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May 28, 2015
Revised October 16, 2015

Ms. Angela Todd-Sheremet, P.E., Ph.D.
Watershed Protection Department
Watershed Engineering Divison
505 Barton Springs Road, 12th Floor
Austin, Texas 78704

Re: Preliminary Engineering Letter Report
Meredith Street Storm Drainage Improvement Project
Klotz Associates Project Number 0501.031.001

Dear Ms. Todd-Sheremet:

Klotz Associates was retained by the City of Austin to review eleven (11) Meredith Street Drainage options analyzed by the City, and consider a twelfth alternative, to mitigate flooding issues within the project limits. Our work builds upon the Preliminary Engineering Report (PER) completed by the City in September 2013 titled "Meredith Street Storm Drain Improvement Project Preliminary Engineering Report". The Klotz Associates analysis resulted in the preparation and submittal of three (3) task memorandums. These memorandums were submitted and reviewed as they were developed. The review comments were then incorporated into each memorandum and finalized. The technical areas of review for the memorandums covered three (3) general elements:

- Identification of a Potential twelfth Alternative (Technical Memorandum Task 2 – September 8, 2014)
- Hydrologic and Hydraulic Evaluation of Alternative 12 (Technical Memorandum Task 5 – October 13, 2014)
- Development of an Evaluation Matrix for the ranking of all twelve of the alternatives, including the previous eleven developed by the City of Austin September 2013 PER (Technical Memorandum Task 6 – Revised October 16, 2015)

In addition to the review elements referenced above, the Klotz Associates team:

- Gathered information on the environmental permitting requirements for the storm drain improvement project;

- Developed open space concepts for the property buy-out option;
- Performed an on the ground survey of the finished floor elevations of the residents at 3605 and 3607 Meredith Street, 1813 Rockmoor Avenue and 1901 Rockmoor Avenue. See the elevation summary from Landmark Surveying in the attachment for Task 4.
- Attended public meetings with the residential stake holders in November 2014 and April 2015
- Made a site visit to document high water marks from the Memorial Day 2015 Flood.
- Sought consultation from Brierly and Raba Kistner on the issues associated with trenchless construction from 3607 Meredith to 1813 Rockmoor.
- Reviewed City of Austin water and wastewater record information to evaluate the impacts to existing utilities.

PROJECT BACKGROUND

The Meredith Street Storm Drain Improvements is a high priority flood mitigation and water quality improvement project for the City of Austin's (COA) Localized Flood Hazard Mitigation program. The project initially involved the design and construction of infrastructure to address flooding issues at 3605 Meredith Street, 1813 Rockmoor Avenue and 1901 Rockmoor Avenue. However, when the City of Austin investigated the issue, other constructability, water quality and erosion issues were identified.

The existing storm drain system on Meredith Street was originally constructed to drain into Austin Caverns. Inlets on Meredith Street, Raleigh Avenue, and Stevenson Avenue are all interconnected by an existing storm drain system. The outfall for this system is Austin Caverns below the inlet on the south side of Meredith Street in front of 3605 Meredith. Based on City of Austin 311 reports of flood damage, it appears that the cave system has lost the capacity to convey the larger intensity runoff from the existing sub basin. This reduction in capacity is the reason that the inlets continue to overflow causing runoff to travel overland through the development south of Meredith Street.

Significant topography within the neighborhood creates challenges for the layout and construction of a new storm drain system that would relieve the flooding along Meredith Street. These topographic challenges make it difficult to reach low points within the flood area without constructing significantly deep storm sewer mains (up to 20 feet deep). In addition, cave features north and south of Meredith Street, and the rubble used to fill in the old quarry south of Meredith, limit the ability to utilize trenchless construction methods, such as boring or tunneling. Based on conversations with City Staff, a nearby City of Austin wastewater project attempted trenchless construction and was stopped due to unstable subsurface conditions.

The COA Watershed Protection Department (WPD) prepared a Draft Preliminary Engineering Report (PER), dated September 2013, to identify and evaluate 11 alternatives for the design and construction of improvements to mitigate flooding issues. In July 2014, Klotz Associates was retained by the City of

Austin to evaluate the City of Austin alternatives and expand on that work with an additional alternative; ultimately recommending a best option for the design and construction of the flood mitigation project.

PROJECT LIMITS

The project area is generally bound by Windsor Road along the north, Bridle Path to the south, Matthews Drive to the west and Robinhood Trail to the east. A site location map can be found in Exhibit 1 attached to Technical Memorandum Task 5 at the end of this report. A majority of the area is built out with existing single family residential. This general project area bounds the sub-basins and storm drain infrastructure evaluated by the City of Austin and Klotz Associates for the various alternatives.

AUSTIN CAVERNS

Concurrent with the development of Klotz Associates' analysis for a recommended design alternative, Sylvia Pope, P.G., with the City of Austin, researched existing cave data to develop a general mapping of the Austin Caverns system within the project limits. Based on her analysis, the cave system is generally oriented north/south, centered between Raleigh Avenue and Robinhood Trail, with north and south limits bound by Stevenson Avenue and Clearview Drive. A map of the assumed cave system, developed by the City of Austin, is attached at the end of this letter report. The larger portion of the cave system is assumed to be located in the area north of Meredith Street. The portion south of Meredith Street is a smaller section that leads to an old quarry that was filled prior to the construction of homes along Rockmoor Avenue south of Meredith Street. This quarry was filled with rock and earthen rubble prior to the development of many of the homes south of Meredith Street.

ALTERNATIVES ANALYSIS

Klotz Associates reviewed the original 11 alternatives analyzed in the City of Austin September 2013 PER. These alternatives generally involve three (3) main design and construction options for alleviating the flooding on Meredith Street:

- Open cut construction to connect a new main to the outfall of the inlets on Meredith Street. This new outfall would replace the existing one thereby allowing the city to close the outfall that currently drains to Austin Caverns;
- Trenchless construction of a new main to the inlets on Meredith Street by tunneling from Rockmoor Avenue to a bore pit located somewhere on the property at 3605 Meredith;
- Purchase and demolition of 2 – 4 of the residential structures south of Meredith Street and east of Rockmoor Avenue in order to open cut a new outfall and create a water quality / detention pond for the area draining to Meredith Street.

Each of these options included the construction of downstream storm sewer improvements to increase the capacity of the undersized storm lines. They also require the design of erosion control measures at the outfall point and the acquisition of easements for the maintenance and construction of the outfall improvements.

In the Technical Memorandum for Task 2, attached to this report, Klotz Associates reviewed the existing recommendations of the 2013 COA PER and developed a twelfth alternative that sought to balance the constructability, water quality and cost issues associated with the flood mitigation along Meredith Street. This alternative involves the open cut construction of storm sewer mains and inlets that would divert approximately 2/3 of the existing runoff away from the system that drains to Austin Caverns. The diverted runoff would drain through a system of new and existing inlets and upsized storm drain pipes to the current outfall on Cherry Lane. The remaining 1/3 of the runoff would continue to drain into Austin Caverns. New filtration/water quality inlets would be installed in place of the existing inlets on Meredith Street, thereby reducing the potential for sediment buildup in the caverns.

Technical Memorandum for Task 5, attached to this report, analyzes the hydrology and hydraulic elements of Alternative 12.

PUBLIC MEETINGS

On November 18, 2014 and again on April 21, 2015 public meetings were held at O'Henry Middle School at 2610 W. 10th Street. These meetings presented status updates and information on the design alternatives associated with the flood mitigation for the Meredith Street area. The November 2014 meeting presented the four (4) basic recommended options for the design phase of the project:

- Open cut construction of a new outfall for the Meredith Street System;
- Trenchless construction of a new outfall for the Meredith Street System;
- Property buyouts for the demolition of existing structures and the construction of a water quality pond, including storm drain upgrades to the outfall;
- Diversion of 2/3 of the existing runoff away from the existing Meredith Street system by upgrading the surrounding storm system and the installation of water quality inlets within the Meredith system for the remaining 1/3 draining to the cavern.

The primary concern voiced by the residents in each public meeting centered on the potential for subsidence due to construction near the cave system and the affect it would have on their home foundations. Following the November meeting, a web site was developed by the City of Austin to convey project information to the residential stakeholders. A second public meeting was held in April 2015 to provide follow up information. Based on the majority of comments received as a result of the November

2014 meeting, the April 2015 meeting focused on available information regarding Austin Caverns and the construction issues associated with the cave system.

RECOMMENDATIONS

The Technical Memorandum for Task 6, attached to this report, details the criteria used to evaluate the 12 alternatives. These criteria take into account nine (9) scoring options based on a system of weighted values. These criteria are:

- Meeting Project Goals
- Water Quality
- Environmental Considerations
- Karst / Rubble Constructability
- Utility Conflicts
- Neighborhood Impact
- Neighborhood Support
- Opinion of Cost
- Time of Construction

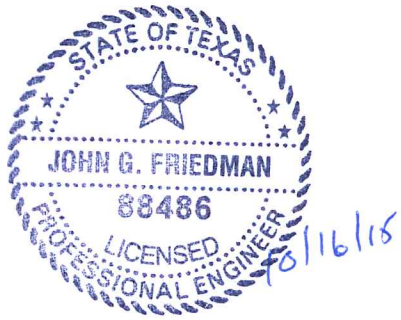
Based on the evaluation of each of these measures, as detailed in the attached Technical Memorandum 6, the recommended improvement alternative is number 5. This alternative scores highest in the evaluation matrix and provides the most direct route for constructing improvements that mitigate the flooding. The potential instability of the rubble material used to fill the quarry significantly influenced the scoring of the project alternatives. Trenchless construction options scored very low on the "Karst/Rubble Constructability" item in the evaluation matrix. This item was also heavily weighted in order to emphasize the significance of the concern regarding the potential for failure when using this construction method. Another factor affecting the scores within the matrix was the higher neighborhood support for options that minimize construction. Alternative 5 achieves this goal by providing one of the most direct routes from the problem area to the nearest outfall. One of the main drawbacks to Alternative 5 is the deep cut needed to install a line from the inlets on Meredith through the steep incline at the corner of Meredith Street and Rockmoor Avenue. Some benching will be necessary to lower an excavator through that section to reach deep enough to install the new line. Record City of Austin water and wastewater information appears to indicate that the water main will likely need to be temporarily cut through that section to make room for the construction equipment. However, the existing wastewater main is significantly deep through that section and should not be affected by the construction activity.

In addition to the 12 alternatives evaluated in our Preliminary Engineering Analysis, it has come to our attention that the City of Austin Watershed Engineering Division is considering a variation on Alternative

5, labeled Alternative 5a. This alternative would delete portions of the proposed storm drain improvements that run east of the inlets on Meredith, up Raleigh Avenue to Stevenson Avenue. This option would further improve the score for Alternative 5 by reducing the construction cost and further minimizing the disruption to the neighborhood. Therefore Alternative 5a would be the best option if chosen.

We appreciate the opportunity to work with the City of Austin on this unique drainage improvement project. If you should have any questions in your review of this report, please contact me at 512-328-5771.

Sincerely,



John Friedman, PE
Senior Project Manager

JF:lc

Attachments:

- Technical Memorandum for Task 2 – Meredith Street Additional Alternative Recommendation
- Task 4 – Finish floor information from Landmark Surveying
- Technical Memorandum for Task 5 – Hydrologic and Hydraulic Analysis of Alternative 12
- Technical Memorandum for Task 6 – Matrix Evaluation of Alternatives 1-12
- Baer Engineering and Environmental Consulting, Inc. Preliminary Permitting Analysis Report – March 2015
- McCann Adams Open Space Concept
- Austin Caverns Map (Titled "Current Flood Risk and Recommendations Solution")

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Attachment

Technical Memorandum for Task 2 –

Meredith Street Additional Alternative Recommendation

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Memo

To: Angela Todd-Sheremet, P.E., Ph. D.

From: John Friedman, P.E.

Date: September 8, 2014 (revised per comments received from COA)

Re: Meredith Street Drainage Improvements - Task 2 - Additional Alternative Recommendation

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Klotz Associates is currently under contract with the City of Austin (COA) to review and expand on a draft Preliminary Engineering Report (PER) completed by the City in September 2013 titled "Meredith Street Storm Drain Improvement Project". The PER identifies and analyzes multiple potential solutions to the reoccurring flooding problems in the Meredith Street area. The following memo provides an additional alternative beyond what is discussed in the PER.

The COA states in the PER that curb inlets along Meredith Street discharge directly into a deep cave system under the road. Due to increased development over the years, possible cave deterioration and sediment/debris accumulation in the cave, the original drainage system does not have the capacity to convey area runoff. This results in overland flow and flooding of nearby homes. The COA draft PER included 11 mitigation alternatives, which in general fall into three categories:

1. Rerouting of the runoff away from the Meredith Street inlets/cave by capturing the majority of water upstream and upsizing existing storm drain systems to outfall the water into Lake Austin. The cave inlet would be sealed and no water would discharge into the cave.

2. Capturing runoff at the cave inlets but routing the water between existing homes by acquiring drainage easements and installing new storm drain pipe. The cave inlet would be sealed and no water would discharge into the cave.

3. Purchasing the properties that flood near the Meredith Street inlets and transforming the lots into a detention type structure that outfalls between existing homes in a new storm drain system. The cave inlet would be sealed and no water would discharge into the cave.

The COA draft PER recommends strategy 2 because the solution allows water to flow in its natural direction while also capturing and conveying the runoff in new storm drain pipes underground. However, this option would be difficult due to the need to use trenchless construction to place the line in the limited space between existing homes. Previously designed wastewater line projects in the area, using trenchless construction techniques, had to be abandoned during construction due to the instability of the soil materials in the cave area.

Klotz Associates has preliminarily developed an additional alternative, Alternative 12, which combines some of the strategies of the COA report as well as introduces some additional concepts that could be effective in solving the flooding problems along Meredith Street. Please see the attached Exhibit 1. Alternative 12 will redirect runoff upstream of the inlets along Meredith similar to COA concept 1 discussed above. However, this alternative will keep the inlets along Meredith Street open to discharge into the cave with a significantly reduced flow. The rerouting of the upstream runoff will remove approximately 2/3 of the existing contributing drainage area and will use Rockmore Ave and Robinhood Trail as routes to install new connections to an existing storm drain system. These routes minimize the depth of trenching required to place the storm drain pipe. The trenches will be less than 13 feet deep at all locations. In addition to the new storm drain pipe, the existing pipe along Rockmore Ave and Cherry Lane will need to be upsized to convey the additional flows.

Alternative 12 will replace the existing inlets along Meredith Street with "filtering" inlets that provide water quality benefits. The purpose of the filtration is to minimize the amount of debris entering the cave, thereby maintaining the ability of the cave to store and convey a limited amount of the remaining runoff. By allowing filtered water to still enter the cave system, it provides multiples benefits to the overall system:

1. It could help to maintain the environmental integrity of the cave eco system by allowing some of the water to continue to flow into the cave.
.
2. By rerouting roughly 2/3 of the existing runoff, the cave should be able to convey the reduced flow without flooding.

3. Due to the fact that the inlets along Meredith are much lower than nearby streets, open cutting inside the street would be difficult and expensive to accomplish. By keeping the inlets functional, the need for special excavation and shoring will be greatly reduced.

4. There is no need to acquire easements. All construction could take place inside the existing right of way.

5. There is no need to bore near existing homes. The COA draft PER notes that a wastewater micro tunneling project had to be stopped during construction due to poor conditions. This alternative removes much of the risk related to encountering poor subsurface conditions.

The proposed Alternative 12 will require additional hydrologic and hydraulic calculations associated with storm sewer design to route runoff away from the Meredith street inlets. The capacity of the cave will be determined empirically using rainfall data and flood incident reports. This analysis will then be used to determine an estimate of probable cost. Klotz Associates anticipates the cost of Alternative 12 will be comparable to the alternatives discussed in the COA draft PER.

In addition to Alternative 12, Klotz Associates recommends that we prepare a land plan for Alternative #4 of the COA draft PER. Alternative #4 recommended buying the properties that flood and converting the lots into a detention facility. This option requires public involvement and assistance from a landscape architect and is in our current scope of services as Task 3. This additional information will be necessary to fully evaluate the cost and potential benefits for that option.

N

200 100 0 Feet

SWEETBRUSH

ROCKMOOR

KENMORE

WINDSOR

GILBERT

GILBERT

ROCKMOOR

STEVENSON

LEBER MAN

ROCKMOOR

SCENIC

MATTHEWS

MEREDITH

MEREDITH

RALEIGH

KENNELWOOD

CLEARVIEW

CHERRY

CHERRY

ROCKMOOR

ROBINHOOD

NFIELD

Legend

- Proposed Manhole
- Proposed Inlets
- Proposed WQ Filter Inlets
- Proposed Pipe
- Existing Outfalls
- Exsiting Manholes
- Existing Curb Inlets
- Existing Pipe
- Buildings
- Parcels
- Existing Meredith Drainage Area
- Proposed Meredith Drainage Area
- Rerouted Drainage Area

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Meredith Street
Drainage Improvements
Klotz Associates Alternative

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SCALE: 1" = 200 '	1
Date: September 2014	

klotz associates

Attachment

Landmark Survey Summary for Task 4

Meredith Street Storm Drain Improvements

Client: Klotz and Associates
Date: 10-15-14
FB. 1401/40, TBD

POINT	ELEVATION	DESCRIPTION	COMMENTS
Trav 1	563.48	TP1 IS A COTTON SPINDLE PREVIOUSLY SET IN ASPHALT AT THE SOUTHEAST CORNER OF ROCKMOOR AVE. AND MEREDITH ST.	Elevation was obtained using RTK redundancy and adjusted to Geoid Model 2012A Conus See LM FB 1335/10.
Trav 100	551.31	Trav 100 is a cotton spindle set in asphalt on the south side of Rockmoor across from 1901 Rockmoor	
1901 A	549.06	Finished Floor 1901 A Rockmoor	
1901 B	549.13	Finished Floor 1901 B Rockmoor	This elevation was calculated using the reflectorless instrument (no ROE granted)
3607A	550.18	Finished Floor 3607A Meredith	
3607B	550.11	Finished Floor 3607B Meredith	
3605A	550.43	Finished Floor 3605A Meredith	
3605B	549.91	Finished Floor 3605B Meredith	
1813	545.97	Finished Floor 1813 Rockmoor	
BM1	*535.89*	Triangle cut on curb at southwest corner of Cherry Lane and Rockmoor Avenue	Marking was an L cut, with a discolored line forming the 3rd edge of the triangle. Elevation from COA published documents=535.20 NGVD 29 Note: It is possible that this marking is not the original bench mark described.

Attachment

Technical Memorandum for Task 5 – Hydrologic and Hydraulic Analysis of Alternative 12

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Memo

To: Angela Todd-Sheremet, P.E., Ph. D.

From: John Friedman, P.E.

Date: October 13, 2014 (revised per COA comments)

Re: Meredith Street Drainage Improvements - Task 5 - Hydrologic and Hydraulic Analysis of Alternative 12

Klotz Associates is currently under contract with the City of Austin (COA) to review and expand on a draft preliminary engineer report (PER) completed by the City of Austin Watershed Protection Department (WPD) in September 2013 titled "Meredith Street Storm Drain Improvement Project". The PER identifies multiple potential solutions to reoccurring flooding problems in the Meredith Street area. The following memo provides a more detailed analysis of an additional alternative, Alternative 12, Klotz Associates discussed in a September 8, 2014 Memo – Meredith Street Drainage Improvements – Task 2 – Additional Alternative Recommendation.

The Task 2 Memo described an Alternative 12 which proposed to divert water from the cave inlets along Meredith Street through new inlets and storm sewer trunk line located in the surrounding streets. Additionally, the alternative proposed to allow some water to continue to flow into the cave maintaining the existing ecologic condition and reducing construction cost.

The following memo details the hydrologic and hydraulic analysis completed to determine the feasibility of Alternative 12.

Hydrologic Study

Klotz Associates preliminarily located curb inlets in the project area using City of Austin provided 2-foot contour data. Inlets were located at roadway low points and judgment was used to place on-grade curb inlets at strategic locations. Curb inlets were placed to maximize the amount of runoff diverted from the cave inlets on Meredith Street. Further analysis of the cave inlets is discussed later in the memo. After determining inlet locations, drainage area

boundaries were delineated using the available contour data. A copy of the Drainage Area Map is attached to this memo as Exhibit 1. All the areas were less than 100 acres and the Rational Method was used to determine the peak flow from each drainage area. The Rational Method is consistent with the methodology used by the COA WPD in the PER. Klotz Associates used the City of Austin Drainage Criteria Manual (DCM) – 2014 Update to determine the Time of Concentration for each area. Additionally, Klotz Associates used the methodology described in the COA PER to determine the Runoff Coefficient. In general, areas that had only roadway as the contributing area were categorized as fully impervious with a Runoff Coefficient of 0.95. Areas that had outside the curb runoff were categorized as single family and a 100 year runoff coefficient of 0.66 was used. See comment response memorandum (attached) for a "C" value justification analysis. The City of Austin DCM has a Runoff Coefficient factor applied to smaller storms that was used in this analysis. A detailed table of the Peak Flow Calculations is attached to this memo.

Hydraulic Study

Klotz Associates was provided StormCAD files from the COA. We used those existing models to create a new model to analyze Alternative 12. The hydrologic data detailed above was entered into the model for the 25 year (COA design storm) and the 100 year storm events. The following assumptions were made to complete the preliminary analysis:

- StormCAD would calculate the necessary pipe size. The sizes in the output are not optimized for economics or City of Austin minimum/maximum criteria.
- All inlets were set to "full capture" which does not allow bypass. This was done to determine the maximum required capacity in the pipe network.
- Inlet ponding depth was kept to a maximum of 0.50 feet.

Using these assumptions, the model was run for both the 25 and 100 year storms. The existing outfall location along Cherry Lane was used. StormCAD files for Alternative 12 were sent to the COA WPD as an attachment to this memo via email. The trunk line path and size are shown on the Drainage Area Map Exhibit 1 also sent via email with this memo.

In general, the results show that to capture and convey the 25 year storm, the trunk line will vary in size, from 36" up to 60" RCP. The existing trunk line is 36" RCP. The required inlet capture volumes are reasonable for a standard COA inlet of 10-foot opening width. In some locations multiple inlets would be required to achieve maximum capture. These inlet size and location decisions should be made during detailed design. It is recommended that for the future cost estimating of this alternative, the 25 year storm design be used with provisions for the 100 year as described by the City of Austin Drainage Criteria Manual.

Cave Capacity

Alternative 12 seeks to utilize some of the drainage capacity of the cave inlets. This provides three main benefits:

- Reduces construction cost by eliminating the need to drain the inlets along Meredith Street to the side streets using trenching deeper than standard construction will allow.
- Maintain ecological integrity of the caves by allowing filtered water to enter the caves through water quality type inlets.
- Eliminates the need for trenchless construction of an outlet structure between existing homes to drain the cave inlets.

The drainage analysis of the proposed storm sewer system compared to the existing condition indicates that the amount of water coming to the cave inlets during a 25 year storm event, with Alternative 12 in place, would be less than the equivalent of a 2 year storm in the existing condition. Please see the table below:

Area ID	Area	Q – 2 yr	Q – 25 yr	Q – 100 yr
	(acre)	(cfs)	(cfs)	(cfs)
Existing	16.94	32.8	73.5	106.9
Alt 12 - Cave	5.59	12.3	27.4	39.4

The Drainage Area Map for Existing Conditions is attached as Exhibit 2. The time of concentration, "C" value and drainage area information is summarized in the table attached at the end of this memorandum.

Klotz Associates used the days the City received flooding complaints (Appendix A of the City of Austin September 2013 Meredith Street Storm Drain Improvement Preliminary Engineering Report) and available rain gauge data to approximate a storm event that created a flooding incident report. Below is a table showing the dates of complaints and the corresponding rain event based on rain gauge data.

Event Date	Rainfall	Storm Duration	Equivalent Event
	(inches)	(hours)	(year)
11-15-2001	3.35	12 h	2 yr
6-30-2004	0.98	2 hr	2 yr
9-7-2010	12.6	24 hr	100 yr

Based on the preliminary analysis, we anticipate that the caves can convey the design storm (25 year) with the new Alternative 12 system, but that during significant events (larger than

25 year) flooding could occur. During the site visit we observed that the area behind the inlets, in the adjacent property parking lot, is a low point that could hold some water should the curb be breached. We anticipate that in an event that currently causes the inlets to flood, impact to the inside of homes would be minimized or removed under Alternative 12.

Summary

The preliminary analysis of Alternative 12 demonstrates a reasonable alternative that diverts significant runoff from the cave inlets and is conveyed in a traditional storm sewer system of concrete pipe ranging in size from 18 inches to 60 inches. The inlets at the cave will remain open and continue to drain into the cave system. Filtration type inlets will be installed to keep sediment from discharging into the cave. Preliminary analysis of the cave capacity based off of known flooding complaints and available rain gauge data reveals a capacity of the cave system that would likely exceed a proposed condition 25 year peak event. StormCAD files for Alternative 12 were sent to the COA WPD as an attachment to this memo via email. The trunk line path and size are shown on the Drainage Area Map Exhibit 1 also sent via email with this memo.

N

200 100 0 Feet

SWEETBRUSH

ROCKMOOR

KENMORE

WINDSOR

GILBERT

DA-14

DA-1

GILBERT

DA-13

DA-2

DA-3

ROCKMOOR

24" RCP

30" RCP

STEVENSON

DA-4

STEVENSON

24" RCP

MATTHEWS

SCENIC

30" RCP

18" RCP

DA-15

DA-5

DA-6

30" RCP

Cave Inlets to be replaced with Filtration Inlets.

36" RCP

DA-16

DA-16A

Cave Drainage Area

MEREDITH

KENNELWOOD

DA-18

RALEIGH

DA-8

36" RCP

36" RCP

DA-17

DA-10

CLEARVIEW

DA-11

36" RCP

DA-19

36" RCP

Existing Outfall to Remain

CHERRY

DA-22

DA-21

42" RCP

CHERRY

DA-7

60" RCP

DA-20

DA-9

60" RCP

60" RCP

42" RCP

48" RCP

DA-12

ROCKMOOR

BRIDLE

SCENIC

ROBINHOOD

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Legend

- Proposed Manhole
- Proposed Inlets
- Proposed WQ Filter Inlets
- Proposed Pipe
- Cave Inlets Drainage Area
- Proposed Drainage Areas
- Existing Outfalls
- Exsiting Manholes
- Existing Curb Inlets
- Existing Pipe
- Buildings
- Parcels

klotz associates

Proposed Cave Inlet Drainage Area

Meredith Street
Drainage Improvements
Klotz Associates Alternative

KLOTZ PROJ. NO.: 0501.031.001	EXHIBIT
SCALE: 1" = 200 '	1
Date: May 2015	

N

200 100 0 Feet

Legend

- Existing Outfalls
- Exsiting Manholes
- Existing Curb Inlets
- Tc Path
- Existing Pipe
- Existing Meredith Drainage Area
- Buildings
- Parcels

klotz associates

Meredith Street
Cave Inlets
Existing Condition

Meredith Street
Drainage Improvements

KLOTZ PROJ. NO.: 0501.031.001	EXHIBIT
SCALE: 1" = 200 '	2
DATE: May 2015	

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Peak Flow Summary

Area ID	Area (Ac)	C, Runoff Coefficient						I, Intensity (in/hr)						Tc (min)	Q, Peak Discharge (cfs)					
		2-year	5-year	10-year	25-year	50-year	100-year	2-year	5-year	10-year	25-year	50-year	100-year		2-year	5-year	10-year	25-year	50-year	100-year
1	1.15	0.46	0.50	0.53	0.58	0.61	0.66	3.96	5.11	5.94	7.08	8.03	9.10	14.4	2.1	2.9	3.6	4.7	5.6	6.9
2	0.61	0.46	0.50	0.53	0.58	0.61	0.66	5.29	6.80	7.89	9.33	10.42	11.69	6.7	1.5	2.1	2.6	3.3	3.9	4.7
3	3.82	0.46	0.50	0.53	0.58	0.61	0.66	3.70	4.77	5.55	6.63	7.54	8.56	16.6	6.5	9.0	11.3	14.7	17.7	21.6
4	0.31	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	1.2	1.6	2.0	2.6	3.1	3.7
5	0.11	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	0.4	0.6	0.7	0.9	1.1	1.3
6	0.14	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	0.5	0.7	0.9	1.2	1.4	1.7
7	1.82	0.46	0.50	0.53	0.58	0.61	0.66	4.70	6.04	7.01	8.33	9.36	10.55	9.6	4.0	5.4	6.8	8.8	10.5	12.7
8	1.81	0.67	0.71	0.77	0.84	0.88	0.95	3.98	5.13	5.96	7.11	8.05	9.13	14.2	4.8	6.6	8.3	10.8	12.9	15.7
9	4.69	0.46	0.50	0.53	0.58	0.61	0.66	4.99	6.42	7.44	8.82	9.89	11.12	8.1	10.8	14.9	18.7	24.0	28.5	34.4
10	1.40	0.46	0.50	0.53	0.58	0.61	0.66	5.22	6.71	7.78	9.21	10.30	11.56	7.0	3.4	4.7	5.8	7.5	8.8	10.7
11	0.26	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	1.0	1.4	1.7	2.2	2.6	3.1
12	0.51	0.46	0.50	0.53	0.58	0.61	0.66	4.35	5.60	6.50	7.74	8.74	9.87	11.6	1.0	1.4	1.8	2.3	2.7	3.3
13	3.26	0.46	0.50	0.53	0.58	0.61	0.66	3.91	5.04	5.86	7.00	7.94	9.00	14.8	5.9	8.1	10.2	13.2	15.9	19.4
14	1.74	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	6.7	9.2	11.5	14.7	17.3	20.7
15	0.23	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	0.9	1.2	1.5	1.9	2.3	2.7
16	0.91	0.46	0.50	0.53	0.58	0.61	0.66	5.76	7.39	8.57	10.11	11.23	12.54	5.0	2.4	3.3	4.2	5.3	6.3	7.5
16A	0.12	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	0.5	0.6	0.8	1.0	1.2	1.4
17	0.43	0.46	0.50	0.53	0.58	0.61	0.66	5.76	7.39	8.57	10.11	11.23	12.54	5.0	1.1	1.6	2.0	2.5	3.0	3.6
18	2.39	0.46	0.50	0.53	0.58	0.61	0.66	5.55	7.13	8.26	9.76	10.87	12.16	5.7	6.1	8.4	10.6	13.5	15.9	19.2
19	2.88	0.46	0.50	0.53	0.58	0.61	0.66	4.70	6.04	7.01	8.32	9.36	10.55	9.6	6.2	8.6	10.8	13.9	16.5	20.0
20	0.73	0.67	0.71	0.77	0.84	0.88	0.95	4.84	6.22	7.22	8.56	9.61	10.82	8.8	2.3	3.2	4.1	5.2	6.2	7.5
21	0.67	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	2.6	3.5	4.4	5.7	6.6	8.0
22	0.21	0.67	0.71	0.77	0.84	0.88	0.95	5.76	7.39	8.57	10.11	11.23	12.54	5.0	0.8	1.1	1.4	1.8	2.1	2.5
Exist Cave	16.94	0.46	0.50	0.53	0.58	0.61	0.66	4.19	5.40	6.27	7.47	8.45	9.56	12.7	32.8	45.3	56.8	73.5	87.9	106.9
Prop Cave	5.59	0.46	0.50	0.53	0.58	0.61	0.66	4.76	6.13	7.11	8.44	9.48	10.68	9.2	12.3	16.9	21.2	27.4	32.5	39.4
Cave 1	2.80	-	-	-	-	-	-	-	-	-	-	-	-	4.61	6.15	8.47	10.62	13.70	16.26	19.70
Cave 2	2.80	-	-	-	-	-	-	-	-	-	-	-	-	4.61	6.15	8.47	10.62	13.70	16.26	19.70

TIME OF CONCENTRATION CALCULATIONS

All calculations done using equations found in 2014 COA Drainage Criteria Manual

P2 (24) = 3.44

Tc = T(sheet) + T(shallow conc) + T(channel)
T(sheet) = .007(nL)^.8/(P2)^.5S^.4
T(shallow conc) = L/60*(16.1345)S^.5 unpaved
T(shallow conc) = L/60*(20.3282)S^.5 paved
T(channel) = mannings

Sheet flow 'n'	
0.015	concrete
0.016	asphalt
0.015	short grass prairie
0.24	dense grass
0.013	range, natural

AREAS	REACH (FT)			DESCRIPTION OF FLOW	SLOPE (ft/ft)	LENGTH (FT)	"n" VALUE	ELEVATIONS (FT)		Paved/Unpaved	Channel Velocity (f/s)	TIME OF CONC. (MIN)
1	0	TO	100	SHEET FLOW	0.020	100	0.2	597	595	-	-	11.9
	100	TO	179	SHALLOW CONCENTRATED FLOW	0.038	79	-	595	592	16.1345	-	0.4
	179	TO	623	SHALLOW CONCENTRATED FLOW	0.032	444	-	592	578	20.3282		2.1
	179	TO	179	CHANNEL	-	0		592		-		0.0
					TOTAL	623					**TOTAL**	**14.4**
2	0	TO	61	SHEET FLOW	0.041	61	0.2	591.5	589	-	-	6.0
	61	TO	267	SHALLOW CONCENTRATED FLOW	0.053	206	-	589	578	20.3282	-	0.7
	267	TO	267	CHANNEL	-	0		578		-		0.0
					TOTAL	267					**TOTAL**	**6.7**
3	0	TO	100	SHEET FLOW	0.015	100	0.2	597	595.5	-	-	13.3
	100	TO	177	SHALLOW CONCENTRATED FLOW	0.019	77	-	595.5	594	16.1345	-	0.6
	177	TO	756	SHALLOW CONCENTRATED FLOW	0.031	579	-	594	576	20.3282	-	2.7
	756	TO	756	CHANNEL	-	0		576		-		0.0
					TOTAL	756					**TOTAL**	**16.6**
4	0	TO	25	SHEET FLOW	0.040	25	0.016	576	575	-	-	0.4
	25	TO	140	SHALLOW CONCENTRATED FLOW	0.009	115	-	575	574	20.3282	-	1.0
	140	TO	140	CHANNEL	-	0		574		-		0.0
					TOTAL	140					**TOTAL**	**5.0**
5	0	TO	25	SHEET FLOW	0.040	25	0.016	580	579	-	-	0.4
	25	TO	173	SHALLOW CONCENTRATED FLOW	0.027	148	-	579	575	20.3282	-	0.7
	173	TO	173	CHANNEL	-	0		575		-		0.0
					TOTAL	173					**TOTAL**	**5.0**
6	0	TO	30	SHEET FLOW	0.067	30	0.2	582	580	-	-	2.8
	30	TO	185	SHALLOW CONCENTRATED FLOW	0.032	155	-	580	575	20.3282	-	0.7
	185	TO	185	CHANNEL	-	0		575		-		0.0
					TOTAL	185					**TOTAL**	**5.0**
7	0	TO	68	SHEET FLOW	0.029	68	0.2	572	570	-	-	7.5
	68	TO	188	SHALLOW CONCENTRATED FLOW	0.025	120	-	570	567	16.1345	-	0.8
	188	TO	528	SHALLOW CONCENTRATED FLOW	0.047	340	-	567	551	20.3282	-	1.3
	188	TO	188	CHANNEL	-	0		551		-		0.0
					TOTAL	528					**TOTAL**	**9.6**
8	0	TO	88	SHEET FLOW	0.023	88	0.2	572	570	-	-	10.2
	88	TO	183	SHALLOW CONCENTRATED FLOW	0.032	95	-	570	567	16.1345	-	0.6
	183	TO	845	SHALLOW CONCENTRATED FLOW	0.024	662	-	567	551	20.3282	-	3.5
	183	TO	183	CHANNEL	-	0		551		-		0.0
					TOTAL	845					**TOTAL**	**14.2**

9	0	TO	88	SHEET FLOW	0.080	88	0.2	572	565	-	-	6.2
	88	TO	318	SHALLOW CONCENTRATED FLOW	0.052	230	-	565	553	16.1345	-	1.0
	318	TO	566	SHALLOW CONCENTRATED FLOW	0.056	248	-	553	539	20.3282	-	0.9
	318	TO	318	CHANNEL	-	0		539		-		0.0
					TOTAL	566					**TOTAL**	**8.1**
10	0	TO	60	SHEET FLOW	0.050	60	0.2	579	576	-	-	5.5
	60	TO	116	SHALLOW CONCENTRATED FLOW	0.036	56	-	576	574	16.1345	-	0.3
	116	TO	493	SHALLOW CONCENTRATED FLOW	0.061	377	-	574	551	20.3282	-	1.3
	116	TO	116	CHANNEL	-	0		551		-		0.0
					TOTAL	493					**TOTAL**	**7.0**
11	0	TO	25	SHEET FLOW	0.040	25	0.016	577	576	-	-	0.4
	25	TO	180	SHALLOW CONCENTRATED FLOW	0.006	155	-	576	575	20.3282	-	1.6
	180	TO	180	CHANNEL	-	0		575		-		0.0
					TOTAL	180					**TOTAL**	**5.0**
12	0	TO	93	SHEET FLOW	0.022	93	0.2	549	547	-	-	10.9
	93	TO	269	SHALLOW CONCENTRATED FLOW	0.043	176	-	547	539.5	20.3282	-	0.7
	269	TO	269	CHANNEL	-	0		539.5		-		0.0
					TOTAL	269					**TOTAL**	**11.6**
13	0	TO	100	SHEET FLOW	0.020	100	0.2	596	594	-	-	11.9
	100	TO	595	SHALLOW CONCENTRATED FLOW	0.057	495	-	594	566	16.1345	-	2.1
	595	TO	798	SHALLOW CONCENTRATED FLOW	0.054	203	-	566	555	20.3282	-	0.7
	595	TO	595	CHANNEL	-	0		555		-		0.0
					TOTAL	798					**TOTAL**	**14.8**
14	0	TO	25	SHEET FLOW	0.040	25	0.016	600	599	-	-	0.4
	25	TO	1,047	SHALLOW CONCENTRATED FLOW	0.043	1,022	-	599	555	20.3282	-	4.0
	1,047	TO	1,047	CHANNEL	-	0		555		-		0.0
					TOTAL	1,047					**TOTAL**	**5.0**
15	0	TO	25	SHEET FLOW	0.040	25	0.016	577	576	-	-	0.4
	25	TO	314	SHALLOW CONCENTRATED FLOW	0.069	289	-	576	556	20.3282	-	0.9
	314	TO	314	CHANNEL	-	0		556		-		0.0
					TOTAL	314					**TOTAL**	**5.0**
16	0	TO	23	SHEET FLOW	0.043	23	0.2	576	575	-	-	2.7
	23	TO	459	SHALLOW CONCENTRATED FLOW	0.060	436	-	575	549	20.3282	-	1.5
	459	TO	459	CHANNEL	-	0		549		-		0.0
					TOTAL	459					**TOTAL**	**5.0**
16A	0	TO	47	SHEET FLOW	0.085	47	0.016	566	562	-	-	0.5
	47	TO	247	SHALLOW CONCENTRATED FLOW	0.065	200	-	562	549	20.3282	-	0.6
	247	TO	247	CHANNEL	-	0		549		-		0.0
					TOTAL	247					**TOTAL**	**5.0**
17	0	TO	51	SHEET FLOW	0.137	51	0.2	559	552	-	-	3.2
	51	TO	314	SHALLOW CONCENTRATED FLOW	0.065	263	-	552	535	20.3282	-	0.8
	314	TO	314	CHANNEL	-	0		535		-		0.0
					TOTAL	314					**TOTAL**	**5.0**
18	0	TO	46	SHEET FLOW	0.043	46	0.2	577	575	-	-	4.7
	46	TO	364	SHALLOW CONCENTRATED FLOW	0.116	318	-	575	538	16.1345	-	1.0
	364	TO	399	SHALLOW CONCENTRATED FLOW	0.086	35	-	538	535	20.3282	-	0.1
	364	TO	364	CHANNEL	-	0		535		-		0.0
					TOTAL	399					**TOTAL**	**5.7**

19	0	TO	88	SHEET FLOW	0.057	88	0.2	577	572	-	-	7.1
	88	TO	699	SHALLOW CONCENTRATED FLOW	0.064	611	-	572	533	16.1345	-	2.5
	699	TO	699	CHANNEL	-	0		533		-		0.0
					TOTAL	699					**TOTAL**	**9.6**
20	0	TO	77	SHEET FLOW	0.039	77	0.2	549	546	-	-	7.4
	77	TO	112	SHALLOW CONCENTRATED FLOW	0.114	35	-	546	542	16.1345	-	0.1
	112	TO	399	SHALLOW CONCENTRATED FLOW	0.031	287	-	542	533	20.3282	-	1.3
	112	TO	112	CHANNEL	-	0		533		-		0.0
					TOTAL	399					**TOTAL**	**8.8**
21	0	TO	25	SHEET FLOW	0.040	25	0.016	534	533	-	-	0.4
	25	TO	545	SHALLOW CONCENTRATED FLOW	0.050	520	-	533	507	20.3282	-	1.9
	545	TO	545	CHANNEL	-	0		507		-		0.0
					TOTAL	545					**TOTAL**	**5.0**
22	0	TO	25	SHEET FLOW	0.040	25	0.016	534	533	-	-	0.4
	25	TO	588	SHALLOW CONCENTRATED FLOW	0.046	563	-	533	507	20.3282	-	2.1
	588	TO	588	CHANNEL	-	0		507		-		0.0
					TOTAL	588					**TOTAL**	**5.0**
Exist	0	TO	80	SHEET FLOW	0.025	80	0.2	597	595	-	-	9.1
	80	TO	195	SHALLOW CONCENTRATED FLOW	0.026	115	-	595	592	16.1345	-	0.7
	195	TO	615	SHALLOW CONCENTRATED FLOW	0.033	420	-	592	578	20.3282	-	1.9
	195	TO	867	CHANNEL	0.045	672	0.012	578	548	-	12.0	0.9
					TOTAL	1,287					**TOTAL**	**12.7**
Cave	0	TO	100	SHEET FLOW	0.050	100	0.2	577	572	-	-	8.2
	100	TO	264	SHALLOW CONCENTRATED FLOW	0.061	164	-	572	562	20.3282	-	0.5
	264	TO	568	CHANNEL	0.046	304	0.012	562	548	-	12.0	0.4
					TOTAL	568					**TOTAL**	**9.2**

Intensity Calculations

i=a/(tc +b)^c

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
a =	54.767	62.981	70.82	82.936	100.6	118.3
b =	11.051	10.477	10.396	10.746	12.172	13.185
c =	0.8116	0.782	0.7725	0.7634	0.7712	0.7736

Drain Area	2 year	5 year	10 year	25 year	50 year	100 year
1	3.96	5.11	5.94	7.08	8.03	9.10
2	5.29	6.80	7.89	9.33	10.42	11.69
3	3.70	4.77	5.55	6.63	7.54	8.56
4	5.76	7.39	8.57	10.11	11.23	12.54
5	5.76	7.39	8.57	10.11	11.23	12.54
6	5.76	7.39	8.57	10.11	11.23	12.54
7	4.70	6.04	7.01	8.33	9.36	10.55
8	3.98	5.13	5.96	7.11	8.05	9.13
9	4.99	6.42	7.44	8.82	9.89	11.12
10	5.22	6.71	7.78	9.21	10.30	11.56
11	5.76	7.39	8.57	10.11	11.23	12.54
12	4.35	5.60	6.50	7.74	8.74	9.87
13	3.91	5.04	5.86	7.00	7.94	9.00
14	5.76	7.39	8.57	10.11	11.23	12.54
15	5.76	7.39	8.57	10.11	11.23	12.54
16	5.76	7.39	8.57	10.11	11.23	12.54
16A	5.76	7.39	8.57	10.11	11.23	12.54
17	5.76	7.39	8.57	10.11	11.23	12.54
18	5.55	7.13	8.26	9.76	10.87	12.16
19	4.70	6.04	7.01	8.32	9.36	10.55
20	4.84	6.22	7.22	8.56	9.61	10.82
21	5.76	7.39	8.57	10.11	11.23	12.54
22	5.76	7.39	8.57	10.11	11.23	12.54
Exist	4.19	5.40	6.27	7.47	8.45	9.56
Cave	4.76	6.13	7.11	8.44	9.48	10.68

Runoff Coefficient Calculations

Area ID	Runoff Coefficient					
	2-year	5-year	10-year	25-year	50-year	100-year
Reduction	0.70	0.75	0.81	0.88	0.93	1.00
1	0.46	0.50	0.53	0.58	0.61	0.66
2	0.46	0.50	0.53	0.58	0.61	0.66
3	0.46	0.50	0.53	0.58	0.61	0.66
4	0.67	0.71	0.77	0.84	0.88	0.95
5	0.67	0.71	0.77	0.84	0.88	0.95
6	0.67	0.71	0.77	0.84	0.88	0.95
7	0.46	0.50	0.53	0.58	0.61	0.66
8	0.67	0.71	0.77	0.84	0.88	0.95
9	0.46	0.50	0.53	0.58	0.61	0.66
10	0.46	0.50	0.53	0.58	0.61	0.66
11	0.67	0.71	0.77	0.84	0.88	0.95
12	0.46	0.50	0.53	0.58	0.61	0.66
13	0.46	0.50	0.53	0.58	0.61	0.66
14	0.67	0.71	0.77	0.84	0.88	0.95
15	0.67	0.71	0.77	0.84	0.88	0.95
16	0.46	0.50	0.53	0.58	0.61	0.66
16A	0.67	0.71	0.77	0.84	0.88	0.95
17	0.46	0.50	0.53	0.58	0.61	0.66
18	0.46	0.50	0.53	0.58	0.61	0.66
19	0.46	0.50	0.53	0.58	0.61	0.66
20	0.67	0.71	0.77	0.84	0.88	0.95
21	0.67	0.71	0.77	0.84	0.88	0.95
22	0.67	0.71	0.77	0.84	0.88	0.95
Exist	0.46	0.50	0.53	0.58	0.61	0.66
Cave	0.46	0.50	0.53	0.58	0.61	0.66

Calculation for C value

Assume 40% impervious cover and good 2-7% sloped grass area on drainage areas that are both streets and residential. The analysis uses City of Georgetown, City of San Antonioand TxDOT Hydraulic Design Manual recommendations for determining an assumed average impervious cover for single family residential lots of less than 1/2 acre. The assumed impervious cover was then applied to the C values from the City of Austin Drainage Criteria Manual to determine average C value for each drainage area. An assumption was made on the quality of the pervious cover based on a site visit. Most yards are well maintained and vegetated with grass.

C calc = (.40x.95)+(.60x.66)
0.40 = % impervious
0.95 = C value of 100 yr asphalt
0.60 = % pervious
0.46 = C value of 100 yr good condition grass area 2-7% slope
0.66 = C value for single family residential areas
0.95= C value for street right-of-way areas only

Apply a reduction of C for lesser storms based on COA manual

2 yr =	0.70
5 yr =	0.75
10 yr =	0.81
25 yr =	0.88
50 yr =	0.93
100 yr =	1.00

reduction calculation

0.46	0.29	0.63
0.46	0.32	0.70
0.46	0.35	0.76
0.46	0.39	0.85
0.46	0.42	0.91
0.46	0.46	1.00

0.95	0.73	0.77	0.70
0.95	0.77	0.81	0.75
0.95	0.81	0.85	0.81
0.95	0.86	0.91	0.88
0.95	0.9	0.95	0.93
0.95	0.95	1.00	

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Memo

To: Angela Todd-Sheremet, PE, PhD (City of Austin (COA, WPD, WED, LFHM)
From: John Friedman, PE (Klotz Associates)
Date: May 14, 2015
Re: Meredith Storm Impr. – March 26, 2015 "C" Value Analysis Comment Response

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COA March 26 "C" Value comments:

I do not think that calculated C values that you provided are in compliance with the DCM and that's why: The last sentence of the last paragraph of section 2.4.1 – Runoff Coefficient "C" says:

"C" values for developed conditions should be based on maximum allowable impervious cover as listed in the City's zoning and watershed ordinances.

For the residential area, single family home the Max impervious is 45% based on Zoning. Zoning factor applies only for area that is not in the ROW. Impervious cover percentage should be increased by the percentage that road area adds to the particular drainage area. I've attached a spreadsheet that I developed based on DCM and Zoning requirements that assume no roads at all- just 45% factor. I looked in both cases: 45% only concrete and 45% only asphalt. Also I looked at 3 possible scenarios: poor, fair and good conditions. In your C value Calcs you use "Good conditions". However, for some areas you get C=0.58 for 25-year and C=0.66 for 100-year storm. Based on the DCM requirements, the lowest value for 25-year should be **0.6** (asphalt) and **0.68** for 100-year – please refer to the attached spreadsheet. All your Drainage areas are intersected by road – that means that C values should be even higher. Please reconsider your C values calculation, provide us with the updated C values and updated StormCAD in addition to the comments that I sent to you on March 18th.

Klotz Associates Response:

Attached is a table comparing the "C" values assumed in the Klotz Associates analysis to "C" values calculated based on 45% and 30% impervious cover for single family lots and 95% imperious cover for road Right-of –Way (R.O.W.). The areas for Single Family lots and R.O.W. were determined using COA GIS information. Also attached is the summary sheet for imperious cover limitations for COA Watershed areas. The watershed limitations are more restrictive than those allowed by zoning. The maximum allowed "C" values assumed in the current analysis appear to provide a conservative assumption for the amount of runoff calculated for each sub-basin.

Runoff Coefficient Variations

Category	% Impervious
Zoning	45%
Watershed Ordinance	30%
ROW	95%

DA	Total Area	Acreage R.O.W. SF	Acerage Lot SF	KA Model		Watershed Ordinance		Zoning	
					C Value	% Impervious	C Value	% Impervious	C Value
1	1.15	0.30	0.85		0.66	47%	0.45	58%	0.55
2	0.61	0.28	0.33		0.66	60%	0.57	68%	0.64
3	3.82	1.06	2.75		0.66	48%	0.46	59%	0.56
4	0.31	0.21	0.10		0.95	74%	0.70	79%	0.75
5	0.11	0.11	0.00		0.95	95%	0.90	95%	0.90
6	0.14	0.09	0.05		0.95	72%	0.68	77%	0.73
7	1.82	0.62	1.20		0.66	52%	0.49	62%	0.59
8	1.81	0.81	1.00		0.95	59%	0.56	67%	0.64
9	4.69	1.07	3.62		0.66	45%	0.43	56%	0.54
10	1.40	0.45	0.95		0.66	51%	0.48	61%	0.58
11	0.26	0.26	0.00		0.95	95%	0.90	95%	0.90
12	0.51	0.33	0.18		0.66	73%	0.69	78%	0.74
13	3.26	0.21	3.05		0.66	34%	0.33	48%	0.46
14	1.74	1.22	0.51		0.95	76%	0.72	80%	0.76
15	0.23	0.23	0.00		0.95	95%	0.90	95%	0.90
16	0.91	0.40	0.51		0.66	59%	0.56	67%	0.64
16A	0.12	0.12	0.00		0.95	95%	0.90	95%	0.90
17	0.43	0.23	0.20		0.66	65%	0.62	72%	0.68
18	2.39	0.13	2.26		0.66	34%	0.32	48%	0.45
19	2.88	0.34	2.54		0.66	38%	0.36	51%	0.48
20	0.73	0.37	0.36		0.95	63%	0.60	70%	0.67
21	0.67	0.48	0.19		0.95	76%	0.72	81%	0.77
22	0.21	0.21	0.00		0.95	95%	0.90	95%	0.90
Exist	5.77	1.32	4.45		0.66	45%	0.43	56%	0.54
Cave	5.77	1.32	4.45		0.66	45%	0.43	56%	0.54

City of Austin Watershed Protection Ordinance Regulations Summary Table

Effective: October 28, 2013

Red Text = Change from Previous Requirements

REGULATORY CATEGORY	ZONE	DESIRED DEVELOPMENT ZONE			DRINKING WATER PROTECTION ZONE		
		Urban	**Suburban City Limits**	**Suburban N. Edwards / ETJ**	**Water Supply Suburban**	**Water Supply Rural**	**Barton Springs Zone**
Impervious Cover (IC)	**Calculation Basis**	Gross Site Area	**Gross Site Area**	**Gross Site Area**	Net Site Area	Net Site Area	Net Site Area
	Transfers Allowed	No	Yes	Yes	Yes	Yes	No
	Uplands: Max Pct IC	Max Pct	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct [No Transfers]
	Single-Family Res. (Lot > 5750 ft²)	No Watershed IC Limit: Zoning Limits only	50% / 60%	45% / 50%	30% / 40%	1 unit per 1 ac. / 1 unit per 2 ac.*	R / BC / C ** 15% / 20% / 25% for all uses
	Single-Family Res. (Lot < 5750 ft²)		55% / 60%	55% / 60%			
	Multi-Family Residential Max Pct		60% / 70%	60% / 65%	40% / 55%	20% / 25%	
	Commercial Max Pct		80% / 90%	65% / 70%			
						* Min lot ¾-acre; ½-acre with transfers; Clustering: 1 unit/ac max; 2 units/ac w transfer	** R = Recharge Zone BC = Barton Creek Contributing C = Other Contributing
	WQ Transition Zone: **Max Pct IC (outside floodplain)**	Not Applicable	**Not Applicable**	**Not Applicable**	18%	1 SF unit / 3 acres	1 SF unit / 3 acres None over recharge
	Critical WQ Zone: Max Pct IC	None (except road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)
	Critical Environmental Feature (CEF) Max Pct IC	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius
Waterway Classifications	**Minor**	64 acres	**64 – 320 acres**	**64 – 320 acres**	**64 – 320 acres**	64 – 320 acres	**64 – 320 acres**
	Intermediate		**320 – 640 acres**	**320 – 640 acres**	320 – 640 acres	320 – 640 acres	320 – 640 acres
	Major		**over 640 acres**	**over 640 acres**	over 640 acres	over 640 acres	over 640 acres
	Notes	Urban creeks not classified					
Waterway Setbacks	**Critical Water Quality Zone**						
	Minor	50 – 400 ft.	**100 ft.**	**100 ft.**	50 – 100 ft.	50 – 100 ft.	50 – 100 ft.
	Intermediate		**200 ft.**	**200 ft.**	100 – 200 ft.	100 – 200 ft.	100 – 200 ft.
	Major	No CWQZ Downtown	**300 ft.**	**300 ft.**	200 – 400 ft.	200 – 400 ft.	200 – 400 ft. (Barton mainstem 400 ft.)
	Notes	Between min and max width, coincides with the 100-year **fully-developed** floodplain	**"Buffer averaging" allows sites to reduce width of buffers by up to one-half if the overall amount protected remains the same**		Between min and max width, coincides with the 100-year fully-developed floodplain		
	Water Quality Transition Zone						
	Minor	Not Required	**Not Required**	**Not Required**	100 ft.	100 ft.	100 ft.
	Intermediate				200 ft.	200 ft.	200 ft.
	Major				300 ft.	300 ft.	300 ft.
	Variances from Buffers	**Administrative under certain conditions**	Must apply for Land Use Commission variance		Must apply for Land Use Commission variance.		
Water Quality Controls	**Treatment Standard**	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Non-Degradation
	When Required	**All new/redeveloped if IC > 8,000 sq. ft.**	**All new/redeveloped if IC > 8,000 sq. ft.**	**All new/redeveloped if IC > 8,000 sq. ft.**	All new/redeveloped if IC > 8,000 sq. ft.; all IC in WQTZ	All new/redeveloped if IC > 8,000 sq. ft.; all IC in WQTZ	All development
	Allowed in Creek Buffer	**CWQZ = Yes per ECM** WQTZ = N/A	**CWQZ = Yes per ECM** **WQTZ = N/A**	**CWQZ = Yes per ECM** **WQTZ = N/A**	CWQZ = No **WQTZ = Yes per ECM**	CWQZ = No **WQTZ = Yes per ECM**	CWQZ = No WQTZ = Yes **per ECM**
	Alternative Strategies Allowed	Yes	Yes	Yes	Yes	Yes	No
	Optional Payment-in-Lieu	Yes	No	No	No	No	No

Key: CWQZ = Critical Water Quality Zone; ETJ = Extra-Territorial Jurisdiction; IC = Impervious Cover; SF = Single-Family Residential; WQ = Water Quality; WQTZ = Water Quality Transition Zone

Attachment

Technical Memorandum for Task 6 – Matrix Evaluation of Alternatives 1-12

klotz associates

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Memo

To: Angela Todd-Sheremet, P.E., Ph. D.

From: John Friedman, P.E.

Date: October 16, 2015 (revised per COA comments)

Re: Meredith Street Drainage Improvements - Task 6 - Matrix Evaluations of Alternatives 1-12

Klotz Associates is currently under contract with the City of Austin (COA) to review and expand on a draft preliminary engineer report (PER) completed by the City of Austin Watershed Protection Department (WPD) in September 2013 titled "Meredith Street Storm Drain Improvement Project". The PER identifies multiple potential solutions to reoccurring flooding problems in the Meredith Street area. Klotz Associates discussed an additional alternative in a September 8, 2014 Memo – Meredith Street Drainage Improvements – Task 2 as well as in a October 13, 2014 Memo – Meredith Street Drainage Improvements – Task 5 which provided a more detailed analysis and design.

The following memo details the criteria established to analyze the 12 Alternate designs, as well as the findings based on this matrix.

Matrix Scoring

Matrix Scoring was based on the weighted values from the following 9 criteria:

1. Meeting Project Goals
2. Water Quality
3. Environmental Considerations
4. Karst Constructability
5. Utility Conflicts
6. Neighborhood Impact
7. Neighborhood Support
8. Opinion of Cost
9. Time of Construction

These criteria were determined as follows.

Meeting Project Goals

Scoring was calculated based on the following parameters:

- Provide mitigation for flood damage
- Prevent the creation of future flood hazards to human life and property
- Reduce the depth and frequency of localized flooding for buildings
- Reduce the depth and frequency of localized flooding for yards
- Reduce the danger of street flooding associated with old storm drains
- Reduce standing water in public rights-of-way and drainage easements outside the 100-year floodplain

Each of the alternatives was given a score, depending on how many of these goals the alternatives met. If the alternative met 5 or more goals, they were given a score of 5; if the alternative met 4 goals, they were given a score of 4; if the alternative met 3 goals, they were given a score of 3; if the alternative met 2 goals, they were given a score of 2; and if the alternative met only 1 goal, they were given a score of 1.

Water Quality

Scoring was based on how well the alternative design restored baseflow quantity and quality. The alternatives which had a maximum, average, minimal and no beneficial affect were given a score of 5, 3, 1 or 0 (respectively). It was decided that filtration inlets would be used for all options; therefore each received a minimum score of 3. Options with additional features, such as the construction of water quality ponds, received the higher score of 5

Environmental Considerations

Scoring was based on the extent of disturbance to existing conditions/environmental features. The alternatives which had no disturbance, minimal disturbance, fair disturbance and maximum disturbance were given a score of 5, 3, 1 or 0 (respectively).

Karst / Rubble Constructability

Scoring was based on the extent of disturbance within the approximate Karst / Rubble Zone as determined from Figure 2 of the January 12, 2015 Austin Caverns Report prepared by Shaw and Hauwet. The alternatives which had only open cut outside of the Karst Zone or old quarry were given a score of 5, while the alternatives which had open cut inside of a

Karst Zone where given a score of 3. The alternatives which had boring were give a score of 1 due to the unstable conditions in the Karst Zones or the rubble material of the old quarry.

Utility Conflicts

Scoring was based on the extent of utilities crossed or possibly affected due to the proposed alternatives. The alternatives which had 10-14 crossings were given a score of 5; alternatives which had 15-19 crossings were given a score of 4; alternatives which had 20-24 crossings were given a score of 3; alternatives which had 25-29 crossings were given a score of 2; alternatives which had 30-34 crossings were given a score of 1; alternatives which had 35 or more crossings were given a score of 0.

Neighborhood Impact

Scoring was based on the extent of disturbance to existing conditions/environmental features. The alternatives which had no property buyout or easement, property easement without property buyout, property buyout without property easement and property buyout and easement were given a score of 5, 3, 2 or 0 (respectively).

Neighborhood Support

Scoring was based on the input from the neighborhood open house conducted on November 18, 2014. The alternatives which had high neighborhood support, average neighborhood support, low neighborhood support and no neighborhood support were given a score of 5, 3, 2 or 0 (respectively).

Opinion of Cost

Scoring was based on the estimated cost of the alternatives construction, engineering, inspection, management and land acquisition costs. A copy of the cost estimate tables is attached to this memorandum. The alternatives where given a score from 5 to 0, depending on the cost range. The ranges are listed below, starting with the range associated with the highest score and ending with the range associated with the lowest score:

- (5) < $1,000,000
- (4) $1,000,000 - $1,999,999
- (3) $2,000,000 - $2,999,999
- (2) $3,000,000 - $3,999,999
- (1) $4,000,000 - $4,999,999
- (0) > $5,000,000

Time of Construction

Scoring was based on the estimated time of construction, as shown in the cost estimates as the length of traffic control. The alternatives where given a score from 5 to 0, depending on which time of construction range they fell in. The ranges are listed below, starting with the range associated with the highest score and ending with the range associated with the lowest score:

- (5) 6 – 7.9 Months
- (4) 8 – 9.9 Months
- (3) 10 – 11.9 Months
- (2) 12 – 13.9 Months
- (1) 14 – 15.9 Months
- (0) 16 - 18 Months

Summary

The preliminary analysis of all alternatives finds that, based on the total score, the top 4 alternates are as follows:

- Alternative 5
- Alternative 12
- Alternative 1 and 9 tied

TABLE 1 - EVALUATION MATRIX

Criteria	Meeting MIPT Goals	Water Quality	Enviromnental Considerations	Karst/Rubble Constructability	Utility Conflicts	Neighborhood Impact	Neighborhood Support	Opinion of Cost	Time of Construction	Weighted Total	
Criteria Weight	**3**	**3**	**3**	**4**	**2**	**4**	**4**	**3**	**2**		
Alternative 1	5	3	5	3	0	5	3	1	2	90	64.29%
Alternative 2	5	3	3	1	5	3	2	3	2	80	57.14%
Alternative 3	5	3	3	1	4	3	2	3	0	74	52.86%
Alternative 4	5	5	3	1	4	0	2	0	5	69	49.29%
Alternative 5	5	3	5	3	2	5	3	3	3	102	72.86%
Alternative 6	5	3	3	1	2	3	2	2	3	73	52.14%
Alternative 7	5	3	1	3	3	3	3	3	5	88	62.86%
Alternative 8	5	3	0	1	3	3	2	2	5	70	50.00%
Alternative 9	5	3	1	3	4	3	3	3	5	90	64.29%
Alternative 10	5	3	0	1	3	3	2	2	5	70	50.00%
Alternative 11	5	3	5	2	2	5	2	2	0	85	60.71%
Alternative 12	5	3	5	5	1	5	2	1	0	92	65.71%

Max Score	5	5	5	5	5	5	5	5	5	140
Min Score	0	0	0	0	0	0	0	0	0	0

TABLE 2 - PROJECT GOALS

Meeting Mission Integration Prioritization Team Goals	
Provide mitigation for flood damage	
Prevent the creation of future flood hazards to human life and property	
Reduce the depth and frequency of localized flooding for buildings	
Reduce the depth and frequency of localized flooding for yards	
Reduce the danger of street flooding associated with old storm drains	
Reduce standing water in public rights-of-way and drainage easements outside the 100-year floodplain	
Parameter	Score
Meets 5 or More Goals	5
Meets 4 Goals	4
Meets 3 Goals	3
Meets 2 Goals	2
Meets 1 Goal	1

Alternative 1	5
Alternative 2	5
Alternative 3	5
Alternative 4	5
Alternative 5	5
Alternative 6	5
Alternative 7	5
Alternative 8	5
Alternative 9	5
Alternative 10	5
Alternative 11	5
Alternative 12	5

TABLE 3 - WATER QUALITY

Water Quality	
Restore Baseflow Quantity and Quality to the Maximum Extent Possible	
Parameter	Score
Maximum Beneficial Affect	5
Average Beneficial Affect	3
Minimal Beneficial Affect	1
No Affect	0

Alternative 1	3
Alternative 2	3
Alternative 3	3
Alternative 4	5
Alternative 5	3
Alternative 6	3
Alternative 7	3
Alternative 8	3
Alternative 9	3
Alternative 10	3
Alternative 11	3
Alternative 12	3

TABLE 4 - ENVIRONMENTAL CONSIDERATIONS

Environmental Considerations	
Extent of disturbance to existing conditions/environmental features	
Parameter	Score
No Disturbance	5
Minimal Disturbance	3
Fair Disturbance	1
Maximum Disturbance	0

		Y	Y	Y	N	N
		> 75% Remain in Exist Align.	> 75% Remain in Exist EOP	All in Exist EOP/ Easement	Through Property	New Outfall
Alternative 1	5	N	Y	Y	N	N
Alternative 2	3	Y	N	N	Y	N
Alternative 3	3	Y	Y	N	Y	N
Alternative 4	3	Y	Y	N	Y	N
Alternative 5	5	N	Y	Y	N	N
Alternative 6	3	N	Y	N	Y	N
Alternative 7	1	N	Y	N	Y	Y
Alternative 8	0	N	N	N	Y	Y
Alternative 9	1	N	Y	N	Y	Y
Alternative 10	0	N	N	N	Y	Y
Alternative 11	5	N	Y	Y	N	N
Alternative 12	5	N	Y	Y	N	N

TABLE 5 - KARST/RUBBLE CONSTRUCTABILITY

Karst Constructability	
Parameter	Score
Open Cut outside Approximate Karst Zone	5
Open Cut within Approximate Karst Zone	3
Trenchless Construction within Karst/Rubble Zone	1

		Open Cut Inside	Open Cut Outside	Trenchless Option
Alternative 1	3	Y	Y	N
Alternative 2	1	N	Y	Y
Alternative 3	1	N	Y	y
Alternative 4	1	N	Y	Y
Alternative 5	3	Y	Y	N
Alternative 6	1	Y	Y	Y
Alternative 7	3	Y	Y	N
Alternative 8	1	Y	Y	Y
Alternative 9	3	Y	Y	N
Alternative 10	1	Y	Y	Y
Alternative 11	2	Y	Y	N
Alternative 12	5	N	Y	N

TABLE 6 - UTILITY CONFLICTS

Utility Conflcits	
Parameter	Score
10 - 14 Conflicts	5
15 - 19 Conflicts	4
20 - 24 Conflicts	3
25 - 29 Conflicts	2
30 - 34 Conflicts	1
≥ 35 Conflicts	0

		ATT	Austin Energy				AWU Waste Water							AWU Water						Texas	Total
		Cable	UG	Purple	Blue	Orange	6"	8"	8"	8" CI	12"	15"	18"	2" CI	4" CI	6" CI	8"	12" CI	12"	Gas	
Alternative 1	0	3	0	4	5	1	3	4	0	0	2	1	3	1	0	3	0	4	0	5	36
Alternative 2	5	2	1	2	1	0	0	2	0	0	0	0	2	0	0	1	0	1	0	2	12
Alternative 3	4	0	2	1	2	2	0	3	3	0	0	0	1	0	0	0	0	2	1	2	19
Alternative 4	4	0	2	1	1	2	1	1	3	0	0	0	0	0	0	0	0	2	1	2	16
Alternative 5	2	1	0	1	1	2	2	5	2	0	0	0	0	0	0	2	0	3	2	5	25
Alternative 6	2	1	2	2	2	2	1	6	2	0	0	0	0	0	0	2	0	2	2	4	27
Alternative 7	3	1	0	1	1	1	0	6	0	1	0	0	0	0	0	2	0	3	0	4	19
Alternative 8	3	1	2	2	2	0	0	6	0	1	0	0	0	0	0	2	0	3	0	5	23
Alternative 9	4	1	0	1	1	0	0	7	0	0	0	0	0	0	0	2	0	3	0	4	18
Alternative 10	3	1	2	2	2	0	0	6	0	0	0	0	0	0	0	2	0	4	0	4	22
Alternative 11	2	2	0	2	2	2	4	0	4	0	0	0	0	0	0	2	0	4	2	3	25
Alternative 12	1	2	0	2	1	5	2	3	3	0	0	0	1	0	1	3	1	2	2	8	34

TABLE 7 - NEIGHBORHOOD IMPACT

Neighborhood Impact	
Parameter	Score
No Property Buyout or Easement	5
Property Easement without Property Buyout	3
Property Buyout without Property Easement	2
Property Buyout and Easement	0

		Easements	Buyouts
Alternative 1	5	0	0
Alternative 2	3	5	0
Alternative 3	3	5	0
Alternative 4	0	2	3
Alternative 5	5	0	0
Alternative 6	3	5	0
Alternative 7	3	1	0
Alternative 8	3	5	0
Alternative 9	3	1	0
Alternative 10	3	6	0
Alternative 11	5	0	0
Alternative 12	5	0	0

TABLE 8 - NEIGHBORHOOD SUPPORT

Neighborhood Support	
Parameter	Score
High Neighborhood Support	5
Average Neighborhood Support	3
Low Neighborhood Support	2
No Neighborhood Support	0

Alternative 1	3
Alternative 2	2
Alternative 3	2
Alternative 4	2
Alternative 5	3
Alternative 6	2
Alternative 7	3
Alternative 8	2
Alternative 9	3
Alternative 10	2
Alternative 11	2
Alternative 12	2

TABLE 9 - OPINION OF COST

Opinion of Cost	
Parameter	Score
< $1,000,000	5
$1,000,000 - $1,999,999	4
$2,000,000 - $2,999,999	3
$3,000,000 - $3,999,999	2
$4,000,000 - $4,999,999	1
>$5,000,000	0

		Cost
Alternative 1	1	$4,184,644
Alternative 2	3	$2,366,686
Alternative 3	3	$2,232,641
Alternative 4	0	$5,539,261
Alternative 5	3	$2,950,254
Alternative 6	2	$3,639,626
Alternative 7	3	$2,495,078
Alternative 8	2	$3,067,313
Alternative 9	3	$2,299,193
Alternative 10	2	$3,391,660
Alternative 11	2	$3,571,047
Alternative 12	1	$4,019,001

TABLE 10 - TIME OF CONSTRUCTION

Time of Construction	
Parameter	Score
6 - 7.9 Months	5
8 - 9.9 Months	4
10 - 11.9 Months	3
12 - 13.9 Months	2
14 - 15.9 Months	1
16 - 18 Months	0

		Months
Alternative 1	2	13
Alternative 2	2	12
Alternative 3	0	18
Alternative 4	5	7.7
Alternative 5	3	11
Alternative 6	3	11
Alternative 7	5	7.7
Alternative 8	5	7.7
Alternative 9	5	6.5
Alternative 10	5	6.5
Alternative 11	0	18
Alternative 12	0	22

UNIT PRICING FOR COST ESTIMATES

Description	Unit	Unit Price, $	
Concrete Pipe			
18-inch pipe	L.F.	$ 85.00	**
21-inch pipe	L.F.	$ 90.00	***
24-inch pipe	L.F.	$ 95.00	**
30-inch pipe	L.F.	$ 110.00	**
36-inch pipe	L.F.	$ 140.00	**
42-inch pipe	L.F.	$ 145.00	**
48-inch pipe	L.F.	$ 155.00	**
48-inch pipe - Jacking or Boring Steel Encasement Pipe	L.F.	$ 310.00	***
'48-inch pipe - Installed In Steel Encasement	L.F.	$ 200.00	***
54-inch pipe	L.F.	$ 205.00	**
60-inch pipe	L.F.	$ 250.00	***
66-inch pipe	L.F.	$ 300.00	***
72-inch pipe	L.F.	$ 350.00	***
* All pipe costs includes cost of structural fill and pavement replacement			

Concrete Box			
4' X 2'	L.F.	$ 450.00	***
4' X 3'	L.F.	$ 250.00	**
4' X 4'	L.F.	$ 600.00	***
5' X 3'	L.F.	$ 275.00	**
5' X 4'	L.F.	$ 700.00	***
6' X 3'	L.F.	$ 340.00	**
6' X 4'	L.F.	$ 800.00	***
7' X 3'	L.F.	$ 525.00	**
7' X 4'	L.F.	$ 420.00	**
8' X 5'	L.F.	$ 1,300.00	***

Inlets			
10-foot Standard Inlet	EA	$ 3,600.00	**
15-foot Standard Inlet	EA	$ 4,850.00	**
20-foot Standard Inlet	EA	$ 4,900.00	**

Manholes			
48"	EA	$ 4,400.00	**
60"	EA	$ 5,400.00	**
72"	EA	$ 7,000.00	**
84"	EA	$ 8,000.00	**
4'x4'	EA	$ 10,000.00	***
4'x5'	EA	$ 10,000.00	***
7'x5'	EA	$ 9,500.00	***
8'x4'	EA	$ 10,000.00	***
8'x5'	EA	$ 10,500.00	***
8'x5.5'	EA	$ 10,000.00	***

Outfalls		
18-inch pipe	EA	$ 25,000.00
24-inch pipe	EA	$ 27,500.00
30-inch pipe	EA	$ 30,000.00
36-inch pipe	EA	$ 35,000.00
42-inch pipe	EA	$ 45,000.00
48-inch pipe	EA	$ 57,500.00
54-inch pipe	EA	$ 60,000.00
60-inch pipe	EA	$ 65,000.00
66-inch pipe	EA	$ 70,000.00
72-inch pipe	EA	$ 75,000.00
7' X 3'	EA	$ 100,000.00
7' X 4'	EA	$ 90,000.00

Environmental	LS	$ 50,000.00
Utility Relocation	LS	$ 100,000.00
Traffic Control	MON	$ 10,000.00

Mobilization	% of Base Constr.	10
Overhead / Profit	% of Base Constr.	10
Contingency	% of Base Constr.	100

Eng. (Design & Constr.)	% of Total Constr.	20
Construction Inspection	% of Total Constr.	10
City Project Management	% of Total Constr.	5
Land Acquisition	N/A	N/A

** Pricing Averaged from City of Austin Average Bid Costs 08-04-14

*** Pricing Estimated from City of Austin Average Bid Costs 08-04-14

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 1

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	350	feet	$ 85.00	$ 29,750.00
		24-inch	847	feet	$ 95.00	$ 80,465.00
		30-inch	409	feet	$ 110.00	$ 44,990.00
		36-inch	251	feet	$ 140.00	$ 35,140.00
		48-inch	895	feet	$ 155.00	$ 138,725.00
		54-inch	40	feet	$ 205.00	$ 8,200.00
	Boxes:	7'x3'	186	feet	$ 525.00	$ 97,650.00
		Total Length:	**2978**			
	Inlets:	10-foot Standard Inlet	13	EA	$ 3,600.00	$ 46,800.00
		20-foot Standard Inlet	3	EA	$ 4,900.00	$ 14,700.00
	Manholes:	48"	8	EA	$ 4,400.00	$ 35,200.00
		72"	5	EA	$ 7,000.00	$ 35,000.00
		84"	2	EA	$ 8,000.00	$ 16,000.00
		8'x5.5'	1	EA	$ 10,000.00	$ 10,000.00
	Outfall:	7'x3'	1	EA	$ 100,000.00	$ 100,000.00
MISCELLANEOUS						
	Traffic Control		13	months	$ 10,000.00	$ 130,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 0	1	LS	$ 1,500,000.00	$ 1,500,000.00
	SUBTOTAL					**$ 2,372,620.00**
	Mobilization and Demobilization		10	%	$ 2,372,620.00	$ 237,262.00
	Overhead and Profit		10	%	$ 2,372,620.00	$ 237,262.00
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 2,847,144.00**
	Engineering (Design and Construction Phase)		20	%	$ 2,847,144.00	$ 569,428.80
	Construction Inspection		10	%	$ 2,847,144.00	$ 284,714.40
	City Project Management		5	%	$ 2,847,144.00	$ 142,357.20
	Land Acquisition					$ 341,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 4,184,644.40**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 2

Item	Description			Quantity	Unit	Unit Price	Total
Storm Drain Improvements							
	Pipes:	24-inch		31	feet	$ 95.00	$ 2,945.00
		30-inch		24	feet	$ 110.00	$ 2,640.00
		36-inch		21	feet	$ 140.00	$ 2,940.00
		48-inch		880	feet	$ 155.00	$ 136,400.00
		48-inch	JACKING OR BORING STEEL ENCASEMENT PIPE FOR 48 IN. RCP	180	feet	$ 310.00	$ 55,800.00
		48-inch	PIPE, 48-IN. RCP INSTALLED IN STEEL ENCASEMENT	180	feet	$ 200.00	$ 36,000.00
			Total Length:	**1136**			
	Inlets:	10-foot Standard Inlet		4	EA	$ 3,600.00	$ 14,400.00
		15-foot Standard Inlet		1	EA	$ 4,850.00	$ 4,850.00
	Manholes:	60"		2	EA	$ 5,400.00	$ 10,800.00
		84"		1	EA	$ 8,000.00	$ 8,000.00
	Outfall:	48" pipe		1	EA	$ 57,500.00	$ 57,500.00
MISCELLANEOUS							
	Traffic Control			12	months	$ 10,000.00	$ 120,000.00
	Environmental			10	LS	$ 50,000.00	$ 500,000.00
	Utility Adjustments *	Matrix Score 5		1	LS	$ 250,000.00	$ 250,000.00
	SUBTOTAL						**$ 1,202,275.00**
	Mobilization and Demobilization			10	%	$ 1,202,275.00	$ 120,227.50
	Overhead and Profit			10	%	$ 1,202,275.00	$ 120,227.50
OPINION OF PROBABLE CONSTRUCTION COST:							**$ 1,442,730.00**
	Engineering (Design and Construction Phase)			20	%	$ 1,442,730.00	$ 288,546.00
	Construction Inspection			10	%	$ 1,442,730.00	$ 144,273.00
	City Project Management			5	%	$ 1,442,730.00	$ 72,136.50
	Land Acquisition						$ 419,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:							**$ 2,366,685.50**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 3

Item	Description			Quantity	Unit	Unit Price	Total
Storm Drain Improvements							
	Pipes:	24-inch		43	feet	$ 95.00	$ 4,085.00
		30-inch		25	feet	$ 110.00	$ 2,750.00
		36-inch		144	feet	$ 140.00	$ 20,160.00
		48-inch		266	feet	$ 155.00	$ 41,230.00
		48-inch	JACKING OR BORING STEEL ENCASEMENT PIPE FOR 48 IN. RCP	165	feet	$ 310.00	$ 51,150.00
		48-inch	PIPE, 48-IN. RCP INSTALLED IN STEEL ENCASEMENT	165	feet	$ 200.00	$ 33,000.00
		60-inch		280	feet	$ 250.00	$ 70,000.00
		66-inch		724	feet	$ 300.00	$ 217,200.00
			Total Length:	**1647**			
	Inlets:	10-foot Standard Inlet		5	EA	$ 3,600.00	$ 18,000.00
		15-foot Standard Inlet		1	EA	$ 4,850.00	$ 4,850.00
	Manholes:	60"		4	EA	$ 5,400.00	$ 21,600.00
		72"		2	EA	$ 7,000.00	$ 14,000.00
		84"		4	EA	$ 8,000.00	$ 32,000.00
	Outfall:	66"-outfall		1	EA	$ 70,000.00	$ 70,000.00
MISCELLANEOUS							
	Traffic Control			18	months	$ 10,000.00	$ 180,000.00
	Environmental			1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 4		1	LS	$ 500,000.00	$ 500,000.00
	SUBTOTAL						**$ 1,330,025.00**
	Mobilization and Demobilization			10	%	$ 1,330,025.00	$ 133,002.50
	Overhead and Profit			10	%	$ 1,330,025.00	$ 133,002.50
OPINION OF PROBABLE CONSTRUCTION COST:							**$ 1,596,030.00**
	Engineering (Design and Construction Phase)			20	%	$ 1,596,030.00	$ 319,206.00
	Construction Inspection			10	%	$ 1,596,030.00	$ 159,603.00
	City Project Management			5	%	$ 1,596,030.00	$ 79,801.50
	Land Acquisition						$ 78,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:							**$ 2,232,640.50**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 4

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	48-inch	165	feet	$ 200.00	$ 33,000.00
		60-inch	400	feet	$ 250.00	$ 100,000.00
		66-inch	750	feet	$ 300.00	$ 225,000.00
		Total Length:	**1315**			
	Inlets:	10-foot Standard Inlet	4	EA	$ 3,600.00	$ 14,400.00
		15-foot Standard Inlet	1	EA	$ 4,850.00	$ 4,850.00
	Manholes:	60"	4	EA	$ 5,400.00	$ 21,600.00
		72"	2	EA	$ 7,000.00	$ 14,000.00
	Outfall:	66"	1	EA	$ 70,000.00	$ 70,000.00
MISCELLANEOUS						
	Green Space - Demolition of Residential and Construction		36,460	SF	$ 20.00	$ 729,200.00
	Traffic Control		7.7	months	$ 10,000.00	$ 77,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 4	1	LS	$ 500,000.00	$ 500,000.00
	SUBTOTAL					**$ 1,839,050.00**
	Mobilization and Demobilization		10	%	$ 1,839,050.00	$ 183,905.00
	Overhead and Profit		10	%	$ 1,839,050.00	$ 183,905.00
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 2,206,860.00**
	Engineering (Design and Construction Phase)		20	%	$ 2,206,860.00	$ 441,372.00
	Construction Inspection		10	%	$ 2,206,860.00	$ 220,686.00
	City Project Management		5	%	$ 2,206,860.00	$ 110,343.00
	SUBTOTAL					**$ 2,979,261.00**
Land Acquisition						

Address	Improved Value
1813 Rockmoor Ave	$ 750,000.00
1815 Rockmoor Ave	$ 720,000.00
3605 Meredith A	$ 450,000.00
3605 Meredith B	$ 500,000.00
3607 Meredith #1	$ 430,000.00
3607 Meredith #2	$ 430,000.00
Total:	**$ 3,280,000.00**

Buyouts, Relocation,		$ 750,000.00
Buyouts, Relocation,		$ 1,810,000.00
SUBTOTAL		**$ 2,560,000.00**
OPINION OF PROBABLE TOTAL PROJECT COST:		**$ 5,539,261.00**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 5

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	223	feet	$ 85.00	$ 18,955.00
		24-inch	50	feet	$ 95.00	$ 4,750.00
		30-inch	372	feet	$ 110.00	$ 40,920.00
		36-inch	308	feet	$ 140.00	$ 43,120.00
		42-inch	33	feet	$ 145.00	$ 4,785.00
		48-inch	717	feet	$ 155.00	$ 111,135.00
		54-inch	290	feet	$ 205.00	$ 59,450.00
		60-inch	708	feet	$ 250.00	$ 177,000.00
		Total Length:	**2701**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	4	EA	$ 4,400.00	$ 17,600.00
		60"	4	EA	$ 5,400.00	$ 21,600.00
		72"	6	EA	$ 7,000.00	$ 42,000.00
	Outfall:	60" pipe	1	EA	$ 65,000.00	$ 65,000.00
MISCELLANEOUS						
	Traffic Control		11	months	$ 10,000.00	$ 110,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 2	1	LS	$ 1,000,000.00	$ 1,000,000.00
	SUBTOTAL					**$ 1,791,515.00**
	Mobilization and Demobilization		10	%	$ 1,791,515.00	$ 179,151.50
	Overhead and Profit		10	%	$ 1,791,515.00	$ 179,151.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 2,149,818.00**
	Engineering (Design and Construction Phase)		20	%	$ 2,149,818.00	$ 429,963.60
	Construction Inspection		10	%	$ 2,149,818.00	$ 214,981.80
	City Project Management		5	%	$ 2,149,818.00	$ 107,490.90
	Land Acquisition					$ 48,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 2,950,254.30**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 6

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	250	feet	$ 85.00	$ 21,250.00
		24-inch	54	feet	$ 95.00	$ 5,130.00
		30-inch	372	feet	$ 110.00	$ 40,920.00
		36-inch	316	feet	$ 140.00	$ 44,240.00
		42-inch	33	feet	$ 145.00	$ 4,785.00
		48-inch	459	feet	$ 155.00	$ 71,145.00
		54-inch	290	feet	$ 205.00	$ 59,450.00
		60-inch	708	feet	$ 250.00	$ 177,000.00
		Total Length:	**2482**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	6	EA	$ 4,400.00	$ 26,400.00
		60"	3	EA	$ 5,400.00	$ 16,200.00
		72"	6	EA	$ 7,000.00	$ 42,000.00
	Outfall:	60" pipe	1	EA	$ 65,000.00	$ 65,000.00
MISCELLANEOUS						
	Traffic Control		11	months	$ 10,000.00	$ 110,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 2	1	LS	$ 1,000,000.00	$ 1,000,000.00
	SUBTOTAL					**$ 1,758,720.00**
	Mobilization and Demobilization		10	%	$ 1,758,720.00	$ 175,872.00
	Overhead and Profit		10	%	$ 1,758,720.00	$ 175,872.00
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 2,110,464.00**
	Engineering (Design and Construction Phase)		20	%	$ 2,110,464.00	$ 422,092.80
	Construction Inspection		10	%	$ 2,110,464.00	$ 211,046.40
	City Project Management		5	%	$ 2,110,464.00	$ 105,523.20
	Land Acquisition					$ 790,500.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 3,639,626.40**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 7

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	154	feet	$ 85.00	$ 13,090.00
		24-inch	20	feet	$ 95.00	$ 1,900.00
		30-inch	442	feet	$ 110.00	$ 48,620.00
		36-inch	270	feet	$ 140.00	$ 37,800.00
		48-inch	654	feet	$ 155.00	$ 101,370.00
		54-inch	303	feet	$ 205.00	$ 62,115.00
		Total Length:	**1843**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	4	EA	$ 4,400.00	$ 17,600.00
		60"	4	EA	$ 5,400.00	$ 21,600.00
		72"	2	EA	$ 7,000.00	$ 14,000.00
	Outfall:	54"	1	EA	$ 60,000.00	$ 60,000.00
MISCELLANEOUS						
	Traffic Control		7.7	months	$ 10,000.00	$ 77,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 3	1	LS	$ 750,000.00	$ 750,000.00
	SUBTOTAL					**$ 1,280,295.00**
	Mobilization and Demobilization		10	%	$ 1,280,295.00	$ 128,029.50
	Overhead and Profit		10	%	$ 1,280,295.00	$ 128,029.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 1,536,354.00**
	Engineering (Design and Construction Phase)		20	%	$ 1,536,354.00	$ 307,270.80
	Construction Inspection		10	%	$ 1,536,354.00	$ 153,635.40
	City Project Management		5	%	$ 1,536,354.00	$ 76,817.70
	Land Acquisition					$ 421,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 2,495,077.90**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 8

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	162	feet	$ 85.00	$ 13,770.00
		24-inch	44	feet	$ 95.00	$ 4,180.00
		30-inch	372	feet	$ 110.00	$ 40,920.00
		36-inch	234	feet	$ 140.00	$ 32,760.00
		42-inch	172	feet	$ 145.00	$ 24,940.00
		48-inch	448	feet	$ 155.00	$ 69,440.00
		54-inch	285	feet	$ 205.00	$ 58,425.00
		Total Length:	**1717**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	5	EA	$ 4,400.00	$ 22,000.00
		60"	3	EA	$ 5,400.00	$ 16,200.00
		72"	2	EA	$ 7,000.00	$ 14,000.00
	Outfall:	54"	1	EA	$ 60,000.00	$ 60,000.00
MISCELLANEOUS						
	Traffic Control		7.7	months	$ 10,000.00	$ 77,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 3	1	LS	$ 750,000.00	$ 750,000.00
	SUBTOTAL					**$ 1,258,835.00**
	Mobilization and Demobilization		10	%	$ 1,258,835.00	$ 125,883.50
	Overhead and Profit		10	%	$ 1,258,835.00	$ 125,883.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 1,510,602.00**
	Engineering (Design and Construction Phase)		20	%	$ 1,510,602.00	$ 302,120.40
	Construction Inspection		10	%	$ 1,510,602.00	$ 151,060.20
	City Project Management		5	%	$ 1,510,602.00	$ 75,530.10
	Land Acquisition					$ 1,028,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 3,067,312.70**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 9

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	145	feet	$ 85.00	$ 12,325.00
		24-inch	24	feet	$ 95.00	$ 2,280.00
		30-inch	409	feet	$ 110.00	$ 44,990.00
		36-inch	271	feet	$ 140.00	$ 37,940.00
		48-inch	636	feet	$ 155.00	$ 98,580.00
	Boxes:	4'x3'	50	feet	$ 250.00	$ 12,500.00
		6'x4'	36	feet	$ 800.00	$ 28,800.00
		7'x4'	302	feet	$ 420.00	$ 126,840.00
		Total Length:	**1873**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	4	EA	$ 4,400.00	$ 17,600.00
		60"	3	EA	$ 5,400.00	$ 16,200.00
		7'x5'	1	EA	$ 9,500.00	$ 9,500.00
		8'x5'	3	EA	$ 10,500.00	$ 31,500.00
	Outfall:	7'x4'	1	EA	$ 90,000.00	$ 90,000.00
MISCELLANEOUS						
	Traffic Control		6.5	months	$ 10,000.00	$ 65,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 4	1	LS	$ 500,000.00	$ 500,000.00
	SUBTOTAL					**$ 1,169,255.00**
	Mobilization and Demobilization		10	%	$ 1,169,255.00	$ 116,925.50
	Overhead and Profit		10	%	$ 1,169,255.00	$ 116,925.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 1,403,106.00**
	Engineering (Design and Construction Phase)		20	%	$ 1,403,106.00	$ 280,621.20
	Construction Inspection		10	%	$ 1,403,106.00	$ 140,310.60
	City Project Management		5	%	$ 1,403,106.00	$ 70,155.30
	Land Acquisition					$ 405,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 2,299,193.10**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 10

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	174	feet	$ 85.00	$ 14,790.00
		24-inch	28	feet	$ 95.00	$ 2,660.00
		30-inch	409	feet	$ 110.00	$ 44,990.00
		36-inch	281	feet	$ 140.00	$ 39,340.00
		48-inch	376	feet	$ 155.00	$ 58,280.00
	Boxes:	4'x3'	84	feet	$ 250.00	$ 21,000.00
		7'x3'	63	feet	$ 525.00	$ 33,075.00
		7'x4'	302	feet	$ 420.00	$ 126,840.00
		Total Length:	**1717**			
	Inlets:	10-foot Standard Inlet	7	EA	$ 3,600.00	$ 25,200.00
	Manholes:	48"	5	EA	$ 4,400.00	$ 22,000.00
		60"	2	EA	$ 5,400.00	$ 10,800.00
		8'x4'	1	EA	$ 10,000.00	$ 10,000.00
		8x5	2	EA	$ 10,500.00	$ 21,000.00
	Outfall:	7X4	1	EA	$ 90,000.00	$ 90,000.00
MISCELLANEOUS						
	Traffic Control		6.5	months	$ 10,000.00	$ 65,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 3	1	LS	$ 750,000.00	$ 750,000.00
	SUBTOTAL					**$ 1,384,975.00**
	Mobilization and Demobilization		10	%	$ 1,384,975.00	$ 138,497.50
	Overhead and Profit		10	%	$ 1,384,975.00	$ 138,497.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 1,661,970.00**
	Engineering (Design and Construction Phase)		20	%	$ 1,661,970.00	$ 332,394.00
	Construction Inspection		10	%	$ 1,661,970.00	$ 166,197.00
	City Project Management		5	%	$ 1,661,970.00	$ 83,098.50
	Land Acquisition					$ 1,148,000.00
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 3,391,659.50**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Conceptual Cost Analysis
Alternative Design 11

Item	Description			Quantity	Unit	Unit Price	Total
Storm Drain Improvements							
	Pipes:	18-inch		100	feet	$ 85.00	$ 8,500.00
		36-inch		210	feet	$ 140.00	$ 29,400.00
		48-inch		160	feet	$ 155.00	$ 24,800.00
		48-inch	JACKING OR BORING STEEL ENCASEMENT PIPE FOR 48 IN. RCP	850	feet	$ 310.00	$ 263,500.00
		48-inch	PIPE, 48-IN. RCP INSTALLED IN STEEL ENCASEMENT	850	feet	$ 200.00	$ 170,000.00
		66-inch		1060	feet	$ 300.00	$ 318,000.00
			Total Length:	**2380**			
	Inlets:	10-foot Standard Inlet		6	EA	$ 3,600.00	$ 21,600.00
		15-foot Standard Inlet		1	EA	$ 4,850.00	$ 4,850.00
		20-foot Standard Inlet		1	EA	$ 4,900.00	$ 4,900.00
	Manholes:	60"		7	EA	$ 5,400.00	$ 37,800.00
		72"		3	EA	$ 7,000.00	$ 21,000.00
	Outfall:	66"-outfall		1	EA	$ 70,000.00	$ 70,000.00
MISCELLANEOUS							
	Traffic Control			18	months	$ 10,000.00	$ 180,000.00
	Environmental			1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 2		1	LS	$ 1,000,000.00	$ 1,000,000.00
	SUBTOTAL						**$ 2,204,350.00**
	Mobilization and Demobilization			10	%	$ 2,204,350.00	$ 220,435.00
	Overhead and Profit			10	%	$ 2,204,350.00	$ 220,435.00
OPINION OF PROBABLE CONSTRUCTION COST:							**$ 2,645,220.00**
	Engineering (Design and Construction Phase)			20	%	$ 2,645,220.00	$ 529,044.00
	Construction Inspection			10	%	$ 2,645,220.00	$ 264,522.00
	City Project Management			5	%	$ 2,645,220.00	$ 132,261.00
	Land Acquisition						$ -
OPINION OF PROBABLE TOTAL PROJECT COST:							**$ 3,571,047.00**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT
Lake Austin Watershed - Meredith Street Storm Drain Imrovements Project
Klotz Associates Conceptual Cost Analysis
Alternative Design 12

Item	Description		Quantity	Unit	Unit Price	Total
Storm Drain Improvements						
	Pipes:	18-inch	354	feet	$ 85.00	$ 30,090.00
		24-inch	327	feet	$ 95.00	$ 31,065.00
		30-inch	388	feet	$ 110.00	$ 42,680.00
		36-inch	1999	feet	$ 140.00	$ 279,860.00
		42-inch	213	feet	$ 145.00	$ 30,885.00
		48-inch	247	feet	$ 155.00	$ 38,285.00
		60-inch	704	feet	$ 250.00	$ 176,000.00
		Total Length:	**4232**			
	Inlets:	10-foot Standard Inlet	21	EA	$ 3,600.00	$ 75,600.00
		Filtration Inlets for Cave Entrance	2	EA	$ 10,000.00	$ 20,000.00
	Manholes:	48"	1	EA	$ 4,400.00	$ 4,400.00
		60"	5	EA	$ 5,400.00	$ 27,000.00
		84"	3	EA	$ 8,000.00	$ 24,000.00
		4'x4' Box	7	EA	$ 10,000.00	$ 70,000.00
		5'x5' Box	2	EA	$ 11,000.00	$ 22,000.00
		7'x7' Box	2	EA	$ 12,000.00	$ 24,000.00
	Outfall:	60"	1	EA	$ 65,000.00	$ 65,000.00
MISCELLANEOUS						
	Traffic Control		22	months	$ 10,000.00	$ 220,000.00
	Environmental		1	LS	$ 50,000.00	$ 50,000.00
	Utility Adjustments *	Matrix Score 1	1	LS	$ 1,250,000.00	$ 1,250,000.00
	SUBTOTAL					**$ 2,480,865.00**
	Mobilization and Demobilization		10	%	$ 2,480,865.00	$ 248,086.50
	Overhead and Profit		10	%	$ 2,480,865.00	$ 248,086.50
OPINION OF PROBABLE CONSTRUCTION COST:						**$ 2,977,038.00**
	Engineering (Design and Construction Phase)		20	%	$ 2,977,038.00	$ 595,407.60
	Construction Inspection		10	%	$ 2,977,038.00	$ 297,703.80
	City Project Management		5	%	$ 2,977,038.00	$ 148,851.90
	Land Acquisition					$ -
OPINION OF PROBABLE TOTAL PROJECT COST:						**$ 4,019,001.30**

* Lump sum dollar value assumed relative to the matrix score determined in Klotz Associates Task Memrandum 6 - Table 6. Dollar values for construction assumed as follows:

Matrix Score	Utility Adjustment
0	$1,500,000
1	$1,250,000
2	$1,000,000
3	$750,000
4	$500,000
5	$250,000

Attachment

Baer Engineering and Environmental Consulting – Preliminary Permitting Analysis Report

PRELIMINARY PERMITTING ANALYSIS REPORT

Meredith Street Storm Drain Improvement Project
Meredith Street Neighborhood
Austin, Texas

Project Engineer:

klotz associates

901 South MoPac Expressway
Austin, Texas 78746

Project Sponsor:

City of Austin WATERSHED PROTECTION

625 E 10th Street
Austin, Texas 78701

Baer Engineering Document No. 142023-8i.011
May 28, 2015

Baer Engineering and Environmental Consulting, Inc.
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CONTENTS

1.0 INTRODUCTION

The City of Austin (COA) Watershed Protection Department (WPD) has identified the Meredith Street Storm Drain Improvements as a high priority project that requires upgrades to the storm water system infrastructure. The existing storm drain system, about 750 feet long, is composed of 15 to 18-inch pipes, and has four 5-foot inlets and a single 10-foot inlet. The 10-foot inlet discharges directly to the Austin Caverns cave, an underground cave having an entrance at 3605 and 3607 Meredith Street. The existing storm drain system was constructed in 1952 and modified to discharge into the Austin Caverns cave in the 1960s. Due to increased development in the contributing drainage area, accumulation of debris, and some apparent sloughing of the cave walls and roof, the cave is no longer able to convey runoff satisfactorily from the storm drain system. The neighborhood has experienced flooding issues since 1996, and has filed the appropriate requests to improve the storm water drainage system. The COA and Klotz Associates (Klotz) evaluated several alternatives. The COA and Klotz alternatives 5, 6, 7, 8, 9, 10, and 11 were determined not feasible because of impacts to the Austin Caverns. Baer Engineering evaluated the remaining 5 alternatives; we group COA and Klotz alternatives 2 and 3 due to similarity. The 5 alternatives are as follows (Baer Engineering's alternative name is in bold followed by COA and Klotz alternative name in parentheses):

Alternative 2. (COA / Klotz Alternative 2 and 3): This alternative focuses on immediate drainage issues without upgrading the upstream section of the Meredith storm drain system where no drainage complaints have been recorded. It includes a boring between the houses at 1813 and 1815 Rockmoor Ave. and upgrading the existing 36-inch discharging pipe to a 66-inch pipe from the intersection of Rockmoor Ave. and Cherry Ln. to the outfall at 1804 Rockmoor Ave. This alternative would need to include some means of energy dissipation at the outfall that will prevent additional erosion of the soft-bottom substrate and banks of Lake Austin.

Alternative 3. (COA / Klotz Alternative 4): This alternative includes the buyout of private properties at 3605 and 3607 Meredith St. and the construction of a detention pond at this location. The preliminary detention pond design followed the Drainage Criteria Manual (DCM) and Environmental Criteria Manual (ECM) standards. The conceptual design is that of a concrete-walled detention pond with depth variation of 8.5 to 10 feet. This alternative requires the upgrade of the existing 36-inch discharging pipe to a 66-inch pipe to the outfall on 1804 Rockmoor Ave.

Alternative 4. (COA / Klotz Alternative 12): This alternative will redirect runoff upstream of the inlets along Meredith St. and will keep the inlets along Meredith Street open to discharge into the cave with a significantly reduced flow. The rerouting of the upstream runoff will remove approximately 2/3 of the existing contributing drainage area and will use Rockmore Ave and Robinhood Trail as routes to install new connections to an existing storm drain system. These routes minimize the depth of trenching required to place the storm drain pipe. The trenches will be less than 13 feet deep at all locations. In addition to the new storm drain pipe, the existing pipe along Rockmore Ave. and Cherry Ln. will need to be upsized to convey the additional flows.

Alternative 4 will replace the existing inlets along Meredith Street with "filtering" inlets that provide water quality benefits. The purpose of the filtration is to minimize the amount of debris entering the cave, thereby maintaining the ability of the cave to store and convey a limited amount of the remaining runoff. By allowing filtered water to still enter the cave system, it provides multiples benefits to the overall system:

1. It could help to maintain the environmental integrity of the cave ecosystem by allowing some of the water to continue to flow into the cave.

2. By rerouting roughly 2/3 of the existing runoff, the cave should be able to convey the reduced flow without flooding.

3. Due to the fact that the inlets along Meredith are much lower than nearby streets, open cutting inside the street would be difficult and expensive to accomplish. By keeping the inlets functional, the need for special excavation and shoring will be greatly reduced.

Alternative 5. (COA / Klotz Alternative 12 with extension to Walsh Boat Landing) This alternative is essential be the same as Alternative 4 with the exception of the outfall location. Instead of using the outfall at 1804 Rockmoor Ave., a new storm water pipe would be installed to convey storm water to Walsh Boat Landing where it would discharge directly into Lake Austin.

The project alternatives are shown on the environmental constraints maps located in **Appendix A**.

Baer Engineering, sub-consultant to Klotz, reviewed the *Meredith Street Storm Drain Improvement Project Preliminary Engineering Report* prepared by WPD and identified applicable municipal, state, and federal regulatory programs which have jurisdiction over this project. This report includes a summary of requisite agency coordination, clearances, and permit approvals that must be obtained prior to construction. We have based this analysis report on the preliminary alternatives provided by Klotz and WPD in January 2015.

All four proposed alternatives will require coordination with the following agencies and departments:

1. COA Planning and Development Review Department (PDRD);
2. Balcones Canyonlands Preserve Program (BCPP)
3. Texas Parks and Wildlife Department (TPWD)
4. Texas Historical Commission (THC)
5. Texas Commission on Environmental Quality (TCEQ); and
6. U.S. Fish and Wildlife Service (USFWS).

Alternative 5 (COA / Klotz Alternative 12 with extension to Walsh Boat Landing) will also require coordination with the following department:

7. COA Parks and Recreation Department (PARD);

Alternative 2 (COA / Klotz Alternative 2 and 3) and **Alternative 5** (COA / Klotz Alternative 12 with extension to Walsh Boat Landing) will also require coordination with the following agency:

8. U.S. Army Corps of Engineers (USACE)

2.0 ENVIRONMENTAL CONSTRAINTS MAP

Part of the preliminary analysis included production of an environmental constraints map. The constraints map includes data purchased from a third-party source and from information found in public databases. These databases identify major environmental constraints, including the potential for hazardous materials contamination and other environmental conditions, in the vicinity of the proposed project. A copy of the environmental constraints map report is provided in **Appendix A**. The following section summarizes the environmental constraints that will impact the project and provides recommendations.

Veni Zone 2 and 3

Portions of the project area lie within Veni Zones 2 and 3 (Veni 1992, 1994, 2002). Veni Zone 2 is defined as an area having a high probability of containing suitable habitat for endangered karst invertebrate species. Veni Zone 3 is defined as areas that probably do not contain endangered karst invertebrate species.

Recommendation:

According to the Balcones Canyonlands Habitat Conservation Plan (BCHCP) fee zone map, the project lies within Endangered Cave Species Habitat Karst Zones 1 and 2. Coordination with the Balcones Canyonlands Preserve Program (BCPP) is required. For this specific project, participation in the BCHCP allows for incidental "take" of habitat for the six federal-listed endangered karst invertebrates stemming from construction.

Because there is potential for construction to uncover a void, the project design should include City of Austin Void and Water Flow Mitigation Specification No. 658S.

Critical Water Quality Zone

The project lies within the COA-defined Lake Austin Watershed, classified as a Water Supply Suburban watershed. Certain restrictions apply to development within the Critical Water Quality (CWQZ) of this watershed. Portions of the proposed project lie within the CWQZ of Lake Austin. The boundary of the CWQZ for Lake Austin coincides with the 492.8 foot contour line. Utility lines, including storm water lines, are prohibited in the CWQZ, unless the utility line follows the most direct path into the CWQZ and minimizes disturbances. The proposed storm water line and associated access shafts are not to be located in the erosion hazard zone, unless protective works are provided as prescribed in the DCM.

Recommendation:

The design engineer should route the utility line in the most direct path into the CWQZ and limit disturbances within this zone. If the storm water line or associated access shafts are within the erosion hazard zone, additional protective works, such as bioengineering bank stabilization or Rock Grade Control, as described in the DCM Appendix E, are required.

3.0 REGULATORY AGENCY REQUIREMENTS

The following table provides a summary of the applicable regulatory programs for all the proposed project alternatives. Regulatory programs specific for each alternative are presented in Table 2. An explanation of the coordination process for each program is provided in the sub-sections following the Table 2.

Table 1: Summary of Regulatory Agency Requirements for All Four Alternatives

	AGENCY	CITATION	COMMENT
MUNCIPAL			
	COA PDRD	COA Land Development Code (LDC), §25-5-1	The proposed alternatives are located within COA full purpose. A Site Development Permit or a General Permit is required.
	COA PDRD	COA LDC, §25-8-121	The proposed alternatives lie within the COA defined Edwards Aquifer. A COA Environmental Resources Inventory Report is required.
	COA PDRD	COA LCD, §25-8-281	If Critical Environmental Features (CEFs) are identified, development within the no-development buffer zone will require a variance.
	COA PDRD	ECM 1.12.3	Alternatives are located over karst topography. If voids are discovered during construction appropriate mitigation is required.
	COA PDRD	COA LDC, §25-5-92	Development restrictions exist when installing utility lines within CWQZ of Lake Austin.
	COA PDRD	COA LDC, §25-8-621	If the chosen alternative plans to remove trees larger than 19 inches in diameter, a permit is required.
	COA PDRD	COA LDC, §25-8-641	If the chosen alternative plans to remove COA-defined heritage trees a permit is required.
	BCPP	BCHCP	The project lies within a fee zone of the BCHCP. The Project owner, COA, will need to coordinate with BCPP.

STATE			
	TPWD	Texas Parks and Wildlife Code Chapter 12	Alternatives have the potential to disturb protected biological resources. Regulatory agency coordination is required.
	THC	Antiquities Code of Texas	Alternatives have the potential to disturb protected cultural resources. Regulatory agency coordination is required.
	TCEQ	Texas Water Code Section 26.040	If the chosen alternative will disturb greater than one acre of land. A Storm Water Pollution Prevention Plan (SWPPP) is required.
FEDERAL			
	USFWS	Endangered Species Act 1973	Alternative have the potential to disturbed protected biological resources. Coordination with USFWS is required.
	Federal Emergency Management Agency (FEMA)	National Flood Insurance Program	No portion of the project lies within the FEMA-defined 100-year floodplain.

Table 2. Summary of Regulatory Agency Requirements for Each Specific Alternative

AGENCY	CITATION	COMMENT	APPLICABLE ALTERNATIVE
COA PARD	COA LDC, §8-1-12	If construction occurs within the boundaries of Walsh Boat Landing coordination with COA PARD is required.	**Alternative 5** (COA / Klotz Alternative 12 with extension to Walsh Boat Landing)
USACE	Clean Water Act Section 404	Disturbances below the Ordinary High Water Mark (OHWM) of Lake Austin will require coordination with USACE.	**Alternative 2** (COA / Klotz Alternative 2 and 3) **Alternative 5** (COA / Klotz Alternative 12 with extension to Walsh Boat Landing)

3.1 Local Coordination

The proposed project alternatives are within the COA full purpose jurisdiction. As such, the chosen alternative must comply with the regulations set forth by the COA LDC. The following subsections provide a summary of applicable requirements associated with the proposed activities, as defined in the COA LDC, Title 25, Land Development.

3.1.1 COA PDRD

As depicted on the ECM, in **Appendix A**, the project is located within COA full purpose jurisdiction.

3.1.1.1 COA Site Development Permit

COA LDC, Chapter 25-5, requires site plan review and approval by PDRD prior to development of property within the City's jurisdiction. The site plan approval may be obtained through either the Site Development Permit Process or the General Permit Program. To determine if the project is eligible to participate in the General Permit Program, the design plans will need to be reviewed by the General Permit Program Coordinator.

3.1.1.2 Environmental Resources Inventory Report

The proposed alternatives will require a COA Environmental Resources Inventory (ERI) Report. The COA LDC, Section 25-8-121 (A) states the following:

> *An applicant shall file an environmental resources inventory report with the Site Development Permit Application for proposed development located:*
>
> 1. *Over a karst aquifer;*
> 2. *Within an area draining to a karst aquifer or reservoir;*
> 3. *In a water quality transition zone;*
> 4. *In a critical water quality zone;*
> 5. *In a flood plain; or*
> 6. *On a tract with a gradient of more than 15 percent.*

The proposed project site meets criteria 1, 2, and 4 above.

The COA LDC, Section 25-8-121 (B) and (C) state the following:

> *An environmental resource inventory must:*
>
> 1. *Identify critical environmental features (CEFs) and propose protection measures for the features;*
> 2. *Provide environmental justification for spoil disposal or roadway alignments;*
> 3. *Propose methods to achieve overland flow;*
> 4. *Describe proposed industrial uses and the pollution abatement program; and*
> 5. *Be completed as prescribed by the Environmental Criteria Manual.*
>
> *An environmental resource inventory must include:*
>
> 1. *Hydrogeologic report in accordance with LDC, Section 25-8-122;*
> 2. *Vegetation report in accordance with LDC, Section 25-8-123; and*
> 3. *Wastewater report in accordance with LDC, Section 25-8-124.*

3.1.1.3 Critical Environmental Features (CEFs)

The COA LDC, Section 25-8-281 defines CEFs as features that are of vital importance to the protection of natural resources. CEFs include bluffs, canyon rimrock, caves, sinkholes, springs, and wetlands.

The LDC defines these features as follows:

- *Bluff CEF – Bluff with a vertical change in elevation of more than 40 feet and an average gradient greater than 400 percent.*
- *Canyon rimrock CEF – Rimrock with a rock substrate that has a gradient that exceeds 60 percent for a vertical distance of at least four feet and is exposed for at least 50 feet horizontally along the rim of the canyon.*
- *Cave and sinkhole CEFs – Caverns or fissures that lie over the Edwards Aquifer Recharge Zone and may transmit a significant amount of surface water into the subsurface strata.*
- *Spring CEF – Point over an aquifer system where water flows from the aquifer to the ground surface.*
- *Wetland CEF – Transitional area between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water, and conforms to the Army Corps of Engineers' definition.*

LDC Chapter 25-8, Article 7, Division 2, Protection of Special Features, establishes a protective buffer around CEFs. This protective buffer is provided for each CEF. The buffer zones are determined by the following:

The width of the buffer zone is 150 feet from the edge of the critical environmental feature. Except for point recharge features, where the buffer zone coincides with the topographically defined catchment basin, except that the width of the buffer zone from the edge of the critical environmental feature is:

1. not less than 150 feet;
2. not more than 300 feet; and
3. calculated in accordance with the Environmental Criteria Manual.

Within a CEF buffer zone:

1. the natural vegetative cover must be retained to the maximum extent practicable;
2. construction is prohibited; and
3. wastewater disposal or irrigation is prohibited.

If during the site visit, field personnel identified CEFs within or near the project limits the appropriate no-development buffers need to be established. If the proposed alternative requires development within the no-development buffer a variance from the LDC will be required (additional information on variances is located in Section 3.1.1.7).

The appropriate coordination with WPD is required for work within the Austin Caverns catchment basin.

3.1.1.4 Void Discovery During Construction

If voids in the rock substrate are uncovered during development, construction in the area of the void must cease while the contractor or agent conducts a preliminary investigation of the void as prescribed by the ECM 1.12.3.

The contractor or agent shall contact a COA Environmental Inspector to schedule further investigation by the COA of the void as prescribed by the ECM if the preliminary investigation indicates that the void:

- is at least one square foot in total area;
- blows air from within the substrate;
- consistently receives water during any rain event; or
- potentially transmits groundwater.

Construction may only proceed after mitigation measures (see City of Austin Void and Water Flow Mitigation Specification No. 658S) are reviewed and approved by the WPD.

3.1.1.5 Tree Removal

The COA LDC, Section 25-8-602, defines a protected tree as "*a tree with a diameter of 19 inches or more, measured four and one-half feet above natural grade.*" The COA LDC, Section 25-8-621, states that "*except as otherwise provided in this section, a person may not remove a protected tree unless the Planning and Development Review Department has issued a permit for the removal under this division.*" If the chosen alternative includes plans to remove protected trees, additional coordination with the COA is required. The COA has an approval process that may involve a site visit by a COA arborist as well as certain approval criteria noted below from LDC, Section 25-8-624, Sub-sections A and D:

(A) The Planning and Development Review Department may approve an application to remove a protected tree only after determining that the tree:
- *(1) prevents reasonable access to the property;*
- *(2) prevents a reasonable use of the property;*
- *(3) is an imminent hazard to life or property, and the hazard cannot reasonably be mitigated without removing the tree;*
- *(4) is dead;*
- *(5) is diseased, and:*
  - *(a) restoration to sound condition is not practicable; or*
  - *(b) the disease may be transmitted to other trees and endanger their health; or*
- *(6) for a tree located on public property or a public street or easement:*
  - *(a) prevents the opening of necessary vehicular traffic lanes in a street or alley; or*
  - *(b) prevents the construction of utility or drainage facilities that may not feasibly be rerouted.*

(D) The Planning and Development Review Department shall require mitigation as a condition of application approval. A removal permit may not be issued until the applicant satisfies the condition or posts fiscal security to ensure performance of the condition within one year.

A heritage tree is defined as a tree that has a diameter of 24 inches or more, measured four and one-half feet above natural grade, and is one of the following species:

(a) Ash, Texas
(b) Cypress, Bald
(c) Elm, American

(d) Elm, Cedar
(e) Madrone, Texas
(f) Maple, Bigtooth
(g) All Oaks
(h) Pecan
(i) Walnut, Arizona
(j) Walnut, Eastern Black

The COA LDC, Section 25-8-641, addresses the removal of a heritage tree:

(A) Removal of a heritage tree is prohibited unless the Planning and Development Review Department has issued a permit for the removal under this division.

(B) A permit to remove a heritage tree may be issued only if a variance is approved under Section 25-8-642 (Administrative Variance) or 25-8-643 (Land Use Commission Variance).

If the chosen alternative includes plans to remove any heritage trees one of the following types of coordination will be required:

1) a variance from the LDC (additional information on variances is located in Section 3.1.1.7); or
2) approved mitigation by the Watershed Protection Department.

3.1.1.6 Cut and Fill Requirements

No cut or fill exceeding four feet in depth is allowed in Water Supply Suburban watershed. Lake Austin is considered a Water Supply Suburban watershed by the COA LDC Section 25-8-2.

The COA LDC, Section 25-8-341and Section 25-8-342 addresses the cut and fill requirements:

CUT REQUIREMENTS

(A) Cuts on a tract of land may not exceed four feet of depth, except:
(1) in an urban watershed;
(2) in a roadway right-of-way;
(3) for construction of a building foundation;
(4) for utility construction or a wastewater drain field, if the area is restored to natural grade;
(5) in a state-permitted sanitary landfill or a sand or gravel excavation located in the extraterritorial jurisdiction, if:
(a) the cut is not in a critical water quality zone;
(b) the cut does not alter a 100-year floodplain;
(c) the landfill or excavation has an erosion and restoration plan approved by the City; and
(d) all other applicable City Code provisions are met.
(B) A cut must be restored and stabilized.
(C) A roadway cut must be contained within the roadway clearing width described in Section 25-8-322(Clearing For A Roadway).

FILL REQUIREMENTS.

(A) Fill on a tract of land may not exceed four feet of depth, except:
(1) in an urban watershed;

(2) in a roadway right-of-way;
(3) under a foundation with sides perpendicular to the ground, or with pier and beam construction;
(4) for utility construction or a wastewater drain field; or
(5) in a state-permitted sanitary landfill located in the extraterritorial jurisdiction, if:
(a) the fill is derived from the landfill operation;
(b) the fill is not placed in a critical water quality zone or a 100-year floodplain;
(c) the landfill operation has an erosion and restoration plan approved by the City; and
(d) all other applicable City Code provisions are met.
(B) A fill area must be restored and stabilized.
(C) Fill for a roadway must be contained within the roadway clearing width described in Section 25-8-322(Clearing For A Roadway).

If the proposed alternative requires cuts or fills that exceed four feet a variance from the LDC will be required (additional information on variances is located in Section 3.1.1.7).

3.1.1.7 <u>LDC Variance Request</u>

It is possible that up to five variances from the LDC will be needed for this project. These variances include:

1. Encroachment on CEF setbacks (LDC 25-8-121(C)(2)(b));
   The proposed alternatives will encroach upon the protected CEF, Austin Caverns, mitigation or a setback reduction must be approved by COA PDRD staff. This type of LDC variance may be approved administratively during the Site Development Permit Application review process or the General Permit Program review process. If additional CEFs are identified mitigation or a setback reduction must be approved by COA PDRD staff.

2. Removal of heritage trees (LDC 25-8-641);
   If the proposed alternative includes the removal of heritage trees, then the COA or designer will need to file a "*request for a variance to remove a heritage tree under Division 3 of this Article before the application may be administratively approved or presented to the Land Use Commission or City Council,*" as per LDC, Section 25-8-604.

3. Development within the CWQZ (LDC 25-8-422);
   If the proposed alternative includes construction within the CWQZ, then the project designer will need to request an administrative variance for LDC 25-8-422 during the Site Development Permit Application review process or the General Permit Program review process.

4. Cut Requirements (LDC 25-8-341);
   If the proposed alternative includes cuts greater than 4 feet in depth, then the project designer will need to request an administrative variance for LDC 25-8-341 during the Site Development Permit Application review process or the General Permit Program review process.

5. Fill Requirements (LDC 25-8-342);
   If the proposed alternative includes fills greater than 4 feet in depth, then the project designer will need to request an administrative variance for 25-8-342 the Site Development Permit Application review process or the General Permit Program review process.

3.1.2 COA Parks and Recreation Department

The proposed Alternative 5 is located within the boundaries of Walsh Boat Dock which is managed by COA PARD. For reference, the COA-owned parcels within the project area are depicted on the Environmental Constraints Map provided as an attachment. Coordination with PARD is required as per LDC Section §8-1-12.

3.1.3 Balcones Canyonlands Conservation Plan (BCCP)

The project is located within the boundaries of the BCHCP fee zone, which contains potential threatened and endangered species habitat. According to the BCCP map the project lies within Endangered Cave Species Habitat Karst Zone1 & 2. For this specific project, participation in the BCHCP allows for incidental “take” of karst habitat stemming from construction. The COA will participate in an established mitigation bank setup for infrastructure projects, as stipulated in the guidelines of the BCHCP.

3.2 State Coordination

The proposed project alternatives will be subject to various state regulations and will require coordination with associated state agencies. Coordination with the following regulatory entities must be conducted prior to construction:

3.2.1 Texas Parks and Wildlife Department (TPWD)

TPWD is charged with the protection of state biological resources, such as rare, threatened, and endangered plant and animal species. A list of threatened, endangered, and rare species for Travis County is provided in **Appendix B**. The proposed project alternatives may impact potential state-listed threatened and endangered species habitat. During the field reconnaissance a biologist who is familiar with the resource needs and requirements of the state-listed species needs to visit the site and determine if potential habitat exists within the project area. Results from this habitat assessment should be sent to TPWD to facilitate the protection of rare state biological resources prior to construction.

3.2.2 Texas Historical Commission (THC)

Construction projects sponsored by the COA are required to comply with the National Historic Preservation Act. The Texas Historical Commission (THC) enforces this code. Appropriate project coordination must be submitted to the THC prior to construction. The THC will review project details to determine if the chosen project alternative has potential to impact archeological or historical resources. The THC will either provide a formal response that clears the project from further investigations or request additional cultural resources investigations.

3.2.3 Texas Commission on Environmental Quality (TCEQ)

TCEQ is the environmental agency for the state of Texas. TCEQ strives to protect the state's public health and natural resources consistent with sustainable economic development. The goal of TCEQ is clean air, clean water, and safe management of waste.

If the chosen project alternative disturbs greater than one acre of land during construction, the project must implement a SWPPP to satisfy Section 26.040 of the Texas Water Code, which establishes the requirements for the Texas Pollution Discharge Elimination System (TPDES). The SWPPP should be prepared in accordance with the TCEQ TPDES Construction General Permit. If the chosen project alternative disturbs more than five acres of unpaved surface, then a Notice of Intent (NOI) and a Notice of Termination (NOT) are also required.

3.3 Federal Coordination

The proposed project alternatives will be subject to various federal regulations and requisite coordination with associated federal agencies.

3.3.1 United States Fish and Wildlife Department (USFWS)

The Endangered Species Act focuses on adverse impact to critical and suitable habitat for endangered species. The USFWS allows landowners to take habitat, provided provisions are made for mitigation. During the field reconnaissance a biologist who is familiar with the resource needs and requirements of the federal-listed species needs to visit the site and determine if potential habitat exists within the project area. If suitable habitat for Federal-listed species is identified within or near the project area; consultation with USFWS is necessary. A list of threatened, endangered, and rare species for Travis County is provided in **Appendix B**.

3.3.2 United States Army Corps of Engineers (USACE)

The project alternatives are located near Lake Austin. Lake Austin is a known Waters of the U.S. (WOUS), regulated by the USACE through Section 404 of the Clean Water Act. Construction projects involving the discharge of dredged or fill material, such as a bank stabilization projects, must comply with USACE regulations.

WOUS include, but are not limited to, lakes, rivers, streams, creeks, ponds, and other special aquatic features, such as wetlands. The jurisdictional boundary is delineated by the OHWM. Construction activities below the OHWM of Lake Austin are subject to USACE regulation. The OHWM is defined by the USACE as:

> *…that line on the shore established by the fluctuations of water and indicated by physical characteristics, such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.*

To determine USACE jurisdiction the OHWM and potential wetland will require formal delineation following USACE guidelines. The descriptions of the four alternatives likely involve some amount of discharge of fill material into WOUS. The construction activities within the WOUS will likely be covered under a USACE Nationwide Permit (NWP).

Depending on the selected alternative and further design, it is likely the construction activities will be covered by one of the following NWPs:

Nationwide Permit	Limits	Pre-Construction Notification Threshold	Likely Applicable to:
NWP 13 – Bank Stabilization	500 feet along the bank or 1 cubic yard per running foot (unless waived by District Engineer (DE))	PCN required if: • >500 linear feet in length • >1 cubic yard per running foot along bank below OHWM • Discharges into special aquatic site	Alternative #2 *Reasoning: Alternative may result in bank stabilization activities for erosion prevention.*

NWP 43 – Stormwater Management Facilities	½ acre of non-tidal waters of the U.S. or 300 linear feet of stream bed (unless waived by DE)	PCN required if: • Construction or expansion of stormwater management facilities.	Alternative 5 *Reasoning: Alternative may require the installation of outfall structures or other integrated management features at Lake Austin.*

If the chosen alternative requires coverage under a NWP, it is required to comply with the terms and conditions of the selected NWP(s). Terms and conditions for all NWP include coordination with state and federal agencies. A detailed explanation of the coordination requirements are listed within the terms and conditions of each NWP. A copy of the USACE conditional requirements for NWP 13 and 43 are provided at:

http://www.swf.usace.army.mil/Missions/Regulatory/Permitting/NationwideGeneralPermits.aspx.

Notifying USACE may be required, depending on the conditions of the NWP. Although, the two alternatives may require coverage under different NWPs the process for obtaining coverage will likely be the same.

3.3.3 Federal Emergency Management Agency (FEMA)

The proposed project does not lie within the FEMA-defined 100-year floodplain. A map of the floodplains near the project site is provided in **Appendix A.** No coordination with FEMA is expected.

4.0 CONCLUSIONS

Baer Engineering has reviewed project information provided by Klotz to analyze potential regulatory requirements associated with the Meredith Street Drainage Improvements Project. Upon review of the provided preliminary information, we have determined the project is or may be subject to several local, state, and federal requirements.

Local Coordination Summary

The proposed project requires review and approval by several COA departments. The following is a summary of recommendations for municipal requirements:

1. COA Site Development or General Permit is required per LDC, Section §25-5-1.
2. A COA ERI report is required per LDC, Section §25-8-121.
3. The Austin Caverns is a CEF and development within the catchment basin will required the appropriate variance. There is potential additional CEFs will be identified during the design phase of the project. Development within the appropriate no-development buffer zone will also require a variance.
4. The proposed alternatives are located over karst topography. If voids are discovered during construction appropriate investigations and mitigation is required.
5. The proposed project may require the removal of trees protected by LDC, Section §25-8-621, and LDC, Section §25-8-641. If removal is necessary, we recommend coordinating with the COA Arborist early in the design process to address tree removal and mitigation.
6. **Alternative 5** (COA / Klotz Alternative 12 with extension to Walsh Boat Landing) includes construction within COA parkland. Any work in, or use of, COA parkland requires coordination with COA PARD, as required by LDC Section §8-1-12.
7. The project is located within the boundaries of BCHCP fee zone. Participation in the BCHCP is required.

State Coordination Summary

The proposed project requires review and approval by several state agencies. The following is a summary of recommendations for state requirements:

8. Alternatives must be reviewed by TPWD for threatened and endangered species protection. Coordination with TPWD is required, as part of the terms and conditions of USACE NWP.
9. Alternative must be reviewed by the THC for cultural resources protection. Coordination with THC is required.
10. If the chosen alternative will disturb more than one acre of land, a SWPPP is required in accordance with the TCEQ TPDES Construction General Permit. This general permit requires all construction projects with greater than one acre of disturbance to prepare a SWPPP to be kept on site during construction activities. If the project will disturb more than five acres of unpaved surface, then a NOI and a NOT are also required.

Federal Summary

1. If suitable habitat for Federal-listed species is identified within or near the project area; consultation with USFWS will be required.
2. **Alternatives 2** (COA / Klotz Alternative 2 and 3) and **Alternative 5** (COA / Klotz Alternative 12 with extension to Walsh Boat Landing) will likely include work below the OHWM and these activities will require coverage under USACE NWP.

5.0 LIMITATIONS

We have relied upon information provided by Klotz and others to perform this analysis. Changes to the alternatives could result in significant changes to regulatory permitting requirements. No site reconnaissance was performed as part of this analysis. Baer Engineering has exercised due diligence and performed appropriate inquiry within the limits of the scope of this specific project. Nonetheless, Baer Engineering cannot and does not guarantee the authenticity or reliability of the information upon which it has relied.

6.0 QUALIFICATIONS

This report was prepared using the Meredith Street Storm Drain Improvement Project Preliminary Engineering Report provided by Klotz in September of 2013. Baer Engineering assessed the required permitting based on the alternatives within the report and with correspondence with Klotz. Subsequent design plans and specific construction are not covered in this report.

David Sperry M.S.
Wildlife/Conservation Biologist

Rosemary Wyman, P.G. CHMM, CPESC
Executive Vice President

REFERENCES

Veni, G. 1992. Geological controls on cave development and the distribution of cave fauna in the Austin, Texas, region. Report prepared for U.S. Fish and Wildlife Service, Austin, Texas.

Veni, G. 1994. Geological controls on cave development and the distribution of endemic cave fauna in the San Antonio, Texas, region. Report prepared for Texas Parks and Wildlife Department, Austin, Texas, and U.S. Fish and Wildlife Service, Austin, Texas.

Veni, G. 2002. Delineation of hydrogeologic areas and zones for the management and recovery of endangered karst invertebrate species in Bexar County, Texas. Report prepared for the U.S. Fish and Wildlife Service, Austin, Texas.

APPENDIX A – Environmental Constraints Map and Report

Baer Engineering
and Environmental Consulting, Inc.

May 28, 2015

Klotz Associates
901 South MoPac Expressway
Building 9, Suite 220
Austin, Texas 78746

Delivered via e-mail to john.friedman@Klotz.com.

Attention: **Mr. John Friedman, P.E.**

Reference: **Environmental Constraints Map**
Meredith Street Storm Drain Improvement Project
Baer Engineering Document No. 142023-8i.011

Dear Mr. Buonodono:

Baer Engineering and Environmental Consulting, Inc. (Baer Engineering) is pleased to present this letter report which includes results from the environmental constraints map to Klotz Associates (Klotz) for the above-referenced project.

CONCLUSIONS

Baer Engineering has identified two environmental constraints that will impact this project:

Constraint ID #5 – Veni Zone 2 and 3

According to the Balcones Canyonlands Conservation Plan (BCCP) fee zone map, the project lies within Endangered Cave Species Habitat Karst Zones 1 and 2. Coordination with the Balcones Canyonlands Preserve Program is required. Because there is potential for construction to uncover a void, the project design should include City of Austin Void and Water Flow Mitigation Specification No. 658S.

Constraint ID #6 – Critical Water Quality Zone

Portions of the proposed project lie within the CWQZ of Lake Austin. Utility lines, including storm water lines, are prohibited in the CWQZ, unless the utility line follows the most direct path into the CWQZ and minimizes disturbances. The design engineer should route the utility line in the most direct path into the CWQZ and limit disturbances within this zone. If the storm water line or associated access shafts are within the erosion hazard zone, additional protective works, such as bioengineering bank stabilization or Rock Grade Control, as described in the Drainage Criteria Manual Appendix E are required.

BACKGROUND INFORMATION

We understand the City of Austin (COA) has received several requests from residents along Meredith Street and the surrounding area to resolve localized flooding issues. Klotz reviewed 5 alternatives to increase the capacity of the storm water drainage system to help reduce flooding issues. Alternative 1 was determined not feasible due to impacts to the Austin Caverns. The remaining 4 alternatives are:

Alternative 2. This alternative focuses on immediate drainage issues without upgrading the upstream section of the Meredith SDS where no drainage complaints have been recorded. It includes a boring between the houses at 1813 and 1815 Rockmoor Ave. and involves upgrading the existing 36-inch discharging pipe to a 66-inch pipe from the intersection of Rockmoor Ave. and Cherry Ln. all the way to the outfall at 1804 Rockmoor Ave. This alternative would need to include some means of energy dissipation at the outfall that will prevent additional erosion of the soft-bottom substrate and banks of the lake.

Alternative 3. This alternative includes the buyout of private properties at 3605 and 3607 Meredith St. and the construction of a detention pond at this location. The preliminary detention pond design followed DCM and Environmental Criteria Manual (ECM) standards. The conceptual design is that of a concrete-walled detention pond with depth variation of 8.5 to 10 feet. This alternative requires the upgrade of the existing 36-inch discharging pipe to a 66-inch pipe all the way to the outfall on 1804 Rockmoor Ave.

Alternative 4. This alternative will redirect runoff upstream of the inlets along Meredith. However, this alternative will keep the inlets along Meredith Street open to discharge into the cave with a significantly reduced flow. The rerouting of the upstream runoff will remove approximately 2/3 of the existing contributing drainage area and will use Rockmoor Ave and Robinhood Trail as routes to install new connections to an existing storm drain system. These routes minimize the depth of trenching required to place the storm drain pipe. The trenches will be less than 13 feet deep at all locations. In addition to the new storm drain pipe, the existing pipe along Rockmoor Ave and Cherry Lane will need to be upsized to convey the additional flows.

Alternative 4 will replace the existing inlets along Meredith Street with “filtering” inlets that provide water quality benefits. The purpose of the filtration is to minimize the amount of debris entering the cave, thereby maintaining the ability of the cave to store and convey a limited amount of the remaining runoff. By allowing filtered water to still enter the cave system, it provides multiples benefits to the overall system:

1. The filtration could help to maintain the environmental integrity of the cave eco system by allowing some of the water to continue to flow into the cave.

2. By rerouting roughly 2/3 of the existing runoff, the cave should be able to convey the reduced flow without flooding.

3. Due to the fact that the inlets along Meredith are much lower than nearby streets, open cutting inside the street would be difficult and expensive to accomplish. By keeping the inlets functional, the need for special excavation and shoring will be greatly reduced.

Alternative 5. This alternative is essential be the same as Alternative 4 with the exception of the outfall location. Instead of using the outfall at 1804 Rockmoor Ave. a new storm water pipe would be installed to convey storm water to Walsh Boat Landing where it would discharge direction into Lake Austin.

This report discusses the constraints for all four alternatives. This report includes the following:

1. Environmental constraints maps (4 sheets);
2. A table of identified environmental constraints; and
3. GeoSearch (third-party vendor) results report.

The purpose of the constraints maps and report is to list and describe features, spills, locations, historical events, and other environmental issues that have the potential to impact construction of the project. The identified constraints can be used to help plan the project from design to construction.

ENVIRONMENTAL CONSTRAINTS MAP METHODS

Baer Engineering relied upon a variety of environmental and regulatory research databases when preparing the attached environmental constraints maps. The maps are based on the project alternatives provided by Klotz and data obtained from a third-party vendor. Constraint locations provided by the third-party vendor have not been verified in the field.

Three separate regulatory searches were purchased from GeoSearch:

National Environmental Policy Act Regulatory Search
Provides critical information needed to comply with the National Environmental Policy Act (NEPA). The NEPA Check Report evaluates a location for potential environmental impacts as outlined by NEPA.

Radius Report Search
The Radius Report identifies sites near the project areas with real or potential environmental concerns, including environmental compliance violations, contamination, hazardous waste generators, emission generators, leaking tanks, spills, landfills, and other environmentally active properties.

Texas Oil & Gas Pipeline Review
This review provides information about oil and gas pipelines in or near the project limits.

The GeoSearch report, with tables summarizing the databases used to identify environmental constraints is attached. The tables include the name, acronym, radius searched, and number of findings that were located within each search radius.

IDENTIFIED ENVIRONMENTAL CONSTRAINTS

This section describes the regulatory databases that contain at least one listing for an environmental constraint known to exist within ¼ mile of the project areas.

Petroleum Storage Tank (PST)
The PST database stores information on both underground storage tanks (USTs) and aboveground storage tanks (ASTs). PST registration has been a requirement with the Texas Commission on Environmental Quality (TCEQ) since 1986. This database is maintained by TCEQ.

Leaking Petroleum Storage Tank (LPST):
The LPST database is derived from the PST database. These listings include underground and aboveground storage tank facilities which have reported releases from on-site PSTs. This database is maintained by TCEQ.

Closed and Abandoned Landfill Inventory (CALF):
The TCEQ has located over 4,000 closed and abandoned municipal solid waste landfills throughout Texas. This database contains “unauthorized sites”. Unauthorized sites have no permit and are considered abandoned. The information available for each site varies in detail and this historical information is not updated.

Recycling Facilities (WMRF):
This listing of recycling facilities is provided by the TCEQ's Recycle Texas Online service. The company information provided in this database is self-reported. Since recyclers post their own information, a facility or company appearing on the list does not imply that it is in compliance with TCEQ regulations or other applicable laws. This database is no longer maintained and includes the last compilation of the program participants before the Recycle Texas Online program was closed.

ENVIRONMENTAL CONSTRAINTS MAP RESULTS AND RECOMMENDATIONS

This section discusses the specific constraints located within ¼ mile of the project location. The Constraint ID# corresponds to the constraint ID# shown on the attached maps.

Constraint ID #1 – Petroleum Storage Tank and Leaking Petroleum Storage Tank
A PST was located at 1900 Scenic Drive the Kennelwood Boat Dock. The capacity of the tank was 3,000 gallons and contained gasoline. This tank was removed from the ground in 1993 and minor soil contamination was observed. TCEQ did not require any remedial action the site was given regulatory closure. There is potential for residual soil contamination resulting from this tank to be present in the project area.

Recommendation:
There is a potential for residual hydrocarbon contamination to be present in the soil on and near the Kennelwood property. This location is 0.10 miles from the proposed project. Due to the distance of this potential contamination from the project site, no impacts to the proposed project are expected.

Constraint ID #2 – Closed and Abandoned Landfill Facility
A closed and abandoned landfill facility is located 0.20 miles from the proposed project. The former landfill was open in 1935 and closed by 1945. According to the database, this landfill was known to accept household waste.

Recommendation:
There is a potential for contamination to be present in the soil on and near the closed landfill property. This location is 0.20 miles from the proposed project. Due to the distance of this former landfill from the project site, no impacts to the project are expected.

Constraint ID #3 – Leaking Petroleum Storage Tank
An LPST was located at 3826 Lake Austin Blvd. at the Boat Town facility. The capacity of the tank was not reported but the contents were listed as gasoline. This tank was removed from the ground sometime before 1992 and minor soil contamination was observed. TCEQ required a full site assessment and remedial action plan (RAP). TCEQ issued final concurrence and this case achieved regulatory closure. There is potential for soil contamination from this tank to be present in the project area.

Recommendation:
There is a potential for hydrocarbon contamination to be present in the soil on and near the Boat Town facility. This location is 0.20 miles from the proposed project. Due to the distance of this potential contamination from the project site, no impacts to the proposed project are expected.

Constraint ID #4 – Recycling Facilities
The Central Texas Recycling Association facility is located at 3700 Lake Austin Blvd. This facility accepts general household recyclables which include glass, paper, and plastics.

Recommendation:
The activities at this facility do not have potential to impact the proposed project.

Constraint ID #5 – Veni Zone 2 and 3
Portions of the project area lie within Veni Zones 2 and 3 (Veni 1992, 1994, 2002). Veni Zone 2 is defined as an area having a high probability of containing suitable habitat for endangered karst invertebrate species. Veni Zone 3 is defined as areas that probably do not contain endangered karst invertebrate species.

Recommendation:
According to the Balcones Canyonlands Conservation Plan (BCCP) fee zone map, the project lies within Endangered Cave Species Habitat Karst Zones 1 and 2, for reference the BCCP fee zone map is attached. Coordination with the Balcones Canyonlands Preserve Program is required. For this specific project, participation in the BCCP allows for incidental "take" of habitat for the six federal-listed endangered karst invertebrates stemming from construction.

Because there is potential for construction to uncover a void, the project design should include City of Austin Void and Water Flow Mitigation Specification No. 658S.

Constraint ID #6 – Critical Water Quality Zone
The project lies within the COA-defined Lake Austin Watershed, classified as a Water Supply Suburban watershed. Certain restrictions apply to development within the Critical Water Quality (CWQZ) of this watershed. Portions of the proposed project lie within the CWQZ of Lake Austin. The boundary of the CWQZ for Lake Austin coincides with the 492.8 foot contour line. Utility lines, including storm water lines, are prohibited in the CWQZ, unless the utility line follows the most direct path into the CWQZ and minimizes disturbances. The proposed storm water line and associated access shafts are not to be located in the erosion hazard zone, unless protective works are provided as prescribed in the Drainage Criteria Manual.

Recommendation:
The design engineer should route the utility line in the most direct path into the CWQZ and limit disturbances within this zone. If the storm water line or associated access shafts are within the erosion hazard zone, additional protective works, such as bioengineering bank stabilization or Rock Grade Control, as described in the Drainage Criteria Manual Appendix E are required.

QUALIFICATIONS
The attached Environmental Constraints Maps and this report are based upon a record search by GeoSearch, and as such, Baer Engineering cannot confirm the accuracy of the provided data. No field work has been conducted to verify the accuracy of the GeoSearch data.

Baer Engineering appreciates this opportunity to provide our services to Klotz Associates, Inc. and the City of Austin. Please call me if there are questions regarding this report. I can be reached at (707) 616-8583.

Respectfully submitted,
BAER ENGINEERING AND ENVIRONMENTAL CONSULTING, INC.

David Sperry
Wildlife Conservation Biologist

Attachments: Environmental Constraints Map
Project Figures
Table of Identified Environmental Constraints
GeoSearch Report

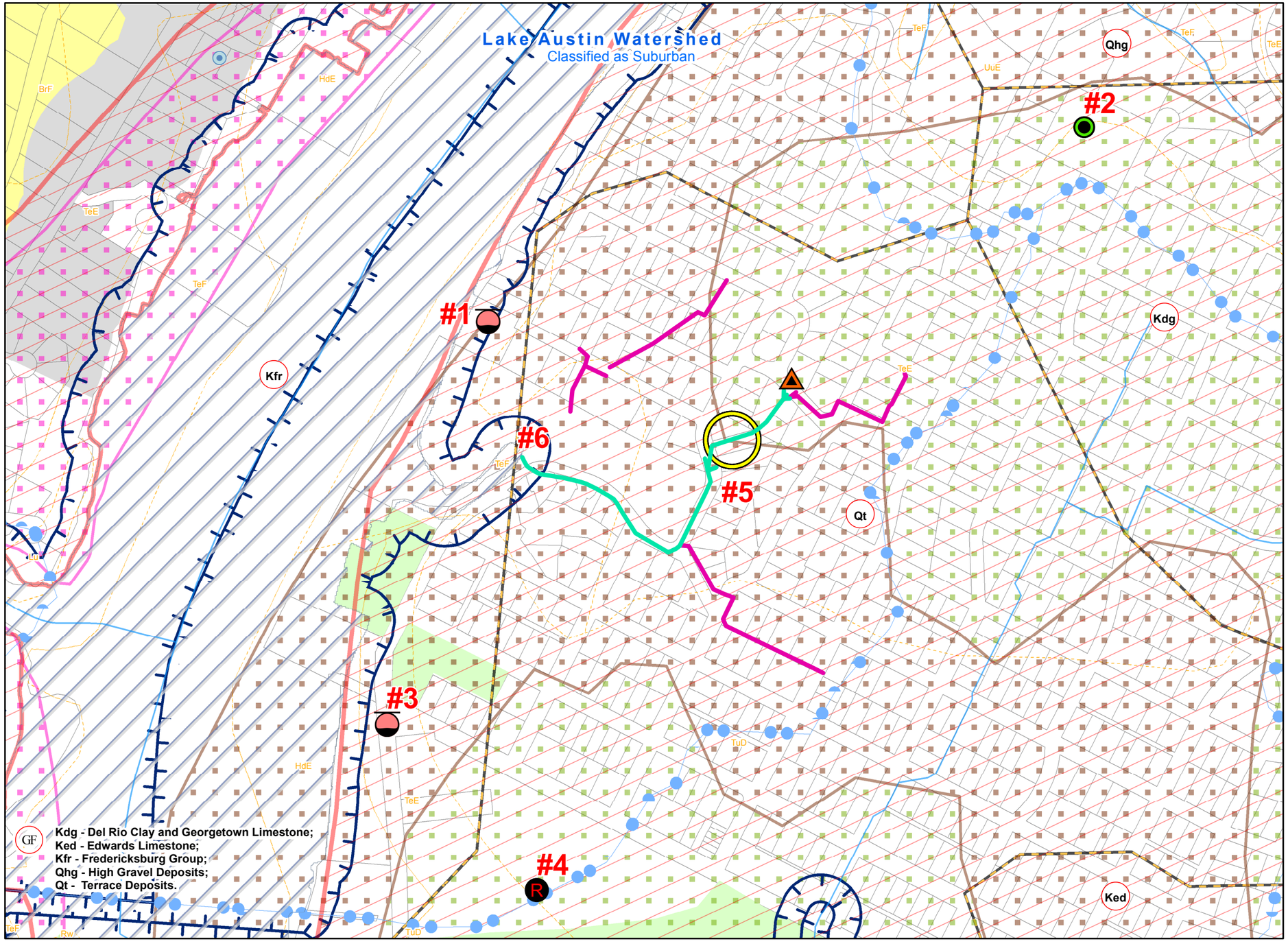
REFERENCES

Veni, G. 1992. Geological controls on cave development and the distribution of cave fauna in the Austin, Texas, region. Report prepared for U.S. Fish and Wildlife Service, Austin, Texas.

Veni, G. 1994. Geological controls on cave development and the distribution of endemic cave fauna in the San Antonio, Texas, region. Report prepared for Texas Parks and Wildlife Department, Austin, Texas, and U.S. Fish and Wildlife Service, Austin, Texas.

Veni, G. 2002. Delineation of hydrogeologic areas and zones for the management and recovery of endangered karst invertebrate species in Bexar County, Texas. Report prepared for the U.S. Fish and Wildlife Service, Austin, Texas.

Environmental Constraints Maps



- Proposed Storm Drain
- Existing Storm Drain
- Location of Bore
- Austin Cavern Location
- CALF -Closed and Abandoned Landfill Inventory
- LPST - Leaking Petroleum Storage Tank
- WMRF - Recycling Facilities
- Water Well
- FEMA 100-Year Floodplain
- Watershed Boundary
- Edwards Aquifer Recharge Zone
- Waterway setback for Lake Austin
- Soils
- Geologic Formation Boundary
- City of Austin Parks
- Austin 2 Mile ETJ
- Austin LTD

Veni Zone Description

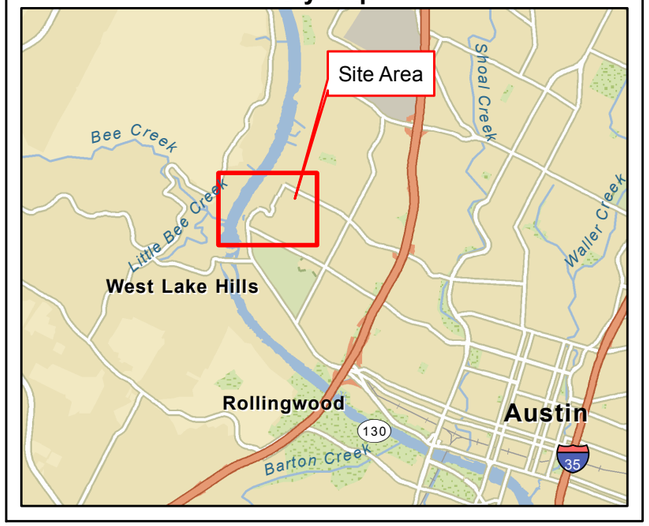
- High Probability Endangered Cave Species
- Known Endangered Cave Species
- Low Probability Endangered Cave Species

This is the COA and Klotz Alternatives 2 & 3.

The project lies within the Edwards Aquifer Recharge Zone.

The project lies within Veni Zones 2 and 3.
Zone 2: areas having a high probability of suitable habitat for endangered or other endemic invertebrate cave fauna (refined now to only endangered cave fauna);
Zone 3: areas that probably do not contain endangered cave fauna.

Key Map



N

0 500 1,000 Feet

The project lies within the Lake Austin watershed which is classified as suburban by the City of Austin.

The project is within the Austin West USGS Quadrangle.

Drawn by: S. Sanders Date: 02/22/15

Checked by: R. Wyman Date: 02/26/15

Sheet 1 of 4

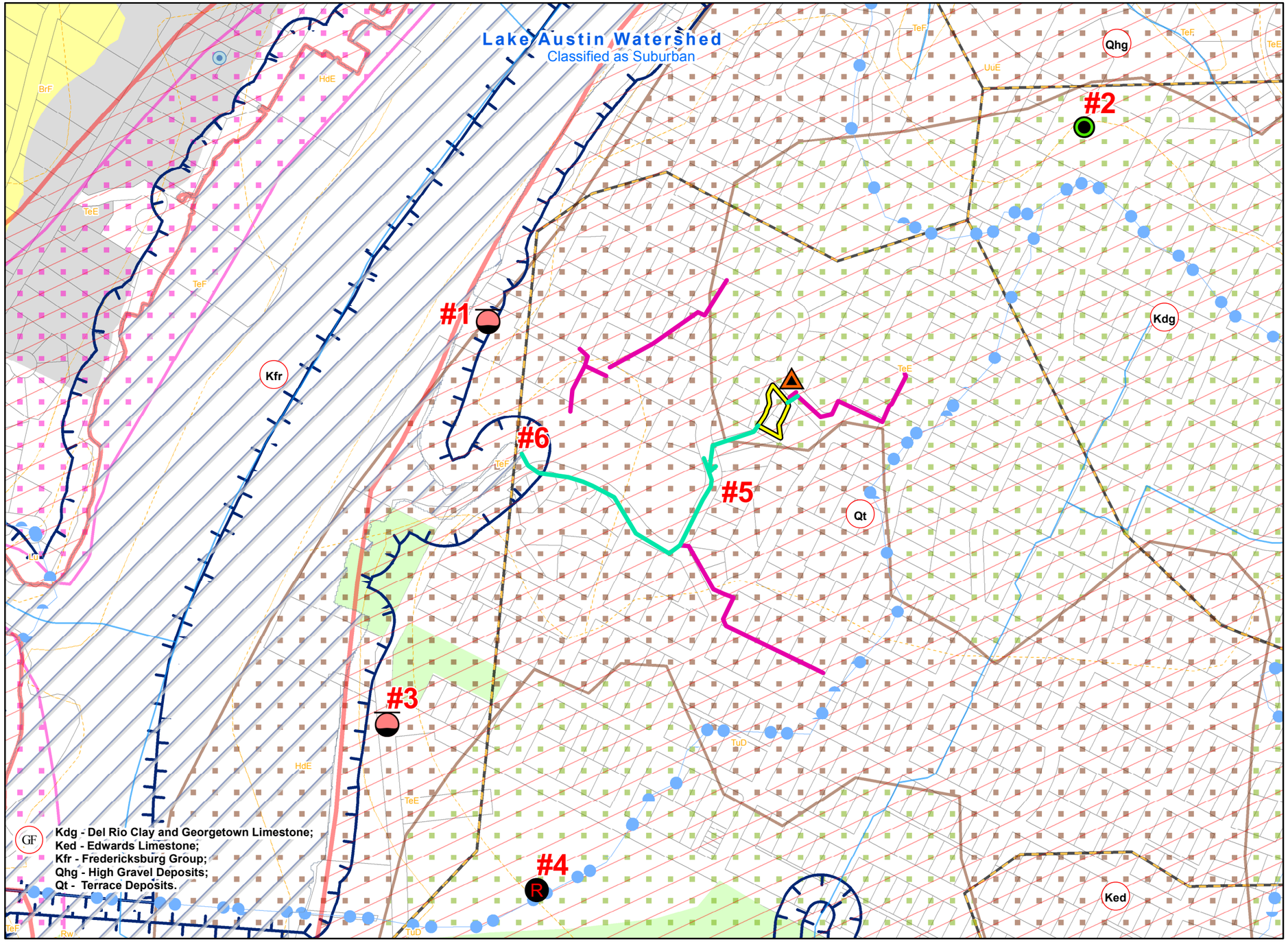
Baer Engineering
and Environmental Consulting, Inc.

TBPE Firm No. F-3181 TBPG Firm No. 50030

Environmental Constraints Map

Meredith Street
Storm Drain Improvement Project Alternative 2

City of Austin Large Scale Civil Engineering
Rotation List Contract
Austin, Travis County, Texas
Baer Engineering Project No. 142023.01



- Proposed Storm Drain
- Existing Storm Drain
- Pond
- Austin Cavern Location
- CALF -Closed and Abandoned Landfill Inventory
- LPST - Leaking Petroleum Storage Tank
- WMRF - Recycling Facilities
- Water Well
- FEMA 100-Year Floodplain
- Watershed Boundary
- Edwards Aquifer Recharge Zone
- Waterway setback for Lake Austin
- Soils
- Geologic Formation Boundary
- City of Austin Parks
- Austin 2 Mile ETJ
- Austin LTD

Veni Zone Description

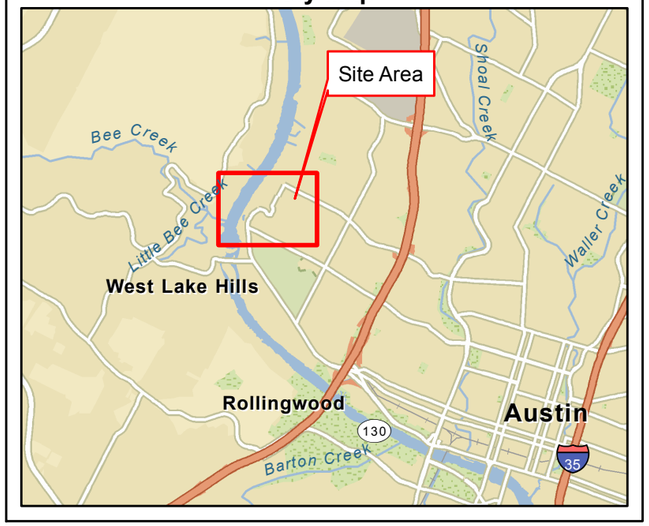
- High Probability Endangered Cave Species
- Known Endangered Cave Species
- Low Probability Endangered Cave Species

This is the COA and Klotz Alternative 4.

The project lies within the Edwards Aquifer Recharge Zone.

The project lies within Veni Zones 2 and 3.
Zone 2: areas having a high probability of suitable habitat for endangered or other endemic invertebrate cave fauna (refined now to only endangered cave fauna);
Zone 3: areas that probably do not contain endangered cave fauna.

Key Map



N

0 500 1,000 Feet

The project lies within the Lake Austin watershed which is classified as suburban by the City of Austin.

The project is within the Austin West USGS Quadrangle.

Drawn by: S. Sanders Date: 02/22/15

Checked by: R. Wyman Date: 02/26/15

Sheet 2 of 4

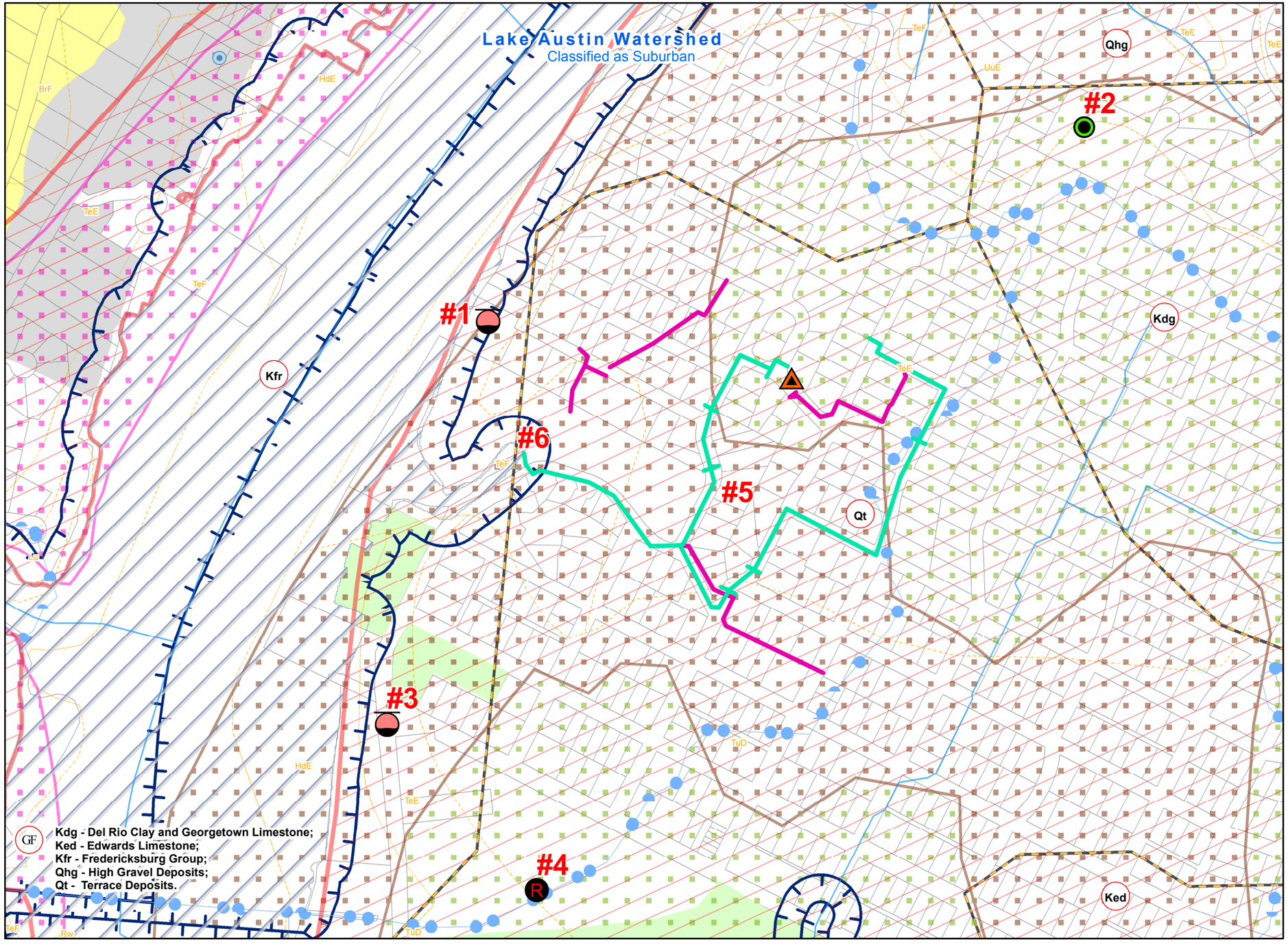
Baer Engineering
and Environmental Consulting, Inc.

TBPE Firm No. F-3181 TBPG Firm No. 50030

Environmental Constraints Map

Meredith Street
Storm Drain Improvement Project Alternative 3

City of Austin Large Scale Civil Engineering
Rotation List Contract
Austin, Travis County, Texas
Baer Engineering Project No. 142023.01



- Proposed Storm Drain
- Existing Storm Drain
- Austin Cavern Location
- CALF -Closed and Abandoned Landfill Inventory
- LPST - Leaking Petroleum Storage Tank
- WMRF - Recycling Facilities
- Water Well
- FEMA 100-Year Floodplain
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- Waterway setback for Lake Austin
- Soils
- Geologic Formation Boundary
- City of Austin Parks
- Austin 2 Mile ETJ
- Austin LTD

Veni Zone Description

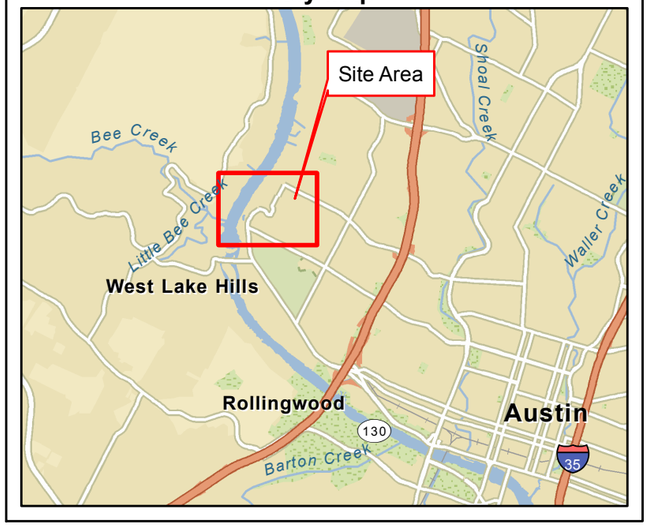
- High Probability Endangered Cave Species
- Known Endangered Cave Species
- Low Probability Endangered Cave Species

This is the COA and Klotz Alternative 12.

The project lies within the Edwards Aquifer Recharge Zone.

The project lies within Veni Zones 2 and 3.
Zone 2: areas having a high probability of suitable habitat for endangered or other endemic invertebrate cave fauna (refined now to only endangered cave fauna);
Zone 3: areas that probably do not contain endangered cave fauna.

Key Map



N

0 500 1,000 Feet

The project lies within the Lake Austin watershed which is classified as suburban by the City of Austin.

The project is within the Austin West USGS Quadrangle.

Drawn by: S. Sanders Date: 02/22/15

Checked by: R. Wyman Date: 02/26/15

Sheet 3 of 4

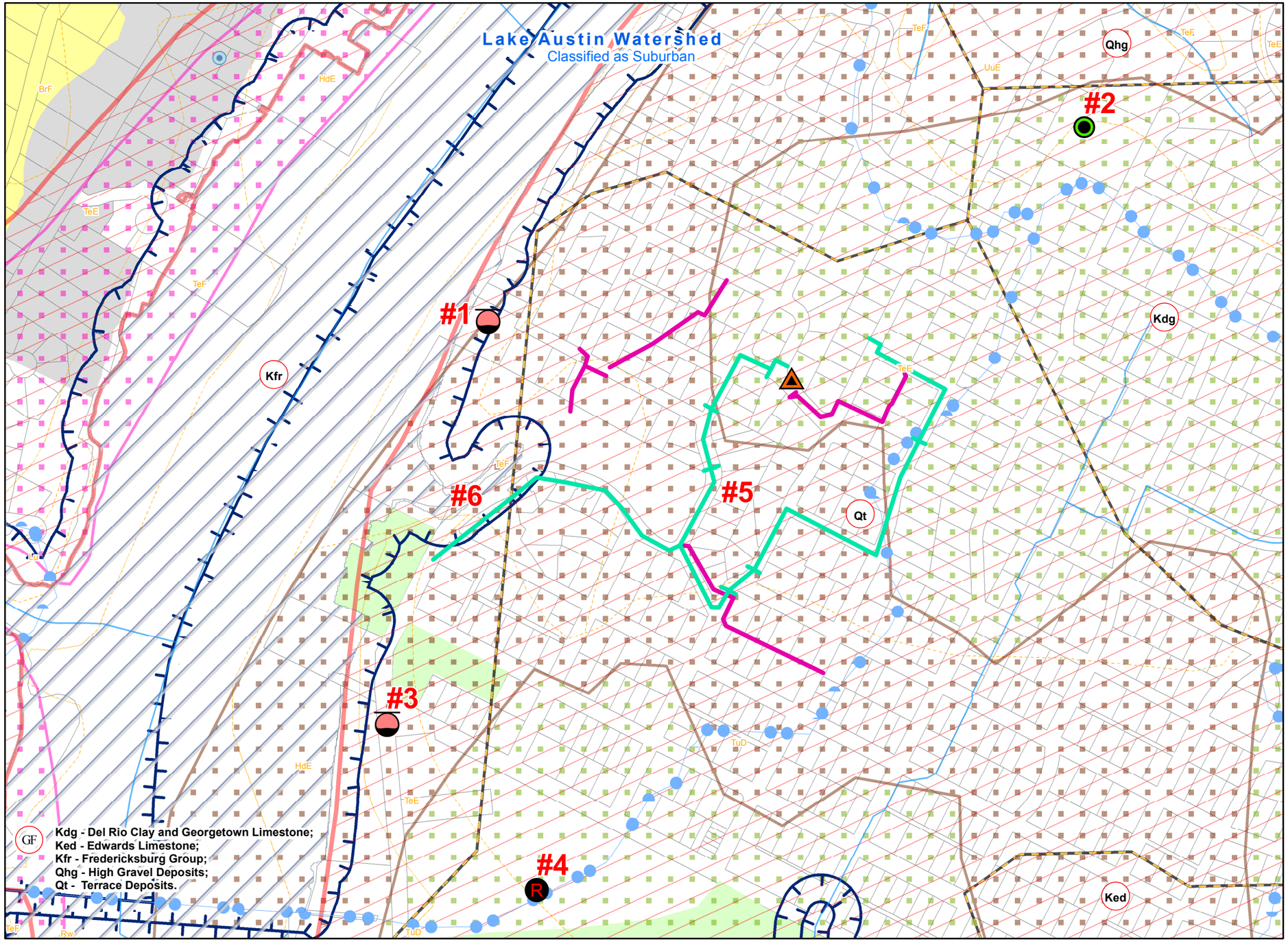
Baer Engineering
and Environmental Consulting, Inc.

TBPE Firm No. F-3181 TBPG Firm No. 50030

Environmental Constraints Map

Meredith Street
Storm Drain Improvement Project Alternative 4

City of Austin Large Scale Civil Engineering Rotation List Contract
Austin, Travis County, Texas
Baer Engineering Project No. 142023.01



- Proposed Storm Drain
- Existing Storm Drain
- Austin Cavern Location
- CALF -Closed and Abandoned Landfill Inventory
- LPST - Leaking Petroleum Storage Tank
- WMRF - Recycling Facilities
- Water Well
- FEMA 100-Year Floodplain
- Watershed Boundary
- Edwards Aquifer Recharge Zone
- Waterway setback for Lake Austin
- Soils
- Geologic Formation Boundary
- City of Austin Parks
- Austin 2 Mile ETJ
- Austin LTD

Veni Zone Description

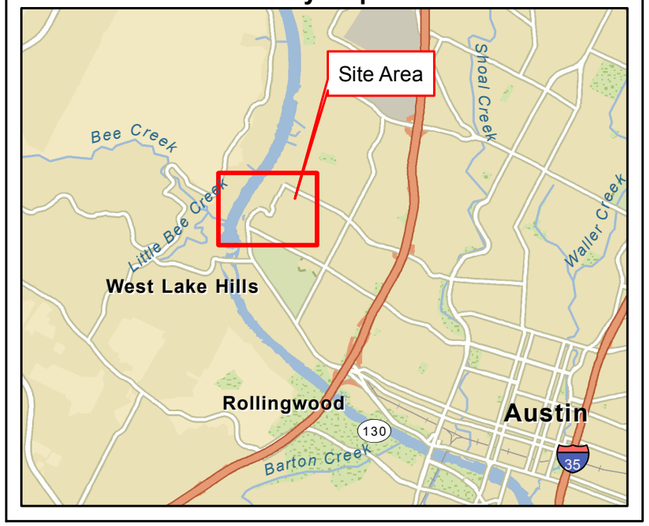
- High Probability Endangered Cave Species
- Known Endangered Cave Species
- Low Probability Endangered Cave Species

This is the COA and Klotz Alternative 12 with extension to Walsh Boat Landing.

The project lies within the Edwards Aquifer Recharge Zone.

The project lies within Veni Zones 2 and 3.
Zone 2: areas having a high probability of suitable habitat for endangered or other endemic invertebrate cave fauna (refined now to only endangered cave fauna);
Zone 3: areas that probably do not contain endangered cave fauna.

Key Map



N

0 500 1,000 Feet

The project lies within the Lake Austin watershed which is classified as suburban by the City of Austin.

The project is within the Austin West USGS Quadrangle.

Drawn by: S. Sanders Date: 02/22/15

Checked by: R. Wyman Date: 02/26/15

Sheet 4 of 4

Baer Engineering
and Environmental Consulting, Inc.

TBPE Firm No. F-3181 TBPG Firm No. 50030

Environmental Constraints Map

Meredith Street
Storm Drain Improvement Project Alternative 5

City of Austin Large Scale Civil Engineering
Rotation List Contract
Austin, Travis County, Texas
Baer Engineering Project No. 142023.01

Project Figures

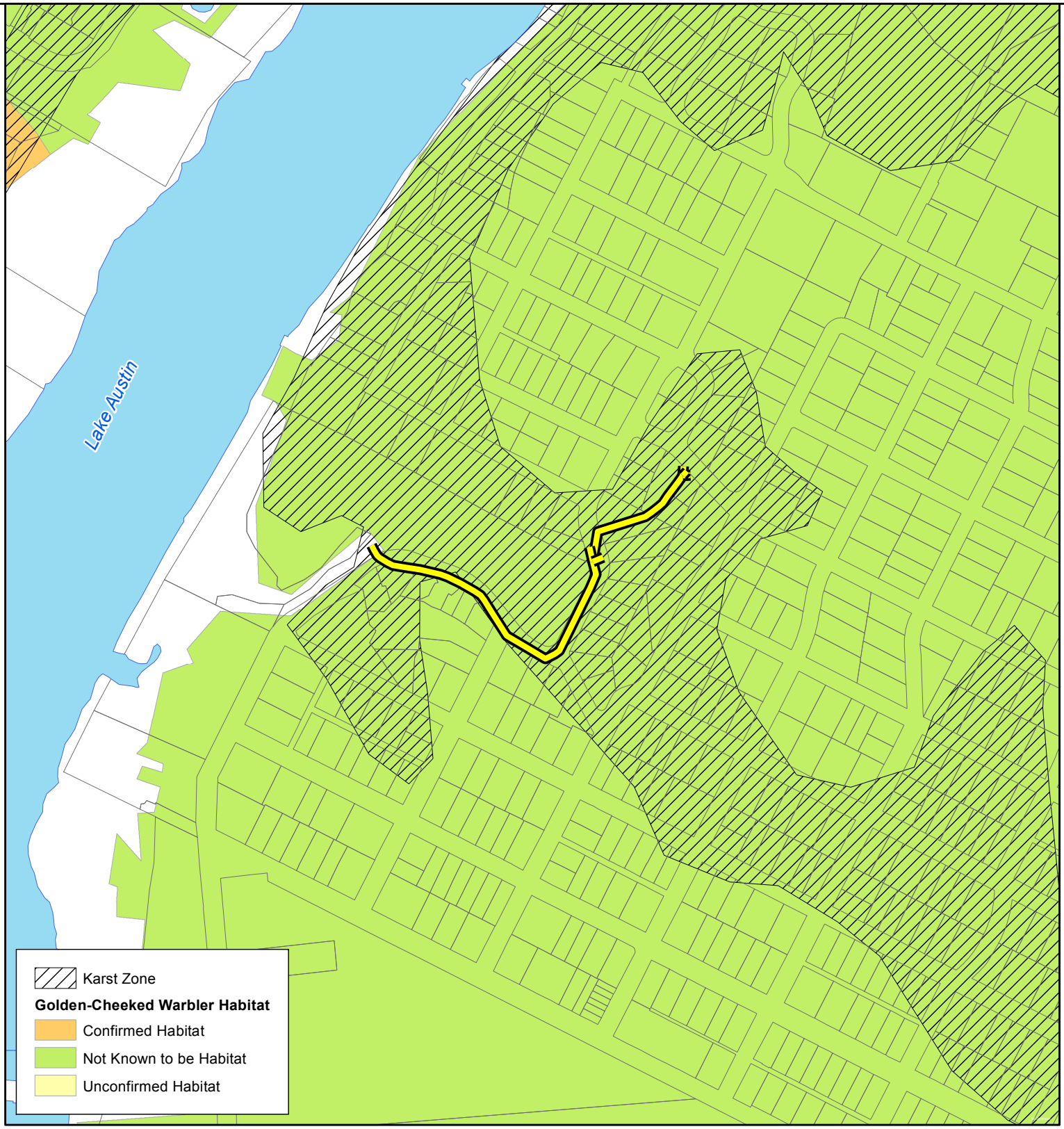


Figure 1

Balcones Canyonlands Conservation Plan-
Endangered Species Habitat and
Potential Karst Zone Map
Meredith Street
Storm Drain Improvement Project Alternative 2

Proposed Storm Drain
Parcel
Lake Austin

N

0 250 500 Feet

Baer Engineering
and Environmental Consulting, Inc.

Baer Engineering
Project No. 142023.01
Date: February 26, 2015

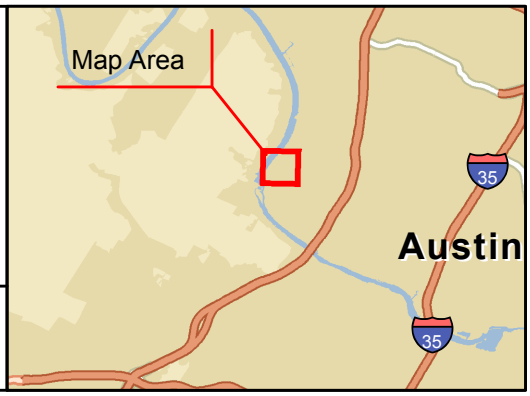


Table of Identified Environmental Constraints

Identified Environmental Constraints Summary

ID #	Constraint	Source	Description	Discussion
1	PST / LPST	GeoPlus Radius Report Page 17-21	Kennelwood Boat Dock 1900 Scenic Dr.	Leaking tank removed from ground. LPST case closed. Potential for soil contamination. No impact to project expected.
2	Closed and Abandoned Landfill	GeoPlus Radius Report Page 23	Martin Property	Former landfill closed in 1945. Potential for soil and water contamination. No impact to project expected.
3	LPST	GeoPlus Radius Report Page 24	Boat Town 3826 Lake Austin Blvd.	Leaking tank removed from ground. LPST case closed. Potential for soil contamination. No impact to project expected.
4	Recycling Facilities	GeoPlus Radius Report Page 29	Central Texas Recycling 3700 Lake Austin Blvd.	Activities at the recycling facility are not expected to impact the project.
5	Veni Zones 2 & 3	Karst Maps	Veni Zone 2 & 3	Portions of the project site lie within Veni Zone 2.
6	CWQZ	City of Austin LDC	CWQZ of Lake Travis	Certain design restrictions exist in the CWQZ.

Geo-Search Reports

APPENDIX B – State and Federal List of Threatened, Endangered, and Rare Species

Federal and State-listed species and status for Travis County, Texas.

SPECIES (*Scientific name*)		FEDERAL LISTING	STATE LISTING
Austin Blind Salamander	*(Eurycea waterlooensis)*	Endangered	none
Barton Springs Salamander	*(Eurycea sosorum)*	Endangered	Endangered
Jollyville Plateau Salamander	*(Eurycea tonkawae)*	Threatened	none
Bone Cave Harvestman	*(Texella reyesi)*	Endangered	none
Bee Creek Cave Harvestman	*(Texella reddelli)*	Endangered	none
Tooth Cave Pseudoscorpion	*(Tartarocreagris texana)*	Endangered	none
Tooth Cave Spider	*(Neoleptoneta myopica)*	Endangered	none
Warton's Cave meshweaver	*(Cicurina wartoni)*	Candidate	none
Kretschmarr Cave Mold Beetle	*(Texamaurops reddelli)*	Endangered	none
Tooth Cave Ground Beetle	*(Rhadine persephone)*	Endangered	none
Bald Eagle	*(Haliaeetus leucocephalus)*	Delisted	Threatened
Black-Capped Vireo	*(Vireo atricapilla)*	Endangered	Endangered
Golden-Cheeked Warbler	*(Setophaga chrysoparia)*	Endangered	Endangered
Interior Least Tern	*(Sterna antillarum athalassos)*	Endangered	Endangered
Peregrine Falcon	*(Falco peregrinus)*	Delisted	Threatened
Sprague's Pipit	*(Anthus spragueii)*	Candidate	none
Whooping Crane	*(Grus americana)*	Endangered	Endangered
Smalleye Shiner	*(Notropis buccula)*	Candidate	none
Red Wolf	*(Canis rufus)*	Endangered	Endangered
False Spike Mussel	*(Quadrula mitchelli)*	none	Threatened
Smooth Pimpleback	*(Quadrula houstonensis)*	Candidate	Threatened
Texas Fatmucket	*(Lampsilis bracteata)*	Candidate	Threatened
Texas Fawnfoot	*(Truncilla macrodon)*	Candidate	Threatened
Texas Pimpleback	*(Quadrula petrina)*	Candidate	Threatened
Texas Horned Lizard	*(Phrynosoma cornutum)*	none	Threatened
Bracted Twistflower	*(Streptanthus bracteatus)*	Candidate	none

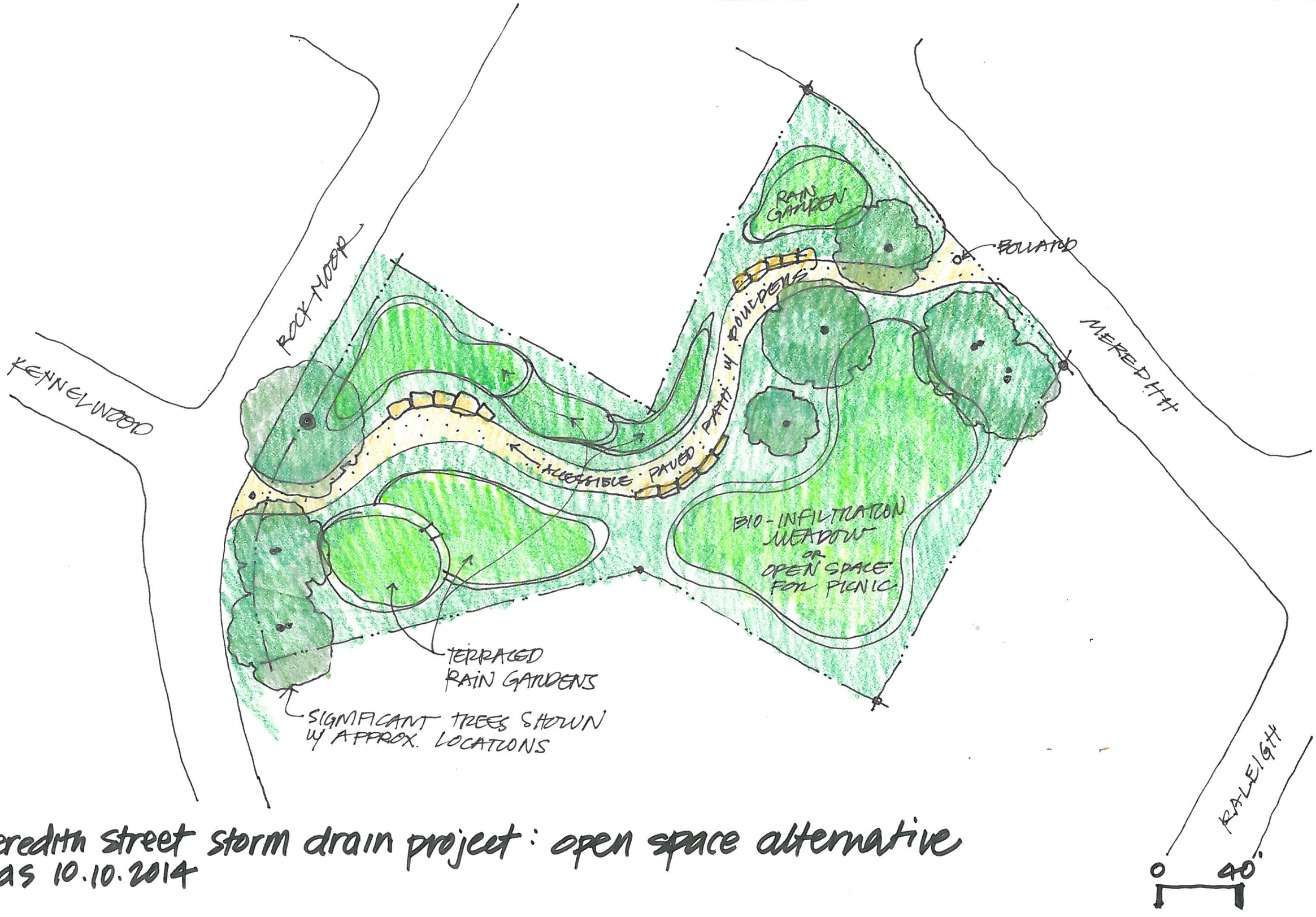
Source: Texas Parks and Wildlife Department, Wildlife Division, Diversity and Habitat Assessment Programs. County Lists of Texas' Special Species. Travis County, revised 12/05/2014. Please refer to the following website for the most updated version of this list http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/.

klotz associates

Attachment

McCann Adams Open Space Concept

meredith street storm drain project - open space alternative
11.14.2014 (MAS)



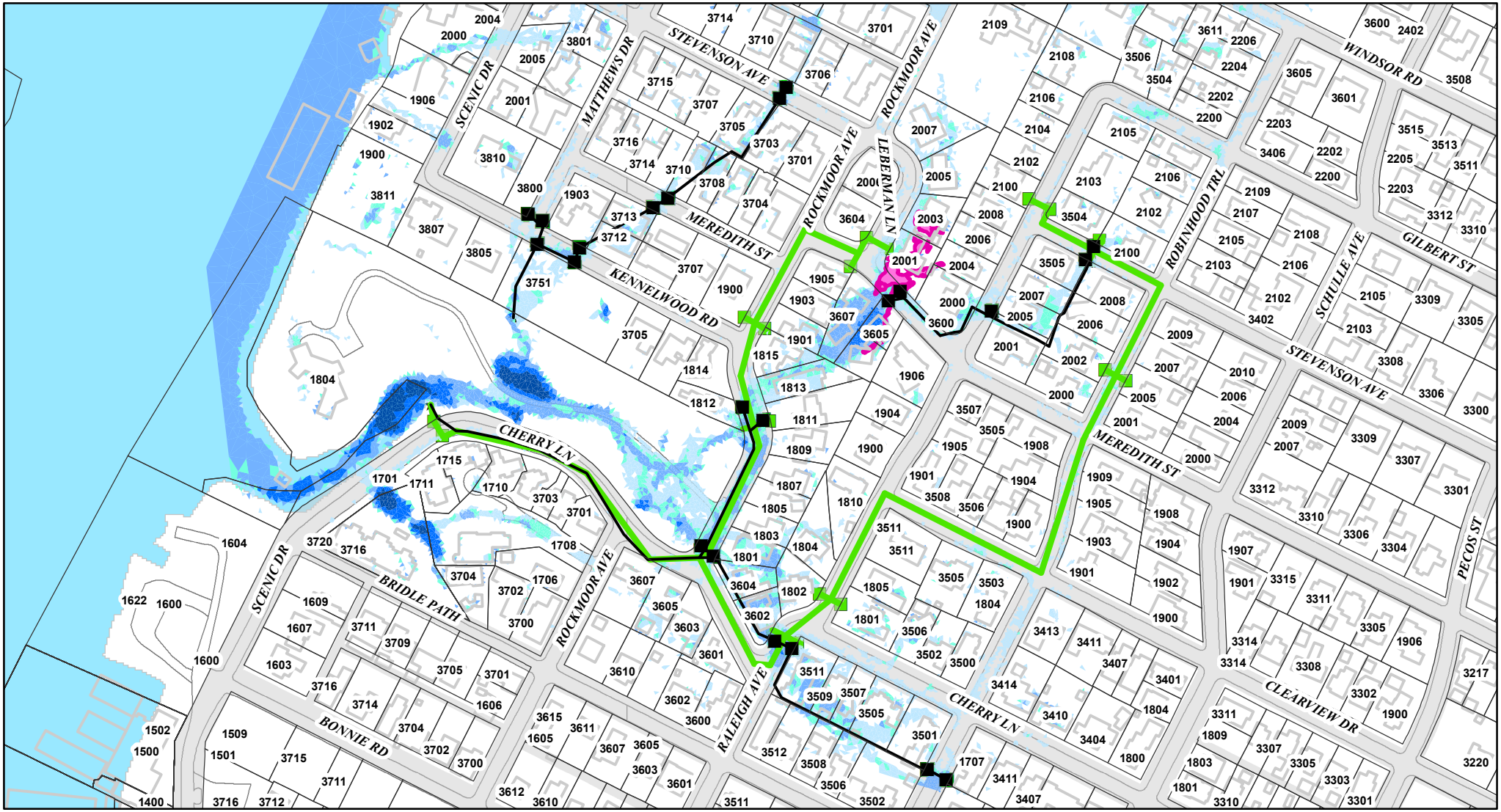
meredith street storm drain project : open space alternative
mas 10.10.2014

klotz associates

Attachment

Austin Caverns Map –

Current Flood Risk and Recommendations Solution



Current Flood Risk and Recommended Solution

NOT TO SCALE

N
W E
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This map is for informational purposes only and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.

This product has been produced by the Watershed Protection Department for the sole purpose of geographic reference. No warranty is made by the City of Austin regarding specific accuracy or completeness.

City of Austin
WATERSHED PROTECTION

Flooding Depth, ft

Existing Pipes	0.100 - 0.300
Existing Inlets	0.301 - 0.500
Proposed Pipes	0.501 - 1.500
Proposed Inlets	1.501 - 3.000
Austin Caverns	3.001 - 5.347