

CITY OF AUSTIN
WEST BOULDIN CREEK DRAINAGE STUDY
Technical Memorandum No. 1
Del Curto Project Area Phase 1A Study

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Introduction

The watershed area which contributes to West Bouldin Creek has been experiencing high levels of development / re-development in recent years, with some of the aging drainage infrastructure in the area being pushed to or beyond capacity. The net result is that there are areas within the watershed which have been experiencing flooding, and the likelihood of future flooding is anticipated to remain or increase in the future, unless improvements are made to the drainage infrastructure in the watershed. The purpose of this project is to reduce flooding in the West Bouldin Creek watershed, through the development of a coordinated watershed planning approach, and phased implementation of the planned capital and programmatic improvements according to priority needs and available funding.

A recent Preliminary Engineering Report (PER) identified a targeted area of the watershed, in the vicinity of Del Curto Road and South Lamar Boulevard, based on documented flood history and community input, with corresponding proposed improvements which would address the flood reduction needs, but fully planning/designing/constructing the scope of improvements would take several years. There is a strong desire within the local neighborhoods and the City of Austin to find and implement improvements in a quicker manner, with the project scope having been re-structured to help meet these short-term and long-term goals effectively.

Goals

The overall “Del Curto” drainage improvements project is being conducted in phases, with separate goals for each phase:

1. Phase 1A: Identify and prioritize potential short-term projects to address the most serious flooding concerns in the Del Curto project area.
2. Phase 1B: Design and implement the projects identified in Phase 1A.
3. Phase 2A: Identify and prioritize potential long-term projects to address the remainder of flooding concerns in the Del Curto project area.
4. Phase 2B: Design and implement the projects identified in Phase 2A.

The remainder of this technical memorandum is intended to address the Phase 1A goals, focusing on the most severe flooding concerns in the Del Curto project area, and to identify and prioritize projects which can be rapidly implemented in a cost effective manner. The goals of the other project phases will not be addressed in this technical memorandum, but will follow afterwards.

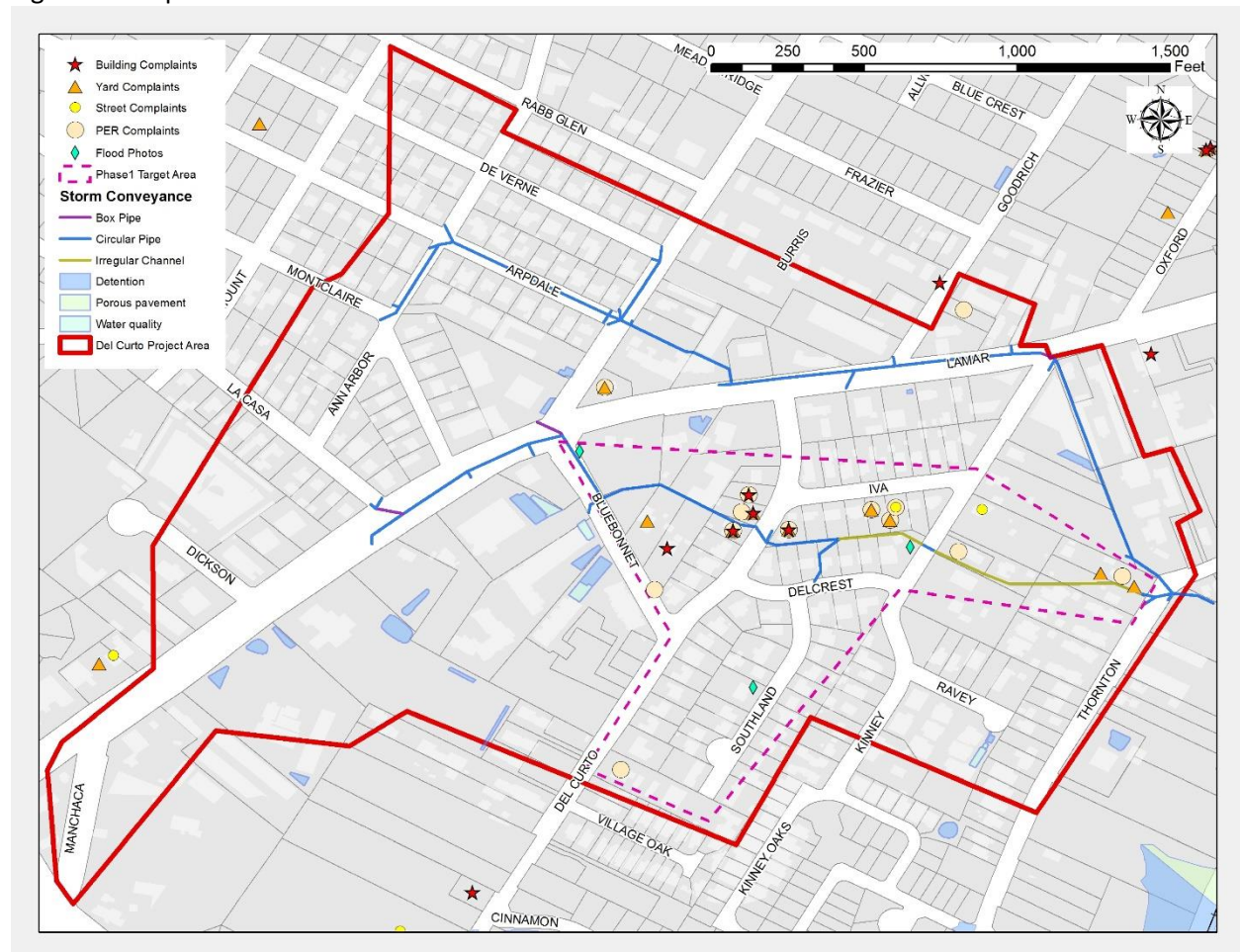
Problem Identification

The initial step in the process is a clear identification of the problems which are affecting the targeted project area. The Watershed Protection Department (WPD) has collected data from public complaints, maintenance records, photos and engineering models over the years, which can graphically identify the areas which are at the greatest risk of flooding. A map of these flood risk areas is shown in Figure 1.

Several types of flood concerns were apparent from the physical conditions and model results presented in the PER:

- Flooding of homes and businesses (structures, high threat)
- Flooding of private properties (non-structural, moderate threat)
- Flooding of roadways (high depth/velocity, high threat)
- Flooding of roadways (low depth/velocity, moderate threat)

Figure 1. Map of Flood Risk Areas



From this information, the portion of the project area having the highest threat from flooding appears to be along the former natural watercourse on the south side of S. Lamar Blvd, from Bluebonnet Lane to Thornton Road. A brainstorming meeting was held on 5-7-2015, with WPD and CAS staff discussing the project concerns, and the consensus opinion was that Phase 1 of the project should focus on reduction of flooding in this highest flood threat area. The remaining areas appear to have the majority of their flooding issues related to curb flows crossing streets and intersections or other low-moderate threat conditions, and will be addressed in Phase 2.

Potential Drainage Improvements

During the staff brainstorming meeting mentioned above, a number of projects / programmatic changes were discussed as having potential for flood reduction benefits in the Phase 1 project area as listed in Table 1. A more detailed assessment of these potential drainage improvements are described and illustrated on the following pages.

Table 1. Project Alternatives	
I. Short-Term	
1)	Expanding private detention/WQ facilities
2)	Bypass Bluebonnet to Kinney
3)	Underground detention at Del Curto
4)	Creek restoration
5)	Buyouts
6)	Curb and gutter (Bluebonnet)
7)	Detention at 2323 S. Lamar
8)	Stacked ponds near Bluebonnet
9)	Detention options at Matt's El Rancho (UG)
10)	Conveyance enhancement (open channel/ combined)
11)	Detention at open tract between Kinney and Thornton
12)	Detention and confluence w/ W. Bouldin
13)	Green streets
14)	Detention 2302 Thornton
15)	Conveyance from Thornton to W. Bouldin
16)	Easement acquisition
17)	Rainwater harvesting
18)	Porous Pavement for any current development
19)	Cost participation with new developments
20)	RSMP / Detention waiver + downstream reviews
II. Long-Term	
21)	Green roofs
22)	Green streets
23)	RSMP

Several detention project alternatives are included on the list and are discussed further in this report, but it is important to note that modeling of potential downstream impacts will need to be performed in Phase 1B, to confirm that no negative impacts will occur. An abbreviated estimation process was used to identify the approximate potential for peak flow reduction at each of these sites, these estimates were not determined from hydrologic modeling.

It should also be noted that property values for real estate acquisition costs were based on 2015 Travis County Appraisal District (TCAD) 2015 total appraised values, except where noted for Project 5, where market value comparisons were compiled (data from Zillow.com), with TCAD valuations being 10-30% below market values.

Project #1 - Expand Existing Private Detention

Description:

There are four properties near the intersection of Bluebonnet and S. Lamar which have multiple stormwater detention and water quality ponds on their properties. There is a potential for expansion of these existing detention facilities into adjacent green space to add storage capacity. These existing ponds were designed to manage runoff from the individual sites, and there is little contributing drainage from off-site properties. Discharge from the Matt's facilities is at the surface, while the remainder appear to connect to underground systems. There are varying amounts of green space adjacent to the existing ponds that could be utilized for additional storage volume in these detention facilities.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
Matt's El Rancho	4	0	2.1 ac-ft	-16 cfs* / -55%*
Verizon / Walgreens	1	1	0.5 ac-ft	-3 cfs / -52%
Spaces 2525	1	1	0.8 ac-ft	-4 cfs / -71%
Sola City Homes	1	1	1.2 ac-ft	-6 cfs / -43%

* Proposed pond has a different drainage area than the existing pond, so the peak reductions are based on comparison of the proposed condition pond with the un-detained condition, whereas the other comparisons use the existing pond configuration for the initial condition.

Estimated Cost:

Engineering	\$230,000
Property Acquisition	\$6,760,000
<u>Construction</u>	<u>\$1,320,000</u>
Total Cost	\$8,310,000

Potential Advantages and Disadvantages:

If all ponds at the 4 properties are expanded, the peak flow reduction would be at an estimated unit cost of \$286,000/cfs of reduction. There is a decent amount of peak reduction available and some of the space could be utilized for water quality enhancements with these pond expansions. However, with the limited amount of green space in this vicinity and several large trees in the potential project area, the impacts to the natural and visual environment are likely to be viewed negatively by the property owners and the environmental community. Also, with the high development potential in this area, property acquisition costs are significant.

Project #2 - Bypass System in ROW – Bluebonnet to Kinney

Description:

This project would add a storm sewer bypass system from where the existing storm sewer turns eastward from Bluebonnet and would tie back in to the existing infrastructure at Kinney, with the intent to reduce flow and subsequent flooding between these locations.

As suggested by the alternatives in the PER; a bypass system can be used to alleviate the undersized conduit and swale from Bluebonnet to Kinney, the area that experiences the most severe flooding in the project area. This conveyance system can be implemented in existing ROW beginning at the sag on Bluebonnet connecting to existing systems conveying runoff from the basin headwaters along Lamar. The alignment of the bypass system will carry runoff to the east to Del Curto, along Del Curto to Delcrest, along Delcrest to Kinney and along Kinney to the west to the existing channel on the north side of Kinney at the sag. As this diversion is directed away from a natural course there will be sections of pipe that run deep, “bucking grade”, which has higher costs for installation and maintenance. The deep piping can also facilitate a wider range of potential lateral configurations.

This trunk will be approximately 1,345 feet and include 15 junction boxes facilitating system laterals and bends.

Line	Piping size	Length	Inlets	Junction Boxes
Bypass Trunk	60"	1,330		
	72"	15	5	15

There are numerous collection options that can serve the area; lateral and inlet arrangement is crucial to meet design standards; scoping may allow for these to be minimized while maintaining effectiveness and leaving the door open for upgrades to the system at a later date.

Lateral Option A

The lateral arrangement as seen connecting to the similar trunk in PER Alternative 6, will include 4 major laterals to the system on Del Curto, Southland, Iva, and Kinney. This collection arrangement will address existing issues with ponding and clear roadway widths that do not comply with design standards.

Line	Piping size	Length	Inlets	Junction Boxes
Del Curto Lateral	18"	235		
	24"	295	4	2
Southland Lateral	18"	255		
	30"	440	5	5

Kinney Lateral	18"	126		
	24"	120	2	1
Iva Lateral	18"	12		
	24"	870	3	7

Lateral Option B

Option B will reduce lateral application as compared to option A. Considering the complaints registered in the area; few are with regard to ponding or clear width. Option B will allow water to flow in the streets to the sags at Bluebonnet and Del Curto as they do today, but at these places add requisite collection to keep flows below the curb. The only major lateral will carry flow from the sag at Del Curto to the trunk line at Del Curto and Delcrest. With the bypass system as currently described there is sufficient elevation to drain a lateral from Del Curto. Option B will minimize cost but likely not meet street clear zone/ponded width requirements.

Flood Reduction Potential:

This project would divert flows away from the areas at the greatest flood risk, and could benefit from other projects (upstream detention to reduce flows to this point, upstream diversion to reduce flows to this point, etc). There is also a potential for flows to increase downstream of Kinney, which would necessitate coupling with other upstream and/or downstream projects.

Estimated Cost:

	<u>Main Bypass</u>	<u>Laterals- Option A</u>	<u>Laterals- Option B</u>
Engineering	\$151,000	\$138,000	\$17,200
Property Acquisition	\$0	\$0	\$0
<u>Construction</u>	<u>\$867,000</u>	<u>\$793,000</u>	<u>\$99,000</u>
Total Cost	\$1,020,000	\$931,000	\$116,000

Potential Advantages and Disadvantages:

This project has the potential to fully alleviate the flooding concerns along the natural stream course between Bluebonnet and Kinney thru the diversion of upstream flows, leaving the existing infrastructure to handle only local flows. One major advantage of this project is that no property acquisition is required. However, this project does not provide for any potential water quality enhancements.

Project #3 - Underground Detention at Del Curto

Description:

The intersection of Del Curto and Bluebonnet is situated advantageously for an underground storage system. Although respectively little flow passes through this intersection, there are more than two acres of highly impervious area that drains thru this intersection. Runoff from 2520 Bluebonnet and 2602 Del Curto that drains onto Del Curto appears to flow across the street and ultimately through 2500 and 2507 Del Curto toward Southland Drive. If this water could be captured at the street, the benefits could be twofold; first, some runoff that flows through yards could be diverted and second, there is detention potential.

Typical design for underground storage is to use conduit in parallel rather than a single vault because of constructability and cost advantages. To achieve the desired detention volume, a network of TxDOT standard culverts could be used. These are implementable as cast-in-place or precast, and can have a variety of sizes. The proposed location is on the hill above Del Curto/ Delcrest allowing the outlet for a deep structure to drain via gravity, requiring no pumping.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
Public ROW	0	0	0.9 ac-ft	-4 cfs / -28%

Estimated Cost:

Engineering	\$161,000
Property Acquisition	\$0
<u>Construction</u>	<u>\$925,000</u>
Total Cost	\$1,090,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at an estimated unit cost of \$273,000/cfs of reduction. If a bypass system were to be implemented, then storage at this location could become integrated with that system, reducing cost for any outlet apportioned to this sub project. This detention and a bypass option would function well together, if underground detention is desired.

Project #4 - Restore Channel from Bluebonnet to Kinney

Description:

Creek restoration through the 2300 block of S. Lamar and 2200 block of Delcrest / Iva is one option to alleviate drainage problems on these blocks. Initially, developers to the area built homes along the original stream through these blocks and some flow was collected via storm sewer. With the continued development of the neighborhood, existing infrastructure has been overwhelmed and runoff no longer is conveyed effectively in the sewer. Overflow is consistently conveyed overland through residents' yards. The drainage path is poorly defined and reportedly causes flooding of many of the homes on these blocks. The surface drainage swale has neither the capacity to handle flood flows, nor does it have the ecological character of the original watercourse. While the restoration of the stream to a more natural state is technically possible, it would likely require the buyout of all adjacent properties, which would make this project prohibitively expensive. The option under consideration would be for an engineered channel for additional conveyance capacity.

Flood Reduction Potential:

A quick normal depth estimate of the potential capacity for a 25' wide channel would be 150-200 cfs in this vicinity, which could contain a significant portion of the flood flows. With this option, restoration of the creek serving the area will begin near 2538 Bluebonnet Lane where runoff from Lamar, Del Curto Road south of Bluebonnet, and Bluebonnet Lane accumulate at the sag in the roadway. The channel will measure approximately 925 feet Bluebonnet Lane to Kinney Road assuming the channel alignment will follow that of the flow accumulation path (and undersized conduit) and outfall into the existing stream between Kinney and Thornton Road. The two major segments of this channel are Bluebonnet to Del Curto and Del Curto to Kinney. Upsizing of street crossings will be required at Del Curto, Kinney and Thornton.

Segment	Q25 (adapted from PER) (cfs)	US FL (existing piping)	DS FL (existing piping)	Segment Length (ft.)	Roadway Elevation
Bluebonnet Rd	112				
Bluebonnet to Del Curto	129	607.82	590.62	512.7	
Del Curto Crossing	204				600
Del Curto to Kinney	145	589.7	580	412.1	
Kinney Crossing	323				584.75
Kinney to Thornton	358	578.7	560.5	652.3	
Thornton Crossing	363				564
Thornton to Outfall	363	559.4	554	152.8	

Estimated Cost:

Engineering	\$137,000
Property Acquisition	\$730,000
<u>Construction</u>	<u>\$788,000</u>
Total Cost	\$1,660,000

Potential Advantages and Disadvantages:

Construction of a channel through these blocks will provide needed conveyance and confine runoff. In addition to added capacity, a channel is an aesthetically pleasing natural long term solution. Channels provide both reach storage and water quality benefits when compared to storm sewer alternatives. The disadvantage to a channel in this circumstance is need for easements; as there are currently no drainage easements from Bluebonnet to Del Curto on the 2300 block of S. Lamar and easements on the 2200 block of Iva/Delcrest may be insufficient.

Maintenance of the proposed channel would be a critical component of the effectiveness of this project, with debris or vegetation buildup potentially removing the flood reduction benefits. The deficient drainage in the area is affecting most parcels on these two blocks. If a channel is chosen as a preferred option and the flow is contained as desired there is a possibility of the houses at 2300, 2302, and 2301 Del Curto being in conflict with the proposed channel.

Project #5 - Buyouts - Bluebonnet to Kinney

Description:

Buyouts are another option that can be used in conjunction with engineered solutions for collection, conveyance, and detention. Buyouts can permanently remove privately owned properties from problem areas providing a long term solution to these drainage problems, which can also provide opportunities for additional flood mitigation projects to make use of the property acquisition (channel restoration or detention could be viable supplemental projects in this location).

Because of inadequate capacity of the existing drainage infrastructure, there is often significant overland flow and ponding that regularly floods the homes at 2300, 2301, and 2302 Del Curto. These homes were constructed along the low path through these blocks and have upwards of 40 acres draining across their boundaries.

Flood Reduction Potential:

This project would not reduce flooding at all, but would provide benefits through the removal of properties at risk during flood events.

Estimated Cost:

Engineering	\$0
Property Acquisition	\$1,190,000
<u>Construction</u>	<u>\$0</u>
Total Cost	\$1,190,000

Potential Advantages and Disadvantages:

2302 and 2301 Del Curto are particularly good candidates for buyouts. 2302 Del Curto is located directly on the flow accumulation path and existing storm sewer. There is an area inlet in the back of the lot that frequently surcharges sending storm water from the storm sewer into the property. There appears to be no drainage easement on the parcel, but it is understood that the existing drain may pass underneath the house. Any channel alignment through the property will likely be in conflict with the house.

2301 Del Curto faces a similar problem, the overland flow path as it crosses Del Curto to the north encounters a choke point between the side of the house and the adjoining property 2210 Delcrest Drive. There is a 5' Drainage/PUE easement on the lot(s) which is insufficient for placement of a new channel.

Voluntary buyouts are an option even if a channel alternative isn't chosen; acquisition of these lots and removal of the houses will address the more severe complaints in the area and provide real estate for parkland, water quality, or detention facilities.

Project #6 - Curb and Gutter on Bluebonnet

Description:

Two parcels on the 2300 block of S. Lamar Blvd are experiencing localized flooding thought to be caused by inability of the street to carry runoff. At 2505 and 2507 Bluebonnet Lane there is no curb and gutter. Complaints in the area indicate that runoff from the southwest flows across Bluebonnet and across the yards from southwest to northeast. The currently proposed solution for this problem is to install curb and gutter for the length of these two properties.

It appears that runoff from the south on Del Curto will primarily stay on Del Curto as the roadway splits at the intersection with Bluebonnet Lane. Some water may divert during larger events but the drainage area that contributes directly to this issue is relatively small. The roadway in this segment of Bluebonnet Lane looks to have a super-elevation favoring conveyance on the north side of the roadway and with the lack of curb and gutter this runoff is passing through the yards and encroaching on the homes. Homeowners at this problem area have made makeshift curbs along their existing driveways and have raised planter boxes working as barricades. The effectiveness of these ad hoc implementations are unknown, but they indicate that a curb and gutter project might be welcome.

Flood Reduction Potential:

This project would retain flows in the street from entering the 2 properties currently experiencing flood issues.

Estimated Cost:

Engineering	\$9,460
Property Acquisition	\$0
<u>Construction</u>	<u>\$54,400</u>
Total Cost	\$63,900

Potential Advantages and Disadvantages:

While this is an isolated issue that only affects these two parcels, it may be constructed with the proposed bypass project as part of a complete street solution. The curb construction would need to be accompanied with driveway improvements to keep flows in City right of way.

Project #7 - Detention at 2323 S. Lamar

Description:

2323 South Lamar is currently an asphalt paved lot that has development plans in process for a Chick-fil-A restaurant in the near future. The potential exists to supplement the detention requirement for this re-development (10% peak reduction required by the recent S. Lamar ordinance) for additional storage, especially if coupled with the adjacent vacant lot at the rear of the property (2421 Bluebonnet Rd). Together this could make approximately half an acre of land located along the natural watercourse available for detention.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
2323 S. Lamar	0	0	2.7 ac-ft	-12 cfs / -8%

Estimated Cost:

Engineering	\$46,100
Property Acquisition	\$555,000
<u>Construction</u>	<u>\$265,000</u>
Total Cost	\$866,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at a unit cost of \$72,200/cfs of reduction. 2421 Bluebonnet Road is currently uninhabited as it has tremendous flooding issues, usage of this land would likely be less of a challenge than the neighboring 2323 S. Lamar. 2323 S. Lamar is a prime location for a detention project as it is along the natural watercourse in the area and is adjacent to the proposed bypass system. Partnering with developers may be possible as there is currently a permit in process, but the stage of development is currently unknown and a partnership may not be preferred by the owners.

Project #8 - Stacked ponds near Bluebonnet

Description:

This project would involve reconstructing the existing detention & separate water quality ponds at 3 properties along Bluebonnet into combined detention / WQ ponds, with the 2 retained volumes stacked one atop the other.

Flood Reduction Potential:

There is a potential to add detention volume through lowering the pond bottom, and for the purposes of this estimate, an additional 1' of depth was assumed across the pond footprints.

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
Verizon / Walgreens	1	1	0.05 ac-ft	-0.3 cfs / -5%
Spaces 2525	1	1	0.04 ac-ft	-0.2 cfs / -3%
Sola City Homes	1	1	0.05 ac-ft	-0.3 cfs / -2%

Estimated Cost:

Engineering	\$71,000
Property Acquisition	\$1,560,000
<u>Construction</u>	<u>\$327,000</u>
Total Cost	\$1,960,000

Potential Advantages and Disadvantages:

If all 3 ponds are modified, the peak flow reduction would be at a unit cost of \$2,450,000/cfs of reduction. Exhibit #8 shows the locations of existing water quality/detention ponds near Bluebonnet that could possibly be used as stacked ponds to gain more detention. The principle is to build vertically, creating more storage volume in the same footprint as the existing ponds. However, at these locations there is insufficient elevation difference between the tops of the ponds and the existing areas that would flow into the ponds, but instead of raising the top of the ponds, the bottoms could be lowered, with a syphon type outfall to permanently retain a small WQ volume in the filter media.

Project #9 - Install new underground detention facilities

Description:

This project proposes to construct new detention facilities under the existing parking lots at Matt’s El Rancho. Site A would be under the primary front parking area, and Site B would be under the rear parking area. There are approximately 10 acres of headwaters above Matt’s El Rancho that accumulate on Lamar Blvd and are conveyed via curb and gutter. It may be possible to collect some of this runoff and route it into an underground facility that either feeds back into the existing storm sewer on Lamar or reroutes runoff from Lamar and outfalls with existing Matt’s El Rancho runoff.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add’l Storage Vol.</u>	<u>Peak Reduction</u>
A) Matt’s (front)	2	0	1.4 ac-ft	-10 cfs* / -18%*
B) Matt’s (back)	2	0	4.6 ac-ft	-24 cfs* / -35%*

* Proposed pond has a different drainage area than the existing pond, so the peak reductions are based on comparison of the proposed condition pond with the un-detained condition, whereas the other comparisons use the existing pond configuration for the initial condition.

Estimated Cost:

	<u>Site A</u>	<u>Site B</u>
Engineering	\$270,000	\$965,000
Property Acquisition	\$1,040,000	\$2,430,000
<u>Construction</u>	<u>\$1,550,000</u>	<u>\$5,550,000</u>
Total Cost	\$2,860,000	\$8,950,000

Potential Advantages and Disadvantages:

There is not sufficient contributing drainage area available to support construction of both sites; construction of Site A would be at a peak flow reduction unit cost of \$286,000/cfs of reduction, and construction of Site B would be at a peak flow reduction unit cost of \$373,000/cfs of reduction.

There are numerous challenges associated with this project. First would be obtaining permission from Matt’s which often uses most of its parking area, making construction a potential hardship. Second, and a more fundamental issue, would be outfalling detained storm water. At the north end of Matt’s on Lamar is the first curb inlet of the existing system that runs down Lamar toward the Del Curto project area; this would be the preferred location to release the outflow from the detention system. This first run of storm sewer starts at the curb inlet here having a flowline elevation of 643.29 and a top of approximately 647. This is less than 4’ of utilizable elevation, little when considering that the existing parking lot slopes to the southeast, away from Lamar.

To effectively use this area there would likely need to be improvements to either the storm sewer on Lamar or the storm sewer that Matt's runoff uses that flows through the Walgreens parking lot. If these infrastructure improvements were made, Matt's could provide a generous amount of storage to this project area.

There are also quite a few heritage trees scattered through the parking areas, potentially dividing up the potential storage areas into less efficient / more expensive shapes.

Project #10 - Conveyance Enhancement between Kinney and Thornton

Description:

There is an existing channel beginning between 2307 and 2309 Kinney. The channel curves to the east toward the back of these lots crossing a corner of 2304 Thornton, and flows through 2300 Thornton to an existing culvert at Thornton Road.

There have been numerous complaints and concerns on this block with regard to the existing channel. From logged complaints there are culvert capacity and backwater problems at Thornton Road. Additionally the City has concerns of erosion of the watercourse behind the townhouses at 2304 Thornton. While erosion is a natural occurrence in waterways, it can be exacerbated by overloading. The proposed solutions for this block are either channel improvement or bypass system or a combined channel/storm sewer system.

Among choices to improve conveyance is to improve the channel. Channel improvement will include augmentation of the channel about choke points, allowing collected flows to be confined within the banks, and potentially the lining of select areas. Side slope lining can be done to match existing limestone blocks, preventing erosion along bends, and improving conveyance at key locations.

Flood Reduction Potential:

While there have not been flooding complaints noted along this reach, the current channel is extremely constricted and has dense vegetation in several locations, making it seem possible that some degree of flooding could be currently be occurring, even if no complaints have been noted. There is also a potential for flood levels to increase from some of the other proposed projects.

Estimated Cost:

Engineering	\$125,000
Property Acquisition	\$241,000
<u>Construction</u>	<u>\$718,000</u>
Total Cost	\$1,080,000

Potential Advantages and Disadvantages:

Unlike residents to the south who are regularly flooded by the headwaters of this existing channel, owners along this creek segment have knowingly purchased along a creek. As an aesthetically pleasing feature this creek could potentially flourish without the overloading it experiences today. Suggested engineering options such as a 6'x6' channel would detract from the ambiance of the natural creek or the slightly improved portions with limestone lining. Another option to improve conveyance with minimal impact to the existing creek is installation of a storm sewer system to function in tandem with the existing channel. There are no current designs for a storm sewer system on this block, nor any criteria for the functionality of the system; whether it would be primary or secondary conveyance

mechanism, if the storm sewer would only carry flows from the west side of the block to the east end or to the confluence with West Bouldin.

There are numerous challenges to a combined channel/storm sewer system. The storm sewer system will need to be located on either side of the channel where there is little or no easement. Along with space requirements there may be conflicts with existing structures and large trees, depending on the alignment chosen. A combined system offers very little increase in capacity relative to the space needed to install the storm sewers, therefore sizing and costs were not developed for this option.

Project #11 - Detention at open tract between Kinney and Thornton

Description:

There are approximately 1.5 acres of undeveloped land just south of Lamar between Kinney and Thornton that has been proposed as a site for stormwater detention. There are around 33 acres that drain through this undeveloped tract of land, the majority of this is runoff from Lamar conveyed through storm sewer. Detention at this site would involve diverting water in the storm sewer into a newly developed pond and discharging it back into sewer to cross Thornton Road towards the confluence of the Del Curto area with West Bouldin Creek.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
2207-2209 Kinney	0	0	7.4 ac-ft	-23 cfs / -21%

Estimated Cost:

Engineering	\$58,000
Property Acquisition	\$2,250,000
<u>Construction</u>	<u>\$338,000</u>
Total Cost	\$2,650,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at a unit cost of \$115,000/cfs of reduction. While this facility would not provide any direct flood reduction for the Phase 1 project area, it could be used if needed to mitigate increases in basin runoff from implementation of other projects from both Phases 1 and 2.

The cost of detention at this site would be high mainly as a result of land values. Further consideration will be needed with regard to the outlet from the pond; to not produce additional flooding downstream along West Bouldin creek; upsizing of the fallout that crosses Thornton may need to be upsized as well.

Project #12 - Detention at Confluence with W. Bouldin Creek

Description:

Downstream of this project area where runoff converges with West Bouldin Creek, this tributary crosses the backs of several lots along Thornton. Presumably the backs of these lots have little promise for future development as they are near, inside, or encompassed by the creek’s floodplain. There is approximately one acre of land that could be usable for storage. While storing water here cannot provide benefits to residents in the Del Curto area; it could possibly be used to mitigate any increased flows from improved conveyance upstream. There is a possibility that this area can be used as either inline detention from the project area or for peak shaving from upstream on West Bouldin Creek.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
2111-2209 Thornton	0	0	5.4 ac-ft	-13 cfs / -5%

Estimated Cost:

Engineering	\$77,200
Property Acquisition	\$1,180,000
<u>Construction</u>	<u>\$444,000</u>
Total Cost	\$1,700,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at an estimated unit cost of \$131,000/cfs of reduction. If this area were combined with 2303 Thornton the total area & volume would increase, thereby increasing overall performance.

There would be significant costs associated with both property acquisition and implementation.

Project #13 - Green Streets – One Way Street Diets on Iva and Delcrest

Description:

In order to mitigate infill development in the watershed and project area, the idea of transforming both Iva and Delcrest into green streets has been proposed. While any low impact improvements to the area will need to be thoroughly vetted, possibilities include reduction in pavement area by turning Iva and Delcrest into one-way streets, each transporting traffic in the opposite direction. This, in theory, would permit the pavement width to be reduced.

Flood Reduction Potential:

The reduction of impervious area would very slightly reduce the runoff in the target area, but the reductions are estimated at slightly less than 1 cfs.

Estimated Cost:

Engineering	\$109,000
Property Acquisition	\$0
<u>Construction</u>	<u>\$628,000</u>
Total Cost	\$737,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at an estimated unit cost of \$737,000/cfs of reduction. Implementation of a low impact practices here would likely include reconstruction of pavement using a porous material, concrete or pavers, and base, as well as vegetated swales to convey runoff. The project would also have benefits to water quality, traffic calming, and could provide a peaceful aesthetic to the area.

Concerns include interim accessibility on Southland Drive and required street widths for passage of emergency vehicles.

Project #14 - Detention at 2303 Thornton

Description:

2303 Thornton is a parcel that appears to be currently under development. Although there is no construction activity at the moment, the parcel is surrounded with construction fencing and appears to have already been cleared. This lot is approximately 1.8 acres and could offer upwards of 9 acre-feet of storage. This is a very significant volume as approximately 80 acres of the Del Curto neighborhood drain to this parcel. This piece of land could offer significant peak outflow control and serve as dual purpose land. Residents of this area are consistently asking for additional park land and this could easily be transformed into a youth soccer field or dog park.

Flood Reduction Potential:

<u>Property</u>	<u>Exist. Det. Ponds</u>	<u>Exist. WQ Ponds</u>	<u>Add'l Storage Vol.</u>	<u>Peak Reduction</u>
2303 Thornton	0	0	9.0 ac-ft	-21 cfs / -8%

Estimated Cost:

Engineering	\$111,000
Property Acquisition	\$783,000
<u>Construction</u>	<u>\$637,000</u>
Total Cost	\$1,530,000

Potential Advantages and Disadvantages:

The peak flow reduction would be at an estimated unit cost of \$72,900/cfs of reduction. Because of the interplay of the catchments in the project area within the entire West Bouldin Creek watershed, the exact usage of this property will require further examination. Because project area peaks are around 20 minutes before the watershed upstream, it may be preferable to use this lot to store runoff already in West Bouldin rather than that from the Del Curto project area. The net effect of detaining runoff from the project area will be to reduce peak runoff but will also cause the project area catchment to peak later, coinciding more with upstream catchments. If West Bouldin is stored, peaks will be reduced for the upstream catchments (effects seen downstream as well) and increase the timing between the upstream and project areas. This could involve piping water from nearby 2505 Thornton to this lot. If this peak shaving storage is advantageous, then usage of the drainage easement at 2505 Thornton should also be explored.

The primary factor when considering this project alternative as with all detention alternatives will be the cost associated with the land acquisition. It also appears that the property may be in some level of development, although it may be on hold, as vegetation has begun to take over some of the previously leveled pad areas.

Project #15 - Conveyance Enhancements Thornton to Confluence

Description:

Registered complaints of flooding at 2300 Thornton are of yard flooding because of suspected clogging of the existing 48" culvert pipe. Even without clogging, the conduit is known to be undersized and has potential to overtop the roadway and produce backwater effects.

Scoping of this system will be required before more accurate design and cost can be assessed. The primary contributions of runoff will be from the creek that delivers runoff from the Phase 1 project area and runoff collected on Thornton Road. Preliminary design for the creek crossing alone shows adequate capacity from a 72" RCP. The line size will need to be upsized to 96" on the downstream side of the Thornton Road crossing, where the runoff from a drainage trunk line serving the Phase 2 portion of the project area connects into the existing system.

Flood Reduction Potential:

The addition of conveyance thru this area can reduce flooding immediately upstream of Thornton thru reduced backwater.

Estimated Cost:

Engineering	\$84,600
Property Acquisition	\$0
<u>Construction</u>	<u>\$487,000</u>
Total Cost	\$572,000

Potential Advantages and Disadvantages:

There are existing easements in this area, so land acquisition is not required. Due to the flow contributions from the Phase 2 area, it may be prudent to wait until Phase 2 to fully design this project.

Project #16 - Easement Acquisition – Bluebonnet to Del Curto

Description:

Regardless of the need for easements for proposed projects, there are significant gaps in the easements for existing drainage infrastructure. This project would acquire easements along the existing infrastructure paths, sometimes adding entirely new easements, other times simply widening or re-aligning existing easements to meet existing and proposed project needs.

Flood Reduction Potential:

There is no flood reduction potential for this project, but is required for City maintenance of public drainage infrastructure.

Estimated Cost:

Engineering	\$0
Property Acquisition	\$948,000
<u>Construction</u>	<u>\$0</u>
Total Cost	\$948,000

Discussion by Reach:

Easement Acquisition - Bluebonnet to Del Curto

Current topography causes runoff from approximately 25 acres to converge at the sag near 2421 Bluebonnet Lane either by overland flow or storm sewer. Flow is then conveyed through the block, namely through the parcels tabulated below toward the street in front of 2300 and 2302 Del Curto. There are no apparent drainage easements in this segment to provide conveyance of storm water runoff via overland or existing storm sewer systems. Purchasing easements through these properties will give the City needed control of runoff in the area, providing protection for residents and conveyance of storm water. Given that the City requires a minimum drainage width of 15 feet, a variance will be required for the lesser width easements.

The purchase of these easements would be a necessary step for implementation of a channel through the block. A proposed bypass system could in theory eliminate flood threats to the block, but the inter-block drainage may be sufficient to warrant the need for easements here. If a bypass were implemented in this area, obtaining these easements would be wise as systems can fail or become compromised, causing flows to revert to natural overland flowpaths.

Easement Acquisition – Del Curto to Kinney

Along this overland flow segment there appear to be drainage easements in place, but systems therein are observably insufficient. The easements in place today are poorly aligned with actual flow paths and are littered with obstacles including trees, fences, gardens and a house at 2301 Del Curto. Easement acquisition at these locations can provide a continuous uninterrupted path for overland

flow and improve access for maintenance. Acquiring these easements will be critical for the construction of any channel through the 2200 block of Iva/ Delcrest.

Easement Acquisition – Kinney to Thornton

An existing channel serves this block, starting between 2307 and 2311 Kinney Rd. the creek travels the length of the lots, reaches the back of 2304 Thornton and turns to the north into 2300 Thornton where it turns back east running through the center of the property to Thornton Rd. Along 2307 and 2311 Thornton Rd the channel appears to be maintained in variable width drainages within the properties. There is noticeable discontinuity between these easements and the next easement downstream at 2304 Thornton and there is a complete absence of easement throughout 2300 Thornton.

Acquisition of these easements will be necessary for any conveyance improvements in the area, whether bypass system or channel improvement. With trending development of the area, the procurement of these easements now will prevent future conflicts and provide options in the future.

Easement Acquisition – Thornton to Outfall

There are currently drainage easements at 2209 and 2211 Thornton Road. These easements contain storm sewer from the culvert upstream of Thornton Road, and likely convey overland flow. There is an outfall in the vicinity of 2211 Thornton Road and from there water flows through a heavily wooded area at 2201 and 2111 Thornton Road to the confluence with West Bouldin Creek. There are no easements currently at 2201 or 2111 Thornton.

Easements at these parcels will give the City control needed for future improvements and to control development along this creek.

Programmatic Alternatives

Project #17 - Rainwater Harvesting

Rainwater harvesting of runoff from private property offers an opportunity to reduce total storm runoff volume through the capture of local runoff in barrels or cisterns. While it is theoretically possible to reduce peak flood discharges through harvesting, it is difficult to collect enough volume to capture up to the peak timing, and once the barrels are full, the runoff bypasses unabated. The fact that this captured runoff can be retained for later local use in yards and gardens can have the added benefit of reducing demand on the drinking water supply.

Implementation of this program would involve providing barrels / cisterns and training to local residents, who would then be responsible for their installation and maintenance.

Estimated Cost:

Capital expenses (residential barrels, commercial cisterns) are estimated at \$60,000, and City labor (materials acquisition and training workshops) is estimated at \$20,000, for a total estimated project cost of \$80,000.

Pros:

- Reduces total storm runoff volume.
- Reduces demand on drinking water supply.
- Allows residents to participate in the solution.
- Can be implemented quickly.
- No property acquisition.

Cons:

- Unlikely to have significant impact on flood reduction, and could result in sharp rise in downstream discharges (as barrels rapidly shift from no discharge to full discharge).
- Barrels / cisterns not drained prior to storm events will have less storage volume available.
- As privately owned facilities, property owners would need to perform their own maintenance.

Project #18 - Porous Pavement

Through the replacement of existing impervious paved surfaces (roads, parking lots) with pervious materials, it is possible to reduce storm runoff volumes and peak discharges, and to provide a degree of water quality enhancement. TxDOT has begun to implement porous pavement in some locations, with varying degrees of success. Maintenance of roadways typically requires periodic cleaning with high pressure washing equipment for roadways with traffic speeds under 35 MPH.

Implementation of this program in public ROW is not likely to be recommended under current Street & Bridge guidance (low volume, low velocity roadways, would require cleaning). Implementation in privately owned parking lots would be voluntary, as would their maintenance programs.

Estimated Cost:

Capital expenses (roadway construction in public ROW in the Del Curto project area south of Lamar) are estimated at \$560,000, and City labor (project management) is estimated at \$20,000, for a total estimated project cost of \$580,000.

Pros:

- Can reduce runoff and peak discharge somewhat through increased initial abstraction and increased travel time.
- No property acquisition

Cons:

- Flood reduction benefits decrease after the first flush as pavement becomes saturated.
- Maintenance cleanings would be required to keep effectiveness, which would be an additional cost for public facilities, and a risk for private facilities.

Project #19 - Cost Participation with New Development

When new developments are planned, there is an opportunity for the City to coordinate and cost-share on the design of onsite detention / water quality facilities for additional capacity. This additional capacity could provide benefits beyond the footprint of the development under design, at a reduced incremental cost to the City. Such cooperative efforts would be designed to have minimal impact on the property owners, else the owners will have little interest in participating.

Possible alternatives could include increasing pond depth for additional storage volume, or additional storage under parking areas.

Estimated Cost:

Project expenses (incremental costs: design, land acquisition, construction, City labor) cannot be estimated until development opportunities arise.

Pros:

- Potential reduced project cost (reduced land acquisition, shared common expenses for plan development and permitting).

Cons:

- Only possible as development is in the planning stage, little control of project timing.
- Property owners / developers may feel little incentive to participate in voluntary program.
- Maintenance responsibilities would be more complicated and would require agreements.
- Easements would be required for City maintained components.

Project #20 - RSMP

The Regional Stormwater Management Program (RSMP) presents opportunities for funding watershed level drainage improvements from incremental development projects. If a development is being planned, there is an option for the developer to pay a fee in lieu to the RSMP and not to provide flood detention onsite.

No specific capital projects are proposed under this alternative, as it is a funding mechanism only. While the West Bouldin Creek watershed is not in the current list of RSMP watersheds, the ordinance does allow for non-RSMP watershed funding as well.

Estimated Cost:

There is no capital cost for this alternative, and the only administrative costs would be the staff labor to process developer requests and regional improvements.

Pros:

- Allows for an additional funding source.
- Allows for a planned regional approach, which can be more effective at meeting watershed goals.

Cons:

- Funding trickles in as development occurs, no actual flood reduction until actual projects have been funded and implemented, projects needing rapid implementation would still require traditional funding, with reimbursement from the RSMP over time.
- Some projects in this area may not have meaningful detention requirements (no increase in impervious cover, if already fully developed).