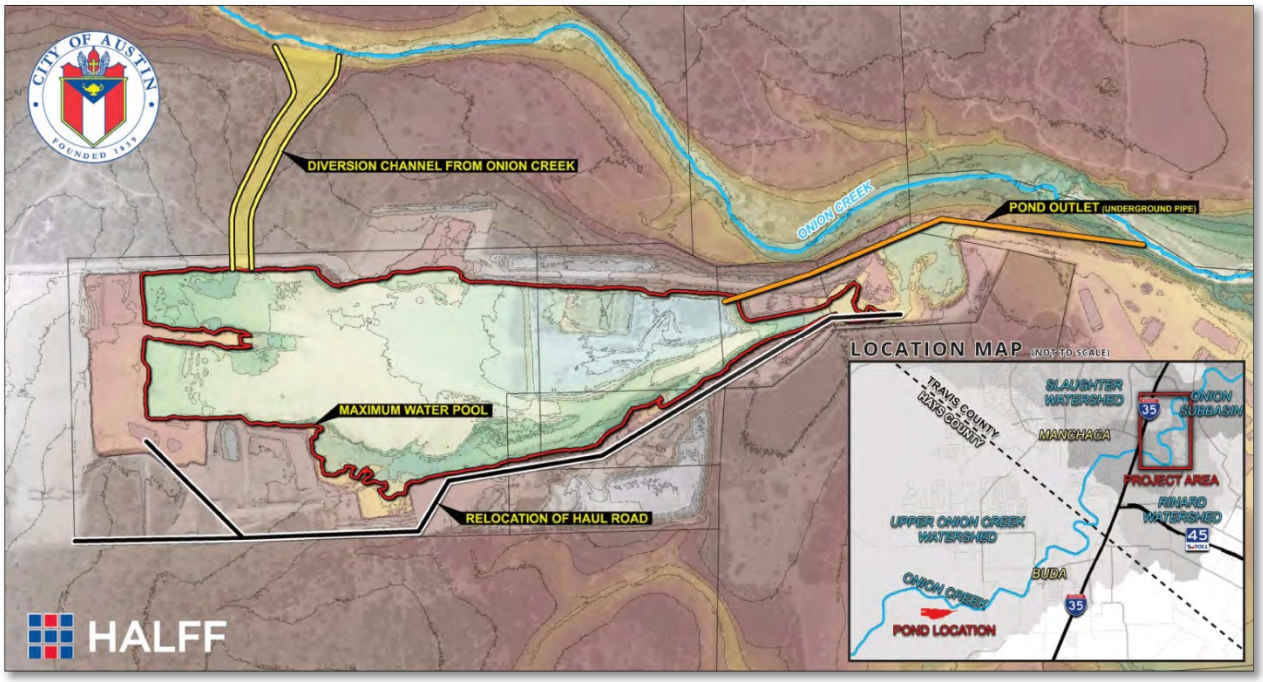


Figure 18: Schematic of Centex West Regional Detention Pond

The water diverted into the simulated pond was defined using the updated Onion Creek hydraulic analysis by the addition of a lateral weir. Storage volume was defined using Hays County 2012 LiDAR. As mining operations continue, the storage volume could likely increase. These features were then added to the updated Onion Creek hydrology analysis to define the potential downstream benefits.

Since this is currently an active quarry, in order to utilize it for detention, negotiations with the property owner and quarry operator would be required to allow for disruptions to mining operations during and after flood events that engage the pond. Agreements would also need to be established regarding the property once mining operations are complete. The current quarry operations haul road is located in an area that would be inundated during flood events that utilize the pond. During an informal meeting with the quarry operator in February of 2016, it was identified that a secondary haul road would be preferable in the event the western Centex quarry was utilized for detention.

As previously mentioned, when utilizing regional detention as a flood mitigation alternative there is a risk that if the rain falls primarily downstream of the detention pond, the pond would not be able to store a sufficient quantity of flood waters, and the study area would not see the full anticipated flood mitigation benefits. Also the proposed detention pond and diversion channel are located on water quality protection land with a conservation easement. This could be considered during implementation to ensure the project would not negatively impact conservation, safety, and water supply in the Barton Springs and Edwards Aquifer recharge zone. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$50,700,000** and **$40,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative could be utilized to produce about an 11% flow reduction of the computed 1% ACE peak flow at the Pinehurst and Wild Dunes neighborhoods. This 11% reduction in peak flow results in an average 1% ACE water surface depth reduction of approximately 0.8 feet, and a max water surface depth reduction of 2.0 feet within the homes in the Pinehurst and Wild Dunes neighborhoods, and eliminates structural flooding for approximately 78 out of 138 homes from the 1% ACE.
- **Flood mitigation for multiple jurisdictions** – Because the Centex West Pond is located approximately 12 miles upstream from the study area, flood mitigation benefits downstream of the pond could be observed through Hays County, City of Buda, Travis County and the City of Austin.
- **Utilize existing quarry for detention** – The existence of a large pre-excavated reservoir significantly reduces construction costs. The only additional excavation required would be a diversion channel from Onion Creek to the quarry.

- **Potential aquifer recharge opportunity** – In coordination with Barton Springs and Edwards Aquifer Conservation District, this area has been identified as having a high potential for recharge. Storage of flood waters may allow for enhanced recharge opportunities.

CONSTRAINTS

- **Multi-stakeholder coordination** – Since the Centex quarry is still active, negotiations with the property owner and quarry operator would be required to allow for disruptions to mining operations during and after flood events that utilize the pond.
- **Property purchase required** – Agreements would need to be established regarding the property once mining operations are complete.
- **Permitting** – A USACE Nationwide permit is anticipated due to the proposed connections to Onion Creek. Because the quarry is an existing condition that currently stores water, USACE 404 Individual Permit is not anticipated. In addition, permitting is likely required from Hays County, TCEQ, and US Fish and Wildlife.
- **Environmental impacts on water quality protection land** – The proposed detention pond and diversion channel are located on water quality protection land with a conservation easement. This could be considered during implementation to ensure the project would not negatively impact conservation, safety, and water supply in the Barton Springs and Edwards Aquifer recharge zone.
- **Flood mitigation benefits depend on rainfall location** – When utilizing detention 12 miles upstream from the study area there is a risk that if the rain falls primarily downstream of the detention pond, the pond would not be able to store a sufficient quantity of flood waters, and the study area could not see the full anticipated flood mitigation benefits.
- **Long timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is greater than 10 years due to the required stakeholder coordination, property acquisition, and permitting.

Channel Clearing

This alternative includes channel clearing for 126 acres of the densest areas of vegetation within the Onion Creek floodplain adjacent to the Pinehurst and Wild Dunes neighborhoods. In order to provide a flood mitigation benefit within the study area, channel clearing would require more than simply removing debris and fallen trees along Onion Creek. A schematic of the approximate channel clearing area is included in Figure 19.

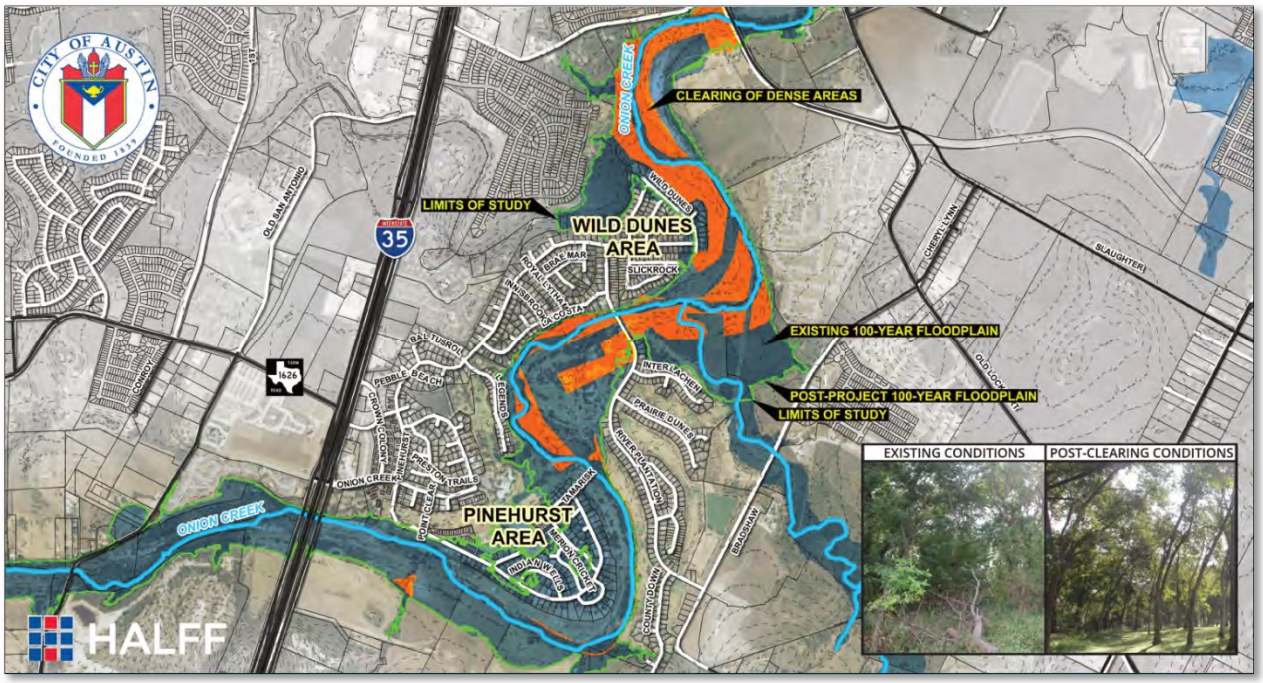


Figure 19: Schematic of Channel Clearing

Channel clearing was simulated in the hydraulic model with decreases in roughness coefficients. Roughness coefficients represent the friction applied to the flow of the channel based on the condition of the creek. Roughness coefficients depend on vegetation, material, and sinuosities of the channel. The post-clearing roughness coefficients were directly correlated to the existing roughness coefficient. Table 3 summarizes the existing and post-clearing roughness coefficients utilized for this analysis.

Table 3. Channel Clearing Roughness Coefficients

Simulated Existing Roughness Coefficients	Simulated Post-Clearing Roughness Coefficients
0.06	0.045
0.09 - 0.12	0.06

Although channel clearing is somewhat effective it does not have the impact necessary to provide relief to a majority of the homes at risk in the 1% ACE floodplain compared to other flood mitigation alternatives analyzed. Also, the City of Austin does not currently own easement or property along this reach of Onion Creek. Easements would be required in the areas where channel clearing is proposed. Once the channel clearing is complete, great efforts would be required to maintain the "cleared" channel. The initial channel clearing and the perpetual maintenance would significantly impact the riparian corridor along Onion Creek including negative effects on water quality, creek stability, wildlife, and trees. This channel clearing alternative would remove all underbrush and more than 50% of existing trees within the dense vegetation areas, and would negatively impact heritage trees. Because of the environmental impacts, utilizing channel clearing as a flood mitigation alternative runs contrary to both the national trend in floodplain management and the City of Austin's goal of natural channel preservation. The estimated annual O&M cost estimate for this alternative assumes mowing two times per year and debris removal after significant storm events. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$35,300,000** and **$448,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative results in an average 1% ACE water surface depth reduction of approximately 0.8 feet, and a max water surface depth reduction of 2.2 feet within the homes in the Pinehurst and Wild Dunes neighborhoods, and eliminates structural flooding for approximately 51 out of 138 homes from the 1% ACE.
- **Moderate timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is 2-5 years due to the required easement acquisition and large area (126 acres) of proposed clearing.

CONSTRAINTS

- **Perpetual channel maintenance** – Once the channel clearing is complete, great efforts would be required to maintain the "cleared" channel.
- **Easement acquisition required** – The City of Austin does not currently own easement or property along this reach of Onion Creek. Easements would be required in the areas where channel clearing is proposed.
- **Significant long-term environmental impacts** – Clearing the channel impacts water quality, creek stability, wildlife, and trees. To maintain the flood mitigation benefits of this alternative, perpetual maintenance is required prolonging the environmental impact.
- **High tree mitigation costs** – This channel clearing alternative would remove all underbrush and more than 50% of existing trees within the dense vegetation areas, and would negatively impact heritage trees. In accordance with City of Austin requirements, tree mitigation costs are estimated to be approximately $5,760,000.

- **Less flood protection than other alternatives** – This flood mitigation alternative could be utilized to eliminate structural flooding for approximately 78 out of 138 homes from the 1% ACE.

Buyouts

Property acquisition is often the most effective means of improving public safety and reducing flood damages in previously developed floodplain areas. When people and homes are removed from the floodplain, risk is eliminated permanently. The buyout option considered in this study is based on the offer of flood mitigation buyouts to homes within the study area that are expected to experience structural flooding during the 1% ACE. Such buyouts should be prioritized based on the expected depth of flooding and should proceed from the highest risk homes to the lowest risk as funding becomes available. The estimated cost of buyouts or property acquisition includes real estate services, appraisals, acquisition costs, relocation and moving expenses, asbestos testing and abatement, demolition, and property management. In order to avoid isolating homes, the cost estimate for this project includes estimates to offer buyouts to a handful of homes that are not at risk of structural flooding in the 1% ACE, but are located between at risk homes. A map of the buyout properties is included in Figure 20. The effectiveness of this alternative is dependent on successful acquisition of at risk homes. If property owners decline to sell, the home could remain at risk. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$77,500,000** and **$105,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative eliminates structural flooding for approximately 138 out of 138 homes at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.
- **Highest level of flood protection** – The most effective means of improving public safety and reducing flood damages in previously developed floodplain areas is property acquisition. When people and homes are removed from the floodplain, risk is eliminated indefinitely.
- **Least environmental impacts** – Buyouts would have the least environmental impact to the riparian corridor because it requires no clearing or modifications within the channel.
- **Shortest timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is 0-2 years because this project only requires acquisition of residential properties.
- **Could be implemented as funding becomes available** – Unlike all other alternatives, buyouts could proceed as funding becomes available. Additionally, buyouts would be prioritized based on the depth of flooding and could proceed from the homes at highest risk of flooding to those at the lowest risk of flooding.
- **Fully addresses homes at risk** – This flood mitigation alternative could be utilized to eliminate structural flooding for all at risk homes from the 1% ACE.

CONSTRAINTS

- **Voluntary property purchase** – The effectiveness of this alternative is dependent on successful acquisition of at risk homes. If property owners decline to sell, the home could remain at risk.
- **Impact to community** – This alternative would significantly impact the appearance of the neighborhood and may require perpetual vegetation maintenance.

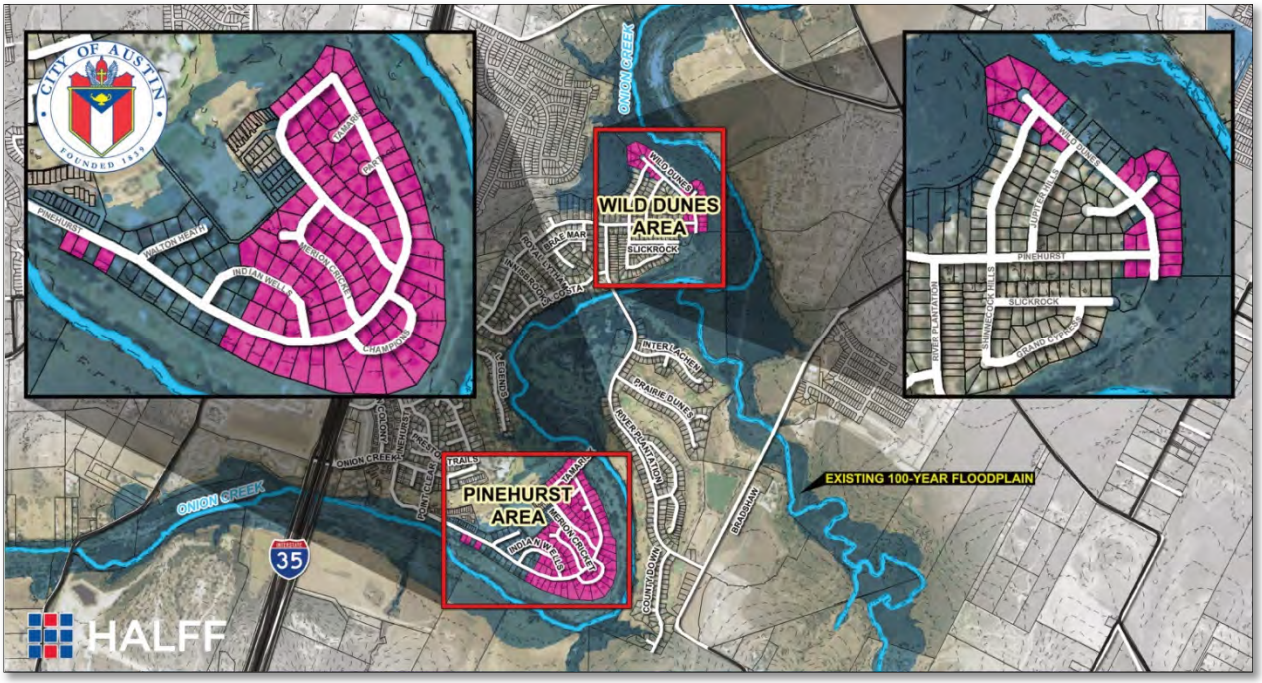


Figure 20: Schematic of Buyouts

Combined Alternatives

The buyout alternative presented above is the only stand-alone alternative that would potentially mitigate the full risk of flooding in the study area during the 1% ACE flood. In order to provide this level of mitigation without relying solely on buyouts, a combination of alternatives is required.

Centex West Regional Detention Pond with Channel Modifications

This alternative includes a combination of the Centex West Regional Detention Pond, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive near the Wild Dunes neighborhood. A location map of the channel modifications and bridge improvements for this combined alternative is included in Figure 21.

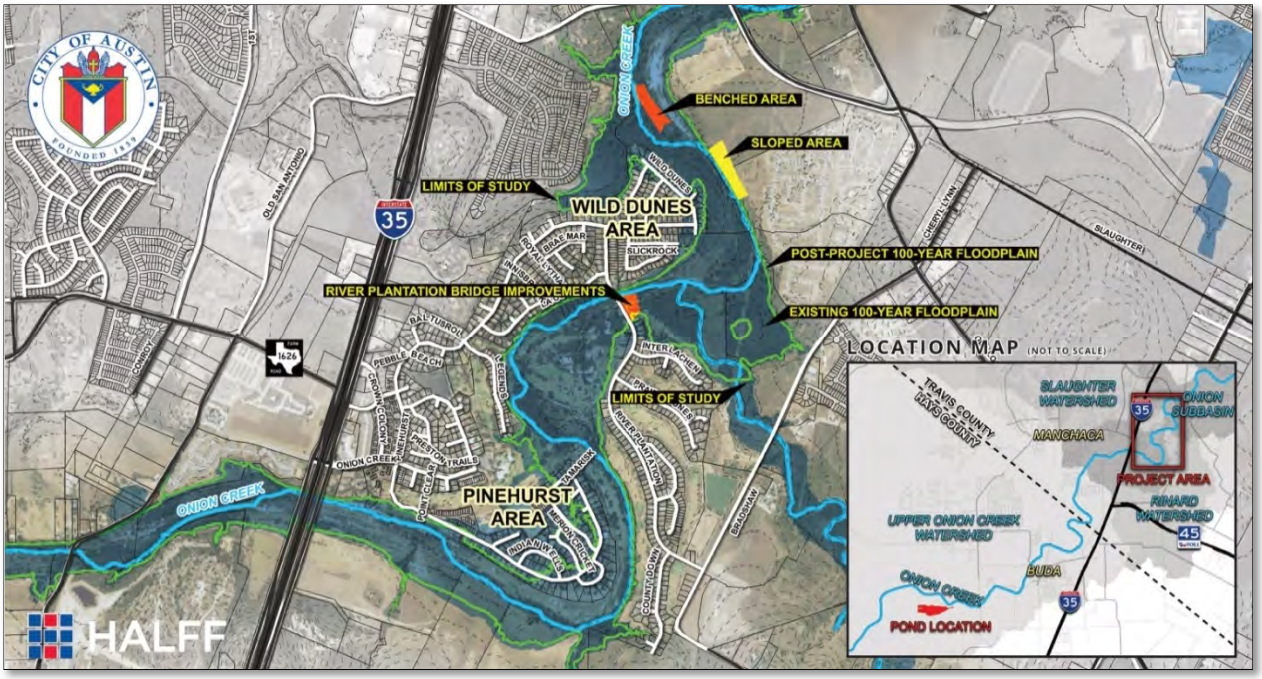


Figure 21: Schematic of Centex West Regional Detention Pond with Channel Modifications

The River Plantation bridge improvements would include widening the bridge span across the channel from 420 feet to 580 feet. These bridge improvements would require approximately 210,000 cubic yards of excavation and the construction of an additional bridge span along the southeast bank of the Onion Creek channel at River Plantation Drive. To see an example of what this might look like in the channel refer to Figure 22. The Wild Dunes channel modifications are located east of the Wild Dunes neighborhood across Onion Creek. These channel modifications would require approximately 410,000 cubic yards of excavation along an 820 foot long channel reach and another 1,040 foot long channel reach, both along the eastern bank of Onion Creek. Improvements to this crossing result in a velocity increase of 22% on average through 9,000 feet of channel. This increase in velocity could potentially be very erosive, but could be resolved utilizing erosion protection within the channel in any subsequent design.

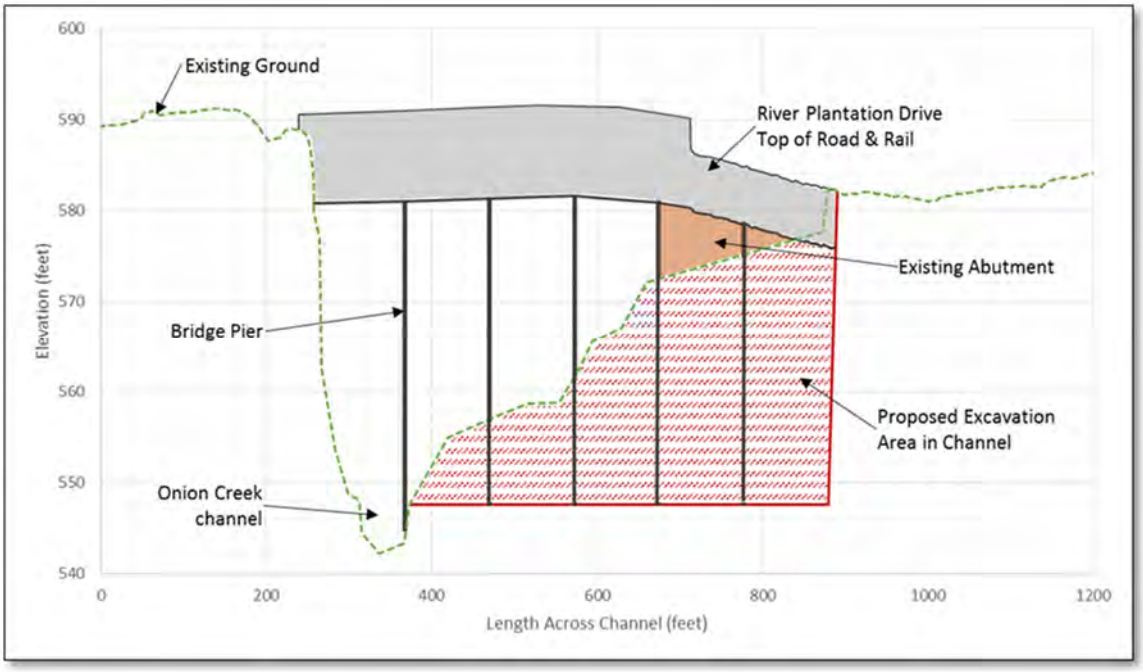


Figure 22: River Plantation Bridge Channel Section

For more details regarding the Centex West Regional Detention Pond please refer to the Stand-Alone Centex West Regional Detention Pond section above. The City of Austin does not currently own easement or property along this reach of Onion Creek. Property acquisition would be required in the areas where channel modifications are proposed. In the areas of the proposed channel modifications, significant efforts to maintain the "cleared" channel once the project is complete could be required. Cutting into the channel would significantly impact the riparian corridor along Onion Creek negatively impacting water quality, creek stability, wildlife, and trees. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$70,200,000** and **$88,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative could be utilized to produce about an 11% flow reduction of the computed 1% ACE peak flow at the Pinehurst and Wild Dunes neighborhoods. This combined alternative results in an average1% ACE water surface depth reduction of approximately 1.1 feet, and a max water surface depth reduction of 2.6 feet within the homes in the Pinehurst and Wild Dunes neighborhoods, and eliminates structural flooding for approximately 110 out of 138 homes from the 1% ACE.
- **Flood mitigation for multiple jurisdictions** – Because the Centex West Pond is located approximately 12 miles upstream from the study area, flood mitigation benefits downstream of the pond would be observed through Hays County, City of Buda, Travis County and the City of Austin.

- **Utilize existing quarry for detention** – The existence of a large pre-excavated reservoir significantly reduces construction costs. The only additional excavation required would be a diversion channel from Onion Creek to the quarry.
- **Potential aquifer recharge opportunity** – In coordination with Barton Springs and Edwards Aquifer Conservation District, this area has been identified as having a high potential for recharge. Storage of flood waters may allow for enhanced recharge opportunities.

CONSTRAINTS

- **Multiple projects required** – This alternative requires a combination of projects to provide flood mitigation benefits in the study area.
- **Multi-stakeholder coordination** – Since the Centex quarry is still active, negotiations with the property owner and quarry operator would be required to allow for disruptions to mining operations during and after flood events that utilize the pond.
- **Property purchase required** – Agreements would need to be established regarding the property once mining operations are complete. Additionally, the City of Austin does not currently own easement or property along this reach of Onion Creek. Easements would be required in the areas where channel clearing is proposed.
- **Permitting** – A USACE Nationwide permit is anticipated due to the proposed connections to Onion Creek and channel modifications that are proposed above the ordinary high water mark. Because the quarry is an existing condition that currently stores water, USACE 404 Individual Permit is not anticipated. In addition, permitting is likely required from Hays County, TCEQ, and US Fish and Wildlife.
- **Environmental impacts** – The proposed detention pond and diversion channel are located on water quality protection land with a conservation easement. This would need to be considered during implementation to ensure the project would not negatively impact conservation, safety, and water supply in the Barton Springs and Edwards Aquifer recharge zone. Additionally, cutting into the channel impacts water quality, creek stability, wildlife, and trees. To maintain the flood mitigation benefits of this alternative, perpetual maintenance is required prolonging the environmental impact.
- **Flood mitigation benefits depend on rainfall location** – When utilizing detention 12 miles upstream from the study area there is a risk that if the rain falls primarily downstream of the detention pond, the pond would not be able to store a sufficient quantity of flood waters, and the study area could not see the full anticipated flood mitigation benefits.
- **Long timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is greater than 10 years due to the required stakeholder coordination, property acquisition, and permitting.
- **Perpetual channel maintenance** – Once the channel improvements are complete, great efforts would be required to maintain the improved channel conditions.

Pinehurst Flood Protection Wall with Buyouts

This alternative includes a flood protection wall in the Pinehurst neighborhood in combination with buyouts for the homes at risk of flooding in the 1% ACE in the Wild Dunes neighborhood, because the flood protection wall would only provide limited flood reduction benefits to the Wild Dunes neighborhood. The flood protection wall would be approximately 7,200 feet long and located on the southeast side of Pinehurst Drive. The purchase of 48 properties along the creek side of Pinehurst Drive would be required for construction of the wall. The height of the proposed wall is on average 5.5 feet, similar to the height of a standard privacy fence, with a max height of 14 feet. These dimensions include the FEMA requirements of freeboard (height above the 1% ACE water surface elevation) of at least 3 feet for the entire length of the wall, and 3.5 to 4 feet of freeboard at the upstream and downstream ends of the wall. The facade of the wall could be constructed to match current architecture in the neighborhood. The flood protection wall's alignment would also allow for the full function of the golf course as it is today. A layout of the flood protection wall and buyouts along with an example rendering of the wall as well as a typical section of the channel with the flood protection wall on the overbanks, is shown in Figure 23.

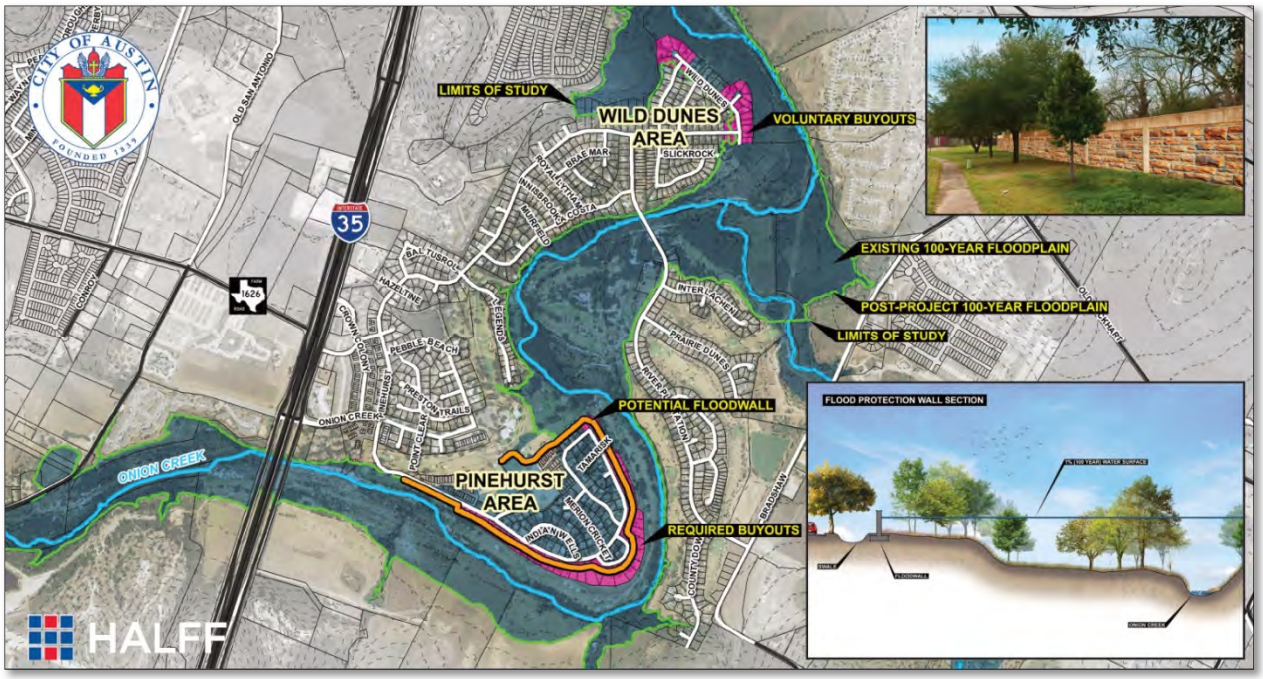


Figure 23: Schematic of Pinehurst Flood Protection Wall with Buyouts

When a flood protection wall is constructed, internal drainage for the local rain that falls behind the wall must be considered to avoid local flooding inside the protected area. There is approximately 77 acres of neighborhood (local) drainage behind the wall. The internal drainage area and existing storm drainage system is displayed in Figure 24. Internal drainage could be accounted for utilizing an open channel along the proposed wall and Pinehurst Drive as a linear detention pond or underground detention utilizing subsurface pipes or vaults. During design and implementation, the level of service and volume requirements must be refined for the internal

drainage system. An internal drainage system that is designed to detain the 2% ACE or 50-year event would be smaller than an internal drainage system that is designed to detain the 1% ACE or 100-year event. Due to the large difference in hydrologic timing between local drainage and peak flow along Onion Creek, it was assumed that the majority of the local drainage could drain prior to the Onion Creek flood wave. For this feasibility analysis the internal drainage system is designed to detain the 2% ACE.

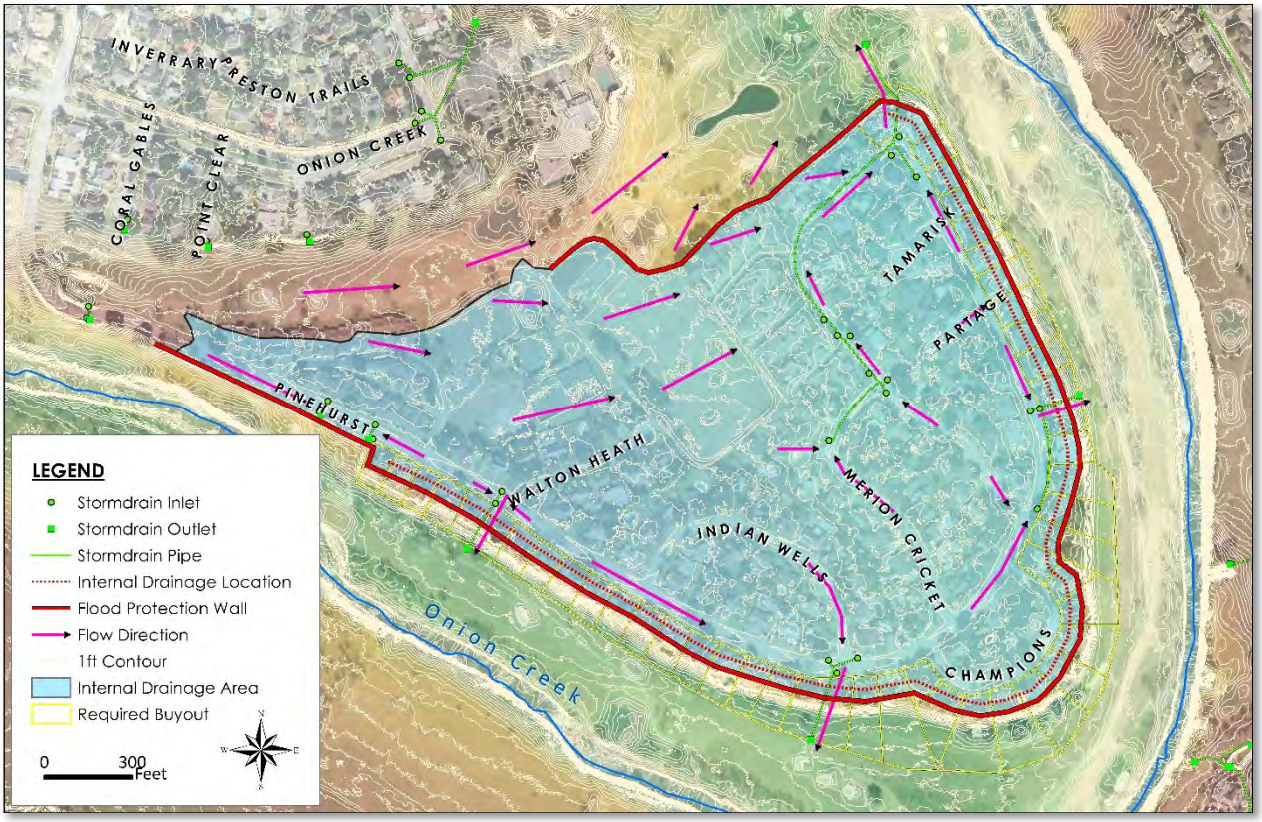


Figure 24: Flood Protection Wall Internal Drainage

The flood protection wall showed no adverse impacts downstream. If this alternative is chosen during design and implementation, no increase in water surface elevation downstream would be permitted in any portion of the Onion Creek channel. Any increase in water surface elevation caused by the flood protection wall would have to be mitigated utilizing detention or other means of preventing rises in water surface. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$59,400,000** and **$68,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative eliminates structural flooding for approximately 138 out of 138 homes at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.
- **Highest level of flood protection** – The Pinehurst floodwall includes an additional 3 feet of height above the 1% ACE water surface elevation, providing a high level of flood protection. Additionally, buyouts eliminate risk indefinitely by removing people and homes from the floodplain.
- **Lower environmental impact** – This flood mitigation alternative would have the least environmental impact to the riparian corridor because it requires no clearing or modifications within the channel.
- **Moderate timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is 5-7 years due to the required property acquisition and estimated timeline to construct the floodwall.
- **Fully addresses homes at risk** – This flood mitigation alternative could be utilized to eliminate structural flooding for all at risk homes from the 1% ACE.

CONSTRAINTS

- **Property purchase required** – Construction of a floodwall in this location would require the mandatory acquisition of about 48 homes along the southern side of Pinehurst Drive and the acquisition of 23 homes in the Wild Dunes neighborhood.
- **Levee compliance and permitting** – The flood protection wall must be designed and constructed in accordance with FEMA's levee criteria. Additionally, once a floodwall is constructed, great efforts would be required to maintain FEMA levee compliance.
- **Internal drainage challenges** – When a flood protection wall is constructed, internal drainage for the local rain that falls behind the wall must be considered to avoid localized flooding inside the protected area. An internal drainage system would be required to drain approximately 77 acres of neighborhood drainage located behind the wall.
- **Impact to community** – This alternative would significantly impact the appearance and use of the acquired vacant lots in the Onion Creek neighborhoods. Since purchased properties require some level of continuous maintenance, the City of Austin would also be required to coordinate with the Onion Creek Homeowner's Association.

Pinehurst Flood Protection Wall with Channel Modifications

This alternative includes the combination of the Pinehurst flood protection wall, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive. The Pinehurst flood protection wall is the same as the wall proposed in the combined alternative Pinehurst Flood Protection Wall with Buyouts. For more details regarding the flood protection wall, refer to the Combined Alternative Pinehurst Flood Protection Wall with Buyouts section above. The River Plantation bridge improvements are the same as those included in the combined alternative with the Centex West Pond and channel modifications.

The bridge improvements would include widening the bridge span across the channel from 420 feet to 580 feet. The bridge improvements would require approximately 210,000 cubic yards of excavation within the Onion Creek channel. Channel modifications in the Wild Dunes neighborhood would include a large benched section on the eastern bank of Onion Creek between Wild Dunes Drive to East Slaughter Lane. The Wild Dunes channel modifications would require approximately 1,180,000 cubic yards of excavation along 3,800 linear feet of channel. The channel modifications in combination with the flood protection wall would require more conveyance and excavation than the channel modifications in combination with the Centex West Pond, because it does not experience the flow reduction benefits that the Centex West Pond would provide. A location map of the channel modifications and flood protection wall is included in Figure 25.

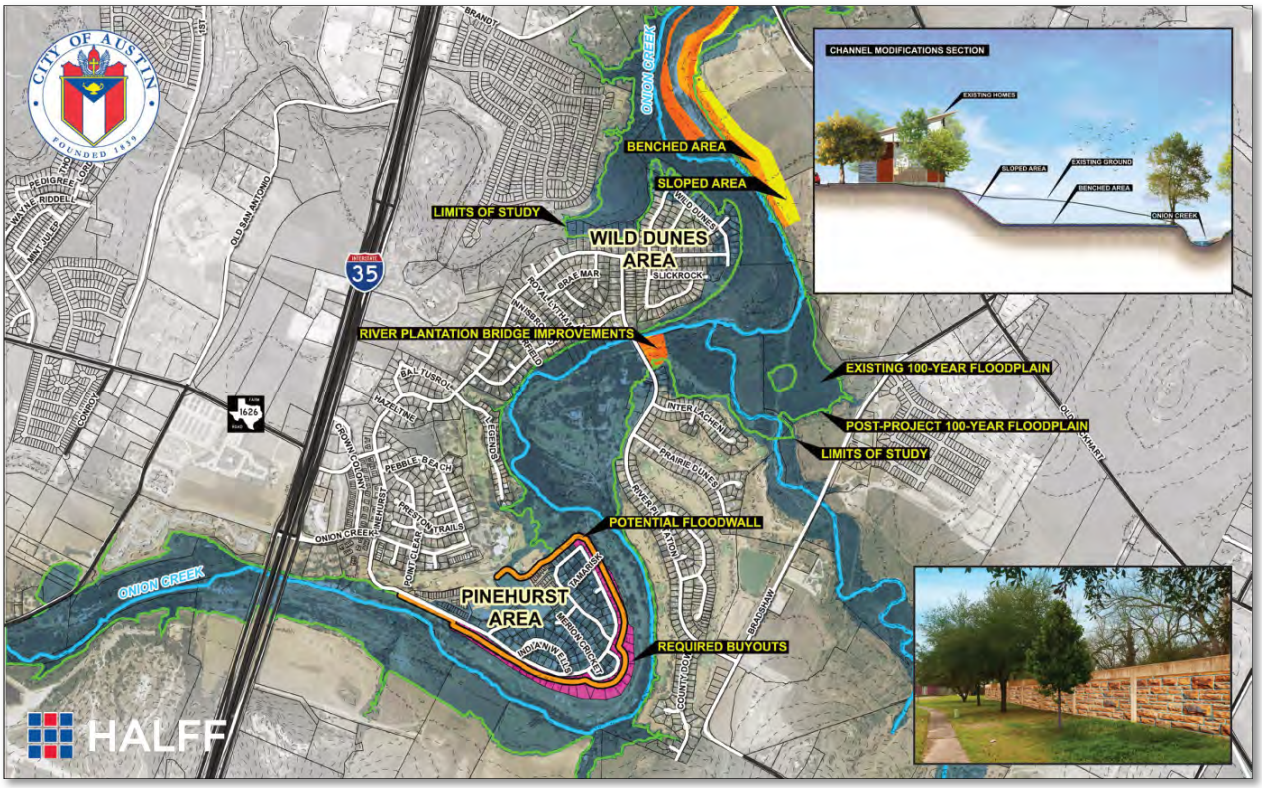


Figure 25: Schematic of Pinehurst Flood Protection Wall with Channel Modifications

The City of Austin does not currently own easement or property along this reach of Onion Creek. Property acquisition would be required in areas where channel modifications are proposed. In the areas of the proposed channel modifications the channel could require significant efforts to maintain the "cleared" channel once the project is complete. Cutting into the channel would significantly impact the riparian corridor along Onion Creek negatively impacting water quality, creek stability, wildlife, and trees. The estimated project cost and annual O&M cost for this flood mitigation alternative are **$88,900,000** and **$159,000** respectively. The benefits and constraints of this alternative are listed below:

BENEFITS

- **Flood mitigation benefits** – This flood mitigation alternative results in an average 1% ACE water surface depth reduction of approximately 1.0 feet, and a max water surface depth reduction of 3.0 feet within the homes in the Pinehurst and Wild Dunes neighborhoods, and eliminates structural flooding for approximately 138 out of 138 homes at risk within the Pinehurst and Wild Dunes neighborhoods from the 1% ACE.
- **Highest level of flood protection** – The Pinehurst floodwall includes an additional 3 feet of height above the 1% ACE water surface elevation, providing a high level of flood protection. Additionally, buyouts eliminate risk indefinitely by removing people and homes from the floodplain.
- **Moderate timeline for implementation** – The estimated timeline for implementation (not including time to obtain funding) is 7-10 years due to the required property and easement acquisition and estimated timeline to construct the floodwall.
- **Fully addresses homes at risk** – This flood mitigation alternative could be utilized to eliminate structural flooding for all at risk homes from the 1% ACE.

CONSTRAINTS

- **Multiple projects required** – This alternative requires a combination of projects to provide flood mitigation benefits in the study area.
- **Property purchase required** – Construction of a floodwall in this location would require the mandatory acquisition of about 48 homes along the southern side of Pinehurst Drive.
- **Levee compliance and permitting** – The flood protection wall must be designed and constructed in accordance with FEMA's levee criteria. Additionally, once a floodwall is constructed, great efforts would be required to maintain FEMA levee compliance.
- **Environmental impacts** – Cutting into the channel impacts water quality, creek stability, wildlife, and trees. To maintain the flood mitigation benefits of this alternative, perpetual maintenance is required prolonging the environmental impact.
- **Internal drainage challenges** – When a flood protection wall is constructed, internal drainage for the local rain that falls behind the wall must be considered to avoid localized flooding inside the protected area. An internal drainage system would be required to drain approximately 77 acres of neighborhood drainage located behind the wall.
- **Impact to community** – This alternative would significantly impact the appearance and use of the acquired vacant lots in the Pinehurst neighborhood. Since purchased properties require some level of continuous maintenance, the City of Austin would also be required to coordinate with the Onion Creek Homeowner's Association.
- **Perpetual channel maintenance** – Once the channel improvements are complete, great efforts would be required to maintain the improved channel conditions.

Project Scoring

Each of the flood mitigation alternatives were evaluated and compared based on a set of project scoring criteria. The scoring criteria cover a wide range of issues and were established based on a review of prioritization approaches used previously by the City of Austin and methods used by other municipalities and agencies. The selected criteria balance a broad range of considerations. The project scoring criteria acts as a decision making tool. By creating and utilizing a multi-attribute decision making tool, stake holders are able to discern which alternative should have priority for implementation in order to help overall public safety objectives amidst increased community exposure to flood emergencies. The final flood mitigation alternatives were given a rank 1 through 5 for each criteria. The ranks 1 through 5 represents the level at which the project meets the criteria, where 5 is the best and 1 is the worst. Therefore the higher the score of the alternative the better the project for that criteria. There are seven different criteria:

- **Cost Effectiveness** – A FEMA compliant Benefit-Cost Analysis (BCA) was performed for the six final flood mitigation alternatives. The FEMA BCA was established as the standard in order to provide technical and financial assistance for implementation of flood or hazard mitigation undertakings. From the BCA analysis it was determined all final alternatives fall significantly below the minimum criteria for state and federal funding. This shortcoming is largely due to the fact that homes are estimated to only flood in the 1% ACE and less frequent flood events. The benefits would be greater if the flood mitigation alternatives were protecting homes from more frequent flood events. However, this is not possible as homes in the Pinehurst and Wild Dunes neighborhoods are not estimated to be impacted during the more frequent flood events. Based on this analysis, all of the proposed flood mitigation alternatives would be ineligible for state or federal funding because they fail to meet the minimum criteria. Because all projects fall significantly below the BCA minimum criteria, a Benefit-Cost Index (BCI) was applied for comparison purposes. This Benefit-Cost Index including simply dividing all BCA ratios by the highest ratio. Therefore the highest ratio would equal one, and all other ratios fall below. The Pinehurst flood protection wall with buyouts had the highest BCA ratio, and the combined alternative with the Centex West pond and the channel modifications had the lowest. See the proposed alternatives FEMA BCA ratios and BCI ratios compared in Table 4 below. For more details on the FEMA BCA please refer to Appendix E.

Table 4. Benefit-Cost Index

Final Flood Mitigation Alternative	FEMA BCA Ratio	BCI
Pinehurst Flood Protection Wall with Buyouts	0.07	1.00
Wild Dunes Buyouts	0.06	0.83
Pinehurst Buyouts	0.05	0.75
Pinehurst Flood Protection Wall with Channel Modifications	0.04	0.58
Channel Clearing	0.02	0.27
Centex West Regional Detention Pond	0.02	0.26
Centex West Regional Detention Pond with Channel Modifications	0.01	0.21

- **Environmental Impacts** – The estimate of environmental impact is generally based on whether the environmental impact would be moderate or significant, and if the impact would be short-term or long-term. The environmental impact considers the impact to Critical Environmental Features; water quality such as Critical Water Quality Zones and Water Quality Transition Zones; creek stability and Erosion Hazard Zones; wildlife; and trees. Through evaluation of the alternatives, it was found that some alternatives may only be an impact during construction such as buyouts while other alternatives could result in a long-term impact such as the channel clearing alternative.
- **Funding Constraints** – This criteria is based on what could be the project's funding source and the estimated time required to obtain funding. This criteria considers the alternative's potential to be implemented as funding is available. Through evaluation of the alternatives, it was found that some alternatives could be implemented as funding is available such as buyouts while other alternatives require full funding prior to construction such as the Centex West Pond. Combined alternatives have the ability to be implemented in phases but funding must be secured prior to construction of each phased improvement.
- **Time of Implementation** – Time of Implementation criteria considers the time it takes to design, permit, and construct for each project. This criteria does not include the time to obtain funding. In coordination with the City of Austin, timeline estimates were established for each alternative. These timeline estimates would be refined should any of the projects be recommended for further evaluation.
- **Land & Easement Acquisition Required** – This criteria takes into account the land or easement acquisition required for the flood mitigation alternative to be implemented. The City of Austin does not currently own easement or property along the reach of Onion Creek within the study area or near the Centex West Pond. This criteria considers the type (easement or land purchase) and amount (minimal or significant) of property required for implementation of each mitigation alternative. No additional land or easement acquisition is required for the buyout because the land is included in the acquisition of a residential property. All other alternatives require property acquisition.
- **Neighborhood Input** – The neighborhood survey results from the Onion Creek public meeting on November 15, 2016 are considered in this criteria. Eight questions were asked through the public survey to gain input regarding the neighborhood's most favorable

and least favorable flood mitigation alternative project, as well as, most important and least important project constraint. Approximately 80 residents participated in the public survey. Based on this survey the neighborhood's most favorable alternatives were channel clearing and combined alternatives while the neighborhood's least favorable alternative was a flood protection wall.

- **Complexity of Permitting** – This criteria is based on what permits would be required for the proposed flood mitigation projects and what is the difficulty in obtaining those permits due to other entities' involvement. Project permitting could have a major impact on the timeline and associated costs of design and construction. Through evaluation of the alternatives, it was found that some alternatives may be implemented using only local permits such as buyouts while other alternatives require multiple jurisdiction, state and federal permits such as the Centex West Pond.

Each of the scoring criteria was given a weight factor in an effort to rank the flood mitigation alternatives based on which project helps improve public safety in the most efficient means possible. In order to do this some criteria must be prioritized over the others. The criteria's weight factors were established in coordination with the City of Austin. The description for the 1 through 5 scoring and weighted factors are displayed in Table 5.

Table 5. Project Scoring Criteria

CRITERIA	CRITERIA WEIGHT	SCORE RANGE
Cost Effectiveness (Benefit-Cost Index)	25	**5:** BCI = 1 **4:** 1 - 0.75 BCI **3:** 0.75 - 0.5 BCI **2:** 0.5 - 0.25 BCI **1:** BCI < 0.25
Environmental Impact	20	**5:** Limited to no environmental impact **4:** Short term, moderate impact during construction **3:** Short term, significant impact during construction **2:** Long term, moderate impact in perpetuity **1:** Long term, significant impact in perpetuity
Funding Constraints	5	**5:** Project can be implemented incrementally as funding is available **3:** Project is comprised of multiple smaller projects which can be implemented separately as funding is available for each **1:** Full project funding required prior to implementation
Time of Implementation	15	**5:** 0-2 years, once funding is available **4:** 2-5 years, once funding is available **3:** 5-7 years, once funding is available **2:** 7-10 years, once funding is available **1:** > 10 years, once funding is available
Land & Easement Acquisition	15	**5:** No additional land/easement acquisition needed in order to implement project **3:** Minimal land/easement acquisition needed **1:** Significant land/easement acquisition needed in order to implement project
Neighborhood Input	10	**5:** Most favorable **3:** Neutral results **1:** Least favorable
Complexity of Permitting	10	**5:** Limited local permits **4:** Local site plan permit **3:** Local permit with variances/Nationwide **2:** Multi-jurisdiction less permits **1:** Multi-jurisdiction more permits

In Table 6, the results of the project scoring are summarized. The alternative that received the highest score, Buyouts, is highlighted in green. The alternative that received the lowest score, the combination of the Centex West Pond with channel modifications, is highlighted in red. The table illustrates where each alternative fell for each project scoring criteria.

Table 6. Project Scoring Results Summary

Criteria	Best		Worst
Cost Effectiveness (Benefit-Cost Index)	• Wall with Buyouts	• **Buyouts** • Wall with Chl. Mods.	• Centex West Pond • Channel Clearing • **Pond with Chl. Mods.**
Environmental Impact	• **Buyouts**	• Centex West Pond • Wall with Buyouts	• Channel Clearing • **Pond with Chl. Mods.** • Wall with Chl. Mods.
Funding Constraints	• **Buyouts**	• Channel Clearing • **Pond with Chl. Mods.** • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond
Time of Implementation	• **Buyouts**	• Channel Clearing • Wall with Buyouts	• Centex West Pond • **Pond with Chl. Mods.** • Wall with Chl. Mods.
Land & Easement Acquisition	• **Buyouts**	• Channel Clearing • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond • **Pond with Chl. Mods.**
Neighborhood Input	• Centex West Pond • Channel Clearing • **Pond with Chl. Mods.**	• **Buyouts** • Wall with Chl. Mods.	• Wall with Buyouts
Complexity of Permitting	• **Buyouts**	• Channel Clearing • Wall with Buyouts • Wall with Chl. Mods.	• Centex West Pond • **Pond with Chl. Mods.**

Conclusion & Recommendations

The Onion Creek Flood Mitigation Analysis allowed the City to re-evaluate flood risk within the Pinehurst and Wild Dunes neighborhoods in light of the October 2013 and 2015 floods and evaluate potential flood mitigation alternatives. There are 115 homes in the Pinehurst neighborhood and 23 in the Wild Dunes neighborhood where the estimated 1% ACE water surface elevation exceeds the finished floor elevations. The ultimate flood mitigation objective is to eliminate the interior flooding risk of homes during the 1% ACE within the Pinehurst and Wild Dunes neighborhoods.

Buyouts are less expensive than regional detention and have the flexibility of being implemented as funding becomes available. A buyout program offers the shortest time of implementation and allows for prioritization of the most at risk homes. In addition to these benefits, this alternative has the least environmental impact to the Pinehurst and Wild Dunes neighborhoods. Based on the results of the analysis and the project scoring criteria, Halff recommends **Buyouts** as the preferred flood mitigation alternative.

As stated previously, this study focused on mitigating the flooding issues between IH-35 and Slaughter Lane in the Pinehurst and Wild Dunes neighborhoods. Regional Detention could also be considered as a flood mitigation alternative for long-term and comprehensive planning. However high project cost, lack of funding, complex permitting, property acquisition, and environmental impact could all be obstacles that would need to be overcome if regional detention was ever implemented. Regional detention would also require regional partnerships between multiple jurisdictions, including coordination between Travis and Hays Counties through their recent Interlocal Agreement (ILA).

This Onion Creek Flood Mitigation Analysis is a feasibility study. Any results from this study, including post-project flood risk, would be refined should any of the projects mentioned in this analysis be recommended for further evaluation.

References

- *Onion Creek Flood Control Study for the City of Austin Drainage Utility*
  Submitted by Loomis and Moore (September 1997)

- *Lower Colorado River Basin Phase I, Texas Interim Feasibility Report and Integrated Environmental Assessment – FINAL*
  Submitted by USACE Fort Worth District (October 2006)

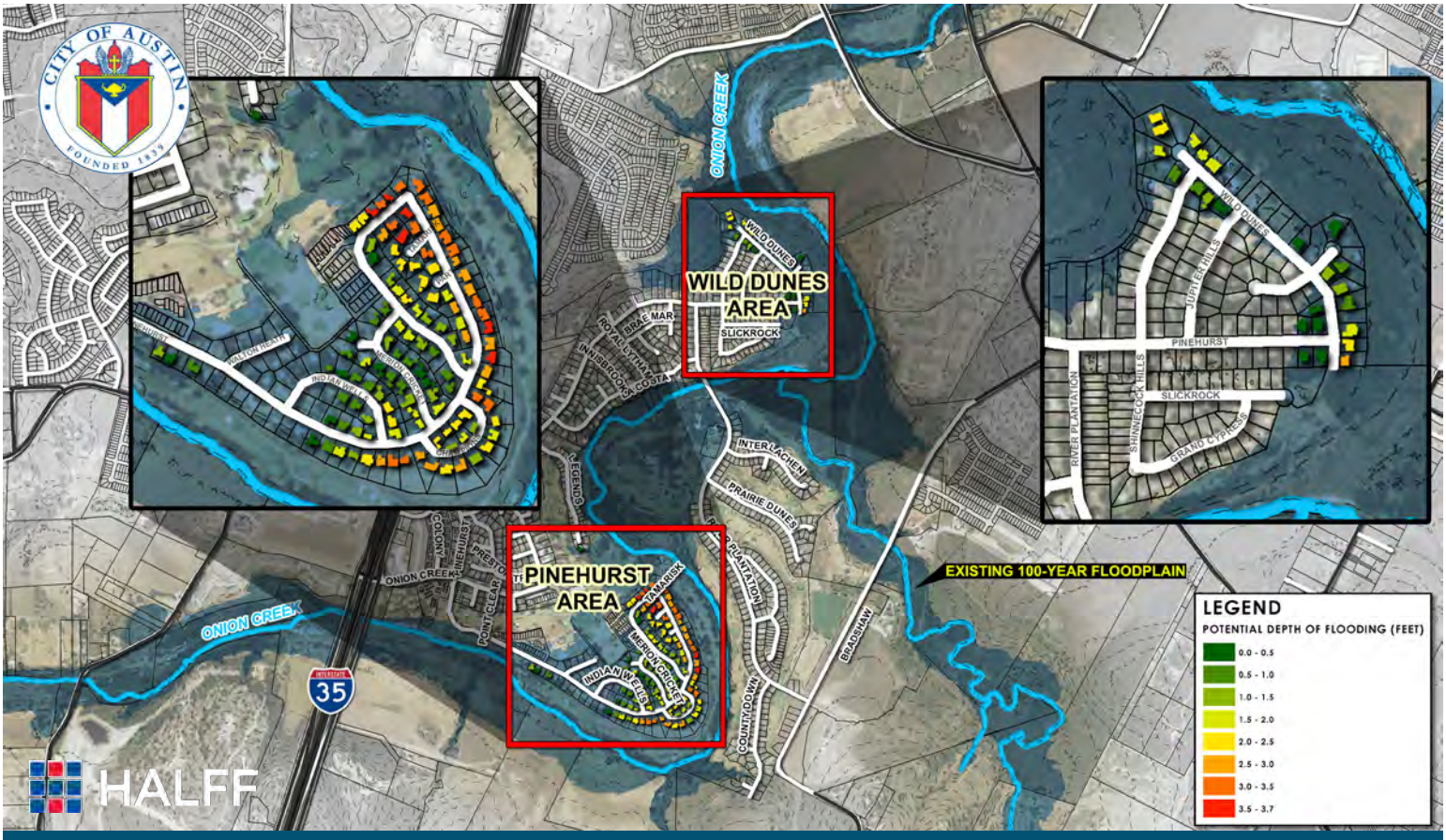
- *Lower Colorado River Basin County Interim Feasibility Study Technical Report Notebook Appendix H Alternatives Development and Benefit-Cost Analysis Onion Creek, Bear Creek, Little Bear Creek, Barton Creek, and Pedernales River Watersheds*
  Submitted by USACE and prepared by Halff Associates (October 2013)

References can be found on the City of Austin's website at the link below

Link: http://www.austintexas.gov/onioncreekstudy

APPENDIX A: Fact Sheets

EXISTING CONDITIONS



PROJECT DESCRIPTION:

The Onion Creek watershed encompasses approximately 344 square miles. Onion Creek generally flows easterly, from the headwaters in Blanco County, through Hays County, to the confluence with the Colorado River in Travis County. In response to the October 2013 flood along Onion Creek, the City of Austin initiated a re-evaluation of Onion Creek with the goal of updating flood risk information as well as the identification of potential flood mitigation alternatives. In October 2015, Onion Creek once again experienced a significant flooding event which further demonstrated the importance of this evaluation. To validate the updated hydrologic and hydraulic analysis, the study team simulated three historical events (October 2013, May 2015, and October 2015) using City provided gage-adjusted radar rainfall and gage records. Once validated, the updated analysis was used to redefine computed peak discharges and water surface elevations along Onion Creek. Based on this study, the City was able to re-evaluate flood risk within the Pinehurst and Wild Dunes neighborhoods and evaluate potential flood mitigation alternatives.

QUICK FACTS

Within the Pinehurst and Wild Dunes neighborhoods

Number of Homes Inundated by 100-year Flood:
115 in Pinehurst
23 in Wild Dunes

Average Depth in Home in the 100-year Flood:
1.9 feet in Pinehurst
1.0 feet in Wild Dunes

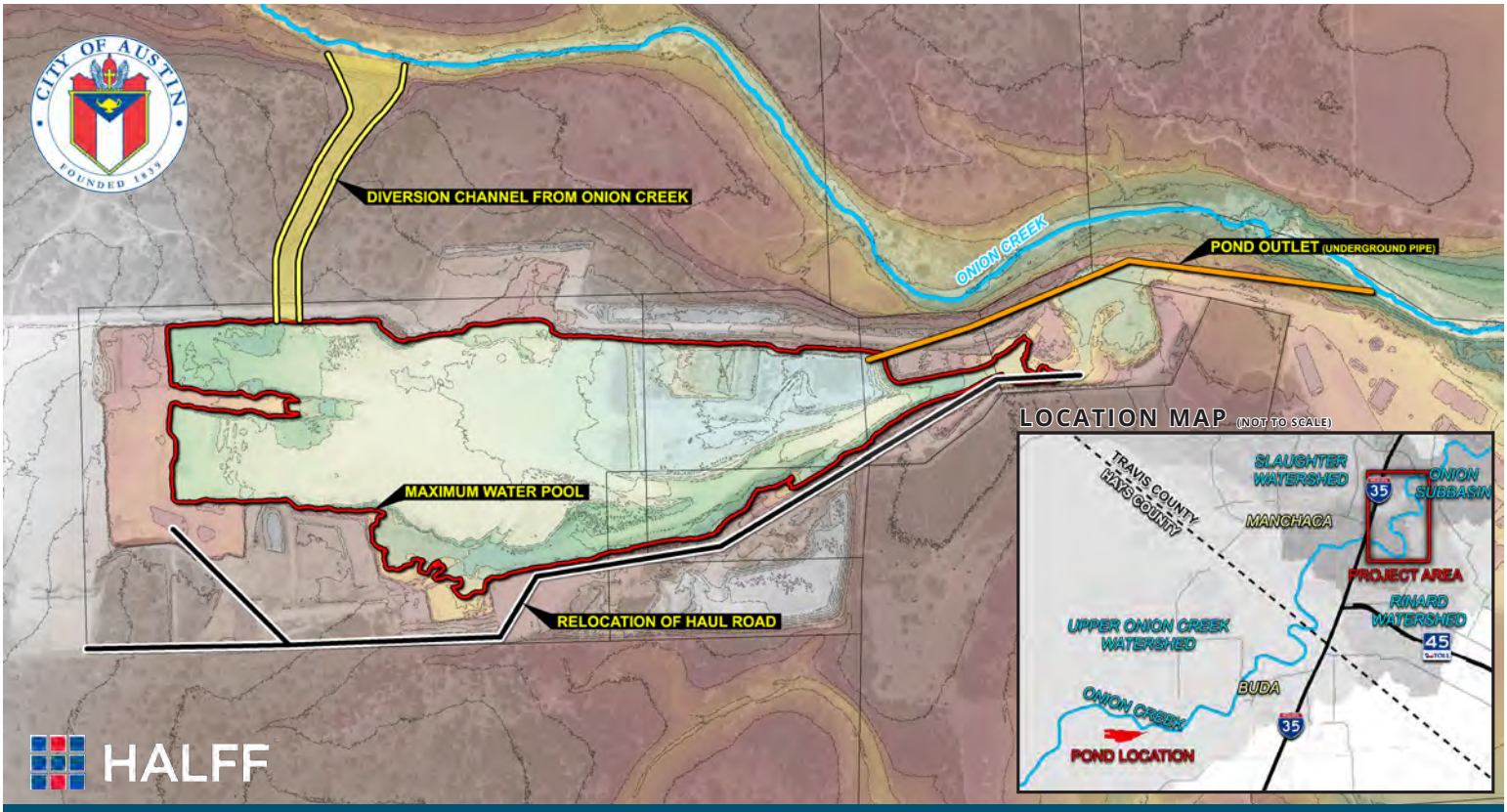
Number of Homes within 100-year Floodplain Footprint:
174 in Pinehurst
45 in Wild Dunes

Number of Homes Inundated by Simulated October 2015 Flood:
138 in Pinehurst
21 in Wild Dunes

Average Depth in Home in the Simulated October 2015 Flood:
2.1 feet in Pinehurst
1.2 feet in Wild Dunes

City of Austin Onion Creek Study Flood Mitigation Alternatives

CENTEX WEST REGIONAL DETENTION POND



PROJECT DESCRIPTION:

The Centex West Regional Detention Pond would utilize the active Centex quarry as an offline detention pond. Since the existing quarry is essentially a large excavated reservoir, the only additional excavation required would be a diversion channel from Onion Creek to the quarry. Flood waters would be diverted from Onion Creek main stem into the Centex West Pond and then slowly released back into Onion Creek. Construction of an offline detention pond at this location would require extensive negotiations with the property owner and the quarry operator to allow for disruptions to mining operations during and after flood events. Agreements would also need to be established regarding the property and detention pond once mining operations are eventually complete.

BENEFITS

- Benefits to multiple jurisdictions
- Utilize existing quarry
- Potential aquifer recharge opportunity

CONSTRAINTS

- Multi-stakeholder coordination
- Property purchase
- Permitting
- Environmental impacts due to construction of diversion channel on water quality protection land
- Flood mitigation benefits depend on rainfall location
- Long timeline for implementation

QUICK FACTS

Pond Volume:
5,700 acre-feet

Surface Area:
135 acres

Project Cost Estimate:
$50,700,000

Estimated Annual O&M Cost
$40,000

Within the Pinehurst & Wild Dunes neighborhoods

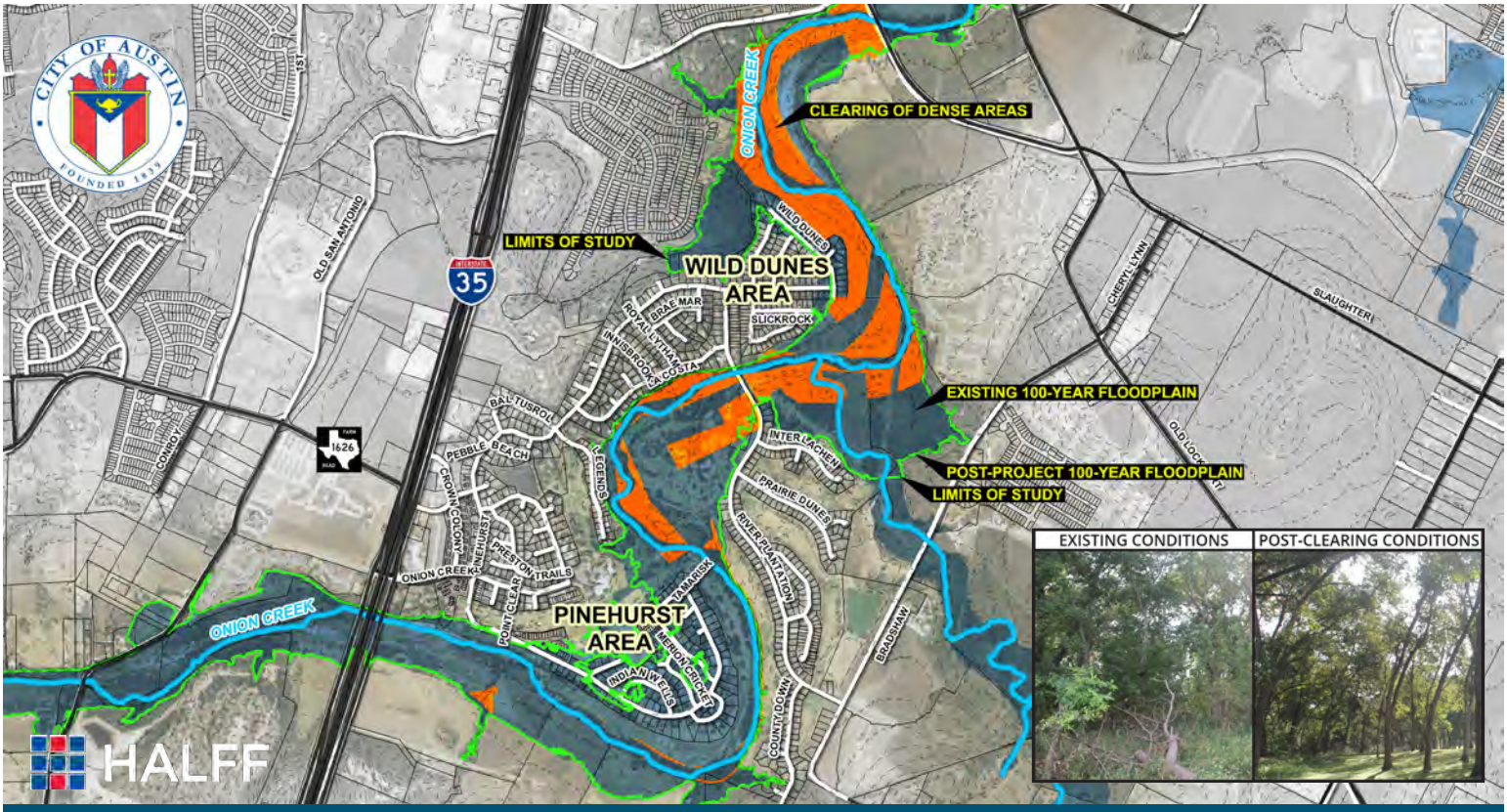
Average/Max Depth Decrease in Home:
1.2 / 2.5 feet in Pinehurst
0.4 / 1.5 feet in Wild Dunes

Average Flow Decrease:
11%

Number of Homes Protected from the 100-Year Flood:
78 out of 138

Limited or no flood mitigation benefits if rainfall occurs down stream of facility.

CHANNEL CLEARING



PROJECT DESCRIPTION:

Reducing the friction losses within a channel and immediate overbanks can be an effective alternative to reduce flood elevations. Friction losses can be reduced by selective clearing of the channel and overbanks, including the removal of debris, underbrush, and small trees. However, such clearing has a significant environmental impact and requires high maintenance and mitigation costs. Although this alternative is somewhat effective it does not have the impact necessary to provide relief to most homes at risk in the 100-year floodplain. In addition, this alternative would require great efforts to maintain the "cleared" channel and would significantly impact the riparian corridor along Onion Creek. It is expected that intensive vegetation maintenance would be needed at least twice a year in order to maintain the project's design conditions. Since the channel clearing alternative impacts water quality, creek stability, wildlife, and trees, this mitigation alternative is contrary to the City of Austin goal of natural channel preservation.

BENEFITS

- Moderate timeline for implementation

CONSTRAINTS

- Perpetual channel maintenance
- Easement acquisition
- Significant long-term environmental impacts
- High tree mitigation costs
- Less flood protection

QUICK FACTS

Clearing Area:
126 acres

Project Cost Estimate:
$35,300,000

Estimated Annual O&M Cost:
$448,000

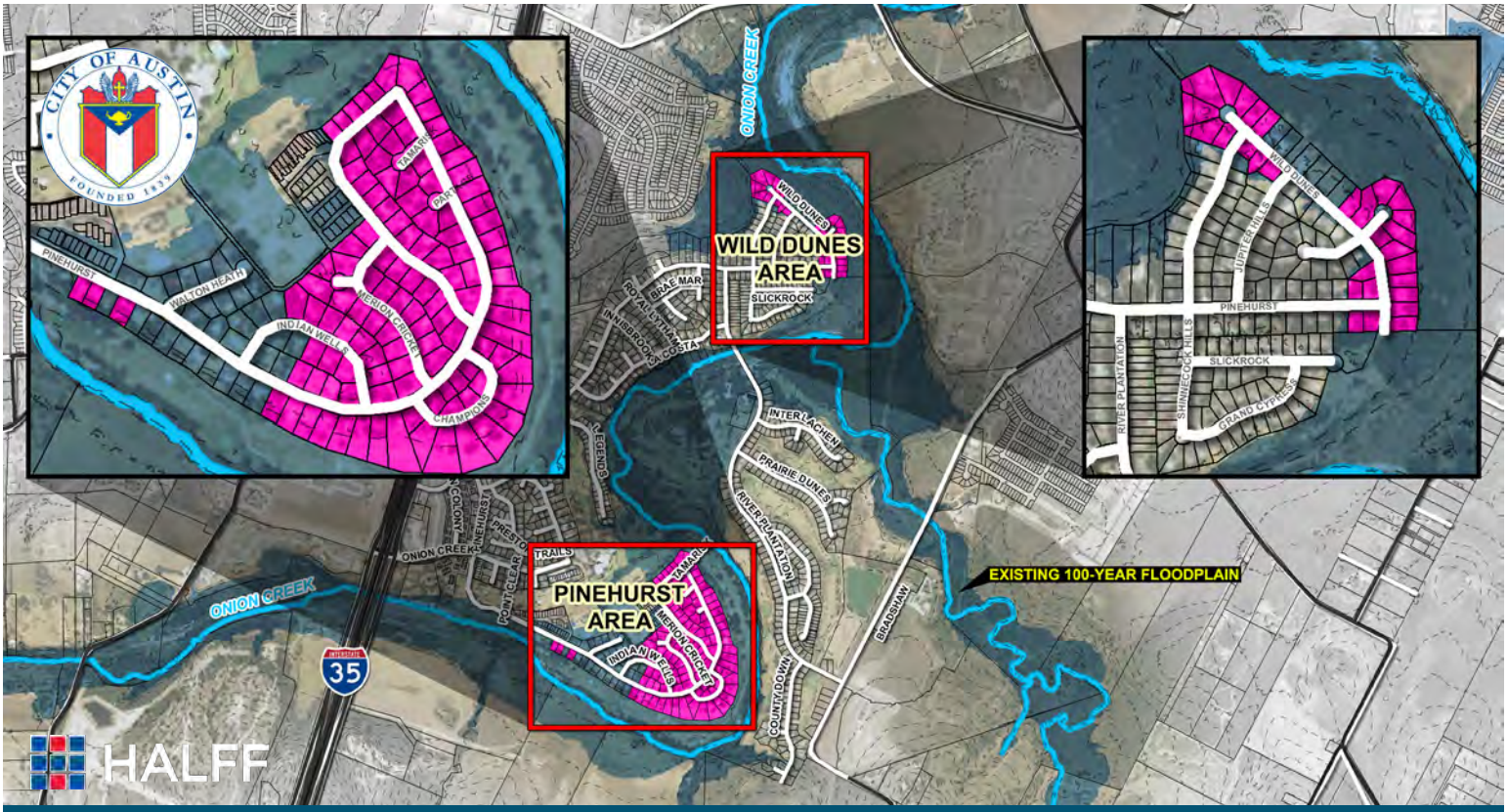
Removal of all underbrush and over 50% of all trees, including potential impact to Heritage Trees

Within the Pinehurst & Wild Dunes neighborhoods

Average/Max Depth Decrease in Home:
1.0 / 2.4 feet in Pinehurst
0.5 / 1.9 feet in Wild Dunes

Number of Homes Protected from the 100-Year Flood:
51 out of 138

VOLUNTARY BUYOUTS



PROJECT DESCRIPTION:

The most effective means of reducing flood damages and improving public safety in previously developed floodplain areas is property acquisition. When people and structures are removed from the floodplain, risk is eliminated indefinitely. For this evaluation, the estimated cost of property acquisition includes real estate services, appraisals, acquisition costs, relocation/moving expenses, asbestos testing/abatement, demolition, and property management for the acquisition of all homes expected to be inundated by the 100-year flood. All property acquisition for this project would be implemented on a voluntary basis unless directed otherwise by the Austin City Council. In order to avoid isolating properties, the cost estimate for this project includes estimates to offer voluntary buyouts to a handful of properties that aren't at risk of structural flooding in a 100-year event, but that are located between properties that are at risk.

BENEFITS

- Highest level of flood protection
- Least environmental impact
- Shortest timeline for implementation
- Can be implemented as funding becomes available
- Fully addresses homes most at risk

CONSTRAINTS

- Voluntary property purchase
- Impact to community

QUICK FACTS

Total Area of Property Buyouts:
44 acres in Pinehurst
10 acres in Wild Dunes

Project Cost Estimate:
$65,000,000 in Pinehurst
$12,500,000 in Wild Dunes

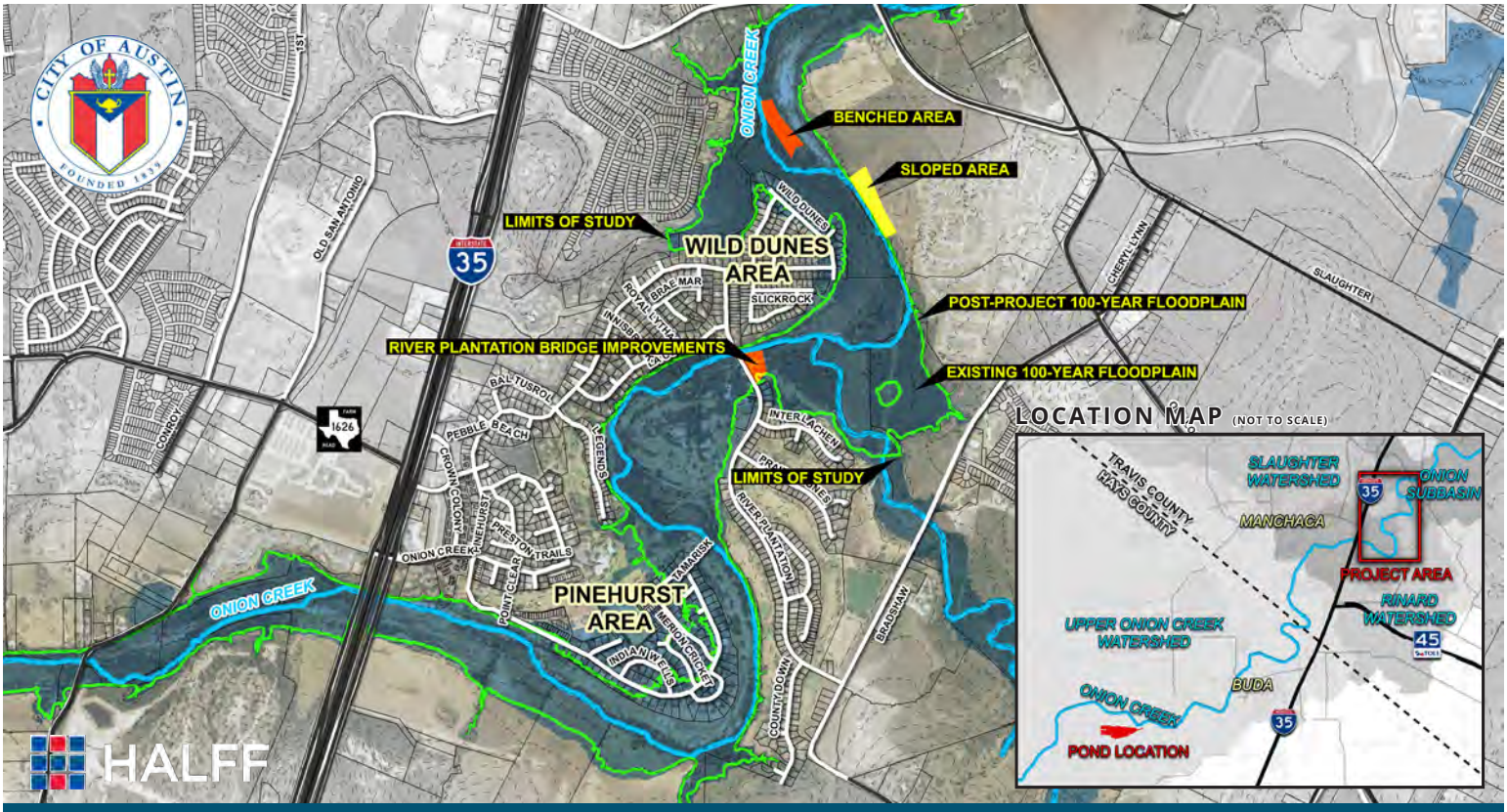
Voluntary Property Acquisition:
118 Homes in Pinehurst
29 Homes in Wild Dunes

Estimated Annual O&M Cost:
$85,000 in Pinehurst
$19,000 in Wild Dunes

Within the Pinehurst & Wild Dunes neighborhoods

Number of Homes Protected from the 100-Year Flood:
138 out of 138

CENTEX WEST DETENTION POND WITH CHANNEL MODIFICATIONS



PROJECT DESCRIPTION:

This alternative includes the combination of the Centex West Regional Detention Pond, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive. Increases in water surface elevation along a creek can be caused by channel constrictions that reduce the flow area of a channel. The proposed River Plantation Drive bridge improvements would include excavating the channel to add flow area under the River Plantation Drive bridge. Similar to constriction removal, channel benching can be used to increase the area of a channel. To minimize permitting requirements, channel benching was evaluated above Onion Creek's estimated ordinary high water elevations. This alternative would require significant efforts to maintain the "cleared" channel and would significantly impact the riparian corridor along Onion Creek.

BENEFITS

- Benefits to multiple jurisdictions
- Utilize existing quarry
- High level of protection for Pinehurst and Wild Dunes neighborhoods
- Potential aquifer recharge opportunity

CONSTRAINTS

- Multiple projects required
- Multi-stakeholder coordination
- Property purchase
- Permitting
- Environmental impacts
- Flood mitigation benefits depend on rainfall location
- Long timeline for implementation
- Perpetual channel maintenance

QUICK FACTS

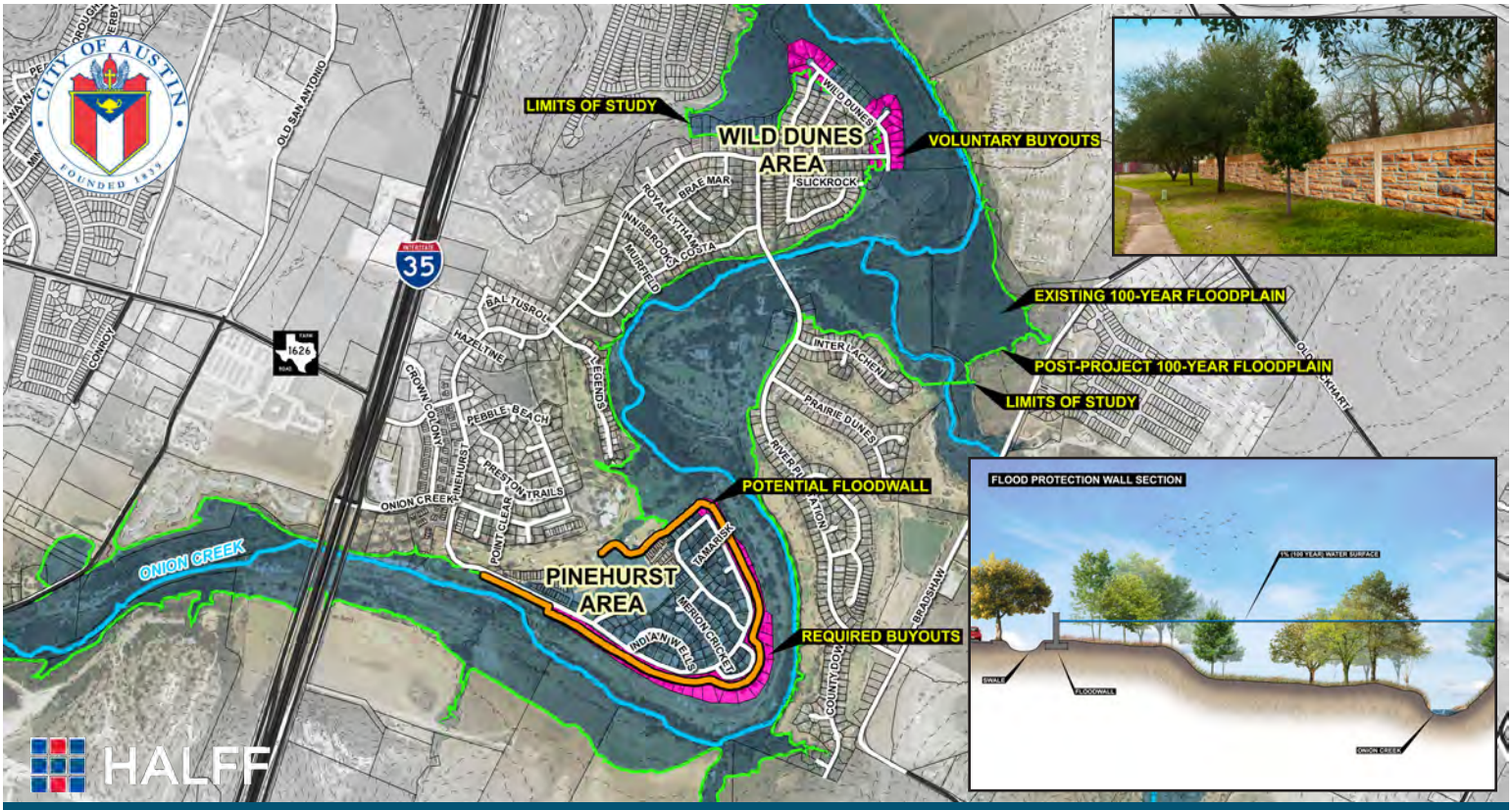
- Centex West Pond Volume: **5,700 acre-feet**
- Channel Benching: **410,000 yd³ of excavation**
- Bridge Improvements: **210,000 yd³ of excavation**
- Project Cost Estimate: **$70,200,000**
- Estimated Annual O&M Cost: **$88,000**

Within the Pinehurst & Wild Dunes neighborhoods

- Average/Max Depth Decrease in Home: **1.4 / 3.4 feet in Pinehurst** **0.7 / 1.8 feet in Wild Dunes**
- Number of Homes Protected from the 100-Year Flood: **110 out of 138**
- Limited or no flood mitigation benefits if rainfall occurs downstream of facility

City of Austin Onion Creek Study Flood Mitigation Alternatives

PINEHURST FLOOD PROTECTION WALL WITH VOLUNTARY BUYOUTS



PROJECT DESCRIPTION:

Flood protection walls provide high levels of protection to flood prone areas. FEMA requires the flood protection walls to have a minimum freeboard (height above the 100-year water level) of at least 3 feet for the entire wall and 3.5 to 4.0 feet of freeboard at the upstream and downstream tie-in locations. In addition, an internal drainage system would be required to drain approximately 77 acres of neighborhood drainage behind the wall. The purchase of 48 properties in the Pinehurst area will be required for the construction of the flood protection wall. The height of the proposed wall is on average 5.5 feet with a maximum height of 14 feet, and would be similar to the height of a standard privacy fence. The appearance of the wall could be constructed to match current architecture in the neighborhood. This flood protection wall's alignment would allow for the full function of the golf course as it is today.

Because the flood protection wall would only provide limited benefits to the Wild Dunes area, this option is presented in combination with voluntary buyouts for the houses at risk of 100-year flooding in the Wild Dunes area.

BENEFITS

- High level of protection for Pinehurst neighborhood
- Lower environmental impact
- Moderate timeline for implementation
- Fully addresses homes most at risk

CONSTRAINTS

- Property purchase
- Levee compliance/permitting
- Internal drainage challenges
- Impact to community

QUICK FACTS

Flood Protection Wall Length:
7,200 feet

Flood Protection Wall Average/Max Height:
5.5/14 feet

Required Property Acquisition for Floodwall:
48 Homes

Project Cost Estimate:
$59,400,000

Estimated Annual O&M Cost:
$68,000

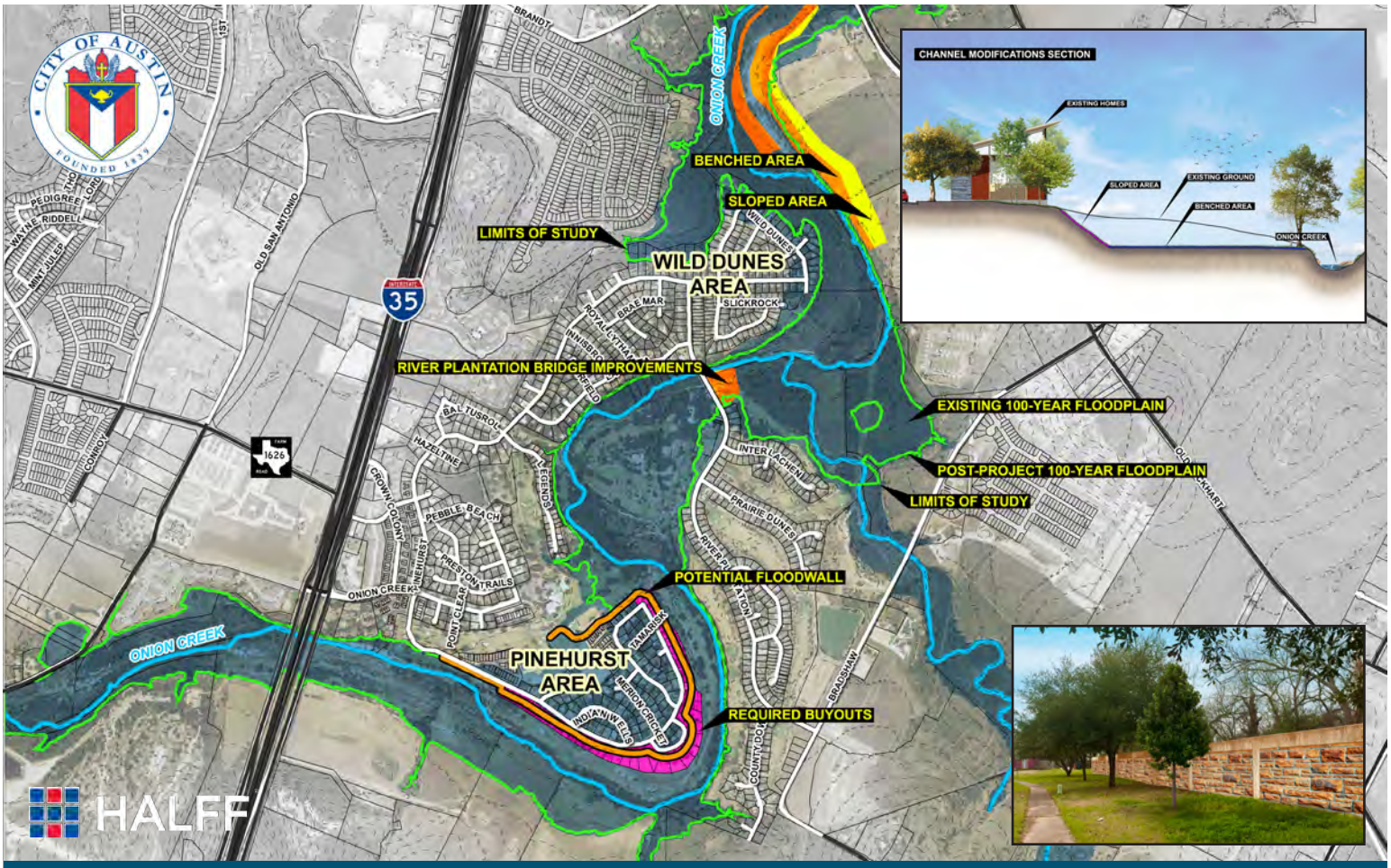
Within the Pinehurst & Wild Dunes neighborhoods

Number of Homes Protected from the 100-Year Flood:
138 out of 138

Onion Creek Website: www.austintexas.gov/onioncreekstudy

City of Austin Onion Creek Study Flood Mitigation Alternatives

PINEHURST FLOOD PROTECTION WALL WITH CHANNEL MODIFICATIONS



PROJECT DESCRIPTION:

This alternative includes the combination of the Pinehurst Flood Protection Wall, River Plantation Drive bridge improvements, as well as channel modifications downstream of River Plantation Drive. Increases in water surface elevation along a creek can be caused by channel constrictions that reduce the flow area of a channel. The proposed River Plantation Drive bridge improvements would include excavating the channel to add flow area under the River Plantation Drive bridge. Similar to constriction removal, channel benching can be used to increase the area of a channel. To minimize permitting requirements, channel benching was evaluated above Onion Creek's estimated ordinary high water elevations. Channel modifications in the Wild Dunes area would include a large benched section on the eastern bank of Onion Creek from Wild Dunes Drive to Slaughter Lane. This alternative would require significant efforts to maintain the "cleared" channel and would significantly impact the riparian corridor along Onion Creek.

BENEFITS

- High level of protection for Pinehurst and Wild Dunes neighborhoods
- Moderate timeline for implementation

CONSTRAINTS

- Multiple projects required
- Property purchase
- Levee compliance/permitting
- Environmental impacts
- Internal drainage challenges
- Impact to community
- Perpetual channel maintenance

QUICK FACTS

- Flood Protection Wall Length: **7,200 feet**
- Flood Protection Wall Avg/Max Height: **5.5/14 feet**
- Channel Benching: **1,180,000 yd³ of excavation**
- Project Cost Estimate: **$88,900,000**
- Estimated Annual O&M Cost: **$159,000**
- Required Property Acquisition for Floodwall **48 Homes**

Within the Pinehurst & Wild Dunes neighborhoods

- Average/Max Depth Decrease in Home: **1.0 / 3.0 feet in Wild Dunes**
- Number of Homes Protected from the 100-Year Flood: **138 out of 138**

Onion Creek Website: www.austintexas.gov/onioncreekstudy

APPENDIX B: Opinion of Probable Costs

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

ALTERNATIVE: Centex West Regional Detention Pond

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
1	Clearing and Grubbing	AC	$ 11,000	12	$ 131,890
2	Tree protection and mitigation	AC	$ 10,000	12	$ 119,900
3	Channel Excavation for diversion	CY	$ 15	534,000	$ 8,010,000
4	Concrete Channel Lining (6")	CY	$ 560	11,700	$ 6,552,000
5	Energy dissipation structure for diversion	EA	$ 400,000	1	$ 400,000
6	Double outlet pipes (2 - 48")	LF	$ 275	7,000	$ 1,925,000
7	Tunneling of pipe (2 - 48")	LF	$ 1,000	7,000	$ 7,000,000
8	Tunneling Pit Excavation (8 pits)	CY	$ 11	670	$ 7,370
9	Headwall	EA	$ 12,000	2	$ 24,000
10	Channel connection at pond culvert outlet	EA	$ 300,000	1	$ 300,000
11	Stockpiling and Placing Topsoil (4")	SY	$ 5	58,100	$ 290,500
12	Hydromulch Seeding	SY	$ 1	58,100	$ 29,050
13	Soil Retention Blankets	SY	$ 2	58,100	$ 116,200
14	Pilot channel in pond (4")	CY	$ 400	1,650	$ 660,000
15	Care of Water	LS	$ 50,000	1	$ 50,000
16	Haul Road Relocation Flex Base 24" (50' wide)	CY	$ 50	30,000	$ 1,500,000
17	Temporary Erosion and Sediment Control (5%)	LS	$ 1,360,000	1	$ 1,360,000
18	Mobilization (10%)	LS	$ 2,720,000	1	$ 2,720,000
				SUBTOTAL	**$ 31,195,910**
				CONTINGENCY (40%)	**$ 12,478,364**
				TOTAL PROJECT COST	**$ 43,674,274**
19	Engineering and Survey Fees (10%)	LS	$ 4,370,000	1	$ 4,370,000
20	Regulatory Permitting (3%)	LS	$ 1,320,000	1	$ 1,320,000
21	Property Acquistion	AC	$ 3,200	400	$ 1,280,000
				PROJECT GRAND TOTAL	**$ 50,644,274**
OPERATION & MAINTENANCE					
22	Present Worth 50-year O&M Cost	LS	$ 552,000	1	$ 552,000
				ANNUAL O&M COST	**$ 552,000**
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					**$ 51,196,274**

Note: Estimate excludes cost of Centex operation compensation, and protection, relocation, reconstruction of utilities.

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

Alternative: Channel Clearing

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
1	Selective Clearing	AC	$ 11,000	126	$ 1,386,000
2	Tree protection and mitigation (low density)	AC	$ 10,000	76	$ 760,000
3	Tree protection and mitigation (high density)	AC	$ 100,000	50	$ 5,000,000
4	Hydromulch Seeding	SY	$ 2	92,000	$ 184,000
5	Soil Retention Blankets	SY	$ 6	92,000	$ 552,000
6	Care of Water	LS	$ 50,000	1	$ 50,000
7	Temporary Erosion and Sediment Control (5%)	LS	$ 325,000	1	$ 325,000
8	Mobilization (10%)	LS	$ 688,000	1	$ 688,000
				SUBTOTAL	**$ 8,945,000**
				CONTINGENCY (30%)	**$ 2,683,500**
				TOTAL PROJECT COST	**$ 11,628,500**
9	Management, engineering, and survey fees (10%)	LS	$ 1,163,000	1	$ 1,163,000
10	Regulatory Permitting (3%)	LS	$ 349,000	1	$ 349,000
11	Property Acquistion	AC	$ 170,000	130	$ 22,100,000
				PROJECT GRAND TOTAL	**$ 35,240,500**
OPERATION & MAINTENANCE					
12	Present Worth 50-year O&M Cost	LS	$ 6,180,000	1	$ 6,180,000
				ANNUAL O&M COST	**$ 6,180,000**
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					**$ 41,420,500**

Note: Estimate excludes cost of easement acquisition and cost of protection, relocation, and reconstruction of utilities

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

Alternative: Buyouts

PINEHURST NEIGHBORHOOD

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
1	Property Acquisition, Pinehurst area (118 properties)	LS	$ 65,000,000	1	$ 65,000,000
				PROJECT GRAND TOTAL	$ 65,000,000
OPERATION & MAINTENANCE					
2	Present Worth 50-year O&M Cost	LS	$ 1,170,000	1	$ 1,170,000
				ANNUAL O&M COST	$ 1,170,000
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					$ 66,170,000

WILD DUNES NEIGHBORHOOD

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
3	Property Acquisition, Wild Dunes area (29 properties)	LS	$12,500,000	1	$ 12,500,000
				PROJECT GRAND TOTAL	$ 12,500,000
OPERATION & MAINTENANCE					
4	Present Worth 50-year O&M Cost	LS	$ 260,000	1	$ 260,000
				ANNUAL O&M COST	$ 260,000
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					$ 12,760,000

Note: Estimates include all costs associated with property acquisition (including real estate services, appraisals, acquisition costs, relocation/moving expenses, asbestos testing/abatement, demolition, and property management during the entire process). Estimates also include a contingency to account for potential real estate market changes in the future and if eminent domain is required.

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

Alternative: Centex West Regional Detention Pond with Channel Modifications

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
Centex West Regional Detention Pond					
1	Clearing and Grubbing	AC	$ 11,000	12	$ 131,890
2	Tree protection and mitigation	AC	$ 10,000	12	$ 119,900
3	Double outlet pipes (2 - 48")	LF	$ 275	7,000	$ 1,925,000
4	Tunneling of pipe (2 - 48")	LF	$ 1,000	7,000	$ 7,000,000
5	Tunneling Pit Excavation (8 pits)	CY	$ 11	670	$ 7,370
6	Headwall	EA	$ 12,000	2	$ 24,000
7	Channel connection at pond culvert outlet	EA	$ 300,000	1	$ 300,000
8	Channel Excavation for diversion	CY	$ 15	534,000	$ 8,010,000
9	Concrete Channel Lining (6")	CY	$ 560	11,700	$ 6,552,000
10	Energy dissipation structure for diversion	EA	$ 400,000	1	$ 400,000
11	Stockpiling and Placing Topsoil (4")	SY	$ 5	58,100	$ 290,500
12	Hydromulch Seeding	SY	$ 1	58,100	$ 29,050
13	Soil Retention Blankets	SY	$ 2	58,100	$ 116,200
14	Pilot channel in pond (4")	CY	$ 400	1,650	$ 660,000
15	Care of Water	LS	$ 50,000	1	$ 50,000
16	Haul Road Relocation Flex Base 24" (50' wide)	CY	$ 50	30,000	$ 1,500,000
17	Temporary Erosion and Sediment Control (5%)	LS	$ 1,360,000	1	$ 1,360,000
18	Mobilization (10%)	LS	$ 2,720,000	1	$ 2,720,000
				SUBTOTAL	***$ 31,195,910***
River Plantation Drive Bridge Improvements					
19	Tree protection and mitigation (low density)	AC	$ 10,000	3	$ 31,300
20	Temp Traffic Control (Detour)	MO	$ 8,000	14	$ 112,000
21	Channel Excavation	CY	$ 15	209,000	$ 3,135,000
22	Hydromulch Seeding	SY	$ 1	15,200	$ 15,200
23	Soil Retention Blankets	SY	$ 2	15,200	$ 30,400
24	Care of Water	LS	$ 50,000	1	$ 50,000
25	Bridge Expansion (60' W. 115' L)	SF	$ 90	12,900	$ 1,161,000
26	Temporary Erosion and Sediment Control (5%)	LS	$ 227,000	1	$ 227,000
27	Mobilization (10%)	LS	$ 454,000	1	$ 454,000
				SUBTOTAL	***$ 5,215,900***
Wild Dunes Channel Modifications					
28	Tree protection and mitigation (low density)	AC	$ 10,000	9	$ 92,500
29	Channel Excavation	CY	$ 15	410,000	$ 6,150,000
30	Hydromulch Seeding	SY	$ 2	44,800	$ 89,600
31	Soil Retention Blankets	SY	$ 6	44,800	$ 268,800
32	Care of Water	LS	$ 50,000	1	$ 50,000
33	Relocation of Water Quality Pond	LS	$ 200,000	1	$ 200,000
34	Temporary Erosion and Sediment Control (5%)	LS	$ 343,000	1	$ 343,000
35	Mobilization (10%)	LS	$ 686,000	1	$ 686,000
				SUBTOTAL	***$ 7,879,900***
				SUBTOTAL	**$ 44,291,710**
				CONTINGENCY (30%)	**$ 16,407,104**
				TOTAL PROJECT COST	**$ 60,698,814**
36	Engineering and Survey Fees (10%)	LS	$ 6,070,000	1	$ 6,070,000
37	Regulatory Permitting (3%)	LS	$ 1,830,000	1	$ 1,830,000
38	Property Acquistion	AC	$ 3,900	400	$ 1,560,000
				PROJECT GRAND TOTAL	**$ 70,158,814**

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
OPERATION & MAINTENANCE					
39	Present Worth 50-year O&M Cost	LS	$ 1,210,000	1	$ 1,210,000
				ANNUAL O&M COST	**$ 1,210,000**
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					**$ 71,368,814**

Note: Estimate excludes cost of protection, relocation, and reconstruction of utilities.

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

ALTERNATIVE: Pinehurst Flood Protection Wall with Buyouts

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
1	Clearing and Grubbing	AC	$ 11,000	2	$ 21,556
2	Tree protection and mitigation (residential)	AC	$ 3,000	7	$ 19,835
3	Flood protection wall	LF	$ 750	7,200	$ 5,400,000
4	Form liner, stain, and seal for wall	LF	$ 150	7,200	$ 1,080,000
5	Internal Drainage Ditch Excavation	CY	$ 15	41,300	$ 619,500
6	Internal Drainage Outlet Structure	LS	$ 10,000	1	$ 10,000
7	Stockpiling and Placing Topsoil (4")	SY	$ 5	32,000	$ 160,000
8	Hydromulch Seeding	SY	$ 2	71,800	$ 143,600
9	Soil Retention Blankets	SY	$ 6	32,000	$ 192,000
10	Temporary Erosion and Sediment Control (5%)	LS	$ 383,000	1	$ 383,000
11	Neighborhood Street Maintenance	LS	$ 400,000	1	$ 400,000
12	Neighborhood Safety and Security	LS	$ 100,000	1	$ 100,000
13	Mobilization (10%)	LS	$ 853,000	1	$ 853,000
				SUBTOTAL	**$ 9,382,490**
				CONTINGENCY (30%)	**$ 2,814,747**
				TOTAL PROJECT COST	**$ 12,197,237**
14	Engineering and Survey Fees (10%)	LS	$ 1,220,000	1	$ 1,220,000
15	Regulatory Permitting (3%)	LS	$ 366,000	1	$ 366,000
16	Property Acquistion for Floodwall	LS	$ 33,100,000	1	$ 33,100,000
17	Wild Dunes Buyouts	LS	$ 12,500,000	1	$ 12,500,000
18	Easement Acquistion	AC	$ 9,100	1	$ 9,100
				PROJECT GRAND TOTAL	**$ 59,392,337**
OPERATION & MAINTENANCE					
19	Present Worth 50-year O&M Cost	LS	$ 935,000	1	$ 935,000
				ANNUAL O&M COST	**$ 935,000**
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					**$ 60,327,337**

Note: Estimate excludes cost of protection, relocation, and reconstruction of utilities.

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

DATE: 6/30/2017

AVO: 27490B

PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

Alternative: Pinehurst Flood Protection Wall with Channel Modifications

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
Pinehurst Flood Protection Wall					
1	Clearing and Grubbing	AC	$ 11,000	2	$ 21,556
2	Tree protection and mitigation (residential)	AC	$ 3,000	7	$ 19,835
3	Flood protection wall	LF	$ 750	7,200	$ 5,400,000
4	Form liner, stain, and seal for wall	LF	$ 150	7,200	$ 1,080,000
5	Internal Drainage Ditch Excavation	CY	$ 15	41,300	$ 619,500
6	Internal Drainage Outlet Structure	LS	$ 10,000	1	$ 10,000
7	Stockpiling and Placing Topsoil (4")	SY	$ 5	32,000	$ 160,000
8	Hydromulch Seeding	SY	$ 2	71,800	$ 143,600
9	Soil Retention Blankets	SY	$ 6	32,000	$ 192,000
10	Temporary Erosion and Sediment Control (5%)	LS	$ 383,000	1	$ 383,000
11	Neighborhood Street Maintenance	LS	$ 400,000	1	$ 400,000
12	Neighborhood Safety and Security	LS	$ 100,000	1	$ 100,000
13	Mobilization (10%)	LS	$ 853,000	1	$ 853,000
				SUBTOTAL	***$ 9,382,490***
River Plantation Drive Bridge Improvements					
14	Tree protection and mitigation (low density)	AC	$ 10,000	3	$ 31,300
15	Temp Traffic Control (Detour)	MO	$ 8,000	14	$ 112,000
16	Channel Excavation	CY	$ 15	209,000	$ 3,135,000
17	Hydromulch Seeding	SY	$ 1	15,200	$ 15,200
18	Soil Retention Blankets	SY	$ 2	15,200	$ 30,400
19	Care of Water	LS	$ 50,000	1	$ 50,000
20	Bridge Expansion (60' W. 115' L)	SF	$ 90	12,900	$ 1,161,000
21	Temporary Erosion and Sediment Control (5%)	LS	$ 227,000	1	$ 227,000
22	Mobilization (10%)	LS	$ 454,000	1	$ 454,000
				SUBTOTAL	***$ 5,215,900***
Wild Dunes Channel Modifications					
23	Tree protection and mitigation (low density)	AC	$ 10,000	32	$ 322,000
24	Channel Excavation	CY	$ 15	1,180,000	$ 17,700,000
25	Hydromulch Seeding	SY	$ 2	156,000	$ 312,000
26	Soil Retention Blankets	SY	$ 6	156,000	$ 936,000
27	Care of Water	LS	$ 50,000	1	$ 50,000
28	Relocation of Water Quality Pond	LS	$ 200,000	1	$ 200,000
29	Temporary Erosion and Sediment Control (5%)	LS	$ 976,000	1	$ 976,000
30	Mobilization (10%)	LS	$ 2,050,000	1	$ 2,050,000
				SUBTOTAL	***$ 22,546,000***
				SUBTOTAL	**$ 37,144,390**
				CONTINGENCY (30%)	**$ 11,143,317**
				TOTAL PROJECT COST	**$ 48,287,707**
31	Engineering and Survey Fees (10%)	LS	$ 4,830,000	1	$ 4,830,000
32	Regulatory Permitting (3%)	LS	$ 1,450,000	1	$ 1,450,000
33	Property Acquistion for Floodwall	LS	$ 33,100,000	1	$ 33,100,000
34	Property Acquistion for Channel Modifications	LS	$ 1,200,000	1	$ 1,200,000
				PROJECT GRAND TOTAL	**$ 88,867,707**

PAY ITEM NO	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
OPERATION & MAINTENANCE					
35	Present Worth 50-year O&M Cost	LS	$ 2,190,000	1	$ 2,190,000
				ANNUAL O&M COST	**$ 2,190,000**
PROJECT GRAND TOTAL + OPERATION & MAINTENANCE					**$ 91,057,707**

Note: Estimate excludes cost of protection, relocation, and reconstruction of utilities.

This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

HALFF

ENGINEER'S OPINION OF PROBABLE OPERATION & MAINTENANCE (O&M) COST

DATE: 6/30/2017

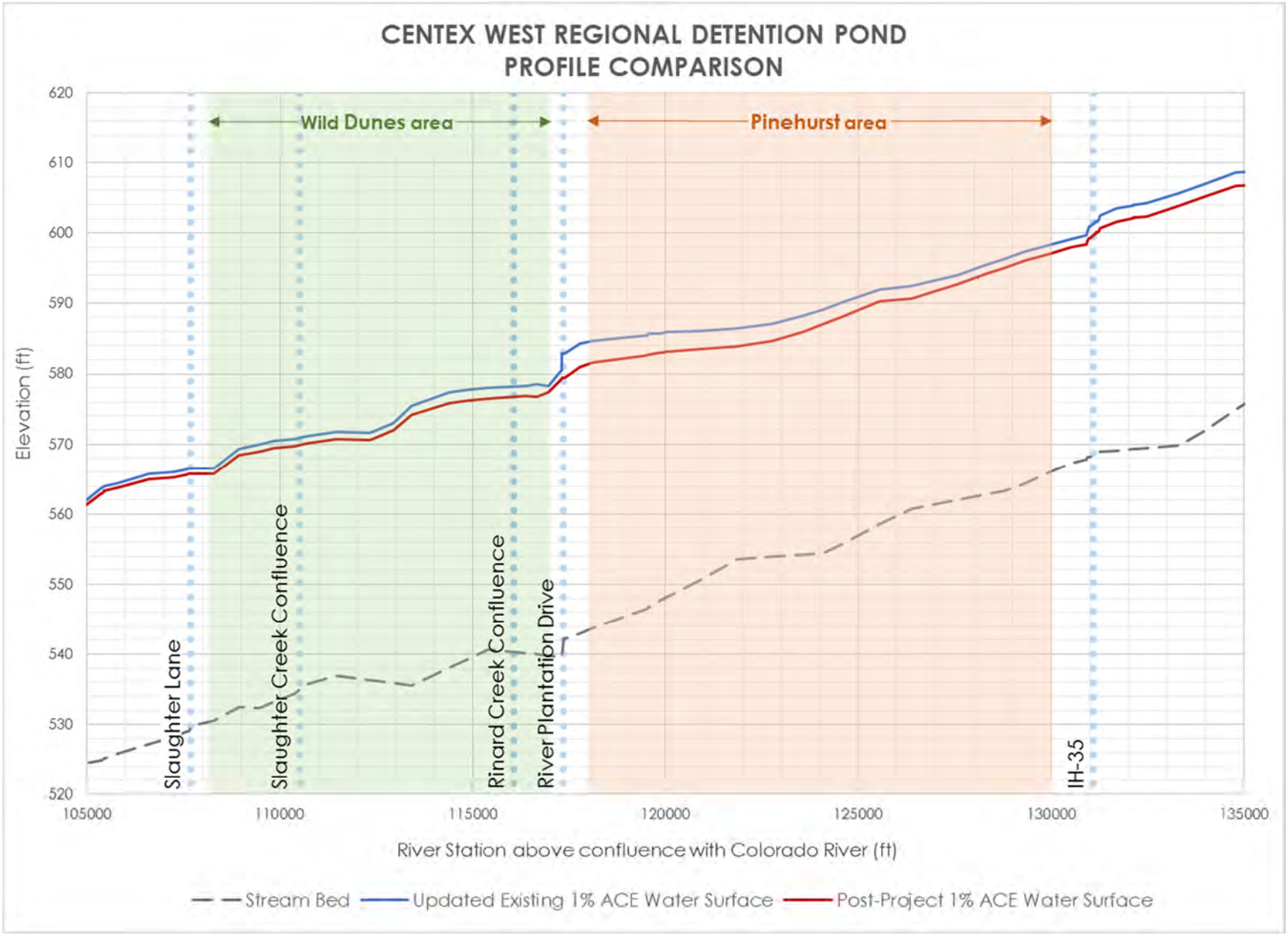
AVO: 27490B

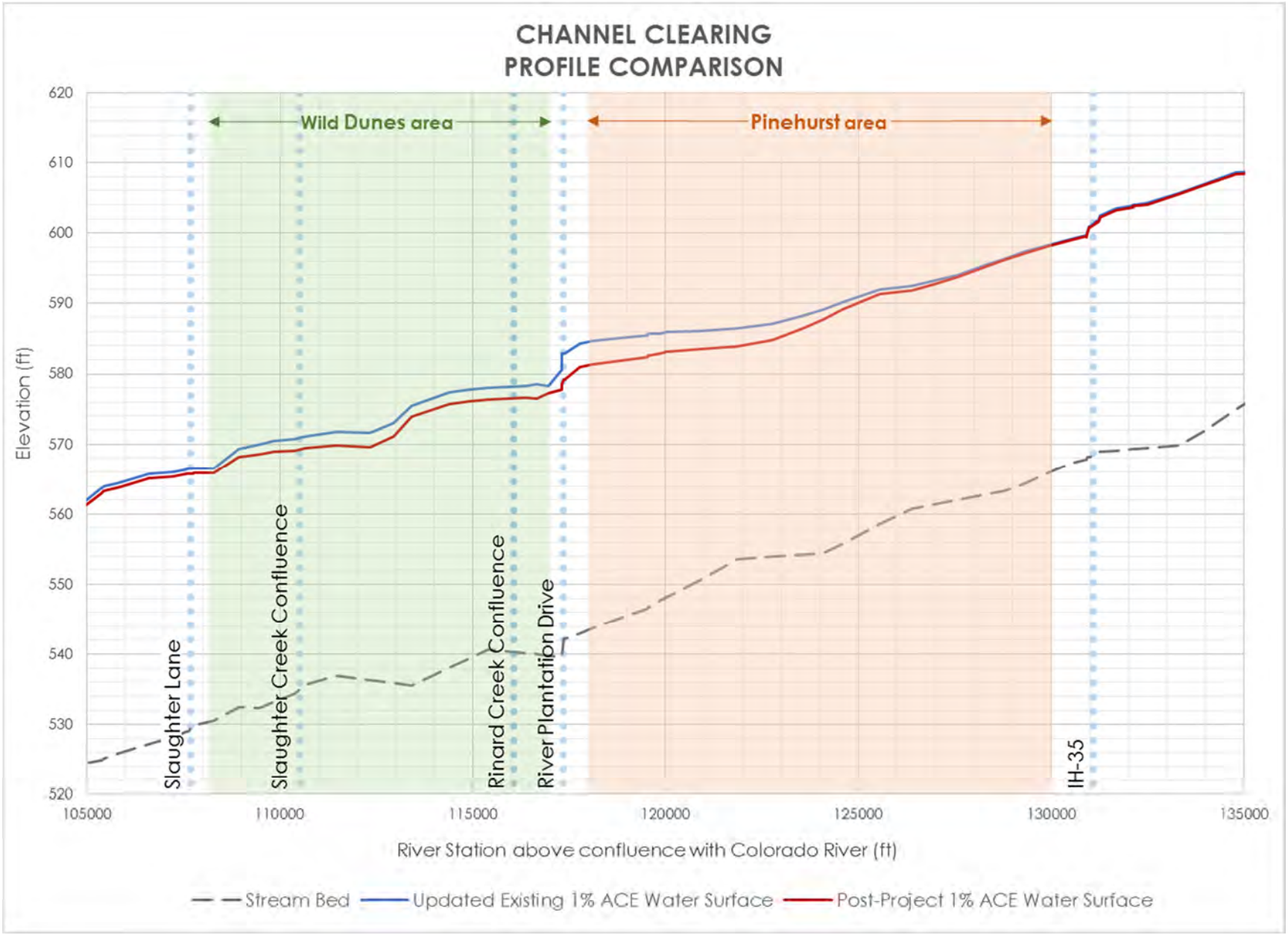
PROJECT: City of Austin Onion Creek Floodplain Modeling and Mapping Phase 2 - Risk Identification & Mitigation

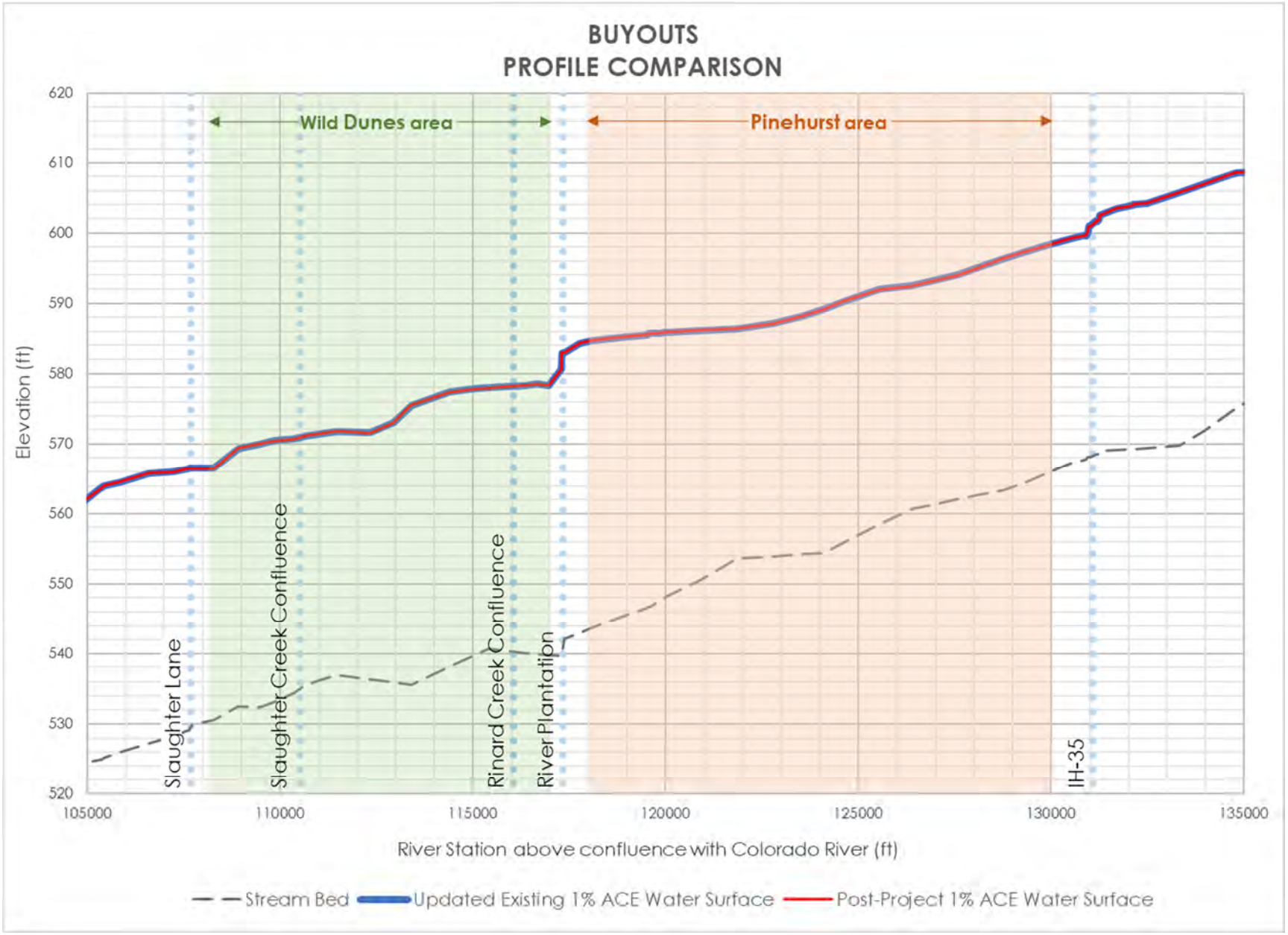
ALTERNATIVE	DESCRIPTION	UNITS	UNIT PRICE	QUANTITY	SUB-TOTALS
Centex West Regional Detention Pond					
Centex West Regional Detention Pond	Annual clearing and maintenance	LS	$ 40,000	1	$ 40,000
				Total Annual Cost	***$ 40,000***
				50-yr Present Worth O&M Cost	***$ 552,028***
Centex West Regional Detention Pond with Channel Modifications					
Centex West Offline Detention Pond	Annual clearing and maintenance	LS	$ 40,000	1	$ 40,000
Bridge Improvements & Wild Dunes Channel Modifications	Mowing (medium terrain) (biannual)	AC	$ 325	25	$ 8,125
Bridge Improvements & Wild Dunes Channel Modifications	Post flood event debris removal (20% annual chance)	LF	$ 16	2,520	$ 39,312
				Total Annual Cost	***$ 87,437***
				50-yr Present Worth O&M Cost	***$ 1,206,692***
Pinehurst Flood Protection Wall with Buyouts					
Pinehurst Flood Protection Wall	Mowing (channel side of wall) (biannual)	AC	$ 325	30	$ 9,750
Pinehurst Flood Protection Wall	Mowing (neighborhood side of wall) (6x/year)	AC	$ 325	60	$ 19,500
Pinehurst Flood Protection Wall	Annual inspection and maintenance	LS	$ 20,000	1	$ 20,000
Wild Dunes Buy Outs	Mowing (medium terrain) (6x / year)	AC	$ 325	57	$ 18,525
				Total Annual Cost	***$ 67,775***
				50-yr Present Worth O&M Cost	***$ 935,342***
Pinehurst Flood Protection Wall with Channel Modifications					
Pinehurst Flood Protection Wall	Mowing (channel side of wall) (biannual)	AC	$ 325	30	$ 9,750
Pinehurst Flood Protection Wall	Mowing (neighborhood side of wall) (6x/year)	AC	$ 325	60	$ 19,500
Pinehurst Flood Protection Wall	Annual inspection and maintenance	LS	$ 20,000	1	$ 20,000
Bridge Improvements & Wild Dunes Channel Modifications	Mowing (medium terrain) (biannual)	AC	$ 325	71	$ 23,075
Bridge Improvements & Wild Dunes Channel Modifications	Post flood event debris removal (20% annual chance)	LF	$ 16	5,540	$ 86,424
				Total Annual Cost	***$ 158,749***
				50-yr Present Worth O&M Cost	***$ 2,190,847***
Channel Clearing					
Channel Clearing	Mowing (medium terrain) (biannual)	AC	$ 325	260	$ 84,500
Channel Clearing	Post flood event debris removal (20% annual chance)	LF	$ 16	23,300	$ 363,480
				Total Annual Cost	***$ 447,980***
				50-yr Present Worth O&M Cost	***$ 6,182,438***
Pinehurst Neighborhood Buy Outs					
Pinehurst Buy Outs	Mowing (medium terrain) (6x / year)	AC	$ 325	261	$ 84,825
				Total Annual Cost	***$ 84,825***
				50-yr Present Worth O&M Cost	***$ 1,170,644***
Wild Dunes Neighborhood Buy Outs					
Wild Dunes Buy Outs	Mowing (medium terrain) (6x / year)	AC	$ 325	57	$ 18,525.00
				Total Annual Cost	***$ 18,525***
				50-yr Present Worth O&M Cost	***$ 255,658***

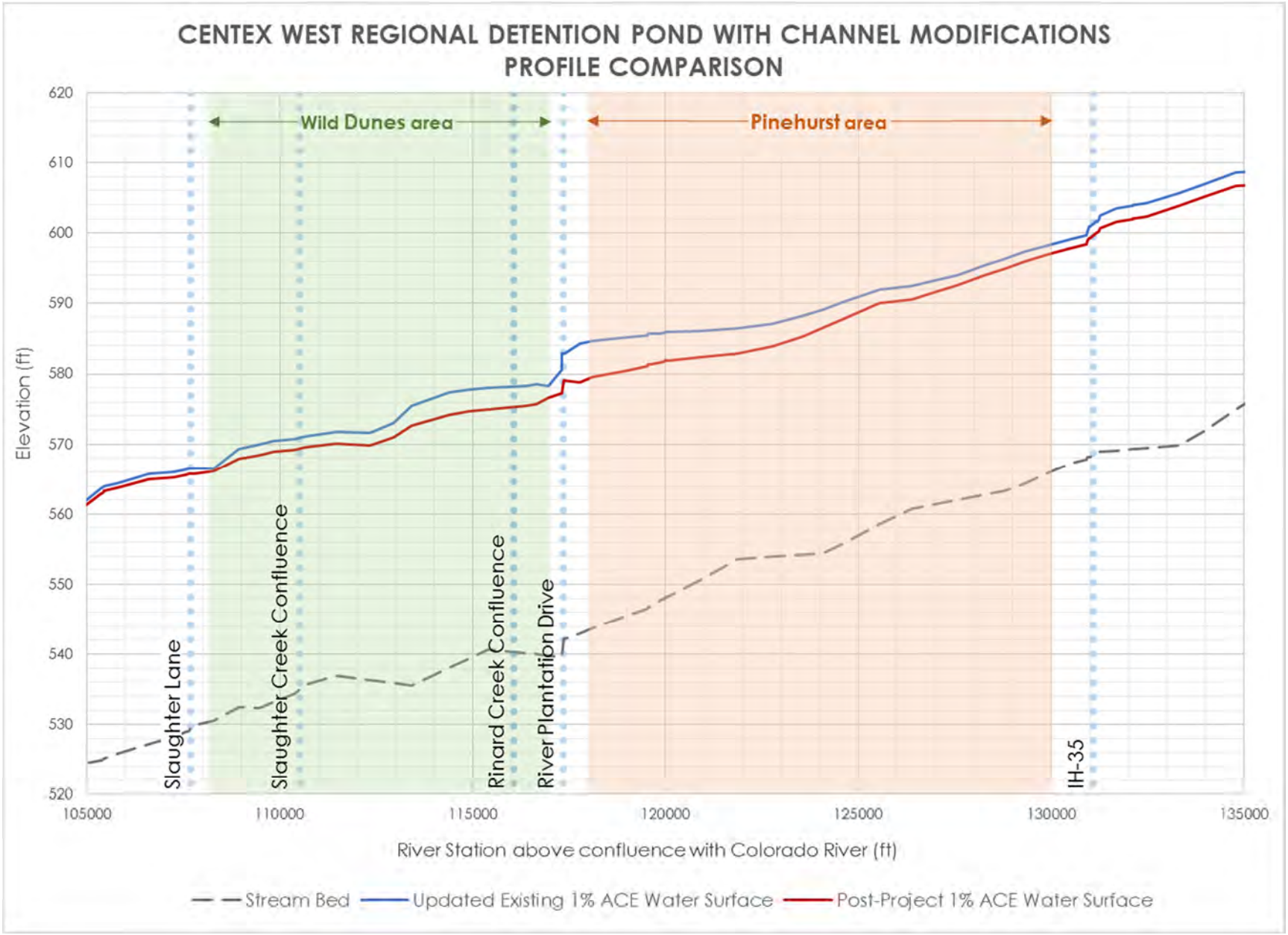
The project operation and maintenance costs were based on a 50-year outlook, assuming an ineterst rate of 7%. This statement was prepared utilizing standard cost estimate practices. It is understood and agreed that this is an estimate only, and the Engineer shall not be held liable to Owner or third party for any failure to accurately estimate the cost of the project, or any part thereof. Unit Prices are in current dollars and should be adjusted as required when schedule for project is determined.

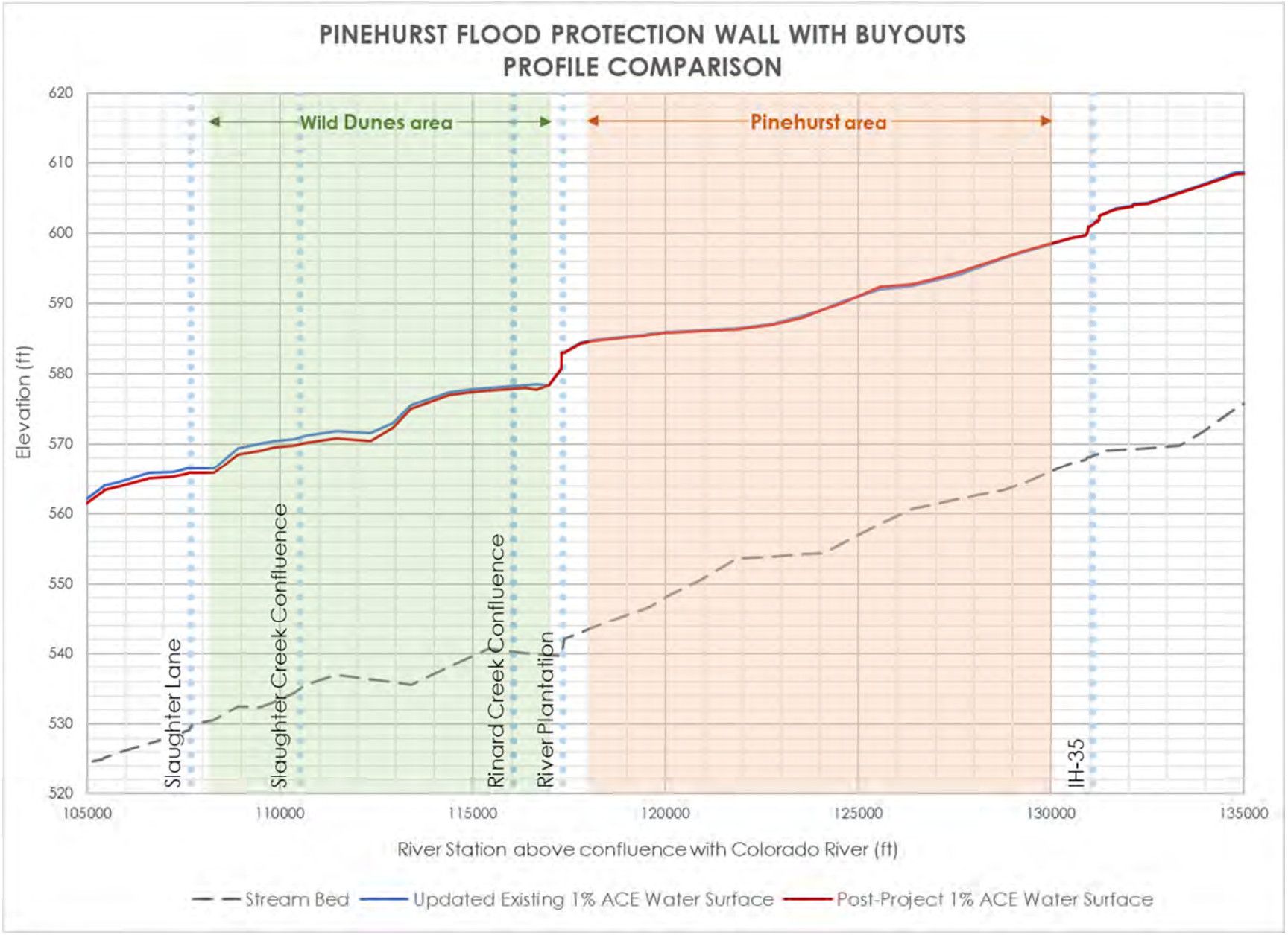
APPENDIX C: Profile Comparisons

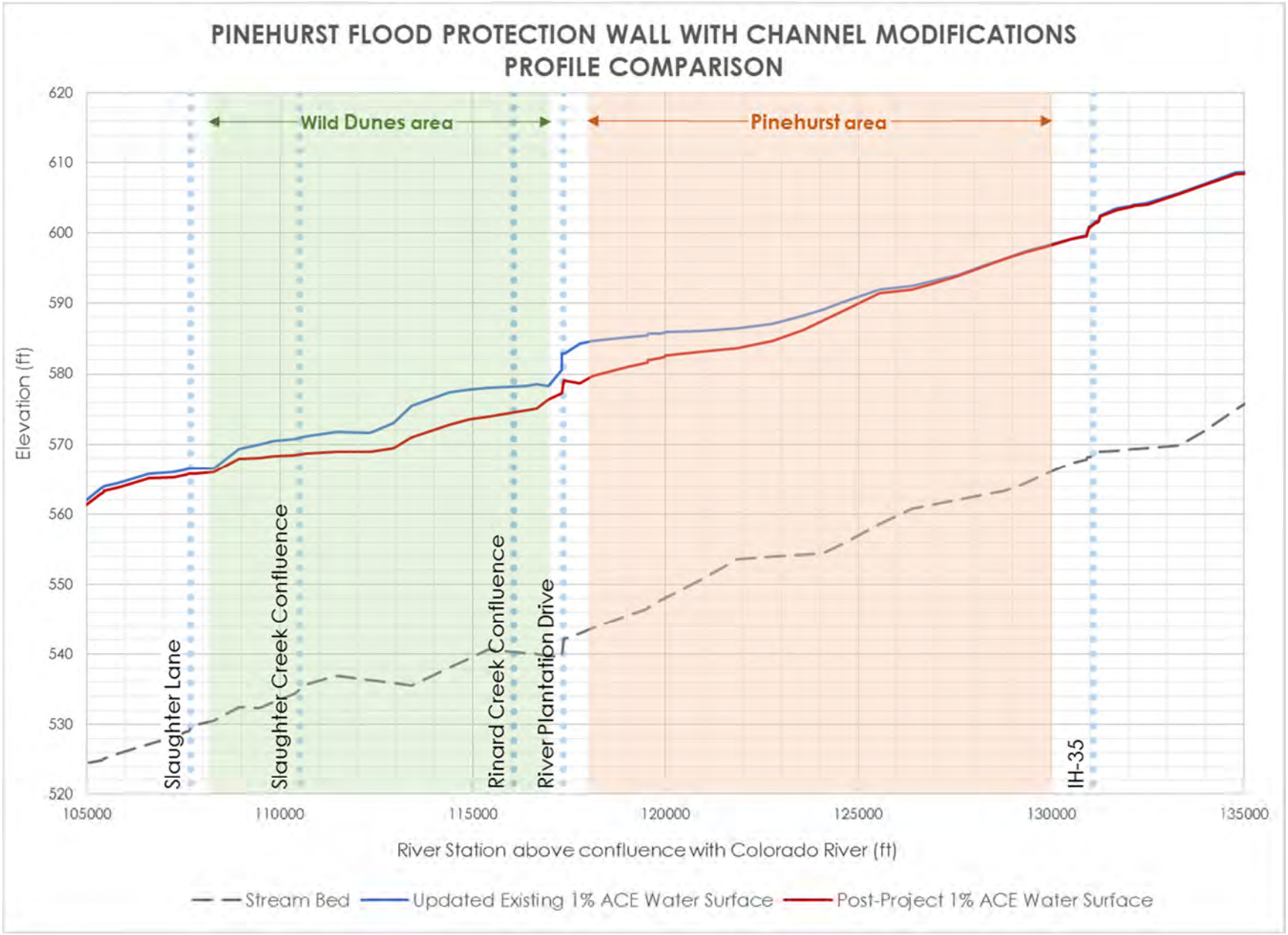

CENTEX WEST REGIONAL DETENTION POND
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation Drive
IH-35
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface


CHANNEL CLEARING
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation Drive
IH-35
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface

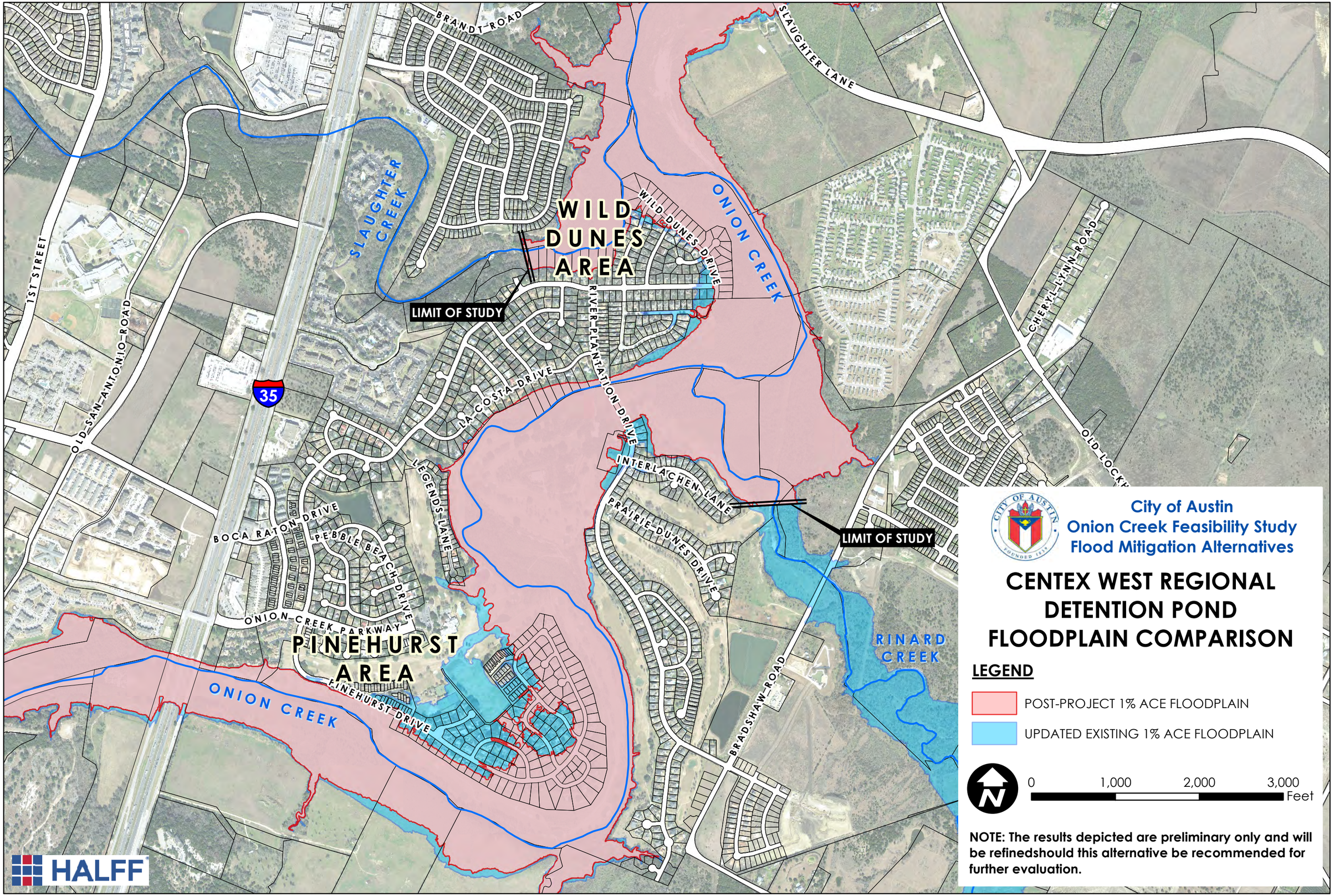

BUYOUTS
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation
IH-35
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface

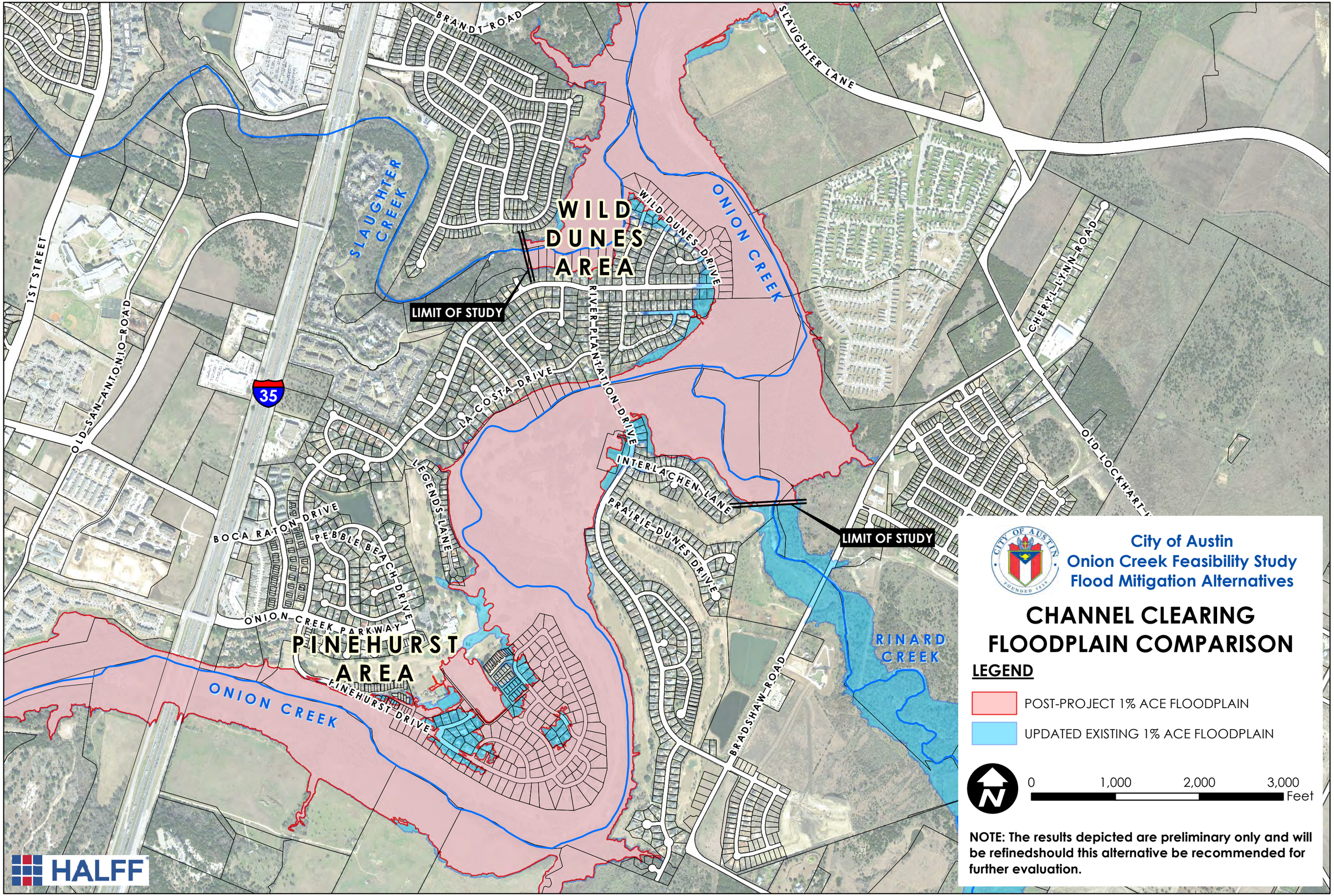

CENTEX WEST REGIONAL DETENTION POND WITH CHANNEL MODIFICATIONS
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation Drive
IH-35
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface


PINEHURST FLOOD PROTECTION WALL WITH BUYOUTS
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation
IH-35
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface


PINEHURST FLOOD PROTECTION WALL WITH CHANNEL MODIFICATIONS
PROFILE COMPARISON
Wild Dunes area
Pinehurst area
Slaughter Lane
Slaughter Creek Confluence
Rinard Creek Confluence
River Plantation Drive
IH-35
Elevation (ft)
620
610
600
590
580
570
560
550
540
530
520
105000
110000
115000
120000
125000
130000
135000
River Station above confluence with Colorado River (ft)
Stream Bed
Updated Existing 1% ACE Water Surface
Post-Project 1% ACE Water Surface

APPENDIX D: Floodplain Comparisons


BRANDT ROAD
SLAUGHTER LANE
SLAUGHTER CREEK
WILD DUNES AREA
WILD DUNES DRIVE
ONION CREEK
LIMIT OF STUDY
1ST STREET
OLD SAN ANTONIO ROAD
35
RIVER PLANTATION DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
OLD LOCKHART
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
LEGENDS LANE
BOCA RATON DRIVE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
PINEHURST AREA
PINEHURST DRIVE
ONION CREEK
BRADSHAW ROAD
RINARD CREEK
LIMIT OF STUDY
HALFF
City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives
CENTEX WEST REGIONAL DETENTION POND FLOODPLAIN COMPARISON
LEGEND
POST-PROJECT 1% ACE FLOODPLAIN
UPDATED EXISTING 1% ACE FLOODPLAIN
N
0
1,000
2,000
3,000
Feet
NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.


BRANDT ROAD
SLAUGHTER LANE
SLAUGHTER CREEK
WILD DUNES AREA
WILD DUNES DRIVE
ONION CREEK
LIMIT OF STUDY
1ST STREET
OLD SAN ANTONIO ROAD
35
RIVER PLANTATION DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
OLD LOCKHART
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
LEGENDS LANE
BOCA RATON DRIVE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
PINEHURST AREA
PINEHURST DRIVE
ONION CREEK
RINARD CREEK
BRADSHAW ROAD
LIMIT OF STUDY
HALFF
City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives
CHANNEL CLEARING FLOODPLAIN COMPARISON
LEGEND
POST-PROJECT 1% ACE FLOODPLAIN
UPDATED EXISTING 1% ACE FLOODPLAIN
N
0
1,000
2,000
3,000
Feet
NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

BRANDT ROAD
SLAUGHTER LANE
SLAUGHTER CREEK
WILD DUNES AREA
WILD DUNES DRIVE
ONION CREEK
LIMIT OF STUDY
1ST STREET
OLD SAN ANTONIO ROAD
35
RIVER PLANTATION DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
OLD LOCKHART
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
LEGENDS LANE
BOCA RATON DRIVE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
PINEHURST AREA
PINEHURST DRIVE
ONION CREEK
RINARD CREEK
BRADSHAW ROAD
HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives

BUYOUTS FLOODPLAIN COMPARISON

LEGEND

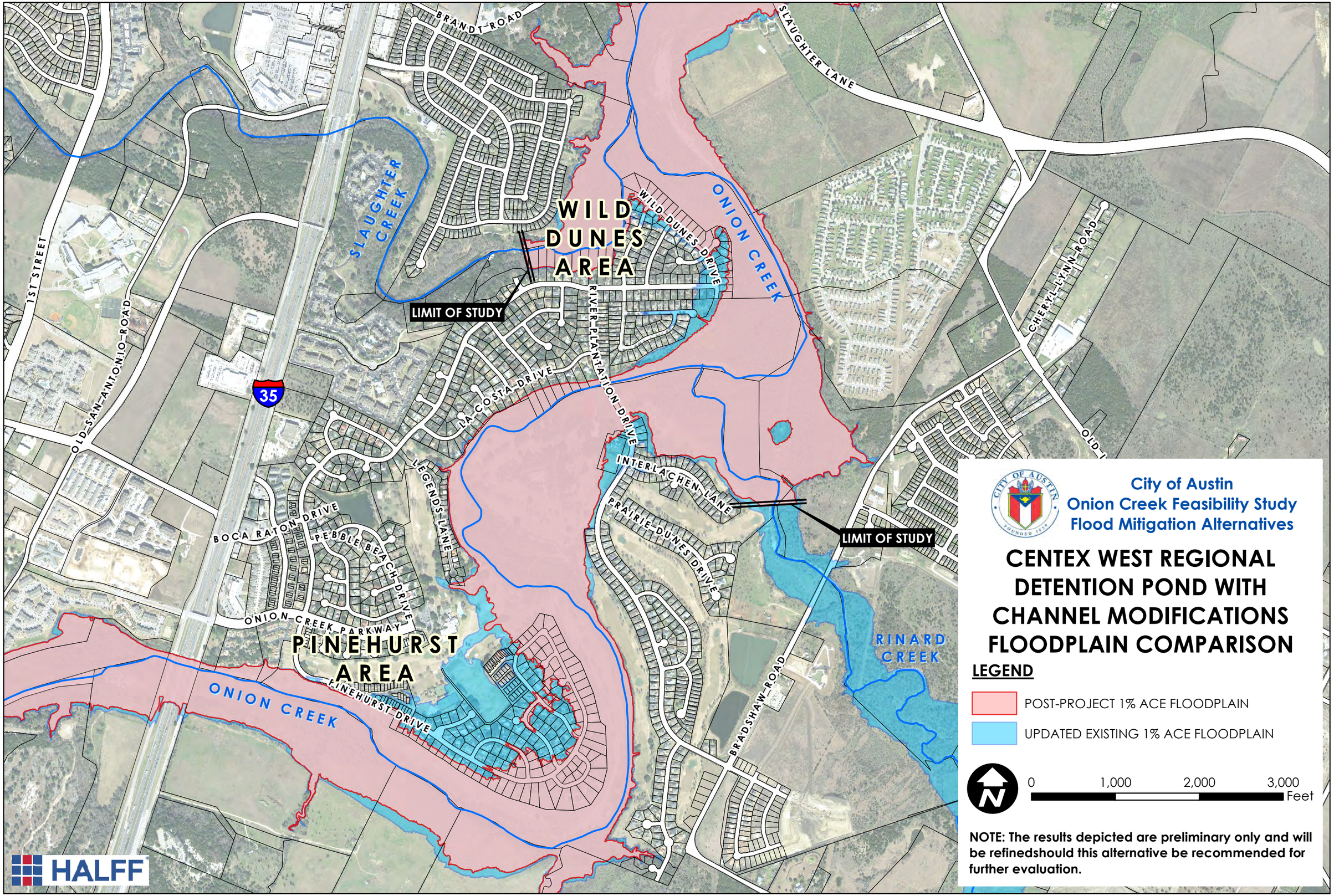
POST-PROJECT 1% ACE FLOODPLAIN

UPDATED EXISTING 1% ACE FLOODPLAIN

N

0 1,000 2,000 3,000 Feet

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.



City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives

CENTEX WEST REGIONAL DETENTION POND WITH CHANNEL MODIFICATIONS FLOODPLAIN COMPARISON

LEGEND

- POST-PROJECT 1% ACE FLOODPLAIN
- UPDATED EXISTING 1% ACE FLOODPLAIN

0 1,000 2,000 3,000 Feet

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

HALFF

BRANDT ROAD
SLAUGHTER LANE
SLAUGHTER CREEK
WILD DUNES AREA
WILD DUNES DRIVE
ONION CREEK
1ST STREET
OLD SAN ANTONIO ROAD
LIMIT OF STUDY
RIVER PLANTATION DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
35
INTERLACHEN LANE
LEGENDS LANE
BOCA RATON DRIVE
PEBBLE BEACH DRIVE
PRAIRIE DUNES DRIVE
ONION CREEK PARKWAY
PINEHURST AREA
PINEHURST DRIVE
ONION CREEK
BRADSHAW ROAD
RINARD CREEK
LIMIT OF STUDY

HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives

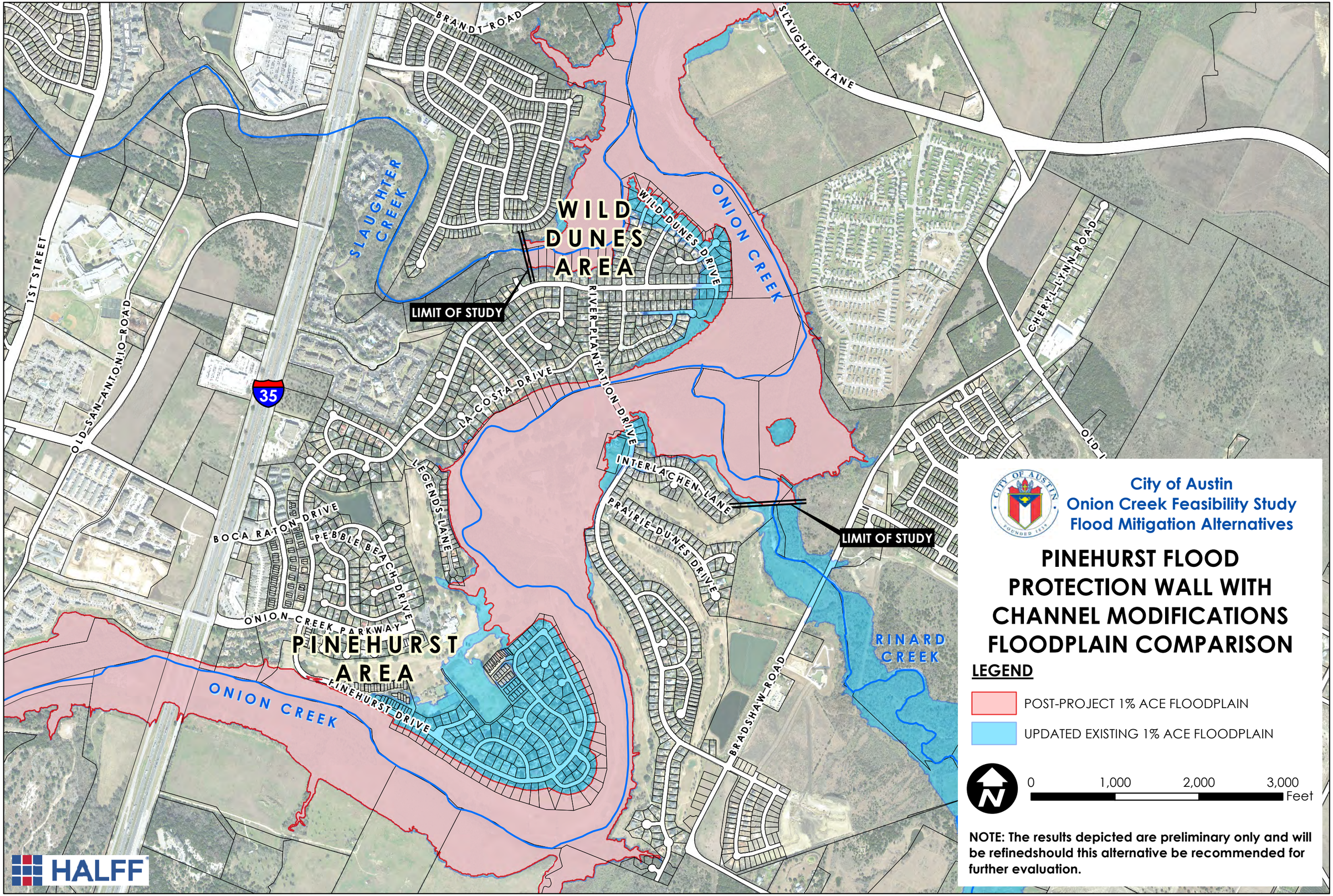
PINEHURST FLOOD PROTECTION WALL WITH BUYOUTS FLOODPLAIN COMPARISON

LEGEND

- POST-PROJECT 1% ACE FLOODPLAIN
- UPDATED EXISTING 1% ACE FLOODPLAIN

0 1,000 2,000 3,000 Feet

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.


BRANDT ROAD
SLAUGHTER LANE
SLAUGHTER CREEK
WILD DUNES AREA
WILD DUNES DRIVE
ONION CREEK
1ST STREET
OLD SAN ANTONIO ROAD
LIMIT OF STUDY
RIVER PLANTATION DRIVE
LA COSTA DRIVE
INTERLACHEN LANE
CHERYL LYNN ROAD
35
LEGENDS LANE
BOCA RATON DRIVE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
PINEHURST AREA
PINEHURST DRIVE
ONION CREEK
PRAIRIE DUNES DRIVE
LIMIT OF STUDY
BRADSHAW ROAD
RINARD CREEK
HALFF
City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives
PINEHURST FLOOD PROTECTION WALL WITH CHANNEL MODIFICATIONS FLOODPLAIN COMPARISON
LEGEND
POST-PROJECT 1% ACE FLOODPLAIN
UPDATED EXISTING 1% ACE FLOODPLAIN
0
1,000
2,000
3,000
Feet
NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

APPENDIX E: Benefit-Cost Analysis

APPENDIX E KEY

Flood Source - Waterway that is the flood source to the designated property

Property ID - Travis County Appraisal District property identification number

Address - Property address and location

FFE Source - How the finished floor elevation was estimated

FFE - Finished floor elevation of structure on designated property

SBE - Stream bed elevation

SQFT_Live - Square foot of living area based on County's appraisal district information

Type of Construction - Material used for structure on designated property

CAD Improvement Value - Appraisal district's improvement property value ($)

CAD Land Value - Appraisal district's land property value ($)

Total Cad - Appraisal district's total property value ($)

Value/SQFT - Total property value divided by square foot of living space

Structure Value - Value of structure on designated property ($)

Benefits by Alternative - Estimated monetary value of benefits for each flood mitigation alternative ($)

Count	Flood Source	Property ID	Address	FFE Source	FFE	SBE	SQFT_Live	Type of Construction	CAD Improvement Value	CAD Land Value	Total Cad	Value/SQFT	Structure Value	Benefits by Alternative					
														Buyouts	Centex West Pond	Channel Clearing	Centex West Pond with Channel Modifications	Flood Protection Wall Only	Flood Protection Wall with Channel Modifications
1	Onion Creek	351248	11001 Champions Lane	USACE 2005/Travis Co Survey +0.27'	586.39	554.44	2823	Masonry	$ 385,141	$ 37,500	$ 422,641	64.71	182676.33	$ 38,390	$ 8,526	$ 6,558	$ 9,281	$ 38,390	$ 38,390
2	Onion Creek	351247	11003 Champions Lane	USACE 2005/Travis Co Survey +0.27'	586.25	554.44	2850	Masonry	$ 158,813	$ 37,500	$ 196,313	64.71	184423.5	$ 40,999	$ 9,381	$ 4,344	$ 10,001	$ 40,999	$ 40,999
3	Onion Creek	351256	11100 Champions Lane	USACE 2005/Travis Co Survey +0.27'	588.71	555.80	2740	Wood	$ 268,658	$ 37,500	$ 306,158	69	189060	$ 28,592	$ 6,354	$ 4,193	$ 7,170	$ 27,653	$ 27,653
4	Onion Creek	351246	11101 Champions Lane	USACE 2005/Travis Co Survey +0.27'	587.62	555.80	2776	Masonry	$ 307,435	$ 57,750	$ 365,185	65.62	182161.12	$ 34,497	$ 8,295	$ 5,949	$ 10,327	$ 34,497	$ 34,497
5	Onion Creek	351257	11102 Champions Lane	USACE 2005/Travis Co Survey +0.27'	588.63	555.80	2792	Masonry	$ 296,421	$ 37,500	$ 333,921	65.62	183211.04	$ 30,415	$ 6,759	$ 2,726	$ 7,404	$ 29,416	$ 29,416
6	Onion Creek	351245	11103 Champions Lane	USACE 2005/Travis Co Survey +0.27'	588.23	555.80	2480	Masonry	$ 249,430	$ 57,750	$ 307,180	66.62	165217.6	$ 27,361	$ 6,154	$ 2,677	$ 6,731	$ 27,361	$ 27,361
7	Onion Creek	351258	11104 Champions Lane	USACE 2005/Travis Co Survey +0.27'	589.73	555.80	2700	Masonry	$ 300,024	$ 37,500	$ 337,524	65.62	177174	$ 26,810	$ 5,829	$ 2,230	$ 6,610	$ 25,929	$ 25,929
8	Onion Creek	351244	11105 Champions Lane	USACE 2005/Travis Co Survey +0.27'	588.32	555.80	3003	Masonry	$ 304,215	$ 57,750	$ 361,965	63.87	191801.61	$ 32,216	$ 7,163	$ 3,008	$ 7,836	$ 32,216	$ 32,216
9	Onion Creek	351243	11107 Champions Lane	USACE 2005/Travis Co Survey +0.27'	589.39	555.80	4144	Masonry	$ 434,658	$ 63,000	$ 497,658	63.87	264677.28	$ 39,918	$ 8,750	$ 3,580	$ 9,904	$ 39,918	$ 39,918
10	Onion Creek	351242	11109 Champions Lane	USACE 2005/Travis Co Survey +0.27'	588.21	558.52	2594	Masonry	$ 315,961	$ 63,000	$ 378,961	66.62	172812.28	$ 35,160	$ 7,506	$ 4,681	$ 8,231	$ 35,160	$ 35,160
11	Onion Creek	351241	11111 Champions Lane	USACE 2005/Travis Co Survey +0.27'	589.41	558.52	3380	Masonry	$ 358,799	$ 63,000	$ 421,799	63.87	215880.6	$ 36,056	$ 7,771	$ 2,649	$ 8,552	$ 36,056	$ 36,056
12	Onion Creek	351240	11113 Champions Lane	USACE 2005/Travis Co Survey +0.27'	589.17	558.52	2877	Masonry	$ 272,376	$ 57,750	$ 330,126	64.71	186170.67	$ 36,340	$ 8,117	$ 4,814	$ 8,787	$ 36,340	$ 36,340
13	Onion Creek	351333	4607 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	592.26	561.36	2090	Masonry	$ 248,075	$ 41,250	$ 289,325	69.57	145401.3	$ 19,107	$ 3,929	$ 1,489	$ 4,644	$ 18,480	$ 18,480
14	Onion Creek	351319	4608 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	592.42	561.36	2289	Masonry	$ 270,436	$ 43,125	$ 313,561	67.71	154988.19	$ 20,307	$ 4,172	$ 1,566	$ 4,932	$ 19,641	$ 19,641
15	Onion Creek	351318	4610 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	592.42	561.36	2587	Masonry	$ 341,224	$ 37,500	$ 378,724	66.62	172345.94	$ 20,751	$ 3,694	$ 1,280	$ 4,591	$ 20,070	$ 20,070
16	Onion Creek	351317	4612 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	591.90	560.69	2104	Masonry	$ 246,730	$ 37,500	$ 284,230	68.91	144986.64	$ 19,798	$ 4,633	$ 2,208	$ 5,366	$ 19,148	$ 19,148
17	Onion Creek	351316	4700 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	591.68	560.69	2071	Masonry	$ 255,369	$ 37,500	$ 292,869	69.57	144079.47	$ 19,909	$ 4,669	$ 2,270	$ 5,371	$ 19,255	$ 19,255
18	Onion Creek	351334	4701 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	592.21	560.69	2082	Masonry	$ 245,053	$ 37,500	$ 282,553	69.57	144844.74	$ 18,760	$ 3,837	$ 1,402	$ 4,607	$ 18,144	$ 18,144
19	Onion Creek	351315	4702 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	590.85	558.52	2059	Masonry	$ 231,138	$ 37,500	$ 268,638	69.57	143244.63	$ 21,242	$ 4,507	$ 1,422	$ 5,133	$ 20,545	$ 20,545
20	Onion Creek	351335	4703 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	591.42	560.69	2369	Masonry	$ 278,969	$ 37,500	$ 316,469	67.71	160404.99	$ 24,058	$ 5,549	$ 1,532	$ 6,357	$ 23,269	$ 23,269
21	Onion Creek	351314	4704 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	590.03	558.52	2086	Masonry	$ 234,151	$ 50,000	$ 284,151	69.57	145123.02	$ 24,164	$ 5,165	$ 1,538	$ 5,693	$ 23,370	$ 23,370
22	Onion Creek	351313	4706 Indian Wells Drive	USACE 2005/Travis Co Survey +0.27'	590.11	560.69	2596	Masonry	$ 290,862	$ 50,000	$ 340,862	66.62	172945.52	$ 29,027	$ 6,164	$ 1,779	$ 6,813	$ 28,074	$ 28,074
23	Onion Creek	351305	11001 Merion Cricket Court	USACE 2005/Travis Co Survey +0.27'	589.43	558.52	2011	Masonry	$ 242,548	$ 55,000	$ 297,548	69.57	139905.27	$ 22,449	$ 4,904	$ 1,798	$ 5,515	$ 21,712	$ 21,712
24	Onion Creek	351303	11002 Merion Cricket Court	USACE 2005/Travis Co Survey +0.27'	590.69	555.80	1962	Masonry	$ 216,508	$ 50,000	$ 266,508	70.27	137869.74	$ 16,006	$ 3,142	$ 1,682	$ 3,662	$ 15,480	$ 15,480
25	Onion Creek	351304	11003 Merion Cricket Court	USACE 2005/Travis Co Survey +0.27'	591.63	560.69	2556	Masonry	$ 262,415	$ 55,000	$ 317,415	66.62	170280.72	$ 23,979	$ 5,608	$ 2,705	$ 6,413	$ 23,192	$ 23,192
26	Onion Creek	351300	4601 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	587.30	554.22	2105	Masonry	$ 235,326	$ 37,500	$ 272,826	68.91	145055.55	$ 20,716	$ 5,177	$ 4,421	$ 5,837	$ 20,035	$ 20,035
27	Onion Creek	351367	4602 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	587.94	554.44	2598	Masonry	$ 272,976	$ 37,500	$ 310,476	66.62	173078.76	$ 25,240	$ 6,198	$ 4,474	$ 6,942	$ 24,412	$ 24,412
28	Onion Creek	351301	4603 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.08	554.44	2831	Masonry	$ 294,124	$ 41,250	$ 335,374	64.71	183194.01	$ 25,567	$ 6,339	$ 5,084	$ 7,254	$ 24,727	$ 24,727
29	Onion Creek	351366	4700 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.43	554.44	2104	Masonry	$ 243,474	$ 37,500	$ 280,974	68.91	144986.64	$ 19,715	$ 4,879	$ 3,929	$ 5,643	$ 19,068	$ 19,068
30	Onion Creek	351306	4701 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	589.73	555.80	2299	Masonry	$ 252,221	$ 50,000	$ 302,221	67.71	155665.29	$ 19,444	$ 4,061	$ 2,474	$ 4,827	$ 18,806	$ 18,806
31	Onion Creek	351365	4702 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.38	554.44	2209	Masonry	$ 240,756	$ 37,500	$ 278,256	67.71	149571.39	$ 20,062	$ 4,930	$ 4,056	$ 5,704	$ 19,403	$ 19,403
32	Onion Creek	351307	4703 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	589.20	555.80	2414	Masonry	$ 280,445	$ 50,000	$ 330,445	66.62	160820.68	$ 22,107	$ 5,365	$ 3,715	$ 6,258	$ 21,381	$ 21,381
33	Onion Creek	351364	4704 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.87	554.44	2402	Masonry	$ 260,350	$ 37,500	$ 297,850	66.62	160021.24	$ 19,072	$ 3,711	$ 2,708	$ 4,442	$ 18,446	$ 18,446
34	Onion Creek	351308	4705 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	589.19	554.44	1922	Masonry	$ 237,945	$ 50,000	$ 287,945	70.27	135058.94	$ 18,204	$ 4,426	$ 3,126	$ 5,131	$ 17,606	$ 17,606
35	Onion Creek	431207	4706 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	589.14	554.44	2123	Masonry	$ 262,114	$ 37,500	$ 299,614	68.91	146295.93	$ 17,204	$ 3,423	$ 2,440	$ 4,035	$ 16,639	$ 16,639
36	Onion Creek	351309	4707 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.88	555.80	2749	Masonry	$ 313,488	$ 37,500	$ 350,988	65.62	180389.38	$ 26,025	$ 6,299	$ 4,000	$ 7,054	$ 25,170	$ 25,170
37	Onion Creek	351229	4708 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.39	554.44	2037	Masonry	$ 258,379	$ 37,500	$ 295,879	69.57	141714.09	$ 20,571	$ 5,031	$ 3,431	$ 5,627	$ 19,895	$ 19,895
38	Onion Creek	351310	4709 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.67	555.80	2390	Masonry	$ 259,134	$ 50,000	$ 309,134	67.71	161826.9	$ 25,453	$ 5,729	$ 2,474	$ 6,453	$ 24,617	$ 24,617
39	Onion Creek	351311	4711 Merion Cricket Drive	USACE 2005/Travis Co Survey +0.27'	588.90	555.80	2328	Masonry	$ 268,182	$ 41,250	$ 309,432	67.71	157628.88	$ 25,313	$ 5,633	$ 2,323	$ 6,324	$ 24,482	$ 24,482
40	Onion Creek	557106	4700 Partage Circle	USACE 2005/Travis Co Survey +0.27'	585.63	554.22	3461	Masonry	$ 75,906	$ 43,125	$ 119,031	63.87	221054.07	$ 37,711	$ 8,681	$ 8,011	$ 9,467	$ 36,473	$ 36,473
41	Onion Creek	351215	4701 Partage Circle	USACE 2005/Travis Co Survey +0.27'	585.79	554.22	2890	Masonry	$ 61,169	$ 41,250	$ 102,419	64.71	187011.9	$ 32,182	$ 7,359	$ 5,286	$ 8,044	$ 31,126	$ 31,126
42	Onion Creek	351220	4710 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.88	554.44	2389	Masonry	$ 246,349	$ 41,250	$ 287,599	67.71	161759.19	$ 27,155	$ 6,228	$ 3,722	$ 6,789	$ 26,263	$ 26,263
43	Onion Creek	349474	10100 Pinehurst Drive	2014 Halff FFE Survey	575.36	535.55	2537	Masonry	$ 86,060	$ 37,500	$ 123,560	66.62	169014.94	$ 23,145	$ 4,672	$ 5,386	$ 4,691	$ 1,365	$ 9,552
44	Onion Creek	349493	10101 Pinehurst Drive	2014 Halff FFE Survey	576.71	538.09	4624	Masonry	$ 75,868	$ 37,500	$ 113,368	63.87	295334.88	$ 39,819	$ 8,050	$ 9,179	$ 8,084	$ 1,982	$ 16,282
45	Onion Creek	349475	10102 Pinehurst Drive	2014 Halff FFE Survey	575.47	535.55	3363	Masonry	$ 62,948	$ 50,000	$ 112,948	63.87	214794.81	$ 28,726	$ 5,740	$ 6,645	$ 5,765	$ 1,574	$ 11,680
46	Onion Creek	349492	10103 Pinehurst Drive	2014 Halff FFE Survey	576.57	538.09	2095	Masonry	$ 56,868	$ 50,000	$ 106,868	69.57	145749.15	$ 20,253	$ 4,156	$ 4,735	$ 4,172	$ 1,126	$ 8,423
47	Onion Creek	351361	11130 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	594.44	562.80	3141	Masonry	$ 291,000	$ 52,500	$ 343,500	63.87	200615.67	$ 29,515	$ 6,566	$ 2,126	$ 7,756	$ 29,515	$ 29,515
48	Onion Creek	351362	11132 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	595.17	562.80	3223	Masonry	$ 258,346	$ 52,500	$ 310,846	63.87	205853.01	$ 24,214	$ 3,939	$ 711	$ 5,173	$ 24,214	$ 24,214
49	Onion Creek	351342	11136 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	594.42	562.80	2683	Masonry	$ 264,075	$ 52,500	$ 316,575	65.62	176058.46	$ 22,407	$ 3,873	$ 567	$ 4,796	$ 22,407	$ 22,407
50	Onion Creek	351352	11204 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	593.05	561.36	2170	Masonry	$ 226,578	$ 52,500	$ 279,078	68.91	149534.7	$ 17,787	$ 3,133	$ 1,020	$ 3,967	$ 17,787	$ 17,787
51	Onion Creek	351339	11205 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	592.83	561.36	2101	Masonry	$ 222,876	$ 37,500	$ 260,376	68.91	144779.91	$ 17,682	$ 3,179	$ 1,117	$ 3,979	$ 17,101	$ 17,101
52	Onion Creek	351353	11206 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	592.25	561.36	3003	Masonry	$ 330,144	$ 52,500	$ 382,644	63.87	191801.61	$ 27,022	$ 6,260	$ 2,910	$ 7,219	$ 27,022	$ 27,022
53	Onion Creek	351338	11207 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	592.48	561.36	2186	Masonry	$ 253,240	$ 37,500	$ 290,740	68.91	150637.26	$ 19,606	$ 4,015	$ 1,478	$ 4,773	$ 18,962	$ 18,962
54	Onion Creek	351354	11208 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	591.11	561.36	3385	Masonry	$ 365,101	$ 52,500	$ 417,601	63.87	216199.95	$ 35,674	$ 7,610	$ 1,991	$ 8,423	$ 35,674	$ 35,674
55	Onion Creek	351337	11209 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	591.71	560.69	2179	Masonry	$ 260,964	$ 37,500	$ 298,464	68.91	150154.89	$ 22,353	$ 5,198	$ 2,379	$ 5,909	$ 21,619	$ 21,619
56	Onion Creek	351355	11210 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	591.67	561.36	1891	Masonry	$ 205,774	$ 57,750	$ 263,524	71	134261	$ 19,909	$ 4,618	$ 2,133	$ 5,251	$ 19,909	$ 19,909
57	Onion Creek	351336	11211 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	591.26	560.69	2495	Wood	$ 278,519	$ 37,500	$ 316,019	70.06	174799.7	$ 27,347	$ 5,893	$ 1,633	$ 6,714	$ 26,449	$ 26,449
58	Onion Creek	351356	11212 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	590.45	560.69	3766	Masonry	$ 315,209	$ 57,750	$ 372,959	63.87	240534.42	$ 41,958	$ 8,565	$ 2,384	$ 9,532	$ 41,958	$ 41,958
59	Onion Creek	351312	11213 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	590.41	560.69	2449	Masonry	$ 326,911	$ 55,000	$ 381,911	66.62	163152.38	$ 26,583	$ 5,750	$ 1,691	$ 6,349	$ 25,711	$ 25,711
60	Onion Creek	351357	11214 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	590.07	560.69	2586	Masonry	$ 237,317	$ 57,750	$ 295,067	66.62	172279.32	$ 33,804	$ 7,462	$ 4,238	$ 8,136	$ 33,804	$ 33,804
61	Onion Creek	351358	11216 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	589.52	560.69	2685	Masonry	$ 292,538	$ 57,750	$ 350,288	65.62	176189.7	$ 36,877	$ 7,976	$ 1,850	$ 8,723	$ 36,877	$ 36,877
62	Onion Creek	351359	11218 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	589.22	560.69	2582	Masonry	$ 241,104	$ 63,000	$ 304,104	66.62	172012.84	$ 37,428	$ 8,195	$ 2,118	$ 8,777	$ 37,428	$ 37,428
63	Onion Creek	351360	11220 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	589.34	558.52	2854	Masonry	$ 304,898	$ 37,500	$ 342,398	64.71	184682.34	$ 35,807	$ 8,030	$ 4,719	$ 8,688	$ 35,807	$ 35,807
64	Onion Creek	351252	11222 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	588.99	555.80	2588	Wood	$ 295,383	$ 37,500	$ 332,883	70.06	181315.28	$ 30,879	$ 6,652	$ 2,384	$ 7,338	$ 29,866	$ 29,866
65	Onion Creek	351253	11224 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	588.18	555.80	2361	Masonry	$ 261,331	$ 37,500	$ 298,831	67.71	159863.31	$ 30,785	$ 7,188	$ 4,742	$ 7,732	$ 29,774	$ 29,774
66	Onion Creek	351228	11225 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.99	555.80	3382	Masonry	$ 344,940	$ 41,250	$ 386,190	63.87	215976.41	$ 35,143	$ 7,960	$ 3,926	$ 8,826	$ 33,989	$ 33,989
67	Onion Creek	351254	11226 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.99	555.80	1961	Masonry	$ 209,226	$ 37,500	$ 246,726	70.27	137799.47	$ 23,659	$ 5,198	$ 2,252	$ 5,711	$ 22,882	$ 22,882
68	Onion Creek	351255	11228 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.79	555.80	2071	Masonry	$ 249,625	$ 37,500	$ 287,125	69.57	144079.47	$ 24,153	$ 5,440	$ 2,628	$ 5,944	$ 23,360	$ 23,360
69	Onion Creek	351227	11231 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	588.43	554.44	2462	Masonry	$ 214,433	$ 41,250	$ 255,683	66.62	164018.44	$ 23,128	$ 5,703	$ 4,323	$ 6,481	$ 22,369	$ 22,369

Count	Flood Source	Property ID	Address	FFE Source	FFE	SBE	SQFT_Live	Type of Construction	CAD Improvement Value	CAD Land Value	Total Cad	Value/SQFT	Structure Value	Benefits by Alternative					
														Buyouts	Centex West Pond	Channel Clearing	Centex West Pond with Channel Modifications	Flood Protection Wall Only	Flood Protection Wall with Channel Modifications
70	Onion Creek	351249	11232 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.90	554.44	4003	Masonry	$ 396,827	$ 63,000	$ 459,827	63.87	255671.61	$ 48,574	$ 13,650	$ 9,427	$ 14,646	$ 48,574	$ 48,574
71	Onion Creek	351250	11234 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.35	554.44	2568	Masonry	$ 51,106	$ 57,750	$ 108,856	66.62	171080.16	$ 34,170	$ 7,889	$ 6,368	$ 8,549	$ 34,170	$ 34,170
72	Onion Creek	351251	11236 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.28	554.44	2422	Masonry	$ 48,886	$ 57,750	$ 106,636	66.62	161353.64	$ 37,392	$ 8,715	$ 4,952	$ 9,066	$ 37,392	$ 37,392
73	Onion Creek	351231	11238 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.75	554.22	3740	Masonry	$ 111,766	$ 52,500	$ 164,266	63.87	238873.8	$ 48,951	$ 10,871	$ 9,229	$ 11,842	$ 48,951	$ 48,951
74	Onion Creek	351219	11239 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.95	554.22	2441	Masonry	$ 92,490	$ 37,500	$ 129,990	66.62	162619.42	$ 32,136	$ 7,582	$ 6,464	$ 8,144	$ 31,081	$ 31,081
75	Onion Creek	351232	11240 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.76	554.22	2950	Masonry	$ 128,458	$ 52,500	$ 180,958	64.71	190894.5	$ 44,950	$ 10,541	$ 6,488	$ 10,879	$ 44,950	$ 44,950
76	Onion Creek	351233	11242 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.10	554.22	3201	Masonry	$ 57,139	$ 52,500	$ 109,639	63.87	204447.87	$ 43,671	$ 10,020	$ 9,003	$ 10,865	$ 43,671	$ 43,671
77	Onion Creek	351218	11243 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.35	554.22	2438	Masonry	$ 234,048	$ 37,500	$ 271,548	66.62	162419.56	$ 27,197	$ 6,296	$ 4,182	$ 6,858	$ 26,304	$ 26,304
78	Onion Creek	351234	11244 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.02	554.22	3462	Masonry	$ 64,005	$ 52,500	$ 116,505	63.87	221117.94	$ 46,233	$ 10,420	$ 9,620	$ 11,325	$ 46,233	$ 46,233
79	Onion Creek	351217	11245 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.32	554.22	2444	Masonry	$ 92,131	$ 37,500	$ 129,631	66.62	162819.28	$ 32,971	$ 7,537	$ 6,818	$ 8,176	$ 31,888	$ 31,888
80	Onion Creek	351235	11246 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.20	554.22	3741	Masonry	$ 70,061	$ 52,500	$ 122,561	63.87	238937.67	$ 47,655	$ 11,165	$ 10,477	$ 12,061	$ 47,655	$ 47,655
81	Onion Creek	351216	11247 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.02	554.22	2511	Masonry	$ 170,166	$ 37,500	$ 207,666	66.62	167282.82	$ 27,754	$ 6,467	$ 5,770	$ 7,070	$ 26,843	$ 26,843
82	Onion Creek	351236	11248 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.04	554.22	3016	Masonry	$ 52,227	$ 52,500	$ 104,727	63.87	192631.92	$ 38,283	$ 9,048	$ 8,785	$ 9,731	$ 38,283	$ 38,283
83	Onion Creek	351237	11250 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.99	553.92	3178	Masonry	$ 65,312	$ 52,500	$ 117,812	63.87	202978.86	$ 39,641	$ 9,540	$ 9,536	$ 11,780	$ 39,641	$ 39,641
84	Onion Creek	351213	11251 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.22	553.92	2226	Masonry	$ 54,007	$ 37,500	$ 91,507	67.71	150722.46	$ 29,012	$ 8,186	$ 6,973	$ 8,761	$ 28,059	$ 28,059
85	Onion Creek	351238	11252 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.18	553.92	2830	Masonry	$ 121,890	$ 52,500	$ 174,390	64.71	183129.3	$ 39,469	$ 9,194	$ 9,498	$ 9,956	$ 39,469	$ 39,469
86	Onion Creek	557105	11253 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.36	553.92	2430	Masonry	$ 54,857	$ 37,500	$ 92,357	66.62	161886.6	$ 34,039	$ 7,786	$ 7,981	$ 8,449	$ 32,921	$ 32,921
87	Onion Creek	431191	11254 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.08	553.92	3393	Masonry	$ 60,060	$ 52,500	$ 112,560	63.87	216710.91	$ 44,614	$ 10,007	$ 10,839	$ 10,886	$ 44,614	$ 44,614
88	Onion Creek	350672	11256 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.02	553.92	3191	Masonry	$ 62,657	$ 52,500	$ 115,157	63.87	203809.17	$ 41,593	$ 9,504	$ 10,430	$ 10,247	$ 41,593	$ 41,593
89	Onion Creek	350757	11257 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.80	553.92	2765	Masonry	$ 140,177	$ 50,000	$ 190,177	65.62	181439.3	$ 38,091	$ 8,730	$ 9,581	$ 9,413	$ 36,840	$ 36,840
90	Onion Creek	431192	11258 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.11	553.92	3432	Masonry	$ 162,137	$ 52,500	$ 214,637	63.87	219201.84	$ 43,584	$ 10,430	$ 11,370	$ 11,122	$ 43,584	$ 43,584
91	Onion Creek	350756	11259 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.10	553.92	2337	Wood	$ 132,395	$ 37,500	$ 169,895	71.23	166464.51	$ 38,685	$ 9,225	$ 10,234	$ 9,542	$ 37,415	$ 37,415
92	Onion Creek	431193	11260 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.43	553.92	3113	Masonry	$ 61,095	$ 52,500	$ 113,595	63.87	198827.31	$ 43,059	$ 10,090	$ 11,178	$ 10,857	$ 43,059	$ 43,059
93	Onion Creek	350748	11262 Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.53	553.58	2580	Masonry	$ 203,214	$ 57,750	$ 260,964	66.62	171879.6	$ 35,493	$ 8,059	$ 9,110	$ 8,698	$ 35,493	$ 35,493
94	Onion Creek	350749	4601 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.39	553.58	2636	Masonry	$ 53,252	$ 52,500	$ 105,752	65.62	172974.32	$ 36,459	$ 8,380	$ 9,441	$ 9,031	$ 36,459	$ 36,459
95	Onion Creek	350755	4602 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.58	553.92	2566	Masonry	$ 55,408	$ 50,000	$ 105,408	66.62	170946.92	$ 36,809	$ 8,600	$ 9,464	$ 9,254	$ 35,601	$ 35,601
96	Onion Creek	350750	4603 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	582.89	553.58	1870	Wood	$ 83,680	$ 44,625	$ 128,305	74.75	139782.5	$ 32,945	$ 7,877	$ 8,801	$ 8,105	$ 31,863	$ 31,863
97	Onion Creek	431199	4604 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.98	553.92	2273	Masonry	$ 53,340	$ 50,000	$ 103,340	67.71	153904.83	$ 31,241	$ 7,238	$ 7,983	$ 7,789	$ 30,216	$ 30,216
98	Onion Creek	350751	4605 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.32	553.58	3316	Masonry	$ 51,178	$ 44,625	$ 95,803	63.87	211792.92	$ 46,707	$ 11,084	$ 12,286	$ 11,747	$ 45,173	$ 45,173
99	Onion Creek	351377	4606 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.88	553.92	2371	Masonry	$ 105,099	$ 37,500	$ 142,599	67.71	160540.41	$ 23,014	$ 5,842	$ 6,296	$ 6,499	$ 22,259	$ 22,259
100	Onion Creek	350752	4607 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	583.19	553.58	2536	Masonry	$ 46,902	$ 44,625	$ 91,527	66.62	168948.32	$ 38,642	$ 9,216	$ 10,249	$ 9,606	$ 37,373	$ 37,373
101	Onion Creek	351376	4608 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.64	553.92	2843	Masonry	$ 229,195	$ 37,500	$ 266,695	64.71	183970.53	$ 22,936	$ 5,065	$ 5,455	$ 5,848	$ 22,183	$ 22,183
102	Onion Creek	350753	4609 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.64	553.58	2380	Masonry	$ 47,899	$ 44,625	$ 92,524	67.71	161149.8	$ 27,448	$ 6,435	$ 6,928	$ 6,949	$ 26,547	$ 26,547
103	Onion Creek	350754	4611 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	584.77	553.58	2294	Masonry	$ 47,877	$ 44,625	$ 92,502	67.71	155326.74	$ 26,201	$ 6,166	$ 6,621	$ 6,661	$ 25,341	$ 25,341
104	Onion Creek	351374	4612 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.58	553.92	2550	Masonry	$ 136,515	$ 37,500	$ 174,015	66.62	169881	$ 25,555	$ 6,295	$ 5,875	$ 7,110	$ 24,716	$ 24,716
105	Onion Creek	351373	4614 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.16	554.22	2286	Masonry	$ 50,991	$ 37,500	$ 88,491	67.71	154785.06	$ 25,317	$ 5,896	$ 5,252	$ 6,524	$ 24,486	$ 24,486
106	Onion Creek	351372	4700 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	585.71	554.22	1923	Masonry	$ 100,821	$ 37,500	$ 138,321	70.27	135129.21	$ 25,761	$ 7,318	$ 5,815	$ 7,845	$ 24,916	$ 24,916
107	Onion Creek	351368	4701 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.84	554.22	2046	Masonry	$ 281,265	$ 37,500	$ 318,765	69.57	142340.22	$ 22,193	$ 5,118	$ 4,382	$ 5,740	$ 21,464	$ 21,464
108	Onion Creek	351371	4702 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.39	554.22	2177	Masonry	$ 259,486	$ 37,500	$ 296,986	68.91	150017.07	$ 24,239	$ 5,641	$ 4,897	$ 6,312	$ 23,444	$ 23,444
109	Onion Creek	351369	4703 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	586.96	554.22	2486	Masonry	$ 277,625	$ 37,500	$ 315,125	66.62	165617.32	$ 25,899	$ 5,982	$ 4,997	$ 6,708	$ 25,049	$ 25,049
110	Onion Creek	431208	4704 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.04	554.22	2617	Masonry	$ 311,690	$ 37,500	$ 349,190	65.62	171727.54	$ 25,599	$ 6,282	$ 5,514	$ 7,098	$ 24,759	$ 24,759
111	Onion Creek	351370	4705 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.39	554.22	2638	Masonry	$ 218,653	$ 37,500	$ 256,153	65.62	173105.56	$ 25,879	$ 6,320	$ 4,923	$ 7,149	$ 25,030	$ 25,030
112	Onion Creek	351222	4706 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.39	554.22	2193	Masonry	$ 288,823	$ 37,500	$ 326,323	68.91	151119.63	$ 21,811	$ 5,429	$ 4,568	$ 6,124	$ 21,094	$ 21,094
113	Onion Creek	351224	4707 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	588.15	554.44	2042	Masonry	$ 227,116	$ 37,500	$ 264,616	69.57	142061.94	$ 19,351	$ 4,807	$ 3,998	$ 5,555	$ 18,716	$ 18,716
114	Onion Creek	351221	4708 S Pinehurst Drive	USACE 2005/Travis Co Survey +0.27'	587.20	554.22	1963	Masonry	$ 167,819	$ 37,500	$ 205,319	70.27	137940.01	$ 21,069	$ 4,812	$ 4,077	$ 5,402	$ 20,378	$ 20,378
115	Onion Creek	351226	4711 S Pinehurst Drive	Halff FFE Estimated 2012 LiDAR	588.52	554.44	2065	Masonry	$ 221,872	$ 37,500	$ 259,372	69.57	143662.05	$ 19,453	$ 4,799	$ 3,839	$ 5,552	$ 18,815	$ 18,815
116	Onion Creek	351380	4600 Tamarisk Cove	USACE 2005/Travis Co Survey +0.27'	584.67	553.92	2171	Masonry	$ 48,260	$ 41,250	$ 89,510	67.71	152347.5	$ 27,984	$ 8,035	$ 8,472	$ 8,576	$ 2,967	$ 8,134
117	Onion Creek	351381	4601 Tamarisk Cove	USACE 2005/Travis Co Survey +0.27'	585.35	553.92	3554	Masonry	$ 72,796	$ 37,500	$ 110,296	68.91	149603.61	$ 41,217	$ 9,622	$ 9,505	$ 10,467	$ 27,065	$ 27,065
118	Onion Creek	351379	4602 Tamarisk Cove	USACE 2005/Travis Co Survey +0.27'	583.27	553.92	2844	Masonry	$ 62,481	$ 37,500	$ 99,981	63.87	226993.98	$ 42,342	$ 10,080	$ 11,045	$ 10,398	$ 39,864	$ 39,864
119	Onion Creek	351382	4603 Tamarisk Cove	USACE 2005/Travis Co Survey +0.27'	585.50	553.92	2368	Masonry	$ 53,824	$ 37,500	$ 91,324	64.71	184035.24	$ 26,442	$ 6,064	$ 5,685	$ 6,624	$ 40,952	$ 40,952
120	Onion Creek	349393	4513 Wild Dunes Ct	2014 Halff FFE Survey	572.08	535.90	3112	Masonry	$ 135,708	$ 37,500	$ 173,208	67.71	160337.28	$ 34,647	$ 5,287	$ 9,055	$ 5,303	$ 25,574	$ 25,574
121	Onion Creek	349394	4515 Wild Dunes Ct	2014 Halff FFE Survey	572.69	535.90	3076	Masonry	$ 59,505	$ 41,250	$ 100,755	63.87	198763.44	$ 29,396	$ 5,688	$ 8,076	$ 5,709	$ 3,114	$ 15,282
122	Onion Creek	349397	4516 Wild Dunes Ct	2014 Halff FFE Survey	572.45	535.90	3197	Masonry	$ 317,062	$ 37,500	$ 354,562	63.87	196464.12	$ 28,620	$ 5,485	$ 8,156	$ 5,510	$ 2,665	$ 12,272
123	Onion Creek	349413	10000 Wild Dunes Dr	2014 Halff FFE Survey	570.28	536.93	2724	Masonry	$ 61,397	$ 43,125	$ 104,522	63.87	204192.39	$ 31,033	$ 6,978	$ 9,815	$ 6,990	$ 4,115	$ 11,003
124	Onion Creek	349412	10001 Wild Dunes Dr	Halff FFE Estimated 2012 LiDAR	569.58	536.93	5732	Masonry	$ 107,159	$ 45,000	$ 152,159	65.62	178748.88	$ 71,651	$ 14,417	$ 20,210	$ 14,438	$ 5,883	$ 12,288
125	Onion Creek	349415	10004 Wild Dunes Dr	2014 Halff FFE Survey	571.00	536.31	2913	Masonry	$ 139,287	$ 37,500	$ 176,787	63.87	366102.84	$ 27,764	$ 3,933	$ 7,647	$ 5,313	$ 12,762	$ 27,622
126	Onion Creek	349410	10005 Wild Dunes Dr	2014 Halff FFE Survey	569.84	536.93	3547	Masonry	$ 338,030	$ 37,500	$ 375,530	64.71	188500.23	$ 42,309	$ 8,574	$ 11,763	$ 8,587	$ 3,414	$ 9,929
127	Onion Creek	349409	10007 Wild Dunes Dr	2014 Halff FFE Survey	570.12	536.93	2353	Masonry	$ 48,166	$ 37,500	$ 85,666	63.87	226546.89	$ 27,392	$ 6,092	$ 7,768	$ 6,105	$ 7,556	$ 16,312
128	Onion Creek	349439	10008 Wild Dunes Dr	2014 Halff FFE Survey	570.87	536.31	2250	Masonry	$ 53,062	$ 37,500	$ 90,562	67.71	159321.63	$ 23,169	$ 3,293	$ 6,022	$ 3,303	$ 5,180	$ 10,500
129	Onion Creek	349408	10009 Wild Dunes Dr	2014 Halff FFE Survey	570.24	536.93	2462	Masonry	$ 56,467	$ 37,500	$ 93,967	66.62	164018.44	$ 29,478	$ 6,581	$ 9,383	$ 6,596	$ 5,619	$ 11,286
130	Onion Creek	349440	10010 Wild Dunes Dr	2014 Halff FFE Survey	570.31	536.31	2143	Masonry	$ 15,452	$ 37,500	$ 52,952	68.91	147674.13	$ 26,563	$ 5,782	$ 8,576	$ 5,793	$ 5,214	$ 10,691
131	Onion Creek	349441	10012 Wild Dunes Dr	2014 Halff FFE Survey	571.49	536.31	2145	Masonry	$ 108,043	$ 37,500	$ 145,543	68.91	147811.95	$ 20,742	$ 3,881	$ 5,776	$ 3,897	$ 3,327	$ 7,289
132	Onion Creek	349400	10025 Wild Dunes Dr	2014 Halff FFE Survey	572.29	535.90	2563	Masonry	$ 313,371	$ 37,500	$ 350,871	66.62	170747.06	$ 24,201	$ 4,611	$ 6,898	$ 4,632	$ 3,545	$ 9,337
133	Onion Creek	349473	10102 Wild Dunes Dr	2014 Halff FFE Survey	574.55	535.55	3064	Masonry	$ 62,331	$ 37,500	$ 99,831	63.87	195697.68	$ 27,230	$ 5,443	$ 6,720	$ 5,466	$ 1,902	$ 11,173
134	Onion Creek	349392	10103 Wild Dunes Dr	2014 Halff FFE Survey	573.00	535.90	2904	Masonry	$ 60,093	$ 50,000	$ 110,093	64.71	187917.84	$ 29,357	$ 5,912	$ 7,217	$ 5,934	$ 2,400	$ 12,829
135	Onion Creek	349391	10105 Wild Dunes Dr	2014 Halff FFE Survey	574.05	535.55	3401	Masonry	$ 55,608	$ 37,500	$ 93,108	63.87	217221.87	$ 31,943	$ 6,413	$ 8,038	$ 6,438	$ 2,468	$ 13,562
136	Onion Creek	349389	10109 Wild Dunes Dr	2014 Halff FFE Survey	574.42	535.55	3015	Masonry	$ 63,684	$ 37,500	$ 101,184	63.87	192568.05	$ 34,430	$ 8,078	$ 8,820	$ 8,090	$ 4,706	$ 17,399
137	Onion Creek	349388	10111 Wild Dunes Dr	2014 Halff FFE Survey	574.28	535.55	2603	Masonry	$ 89,179	$ 37,500	$ 126,679	65.62	170808.86	$ 32,810	$ 7,369	$ 8,060	$ 7,382	$ 1,429	$ 16,958
138	Onion Creek	349387	10113 Wild Dunes Dr	2014 Halff FFE Survey	573.78	538.09	3569	Masonry	$ 62,516	$ 37,500	$ 100,016	63.87	227952.03	$ 48,195	$ 9,623	$ 10,803	$ 9,640	$ 1,704	$ 24,213

APPENDIX F: Project Scoring

Criteria	*Criteria Weight*	*Score Range*	*Centex West Regional Detention Pond*	*Channel Clearing*	*Pinehurst Buyouts*	*Wild Dunes Buyouts*	*Centex West Regional Detention Pond with Channel Modifications*	*Pinehurst Flood Protection Wall with Buyouts*	*Pinehurst Flood Protection Wall with Channel Modifications*
Cost Effectiveness (Benefit-Cost Index)	25	5: BCI = 1 4: 1 - 0.75 BCI 3: 0.75 - 0.5 BCI 2: 0.5 - 0.25 BCI 1: BCI < 0.25	2	2	4	4	1	5	3
Environmental Impact	20	5: Limited to no environmental impact 4: Short term, moderate impact during construction 3: Short term, significant impact during construction 2: Long term, moderate impact in perpetuity 1: Long term, significant impact in perpetuity	4	1	5	5	2	4	1
Funding Constraints	5	5: Project can be implemented incrementally as funding is available 3: Project is comprised of multiple smaller projects which can be implemented separately as funding is available for each 1: Full project funding required prior to implementation	1	3	5	5	3	3	3
Time of Implementation	15	5: 0-2 years, once funding is available 4: 2-5 years, once funding is available 3: 5-7 years, once funding is available 2: 7-10 years, once funding is available 1: > 10 years, once funding is available	1	4	5	5	1	3	2
Land & Easement Acquisition	15	5: No additional land/easement acquisition needed in order tc implement project 3: Minimal land/easement acquisition needed 1: Significant land/easement acquisition needed in order to implement project	1	3	5	5	1	3	3
Neighborhood Input	10	5: Most favorable 3: Neutral results 1: Least favorable	5	5	3	3	5	1	3
Complexity of Permitting	10	5: Limited local permits 4: Local site plan permit 3: Local permit with variances/Nationwide 2: Multi-jurisdiction less permits 1: Multi-jurisdiction more permits	2	3	5	5	2	3	3
		Weighted Score	235	270	455	455	180	350	245

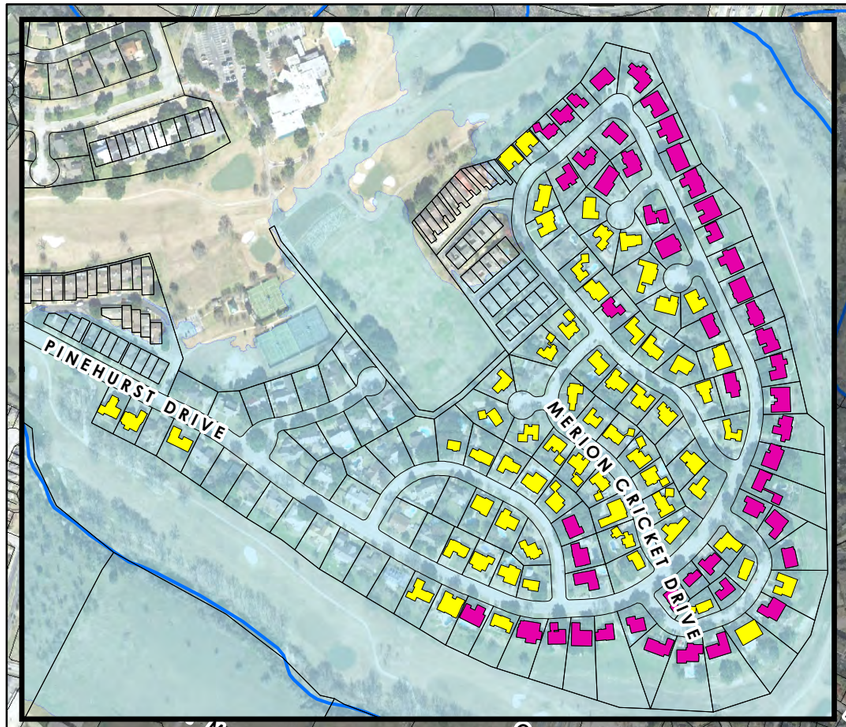
Quick Facts

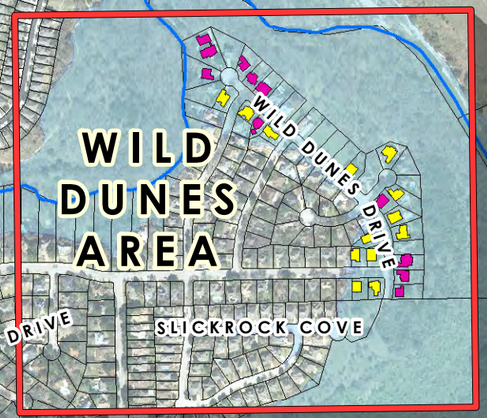
Project Cost + Present Worth 50-year O&M Cost	$ 51,200,000	$ 41,500,000	$ 66,170,000	$ 12,760,000	$ 71,400,000	$ 60,400,000	$ 91,100,000
Project Benefit	$ 931,000	$ 768,000	$ 3,450,000	$ 733,000	$ 1,020,000	$ 4,180,000	$ 3,670,000
Number of structures no longer at risk of structural flooding in 100-year floodplain*	78	51	115	23	110	138	138
Number of structures no longer within 100-year floodplain footprint	70	50	115	23	111	183	211
Number of structures with reduced risk in 100-year floodplain (average depth decrease)	60 (1.0')	87 (0.8')	0 (0')	0 (0')	28 (1.3')	None at risk	None at risk

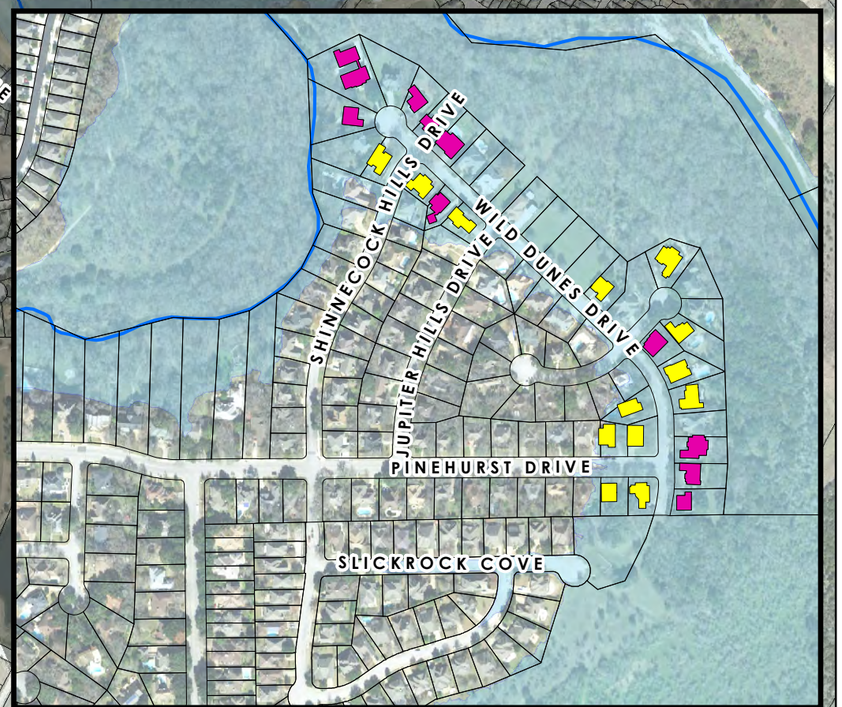
* In existing conditions 115 structures in the Pinehurst neighborhood and 23 structures in the Wild Dunes neighborhood are flooded in 100-year event.

APPENDIX G: Post-Project Risk Maps

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives







LA COSTA DRIVE
M 1626 COUNTY HIGHWAY
CROWN COLONY DRIVE
DRIVE
LEGENDS LANE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
35
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
RIVER PLANTATION DRIVE
COUNTY DOWN DRIVE
CHERYL LYNN ROAD
OLD LOCKHART HIGHWAY

CENTEX WEST REGIONAL DETENTION POND

LEGEND

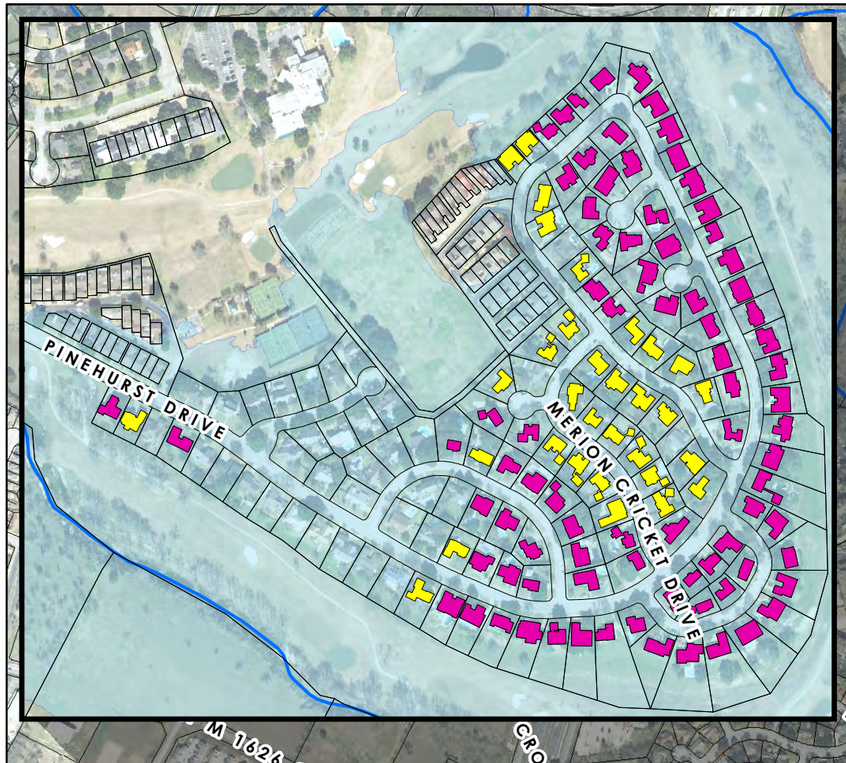
- House potentially at risk in 100-year flood (60)
- House potentially protected in 100-year flood (78)

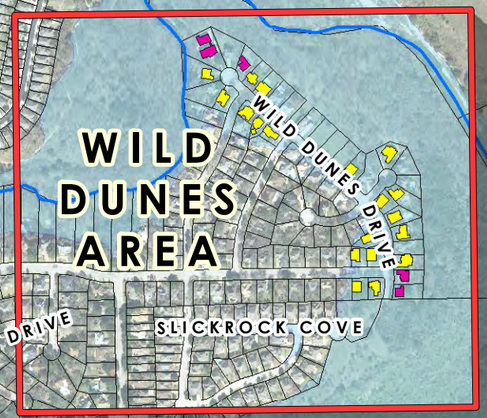
NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

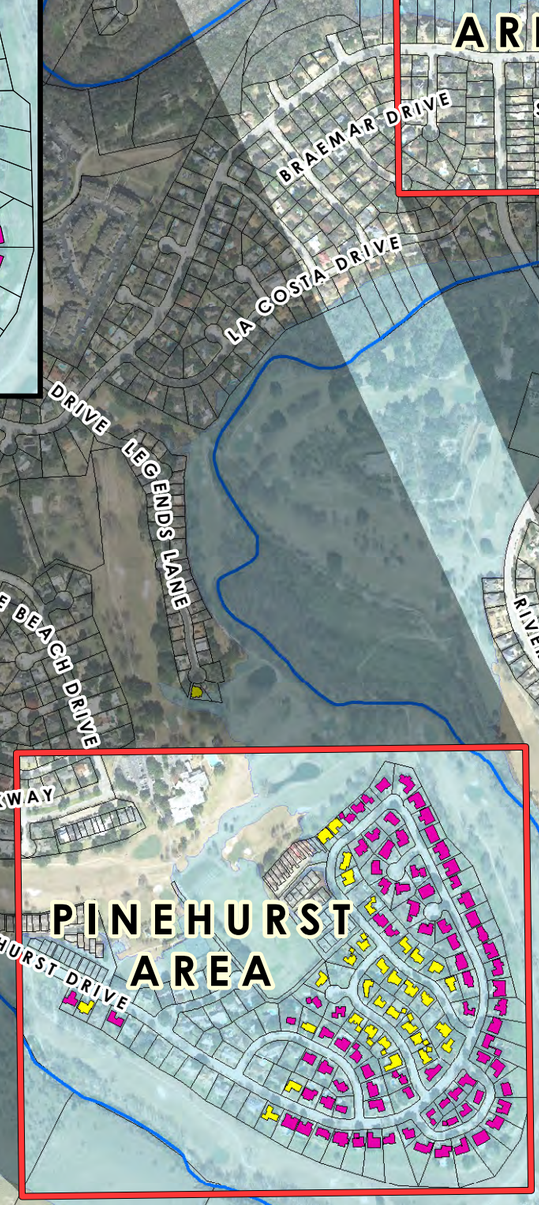
UPDATED EXISTING 1% ACE FLOODPLAIN

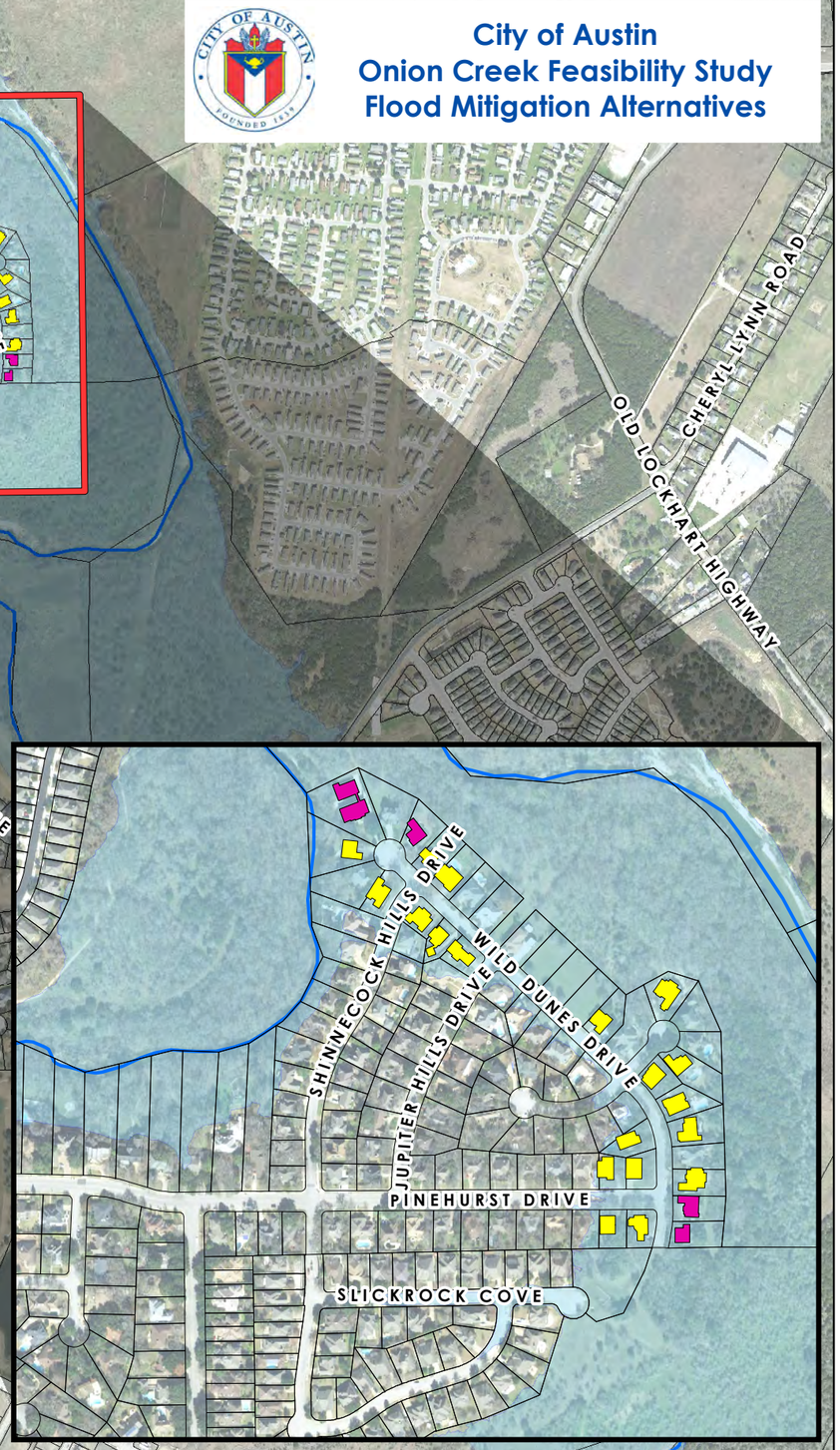
HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives









CHANNEL CLEARING

LEGEND

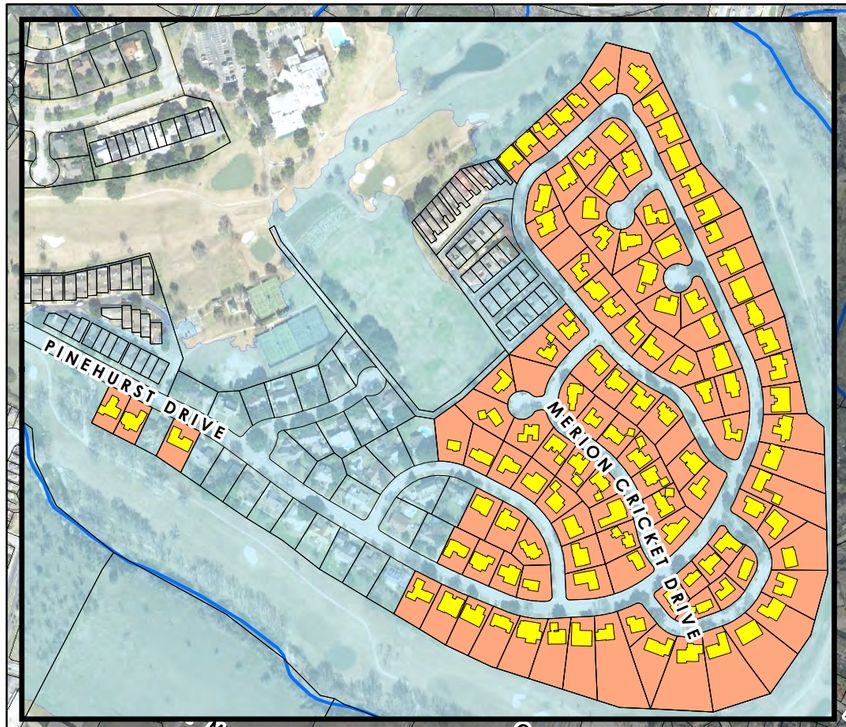
- House potentially at risk in 100-year flood (87)
- House potentially protected in 100-year flood (51)

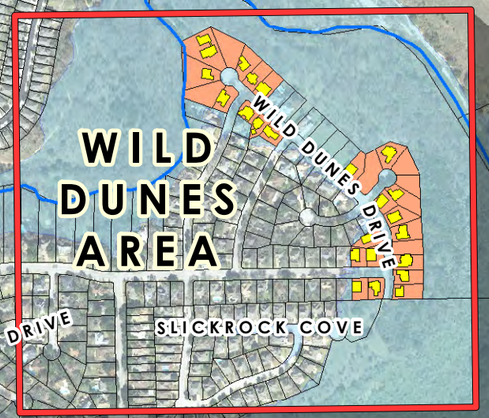
NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

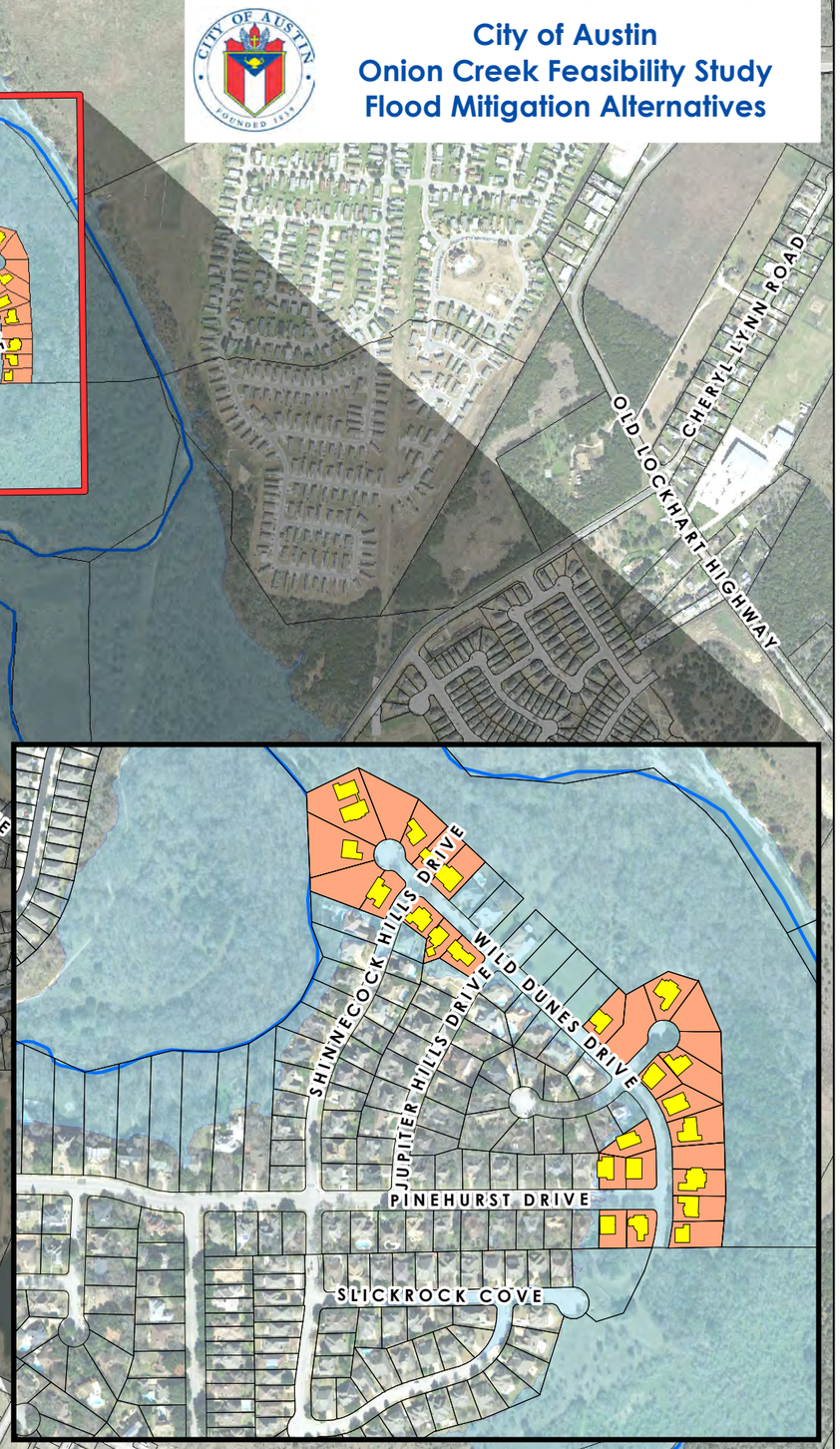
UPDATED EXISTING 1% ACE FLOODPLAIN

HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives







BUYOUTS

LEGEND

- House potentially at risk in 100-year flood (0)
- House potentially protected in 100-year flood (138)
- Buyout (138)

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

UPDATED EXISTING 1% ACE FLOODPLAIN

HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives

CENTEX WEST REGIONAL DETENTION POND WITH CHANNEL MODIFICATIONS

LEGEND

House potentially at risk in 100-year flood (28)

House potentially protected in 100-year flood (110)

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

WILD DUNES AREA

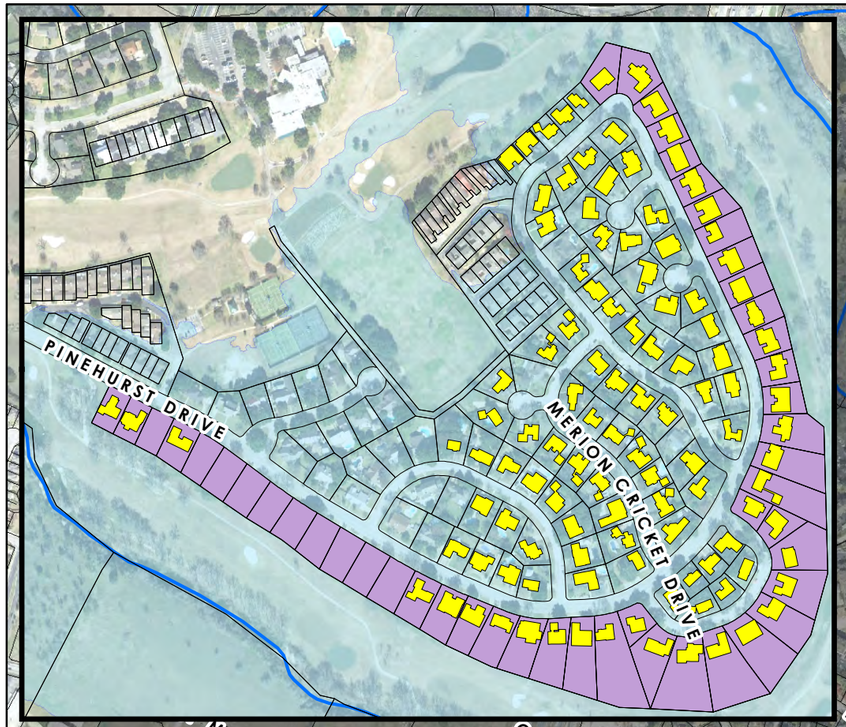
PINEHURST AREA

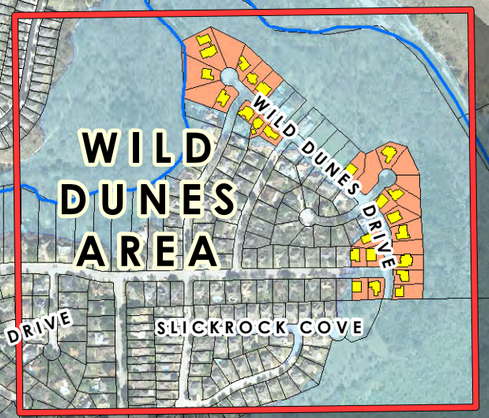
UPDATED EXISTING 1% ACE FLOODPLAIN

PINEHURST DRIVE
MERION CRICKET DRIVE
WILD DUNES DRIVE
SLICKROCK COVE
BRAEMAR DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
OLD LOCKHART HIGHWAY
M 1626 COUNTY HIGHWAY
CROWN COLONY DRIVE
LEGENDS LANE
PEBBLE BEACH DRIVE
ONION CREEK PARKWAY
35
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
RIVER PLANTATION DRIVE
COUNTRY DOWN DRIVE
SHINNECOCK HILLS DRIVE
JUPITER HILLS DRIVE

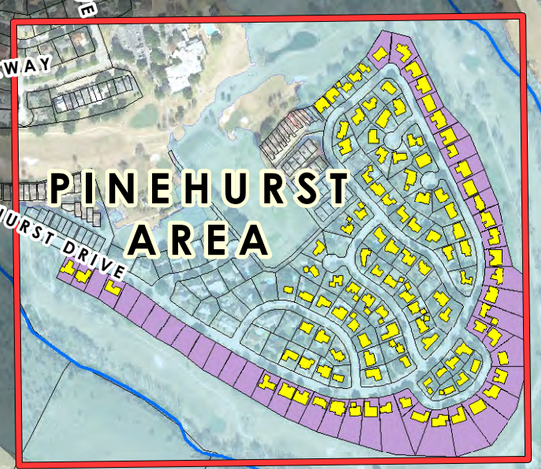
HALFF

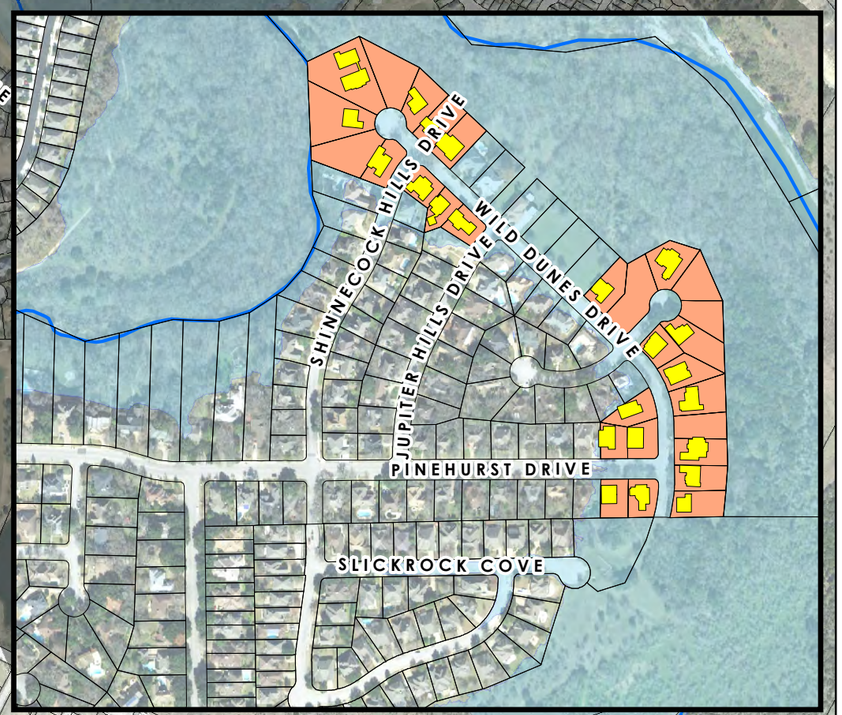
City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives





BRAEMAR DRIVE
LA COSTA DRIVE
CHERYL LYNN ROAD
OLD LOCKHART HIGHWAY
M 1626 COUNTY HIGHWAY
CROWN COLONY DRIVE
35
PEBBLE BEACH DRIVE
LEGENDS LANE
INTERLACHEN LANE
PRAIRIE DUNES DRIVE
RIVER PLANTATION DRIVE
COUNTRY DOWN DRIVE





PINEHURST FLOOD PROTECTION WALL WITH BUYOUTS

LEGEND

- House potentially at risk in 100-year flood (0)
- House potentially protected in 100-year flood (138)
- Buyout (23)
- Required Buyout (48)

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

UPDATED EXISTING 1% ACE FLOODPLAIN

HALFF

City of Austin
Onion Creek Feasibility Study
Flood Mitigation Alternatives

WILD DUNES AREA

PINEHURST AREA

PINEHURST FLOOD PROTECTION WALL WITH CHANNEL MODIFICATIONS

LEGEND

- House potentially at risk in 100-year flood (0)
- House potentially protected in 100-year flood (138)
- Required Buyout (48)

NOTE: The results depicted are preliminary only and will be refinedshould this alternative be recommended for further evaluation.

UPDATED EXISTING 1% ACE FLOODPLAIN

HALFF

APPENDIX H: Digital Data (DVD only)