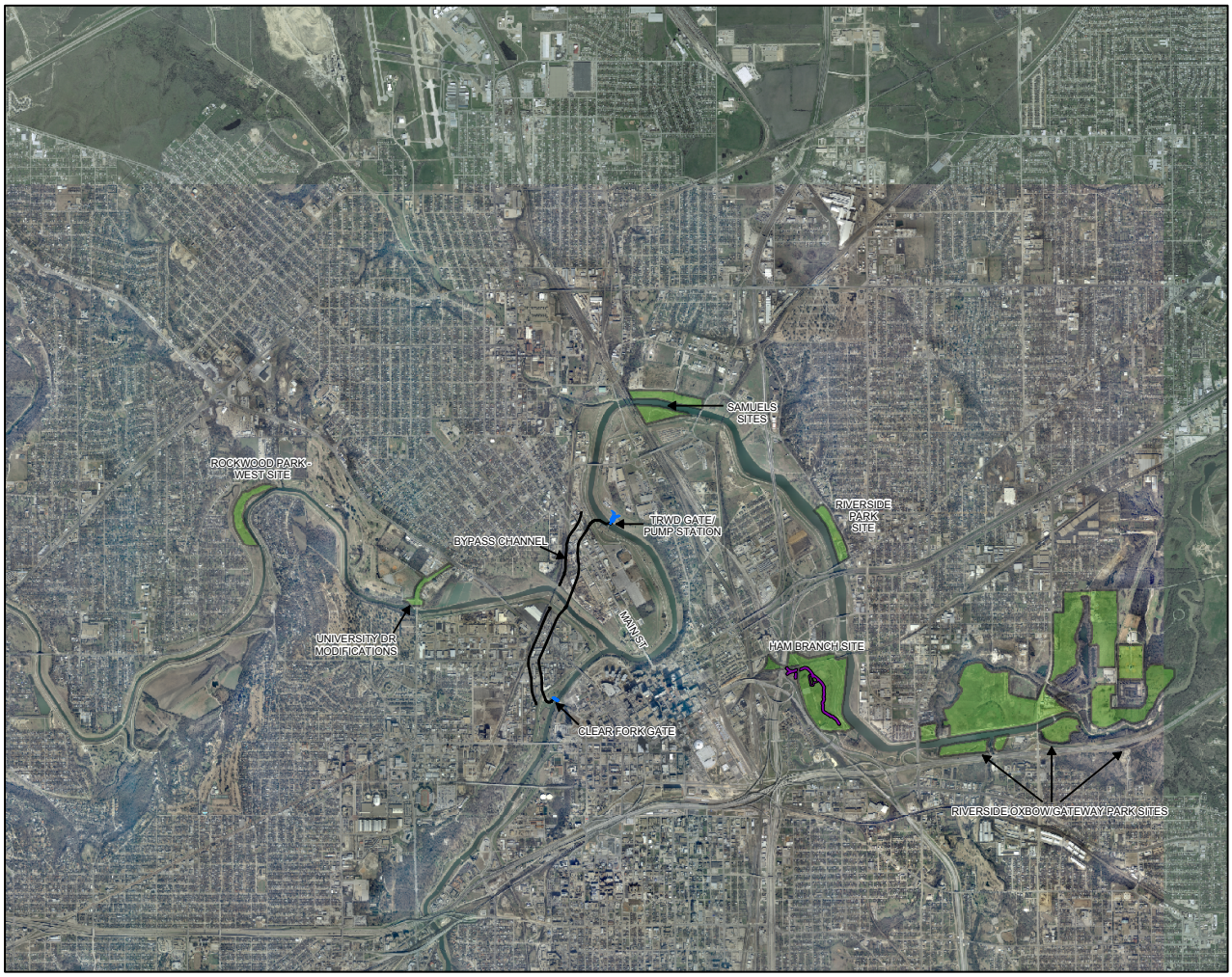

Project Report

Figure 2-1
Modified Central City
$220 M Project Features

Legend

- BYPASS CHANNEL
- ISOLATION GATES
- VALLEY STORAGE SITE
- AQUATIC HABITAT MITIGATION AREA

N

0 1,750 3,500 7,000 Feet

Aerial Photography Date: January 2005

US Army Corps of Engineers
Fort Worth District

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As of 4/1/08

Project Report

Figure 2-2
Approved Central City $220 M Project Features

Legend

- BYPASS CHANNEL
- ISOLATION GATES
- PROPOSED SAMUELS AVE DAM
- VALLEY STORAGE SITE
- AQUATIC HABITAT MITIGATION AREA

N

0 1,750 3,500 7,000 Feet

Aerial Photography Date: January 2005

US Army Corps of Engineers
Fort Worth District

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As of 4/1/08

CHAPTER 3 - TECHNICAL SOUNDNESS

Introduction

The Technical Soundness evaluation was performed for the entire Modified Central City project, due to the need to evaluate the overall system performance and its potential effects on the existing Federal Floodway Project. All components of the Modified Corps Project were included within the Technical evaluations. Each feature and component of the project was reviewed by various technical disciplines including; hydraulic, geotechnical, civil, and structural for compliance with Corps of Engineers standards and criteria. The evaluation for Technical Soundness conducted during the reformulation was focused primarily on those project components being modified, specifically the Valley Storage sites and Samuels Avenue Dam/Marine Creek components to meet Corps of Engineers standards and that the Modified Project would be fully functional. Those features which are not modified by the incorporation of features from the Riverside Oxbow project were previously evaluated as part of the Central City Project report Technical Soundness review. The preliminary design analysis conducted concurrently with the development of the Modified Central City Plan was comprised a series of studies and technical evaluations. These studies and evaluations which formed the basis of the Technical Soundness review are contained in the following technical appendices to the Supplemental Environmental Impact Statement:

Appendix A Hydrology and Hydraulics
Appendix B Geotechnical
Appendix C Civil/Structural

Those documents served as the basis for review by the Fort Worth District and ITR conducted by the Tulsa District for conformance to USACE Standards and Regulations. The following sections discuss the Modified Central City Project components and the various engineering analysis completed to support the SEIS process and technical soundness as related to the Corps of Engineers technical standards and regulations.

Hydrology and Hydraulics

The Central City Project is located within the Upper Trinity River watershed, which is governed by two major floodplain management policies, the 1988 Record-of-Decision associated with the USACE's Trinity River and Tributaries Regional Environmental Impact Statement (TREIS), developed as part of the USACE Fort Worth District Section 404 permit program, and the regional Corridor Development Certificate (CDC) Program which is also a part of the City of Fort Worth floodplain ordinances. The Central City project is also located within the boundary of the Fort Worth Floodway, a federal flood control project constructed by the USACE Fort Worth District in phases from the 1950's to the 1970's.

The baseline conditions hydraulic model (Pre-Project) used for this study was based on the Upper Trinity River CDC Model, developed and maintained by the USACE. The CDC Model was originally developed using the backwater program HEC-2 Water Surface Profiles. The model was subsequently converted to HEC-RAS River Analysis System. The Hydrologic and Hydraulic analysis includes all of the components of the Modified Central City Project.

The Fort Worth District, in consultation with TRWD, determined that the hydrologic and hydraulic analysis of the Central City Project met the standard criteria established in the regional CDC guidelines, and therefore satisfied the regulatory criteria.

The TREIS and the CDC includes hydrologic and hydraulic criteria for proposed projects in the upper Trinity River watershed. These criteria must be achieved in order for the proposed projects

to be granted a USACE permit or a CDC permit by the City of Fort Worth. The Central City project was designed to meet the TREIS and CDC criteria, and the Fort Worth District criteria for construction within a Federal flood control project.

The main CDC hydrologic and hydraulic criteria are as follows:

- No increase in the 100-year flood and no significant increase in the Standard Project Flood water surface elevations;
- The maximum allowable valley storage decrease for the 100-year flood and Standard Project Flood are 0% and 5% respectively.
- No increase in erosive water velocity on-site or off-site.

The main TREIS hydrologic and hydraulic criteria are as follows:

- No rise in the 100-year or SPF elevation for the proposed condition will be allowed.
- The maximum allowable loss in storage capacity for the 100-year and SPF discharges will be 0% and 5%, respectively.

Other criteria considered as part of the design of the Central City project are:

- Discharges will not be increased downstream of the project limits;
- Velocities will not be increased above erosive levels outside the project limits;
- Manageable flow velocities will be maintained throughout the range of return periods such that infrastructure, earthen structures, habitats, etc. will not be damaged;
- Levee freeboard above the SPF water surface elevation will be provided consistent with the 1988 Record of Decision. For levees protecting urban development the minimum criteria is “SPF plus four feet,” for all new levees.

Hydrologic Analysis

A baseline HEC-1 model for the Modified Central City Project was developed from the CDC HEC-1 model to provide the best available representation of Year 2050 flows in the existing configuration of the floodway. The routing reach storage and outflow data were updated in the project area so the modeled storage for each reach conformed to the most current channel geometry in the Upper Trinity HEC-RAS model.

Coincident events and conservative starting pool elevations were employed to develop the SPF flows for the baseline model. Two storm centers using one-half of the PMP storm depths were analyzed to develop the SPF flows.

Although a proposed conditions hydrologic model was developed, the baseline flows were used in evaluating the project. This was done in consensus with USACE to provide a conservative assumption consistent with previous applications of the CDC process.

The modeling analysis evaluated the affect of re-routing flood flows through the proposed bypass channel rather than the existing reaches of the Clear and West Forks of the River. As the bypass channel shortens an existing meander in the river, there would be a significant net loss of

storage. The reduced storage values were determined by conducting a multiple profile analysis on a proposed conditions HEC-RAS model that included a likely bypass channel configuration and ancillary structures.

The construction of the proposed bypass channel is estimated to cause a net loss of approximately 2,850 acre feet of valley storage under SPF conditions. Additional estimated 2,400 acre feet of valley storage would be lost due to drawdown under SPF conditions, if no action is taken to reduce drawdown. In the proposed project, the aggregate lost valley storage (5,250 acre feet) would be mitigated using in-line and off-line storage and an additional structure to reduce water surface drawdown. Approximately 3,199 acre-feet will be provided by off-line storage at the Ham Branch and Riverside Oxbow/Gateway sites. Modifications at University Drive will provide a reduction in drawdown of approximately 1,275 acre-feet, and 817 acre-feet of in-line storage will be provided in proximity to Rockwood Park, Riverside Park and downstream from the Samuels Avenue Dam site. In addition a number of contingency valley storage sites have been identified if additional valley storage is required as the design of the project is refined and developed during the detailed design.

Hydraulic Analysis and Results

The hydraulic evaluation of the proposed bypass channel alignment for the Fort Worth Central City Project was performed using the USACE HEC-RAS version 3.1.2. HEC-RAS calculates water surface elevations and computes resulting river reach storage and flow velocities and was used to demonstrate compliance with the TREIS Record of Decision, CDC criteria, and Fort Worth District construction within the limits of a Federal flood control project criteria.

The major hydraulic elements of the proposed modified project were incorporated in the baseline model to create the proposed conditions model. This included the addition of the proposed bypass channel, three isolation gates, Samuels Avenue Dam and the proposed valley storage mitigation sites. In addition, three roadway bridges and two pedestrian bridges were incorporated in the proposed conditions model. The proposed conditions HEC-1 model was run for a range of storm frequencies. Valley storage was computed for baseline and proposed conditions for both the 100-year and SPF events. All valley storage volumes were obtained from the HEC-RAS model results and supplemented with Micro-Station/Inroads volumetric modeling for off channel areas.

The local sponsor established a goal of mitigating 100 percent of the project's valley storage reductions, which is beyond the requirements of the TREIS Record of Decision and CDC process. The analyses show that the goal of 100% valley storage mitigation has been met.

The project maintains or decreases baseline water levels at all locations with minor exceptions. Water levels increase in the 100-year event between Samuels Avenue Dam and the bypass channel. The maximum water level increase is 0.25 feet immediately upstream of Samuels Avenue Dam. Water levels increase in the SPF a maximum of 0.02 feet at the downstream end of the Clear Fork. The increases are confined to areas that are either in the floodway or that will be purchased and maintained by TRWD, thus would have no impact on private property if the increases are actually realized.

In conclusion, the Hydrologic and Hydraulic analysis performed confirm that the Modified Central City Project recommended plan provides the design level of flood protection while fully complying with the 1988 Record of Decision, the CDC process, and other USACE applicable standards.

Geotechnical

The Central City geotechnical investigation included the review of existing geotechnical and geologic data, a field drilling exploration program, and a laboratory testing program. The initial field investigation program was conducted during May – June 2005 with 20 borings. Nine of these borings were drilled along the By-Pass-Channel alignment with additional borings at the proposed locations of Samuels Avenue Dam, three Isolation Gates, 2 pedestrian bridges and bridges at Main Street, Henderson Street and White Settlement Road. To supplement subsurface information obtained from the original field investigation program additional borings designated as Phase 1 were drilled. Due to issues associated with rights-of-entry for drilling on several drilling sites, the Phase 1 investigation was originally split into two phases: 1A and 1B. Phase 1A consists of 22 borings drilled September – November 2006 and Phase 1B consists of 28 borings drilled July – October 2007 with seven of these borings drilled at the new proposed location of the Samuels Avenue Dam. In support of the Modified Central City Project, 27 borings designated as Phase 1C were also drilled at the Riverside Oxbow Area during August – October 2007 to supplement the original 7 borings drilled in May 2002. In addition to the borings, permanent monitoring wells were installed in most of the boring holes to provide long term monitoring of groundwater fluctuations. The boring locations (plan and elevation) were surveyed by a licensed land surveyor. All field work and laboratory testing were performed in accordance with USACE requirements and in compliance with USACE Engineering Manual (Geotechnical Investigations) EM 1110-1-1804 and Engineering Manual (Laboratory Soils Testing) EM 1110-2-1906, respectively**.** As design progresses from feasibility level it is anticipated that a supplemental geotechnical investigation may be required to provide final design data.

Field Investigation and Laboratory Testing

Bypass Channel: The alignment of the proposed bypass channel was investigated by drilling test borings along the proposed alignment on each side of the riverbank. The borings were spaced at approximately 1,000-foot intervals as near to the proposed bypass channel centerline as practicable since access was limited in some areas.

Structures: The original Samuels Avenue Dam location was explored by two borings, one on each side of the Trinity River. The proposed location of Samuels Avenue Dam and Marine Creek Dam were moved and 7 additional borings were drilled as part of Phase 1B to investigate the new location.

Isolation Gates: The proposed sites for three isolation gates were explored by nine soil test borings, one drilled at each isolation gate site near the river during the initial field investigation program and then 2 more borings during Phase 1B at each isolation gate close to the isolation gate abutment.

Bridges: The three proposed vehicular bridge sites were explored by six soil test borings, one drilled at each of the proposed bridge abutments. The design of these bridges will be a responsibility of the Local Sponsor.

The borings were drilled to refusal on bedrock and then 5 to 10 feet of rock core of the primary formation was obtained from each boring. Soil samples were taken at approximately 5-foot depth intervals and at changes in strata. Standard Penetration Tests (SPT) split-spoon samples were typically taken in granular soils. Shelby (thin-walled) tube samples were taken in the cohesive soils, on which hand pocket penetrometer tests were performed in the field to measure the approximate unconfined compressive strength. All soil samples and rock core were delivered to the soil testing laboratory for testing. Laboratory tests were performed on cohesive soil samples including visual classification, moisture content tests, unit dry weight tests, and Atterberg limits. On granular soil samples visual classification and grain-size analysis (wet sieve on non-cohesive soils) were conducted. In addition on selected soil samples consolidation, direct

shear, unconsolidation-undrained triaxial tests and consolidation-undrained triaxial tests were conducted. On the minimum of 5 feet of rock core taken of the primary formation selected samples were tested by conducting unconfined compression tests.

Riverside Oxbow: In addition to the initial field investigation conducted in May 2002 for the Riverside Oxbow Site an additional 27 borings were drilled as Phase 1C. These borings were drilled to a depth of 40 feet or top of primary formation which ever occurs first. Monitoring wells were installed in most of the boring holes and soil samples were delivered to the soils laboratory for testing.

Analysis and Results

The geotechnical investigation encountered alluvial soils overlying limestone primary formation. The alluvial soils were found to be mostly “CL” clay in accordance with the Unified Soil Classification System. The majority of the clay can be described as having a medium potential for volume change, which is defined as clay with a Plasticity Index ranging from 15 to 28% and a Liquid Limit ranging from 35 to 50%.

Pursuant to Visual Identification of Soil Samples in Appendix F-3 of the USACE Manual EM 1110-1-1906 Laboratory Testing, the surficial clay (upper 10 feet) was found to be firm to hard in consistency with hand pocket penetrometer values ranging from 1.0 to 4.5 tons per square foot (tsf). From a depth of 10 to 20 ft-bgs (below ground surface), the clay was typically medium to medium firm with the hand pocket penetrometer values ranging from 0.5 to 4.0 tsf. From a depth of 20 to 30 ft-bgs, the clay was generally medium to firm with penetrometer values ranging from about 0.75 to 1.75 tsf. From a depth from 30 to 40 ft-bgs, the clays were defined as soft to medium firm with penetrometer values ranging from 0.25 to 1.0 tsf.

Earthquake loading was analyzed using a horizontal acceleration of 0.01 g for the long term (steady-state seepage) condition of the channel and levee slopes. Based on the National Seismic Hazard Maps of 1996, the peak horizontal acceleration (%g) with 10 % probability of exceedance in 50 years is 0.01 g for the project area. Additional analysis will be provided in the next design phase.

Analysis for overall stability was performed with XSTABL, slope stability software, version 5.203. This computer program uses the inputted slope geometry, soil properties and groundwater conditions to calculate safety factors against overall mass slope failures. The minimum acceptable safety factors against overall slope failure is 1.3 for end of construction conditions, 1.4 for long-term conditions, and 1.0 to 1.2 for rapid draw down condition (based upon Engineer Manual EM 1110-2-1913, Design and Construction of Levees). Analyses for circular failure surfaces through the foundation soils were performed using the Modified Bishop Method in a manner consistent with the USACE’s Engineer Manual EM 1110-2-1902, Slope Stability.

The three tiers of retaining walls proposed on the east side of the bypass channel were considered in the slope stability analyses. Soft and loose soil conditions at and near the base of a 30-foot-deep channel excavation were considered. The earthen levees on the west side of the bypass channel were also analyzed. The computed safety factors for slope stability exceed the minimum factors of safety in EM 1110-2-1913.

Abutment and pier foundations for the proposed Main Street, Henderson Street and White Settlement Road Bridges were designed and analyzed for vertical and lateral loads. The level of investigation and testing is generally adequate for this phase of the project and level of study. Pile or drilled shaft capacities were computed using shear strength parameters derived from laboratory unconfined compression tests (soil and rock) and field SPT blow counts. The Texas Department of Transportation (TxDOT) Geotechnical Manual will be used for design guidelines during the PED phase. Deep foundation support is expected to be required based on the

available subsurface information. Design of these bridges will be done by others as part of the Local Sponsor responsibility

The current level of investigation and testing is generally adequate for this phase of the project and level of study. Parameters, methods and results show soil conditions and recommended design factors meet Corps standards. Additional geotechnical investigations will be undertaken to support the final design in accordance with applicable USACE criteria

Civil

The geometric design of the bypass channel and associated structures are based upon the results of the Hydrology and Hydraulics Analysis, Urban Design considerations, and minimization of impacts to properties, utilities and infrastructures. Roadway and utility relocations and modifications to existing facilities were identified and coordinated with the City of Fort Worth and private utilities. Existing topographic information and utility data has been incorporated into the base Corps data file. Base horizontal and vertical control has been established for the project and integrated with the Corps files.

Excavation

Preliminary plan and profiles, grading plans, and earthwork volumes for the bypass channel were developed from center line stations and existing topographic data. The alignment, width and depth of the channel was based on the results of the hydraulic modeling. Locations of cross-sections, utilities, bridge piers and curve data have been identified by channel station and cross referenced to existing river stations. Supplemental field surveys were performed at key locations and field control established in accordance with EM-1110-1-1005, Topographic Surveying.

The typical sections were applied along the proposed alignment of the bypass channel to define the approximate grading limits and real estate requirements. The bypass channel typical sections consist of four general elements: the base flow channel, soft edge (levee), hard edge (walls), and staging area.

The west side of the proposed bypass channel will consist of Native or Bermuda grasses on the levee and will be maintained in accordance with current TRWD operation and maintenance procedures. On the outside slope of the levee, at toe of slope, overland drainage will be provided through existing drainage swales or the construction of new swales where necessary.

The “hard edge” is located on the eastern side of the bypass channel. This edge section is planned to contain a series of tiered retaining walls, multiple walkways, and landscape areas.

Staging areas have been identified to provide adequate space for the contractor to stage and construct the work. Significant activities in this area would include the excavation of the base channel, construction of the soft edge levee, excavation of the hard edge and retaining walls. Sites have been identified adjacent to Henderson Street and along a construction buffer zone.

Preliminary earthwork volume calculations were performed based on the proposed bypass channel alignment and typical sections. Approximately 1.4 million cubic yards (CY) of material are anticipated to be excavated for the construction of the bypass channel. Of the 1.4 million CY, approximately 130,000 CY is expected to be rock excavation. In addition, approximately 490,000 CY are anticipated to be excavated from the areas around the isolation gates and interior water feature. The excavation material will be used for the construction of new levees and fill to raise the area immediately behind the retaining walls. Excavated materials are estimated to remain on site as fill.

The geotechnical investigation found that suitable soils were encountered for use on the project. Construction of the levee and embankment immediately adjacent to the retaining walls

will require specific materials that will need to be segregated from other excavated soils. The remaining materials not used for levee and embankment construction will be used to fill additional interior areas and available spoil sites.

Grading plans were developed for each of the valley storage sites. Valley storage grading has been developed to avoid impacts to existing utilities where possible. In addition grading plans were coordinated with ecosystem and recreational components to maximize benefits. Valley storage and excavation volumes were verified through computations using both HEC-RAS and Micro-Station Inroads

Preliminary earthwork volume calculations were performed based on the proposed valley storage mitigation site grading plans. Approximately 4.4 million cubic yards (CY) of material are anticipated to be excavated for the construction of the five valley storage mitigation sites. Of the 4.4 million CY, approximately 3.1 million CY is at the Riverside Oxbow/ Gateway sites. The excavation material will be disposed of at a combination of on and off-site disposal areas which have been identified on the grading plans. The increase in excavation volumes as a result of the Modified Central City Project necessitated a review of potential haul routes and excavation sequence. The evaluation included analysis of air emissions and noise with both being found to be within acceptable levels. The haul routes and excavation productivity factors were incorporated and documented in the FSEIS and in the project cost estimate.

A sequence of work has been developed to minimize construction impacts to waterways. Considerations in the sequences include minimizing the duration of construction activities within or directly connected to the existing river channel; maintaining a comparable level of flood protection during construction; and maximizing construction opportunities under dry conditions.

The locations of the proposed bypass channel, major structures, valley storage sites, and miscellaneous improvements have been coordinated with property and right-of-way needs. The proposed bypass channel alignment has been offset from the FW&WRR right-of-way to avoid any intrusion during construction to allow for future maintenance. Property requirements for permanent improvements, maintenance and short-term construction have been identified. Surveys and mapping support the property requirements identified in the real estate plan.

Initial parcel ownership identification was performed using parcel ownership information provided by the TRWD geographical information system and Tarrant Appraisal District (TAD).

Utilities/Roadways

Utilities requiring relocation have been identified and proposed re-alignments shown. These include water, sewer, gas, electric and telephone. The Corps has suggested, and the Sponsor concurred that local criteria for additional construction within the limits of existing floodways (pamphlet No. 1150-2-1), prepared by the Fort Worth District, and Chapter 8 of EM 1110-2-1913 Design and Construction of Levees Manual, 30 April 2000 will be followed.

Major utility relocations associated with the proposed bypass channel are proposed to occur before excavation of the channel and construction of the levees. Therefore, open cut (trench) methods of construction can be used. In the event that horizontal direction drilling is used in lieu of the open-cut method, “Guidelines for Installation of Utilities beneath Corps of Engineers Levees Using Horizontal Direction Drilling, ERDC/GS: TR-02-9, June 2002, Geotechnical and Structures Laboratory” will be followed. The Project Management Plan for the design phase will identify in detail the process to be used by the design team to ensure that utility relocations, performed by non-Federal interests as part of the base conditions, in fact meets Corps standards for such work in light of subsequent work on the bypass channel and levees occurring in the context of the Corps project.

Local utility companies servicing the area have been contacted and their requirements noted. Relocation plans were developed as part of the initial studies. Major utility relocation will include a 138 kVA overhead electric transmission line by TXU Electric.

New storm drainage outfall structures will be constructed at points where the existing drainage system will be intercepted by the bypass channel. The outfall structures will provide transfer of storm water from the existing system into the bypass channel, either through gravity systems or a pumped system.

The preliminary design has identified which roadways will be impacted by the construction of the bypass channel. A roadway plan to restore roadways and relevant design criteria has been developed and coordinated with the City of Fort Worth. Local streets and roadways will meet City of Fort Worth Standards. In addition, temporary detours and rerouting options have been presented to the City.

It is anticipated that future redevelopment will reconfigure a significant number of the remaining minor roadways. Future transportation improvements will be coordinated with the Traffic Impact Study prepared by the City.

Roadways which are replaced with a cul-de-sac will incorporate a pavement design “in-kind” with the adjacent existing pavement cross section. All new roadways associated with the University Drive mitigation and bridge crossings will meet City of Fort Worth minimum pavement standards.

Construction of the bypass channel will impact two designated State highways (Main Street & Henderson Street) and one major City roadway (White Settlement Road). Classification of the streets to be impacted in the project area was made using the City of Fort Worth’s “Proposed Street Development Standards, Roadway Standards and Master Thoroughfare Plan”, February 2002. In addition the existing Beach Street Bridge at the Riverside Oxbow/Gateway site will be rebuilt to improve the hydraulics as part of the ecosystem restoration and hydraulic mitigation plan. This design and construction will follow appropriate City and state design criteria and standards.

Bridge structures crossing the bypass channel are proposed at Main Street, Henderson Street, and White Settlement Road. TxDOT Roadway standards apply to Henderson Street (State Hwy. 199) and Main Street (State Hwy. 287). Approach grades to the structure will maintain minimum clearance of 4 feet over the SPF water surface elevation. The Henderson and White Settlement Bridge Crossings also include grade separations of the FW&WRR thus improving safety as well as traffic flow. Proposed bridge structures will maintain a minimum clearance of 24 feet from the railroad to the superstructure of the bridge deck as required by the local railroad.

All new bridge structures will be designed to meet current AASHTO specifications and TxDOT requirements, as applicable. All bridge design will be governed by AASHTO’s Load and Resistance Factor Design (LRFD). Preliminary calculations and structural component sizing in this section incorporated the LRFD method. The proposed bypass channel bridge structures will have some bridge piers located within the bypass channel; these were incorporated into the hydraulic model.

Structures

The major structures (retaining walls, isolation gates, dam, and floodwalls) were analyzed for various loading conditions including hydrostatic and uplift conditions. Overturning and sliding stability of the dam and abutments were analyzed using the methodology and stability criteria of USACE document EM 1110-2-2200 Gravity Dam Design, dated 30 June 1995. The training walls, which are not integral to the dam structure, were analyzed using the methodology and

stability criteria of USACE document EM 1110-2-2502 Retaining and Flood Walls, dated 29 September 1989. Concrete member design was based on ultimate strength design. Load factors were based on the USACE document EM 1110-2-2104 Strength Design for Reinforced-Concrete Hydraulic Structures, dated 30 June 1992.

A series of tiered retaining walls are proposed for the eastern edge of the bypass channel. The walls will be reinforced concrete with a series of walkways and landscape areas. The walls will vary in height from 5 – 15 feet.

These walls assist in containing the floodway, and have been designed in accordance with USACE criteria for "Inland Flood Walls". Geotechnical design parameters are based on preliminary estimates of soil properties. Wall designs will be updated based upon site specific subsurface investigations and evaluation of soil properties, when available. Long-term and short-term stress conditions were considered for clays based upon expected drainage conditions as noted for the various loading conditions. Various drawdown conditions were considered during the analysis.

Where applicable for final designs, general environmental loads (seismic) should be based upon the ER 1110-2-1806 and EM 1110-2-6050. Retaining walls have been designed in conformance with EM 1110-2-2502, Retaining and Flood Walls. Final design of concrete elements should be in accordance with EM 1110-2-2104, Strength Design for Reinforced-Concrete Hydraulic Structures, (in lieu of concrete design requirements specified in Chapter 9 in EM 1110-2-2502).

Retaining walls have been evaluated for sliding, overturning, and foundation bearing capacity. For concrete strength and foundation bearing capacity at retaining walls, resisting pressures have been limited to 50% of unfactored passive pressure. For sliding stability, driving and resisting earth pressures are based on the multiple wedge method with applicable factors of safety applied to soil properties.

Consideration was given to uplift, due to seepage along the base of the structure, where applicable. The line of creep method for seepage analysis has been used in accordance with the USACE computer program CTWALL.

Preliminary seismic analyses for stability were provided, based on approximate methods using CTWALL. Estimated lateral forces due to earthquake were manually calculated and compared to the forces already included in CTWALL. Where the manually calculated seismic forces exceeded the static forces included in CTWALL, an added lateral force was input using the horizontal line load input under "Surcharge Loads".

Stability analyses of retaining walls were performed for various heights and loading conditions using the USACE computer program CTWALL. The factors of safety and stability criteria applied are in accordance with Table 4-2 of EM 1110-2-2502, Inland Flood Walls. The total base width of retaining wall used in the analysis for each load case, the calculated factor of safety against sliding, the maximum calculated soil bearing pressure, and comments regarding the results have been provided. The resultant factors of safety, design parameters, loading conditions and analysis are consistent with Corps standards and requirements.

A variable level control dam is proposed to maintain a normal pool elevation in the project area and will be lowered during significant rainfall events. The dam structure will be constructed primarily of reinforced concrete. The foundation will consist of drilled shafts embedded into the bedrock below a sufficient dept to develop the moment capacity. The shafts were molded using Lpile Plus, version 4.0 by Ensoft, Inc. A small fixed low water dam is proposed on Marine Creek. The design of the dam is based on a reinforced capped concrete section composed of RCC and cast-in-place facing. A small reinforced concrete low lift type lock structure for recreational purposes will connect the two pool elevations.

Additional geotechnical investigations will be conducted during the next phase of design. A physical model study of the dam and its gate operations is recommended as part of the preliminary design process. This will further define the final configuration of the structure and stilling basin as well as provide data on erosion protection requirements, gate operation and hydraulic parameters.

Isolation gates will be used to protect the interior area from flood flows during major flood events. The gates will be installed within concrete structures to be constructed within the proposed levee and floodwall system. Gate structural design will be in conformance with the following USACE Engineering Manuals: EM 1110-2-2105 Design of Hydraulic Steel Structures, EM 1110-2-2701 Vertical Lift Gates and EM 1110-2-2705 Structural Design of Flood Closure Structures for Local Flood Control Projects.

Coating selection, surface preparation, and application will be in accordance with USACE Engineering Manual: EM 1110-2-3400 Painting: New Construction and Maintenance. Gate operating equipment will be designed in conformance with USACE Engineering Manuals; EM 1110-2-2610 Lock and Dam Operating and Control Systems and EM 1110-2-3200 Wire Rope Selection Criteria for Gate Operating Devices.

Isolation gate design incorporates fixed-wheel vertical gates. The fixed-wheel gates will be lowered into position in anticipation of high water events in the new bypass channel. The operating system will be triple-redundant, providing three methods of gate closures during periods of high floods. Closure of the isolation gates is anticipated for only major storm events.

Further analysis will be performed prior to final design of the gate structures. Geotechnical investigations and testing will be required to further define foundation and structural requirements. In addition to the modeling efforts completed to date, unsteady state modeling will be utilized to further define this operation. Analysis will include the use of historical storm data, local storms, as well as, basin wide events, and various operating scenarios.

Hazardous, Toxic, and Radioactive Waste

The bypass channel will be constructed through an existing industrial and commercial area that has a history of environmental issues. Pursuant to ER 1165-2-132, the Corps, in conjunction with CDM, conducted a Hazardous, Toxic, and Radioactive Waste (HTRW) investigation for the Central City project including the bypass channel, isolation gates and dam locations. The initial environmental site assessment was conducted to determine if widespread contamination will be encountered in the project construction areas. The environmental site assessment also identified potential environmental conditions that may be associated with the project-related parcels or adjacent properties and assessed how these conditions may impact the construction project. A framework for planning the next phase of the project was also provided as part of the assessment. The USACE as part of the Riverside Oxbow Ecosystem restoration project conducted an environmental assessment of the Riverside/Gateway site and included its findings in the Interim Feasibility Report and Integrated Environmental Assessment.

Records Review

Components of the American Society for Testing and Materials (ASTM) Standard for Phase I Environmental Site Assessment (ESA) (ASTM Standard E 1527-00) were applied for a Limited ESA. A records review was conducted for the properties located in the proposed bypass channel, isolation gates, dam locations and roadway construction areas. Records and previous summaries were reviewed for the properties adjacent to the interior water feature and some of the mitigation areas. Site inspections were not conducted for this ESA.

Environmental databases were searched for the project area including the US Environmental Protection Agency (USEPA) database, the Texas Natural Resource Conservation Commission

(TNRCC) database, and additional municipal information sources (City of Fort Worth, 2000). In 2003, the Corps conducted an environmental records review to delineate probable HTRW sites within the project boundary (USACE 2003a).

Results from the records review indicate the majority of known major soil and groundwater contamination is located in the North Main Street area. Within the study area there are numerous sites (i.e. vehicle maintenance, dry cleaners, USTs, etc.) where experience indicates environmental issues could typically occur. There are four sites within the North Main Street area where known significant releases to the environment have occurred. These sites may warrant future investigation depending upon final locations of project features.

Due to the age of many of the buildings located within the project area, the presence of both asbestos and lead-based paint (LBP) is expected. Asbestos is a component of commonly used pipe wrap insulation and floor/ceiling tiles used early in the Twentieth century, as was lead in interior wall paints. The potential presence of both materials will be assessed during site visits and interviews as part of the next phase of environmental assessment. The presence of suspect asbestos containing materials (ACM) and LBP should be verified prior to demolition of any building expected to contain such materials to ensure abatement and monitoring in accordance with all applicable safety codes and all Federal and state regulations and monitoring prior to and during demolition.

Soil and Groundwater

Since there was the potential for previous releases in the project area and contamination along the proposed bypass channel route, an initial screening and investigation of soil and groundwater samples was conducted. Eight monitoring wells were installed along the proposed alignment of the bypass channel. Soil and groundwater samples were collected and analyzed for priority and suspected pollutants during and after installation of the monitoring wells. All monitoring well installation was conducted by the Corps and groundwater sampling was performed by CDM. Two rounds of groundwater sampling were conducted.

Groundwater samples were analyzed for Priority Pollutant Metals (6010B/7470A), SVOCs (8270C), pesticides/PCBs (8081A/8082), and VOCs (8260B). Only arsenic and bis (2-ethylhexyl) phthalate were detected above the Texas Tier 1 Protective Concentration Limit during the first round of sampling. The preliminary laboratory report indicated that these chemicals were not detected during the second sampling event. Bis (2-ethylhexyl) phthalate is a common artifact of sampling and laboratory procedures. Additionally, the background concentration of arsenic in the native soil may be sufficient to produce the observed concentrations in the groundwater. Outside of the known areas of groundwater contamination in the North Main Street area, south of the proposed bypass channel, no groundwater contamination has been discovered to date that may require remediation.

Water encountered during excavation of the bypass channel will be tested prior to dewatering. If arsenic, or any other compound, is present above regulatory levels, then the appropriate discharge permit may be required and portable water treatment system established for dewatering. The City of Fort Worth and the Texas Commission on Environmental Quality (TCEQ) have established a Municipal Settings Designation (MSD) area that includes the Central City Project Area, and will be implemented in the assessment the groundwater within its boundary. This provides a means to simplify the cleanup of contamination in shallow groundwater under TCEQ guidelines.

Preliminary groundwater modeling was conducted by CDM to assess the potential impacts of groundwater on construction of the proposed bypass channel and to evaluate the potential impacts of the project on groundwater conditions after construction. The analysis included development of a reconnaissance level groundwater model, using MODFLOW, to assess

groundwater conditions over the project site, including the potential range of inflow rates during construction dewatering, post project water levels and changes in groundwater flow directions.

The evaluation of conditions during the construction phase includes an assessment of the probable range of dewatering inflows that will be encountered during construction of the bypass channel. The potential for inducing flow of contaminated groundwater into the excavation for the new channel was also evaluated.

The baseline model reflecting current groundwater conditions was configured and used to assess groundwater conditions both during dewatering and after project construction. Dewatering flows for the channel construction phase are estimated to range from about 150 to 450 gpm. The modeling indicates that dewatering operations will locally change groundwater flow directions, but are not anticipated to induce flow of contaminated groundwater from known HTRW sites to the channel. Water levels will rise after project construction in response to a higher stream elevation behind the new dam causing a change in groundwater flow rates and direction of flow. In addition, groundwater velocities will decrease, since stream stage will be flat over the extent of the pool.

Summary – Soil and Groundwater

Soil and groundwater data collected indicate minimal subsurface contamination over most of the study area. Therefore, widespread subsurface contamination is not likely to be encountered throughout the project area. However, although below action levels, the presence of some contaminants may indicate the potential for nearby soil contamination. Based on these findings it appears that contamination from individual properties is mainly restricted to private industrial properties and has migrated minimally into adjacent areas. Base line costs for this remediation have been developed. Also, analytical results from the HTRW investigation imply that soil and groundwater from the area sampled should not require special handling, disposal or remediation.

However, further identification and qualification of HTRW sites including design of response work will be provided as required in conjunction with USEPA, Texas Commission on Environmental Quality (TCEQ), and local authorities. This work will be identified and accomplished through a systematic process of investigation, quantification, design, and response. On-site inspections and interviews will be conducted as part of the remaining Phase I activities. Phase II sampling and analysis will be conducted to determine the type and extent of soil and groundwater contamination on suspected sites. Based upon the results of the Phase I survey, response and remediation alternatives will be developed and reviewed with USEPA, TCEQ and local authorities as applicable. Detailed engineering and design of response actions will be the responsibility of the local sponsor. The local sponsor will be responsible for the cost of the response actions external of the Corps Project.

Operations and Maintenance

Channel and levee side slopes are tentatively planned for 3 horizontal to 1 vertical slope, similar to what has been successfully used and maintained for the existing Trinity River levee system. Retaining wall structures are proposed along the east side of the bypass channel in three tiers; lower level interior walls at about normal pool level, mid-level interior walls above normal pool level and below Standard Project Flood (SPF) level, and upper level interior walls above the SPF level.

A dam with leaf gates and three separate isolation gates will control water levels in the bypass channel and interior area. The dam with leaf gates is proposed in the vicinity of Samuels Avenue. The isolation gates are planned to control the quiescent river segment of the old West Fork River channel at the upper, lower, and middle confluences with the bypass channel.

Currently the TRWD performs a variety of maintenance activities, similar to that expected for the FWCC Project. These practices include turf maintenance which includes mowing, weed removal, fertilizing, tree removal, fencing, litter control, walkway and trail maintenance and the trimming of areas not accessible to mowers and operation of gate and pump station structures at several reservoirs.

The equipment and facilities currently maintained by TRWD staff include building facilities, and equipment used by personnel at the operations. The existing overall operations and maintenance effort is extensive. TRWD personnel are engaged in maintaining dam structures, gates and pump stations. Therefore, experience, knowledge and expertise for maintaining these types of structures are high.

The planned operations and maintenance program provides for the maintenance of the new levee system including mowing, fertilization, repair, debris removal and renovation. The hard edge, consisting of a series of retaining walls and walkways, will be landscaped and maintained. The isolation gates, Samuels Avenue Dam and storm water pump station will be operated and maintained by the District. Routine and preventative maintenance will include electrical, electronic, mechanical and hydraulic systems. Costs have been developed for the various operation and maintenance requirements based upon actual unit costs and records from the TRWD's Computerized Maintenance Management System.

The overall operations and maintenance for the Central City plan will be provided by the TRWD. This will be an extension of current operations which have proven to be very efficient and exceed minimum Corps requirements.

Summary

Preliminary design analyses for the modified components have been performed and are reflected in the Supplemental EIS. The preliminary design completed during this phase is technically adequate for the current stage of the project and will provide a sound basis for future development of engineering products. The design to date does not completely meet the requirements of ER 1110-2-1150 for a Feasibility Study. The future work needs to follow the guidance and format prescribed in ER 1110-2-1150, "Engineering and Design for Civil Works Projects", Appendix C Section C-7 and Appendix D. As noted by the CESWF and CESWT review teams, all subsequent structural design submittals should follow the format prescribed by those references.

In addition, specific design codes (ACI, ASCE, AISC, etc.) and Corps guidance based on the systems and materials chosen should clearly indicate the design requirements and levels and methodology of analysis.

These requirements outline the specific areas, data and investigations that will be developed as the design process continues. ER 1110-2-1150, "Engineering and Design for Civil Works Projects", Section C-7 and Appendix D, identify the general areas to consider and the proper format for future submittals.

The formulation of the Central City project was first and foremost focused on decreasing the risk to public health and safety from potentially catastrophic flood events. The original Fort Worth Floodway was authorized to provide a Standard Project Flood (SPF) level of protection, with an additional four feet of freeboard. Over time, this level of protection has been reduced due to watershed development and settlement of the existing levees. The authorized Central City project, and the proposed Modified Central City Project, were designed using state-of-the-art hydrologic and hydraulic models and current technical design standards, and will restore the authorized level of flood protection, thereby significantly reducing existing risks to public health and safety. For future detailed design efforts, the District will establish a risk analysis framework that permits quantification of each source of uncertainty, and properly incorporates each

uncertainty in the analyses that will be presented in the Design Documentation Report (DDR). Risk and uncertainty assumptions will be evaluated throughout the life of the overall project at major milestones of design and construction. In addition, each design contract will have an independent technical review appropriate to the level of risk and complexity inherent in the bid set of drawings and specifications as defined in the Quality Control Plan. Furthermore, in accordance with the Water Resources Development Act of 2007, Section 2035 (and pending Implementation Guidance), Safety Assurance Reviews will be conducted, if needed, throughout the life of the overall Central City project. This technical review will occur for the federally authorized component of the project, and for the locally cost shared components. The evaluation will be accomplished, at a minimum, during four stages of project design and implementation, including preliminarily design, complete design, contracting method review and construction contract execution.

Conclusion

The technical soundness of all components of the Modified Central City project has been demonstrated through the preliminary engineering analysis performed to date and resolution of all ITR comments. The Modified Central City project complies with all applicable USACE technical standards and regulations. The normal authorization process was not followed which lead to some modification of the phases of project development. However, work completed to date demonstrates the technical soundness of the plan and forms the baseline for future technical and engineering development pursuant to Corps standards and regulations.

Future work will follow the normal design process to include required investigations and analysis. All components of the Modified Central City project will be thoroughly coordinated within the integrated design framework. The Corps will be the lead agency for the components of the Corps Project, with full responsibility for ensuring that design standards are met. Standard review and approval processes are envisioned. In addition, close coordination will be maintained with the design of the transportation elements in order to ensure functional compatibility and compliance with applicable Corps standards where the transportation elements affect features of the Corps project. As with the current system and in accordance with regulation and policy, the Corps will inspect the completed project to ensure appropriate levels of maintenance for the Corps Project are provided by the Sponsor.

CHAPTER 4 - ENVIRONMENTAL ACCEPTABILITY

National Environmental Policy Act

Section 116 of Public Law 108-447 directs the Corps to undertake the Central City Project as generally described in the Trinity River Master Plan if the Secretary determines that the work is technically sound and environmentally acceptable. After completion of the NEPA process, the original Central City project was determined to be environmentally acceptable and documented as such in the Record of Decision signed by the ASA (CW) on April 6, 2006. The NEPA process has been used to document that the Modified Central City Project is likewise environmentally acceptable.

On 17 February 2007 a Notice of Intent to Prepare a Supplement to the Central City Final Environmental Impact Statement was published in the Federal Register. Subsequently a Draft Supplement No.1 to the Final Central City Environmental Impact Statement (DSEIS) was prepared and coordinated with the public and with State and Federal resource agencies. On 4 January 2008, the Notice of Availability for the DSEIS was published in the Federal Register.

A public meeting to receive comments on the DSEIS was held on 24 January 2008 in the Horizon Room of the Inn Suites Hotel, Trinity Suites and Resort, 2000 Beach Street, Fort Worth, Texas 76103. A total of 252 persons registered at the meeting and twenty six offered verbal comments. Ninety three persons filled out cards available at the meeting offering comments of support, opposition or more detailed written comments. Eighty two indicated support for the Modified Central City project and nine opposed it. The majority of speakers and those who offered written comments were in favor of the Modified Central City Project because of the opportunities to provide multi-objective benefits within the Central City and Riverside-Gateway areas. Several expressed concern related to ongoing natural gas exploration within the Trinity floodplain and how some existing sites near the Gateway Park and other parks might impact natural resources and adversely impact plans to provide improved habitat and park amenities. Two commenters expressed concern related to proposed construction of the Central City project while other nearby areas were more in need of flood damage reduction projects. Two other commenters suggested that the project lacked economic justification or that the sponsors should not support expenditure of local tax dollars for the project.

The public comment period closed on 19 February 2008. State agencies providing comments included the Texas Commission on Environmental Quality (TCEQ), the Texas Parks and Wildlife Department (TPWD), the Texas State Historic Preservation Office, and the Texas Water Development Board. Federal agencies providing comments were the Department of Interior and the Environmental Protection Agency. Local entities providing comments included the City of Fort Worth, Tarrant Regional Water District, local Congressional representatives, Chambers of Commerce, business interests and concerned citizens and neighborhood associations. All comments received during the public meeting and during the public review period are published in Appendix H of the FSEIS with the Corps' responses.

In response to public and agency comments, the DSEIS was revised and filed as Final Supplement No. 1 to the Final Central City Environmental Impact Statement (FSEIS) on 21 March 2008. The wait period extended 30 days to April 21, 2008. The final array of alternatives addressed in the FSEIS included No Action and the Modified Central City Project Alternative. The FSEIS addressed direct, indirect, and cumulative impacts of modifications to the Central City project including the incorporation of the Riverside Oxbow project features. The FSEIS also analyzed the environmental impacts of the proposed action when added to the other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes those actions.

One electronic message was received from the Union Pacific Railroad (UPR) on the FEIS that raised concerns about the project's potential effects on operation and maintenance of their rail lines in the vicinity of Samuels Avenue Dam. The project as proposed is not expected to impact URP's right of way or their operations, including related drainage requirements. A letter will be provided to UPR to advise them the project's construction should not encroach within the railroad's existing right of way and that future coordination will be undertaken during detailed design to assure exiting drainage flows are not adversely impacted.

Comparison of Environmental Effects

Under the Modified Central City Project, the valley storage mitigation sites are located downstream in the Riverside Oxbow area instead of the upstream Riverbend area. This reduces the amount of private land acquisition and increases the amount of excavation required to attain the necessary valley storage. These Riverside Oxbow valley storage sites are located primarily in grassland areas so the extent of impacts to existing riparian and wetland habitat from construction is reduced. Following excavation, these valley storage sites will be developed into riparian woodland and wetland habitat which will result in more riparian woodland and slightly less wetland habitat than under the No Action alternative. In addition, the extent of impacts to stream habitat is reduced with the Modified Central City Project due to less inundation of Marine Creek and no impact to Lebow Creek caused by the relocation of Samuels Avenue Dam. The Modified Central City Project would develop more stream habitat by also restoring Sycamore Creek in the Riverside Oxbow area and provides a mechanism to accelerate implementation of features of the City's Gateway Park Master Plan.

Other Environmental Compliance

The proposed modifications to the Central City Project have been extensively coordinated with Federal and State resource agencies to address project concerns. In particular, the U.S. Fish and Wildlife Service (USFWS), the Texas Parks and Wildlife Department, the State Historic Preservation Office, and the Texas Commission on Environmental Quality were involved in identifying, minimizing and mitigating project impacts. The USFWS' final Fish and Wildlife Coordination Act report (Appendix G of the FSEIS) indicates support of the Modified Central City Project due to reduced impacts as compared to the No Action Alternative. The Modified Central City Project does not affect agreements developed during the original project with respect to cultural resources, and coordination with the State Historic Preservation Office under Section 106 of the National Historic Preservation Act (NHPA) is proceeding.

Coordination to date with the TCEQ has not identified any concerns that would preclude obtaining a State Water Quality Certificate and the project team is providing information requested by TCEQ to facilitate receipt of the certificate. The Notice of Availability for the DSEIS was issued jointly with TCEQ to allow public comment required for their water quality certification process as well as to meet the NEPA requirements. The DSEIS included a Section 404(b)(1) analysis in Appendix F and no comments from the public were received relative to water quality certification. It is the project team's intent to obtain the State water quality certificate prior to signing the PCA (PPA, WRDA 2007) in accordance with standard policy. However, if the state process does not mature as quickly as PCA (PPA, WRDA 2007) development, the team plans to request an exception to policy in order to allow the PCA (PPA, WRDA 2007) to be signed as soon as it is ready. This would allow construction start for those features to be constructed "in the dry." In no case, however, would construction start on a component affecting "waters of the U.S." prior to receiving water quality certification. The TCEQ has also agreed that the project conforms to the Texas Clean Air Act (CAA) State Implementation Plan and therefore the project is in compliance with Section 176 of the CAA. Table 4-1 summarizes the status of environmental compliance for the Corps Project.

Table 4-1
Status of Environmental Compliance

Law, Executive Order, MOA	Status
Section 401 - Water Quality Certification	Corps will obtain a State Water Quality Certificate from TCEQ prior to initiating construction of features involving discharges into waters of the United States.
Section 404 -Clean Water Act	Section 404(b)(1) analysis of authorized plan conducted included in the FEIS. The report describes the preferred alternative, provides discussion of why the project must include modifications to waters of the United States and discloses impacts to waters of the United States. Appropriate environmental mitigation for unavoidable impacts to Marine Creek has been determined in coordination with resource agencies. State is reviewing project for water quality certification.
Construction Storm Water	The preferred alternative, as proposed, will likely cause disturbance to more than one acre of soils, and prior to commencement of construction a stormwater pollution prevention plan would be developed and a Notice of Intent would be submitted to TCEQ by the construction contractor as the primary operator and the Corps will certify the contractor's SWPPP The project is in full compliance at this time.
Executive Order 11988 Flood Plain Management	The preferred alternative is in full compliance.
Trinity River EIS Record of Decision and Local Corridor Development Certification	The preferred alternative is in full compliance.
Section 202 (C) Water Resources Development Act of 1996	Sponsor will be required to develop a flood management plan within one year of signing the Project Cooperation Agreement, and then implement the plan within one year after project completion.
Executive Order 11990 Protection of Wetlands	The preferred alternative would initially impact lower quality wetlands, but ultimately it would increase the size and functional quality of wetlands occurring within the study area. The plan is in full compliance.
Executive Order 13112 Invasive Species	The preferred alternative is not likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere and is in compliance with the E.O.
Public Law 93-205 Endangered Species Act	U.S. Fish and Wildlife Service has reviewed the proposed project and concurs that the project is not likely to adversely affect threatened or endangered species. Prior to construction, a review would be conducted to determine if additional new species or impact information is available which warrants further consideration.
Fish and Wildlife Coordination Act	Fish and Wildlife Service provided Final Coordination Act Report and attached letter from Texas Parks and Wildlife Department providng no objections to implementation of recommended project alternative including fish and wildlife mitigation proposed.
Section 106 of National Historic Preservation Act	Project to date is in compliance with Section 106. Maintenance of compliance requires ongoing project evaluation and coordination as outlined within previous agreements with the SHPO and Native American groups and other interested parties.

Conclusion

Based on analyses conducted during the NEPA process, the Modified Central City Project was identified as the Preferred Alternative in the SEIS. All practical means to avoid or minimize environmental impacts from the selected alternative have been adopted. Upon consideration of comments received during review of the Final SEIS and signing of the Record of Decision, the requirements of NEPA will be accomplished. Continued engagement by the Corps through the design and construction process will ensure that compliance with appropriate laws and regulations is maintained as the project team proceeds with those phases. Subject to completion of the NEPA process, completion of Section 106 of the NHPA, and issuance of a State Water Quality Certificate, the Corps Project of the Modified Central City Project is environmentally acceptable for the purpose of complying with the project authorization in Section 116 of Public Law 108-447.

CHAPTER 5 – CONCLUSION AND RECOMMENDATION

Public Law 108-447, Section 116 authorized the Secretary of Army to undertake the Central City Project, as generally described in the Trinity River Vision Master Plan, dated April 2003. The Army Corps of Engineers (Corps) is authorized to participate in the Central City project at a total cost not to exceed $220,000,000 and the Corps and non-Federal share will each be $110,000,000. The Record of Decision dated April 2006 concluded that the recommended plan for the Central City project and the Corps participation in the project was technically sound and environmentally acceptable as required by the authorization contained in Section 116. This decision was based on the analyses and recommendations contained in the Final Project Report dated March 2006 and the Final Environmental Impact Statement dated January 2006.

Subsequent to the Record of Decision dated April 2006, the City of Fort Worth requested the Corps conduct an evaluation to consider the potential benefits of modifying the Central City Project to include the Riverside Oxbow Ecosystem Restoration project area to accommodate valley storage mitigation requirements caused by the increased hydraulic efficiency of the bypass channel instead of using the privately held Riverbend area. Incorporation of ecosystem restoration and recreation features of the Riverside Oxbow project and moving Samuels Avenue Dam upstream of the Marine Creek/West Fort Trinity River (MC/TR) confluence were also proposed. A Final Supplement No. 1 to the Final Environmental Impact Statement (FSEIS) dated March 2008 was completed to analyze the technical soundness and environmental acceptability of modifying the project.

Alternatives considered in the FSEIS included a number of sites and configurations for providing valley storage mitigation, and alternative locations for Samuels Avenue Dam upstream of the MC/TR confluence. The analysis also considered five contingency valley storage sites that could be used if analyses during the detailed design phase indicate the primary storage sites are not sufficient to achieve the required valley storage or if other factors preclude their use. The evaluation of valley storage sites included avoiding, to the extent feasible, important habitats and developing habitat within these sites following excavation. Locations upstream of the MC/TR confluence for Samuels Avenue Dam would reduce geotechnical concerns, avoid impacts to aquatic habitat in Lebow Creek, and reduce aquatic impacts in Marine Creek.

The Modified Central City alternative retains the major features of the original Central City Project but utilizes existing public lands and minimizes use of private lands to a greater extent to accommodate the valley storage requirement. Major components, ecosystem restoration and recreation features of the Riverside Oxbow project were also incorporated into the Modified Central City alternative and a location upstream of the MR/TR confluence was selected for Samuels Avenue Dam.

The Modified Central City alternative would avoid much of the initial impact to riparian woodland that would occur with the original Central City project. Upon completion of habitat development and compensating for impacts, the Modified Central City alternative would result in more riparian woodland outputs but less wetland outputs relative to the No Action alternative. The changes in habitat outputs are primarily due to relocating the valley storage sites from the Riverbend area to the Riverside Oxbow project area and replacing grassland habitat at these sites with riparian woodland.

Relocation of Samuels Avenue Dam upstream of the MC/TR confluence would avoid some adverse effects to riparian and aquatic habitat along lower Marine Creek and all impacts to Lebow Creek. The aquatic habitat mitigation that is still required will occur in the Ham Branch tributary and in the remnant Sycamore Creek and has been coordinated with the U.S. Fish and Wildlife Service and state of Texas resource agencies.

Implementation of the Modified Central City alternative would provide a similar level of flood protection, increase habitat and recreation outputs, reduce habitat mitigation requirements, and reduce acquisition of private lands relative to the No Action alternative. Total project costs would increase due to increased excavation and habitat development associated with the valley storage sites and inclusion of recreation features in the Riverside Oxbow area. Based upon detailed evaluations presented in the FSEIS, resource agency coordination, and public review under the National Environmental Policy Act, the Corps has recommended the Modified Central City alternative which is also considered the environmentally preferable alternative. The Modified alternative fully complies with Corps hydraulic criteria and regional criteria established in the Corridor Development Certificate process which is part of the City of Fort Worth floodplain ordinances.

The Modified Central City Project provides a number of significant benefits over the No Action Alternative and the Approved Central City Project. The reduction of private property acquisition by 397 acres for the No Action Alternative and 293 acres for the Approved Central City Project is achieved by revising the valley storage locations and is a major benefit to overall project implementation. Adverse environmental impacts are reduced by eliminating all impacts to Lebow Creek and reducing impacts to Marine Creek as a result of the Dam relocation. Recreational enhancements also have been integrated with valley storage mitigation features to provide synergism of improvements. These enhancements over the No Action Alternative include:

- 5% increase in Concrete Trails
- 77% increase in Composite Trails
- 376% increase in Parking Area

These same enhancements over the Approved Central City Project include:

- 44% increase in Concrete Trails
- 171% increase in Composite Trails
- No Parking area was proposed in this alternative

The Modified Central City Project also provides for extensive development of dense riparian forests that would not be included in the No Action Alternative or in the Approved Central City Project. There will be a total of 418 acres of Riparian Woodlands in the Modified Project, which is a 15% increase over the No Action Alternative and a 350% increase over the Approved Central City Project. The Modified Project also provides for the development and improvement of wetlands, and native grassland savannah. The abandoned Sycamore Creek and Riverside Oxbow channels will be restored, adding 5.8 acres of stream habitat that would not be developed in the No Action Alternative or the Approved Central City Project.

The net effect of the recommended changes that would result from the Modified Central City Project alternative is beneficial. The Modified Central City Project alternative would not add or delete any project purpose, nor would it require the acquisition of additional lands or waters specifically for mitigation of fish and wildlife values. The cumulative benefits identified go above and beyond both the Approved Central City Project and the No Action Alternative and result in a project that is not only technically sound and environmentally acceptable, but also creates more public benefits with less environmental cost.

Those features identified for Corps participation in the Modified Central City alternative, in accordance with the cost limitations contained in Section 116, includes the bypass channel, two isolation gates, associated real estate and property owner relocations, all valley storage and habitat mitigation, and soft costs associated with these features. Also included is all cultural

resources mitigation except mitigation of impacts to buried archeological resources that may be discovered in conjunction with project features other than those included in the Corps Project. The Corps Project estimate ($220M) is based on the updated MII Cost Estimate with escalation and contingencies and has been independently cost reviewed. All major flood control functional features associated with the bypass channel and valley storage are included in the Corps Project.

Specifically, utility relocations, demolition of the Henderson and Main Street Bridges, and the cleanup of substances regulated by the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act will be performed by the sponsor as a non-project cost prior to or concurrent with construction on appropriate elements of the Corps Project. The Trinity Point Gate and Samuels Avenue Dam will become base conditions with the same requirements as the other base conditions. Adoption of the Modified Project results in significant improvements with lessened environmental impacts as compared to the Approved Central City Project.

Analysis of the Section 116 authorization clearly indicates that inclusion of the Riverside Oxbow features is allowed under the original Central City Project authorization. In addition, this Project Report should be used to support development of the PCA and or PPA.

The overall project has been evaluated for technical soundness, in order to accommodate full consideration of the project's hydraulic performance and its potential to affect the flood protection afforded by the existing Fort Worth Floodway. The project design fully meets the Corps and regional criteria for projects in the Trinity River floodplain in terms of its hydraulic performance. Corps criteria was followed during the plan development and the project design fully meets Corps criteria for geotechnical, civil and structural design elements. The Fort Worth District's extensive review of the design documents was augmented by an Independent Technical Review performed by the Tulsa District and an Independent Cost Review by the Walla Walla District. The project, as currently designed, meets the technical soundness and environmental acceptability requirements of Section 116.

Appendix A

Upper Trinity River Central City Modified Project Report Certifications

This Appendix contains copies of certifications based on a series of internal and external independent reviews conducted on technical components used in the preparation of the Modified Central City Project Report. The certifications, which determined that the Modified Central City Project and supporting reports and studies were completed in accordance with applicable policies, guidelines, requirements and standards include:

- Independent Technical Review conducted for all technical designs, analyses and documents (except the final cost estimate) which were included in the FSEIS, performed by the Tulsa District as part of the NEPA process. See enclosed Memorandum for Commander, signed by the Tulsa District ITR team leader, dated 14 November 2007.

- Internal Quality Assurance reviews of the Modified Project Report, conducted by the Fort Worth District personnel, for compliance with appropriate standards and policies. See enclosed Certification of Technical Review, dated 03 April 2008, and Certification of Legal Sufficiency, dated 03 April 2008.

- Independent Cost, Schedule Baseline, and Risk review conducted by the Walla Walla District, Cost Engineering Center of Expertise for Civil Works, for the Modified Project Report, which reviewed the project scope, cost estimates, escalation, risk analysis, and contingencies. See enclosed Certification dated 16 April 2008.

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

CESWT-PE 14 November 2007

MEMORANDUM FOR COMMANDER, Forth Worth District, ATTN: Chief, CESWF-PER-P

SUBJECT: Technical Review – Fort Worth Central City Preliminary Design, Supplement No1 to the FEIS Appendices.

1. Background. The Fort Worth District project manager, Saji Alummuttil, requested technical review of the subject documents by a Tulsa District review team. The review team conducted a site tour and project briefing in August 2007. In August and September the review team examined the documents and provided comments to which the project deliver team responded in November 2007.

2. Finding. The project delivery team responses to comments appropriately address all issues raised during technical review. The responses generally indicated corrective action taken.

3. Comments and responses. Comments and responses are compiled within Dr. Checks and are enclosed by reference. The enclosure will be transmitted separately. The Tulsa District appreciates the opportunity to review this project. One critical issue remains to be resolved by higher headquarters. Comment 1638602 relates to differences in descriptions of the no action plan and the future without project conditions that could not be resolved during review.

FOR THE COMMANDER:

Encl

SUSAN J. HASLETT
Chief, Planning,
and Environmental Division

TRINITY RIVER, CENTRAL CITY, FT WORTH, TEXAS PROJECT REPORT

CERTIFICATION OF TECHNICAL REVIEW & LEGAL SUFFICIENCY

The intent of the Certificate of Technical Review & Legal Sufficiency is to: 1) ensure the technical analyses meet appropriate standards; 2) ensure compliance with applicable laws and statutes, as well as Corps of Engineers policy; 3) resolve issues prior to the release of the report to the public, customer, and Corps higher authority; 4) be a continual process commensurate with the scope and complexity of the analyses; and 5;) the Certification be documented.

In accordance with the District's Quality Control Plan, critical technical components of the formulation and evaluation of the alternatives leading to the identification of the recommended plan were undertaken. The most critical components included the hydrologic and hydraulic modeling and civil, structural, and geotechnical evaluations. The study was completed by a combination of in-house labor, sponsor technical support, and the AE staff. Independent Technical Review of real estate and engineering analyses was performed by U.S. Corps of Engineers, Tulsa District.

The documents, figures, appendices were reviewed several times by USACE Headquarters and Southwestern Division Office personnel. Substantive comments and documentation was received from USACE Headquarters Policy Division and Southwestern Division, Corps of Engineers. The District responded and revised the document until the issues were resolved to all parties' satisfaction. The District was given permission to release the report to the public without further review.

CERTIFICATION OF TECHNICAL REVIEW

I (we) have reviewed the Trinity River, Central City, Ft Worth, Texas Project Report. The studies and analyses conducted as part of the study were completed in accordance with all applicable laws, policies, and guidelines, and meet the standards of technical adequacy.

4/3/08

Mead Sams, Acting Chief, Planning Branch — Date

4-3-08

Mark Harberg, Chief, Environmental Resources Branch — Date

04-03-08

William Fickel, Chief, Planning, Environmental, and Regulatory — Date

FOR: 4-03-08

Hyla Head, Chief, Real Estate Division — Date

4/3/08

Terri Nolen, Chief, Design Branch — Date

4-3-08

Mike Zalesak, Acting Chief, Engineering and Construction Division — Date

CERTIFICATION OF LEGAL SUFFICIENCY

I (we) have reviewed the Trinity River, Central City, Ft Worth, Texas Project Report. The studies and analyses conducted as part of the study were completed in accordance with all applicable laws, policies, and guidelines, and meet the standards of legal sufficiency.

3 April 08

Rex Crosswhite, District Counsel

Date

Upper Trinity River, Central City - Fort Worth, TX
Cost and Schedule Baseline Certification

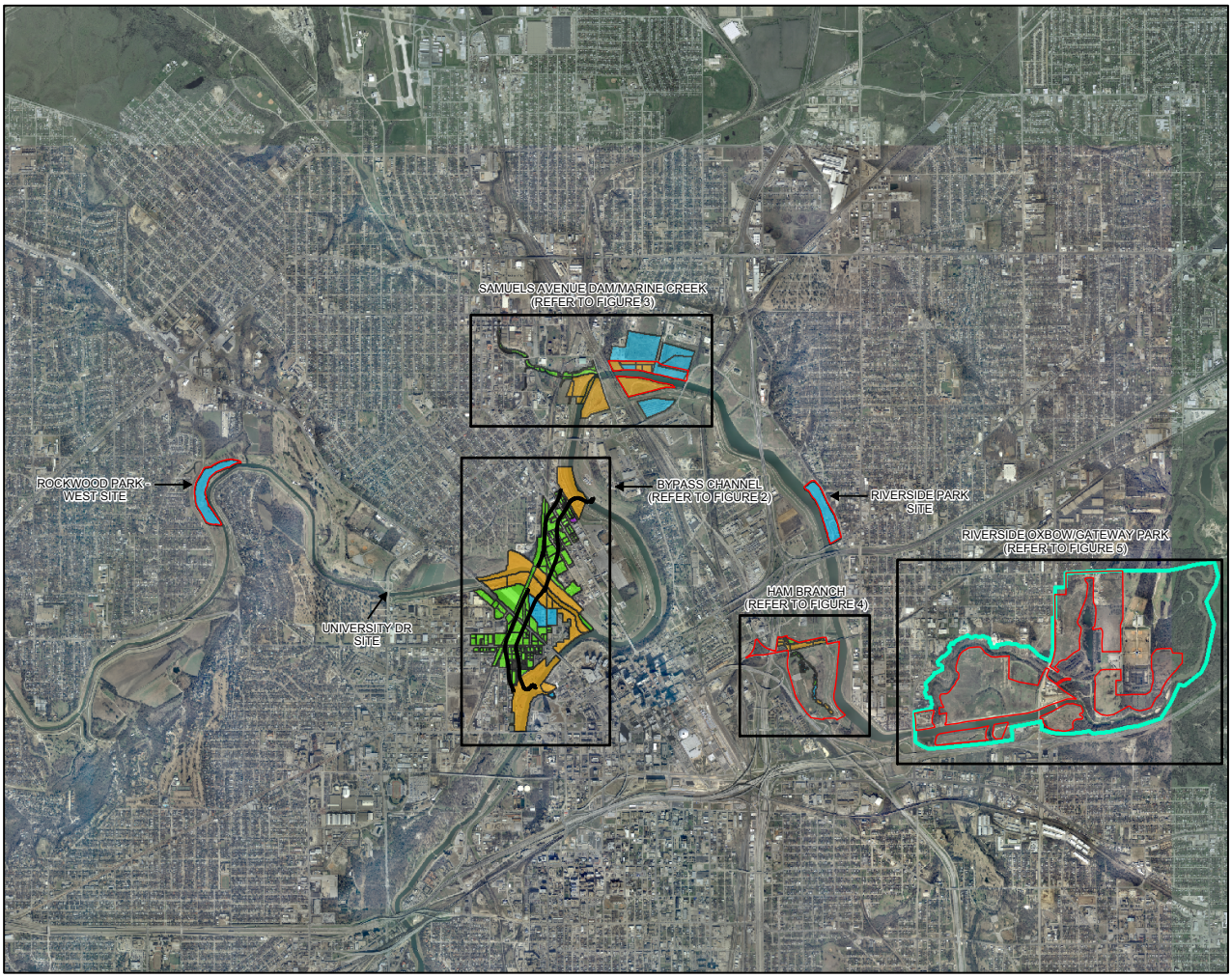
As of April 16, 2008, Walla Walla District, Cost Engineering Center of Expertise (Cx) for Civil Works Projects, certifies the $220M Federal component of the Total Project Cost approximating $673.4M for the Fort Worth District project Upper Trinity River, Central City located in Fort Worth, TX. The stated value reflects the $220M Congressional authorization for the Federal component of the locally preferred plan. The Federal / Non-federal cost share is 50 percent resulting in a Federal commitment of $110M.

The Walla Walla Cost Cx representatives have provided an adequate Independent Technical Review (ITR) of the congressionally authorized baseline ($220M), studying the project scope, report, cost estimates, schedules, escalation, risk analysis and contingencies in accordance with ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

It remains the responsibility of the Corps project manager to continue monitoring progress of the Federal costs, schedules and risks throughout the project period. As designs evolve and progress, another independent review may be in order.

Kim Callan, PE, CCE, PM1
CH, Cost Engineering Branch
Walla Walla District

16 Apr 2008



Project Report
Appendix B

Figure 1 - Overall Project Real Estate Plan

Legend

GENERAL

BYPASS CHANNEL

OWNERSHIP

TRWD PROPERTY

COFW PROPERTY

TARRANT COUNTY PROPERTY

PRIVATE PROPERTY

0 1,500 3,000 6,000 Feet

N

Aerial Photography Date: January 2005

US Army Corps of Engineers
Fort Worth District

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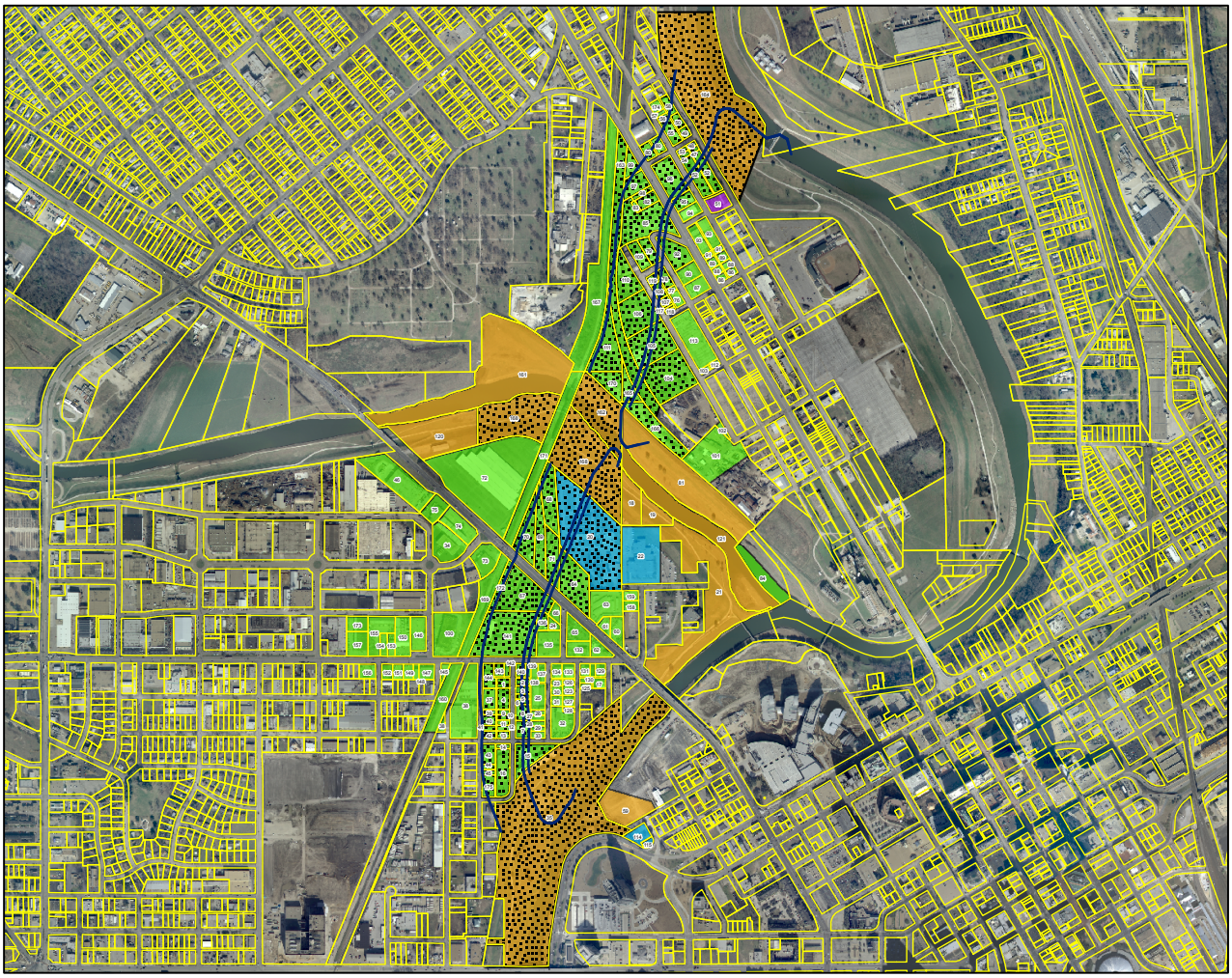
As of 4/2/08



Project Report
Appendix B

Figure 2 - Modified Project Bypass Channel Real Estate

Legend

GENERAL

- BYPASS CHANNEL
- TAD PROPERTY BOUNDARIES
- CORPS PROJECT

OWNERSHIP

- TRWD PROPERTY
- COFW PROPERTY
- TARRANT COUNTY PROPERTY
- PRIVATE PROPERTY

N

0 450 900 1,800 Feet

Aerial Photography Date: January 2005

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As of 4/2/08