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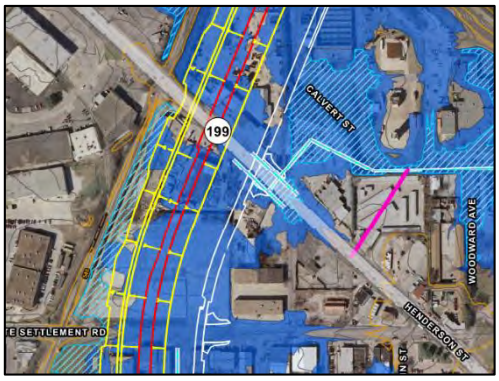

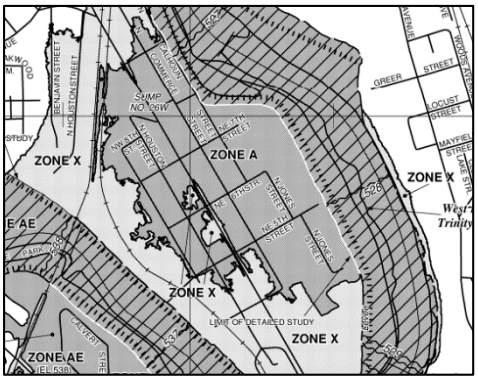

Trinity River Vision Storm Drain Master Plan
Volume II: Proposed Conditions

Prepared for:

City of Fort Worth

October 2014

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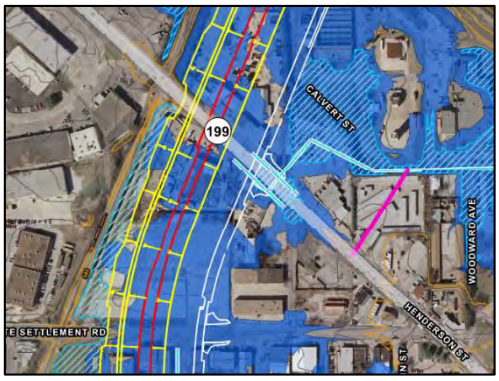

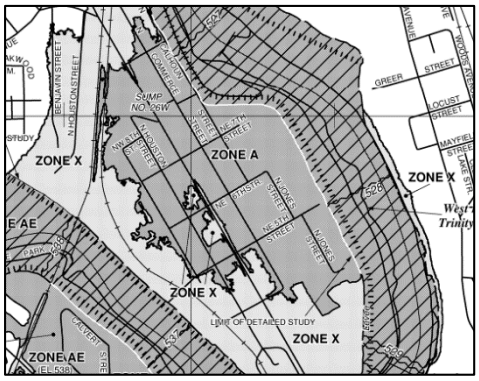

Trinity River Vision Storm Drain Master Plan
Volume II: Proposed Conditions

Prepared for:

City of Fort Worth

October 2014

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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

This volume of the Trinity River Vision (TRV) Storm Drain Master Plan discusses changes in stormwater conditions caused by the TRV project. In addition, this volume identifies local drainage projects required to support the overall TRV project and establishes phasing for these projects. The phasing of these projects considers the effects of major, predictable interim phases as each of the public TRV project components are completed—namely the bypass channel, bridges, and gates. For the purposes of this analysis, proposed conditions are defined as the completion of these public TRV project components, and do not include future mass grading and private development of the TRV project area. However, local drainage projects identified in this volume were adapted to match the ultimate storm drain configuration presented in Volume III of this report where possible.

All work was coordinated with the Trinity River Vision Authority (TRVA), the City of Fort Worth, the U.S. Army Corps of Engineers (USACE), and their consultants. For the purposes of drainage coordination, these entities are referred to as the TRV project partners.

1.2 OVERVIEW

Section 2 of this report discusses the development of a coincidental occurrence methodology that was used both to evaluate local drainage projects and to analyze sumps. Section 3 discusses the identification and sizing of local drainage projects which are required to successfully construct each of the TRV components. These projects have been assigned to the overall project work breakdown structure (WBS). Section 4 discusses FNI's analysis of TRV project impacts to existing sumps on the landward side of the levee systems caused by the hydraulics of the river system.

The goal of the analyses and proposed improvements is to provide solutions such that the TRV project has no adverse impact on the adjacent local drainage systems. FNI was directed to determine methods to analyze the impacts to both local drainage (pipe and gutter) and sump conditions caused by levees. The local projects discussed in the following sections were evaluated to address the following criteria:

1. Mitigate impacts for a 100-year recurrence interval at any interim or final condition.
2. Phase projects to minimize up-front cost.
3. Minimize interim costs such as pumping during bypass channel construction.
4. Facilitate ultimate development conditions with appropriate layout and sizing where possible.

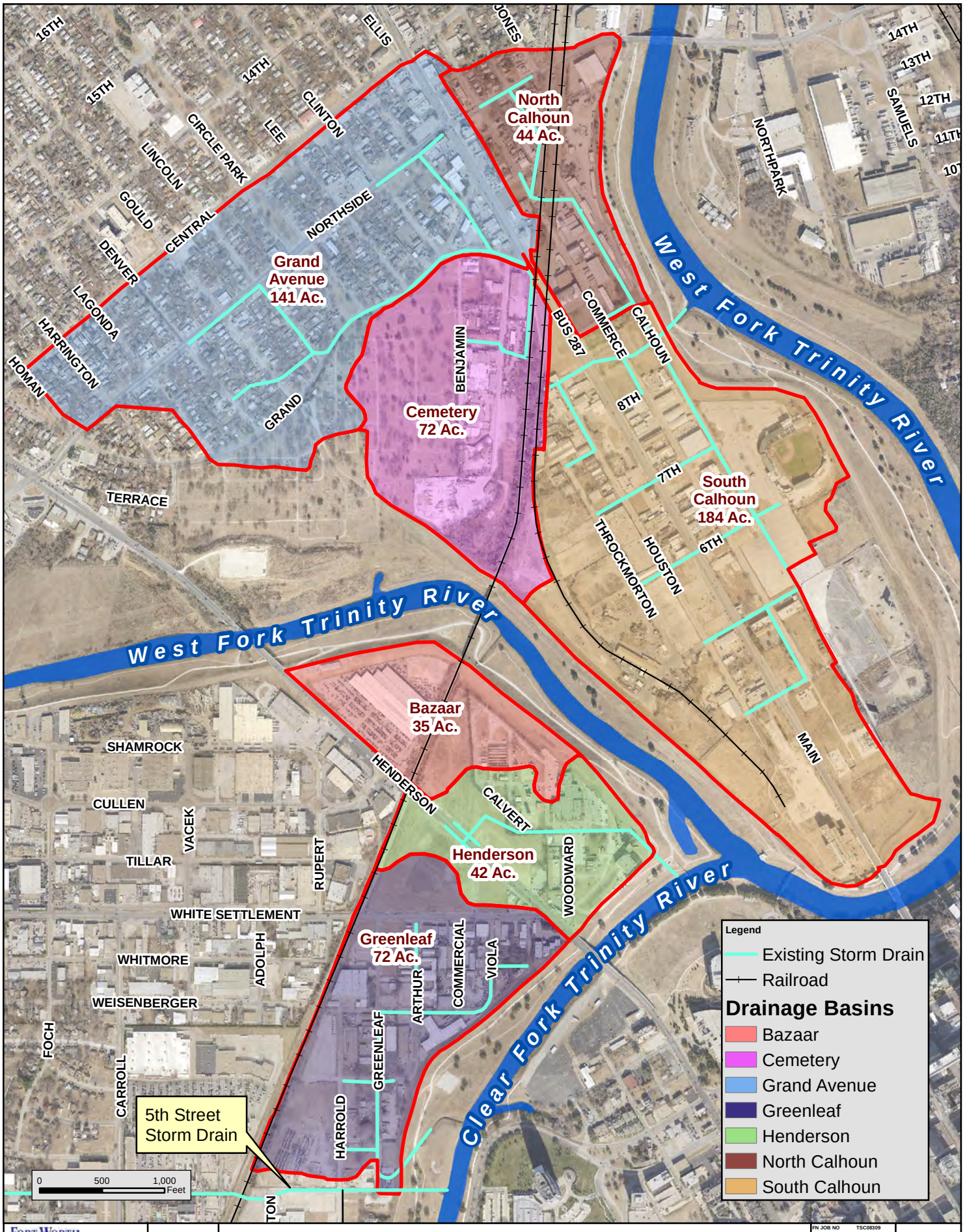
2.0 METHODOLOGY

2.1 COINCIDENTAL OCCURRENCE ANALYSIS

The tailwater elevation at each outfall location is a critical variable affecting storm drain system capacity and floodplain delineation used to identify project impacts. The exterior drainage area of the Trinity River in the TRV project vicinity is several orders of magnitude larger than the interior TRV project drainage area. The interior TRV project drainage areas are shown in Exhibit 1. Because of this disparity in drainage areas, it is beyond the City's design criteria to analyze the instance where the peak 100-year interior flow would occur concurrently with the peak 100-year exterior tailwater. Instead, the existing and proposed conditions InfoWorks SD models were both executed using two coincidental occurrence storms, each approximately corresponding to a 1% annual exceedance probability storm event.

An analysis of the probability of coincidental occurrence of storms indicated that a 10-year interior storm should be paired with 100-year discharges in the Trinity River. The USACE indicated that the 100-year interior storm should be paired with prevailing discharges in the Trinity River. All proposed WBS projects and sumps were evaluated using the coincidental occurrence storm that resulted in worst-case flooding.

At the time of this study, the precise operations of certain TRV project elements were unknown, including operations of the Samuels Avenue Dam and the isolation gates. Due to the uncertain nature of upstream reservoir starting pool elevations and dam operations, steady-state tailwaters were chosen over time-varying tailwaters. Assumptions regarding the design conditions for the proposed system were developed in coordination with TRVA and USACE and are discussed in further detail in the *TRVA Storm Drain Tailwater Design Assumptions* memorandum, which is provided in Appendix B and summarized here. Table 2 of the memorandum summarizes the tailwater elevations determined for each outfall. These tailwater elevations are also provided in Appendix A. Note that the design assumptions memorandum was based on an older USACE model of proposed conditions, dated June 2009. The tailwater elevations discussed in this report and provided in Appendix A are based on an updated model dated May 2011, and therefore supersede the slightly higher elevations in the memorandum. The tailwater elevations from the different models are in general agreement, and using the newer model did not create significant changes to the proposed projects under consideration.



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Trinity River Vision
Drainage Area Map

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DATE	Sep 2014
SCALE	1" = 1,000'
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Exhibit 1

2.2 TAILWATER CONDITIONS—TRINITY RIVER PREVAILING DISCHARGES

The USACE indicated that tailwaters associated with prevailing discharges should be paired with a 100-year interior design storm. To determine prevailing tailwater elevations under existing conditions, the USACE Trinity River HEC-RAS model (baseline conditions, dated February 2008) was executed using prevailing discharges provided by the USACE. Water surface elevations were then extracted at the appropriate cross-sections and transferred to the InfoWorks SD model as steady-state tailwater levels.

To determine prevailing tailwater elevations under proposed conditions, the USACE Trinity River HEC-RAS model (proposed conditions, dated May 2011) were executed using the same prevailing discharges. Based on discussions with the project partners, the gate openings at the proposed Samuels Avenue Dam were calibrated to maintain a water surface elevation of 525 at the dam crest during prevailing discharge; this corresponds to a gate opening of 5.52 feet at the dam during the prevailing discharge. Steady-state tailwater levels were then extracted and transferred to the InfoWorks SD model.

For outfalls to the proposed interior lake or canals, a prevailing tailwater elevation of 526 was selected. This is based on the normal pool of 525 plus one foot of allowable rise in water depths.

2.3 TAILWATER CONDITIONS—TRINITY RIVER 100-YEAR DISCHARGES

Tailwater elevations corresponding to the 100-year Trinity River discharges were developed using the same methodology described above. The 100-year tailwater elevations were matched with a 10-year interior storm. Under proposed conditions for this case, the gate openings at the proposed Samuels Avenue Dam are assumed to be fully opened during the 100-year discharge. This results in the water surface elevation at the dam crest exceeding the normally maintained elevation of 525.

For outfalls to the proposed interior lake or canals, a 100-year tailwater elevation of 526 was selected, the same elevation used under prevailing conditions. This assumption is based on discussions with the project partners and assumes that the interior lake and canals will operate as an independent hydraulic system from the river with the goal of maintaining a constant water surface elevation.

3.0 PROPOSED PROJECTS (WBS)

This section includes a discussion of the methodology used to identify and formulate the proposed drainage improvements. It also includes description of each of the proposed projects identified in the WBS. The proposed projects are depicted in the attached WBS exhibits. The WBS alignments and exhibits were approved by TRV project partners in August 2012. Refer to the *Technical Design Memorandum* in Appendix B for details.

The overall methodology used to identify projects is discussed below as well as a description of each identified project required for the TRV project. Costs for each project were developed with TranSystems Corporation (TSC) and are provided in Appendix C. These cost opinions may be updated by the project partners as the TRV project progresses.

3.1 PROJECT IDENTIFICATION

Proposed improvement projects were identified by first evaluating physical conflicts with each TRV project component. Each component was evaluated sequentially to determine the WBS project component that would trigger a necessary drainage improvement. The preliminary design footprint for each component was overlaid on the existing conditions storm drain network and drainage areas discussed in Volume I. Conflict points were then mapped and evaluated to determine optimal solutions to meet the criteria identified above. These projects were then assigned to the WBS phases to tie their completion to specific project milestones.

3.2 PROJECT SIZING

The proposed improvements were sized using the existing conditions InfoWorks SD model developed as part of the analysis discussed in Volume I. Interim conditions models were created for each phase of the project by modifying the drainage areas and storm drain pipes to account for the physical changes associated with each project component. The models were then executed for each major interim phase of the project to evaluate the flooding impact. The inundation depth results from the 2D mesh were exported and compared to existing conditions to evaluate the change in flooding conditions. All proposed projects were sized such that the proposed conditions 100-year flooding would be no worse than existing conditions 100-year flooding in any interim phase. Proposed projects were also coordinated with the ultimate conditions layout to provide a plan for efficient pipe layout and sizing. The ultimate conditions layout is provided in Volume III.

3.3 HENDERSON STREET BRIDGE (WBS 06.02)

Description

This component includes reconstructing Henderson Street from the West Fork Trinity River to the Clear Fork Trinity River. The project includes a new bridge over the future bypass channel and the Fort Worth & Western Railroad tracks as well as a roundabout at the future intersection at White Settlement Road.

Proposed Improvement

The bridge design includes minor storm drain lines to carry runoff from the roadway and areas that drain toward the road. These lines are considered a part of the bridge design, and not a separate drainage WBS item. The outfall pipe from the realigned White Settlement Road/Henderson Street intersection is identified as a drainage WBS component. The outfall extends from the intersection to Calvert Street downstream, where it will be connected to an existing storm drain. The pipe is sized as a 48" RCP and runs approximately 190 feet to the existing 42" RCP in Calvert Street. Due to the constrictions downstream, the proposed pipe will not function according to City criteria in the interim condition. The pipe has been sized according to the mass grading plan (refer to Volume III) to function in the ultimate development condition. It was also evaluated under interim conditions to verify that no adverse impacts are caused. The estimated construction cost of this drainage improvement is $243,100.

3.4 MAIN STREET BRIDGE (WBS 06.03)

Description

The Main Street bridge consists of reconstructing Main Street from the FWWR tracks to Northeast 7th Street. This involves a bridge spanning the location of the future bypass channel.

Proposed Improvement

The bridge design includes minor storm drain lines to drain runoff from the roadway and to provide connections for future development. The storm drain lines are considered a part of the bridge project and are not assigned an individual WBS number. To maintain existing drainage patterns through this WBS phase, the existing arch pipe draining west to east across Main Street will need to remain operational during bridge construction. This line varies in size, but is an arch section measuring 84" wide by 109" tall where it crosses Main Street. This line will drain the entire Grand Avenue and Cemetery watersheds until the completion of the Grand Avenue line. The current construction drawings indicate that the areas adjacent to this line will be excluded from the excavation area beneath the bridge to protect the line. Due to the timing of the utility relocations around the bridge, the first phase of the Grand Ave/10th Street

project are scheduled to be constructed with this WBS phase. These improvements are discussed in more detail in the following section. The estimated construction cost of the Grand Avenue Phase 1 project is $377,100.

3.5 GRAND AVENUE/ 10TH STREET PHASE 2 (WBS 06.05)

Description

The Grand Avenue/10th Street project is triggered by the construction of the northern segments of the bypass channel. This WBS phase triggers several projects as a number of drainage patterns are interrupted by the bypass channel alignment, including the Grand Avenue, Cemetery, and 8th Street projects.

3.5.1 06.05.01 Grand Avenue/10th Street Phase 2 and North Calhoun

A new outfall is proposed at Northeast 10th Street. This new outfall is necessitated by the severing of the Calhoun trunk line by the bypass channel. This existing line flows to the south toward the existing Main Street outfall. Additionally, the existing Grand Avenue trunk line will be diverted to this new outfall. Redirecting the Grand Avenue line will reduce the required size of the Cemetery outfall to the bypass channel, and will minimize any interim pumping required during channel construction.

The proposed outfall consists of (3)-72" RCP bored beneath the existing levee from the West Fork to Calhoun Street. From Calhoun Street to Commerce Street, the proposed line is (2)-6'x6' RCBs. From Commerce Street to the Grand Avenue tie-in point, in proposed Main Street line is (3)-72" RCPs installed by bore. Additionally, it is proposed that the lateral serving the sag intersection at Northeast 11th Street and Commerce Street be constructed with this WBS phase to prevent adverse impacts to the existing system. The intersection suffers from flooding due to the impoundment of runoff caused by the adjacent Fort Worth & Western Railroad (FWWR) embankment. This lateral varies in size from a 6'x6' RCB to a 42" RCP over its approximate length of 820 feet. A bored portion of the lateral is required beneath the FWWR tracks.

The proposed Grand Avenue line design has been completed by TSC and is to be constructed in two phases. The first phase consists of constructing the (2)-6'x6' RCBs in Northeast 10th Street from Calhoun Street to Commerce Street. The second phase consists of installing the (3)-72" RCPs to connect the existing Grand Avenue line with the new outfall to the West Fork downstream of the isolation gates. The first phase was constructed in the dry in 2013. This accelerated timing was initiated due to multiple utility relocations being undertaken in advance of the Main Street bridge project. Northeast 10th Street includes

an Atmos gas line, an AT&T telecommunications conduit, and a sanitary sewer line in addition to the (2)-6'x6' RCB. The project partners proposed to construct these lines concurrently with the TRV project to reduce the likelihood of conflict between these numerous utilities. The estimated construction cost of Phase 1 is $377,100 and the estimated cost of Phase 2 is $3,310,300. The Calhoun lateral is estimated to cost $641,900.

3.5.2 06.05.02 Cemetery

The Cemetery outfall is required due to the severing of the arch trunk draining west to east under Main Street by the bypass channel excavation. The arch line currently drains a low-lying swale downstream of the cemetery watershed. Runoff from the Oakwood Cemetery sheet flows to this location under existing conditions.

When this area is cut off by the soft edge levee of the bypass channel, the Cemetery project must be constructed. The drainage area to this outfall is reduced significantly by the Grand Avenue project which redirects the Grand Avenue watershed to a new outfall (WBS 06.05.01). To maintain an inundation depth in the swale lower than existing conditions, a 48" RCP penetration of the soft edge levee is required. This line extends approximately 220 feet, draining west to east through the soft edge levee. This outfall size can be adjusted to maintain a reduced water surface elevation in the upstream swale.

The original USACE design guidance prohibited pipe outfalls penetrating the levees of the proposed bypass channel. After analyzing the alternatives, it was determined that the Cemetery outfall penetration of the soft edge levee provided the most feasible drainage solution. Written permission for this alignment was requested of the TRV project partners. This concept was approved in the *Technical Design Memorandum* dated August 21, 2012, included in Appendix B. The estimated construction cost of this drainage improvement is $541,300.

3.5.3 06.05.03 8th Street

The 8th Street line is required due to the severing of the lateral in Commerce Street that drains toward the existing Main Street arch in conflict with the bypass channel. The intersection of Northeast 8th Street and Commerce Street is proposed to be a future sag location after mass grading is completed and will require a line to drain it. Refer to Volume III of this report for details.

The 8th Street line is proposed to be a 48" RCP running along Northeast 8th Street from Commerce Street to Calhoun Street. This line meets the ultimate sizes required by the Volume III mass grading study, and

has been analyzed in interim conditions to demonstrate that no adverse impacts will be caused. Upstream extension of this line may be required for future conditions, but is not required for the TRV project. The estimated construction cost of this drainage improvement is $134,100.

3.6 HOUSTON STREET (WBS 06.06)

Description

The Houston Street line is required with the construction of the middle portion of the bypass channel. Houston Street currently drains to the north to an existing arch pipe system that drains to the Main Street line. Most of Houston Street north of Northeast 7th Street will be removed by the bypass channel, but a portion will remain. This remaining portion and the adjacent land will drain toward the hard edge of the bypass channel and will not be able to drain without additional drainage improvements.

Proposed Improvement

The proposed line is a 24” RCP along Houston Street draining from Northeast 7th Street to the low point of the fill behind the hard edge of the bypass channel. This line would run for approximately 300 feet. It may also be possible that this line would not be necessary if grading is performed to reverse surface flow from north to south. This line is not identified in the Volume III mass grading study because this portion of Houston Street is not identified as future public right-of-way. In summary, this line should be considered as a temporary requirement of interim conditions that may be eliminated with re-grading of Houston Street from north to south. The estimated construction cost of this drainage improvement is $220,600.

3.7 BAZAAR (WBS 06.07)

Description

The Bazaar area is located north of the intersection of Henderson Street and the FWWR tracks. It is surrounded by levees and the embankment for the FWWR tracks. The Bazaar area and a portion of the runoff from Henderson Street drain towards an existing 42” RCP under the tracks toward the 16W sump. The 16W sump will be removed by the footprint of the bypass channel, leaving nowhere for the Bazaar to drain after bypass channel construction is complete.

Proposed Improvement

The proposed improvement is to extend the 42" RCP from the FWWR tracks parallel to the proposed bypass channel to the West Fork Trinity River at the location of the current outfall for the 16W sump. The current 16W sump outfall is an open channel that extends to the river from the face of the levee. If the existing 16W outfall is compatible with the grading of the soft edge levee of the bypass channel, the 42" RCP from the Bazaar could be connected to this outfall for minimal cost. If this proposed line were to outfall into the river at the water line, it would extend approximately 600 feet. Either configuration would be appropriate and would depend on the preference of the project partners. In the interim condition between when the bypass channel is constructed and when the levees are removed, some of the adjacent areas will continue to drain toward the 16W sump. Without corrective measures, this drainage would impound behind the hard edge levee fill. This impounding can be resolved by lowering and extending the existing ditch to the east for 1200' to the 16W sump. This will require some marginal fill in the old sump to achieve positive drainage of 0.5%. The estimated construction cost of this project is $579,500.

3.8 VIOLA STREET OUTFALL (WBS 06.08)

Description

The Viola Street outfall is required by the severing of the trunk line in Kansas Street that currently drains to the Greenleaf outfall. This severing will be caused by the excavation for the southern segment of the bypass channel.

Proposed Improvement

Because USACE project design guidance prohibits new outfalls to the bypass channel, the new Viola Street outfall is proposed to drain the existing Kansas Street trunk line into the internal lake. This will require reversing the flow direction of the pipe in Kansas Street to flow to the east. The proposed Viola Street alignment will outfall to the Clear Fork during interim conditions and to the interior lake under proposed conditions. This pipe is sized as a 42" RCP and extends for approximately 450 feet. This pipe is sized for ultimate conditions as determined in the Volume III mass grading study and has been checked in interim conditions. This alignment works best for existing and interim conditions, but depending on future development, this outfall could be relocated to discharge into the interior canal. The estimated construction cost of this drainage improvement is $904,400.

3.9 NEW MAIN STREET OUTFALL (WBS 06.21)

Description

The existing Main Street outfall needs to be relocated as it conflicts with the north end of the bypass channel and the isolation gates. The existing outfall is located within the fill area behind the hard edge levee of the bypass channel. The hard edge is intended to be the high ground in the TRV project area with all areas draining away from it. In keeping with the USACE project design guidance, the outfall is proposed to be relocated away from the hard edge levee.

Proposed Improvement

The alignment of the proposed New Main Street outfall projects from the Northeast 8th Street/Calhoun Street intersection to the TRV project's interior lake. This outfall location coincides with the outfall from future proposed Canal D. The pipe will be approximately 670 feet in length. This line is proposed to be a 7'x6' RCB. The existing Main Street outfall is (3)-5'x5' RCBs.

The Main Street outfall currently drains the entire north TRV project area of approximately 441 acres. Approximately 277 acres of this area will be removed from this outfall by the bypass channel, 253 acres of which will be redirected to the Cemetery outfall or Grand Avenue line. The remaining 164 acres will drain to the New Main Street outfall until the area is regraded according to the mass grading plan as described in Volume III. In the ultimate configuration this line will drain 25.5 acres, as other areas will drain directly to the proposed canal system before reaching this outfall.

Note that interim conditions control the sizing of this outfall, not the ultimate condition. In the ultimate condition, the large arch trunk in Calhoun Street will be replaced by Canal D which generally runs parallel to the street. The 7'x6' size maintains existing or better inundation levels at each phase of the TRV project, but is oversized for ultimate conditions. Refer to Volume III for additional information on the ultimate sizing of this line. The estimated construction cost of this drainage improvement is $1,580,600.

4.0 SUMP IMPACTS

This section documents the assumptions and methodologies utilized in the delineations of sumps for the TRV project. For the purposes of this report, the sumps are generally defined as areas of shallow ponding on the landward side of the levee. The ponding results from interior drainage that is unable to drain due to high river levels. FEMA provides guidance for mapping this type of ponding flooding in *Appendix E* of the *Guidelines and Specifications for Flood Hazard Mapping Partners*. This document classifies ponding as shallow flooding (less than three feet) behind manmade obstructions such as levees or railroad embankments, and recommends mapping these ponding areas with a designated base flood elevation (BFE).

Currently, the TRV project area is almost completely mapped as Zone A or Zone AE as delineated on FEMA FIRM panel number 48439C0190K, which is included in Exhibit 10. Both Zone A and Zone AE areas are subject to inundation by the 1-percent-annual-chance flood event (sometimes referred to as the "100-year storm"). Zone AE areas are mapped using detailed hydraulic analyses and are shown with BFEs representing the expected level of flooding, while Zone A areas are mapped using more approximate methodologies and do not have associated BFEs.

4.1 BACKGROUND

The proposed TRV project changes area topography and the hydraulic operation of storm drain systems. Changes to these elements will also change FEMA flood zone delineations. This report quantifies changes to sump delineation due to the TRV project and associated storm drain re-alignments. Because one of the critical elements of the project is to provide improved flood control for the TRV project area, it was especially important that the project and associated storm drain relocations mitigate any impact to the interior drainage created by project construction. The main goals of the sump impact analysis were to:

- Assign BFEs to all areas of flooding for existing conditions.
- Develop a methodology for delineation of flooding using dynamic 2D storm drain models.
- Compare the impacts of the TRV project on flooding between existing and proposed conditions.

FEMA has designated names for TRV project area sumps, as shown in Exhibit 10. The area near North Main Street is labeled Sump 26W and is currently delineated as Zone A. The areas near North Henderson Street and White Settlement Road are labeled as Sump 16W and Sump 25C, respectively, and are currently delineated as Zone AE with BFEs from detailed study of 539 and 538, respectively. These sump studies are

generally performed as simplified analyses of the drainage system. The standard procedure entails assuming a head-discharge relationship at the outfall and allowing the entire volume of the storm to pond to a uniform elevation at the sump. Typically, no separate accounting is made for above- or below-ground storage or routing effects of the rest of the system. The use of dynamic 2D InfoWorks simulations affords the opportunity to achieve accurate representations of these two factors and develop a more complete picture of the flooding.

4.2 SUMP DELINEATION METHODOLOGY

Determining the extents to map as floodplain can be challenging with the dynamic modeling approach. In a traditional sump analysis, the entire drainage area is routed through a single reservoir at the outlet that fills and drains over time according to the outlet conditions. For that kind of analysis, the maximum elevation is determined, and then intersected with the topography of the area to determine the extent of sump flooding. Because the InfoWorks dynamic models for the TRV project area are significantly more detailed, they produce flooding results across the entire drainage area—not just the sump. Several alternatives were considered for separating the sump flooding (related to tailwater conditions) from the local flooding that might occur upstream in the watershed (independent of tailwater conditions).

This study recommends defining the sump elevation as the maximum hydraulic level achieved immediately upstream of the levee at each outfall. Improvements to this water level can only be made by modification of the outfall or a change in the operation of the river. In some instances, sump elevations are exacerbated by a lack of inlet capacity. In these cases, sump elevations can be reduced by improving surface capture.

Two pairings of internal storms and tailwater conditions were considered for both the existing and proposed models. The first pairs a 100-year internal storm with prevailing flow tailwater elevations. The second pairs a 10-year internal storm with 100-year tailwater elevations. Both 2D and 1D hydraulic elevations were considered in order to analyze the true behavior of interior drainage systems, including undersized storm drain and lack of inlet capacity. At each outfall, the worst case 2D (surface) or 1D (closed system) hydraulic elevation of the two coincidental models was determined for existing and proposed conditions. This maximum hydraulic elevation represents the worst case storage of water behind the levees and will control the hydraulic behavior of upstream storm drain systems. This elevation was then projected across our terrain model to determine the area of inundation. Because the ground has relatively little topographic relief, some ponding areas top drainage divides. In these instances the model allows for

this overtopping, but the delineation of the flooding stops at the drainage divide. The movement of water to the adjacent sump will control the flood elevation of that side of the divide.

While this method works well for the outfall sumps, there is significant flooding in areas upstream of the outfalls that were not mapped with this methodology. The criterion for sump flooding was therefore expanded to include any area behind an embankment that fills with water to a constant elevation. FNI identified these additional areas of flooding manually and performed the analysis at those points. Two of these areas were identified—upstream of the railroad culvert near Oakwood Cemetery, and upstream of the railroad at the sag location at Commerce Street and Northeast 11th Street.

4.3 EXISTING CONDITIONS RESULTS

Using the above methodology, seven sump flooding locations were identified under existing conditions. Because of the addition of two outfall locations, nine sump flooding locations were identified under proposed conditions. Note that the Main Street outfall is relocated between existing and proposed conditions and is therefore not directly comparable to the New Main Street outfall. In general, when the 100-year tailwater controls, the tailwater is high enough that the location in question does not drain during the simulation. In this case, the outfall discharge equals zero and the flooded area essentially retains the entire storm runoff volume. Alternatively, locations controlled by prevailing tailwater are generally controlled by the hydraulic capacity of the storm drain outfall. The result of this analysis is presented in Table 1 below. Exhibit 11, attached, compares existing and proposed sump delineations.

4.4 PROPOSED CONDITIONS RESULTS

Table 1 below compares the controlling base flood elevations (BFEs) under both existing and proposed conditions. A more detailed table including tailwater elevations and BFEs for both prevailing and 100-year tailwater conditions is provided in Appendix A.

The TRV project creates new sump locations at Grand Avenue, New Main Street, and Viola Street. The New Main Street and Viola Street sumps are considered interim sumps since they are expected to be removed along with the levees during future mass grading. Refer to Volume III of this report for details regarding mass grading and ultimate conditions. The Grand Avenue sump is delineated due to the construction of a new outfall through the levee. While this area will be designated as a sump under proposed conditions, the inundation levels actually decrease between existing and proposed conditions.

No mass grading is currently planned for the Grand Avenue location, but this sump can also be reduced or eliminated in the future by increasing inlet capacity and elevating the affected area.

In all but one location (Greenleaf Street), the sump elevation of the proposed system is less than or equal to the sump elevation of the existing system. Also, there is potential for surface flooding to overflow into the Greenleaf basin from the adjacent 5th Street basin to the south. The 5th Street storm drain system was not studied as part of this report and is not accounted for in the Greenleaf Street sump calculations.

Table 1. Sump Summary

Sump Name	*Sump ID*	*Existing BFE*	*Proposed BFE*
Grand Avenue	-	-	532.76
Main Street	26W	531.32	-
New Main Street	26W	-	530.70
Calhoun at FWWR	-	538.22	537.79
Cemetery	-	535.44	532.41
Bazaar	16W	536.09	535.43
Existing 16W Sump	16W	536.06	-
Greenleaf Street	-	537.75	538.62
Calvert Street	25C	536.04	535.30
Viola Street	-	-	536.90

4.5 GRAND AVENUE

The low point of this proposed conditions sump is located at the Grand Avenue line near Calhoun Street and Northeast 10th Street. This sump is controlled by prevailing tailwater conditions. The controlling elevation for this sump is caused by upstream overflow to the low point during the worst case 100-year interior storm. With the current configuration of the Samuels Avenue Dam and level control gates, only upstream storm drain and inlet improvements would prevent overland flow from collecting in this location. Although the TRV project causes this area to be classified as a sump, the peak hydraulic elevation in this area actually decreases between existing and proposed conditions. This sump could be removed in the future by improving surface runoff capture and elevating the adjacent area.

4.6 MAIN STREET (26W SUMP)

4.6.1 Existing Main Street

The low point of this sump is located at North Calhoun Street, midway between Northeast 8th Street and Northeast 9th Street, just upstream of the West Fork Trinity River outfall. Under existing conditions, this sump has a hydraulic elevation of 531.32 and is controlled by a 100-year tailwater of 529.47. The TRV project will remove this outfall and establish the New Main Street sump.

4.6.2 New Main Street

The low point of this interim sump is located at the intersection of North Calhoun Street and Northeast 8th Street, just upstream of the proposed interior lake outfall to the northeast. This location was analyzed as a point of comparison to the existing Main Street sump, since the existing Main Street outfall will be removed by the TRV project. Under proposed conditions, the peak hydraulic elevation in this area decreases from 531.32 to 530.70. This is caused by a lack of upstream storm drain and inlet capacity, not a restricted outfall condition. The peak HGL in the pipe remains below existing ground. Therefore, although the TRV project creates an interim sump in this location, the sump will be removed when mass grading occurs and levees are removed. Refer to Volume III of this report for details regarding mass grading and ultimate conditions.

4.7 CALHOUN AT FWWR

The low point of this sump is located at the intersection of North Commerce Street and Northeast 11th Street behind the railroad embankment. This sump is currently not designated as a FEMA flood hazard zone and is only analyzed due to the railroad embankment. Between existing and proposed conditions, this sump decreases from 538.22 to 537.79. Under both existing and proposed conditions, the sump is controlled by the 100-year interior, prevailing tailwater scenario. This sump could be removed in the future by increasing inlet capacity throughout the basin.

4.8 CEMETERY

The low point of this sump is located just upstream of the railroad culvert near Oakwood Cemetery. This sump decreases from 535.44 to 532.41 between existing and proposed conditions. Under existing conditions, this area currently drains through a railroad culvert into the North Main storm drain system. Under proposed conditions, this area will drain through a 48” pipe directly into the bypass channel. Under

both existing and proposed conditions, the sump is controlled by the 10-year interior, 100-year tailwater scenario. The significant reduction in the Cemetery sump elevation is caused by the lower tailwater level from the proposed bypass channel. This sump could be removed in the future by elevating the low point above the sump elevation.

4.9 BAZAAR AND 16W SUMP

4.9.1 Bazaar

The Bazaar area is located north of the intersection of Henderson Street and the FWWR tracks. It is surrounded by levees and the embankment for the FWWR tracks. Under existing conditions, the Bazaar area drains through a 42" RCP to the Existing 16W area, and these sumps fill to approximately the same peak elevation. Under proposed conditions, the Bazaar railroad culvert drains directly to the river outfall. This sump decreases from 536.09 to 535.43 between existing and proposed conditions. Under both existing and proposed conditions, the sump is controlled by the 100-year tailwater, which decreases from 539.45 to 535.02. This sump could be removed in the future by elevating the low point above the sump elevation.

4.9.2 Existing 16W Sump

The low point of this sump is located across the railroad tracks from the Bazaar and north of Calvert Street, behind the West Fork Trinity River levee. Under existing conditions, the sump is controlled by a 100-year tailwater of 539.45. The TRV project bypass channel passes directly through this area and will remove this sump. Any remaining area will be regraded toward either the interior lake or the Calvert sump.

4.10 GREENLEAF STREET

4.10.1 Description

The low point of this sump is located at the intersection of Greenleaf Street and Kansas Street, upstream of the outfall to the Clear Fork. Here the sump elevation is increased from 537.75 to 538.62, and is controlled by the 100-year tailwater. In both existing and proposed conditions, the 100-year tailwater in the river is high enough that all runoff from the Greenleaf system is stored behind the levee.

This increase is counter-intuitive because the TRV project decreases the 100-year tailwater from 541.23 to 540.67, and the construction of the bypass channel bisects the drainage area, decreasing the contributing drainage area of the Greenleaf system from 72.2 acres to 25.6 acres. However, several low

points that flood under existing conditions are located within the limits of the proposed bypass channel. Removing these low points causes a significant loss of flood storage volume on the surface. Under existing conditions, the flood volume above the surface peaks at 20.2 ac-ft during the 10-year interior/100-year tailwater storm event. Under proposed conditions, the surface flood volume for the same event peaks at 14.5 ac-ft, but this volume is stored only in the area west of the bypass channel, where only 7.0 ac-ft is stored under existing conditions. Therefore, the available surface storage for the Greenleaf system decreased in greater proportion than the runoff volume and tailwater level, which will worsen sump flooding conditions.

Furthermore, under existing conditions, floodwaters are diverted over the Greenleaf drainage divide and into the Calvert sump. The proposed TRV bridges remove the possibility of this diversion, further contributing to the Greenleaf sump increase. There is also the potential for surface flooding from the 5th Street storm drain system to spill over into the Greenleaf area, although this interaction has not yet been confirmed with a detailed study. The City of Fort Worth plans to begin a study of the 5th Street system in 2015. The findings of this future study will clarify whether flooding from the 5th Street system has any impact on flooding the Greenleaf sump.

Because the existing outfall, storm drain system, and drainage area remains undisturbed to the west of the proposed bypass channel, no impact was initially anticipated and the Greenleaf system was not initially included in the WBS. The impact to the Greenleaf area was only revealed after completion of this sump analysis.

4.10.2 Mitigation Options

Several conceptual options have been developed for mitigating this sump increase. Under each conceptual mitigation option presented here and in Exhibit 12, the existing Greenleaf outfall remains and is still utilized under prevailing tailwater conditions; however, it is not active under 100-year tailwater conditions due to the submerged outfall. Concept opinions of probable construction cost have been developed for each option which are presented in Appendix D.

1. Establish a new outfall at the downstream side of the White Settlement Bridge. This location is further downstream on the bypass channel where the 100-year tailwater would be 537.24. This tailwater is low enough to allow partial drainage of the sump behind the bypass channel levee, lowering the sump elevation to 537.64. This would require approximately 1300 LF of 72” pipe. The estimated cost of this option is $652,900.

2. Establish a new outfall at the downstream side of the Henderson Bridge, where the 100-year tailwater would be 536.52. This tailwater is low enough to allow partial drainage of the sump behind the bypass channel levee using a smaller-diameter pipe, lowering the sump elevation to 537.73. This would require approximately 2000 LF of 48" pipe. The estimated cost of this option is $625,800.

3. Construct a detention pond or storage area to offset the sump increase. One potential location for this detention is the area just west of the existing Greenleaf outfall. However, this location is arbitrary, and the exact location of this storage is unimportant as long as it connects to the existing Greenleaf system and provides 8.2 acre-feet of storage below elevation 537.75. The location shown in Exhibit 12 was chosen purely for the purpose of developing a conceptual cost estimate. The estimated cost of this option is $537,200.

4. Mass grading of the basin to eliminate the Greenleaf sump. To minimize the amount of mass grading required, this new outfall should be established at the low point of the Greenleaf area, just east of the existing sump, where the 100-year tailwater in the bypass channel is 538.38. This would require approximately 250 feet of 7'x6' RCB and mass grading of the entire Greenleaf area. Approximately 7.6 feet of fill would be required just upstream of the new outfall in order to provide 2 feet of cover over the peak HGL. This would raise the low point in the Greenleaf area from 534.6 to 542.2. This conceptual mitigation option would be similar to the mass grading contemplated in Volume III of this report, which eliminates existing sumps. The estimated cost of this option is $336,000. This cost is for the construction of the new outfall and does not include the cost for the mass grading of the area. This cost would likely be borne by developers wishing to eliminate the flood risk for their site.

To summarize, the TRV project causes an increase in the Greenleaf sump elevation, and no local drainage projects are currently identified in the WBS to mitigate this increase. The mitigation options presented here are shown in Exhibit 12, and a conceptual cost estimate for each mitigation option is provided in Appendix D. These costs are not currently included in the TRV project budget.

4.11 CALVERT STREET (25C SUMP)

The low point of this interim sump is located at the intersection of Calvert Street and Congress Street, just upstream of the Clear Fork Trinity River outfall. This sump decreases from 536.04 to 535.30. Under existing conditions, this sump is controlled by the 100-year tailwater, and under proposed conditions, it is controlled by the prevailing tailwater. With the construction of the interior lake, both the prevailing tailwater and the controlling 100-year tailwater decrease to 526.00. Note that the BFE in the 100-year interior, prevailing exterior scenario increases from existing to proposed; however, this is not the controlling scenario. Because the project partners own most of the property affected by this interim sump, which will be removed when mass grading occurs, improvements to this outfall are not recommended. Refer to Volume III of this report for details regarding mass grading and ultimate conditions.

4.12 VIOLA STREET

The low point of this interim sump is located at the intersection of Viola Street and South Commercial Street, just upstream of the new outfall to the interior lake. Under existing conditions, this area drains to the Greenleaf storm drain system. Under proposed conditions, the TRV bypass channel alignment isolates this area from the Greenleaf outfall, requiring a new outfall to the interior lake. Under proposed conditions, the peak hydraulic elevation of 536.90 in this area is caused by upstream overflow collecting at this low point. The peak HGL in the pipe remains below existing ground. For existing conditions, the peak hydraulic elevation in this area is 537.11 under the prevailing tailwater and 537.78 under the 100-year tailwater. Therefore, although the TRV project creates an interim sump in this location, the peak hydraulic elevation decreases between existing and proposed conditions and the sump will be removed when mass grading occurs. Refer to Volume III of this report for details regarding mass grading and ultimate conditions.

5.0 SUMMARY AND DISCUSSION

The existing conditions models developed for the Volume I report were used to evaluate the interim and final conditions of the TRV project. The purpose of this study was to identify drainage projects required to construct the TRV project without causing adverse changes to existing flooding conditions.

FNI developed a methodology to evaluate and identify impacts to both the interior storm drain system and the sump flooding caused by riverine impacts. The methodology is based on using steady-state tailwater conditions and interior storms based on the coincident probability of a 100-year storm in the TRV project area. Interior projects were identified by investigating physical changes to the watershed caused by the TRV project. Sump impacts were identified by using a detailed analysis of overland and below-ground hydraulic conditions upstream of levees and embankments.

A number of drainage projects were identified that must be constructed at various phases of the TRV project to mitigate impacts to existing hydraulic conditions. These projects are intended to represent the minimum improvements necessary to construct the major components of the TRV project. They have been coordinated with the mass grading improvements proposed in Volume III of this report to provide infrastructure compatible with ultimate development where feasible. With the exception of the Greenleaf sump mitigation, these projects have been entered into the work breakdown structure (WBS) maintained by TRV project partners. The WBS ties the projects identified in this report to the overall project components, and maintains an overall project budget based on the cost opinions for these projects.

Project Location Map

Central City Storm Water

Fort Worth, Texas

FORT WORTH

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
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TranSystems

WBS #	Description
06.02	Henderson St Br.
06.03	Main St Br.
06.05	Bypass Seg A
06.06	Bypass Seg B
06.07	Bypass Seg C
06.08	Bypass Seg D
06.21	TRWD Gate

Proposed Storm Drain

TRVA Comp Plan

N

0 800 1,600 Feet

DRAFTED: RCT FNI JOB: TSC08329 DATE: APRIL, 2011

FILE_LOC:H:\STORMWATER\FNI_DATA\Project Location Map

06.02 Henderson St Br.

Central City Storm Water

Fort Worth, Texas

FORT WORTH

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TranSystems

Bridge Drainage (NOT part of Storm Drain WBS)

Bridge Drainage (NOT part of Storm Drain WBS)

06.02 Henderson Line

HENDERSON ST

SHAMROCK AVE

CULLEN ST

RUPERT ST

TILLAR ST

HERITAGE PARK

WHITE SETTLEMENT RD

CALVERT ST

COMMERCIAL ST

WOODWARD AVE

24" 24" 30" 18" 24" 24" 42" 4' x 4' 18" 30" 18" 24" 36" 42" 42" 48" 24" 36" 36" 24" 24"

- Existing Pipe
- Proposed Pipe
- Abandoned Pipe
- Bridge Drainage
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 100 200 400 Feet

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06.03 Main St Br.

Grand Ave/10th Street Ph1

Central City Storm Water

Fort Worth, Texas

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TranSystems

06.03 Grand Ave/ 10th Street Phase 1

Bridge Drainage (NOT part of Storm Drain WBS)

78" Arch to Remain During Bridge Construction

MAIN ST
GRAND AVE
HOUSTON ST
BENJAMIN ST
10TH ST
9TH ST
8TH ST
7TH ST
COMMERCE ST
CALHOUN ST
REFINERY ST

15" 18" 48"x43"Arch 15" 24" 18" 15" 60"x54"Arch 24" 18" PROP 2-6'X6' RCB 24" 42" 42" 24" 42" 3 - 5'X5' 78"x62"Arch 96"x54"Arch 96"x54"Arch 24" 78"x61"Arch 84"x109"Arch 78"x54"Arch 36"x24"Arch 18" 24" 24"

- Existing Pipe
- Proposed Pipe
- Abandoned Pipe
- Bridge Drainage
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 100 200 400 Feet

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06.05 Grand Ave/10th Street Phase 2

Central City Storm Water

Fort Worth, Texas

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06.05.01 Grand Ave/10th Street Phase 2 and N. Calhoun

Bridge Drainage (NOT part of Storm Drain WBS)

06.05.02 Cemetery

Existing Main Street Outfall

06.05.03 8th Street

11TH ST
GRAND AVE
10TH ST
9TH ST
8TH ST
COMMERCE ST
MAIN ST
CALHOUN ST
HOUSTON ST
BENJAMIN ST

18"-21"
42"
60"
6x6
6x6
24"
PROP 3-72" RCP (BORED)
PROP 3-72" RCP (BORED)
PROP 2-6'X6' RCB
48"x43"Arch
60"x54"Arch
42"
24"
42"
3 - 5' x 5'
78"x62"Arch
96"x54"Arch
78"x61"Arch
84"x109"Arch
78"x54"Arch
96"x124"Arch
24"
48"
48"
18"
24"
24"

- Existing Pipe
- Proposed Pipe
- Bridge Drainage
- Abandoned Pipe
- Previously Abandoned Pipe
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 100 200 400 Feet

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06.06 Houston St

Central City Storm Water

Fort Worth, Texas

FORT WORTH

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TranSystems

HOUSTON ST
REFINERY ST
8TH ST
COMMERCE ST
MAIN ST
CALHOUN ST
THROCKMORTON ST
7TH ST
06.06 Houston St
78"x54"Arch
84"x109"Arch
36"x24"Arch
24"
28"
42"
30"
36"
96"x54"Arch

- Existing Pipe
- Proposed Pipe
- Abandoned Pipe
- Peviously Abandoned Pipe
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 50 100 200 Feet

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06.07 Bazaar

Central City Storm Water

Fort Worth, Texas

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HERITAGE PARK

Bazaar 16W Sump Area

06.07 Bazaar Outfall

4' x 4'

42"

42"

42"

Existing 16W Sump Area

CALVERT ST

- Existing Pipe
- Proposed Pipe
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 50 100 200 Feet

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06.08 Viola

Central City Storm Water

Fort Worth, Texas

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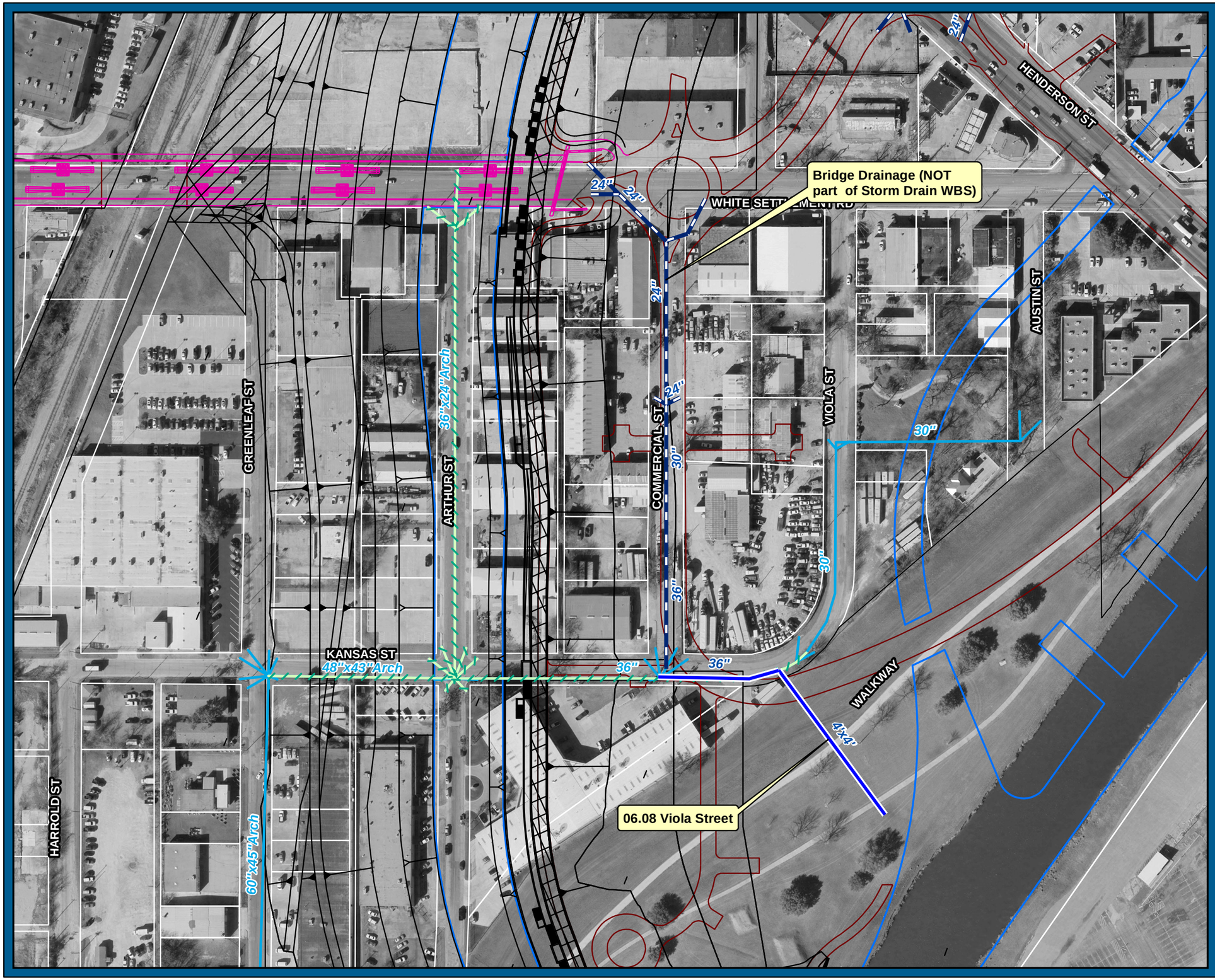
TranSystems



- Existing Pipe
- Proposed Pipe
- Abandoned Pipe
- Bridge Drainage
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 75 150 300 Feet

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06.21 New Main St Outfall

Central City Storm Water

Fort Worth, Texas

FORT WORTH

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
(P) 817-735-7300 (F) 817-735-7491

TranSystems

42"
3 - 5' x 5'
78"x62" Arch
96"x54" Arch
7' x 6'
06.21 New Main Street Outfall
24"
48"
18"
15"
12"
CALHOUN ST
8TH ST
COMMERCE ST

- Existing Pipe
- Proposed Pipe
- Previously Constructed
- Abandoned Pipe
- Previously Abandoned Pipe
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 50 100 200 Feet

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...e Flood Insurance Study report for this jurisdiction.

...ce is available in this community, contact your insurance ...d Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

0 300 600

PANEL 0190K

FIRM

FLOOD INSURANCE RATE MAP

TARRANT COUNTY, TEXAS

AND INCORPORATED AREAS

PANEL 190 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FORT WORTH, CITY OF	480596	0190	K

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

MAP NUMBER
48439C0190K

MAP REVISED
SEPTEMBER 25, 2009

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

THIS AREA PROTECTED FROM THE ONE PERCENT ANNUAL CHANCE (1%) FLOOD BY LEVEE, DIKE OR OTHER STRUCTURE SUBJECT TO POSSIBLE FAILURE OR OVERTOPPING DURING LARGER FLOODS.

ZONE X
ZONE AE
ZONE A
AE
LIMIT OF DETAILED STUDY
CS1587
CS1585
CS1780
CS1778
CS1584
CS1744
CS1745
CS1741
CS1726
SUMP NO. 16W
SUMP NO. 14W
SUMP NO. 25C
SUMP NO. 26W
SUMP NO. 28W
ZONE AE (EL 538)
ZONE AE (EL 537)
West Fork Trinity River
Clear Fork Trinity River
OAKWOOD CEM.
GREENWOOD CEM.
HERITAGE PARK
WALKWAY
LEVEE

Sump Comparison

- Existing Sump
- Existing Storm Drain
- Proposed Sump
- Interim Sump
- Proposed Storm Drain

Bypass Channel
- Overbank
- Top of Levee / Toe of Slope

Contours
- 10ft Index
- 1ft Interval

0 300 600 Feet

FREESE NICHOLS September 2014

Grand Avenue
Proposed BFE = 532.76

Grand Tailwater
Proposed Prevailing: 525.07*
Proposed 100-yr: 529.66

Calhoun at FWWR
Existing BFE = 538.22
Proposed BFE = 537.79

Main Tailwater
Existing Prevailing: 511.72
Existing 100-yr: 529.47*

New Main Tailwater
Proposed Prevailing: 526.00*
Proposed 100-yr: 526.00

Cemetery Tailwater
Proposed Prevailing: 525.17
Proposed 100-yr: 530.60*

Main Street / New Main Street
Existing BFE = 531.32
Proposed BFE = 530.70

Cemetery
Existing BFE = 535.44
Proposed BFE = 532.41

Bazaar / 16W Tailwater
Existing Prevailing: 527.77
Existing 100-yr: 539.45*
Proposed Prevailing: 525.90
Proposed 100-yr: 535.02*

Bazaar
Existing BFE = 536.09
Proposed BFE = 535.43

NOTE: This area assumed to be graded toward Calvert outfall under proposed conditions.

Existing 16W
Existing BFE = 536.06

Calvert Street
Existing BFE = 536.04
Proposed BFE = 535.30

Calvert Tailwater
Existing Prevailing: 527.18
Existing 100-yr: 538.79*
Proposed Prevailing: 526.00*
Proposed 100-yr: 526.00

Greenleaf Street
Existing BFE = 537.75
Proposed BFE = 538.62

Viola Street
Proposed BFE = 536.90

Viola Tailwater
Proposed Prevailing: 526.00*
Proposed 100-yr: 526.00

Greenleaf Tailwater
Existing Prevailing: 527.70
Existing 100-yr: 541.23*
Proposed Prevailing: 526.56
Proposed 100-yr: 540.67*

Note: BFEs are based on the worst-case coincidental occurrence of either (1) a 10-year internal design storm paired with a 100-year tailwater condition or (2) a 100-year internal design storm paired with prevailing tailwater conditions. For each outfall, the tailwater corresponding to the worst-case BFE is marked with an asterisk (*).

Greenleaf Sump Mitigation Options

Central City Storm Water

Fort Worth, Texas

FORT WORTH

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TranSystems

- Option 1: Outfall at White Settlement Rd
- Option 2: Outfall at Henderson St
- Option 3: Detention
- Option 4: Mass Grading Outfall
- Existing Pipe
- Abandoned Pipe
- Bridge Drainage
- Bypass Channel
- Bridges
- Control Gate
- Lakes and Canals
- Pedestrian Bridges
- Roadways
- 2009 Parcels

N

0 150 300 600 Feet

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Appendix A
Sump Details

		Existing				Proposed			
		Prevailing Exterior		*100-Year Exterior*		*Prevailing Exterior*		*100-Year Exterior*	
Sump Name	*Sump ID*	*TW*	*BFE*	*TW*	*BFE*	*TW*	*BFE*	*TW*	*BFE*
Grand Avenue*	-	-	-	-	-	525.07	532.76	529.66	532.29
Main Street	26W	511.72	529.67	529.47	531.32	-	-	-	-
New Main Street*	26W	-	-	-	-	526.00	530.70	526.00	530.37
Calhoun at FWWR	-	-	538.22	-	537.26	-	537.79	-	536.86
Cemetery	-	-	534.57	-	535.44	525.17	531.26	530.60	532.41
Bazaar	16W	-	534.24	-	536.09	525.90	534.04	535.02	535.43
Existing 16W Sump	16W	527.77	530.89	539.45	536.06	-	-	-	-
Greenleaf Street	-	527.70	536.86	541.23	537.75	526.56	535.96	540.67	538.62
Calvert Street	25C	527.18	534.68	538.79	536.04	526.00	535.30	526.00	534.72
Viola Street*	-	-	-	-	-	526.00	536.90	526.00	536.60

Notes:

- BFE values marked with an asterisk are caused by upstream overflow, not by an outfall restriction. These areas are classified as interim sumps and will be removed by mass grading under ultimate conditions. Volume III of this report addresses ultimate conditions.
- Controlling BFEs are highlighted in blue.
- Existing steady tailwater values are from the HEC-RAS Trinity River CDC model developed by USACE for Central City dated February 2008.
- Proposed steady tailwater values are from the HEC-RAS Trinity River Model developed by CDM dated May 2011.
- Prevailing flow tailwaters are paired with all local frequency storms for capacity checks.
- Sump methodology analyzed for 100-year return interval. Sump elevation selected as worst case combination of 10-yr local storm with 100-yr external tailwater or 100-yr local storm with prevailing tailwater.

Appendix B
Technical Design Memorandum
Storm Drain Conceptual Alignments, Outfall Locations, and Design Assumptions

CENTRAL CITY PROJECT
CITY STORM DRAIN FACILITIES
TECHNICAL DESIGN MEMORANDUM
STORM DRAIN CONCEPTUAL ALIGNMENTS, OUTFALL LOCATIONS, AND DESIGN ASSUMPTIONS

Issue: Conceptual Alignments for municipal storm drain relocations including discharges into the Bypass Channel and corresponding tailwater assumptions

Background:

- Under contract with the City of Fort Worth, Freese and Nichols, Inc. (FNI) and Transystems Corporation (TSC) have performed storm drain master planning for the relocation of municipal storm drain systems impacted by the Central City project components.

- The storm drain masterplan includes storm drain systems impacted by the bypass channel, the Henderson, North Main, and White Settlement bridges, and the interior lake and associated gate structures.

- Detailed modeling of the existing and proposed storm drain facilities was developed using Infoworks SD for the masterplan.

- Representatives from the City of Fort Worth, TRVA, FNI, Transystems, TRWD, and the USACE have met on multiple occasions to discuss the storm drain relocations and conceptual alignments. These meetings have occurred on or around the following dates (most recent listed first): July 2012, May 2012, August 2011, January 2011, September 2010, July 2009, and November 2008.

- The proposed storm drain alignments have been presented in writing to the project partners most recently through the preparation of the Work Breakdown Structure (WBS) exhibits. The WBS exhibits are attached for reference.

- The Cemetery drainage area is proposed to outfall in the bypass channel along the natural flowpath for the contributing drainage area. The impact of this outfall location is additional dewatering considerations during construction for the channel contractor. FNI performed calculations to estimate the potential cost impacts of dewatering the channel compared to constructing a gravity line paralleling the bypass channel to outfall further downstream of the project limits. The results of the analysis indicated that it was much more cost effective to bear the temporary pumping costs than encumber the larger capital costs for the longer drainage alignment.

- The Grand Avenue drainage area is proposed to be served by a storm drain trunk line that runs along 10th Street and under the existing levee then outfalls into the floodway at a location near the TRWD maintenance facility. In November 2010, FNI sent a letter to the USACE asking for approval of this concept alignment in writing. No written response was ever received according to our files, but we have understood based on discussion with the TRVA that this line was approved in concept pending the details of the outfall and levee crossing details to be provided further in design. A separate technical design memorandum deals explicitly with the design assumptions associated with Grand Avenue.

- FNI has requested guidance from the USACE and TRWD concerning the future operation of the Central City system with respect to tailwater conditions for the storm drain systems but never received conclusive guidance. In order to move the project forward, FNI documented the design assumptions in a tailwater design memorandum dated February 21, 2012 and circulated to the project partners for review. This memo was discussed during a meeting with the USACE on May 15, 2012. This information has been provided and discussed in the above identified meetings. This document is to provide guidance in writing that the assumptions were agreed upon among all participants (TRVA, TRWD, CFW, TSC, FNI, CDM and USACE) during the meeting held on May 15, 2012.

Conceptual Alignments and Design Assumptions

- The Conceptual Alignments including discharge locations shown in the WBS exhibits have been approved in concept pending further details of the actual outfall structures.

- The assumptions documented in the tailwater memorandum have been approved.

Attachments:

- WBS Exhibits
- Tailwater Memorandum

Project Delivery Team Meeting

Representatives from the City of Fort Worth, TRVA, FNI, Transystems, TRWD, and the USACE have met on multiple occasions to discuss the storm drain relocations and conceptual alignments. These meetings have occurred on or around the following dates (most recent listed first): July 2012, May 2012, August 2011, January 2011, September 2010, July 2009, and November 2008.

Conclusion/Recommendation

USACE as the contracting agency and TRWD as the local sponsor approve the conceptual alignments and design assumptions as noted above.

Date: 8/21/12

Name: Woody Frossard
Title: Project Manager
Trinity River Vision Authority

Date: 8/21/12

Name: Gail Hicks
Title: Project Manager
USACE Fort Worth District

END OF TECHNICAL DESIGN DOCUMENT

MEMORANDUM

FREESE AND NICHOLS

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TO: Raul Pena - TSC

CC: File – FNI

Liam Conlon, Steve Eubanks, Clair Davis – CFW

Craig Loftin, Mike Danella, Paul Roadman, Darlene Prochaska - USACE

FROM: Kelly Dillard, Scott Hubley, Justin Oswald - FNI

SUBJECT: TRVA Storm Drain Tailwater Design Assumptions

DATE: February 21, 2012

This memorandum documents the design assumptions related to the downstream starting conditions (i.e. tailwaters) utilized during the TRVA storm drain master planning efforts. The content of this memo will be included in the final storm drain report, so full project background information is not presented here.

The tailwater conditions were analyzed under existing and proposed conditions. Existing conditions refers to the current condition of the Trinity River, before any TRVA project components are implemented. Proposed conditions refer to post project conditions following the completion of the TRVA project including the bypass channel, interior gates, and Samuels Avenue Dam.

FNI considered several different tailwater scenarios for the sizing of the storm drain. In general, two types of scenarios were considered: unsteady (time varying) and steady (non-time varying). Ultimately, it was decided that steady tailwaters were the most appropriate design assumption for this application. Each of these scenarios is discussed in detail below.

Unsteady Tailwater

The time varying tailwaters focused on synthetic stage hydrographs approximated from paired hydrologic (HEC-1) and hydraulic (HEC-RAS) models of the Trinity River provided by the USACE. Ideally, a synthetic stage hydrograph would be developed from an unsteady hydraulic model but such a model was not available as it is still under development by the USACE. These tailwaters provided a good approximation of potential downstream starting conditions during a synthetic design storm.

However, after consultation with the City and USACE, unsteady tailwaters were determined to be too uncertain given the possible combinations of timing that could impact the river stage, especially in an operated system such as the Fort Worth Floodway. Several unknowns contributed to the decision that unsteady tailwaters were not an appropriate design assumption including:

- the operation of upstream reservoirs in the TRWD system
- uncertain initial conditions (starting lake levels)
- unknown operation of the Samuels Avenue Dam and other TRVA gates
- orientation and direction of storm movement
- spatial distribution of rainfall

Rather than make assumptions for each of these unknowns, it was decided that a steady tailwater provided a simpler and more conservative design assumption.

Steady Tailwater – Existing Conditions

The existing conditions tailwater for the 100-year storm of interior drainage events was based on a prevailing river discharge defined as 15,000 and 13,500 cubic feet per second (cfs) on the West Fork Trinity River reaches downstream and upstream from the Clear Fork confluence, respectively. The prevailing river discharge on the Clear Fork was 6,000 cfs based on the regulated release from Benbrook Dam. These values were provided by the USACE via email from Craig Loftin on November 8, 2010. For information purposes, Table 1 summarizes the relationship between the prevailing discharge and the frequency events.

Table 1. Trinity River Summary of Flows (cfs)

	2-yr	5-yr	10-yr	100-yr	USACE
West Fork Above Confluence	7800	13500	14500	35400	13500
Clear Fork Above Confluence	9400	14300	19800	39800	6000
West Fork Below Confluence	12100	18800	26100	58200	15000

At each outfall location, the prevailing river discharge was input to the existing conditions HEC-RAS model to develop a starting water surface condition. Review of the standard coincidental occurrence ratios suggests that the study drainage areas are in the ratio category of 1,000:1. This ratio would suggest for a 100-yr storm on the local drainage area, that a 10-yr tailwater would be appropriate. In light of the relative magnitude of the prevailing discharge to the frequency events, it was decided to use the prevailing discharge river tailwater elevations for all storm events. Table 2 (attached) summarizes the tailwaters used for the existing conditions analysis at each outfall location for each storm event.

Steady Tailwater – Proposed Conditions

The proposed conditions tailwater requires consideration of proposed TRVA project components. This task is complicated by the fact that the gate operations of the Samuels Avenue Dam have not been finalized. Multiple river discharge rate and dam gate elevation combinations were analyzed to develop proposed conditions tailwaters. The proposed tailwaters for each outfall location are discussed in detail below.

Grand Avenue Outfall

The proposed tailwater at the Grand Avenue outfall location was assumed as 525 ft-msl. Several different scenarios were evaluated before determining the 525 elevation. These included peak on peak (i.e. 100-year river elevation), coincident analysis, and a range of "target" WSELs at the outfall location. A sensitivity analysis was performed whereby proposed storm drain sizes were developed for each scenario to determine the most appropriate starting condition. The minimum size of the proposed storm drain at the Grand Avenue outfall was determined by analyzing the system at free outfall conditions. This produced a size of 10x6. The highest tailwater that still produced the 10x6 outlet size was a tailwater elevation of 519. The maximum possible tailwater analyzed was the 100-year (peak on peak), which resulted in a 19x6 box with a tailwater elevation of 530. Therefore, the sensitivity analysis considered tailwater elevations 519 through 530 in one foot increments which produced box sizes between 10x6 and 19x6.. Table 3 summarizes the results of the sensitivity analysis. Based on the

sensitivity analysis and other factors, the 525 elevation was determined to be the most appropriate starting condition. Other factors that contributed to this decision include:

- 525 is the target normal water surface elevation in the bypass channel and the outfall will experience this elevation during the majority of the rainfall events
- The Samuels Avenue Dam has sufficient capacity to pass the prevailing river discharge of 15,000 cfs while maintaining the 525 elevation.

Table 3. Grand Ave Sensitivity Analysis

Tailwater	Pipe Size
Free Discharge up to 519	10x6
525	12x6
526	13x6
527	13x6
528	14x6
529	17x6
530	19x6

The 100-year storm event was the baseline condition for determining proposed pipe sizes. Proposed pipes in lower return events were modeled with the same assumptions as the 100-year storm. The water surface at the dam was assumed to be at elevation 525 as this is considered to be the lowest potential tailwater elevation in the bypass channel.

Cemetery and Bazaar Outfalls

To be consistent with the Grand Avenue design assumption, the proposed tailwater for the Cemetery Outfall was assumed to be 525.16, which is the normal water surface in the Bypass Channel at this location under prevailing discharge. Likewise, the proposed tailwater for the Bazaar Outfall was assumed to be 525.88 and the proposed tailwater for the Greenleaf Outfall was assumed to be 526.54.

Interior Outfalls

The proposed tailwaters for the storm drain systems that outfall into the interior lake were assumed to be 526 ft-msl for the 100-year design storm. This was based on the normal water surface of 525 ft-msl plus one (1) foot of additional freeboard to account for fluctuations in the water surface due to interior drainage events. These outfalls include the Viola Outfall, the New Main Outfall, the Henderson Outfall, all Canals and future local drainage lines. Based on the project EIS, the interior lake is planned to be isolated from the river and bypass channel during flood events by operating the Clear Fork Gate, the Trinity Point Gate, and the TRWD gate. Under these scenarios, only local drainage will contribute to the interior area which will be removed by operation of a stormwater pump station. According to the EIS, if all of the pumps fail, water in the interior could reach the 529.69 level. However, it should be noted that the pump stations are only needed when the river level is high and the interior cannot drain by gravity. The river level would only be high in a significant storm event for the entire Trinity Basin. The joint probability of a significant storm event on the entire Trinity Basin as well as the local interior drainage area exceeds a 100-year design storm. Therefore, in an attempt to be consistent with the other outfall design assumptions, the river was assumed to be at prevailing discharge which would allow the interior to either drain by gravity or through the operation of one or more pumps from the pump stations which led to the 526 ft-msl design assumption.

Coincident Tailwaters

In addition to the design tailwaters discussed above, tailwater elevations were developed for the opposite coincident pair of the 100-year storm. Based on the ratio of drainage areas, the opposite pair of a 10-year storm should be evaluated on a 100-year tailwater elevation. These elevations were obtained from the same hydraulic models mentioned above. We anticipate that for a 100-year event on the Trinity, the dam would be operated to provide maximum conveyance. Therefore for the proposed models, the dam gates were assumed to be open to their lowest elevation. This set of tailwaters was only developed for the 100-year check storm. Post-project tailwater elevations for all events are summarized in the attached Table 2.

Table 2. Tailwater Summary

		Existing		Proposed	
Outfall Name	**Sump ID**	**Prevailing**	**100-Year**	**Prevailing**	**100-Year**
Grand Avenue	-	-	-	525.07	530.09
Cemetery	-	-	-	525.16	531.05
Bazaar	16W	527.77	539.45	525.88	535.14
Greenleaf Street	-	527.70	541.23	526.54	540.77
Main Street	26W	511.72	529.47	-	-
New Main Street	26W	-	-	526.00	526.00
Calvert Street	25C	527.18	538.79	526.00	526.00
Viola Street	-	-	-	526.00	526.00

Notes:

Existing tailwaters from HEC-RAS Trinity River CDC model developed by USACE for Central City dated February 2008

Proposed tailwaters from HEC-RAS Trinity River Model developed by CDM dated June 2009

Prevailing flow tailwaters are paired with all local frequency storms for capacity checks. 100-year tailwater used for 10-year coincidence check only.

Sump methodology analyzed for 100-year return interval. Sump elevation selected as worst case combination of 10-yr local storm with 100-yr external tailwater or 100-yr local storm with prevailing tailwater.

Appendix C
WBS Cost Estimates

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.02 HENDERSON

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$17,000.00	$17,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Misc. Utility Relocation	1	LS	$10,000.00	$10,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
2	Concrete Curb and Gutter	20	LF	$27.50	$550.00	FW-TXDOT 12-MO AVG PLUS 250% FOR ECONOMY OF SCALE
3	Asphalt Pavement	30	SY	$63.00	$1,890.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
4	Storm Drain Junction Box	2	EA	$25,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
5	Storm Drain Pipe - 48" diameter	416	LF	$145.00	$60,320.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
6	Contaminated Soils Remediation	200	TON	$125.00	$25,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	Contaminated Liquids Remediation	100	GAL	$20.00	$2,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
8	Erosion Control	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
9	Traffic Control	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
10	Project Sign	1	EA	$900.00	$900.00	RS MEANS 01580-700-0020 ASSUME 5'X7' SIZE
11	Trench Safety	416	LF	$1.05	$436.80	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
12	SWPPP	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
13	Undefined Construction Elements	1	LS	$1.00	$60,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$243,096.80	

PROJECT TOTAL **$243,100 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.03 GRAND AVE/10TH PH 1

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$92,000.00	$92,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Clearing and Grubbing	100	SY	$4.50	$450.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
2	Saw Cutting	60	LF	$2.50	$150.00	RS MEANS 02220-360-0400
3	Boring Pipe under levee (14x6 RCB)	-	LF	$4,000.00	$0.00	FW-TXDOT 12-MO AVG, ENGINEER'S JUDGEMENT
4	Boring Pipe under Railroad (12x6 RCB)	-	LF	$3,800.00	$0.00	FW-TXDOT 12-MO AVG, ENGINEER'S JUDGEMENT
5	Sidewalk and Driveway Removal	100	SF	$2.00	$200.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
6	Misc. Structure Relocation	1	LS	$1,500.00	$1,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	Concrete Curb and Gutter	300	LF	$22.00	$6,600.00	FW-TXDOT 12-MO AVG PLUS 200% FOR ECONOMY OF SCALE
8	HMAC Pavement	1,200	SY	$30.00	$36,000.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
9	10' Storm Inlet	2	EA	$3,000.00	$6,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
10	Storm Drain Pipe - 12x6 RCB	200	LF	$470.00	$94,000.00	FW-TXDOT 12-MO AVG, INTERPOLATION FOR LARGE SIZE
11	Storm Drain Pipe - 13x6 RCB	-	LF	$520.00	$0.00	FW-TXDOT 12-MO AVG, INTERPOLATION FOR LARGE SIZE
12	Storm Drain Pipe - 24" diameter	60	LF	$45.00	$2,700.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
13	Manhole Risers	1	EA	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
14	Special Junction Box	-	EA	$75,000.00	$0.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
15	Flared Wing Headwall	-	EA	$20,000.00	$0.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
16	Storm Drain Abandonment	800	LF	$10.00	$8,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
17	Water Quality Unit/Outlet Control Structure	-	EA	$50,000.00	$0.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
18	Contaminated Soils Remediation	300	TON	$125.00	$37,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
19	Contaminated Liquids Remediation	150	GAL	$20.00	$3,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
20	Seeding	100	SY	$2.00	$200.00	RS MEANS 02920-310-0310
21	Topsoil	20	CY	$20.00	$400.00	RS MEANS 02055-150-0200
22	Erosion Control	1	LS	$6,000.00	$6,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
23	Traffic Control	1	LS	$3,000.00	$3,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
24	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
25	SWPP	1	LS	$1,500.00	$1,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
26	Dewatering	1	LS	$1,500.00	$1,500.00	RS MEANS 02240-500-0650, ASSUME 21 DAYS OF USE
27	Demolition, Haul Off, Disposal	15	CY	$40.00	$600.00	RS MEANS 02220-350-3080, INCREASED COST DUE TO QTY
28	Trench Safety	200	LF	$1.05	$210.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
29	Undefined Construction Elements	1	LS	$70,000.00	$70,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$377,010.00	

PROJECT TOTAL **$377,100 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.05 GRAND AVE/10TH PH 2

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$170,000.00	$170,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Clearing and Grubbing	200	SY	$4.50	$900.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
2	Saw Cutting	110	LF	$2.50	$275.00	RS MEANS 02220-360-0400
3	Boring Pipe under levee (72" Steel Encased)	1,730	LF	$950.00	$1,643,500.00	FW-TXDOT 12-MO AVG, ENGINEER'S JUDGEMENT
4	Sidewalk and Driveway Removal	200	SF	$2.00	$400.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
5	Misc. Structure Relocation	1	LS	$3,500.00	$3,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
6	Concrete Curb and Gutter	400	LF	$22.00	$8,800.00	FW-TXDOT 12-MO AVG PLUS 200% FOR ECONOMY OF SCALE
7	HMAC Pavement	600	SY	$30.00	$18,000.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
8	10' Storm Inlet	8	EA	$3,000.00	$24,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
9	Storm Drain Pipe - 6x6 RCB	370	LF	$350.00	$129,500.00	
10	Storm Drain Pipe - 72" RCP	260	LF	$475.00	$123,500.00	
11	Storm Drain Pipe - 24" diameter	340	LF	$45.00	$15,300.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
12	Manhole Risers	2	EA	$5,000.00	$10,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
13	Special Junction Box	3	EA	$75,000.00	$225,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
14	Flared Wing Headwall	1	EA	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
15	Storm Drain Abandonment	1,800	LF	$10.00	$18,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
16	Water Quality Unit/Outlet Control Structure	1	EA	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
17	Contaminated Soils Remediation	600	TON	$125.00	$75,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
18	Contaminated Liquids Remediation	350	GAL	$20.00	$7,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
19	Seeding	300	SY	$2.00	$600.00	RS MEANS 02920-310-0310
20	Topsoil	50	CY	$20.00	$1,000.00	RS MEANS 02055-150-0200
21	Erosion Control	1	LS	$19,000.00	$19,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
22	Traffic Control	1	LS	$7,000.00	$7,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
23	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
24	SWPP	1	LS	$3,500.00	$3,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
25	Dewatering	1	LS	$3,500.00	$3,500.00	RS MEANS 02240-500-0650, ASSUME 21 DAYS OF USE
26	Demolition, Haul Off, Disposal	35	CY	$40.00	$1,400.00	RS MEANS 02220-350-3080, INCREASED COST DUE TO QTY
27	Trench Safety	1,025	LF	$1.05	$1,076.25	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
28	Undefined Construction Elements	1	LS	$730,000.00	$730,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$3,310,251.25	

PROJECT TOTAL **$3,310,300** **(YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.05 GRAND AVE PH 2 LATERAL NORTH UNDER RR

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$46,000.00	$46,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Misc. Structure Relocation	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
2	Concrete Curb and Gutter	200	LF	$27.50	$5,500.00	FW-TXDOT 12-MO AVG PLUS 250% FOR ECONOMY OF SCALE
3	HMAC Pavement	760	SY	$30.00	$22,800.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
4	10' Storm Inlet	8	EA	$3,400.00	$27,200.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
5	Boring Pipe under railroad (60" RCP)	100	LF	$1,000.00	$100,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
6	Storm Drain Pipe - 24" diameter	320	LF	$45.00	$14,400.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
7	Storm Drain Pipe - 6'x6' RCB	550	LF	$350.00	$192,500.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
8	Storm Drain Pipe - 42" diameter	200	LF	$125.00	$25,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
9	Contaminated Soils Remediation	200	TON	$125.00	$25,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
10	Contaminated Liquids Remediation	100	GAL	$20.00	$2,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
11	Erosion Control	1	LS	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
12	Traffic Control	1	LS	$10,000.00	$10,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
13	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
14	Trench Safety	910	LF	$1.05	$955.50	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
15	SWPPP	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
16	Undefined Construction Elements	1	LS	$140,000.00	$140,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$641,855.50	

PROJECT TOTAL **$641,900 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.05.02 CEMETERY OUTFALL

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$15,000.00	$15,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Clearing and Grubbing	150	SY	$4.50	$675.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
2	Misc. Structure Relocation	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
3	Storm Drain Pipe - 48" diameter	210	LF	$115.00	$24,150.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
4	Flared Wing Headwall	1	EA	$5,000.00	$5,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
5	Water Quality/Outlet Control Structure	1	EA	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
6	Contaminated Soils Remediation	150	TON	$125.00	$18,750.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	Contaminated Liquids Remediation	100	GAL	$20.00	$2,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
8	Erosion Control	1	LS	$25,000.00	$25,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
9	SWPP	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
10	Traffic Control	1	LS	$10,000.00	$10,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
11	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
12	Trench Safety	210	LF	$1.05	$220.50	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
13	Undefined Construction Elements	1	LS	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
	Pumping Allocation	1	LS	$330,000.00	$330,000.00	PRELIMINARY STUDY
				SUBTOTAL	$541,295.50	

PROJECT TOTAL **$541,300 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.05.03 8th

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$12,000.00	$12,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
3	Sidewalk and Driveway Removal	350	SF	$2.00	$700.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
4	Demolition, Haul Off, Disposal	50	CY	$40.00	$2,000.00	RS MEANS 02220-350-3080, INCREASED COST DUE TO QTY
5	Uncl. Excavation	400	CY	$15.00	$6,000.00	RS MEANS 02315-432-2440
6	Misc. Structure Relocation	1	LS	$1,500.00	$1,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	Select Backfill and Placement	220	CY	$20.00	$4,400.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
8	Concrete Curb and Gutter	200	LF	$27.50	$5,500.00	FW-TXDOT 12-MO AVG PLUS 250% FOR ECONOMY OF SCALE
9	HMAC Pavement	250	SY	$30.00	$7,500.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
10	4' Sidewalk	800	SF	$3.75	$3,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
14	10' Storm Inlet	2	EA	$3,400.00	$6,800.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
19	Storm Drain Pipe - 48" diameter	270	LF	$145.00	$39,150.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
25	Contaminated Soils Remediation	65	TON	$125.00	$8,125.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
26	Contaminated Liquids Remediation	30	GAL	$20.00	$600.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
30	Erosion Control	1	LS	$6,000.00	$6,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
31	Traffic Control	1	LS	$3,500.00	$3,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
32	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
36	SWPPP	1	LS	$1,500.00	$1,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
37	Trench Safety	270	LF	$1.05	$283.50	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
38	Undefined Construction Elements	1	LS	$1.00	$25,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$134,058.50	

PROJECT TOTAL **$134,100 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.06 Houston

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$12,000.00	$12,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
3	Sidewalk and Driveway Removal	650	SF	$2.00	$1,300.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
4	Demolition, Haul Off, Disposal	100	CY	$40.00	$4,000.00	RS MEANS 02220-350-3080, INCREASED COST DUE TO QTY
5	Uncl. Excavation	900	CY	$15.00	$13,500.00	RS MEANS 02315-432-2440
6	Misc. Structure Relocation	1	LS	$3,500.00	$3,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	Select Backfill and Placement	430	CY	$20.00	$8,600.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
8	Concrete Curb and Gutter	400	LF	$27.50	$11,000.00	FW-TXDOT 12-MO AVG PLUS 250% FOR ECONOMY OF SCALE
9	HMAC Pavement	420	SY	$30.00	$12,600.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
10	4' Sidewalk	1,600	SF	$3.75	$6,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
14	10' Storm Inlet	4	EA	$3,400.00	$13,600.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
19	Storm Drain Pipe - 24" diameter	600	LF	$60.00	$36,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
25	Contaminated Soils Remediation	135	TON	$125.00	$16,875.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
26	Contaminated Liquids Remediation	70	GAL	$20.00	$1,400.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
30	Erosion Control	1	LS	$14,000.00	$14,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
31	Traffic Control	1	LS	$6,500.00	$6,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
32	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
36	SWPPP	1	LS	$3,500.00	$3,500.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
37	Trench Safety	600	LF	$1.05	$630.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
38	Undefined Construction Elements	1	LS	$1.00	$55,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$220,505.00	

PROJECT TOTAL **$220,600 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.07 NEW BAZAAR OUTFALL

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
1	MOBILIZATION	1	LS	$41,000.00	$41,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
2	EROSION CONTROL PLAN	1	LS	$4,000.00	$4,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
3	SOLID MATERIAL REMEDIATION	50	TON	$125.00	$6,250.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
4	LIQUID MATERIAL REMEDIATION	250	GAL	$20.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
5	JUNCTION BOX, 5'x5'	1	EA	$4,750.00	$4,750.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
6	42" HEADWALL WITH FLAP GATE	1	EA	$15,000.00	$15,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
7	42" FLARED WING HEADWALL	1	EA	$7,000.00	$7,000.00	TXDOT 12-MO AVG
8	WATER QUALITY UNIT	1	EA	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
9	42" RCP, BORED	630	LF	$525.00	$330,750.00	TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
10	DEWATERING	1	LS	$3,750.00	$3,750.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
11	DEMO/ABANDON EXIST DRAIN	1	LD	$12,000.00	$12,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
12	UNDEFINED CONSTRUCTION ELEMENTS	1	LS	$130,000.00	$130,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$579,500.00	

PROJECT TOTAL **$579,500 (YEAR 2010 COST)**

NOTES:

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO
RP/MRH		

06.08 VIOLA

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
1	MOBILIZATION	1	LS	$81,000.00	$81,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
2	EROSION CONTROL PLAN	1	LS	$4,000.00	$4,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
3	TRAFFIC CONTROL	3	MO	$1,000.00	$3,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
4	SAWCUTTING	1,200	LF	$5.00	$6,000.00	RS MEANS 02220-360-0400
5	PAVEMENT REMOVAL	835	SY	$5.00	$4,175.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
6	REMOVE EXISTING PIPE WHILE INSTALLING NEW	295	LF	$5.00	$1,475.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
7	REMOVE EXISTING PIPE WITHOUT NEW PIPE INSTALLA	250	LF	$50.00	$12,500.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
8	SOLID MATERIAL REMEDIATION	250	TON	$125.00	$31,250.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
9	LIQUID MATERIAL REMEDIATION	1,000	GAL	$20.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
10	JUNCTION BOX, 4'x4'	2	EA	$4,500.00	$9,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
11	SPECIAL JUNCTION BOX	1	EA	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
12	CURB INLET, 10'	10	EA	$3,500.00	$35,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
13	60" HEADWALL WITH FLAP GATE	1	EA	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
14	WATER QUALITY UNIT	1	EA	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
15	18" RCP	75	LF	$38.00	$2,850.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
16	36" RCP	240	LF	$85.00	$20,400.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
17	4'x4' RCB, JACK OR TUNNEL	280	LF	$685.00	$191,800.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
18	DEWATERING	1	LS	$3,750.00	$3,750.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
19	LANDSCAPING	1	LS	$2,500.00	$2,500.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
20	HMAC PAVEMENT	900	SY	$40.00	$36,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
21	CONCRETE CURB AND GUTTER	500	LF	$23.00	$11,500.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
22	PAVEMENT MARKINGS	1	LS	$750.00	$750.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
23	CURB RAMPS	4	EA	$1,350.00	$5,400.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
24	ADDITIONAL CONCRETE SIDEWALK	400	SF	$5.00	$2,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
25	UNDEFINED CONSTRUCTION ELEMENTS	1	LS	$300,000.00	$300,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$904,350.00	

PROJECT TOTAL **$904,400 (YEAR 2010 COST)**

NOTES:

THE ESTIMATE ASSUMES THAT A 10' WIDTH OF ROADWAY WILL BE REPLACED.
PHASE 1 CONSTRUCTION IS EXPECTED TO BEGIN MARCH 2010
PHASE 2 CONSTRUCTION IS EXPECTED TO BEGIN MARCH 2012

TRV STORM DRAIN RELOCATION
CITY OF FORT WORTH

OPINION OF PROBABLE CONSTRUCTION COST

MAY 2014

ESTIMATOR	CHECKED BY	ACCOUNT NO	
RP/MRH			

06.21 NEW MAIN ST OUTFALL

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	COST SOURCE
0	Mobilization	1	LS	$113,000.00	$113,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
1	Clearing and Grubbing	700	SY	$4.50	$3,150.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
2	Saw Cutting	180	LF	$2.50	$450.00	RS MEANS 02220-360-0400
3	Boring Pipe under levee (7x6 RCB)	220	LF	$2,800.00	$616,000.00	FW-TXDOT 12-MO AVG, ENGINEER'S JUDGEMENT
4	Sidewalk and Driveway Removal	120	SF	$2.00	$240.00	RS MEANS 02220-250-5800, ROUNDED TO NEAREST DOLLAR
5	Concrete Curb and Gutter	100	LF	$22.00	$2,200.00	FW-TXDOT 12-MO AVG PLUS 200% FOR ECONOMY OF SCALE
6	HMAC Pavement	250	SY	$30.00	$7,500.00	ENGINEER'S BID TAB BASED ON 4" HMAC AND 6" FLEX BASE
7	10' Storm Inlet	4	EA	$3,000.00	$12,000.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
8	5' Drop Inlet	2	EA	$3,500.00	$7,000.00	TX-DOT 12-MO AVG
9	Storm Drain Pipe - 7x6 RCB	700	LF	$300.00	$210,000.00	FW-TXDOT 12-MO AVG, INTERPOLATION FOR LARGE SIZE
10	Storm Drain Pipe - 24" diameter	120	LF	$45.00	$5,400.00	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
11	Manhole Risers	1	EA	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
12	Special Junction Box	1	EA	$25,000.00	$25,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
13	Flared Wing Headwall	1	EA	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
14	Water Quality Unit/Outlet Control Structure	1	EA	$50,000.00	$50,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
15	Contaminated Soils Remediation	600	TON	$125.00	$75,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
16	Contaminated Liquids Remediation	300	GAL	$20.00	$6,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
17	Seeding	900	SY	$2.00	$1,800.00	RS MEANS 02920-310-0310
18	Erosion Control	1	LS	$20,000.00	$20,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
19	Traffic Control	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
20	Project Sign	1	EA	$500.00	$500.00	RS MEANS 01580-700-0020 ASSUME 6'X3' SIZE
21	SWPP	1	LS	$5,000.00	$5,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
22	Dewatering	1	LS	$5,000.00	$5,000.00	RS MEANS 02240-500-0650, ASSUME 21 DAYS OF USE
23	Demolition, Haul Off, Disposal	120	CY	$40.00	$4,800.00	RS MEANS 02220-350-3080, INCREASED COST DUE TO QTY
24	Demolition and Disposal of Existing Outfall	1	LS	$40,000.00	$40,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
25	Trench Safety	570	LF	$1.05	$598.50	FW-TXDOT 12-MO AVG PLUS 5% ABOVE AVG LOW BID
26	Undefined Construction Elements	1	LS	$340,000.00	$340,000.00	ENGINEER'S JUDGEMENT BASED ON KNOWLEDGE OF PROJECT
				SUBTOTAL	$1,580,638.50	

PROJECT TOTAL **$1,580,700 (YEAR 2010 COST)**

NOTES:

Appendix D
Greenleaf Sump Mitigation Cost Estimates

Greenleaf Sump Mitigation Options

Opinion of Probable Construction Cost

Option 1: Outfall at White Settlement Road

Trinity River Vision

ACCOUNT NO.	ESTIMATOR	CHECKED BY	DATE
TSC08309	JGJ		May 1, 2014

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	HMAC Pavement	1,000	SY	$30	$30,000
	Storm Drain Pipe - 72" diameter	1,300	LF	$250	$325,000
	Manhole Risers	2	EA	$5,000	$10,000
	Flared Wing Headwall	1	EA	$20,000	$20,000
	Water Quality Unit/Outlet Control Structure	1	EA	$50,000	$50,000
	Erosion Control	1	LS	$20,000	$20,000
	Traffic Control	1	LS	$5,000	$5,000
	SWPP	1	LS	$5,000	$5,000
	Trench Safety	1,300	LF	$1	$1,365
				Subtotal	**$466,365**
	Mobilization	10	%	$46,637	$46,637
	Contingency	30	%	$139,910	$139,910
				Subtotal	**$652,900**
				Project Total	**$652,900**

Notes: This cost estimate does not include any potential utility relocations.

Greenleaf Sump Mitigation Options
Opinion of Probable Construction Cost
Option 2: Outfall at Henderson Street
Trinity River Vision

ACCOUNT NO.	ESTIMATOR	CHECKED BY	DATE
TSC08309	JGJ		May 1, 2014

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	HMAC Pavement	1,000	SY	$30	$30,000
	Storm Drain Pipe - 48" diameter	2,000	LF	$150	$300,000
	Manhole Risers	2	EA	$5,000	$10,000
	Flared Wing Headwall	1	EA	$20,000	$20,000
	Water Quality Unit/Outlet Control Structure	1	EA	$50,000	$50,000
	Sod	980	SY	$5	$4,900
	Erosion Control	1	LS	$20,000	$20,000
	Traffic Control	1	LS	$5,000	$5,000
	SWPP	1	LS	$5,000	$5,000
	Trench Safety	2,000	LF	$1	$2,100
				Subtotal	**$447,000**
	Mobilization	10	%	$44,700	$44,700
	Contingency	30	%	$134,100	$134,100
				Subtotal	**$625,800**
				Project Total	**$625,800**

Notes: This cost estimate does not include any potential utility relocations.

Greenleaf Sump Mitigation Options
Opinion of Probable Construction Cost
Option 3: Detention
Trinity River Vision

ACCOUNT NO.	ESTIMATOR	CHECKED BY	DATE
TSC08309	JGJ		May 1, 2014

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	HMAC Pavement	933	SY	$30	$28,000
	Storm Drain Pipe - 30" diameter	700	LF	$70	$49,000
	Manhole Risers	1	EA	$5,000	$5,000
	Flared Wing Headwall	1	EA	$20,000	$20,000
	Sod	8,190	SY	$5	$40,950
	Erosion Control	1	LS	$20,000	$20,000
	Traffic Control	1	LS	$5,000	$5,000
	SWPP	1	LS	$5,000	$5,000
	Excavation and Haul	14,000	CY	$15	$210,000
	Trench Safety	700	LF	$1	$735
				Subtotal	**$383,685**
	Mobilization	10	%	$38,369	$38,369
	Contingency	30	%	$115,106	$115,106
				Subtotal	**$537,200**
				Project Total	**$537,200**

Notes: This cost estimate does not include any potential utility relocations.

Greenleaf Sump Mitigation Options
Opinion of Probable Construction Cost
Option 4: Mass Grading
Trinity River Vision

ACCOUNT NO.	ESTIMATOR	CHECKED BY	DATE
TSC08309	JGJ		May 1, 2014

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	Storm Drain Pipe - 7'x6' RCB	250	LF	$360	$90,000
	HMAC Pavement	1,000	SY	$30	$30,000
	Special Junction Box	1	EA	$20,000	$20,000
	Flared Wing Headwall	1	EA	$20,000	$20,000
	Water Quality Unit/Outlet Control Structure	1	EA	$50,000	$50,000
	Erosion Control	1	LS	$20,000	$20,000
	Traffic Control	1	LS	$5,000	$5,000
	SWPP	1	LS	$5,000	$5,000
				Subtotal	**$240,000**
	Mobilization	10	%	$24,000	$24,000
	Contingency	30	%	$72,000	$72,000
				Subtotal	**$336,000**
				Project Total	**$336,000**

Notes: This cost estimate does not include any potential utility relocations.
This cost estiamte does not include the cost of mass grading.