HOUSTON-CONROE MITIGATION BANK MITIGATION BANKING INSTRUMENT

Date: 11/10/2015
Splendora, Liberty County, Texas

USACE Project No.: SWG-2013-00141
RS&H No.: 115-2370-003

Prepared by RS&H, Inc. at the direction of Forestar (USA) Real Estate Group, Inc. for submittal to the U.S. Army Corps of Engineers, Galveston District.

FORESTAR

RS&H

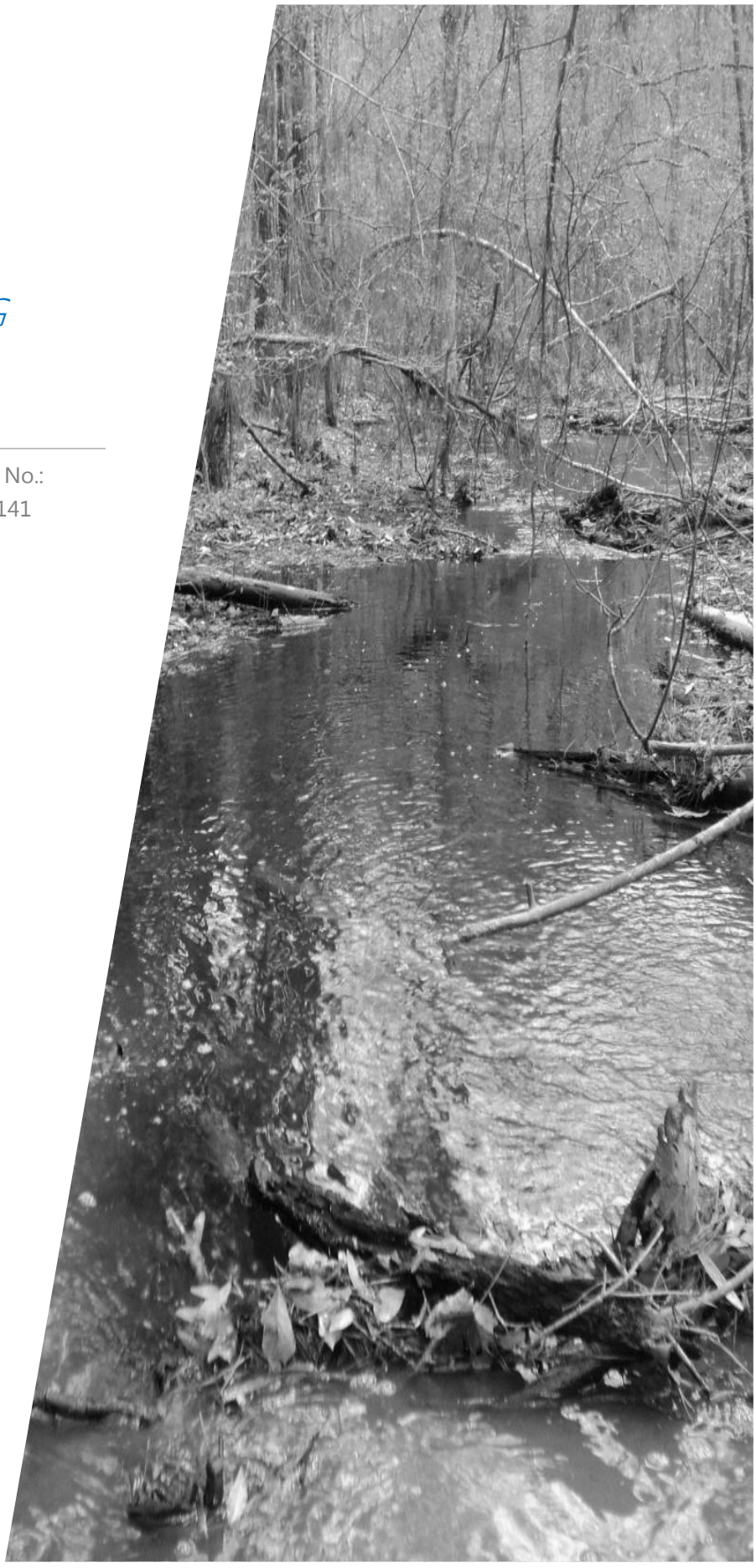


TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

Acre	*Ac*
Animal and Plant Health Inspection Service	*APHIS*
Animal Welfare Act	*AWA*
Bank Height Ratio	*BHR*
Coarse Woody Debris	*CWD*
Credit Adjustment Factor	*AF*
Cross-Sectional Area	*Abkf*
Department of the Army	*DA*
Depth of the Top Most Bank	*Dmaxtob*
District Engineer	*DE*
Entrenchment Ratio	*ER*
Federal Emergency Management Agency's	*FEMA*
Forestar (USA) Real Estate Group, Inc.	*Forestar*
Functional Capacity Index	*FCI*
Functional Capacity Units	*FCU*
Galveston District's Stream Condition Assessment 2013	*Galveston SOP*
Geographic Information System	*GIS*
Houston Galveston Area Council	*HGAC*
Houston-Conroe Mitigation Bank	*HCMB or Bank*
Hydrologic Unit Code	*HUC*
Interagency Review Team	*IRT*
Interim Hydrogeomorphic Method	*iHGM*
Light Detecting and Ranging	*LiDAR*
Linear Foot	*Lf*
Maintenance of the Plant and Animal Community	*MPAC*
Maximum Depth at Bankfull	*Dmax*
Mean Sea Level	*MSL*
Meander Width Ratio	*MWR*
Mitigation Banking Instrument	*MBI*
National Wetland Inventory	*NWI*
Natural Resource Conservation Service	*NRCS*
North American Vertical Datum	*NAVD*
Obligate	*OBL*
Ordinary High Water Mark	*OHWM*
Radius of Curvature	*Rc*
Remote-Sensing Infrared	*IR*
Removal and Sequestration of Elements and Compounds	*RSEC*
Sinuosity	*K*
Temporary Storage and Detention of Storage Water	*TSDSW*
Texas Historical Commission	*THC*
Texas Parks and Wildlife Department	*TPWD*
Total Maximum Daily Load	*TMDL*
U.S. Army Corps of Engineers	*USACE*
U.S. Department of Agriculture	*USDA*

U.S. Fish and Wildlife Service ..... *USFWS*
U.S. Geological Survey ..... *USGS*
Waters of the U.S. ..... *WOUS*
Wetland Assessment Areas ..... *WAAs*
Width of Flood-Prone Area ..... *Wfpa*
Width to Depth at Bankfull Ratio ..... *W:D*

1 INTRODUCTION

1.1 PRIMARY INFORMATION

Forestar (USA) Real Estate Group, Inc. (Forestar) has prepared this Mitigation Banking Instrument (MBI) to provide the physical and legal characteristics for establishment and operation of the Houston-Conroe Mitigation Bank (HCMB or "Bank").

The proposed HCMB is 396 acres (Ac) and is located within a larger parent tract, wholly owned by Forestar, located in the U.S. Geological Survey (USGS) East Fork San Jacinto 8-digit Hydrologic Unit Code (HUC) 12040103, near Cleveland, Liberty County, Texas (Appendix A - Exhibit 1). Specifically, the proposed Bank site is located at Latitude 30.2406° North and Longitude 95.0596° West on the Plum Grove, USGS 7.5 minute quadrangle topographic map, and is situated within the South Central Plains Level III Ecoregion. The bank is situated approximately 5 miles east of the City of Splendora on U.S. Highway 59 and can be accessed from Farm to Market Road 1010 approximately 2.5 miles north of Plum Grove or 6 miles south of Cleveland, Texas.

Title and ownership information for the bank property as well as a legal description of the tract can be found in Appendix B. The Bank is composed of three separate tracts consisting of the following:

- Being 249.93 acres, more or less, located in the James Humphries Survey, A-212, in Liberty County, Texas and being a portion of the called 3517.13 acre tract described in a Deed from TIN Inc. to Forestar (USA) Real Estate Group, Inc. Dated October 1, 2007 and recorded in the Document No. 2007014953 of the Office of Public Records of Liberty County, Texas (OPRLCT).
    - Surveyed by Gary G. Brown of Goodwin-Lasiter, Inc. on June 19, 2012.
        - Save and Except Tract (0.48 Acres) – All that certain tract or parcel of land situated about 20-1/2 miles Northwest of the City of Liberty, Liberty County, Texas on the James Humphries Survey, A-212 and being part of a 3517.13 acre tract described in a Deed from TIN Inc. to Forestar (USA) Real Estate Group, Inc. Dated October 1, 2007 and recorded in the Document No. 2007014953 of the Office of Public Records of Liberty County, Texas and also being part of a 249.93 acre tract surveyed by Goodwin-Lasiter, Inc. of Lufkin, Texas on the 19th day of June, 2012.
            - Surveyed by Jeffrey D. Opperman on June 25, 2014.
    - Note: The Save and Except Tract (0.48 acres) was excluded from the bank resulting in an acreage of 249.45 for this tract.
- 100.96 Acres. All that certain tract or parcel of land situated about 21 miles Northwest of the City of Liberty, Liberty County, Texas on the James Humphries Survey, A-212 and being part of a 3517.13 acre tract described in a Deed from TIN Inc. to Forestar (USA) Real Estate Group, Inc. Dated October 1, 2007 and recorded in the Document No. 2007014953 of the Office of Public Records of Liberty County.
    - Surveyed by Jeffrey D. Opperman on June 25, 2014.
- 45.66 Acres. All that certain tract or parcel of land situated about 21 miles Northwest of the City of Liberty, Liberty County, Texas on the James Humphries Survey, A-212 and being part of a 3517.13 acre tract described in a Deed from TIN Inc. to Forestar (USA) Real Estate Group, Inc. Dated October 1, 2007 and recorded in the Document No. 2007014953 of the Office of Public Records of Liberty County.

    - Surveyed by Jeffrey D. Opperman on June 25, 2014.
- Note: the three tracts (249.45 acres, 100.96 acres, and 45.66 acres) constitute the mitigation bank boundary of 396.07 acres.

1.2 BANK PURPOSE

The primary goals of HCMB are to restore the ability to transport an amount of sediment adequate for the stream's watershed; protect the water quality of the downstream San Jacinto system; provide habitat and refuge to wildlife; establish a dynamically stable forest both resistant and resilient to disturbance events; and to ensure the longevity and function of the system through long-term conservation measures.

Another purpose of the HCMB is to provide the necessary resources to allow for compensation of authorized/unavoidable impacts to aquatic resources and meet the need for stream mitigation credits within the geographic service areas of the Bank and in areas outside the service area as approved by the U.S. Army Corps of Engineers (USACE) Galveston District in coordination with the Interagency Review Team (IRT). Credits generated by the Bank will (a) reduce uncertainties on behalf of the USACE when gauging the ecological benefit and success of required mitigation; (b) decrease the time necessary to permit projects with aquatic resource impacts; and (c) reduce the strain on the limited resources of the agencies for review and compliance monitoring for non-bank mitigation credits.

The Bank will provide general use stream credits to mitigate for unavoidable impacts to stream resources as approved by the USACE. Once a permittee has secured the appropriate number and resource type of credits from the Sponsor, the Sponsor assumes responsibility for a permittee's compensatory mitigation requirement.

1.3 CONTACT INFORMATION

Forestar is the Bank Sponsor and also the surface owner of the HCMB property. The Sponsor is the responsible entity for providing the necessary financial resources, the technical and scientific expertise for the design and implementation, and financial management and long-term maintenance for the Bank. The contact information for the Sponsor and primary agent are shown in Table 1.

TABLE 1: CONTACT INFORMATION FOR HCMB

Sponsor	**Sponsor's Agent:**
Bill Goodrum	Neil Boitnott
Forestar (USA) Real Estate Group, Inc.	RS&H, Inc.
6300 Bee Cave Road	100 East Ferguson Street
Building 2, Suite 500	Suite 420
Austin, Texas 78746	Tyler, Texas 75702
billgoodrum@forestargroup.com	neil.boitnott@rsandh.com
512.433.5386 (office)	903.525.9838 (office)

1.3.1 Qualifications of Sponsor

The Sponsor has been actively involved in the development of successful aquatic mitigation sites throughout the southern United States for the past two decades. The Sponsor has prior experiences in selecting high-quality sites with excellent potential for restoration success. By employing accomplished designers and regional technical experts, the success rate for these banks has been exceptional. Table 2 below highlights the projects and locations of the Sponsor's experience with compensatory mitigation projects.

TABLE 2: BANK SPONSOR QUALIFICATIONS

	Project	State	Year Initiated	Status	Mitigation Type	Credits/Acres/Ft.
1	Tower Road	GA	1995	Monitoring Year 2	Stream	33,000 credits
2	Tower Phase II	GA	2011	Design/Permitting	Stream & Wetland	TBD
3	Messer Creek	GA	2011	Design/Permitting	Stream & Wetland	TBD
4	Good Neighbor Creek	GA	2009	Permitted (6/2012)	Stream	470,000 credits
5	Cochran's Creek	GA	2009	Permitted 2010 Purchased 2012	Stream	212,000 credits
6	Tallapoosa	GA	2012	Design/Permitting	Stream & Wetland	TBD
7	Houston/Conroe Mitigation Bank	TX	2010	Draft MBI Submitted	Stream	109,820 credits
8	Upper Neches Mitigation Bank	TX	2011	Design/Permitting	Stream & Wetland	TBD
9	Lufkin Stream Mitigation Bank	TX	2012	Draft MBI Submitted	Stream	TBD
10	Sabine Investment Project Specific Mitigation	TX	1996	Completed	Wetland	14 Ac
11	Humble Independent School District Project Specific Mitigation	TX	2005	Completed	Wetland	50 Ac
12	Silver Stone III Project Specific Mitigation	TX	2006	Completed	Wetland	15 Ac
13	Home Depot, Lufkin Project Specific Mitigation	TX	2007	Completed	Stream	5,000 ft
14	242-LLC Project Specific Mitigation	TX	2008	Completed	Wetland	190 Ac
15	Lufkin Garden District Project Specific Mitigation	TX	2010	Completed	Stream	5,600 ft

1.3.2 Qualifications of Sponsor's Consultants

RS&H, Inc.

RS&H is a facilities and infrastructure consulting firm that employs a multidisciplinary staff of over 800 architects, engineers, planners, and environmental scientists. Neil Boitnott (Project Manager) has led RS&H's efforts on the HCMB. RS&H personnel possess extensive experience in aquatic resource restoration throughout the southeast and have been involved in protecting, enhancing, and/or restoring over 15,000 Ac on numerous restoration sites. RS&H's responsibilities for the HCMB have consisted of conducting preliminary studies including a market analysis to determine feasibility of the Bank, desktop assessments of the biological and hydrologic suitability of the site, coordination with other project partners, and negotiations with the permitting agencies.

Meanders River Restoration

Meanders River Restoration, Inc., is under the leadership of Dr. Steve Jones who has personally been involved in preparing plans on over 20 mitigation bank sites, which include over 30 miles of natural channel design stream restoration. The responsibility of Meanders River Restoration, Inc. has included the preparation of MBI design plans for the approximately 29,471 Lf of stream restoration on the HCMB. The design is much more comprehensive than what is provided in many MBIs and includes reference stream data collection, channel plan-form design with structure locations, longitudinal profile, channel bed slope and bankfull slope, cross-sectional design for typical pools and riffles, and details for in-channel structures.

Hydrex Environmental, Inc.

Hydrex Environmental, Inc., led by Clayton Collier (Manager of Ecological Services) has over 15 years of experience conducting wetland investigations, Phase I Environmental Site Assessments, and numerous other environmental sampling and analyses. Hydrex Environmental, Inc. was responsible for conducting extensive preliminary field studies to characterize the site and determine the Bank's feasibility as well as Geographic Information System (GIS) analyses.

1.4 REGULATORY AUTHORITIES

The establishment, use, and operation of the Bank will be carried out in accordance with the following authorities:

- Clean Water Act (33 USC 1251 et. seq.)
- Rivers and Harbors Act (33 USC 403)
- Fish and Wildlife Coordination Act (16 USC 661 et. seq.)
- Regulatory Programs of the U.S. Army Corps of Engineers, Final Rule (33 CFR 320-330)
- Guidelines for Specification of Disposal Sites for Dredged and Fill Materials (40 CFR 230)
- Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army concerning Determination of Mitigation Under the Clean Water Act, Section 404(b) 1 Guidelines (February 6, 1990)
- Final Rule for the Compensatory Mitigation for Losses of Aquatic Resources issued by the U.S. Army Corps of Engineers and the Environmental Protection Agency (April 10, 2008)
- Section 7 of the Endangered Species Act (16 USC 1531-1544)
- Section 106 of the National Historic Preservation Act (16 U.S.C. 470f)
- Texas State Water Quality Certification [(30 Tex. Admin. Code §279.12 (2001)]
- Texas State Water Quality Standards [30 Tex. Admin. Code §301 (2000)]
- Texas Parks and Wildlife Code Chapter 14 Powers and Duties Concerning Wetlands

1.5 INTERAGENCY REVIEW TEAM

Multiple state and federal agencies participated in the development of this MBI as members of the IRT. The IRT is composed of the agencies and their designated representatives listed in Table 3 and is chaired by the USACE Galveston District representative, Mr. Jayson Hudson.

TABLE 3: INTERAGENCY REVIEW TEAM MEMBERS

Agency	Representative	Address	Email
U.S. Army Corps of Engineers	Mr. Jayson Hudson (Chair)	2000 Fort Point Road Galveston, TX 77553	Jayson.M.Hudson@usace.army.mil
U.S. Fish and Wildlife Service	Mr. Arturo J (AJ) Vale	17629 El Camino Real, Suite 211 Houston, TX 77058	Arturo_Vale@fws.gov
U.S. Environmental Protection Agency (Region VI)	Ms. Alison Kitto	1445 Ross Ave. Dallas, TX	Kitto.Alison@epa.gov
National Marine Fisheries Service	Ms. Heather Young	4700 Avenue U Galveston, TX 77550	Heather.Young@noaa.gov
Texas Parks and Wildlife Department	Mr. Mike Morgan	1502 East FM 517 Dickinson, TX 77539	Mike.Morgan@tpwd.texas.gov
Texas General Land Office	Mr. Tony Williams	1700 North Congress Avenue Austin, TX 78701	Tony.Williams@glo.texas.gov
Texas Commission on Environmental Quality	Ms. Brittany Lee	12100 Park 35 Circle, MC-150 Austin, TX 78753	Brittany.Lee@tceq.texas.gov
Natural Resource Conservation Service	Mr. Dan Keesee	101 South Main St. Temple, TX 76501	Dan.Keesee@tx.usda.gov

1.6 LEGAL RESPONSIBILITY STATEMENT

The Sponsor assumes all legal responsibility for satisfying the mitigation requirements (i.e. the implementation, performance, and long-term management of the compensatory mitigation project approved under this agreement) of Department of the Army (DA) or State permits for which the bank has been utilized or fees have been accepted. The transfer of liability from permittee to the Sponsor is established by: 1) the approval of this MBI by the Sponsor and the District Engineer (DE), 2) receipt of a credit transaction report by the DE that is signed and dated by the Sponsor, and 3) the transfer of fees required from the permittee to the Sponsor.

The responsibility for financial success and risk to the investment initiated by the Sponsor rests solely with the Sponsor. The regulatory agencies that are parties to this agreement administer their regulatory programs to best protect and serve the public's interest, and not to guarantee the financial success of banks, specific individuals, or entities. Accordingly, there is no guarantee of profitability for any individual mitigation bank. As such, the Sponsor does not construe this agreement as a guarantee that the agencies will ensure sale of credits or that the agencies will forgo other mitigation options that may also serve the public interest. Since the agencies do not control the number of banks proposed or the resulting market impacts upon success or failure of individual banks, in-depth market studies of the potential and future demand for bank credits are the sole responsibility of the Sponsor.

1.7 OWNERSHIP STATEMENT

Forestar is the surface owner of the HCMB property, as documented in Appendix B. The Sponsor is the responsible entity for providing the necessary financial resources, the technical and scientific expertise for the design and implementation, and financial management and long-term maintenance for the Bank.

2 MITIGATION PLAN

2.1 OBJECTIVES

The Bank Purpose (Section 1.2) explains the overall goals of the HCMB, but these goals will be achieved through the attainment of certain objectives. These objectives are:

- Restore the pattern, profile, and dimensions to the 29,471 Lf of Orange Branch and its tributaries through Priority 1 restoration and channel re-creation;
- Enhance and rejuvenate buffer vegetation and community structure through selective planting and forest management strategies;
- Ensure channel stability and continuity by the cessation of silvicultural activities within the bank boundary and protecting the site in perpetuity with a conservation easement.

The Sponsor and the Sponsor's agents will utilize the principles and techniques in Natural Channel Design coupled with the most relevant research in forestry and wildlife management to achieve these objectives.

2.2 SITE SELECTION

The selection of the proposed Bank incorporated a tiered approach to provide the most effective and efficient methodologies to identify and evaluate suitable Bank sites that would provide the highest yields of ecological functional gain. First, a landscape-level GIS evaluation and technical investigations (soils, hydrology, floral/faunal community assessments, rare and endangered species, critical habitat, etc.) were performed to select the site and determine potential feasibility. After the site selection process identified a potential area, an in-depth analysis to determine the Bank's restoration/enhancement/preservation potential was completed.

2.3 SERVICE AREA

The Sponsor is requesting the designation of the Bank as a unique, high-quality restoration area to provide compensatory stream mitigation credits for the Lake Houston and Galveston Bay geographic. The Bank is located within the East Fork San Jacinto Sub-basin (8-digit HUC 12040103), which is a sub-basin of the San Jacinto Basin (6-digit HUC 120401).

The following guidelines were utilized in the designation of primary and secondary service areas. All service area designations are limited to the Galveston District of the USACE and exclude all Texas Parks and Wildlife Department (TPWD) properties and facilities. The primary service area consists of the Lake Houston Watershed excluding the Western Gulf Coastal Plain Level III Ecoregion. The secondary service area consist of 8-digit HUCs, or portion thereof, adjacent to the primary service area with proven hydrologic connection and similar stream types to the primary service area. Appendix A - Exhibit 3 illustrates the proposed service area.

The primary service area is the Lake Houston Watershed excluding the Western Gulf Coastal Plain Level III Ecoregion, which includes portions of the following sub-basins (8-digit HUCs):

- East Fork San Jacinto (8-digit HUC 12040103);
- West Fork San Jacinto (8-digit HUC 12040101), downstream of Lake Conroe;
- Spring (8-digit HUC 12040102), within South Central Plains Ecoregion.

The secondary service area includes all or portions of the following sub-basins (8-digit HUCs) adjacent to the primary service area:

- West Fork San Jacinto (8-digit HUC 12040101), Lake Conroe watershed;
- Spring (8-digit HUC 12040102), outside of South Central Plains Ecoregion;
- Lower Trinity (8-digit HUC 12030203), within South Central Plains Ecoregion.

The Geographic Service Areas were determined by utilizing the watershed approach combined with ecological, hydrological, and finally, economic considerations for compensatory mitigation. Rationale for this service area determination is in accordance with the 2008 mitigation banking rule, and comprehensive scientific justification, appropriate supporting data, and references to peer reviewed literature were used to support these assertions. The following are the major justifications for determination of the service area for HCMB:

- A watershed approach was utilized to determine all service areas.
    - Primary Service Area flows into one common waterbody (Lake Houston).
    - Secondary Service Area Flows into one common waterbody (Galveston Bay).
    - Significant hydrologic connectivity exists between mapped HUC boundaries within the proposed service area.
    - Watershed approach was in accordance with locally developed standards and practices.
- Stream restoration within HCMB will provide direct and tangible stream function benefits to the service area.
    - HCMB will provide a substantial benefit to Luce Bayou, one of the few remaining unimpaired streams in the area, and one of the few watersheds lacking a Total Maximum Daily Load (TMDL) (TCEQ, 2012).
    - Several unique and rare loess blowout/depressions and flow-through swale wetland communities on site will be preserved/enhanced.
    - Stream restoration within the HCMB and the associated wetlands within the riparian buffer will provide water quality improvement and protection for both the East Fork of the San Jacinto as well as Lake Houston. This can mitigate the inputs from the more impacted West Fork of the San Jacinto and Spring Sub-basins.
    - Ecological "in-kindness" and significance extends beyond the limits of the mapped ecoregion boundaries, especially with regard to stream type and functions.
- Proposed Service Area is based on needs within the watershed.
    - Proposed service area has experienced significant stream function losses with no stream mitigation banking option.
        - As a result, mitigation requirements have had to depend on out-of-kind mitigation and permittee responsible mitigation.
        - Losses of stream resources and overall stream functions have also occurred due to mitigation through stream preservation.
- Proposed service area is necessary for the economic viability of the bank.

2.4 SITE PROTECTION INSTRUMENT

A conservation easement will act as a real estate instrument to ensure the land will remain in a state of conservation in perpetuity. The proposed conservation easement holder is Bayou Land Conservancy who

is an Accredited Land Trust by the Land Trust Accreditation Commission; a national accreditation organization. A draft of the conservation easement is provided in Appendix C. The conservation easement will be filed upon execution of the MBI.

If the Sponsor requests transfer of ownership and operations of the Bank, the Sponsor recognizes such a transfer will require supplying the pertinent third-party entity information to the IRT. Further, the IRT retains the right to approve, and/or modify any agreements to transfer the Bank from the Sponsor to another entity or organization.

2.5 BASELINE INFORMATION

2.5.1 Preliminary Assessment

A preliminary site feasibility and resources determination was performed utilizing field surveys and remote-sensing infrared (IR) ortho-imagery, desktop elevation reconnaissance using 7.5 minute USGS topographic information, U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) maps, and Natural Resource Conservation Service (NRCS) soil survey data. The baseline data were compiled into a geo-referenced database system and were delineated based on scientific interpretation of the data, including elevations and vegetative community signatures, hydric soil delineations, and infrared temperature changes.

Field surveys were conducted to gather on-site information regarding the vegetative community structure, the in-channel stream conditions, and the potential for success from the proposed mitigation activities. Primary focus was placed upon wetland and riparian communities. The following sections detail the existing site conditions prior to any proposed restorative efforts.

Vegetation

The site consists of three distinct habitat types that include depressional areas, flats, and riparian areas. The depressional areas are primarily forested and are periodically ponded throughout the year. Forested depressions within the Bank are typically represented by laurel oak (*Quercus laurifolia*), Drummond's maple (*Acer rubrum var. drummondii*), Chinese tallow (*Triadica sebifera*), sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), common buttonbush (*Cephalanthus occidentalis*), and dwarf palmetto (*Sabal minor*). The "Flat" communities are low-lying wetland areas of less than 1 percent slope and are dominated by laurel oak, loblolly pine, Drummond's maple, Chinese tallow, and dwarf palmetto. These areas are associated with the upper regions of the Orange Branch system. The riparian and floodplain systems associated with Orange Branch consist of a mixture of large pine and hardwoods, including water oak, laurel oak, swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Quercus pagoda*), red maple (*Acer rubrum*), sweetgum, Chinese tallow, dwarf palmetto, and various understory species tolerant to moist environments (*Cephalanthus* spp., *Vaccinium* spp., *Viburnum* spp., *Morella* spp., etc.).

Many of the existing habitats located within the bank, particularly in the northern portions, have been altered by previous agriculture and/or intensely managed silvicultural practices and do not optimally function compared to similarly classified, reference ecosystems within the region.

Hydrology

The hydrology of the Bank consists of altered forested wetlands, uplands, and intermittent and ephemeral streams making up the Orange Branch drainage system. Orange Branch flows in a southwesterly direction and ultimately joins the East Fork of the San Jacinto River south of Plum Grove, Texas. The East Fork of the San Jacinto merges with the West Fork and flows into Lake Houston, then ultimately into Galveston Bay.

The 2008 Houston Galveston Area Council (HGAC) Light Detecting and Ranging (LiDAR) data verify the drainage patterns as described by the USGS topographic maps but with greater detail. The digital terrain model and 1 ft contours derived from the LiDAR data clearly define the boundaries of the valley and relic channels as well as the depressions depicted on the USGS topographic maps. In addition, the LiDAR data reveals the micro-topography of the flats and upland mounds occurring across the site.

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate map for the project area indicates the 100 year floodplain extends approximately 0.4 miles along Orange Branch in the southern portion of the site (FEMA, 2014). The remainder of the project site is shown to be located within Zone X. Zone X is described as those areas outside the 0.2 percent chance of annual flooding.

Given the historic land use, agricultural and silvicultural practices have adversely affected the natural hydrologic regime of this area. Specifically, the insertion of elevated roadways and drainage ditches, the alteration to topographic elevations via bedding and/or roller chopping site preparation, and the alteration of the native vegetation for intensive pine plantation management have altered the natural hydrology of the Bank. Sedimentation from overland sheet flow and/or reduced flow pulsations from hydrologic impediments have caused depositional aggradation within the stream channels of the East Fork, West Fork and the mainstem of Orange Branch to where the natural channel is virtually non-existent. In addition, an existing channel in the upper West Fork has been channelized and converted to a drainage ditch. On the East Fork there are reaches of remnant channel classified as an aggraded Rosgen Type C stream. In the valley reaches where the channel is non-existent due to aggradation, the flow occurs as sheet flow through the forested wetland valleys.

Due to the effects of the hydrologic alterations and native vegetative community manipulation, the existing streams and wetlands are not functioning as optimal sources of natural conveyances, aquatic storage, aquatic filters, and/or suitable aquatic habitat associated with the natural and unaltered stream system.

Soils and Topography

Property elevations of the Bank are relatively low relief, sloping generally to the south towards the floodplains of Orange Branch. The 7.5' quadrangle (Plum Grove) lists the property elevation to be consistently between 95 and 120 ft North American Vertical Datum (NAVD) contours above Mean Sea Level (MSL) (USGS, 2014).

A review of the NRCS Soil Survey of Liberty County, Texas (USDA NRCS, 1996) indicates the site contains six (6) soil mapping units (Table 4). The mapping unit Kirbyville fine sandy loam, 0 to 2 percent slopes (30) are moderately well drained soils located on the rise of flats. Sorter loam, 0 to 1 percent slopes (51) are poorly

drained soils located on flats. Soils mapped as Sorter-Dallardsville complex, 0 to 1 percent slopes (52) are poorly drained soils located on the inter-mounds of flats containing mound/inter-mound complexes. Dallardsville are moderately well drained soils located on pimple (Mima) mounds of flats containing mound/inter-mound complexes. The Lelavale silt loam, 0-1 percent slopes (33), are very deep, very poorly drained soils formed in loamy, fluviomarine Pleistocene deposits. The Splendora fine sandy loam, 0-2 percent slopes (54) are somewhat poorly drained soils located on the foot slopes and base slopes of hills. Hatliff soils, of the Hatliff-Pluck complex frequently flooded (241), are moderately well drained soils located along floodplains. Pluck soils, of the Hatliff-Pluck complex frequently flooded, are poorly drained soils located along floodplains.

Soils of the proposed Bank are classified as loamy fluviomarine depositions from the early Pleistocene era. These depositions are characterized as having a loamy surface layer of siliceous or smectitic mineralogy (USDA, 2006). According to the Geologic Atlas of Texas map (Beaumont sheet), the majority of the site lies in an outcrop area of the Lissie Formation along the western side of a north-south trending ridge dividing the East Fork San Jacinto River and Tarkington (USDA, 2006) Bayou. The Pleistocene age Lissie Formation conformably overlies the Willis Formation and includes the age-equivalent Montgomery and Bentley Formations. The formation is considered fluvial with suggested thicknesses from approximately 200 ft (Barnes, 1992) to 1,000 ft in near coast sections (Doering, 1935).

The Upper Lissie (formerly Montgomery Formation in southeast Texas) consists of clayey sands with silt, and minor amounts of siliceous gravel of granule and pebble sizes. The upper portion may be locally calcareous and commonly contains concretions of calcium carbonate, iron oxide, and iron-manganese oxides in the zone of weathering. The lower Lissie (formerly Bentley Formation in southeast Texas) contains slightly coarser gravel and is non-calcareous with slightly more abundant iron/iron-manganese concretions. In outcrop, surface expression is fairly flat and featureless, except for numerous, rounded, shallow depressions and pimple mounds (Barnes, 1992). Soils that exhibit the primary hydric soil indicator A16: Coastal Prairie Redox occur mainly on depressions and portions of the inter-mound landforms of the Lissie Formation.

TABLE 4: CHARACTERISTICS OF INDIVIDUAL SOIL MAPPING UNITS WITHIN BANK

Soil Mapping Unit	SOIL CHARACTERISTICS					
(Map Symbol)	**Drainage Class**	**Flooding**	**Potential for Wetland Plants**	**Potential for Wetland Wildlife**	**Hydric Soil Component[1]**	**Hydric Soil Inclusions [1]**
Kirbyville fine sandy loam, 0-2 percent slopes (#30)	Poorly	None	Fair	Fair	No	Sorter (5 percent) Waller (5 percent)
Sorter loam, 0-1 percent slopes (#51)	Poorly	None	Good	Good	Sorter (85 percent)	- - -
Sorter-Dallardsville complex, 0-1 percent slopes (#52)	Poorly	None	Good/Fair	Good/Fair	Sorter (55 percent)	- - -
Lelavale silt loam, 0-1 percent slopes, ponded (#33)	Very Poorly Drained	None	Good	Good	Lelavale (95 percent)	Jayhawker (3 percent) Jasco (2 percent)
Splendora fine sandy loam, 0-2 percent slopes (#54)	Somewhat Poorly	None	Fair	Fair	No	Sorter (5 percent)
Hatliff-Pluck complex, frequently flooded (#241)	Moderately Well/Poorly	Occasional/ Frequent	Poor/Good	Poor/Fair	Pluck	- - -

[1] **National Hydric Soils List (NRCS, 2013)**

Wildlife Surveys

Zoological surveys were conducted within the entire parent tract. These reports and their summary conclusions are found within Appendix D.

2.5.2 Threatened and Endangered Species

Federally listed or candidate threatened and endangered occurring or potentially occurring within Liberty County include the red-cockaded woodpecker (*Picoides borealis*), interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus*) (USFWS, 2014). There are no federally listed threatened, endangered, or candidate species for mussels or other invertebrates within the bank watershed (USFWS, 2014) (USFWS, 2009) (USFWS, 2011).

The red-cockaded woodpecker nests in old-growth pine forest generally maintained by frequent, low-intensity burns to limit hardwood encroachment and to maintain an open "savannah" like habitat. Suitable foraging habitat can be younger than nesting habitat; however little to no mid-story is still required to provide an abundance of native bunchgrass and forb groundcover (USFWS, 2003). No nesting or foraging habitat is within HCMB, therefore no effects to the red-cockaded woodpecker are anticipated.

The interior least tern, piping plover and red knot are shore birds known to winter along the Texas Gulf Coast. HCMB may provide stopover habitat during migration for these species, but due to the distance from the coast and other habitat factors, would not provide nesting or breeding habitat for these species. As a result, the restoration activities at HCMB will not have an effect on these species.

Review of the literature provided by the TPWD indicates several state listed threatened and endangered species may benefit from the proposed Bank site. Surveys of the wildlife on the parent tract were conducted, and a more detailed discussion of species found and their relevance is provided in Appendix D. Existing bird populations on-site are impressive, with 43 different species observed during a 140 man-hour study conducted within the parent tract. Additionally, habitat within the bank will be improved during bank establishment by increasing vegetative species composition and diversity which will likely increase bird species and abundance.

The Bank, as proposed, will provide a beneficial wildlife corridor and complimentary wildlife habitat to the nearby Sam Houston National Forest, the Lake Houston Wilderness Park, and USFWS's Trinity River Wildlife Refuge. Further, it will provide permanent and perpetual benefit to the State-listed species that require aquatic, mesic, and riparian habitat dominated by climax hardwood species, such as alligator snapping turtle (*Macrochelys temminckii*), timber rattlesnake (*Crotalus horridus*), white-faced ibis (*Plegadis chihi*), wood stork (*Mycteria americana*), as well as the Townsend's big-eared bat (*Corynorhinus townsendii*) and southeastern myotis bat (*Myotis austroriparius*).

2.5.3 Cultural Resources Assessment

An intensive archaeological survey was conducted by Victor Golan, Ph.D. of Deep East Texas Archeological Consultants. This study did not identify any cultural or historic resources within the property. The Texas Historical Commission (THC) has concurred with these findings. Please see Appendix E for a copy of the report and THC's concurrence.

There are no documented sites associated with the Bank, but if any archeological objects are discovered during the course of this process, the Sponsor will disseminate any and all information to the Texas Historical Commission for further review.

2.5.4 Delineation of Waters of the U.S. Including Wetlands

Hydrex Environmental, Inc. (Hydrex) completed a delineation of all waters of the U.S. (WOUS), including wetlands, and their full report is located in Appendix F. This report contains a history of the property's land use, soil data and maps, vegetation surveys, and hydrologic data. Historical aerial maps are also included to confirm previous land use changes. An official jurisdictional determination was conducted, and those findings are included.

Based upon the information collected by Hydrex, the proposed HCMB possesses approximately 1,627 Lf of intermittent channels; 5,233 Lf of ephemeral channels; 0.66 Ac of open water; and 217.34 Ac of wetlands. Channels were defined as having evidence of an Ordinary High Water Mark (OHWM). Approximately 19,392 Lf of stream valley was mapped where channels exist upstream and/or downstream, but channels were not currently evident between the remnant reaches. Overland, sheet flow was observed through these valleys. Anthropogenic disturbances in the original channels have caused severe aggradation. As a result, bed and bank channels no longer exist between the existing segments (no discernable OHWM). Common disturbances on the property were pipelines, ATV use, roads with improperly constructed streams crossings, and silvicultural activity involved in the planting and management of a working pine plantation before the adoption of the State's best management practices for forestry. The soil was appreciably hydric in many areas of the property, suggesting more intensive bedding and rowing may have been necessary for pine establishment. Harvesting equipment and thinning led to soil disturbance, and was a probable contributor to channel aggradation.

Additional easements and rights-of-way were not included in the Delineation Report. The revised acreages for the various land use areas of the HCMB are listed in Table 5 below and can be seen in Appendix A - Exhibits 3 and 4.

TABLE 5: CURRENT LAND USE ACREAGES FOR THE HCMB

Feature	Acreage	Total Acreage
Uplands (Predominantly Pine Plantation)	166.6	383.9
Wetlands (Predominantly Pine Plantation)	217.3	
Existing Streams	1.4	1.4
Open Water	0.7	0.7
Exclusions (Roads, Pipelines, Well Pads)	10.1	10.1
HCMB Property		396.1

2.5.5 Functional Assessment of Streams and Wetlands

RS&H used the Galveston District's Stream Condition Assessment 2013 (Galveston SOP) (USACE, 2013) for evaluating all in-stream channels and associated riparian buffers involved with the restoration of Orange Branch. RS&H conducted a Level I assessment (Section 1) to appraise the conditions and functionality of the channel, the riparian buffers, and in-stream habitat, as well as any anthropogenic alterations to the channel or hydrologic regime. The results of this study can be found within the Functional Assessment Report (Appendix G), along with photos of all study sites.

For the wetlands within the Bank, RS&H used the Riverine Forested Interim Hydrogeomorphic Method (iHGM) and the Riverine Herbaceous/Shrub iHGM to evaluate baseline conditions. This iHGM assessment focuses on three main categories (a) the Temporary Storage and Detention of Storage Water (TSDSW), (b) Maintenance of the Plant and Animal Community (MPAC), and (c) the Removal and Sequestration of Elements and Compounds (RSEC). The complete functional assessment data and report can be found in Appendix G and includes photos for all sampling locations. An iHGM assessment was conducted, however wetlands within the bank are credited as riparian buffer credits, and are not generating any wetland credits. Therefore wetland impacts will not be compensated for at HCMB.

Streams

The wetlands and streams both exhibit reduction in function due primarily to anthropogenic activities. The majority of the site was cleared in 1989 for a commercial timber harvest and was replanted to a loblolly pine plantation. Timber harvesting before best management practices and its associated effects on the surrounding landscape have decreased vegetative species diversity across the site and have resulted in severe stream aggradation. The overall impact as assessed by the Galveston SOP Level I methods used in the Functional Assessment (Appendix G) can be seen in Table 6. The Galveston SOP Level I method is only valid for channels with an OHWM.

TABLE 6: AVERAGE STREAM FUNCTIONAL ASSESSMENT RESULTS BY REACH AND VARIABLE

Reach	Transect	Type	Length (Lf)	Condition Index*	WAA in Buffer
Main Stem (MS)	1	Intermittent	350	2.75	WAA 2
	2	Intermittent	350	2.25	WAA 2
	3	Intermittent	350	2.00	WAA 2
	4	Intermittent	350	2.00	WAA 2
Main Stem (MS)	**MS Transects Total**	**Intermittent**	**1,350**	**2.25**	
	Stream Total**	**Intermittent**	**1,627**		
West Fork (WF)	1	Ephemeral	350	2.00	WAA 2
	2	Ephemeral	258	2.00	WAA 2 and 3
	3	Ephemeral	350	2.00	WAA 1
	4	Ephemeral	350	2.00	WAA 1
	5	Ephemeral	350	1.79	WAA 1 and 4
	6	Ephemeral	350	3.13	WAA 4
West Fork (WF)	**WF Transects Total**	**Ephemeral**	**2,008**	**2.15**	
	Stream Total**	**Ephemeral**	**2,639**		
West Fork C (WFC)	**1**	**Ephemeral**	**343**	**2.38**	WAA 4
	Stream Total**	**Ephemeral**	**343**		
East Fork (EF)	1	Ephemeral	350	2.25	WAA 2
	2	Ephemeral	215	1.75	WAA 2
	3	Ephemeral	350	1.75	WAA 2
	4	Ephemeral	350	1.75	WAA 2
	5	Ephemeral	303	2.00	WAA 1
East Fork (EF)	**EF Transects Total**	Ephemeral	1,568	1.90	
	Stream Total**	**Ephemeral**	**2,251**	**1.90**	

* Scores range from 1 (severely impacted) to 5 (optimal)
**Stream Total lengths refer to channel with OHWM, and are the sum of the transects and gaps for a specific reach.

It should be noted the Aquatic Use variable is low, but not severely impacted per se. The score of 1.0 is default for ephemeral and intermittent reaches without perennial pools that are not listed as stream segments by TCEQ. Channel Alteration and Channel Condition address degradation/aggradation within the channel and direct stream impacts (road crossings, culverts, livestock, etc.), respectively. The low scores for Channel Condition reflect the stream channel aggradation in the relic channels still possessing an OHWM. The Channel Alteration illustrates the impacts of road crossings and other influences associated with silviculture (mulch lines, logging decks, etc.). Riparian buffers have better scores as the species diversity was usually acceptable near the channel, but the species distribution amongst strata was undesirable or

there was thinning in the area. The potential for recovery observed in these regions has influenced the restoration strategy discussed later in this document.

Where channels and OHWMs are visible, they are usually an aggraded Rosgen Type C channel with large width to depth ratios. Following the relic channel using LIDAR and topographic maps, Hydrex mapped 19,392 Lf of former stream channel no longer possessing an OHWM. Surveys of streams conducted by Meanders River Restoration, Inc. at reference locations show watersheds one-tenth the area of the watershed catchments for the East and West Forks capable of sustaining stable Rosgen C5 and E5 channels. The evidence of approximately 19,000 Lf of valley that appears to be filled in channel when compared to the LIDAR maps and USGS historical maps suggests the HCMB had a considerably larger stream network to accommodate this watershed. The extent to which the channels have degenerated will require extensive, Priority 1 restoration to return to a functioning condition.

Wetlands

RS&H identified six wetland assessment areas (WAAs), totaling 217.3 Ac, within the data collection boundary. The complete baseline functional assessment report is provided in Appendix G. Table 7 shows the Functional Capacity Index (FCI), the relative score for each category, and the Functional Capacity Units (FCU), the score multiplied by the acreage of each WAA, for the wetland identified within HCMB.

TABLE 7: SUMMARY OF FCI AND FCU VALUES FOR WAAS IDENTIFIED WITHIN HCMB

WAA	Ac	FCI			FCU			Description
		TSDSW	MPAC	RSEC	TSDSW	MPAC	RSEC	
1	118.79	0.70	0.80	0.65	83.66	92.89	77.35	24 year old pine plantation that has undergone multiple thinning operations.
2	48.47	0.79	0.82	0.72	38.16	39.55	34.70	Recently thinned mature hardwood stand.
3	32.72	0.83	0.72	0.82	27.16	23.59	26.68	Young hardwood stands. Areas were cleared in late 1980's and allowed to naturally regenerate.
4	8.06	0.89	0.75	0.89	7.17	6.08	7.15	Young oak dominated stand influenced by beaver activity.
Forested	**208.04**				**156.15**	**162.10**	**145.87**	
5	4.30	0.90	0.75	0.74	3.88	3.23	3.17	*Juncus effusus* dominated herbaceous area influenced by beaver activity.
6	5.00	0.81	0.75	0.70	4.07	3.75	3.50	Various cleared areas dominated by early successional shrubs and herbaceous species.
Herbaceous	**9.30**				**7.95**	**6.98**	**6.67**	
TOTAL	**217.34**				**164.10**	**169.08**	**152.54**	**Wetland A - See Hydrex Delineation Report.**

All six WAAs exhibited a reduction in overall function due to various anthropogenic disturbances, silvicultural practices being the most prevalent. In general, the wetlands encountered lacked vegetation characteristics of high quality wetlands. The species diversity was reduced in most areas and a moderate

component of Chinese tallow and other undesirable, early-successional species were observed as understory coverage.

2.6 DETERMINATION OF CREDITS

The Bank will provide stream credits, as defined in the Galveston SOP, Section 5 (Determination of Compensation) for USACE-authorized aquatic resource losses within the defined Geographic Service Areas as well as in areas outside of the service area as approved by the USACE Galveston District in coordination with the IRT. Wetlands within the bank are credited as riparian buffer credits, and are not generating any wetland credits. Therefore wetland impacts will not be compensated for at HCMB. The proposed Bank will provide credits to the general public (private and public sectors) for general use.

For stream channel restoration, credits are determined using the guidelines provided by the Galveston SOP, Section 5 (Determination of Compensation) (USACE, 2013). The calculation of credits for the HCMB is shown in Table 8, and all stream lengths associated with road crossings or rights-of-way have been removed (468 Lf). The re-creation and restoration of the relic stream channel and aggraded valleys as outlined above qualifies the HCMB to receive Re-establishment Credits at 3 credits per linear foot (Lf) with exceptions for road crossings and rights-of-way. No credits will be requested for these areas, but the system will be devoid of dams, culverts, or other form of channelized stream. In addition to Re-Establishment Credits, the Bank will generate credits through Light Buffer Planting in the outer 100-200 feet (along with approved additional buffer areas), and the Riparian Buffers with Wetlands Credit Adjustment Factor (AF). The channel design, as shown in Appendix H, addresses dimension, pattern, and profile along the entire proposed project.

Channel re-establishment generates 3 credits per Lf according to the Galveston SOP, Section 5. "Re-establishment means the manipulation of the physical, chemical, and biological characteristics of a site with the goal or returning natural/historic functions to a former or degraded aquatic resource" (USACE, 2013). To qualify for re-establishment credits, there is a required 100 ft buffer (inner buffer). Certain improvements outside of inner buffer provide additional credit enhancements. Buffer Credits outside of the mandatory 100' buffer are credited similar to light buffer planting in the optional 200 ft buffer (0.25 credits / Lf). One Lf of stream with the 200' buffer is equivalent to 200 ft^2, which results in the conversion factor of 1 Ac being worth 54.45 credits (reference Table 8). This conversion is necessary due to the requested inclusion of headwater wetlands within the bank that were outside of the outer 200 ft buffer. Additionally, the Riparian Buffers with Wetlands AF generates 0.25 credits per linear foot for riparian buffers where medium to high quality wetlands are created, enhanced, or restored. The entire buffer of the HCMB currently contains, or will contain, wetlands when channel construction is complete and natural hydrology is restored. The total number of credits per linear foot, if all suggested actions are completed, can be seen in Table 8.

As seen in Table 8, HCMB has been split into three monitoring units due to the reasons outlined in the following section. Total credits for each monitoring unit are provided.

TABLE 8: CALCULATED STREAM CREDITS FOR HCMB

Stream Name	Linear Feet	Re-Establishment Credits (3 / Lf)	Wetland Enhancement in Buffer (0.25 / Lf)	Buffer Outside Mandatory 100' (Acreage*)	Buffer Outside Mandatory 100' Credits**	Total Credits
EFC Total	5,076					
EFC Road	132					
EFC Creditable	4,944	14,832	1,236	43.3	2,358	18,426
EFA Total	2,206					
EFA Road	78					
EFA Creditable	2,128	6,384	532	17.7	964	7,880
EFB Total	4,336					
EFB Road	58					
EFB Creditable	4,278	12,834	1,070	62.4	3,398	17,301
Monitoring Unit 1	**11,350**	**34,050**	**2,838**	**123.4**	**6,719**	**43,607**
Mainstem Total	1,483					
Mainstem Road	9					
Mainstem Creditable	1,474	4,422	369	18.4	1,002	5,792
East Fork Total	6,052					
East Fork Road	26					
East Fork Creditable	6,026	18,078	1,507	44.5	2,423	22,008
Monitoring Unit 2	**7,500**	**22,500**	**1,875**	**62.9**	**3,425**	**27,800**
WFA Total	563					
WFA Road	49					
WFA Creditable	514	1,542	129	3.0	162	1,833
West Fork Total	9,755					
West Fork Road	116					
West Fork Creditable	9,639	28,917	2,410	96.5	5,254	36,581
Monitoring Unit 3	**10,153**	**30,459**	**2,538**	**99.5**	**5,417**	**38,414**
TOTAL CREDITABLE	**29,003**	**87,009**	**7,251**	**285.8**	**15,561**	**109,820**

* Acreage is based on area outside of required 100' buffer within the drainage area for each reach.

**Buffer Credits outside of the mandatory 100' buffer are credited similar to light buffer planting in the optional 200 ft buffer (0.25 credits / lf). One Lf of stream with the 200' buffer = 200 sq ft, which results in the conversion factor of 1 ac = 54.45 credits (@ .25 / Lf) (43,560 / 200 * 0.25).

2.7 MITIGATION WORK PLAN

The mitigation work plan encompasses the overall design of the stream channel; restoration/preservation/enhancement of riparian zones; performance and monitoring requirements; and credit generation and release. Table 9 shows the relative acreages of uplands, wetlands, open water, and exclusions (roads and well pads) for the proposed HCMB when construction is completed. A map of the proposed work can be found in Appendix A - Exhibit 4.

TABLE 9: PROJECTED LAND USE ACREAGES UPON COMPLETION OF HCMB

Feature	Acreage	Total Acreage
Enhanced Uplands	165.2	375.9
Enhanced Wetlands	210.7	
Restored Streams	9.6	9.6
Open Water	0.7	0.7
Exclusions (roads, pipelines, well pads	9.9	9.9
HCMB Property		396.1

2.7.1 Stream Channel Design

An assessment of the in-channel condition of Orange Branch and its tributaries was conducted following the guidelines set forth in FBF Assessment. Reference streams were identified for use for comparison of baseline conditions and evaluation of functional lift. The hydraulic geometry of the reference stream channels was measured in addition to the hydraulic geometry of Orange Branch at several locations. These data and other information about the streams, their catchments, and the watershed were used as the basis for the natural channel design of the restored streams.

Natural channel design stream restoration will follow the guidance provided in the FBF Assessment, with particular attention paid to Levels 2 and 3 (Hydraulics and Geomorphology). Level 1 (Hydrology) is not addressed as it pertains to water supply (flood frequency and duration), and as the Sponsor will not artificially supply water to the site, this variable is not within the Sponsor's control. Levels 4 and 5 (Physiochemistry and Biology) are not priorities as these streams would naturally be ephemeral or intermittent channels. As such, water chemistry and biota are highly variable depending upon season, year, etc.

Hydraulics and geomorphology address the dimension, pattern, and profile of the stream channel. The goal of this level of restoration is to restore flow dynamics from laminar flow across the valley to channel forming flows by creating a stable, bankfull discharge channel. When this is achieved, the stream will have dynamic stability where the energy of the flows of the channel are appropriately distributed and the minimal amount of work is accomplished. The proper channel will be modeled using the baseline data of reference reaches and the Harris County regional curves (AMEC Geomatrix, 2009) (Jones, 2014). Groundwater/surface water exchange will be increased by creating a channel with proper bed-form diversity and pools with the proper maximum depth.

The dimensions of a stream refer to the volumetric shape of the channel as it relates to sediment transport capacity. Some of the variables associated with dimensions of the channel are width of flood-prone area (Wfpa), cross-sectional area (Abkf), the width to depth at bankfull ratio (W:D or Wbkf/Dbkf), the flood prone area divided by the bankfull width known as Entrenchment Ratio (ER or Wfpa/Wbkf), and the depth of the top most bank (Dmaxtob) divided by the maximum depth at bankfull (Dmax) known as Bank Height Ratio (BHR).

The overall footprint of the stream on the landscape usually refers to the stream's pattern. Pattern is addressed by variables such as sinuosity (K) of the channel, the radius of curvature (Rc), and the Meander Width Ratio (MWR), which is the belt width of the channel divided by the width at bankfull, among others.

The profile variables of a stream describe the stream's form and function as it moves downslope. The depths and slopes of various reaches in the proposed HCMB restoration can be seen in Appendix H (Sheets 34-36). The success of depth and slope construction is evidenced in stable bed form and diversity. Excessive scouring or deposition is evidence of a channel not in balance with its watershed. Emphasis will be placed on depth variability, riffle/pool/channel slope, riffle/pool spacing, and vertical stability of the channel.

2.7.2 Restoration by Tributary

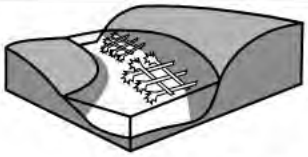
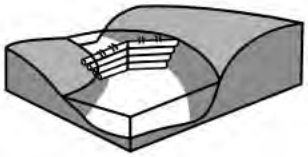
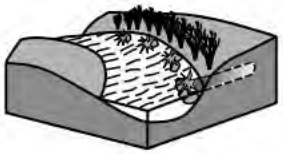
The HCMB in-channel stream restoration effort is one of the largest endeavors of its kind within the Galveston District. Due to the size of the restoration initiative, the stream channel restoration must be conducted in segments to allow for climatic events or other issues that may arise unique to the site. These construction phases are called Monitoring Units. Monitoring Unit 1 will include East Fork A (EFA), East Fork B (EFB), and East Fork C (EFC); Monitoring Unit 2 will include East Fork below the confluence of the headwater tributaries as well as the mainstem of Orange Branch; and Monitoring Unit 3 will include West Fork A (WFA) and the main channel of West Fork. Even though the endeavor is large, all three monitoring units will complete construction within 5 years of bank establishment.

For the purposes of the HCMB stream restoration, comprehensive use will be made of coarse woody debris (CWD), toe wood, root wads, and cover logs. Digger logs, scour logs, and brush riffles shall be utilized as well. The designed locations for the proposed structures can be seen in the diagrams Appendix H. Table 10 is from *Technical Supplement 14J of the Stream Restoration Design Handbook* (USDA NRCS, 2007), and contains both descriptions and illustrations of some of the structures to be utilized.

Riparian vegetation diminishes the velocity of storm-water runoff, entrains sediments, and stabilizes bank structures through extensive root systems. In addition to these physical benefits, riparian plants process and sequester nutrients along with redox reactive metals and contribute organic matter to the channel. Table 18 lists those species currently of some importance found in the HCMB and those under consideration for use in planting. Those listed by the TPWD Texas Plant Information Database (Texas Parks and Wildlife, 2004) as being highly erosion resistant, inundation tolerant, and hardy will be considered for bank stabilization planting. This assortment provides the optimal strategy for mass wasting avoidance, bank stability, and species diversity. Herbaceous plantings will be done in accordance with the stipulations put

forth under Streambank Planting in the USACE Galveston District Stream Condition Assessment: 2013 (USACE, 2013).

TABLE 10: IN STREAM STRUCTURES COMMONLY USED IN STREAM CHANNEL RESTORATION

Configuration	Sketch	Description	Strengths
Engineered logjams		Intermittent structures built by stacking whole trees and logs in crisscross arrangements	Emulates natural formations. Creates diverse physical conditions, traps additional debris
Log vanes		Single logs secured to bed protruding from bank and angled upstream. Also called log bendway weir	Low-cost, minimally intrusive
Log weirs		Weirs spanning small streams comprised of one or more large logs	Creates pool habitat
Rootwads		Logs buried in bank with rootwads protruding into channel	Protects low banks, provides scour pools with woody cover
Tree revetments or roughness logs		Whole trees placed along bank parallel to current. Trees are overlapped (shingled) and securely anchored	Deflects high flows and shear from outer banks; may induce sediment deposition and halt erosion
Toe logs		One or two rows of logs running parallel to current and secured to bank toe. Gravel fill may be placed immediately behind logs	Temporary toe protection

It is important to note C and E channels in sandy loamy soils of little topographic relief are very similar in pattern, profile, and dimension. In the case of HCMB, the major differentiator for a C versus an E channel is the channel width. The start of all the headwater channels on HCMB is a C as the water from the catchment begins to coalesce and the channel forming forces first begin to manifest. As the water moves down slope, the channel becomes more defined, narrows, and deepens to form an E channel, which is the more common stream type for low topographic relief. Reference streams and the Harris County Regional Curve Data were used to determine the pattern, profile, and dimension of the restored stream channels. These data can be found in Appendix H.

East Fork A

Stream design on EFA begins as a C Rosgen stream type and the specific design variables can be found

Table 11. C and E type streams are natural and common for low elevation streams, particularly in sandy loamy soils. EFA's uppermost reach (Sta. 0+00 to Sta. 4+50) includes the beginning of channel formation out of the depressional wetland, and this reach will be shallower and wider as the channel is just beginning to form. The valley slope is the least here (0.0012 ft/ft) as well as the drainage area. The channel has a slope of 0.00104 ft/ft, a K of 1.15, and a W:D of 13.92 (3.62 cross-sectional area) to match the Peach Creek reference stream and the Harris County Regional Curve. At Sta. 4+50, the valley begins to narrow and the valley slope increases (0.0023 ft/ft). Shell Branch is the more appropriate reference for this section. Sta. 4+50 to Sta. 11+17 is unique from the headwaters because of differences in valley slope and width, but it is unique from the downstream reaches because of catchment area. The watershed size at Sta. 0+00 is 0.07 mi^2, and at Sta. 4+50 it is 0.08 mi^2. At Sta. 11+17, the catchment area is now 0.12 mi^2, and this increase in available water along with an increase in valley slope (0.00458 ft/ft) warrants a change in channel design to stay within the design parameters of a reference reach. Although the channel is larger for this reach, the dimensionless ratios of width to depth and sinuosity do not change dramatically from the Sta. 4+50 – Sta. 11+17 reach to the Sta. 11+17 – Sta. 22+06 reach.

East Fork B

The EFB channel will progress from a Rosgen C to an E stream channel in much the same way as EFA will. The W:D of the reference reach, Peach Creek, is 14.20 and the average sinuosity is 1.1, so EFB from Sta. 0+00 – 3+14 has a W:D ratio of 13.56 (average) and a sinuosity of 1.1. This reference reach was chosen because both the reference reach and this segment of EFB have a valley slope of 0.003 ft/ft. The headwaters of EFB will have a larger cross-sectional area (14.11) because of a larger drainage area, but the proportionality reflected in the W:D ratio is the same as the reference condition (13.56 designed compared to 14.20 reference). EFB Sta. 3+14 – 18+54 has a similarly sized watershed, but the topography, soils, and hydrology of the region show a E channel is the more dynamically stable condition, and Shell Branch was used as the reference reach. EFB Sta. 18+54 – 43+36 is similar to Sta. 3+14 – 18+54, but the downstream accrual of more water means a larger cross-sectional area (albeit similar W:D ratio). These specifications and more can be found in Table 12.

East Fork C

The progression in EFC is the same transition as seen in EFA and EFB as shown in Table 13. The reference reach is Peach Creek for Sta. 0+00 – 10+50 because of reference and regional curve data. The W:D ratio is 14.13 for EFC and 14.20 for Peach Creek. The watershed area for EFC is 0.71 mi^2 versus the reference 0.07 mi^2, which is why the cross-sectional area is 15.29 ft^2 for EFC as opposed to 3.55 ft^2 for the reference.

TABLE 11: STREAM DESIGN PARAMETERS FOR EAST FORK A OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 4+50			Design Criteria Sta. 4+50 to Sta. 11+17			Design Criteria Sta. 11+17 to Sta. 22+06			"C" Reference Condition U/S to Point "D"			"E" Reference Condition Shell Branch		
Stream Name: EFA	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.07	N/A	N/A	0.08	N/A	N/A	0.12	N/A	N/A	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	7.10	6.39	7.81	6.10	5.49	6.71	6.90	6.21	7.59	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	0.51	0.43	0.59	0.64	0.54	0.74	0.73	0.62	0.84	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	21.30	14.06	35.50	18.30	12.08	30.50	20.70	13.66	34.50	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	3.62	3.08	4.16	3.90	3.32	4.49	5.04	4.28	5.79	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.92	11.92	15.92	9.53	7.53	11.53	9.45	7.45	11.45	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max depth at bankfull)	0.88	0.79	0.94	1.14	1.02	1.22	1.30	1.17	1.39	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	0.92	0.79	1.04	1.20	1.02	1.34	1.36	1.17	1.53	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.78	1.60	1.90	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	67.5	49.7	85.2	67.1	54.9	85.4	75.9	62.1	96.6	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	49.7	35.5	71.0	45.8	36.6	58.0	51.8	41.4	65.6	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	21.3	12.4	N/A	14.0	9.2	N/A	15.9	10.4	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	14.2	8.9	24.9	15.9	10.7	27.5	17.9	12.1	31.1	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	15.6	9.2	24.9	24.4	16.8	30.5	27.6	19.0	34.5	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.15	N/A	N/A	1.48	N/A	N/A	1.42	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	12.0	11.0	9.0	14.0	11.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	4.0	2.8	5.0	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0012	N/A	N/A	0.0023	N/A	N/A	0.00458	N/A	N/A	0.00363	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.00104	N/A	N/A	0.00156	N/A	N/A	0.00322	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.00286	0.00208	0.00416	0.00428	0.00311	0.00622	0.00886	0.00644	0.01288	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.00016	7.8E-05	0.000208	0.00023	0.00012	0.000311	0.00048	0.00024	0.000644	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	1.12	0.87	1.63	1.47	1.09	2.56	1.72	1.24	2.92	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	7.24	6.39	8.52	6.22	5.49	7.32	7.04	6.21	8.28	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	7.10	3.55	14.20	6.10	3.05	11.59	6.90	3.45	12.42	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	12.43	7.10	21.30	15.25	10.37	24.40	17.25	11.73	27.60	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	7.10	5.68	10.65	7.32	5.49	9.15	8.28	6.21	10.35	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	31.95	26.98	46.15	33.55	27.45	42.70	37.95	31.05	48.30	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.30	1.70	4.00	2.35	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht	Reach	Riffle	Prot. Ht
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

TABLE 12: STREAM DESIGN PARAMETERS FOR EAST FORK B OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 3+14			Design Criteria Sta. 3+14 to Sta. 18+54			Design Criteria Sta. 18+54 to Sta. 43+36			[illegible]			[illegible]		
Stream Name: EFB	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.62	N/A	N/A	0.65	0.63	0.67	0.81	0.72	0.90	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	13.83	12.45	15.21	11.80	10.62	12.98	12.00	10.80	13.20	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	1.02	0.87	1.17	1.25	1.06	1.44	1.40	1.19	1.61	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	41.49	27.38	69.15	35.40	23.36	59.00	36.00	23.76	60.00	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	14.11	11.99	16.22	14.75	12.54	16.96	16.80	14.28	19.32	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.56	11.56	15.56	9.44	7.44	11.44	8.57	6.57	10.57	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.75	1.58	1.89	2.23	2.00	2.38	2.41	2.17	2.59	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.84	1.58	2.08	2.34	2.00	2.61	2.53	2.17	2.85	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	131.4	96.8	159.0	141.6	106.2	165.2	144.0	108.0	168.0	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	96.8	69.2	138.3	88.5	70.8	112.1	90.0	72.0	114.0	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	41.5	24.2	N/A	27.1	17.7	N/A	27.6	18.0	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	27.7	17.3	48.4	30.7	20.7	53.1	31.2	21.0	54.0	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	30.4	18.0	48.4	47.2	32.5	59.0	60.0	48.0	78.0	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.10	N/A	N/A	1.31	N/A	N/A	1.40	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	12.0	9.0	14.0	12.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0033	N/A	N/A	0.0016	N/A	N/A	0.0021	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0030	N/A	N/A	0.0012	N/A	N/A	0.0015	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0082	0.0060	0.0120	0.0033	0.0024	0.0048	0.0041	0.0030	0.0060	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.0004	0.0002	0.0006	0.0002	0.0001	0.0002	0.0002	0.0001	0.0003	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	2.24	1.73	4.08	3.06	2.13	5.00	3.50	2.38	5.60	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	14.11	12.45	16.60	12.04	10.62	14.16	12.24	10.80	14.40	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	13.83	6.92	27.66	11.80	5.90	22.42	12.00	6.00	21.60	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	24.20	13.83	41.49	29.50	20.06	47.20	30.00	20.40	48.00	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	13.83	11.06	20.75	14.16	10.62	17.70	14.40	10.80	18.00	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	62.24	52.55	89.90	64.90	53.10	82.60	66.00	54.00	84.00	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	4.00	2.45	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

TABLE 13: STREAM DESIGN PARAMETERS FOR EAST FORK C OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 10+50			Design Criteria Sta. 10+50 to Sta. 21+73			Design Criteria Sta. 21+73 to 50+76			"C5" Reference Condition UT to Trib TL-2			"E5" Reference Condition Snell Branch		
Stream Name: EFC	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.71	N/A	N/A	0.72	N/A	N/A	0.9	N/A	N/A	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	14.70	13.23	16.17	12.30	11.07	13.53	12.30	11.07	13.53	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	1.04	0.88	1.20	1.25	1.06	1.44	1.45	1.23	1.67	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	44.10	29.11	73.50	36.90	24.35	61.50	36.90	24.35	61.50	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	15.29	12.99	17.58	15.38	13.07	17.68	17.84	15.16	20.51	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	14.13	12.13	16.13	9.84	7.84	11.84	8.48	6.48	10.48	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.79	1.61	1.92	2.23	2.00	2.38	2.49	2.25	2.68	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.88	1.61	2.12	2.34	1.61	2.61	2.62	1.61	2.95	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	139.7	102.9	176.4	147.6	110.7	172.2	147.6	110.7	172.2	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	102.9	73.5	147.0	92.3	73.8	116.9	92.3	73.8	116.9	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	44.1	25.7	N/A	28.3	18.5	N/A	28.3	18.5	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	29.4	18.4	51.5	32.0	21.5	55.4	32.0	21.5	55.4	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	32.3	19.1	51.5	49.2	33.8	61.5	61.5	49.2	80.0	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.13	N/A	N/A	1.31	N/A	N/A	1.42	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	12.0	12.0	9.0	14.0	12.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0014	N/A	N/A	0.0016	N/A	N/A	0.0011	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0012	N/A	N/A	0.0012	N/A	N/A	0.0008	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Snf (Riffle slope, ft/ft)	0.0033	0.0024	0.0048	0.0034	0.0025	0.00492	0.0022	0.0016	0.00316	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.0002	9E-05	0.00024	0.0002	9.2E-05	0.000246	0.0001	6E-05	0.000158	0.0004	0.0002	0.0007	0.0005	3E-05	0.0011
Snf/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	2.29	1.77	3.33	3.13	2.13	5.00	3.63	2.47	5.80	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	14.99	13.23	17.64	12.55	11.07	14.76	12.55	11.07	14.76	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	14.70	7.35	29.40	12.30	6.15	23.37	12.30	6.15	22.14	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	25.73	14.70	44.10	30.75	20.91	49.20	30.75	20.91	49.20	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	14.70	11.76	22.05	14.76	11.07	18.45	14.76	11.07	18.45	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	66.15	55.86	95.55	67.65	55.35	86.10	67.65	55.35	86.10	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht	Reach	Riffle	Prot. Ht
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

East Fork

The East Fork refers to the reach beginning with the confluence of EFA, EFB, and EFC and ending with the confluence with West Fork to create the mainstem of Orange Branch. The channel from confluence to confluence is a Rosgen E channel with a W:D ratio transitioning from 8.05 for Sta. 0+00 – 30+76 to 7.95 for Sta. 30+76 – 41+45 and then finally 11.92 for Sta. 41+45 – 60+52 where the stream joins Orange Branch. The sinuosity ranges from 1.41 to 1.59 with the reference condition of 1.49. The research and reference data included in Appendix H support the design parameters for this channel, which can be found in Table 14.

TABLE 14: STREAM DESIGN PARAMETERS FOR EAST FORK OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 30+76			Design Criteria Sta. 30+76 to Sta. 41+45			Design Criteria Sta. 41+45 to Sta. 60+52			[illegible]			[illegible]		
Stream Name: East Fork	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	1.95	1.83	2.07	2.34	N/A	N/A	2.36	N/A	N/A	3.86	N/A	N/A	0.85	N/A	N/A
Stream Type (Rosgen)	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	14.90	13.41	16.39	15.90	14.31	17.49	19.55	17.60	22.48	18.80	18.80	18.90	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.85	1.57	2.13	2.00	1.70	2.30	1.64	1.39	1.89	2.29	2.14	2.44	1.09	-	-
Wfpa (Width of floodprone area)	44.70	29.50	74.50	47.70	31.48	79.50	58.65	38.71	97.75	73.10	68.10	78.00	30.00	-	-
Abkf (Cross-sectional Area)	27.57	23.43	31.70	31.80	27.03	36.57	32.06	27.25	36.87	43.10	40.11	46.09	6.09	-	-
Wbkf / Dbkf ratio	8.05	6.05	10.05	7.95	5.95	9.95	11.92	9.92	14.81	8.26	7.75	8.77	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.89	3.60	4.15	3.58	-	-
Dmax (Max. depth at bankfull)	3.18	2.87	3.42	3.44	3.10	3.70	2.82	2.54	3.03	4.12	4.08	4.15	1.59	-	-
Dmaxtob (Max depth at top of bank)	3.34	1.61	3.76	3.61	1.61	4.07	2.96	1.61	3.34	4.19	4.08	4.37	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.80	1.67	1.94	1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.02	1.00	1.05	1.00	-	-
PATTERN VARIABLES															
Lm (Meander length in feet)	163.9	134.1	208.6	174.9	143.1	222.6	215.1	176.0	273.7	178.0	145.9	194.7	135.9	118.0	153.0
Lw(Linear Wave length in feet)	107.3	89.4	149.0	114.5	95.4	151.1	140.8	117.3	185.7	144.6	128.4	160.8	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	34.3	22.4	N/A	36.6	23.9	N/A	45.0	29.3	N/A	29.5	22.9	34.5	20.7	16.7	25.9
Larc(Arc length in feet)	38.7	26.1	67.1	41.3	27.8	71.6	50.8	34.2	88.0	65.3	59.9	71.3	30.3	24.7	42.0
Wblt (Belt width in feet)	74.5	59.6	96.9	79.5	63.6	103.4	97.8	78.2	127.1	9.8	5.4	21.4	39.4	36.7	44.0
K (Sinuosity)	1.59	N/A	N/A	1.47	N/A	N/A	1.41	N/A	N/A	1.49	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	11.0	9.0	14.0	11.0	9.0	14.0	11.0	9.0	14.0	9.5	7.8	10.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	7.2	6.0	10.0	7.2	6.0	9.5	7.2	6.0	9.5	7.7	6.8	8.6	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	2.3	1.5	N/A	2.3	1.5	N/A	2.3	1.5	N/A	1.6	1.2	1.8	1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.6	1.8	4.5	2.6	1.8	4.5	2.6	1.8	4.5	3.5	3.2	3.8	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	5.0	4.0	6.5	5.0	4.0	6.5	5.0	4.0	6.5	0.5	0.3	1.1	2.8	2.6	3.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0013	N/A	N/A	0.0010	N/A	N/A	0.0012	N/A	N/A	0.0051	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.0008	N/A	N/A	0.0007	N/A	N/A	0.0009	N/A	N/A	0.0036	N/A	N/A	0.0013	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0022	0.0016	0.00316	0.0019	0.0014	0.00272	0.0023	0.0017	0.0034	0.011	0.006	0.018	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.0001	6E-05	0.000158	0.0001	5E-05	0.000136	0.0001	6E-05	0.00017	0.001	0.00	0.0009	0.0003	8E-05	0.001
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	3.03	1.65	4.96	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.28	0.00	0.25	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	4.63	3.15	5.92	5.00	3.40	8.00	3.94	2.79	6.56	4.60	4.50	4.60	2.14	-	-
Wpool (Width of pool in feet)	15.20	13.41	17.88	16.22	14.31	19.08	19.94	17.60	23.46	19.26	19.00	19.60	18.80	-	-
Lriffle (Length of riffle in feet)	14.90	7.45	25.33	15.90	7.95	27.03	19.55	9.78	33.24	9.79	5.39	21.40	7.59	4.42	11.30
Lpool (Length of pool in feet)	37.25	25.33	59.60	39.75	27.03	63.60	48.88	33.24	78.20	29.67	12.73	44.20	18.45	11.30	27.00
Lglide (Length of glide in feet)	17.88	13.41	22.35	19.08	14.31	23.85	23.46	17.60	29.33	14.32	12.70	21.50	10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	81.95	67.05	104.30	87.45	71.55	111.30	107.53	87.98	136.85	67.82	47.03	92.80	41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.50	1.70	3.20	2.50	1.70	4.00	2.40	1.70	4.00	2.01	1.97	2.01	1.96	-	-
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.02	1.01	1.04	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	0.52	0.29	1.14	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.58	0.68	2.35	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.20	0.90	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.76	0.68	1.14	0.72	0.52	0.92
**Lps/Wbkf (Pool-pool spacing ratio)	5.50	4.50	7.00	5.50	4.50	7.00	5.50	4.50	7.00	3.61	2.50	4.94	2.96	2.21	4.93
MATERIALS										Reach	Riffle	Prot. Ht	Reach	Riffle	Prot. Ht
D16 (mm)										0.03	0.04	N/A	-	-	-
D35 (mm)										0.07	0.09	N/A	-	-	-
D50 (mm)										0.11	0.15	N/A	-	-	-
D84 (mm)										0.28	4.68	N/A	-	-	-
D95 (mm)										9.18	8.66	N/A	-	-	-
D100 (mm)										16.00	16.00	N/A	-	-	-

Orange Branch Main Stem

The confluence of East Fork and West Fork creates Sta. 0+00 for the Main Stem of Orange Branch (Orange Branch). The stream type is an E channel extending to Sta. 14+83 as seen in Table 15. The reference reach is Long Branch, which has a drainage area of 0.85 mi^2 compared to the Orange Branch 4.48 mi^2, but using reference and regional curve data, the W:D ratio for Orange Branch is 17.5 and the W:D ratio for Long Branch is 12.84, which is very similar. Orange Branch is larger than the reference because of the channel widening necessary to accommodate the reach eventually traveling off-site. The valley slopes are very similar (0.00008 ft/ft difference).

TABLE 15: STREAM DESIGN PARAMETERS FOR MAIN STEM ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 14+83			"C5" Reference Condition Long Branch		
Stream Name: Orange Main Stem	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	4.48	4.39	4.60	0.85	N/A	N/A
Stream Type (Rosgen)	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES						
Wbkf (Bankfull width in feet)	28.00	26.00	32.00	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.60	1.50	1.70	1.09	-	-
Wfpa (Width of floodprone area)	650.0	550.0	800.0	30.00	-	-
Abkf (Cross-sectional Area)	45.00	38.25	51.75	6.09	-	-
Wbkf / Dbkf ratio	17.5	15.5	19.5	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	23.2	21.2	30.8	3.58	-	-
Dmax (Max. depth at bankfull)	2.70	2.5	3.0	1.59	-	-
Dmaxtob (Max depth at top of bank)	2.70	1.6	3.3	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.70	1.55	1.85	1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.00	1.00	1.10	1.00	-	-
PATTERN VARIABLES						
Lm (Meander length in feet)	186.0	84.0	348.0	135.9	118.0	153.0
Lw(Linear Wave length in feet)	151.0	80.0	230.0	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	56	49	98	20.7	16.7	25.9
Larc(Arc length in feet)	59.0	20.0	100.0	30.3	24.7	42.0
Wblt (Belt width in feet)	103	60	160	39.4	36.7	44.0
K (Sinuosity)	1.27	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	6.6	3.0	12.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	5.4	2.9	8.2	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	2.0	1.8	3.5	1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.1	0.7	3.6	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	3.7	2.1	5.7	2.8	2.6	3.1
PROFILE VARIABLES						
Sval (Valley slope, ft/ft))	0.00142	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.00112	N/A	N/A	0.00128	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0083	0.0060	0.0100	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.0001	8.4E-05	0.0002	0.0003	0.00008	0.001
Srif/Schan (Riffle slope ratio)	7.41	5.36	8.93	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.09	0.08	0.18	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	4.00	2.72	4.80	2.14	-	-
Wpool (Width of pool in feet)	25.20	22.40	32.20	18.80	-	-
Lriffle (Length of riffle in feet)	14.60	8.00	25.00	7.59	4.42	11.30
Lpool (Length of pool in feet)	27.12	10.60	140.00	18.45	11.30	27.00
Lglide (Length of glide in feet)	55.07	21.44	93.80	10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	90.00	70.00	130.00	41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.50	1.70	3.00	1.96	-	-
Wpool/Wbkf (Pool width ratio)	0.90	0.80	1.15	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	0.52	0.29	0.89	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	0.97	0.38	5.00	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.97	0.77	3.35	0.72	0.52	0.92
*** Lps/Wbkf (Pool-pool spacing ratio)	3.21	2.50	4.64	2.96	2.21	4.93
MATERIALS				Reach	Riffle	Prot. Ht.
D16 (mm)				-	-	-
D35 (mm)				-	-	-
D50 (mm)				-	-	-
D84 (mm)				-	-	-
D95 (mm)				-	-	-
D100 (mm)				-	-	-

West Fork A

WFA has a drainage area of 0.26 mi^2, as currently mapped and shown in Table 16. The W:D ratio of Sta. 0+00 – 3+36 for WFA as designed currently is 13.46 with a reference of 14.20 from Peach Creek for a C channel, which transitions into Sta. 3+36 – 5+63, an E channel. The reach has a W:D ratio of 9.43 based off of the reference reach (Shell Branch), which was an 8.90 W:D ratio. The sinuosity is closer to what would be expected for a C channel, but the channel dimensions (W:D ratio) are in accordance with an E channel. As stated above, for areas of very little topography, the differences between C and E channels are diminished.

West Fork

The longest tributary to Orange Branch, West Fork, extends almost the entire north/south length of the bank. The parameters for the restoration construction for West Fork are found in Table 17. West Fork begins at the bank boundary at Sta. 0+00 and the first reach extends to Sta. 5+07 with a drainage area of 0.8 mi^2, which is similar to the reference reach for Long Branch. The W:D ratio for Long Branch is 12.84 and is 13.77 for West Fork Sta. 0+00 – 5+07. Shell Branch and Rocky Branch were used as the references for the reaches Sta. 5+07 – 42+96, Sta. 42+96 – 69+50, and Sta. 69+50 – 97+55 at the confluence with East Fork and Orange Branch. The W:D ratios for Sta. 5+07 – 42+96 and Sta. 42+96 – 69+50 were close (8.57 and 8.30, respectively) as were their watershed sizes (1.15 mi^2 and 1.30 mi^2). These most closely resembled Rocky Branch, and so their designs follow Rocky Branch more closely. The catchment area jumps from 1.30 mi^2 to 2.01 mi^2 for the reach Sta. 69+50 – 97+55, so the design for this reach has a greater cross-sectional area and W:D ratio to accommodate the larger flows.

TABLE 16: STREAM DESIGN PARAMETERS FOR WEST FORK A OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 3+36			Design Criteria Sta. 3+36 to Sta. 5+63			"C5" Reference Condition DT to Peach Ck. 2			"E5" Reference Condition Shell Branch		
Stream Name: WFA	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.26	0.25	0.27	0.29	0.28	0.30	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES												
Wbkf (Bankfull width in feet)	10.50	9.45	11.55	9.05	8.15	9.96	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	0.78	0.66	0.90	0.96	0.82	1.10	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	31.50	20.79	52.50	27.15	17.92	45.25	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	8.19	6.96	9.42	8.69	7.38	9.99	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.46	11.46	15.46	9.43	7.43	11.43	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.34	1.21	1.44	1.71	1.54	1.82	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.41	1.61	1.59	1.79	1.61	2.01	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.33	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES												
Lm (Meander length in feet)	99.8	73.5	120.8	99.6	81.5	117.7	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	67.2	52.5	89.3	65.2	54.3	81.5	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	31.5	18.4	N/A	20.8	13.6	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	21.0	13.1	36.8	23.5	15.8	40.7	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	23.1	13.7	36.8	36.2	24.9	45.3	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.17	N/A	N/A	1.1	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	11.0	9.0	13.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	6.4	5.0	8.5	7.2	6.0	9.0	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES												
Sval (Valley slope, ft/ft))	0.0075	N/A	N/A	0.0034	N/A	N/A	0.00363	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0064	N/A	N/A	0.0032	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0176	0.0128	0.0256	0.0088	0.0064	0.0128	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.00096	0.00048	0.00128	0.00048	0.00024	0.00064	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	1.72	1.33	2.50	2.40	1.63	3.84	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	10.71	9.45	12.60	9.23	8.15	10.86	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	10.50	5.25	17.85	9.05	4.53	15.39	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	18.38	10.50	31.50	22.63	15.39	36.20	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	10.50	8.40	15.75	10.86	8.15	13.58	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	47.25	39.90	68.25	49.78	40.73	63.35	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS							Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)							0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)							0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)							0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)							0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)							0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)							4.00	N/A	22.60	1.00	0.50	32.00

TABLE 17: STREAM DESIGN PARAMETERS FOR WEST FORK OF ORANGE BRANCH

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 5+07			Design Criteria Sta. 5+07 to Sta. 42+96			Design Criteria Sta. 42+96 to Sta. 69+50			Design Criteria Sta. 69+50 to Sta. 97+55			[illegible]			[illegible]			[illegible]			[illegible]		
Stream Name: West Fork	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.8	N/A	N/A	1.15	1.12	1.19	1.30	1.27	1.33	2.01	1.97	2.05	0.07	N/A	N/A	0.28	N/A	N/A	3.86	N/A	N/A	0.85	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES																								
Wbkf (Bankfull width in feet)	15.01	13.51	16.51	13.20	11.88	14.52	13.70	12.33	15.07	17.50	15.75	20.13	7.10	6.59	7.61	7.39	6.96	7.81	18.80	18.80	18.90	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.09	0.93	1.25	1.54	1.31	1.77	1.65	1.40	1.90	1.70	1.45	1.96	0.50	0.47	0.52	0.83	0.79	0.87	2.29	2.14	2.44	1.09	-	-
Wfpa (Width of floodprone area)	45.03	29.72	75.05	39.60	29.04	66.00	41.10	27.13	68.50	52.50	34.65	87.50	25.98	21.00	31.00	26.30	26.10	26.50	73.10	68.10	78.00	30.00	-	-
Abkf (Cross-sectional Area)	16.36	13.91	18.82	20.33	17.28	23.38	22.61	19.21	26.00	29.75	25.29	34.21	3.55	3.10	3.96	6.09	6.03	6.14	43.10	40.11	46.09	6.09	-	-
Wbkf / Dbkf ratio	13.77	11.77	15.77	8.57	6.57	10.57	8.30	6.30	10.30	10.29	8.29	13.79	14.20	12.67	16.19	8.90	8.00	9.89	8.26	7.75	8.77	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.44	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81	3.89	3.60	4.15	3.58	-	-
Dmax (Max. depth at bankfull)	1.87	1.69	2.02	2.65	2.39	2.85	2.84	2.56	3.05	2.92	2.64	3.15	0.92	0.85	0.98	1.59	1.55	1.62	4.12	4.08	4.15	1.59	-	-
Dmaxtob (Max depth at top of bank)	1.97	1.77	2.22	2.78	2.50	3.13	2.98	2.68	3.36	3.07	2.76	3.46	0.92	0.85	0.98	1.90	1.80	2.10	4.19	4.08	4.37	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05	1.80	1.67	1.94	1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.05	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.00	1.05	1.00	-	-
PATTERN VARIABLES																								
Lm (Meander length in feet)	142.6	105.1	172.6	145.2	118.8	184.8	150.7	123.3	191.8	192.5	157.5	245.0	59.7	46.7	72.1	83.6	75.3	89.3	178.0	145.9	194.7	135.9	118.0	153.0
Lw(Linear Wave length in feet)	105.1	75.1	150.1	99.0	66.0	125.4	102.8	82.2	130.2	131.3	105.0	166.3	36.1	30.5	48.7	46.5	43.1	52.1	144.6	128.4	160.8	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	45.0	26.3	N/A	30.4	19.8	N/A	31.5	20.6	N/A	40.3	26.3	N/A	20.9	12.6	29.8	11.0	9.8	13.8	29.5	22.9	34.5	20.7	16.7	25.9
Larc(Arc length in feet)	30.0	18.8	52.5	34.3	23.1	59.4	35.6	24.0	61.7	45.5	30.6	78.8	17.9	14.9	20.5	22.2	12.9	30.5	65.3	59.9	71.3	30.3	24.7	42.0
Wblt (Belt width in feet)	33.0	19.5	52.5	66.0	42.2	85.8	68.5	54.8	89.1	87.5	70.0	113.8	13.3	9.2	16.4	38.8	35.3	45.2	9.8	5.4	21.4	39.4	36.7	44.0
K (Sinuosity)	1.07	N/A	N/A	1.31	N/A	N/A	1.41	N/A	N/A	1.36	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A	1.49	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	11.0	9.0	14.0	11.0	9.0	14.0	11.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1	9.5	7.8	10.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	5.0	9.5	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0	7.7	6.8	8.6	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9	1.6	1.2	1.8	1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1	3.5	3.2	3.8	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	5.0	3.2	6.5	5.0	4.0	6.5	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1	0.5	0.3	1.1	2.8	2.6	3.1
PROFILE VARIABLES																								
Sval (Valley slope, ft/ft))	0.0073	N/A	N/A	0.0017	N/A	N/A	0.0023	N/A	N/A	0.0012	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A	0.0051	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.0068	N/A	N/A	0.0013	N/A	N/A	0.0016	N/A	N/A	0.0009	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A	0.0036	N/A	N/A	0.0013	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0187	0.0136	0.0272	0.0036	0.0026	0.0052	0.0045	0.0033	0.00652	0.0024	0.0018	0.00352	0.008	0.0075	0.01	0.011	0.008	0.014	0.011	0.006	0.018	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.001	0.0005	0.00136	0.0002	1E-04	0.00026	0.0002	0.0001	0.000326	0.0001	7E-05	0.000176	0.0004	0.0002	0.0007	0.0005	3E-05	0.0011	0.001	0.00	0.0009	0.0003	8E-05	0.001
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26	3.03	1.65	4.96	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26	0.28	0.00	0.25	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	2.40	1.85	3.49	3.85	2.62	6.16	4.13	2.81	6.60	4.25	2.89	6.80	0.96	0.73	1.38	1.66	1.47	1.87	4.60	4.50	4.60	2.14	-	-
Wpool (Width of pool in feet)	15.31	13.51	18.01	13.46	11.88	15.84	13.97	12.33	16.44	17.85	15.75	21.00	7.35	7.15	7.55	9.03	7.97	10.10	19.26	19.00	19.60	18.80	-	-
Lriffle (Length of riffle in feet)	15.01	7.51	25.52	13.20	6.60	22.44	13.70	6.85	23.29	17.50	8.75	29.75	6.30	2.70	11.60	6.88	5.61	8.35	9.79	5.39	21.40	7.59	4.42	11.30
Lpool (Length of pool in feet)	26.27	15.01	45.03	33.00	22.44	52.80	34.25	23.29	54.80	43.75	29.75	70.00	11.70	6.00	21.40	25.31	17.40	33.70	29.67	12.73	44.20	18.45	11.30	27.00
Lglide (Length of glide in feet)	15.01	12.01	22.52	15.84	11.88	19.80	16.44	12.33	20.55	21.00	15.75	26.25	6.96	6.14	8.67	9.04	7.21	11.04	14.32	12.70	21.50	10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	67.55	57.04	97.57	72.60	59.40	92.40	75.35	61.65	95.90	96.25	78.75	122.50	22.60	17.50	31.30	44.70	41.30	48.20	67.82	47.03	92.80	41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25	2.01	1.97	2.01	1.96	-	-
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37	1.02	1.01	1.04	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	0.89	0.38	1.63	0.93	0.76	1.13	0.52	0.29	1.14	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56	1.58	0.68	2.35	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49	0.76	0.68	1.14	0.72	0.52	0.92
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52	3.61	2.50	4.94	2.96	2.21	4.93
MATERIALS													Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)													0.03	N/A	5.91	0.03	0.03	4.71	0.03	0.04	N/A	-	-	-
D35 (mm)													0.06	N/A	9.65	0.06	0.07	9.40	0.07	0.09	N/A	-	-	-
D50 (mm)													0.09	N/A	12.18	0.09	0.09	11.99	0.11	0.15	N/A	-	-	-
D84 (mm)													0.20	N/A	18.20	0.22	0.19	21.46	0.28	4.68	N/A	-	-	-
D95 (mm)													0.38	N/A	21.23	0.36	0.24	28.04	9.18	8.66	N/A	-	-	-
D100 (mm)													4.00	N/A	22.60	1.00	0.50	32.00	16.00	16.00	N/A	-	-	-

2.7.3 Wetland Buffer Restoration

Wetland restoration activities will include restoring the altered hydrology combined with restoration of the natural hardwood and mixed hardwood/pine ecology of the site. This includes removal of monoculture pine plantations previously established using mechanical and chemical site preparation treatments. Unlike many other commercial and agricultural development activities, silviculture maintains a healthy, albeit homogenous, forest. The pre-development community species are still present on site, but are entrained in the shrub/sapling and herbaceous layers because of the management activities in place and the anthropogenically encouraged dominance of pine in the canopy layer. The preeminent goal of this stage of restoration is the release of these sequestered assemblages and the assistance of the succession to a pre-settlement, bottomland, riparian forest.

Before an in depth discussion of the forested restoration is broached, it is important to consider the "new baseline" created by the channel construction and restoration. Over time, the hydraulics, the sediment competency and capacity, and the floodplain access of the channel have all changed. A completely stable channel will require some bankfull events to reveal potential shortcomings in stream design, and the Sponsor will need time to address those issues. The periodicity of flooding will change as the stream comes into balance with the watershed, and the local ecosystem will change with the restoration as seen in the sections below. Attempting to assume the future community necessities amidst such stochastic conditions would be both ecologically and financially reckless. Therefore, in light of the discussion to follow, it is important to state tree plantings will be minimal within the first 2 years after primary channel construction is completed. Where the necessity is imminent for erosion control, bank stability, or other critical services, plantings will be done in a manner to minimize impacts to the native community as much as possible. After 2 growing seasons (2 years) have passed, the sites will be evaluated on need, and restoration will proceed with the goal of releasing the native population, accelerating establishment and successional processes through planting, and the control of noxious species through chemical and mechanical techniques.

The IRT expressed concerns about the reliance upon planted individuals and their overall hardiness compared to individuals from the region or grown on site. The 2 year relaxation period and the reliance on saplings native to the site should assuage those concerns. However, appropriate species composition is important, and for areas where this is found to be lacking, plantings will be used to supplement the pre-existing community. Saplings will be purchased from a reputable, local source. To ensure adequate tree seedling establishment/survival as well as minimize threats of invasive species, sufficient regeneration density will also be incorporated into planting/survival specifications in terms of stems-per-acre. More specific regeneration regimes by WAA can be seen below, and the WAA functional assessment analysis can be found in Appendix G.

The species in Table 18 represent desirable species seen on site during the functional assessments, seen at reference locations within Lake Houston Park, recommended by TPWD (Texas Parks and Wildlife, 2004), and listed in Ecoregions of Texas (Griffith, Bryce, Omernik, & Rogers, 2007). No more than 20 percent of any one tree species will be planted. Bare root seedlings will be used for the light buffer planting to ensure establishment and rapid successional development. Trees, shrubs, and herbaceous plants will be planted in densities to promote the development of vegetative communities significantly similar to the reference

communities at Lake Houston Wilderness Park when combined with the individuals and seed banks currently present.

Mast producing trees are critical for the development of a healthy wildlife community on site, but also provide sustenance to migratory birds commonly utilizing the area. Fruit bearing trees also provide food and shelter to wildlife on site. With the promotion of wildlife habitat being a cornerstone consideration for the HCMB, native plants were chosen to increase the overall availability of food and shelter for both large (e.g. deer) and small (e.g. rodents and migratory song birds) animals. By releasing some ecological pressures (food acquisition) on the herbivorous community, the carnivorous community is expected to benefit from the increased food supply and find a refuge within the bank.

TABLE 18 : PREFERRED PLANT REGENERATION AND RESTORATION SPECIES

Trees			Shrubs			Herbs		
Scientific	**Common**	**Erosion, Wildlife****	**Scientific**	**Common**	**Erosion, Wildlife****	**Scientific**	**Common**	**Erosion, Wildlife****
*Acer rubrum**	Red Maple	G, G	*Myrica cerifera**	Southern Wax Myrtle	E,G	*Chasmanthium latifolium**	Broadleaf Woodoats	E, G
Acer barbadum	Southern Sugar Maple	NL	*Alnus serrulata**	Hazel Alder	E, E	*Carex cherokeensis**	Cherokee Sedge	G, G
*Asimina triloba**	Common Pawpaw	E, G	*Callicarpa americana*	American Beautyberry	E, E	*Carex glaucescens**	Southern Waxy Sedge	G, G
Carpinus caroliniana	American Hornbeam	G, F	*Chionanthus virginica*	White Fringetree	G, G	*Carex louisianica**	Louisiana Sedge	G, G
*Carya cordiformis**	Bitternut Hickory	G, F	*Lindera benzoin**	Common Spicebush	G, G	*Chasmanthium laxum**	Slender Woodoats	
Celtis laevigata	Sugarberry	G, G	*Prunus angustifolia**	Chickasaw Plum	E, E	*Chasmanthium sessiliflorum**	Narrowleaf Woodoats	F, L
*Diospyros virginiana**	Common Persimmon	G, E	*Prunus mexicana**	Mexican Plum	G, G	*Cyperus esculentus**	Yellow Nutsedge	G, E
Fraxinus pennsylvanica	Green Ash	E, G	*Sambucus canadensis**	American Elderberry	E, G	*Hymenocallis occidentalis*	Carolina Spider Lily	
Ilex opaca	American Holly	E, E	*Symphoricarpos orbiculatus*	Coralberry	E, E	*Polygonum hydropiperoides**	Swamp Smartweed	E, G
*Juglans nigra**	Black Walnut	E, G	*Vaccinium arboreum*	Farkleberry / Huckleberry	E, G	*Scirpus americanus**	Olney Bulrush	E, G
Magnolia grandiflora	Magnolia	G, G	*Viburnum dentatum** α	Southern Arrowwood	G, G	*Sesbania macrocarpa*	Coffee Bean	E, E
*Nyssa sylvatica** α	Blackgum	G, E	*Viburnum nudum**	Possum-Haw Viburnum	E, E	*Sorghastrum nutans**	Yellow Indiangrass	E, E
Ostrya virginiana	Eastern Hop Hornbeam	G, F	*Cephalanthus occidentalis** α	Buttonbush		*Eleocharis palustris*	Common Spikerush	
*Pinus palustris**	Longleaf Pine	E, G	*Salix nigra** α	Black Willow		*Hydrocotyle verticillata*	Pennywort	
Pinus taeda	Loblolly Pine	E, G	*Hibiscus aculeatus*	Big Thicket Hibiscus		*Anemopsis californica*	Lizardstail	
*Prunus serotina**	Black Cherry	E, G	*Hibiscus coccineus*	Texas Star Hibiscus		**Vines**		
*Quercus alba**	White Oak	E, E	*Hibiscus grandiflorus*	Swamp Rosemallow		SCIENTIFIC	COMMON	Erosion, Wildlife
*Quercus laurifolia**	Laurel Oak	G, E	*Hibiscus lasiocarpos*	Rosemallow		*Ampelopsis arborea*	Peppervine	E, E
*Quercus lyrata**	Overcup Oak	G, E	*Amorpha fruticosa** α	False Indigo Bush		*Campsis radicans*	Common Trumpet Creeper	E, G
*Quercus macrocarpa**	Bur Oak	G, E				*Parthenocissus quinquefolia*	Virginia Creeper	E, G
*Quercus michauxii**	Swamp Chestnut Oak	G, G				*Rubus spp.*	Blackberries	E, E
*Quercus nigra**	Water Oak	E, E				*Smilax glauca*	Cat Greenbriar	E, G
*Quercus pagoda**	Cherrybark Oak	NL				*Smilax rotundifolia*	Common Greenbriar	G, G
*Quercus phellos**	Willow Oak	G, E				*Berchemia scandens*	Alabama Supplejack	G, G
*Quercus stellata**	Post Oak	G, G				*Vitis rotundifolia*	Muscadine Grape	L, G
*Taxodium distichum** α	Bald Cypress	E, E				*Gelsemium sempervirens*	Carolina Jasmine	F, L
Ulmus alata	Winged Elm	E, G						

* Species considered for light buffer planting and bank stabilization planting. α Species are candidates for live staking of stream banks. Species chosen will be based upon site specific needs and market availability.

** Letter designations from the Texas Parks and Wildlife (2004) Texas Plant Information Database and represent: Excellent (E); Good (G); Fair (F); Low (L); Not Listed (NL).

WAA 1

As seen in the functional assessment in Appendix G, WAA 1, comprised of 24 year old pine plantation, was the most prevalent wetland type on the HCMB property. The predominant source of uplift will come from alteration of the vegetative community. The pine plantation will be thinned aggressively to allow the present laurel oak and willow oak in the shrub layer to begin to achieve successional dominance.

Light buffer planting (less than 400 stems-per-acre) will be used to supplement the native population. It is likely WAA 1 will require the most buffer planting of all the WAAs as loblolly pines have shaded out the shrub and herbaceous layers. However, the vegetative communities in surrounding areas, length of time between thinnings, and lack of barriers to wildlife movement do provide a supplement to the seed bank within WAA 1. Therefore, it is unlikely heavy buffer planting (more than 400 stems-per-acre) will be necessary. Areas of repeated disturbance, such as logging lanes and logging decks, may require less planting because the emerging herbaceous layer contains a strong composition of oak and maple saplings. Chemical and mechanical control mechanisms (such as manual cutting or herbicide appropriate for aquatic systems) will be used to control noxious species during the initial thinning of the WAA, and during the monitoring period as needed to meet the performance standards.

In addition to those trees removed to provide sufficient sunlight to the understory, some pines will be felled, girdled, or treated with herbicide and left on site to provide wildlife habitat and sources of coarse woody debris. Some pines sufficient in size (15 in to 20 in or greater diameter at breast height or dbh) contribute greater ecological value and will remain intact on site, providing maximum use of ecological resources and reducing unnecessary waste.

Currently there are 289 trees/Ac based upon data collected for the iHGM functional assessment. After thinning the majority of the loblolly pine, sweetgum, and any Chinese tallow, this WAA will have approximately 140 trees/acre at Year 0 (year of stream construction and initiation of timber management). By Year 2, approximately 400 stems (any tree species regardless of stratum)/acre will be targeted. This will be achieved through survivorship of existing species, natural recruitment, as well as supplemental plantings. It is anticipated supplemental plantings will occur at a rate of approximately 200 stems/Ac, although this amount may be lessened if desirable natural recruitment is occurring at an increased rate. By year 4, the desired density will be approximately 320 desirable stems/Ac. By year 7, the desired density of will be approximately 250 desirable stems/Ac.

Another source of uplift will come from the reconnection of the floodplain through channel restoration. When restoration of the channel is complete, WAA 1 will again be subjected to periodic flooding, which will encourage the establishment of bottomland hardwood forest.

WAA 2

Mature hardwood, bottomland stands were the major component of WAA 2. These stands have recently been necessarily thinned because of tree health resulting from extreme drought conditions. The overall species diversity was exceptional by iHGM standards, but only 25 percent were hard mast producers. The predominant tree species within WAA 2 was red maple, rather than loblolly pine, because this region was

not commercially planted. In addition to red maple, American hornbeam (*Carpinus caroliniana*), green ash (*Fraxinus pennsylvanica*), winged elm (*Ulmus alata*), and five species of oak were found in the remaining stands, although the numbers of individuals were fewer. The species composition and distribution can be seen in Appendix G.

The favorable species composition in WAA 2 justifies the rationale to refrain from extensive artificial planting until the effects of the relaxation of harvesting pressures are fully observed. Restoration in WAA 2 will comprise light buffer planting in logging lanes, logging decks, and other locations where the canopy has been opened by silvicultural activities as ecologically necessary.

Plantings will be hard mast producers with some other species included to provide food and habitat to wildlife and to increase overall number of stems-per-acre of desirable species. Chemical and mechanical techniques will be employed to control noxious plant species.

When the present seed bank has developed a community within the disturbed areas, a more comprehensive and adaptive planting strategy can be addressed. By planting disturbed areas, a patchwork mosaic of hard mast producers and other native bottomland species can be created with minimal damage to existing stands, and over time the seed banks will overlap creating a more homogeneous stand.

Chinese tallow was the second most abundant tree species, and as such chemical and mechanical techniques will be employed to control their numbers while new, native saplings are establishing and after plantings. However, the areas of the stand not affected by the thinning had well developed canopies, which can shade out early successional tallow. Therefore, efforts will be made to minimize activity to preserve the established community.

WAA 2 presently comprises 240 trees/acre according to the data collected on site for the iHGM. After the removal of Chinese tallow and some of the pines and sweetgums, the anticipated trees/acre at Year 0 is 155. By Year 2, approximately 400 stems (any tree species regardless of stratum)/acre will be targeted. This will be achieved through survivorship of existing species, natural recruitment, as well as supplemental plantings. It is anticipated supplemental plantings will occur at a rate of approximately 200 stems/Ac, although this amount may be lessened if desirable natural recruitment is occurring at an increased rate. By year 4, the desired density will be approximately 330 desirable stems/Ac. By year 7, the desired density of will be 250 desirable stems/Ac.

As with WAA 1, restoration of the stream channel and natural, cyclical flood events will help to restore the overall structure and function of these forested wetlands.

WAA 3

Some of this land was cleared and allowed to naturally regenerate, but the majority was not harvested due to depressional wetland characteristics. This WAA comprises the recovering, naturally regenerated, hardwood stands in the area today. This WAA comprises four of the depressional areas seen at the headwaters of West Fork, and East Fork A, B, and C tributaries, and is also present along a central portion

of West Fork. Laurel oak comprised the 53 percent of the observed tree species with willow oak, red maple and green ash comprising the remainder of the dominants.

WAA 3 presently comprises 463 trees/acre according to the data collected on site for the iHGM. After the removal of Chinese tallow and some of the pines and sweetgums, and thinning roughly three-quarters of the laurel oak in order to increase diversity, the anticipated trees/acre at Year 0 is 230 for the forested portions of this WAA. By Year 2, approximately 400 stems (any tree species regardless of stratum)/acre will be targeted where appropriate. This will be achieved through survivorship of existing species, natural recruitment, as well as supplemental plantings. It is anticipated supplemental plantings, where needed, will occur at a rate of approximately 150 stems/Ac within WAA 3, although this amount may be lessened if desirable natural recruitment is occurring at an increased rate. By year 4, the desired density will be approximately 330 desirable stems/Ac. By year 7, the desired density of will be 250 desirable stems/Ac.

Interior portions of the depressional wetlands remain inundated for much of the year. In order to avoid disrupting these unique systems more than what is necessary to ensure their proper function, plantings will be targeted around the fringes of the depressions to provide a high quality, diverse depression fringe. This enhanced fringe area around the depressions will likely increase species composition and quality within the interior portions of the buffer through natural recruitment.

WAA 4

This WAA was cleared around the fringes of an impoundment created by previous anthropogenic disturbances and an herbaceous wetland created by beaver activity. The dominant species in WAA 4 was laurel oak, but the density and lack of diversity were strong impediments to proper understory community development and overall stand succession.

WAA 4 presently comprises 525 trees/acre, 440 of which consist of laurel oak, according to the data collected on site for the iHGM. After the removal of Chinese tallow and thinning roughly three-quarters of the laurel oak in order to increase diversity, the anticipated trees/acre at Year 0 is 150. By Year 2, approximately 400 stems (any tree species regardless of stratum)/acre will be targeted. This will be achieved through survivorship of existing species, natural recruitment, as well as supplemental plantings. It is anticipated supplemental plantings will occur at a rate of approximately 200 stems/Ac within WAA 4, although this amount may be lessened if desirable natural recruitment is occurring at an increased rate. By year 4, the desired density will be approximately 330 desirable stems/Ac. By year 7, the desired density of will be 250 desirable stems/Ac.

WAA 5

WAA 5 consisted of the innermost portion of the impoundment created by previous anthropogenic disturbances combined with beaver activity, and consisted of a stable, herbaceous wetland. Forested vegetation was not prevalent, due to the impounding of this area, which became apparent in the 1995 aerial photograph as seen in the delineation report (Appendix F).

Tree species do not currently comprise over 5% of the strata of this WAA, so goal for this WAA is not the typical closed canopy forested system, but a mosaic where woody vegetation would occur on natural rises and mounds, while lower and wetter sites would remain in the current herbaceous condition. Upon completion of stream construction (year 0) some scattered Chinese tallow will be mechanically or chemically controlled. Chinese tallow control may allow some natural species recruitment of desired species, but in year 2 it is anticipated an estimated 150 stems /Ac will be planted and will consist of wetland obligate (OBL) species such as bald cypress (*Taxodium distichum*), overcup oak (*Quercus lyrata*), water tupelo (*Nyssa aquatica*) and/or water elm (*Planera aquatica*). By year 4, the desired stems /Ac for this WAA will be 120, and by year 7 the desired stems /Ac will be 100 for WAA 5.

WAA 6

This area accounts for a portion of the Bank previously denuded by anthropogenic activities. Primary succession in its earliest stages was underway, but herbaceous wetland with a sparse shrub/sapling layer was the only development. As with other WAAs, regeneration will strongly rely on the current seed bank and contributions from surrounding forests. Many of these areas are less than 1 Ac, so the influence from the surrounding forest should be substantial. The year 0 management strategy will be control of noxious species such as Chinese tallow to allow for natural species recruitment. By Year 2, approximately 400 stems (any tree species regardless of stratum) /acre will be targeted. This will be achieved through survivorship of existing species, natural recruitment, as well as supplemental plantings. It is anticipated supplemental plantings will occur at a rate of approximately 200 stems /Ac within WAA 6, although this amount may be lessened if desirable natural recruitment is occurring at an increased rate. By year 4, the desired density will be approximately 330 desirable stems /Ac. By year 7, the desired density of will be 250 desirable stems /Ac.

2.7.4 Uplands

Upland communities in the HCMB will be managed using the same strategies as the wetlands of WAA 1 and WAA 2, depending on age and land use, but with a shift in species composition. Final upland restored acreage will be 165.2 Ac (Table 9).

Table 18 contains obligate, facultative, facultative upland, and upland species. Any plantings will take place along a gradient moving perpendicular to the stream channel, pairing the proper species and community assemblage with the appropriate soil moisture regime (as seen in Table 4). However, as with the wetland communities, the primary goal is to maintain as many of the inherent individuals and promote survivorship. Therefore, plantings will be as needed after a relaxation period has passed allowing the endemic community structure to manifest.

2.7.5 Best Management Practices

The channel must be excavated and the meander of the channel will necessitate disturbing more area than is currently occupied by channel. Belt-width preparation and grading will only remove what is necessary to conduct the work. Large trees will be avoided as much as possible and excess fill material will be placed in upland areas where the probability of run off into a WOUS is minimal. Large equipment will be stored on currently cleared areas such as well pads and logging decks to avoid soil compaction and disturbance. Current logging and access roads will be used whenever possible to avoid further disturbance.

However, restoration will require a significant amount of construction, and these disturbed areas will warrant rehabilitation and stabilization. The totals for areas impacted by construction can be seen in Table 19. The construction width includes the channel itself, the meander belt width, and a 30 ft access and staging area on either side of the belt. It should be noted these are liberal estimates of area and construction width. In many cases, a 30 ft access area will not be necessary on both sides of the channel, and the area within the meander belt will not be completely impacted.

TABLE 19: APPROXIMATE CONSTRUCTION IMPACT FOR CHANNEL RESTORATION

STREAM NAME	REACH	LENGTH (ft)	BELT WIDTH (ft)	CONSTRUCTION WIDTH (ft)	APPX. AREA (Ac)
East Fork	Sta. 0+00 to Sta. 30+76	3076	74.5	134.5	9.5
	Sta. 30+76 to Sta. 41+45	1069	79.5	139.5	3.4
	Sta. 41+45 to Sta. 60+52	1907	97.8	157.8	6.9
EFA	Sta. 0+00 to Sta. 4+50	450	15.6	75.6	0.8
	Sta. 4+50 to Sta. 11+17	667	24.4	84.4	1.3
	Sta. 11+17 to Sta. 22+06	1089	27.6	87.6	2.2
EFB	Sta. 0+00 to Sta. 3+14	314	30.4	90.4	0.7
	Sta. 3+14 to Sta. 18+54	1540	47.2	107.2	3.8
	Sta. 18+54 to Sta. 43+36	2482	60.0	120	6.8
EFC	Sta. 0+00 to Sta. 10+50	1050	32.3	92.3	2.2
	Sta. 10+50 to Sta. 21+73	1123	49.2	109.2	2.8
	Sta. 21+73 to Sta. 50+76	2903	61.5	121.5	8.1
Main Stem	Sta. 0+00 to Sta. 14+83	1483	103.0	163	5.5
West Fork	Sta. 0+00 to Sta. 5+07	507	33.0	93	1.1
	Sta. 5+07 to Sta. 42+96	3789	66.0	126	11.0
	Sta. 42+96 to Sta. 69+50	2654	68.5	128.5	7.8
	Sta. 69+50 to Sta. 97+55	2805	87.5	147.5	9.5
WFA	Sta. 0+00 to Sta. 3+36	336	23.1	83.1	0.6
	Sta. 3+36 to Sta. 5+63	227	36.2	96.2	0.5
TOTAL		**29471**			**84.6**

Overall restoration will follow the prescriptions in WAA 1 with strategic plantings in locations where erosion control is necessary or some other extenuating circumstance requires immediate attention. In WAA 2, efforts will be made to avoid removal of desirable trees of significant size (greater than 10 in dbh). In some situations, this may prove impossible, but the prescription, where applicable, is avoidance.

In the construction zone used for staging and access for the necessary equipment, herbaceous plantings may be used where erosion is considered to be a threat. Light buffer planting of species listed in Table 18 may also be employed to supplement the native population, and to shorten the time necessary to close the canopy. This will be determined on a situational basis predicated on the survivorship and success of the native community. As was stated in the Section 2.7.3 (Wetland Buffer Restoration), the primary goal is to release the native vegetative community and encourage its development. In some situations, this may best be achieved by noxious species control, in others by thinning and/or planting.

2.8 MAINTENANCE PLAN

Once initial construction is completed, there should be little maintenance required within the stream channel. During the annual monitoring, streams will be visually assessed to determine if any structures have failed, or if excessive erosion is occurring. In the instance of these situations, the steps outlined in the Adaptive Management Plan will be utilized.

Where the restored streams cross property roads that cannot be abandoned or moved, the design will incorporate either a bottomless culvert or rock reinforced, low-water crossing. These crossings will be visually assessed for excessive sedimentation and/or instability during the annual monitoring visit. Excessive sediment will be removed and the crossings reinforced on an as-needed basis.

Plantings will be of native species from local stocks, but the predominance of the vegetation within the buffer should come from natural regeneration on site. Therefore, these species should be adapted to local site conditions and climate, so little to no maintenance is anticipated. To restore/maintain the vegetative community, the following schedule of activities is anticipated:

- Year 0 – Remove monoculture pipeline plantation and exotic invasive species
- Year 1 – Visual monitoring to assess success of Year 0 activities
- Year 2 – Plot-based monitoring to determine needed planting density
- Year 3 through end of monitoring period – Plot based monitoring to determine success of supplemental plantings and invasive species control.

The vegetative community will be monitoring on a yearly basis, and should survivorship and/or species composition requirements not meet the criteria outlined in the performance standards, the steps outlined in the Adaptive Management Plan will be utilized.

Signage will be placed along the periphery of the bank to discourage trespassing. Should any trespass occur (e.g. dumping of trash), steps will be taken by the Sponsor or their agent to mitigate any damage and to prevent further trespass in the future. The periphery of the bank will be maintained to allow access the bank by monitoring crews and to ensure boundary continuity. This maintenance may include such activities as replacement of signage, clearing of vegetation, or fence repair. Any clearing of vegetation would solely be on an as needed basis to provide ATV passage at a maximum, but all efforts will be made to minimize impacts wherever possible.

2.9 ECOLOGICAL PERFORMANCE STANDARDS

The goal of the HCMB is to return the tributaries of Orange Branch located on site to the functioning condition to be anticipated for streams of equal size in the region. This is to be accomplished by restoring the pattern, profile, and dimension to the channel while enhancing the native, vegetative communities within the adjoining buffer. The performance standards are a series of metrics by which the success of these endeavors is measured.

Performance standards describe, at a minimum, the standards of success based on the proposed mitigation activities. Specifically, the performance standards will include documentation of the recorded conservation easement or other protective measurements, the discontinuance of incompatible surrounding land uses, demonstrable improvements in hydrologic function, and improvements in the biological communities as

defined by stream/wetland condition indices. Table 20 illustrates the proposed performance standards for within channel.

Performance Standard Achieved means the channel or the buffer has not significantly deviated from the final design, the ecological function of the site is improving according to schedule, and therefore credits will be released (based upon schedule).

Performance Standard Not Achieved means something integral to the stream's ability to maintain its pattern, profile, or dimension is incorrect. This will require extensive work to repair, and so constitutes not meeting the performance standard (no credits are released). This may also apply to vegetative structure or survivorship. An example would be a 90 percent mortality rate within the tree strata at Year 5.

The performance standards in Table 20 refer to the pattern, profile, and dimension of natural channels as covered by Rosgen (Rosgen, Applied River Morphology, 1996), but a more detailed explanation of the standards and their relevance is discussed in the terms of the FBF Assessment (Harman, et al., 2012). Annual monitoring will focus on changes in the final morphology of the channel from the final stream design. The initial stream channel design geomorphology tables, broken out by reach and containing the minimum and maximum values, are found in Appendix H and Section 2.7.2, Restoration by Tributary.

TABLE 20: PERFORMANCE STANDARDS FOR IN-CHANNEL RESTORATION

Parameter	Measurement Method	Performance Standard Achieved	Performance Standard Not Achieved
Bank Height Ratio (BHR)	Floodprone Depth/Bankfull Depth	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
Pool to Pool Spacing	Direct Measurement	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
Pool Width to Depth Ratio	Cross-Sectional Surveys	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
Riffle Width to Depth Ratio	Cross-Sectional Surveys	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
Area At Bankfull	Cross-Sectional Area	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
Entrenchment Ratio (ER)	Floodprone Width/Bankfull Width	Within 15% of the minimum/maximum range in the final stream design	>15% outside of the minimum/maximum range in the final stream design
In-Stream Structures	Visual Assessment of Structures	In-stream structures may have moved slightly, but appear to be stable, or require only minor adjustments.	In-stream structures have become dislocated during high flows. Structure no longer functioning from excessive undercutting, scour, or deposition in the active channel and active erosion (>40%) on banks.

The purpose of the performance standard (In-Stream Structures) in Table 20 is predominantly to ensure the majority of these structures remain in place after bankfull events and continue to function properly. Unlike perennial streams, the wood structures in the channel of intermittent and ephemeral streams are not inundated year round. This exposure to oxygen periodically results in faster decay of the structures. These structures are not designed to last in the channel in perpetuity, but rather are meant to stabilize the channel until the dense, native, vegetative population, which would be the natural form of bank stabilization for this region, has time to develop. Therefore, the performance standards are based upon the ability of the structures to withstand flood events and the erosion they prevent, rather than a simple presence or absence.

Buffer Restoration (Wetland, Construction Zones, and Upland)

The focus of the buffer restoration, as covered in previous chapters, is to facilitate the release of the proper bottomland forest through relaxation of silvicultural pressures and assistance to natural regeneration and recruitment. The performance standards for the riparian buffer are shown in Table 21. By the Year 2 Monitoring Report, the community assemblage represented by the current seed bank should be present.

Initially, approximately 400 stems-per-acre would indicate a trend toward attainment for forested areas, the same number suggested for heavy buffer planting for desirable species (USACE, 2013). Should this not be the situation, the native community will be enhanced with the necessary plantings. Invasive/noxious species abundance will be diminished over time as outlined in Table 23 using chemical and mechanical methods, as well as native species succession anticipated to "shade out" many of these species. The percentages for the native woody community in Canopy Development were derived from the Galveston SOP (USACE, 2013). For wetlands within the buffer, soils and hydrology will also be evaluated and performance standards for these areas will not be considered met if the area no longer qualifies as a wetland based upon vegetation, hydrology, and soils.

TABLE 21: PERFORMANCE STANDARDS FOR RIPARIAN BUFFER

	Parameter	Measurement Method	Year 0 - 1	Year 2	Year 4	Year 7
Riparian Buffer	Buffer Density (Forested Riparian Only)	Stems/Acre	Buffer thinning completed	> 400 Stems/Acre of desired species	> 320 Stems/Acre desired species	> 250 Stems/Acre desired species
	Canopy Development (Forested Riparian Only)	% Canopy Cover	Less desirable species canopy cover is < 30%, densely planted pine removed	Native woody community canopy cover is 30% to 60%	Native woody community canopy cover is 45% to 60%	Native woody community canopy cover is ≥ 60%
	Wetland Hydrology and Hydric Soils	Delineation Data Points	Delineation data points, recording wetland hydrology and hydric soil indicators, will be documented within monitoring plots occurring within previously delineated wetlands. Performance standard will be met if there is not an apparent reduction in wetland area.			
	Noxious Species*	Stems/Acre with Visual Assessment	Removal / eradication of Noxious and Invasive Species	Chinese Tallow < 5% in canopy and < 15% in the herbaceous strata. Other noxious species < 15% in herbaceous strata.	Chinese Tallow < 5% in canopy and < 15% in the herbaceous strata. Other noxious species < 15% in herbaceous strata.	Chinese Tallow < 1% in canopy and < 5% in the herbaceous strata. Other noxious species < 5% in the herbaceous strata.

*Noxious and Invasive species as defined by the Texas Department of Agriculture (Texas Department of Agriculture, 2015)

2.10 MONITORING REQUIREMENTS

In order to provide documentation of success of the restorative efforts, the Bank Sponsor will perform routine monitoring of the ecological conditions of the proposed Bank Site. Monitoring reports will clearly demonstrate whether performance standards are being met and a credit release is warranted. The monitoring schedule and frequency proposed for the Bank will include annual assessments for a minimum of 7 years and two bankfull flood events, per the criteria established in the USACE Guidance Letter (08-03), Minimum Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (USACE, 2008). Bankfull events will be determined using data provided by the USGS gage on the East Fork San Jacinto River near Cleveland, Texas (United States Geological Survey, 2013), direct on-site observation, and/or precipitation data from a nearby weather station. Yearly monitoring reports will be submitted on or before December 1st of the monitoring year. If a bankfull event occurs during the year, an event based report will be generated and submitted to the USACE and IRT for the appropriate credit release at the time of the bankfull event. However, the bankfull report will also be included as an addendum to the regularly scheduled monitoring report submitted on or before December 1st.

Surveys will be conducted of reaches totaling 15 percent of each reach of the constructed channel. The monitoring team will conduct channel cross-sectional and longitudinal surveys after bankfull events and during annual monitoring to ensure the channel is still conforming within range to the regional curve and other standards set forth the final stream channel design. This will be completed using guidance from the FBF Assessment and the Galveston SOP (USACE, 2013). Reference points will be chosen to show changes in channel form over time, should any occur.

The team will also evaluate stems-per-acre of desirable species and evaluate the species dominance within strata for upland and wetland areas within the buffer. Vegetation plots will be established at HGM points/plots used for the wetland functional assessment as well as in upland areas, and parameters such as species composition and species density will be surveyed along with visual assessments of percent cover of the shrub and herbaceous species.

Within the monitoring plots located in previously delineated wetland areas of the buffer, a wetland delineation data point will be taken at each plot, which will include a soil profile and observations of hydrology. This information will serve to verify the continuity of wetlands on-site after channel construction and during buffer restoration and recovery. The release of credits associated with the Riparian Buffers with Wetlands AF is contingent upon the wetlands continuing to meet the criteria for wetland hydrology, hydrophytic vegetation, and hydric soils during the monitoring period.

2.11 LONG-TERM MANAGEMENT PLAN

The Sponsor is the official "Owner" and Sponsor of the Bank throughout the duration of permitting, development and restoration phases, and establishment of the long-term management program. It is the responsibility of the Sponsor to provide a comprehensive, long-term management strategy to reasonably manage the site as a high-quality restoration area so the ecological benefits generated from the proposed Bank are preserved.

Upon the closure of the HCMB (final release of credits and fulfillment of MBI requirements), the responsibility of site maintenance will be retained by the Sponsor or their agent. Should the Sponsor sell the property or relinquish responsibility for the site, the IRT will be notified in a timely manner.

At a minimum, annual, random monitoring will be instigated by the Sponsor or their agent to check for trespassing, damage to the property, or other threats that require remedial action.

Hunting on the bank will be walk in only. Four-wheelers, ATVs, or other motorized vehicles will be prohibited unless expressly specified as necessary (i.e. for annual monitoring, fence maintenance, etc.). Unapproved, improvised trails will be incapacitated or destroyed.

The periphery of the bank will be maintained to allow access the bank by monitoring crews and to ensure boundary continuity. This maintenance may include such activities as replacement of signage, clearing of vegetation, or fence repair. Any clearing of vegetation would solely be on an as needed basis to provide ATV passage at a maximum, but all efforts will be made to minimize impacts wherever possible. Signage will be placed along the periphery of the bank to discourage trespassing. Should any trespass occur (e.g.

dumping of trash), steps will be taken by the Sponsor or their agent to mitigate any damage and to prevent further trespass in the future.

During the annual site visits, the vegetative community will be visually assessed for damage, disease, die-off, and over-abundance of invasive/exotic plant species. If any substantial concerns are noted in regards to the vegetative community, the USACE will be notified, and the appropriate management activity will be agreed upon.

Prior to the final credit release, and in accordance to the timelines established in Table 22, Forestar will establish a non-wasting endowment in the amount of $125,000 for supporting HCMB's long-term maintenance plan. As previously stated, Forestar will be the long-term manager of the bank property. Any expenditures must be related to the maintenance of the bank and must be approved by the USACE. Table 23 shows anticipated annual costs, which were used to determine the amount necessary for the long-term, non-wasting endowment of $125,000. The endowment will generate $5,000 per year in revenue assuming a 4% return on investment (inflation adjusted). The total anticipated cost is $4,679.95 per year, with whatever is not spent being reinvested into the endowment.

TABLE 22: LONG-TERM FINANCIAL ASSURANCES SCHEDULE

Milestone	Verification Metric	Financial Assurance Funded (%)	Financial Assurance Funded ($)
Preconstruction	Execution of MBI	0%	$0.00
Credit Release for Monitoring Unit 1			
Construction	Earthwork and riparian planting complete. Approval of as-built report by USACE	10%	$12,500
1st Bankfull Event	Approval of bankfull (Geomorphology) report by USACE	30%	$37,500
2nd Bankfull Event	Approval of bankfull (Geomorphology) report by USACE	50%	$62,500
Yr-2 Monitoring	Approval of monitoring report by USACE	70%	$87,500
Yr-4 Monitoring	Approval of monitoring report by USACE	90%	$112,500
Yr-7 Monitoring (Final Release)	Approval of monitoring report by USACE. Delivery of long-term endowment. Attainment of all success criteria.	100%	$125,000

TABLE 23: LONG TERM MAINTENANCE COST ESTIMATES

ANNUAL MAINTENANCE COST DISTRIBUTION HOUSTON-CONROE MITIGATION BANK					
LABOR/EXPENSES	QUANTITY	UNIT	UNIT PRICE	TOTAL	ASSUMPTIONS
Consultant	10	HOURS	$ 80.00	$ 800.00	
Boundary Line Maintenance			$ 1,500.00	$ 1,500.00	
Signage	24	UNIT	$ 10.00	$ 240.00	5% Loss Rate
Property Taxes	396	ACRES	$ 5.40	$ 2,139.95	$5.40/Ac Tax Rate
Cost Total				**$ 4,679.95**	

2.12 ADAPTIVE MANAGEMENT PLAN

The primary long-term strategy of the Bank is self-sustainability with relatively low maintenance. This management strategy is directly linked to the development stage of the mitigation banking process, particularly in the design and establishment of the Bank. Natural stream channel design and increased natural flood attenuation will provide these ecological benefits with minimal routine maintenance or attention after establishment.

The Sponsor recognizes that some adaptive management strategies may need to be addressed based on previous knowledge and experiences with other mitigation bank scenarios. If the Bank is underperforming and is not meeting the proposed performance standards, the Sponsor will provide additional management designs to address the ecological benefit. These methodologies may include prescribed burn management, riparian buffer vegetative management, or easement enforcement actions. Many of these strategies, however, will need to be tailored to specific disturbances to achieve optimal results. As such, Adaptive Management Plans will be derived at the time of disturbance based upon data collected at the time, and work plans will be submitted to the IRT and USACE for commentary and guidance before implementation.

Possible issues requiring remedial action are: bank stability failure, loss of in-stream structures, apparent significant changes in the cross-sectional areas, poor vegetation establishment, and/or prevalence of exotic invasive species. Should any of these or other issues of significance occur, the Sponsor will develop a management strategy, and with the consultation of the IRT, begin to remediate the area of issue as soon as practicable. During the time of non-compliance, the USACE Galveston District may suspend the sale or use of mitigation credits until efforts to remediate the disturbance have been implemented.

Stream instability and failure during greater than bankfull conditions is a primary concern. This is also the variable receiving the greatest amount of attention. The sinuosity and in-stream structures chosen should result in little to no lateral movement of the channel or changes in elevation in any frame less than geologic timescales

If toe wood, cross vanes, or logs are placed at an elevation too high or too low in the channel by the construction crew, a bankfull event may reveal the potential for instability over time. If during the monitoring period this is observed, an audit of the site will be conducted and a work crew enlisted to make the necessary adjustments.

A limited use of rock may be implemented for in-stream structures. For shallow water crossings of roads, rock may be employed to protect the bed-form. Rock may be necessary at the downstream terminus of Orange Branch to prevent possible head-cutting over time, but the desired methodology would be to use wood sourced on site if at all possible. The logs used for in-stream structures along the length of the project are buried deep within the banks with crosshatched smaller logs and fill. With the watershed size available to the channel and the lack of appreciable slope of the landscape, it is extremely unlikely these logs will ever be dislodged, if properly installed. If improperly installed in a manner which results in undermined banks or loss of structures, a survey will be made of the damage and a reinstallation of structures with necessary modifications for more appropriate high flow conditions will be made.

Experts were consulted as to the stability of log structures in ephemeral and intermittent streams as they would not be inundated year round and therefore at a greater susceptibility to rot and decay. Concerns were raised that log structures could become compromised before vegetation, a more natural form of bank stabilization, would have sufficiently established. After examining other stream channels and restoration efforts in similar climates, discussing potential rate of decay relative to the embeddedness of the structures, and evaluating anticipated growth rates and recruitment of riparian vegetation, it was determined the log structures were highly unlikely to fail. If there is an eventuality of habitual log structure failure, the possibility of using some rock may be revisited.

The next consideration after in-stream structures is bank stabilizing vegetation. Native vegetation documented as having bank stabilization properties and uses for wildlife will be planted or preserved along the riparian zone. Whereas these plants will be chosen based upon their suitability to the soils and climate on site, unexpected droughts, freezes, or other irregular climatological events may dramatically affect recruitment and mortality. Should such an event occur, an appraisal will be made of the health of surviving individuals, their potential for expansion, and the necessity for additional planting. The planting process

can be harmful or disruptive to the remaining survivors, so in an effort to prevent habitually resetting the successional clock after every disturbance, the appraisal will be critical regarding the need for replanting. However should it be determined the community will not survive, invasive species are an immediate threat, or recovery times will be prohibitively long in terms of bank stabilization objectives, a replanting with a possible selective herbicide of any invading noxious species will be implemented.

A final consideration, and one much more formidable from a management perspective, is the issue of "biological disturbances." The native vegetative structure is mixed oak and pine dominated for upland areas with a larger mix of oaks in riparian areas, but still pines can be found within the riparian zone. Southern pine beetle (*Dendroctonus frontalis*) and the blue-stain fungi (*Ophiostoma* and *Ceratocystis* genera) are a potential threat in this region of Texas, and with nearby properties still practicing commercial silvicultural activities, infestation is a possibility. In the case of infestation, the use of forestry best management practices would need to be implemented immediately to preserve the resource and prevent spread.

The biological disturbance of greatest concern is the North American Beaver (*Castor Canadensis*). Beavers are located on the site at the top of the West Fork of Orange Branch (Appendix A – Exhibits 1 and 2) where a dammed pond and the natural topography create a pinch point; an ideal habitat location for a beaver dam. However, it is unlikely the beavers or their progeny will move to other sites within the mitigation bank as sufficient topography for dam construction is lacking. Beavers require deeper bodies of water for predator evasion and food storage (Jenkins & Busher, 1979). They require water at least deep enough for the 40 lb. animal to swim into the lodge completely submerged. Without the pinch point created by the man-made pond, the beaver dam needed to flood such a low lying, unconfined valley would be massive. The restored channel will be ephemeral or intermittent for most of its reaches, but (Jenkins & Busher, 1979) state the beaver's innate desire to begin dam building is intricately tied to the sound of running water.

Should beavers invade some portion of the restoration area, a professional with U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) and Animal Welfare Act (AWA) training will be employed to live trap the animals using standard equipment (Havahart™, Comstock™, Hancock™, Bailey™, etc.) and methodologies to relocate the animals to suitable habitat off-site. The USACE, in coordination with the IRT, will be notified and consulted prior to any beaver removal activities.

If it becomes apparent performance standards are unachievable under current efforts, the Sponsor may submit a proposal to the USACE to modify the Mitigation Plan after consultation with the IRT. As a final resort, the Sponsor may provide written notice of the intent to discontinue attempting to meet the performance standards for all or a specific aspect of the bank. Once the notice is provided, no further credits can be generated from the particular aspect of the bank.

2.13 MINERAL MANAGEMENT PLAN

Forestar does not own the mineral resources, such as oil and natural gas, which may be situated beneath the Bank. In the State of Texas, surface owners cannot control a mineral owner's access to subsurface minerals. It is unlikely that any drilling will occur within HCMB in the near future. As a stream bank, HCMB is linear in nature and surface impacts to the bank can be avoided by utilization of horizontal drilling

technologies. With these technologies, drilling pads can be strategically placed in uplands outside of the bank and minerals such as oil and natural gas can still be extracted from under the Bank.

The exploration for, and production and transportation of, subsurface mineral resources beneath the HCMB is acceptable provided: ground disturbing activities and surface alterations are minimized to the maximum extent practicable; activities are conducted in a manner that minimizes adverse environmental impacts; impacted areas are restored to pre-existing conditions as soon as practicable; reasonable and appropriate compensatory mitigation is achieved; and the entity conducting the activities complies with all applicable regulatory requirements, including Section 404 of the CWA. The number of credits in the HCMB may be reduced depending on the extent and location of adverse impacts associated with mineral extraction activities. The appropriate compensatory action will be subject to approval by the USACE.

2.14 FINANCIAL ASSURANCES

The Sponsor, Forestar, will be the responsible party for the financial assurances of the Bank. These assurances will be of sufficient substance to insure the proposed compensatory mitigation will be successfully completed in a manner consistent with the performance standards agreed upon by the IRT and the Bank Sponsor. Any financial instrument will be in place prior to commencement of any permitted activity associated with the Houston-Conroe Mitigation Bank.

As seen in Table 24, the total cost of HCMB through the monitoring period is anticipated to be $2,851,920. This cost includes stream channel construction with a 10 percent contingency, riparian buffer planting with a 10 percent contingency, as-built reports, and yearly monitoring. To provide financial assurance protection for these costs, the Sponsor will purchase a casualty insurance policy to protect the Bank in the event of non-compliance. This policy will ensure sufficient funds are available to a third party should the Bank be deemed non-compliant and declared in default by the USACE. Funds would be made available to a third party to restore Bank compliance once a claim has been filed by the USACE. Upon execution of the MBI, the Sponsor will purchase this policy through Ecosystems Insurance Associates, LLC (insurance agent) to meet the short-term financial assurance requirements. A draft policy of this insurance can be found in Appendix I.

TABLE 24: SHORT TERM COSTS ASSOCIATED WITH BANK ESTABLISHMENT

Item	Cost / Unit	Unit	Quantity		TOTAL	Year 0	1	2	3	4	5	6	7	8
Stream Construction Including Streambank Planting	$75	Linear Foot	11,360	(MU1)		$ 852,000								
			7,500	(MU2)	$ 2,175,975		$ 562,500							
			10,153	(MU3)				$ 761,475						
Stream Construction Contengency (10%)					$ 217,598	$ 24,178	$ 24,178	$ 24,178	$ 24,178	$ 24,178	$ 24,178	$ 24,178	$ 24,178	$ 24,178
Riparian Management (Initial Thin and Removal of Exotics)	$500	Acre	163.7	(MU1)		$ 81,850								
			77.0	(MU2)	$ 67,600		$ 38,500							
			135.2	(MU3)				$ 67,600						
Riparian Management (Supplemental Planting)	$200	Acre	163.7	(MU1)				$ 32,740						
			77.0	(MU2)	$ 27,040				$ 15,400					
			135.2	(MU3)						$ 27,040				
Riparian Management / Planting Contengency (10%)					$ 9,464	$ 1,052	$ 1,052	$ 1,052	$ 1,052	$ 1,052	$ 1,052	$ 1,052	$ 1,052	$ 1,052
As-Built Report(s)	$5	Linear Foot	11,360	(MU1)		$ 56,800								
			7,500	(MU2)	$ 145,065		$ 37,500							
			10,153	(MU3)				$ 50,765						
Annual Monitoring (Stream)	$5	Linear Foot*	1,704	(MU1)			$ 17,040	$ 17,040	$ 8,520	$ 8,520	$ 8,520	$ 8,520		
			1,125	(MU2)	$ 174,078			$ 11,250	$ 11,250	$ 5,625	$ 5,625	$ 5,625	$ 5,625	
			1,523	(MU3)					$ 15,230	$ 15,230	$ 7,615	$ 7,615	$ 7,615	$ 7,615
Annual Monitoring (Riparian)	$100	Plot**	17	(MU1)		$ 1,700	$ 3,400	$ 3,400	$ 1,700	$ 1,700	$ 1,700	$ 1,700		
			8	(MU2)	$ 35,100		$ 800	$ 1,600	$ 1,600	$ 800	$ 800	$ 800	$ 800	
			14	(MU3)				$ 1,400	$ 2,800	$ 2,800	$ 1,400	$ 1,400	$ 1,400	$ 1,400
TOTAL					**$ 2,851,920**	**$ 1,017,579**	**$ 684,969**	**$ 972,499**	**$ 81,729**	**$ 86,944**	**$ 50,889**	**$ 50,889**	**$ 40,669**	**$ 34,244**

* 15 Percent of each stream reach will be surveyed for each monitoring period.

** 1 tree-count plot for every 10 acres of riparian buffer will be established and monitored during the monitoring period.

Stream monitorind cost doubled in these years in anticipation of bankfull monitoring reports.

3 BANK OPERATIONS

3.1 ACCOUNTING PROCEDURES

The Sponsor shall be the responsible party for the management of the compensatory stream mitigation credit accounting system that documents all credit transactions. All credit and debit transactions will be recorded in a ledger database and submitted to the appropriate agencies (i.e. the IRT) upon sale/receipt. The ledger will include:

- Permit applicant name, address and telephone number
- Permit number
- 8-digit HUC and county locations
- Brief description of the project impacts
- Number of credits provided
- Remaining balance of Bank credits
- Date of Transaction

Permittees will use the Galveston SOP, Section 4 (Impact Assessment) to determine the amount of credits to be purchased to compensate for unavoidable impacts to WOUS. In general, transactions will be debited at a 1:1 ratio within the primary service area and a 1.5:1 ratio within the secondary service area, however all credit requirements for permittees are established by the USACE on a project specific basis. The Bank and the Sponsor will provide credits for purchase, but it is the responsibility of the permittee to coordinate with the USACE and any other appropriate authorities to determine the number and kind of credits required for their project. The Sponsor shall provide the USACE with a copy of the completed credit transaction within 30 days of transaction. The Sponsor shall provide an annual statement of the ledger to the USACE by January 31st of each year until all credits have been withdrawn and/or the HCMB is closed.

3.2 REPORTING PROTOCOLS

The reporting process is an invaluable component in maintaining effective communication between the Bank management entity (i.e. the Sponsor) and the regulatory agencies. While it does not constitute a replacement for compliance inspections, it does provide the necessary information to the review agencies to monitor the progression of the Bank site as it develops to the desired target resources.

All monitoring reports submitted to the IRT will comply with the Minimum Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (USACE, 2008). The Annual Monitoring Reports will include an evaluation of restoration and enhancement activities to insure those activities are meeting (at a minimum) the performance standards defined in the MBI. Any recommendations for future evaluations or permit modifications congruent to the regulatory guidance will be included within these reports when appropriate. Reports will be submitted to the IRT each year for 7 years by 31 January of the year following the monitoring effort.

3.3 CREDIT RELEASE SCHEDULE

Credit releases will follow the schedule proposed in Table 25, and will be based upon the completion of the strategic milestones illustrated in Table 20 and Table 21. Project milestones and percent of credits released are subsequent to submission and approval of all appropriate documentation.

The Sponsor is making all financial assurances and protections on the entire bank up front, before any construction begins. Due to the significant sequestration of funds and financial risk incurred by the Sponsor, 20 percent (17,402) of the Re-Establishment credits to be generated from the HCMB will be released upon execution of the MBI. The remainder will be released by monitoring unit as seen in the schedule outlined below.

TABLE 25: CREDIT RELEASE SCHEDULE FOR HCMB

Credit Release Schedule								
Milestone	**Verification Metric**	**Stream Re-Establishment**	**Wetland Adjustment Factor**	**Additional Buffer Adjustment Factor**	**Number of Credits (MU1)**	**Number of Credits (MU2)**	**Number of Credits (MU3)**	**Number of Credits (Total)**
Preconstruction	Execution of MBI[1]	20%	0%	0%	6,810	4,500	6,092	**17,402**
Release Schedule for Monitoring Units 1, 2, and 3[3]								
Construction	Earthwork and initial riparian management complete. Approval of as-built report by USACE	20%	30%	30%	9,677	6,090	8,478	**24,245**
1st Bankfull Event	Approval of bankfull (Geomorphology) report by USACE	20%	0%	0%	6,810	4,500	6,092	**17,402**
2nd Bankfull Event[2]	Approval of bankfull (Geomorphology) report by USACE	20%	0%	0%	6,810	4,500	6,092	**17,402**
Yr-2 Monitoring	Approval of monitoring report by USACE. Supplemental planting or demonstration of adequate natural regeneration complete.	5%	30%	30%	4,570	2,715	3,909	**11,194**
Yr-4 Monitoring	Approval of monitoring report by USACE	5%	30%	30%	4,569	2,715	3,909	**11,193**
Yr-7 Monitoring (Final Release)	Approval of monitoring report by USACE. Delivery of long-term endowment. Attainment of all success criteria.	10%	10%	10%	4,361	2,780	3,841	**10,982**
TOTAL	Stream Re-Establishment				34,050	22,500	30,459	
TOTAL	Wetland Adjustment Factor				2,838	1,875	2,538	
TOTAL	Additional Buffer Adjustment Factor				6,719	3,425	5,417	
TOTAL					**43,607**	**27,800**	**38,414**	**109,820**

[1] - Preconstruction task includes the execution of the MBI, IRT's approval of the Mitigation Plan, delivery of the financial assurances, and documentation of a recorded conservation easement. This is a one time credit release for the entire bank.

[2] - Two bankfull events must occur, at least 1 year apart. This may occur at any point during the HCMB's monitoring phase.

[3] - Each monitoring unit will have its own, discrete credit release schedule.

Credits cannot be released for these milestones or subsquent milestones until construction of the next monitoring unit has begun.

3.4 CONTINGENCY PLAN/REMEDIAL ACTION

In the event that one or more components of HCMB does not achieve performance standards or any other requirement specified in the MBI, the following sequence of remedial actions shall be taken.

Once a component of the HCMB is deemed to be non-compliant with the MBI, the Sponsor shall take all appropriate actions to bring that component into compliance as soon as practicable. During the period a specific component of the HCMB is out of compliance, the USACE may suspend its approval of the use of that component's credits as a source of compensatory mitigation for permitted impacts.

If remedial actions taken by the Sponsor are ineffective at bringing an aspect of the HCMB into compliance with the MBI, despite reasonable efforts being made by the Sponsor, the Sponsor may elect to take one of the following courses of action:

1. Submit a proposal to the USACE to modify the Mitigation Plan and/or the appropriate management plan. Any resulting modifications cannot be implemented without approval of the USACE after consultation with the IRT.

2. Provide written notice of the intent to discontinue efforts to meet performance standards for the specific aspect of the HCMB. Once the notice is provided, no further credits can be generated from that aspect of the HCMB. The Sponsor will be released from all future monitoring and maintenance obligations associated with that specific aspect of the HCMB, provided the release of these specific obligations does not adversely affect the remainder of the HCMB. Any unused, previously established credits derived from this aspect shall be removed from the HCMB ledger. Any used previously established credits derived from that aspect shall be replaced with other unused established credits at HCMB. If there are insufficient unused credits to replace those removed credits, the Sponsor shall implement other reasonable appropriate compensatory mitigation approved by the USACE, in coordination with the IRT.

If one or more aspects of the HCMB fails to meet the requirements of the MBI and that failure adversely affects the ability of the HCMB to achieve its goals and objectives, or the Sponsor does not make reasonable efforts to bring the HCMB into compliance with the Mitigation Plan, the USACE, after coordinating with the IRT and notifying the Sponsor, may terminate the MBI and operation of the HCMB. The Sponsor shall implement all reasonably appropriate compensatory mitigation actions that the USACE, after consultation with the IRT, determines is necessary to compensate for those USACE-authorized impacts that have been compensated for by the HCMB pursuant to the requirements of the MBI.

3.5 PROVISIONS COVERING THE USE OF THE LAND

HCMB shall be protected in perpetuity by a Conservation Easement substantially in the same form as the draft Conservation Easement found in Appendix C. Land use practices in conflict with the goals of HCMB and not permitted by the Conservation Easement include, but are not limited to, subdivision and development, commercial/industrial uses, livestock grazing, dumping, surface mining, unauthorized off-road vehicles, new utility conveyances, construction of new roads, other dredge or fill activities, introduction of invasive species, and agricultural uses.

3.6 APPROVED CREDIT QUANTITIES

Using the Galveston SOP, Section 5 (Determination of Compensation) (USACE, 2013), the HCMB will generate 109,820 stream credits. Please refer to Section 2.6, Determination of Credits, for specific details on credit generation calculations. Wetlands within the bank are credited as riparian buffer credits, and are not generating any wetland credits. Therefore wetland impacts will not be compensated for at HCMB.

3.7 DEFAULT AND CLOSURE PROVISIONS

Upon the closure of the HCMB (final release of credits and fulfillment of MBI requirements), the responsibility of site maintenance will be maintained by the Sponsor or their agent. Should the Sponsor sell the property or relinquish responsibility for the site, the IRT will be notified in a timely manner.

The USACE may take appropriate action towards compliance enforcement if the USACE, in coordination with the IRT, determines the Sponsor has failed to:

- Meet the required compensatory mitigation performance standards;

- Submit monitoring reports in a timely manner;
- Establish and maintain ledgers and report in accordance with the provisions in this document;
- Or otherwise comply with the terms of the MBI.

Enforcement actions may include suspending credit sales, decreasing available credits, requiring adaptive management measures, utilizing financial assurances or contingency funds, terminating the MBI, or referring the non-compliance with the terms of the instrument to the Department of Justice. Any delay or failure of the Sponsor to comply with the terms of this MBI shall not constitute a default if the delay or failure is the result of any force majeure or other conditions beyond the Sponsor's reasonable control that significantly, adversely affect their ability to perform their obligations herein, such as severe flooding, extreme drought, earthquake, landslide, arson, wild fire, civil disorder, condemnation or other taking by any governmental body. The Sponsor shall give written notice to the USACE and the IRT if the bank is affected by any such event as soon as reasonably possible in order to restore compliance.

In the event of default, the USACE may provide written notification of non-compliance to the Sponsor, the third party beneficiary, or entity responsible for distributing the funds in accordance with the financial assurances to facilitate required mitigation activities. The third party beneficiary will collect the funds necessary to correct the deficiency and take corrective action.

The bank shall be closed upon the date the performance standards have been met and documented, and either of the following criteria have been met:

- The last authorized credit has been transferred and the financial assurance is fully funded for all credits sold.
- The Sponsor submits written notice to the USACE stating the Sponsor is closing the bank and the long-term financial assurance is fully funded for all credits sold.

When the USACE approves of this written notice, the banking project shall be deemed complete and the bank will be officially closed. Following bank closure, the conservation easement protecting the bank shall remain effective in perpetuity and long-term stewardship shall commence.

3.8 FORCE MAJEURE

The Sponsor shall be responsible to maintain the HCMB and perform remedial action as described herein except for damage or noncompliance caused by events of *force majeure* or unlawful acts. In order for such exception to apply, the Sponsor shall reasonably demonstrate the damage or non-compliance could not have been reasonably foreseen or prevented. For this to apply, the USACE must concur in writing a *force majeure* event has occurred and any failure or non-compliance is the result of such an event. The sponsor shall provide to the USACE and IRT written notice that will include a proposed adaptive management strategy in order to reasonably mitigate events of *force majeure* or unlawful acts. The Sponsor recognizes that force majeure does not include natural weather events that are predictable and normal for the area.

3.9 DISPUTE RESOLUTION

Should a dispute arise between the Sponsor and the USACE/IRT as to the application of this MBI, then the dispute resolution process outlined in 33 CFR 332.8 (e) will be followed.

3.10 VALIDITY, MODIFICATION, AND TERMINATION OF THE BANK

This MBI will become valid upon signature by the USACE and the Sponsor. The initial credit release is authorized following: 1) the recordation of conservation easements; 2) execution of the financial assurance requirements; and 3) any other requirements specified in the MBI and the Mitigation Plan. This MBI may be amended, altered, released, or revoked only by written agreement among the parties hereto or their heirs, assigns, or successors-in-interest. Any amendment must follow the appropriate procedures listed in 33 CFR 332.8(d), unless the district engineer determines the streamlined review process described in 33 CFR 332.8(g)(2) is warranted. Any of the IRT members may terminate their participation upon written notification to all signatory parties. Participation of IRT members will terminate 30 days after written notification.

3.11 CONTROLLING LANGUAGE

To the extent specific language in this document changes, modifies, or deletes terms and conditions contained in those documents that are incorporated in the MBI by reference, and are not legally binding, the specific language within the MBI shall be controlling.

4 REFERENCES

5 SIGNATURE PAGES

APPENDIX A – EXHIBITS

HCMB Project Location
30.249959° W, 95.087253° N

Coordinate System: NAD 1983 StatePlane Texas Central FIPS 4203 Feet

FORESTAR RS&H

Action	Initials	Date
Created:	EH	9/11/2014
Revised:	EH	5/21/2015
Approved:		
Project:	115-2370-003	

Exhibit 1
Project Location
Houston-Conroe Mitigation Bank
Liberty County, Texas
Sponsor: Forestar
USACE Project - SWG-2013-00141

0 10 20 30 Mi

Legend
- Interstate Highways
- Primary Highways
- Secondary Highways
- Grand Parkway
- County Limits
- City Areas
- Protected Lands

SOURCES - Imagery, Roads, Admin Boundaries: **ESRI**, Water: **NWI**, Protected Lands: **ESRI**, **FWS**

Document Path: S:\P\115-2370-003 Houston-Conroe Mitigation Bank (Tyler)\I Dwgs and Design Data\I1_GIS\I1.2_MXD\3000 - MBI\2015 Re-Submittal\Exhibit1_HCMB MBI_Site Location.mxd

HCMB Project Location
30.249959° W, 95.087253° N

Coordinate System: NAD 1983 StatePlane Texas Central FIPS 4203 Feet

FORESTAR RS&H

Action	Initials	Date
Created:	EH	9/11/2014
Revised:	EH	3/19/2015
Approved:		
Project:	115-2370-003	

Exhibit 2
Service Area
Houston-Conroe Mitigation Bank
Liberty County, Texas
Sponsor: Forestar
USACE Project - SWG-2013-00141

0 5 10 15 Mi

Legend

Service Areas
- Primary
- Secondary

Ecological Features
- Lakes
- Ecoregions
- Sub-Basins (8-Digit)

Admin Boundaries
- Counties
- Cities

Roadways
- Interstate Highway
- US Highway
- State Highway
- Grand Parkway

SOURCES - Imagery, Admin Boundaries, Lakes: **ESRI**, Roadways: **TxDOT**, Service Area: **Forestar**

Document Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\3000 - MBI\2014_July dMBI Re-Submittal\Exhibit2_HCMB MBI_Service Area.mxd

West Fork A

East Fork C

East Fork A

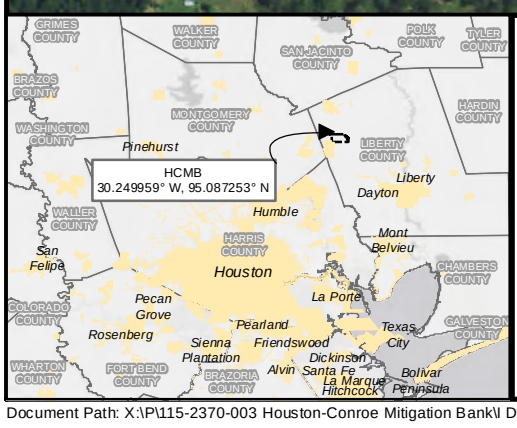
East Fork B

West Fork

East Fork

Mainstem

Coordinate System: NAD 1983 StatePlane Texas Central FIPS 4203 Feet



FORESTAR RS&H

Action	Initials	Date
Created:	EH	9/12/2014
Revised:	EH	3/19/2015
Approved:		
Project:	115-2370-003	

Exhibit 3
Pre-Construction Map
Houston-Conroe Mitigation Bank
Liberty County, Texas
Sponsor: Forestar
USACE Project - SWG-2013-00141

0 500 1,000 Feet

Legend

Boundaries
- Parent Tract *~3,505 Ac*
- HCMB Boundary *396.1 Ac*

Site Features
- Existing Channels (OHWM) *6,820 Lf*
- Aggraded Channels (No OHWM) *19,388 Lf*
- Pond *0.7 Ac*

Wetland Assessment Areas
- WAA 1 - Pine Plantation (Forested) *118.8 Ac*
- WAA 2 - Mature Hardwood (Forested) *48.5 Ac*
- WAA 3 - Young Hardwood (Forested) *32.7 Ac*
- WAA 4 - Beaver Pond (Forested) *8.0 Ac*
- WAA 5 - Beaver Pond (Herbaceous) *4.3 Ac*
- WAA 6 - Clearings (Herbaceous) *5.0 Ac*

SOURCES - Imagery : **NAIP**, Parent Tract: **Forestar**, Bank Boundary: **Opperman Surveying**, WAAs: **Hydrex**.

Document Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\3000 - MBI\2014_July dMBI Re-Submittal\Exhibit3_HCMB MBI_Pre-Construction.mxd

West Fork A

East Fork C

East Fork A

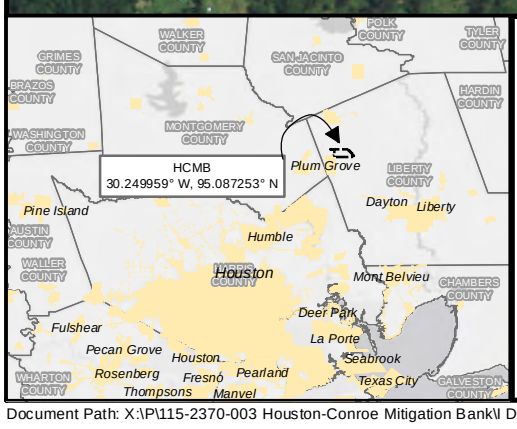
East Fork B

West Fork

East Fork

Mainstem

Coordinate System: NAD 1983 StatePlane Texas Central FIPS 4203 Feet



FORESTAR RS&H

Action	Initials	Date
Created:	EH	9/12/2014
Revised:	EH	3/19/2015
Approved:		
Project:	115-2370-003	

Exhibit 4
Post-Construction Map
Houston-Conroe Mitigation Bank
Liberty County, Texas
Sponsor: Forestar
USACE Project - SWG-2013-00141

0 500 1,000 Feet

Legend

Boundaries
- Parent Tract *~3,505 Ac*
- HCMB Boundary *396.1 Ac*

Easements and Rights-of-Way
- Roads *9.4 Ac*
- Well Pads *0.5 Ac*

Site Features
- Restored Streams *9.6 Ac*
- Preserved Pond *0.7 Ac*
- Wetland *210.7 Ac*
- Uplands *165.2 Ac*

SOURCES - Imagery : **NAIP**, Parent Tract: **Forestar**, Wetlands: **Hydrex**, Uplands: **RS&H**, Restored Streams: **Meanders**, Bank Boundary: **Opperman Surveying**

Document Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\3000 - MBI\2014_July dMBI Re-Submittal\Exhibit4_HCMB MBI_Post-Construction.mxd

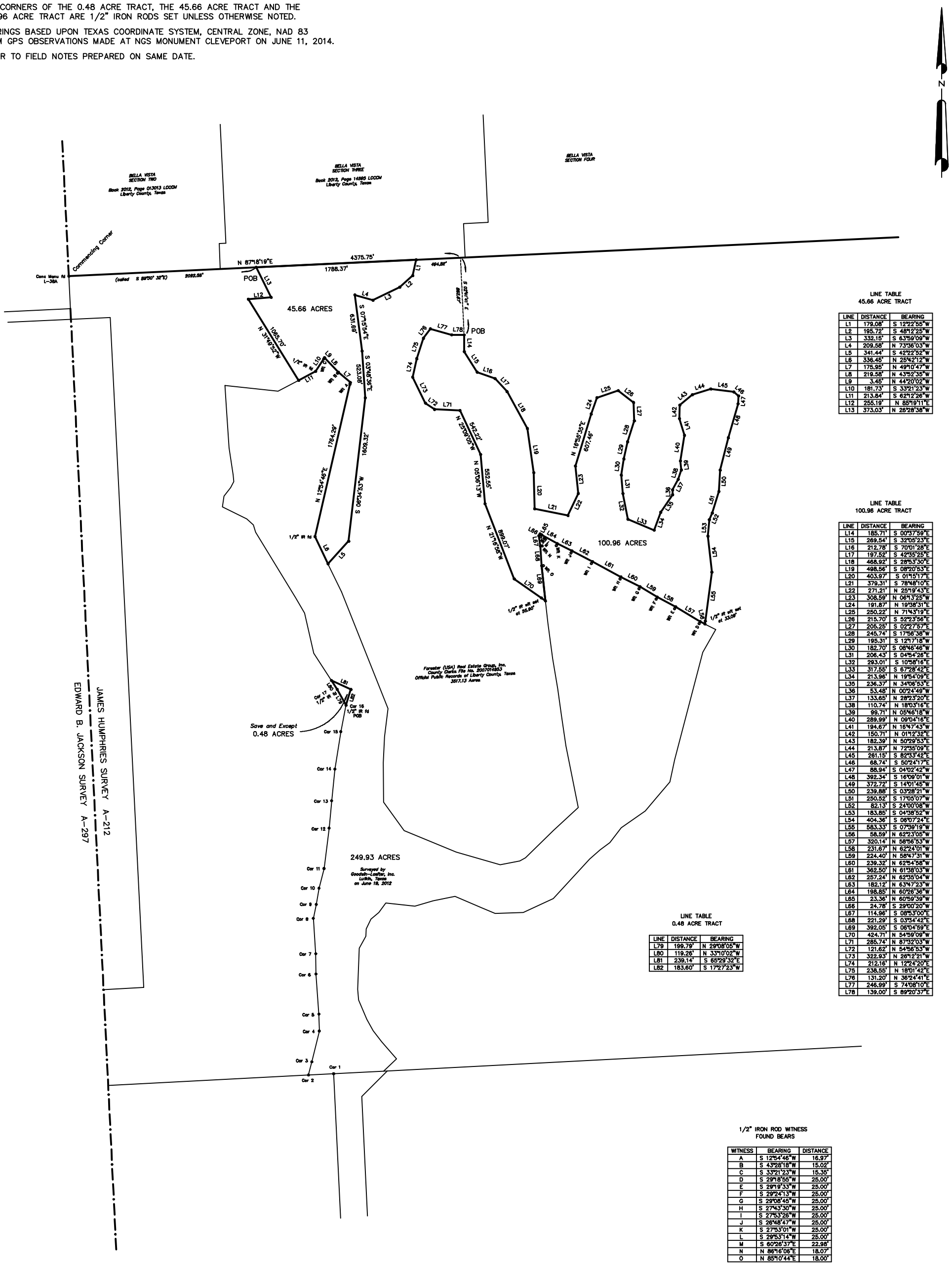
APPENDIX B – TITLE AND OWNERSHIP INFORMATION

SURVEYOR DID NOT ABSTRACT FOR EASEMENTS OR OWNERSHIP.
ALL IMPROVEMENTS AND EASEMENTS ARE NOT SHOWN.

ALL CORNERS OF THE 0.48 ACRE TRACT, THE 45.66 ACRE TRACT AND THE 100.96 ACRE TRACT ARE 1/2" IRON RODS SET UNLESS OTHERWISE NOTED.

BEARINGS BASED UPON TEXAS COORDINATE SYSTEM, CENTRAL ZONE, NAD 83 FROM GPS OBSERVATIONS MADE AT NGS MONUMENT CLEVEPORT ON JUNE 11, 2014.

REFER TO FIELD NOTES PREPARED ON SAME DATE.



LINE TABLE
45.66 ACRE TRACT

LINE	DISTANCE	BEARING
L1	179.08'	S 12°22'55"W
L2	195.72'	S 48°12'25"W
L3	332.15'	S 63°59'09"W
L4	209.58'	N 73°36'03"W
L5	341.44'	S 42°22'52"W
L6	336.45'	N 25°42'12"W
L7	175.95'	N 49°10'47"W
L8	219.58'	N 43°52'35"W
L9	3.45'	N 44°20'02"W
L10	181.73'	S 33°21'23"W
L11	213.84'	S 62°12'26"W
L12	255.19'	N 85°19'11"E
L13	373.03'	N 26°28'38"W

LINE TABLE
100.96 ACRE TRACT

LINE	DISTANCE	BEARING
L14	185.71'	S 00°37'59"E
L15	269.54'	S 32°05'23"E
L16	212.78'	S 70°01'28"E
L17	197.52'	S 42°35'25"E
L18	468.92'	S 28°53'30"E
L19	498.56'	S 08°20'53"E
L20	403.97'	S 01°15'17"E
L21	379.31'	S 78°48'10"E
L22	271.21'	N 25°19'43"E
L23	308.59'	N 06°13'25"W
L24	191.87'	N 19°38'31"E
L25	250.22'	N 71°43'19"E
L26	215.70'	S 52°23'56"E
L27	205.25'	S 02°27'57"E
L28	245.74'	S 17°56'38"W
L29	195.31'	S 12°17'18"W
L30	182.70'	S 08°46'46"W
L31	206.43'	S 04°54'26"E
L32	293.01'	S 10°58'16"E
L33	317.55'	S 67°28'42"E
L34	213.96'	N 19°54'09"E
L35	236.37'	N 34°06'53"E
L36	53.48'	N 00°24'49"W
L37	133.65'	N 28°23'20"E
L38	110.74'	N 18°03'16"E
L39	99.71'	N 05°46'18"W
L40	289.99'	N 09°04'16"E
L41	194.67'	N 16°47'43"W
L42	150.71'	N 01°12'32"E
L43	182.39'	N 50°29'53"E
L44	213.87'	N 72°35'09"E
L45	261.15'	S 82°33'42"E
L46	68.74'	S 50°24'17"E
L47	88.94'	S 04°02'42"W
L48	392.34'	S 16°09'01"W
L49	372.72'	S 14°01'45"W
L50	239.86'	S 03°28'21"W
L51	250.52'	S 17°05'07"W
L52	82.13'	S 24°00'08"W
L53	183.85'	S 04°38'52"W
L54	404.36'	S 06°07'24"E
L55	583.33'	S 07°39'19"W
L56	58.59'	N 62°23'05"W
L57	320.14'	N 58°56'53"W
L58	231.67'	N 62°24'01"W
L59	224.40'	N 58°47'31"W
L60	239.32'	N 62°54'58"W
L61	362.50'	N 61°38'03"W
L62	257.24'	N 62°35'04"W
L63	182.12'	N 63°47'23"W
L64	198.85'	N 60°26'36"W
L65	23.36'	N 60°59'39"W
L66	24.78'	S 29°00'20"W
L67	114.96'	S 08°53'00"E
L68	221.29'	S 03°34'42"E
L69	392.05'	S 06°04'59"E
L70	424.71'	N 54°59'09"W
L71	285.74'	N 87°32'03"W
L72	121.62'	N 54°56'53"W
L73	322.93'	N 26°12'21"W
L74	212.16'	N 12°24'20"E
L75	238.55'	N 18°01'42"E
L76	131.20'	N 36°24'41"E
L77	246.99'	S 74°08'10"E
L78	139.00'	S 89°20'37"E

LINE TABLE
0.48 ACRE TRACT

LINE	DISTANCE	BEARING
L79	199.79'	N 29°08'05"W
L80	119.26'	N 33°10'02"W
L81	239.14'	S 65°29'32"E
L82	183.60'	S 17°27'23"W

1/2" IRON ROD WITNESS
FOUND BEARS

WITNESS	BEARING	DISTANCE
A	S 12°54'46"W	16.97'
B	S 43°28'18"W	15.02'
C	S 35°21'23"W	15.35'
D	S 29°18'55"W	25.00'
E	S 29°19'33"W	25.00'
F	S 29°24'13"W	25.00'
G	S 29°08'45"W	25.00'
H	S 27°43'30"W	25.00'
I	S 27°53'26"W	25.00'
J	S 26°48'47"W	25.00'
K	S 27°53'01"W	25.00'
L	S 29°53'14"W	25.00'
M	S 60°26'37"E	22.98'
N	N 86°16'06"E	18.07'
O	N 85°10'44"E	18.00'

I, Jeffrey D. Opperman, a duly Registered Professional Land Surveyor for the State of Texas hereby certify that the above plat of the property surveyed for FORESTAR (USA) REAL ESTATE GROUP, INC. on the JAMES HUMPHRIES SURVEY, A-212 in Liberty County, Texas is true and correct and was drawn from a survey made by me on the ground the 25th day of June, 2014.

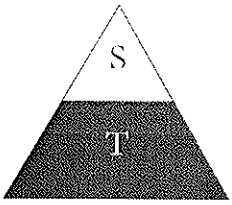
REGISTERED PROFESSIONAL LAND SURVEYOR NO. 4168

STATE OF TEXAS REGISTERED JEFFREY D. OPPERMAN 4168 PROFESSIONAL LAND SURVEYOR

SURVEYED FOR
FORESTAR (USA) REAL ESTATE GROUP, INC.
JAMES HUMPHRIES SURVEY, A-212
LIBERTY COUNTY, TEXAS
SCALE: 1" = 500' JUNE 25, 2014

OPPERMAN SURVEYING COMPANY
316 LEWIS STREET
NACOGDOCHES, TEXAS 75961
(936) 560-5464
FIRM REGISTRATION NUMBER 10017800

MS/FSTAR1



Superior Title

Property Search
14-044

Effective Date: July 18, 2014

Issue Date: July 25, 2014

To: Community Title Company
3502 S. Medford
Lufkin, TX 75901

SUBJECT PROPERTY:

Tract 1:

45.66 acres of land situated in the James Humphrey Survey, Abstract No. 212, Liberty County, Texas.

Tract 2:

100.96 acres of land situated in the James Humphrey Survey, Abstract No. 212, Liberty County, Texas.

Tract 3:

249.93 acres of land situated in the James Humphrey Survey, Abstract No. 212, Liberty County, Texas.

TITLE VESTED IN:

Forestar (USA) Real Estate Group, Inc.

SUPERIOR TITLE COMPANY HAS CONDUCTED A SEARCH OF THE RECORDS OF LIBERTY COUNTY, TEXAS FROM November 4, 2011 TO THE EFFECTIVE DATE SHOWN ABOVE AND FOUND THE FOLLOWING FILED OF RECORD:

Liens:

Modification of Deed of Trust, Assignment of Rents, Leases and other Agreements, Security Agreement and Fixture Filing dated September 14, 2012, filed for record on September 17, 2012 under Clerk's File Number 2012012101, Official Public Records, Liberty County, Texas.

Appointment of Substitute Trustees dated May 15, 2014, recorded May 16, 2014 under Clerk's File Number 2014007537, Official Public Records, Liberty County, Texas.

Modification of Deed of Trust, Assignment of Rents, Leases and other Agreements, Security Agreement and Fixture Filing dated May 15, 2014, filed for record on May 16, 2014 under Clerk's File Number 2014007538, Official Public Records, Liberty County, Texas.

Deed of Trust, Assignment of Rents, Leases and other Agreements, Security Agreement and Fixture Filing dated June 3, 2014, filed for record on June 16, 2014 under Clerk's File Number 2014009076, Official Public Records, Liberty County, Texas.

Judgments:

None of Record.

Other:

Lease for coal, lignite, oil, gas and other minerals, together with rights incident thereto, dated effective July 20, 2011, by and between B. E. Quinn, III, et al, as Lessor, and Resaca resources, L.L.C., as Lessee, recorded on August 17, 2011 in/under Clerk's File No. 2011009945 of the Official Public Records of Liberty County, Texas. Reference to which instrument is here made for particulars. No further search of title has been made as to the interest(s) evidenced by this instrument, and the Company makes no representation as to the ownership or holder of such interest(s).

The following easements/pooling agreements from a prior search apply to the above 3 tracts of land:

Gas Pooling Agreement dated May 15, 1995, recorded in Volume 1578, Page 275 of the Official Public Records of Liberty County, Texas.

Gas Unit Designation Hollimon Oil Corporation Quinn-Grogan Minerals Gas Unit No. 1 Well dated effective November 2, 2001, recorded in Volume 1980, Page 191 of the Official Public Records of Liberty County, Texas.

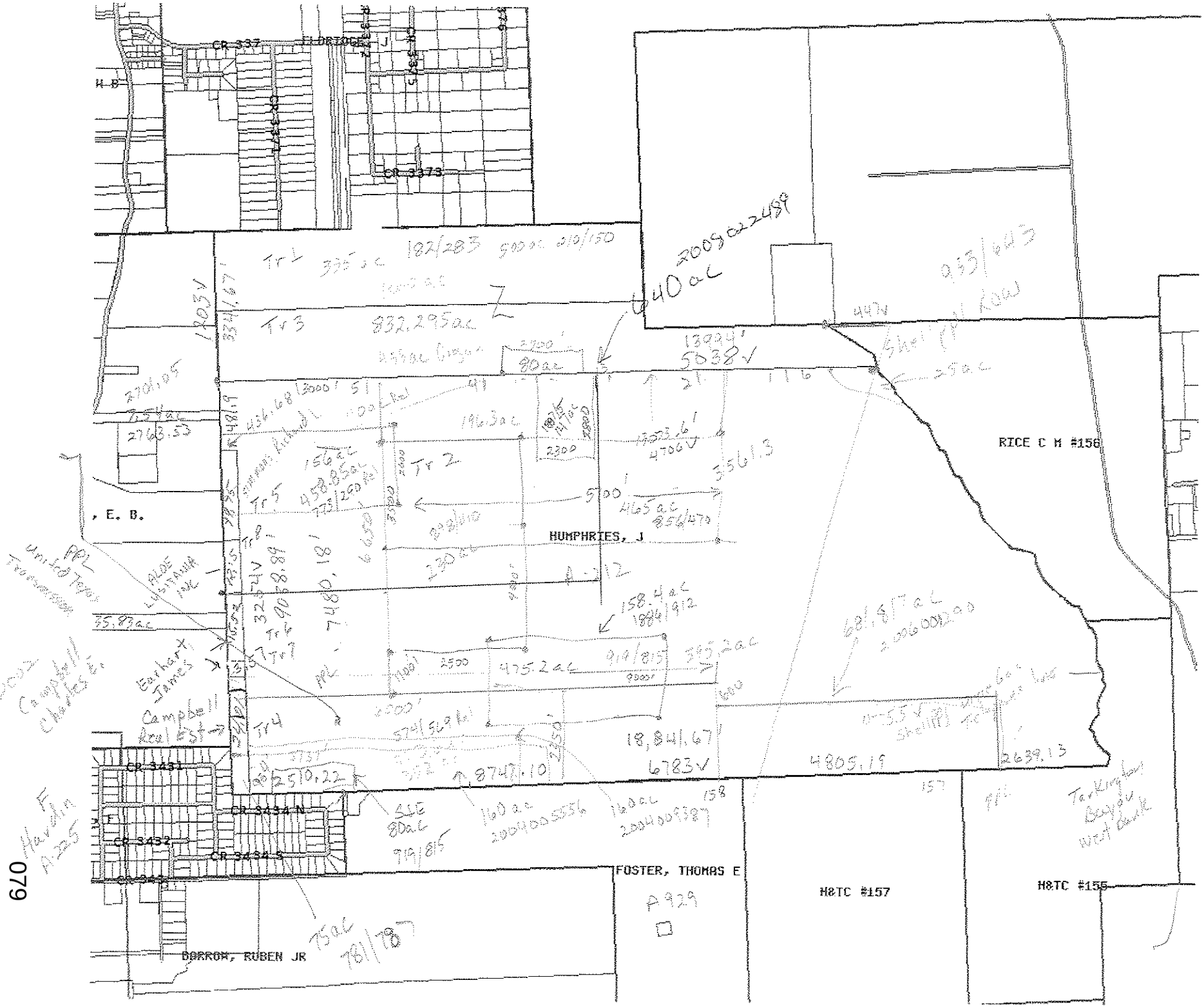
Designation of Unit Resaca Resources, L.L.C.-Quinn-Grogan No. 1 Gas Unit dated effective July 6, 2008, recorded under Clerk's File No. 2008017877 of the Official Public Records of Liberty County, Texas.

Easement dated June 2, 1970, executed by Sabine Investment Company of Texas, Inc. to Pennzoil Pipeline Company, recorded in Volume 663, Page 615 of the Deed Records of Liberty County, Texas.

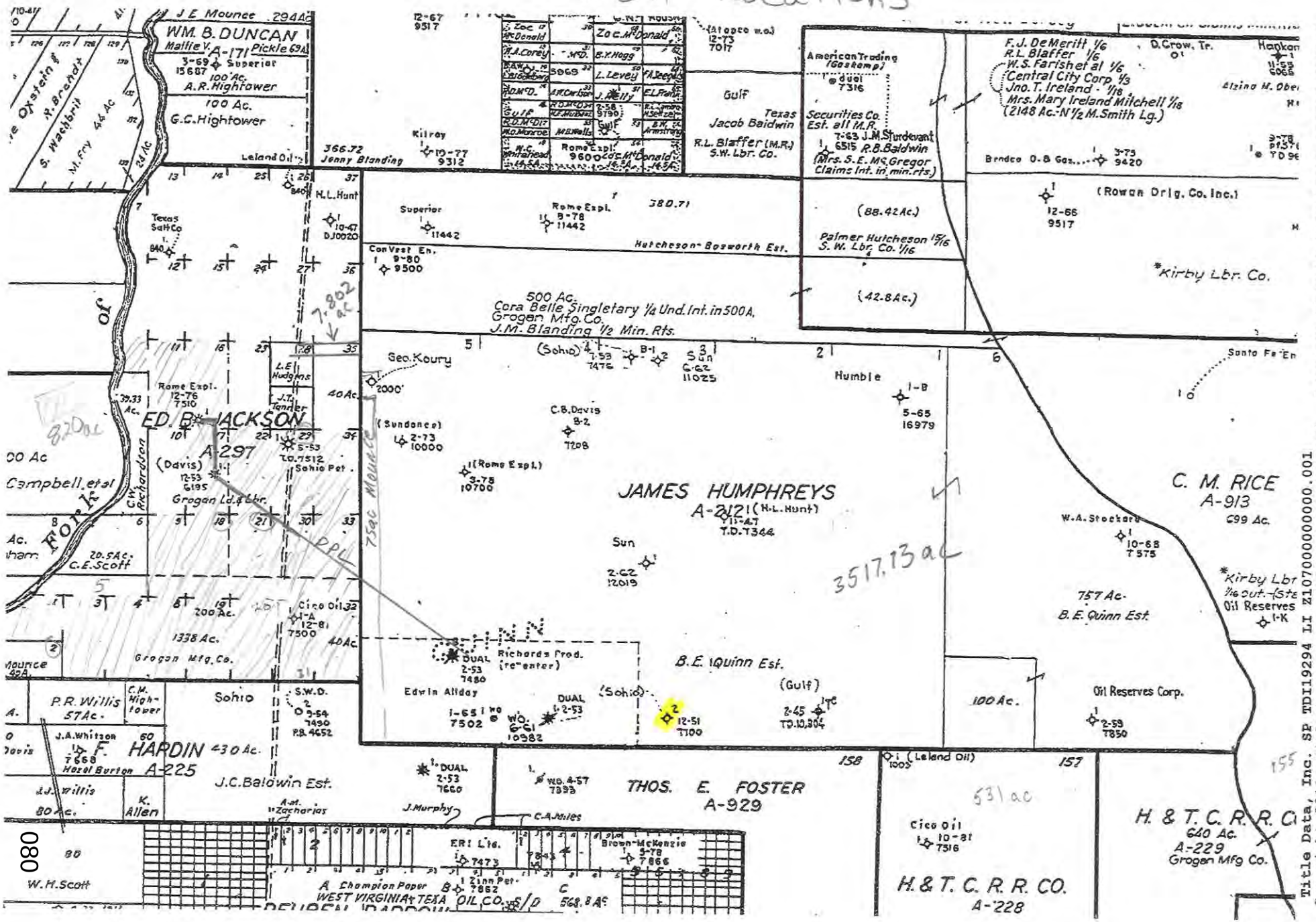
This certificate is neither a guaranty nor warranty of title and is being issued for the sole use and benefit of Community Title Company issued in consideration of $250.00 plus tax paid to Superior Title Company, Inc. Superior Title Company, Inc. disclaims any warranties, expressed or implied, concerning the information provided herein. This information is solely for the use of the party requesting same and no one else. Superior Title Company, Inc.'s liability for errors and omissions in this information, including liability resulting from its negligence, shall be limited to the amount paid for this Certificate. By accepting this Certificate, the party requesting the information agrees that the disclaimer of warranties and liability of limitation contained in this paragraph is a part of its contract with Superior Title Company, Inc. and shall cover all actions hereunder whether arising by statute, in contract, or in tort.

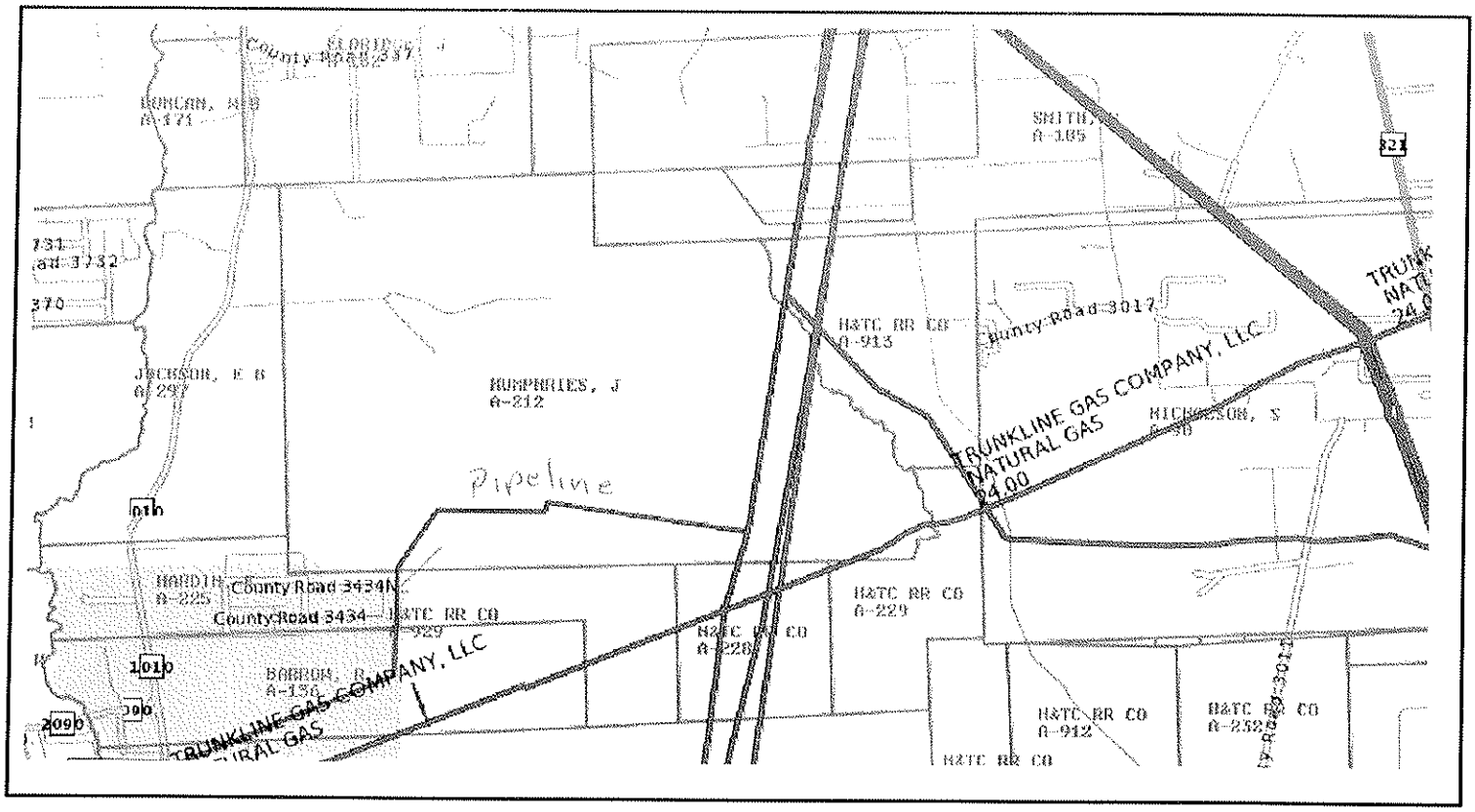
Sincerely,

Donna Lee Kelso


CR 337
CR 3373
CR 3431
CR 3434 N
CR 3432
CR 3434 S
RICE C M #158
HUMPHRIES, J
FOSTER, THOMAS E
H&TC #157
H&TC #155
DORRON, RUBEN JR
Campbell, Charles E.
Earhart, James
Campbell Real Est
640 ac
2009022489
932.295ac
Tr 1
Tr 2
Tr 3
Tr 4
Tr 5
Tr 6
Tr 7
Tr 8
158.4 ac
475.2 ac
160 ac
160 ac
75 ac
80 ac
18,841.67
6783 V
4805.19
2639.13
8747.10
5038 V
4700 V
5700'
2500
2300
9000
13934'
781/787
919/815
1884/912
200600/200
200400/5387
200400/5554

079





OGI

Flex Map

Printed:Jul 18, 2014

city_streets
state_hwy
us_hwy
railroads
rsd_boundaries
aboundis
lots
blocks
subdivisions
parcels
flood
clubs
airports
parks
city_boundaries

N
W
E
S

APPENDIX C – CONSERVATION EASEMENT DOCUMENTATION

Tel: 281-576-1634
10330 Lake Rd. Bldg. J
Houston, TX 77070
Email: info@bayouland.org

Memorandum of Agreement

for proceeding with a conservation easement on 396.07 acres of land situated in the James Humphrey Survey, Abstract No. 212 in Liberty County, Texas.

This Memorandum of Agreement ("Agreement") is made by and between **BAYOU LAND CONSERVANCY ("BLC")** and **FORESTAR (USA) REAL ESTATE GROUP, INC.**

This Agreement shall be signed by all relevant parties, including BLC and **FORESTAR (USA) REAL ESTATE GROUP, INC.** in accordance with the mitigation plan for the Galveston District United States Army Corps of Engineers ("USACE") permit number SWG-2013-00141 for a 396.07 acre parcel of land ("Mitigation Site") (Exhibit A).

RESPONSIBILITIES OF THE PARTIES: The following paragraphs identify the parties and their responsibilities that will commence upon the completion of the document.

FORESTAR (USA) REAL ESTATE GROUP, INC. agrees:

a) No additional easements, for roads, utility lines, cable television, fiber optic communications or any other purpose will be placed on the 396.07 acre mitigation site from the date of this agreement, other than those required by the mitigation banking permit and stream restoration plan.
b) There will be no cutting or harvesting of timber on the 396.07 acre mitigation site from the date of this agreement other than those required by the mitigation banking permit and stream restoration plan.
c) There will be no placement of fill material, excavation spoil or debris of any kind on the 396.07 acre mitigation site, other than those required by the mitigation banking permit and stream restoration plan.
d) There will be no excavation or flood water detention of any other purpose on the 396.07 acre mitigation site, other than those required by the mitigation banking permit and stream restoration plan.
e) The Grantor agrees to conduct channel morphology restoration and in-stream enhancements based on the mitigation banking permit and restoration plan based on the Rosgen approach, using approved native species, in the areas impacted by past excavation and fill material placement. This

includes removal of mono-cultured pine plantations previously established using mechanical and chemical site preparation treatments.

f) The Grantor agrees to restore drainages currently obstructed by the access road and excavation spoil and other drainages similarly obstructed that may be identified during the Baseline Survey of the Conservation Easement Area as required by the mitigation banking permit and restoration plan.

g) To pay **BLC** for the establishment of the conservation easement on the 396.07 acre mitigation site for the administrative, legal, and stewardship fees described in the invoice dated May 21, 2015.

h) To grant **BLC** a conservation easement within 45 days of the issuance of the USACE permit number SWG-2013-00141. To record the conservation easement within fifteen (15) days of the execution of the conservation easement.

BLC agrees:

a) To accept and hold a conservation easement on the 396.07 acre mitigation site.

ACCEPTANCE OF AGREEMENT: This Agreement is executed with multiple duplicate originals and is binding on all parties.

UNILATERAL TERMINATION: This Agreement represents a valid contract, supported by consideration. A unilateral termination by any party will result in an administration fee, payable to BLC for the time and expense of staff members. The administration fee will be determined on a case by case basis by BLC, not to exceed $20,000.

USACE APPROVAL: This Agreement shall be null and void if this specific Mitigation Plan for SWG-2013-00141 is not approved or the USACE permit is not issued. Should USACE not approve this mitigation plan, all parties agree that BLC will be compensated for the time and expense of staff members in the form of an administration fee. The administration fee will be determined on a case by case basis by BLC.

-- SIGNATURES ON FOLLOWING PAGES --

Memorandum of Agreement

for proceeding with a conservation easement on 396.07 acres of land situated in the James Humphrey Survey, Abstract No. 212 in Liberty County, Texas.

FORESTAR (USA) REAL ESTATE GROUP, INC.
a Delaware Corporation

By: W B Goodrum, Sr. Date: 05-26-15

William B. Goodrum, Sr.
6300 Bee Cave Road
Building 2, Suite 500
Austin, Texas 78746
512-433-5259

SIGNATURE BLOCKS CONTINUE ON NEXT PAGE

Memorandum of Agreement

for proceeding with a conservation easement on 396.07 acres of land situated in the James Humphrey Survey, Abstract No. 212 in Liberty County, Texas.

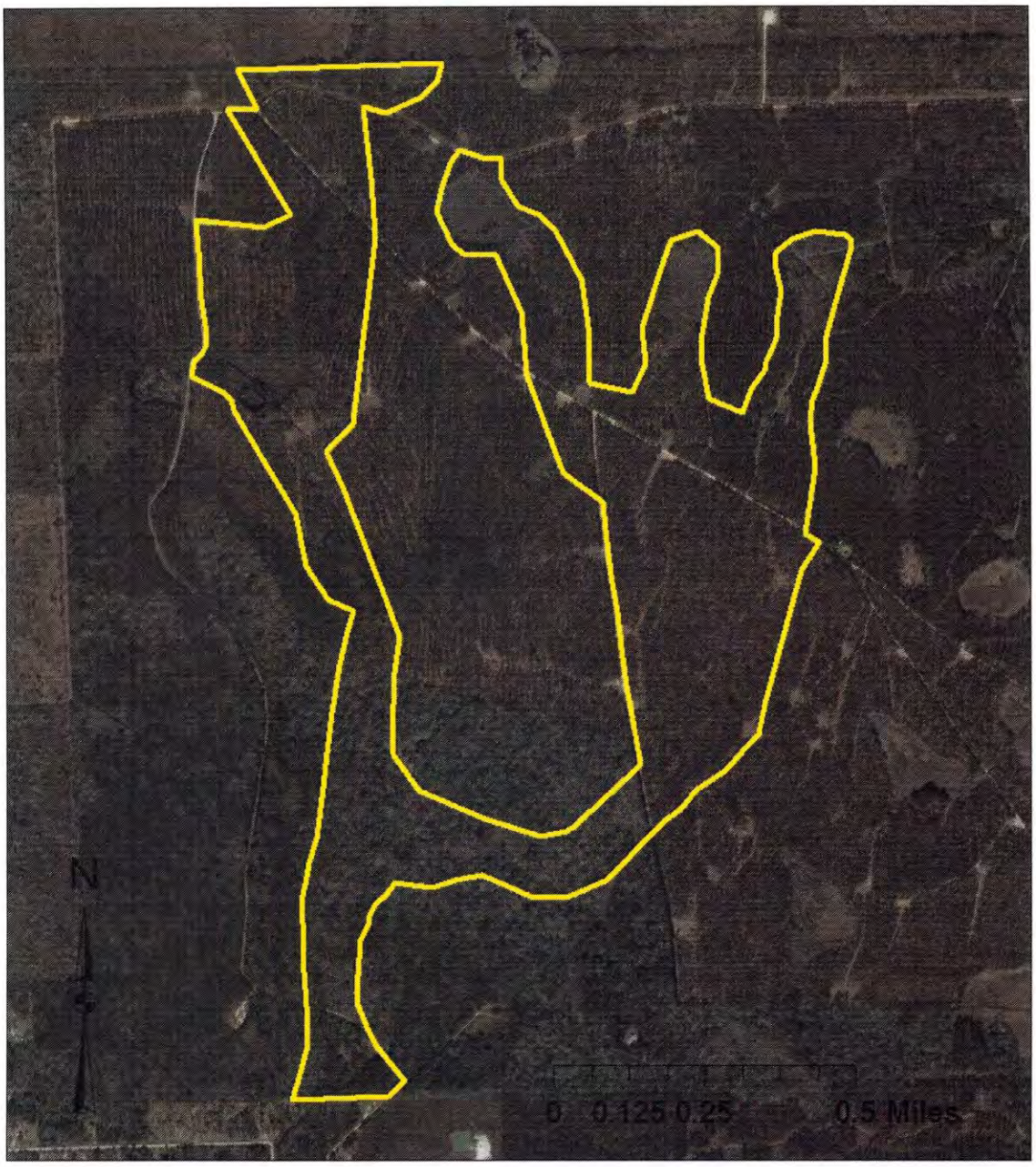
BAYOU LAND CONSERVANCY

By: _____ 5-26-2015

Jennifer Lorenz, Executive Director — Date

10330 Lake Road, Building J
Houston, TX 77070
(281) 576-1634

EXHIBIT A



BayouLandConservancy

Houston-Conroe Mitigation Bank
396.07 acres - Libery County, TX

Map Created By:
Stephanie Prosser
Bayou Land Conservancy
5/26/2015
Image Source: www.esri.org
Imagery: 2012, True Color
Texas State Plane,
South Central, NAD83

[END OF DOCUMENT]

DRAFT
CONSERVATION EASEMENT

S T A T E O F T E X A S §

COUNTY OF LIBERTY §

THIS CONSERVATION EASEMENT is made this ___ day of MONTH, 2015 by the FORESTAR REAL ESTATE GROUP, INC. ("Grantor"), having an address at 6300 Bee Cave Rd. Bldg. 2 #500, Austin, Texas 78746, and its successors and assigns, in favor of BAYOU LAND CONSERVANCY, a Texas non-profit organization qualified to do business in the State of Texas ("Grantee"), having an address at 10330 Lake Rd. Bldg. J, Houston, Texas 77070, and its successors and assigns.

Grantor hereby voluntarily grants and conveys to Grantee, and its successors and assigns, a perpetual and assignable conservation easement, said conservation easement being on, over and across all of a certain parcel of land known as the Houston/Conroe Mitigation Bank ("the Property") of the nature and character and to the extent hereinafter set forth ("Conservation Easement"), as described in Exhibit **A**.

PURPOSES:

The Property possesses Conservation Values of great importance to Grantor, Grantee, the people of the Texas Gulf Coast Area and the people of the State of Texas. Specifically, the Property is a unique, diverse ecological area consisting of 396.07 acres of land. Approximately 219.39 acres of this qualify as waters of the United States, of which 1.39 acres are within stream channels identified as Orange Branch Main Stem, West Fork, and East Fork, 0.66 acres consist of an open water pond, and 217.34 acres are wetlands, providing migratory stop-over and wintering area for numerous migratory bird species. The Property is in the East Fork San Jacinto Watershed (8-Digit HUC 12040103), which is part of the larger San Jacinto River Basin (6-Digit HUC 120401). The Property, of which 375.9 acres will be restored to riparian habitat and wetlands, possesses the capacity to retain and absorb flood waters and overland flows. The Property is currently being restored from silviculture to riparian habitat.

No income tax breaks were taken or received by the Grantor for the conveyance of this Conservation Easement.

The Conservation Easement partially satisfies the United States Army Corps of Engineers (USACE) requirements for establishing the following Wetland Mitigation Bank Permit:

SWG-2013-00141– Houston-Conroe Mitigation Bank

The specific Conservation Values of the Property are documented in the baseline inventory report dated BASELINE DATE and held at the Bayou Land Conservancy office**.** The Property is also a unique, diverse ecological area with numerous native tree and shrub species identified during the_____, 2015 baseline inventory of the 396.07 acres. The Baseline Inventory Report describes the Property's current use and includes reports, maps, photographs, and other documentation. The Baseline Inventory Report is mutually agreed upon by both parties, prepared by Grantee for Grantor, and signed and acknowledged by both parties. Grantor worked

with Grantee to ensure that the report is a complete and accurate description of the Property as of the date of this Conservation Easement.

This Conservation Easement shall be a covenant running with the land. It is the purpose of this Conservation Easement to assure that the Property will, to the maximum extent permitted by law, be retained in perpetuity in its open space condition and to prevent any use of the Property that will significantly impair or interfere with the Conservation Values of the Property. Grantor intends that this Conservation Easement will confine the use of the Property to those activities described and limited in Section 3 of the Terms and Conditions, and be consistent with the purposes of this Conservation Easement.

MAINTENANCE:

1. Establishment of Stewardship and Legal Defense Costs for the Houston/Conroe Mitigation Bank. At or prior to the time of execution of the Conservation Easement, Grantor paid to Grantee one-time Stewardship and Conservation Easement Legal Defense Fees.

2. Mitigation Plan. The United States Army Corps of Engineers (USACE) Wetland Mitigation Banking Instrument Permit SWG-2013-00141 ("the Permit") was permitted with USACE-approved mitigation plans. The mitigation plan is to be executed by Grantor as described within their associated permit.

3. Management Plan. This Conservation Easement includes a management plan, described in **Exhibit D**, which is to be applied in addition to the conditions of the approved mitigation banking instrument and is subject to update as additional ecological issues arise.

4. Costs, Legal Requirements and Liabilities. Grantor retains all responsibilities related to the ownership, operation, upkeep, and maintenance of the Property. Grantor remains solely responsible for obtaining any applicable governmental permits and approvals for any construction or other activity or use permitted by this Conservation Easement, and all such construction or other activity or use shall be undertaken in accordance with all applicable federal, state, and local laws, regulations, and requirements. Grantor shall keep the Property free of any new liens arising out of any work performed for, materials furnished to, or obligations incurred by Grantor.

5. Taxes. Grantor shall pay all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority before delinquency, including any taxes imposed upon, or incurred as a result of, this Conservation Easement, and shall furnish Grantee with satisfactory evidence of payment upon request.

6. Application of Proceeds. Grantee shall use any proceeds received from an action on behalf of this Conservation Easement in a manner consistent with its conservation purposes.

TERMS AND CONDITIONS:

1. Rights of Grantee. To accomplish the purposes of this Conservation Easement, the following rights are hereby conveyed to the Grantee, its employees, agents, contractors, and its successors and assigns, with respect to the Property:

(a) To preserve and protect the Conservation Values of the Property;

(b) To enter upon Property at reasonable times with prior notice in order to monitor Grantor's compliance with and otherwise enforce the terms of this Conservation

Easement and to obtain evidence for the purpose of seeking judicial enforcement of the Easement;

(c) To prevent any activity on or use of the Property that is inconsistent with the purposes of this Conservation Easement and to require, pursuant to the Management Plan, the restoration of such areas or features of the Property that may be damaged by any inconsistent activity or use.

2. Prohibited Uses. Any activity on or use of the Property inconsistent with the purposes of this Conservation Easement is prohibited. Without limiting the generality of the foregoing, the activities and uses described in Exhibit **B** are expressly prohibited, except as provided under Section 3 of this Conservation Easement.

3. Permitted Uses. Grantor reserves to itself, and to its personal representatives, heirs, successors, and assigns, all rights accruing from Grantor's ownership of the Property, including the right to engage in or permit or invite third parties to engage in all uses of the Property that are not expressly prohibited herein and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, and subject to the terms of Section 2, the rights described in the attached Exhibit **C** are expressly reserved.

4. Posting. Bayou Land Conservancy will provide Conservation Easement signage at a cost to the Grantor. These signs will posted by the Grantor in accordance with Exhibit A-3. These signs will be placed by the Grantor within thirty days (30) after execution of the Conservation Easement and will be reasonably maintained.

5. Notice and Approval.

5.1 Notice of Intention to Undertake Certain Permitted Actions. In order to ensure that a proposed action is authorized in accordance with Section 3 of this Conservation Easement and to enable Grantee to ensure that any such activities are designed and will be carried out in a manner consistent with the purposes of this Conservation Easement, the Grantor shall provide advance notice to the Grantee whenever the Grantor or any of the Grantor's lessees propose to construct trails or any type of surface structure on the Property. Whenever notice is required, Grantor shall notify Grantee in writing not less than thirty (30) days prior to the date Grantor intends to undertake the activity in question. The notice shall describe the proposed activity in sufficient detail to permit Grantee to make an informed judgment as to the proposed activity's consistency with the purposes of this Conservation Easement. Permission to undertake these actions will not be unreasonably withheld.

It shall be the responsibility of the Grantor (i) to notify Grantee in writing as soon as practicable after being contacted by any mineral lessee regarding on-site exploration or extraction and (ii) to also notify Grantee in writing not less than thirty (30) days after Grantor receives any notice of cessation of any such activity. To the extent the Grantor is legally able to control the activities of mineral interest owners, it shall act to incorporate into any lease providing access to the surface of the Property a requirement for the lessee to reclaim any surface damage that may have resulted from any exploration for or extraction of subsurface minerals such that the vegetative cover of the reclaimed area is consistent with the purposes of this Conservation Easement.

5.2 Grantee's Approval. Where approval is required, as set forth in Section 5.1, Grantee shall grant or withhold its approval, with or without conditions, in writing within thirty (30) days of receiving the written request. Approval may be withheld only upon a reasonable

determination that the action as proposed would be inconsistent with the purposes of this Conservation Easement. Any such determination shall be in writing and shall identify, if possible, the alterations in the proposed actions which would allow the Grantee to approve the contemplated actions.

5.3 Mediation. If a dispute arises between the parties concerning the consistency of any proposed use or activity with the purposes of this Conservation Easement and the parties are unable to resolve the dispute within thirty (30) days through informal negotiations, either party may refer the dispute to mediation by request made in writing to the other. Grantor shall cease any use or activity objected to by the Grantee during the mediation process detailed herein. Within ten (10) days of the receipt of such a request, the parties shall select a single trained and impartial mediator. If the parties are unable to agree on the selection of a single mediator, then the parties shall, within fifteen (15) days of receipt of the initial request, jointly apply to a proper court for the appointment of a trained and impartial mediator. Neither party shall be obligated to continue the mediation process beyond a period of sixty (60) days from the date of receipt of the initial request or if the mediator concludes that there is no reasonable likelihood that continuing mediation will result in a mutually agreeable resolution of the dispute. The expiration of sixty (60) days or the mediator's declaration of an impasse, whichever occurs first, must be completed before either party may initiate litigation. The costs of the mediator shall be borne equally by Grantor and Grantee.

6. Grantee's Remedies.

6.1 Notice of Violation; Corrective Action. If Grantee determines that a violation of the terms of this Conservation Easement has occurred or is threatened, Grantee shall give written notice to Grantor of such violation and request corrective action sufficient to cure the violation and, where the violation involves injury to the Property resulting from any use or activity inconsistent with the purposes of this Conservation Easement, to restore the portion of the Property so injured to its prior condition in accordance with a plan approved by Grantee.

6.2 Injunctive Relief. If Grantor fails to cure the violation within sixty (60) days after receipt of notice thereof from Grantee, or under circumstances where the violation cannot reasonably be cured within a sixty (60) day period, fails to begin curing such violation within the sixty (60) day period, or fails to continue diligently to cure such violation until finally cured, Grantee may bring an action in a court of competent jurisdiction to enforce the terms of this Conservation Easement, to enjoin the violation by temporary or permanent injunction, and to require the restoration of the Property to the condition that existed prior to any such injury. In the event that Grantor undertakes any action that may seriously impair or destroy the conservation values set forth in the Conservation Easement, Grantee may immediately seek injunctive relief in a court of competent jurisdiction.

6.3 Damages. To the extent permitted by Texas law, Grantee shall be entitled to recover damages for violation of the terms of this Conservation Easement or injury to any Conservation Values protected by this Conservation Easement.

6.4 Scope of Relief. Grantor acknowledges that actual or threatened events of non-compliance under this Conservation Easement constitute immediate and irreparable harm. In such case, Grantor also acknowledges that Grantee is entitled to any remedies as described in this section cumulatively.

6.5 Forbearance. Forbearance or delay by Grantee to exercise its rights under this Conservation Easement shall not be deemed or construed to be a waiver of any of Grantee's rights.

6.6 Waiver of Certain Defenses. Grantor, for itself and for its successors and assigns, hereby waives any defense of laches (i.e., undue delay), estoppel (i.e., prior statement or act that is deceptively inconsistent with the claim being asserted), or prescription (i.e., adverse possession) with respect to Grantee's rights to enforce the terms of this Conservation Easement. Grantor acknowledges Grantee's requirement for this provision due to the Grantee's limited presence on the Property.

6.7 Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor or Grantor's successors and assigns for any injury to or change in the Property resulting from causes beyond Grantor's control, including, without limitation, fire, flood, storm, or earth movement.

6.8 USACE Enforcement. All rights and remedies with respect to this Conservation Easement held by the Grantee are also held by the United States Army Corps of Engineers and its successor agencies. All notices required to be sent to either party must also be sent to the USACE, Galveston District. All plans and contingencies mentioned in this Conservation Easement that require either parties' approval shall also require approval of the USACE. Should any provision of this Conservation Easement conflict with or contradict the Permit, Property, or Mitigation Banking Instrument that the Permit shall control, although in the event a provision in the Conservation Easement has greater requirements than the Permit, Grantor shall comply with the Conservation Easement unless doing so would violate the Permit. Nothing contained herein shall constitute a grant of interest in real property to the USACE. Additionally, before any action by either party is taken to modify this Conservation Easement, Mitigation Banking Instrument, or other long-term protection plan mechanism, including transfer of title to, or establishment of any other legal claim to the Property, the party wishing to take such action to modify shall give 60 days written notice to the USACE district engineer for the Galveston District.

6.9 Additional Third Party Enforcement. Grantor and Grantee may execute an addendum to this Conservation Easement after its creation to authorize an additional appropriate third party to enforce the terms of this Conservation Easement. Any such addendum shall not diminish the enforcement rights of the Grantee.

7. Access. No right of access by the general public to any portion of the Property is conveyed by this Conservation Easement, but controlled access to the public may be implemented at the Property.

8. Representations and Warranties.

8.1 Grantor represents and warrants that, to the best of its actual knowledge:

(a) There are no underground storage tanks located on the Property, whether presently in service or closed, abandoned, or decommissioned, and no underground storage tanks have been removed from the Property in a manner not in compliance with applicable federal, state, and local laws, regulations, and requirements;

(b) There is no pending or threatened litigation in any way affecting, involving, or relating to the Property;

(c) No civil or criminal proceedings or investigations have been instigated at any time or are now pending, and no notices, claims, demands, or orders have been received, arising out of any violation or alleged violation of, or failure to comply with, any federal, state, or local law, regulation, or requirement applicable to the Property or its use, nor do there exist any facts or circumstances that Grantor might reasonably expect to form the basis for any such proceedings, investigations, notices, claims, demands, or orders;

(d) Grantor intends that the Conservation Values of the Property be preserved and maintained;

(e) Grantor further intends, as owner of the Property, to convey to Grantee the right to preserve and protect the Conservation Values of the Property in perpetuity.

8.2 Grantee represents and warrants that:

(a) Grantee is a publicly supported organization pursuant to Section 509(a)(2) of the Internal Revenue Code and is a tax-exempt, nonprofit organization, qualified under Section 501(c)(3) and 170(h) of the Internal Revenue Code, whose primary purpose is to protect and restore relatively natural, vegetated open space areas adjacent to bayous and rivers within the Texas Gulf Coast Area. Grantee meets the requirements of Texas state law to hold a conservation easement;

(b) Grantee agrees, by accepting this grant, to honor the intentions of Grantor stated herein and to preserve and protect in perpetuity the Conservation Values of the Property.

8.3 Remediation. If, at any time, there occurs a release in, on, or posing a threat to the Property of any substance which would present an imminent or substantial danger to human health or the environment, and for which Grantor is a responsible party under applicable state or federal law, Grantor agrees to take all steps necessary to assure its containment and remediation. Nothing in this section shall be interpreted as creating any rights for any third party not a signatory to this Conservation Easement.

8.4 Control. Nothing in this Conservation Easement shall be construed as giving rise, in the absence of a judicial decree, to any right or ability of Grantee to exercise physical or managerial control over the day-to-day operations of the Property, or any of Grantor's activities on the Property, or otherwise to become an operator within the meaning of The Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended ("CERCLA"); the Texas Solid Waste Disposal Act (Texas Health and Safety Code Annotated, Section 361); or any other federal, state, or local law or regulation.

9. Extinguishment and Condemnation

9.1 Extinguishment. If circumstances arise in the future that render the purposes of this Conservation Easement impossible to accomplish, this Conservation Easement can only be terminated or extinguished, whether in whole or in part, by judicial proceedings in a court of competent jurisdiction. The amount of the proceeds to which Grantee shall be entitled, from any sale, exchange, or involuntary conversion of all or any portion of the Property subsequent to such termination or extinguishment, shall be that portion of the proceeds equivalent to the fair market value of the Conservation Easement.

9.2 Condemnation. If all or any part of the Property is taken by exercise of the power of eminent domain or acquired by purchase in lieu of condemnation, so as to terminate this Conservation Easement, in whole or in part, Grantor and Grantee shall act jointly to realize the action most favored by the Grantee according to the following hierarchy:

1. avoiding condemnation of the Property and preserving it in its present condition: both parties shall jointly take actions to formally request that the intended proceeding completely avoid the taking of this Property;
2. minimizing the loss to the property and supplementing the property under easement: if the Property cannot be wholly preserved as a result of the intended proceeding, both parties shall jointly take actions to formally request the intended proceeding minimize its taking of this Property and supplement, on at least a 1:1 acreage basis with nearby land possessing equivalent conservation values, any loss of the Property. Added lands will be protected by a supplemental conservation easement conveyed to the Grantee within 60 days of the acquisition of property;
3. mitigating the loss of the Property: if options (1) and (2) are not acceptable to the Grantee, both parties shall jointly take actions to formally request that the intended proceeding mitigate on at least a 1:1 acreage basis with nearby land possessing equivalent conservation values replace lands taken from the Property. Grantor will protect lands acquired by conveying a replacement conservation easement to the Grantee 60 days of the acquisition of the replacement property; or
4. recover full value: if options (1) through (3) are not available or acceptable to the Grantee, both parties shall jointly take actions to recover full value of the property subject to the taking or in lieu purchase and all direct or incidental damages resulting therefrom. All expenses reasonably incurred by Grantor and Grantee in connection with the taking or in lieu purchase shall be paid out of the amount recovered, in excess of the value of the property.

10. Amendment and Modification. If circumstances arise under which an amendment to or modification of this Conservation Easement would be appropriate, Grantor and Grantee must jointly agree to amend this Conservation Easement, and any amendment shall be consistent with the preservation purposes of this Conservation Easement, shall be neutral or positive to the Conservation Values, and shall not provide any private benefit or private inurement to either party, and shall not affect its perpetual duration. Any such amendment shall be recorded in the official records of Liberty County, Texas, at the expense of the party initiating the amendment.

11. Assignment. Grantee may assign its rights and obligations under this Conservation Easement to any organization that is a qualified organization at the time of transfer under Section 170(h) of the Internal Revenue Code (or any successor provision then applicable), and authorized to acquire and hold conservation easements under Chapter 183 of the Texas Natural Resources Code (or any successor provision then applicable) and any applicable laws of the United States. Moreover, this organization must be either accredited by the Land Trust Accreditation Commission, an independent program of the Land Trust Alliance; actively undergoing accreditation through this Commission; or have adopted the 37 Land Trust Standards and Practices of the Land Trust Alliance through a resolution of their Board of Directors.

As a condition of such transfer, Grantee shall (i) provide advance written notice to

Grantor, (ii) require that the conservation purposes this grant is intended to advance continue to be carried out, and (iii) transfer to the assignee the balance of easement monitoring fees allocated to this Conservation Easement. Notwithstanding any other provision of this Conservation Easement, Grantee covenants and agrees that it will not assign this Conservation Easement without the express written consent of Grantor, which consent shall not be unreasonably withheld.

12. Subsequent Transfers. Any time the Property is transferred by Grantor to any third party by any conveyance, Grantor shall notify Grantee in writing at least thirty (30) days prior to the transfer of the Property, and the document of conveyance shall expressly refer to this Conservation Easement. Except for a transfer by gift, will or trust, Grantor shall pay Grantee an administrative fee of one hundred dollars ($100.00) upon transfer. Grantee may at its discretion waive collection of the administrative fee if it receives notice of the transfer prior to such event. The failure of Grantor to perform any act required by this §12 shall not impair the validity of this Conservation Easement or limit its enforceability in any way.

13. Certification Documents. Upon request by Grantor, Grantee shall, within twenty (20) days, execute and deliver to Grantor, or to any party designated by Grantor, any document, including an estoppel certificate, which certifies, to the best of the Grantee's knowledge, Grantor's compliance with any obligation of Grantor contained in this Conservation Easement and otherwise evidences the status of this Conservation Easement. Such certification shall be limited to the condition of the Property as of Grantee's most recent inspection. If Grantor requests more current documentation, Grantee shall conduct an inspection, at Grantor's expense, within thirty (30) days of receipt of Grantor's written request.

14. Notices. Any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and either served personally or sent by facsimile or by certified first class mail, return receipt requested, postage prepaid, addressed as follows:

To Grantor: Forestar Real Estate Group
6300 Bee Cave Rd. Bldg. 2 #500
Austin, Texas 78746

To Grantee: Bayou Land Conservancy
10330 Lake Rd. Bldg. J
Houston, Texas 77070
(281) 576-1634

With a copy to: Department of the Army
Regulatory Branch
Galveston District, Corps of engineers
P.O. Box 1229
Galveston, TX 77553-1229

or to such other address as either party, from time to time, shall designate by written notice to the other.

15. Recordation. Grantor shall record, at Grantor's expense, within fifteen (15) days of the execution of this instrument by all parties hereto, this instrument in the official records of Liberty County, Texas. Pursuant to Section 10, any amendment to this Conservation Easement

shall be recorded in the official records of Liberty County, Texas, and at the expense of the party initiating the amendment. Grantee shall receive the original recorded instrument within fifteen (15) days of the Grantor's receipt of said instrument.

16. General Provisions.

16.1 Controlling Law. The interpretation and performance of this Conservation Easement shall be governed by the laws of the State of Texas.

16.2 Liberal Construction. Any general rule of construction to the contrary notwithstanding, this Conservation Easement shall be liberally construed in favor of the Grantee, to affect the purposes of this Conservation Easement and the policy and purposes of Chapter 183 of the Texas Natural Resources Code (or any successor provision then applicable). If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purposes of this Conservation Easement that would render the provision valid shall be favored over any interpretation that would render it invalid.

16.3 Severability. If any provision of this Conservation Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Conservation Easement, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid shall not be affected thereby.

16.4 Entire Agreement. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings, or agreements relating to the Conservation Easement, all of which are merged herein. No alteration or variation of this instrument shall be valid or binding unless contained in an amendment that complies with Section 10.

16.5 No Forfeiture. Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

16.6 Successors. The covenants, terms, conditions, and restrictions of this Conservation Easement shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude running in perpetuity with the Property. The terms "Grantor" and "Grantee," wherever used herein, and any pronouns used in place thereof, shall include, respectively, the above-named Grantor and its personal representatives, heirs, successors, and assigns, and the above-named Grantee and its successors and assigns.

16.7 Termination of Rights and Obligations. Unless provided otherwise in the transfer agreement, a party's rights and obligations under this Conservation Easement terminate upon transfer of the party's interest in the Conservation Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

16.8 Counterparts. The parties will execute this instrument in three counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

TO HAVE AND TO HOLD unto Grantee, its successors, and assigns forever.

EXECUTED by Grantor and Grantee on the day and year first above written.

[SIGNATURES CONTINUE ON FOLLOWING PAGE]

GRANTOR:

FORESTAR REAL ESTATE GROUP, INC

By: _____
SIGNATORY
SIGNATORY TITLE

THE STATE OF TEXAS §
COUNTY OF LIBERTY §

This instrument was acknowledged before me on the _____ day of _____, 2015, by SIGNATORY, TITLE of **FORESTAR REAL ESTATE GROUP, INC**, and in the capacity therein stated.

_____
NOTARY PUBLIC, STATE OF TEXAS

GRANTEE:

BAYOU LAND CONSERVANCY

BY:_____
Joseph M. Wong
Chair

THE STATE OF TEXAS §
COUNTY OF HARRIS §

This instrument was acknowledged before me on the _____ day of _____, 2014, by Joseph Wong, Chair of **BAYOU LAND CONSERVANCY, INC.**, on behalf of said organization, and in the capacity therein stated.

_____
NOTARY PUBLIC, STATE OF TEXAS

SCHEDULE OF EXHIBITS
(attached hereto and made a part hereof)

Exhibit A	Legal Description of Conroe/Houston Mitigation Bank
A-1	Boundary Survey Drawing
A-2	Aerial Boundary Map
A-3	Sign Posting Location Map
Exhibit B	Prohibited Uses and Practices
Exhibit C	Permitted Uses and Practices
Exhibit D	Mitigation Banking Instrument (held at Bayou Land Conservancy office)

EXHIBIT A

LEGAL DESCRIPTION OF HOUSTON/CONROE MITIGATION BANK

LEGAL DESCRIPTION – 249.93 ACRES
JAMES HUMPHRIES SURVEY, A-212
LIBERTY COUNTY, TEXAS

BEING 249.93 acres, more or less, located in the James Humphries Survey, A-212, in Liberty County, Texas and being a portion of the called 3517.13 acre tract described in a Deed from TIN Inc. to Forestar (USA) Real Estate Group Inc., dated October 1, 2007 and recorded in Document No. 2007014953 of the Official Public Records of Liberty County, Texas (OPRLCT) and being more particularly described as follows:

BEGINNING at a concrete monument found in the southerly line of the said 3517.13 acre tract for the northwesterly corner of a called 5.834 acre tract described in a Deed from Champion International Corporation to C. C. Lilley, Inc. recorded in Volume 1530, Page 800 OPRLCT;

THENCE South 87° 02' 19" West 280.27 feet along the southerly line of the said 3517.13 acre tract and the northerly line of 59 Estates, Phase II, as shown on the plat recorded in Volume 9, Page 164, Real Property Records of Liberty County, Texas (RPRLCT) to a 1/2-inch iron rod set for the most southwesterly corner of the herein described 247.47 acre tract, from which a concrete monument found for a southwesterly corner of the said 3517.13 acre tract bears South 87° 02' 19" West 2229.73 feet;

THENCE within the said 3517.13 acre tract and along the boundaries of the herein described 247.47 acre tract as follows:

1. North 13° 56' 47" East 151.97 feet to a 1/2-inch iron rod set for corner,
2. North 13° 41' 14" East 353.10 feet to a 1/2-inch iron rod set for corner,
3. North 01° 04' 59" West 189.13 feet to a 1/2-inch iron rod set for corner,
4. North 04° 19' 22" West 448.14 feet to a 1/2-inch iron rod set for corner,
5. North 00° 25' 41" West 227.35 feet to a 1/2-inch iron rod set for corner,
6. North 03° 59' 01" West 394.90 feet to a 1/2-inch iron rod set for corner,
7. North 11° 47' 10" East 158.39 feet to a 1/2-inch iron rod set for corner,
8. North 09° 47' 12" East 184.29 feet to a 1/2-inch iron rod set for corner,
9. North 14° 16' 59" East 225.88 feet to a 1/2-inch iron rod set for corner,
10. North 07° 09' 50" East 454.53 feet to a 1/2-inch iron rod set for corner,
11. North 05° 15' 12" East 306.55 feet to a 1/2-inch iron rod set for corner,
12. North 05° 52' 31" East 354.57 feet to a 1/2-inch iron rod set for corner,
13. North 08° 58' 07" East 423.76 feet to a 1/2-inch iron rod set for corner,
14. North 10° 58' 47" East 301.93 feet to a 1/2-inch iron rod set for corner,
15. North 29° 08' 05" West 199.79 feet to a 1/2-inch iron rod set for corner,
16. North 33° 10' 02" West 481.90 feet to a 1/2-inch iron rod set for corner,
17. North 12° 35' 38" West 460.35 feet to a 1/2-inch iron rod set for corner,
18. North 29° 47' 14" West 195.71 feet to a 1/2-inch iron rod set for corner,
19. North 31° 32' 33" West 857.25 feet to a 1/2-inch iron rod set for corner,
20. North 17° 44' 25" West 85.94 feet to a 1/2-inch iron rod set for corner,
21. North 47° 20' 45" West 102.20 feet to a 1/2-inch iron rod set for corner,
22. North 63° 57' 49" West 302.40 feet to a point on the easterly margin of a 30 foot wide road easement, from which a 1/2-inch iron rod set for reference bears South 63° 57' 49" East 18.25 feet,
23. North 09° 31' 07" East 120.70 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 66° 43' 02" East 18.02 feet,

V:\256\256008\FN\256008 fn 01.doc

24. North 37° 02' 50" East 119.96 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 56° 51' 42" East 17.54 feet,
25. North 29° 13' 45" East 77.17 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 78° 35' 49" East 18.38 feet,
26. North 06° 25' 22" West 73.51 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 82° 26' 04" East 17.50 feet,
27. North 08° 42' 29" West 306.03 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 83° 39' 09" East 17.51 feet,
28. North 03° 59' 12" West 422.40 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 86° 07' 33" East 18.50 feet,
29. North 03° 45' 43" West 275.25 feet to a point for corner,
30. North 02° 19' 03" East 2.08 feet to a point on the easterly margin of the said 30 foot wide road easement from which a 1/2-inch iron rod set for reference bears South 83° 54' 20" East 17.54 feet,
31. South 83° 54' 20" East 599.14 feet to a 1/2-inch iron rod set for corner,
32. North 62° 12' 26" East 471.41 feet to a 1/2-inch iron rod set for corner,
33. North 33° 21' 23" East 181.73 feet to a point on the southwesterly margin of a 30 foot wide road easement, from which a 1/2-inch iron rod set for reference bears South 33° 21' 23" West 15.35 feet,
34. South 44°20' 00" East 3.45 feet to a point for corner,
35. South 43° 52' 35" East 219.57 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 43° 28' 18" West 15.02 feet,
36. South 49° 10' 47" East 175.95 feet to a point on the southwesterly margin of a 30 foot wide road easement, from which a 1/2-inch iron rod set for reference bears South 12° 54' 46" West 16.97 feet,
37. South 12° 54' 46" West 1764.29 feet to a 1/2-inch iron rod set for corner,
38. South 25° 42' 12" East 683.75 feet to a 1/2-inch iron rod set for corner,
39. South 21° 44' 09" East 1086.88 feet to a 1/2-inch iron rod set for corner,
40. South 21° 34' 35" East 313.94 feet to a 1/2-inch iron rod set for corner,
41. South 07° 01' 35" West 317.84 feet to a 1/2-inch iron rod set for corner,
42. South 02° 22' 04" West 288.65 feet to a 1/2-inch iron rod set for corner,
43. South 00° 25' 19" East 441.58 feet to a 1/2-inch iron rod set for corner,
44. South 35° 43' 52" East 388.64 feet to a 1/2-inch iron rod set for corner,
45. South 67° 31' 02" East 630.80 feet to a 1/2-inch iron rod set for corner,
46. South 73° 42' 27" East 509.99 feet to a 1/2-inch iron rod set for corner,
47. North 78° 33' 13" East 224.74 feet to a 1/2-inch iron rod set for corner,
48. North 61° 08' 46" East 73.06 feet to a 1/2-inch iron rod set for corner,
49. North 45° 47' 17" East 431.87 feet to a 1/2-inch iron rod set for corner,
50. North 46° 59' 06" East 380.39 feet to a point on the westerly margin of a 30 foot wide road easement, from which a 1/2-inch iron rod set for reference bears North 46° 59' 06" East 21.14 feet,
51. North 11° 25' 27" West 700.60 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 80° 10' 35" East 18.01 feet,
52. North 08° 13' 25" West 340.83 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 82° 01' 01" East 18.00 feet,
53. North 07° 44' 33" West 304.13 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 81° 16' 07" East 18.00 feet,
54. North 09° 42' 54" West 340.82 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 81° 17' 52" East 18.00 feet,
55. North 07° 41' 21" West 398.82 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 83° 06' 49" East 18.00 feet,

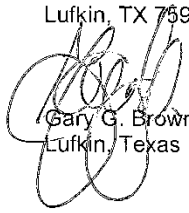
56. North 06° 04' 59" West 643.95 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 85° 10' 44" East 18.00 feet,
57. North 03° 34' 42" West 221.29 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears North 86° 16' 06" East 18.07 feet,
58. North 08° 53' 00" West 114.96 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 60° 26' 37" East 22.98 feet,
59. North 29° 00' 20" East 24.78 feet to a point for corner on the southerly margin of a 30 foot wide road easement,
60. South 60° 59' 40" East 23.36 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 53' 14" West 25.00 feet,
61. South 60° 26' 36" East 198.85 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 27° 53' 01" West 25.00 feet,
62. South 63° 47' 23" East 182.12 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 26° 48' 47" West 25.00 feet,
63. South 62° 35' 04" East 257.24 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 27° 53' 26" West 25.00 feet,
64. South 61° 38' 03" East 362.50 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 27° 43' 30" West 25.00 feet,
65. South 62° 54' 58" East 239.32 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 08' 45" West 25.00 feet,
66. South 58° 47' 31" East 224.40 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 24' 13" West 25.00 feet,
67. South 62° 24' 01" East 231.67 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 19' 33" West 25.00 feet,
68. South 58° 56' 53" East 320.14 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 18' 55" West 25.00 feet,
69. South 62° 23' 05" East 193.93 feet to a point for corner, from which a 1/2-inch iron rod set for reference bears South 29° 46' 27" West 24.90 feet,
70. South 29° 46' 27" West 290.64 feet to a 1/2-inch iron rod set for corner,
71. South 14° 35' 44" West 1238.74 feet to a 1/2-inch iron rod set for corner,
72. South 12° 13' 45" West 256.11 feet to a 1/2-inch iron rod set for corner on the northwesterly margin of a 30 foot wide road easement,
73. South 40° 23' 50" West 215.55 feet to a 1/2-inch iron rod set for corner,
74. South 40° 16' 15" West 209.28 feet to a 1/2-inch iron rod set for corner,
75. South 55° 14' 25" West 325.42 feet to a 1/2-inch iron rod set for corner,
76. South 37° 37' 10" West 211.04 feet to a 1/2-inch iron rod set for corner,
77. South 54° 00' 30" West 134.66 feet to a 1/2-inch iron rod set for corner,
78. South 47° 36' 41" West 153.66 feet to a 1/2-inch iron rod set for corner,
79. South 42° 45' 58" West 600.57 feet to a 1/2-inch iron rod set for corner,
80. South 65° 16' 32" West 367.51 feet to a 1/2-inch iron rod set for corner,
81. South 87° 57' 34" West 314.90 feet to a 1/2-inch iron rod set for corner,
82. North 66° 55' 45" West 164.35 feet to a 1/2-inch iron rod set for corner,
83. North 66° 53' 16" West 324.11 feet to a 1/2-inch iron rod set for corner,
84. South 78° 21' 04" West 245.19 feet to a 1/2-inch iron rod set for corner,
85. South 73° 45' 41" West 214.39 feet to a 1/2-inch iron rod set for corner,
86. North 83° 59' 14" West 327.05 feet to a 1/2-inch iron rod set for corner,
87. South 35° 32' 43" West 131.81 feet to a 1/2-inch iron rod set for corner,
88. South 51° 08' 34" West 115.11 feet to a 1/2-inch iron rod set for corner,
89. South 25° 54' 50" West 121.34 feet to a 1/2-inch iron rod set for corner,
90. South 02° 20' 02" West 82.31 feet to a 1/2-inch iron rod set for corner,
91. South 28° 33' 56" West 150.63 feet to a 1/2-inch iron rod set for corner,

92. South 02° 14' 46" West 460.81 feet to a 1/2-inch iron rod set for corner,
93. South 04° 19' 03" East 121.27 feet to a 1/2-inch iron rod set for corner,
94. South 23° 49' 25" East 232.14 feet to a 1/2-inch iron rod set for corner,
95. South 27° 33' 56" East 145.61 feet to a 1/2-inch iron rod set for corner,
96. South 38° 16' 44" East 157.43 feet to a 1/2-inch iron rod set for corner,
97. South 41° 16' 18" East 251.19 feet to a point on the northwesterly margin of a 30 foot wide road easement, from which a 1/2-inch iron rod set for reference bears North 41° 16' 18" West 7.66 feet,
98. South 46° 29' 05" West 199.03 feet to a 1/2-inch iron rod set for corner in the southerly line of the said 3517.13 acre tract and the northerly line of the said 5.834 acre tract, from which a 3/8-inch iron rod found for the northeasterly corner of the said 5.834 acre tract bears North 86° 56' 44" East 40.92 feet;

THENCE South 86° 56' 44" West 559.65 feet along the southerly line of the said 3517.13 acre tract and the said 5.834 acre tract to the PLACE OF BEGINNING and containing 249.93 acres, more or less, as shown on the accompanying plat of even date herewith.

Basis of bearings is Texas Coordinate System, Central Zone, NAD 83 (CORS96), based on GPS observations May 18, 2012 related to Base Stations TXCN Conroe, TXLI Liberty and TXLV Livingston.

Goodwin-Lasiter, Inc.
1609 S. Chestnut Street, Suite 202
Lufkin, TX 75901



Gary G. Brown, R.P.L.S. 4654
Lufkin, Texas June 19, 2012

V:\256\256008\FN\256008 fn 01.doc

SURVEYED FOR
FORESTAR (USA) REAL ESTATE GROUP , INC.

100.96 ACRES

All that certain tract or parcel of land situated about 21 miles Northwest of the City of Liberty, Liberty County, Texas on the **JAMES HUMPHRIES SURVEY, A-212** and being part of a 3517.13 acre tract described in a conveyance from TIN, INC. to Forestar (USA) Real Estate Group, Inc., dated October 1, 2007 and recorded as County Clerks File No. 2007014953 in the Official Public Records of Liberty County, Texas and being more particularly described as follows:

COMMENCING at a concrete monument marked "L-38A" found at the Northernmost NWC of said 3517.13 acre tract from which a 24" Pine, found marked "X", bears N 52°E, 42.6 feet, said commencing corner being the SWC of Bella Vista, Section Two as recorded in Volume 2012, Page 013013 of the Liberty County Commissioners Court Minutes;

THENCE N 87°18' 19" E, 4375.75 feet (called S 89°30' 32" E) with the Northernmost NBL of said 3517.13 acre tract and the Southernmost SBL of said Bella Vista, Section Two and continuing with the Southernmost SBL of Bella Vista, Section Three as recorded in Volume 2012, Page 14595 of the Liberty County Commissioners Court Minutes to a point for corner;

THENCE S 02°41' 41" E, 862.67 feet to the **POINT OF BEGINNING**, a 1/2" iron rod set for corner;

THENCE S 00°37' 59" E, 185.71 feet to a 1/2" iron rod set for corner;

THENCE S 32°05' 23" E, 269.54 feet to a 1/2" iron rod set for corner;

THENCE S 70°01' 28" E, 212.78 feet to a 1/2" iron rod set for corner;

THENCE S 42°35' 25" E, 197.52 feet to a 1/2" iron rod set for corner;

THENCE S 28°53' 30" E, 468.92 feet to a 1/2" iron rod set for corner;

THENCE S 08°20' 53" E, 498.56 feet to a 1/2" iron rod set for corner;

THENCE S 01°15' 17" E, 403.97 feet to a 1/2" iron rod set for corner;

THENCE S 78°48' 10" E, 379.31 feet to a 1/2" iron rod set for corner;

THENCE N 25°19' 43" E, 271.21 feet to a 1/2" iron rod set for corner;

THENCE N 06°13' 25" W, 308.59 feet to a 1/2" iron rod set for corner;

THENCE N 16°55' 35" E, 607.46 feet to a 1/2" iron rod set for corner;

THENCE N 19°38' 31" E, 191.87 feet to a 1/2" iron rod set for corner;

THENCE N 71°43' 19" E, 250.22 feet to a 1/2" iron rod set for corner;

THENCE S 52°23' 56" E, 215.70 feet to a 1/2" iron rod set for corner;

THENCE S 02°27' 57" E, 205.25 feet to a 1/2" iron rod set for corner;

THENCE S 17°56' 38" W, 245.74 feet to a 1/2" iron rod set for corner;

THENCE S 12°17' 18" W, 195.31 feet to a 1/2" iron rod set for corner;

THENCE S 08°46' 46" W, 182.70 feet to a 1/2" iron rod set for corner;

THENCE S 04°54' 26" E, 206.43 feet to a 1/2" iron rod set for corner;

THENCE S 10°58' 16" E, 293.01 feet to a 1/2" iron rod set for corner;

THENCE S 67°28' 42" E, 317.55 feet to a 1/2" iron rod set for corner;

THENCE N 19°54' 09" E, 213.96 feet to a 1/2" iron rod set for corner;

THENCE N 34°06' 53" E, 236.37 feet to a 1/2" iron rod set for corner;

THENCE N 00°24' 49" W, 53.48 feet to a 1/2" iron rod set for corner;

THENCE N 28°23' 20" E, 133.65 feet to a 1/2" iron rod set for corner;

THENCE N 18°03' 16" E, 110.74 feet to a 1/2" iron rod set for corner;

THENCE N 05°46' 18" W, 99.71 feet to a 1/2" iron rod set for corner;

THENCE N 09°04' 16" E, 289.99 feet to a 1/2" iron rod set for corner;

THENCE N 16°47' 43" W, 194.67 feet to a 1/2" iron rod set for corner;

THENCE N 01°12' 32" E, 150.71 feet to a 1/2" iron rod set for corner;

THENCE N 50°29' 53" E, 182.39 feet to a 1/2" iron rod set for corner;

THENCE N 72°35' 09" E, 213.87 feet to a 1/2" iron rod set for corner;

THENCE S 82°33' 42" E, 261.15 feet to a 1/2" iron rod set for corner;

THENCE S 50°24' 17" E, 68.74 feet to a 1/2" iron rod set for corner;

THENCE S 04°02' 42" W, 88.94 feet to a 1/2" iron rod set for corner;

THENCE S 16°09' 01" W, 392.34 feet to a 1/2" iron rod set for corner;

THENCE S 14°01' 45" W, 372.72 feet to a 1/2" iron rod set for corner;

THENCE S 03°28' 21" W, 239.88 feet to a 1/2" iron rod set for corner;

THENCE S 17°05' 07" W, 250.52 feet to a 1/2" iron rod set for corner;

THENCE S 24°00' 08" W, 82.13 feet to a 1/2" iron rod set for corner;

THENCE S 04°38' 52" W, 183.85 feet to a 1/2" iron rod set for corner;

THENCE S 06°07' 24" E, 404.36 feet to a 1/2" iron rod set for corner;

THENCE S 07°39' 19" W, at 550.24 feet pass a 1/2" iron rod set for witness and a total distance of 583.33 feet to a point for corner in a NEBL of a of a 249.93 acre tract surveyed by Goodwin-Lasiter, Inc. of Lufkin, Texas on the 19th day of June, 2012;

THENCE N 62°23' 05" W, 58.59 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 29°18'55" W, 25.00 feet;

THENCE N 58°56' 53" W, 320.14 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 29°19'33" W, 25.00 feet;

THENCE N 62°24' 01" W, 231.67 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 29°24'13" W, 25.00 feet;

THENCE N 58°47' 31" W, 224.40 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 29°08'45" W, 25.00 feet;

THENCE N 62°54' 58" W, 239.32 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 27°43'30" W, 25.00 feet;

THENCE N 61°38' 03" W, 362.50 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 27°53'26" W, 25.00 feet;

THENCE N 62°35' 04" W, 257.24 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 26°48'47" W, 25.00 feet;

THENCE N 63°47' 23" W, 182.12 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 27°53'01" W, 25.00 feet;

THENCE N 60°26' 36" W, 198.85 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 29°53'14" W, 25.00 feet;

THENCE N 60°59' 39" W, 23.36 feet with a NEBL of said 249.93 acre tract to a North corner of same;

THENCE S 29°00' 20" W, 24.78 feet with a NWBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 60°26'37" E, 22.98 feet;

THENCE S 08°53' 00" E, 114.96 feet with a WBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears N 86°16'06" E, 18.07 feet;

THENCE S 03°34' 42" E, 221.29 feet with a WBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears N 85°10'44" E, 18.00 feet;

THENCE S 06°04' 59" E, 392.05 feet with a WBL of said 249.93 acre tract to a point for corner from which a 1/2" iron rod set for witness bears N 54°59'09" W, 55.90 feet;

THENCE N 54°59' 09" W, 424.71 feet to a 1/2" iron rod set for corner;

THENCE N 21°16' 58" W, 899.07 feet to a 1/2" iron rod set for corner;

THENCE N 05°06' 13" W, 552.55 feet to a 1/2" iron rod set for corner;

THENCE N 25°09' 05" W,542.22 feet to a 1/2" iron rod set for corner;

THENCE N 87°32' 03" W, 285.74 feet to a 1/2" iron rod set for corner;

THENCE N 54°56' 53" W, 121.62 feet to a 1/2" iron rod set for corner;

THENCE N 26°12' 21" W, 322.93 feet to a 1/2" iron rod set for corner;

THENCE N 12°24' 20" E, 212.16 feet to a 1/2" iron rod set for corner;

THENCE N 18°01' 42" E, 238.55 feet to a 1/2" iron rod set for corner;

THENCE N 36°24' 41" E, 131.20 feet to a 1/2" iron rod set for corner;

THENCE S 74°08' 10" E, 246.99 feet to a 1/2" iron rod set for corner;

THENCE S 89°20' 37" E, 139.00 feet to the place of **BEGINNING**, containing 100.96 acres, the bearings of the above described tract are based upon the Texas Coordinate System, Central Zone, NAD 83 from GPS observations made at NGS monument CLEVEPORT on June 11, 2014.

I, Jeffrey D. Opperman, a duly Registered Professional Land Surveyor for the State of Texas, hereby certify that the above field notes of the property surveyed for **FORESTAR (USA) REAL ESTATE GROUP , INC.** on the **JAMES HUMPHRIES SURVEY, A-212** in Liberty County, Texas are true and correct and were written from a survey made by me on the ground the 25th day of June, 2014.

REGISTERED PROFESSIONAL LAND SURVEYOR NO. 4168

REFER TO A PLAT PREPARED ON SAME DATE.
WP18\FSTAR100

SURVEYED FOR
FORESTAR (USA) REAL ESTATE GROUP , INC.

45.66 ACRES

All that certain tract or parcel of land situated about 21 miles Northwest of the City of Liberty, Liberty County, Texas on the **JAMES HUMPHRIES SURVEY, A-212** and being part of a 3517.13 acre tract described in a conveyance from TIN, INC. to Forestar (USA) Real Estate Group, Inc., dated October 1, 2007 and recorded as County Clerks File No. 2007014953 in the Official Public Records of Liberty County, Texas and being more particularly described as follows:

COMMENCING at a concrete monument marked "L-38A" found at the Northernmost NWC of said 3517.13 acre tract from which a 24" Pine, found marked "X", bears N 52°E, 42.6 feet, said commencing corner being the SWC of Bella Vista, Section Two as recorded in Volume 2012, Page 013013 of the Liberty County Commissioners Court Minutes;

THENCE N 87°18' 19" E, 2092.56 feet (called S 89°30' 32" E) with the Northernmost NBL of said 3517.13 acre tract and the Southernmost SBL of said Bella Vista, Section Two and continuing with the Southernmost SBL of Bella Vista, Section Three as recorded in Volume 2012, Page 14595 of the Liberty County Commissioners Court Minutes to the **POINT OF BEGINNING**, a 1/2" iron rod set for corner;

THENCE N 87°18' 19" E, 1788.37 feet continuing with the Northernmost NBL of said 3517.13 acre tract and the Southernmost SBL of said Bella Vista, Section Three to a 1/2" iron rod set for corner;

THENCE S 12°22' 55" W, 179.08 feet to a 1/2" iron rod set for corner;

THENCE S 48°12' 25" W, 195.72 feet to a 1/2" iron rod set for corner;

THENCE S 63°59' 09" W, 332.15 feet to a 1/2" iron rod set for corner;

THENCE N 73°36' 03" W, 209.58 feet to a 1/2" iron rod set for corner;

THENCE S 07°15' 54" E, 631.69 feet to a 1/2" iron rod set for corner;

THENCE S 03°48' 36" E, 523.08 feet to a 1/2" iron rod set for corner;

THENCE S 06°34' 53" W, 1609.32 feet to a 1/2" iron rod set for corner;

THENCE S 42°22' 52" W, 341.44 feet to a 1/2" iron rod set for corner in a NEBL of a 249.93 acre tract surveyed by Goodwin-Lasiter, Inc. of Lufkin, Texas on the 19th day of June, 2012;

THENCE N 25°42' 12" W, 336.45 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a 1/2" iron rod found for corner;

THENCE N 12°54' 46" E, 1764.29 feet with an EBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 12°54'46" W, 16.97 feet;

THENCE N 49°10' 47" W, 175.95 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 43°28'18" W, 15.02 feet;

THENCE N 43°52' 35" W, 219.58 feet with a NEBL of said 249.93 acre tract to an angle corner of same, a point for corner;

THENCE N 44°20' 02" W, 3.45 feet with a NEBL of said 249.93 acre tract to the Northernmost corner of same, a point for corner from which a 1/2" iron rod found for witness bears S 33°21'23" W, 15.35 feet;

THENCE S 33°21' 23" W, 181.73 feet with a NWBL of said 249.93 acre tract to an angle corner of same, a 1/2" iron rod found for corner;

THENCE S 62°12' 26" W, 213.84 feet with a NWBL of said 249.93 acre tract to a 1/2" iron rod set for corner;

THENCE N 31°49' 52" W, 1065.70 feet to a 1/2" iron rod set for corner;

THENCE N 85°19' 11" E, 255.19 feet to a 1/2" iron rod set for corner;

THENCE N 26°28' 38" W, 373.03 feet to the place of **BEGINNING,** containing 45.66 acres, the bearings of the above described tract are based upon the Texas Coordinate System, Central Zone, NAD 83 from GPS observations made at NGS monument CLEVEPORT on June 11, 2014.

I, Jeffrey D. Opperman, a duly Registered Professional Land Surveyor for the State of Texas, hereby certify that the above field notes of the property surveyed for **FORESTAR (USA) REAL ESTATE GROUP , INC.** on the **JAMES HUMPHRIES SURVEY, A-212** in Liberty County, Texas are true and correct and were written from a survey made by me on the ground the 25th day of June, 2014.

REGISTERED PROFESSIONAL LAND SURVEYOR NO. 4168

REFER TO A PLAT PREPARED ON SAME DATE.
WP18\FSTAR45

EXHIBIT A-1
BOUNDARY SURVEY DRAWING

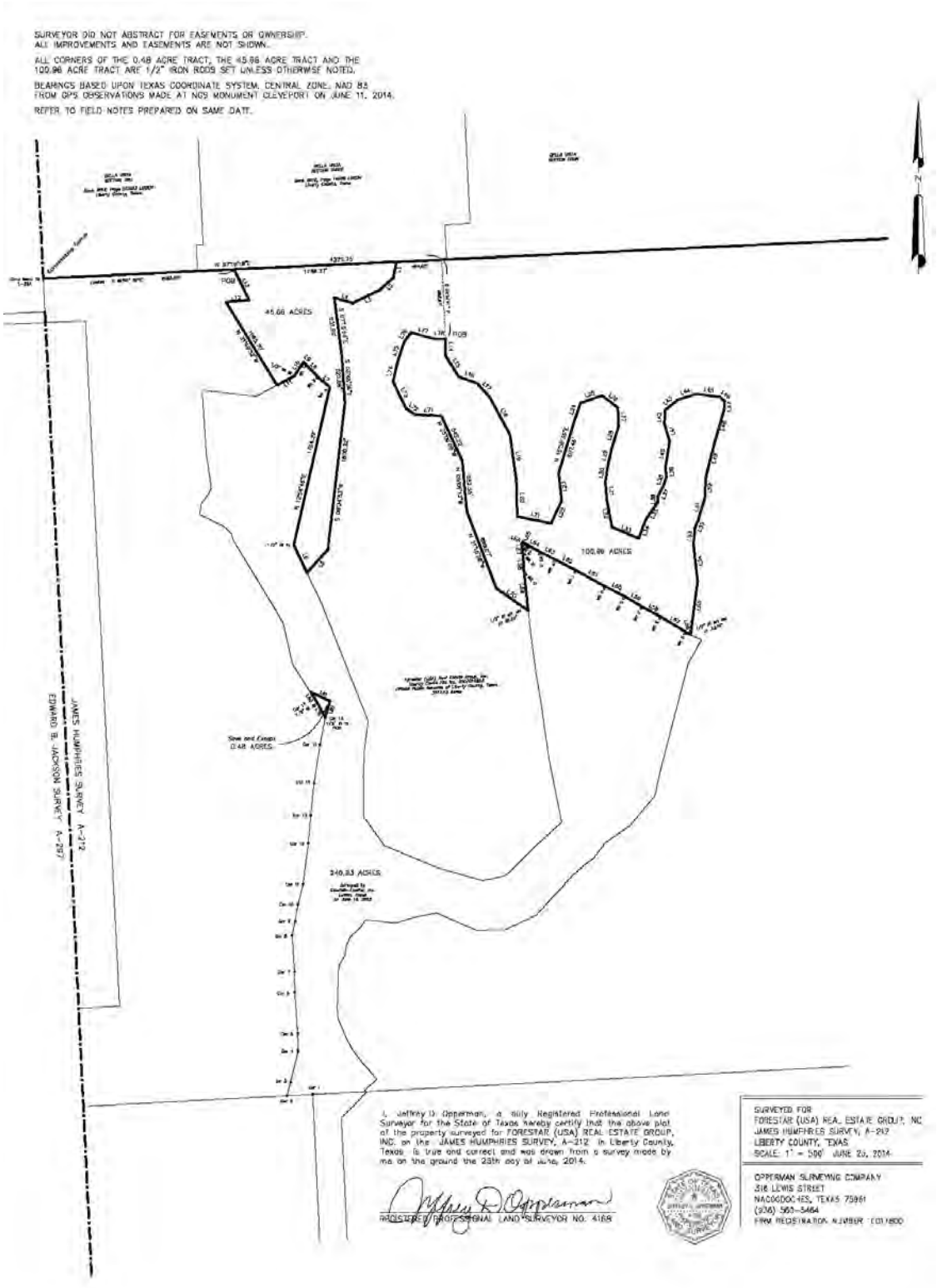
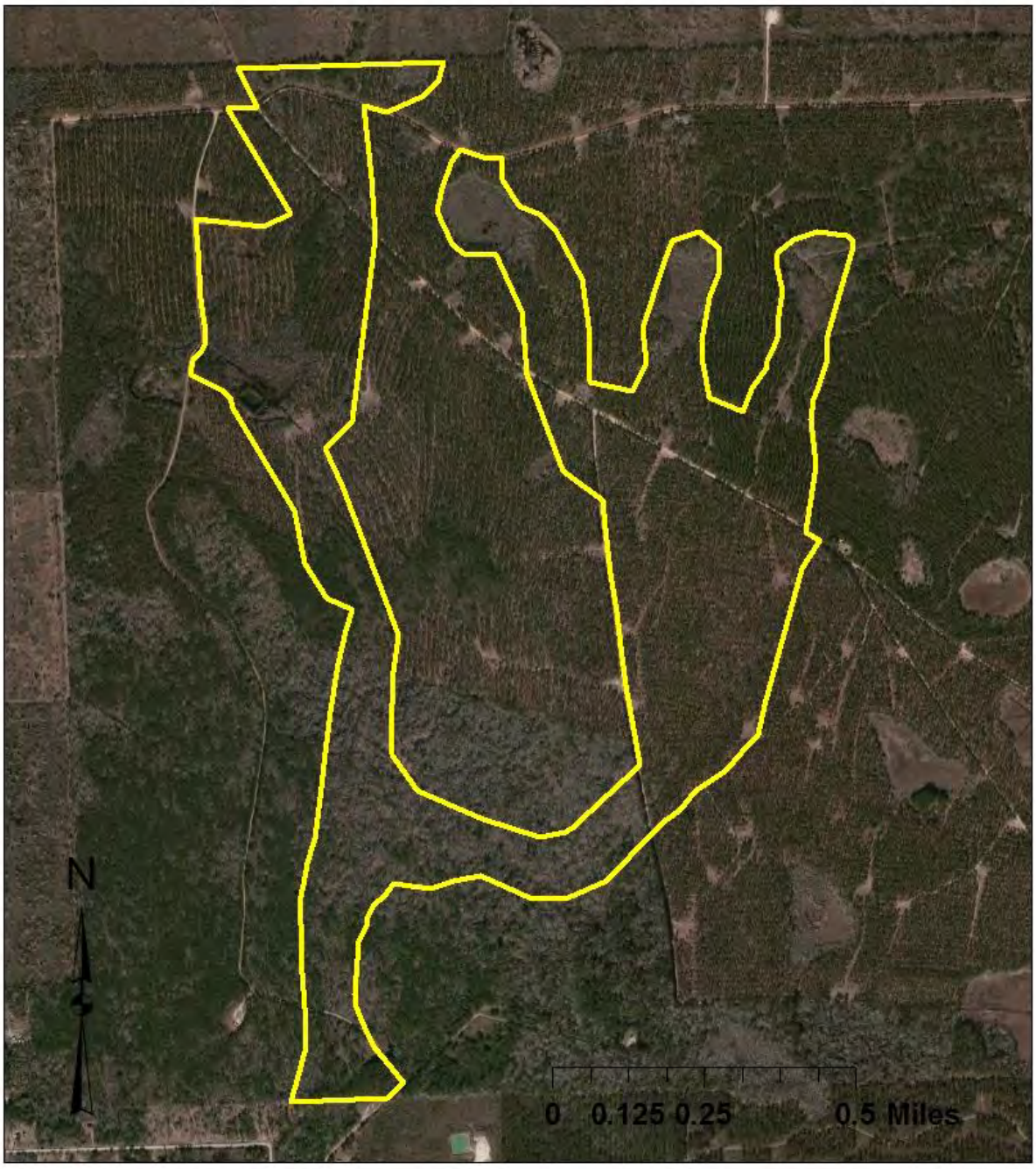


EXHIBIT A-2
AERIAL BOUNDARY MAP



BayouLandConservancy

Houston-Conroe Mitigation Bank
396.07 acres - Libery County, TX

Map Created By:
Stephanie Prosser
Bayou Land Conservancy
5/26/2015
Image Source: www.esri.org
Imagery: 2012, True Color
Texas State Plane,
South Central, NAD83

EXHIBIT A-3
SIGN POSTING LOCATION MAP

TO BE DETERMINED AFTER THE BASELINE

EXHIBIT B

PROHIBITED USES AND PRACTICES
Houston/Conroe Mitigation Bank

The following uses and practices, though not necessarily an exhaustive recital of inconsistent uses and practices, are inconsistent with the purposes of the Conservation Easement and shall be prohibited upon or within the Property.

1. Conservation Values. The diminution of Conservation Values.

2. Subdivision and Development. To subdivide or otherwise divide in ownership. To convey the Property except in its current configuration as an entire parcel. To pledge the Property for a debt.

3. Commercial and Industrial Use. To construct or establish any facility or structure for research and development, manufacture or distribution of any product, except the direct retail sale of any materials that are reasonably and exclusively associated with permitted educational uses.

   To construct billboards, other commercial advertising media, or telecommunications facilities (including antennae or relay stations and accessory towers, satellite dishes or utility of any type).

   To timber in any form.

4. Grazing and Feed Lots. To graze by cattle, horse, other livestock animals, or establish/ maintain a commercial feed lot. A commercial feed lot shall be defined for purposes of this Conservation Easement as a confined area or facility within which the land is not grazed or cropped annually and which is used to receive livestock that have been raised off the Property for feeding and fattening for market.

5. Dumping and Storage. To temporarily or permanently store trash, wastes, garbage, ashes, sewage, scrap materials such as metals, or other unsightly or offensive material, hazardous substance, toxic waste, oil and petroleum by-products, leached compounds, land fill, dredging spoils, nor placement of any underground storage tanks under the property (except as permitted in Exhibit C, sections 8 and 9).

6. Surface Mining. To explore or extract surface minerals, including but not limited to topsoil, peat, loam, sand, gravel, rock, or other materials including near-surface lignite, iron, coals, or other materials, by any surface mining method. To grant or authorize entry for any activity related to surface mineral mining.

7. Hunting/Animals. To lease the property to third party entities or individuals for the purpose of the take of game animals including, but not limited to, deer and bird hunting by any method, or the release of unleashed dogs. Hunting is otherwise prohibited (except as permitted in Exhibit C, section 3 and section 13).

8. All Terrain Vehicles. To use all-terrain, off-road vehicles, or any other form of motorized vehicles for recreational uses (except as permitted in Exhibit C section 10).

9. Recreational construction and usage. To build or bring any of the following onto the Property: barbeque pits, grill pits, picnic tables, restroom facilities, trash containers or receptacles of any kind (unless used temporarily for litter clean-up).

10. New Utility Conveyances. To convey new telephone, cable television, electric, gas, oil, chemical, water, sewer, or other utility line corridors over, under, in, upon or above the Property, shall not restrict the maintenance, replacement or repair of utility lines or pipelines within existing corridors that already contain such lines or pipelines if required by the terms of an existing easement.

11. Roads. To build new roads or other rights of way except for paths and foot trails consistent with the preservation of the Property.

12. Dredge and Fill Activities. To dredge, fill, or alter natural watercourses running on or across the Property, or to construct of ponds or dikes except as authorized in the approved USACE mitigation banking instrument (permit number SWG-2013-00141).

13. Water. Manipulation, alteration, or pollution of creeks, streams, surface or subsurface springs or other bodies of water or any activities on or uses of the Property detrimental to water purity of quality or that could alter the natural water level or flow in or over the Property except in conjunction with activities otherwise specifically authorized herein except as authorized in the approved USACE mitigation banking instrument (permit number SWG-2013-00141).

    To transfer, encumber, sell, lease, or separate any surface water, or surface water rights associated with this Mitigation Bank Property. Groundwater below the Mitigation Bank Property can be captured and produced to the extent that these activities do not affect the surface or surface water within the Mitigation Bank Property.

14. Topography. Ditching; draining; diking; filling; excavating; removal of topsoil, sand, gravel, rock, or other materials; or any change in the topography of the land in any manner except in conjunction with activities otherwise specifically authorized herein.

15. Invasive Species. To plant or deliberately introduce invasive or non-native plant or animal species anywhere on the Property, or invasive species as per current Texas Department of Agriculture noxious plant listings.

16. Agricultural Uses. To engage in any and all commercial and recreational agricultural activity of any kind on the Property. For the purposes of this conservation easement, "agricultural uses" shall be deemed to include breeding, raising, and pasturing of livestock, poultry and other fowl of every nature and description; breeding and raising species of bees; gardening; and planting, raising, harvesting, storage, processing, and production of agricultural crops.

EXHIBIT C

PERMITTED USES AND PRACTICES
Houston/Conroe Mitigation Bank

The following uses and practices, though not necessarily an exhaustive recital of consistent uses and practices, are permitted under this Conservation Easement, and they are not to be precluded, prevented or limited by this Conservation Easement.

1. Consistent Use. To use or lease the Property consistent with the Conservation Values of this Conservation Easement and the Mitigation Banking Instrument, included as Exhibit D, is permitted.

2. Sale or Gift of the Property. To sell, exchange or gift the real property conveying the whole of the Property to another person or entity is permitted (except as restricted in Exhibit B, section 2).

3. Hunting. A single hunting lease is approved as long as a current Texas Parks and Wildlife Management Plan is in effect and signed annually by hunting lease members. Lease is subject to annual renewal and may be revoked or denied for cause at the request of the Grantee.

4. Restoration and Enhancement. To use the Property in accordance with the mitigation plan approved by the USACE for permit number SWG-2013-00141 and the Property Mitigation Banking Instrument.

5. Repair. To maintain, improve, replace, relocate and repair fences on the Property.

6. Construction. Construction for boardwalks, wildlife observation platforms, interpretive displays, commemorative signage, entrance signage and fishing piers may be approved with written consent by Grantee. Low-impact, permeable surface trail construction shall be approved in advance of construction by Grantee.

7. Agrichemicals. To use agrichemicals, including, but not limited to, fertilizers, soil amendments and pesticides as approved by the United States and the State of Texas as necessary to accomplish permitted restoration and enhancement practices and according to applicable government regulations.

8. Compost and Refuse. To compost bio-degradable materials resulting from the permitted recreational uses or the restoration or enhancement practices on the Property.

9. Storage of Materials. To temporarily store fencing materials, posts, equipment and other property necessary to conduct restoration, enhancement, or long-term management practices on the Property. To use and temporarily store organic matter, compost and woody debris to conduct restoration, enhancement, and long-term management practices.

10. All Terrain Vehicles. To use off-road or all-terrain vehicles (ATV) for management purposes, for restoration or enhancement practices, and law enforcement and emergency use, provided such use does not adversely affect the conservation values with visible ruts of the Property or result in shoreline erosion along any portion within the Property (Conservation Values delineated or otherwise described in Baseline Inventory).

11. Unauthorized Persons. To prohibit entry on the Property of unauthorized persons.

12. Oil and Gas Exploration and Extraction. Subject to the surface mining prohibition in Paragraph 6 of Exhibit B and the need to provide notice to Grantee as required, to explore and extract oil, gas and other subsurface minerals, provided that these activities are conducted so as to have a limited, localized impact not irremediably destructive of the Conservation Values of the Property. If Grantor has actual knowledge of the intent of third-party mineral interest holders to conduct subsurface mining on the Property, Grantor shall provide notice of those proposed activities to Grantee, or if Grantor acquires actual knowledge after the required notice date, then as soon thereafter as feasibly possible.

13. Nuisance Species Control. Grantor shall have the right to control, destroy, or trap exotic, invasive and problem animals, such as feral hogs, that pose a material threat to habitat conditions in accordance with applicable state and federal laws and requirements.

EXHIBIT D

MITIGATION BANKING INSTRUMENT
Houston/Conroe Mitigation Bank
Dated July 26, 2013
(May be amended for new issues and/or resolved issues)

DOCUMENT HELD ON FILE AT BAYOU LAND CONSERVANCY OFFICE

APPENDIX D – BIOLOGICAL SURVEYS

PRELIMINARY ECOLOGICAL AND BOTANICAL ASSESSMENT FOR SPLENDORA WETLAND MITIGATION BANK IN COMPARTMENTS 01227, 01228 & 01229 IN LIBERTY COUNTY

9 September 2009

Eric L. Keith
Raven Environmental Services Inc.

I. Introduction

This report includes results of a rare plant community and species assessment for the proposed Splendora Wetlands Mitigation Bank in Compartments 01227, 01228, and 01229 in Liberty County, TX. These compartments were surveyed to determine existing plant associations in the project area with emphasis on the presence of G2G3, G2, and G1 communities and species as outlined in Nature Serve (2009). Surveys were conducted on March 16; April 23; and August 26, 2009. Each potential plant association was evaluated in the field by qualitatively evaluating the dominant plant species that were present and delineated using ArcView mapping software. All community types were evaluated including those with rankings higher than G2. The only stands investigated that contain (or are suspected to contain) rare communities or species are the 730 stands scattered throughout these three compartments. The 730 stands are delineated with a unique polygon number as shown in Figure 1.

II. Association Descriptions

These 730 stands are composed of eight integrating wetland plant associations, most of which are ranked as G2G3, G2, and G1 communities including three undescribed associations. In the undescribed associations, the dominant species are much different than any described flatwoods pond communities (Nature Serve 2009). The first undescribed community (described here as Southeastern Panicgrass Flatwoods Savannah) was found only in two locations (#14 & #55) and is dominated by southeastern panicgrass (*Panicum tenerum*), hyssopleaf thoroughwort (*Eupatorium hyssopifolium*), hairy seedbox (*Ludwigia pilosa*), sticky hedge-hyssop (*Gratiola brevifolia*), coastal water-hyssop (*Bacopa monnieri*), pineland beakrush (*Rhynchospora perplexa*), threadleaf beakrush (*Rhynchospora filifolia*), coastal plain witchgrass (*Dichanthelium longiligulatum*), southern waxy sedge (*Carex glaucescens*), saltmarsh umbrellasedge (*Fuirena breviseta*), glaucous broomsedge (*Carex virginicus* var. *glauca*), redtop panicgrass (*Panicum rigidulum*), rosy camphorweed (*Pluchea rosea*) and early paspalum (*Paspalum praecox*). The second undescribed association (described here as Maidencane – Hairy Seedbox Flatwoods Pond) is the most common herbaceous pond community on the property. The dominant species in this association include maidencane (*Panicum hemitomon*), hairy seedbox, blue waterleaf (*Hydrolea ovata*), sticky hedge-hyssop, coastal water-hyssop, marsh mermaidweed (*Proserpinaca palustris*), warty sedge (*Carex verrucosa*), pineland beakrush, and threadleaf beakrush. The third undescribed association (described here as Warty Sedge Flatwoods Pond) is typically shrubby and dominated by warty sedge, maidencane, silverbells (*Styrax americana*), red maple (*Acer rubrum*), Carolina ash (*Fraxinus caroliniana*), lizard tail (*Saururus cernuus*), nipple-bract arrowhead *(Sagittaria papillosa*), and horsetail spikerush (*Eleocharis equisetoides*). Each stand investigated is listed below.

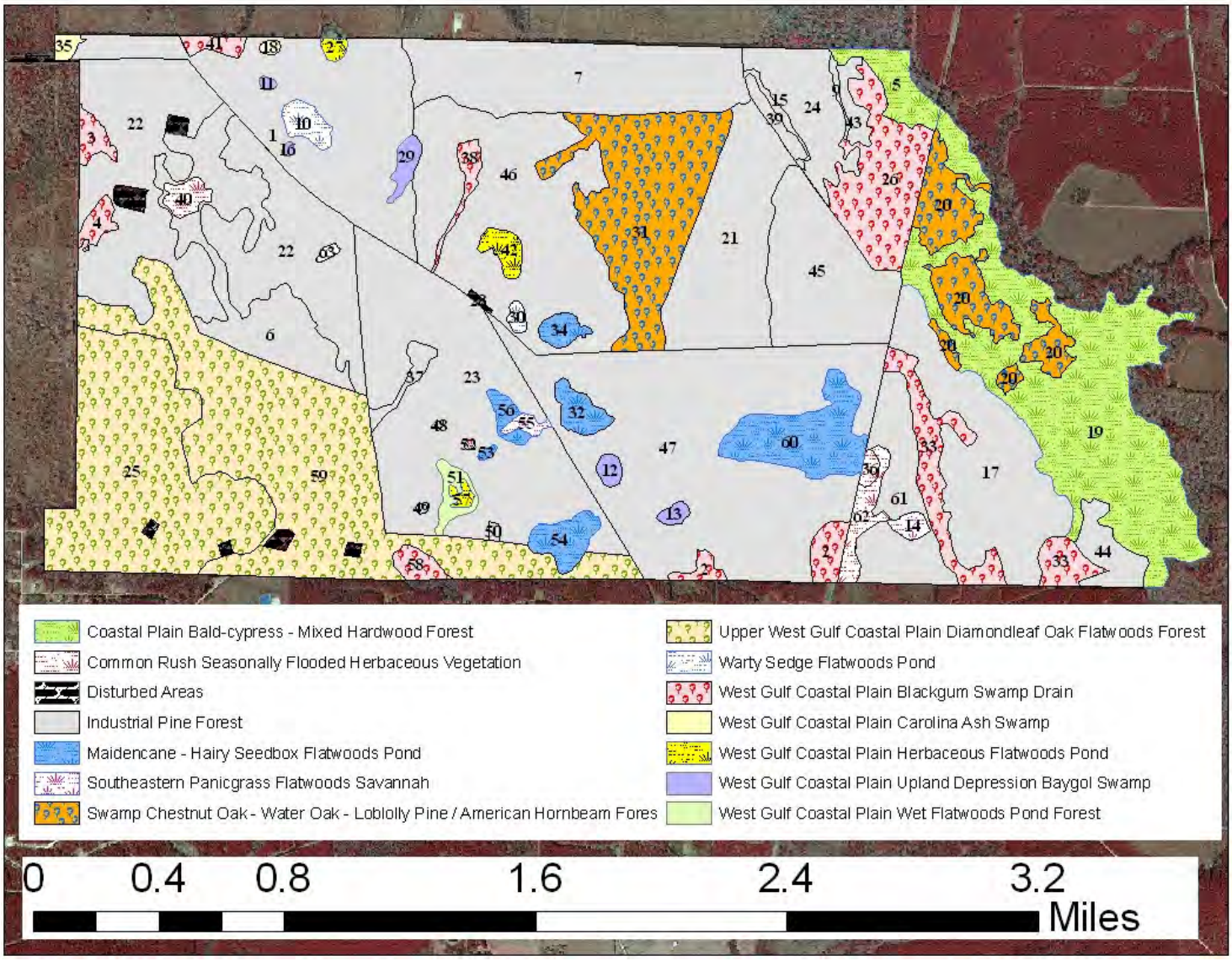


Figure 1. Aerial photo [2008 National Agricultural Image Photography (NAIP) 1-m Color Infrared (CIR)] of Splendora Wetland Mitigation Bank in Compartments 01227, 01228, and 01229 in Liberty County, TX with delineated polygons. (Polygons attributes are provided in separate database and associated ArcView shapefile.)

III. Basic Elemental Occurrence (EO) Viability Rankings for G2G3, G2, and G1 communities. (EO Rankings are outlined on page 6 of the SFI Standard Guidance Manual) (Nature Serve 2009).

West Gulf Coastal Plain Herbaceous Flatwoods Pond (G2) A
(#27, #42, #57)

West Gulf Coastal Plain Wet Flatwoods Pond Forest (G2?) A
(#51)

West Gulf Coastal Plain Carolina Ash Swamp (G2G3) B
(#18, #35)

Undescribed Southeastern Panicgrass Flatwoods Savannah (probable rank G1)
(#14) C
(#55) A

Undescribed Maidencane – Hairy Seedbox Flatwoods Pond (probable rank G1) A
(#32, #34, #53, #54, #56)

Undescribed Warty Sedge Flatwoods Pond (probable rank G1) B
(#10, #30)

Upper West Gulf Coastal Plain Diamondleaf Oak Flatwoods Forest (G2G3)
(#59) A
(#25) B

IV. Other Community Types G3 or higher.

Swamp Chestnut Oak - Water Oak - Loblolly Pine / American Hornbeam Forest G3?
(#20, #31)

West Gulf Coastal Plain Blackgum Swamp Drain G3?
(#2, #3, #4, #26, #33, #38, #41, #58)

Coastal Plain Bald-cypress - Mixed Hardwood Forest G3G4
(#5, #19)

West Gulf Coastal Plain Upland Depression Baygol Swamp G3?
(#11, #12, #13, #16, #29)

Common Rush Seasonally Flooded Herbaceous Vegetation G5
(#36, #40, #52, #62, #63)

V. Rare plant species (Nature Serve 2009.)

	State Rank	Global Rank
Lace lip ladies tresses (*Spiranthes laciniata*)	SNR	G4G5
Rarer in Texas than ranking indicates.		
Warty sedge (*Carex verrucosa*)	S2S3	G4
Common in all herbaceous ponds.		
Bluejoint panicgrass (*Panicum tenerum*)	SNR	G4
Common in all herbaceous ponds. Rarer in Texas than ranking indicates.		

VI. Reference

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.8. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: March 23, 2009).

VI. Appendix

Herpetological Survey of the Splendora Tract, Liberty County, Texas

Submitted by: Toby J Hibbitts

A short survey of the herpetofauna was conducted approximately 2.5 air miles east and 5.9 air miles south of Cleveland, Texas (30˚14'57.92"N; 95˚03'36.01"W) from 1900hrs on 7 May 2009 to 1600hrs on 10 May 2009. I surveyed using four primary methods: turtle trapping with hoop nets, aquatic amphibian trapping with minnow traps, walking searches, and road cruising. I with the aid of some field herpetologists searched for approximately 140 person hours walking and by car. Walking searches consisted walking through habitat and turning any sort of natural or manmade debris likely to house amphibians and reptiles. Hoop nets were out for 26 trap nights (13 traps x 2 nights) and the minnow traps were out for 36 trap nights. The hoop nets were baited with either fresh fish or sardines and the minnow traps were baited with fresh cow liver. Both types of traps were set out on the afternoon of 8 May 2009 and pulled on the morning of 10 May 2009.

The main limitation of this survey was the duration. Different amphibians and reptiles are more or less active in different seasons. The paucity of salamanders found is one example of this because they are more likely to be observed in the winter months in which they breed. This is also true of some of the frog species. The other poorly represented group was the turtles. Some of the turtle species likely to be found on the site are vegetarian so they would not be attracted to the bait that was used in the hoop nets. Trapping is also very labor intensive and to thoroughly trap all available areas would take considerably more time. That being said I (including Dr. James Dixon's observations) observed 29 species on the site out of the 70 species known to occur (or to formerly occur) in Liberty County.

Species Encountered

Amphibians

Rio Grande Chirping Frog (*Syrrhophus cystignathoides*)
These small frogs are an exotic species to the area which have recently become abundant in East Texas (last 15 years). They are native to the Brownsville area of Texas into Mexico. They were heard calling each night from all forested parts of the property.

Gray Tree Frog (*Hyla versicolor*)
The first night of the survey (7 May 2009) was the best night for calling frogs. Many Gray Tree Frogs were heard in the forested wetlands throughout the property.

Green Tree Frog (*Hyla cinerea*)
These frogs were much more prevalent than the Gray Tree Frog and occupied most of the larger wetlands including the large open wetlands on the property.

Squirrel Tree Frog (*Hyla squirella*)
Breeding in this species is more associated with rainfall events than the other tree frog species. It was not heard calling during the survey but one individual was found.

Cricket Frog (*Acris crepitans*)
This very common species was surprisingly only found at one location on the property.

Spring Peeper (*Pseudacris crucifer*)
This species is a winter and early spring breeder. It was not observed on the May trip but Dixon heard this species at numerous locations in March.

Cajun Chorus Frog (*Pseudacris fouquettei*)
This species is a winter and early spring breeder. It was not observed on the May trip but Dixon heard this species at numerous locations in March.

Southern Leopard Frog (*Rana sphenocephala*)
This is one of the most common frogs in east Texas. Found throughout the site.

Bronze Frog (*Rana clamitans*)
Another of the common east Texas frogs, although more restricted to permanent breeding sites. They were heard in large choruses in the large grassy wetlands.

Bullfrog (*Rana catesbeiana*)
Found throughout the site in permanent wetlands.

Eastern Narrowmouth Toad (*Gastrophryne carolinensis*)
They were heard calling at wetlands throughout the site on the first night and only sporadically on other days.

Gulf Coast Toad (*Bufo nebulifer*)
These common toads were heard calling mainly along the roadside ditches. Many were also found under the debris around the hunter camps.

Red-spotted Newt (*Notophthalmus viridescens*)
Several efts were found under debris around the hunter camps. The large grassy wetlands are prime breeding habitat for this species.

Reptiles

Red-eared Slider (*Trachemys scripta*)
This is one of the most common aquatic turtles in east Texas. Three were trapped in Tarkington Bayou and six were found in the wetlands along the road on the southwest corner of the site. One other was seen crossing a road in the center of the site. They can be expected anywhere on the site.

Alligator Snapping Turtle (*Macroclemys temmincki*)
This was the only protected species observed. Two were caught in 10 trap nights (5 traps x 2 nights) on Tarkington Bayou. That is a high success rate compared to other trapping efforts for this species that I have been involved with, therefore Alligator Snapping Turtles likely are fairly common in the Bayou.

Broad-headed Skink (*Eumeces laticeps*)
Two individuals of this large east Texas skink were found at one site. They are fairly common in east Texas but are not that easy to observe.

Ground Skink (*Scincella lateralis*)
This is the most common lizard on the site. They were found throughout scurrying in the leaf litter.

Green Anole (*Anolis carolinensis*)
This species was also quite common and found throughout the site.

Brown Snake (*Storeria dekayi*)
Surprisingly only one specimen of this common snake was found. It was under debris at one of the hunter camps.

Rough Earth Snake (*Virginia striatula*)
This is another common east Texas snake of which only one individual was found.

Texas Rat Snake (*Elaphe obsoleta*)
Three individuals of this common east Texas snake were found. Two were under hunter camp debris and one during road cruising. Several road kills were also seen on FM 1010.

Louisiana Milksnake (*Lampropeltis triangulum*)
This species has a patchy distribution over east Texas; however it is common in the Splendora area. Six individuals were found under hunter camp debris.

Yellow-bellied Watersnake (*Nerodia erythrogaster*)
As expected this snake was very common on the site with more than 10 individuals observed in wetlands throughout the site.

Diamondback Watersnake (*Nerodia rhombifer*)
This species was only observed once on the site and prefers more of a pond lake habitat than the other watersnakes.

Broad-banded Watersnake (*Nerodia fasciata*)
More than 10 individuals of this species were observed at wetland habitats throughout the site, most often during night walks.

Ribbon Snake (*Thamnophis proximus*)
This species was also very common with more than 10 individuals observed. They were found under debris at the hunter camps as well as near wetlands during walking searches and road cruising.

Buttermilk Racer (*Coluber constrictor*)
Two individuals of this diurnal species were observed. One under debris at a hunter camp and the other was active in the pipeline right-of-way near Tarkington Bayou.

Copperhead (*Agkistrodon contortrix*)
More than 10 individuals of this species were observed. They were most often found while road cruising at night but several were found under debris at the hunter camps.

Cottonmouth (*Agkistrodon piscivorus*)
Eight individuals of this species were observed. All were active in the evening or night and were found in wetlands or crossing roads near wetlands. Dixon also observed this species during his visit in March.

Species known from Liberty County
*species expected to occur on the site
observed

Lesser Siren (*Siren intermedia*)*
Three-toed Amphiuma (*Amphiuma tridactylum*)*
Marbled Salamander (*Ambystoma opacum*)*
Smallmouth Salamander (*Ambystoma texanum*)*
Tiger Salamander (*Ambystoma tigrinum*)
Southern Dusky Salamander (*Desmognathus auriculatus*) This species has not been seen in Texas since the mid 90's so it is not expected from the site even though their habitat is present.
Dwarf Salamander (*Eurycea quadridigitata*)*
Red-spotted Newt (*Notophthalmus viridescens*)
Rio Grande Chirping Frog (*Syrrhophus cystignathoides*)
Cricket Frog (*Acris crepitans*)
Gray Tree Frog (*Hyla versicolor*)
Green Tree Frog (*Hyla cinerea*)
Squirrel Tree Frog (*Hyla squirella*)
Strecker's Chorus Frog (*Pseudacris streckeri*) Extirpated from much of its range in east Texas.
Cajun Chorus Frog (*Pseudacris fouquettei*)
Spring Peeper (*Pseudacris crucifer*)
Gulf Coast Toad (*Bufo nebulifer*)
Woodhouse's Toad (*Bufo woodhousii*)*
Bullfrog (*Rana catesbeiana*)
Bronze Frog (*Rana clamitans*)
Southern Leopard Frog (*Rana sphenocephala*)
Pickerel Frog (*Rana palustris*)*
Eastern Narrowmouth Toad (*Gastrophryne carolinensis*)
Great Plains Narrowmouth Toad (*Gastrophryne olivacea*)
Alligator Snapping Turtle (*Macroclemys temminckii*)
Common Snapping Turtle (*Chelydra serpentina*)*
Mississippi Mud Turtle (*Kinosternon subrubrum*)*
Razorback Musk Turtle (*Sternotherus carinatus*)*
Chicken Turtle (*Deirochelys reticularia*)*
Mississippi Map Turtle (*Graptemys pseudogeographica*)
Diamondback Terrapin (*Malaclemys terrapin*)
River Cooter (*Pseudemys concinna*)*
Three-toed Box Turtle (*Terrapene carolina*)*
Ornate Box Turtle (*Terrapene ornata*)
Red-eared Slider (*Trachemys scripta*)
Smooth Softshell Turtle (*Apalone mutica*)
Spiny Softshell Turtle (*Apalone spinifera*)*
American Alligator (*Alligator mississippiensis*)*
Green Anole (*Anolis carolinensis*)
Texas Horned Lizard (*Phrynosoma cornutum*) Extirpated in most of east and central Texas.
Fence Lizard (*Sceloporus undulatus*)*
Five-lined Skink (*Eumeces fasciatus*)*
Broad-headed Skink (*Eumeces laticeps*)
Ground Skink (*Scincella lateralis*)

Six-lined Racerunner (*Cnemidophorus sexlineatus*)*
Slender Glass Lizard (*Ophisaurus attenuatus*)
Buttermilk Racer (*Coluber constrictor*)
Texas Rat Snake (*Elaphe obsoleta*)
Mud Snake (*Farancia abacura*)*
Eastern Hog-nosed Snake (*Heterodon platirhinos*)*
Speckled King Snake (*Lampropeltis getula*)*
Louisiana Milksnake (*Lampropeltis triangulum*)
Coachwhip (*Masticophis flagellum*)* A roadkill was seen on FM 1010.
Green Watersnake (*Nerodia cyclopion*)
Yellow-bellied Watersnake (*Nerodia erythrogaster*)
Broad-banded Watersnake (*Nerodia fasciata*)
Diamondback Watersnake (*Nerodia rhombifer*)
Rough Green Snake (*Opheodrys aestivus*)*
Gulf Crayfish Snake (*Regina rigida*)*
Graham's Crayfish Snake (*Regina grahami*)*
Brown Snake (*Storeria dekayi*)
Flatheaded Snake (*Tantilla gracilis*)
Ribbon Snake (*Thamnophis proximus*)
Eastern Garter Snake (*Thamnophis sirtalis*)
Rough Earth Snake (*Virginia striatula*)
Coral Snake (*Micrurus tener*)*
Copperhead (*Agkistrodon contortrix*)
Cottonmouth (*Agkistrodon piscivorus*)
Timber Rattlesnake (*Crotalus horridus*)*
Pygmy Rattlesnake (*Sistrurus miliarius*)*

More extensive searches should reveal the presence of all the species with an asterisk and maybe some species that have not been observed in Liberty County, such as the Corn Snake or the Prairie Kingsnake which have been found in surrounding counties.

Birds observed

Great Blue Heron
Great Egret
Snowy Egret
Little Blue Heron
Cattle Egret
Green Heron
Black Vulture
Turkey Vulture
Cooper's Hawk
Red-shouldered Hawk
Peregrine Falcon
Mourning Dove
Yellow-billed Cuckoo
Barred Owl
Chuck-will's-widow
Ruby-throated Hummingbird
Red-bellied Woodpecker
Downy Woodpecker
Pileated Woodpecker
Acadian Flycatcher
Great Crested Flycatcher
White-eyed Vireo
Yellow-throated Vireo
Red-eyed Vireo
Blue Jay
American Crow
Carolina Chickadee
Tufted Titmouse
Carolina Wren
Blue-gray Gnatcatcher
Northern Mockingbird
Northern Parula
Yellow-throated Warbler
Pine Warbler
Prothonotary Warbler
Kentucky Warbler
Common Yellowthroat
Hooded Warbler
Yellow-breasted Chat
Summer Tanager
Northern Cardinal
Indigo Bunting
Brown-headed Cowbird
Least Bittern (E. Keith observation)

Odonates observed

Ebony Jewelwing (*Calopteryx maculata*)
Swamp Spreadwing (*Lestes vigilax*)
Turquoise Bluet (*Enallagma divagans*)
Orange Bluet (*Enallagma signatum*)
Rambur's Forktail (*Ischnura ramburii*)
Citrine Forktail (*Ischnura hastata*)
Fragile Forktail (*Ischnura posita*)
Southern Sprite (*Nehalennia integricollis*)
Blue-tipped Dancer (*Argia tibialis*)
Swamp Darner (*Epiaeschna heros*)
Comet Darner (*Anax longipes*)
Common Green Darner (*Anax junius*)
Ashy Clubtail (*Gomphus lividus*)
Bayou Clubtail (*Arigomphus maxwellii*)
Stillwater Clubtail (*Arigomphus lentulus*)
Arrowhead Spiketail (*Cordulegaster obliqua*)
Calico Pennant (*Celithemis elisa*)
Faded Pennant (*Celithemis ornata*)
Amanda's Pennant (*Celithemis amanda*)
Halloween Pennant (*Celithemis eponina*)
Eastern Pondhawk (*Erythemis simplicicollis*)
Little Blue Dragonlet (*Erythrodiplax miniscula*)
Golden-winged Skimmer (*Libellula auripennis*)
Slaty Skimmer (*Libellula incesta*)
Painted Skimmer (*Libellula semifasciata*)
Great Blue Skimmer (*Libellula vibrans*)
Roseate Skimmer (*Orthemis ferruginea*)
Blue Dasher (*Pachydiplax longipennis*)
Eastern Amberwing (*Perithemis tenera*)
Common Whitetail (*Plathemis lydia*)
Carolina Saddlebags (*Tramea carolina*)

APPENDIX E – CULTURAL RESOURCES SURVEY

Deep East Texas Archaeological Consultants (DETAC)
4215 Red Oak
Nacogdoches, TX 75965
936-554-3435

17 September 2014

Jeff Durst
Texas Historical Commission
108 W. 16th
Austin, TX. 78711

Mr. Durst:

Please fine enclosed, for review, a copy of DETAC's *A Cultural Resources Survey of the Houston-Conroe Mitigation Bank SWG-2011-00719 Liberty County, Texas*. The proposed construction includes excavating/restoring three stream channels between Button Willow Ponds and Orange Branch. The linear survey along the proposed stream courses totaled 7.3 kilometers (4.5 miles) in a 6 km (3.7 mi) long route.

A total of 63 shovel tests were excavated along the proposed channels. No mima/pimple mounds, terraces, or other topographic features were found to distinguish high and low probability areas. Neither shovel testing nor visual inspection of the project area found any cultural material. No artifacts were collected.

I am requesting occurrence with a finding of "no effect" to properties listed or eligible for inclusion to the NRHP as defined by the National Historic Preservation Act for the proposed restoration project. If you have any questions or need additional information, I can be contacted by e-mail at detac99@hotmail.com or by phone at (936) 554-3435.

Sincerely;

Victor J. Galan, Ph.D.
Archaeologist

A Cultural Resources Survey of the Houston-Conroe Mitigation Bank SWG-2011-00719 Liberty County, Texas

Draft Report

Prepared for:
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, TX 77553-1229

Upon request by:
Hydrex Environmental, Inc.
1120 NW Stallings Dr.
Nacogdoches, TX 75964

Prepared by:
Deep East Texas Archaeological Consultants
4215 Red Oak
Nacogdoches, Texas 75965

Principal Investigator and Report Author
Victor Galan, Ph.D.

Project Number 524

July 2014

ABSTRACT

In June 2014 Deep East Texas Archaeological Consultants (DETAC) conducted a cultural resource management survey of the proposed Houston-Conroe Mitigation Bank for Hydrex Environmental in Liberty County, Texas. Proposed construction includes excavating/restoring three stream channels between Button Willow Ponds and Orange Branch. The linear survey along the proposed stream courses totaled 7.3 kilometers (4.5 miles in a 6 km (3.7 mi) long route. A total of 63 shovel tests were excavated along the proposed channels. No mima/pimple mounds, terraces, or other topographic features were found to distinguish high and low probability areas. Neither shovel testing nor visual inspection of the project area found any cultural material. No artifacts were collected. No further investigations are recommended at this location. However, if any artifacts, bones, or cultural materials are found or recovered during channel excavation, then all construction should stop and DETAC contacted to evaluate the potential impact to cultural resources important to the State of Texas. Based on the field work, DETAC is requesting concurrence with the determination of "no effect" to NRHP eligible properties for the proposed stream restoration project.

APPENDIX F – WATERS OF THE U.S., INCLUDING WETLANDS, DELINEATION

Hydrex
ENVIRONMENTAL, INC.

July 10, 2014

Mr. Jayson Hudson, Project Manager
U.S. Army Corps of Engineers
Galveston District
2000 Fort Point Road
Galveston, Texas 77550

RE: 2nd ADDENDUM TO DELINEATION OF POTENTIAL WATERS OF THE U.S., INCLUDING WETLANDS REPORT
Houston-Conroe Mitigation Bank (Phase I)
SWG-2011-00719
Liberty County, Texas
Hydrex Project No. A-12-614

Dear Mr. Hudson:

Submitted on behalf of Forestar (USA) Real Estate Group, Inc., please accept this letter report as the 2nd addendum to the previously submitted *Delineation of Potential Waters of the U.S., Including Wetlands Report* dated June 3, 2013. The 1st addendum was dated August 8, 2013 and was submitted to the USACE Galveston District.

As per feedback received from the internal review team, the Phase I mitigation bank boundary was extended to include wetland depressional areas located above the east and west forks of Orange Branch and its tributaries. The extended boundary has been surveyed by a registered professional land surveyor and Phase I now encompasses approximately 396.07 acres. Hydrex Environmental, Inc. (Hydrex) performed the delineation of waters of the U.S., including wetlands, on the extended Phase I area on June 11, 2014. The following revisions to the delineation report have been made and are presented in this addendum:

- The Phase I boundary has been extended to include the wetland depressional areas and now encompasses approximately 396.07 acres. Revised Jurisdictional Determination Maps (2nd Addendum Figures 1 through 4) have been attached for your reference.

- The boundary of Wetland A was modified to include the wetland depressional areas within the extended Phase I boundary. The wetland boundary modifications were based on GPS points collected during the June 11, 2014 site visit as well as LiDAR data, and historic aerial photographs. Pages 20 and 21 from the original delineation report have been revised to show the adjusted acreage of Wetland A (217.34 acres). This acreage excludes the percentage of upland mounds (1.78 percent, 3.93 acres) found within Wetland A, calculated using the point-line intercept model. Revised Pages 20 and 21 are included as

an attachment to this letter report. Wetland Determination Data Forms and site photographs are also attached for your convenience.

Should you have any questions or need any additional information regarding this project, please contact me at (936) 568-9451 or ccollier@hydrex-inc.com.

Sincerely
Hydrex Environmental, Inc.

Clayton A. Collier, PWS
Manager of Ecological Services

ATTACHMENTS

Attachment A PLATES

- 2nd Addendum - Figure 1 (1995 Aerial Photograph)
- 2nd Addendum - Figure 2 (1995 Aerial Photograph - 11x17)
- 2nd Addendum - Figure 3 (LiDAR Digital Terrain Model)
- 2nd Addendum - Figure 4 (LiDAR Digital Terrain Model - 11x17)

Attachment B REVISED PAGES 20-21

Attachment C WETLAND DETERMINATION DATA FORMS

Attachment D SITE PHOTOGRAPHS

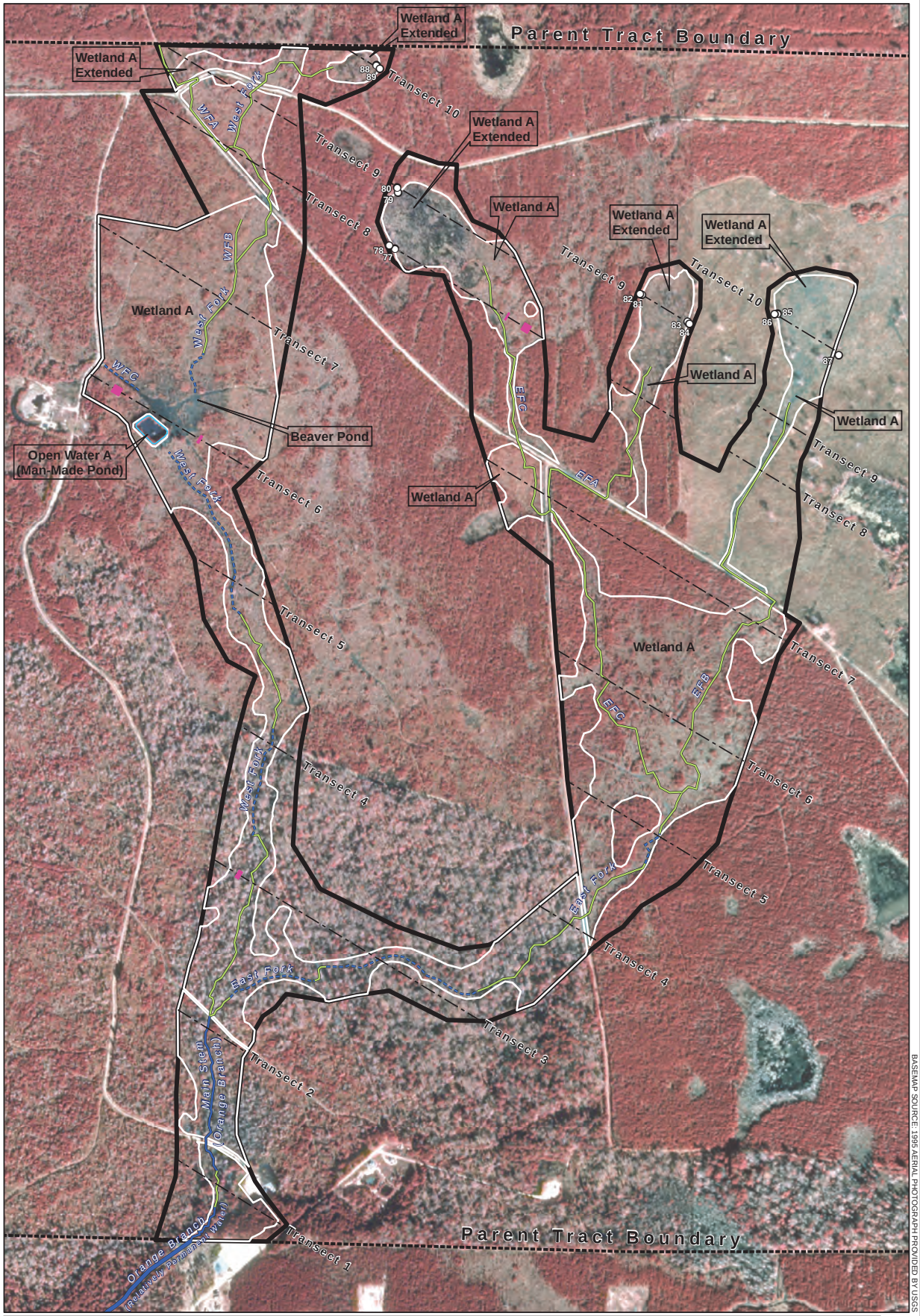
DISTRIBUTION

Mr. Bill Goodrum
Forestar (USA) Real Estate Group, Inc.
6300 Bee Cave Road, Bldg 2, Suite 500
Austin, Texas 78745-5149

Mr. Neil Boitnott
Reynolds Smith and Hills, Inc.
100 East Ferguson Street, Suite 420
Tyler, Texas 75702

ATTACHMENT A

PLATES



- Observation Point collected 6/11/2014
- Delineation Transect
- Phase I Data Collection Boundary (396.07 ac) (revised 6/25/2014)
- Parent Tract (~3,500 ac)
- NHD Flowline (USGS)
- Intermittent Stream
- Ephemeral Stream
- Aggraded Channel
- Non-Wetland along Transect (within Wetland A)
- Wetland A (revised 7/10/2014)
- Open Water A (Man-Made Pond)

Hydrox Environmental, Inc.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
936-568-9451 Fax: 936-568-9527

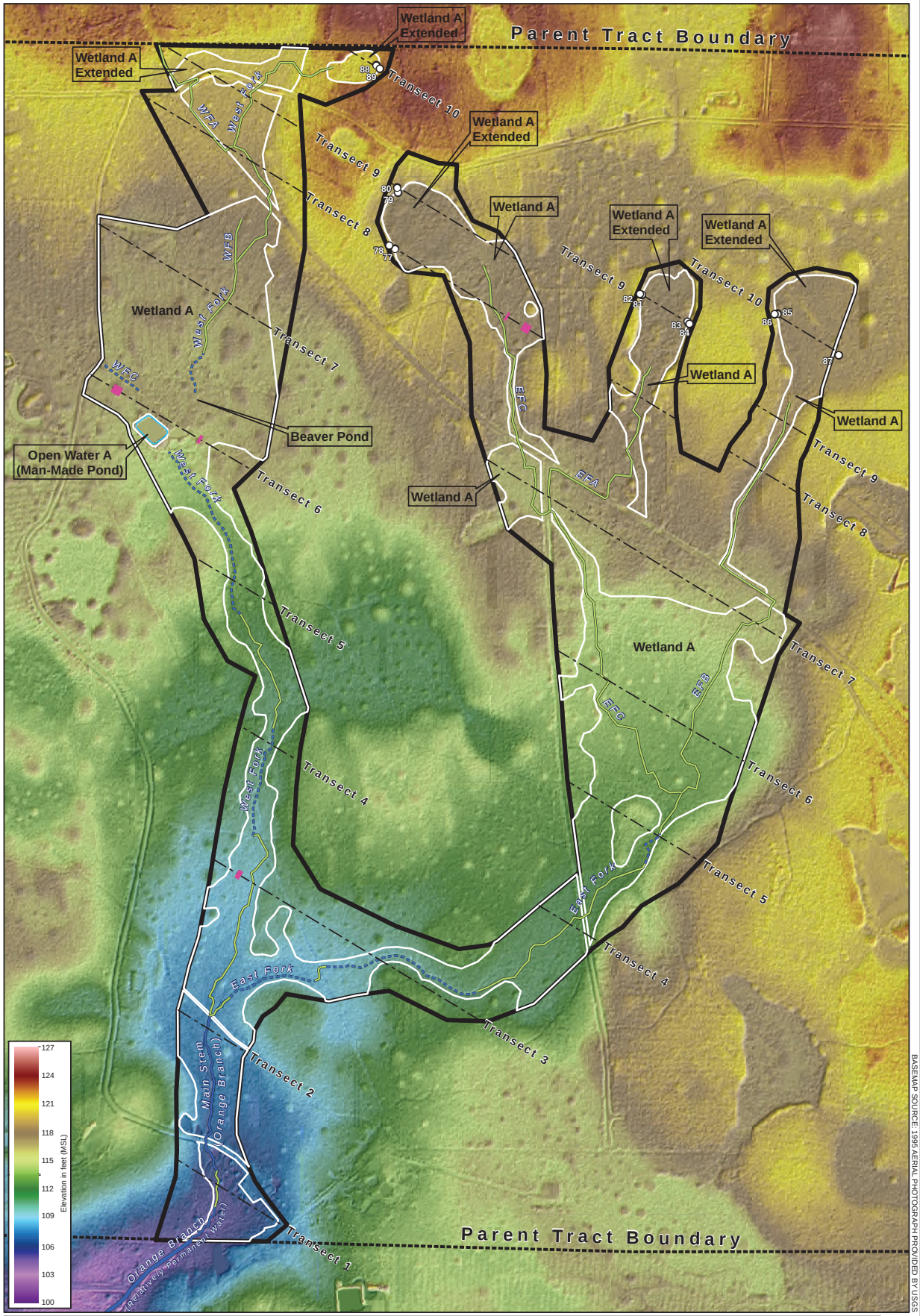
2nd Addendum - Figure 1

Jurisdictional Determination Map (1995 Aerial Photograph)

0 700 Feet

Houston-Conroe Mitigation Bank
Phase I
Hydrologic Unit Code - 12040103
Liberty County, Texas

Map Revised: 07/10/2014 | Project Number: A-12-614 | GIS Analyst: [illegible]



Hydrex Environmental, Inc.
1120 NW Stallings Drive
Nacogdoches, Texas 75964
936-568-9451 Fax: 936-568-9527

2nd Addendum - Figure 3

Jurisdictional Determination Map
(LiDAR Digital Terrain Model)

0 700
Feet

Houston-Conroe Mitigation Bank
Phase I
Hydrologic Unit Code - 12040103
Liberty County, Texas

Map Revised: 07/10/2014 | Project Number: A-12-614 | GIS Analyst: HJS

ATTACHMENT B

REVISED PAGES 20-21

Table 2. Summary of Delineated Waters of the U.S., Including Wetlands, and Aggraded Stream Channels.

Feature ID	Type	Based on OHWM				Northing, Easting (m) NAD83, UTM Z15N	Potentially Jurisdictional
		Width (ft)	Depth (ft)	Length (ft)	Area (ac)		
Main Stem (Orange Branch)	Intermittent Stream	7.25	0.5	1,627	0.27	3345999.17, 300751.76	YES
	Aggraded Stream Channel	-	-	290	-	3345784.71, 300760.14	YES*
West Fork	Ephemeral Stream	9.72	0.63	2,639	0.59	3346724.1, 300862.6	YES
	Aggraded Stream Channel	-	-	5,740	-	3346398.51, 300812.76	YES*
West Fork A (WFA)	Aggraded Stream Channel	-	-	1,257	-	3348311.48, 300702.45	YES*
West Fork B (WFB)	Aggraded Stream Channel	-	-	340	-	3347967.05, 300805.74	YES*
West Fork C (WFC)	Ephemeral Stream	5.0	0.75	343	0.04	3347653.16, 300539.87	YES
East Fork	Ephemeral Stream	9.5	0.5	2,251	0.49	3346314.39, 301196.8	YES
	Aggraded Stream Channel	-	-	2,462	-	3346380.81, 301558.75	YES*
East Fork A (EFA)	Aggraded Stream Channel	-	-	2,032	-	3347427.69, 301684.05	YES*
East Fork B (EFB)	Aggraded Stream Channel	-	-	3,766	-	3347127.27, 302037.29	YES*
East Fork C (EFC)	Aggraded Stream Channel	-	-	4,858	-	3347604.31, 301442.96	YES*
Open Water A	Man-Made Pond	-	4.5	-	0.66	3347532.68, 300612.15	YES
Wetland A	Predominantly Forested	-	-	-	217.34	3346230.27, 300774.87	YES
Total Area of Waters of the U.S., including Wetlands					**219.39**		**YES***

*Where the aggraded stream channels are located within the boundaries of Wetland A, the aggraded stream channels are considered potentially jurisdictional wetlands. The aggraded stream channels currently do not exhibit an ordinary high water mark and were therefore, not delineated as streams.

Throughout Phase I DCB, calculations based on the point-line intercept method indicate upland mounds encompass approximately 1.78 percent of the total wetlands identified. A total of 222.66 acres of land were delineated within the boundaries of Wetland A. Subtracting 1.78 percent (3.93 acres) of the total acreage to account for upland mounds, yields 218.73 acres. The total area of intermittent and ephemeral streams (1.39 acres) was then subtracted from the total area. Thus yielding a total of 217.34 acres of potentially jurisdictional wetlands (Wetland A) within the Phase I DCB, as shown in Table 2 above.

It should be noted, where the aggraded stream channels are located within the boundaries of Wetland A, the areas of the aggraded stream channels were calculated as part of the acreage of Wetland A. The aggraded stream channels currently do not exhibit an ordinary high water mark (OHWM) and a bed and bank system and were therefore, not delineated as streams.

4.5 Jurisdictional Determination

The property of concern at this time is the approximate 396.07-acre Phase I DCB. Hydrologic connection between the delineated waters of the U.S., including wetlands, and navigable waters is based the on-site hydrologic connection to Orange Branch. Orange Branch has been identified in the field, as well as on the USGS Topographic

ATTACHMENT C

WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Houston-Conroe Mitigation Bank (Phase I) City/County: Liberty County Sampling Date: 6/11/14

Applicant/Owner: Forestar Group, Inc. State: TX Sampling Point: 77

Investigator(s): CAC, CRA Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 0-1

Subregion (LRR or MLRA): LRR T Lat: 30.246879 Long: -95.066431 Datum: NAD 83

Soil Map Unit Name: Waller-kirbyville complex NWI classification: PEM1F

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☑ Water-Stained Leaves (B9)
- ☑ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ✓ No _____ Depth (inches): 2

Water Table Present? Yes ✓ No _____ Depth (inches): Surface

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): Surface

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Aquatic Fauna (B13); includes mosquito larvae.

FAC-Neutral Test (D5); using dominant species, the test shows the site is comprised of > 50% of OBL and FACW species than FACU and UPL species. The site passes the FAC-Neutral Test and therefore is a secondary indicator.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 77

Tree Stratum (Plot size: 30' Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Planera aquatica	35	Yes	OBL
2. Cephalanthus occidentalis	15	Yes	OBL
3. Quercus sinuata	12		UPL
4. Quercus laurifolia	10		FACW
5.			
6.			
7.			
8.			
	72	= Total Cover	
50% of total cover: 36	20% of total cover: 14.4		

Sapling/Shrub Stratum (Plot size: 30' Radius)			
1. Cephalanthus occidentalis	30	Yes	OBL
2. Styrax grandifolius	10	Yes	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	40	= Total Cover	
50% of total cover: 20	20% of total cover: 8		

Herb Stratum (Plot size: 30' Radius)			
1. Saururus cernuus	25	Yes	OBL
2. Carex sparganioides	10	Yes	FAC
3. Sabal minor	5		FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	40	= Total Cover	
50% of total cover: 20	20% of total cover: 8		

Woody Vine Stratum (Plot size: 30' Radius)			
1. Smilax rotundifolia	5	Yes	FAC
2.			
3.			
4.			
5.			
	5	= Total Cover	
50% of total cover: 2.5	20% of total cover: 1		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 86 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: 77

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-4	10YR 4/2	100					SiL	Silt Loam
4-12	10YR 4/3	98	10YR 5/8	2	C	M	SiL	Silt Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☑ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No _____

Remarks:

A higher percent of redox features (4"-12") are not visible due to saturation.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Houston-Conroe Mitigation Bank (Phase I) City/County: Liberty County Sampling Date: 6/11/14

Applicant/Owner: Forestar Group, Inc. State: TX Sampling Point: 78

Investigator(s): CAC, CRA Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Ridge Local relief (concave, convex, none): Convex Slope (%): 1

Subregion (LRR or MLRA): LRR T Lat: 30.246948 Long: -95.06657 Datum: NAD 83

Soil Map Unit Name: Waller-kirbyville complex NWI classification: PEM1F

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ✓, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No ✓

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____

Hydric Soil Present? Yes ____ No ✓

Wetland Hydrology Present? Yes ____ No ✓

Is the Sampled Area within a Wetland? Yes ____ No ✓

Remarks:

Located within a clear cut area where vegetation and soil are significantly disturbed due to recent timber management practices.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ____

Water Table Present? Yes ____ No ✓ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No ✓ Depth (inches): ____

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators present.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: 78

Tree Stratum (Plot size: 30' Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus falcata	15	Yes	FACU
2. Ilex vomitoria	12	Yes	FAC
3. Ilex opaca	10	Yes	FAC
4.			
5.			
6.			
7.			
8.			
	37	= Total Cover	
50% of total cover: 18.5	20% of total cover: 7.4		
Sapling/Shrub Stratum (Plot size: 30' Radius)			
1. Ilex vomitoria	15	Yes	FAC
2. Ilex opaca	8	Yes	FAC
3. Triadica sebifera	5		FAC
4.			
5.			
6.			
7.			
8.			
	28	= Total Cover	
50% of total cover: 14	20% of total cover: 5.6		
Herb Stratum (Plot size: 30' Radius)			
1. Pteridium aquilinum	5	Yes	FACU
2. Dichanthelium commutatum	3	Yes	FAC
3. Eupatorium capillifolium	2		FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10	= Total Cover	
50% of total cover: 5	20% of total cover: 2		
Woody Vine Stratum (Plot size: 30' Radius)			
1.			
2.			
3.			
4.			
5.			
	0	= Total Cover	
50% of total cover: ____	20% of total cover: ____		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 57 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: 78

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-3	10YR 4/4	100					SL	Silt Loam
4-12	10YR 5/4	100					SL	Silt Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____

Depth (inches): ____

Hydric Soil Present? Yes ____ No ✓

Remarks:

No hydric soil indicators present.

APPENDIX G – FUNCTIONAL ASSESSMENT OF WETLANDS AND STREAMS

Potential Waters of the US
Functional Assessment Report
Houston-Conroe Mitigation Bank
Phase I

SWG-2011-00719

SUBMITTAL TO:

Mr. Jayson Hudson
United States Army Corps of Engineers
Galveston District
Jadwin Building
2000 Fort Point Road
Galveston, Texas 77553-1229

Mr. Bill Goodrum
Forestar (USA) Real Estate Group, Inc.
6300 Bee Cave Road
Building 2, Suite 500
Austin, Texas 78746-5149

PREPARED BY:

RS&H
100 East Ferguson Street, Suite 420
Tyler, Texas 75702

August 18, 2014

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

1.0 GENERAL INFORMATION

This functional assessment report is being submitted as part of the Baseline Assessment for the Houston-Conroe Mitigation Bank – Phase 1 (HCMB). The Baseline Assessment for the HCMB is partitioned into two separate reports, the determination and delineation of Waters of the US, including wetlands (WOUS), and the baseline functional assessment. Hydrex Environmental, Inc. was contracted by Forestar (USA) Real Estate Group, Inc. (Forestar – Mitigation Bank Sponsor) to conduct the determination and delineation of WOUS, while RS&H, Inc. was contracted to complete the baseline functional assessment. The contents of this report only pertain to the baseline functional assessment.

At the time of data collection (March, April, and May, 2013), the exact boundary of the HCMB was still pending further stream design and discussion with the Interagency Review Team (IRT). In order to keep the permitting process moving ahead, a "Data Collection Boundary" of 346 Ac was established that would either represent the final mitigation bank boundary, or an official boundary would be further defined within the limits of the Data Collection Boundary.

Following extensive soil sampling, a survey of the literature, and a re-evaluation of the unique nature of the wetland depressional areas on site, the decision was made to include the wetland depressional areas at the headwaters of the remnant channels to within the boundary of the HCMB. Another delineation of WOUS was performed by Hydrex Environmental, Inc., and although their findings and adjustments did not change the types of wetlands and streams found, the acreages and linear feet included needed to be adjusted for the purposes of this evaluation. To date, the current acreage of this Data Collection Boundary area, as discussed with the U.S. Army Corps of Engineers (USACE), Galveston District (SWG) and the IRT, is 396 Ac. Information presented below describes this Data Collection Boundary, and this 396 Ac delineation is most likely to be the final boundary of the HCMB.

The proposed HCMB is located at Latitude 30.249959° North and Longitude 95.087253° West approximately fifteen miles north of Lake Houston in Liberty County, Texas (Appendix A - Exhibit 1). The HCMB lies within the US Geological Survey's (USGS's) 8-digit Hydrologic Unit Code (HUC) 12040103, which is the East Fork of the San Jacinto River, and is oriented within the Plum Grove, USGS 7.5 minute quadrangle topographic map. The proposed HCMB is situated within the jurisdictional limits of the US Army Corps of Engineers Galveston District.

The data collection boundary for HCMB is a 396 acre (Ac) portion of a larger approximate 3,500 Ac tract owned by Forestar (Appendix A - Exhibit 2). This location encompasses the majority of the headwater region for multiple tributaries to the East Fork of the San Jacinto River and their associated riparian wetlands, specifically, the headwaters to Orange Branch. Aerial, topographic, and Light Detecting and Ranging (LiDAR) maps can be referenced in Appendix A, Exhibits 3 – 6.

2.0 METHODOLOGY

RS&H environmental specialists Neil Boitnott and Kate Lindekugel conducted functional assessments of WOUS in March, April, and May of 2013. The plot centers and recorded data points were mapped using a Trimble GeoExplorer 2008 series global positioning system (GPS) unit capable of sub-meter accuracy, and then digitized using ArcGIS version 10.1 (ESRI, Inc., 2010). Wetland boundaries and stream centerlines were provided spatially by Hydrex. As described in Hydrex's delineation report, wetland boundaries and streams were mapped in accordance with the SWG – Standard Operation Procedures dated October 22, 2003 for recording jurisdictional delineations using GPS.

Prior to the field visit, aerial photographs and 7.5 minute USGS topographical quadrangle maps were reviewed to familiarize the field staff with the site. A preliminary appraisal was made to identify significantly different wetland habitats and stream types, which were subdivided into Wetland Assessment Areas (WAAs) and Stream Assessment Transects (Stream Transects) respectively. Transects traversed in the field were chosen by Hydrex for the delineation of WOUS based upon the heuristics laid out in the US Army Corps of Engineers 1987 Wetlands Delineation Manual (USACE, 1987) and drawn onto field maps.

2.1 WETLAND FUNCTIONAL ASSESSMENT

During the field surveys, data plots were established along field transects; vegetation, hydrology, and soil characteristics were recorded using the USACE Galveston District's Riverine Herbaceous/Shrub HGM Interim (Herbaceous iHGM) and the Riverine Forested HGM Interim (Forested iHGM) as derived from (Ainslie, et al., 1999). These plots were chosen by best professional judgment to ensure all encountered habitats were adequately described. When a unique wetland habitat is identified, it is referred to as a WAA, and the iHGM data taken from plots within the WAA serve to quantify characteristics of the WAA. Should a potential, unique wetland assemblage not be intersected by a transect line, a plot was established off transect to ensure the habitat was represented in the final data compilation.

The field crew established a plot with a 37 foot (ft) (11.3 meter (m)) radius, which is bisected by a 100 ft (30 m) transect. Two .004 hectare (ha) subplots are established opposite to one another, perpendicular to the 100 ft transect line, and 11.8 ft from plot center. Four, 1-square (sq) m subplots are established equidistant to one another, 11.8 ft from plot center. Using the plot as a point of reference, the field crew described the WAA in which the plot is located using the criteria listed in the iHGM. This plot design was derived from the field sampling guidelines in ERDC/EL TR 10-17, but the variables evaluated were those in the Herbaceous iHGM and Forested iHGM as recommended by the USACE Galveston District. Multiple plots were evaluated per WAA, based on the WAA's size. These iHGM data were evaluated out of the field to describe the overall ecological functionality of the WAA. Table 1 identifies criteria assessed at each plot, and scores range from least preferable (0.0) to most preferable (1.0) wetland condition.

Table 1 – Variables Assessed for Forested iHGM and Herbaceous iHGM Models

Variable		Description
Forested iHGM	**Herbaceous iHGM**	
Vdur	**Vdur**	Percentage and duration of flooding of the WAA due to hydrology of adjacent waterways. Evaluated using LIDAR, topographic maps, and field observations of hydrologic features, vegetative community structure, and soils.
Vfreq	**Vfreq**	The frequency of flooding of the WAA due to hydrology of adjacent waterways. Evaluated using LIDAR, topographic maps, and field observations of hydrologic features, vegetative community structure, and soils.
Vtopo	**Vtopo**	Percentage of the WAA represented by topographic features like dips, hummocks, swales, etc. LIDAR and topographic maps are used to identify major features, and on-site visual assessment evaluates micro-topography.
Vcwd	-	Number of pieces of coarse woody debris (CWD) >3" dbh identified per 100' transect. Four 100' transects are laid out in the cardinal directions, the number of pieces of CWD crossed are counted, and the average between the 4 transects is used.
Vwood	**Vwood**	Percentage of the WAA that is covered by woody vegetation. This is assessed on site by recording percentage of ground shaded by woody vegetation.
Vtree	-	Percentage of trees in the WAA that are hard mast producers. This applies to trees with a dbh >3" counted within the iHGM plot.
Vrich	-	Number of tree species in the WAA comprising at least 5% of the stand and having a dbh >3".
Vbasal	-	The average basal area of trees in the WAA per acre with a dbh >3". Basal area is measured using a basal area prism while standing at the iHGM plot center.
Vdensity	-	Measurement of the number of trees (dbh >3") in the WAA per acre. The number of trees within the plot is counted and the number is multiplied to determine the number of trees per acre.
Vmid	**Vmid**	The average coverage of the midstory (shrubs/saplings) layer in the WAA as a percentage of ground shaded. This is measured in the two .004 ha subplots and averaged.
Vherb	**Vherb**	The average coverage of the herbaceous layer in the WAA as a percentage of ground shaded. This is measured in the 4, 1 sq m subplots and averaged.
Vdetritus	**Vdetritus**	The amount of detritus within the WAA as determined by percentage of the WAA possessing an O or A soil horizon. A spade is used to dig through the top layer of soil and the presence or absence of the horizon is based upon soil value.
Vredox	**Vredox**	Presence of redoximorphic processes expressed as redox concentrations along oxidized root channels or soil mottles. Must comprise 20% of the pedon within the top 4" of the soil profile. This is determined by digging a soil pit and evaluating the layers.
Vsorpt	**Vsorpt**	Observation of the absorptive properties of the soils within the WAA. Soils from the soil pit are evaluated using the ribbon method and feel test for texture.
Vconnect	**Vconnect**	The number of habitat types within a 600' perimeter of the WAA determined by ground observation and confirmed using aerial photography, topographic maps, and LIDAR.

These scores are used in three Functional Capacity Indexes (FCIs) to evaluate the Temporary Storage and Detention of Storage Water (TSDSW), Maintenance of Plant and Animal Communities (MPAC), and Removal and Sequestration of Elements and Compounds (RSEC) for each plot. These FCI calculations can be found in the iHGM guidebooks as referenced above.

Once field data collection was completed, RS&H finalized WAA boundaries and grouped field data sheets by WAA. To adequately describe each WAA, all the field datasheets within each WAA were averaged and the Functional Capacity Units (FCUs) were calculated by multiplying the acreage of the WAA by each FCI (TSDSW, MPAC, and RSEC). These FCUs are the fundamental unit of "credits" that will be used to quantify functional uplift and future credit calculations.

2.2 STREAM CHANNEL FUNCTIONAL ASSESSMENT

The stream channel functional assessment was conducted using the USACE Galveston District's Stream Condition Assessment Methodology Standard Operating Procedure (SOP). After the field work concluded, the USACE Galveston District released a revised version of the SOP (USACE SWG, 2013). As sufficient data had been collected to utilize the new SOP, it was decided to evaluate the data using the new heuristics to stay current with most recent standards. Therefore, references to SOP in this document refer to the 2013 edition of the USACE Galveston District's Stream Condition Assessment.

The channels were evaluated for ordinary high water mark (OHWM) by the Hydrex field crew, and RS&H followed the OHWM survey markers to evaluate stream reaches. The stream was initially split into reaches based upon assessing changes in critical stream function or loss of OHWM altogether. Some of these attributes were floodplain connectivity, width to depth ratios of the channel, width and position of bankfull benches, sediment composition and abundance, and sediment transport capacity among others. This was necessary because of the extent of impairment and degradation to the channel. The boundaries of the stream reaches were recorded using GPS.

These reaches were then further subdivided into 350 linear foot (Lf) transects separated by a 125 Lf gap per the SOP (USACE SWG, 2013). An attempt was made to make all transects 350 Lf in length, but the channel was so severely impaired in many places that it was not always possible. Smaller channels ranging between 200 Lf and 350 Lf were included to avoid any bias created by the impacts themselves. Segments of channel with OHWM were punctuated along the entire relic stream length with collapsed culverts, river crossings, and half collapsed dams (both natural and artificial). Although an effort was made to include any possible reaches with OHWMs, no two transect lengths were closer than 125 Lf, per the requirements of the SOP (USACE SWG, 2013).

Once a Stream Transect was established, data was gathered at a point representative of the transect. The data gathered consisted of the channel width and depth measured from the thalweg, the information necessary to fill out the SOP, and any pertinent descriptions of channel morphology, surrounding habitats and vegetative communities, or other variables which may have an effect on channel stability and function. The SOP requires evaluating four variables which are:

1. Channel Condition– the vertical stability of the channel in terms of aggradation and entrenchment, bank erosional stability, and access to surrounding floodplain during flood events;
2. Riparian Buffer – the capacity of the surrounding riparian buffer to mitigate flow velocities into the channel, reduce undesirable elements in runoff, control water temperature, contribute allochthonous carbon, and mitigate sediment transport;

3. Aquatic Use – the aquatic life use variable used for this assessment is the aquatic life use assigned to the reach by the Texas Commission on Environmental Quality (TCEQ) derived from long term monitoring of chemical, physical, and biological parameters typical of streams;
4. Channel Alteration – the amount of the channel impacted by anthropogenic activities, specifically channelization, bridges, culverts, riprap, spoil piles, roads, domestic livestock crossings among others.

The criteria are scored on a scale of 1-5 with 5 being optimal and 1 is severe. The average of the four scores is the Condition Index (CI) for a particular transect. The Reach Condition Index (RCI) is the average of all the CIs calculated for a reach of channel.

3.0 RESULTS

The results of the wetland and stream functional assessment are presented below. Please note that the results present the findings of multiple field assessments spanning March, April, and May of 2013 and may not reflect current conditions due to extenuating circumstances.

3.1 WETLANDS FUNCTIONAL ASSESSMENT

Using the methods as outlined above, RS&H identified six WAAs within the data collection boundary, shown in Exhibit 7, totaling 217.34 Ac. A summary of the average functional assessment scores by variable for the WAAs is outlined in Table 2; data sheets including photographs can be referenced in Appendix B.

Table 2 – Summary of Functional Assessment Scores by Variable for WAAs Identified within Data Collection Boundary

Variable		Wetland Assessment Area (WAA)					
Forested iHGM	Herbaceous iHGM	WAA 1	WAA 2	WAA 3	WAA 4	WAA 5	WAA 6
Vdur	Vdur	0.75	0.86	1.00	1.00	1.00	1.00
Vfreq	Vfreq	0.71	0.86	1.00	1.00	1.00	1.00
Vtopo	Vtopo	0.70	0.74	0.80	1.00	1.00	0.70
Vcwd	-	0.68	0.79	0.37	0.50	-	-
Vwood	Vwood	0.67	0.64	0.90	0.88	0.10	0.25
Vtree	-	0.81	0.93	0.83	1.00	-	-
Vrich	-	0.73	0.86	0.80	0.50	-	-
Vbasal	-	0.85	0.71	0.80	0.90	-	-
Vdensity	-	0.75	0.83	0.67	0.50	-	-
Vmid	Vmid	0.69	0.61	0.58	1.00	0.25	0.38
Vherb	Vherb	0.66	0.50	0.60	0.65	1.00	0.88
Vdetritus	Vdetritus	0.86	0.79	1.00	1.00	1.00	0.30
Vredox	Vredox	0.33	0.61	0.10	1.00	1.00	1.00
Vsorpt	Vsorpt	0.17	0.10	0.37	0.30	0.50	0.50
Vconnect	Vconnect	1.00	1.00	1.00	1.00	1.00	1.00

Following the methodology covered previously (Ainslie, et al., 1999), these scores were used to calculate the FCI values representing the capacity for the temporary storage of water on site (TSDSW), capability to maintain well developed plant and animal communities (MPAC), and the ability to sequester or remove elements (RSEC). These FCI values were then multiplied by the acreage of the applicable WAA to derive the FCUs (Table 3).

Table 3 – Summary of FCI and FCU Values for WAAs Identified within Data Collection Boundary

WAA	Ac	FCI			FCU			Description
		TSDSW	MPAC	RSEC	TSDSW	MPAC	RSEC	
1	118.79	0.70	0.80	0.65	83.66	92.89	77.35	24 year old pine plantation that has undergone multiple thinning operations.
2	48.47	0.79	0.82	0.72	38.16	39.55	34.70	Recently thinned mature hardwood stand.
3	32.72	0.83	0.72	0.82	27.16	23.59	26.68	Young hardwood stands. Areas were cleared in late 1980's and allowed to naturally regenerate.
4	8.06	0.89	0.75	0.89	7.17	6.08	7.15	Young oak dominated stand influenced by beaver activity.
Forested	**208.04**				**156.15**	**162.10**	**145.87**	
5	4.30	0.90	0.75	0.74	3.88	3.23	3.17	*Juncus effusus* dominated herbaceous area influenced by beaver activity.
6	5.00	0.81	0.75	0.70	4.07	3.75	3.50	Various cleared areas dominated by early successional shrubs and herbaceous species.
Herbaceous	**9.30**				**7.95**	**6.98**	**6.67**	
TOTAL	**217.34**				**164.10**	**169.08**	**152.54**	**Wetland A - See Hydrex Delineation Report.**

Whereas these scores provide insight into the overall character of each WAA, the individual WAAs are discussed in greater detail below.

3.1.1 WAA 1

WAA 1 was the most prevalent wetland habitat type encountered and consisted of 118.79 Ac of 24 year old pine plantation. The area appeared to have undergone two selective timber harvests (thinning) since being planted. This has resulted in a canopy predominantly dominated by loblolly pine (*Pinus taeda*) but significant components of naturally regenerated hardwood species, specifically laurel oak (*Quercus laurifolia*) and willow oak (*Quercus phellos*), were occurring as understory trees, saplings, and shrubs. Reference Table 4 for a summary of tree species counted across the 12 iHGM data points recorded in WAA 1.

Table 4 – Tree Count Summary for iHGM Plots in WAA 1

Species	Total Counted Across 12 Data Points	Average Percent Composition
Quercus laurifolia	133	38%
Pinus taeda	107	31%
Quercus phellos	51	15%
Triadica sebifera	14	4%
Liquidambar styraciflua	14	4%
Acer rubrum	11	3%
Quercus nigra	8	2%
Fraxinus pennsylvanica	5	1%
Ulmus alata	2	1%
Carpinus caroliniana	1	0%
Nyssa sylvatica	1	0%

Due to the frequent disturbance this WAA experienced, suboptimal iHGM variables were generally associated with the vegetative composition and structure of the WAA. The coarse woody debris variable (Vcwd) was reduced due to trees being harvested instead of naturally dying and losing their limbs. Coarse woody debris present was generally concentrated in select areas where logs were de-limbed and the logging debris piled up. The percent of the WAA covered by woody vegetation (Vwood) was lessened because of numerous logging lanes cleared through the WAA. The diversity of tree species in the WAA (Vrich) was suboptimal due to planting and maintaining a pine plantation monoculture. Additionally, variables such as coverage of the sapling shrub layer (Vmid) and coverage of the herbaceous layer (Vherb) were diminished due to the frequent disturbance of the stand as well as initial dense planting of pine which shades out most shrub and herbaceous species until the stand is selectively harvested. *Pinus taeda* is also known to create allelopathic chemicals, which can retard recruitment and growth.

Vredox observations were low across the region for several probable reasons. The soils of WAA 1 (Exhibit 7) are predominantly Waller-Kirbyville Complex (nine out of twelve sites) with three points taken out of Waller Loam (California Soil Resource Lab, 2014). These soils are known to be highly susceptible to rutting, and as previously discussed, these areas are under commercial silviculture with regular thinning. The criteria specifically states redox must be seen in the top 4 in of the soil profile, which is within a depth to be easily disturbed by silvicultural activities. Redox is also most often found on living roots, but shading and disturbance have greatly diminished the herbaceous and shrub layers in these areas. Both Waller and Kirbyville soils are listed as hydric, however, and positive redox features along living roots were found at three of the sampled locations. This area also lies within the Lissie formation, where characteristically it is difficult to identify strong redoximorphic features. Within the Lissie, only a chroma of 3 is required for wetland soils determination, whereas most soil groups require a chroma of 2 or less (USACE, 2010). Waller-Kirbyville and Waller Loam are both fine sandy loams with a clay component beginning at 45 cm to 70 cm, but mostly in the form of a clay film on the faces of peds (USDA, 2014). At depths greater than 90 cm, an argillic horizon begins to form. Because of this, most of the sites in WAA 1 scored a 0.10.

Vdur refers to the amount of WAA area flooded and duration of an individual flood event; while the Vfreq is the annual return rate. Reports from prior site visits indicated most of the area would be

inundated, but upon arrival, many portions of the area were dry. Soils, water stained leaves, buttressing of trees, and low swales indicated historical flooding was frequent and prolonged, but at the time of this investigation the lack of water retained on site resulted in a lower than optimal scoring.

To confirm the scores, the historical daily discharge data for USGS gage 08070200 (E Fk San Jacinto Nr New Caney, TX) (USGS, 2014) was examined and used to compare to previous field visits. This station is approximately five miles downstream from the site. Figure 1 shows several locations around the site during a normal rain event on March 12, 2012. At the time these photos were taken, the discharge at USGS gage 08070200 was approximately 1,000 cfs (Figure 2, blue arrow).

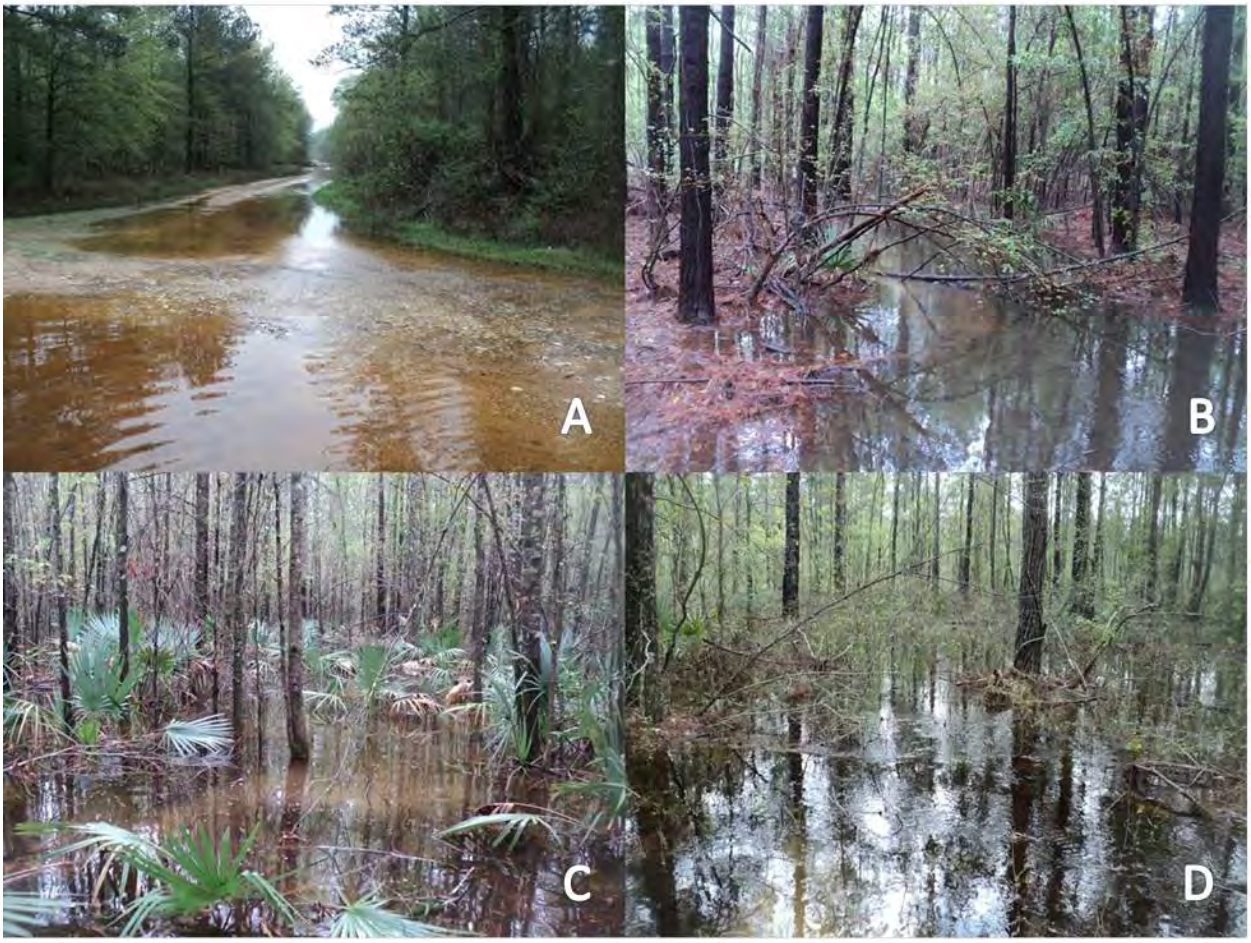


Figure 1: HCMB on March 12, 2014 on Rising Peak of the Storm Hydrograph: (A) Looking East Along Northern Road; (B) Pine Plantation; (C) Young Hardwood (Forested); (D) Pine Plantation Near Northern Road

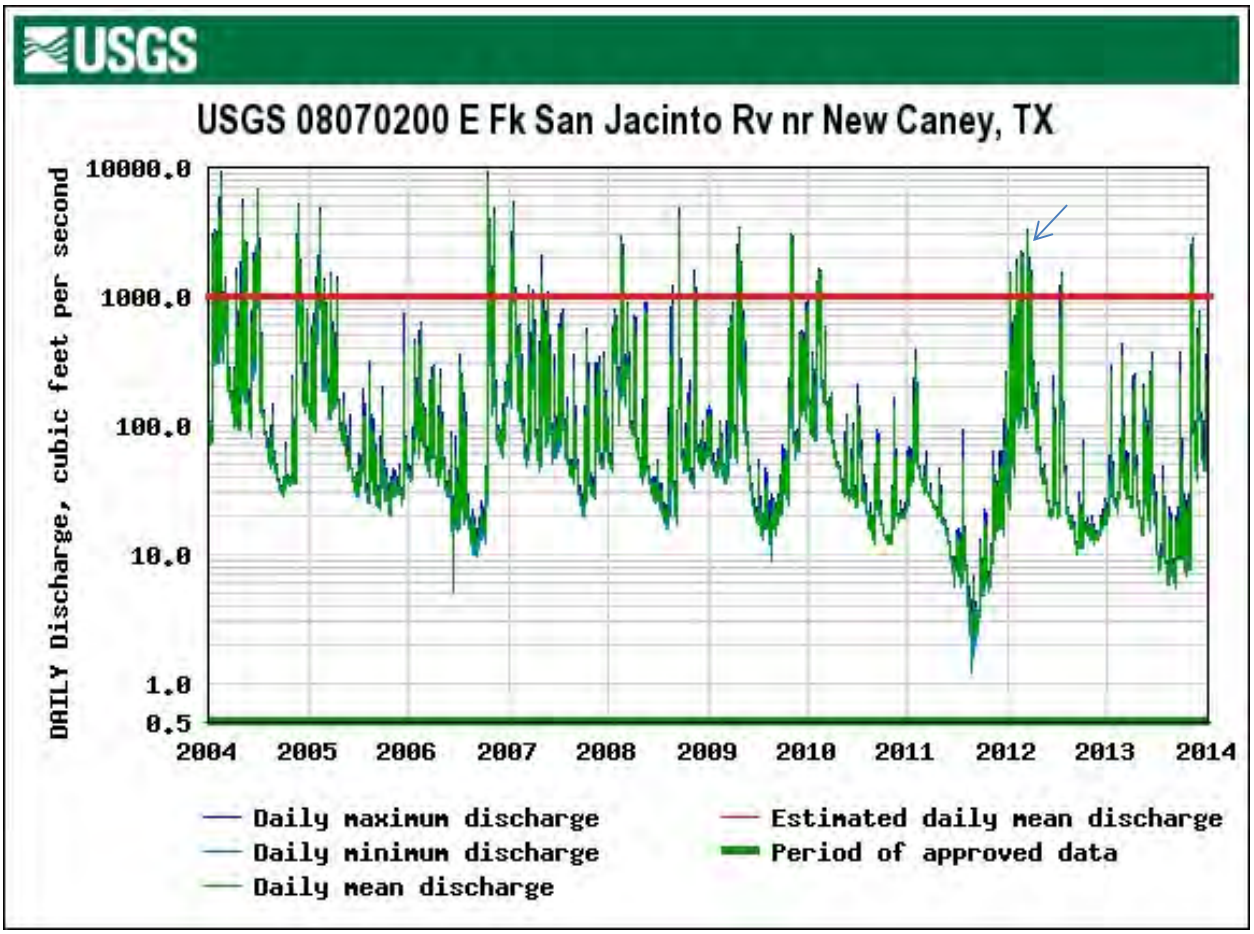


Figure 2: Ten Year Interval of Daily Discharge Data for USGS Gage 08070200 (USGS, 2014), East Fork San Jacinto River near New Caney, Texas

Figure 2 is sufficient to illustrate precipitation patterns in recent years, particularly the severe drought seen 2010 through 2012 and the timeframe when the photos in Figure 1 were taken (blue arrow). Ten years may not be long enough to establish whether a 1,000+ cfs event occurs five out of five years as opposed to three or four out of every five years or perhaps even two out of every five years. To clarify this, a timeframe of thirty years of daily discharge data was evaluated (Figure 3). On five occasions (1989, 1996, 2000, 2006, and 2010-2011) in thirty years, the amount of discharge seen at USGS Gage 08070200 was not great enough to suggest rainfall in the area was sufficient to generate the flows seen in Figure 1. However for all remaining twenty five years, discharge would imply at least once per year the amount of water on the ground at HCMB was equal to or considerably greater than the amount seen on HCMB in Figure 1. On ten separate occasions, the amount of discharge was approximately ten times what it was on the day the photos in Figure 1 were taken.

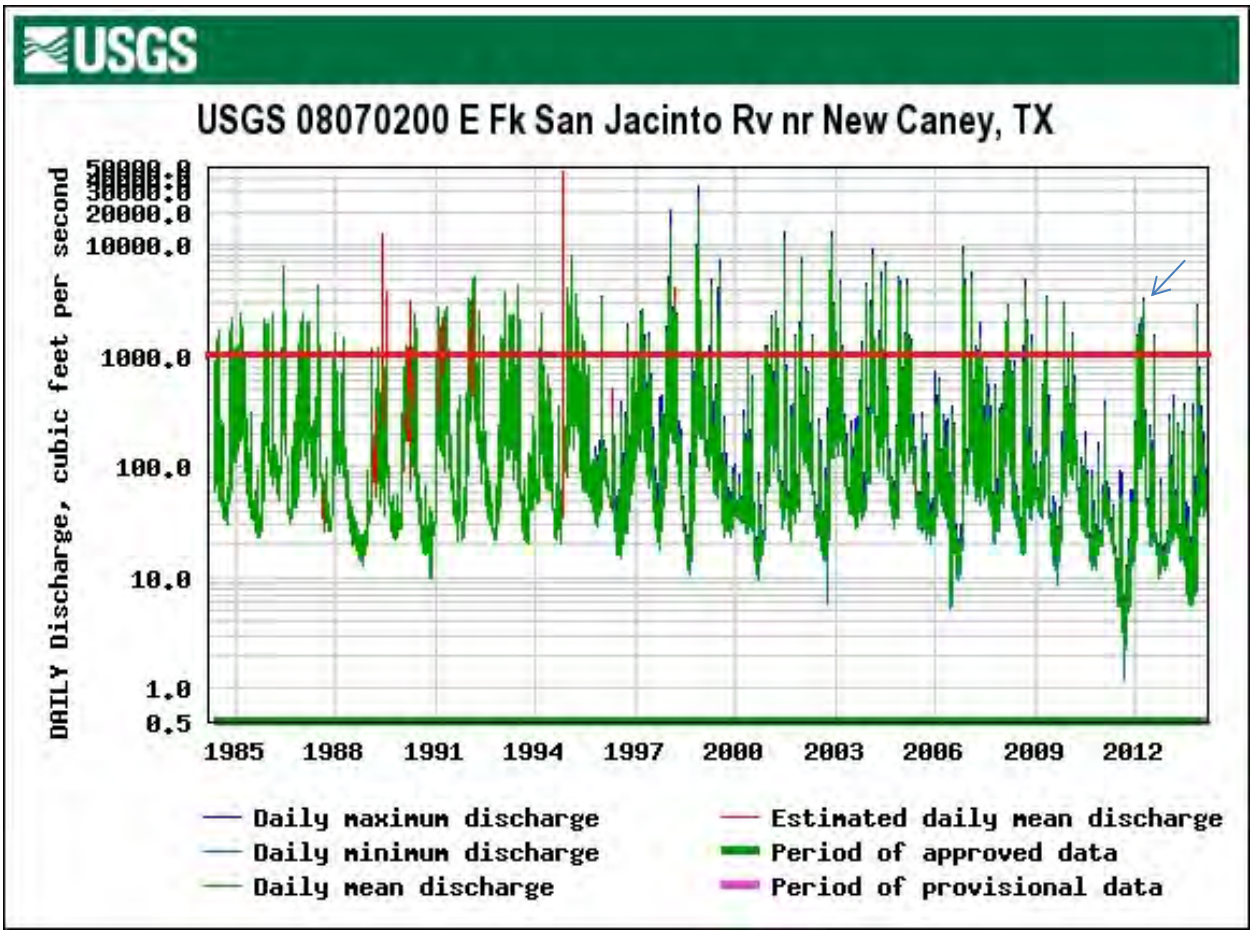


Figure 3: Thirty Year Interval of Daily Discharge Data for USGS Gage 08070200 (USGS, 2014), East Fork San Jacinto River near New Caney, Texas

Vtopo, or the micro-topography on site, exhibited some variability in scoring. Characteristic landscapes in the Lissie Formation should have mima mounds, swales, and depressions as topographic variability (Aronow, date unknown). For most of WAA 1, though, commercial silviculture has significantly changed the landscape. In more hydric areas, raised bedding was evident. Slash from historic harvests had been piled in depressions on site creating artificial mounds. In other areas, slash was scraped across the landscape into these piles, creating broad swaths of almost perfectly flat landscape. Because of this, most sites had a mixture of homogeneity and artificial topography to score 0.70. In general this WAA lacked species diversity and is impacted by frequent disturbances such as silvicultural activities.

Disturbance from silviculture, the dominance of pine in the canopy (the major source of leaf litter), and sandy loam soils prevented a well-defined A horizon from forming in some areas, resulting in the Vdetritus score less than 1.0. As previously stated regarding redox features and topography, in many places, the top several inches of soil were mixed to almost homogeneous. However, most locations did have a defined A horizon. O horizons are not listed as a feature of Kirbyville or Waller soil series, and large accumulations of organic matter were not observed at the time of sampling (California Soil Resource Lab, 2014).

3.1.2 WAA 2

WAA 2 occupied 48.47 Ac and consisted of a mature hardwood dominated stand that was recently thinned (Exhibit 7). According to Forestar personnel, this thinning operation occurred for stand maintenance to remove undesirable, diseased, and dead timber from the stand resulting from the extreme drought in 2011 through early 2012. The lack of flooding events during this time can be seen in Figure 2, which goes toward illustrating the drought conditions experienced on site. As seen in Table 5, the WAA overall had a healthy distribution of tree species across the WAA; however hard-mast producers only accounted for about 25% of the stand.

Table 5 - Tree Count Summary for iHGM Plots in WAA 2

Species	Total Counted Across 7 Data Points	Average Percent Composition
Acer rubrum	36	22%
Triadica sebifera	25	15%
Quercus laurifolia	20	12%
Pinus taeda	18	11%
Liquidambar styraciflua	16	10%
Nyssa slyvatica	12	7%
Quercus phellos	11	7%
Carpinus caroliniana	11	7%
Quercus nigra	6	4%
Fraxinus pennsylvanica	5	3%
Ulmus alata	4	2%
Quercus michauxii	2	1%
Quercus pagoda	2	1%

Overall, this WAA was relatively healthy from an iHGM prospective; however some variables have been reduced by recent silvicultural activities. The percent of the WAA covered by woody vegetation (Vwood) was reduced due to numerous logging lanes cleared through the WAA. Vdensity was also impaired at some locations from the clearing. The basal area of the stand (Vbasal) was suboptimal due to recent removal of selected trees. Additionally, variables such as coverage of the sapling shrub layer (Vmid) and coverage of the herbaceous layer (Vherb) were diminished from the recent disturbance of the stand. In general, this WAA lacked an optimal hard-mast producing component (Vtree) resulting from recent silvicultural activities, but was considerably better than any of the other WAAs. Vrich is also best for this WAA. Vcwd scored well, but not from natural tree fall, but rather from the slash left from harvesting.

Other variables that appear suboptimal such as Vredox and Vsorpt were a result of the soils (Waller Kirbyville Complex, Waller Loam, and Kirbyville Fine Sandy Loam) and not anthropogenic activities. In some areas, disturbances lowered the prevalence of an A Horizon in all pits dug across the site, but Vdetritus score is still relatively high as in all cases at least 10 percent or more of the site exhibited an A horizon. O horizons are not known in these soil series. Vdur and Vfreq improve for this WAA as most of it lies around the remaining channels of Orange Branch still possessing an OHWM. Regular flooding from this waterway appears more prevalent and lasting. This is supported by its having never been

commercially planted in pine. Collapsed or impaired culverts also create an impoundment effect, causing water to stay ponded for longer than other sites on the HCMB. In the pocket areas where the selective harvesting has not taken place, the stereotypical Lissie Formation micro-topography is evident and scores well. In other locations, rutting, logging decks, and other impacts have diminished the score some, but not as much as WAA 1.

3.1.3 WAA 3

WAA 3 consisted of 32.72 Ac of young hardwood dominated stands that were cleared in 1989 and allowed to naturally regenerate. As seen in Table 6, trees in these areas are dominated by laurel oak (*Quercus laurifolia*) with occurrences of other early successional species. This table however does not capture the high component of Chinese tallow (*Triadica sebifera*) occurring in the herbaceous and shrub stratum.

Table 6 - Tree Count Summary for iHGM Plots in WAA 3

Species	Total Counted Across 3 Data Points	Average Percent Composition
Quercus laurifolia	72	52%
Quercus phellos	17	12%
Acer rubrum	16	12%
Fraxinus pennsylvanica	10	7%
Liquidambar styraciflua	7	5%
Triadica sebifera	5	4%
Pinus taeda	4	3%
Diospyros virginiana	3	2%
Ulmus alata	2	1%
Nyssa slyvatica	2	1%
Carpinus caroliniana	1	1%

This WAA exhibited one of the lowest MPAC FCIs as a result of the relatively recent disturbance to the stand and young, early successional nature of the vegetative community. The amount of coarse woody debris (Vcwd) was reduced due to the young age of the plant community; any woody debris encountered was too small to be included in the Vcwd variable (i.e. greater than 3" diameter). Recent disturbance to the stand caused the tree density (Vdensity), coverage of the sapling shrub layer (Vmid) and coverage of the herbaceous layer (Vherb) to be reduced. Vwood was higher because of the density of the young trees, but Vtree, Vrich, and Vbasal were lower due to the youth of some stands and the high *Triadica sebifera* component.

Other variables which appear suboptimal, such as Vredox and Vsorpt, were caused by the soil parent material and not anthropogenic activities, for reasons previously addressed, but there are some differences worthy of note here. One of the sites examined is still in the Waller Kirbyville Complex, but the others lie within the Lelavale soil series (formerly known as the Waller Loam Depressional series) (California Soil Resource Lab, 2014). These are primarily found within the depressional wetlands, or loess blowouts, that form the headwaters to the Orange Branch tributaries. The key difference in this soil series is the percent sand in the top 100 cm is approximately 10 to 15 percent less than the Waller

or Kirbyville series and the percent clay is roughly double. This makes these soils very poorly drained and not farmable under natural conditions (California Soil Resource Lab, 2014). The soil clays were not montmorillonitic in origin and still possess a very high loam component. Redox features were present, but not presented as strongly as there is still a high sand component in the top four inches. Vdetritus, Vdur, and Vfreq all scored high, however, predominantly through the effects of this soil's characteristics and situation on the landscape.

The micro-topography within the basins was not very pronounced, which resulted in a lower score, but this was not the result of an anthropogenic activity, rather the inherent nature of this type of basin.

3.1.4 WAA 4

This WAA consisted of a young oak dominated stand influenced by beaver activities and accounted for 8.06 Ac. This area was also cleared in 1989 and allowed to naturally regenerate, but hydrology was influenced by beavers, so it was separated as a different WAA. As seen in Table 7, this WAA is overwhelmingly dominated by laurel oak (*Quercus laurifolia*) in the tree strata leading to a high Vtree score.

Table 7 - Tree Count Summary for iHGM Plots in WAA 4

Species	Total Counted Across 2 Data Points	Average Percent Composition
Quercus laurifolia	88	84%
Pinus taeda	6	6%
Triadica sebifera	4	4%
Nyssa slyvatica	4	4%
Acer rubrum	2	2%
Liquidambar styraciflua	1	1%

Low species diversity and recent disturbance yielded a low MPAC FCI for this WAA. The amount of coarse woody debris (Vcwd) was reduced due to the young age of the plant community; any woody debris encountered was too small to be included in the Vcwd variable (i.e. greater than 3" diameter). The dominance of laurel oak (*Quercus laurifolia*) in the WAA is negatively reflected in the Vrich variable. The tree density (Vdensity) averaged approximately 525 trees / Ac which is a suboptimal condition. In general, this WAA lacked diversity and exhibited tree densities too great to support proper understory species and encourage healthy stand succession, as reflected in the Vwood, Vmid, and Vherb. The Vbasal is high, not because of large trees, but many, many small sized trees.

The area lies within the Waller Kirbyville Complex, which as previously discussed has a lower clay content and higher sand content, meaning a lower Vsorpt score, but the influence of the beaver pond creates longer periods of inundation leading to high scores for Vdur, Vfreq, Vdetritus, and Vredox. The micro-topography was an assemblage of swales, mima mounds, and beaver/pig wallows resulting in an excellent Vtopo score.

3.1.5 WAA 5

WAA 5 consisted of 4.30 Ac of herbaceous wetland with hydrology heavily influenced by beaver activity. This area was predominantly vegetated by common rush (*Juncus effusus*), and had occurrences of Chinese tallow (*Triadica sebifera*) as scattered trees and shrubs. In general, this WAA was functioning

moderately well from an herbaceous iHGM perspective. Variables reduced in this area consisted of the percentage of WAA covered by woody vegetation (Vwood) and the area generally lacked a mid-story layer (Vmid). These reductions in function were a result of the disturbance to the WAA from both beaver activity and anthropogenic activities such as logging, as well as the hydrology of the WAA as it appeared to be inundated most of the year. Vsorpt was less than 1.0 as the soils in this area were still the Waller Kirbyville Complex sand and loam, but Vredox, Vdur, and Vfreq were all 1.0. In this area, there was considerable deposition of organic material without decomposition, so the Vdetritus score was also high.

3.1.6 WAA 6

WAA 6 accounted for 5.0 Ac and consisted of various cleared areas associated with logging and potential hydrocarbon extraction. In general, these areas were dominated by early successional shrub species and various herbaceous species. Most of these areas have been recently cleared and are in an early state of recovery. This WAA was functioning moderately well from an herbaceous iHGM perspective. Variables that are reduced in this area consisted of the percentage of WAA covered by woody vegetation (Vwood) and the WAA exhibited areas with little mid-story coverage (Vmid). Additionally due to disturbance, many areas in this WAA did not possess an adequate O or A soil horizon (Vdetritus). The area appeared to have been graded in some cases, and in certain instances gravel was previously applied, resulting in almost no micro-topography. These activities, and the resultant lack of topography, are more likely the cause of the apparently persistent hydric conditions, which were the basis for a 1.0 score for Vredox, Vdur, and Vfreq. Changes in function were a result of the anthropogenic disturbance to the WAA. Vsorpt was not the result of anthropogenic changes, but rather was related to the WAA being confined to the Waller Kirbyville Complex soil series. However in areas where gravel was present, the sorptive capacity of the soil surface may be altered.

3.2 STREAM CHANNEL FUNCTIONAL ASSESSMENT

The individual datasheets for each stream transect can be found in Appendix C, but a summary of the RCI scores by reach can be seen in Table 8. Most of the scores were around the value 2 with the highest score for West Fork Transect 6, an ephemeral channel flowing south into the beaver pond. Some of the lowest scores were from the ephemeral channels on the East Fork of Orange Branch. This area was being selectively harvested as routine maintenance after a long drought. As such, the area was strongly impacted by the silvicultural activities.

Scores were limited as the Aquatic Use Variable must be a score of 1 out of a possible 5 for all locations. The channels are not listed by TCEQ under the Texas Surface Water Quality Standards (TSWQS), are all intermittent or ephemeral, and do not possess perennial pools.

Table 8 - Reach Condition Index Scores for Stream Channels of Orange Branch

Reach	Transect	Type	Length (Lf)	Condition Index	WAA
Main Stem (MS)	1	Intermittent	350	2.75	WAA 2
	2	Intermittent	350	2.25	WAA 2
	3	Intermittent	350	2.00	WAA 2
	4	Intermittent	350	2.00	WAA 2
Main Stem (MS)	**MS Transects Total**	**Intermittent**	**1,350**	**2.25**	
	Stream Total*	**Intermittent**	**1,627**		
West Fork (WF)	1	Ephemeral	350	2.00	WAA 2
	2	Ephemeral	258	2.00	WAA 2 and 3
	3	Ephemeral	350	2.00	WAA 1
	4	Ephemeral	350	2.00	WAA 1
	5	Ephemeral	350	1.79	WAA 1 and 4
	6	Ephemeral	350	3.13	WAA 4
West Fork (WF)	**WF Transects Total**	**Ephemeral**	**2,008**	**2.15**	
	Stream Total*	**Ephemeral**	**2,639**		
West Fork C (WFC)	**1**	**Ephemeral**	**343**	**2.38**	WAA 4
	Stream Total*	**Ephemeral**	**343**		
East Fork (EF)	1	Ephemeral	350	2.25	WAA 2
	2	Ephemeral	215	1.75	WAA 2
	3	Ephemeral	350	1.75	WAA 2
	4	Ephemeral	350	1.75	WAA 2
	5	Ephemeral	303	2.00	WAA 1
East Fork (EF)	**EF Transects Total**	Ephemeral	1,568	1.90	
	Stream Total*	**Ephemeral**	**2,251**	**1.90**	

*Stream Total lengths refer to channel with OHWM, and are the sum of the transects and gaps for a given reach.

3.2.1 Intermittent Channels within WAA 2

The channel is severely aggraded through these stream transects from filling in of transient sediments, the most likely origin of which are soils disturbed during silvicultural activities. The channels have very apparent bed and banks, but the channel width increases dramatically moving upstream through the reach. Silvicultural activities have altered the channel, but continued activities prevent its recovery.

Riparian buffers would provide valuable ecosystem function as the stream is surrounded by wetlands and hardwood bottomland forests, except a selective harvest occurred recently (early 2013), so there

were mulch lines, debris jams, and large holes in the canopy. The adjacent areas to this reach are not heavily managed or dramatically impaired, but it is not without management or impairment, and the stark appearance of the channel now is the cumulative effect of decades of silvicultural management and improper road crossings.

The harvesting equipment has had an effect on channel alteration, more so in the downstream transects (MS Transects 1 and 2), but the largest contributor is the road crossing upstream within MS Transect 2, which is restricting the flow from the contributing watershed. The RCI scores reflect this, and are seen in Table 8. The appropriate meander patterns both above and below the stream crossing have not recovered. The stream is connected under the road via culvert. At MS Transect 2, downstream of the road was moist, but did not have standing water. Upstream of the road crossing had a 10' to 20' wide stretch of standing water within a severely over-widened channel. This water was stagnant, and the pool bottom was covered with mucky, silty sediments. These sediments had been in suspension during the last flow event, but when velocities were diminished at the road crossing due to insufficient conveyance downstream, the particles fell out of suspension leading to appreciable aggradation.

Finally, the northern end of this reach (MS Transect 4) is at yet another road crossing; this one without a culvert. Below the road crossing, the channel is so broad it is difficult to identify bankfull markers, but they still exist, and it is evident the channel can still convey a large volume of water. Above the road crossing the stream is eventually ephemeral, but non-existent at the crossing. The same sedimentation processes occurring at the downstream road crossing have had expedited development at this road crossing due to the lack of a culvert.

3.2.2 Ephemeral Channels within WAA 2

These channels were severely aggraded with bed and banks visible within the assessment reaches, but there were distances between the reaches where aggradation has developed to a point where an ordinary high water mark is no longer identifiable. Like the intermittent channels, the aggradation is the result of multiple disturbances of the soils during silvicultural management, which flow to the lowest point in the topography during flood events. The amount of input, over time, overwhelmed the transport capacity of the channel, and it began to fill. In portions of WAA 2, the channel dissipates to a swale with laminar flow, which eventually returns to a channel downstream. Road crossings, culverts, or other diversion structures were mostly absent save for one road crossing downstream from Transect 1 on the East Fork of Orange Branch, but these channels are closer in proximity to the actively managed pine plantation, and therefore are more exposed to the upland silvicultural activities.

A selective harvest in response to the past drought conditions recently occurred, as stated above. This harvest left open spaces in the canopy, debris piles, mulch lines, and skidder ruts through the area. In the case of the ephemeral streams with smaller channels, the debris appeared to have more of an effect on flow than in the larger, intermittent channels. The harvesting activities also made channel identification considerably more difficult, but within the channel stronger redox concentrations were observed in addition to soil textures which were less sandy and possessed more silt than soils within the floodplain. These features helped to confirm other ordinary high water mark characteristics.

3.2.3 Ephemeral Channels within WAA 1

The channels within WAA 1 were in actively managed pine plantation. The plantation is at the end of its rotation, so the floodplains and their vegetative communities were stable, but still the channel was quite aggraded. The channels are considerably wider and deeper through these reaches than the ephemeral channels within WAA 2.

The pine plantation within the buffer consisted of large pine trees and mix of bottomland hardwood species which were marginally large enough to not be considered shrubs. On the West Fork, relic beaver dams created depressions currently used and deepened by wild hogs on the property. WF Transect 4 had large and extensive debris piles within the channel from logging activities. EF Transect 5 on the East Fork was the only reach affected by a road crossing, but the road influences were dwarfed by the impacts of the pine plantation management.

3.2.4 Ephemeral Channels within WAA 4

These channels were within the influence of the beaver pond located in the upstream portions of the West Fork of Orange Branch. The buffer zones were forested wetland, which showed no signs of current harvesting, but was cleared in the late 1980s. Because of the former clearing, there was some Chinese tallow (*Triadica sebifera*) and other primary successional species within the buffer, but the predominance was oak, and recovery seemed to be progressing.

In the case of WFC Transect 1, the channel is probably a former access road of some kind. Aggradation was present in all channels with the most obvious impacts near the road crossing for WFC Transect 1 and upstream near the actively managed pine plantation for WF Transect 6. But both channels appeared to be stable relative to the other reaches documented. Water was found in the downstream portion of WFC Transect 1, but this was a result of the beaver pond and impounded flow rather than active flow or groundwater access.

4.0 CONCLUSION

The wetlands and streams both exhibit reduction in function due primarily to anthropogenic activities. The majority of the site was cleared in 1989 for a commercial timber harvest and was replanted to a loblolly pine (*Pinus taeda*) plantation. Timber harvesting and its associated effects on the surrounding landscape have decreased species diversity across the site and have resulted in severe stream aggradation.

4.1 Wetlands

RS&H identified six WAAs totaling 217.34 Ac within the data collection boundary. All six exhibited a reduction in overall function due to various anthropogenic disturbances, silvicultural practices being the most prevalent. As seen in Table 9, the most prevalent tree species observed consisted of laurel oak (*Quercus laurifolia*). The dominance of *Q. laurifolia* was a result of previously stated activities as most were young and densely populated.

Table 9 - Tree count summary all iHGM plots recorded

Species	Total Counted Across All Data Points	Average Percent Composition
Quercus laurifolia	313	41%
Pinus taeda	135	18%
Quercus phellos	79	10%
Acer rubrum	65	9%
Triadica sebifera	48	6%
Liquidambar styraciflua	38	5%
Fraxinus pennsylvanica	20	3%
Nyssa slyvatica	19	3%
Quercus nigra	14	2%
Carpinus caroliniana	13	2%
Ulmus alata	8	1%
Quercus michauxii	2	0%
Quercus pagoda	2	0%

In general, the wetlands encountered lacked vegetation characteristics of high quality wetlands. The species diversity was reduced in most areas and a moderate component of undesirable, early successional species was observed as understory coverage.

Soils did not show strong redox features, but this is an inherent quality in the Lissie Formation; more specifically the Waller and Kirbyville soil series and their permutations. However in many places, the micro-topography and local topography have been altered from years of silviculture. Stream channels have been filled, mima mounds smoothed, and windrows piled over years of repeated harvests. These impacts and their effects have changed the inherent nature of the wetlands on site to a steady state differing from their original function. Even with these impacts taken into account, all soil map units on

site are listed as hydric; characteristics of which develop over geologic time. With a strong argillic horizon and historical precipitation data taken into account (Figure 3), it is likely wetlands were pervasive throughout the HCMB before intensive agricultural practices began.

4.2 Streams

Severe aggradation of stream channels is the result of silvicultural activities. Where channels and OHWMs are visible, they are usually an aggraded C channel with large width to depth ratios. Following the relic channel using LIDAR and topographic maps, Hydrex mapped 19,392 Lf of former stream channel which no longer possesses an OHWM. Surveys of streams conducted by Meanders River Restoration, Inc. at reference locations show watersheds one tenth the area of the watershed catchments for the East and West Forks capable of sustaining stable C5 and E5 channels. The evidence of approximately 19,000 Lf of relic stream channel would suggest the HCMB had a considerably larger stream network to accommodate this watershed. The extent to which the channels have devolved will require extensive, priority one restoration to return to the previous functioning condition.

5.0 REFERENCES

Ainslie, W. B., Smith, R. D., Pruitt, B. A., Roberts, T. H., Sparks, E. J., West, L., et al. (1999). *A Regional Guidebook for Assessing the Functions of Low Gradient, Riverine Wetlands in Western Kentucky.* U.S. Army Corps of Engineers, Vicksburg District, Waterways Experiment Station. Vicksburg, MS: USACE Waterways Experiment Station (ERDC).

Aronow, S. (date unknown). *Geomorphology and Surface Geology of Harris County and Adjacent Parts of Brazoria, Fort Bend, Liberty, Montgomery, and Waller Counties, Texas.* Lamar University, Department of Geology. Beaumont, TX: Lamar University.

California Soil Resource Lab. (2014). *SoilWeb*. (D. University of California, Producer, & UCDavis) Retrieved 08 10, 2014, from California Soil Resource Lab: http://casoilresource.lawr.ucdavis.edu/soil_web/ssurgo.php?action=list_mapunits&areasymbol=tx291

ESRI, Inc. (2010). ArcGIS 10.1. Redlands, California, USA.

USACE. (2010). *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region.* United States Army Corps of Engineers, Environmental Laboratory: Wetlands Regulatory Assistance Program. Washington, D.C.: Waterways Experiment Station.

USACE SWG. (2013). *Level 1 - Stream Condition Assessment.* U.S. Army Corps of Engineers, Department of Defense. Galveston, TX: U.S. Army Corps of Engineers - Galveston District.

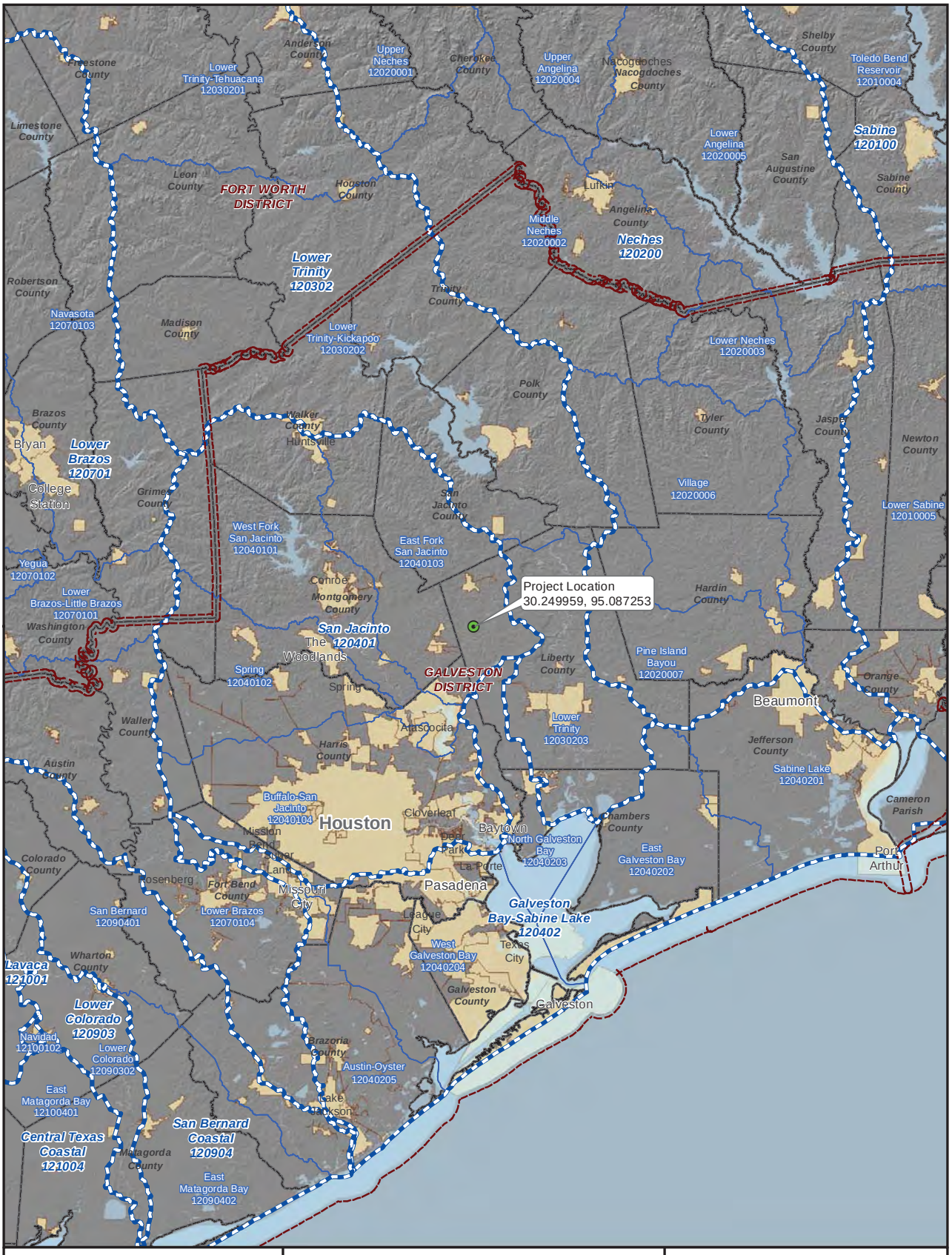
USACE/USEPA. (2008, April 10). Compensatory Mitigation for Losses of Aquatic Resources. *Federal Register/Rules and Regulations, 73, 70*. Washington, D.C., USA: US Army Corps of Engineers and Environmental Protection Agency.

USDA. (2014, 07). *Kirbyville Series*. Retrieved 08 13, 2014, from Official Soil Series Descriptions: https://soilseries.sc.egov.usda.gov/OSD_Docs/K/KIRBYVILLE.html

USDA, NRCS. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* Natural Resources Conservation Service, US Department of Agriculture. Washington, D.C.: United States Department of Agriculture.

USGS. (2014, 08 17). *National Water Information System: Mapper*. Retrieved 08 17, 2014, from United States Geological Survey: http://maps.waterdata.usgs.gov/mapper/index.html?state=tx

APPENDIX A



FORESTAR

RS&H

EXHIBIT 1
PROJECT LOCATION MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

Miles
10 0 10 20 30 40

Coordinate System: NAD 1983 UTM Zone 15N

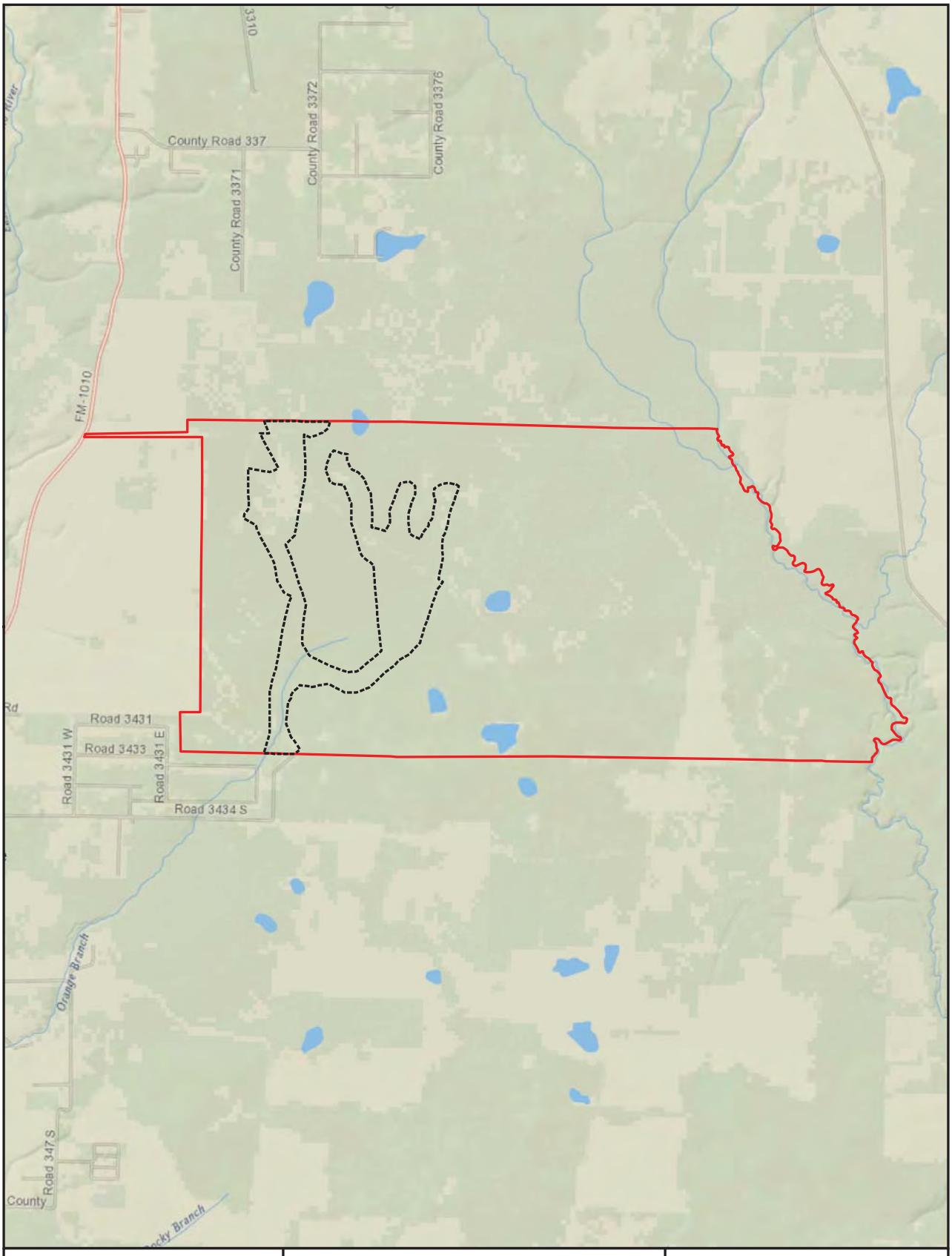
Drawn By: NJB
Date: 05/31/2013
Project No. 115-2370-003

LEGEND

- Project Location
- USACE Districts
- Basins (6-Digit)
- Sub-Basins (8-Digit)
- County Limits
- City Areas
- Ponds/Lakes

SOURCES - Imagery and Admin Boundaries: **ESRI**, USACE Districts: **USACE**, HUCs: **USGS**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 1_Project Location).mxd



FORESTAR

RS&H

EXHIBIT 2
PARENT TRACT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

1,000 0 1,000 2,000 3,000 4,000 5,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

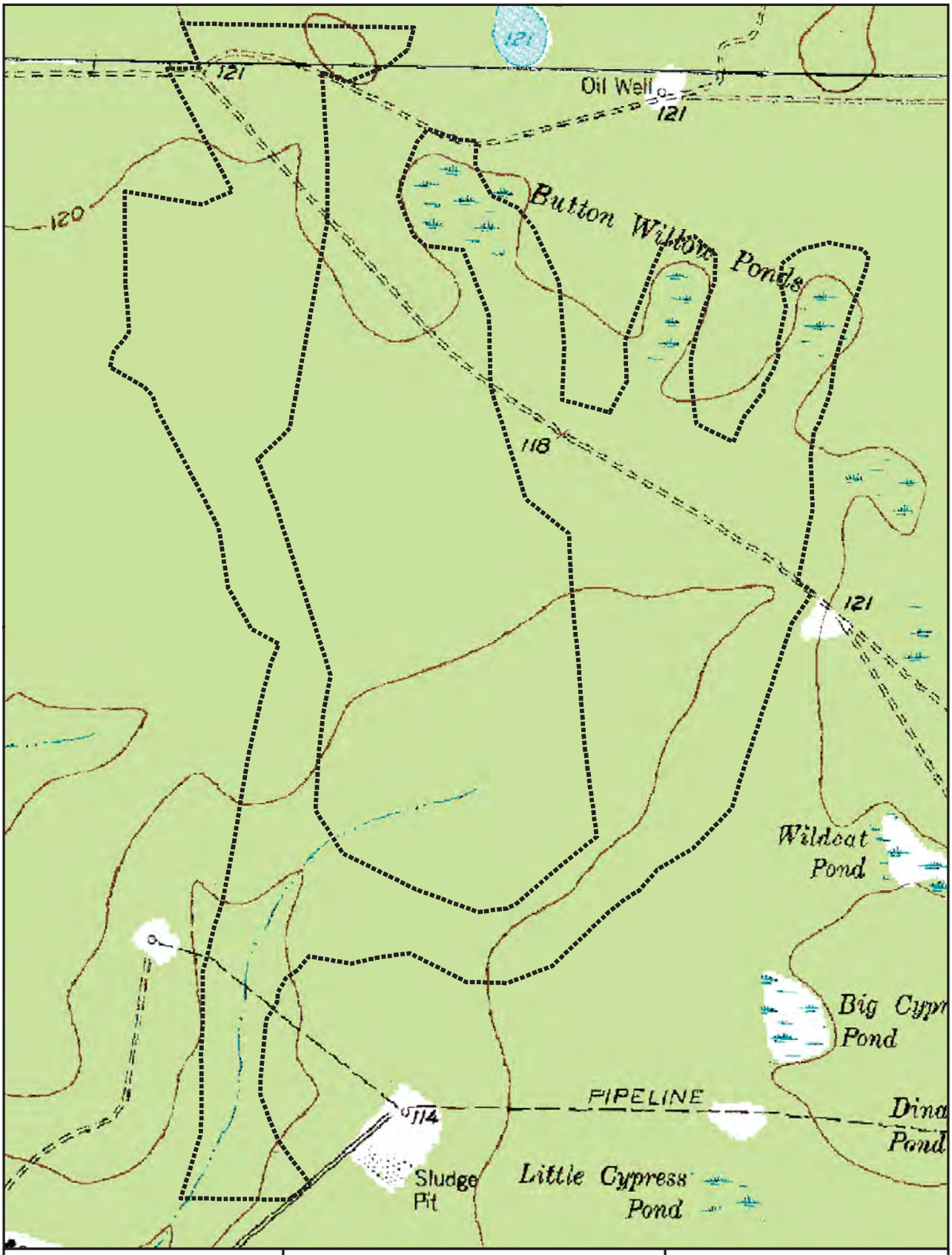
Parent Tract Boundary - 3500 Ac

Data Collection Boundary - 396 Ac

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

SOURCES - Imagery: **ESRI - National Geographic Basemap**, Parent Tract Boundary: **Forestar**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 2_Parent Tract).mxd



FORESTAR

RS&H

EXHIBIT 5
TOPOGRAPHIC MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

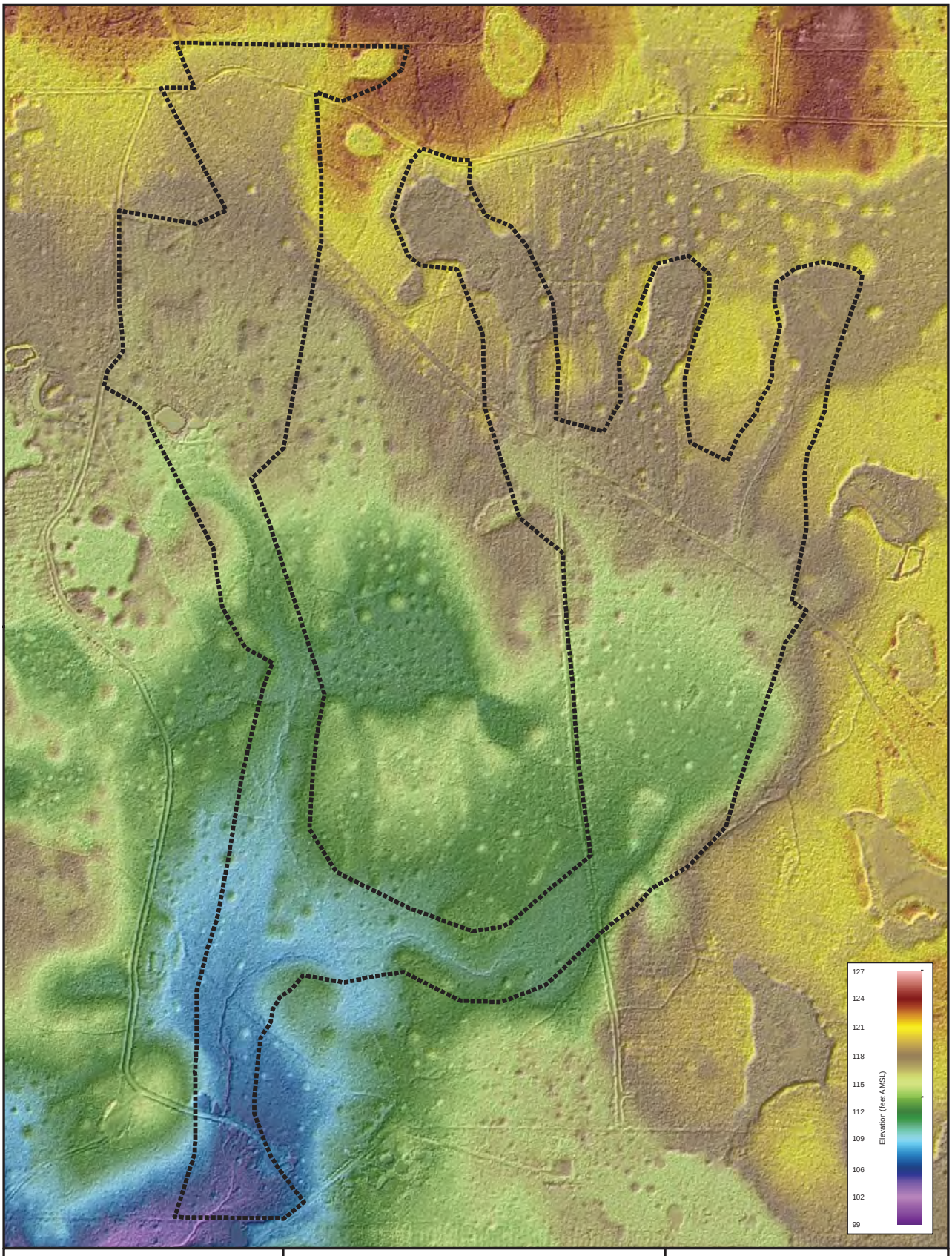
LEGEND

Data Collection Boundary - 396 Ac

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

SOURCES - Imagery: **USGS**, Data Collection Boundary: **Oppermann Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 5_Topo).mxd



FORESTAR

RS&H

EXHIBIT 6
LIDAR DIGITAL TERRAIN MODEL MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

Feet
500 0 500 1,000 1,500 2,000

Coordinate System: NAD 1983 UTM Zone 15N

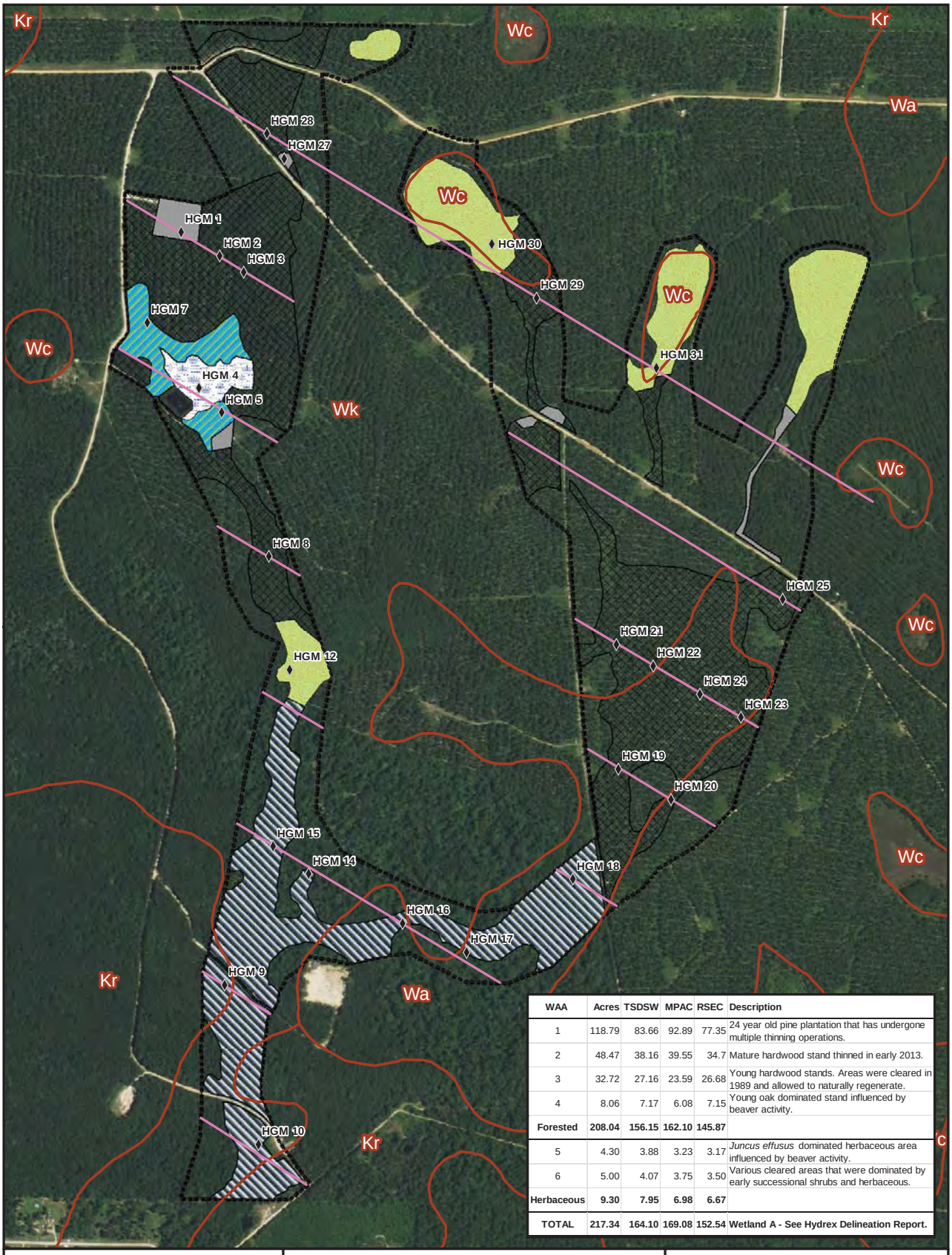
LEGEND

Data Collection Boundary - 396 Ac

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

SOURCES - Imagery: **2008 HGAC**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 6_LiDAR).mxd



WAA	Acres	TSDSW	MPAC	RSEC	Description
1	118.79	83.66	92.89	77.35	24 year old pine plantation that has undergone multiple thinning operations.
2	48.47	38.16	39.55	34.7	Mature hardwood stand thinned in early 2013.
3	32.72	27.16	23.59	26.68	Young hardwood stands. Areas were cleared in 1989 and allowed to naturally regenerate.
4	8.06	7.17	6.08	7.15	Young oak dominated stand influenced by beaver activity.
Forested	**208.04**	**156.15**	**162.10**	**145.87**	
5	4.30	3.88	3.23	3.17	*Juncus effusus* dominated herbaceous area influenced by beaver activity.
6	5.00	4.07	3.75	3.50	Various cleared areas that were dominated by early successional shrubs and herbaceous.
Herbaceous	**9.30**	**7.95**	**6.98**	**6.67**	
TOTAL	**217.34**	**164.10**	**169.08**	**152.54**	**Wetland A - See Hydrex Delineation Report.**

FORESTAR

RS&H

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

EXHIBIT 7
WETLAND FUNCTIONAL ASSESSMENT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

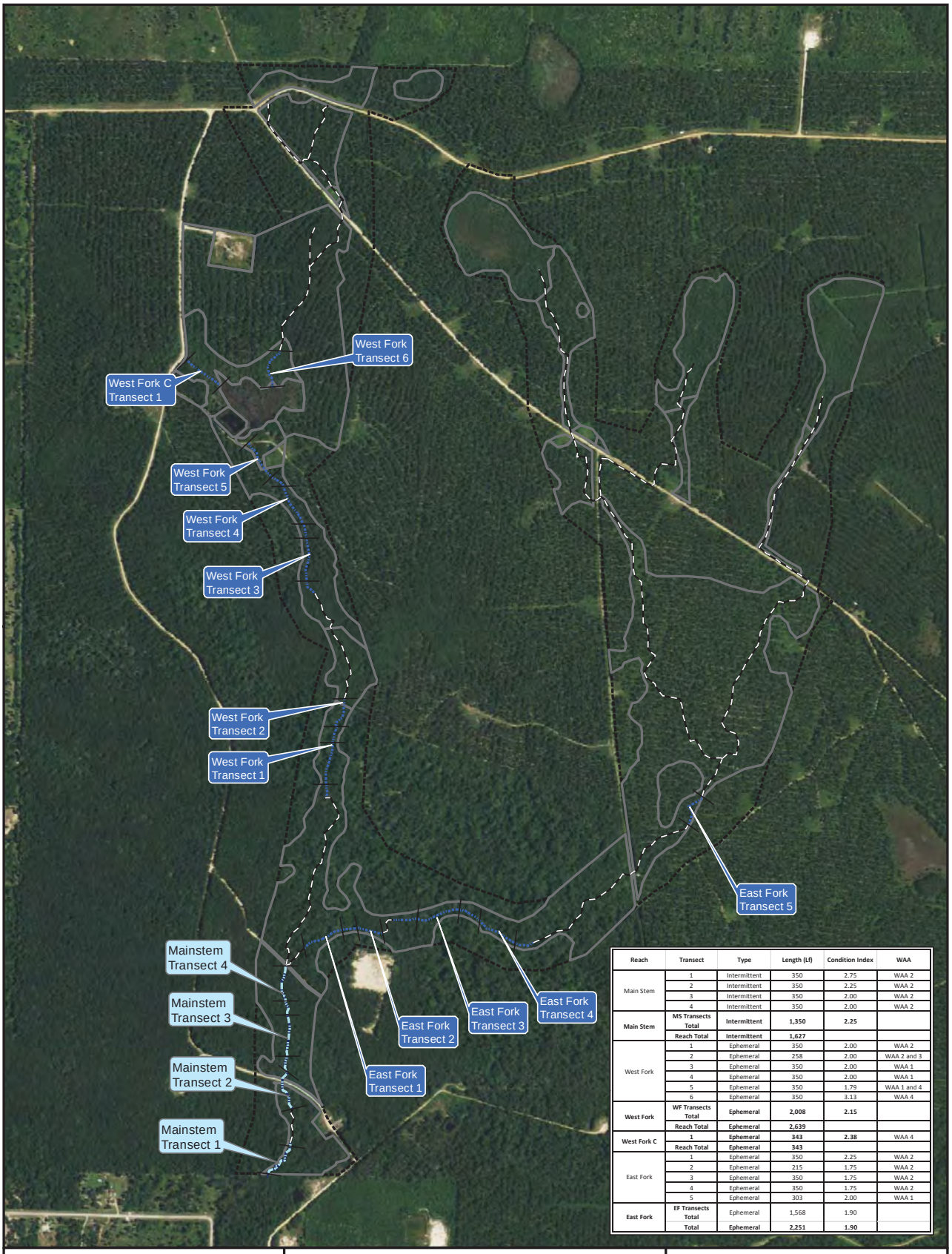
Wetland iHGM
- iHGM Field Plots
- Data Collection Transects
- Data Collection Boundary - 396 Ac

WAAs
- WAA 1 - Pine Plantation (Forested)
- WAA 2 - Mature Hardwood (Forested)
- WAA 3 - Young Hardwood (Forested)
- WAA 4 - Beaver Pond (Forested)
- WAA 5 - Beaver Pond (Herbaceous)
- WAA 6 - Clearings (Herbaceous)

Soil Series
- Kr: Kirbyville Fine Sandy Loam
- Wa: Waller Loam
- Wc: Lelavale (Waller loam, depressional)
- Wk: Waller-Kirbyville Complex

SOURCES - Imagery: **NAIP**, WOUS Limits: **Hydrex**, Functional Assessment Data: **RS&H**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Revision - July 2014\HCMB Phase I FA Revision (Exhibit 7_Wetland Functional Assessment).mxd



Reach	Transect	Type	Length (Lf)	Condition Index	WAA
Main Stem	1	Intermittent	350	2.75	WAA 2
	2	Intermittent	350	2.25	WAA 2
	3	Intermittent	350	2.00	WAA 2
	4	Intermittent	350	2.00	WAA 2
Main Stem	**MS Transects Total**	**Intermittent**	**1,350**	**2.25**	
	Reach Total	**Intermittent**	**1,627**		
West Fork	1	Ephemeral	350	2.00	WAA 2
	2	Ephemeral	258	2.00	WAA 2 and 3
	3	Ephemeral	350	2.00	WAA 1
	4	Ephemeral	350	2.00	WAA 1
	5	Ephemeral	350	1.79	WAA 1 and 4
	6	Ephemeral	350	3.13	WAA 4
West Fork	**WF Transects Total**	**Ephemeral**	**2,008**	**2.15**	
	Reach Total	**Ephemeral**	**2,639**		
West Fork C	**1**	**Ephemeral**	**343**	**2.38**	WAA 4
	Reach Total	**Ephemeral**	**343**		
East Fork	1	Ephemeral	350	2.25	WAA 2
	2	Ephemeral	215	1.75	WAA 2
	3	Ephemeral	350	1.75	WAA 2
	4	Ephemeral	350	1.75	WAA 2
	5	Ephemeral	303	2.00	WAA 1
East Fork	**EF Transects Total**	Ephemeral	1,568	1.90	
	Total	**Ephemeral**	**2,251**	**1.90**	

FORESTAR

RS&H

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

EXHIBIT 8
STREAM FUNCTIONAL ASSESSMENT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

Data Collection Boundary - 396 Ac

Stream Functional Assessment

Transect Endpoints

OHWM Channels

Ephemeral

Intermittent

No OHWM

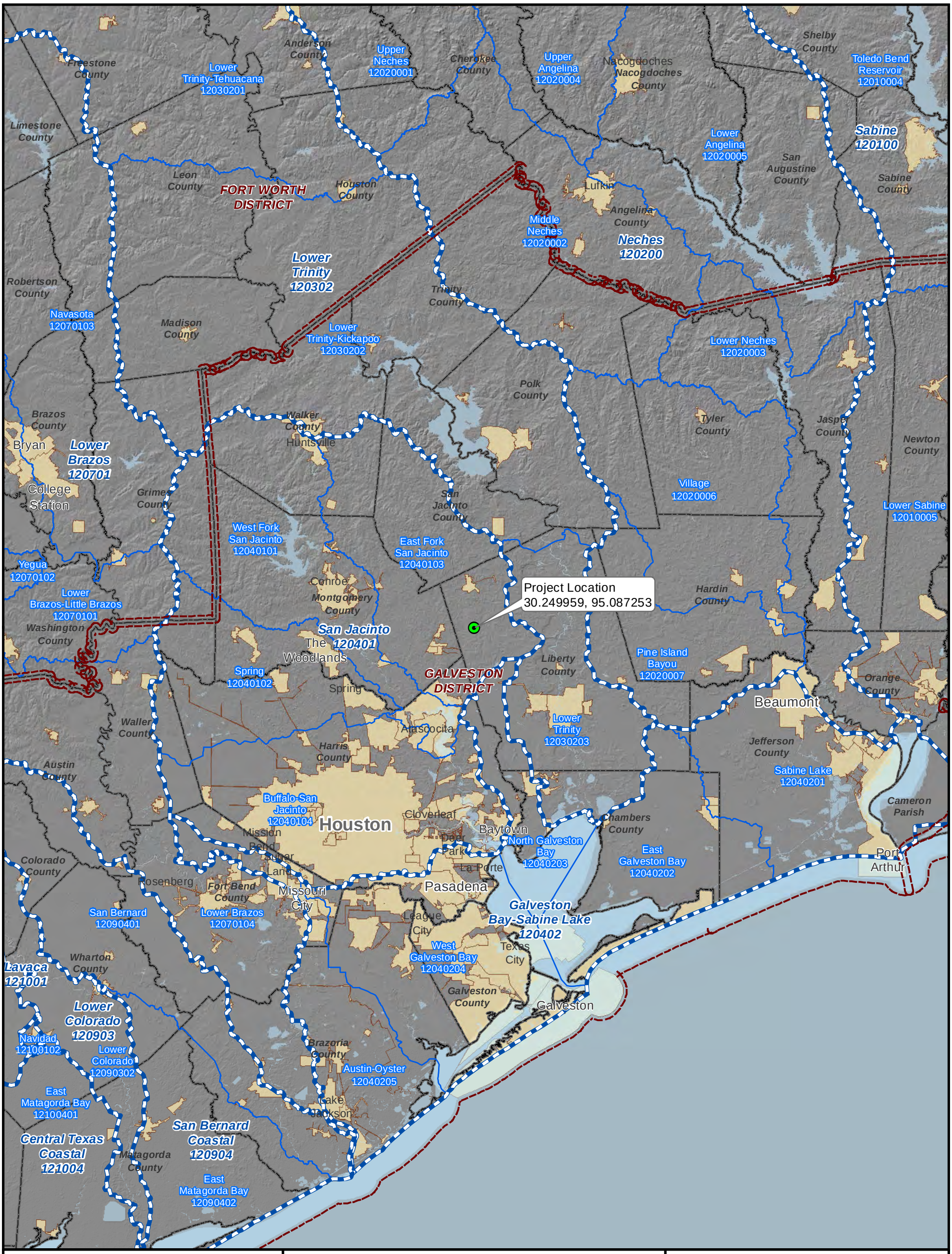
Aggraded Channels

Wetland Boundary

SOURCES - Imagery: **NAIP**, WOUS Limits: **Hydrex**, Functional Assessment Data: **RS&H**, Data Collection Boundary: **Opperman Surveying**

Path: C:\Users\highe\Desktop\Work-At-Home\HCMB\07.10.2014\HCMB Phase I FA (Figure 8).mxd

APPENDIX A1



FORESTAR

RS&H

Drawn By: NJB
Date: 05/31/2013
Project No. 115-2370-003

EXHIBIT 1
PROJECT LOCATION MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

10 0 10 20 30 40 Miles

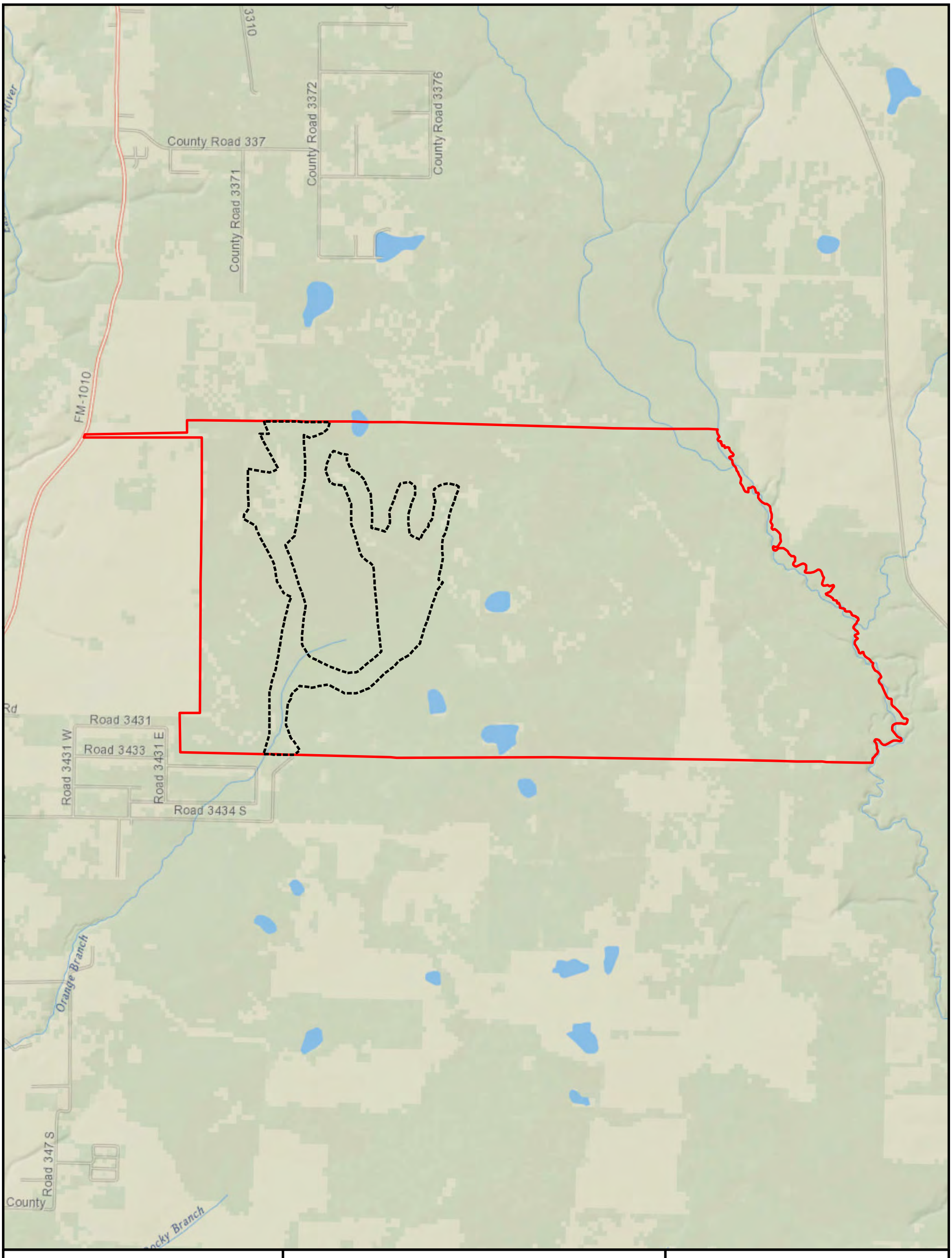
Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

- Project Location
- USACE Districts
- Basins (6-Digit)
- Sub-Basins (8-Digit)
- County Limits
- City Areas
- Ponds/Lakes

SOURCES - Imagery and Admin Boundaries: **ESRI**, USACE Districts: **USACE**, HUCs: **USGS**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 1_Project Location).mxd



FORESTAR

RS&H

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

EXHIBIT 2
PARENT TRACT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

1,000 0 1,000 2,000 3,000 4,000 5,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

- Parent Tract Boundary - 3500 Ac
- Data Collection Boundary - 396 Ac

SOURCES - Imagery: **ESRI - National Geographic Basemap**, Parent Tract Boundary: **Forestar**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 2_Parent Tract).mxd

FORESTAR

RS&H

EXHIBIT 3
1996 AERIAL MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

Feet
500 0 500 1,000 1,500 2,000

Coordinate System: NAD 1983 UTM Zone 15N

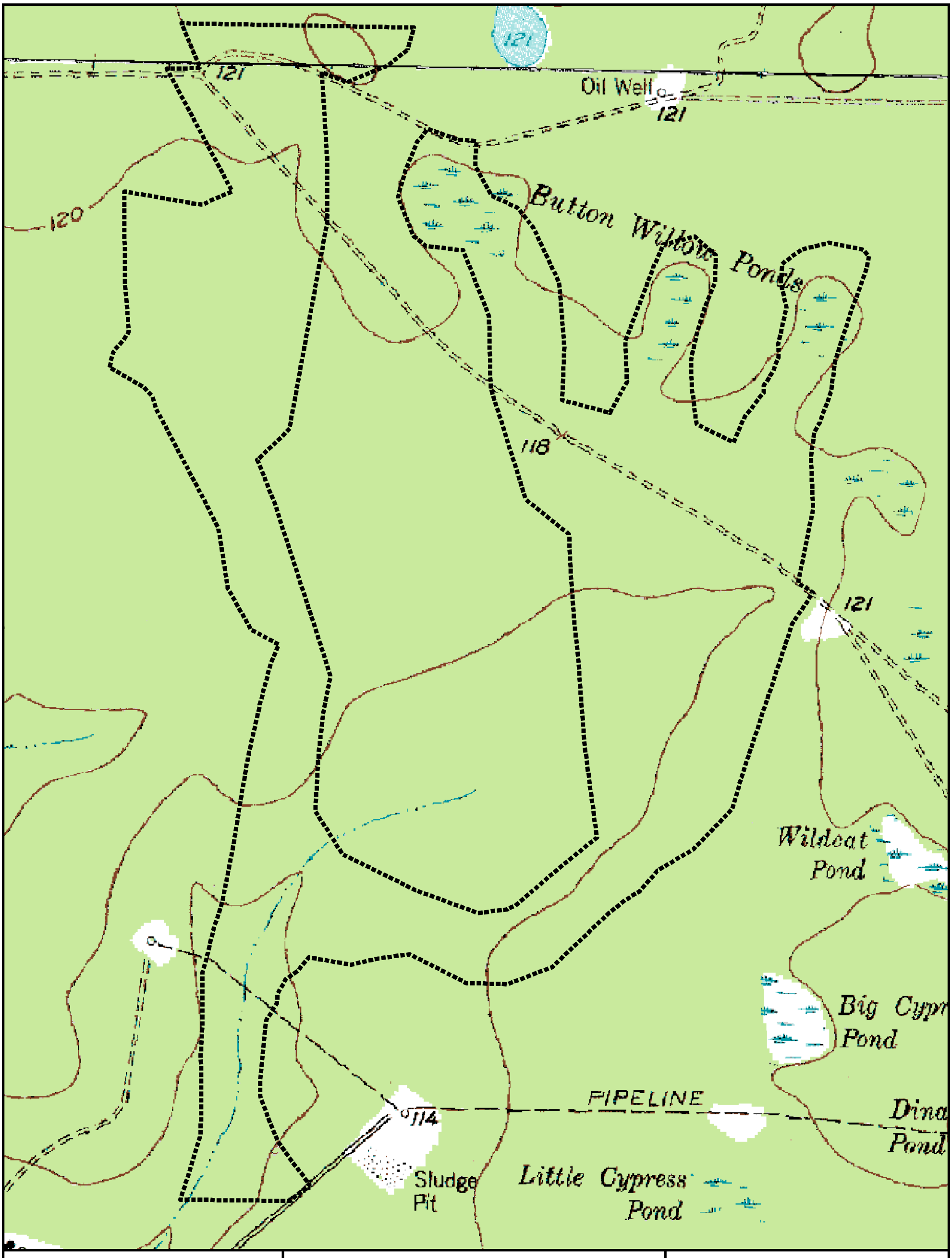
Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

LEGEND

Data Collection Boundary - 396 Ac

SOURCES - Imagery: **TOP**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 3_1996 Aerial).mxd



FORESTAR

RS&H

EXHIBIT 5
TOPOGRAPHIC MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

LEGEND

Data Collection Boundary - 396 Ac

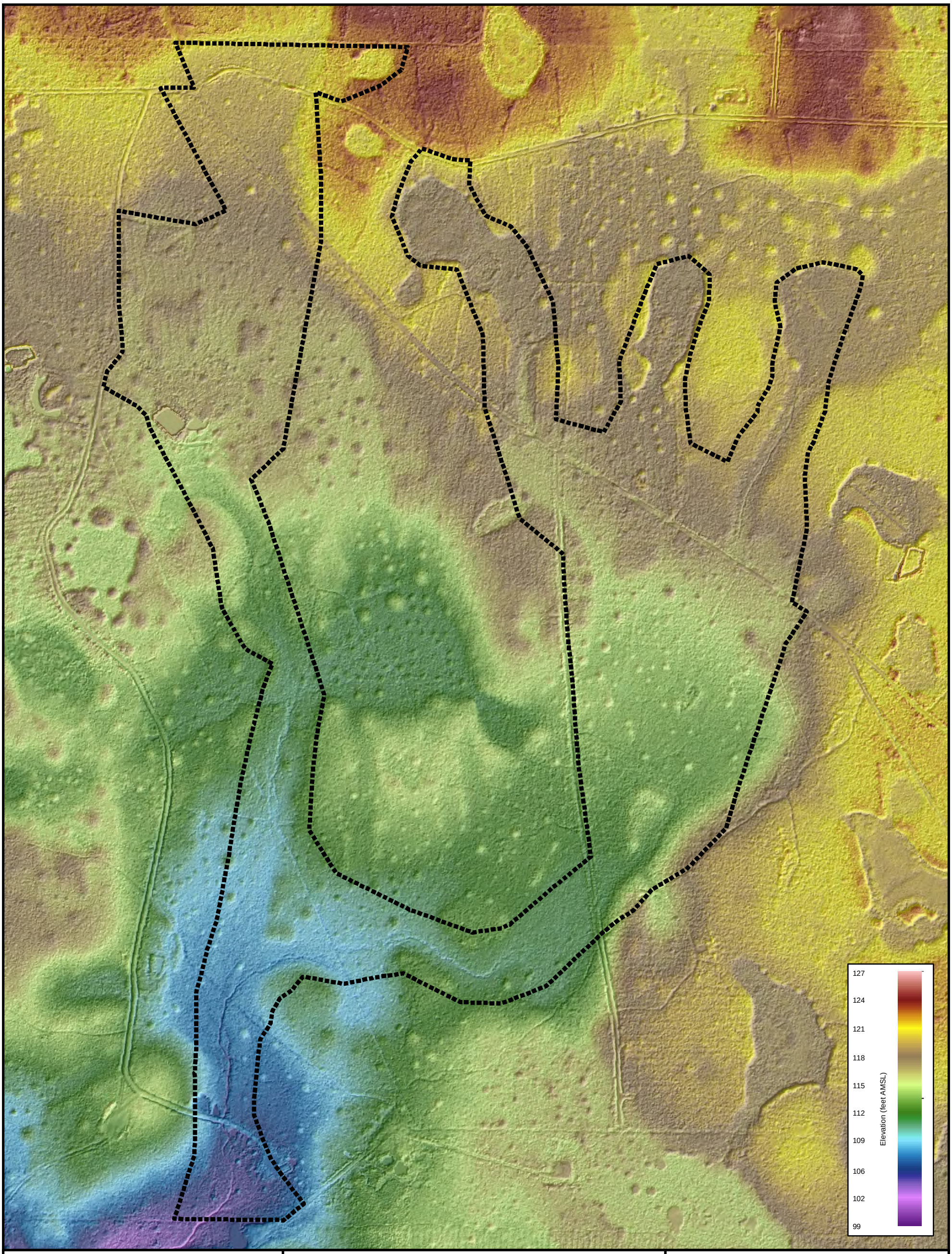
500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

SOURCES - Imagery: **USGS**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 5_Topo).mxd



FORESTAR

RS&H

EXHIBIT 6
LIDAR DIGITAL TERRAIN MODEL MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

Feet
500 0 500 1,000 1,500 2,000

Coordinate System: NAD 1983 UTM Zone 15N

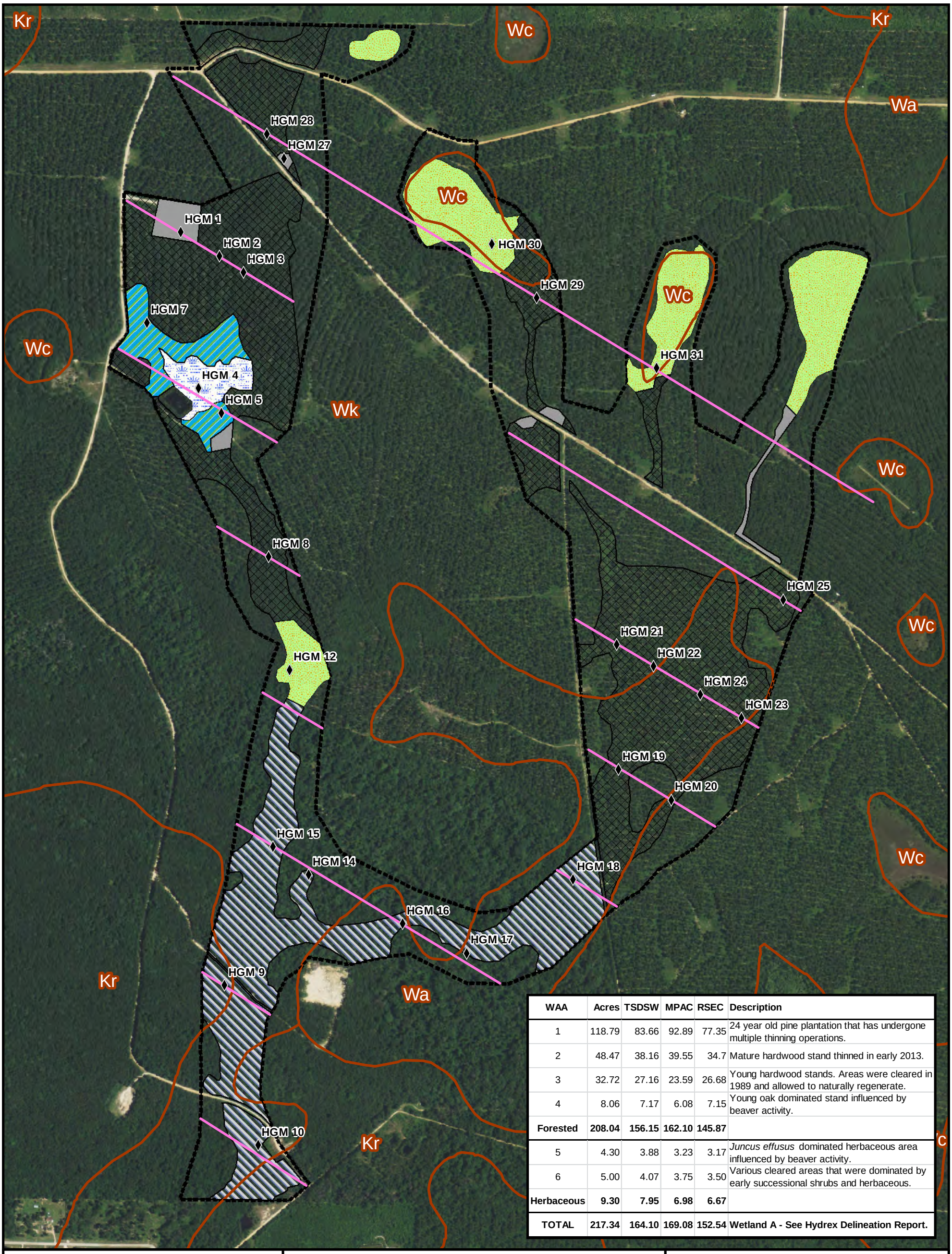
Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

LEGEND

Data Collection Boundary - 396 Ac

SOURCES - Imagery: **2008 HGAC**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Addendum - July 2014\HCMB Phase I FA Revision (Exhibit 6_LiDAR).mxd



WAA	Acres	TSDSW	MPAC	RSEC	Description
1	118.79	83.66	92.89	77.35	24 year old pine plantation that has undergone multiple thinning operations.
2	48.47	38.16	39.55	34.7	Mature hardwood stand thinned in early 2013.
3	32.72	27.16	23.59	26.68	Young hardwood stands. Areas were cleared in 1989 and allowed to naturally regenerate.
4	8.06	7.17	6.08	7.15	Young oak dominated stand influenced by beaver activity.
Forested	**208.04**	**156.15**	**162.10**	**145.87**	
5	4.30	3.88	3.23	3.17	*Juncus effusus* dominated herbaceous area influenced by beaver activity.
6	5.00	4.07	3.75	3.50	Various cleared areas that were dominated by early successional shrubs and herbaceous.
Herbaceous	**9.30**	**7.95**	**6.98**	**6.67**	
TOTAL	**217.34**	**164.10**	**169.08**	**152.54**	**Wetland A - See Hydrex Delineation Report.**

FORESTAR

RS&H

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

EXHIBIT 7
WETLAND FUNCTIONAL ASSESSMENT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

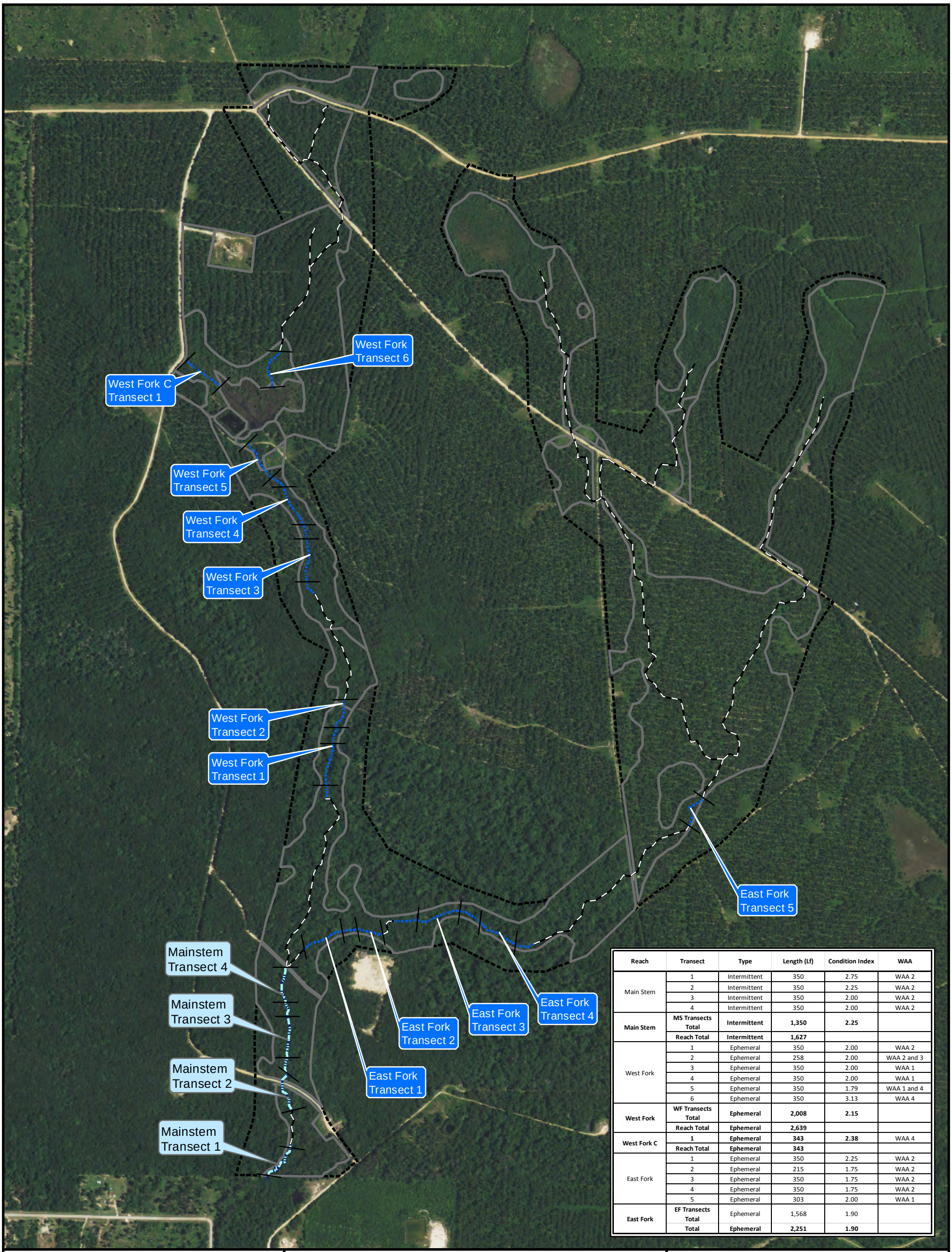
Wetland iHGM
- iHGM Field Plots
- Data Collection Transects
- Data Collection Boundary - 396 Ac

WAAs
- WAA 1 - Pine Plantation (Forested)
- WAA 2 - Mature Hardwood (Forested)
- WAA 3 - Young Hardwood (Forested)
- WAA 4 - Beaver Pond (Forested)
- WAA 5 - Beaver Pond (Herbaceous)
- WAA 6 - Clearings (Herbaceous)

Soil Series
- Kr: Kirbyville Fine Sandy Loam
- Wa: Waller Loam
- Wc: Lelavale (Waller loam, depressional)
- Wk: Waller-Kirbyville Complex

SOURCES - Imagery: **NAIP**, WOUS Limits: **Hydrex**, Functional Assessment Data: **RS&H**, Data Collection Boundary: **Opperman Surveying**

Path: X:\P\115-2370-003 Houston-Conroe Mitigation Bank\I Dwgs and Design Data\GIS\MXD\6000 - Functional Assessment (Phase I)\Revision - July 2014\HCMB Phase I FA Revision (Exhibit 7_Wetland Functional Assessment).mxd



Reach	Transect	Type	Length (Lf)	Condition Index	WAA
Main Stem	1	Intermittent	350	2.75	WAA 2
	2	Intermittent	350	2.25	WAA 2
	3	Intermittent	350	2.00	WAA 2
	4	Intermittent	350	2.00	WAA 2
Main Stem	**MS Transects Total**	**Intermittent**	**1,350**	**2.25**	
	Reach Total	**Intermittent**	**1,627**		
West Fork	1	Ephemeral	350	2.00	WAA 2
	2	Ephemeral	258	2.00	WAA 2 and 3
	3	Ephemeral	350	2.00	WAA 1
	4	Ephemeral	350	2.00	WAA 1
	5	Ephemeral	350	1.79	WAA 1 and 4
	6	Ephemeral	350	3.13	WAA 4
West Fork	**WF Transects Total**	**Ephemeral**	**2,008**	**2.15**	
	Reach Total	**Ephemeral**	**2,639**		
West Fork C	**1**	**Ephemeral**	**343**	**2.38**	WAA 4
	Reach Total	**Ephemeral**	**343**		
East Fork	1	Ephemeral	350	2.25	WAA 2
	2	Ephemeral	215	1.75	WAA 2
	3	Ephemeral	350	1.75	WAA 2
	4	Ephemeral	350	1.75	WAA 2
	5	Ephemeral	303	2.00	WAA 1
East Fork	**EF Transects Total**	Ephemeral	1,568	1.90	
	Total	**Ephemeral**	**2,251**	**1.90**	

FORESTAR

RS&H

Drawn By: EMH
Date: 08/18/2014
Project No. 115-2370-003

EXHIBIT 8
STREAM FUNCTIONAL ASSESSMENT MAP
HOUSTON-CONROE MITIGATION BANK
PHASE I
USACE PROJECT - SWG-2011-00719
LIBERTY COUNTY, TEXAS
SPONSOR: FORESTAR

500 0 500 1,000 1,500 2,000 Feet

Coordinate System: NAD 1983 UTM Zone 15N

LEGEND

Data Collection Boundary - 396 Ac

Stream Functional Assessment

Transect Endpoints

OHWM Channels

Ephemeral

Intermittent

No OHWM

Aggraded Channels

Wetland Boundary

SOURCES - Imagery: **NAIP**, WOUS Limits: **Hydrex**, Functional Assessment Data: **RS&H**, Data Collection Boundary: **Opperman Surveying**

Path: C:\Users\highe\Desktop\Work-At-Home\HCMB\07.10.2014\HCMB Phase I FA (Figure 8).mxd

APPENDIX B

SWG Forested Riverine iHGM

WAA 1 (Average of HGMs 2, 3, 8, 19, 20, 21, 22, 23, 24, 25, 28, and 29)

Site: SWG-2011-00719
Date: 03/27/13 Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
WAA 1	0.75	0.71	0.70	0.68	0.67	0.81	0.73	0.85	0.75	0.69	0.66	0.86	0.33	0.17	1.00

Functional Capacity Index

HGM#	WAA 1
TSDSW	0.70
MPAC	0.78
RSEC	0.65

WAA Acres = **118.79**

Functional Capacity Units

HGM#	WAA 1
TSDSW	83.66
MPAC	92.89
RSEC	77.35

Notes:

WAA 1 consisted of 24 year old pine plantation wetland that has undergone multiple thinning operations. The majority of the overstory tree species observed were pine but there was a significant component of naturally regenerated oak as understory trees and shrubs.

HGM 3 North:

HGM 8 South:

HGM 21 East:

HGM 25 West:

SWG Forested Riverine iHGM

HGM 2

Site: SWG-2011-00719
Date: 03/27/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 2	0.75	0.75	0.70	1.00	1.00	1.00	0.60	1.00	0.60	0.75	0.30	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 2
TSDSW	0.82
MPAC	0.82
RSEC	0.76

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 3

Site: SWG-2011-00719
Date: 03/27/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 3	0.50	0.50	0.40	0.50	0.75	0.80	0.80	1.00	0.40	0.25	0.25	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 3
TSDSW	0.52
MPAC	0.68
RSEC	0.54

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 8

Site: SWG-2011-00719
Date: 03/27/13

Transect: 5
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 8	0.75	0.75	1.00	0.30	1.00	1.00	0.80	1.00	0.60	1.00	0.30	0.50	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 8
TSDSW	0.76
MPAC	0.76
RSEC	0.70

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine. Soils were sandy with sparse redox features.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 19

Site: SWG-2011-00719
Date: 03/28/13

Transect: 5
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 19	0.75	0.75	0.70	0.50	0.50	0.50	0.80	0.40	1.00	1.00	1.00	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 19
TSDSW	0.65
MPAC	0.75
RSEC	0.59

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 20

Site: SWG-2011-00719
Date: 03/28/13

Transect: 5
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 20	0.75	1.00	0.70	1.00	0.50	1.00	1.00	1.00	0.60	0.50	1.00	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 20
TSDSW	0.80
MPAC	0.93
RSEC	0.74

Notes:

Plot was located within pine plantation within or near the aggraded stream channel. Plot had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 21

Site: SWG-2011-00719
Date: 03/28/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 21	0.75	0.50	0.70	1.00	0.50	0.30	0.80	0.80	1.00	0.75	1.00	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 21
TSDSW	0.67
MPAC	0.81
RSEC	0.58

Notes:

Plot was located within pine plantation, but had significant component of Chinese tallow as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 22

Site: SWG-2011-00719
Date: 03/28/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 22	0.75	0.75	0.40	0.50	0.75	1.00	0.40	0.80	0.60	0.75	1.00	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 22
TSDSW	0.64
MPAC	0.75
RSEC	0.64

Notes:

Plot is located within pine plantation near the aggraded stream channel. Plot has significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species are pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 23

Site: SWG-2011-00719
Date: 03/28/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 23	1.00	1.00	1.00	0.50	0.50	1.00	0.60	0.60	0.60	0.75	1.00	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 23
TSDSW	0.82
MPAC	0.76
RSEC	0.77

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 24

Site: SWG-2011-00719
Date: 03/28/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 24	0.75	0.50	0.70	1.00	0.75	0.30	1.00	1.00	1.00	0.75	0.30	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 24
TSDSW	0.71
MPAC	0.80
RSEC	0.64

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 25

Site: SWG-2011-00719
Date: 03/28/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 25	0.75	0.50	0.70	1.00	0.50	1.00	0.80	1.00	0.60	0.50	1.00	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 25
TSDSW	0.67
MPAC	0.89
RSEC	0.64

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 28

Site: SWG-2011-00719
Date: 04/16/13

Transect: 8
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 28	0.75	0.75	0.70	0.50	0.75	0.80	0.60	1.00	1.00	0.75	0.30	0.50	0.10	0.50	1.00

Functional Capacity Index

HGM#	HGM 28
TSDSW	0.70
MPAC	0.74
RSEC	0.65

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 29

Site: SWG-2011-00719
Date: 04/16/13

Transect: 8
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 29	0.75	0.75	0.70	0.30	0.50	1.00	0.60	0.60	1.00	0.50	0.50	0.30	0.10	0.50	1.00

Functional Capacity Index

HGM#	HGM 29
TSDSW	0.61
MPAC	0.70
RSEC	0.56

Notes:

Plot was located within pine plantation, but had significant component of naturally regenerated oak as understory trees and shrubs. Most overstory tree species observed were pine.

North:

South:

East:

West:

SWG Forested Riverine iHGM

WAA 2 (Average of HGMs 9, 10, 14, 15, 16, 17, and 18)

Site: SWG-2011-00719
Date: 03/27/13 Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
WAA 2	0.86	0.86	0.74	0.79	0.64	0.93	0.86	0.71	0.83	0.61	0.50	0.79	0.61	0.10	1.00

Functional Capacity Index

HGM#	WAA 2
TSDSW	0.79
MPAC	0.82
RSEC	0.72

WAA Acres = **48.47**

Functional Capacity Units

HGM#	WAA 2
TSDSW	38.16
MPAC	39.55
RSEC	34.70

Notes:

WAA 2 consisted of mature hardwood stand thinned in early 2013.

HGM 14 North:

HGM 9 South:

HGM 15 East:

HGM 16 West:

SWG Forested Riverine iHGM

HGM 9

Site: SWG-2011-00719
Date: 03/27/13

Transect: 2
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 9	0.75	0.75	0.40	1.00	0.50	0.50	1.00	0.40	1.00	0.75	0.30	0.50	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 9
TSDSW	0.69
MPAC	0.79
RSEC	0.57

Notes:

Plot was within mature hardwood stand thinned in early 2013. Significant amounts of logging debris were present resulting in high coarse woody debris score.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 10

Site: SWG-2011-00719
Date: 03/27/13

Transect: 1
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 10	0.75	0.75	1.00	0.50	0.75	1.00	0.80	1.00	0.60	0.50	1.00	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 10
TSDSW	0.75
MPAC	0.81
RSEC	0.68

Notes:

Plot was within mature hardwood stand thinned in early 2013. Thinning did not occur within the plot boundary, but surrounding areas within the WAA have been thinned.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 14

Site: SWG-2011-00719
Date: 03/28/13

Transect: 3
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 14	1.00	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	0.50	0.30	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 14
TSDSW	0.96
MPAC	0.90
RSEC	0.87

Notes:

Plot was within narrow hardwood dominated wetland near the boundary. High tree diversity with over 10 species seen.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 15

Site: SWG-2011-00719
Date: 03/28/13

Transect: 3
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 15	1.00	1.00	0.70	0.50	0.75	1.00	0.80	1.00	0.60	0.75	0.30	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 15
TSDSW	0.81
MPAC	0.77
RSEC	0.82

Notes:

Plot was within mature hardwood stand thinned in early 2013. Thinning did not occur within the plot boundary, but surrounding areas within the WAA have been thinned.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 16

Site: SWG-2011-00719
Date: 03/28/13

Transect: 3
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 16	1.00	1.00	0.70	1.00	0.25	1.00	0.80	0.40	1.00	0.25	0.30	0.50	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 16
TSDSW	0.81
MPAC	0.80
RSEC	0.69

Notes:

Plot was within mature hardwood stand thinned in early 2013. Significant amounts of logging debris were present resulting in high coarse woody debris score.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 17

Site: SWG-2011-00719
Date: 03/28/13

Transect: 3
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 17	0.75	0.75	0.70	1.00	0.75	1.00	1.00	0.40	0.60	1.00	1.00	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 17
TSDSW	0.78
MPAC	0.92
RSEC	0.75

Notes:

Plot was within mature hardwood stand thinned in early 2013. Significant amounts of logging debris were present resulting in high coarse woody debris score.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 18

Site: SWG-2011-00719
Date: 03/28/13

Transect: 4
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 18	0.75	0.75	0.70	0.50	0.75	1.00	0.60	0.80	1.00	0.50	0.30	0.50	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 18
TSDSW	0.70
MPAC	0.73
RSEC	0.63

Notes:

Plot was within mature hardwood stand thinned in early 2013. Significant amounts of logging debris were present resulting in high coarse woody debris score. Thinning lane was on edge of plot as seen in the photographs.

North:

South:

East:

West:

SWG Forested Riverine iHGM

WAA 3 (Average of HGMs 12, 30, and 31)

Site: SWG-2011-00719
Date: 03/27/13 Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
WAA 3	1.00	1.00	0.80	0.37	0.90	0.83	0.80	0.80	0.67	0.58	0.60	1.00	0.10	0.37	1.00

Functional Capacity Index

HGM#	WAA 3
TSDSW	0.83
MPAC	0.72
RSEC	0.82

WAA Acres = **32.72**

Functional Capacity Units

HGM#	WAA 3
TSDSW	27.16
MPAC	23.59
RSEC	26.68

Notes:

WAA 3 consisted of young hardwood dominated habitats. These areas were cleared in 1989 and were allowed to naturally regenerate and, at the time of field investigation, were dominated by laurel oak and other young, early successional, hardwoods such as ash, maple, elms, and Chinese tallow.

HGM 12 North:

HGM 31 South:

HGM 30 East:

West:

SWG Forested Riverine iHGM

HGM 12

Site: SWG-2011-00719
Date: 03/28/13

Transect: 4
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 12	1.00	1.00	1.00	0.50	1.00	1.00	0.40	1.00	0.40	0.25	0.30	1.00	0.10	0.10	1.00

Functional Capacity Index

HGM#	HGM 12
TSDSW	0.91
MPAC	0.65
RSEC	0.85

Notes:

Plot was within young oak dominated stand. Plot appeared to be frequently saturated / inundated as indicated by presence of water stained leaves, buttressing, drift lines, and an abundance of palmetto.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 30

Site: SWG-2011-00719
Date: 04/16/13

Transect: 8
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 30	1.00	1.00	0.40	0.30	1.00	0.50	1.00	0.40	1.00	1.00	0.50	1.00	0.10	0.50	1.00

Functional Capacity Index

HGM#	HGM 30
TSDSW	0.75
MPAC	0.71
RSEC	0.82

Notes:

Plot was within young green ash dominated depressional wetland. Scattered Chinese tallow and red maple were also present, and the plot had a very diverse herbaceous layer dominated by obligates.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 31

Site: SWG-2011-00719
Date: 04/16/13

Transect: 8
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 31	1.00	1.00	1.00	0.30	0.70	1.00	1.00	1.00	0.60	0.50	1.00	1.00	0.10	0.50	1.00

Functional Capacity Index

HGM#	HGM 31
TSDSW	0.82
MPAC	0.81
RSEC	0.78

Notes:

Plot was within young oak dominated depressional wetland. Scattered green ash, Chinese tallow and red maple were also present

North:

South:

East:

West:

SWG Forested Riverine iHGM

WAA 4 (Average of HGMs 5 and 7)

Site: SWG-2011-00719
Date: 03/27/13 Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
WAA 4	1.00	1.00	1.00	0.50	0.88	1.00	0.50	0.90	0.50	1.00	0.65	1.00	1.00	0.30	1.00

Functional Capacity Index

HGM#	WAA 4
TSDSW	0.89
MPAC	0.75
RSEC	0.89

WAA Acres = **8.06**

Functional Capacity Units

HGM#	WAA 4
TSDSW	7.17
MPAC	6.08
RSEC	7.15

Notes:

WAA 4 consisted of oak dominated stand influenced by and adjacent to beaver pond.

HGM 5 North:

HGM 5 South:

HGM 7 East:

HGM 7 West:

SWG Forested Riverine iHGM

HGM 5

Site: SWG-2011-00719
Date: 03/27/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 5	1.00	1.00	1.00	0.50	0.75	1.00	0.40	0.80	0.60	1.00	1.00	1.00	1.00	0.50	1.00

Functional Capacity Index

HGM#	HGM 5
TSDSW	0.87
MPAC	0.77
RSEC	0.87

Notes:

Plot was within oak dominated stand influenced by and adjacent to beaver pond.

North:

South:

East:

West:

SWG Forested Riverine iHGM

HGM 7

Site: SWG-2011-00719
Date: 03/27/13

Transect: 6
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vcwd	Vwood	Vtree	Vrich	Vbasal	Vdensity	Vmid	Vherb	Vdetritus	Vredox	Vsorpt	Vconnect
HGM 7	1.00	1.00	1.00	0.50	1.00	1.00	0.60	1.00	0.40	1.00	0.30	1.00	1.00	0.10	1.00

Functional Capacity Index

HGM#	HGM 7
TSDSW	0.91
MPAC	0.74
RSEC	0.91

Notes:

Plot was within oak dominated stand influenced by and adjacent to beaver pond. Some occurrences of sweetgum and black gum were also present. Watermarks visible on trees and buttressing present. Soils were a loamy sand with 20% redox in the top 4" and a 2" thick A horizon.

North:

South:

East:

West:

SWG Herbaceous Riverine iHGM

WAA 5 (HGM 4)

Site: SWG-2011-00719
Date: 03/27/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritu	Vredox	Vsorpt	Vconnect
HGM 4	1.00	1.00	1.00	0.10	0.25	1.00	1.00	1.00	0.50	1.00

Functional Capacity Index

HGM#	HGM 4
TSDSW	0.90
MPAC	0.75
RSEC	0.74

WAA Acres = **4.3**

Functional Capacity Units

HGM#	HGM 4
TSDSW	3.88
MPAC	3.23
RSEC	3.17

Notes:

Plot was within herbaceous dominated portion of beaver pond dominated by Juncus effusus with scattered shrubs.

North:

South:

East:

West:

SWG Herbaceous Riverine iHGM

WAA 6 (Average of HGM 1 and 27)

Site: SWG-2011-00719
Date: 03/27/13 Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritu	Vredox	Vsorpt	Vconnect
WAA 6	1.00	1.00	0.70	0.25	0.38	0.88	0.30	1.00	0.50	1.00

Functional Capacity Index

HGM#	WAA 6
TSDSW	0.81
MPAC	0.75
RSEC	0.70

WAA Acres = **5.00**

Functional Capacity Units

HGM#	WAA 6
TSDSW	4.07
MPAC	3.75
RSEC	3.50

Notes:

WAA 6 consisted of various cleared areas that, at the time of field investigation, were dominated by early successional shrubs and herbaceous species.

HGM 1 North:

HGM 1 South:

HGM 27 East:

HGM 27 West:

SWG Herbaceous Riverine iHGM

HGM 1

Site: SWG-2011-00719
Date: 03/27/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritu	Vredox	Vsorpt	Vconnect
HGM 1	1.00	1.00	0.40	0.25	0.25	1.00	0.50	1.00	0.50	1.00

Functional Capacity Index

HGM#	HGM 1
TSDSW	0.72
MPAC	0.75
RSEC	0.69

Notes:

Plot was within cleared area that appeared to be a natural gas well location that was never drilled. Plot was predominantly herbaceous with scattered shrubs. Area was inundated frequently as seen by iron reducing bacteria sheen and obligate species.

North:

South:

East:

West:

SWG Herbaceous Riverine iHGM

HGM 27

Site: SWG-2011-00719
Date: 03/27/13

Transect: 7
Team: Neil Boitnott and Kate Lindekugel

Location	Vdur	Vfreq	Vtopo	Vwood	Vmid	Vherb	Vdetritu	Vredox	Vsorpt	Vconnect
HGM 27	1.00	1.00	1.00	0.25	0.50	0.75	0.10	1.00	0.50	1.00

Functional Capacity Index

HGM#	HGM 27
TSDSW	0.90
MPAC	0.75
RSEC	0.71

Notes:

Plot was within logging deck near aggraded stream channel and was dominated by early successional shrubs and herbaceous species.

North:

South:

East:

West:

APPENDIX C

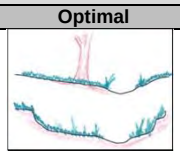
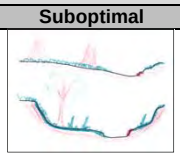
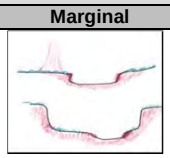
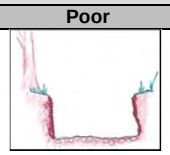
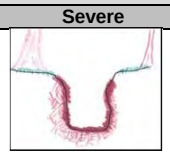
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	1	12040103	07/11/2014	1	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	Mainstem - Orange Branch (Intermittent)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	**5**	**4**	**3**	**2**	**1**	**CV** **3.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**4.00**	
	Score >	**4**							**Lt Bank CI >**	**4.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**3.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.75**

NOTES:

For the channel condition, the channel is severely aggraded in places from filling in of transient sediments. Silvicultural activities have altered the channel, but continued activities prevent its recovery. The stream is surrounded by wetlands and hardwood bottomland forests, except harvesting was happening at the time, which meant there were mulch lines, debris jams, and large holes in the canopy which normally would not exist. This does not qualify as cropland, but it is not without management. TCEQ does not have the channel listed, and it is without perennial pools. There are no unnatural channel alterations as listed, but the silvicultural activities are a form of active land management. Appropriate meander pattern has not recovered. These observations have led to the lesser scores for functional integrity. Buttressing and drift lines were observed at the site, but there were few water marks in the channel. There was a dense layer of pine leaf litter and an A horizon with high organic content in the channel.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

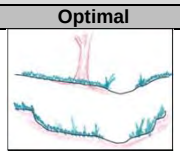
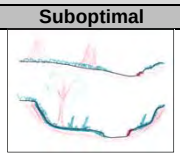
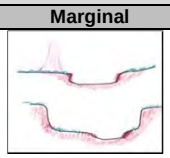
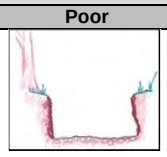
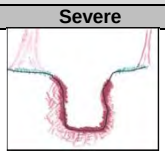
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	1	12040103	07/11/2014	2	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	Mainstem - Orange Branch (Intermittent)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	5	4	3	2	1	**CV** 3.0

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	5	High = 4.5	Low = 4	3	2	1	

Right Bank	% Riparian Area>	100%						100%			
	Score >	4									**BV**
									CI= (Sum % RA * Scores*0.01)/2		4.00
Left Bank	% Riparian Area>	100%						100%	**Rt Bank CI >**	4.00	
	Score >	4							**Lt Bank CI >**	4.00	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.25**

NOTES:

This upstream reach is approximately 100' from the road crossing, and is adjacent to a logging deck. For the channel condition, the channel is severely aggraded in places from filling in of transient sediments. Silvicultural activities have altered the channel, but continued activities prevent its recovery. Riparian buffers score would be greater as the stream is surrounded by wetlands and hardwood bottomland forests, except harvesting was happening at the time, which meant there were mulch lines, debris jams, and large holes in the canopy which normally would not exist with dense chinese tallow thickets. This does not qualify as cropland, but it is not without management. TCEQ does not have the channel listed, and it is without perennial pools. The harvesting equipment has had an effect on channel alteration, but the largest contributor is the road crossing upstream, which is restricting the flow from the contributing watershed. Appropriate meander pattern has not recovered. There is less leaf litter than there was downstream, and the leaf litter is predominantly hardwood rather than pine. Trees show buttressing, and lizard's tail, palmetto, and carex (sp) are abundant. There is a borrow pit / pond abutting stream, and the pond, where small, appears ecologically stable.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

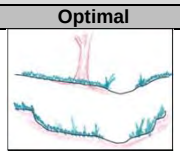
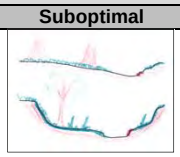
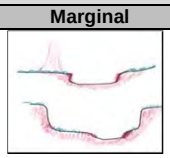
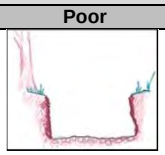
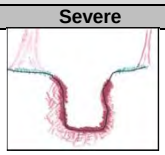
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	1	12040103	07/11/2014	3	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	Mainstem - Orange Branch (Intermittent)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	**5**	**4**	**3**	**2**	**1**	**CV** **2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**4.00**	
	Score >	**4**							**Lt Bank CI >**	**4.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

Over-widening of the channel is apparent with thinning activities happening in the stream bank's buffer zone. The channel bottom is mostly mud with no water movement and very little hydrophytic vegetation. For the whole assessment length, there is an approximately 300' reach of ponded water approximately 6" deep and 10' wide (width/depth ratio of 20), but at the sample site, the width was 20' and the depth was 1' 3" for a width/depth ratio of 16. The culvert and road crossing have caused the water to back up the channel, slowing the velocity and causing sediment to drop out of suspension. This has resulted in an over-widened, aggraded channel. For these reasons, the channel condition received a score of 2 and channel alteration a score of 1. The effects of the road are compounded by the logging activities. The riparian buffer would perhaps have a higher score as there were forested wetlands on both banks, but the logging activities and maintenance occurring within the buffer have created holes in the canopy, an abundance of saplings, and an artificially greater amount of coarse woody debris.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

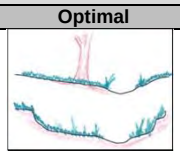
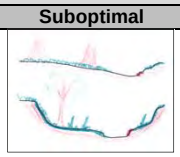
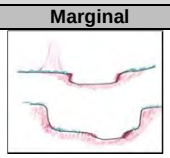
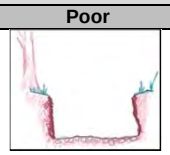
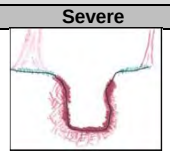
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	1	12040103	07/11/2014	4	300	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	Mainstem - Orange Branch (Intermittent)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	5	4	3	2	1	**CV** 2.0

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	5	High = 4.5	Low = 4	3	2	1	

Right Bank	% Riparian Area>	100%						100%			
	Score >	4									**BV**
									CI= (Sum % RA * Scores*0.01)/2		4.00
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	4.00	
	Score >	4							Lt Bank CI >	4.00	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

There has been a considerable amount of thinning and other logging activities on site, which have disturbed the soil, left copious amounts of coarse woody debris, and opened the canopy much more than downstream reaches. However, there is less chinese tallow in the understory at this sampling location. Because the channel is so severely over-widened within this reach, finding bankfull benches was difficult. The upstream boundary of the reach is cut off from the normal contributions of its watershed by a road, and the channel is ephemeral north of the road. These factors combined result in the channel condition score and the channel alteration score being less, even though there is no entrenchment. The adverse impacts by the road, and the aggradation from altered flows and commercial silviculture are significant. The surrounding buffer zone is wetland, and what trees remain are primarily native, bottomland species, but the harvest shows maintenance, which resulted in a lower score.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

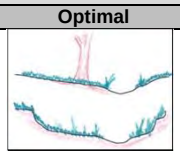
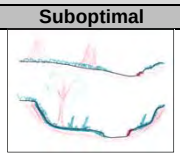
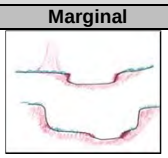
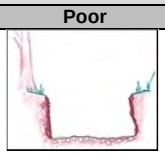
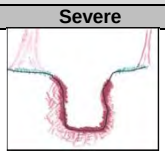
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	1	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	**CV**
Score	**5**	**4**	**3**	**2**	**1**	**2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**	

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**4.00**	
	Score >	**4**							**Lt Bank CI >**	**4.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

Aggradation is present. Riparian corridor is hardwood dominated wetland but has been recently thinned, reducing the CI on riparian buffer. Silvicultural activities and related equipment movements have contributed to sediment deposition in the channel over time leading to the severe aggradation. There are no channel altering structures, per se, but these activities have had a similar effect as hoof tread, ATV use, etc., so the channel alteration score is lower. The degree of aggradation warrants the low channel condition score, and if aggradation of this severity continues, the channel will devolve into a swale with laminar flow.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

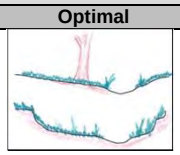
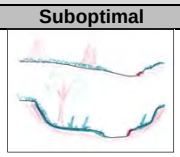
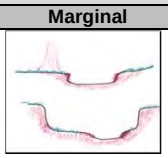
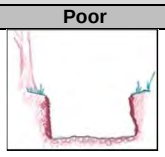
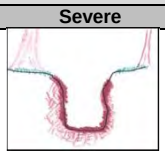
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	2	258	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	**CV**
Score	**5**	**4**	**3**	**2**	**1**	**2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**	

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**4.00**	
	Score >	**4**							**Lt Bank CI >**	**4.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

Aggradation is present. Riparian corridor is hardwood dominated wetland but has been recently thinned, reducing the CI on riparian buffer. Silvicultural activities and related equipment movements have contributed to sediment deposition in the channel over time leading to the severe aggradation. There are no channel altering structures, per se, but these activities have had a similar effect as hoof tread, ATV use, etc., so the channel alteration score is lower. The degree of aggradation warrants the low channel condition score, and if aggradation of this severity continues, the channel will devolve into a swale with laminar flow.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

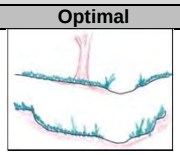
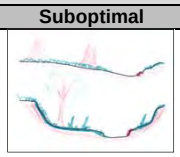
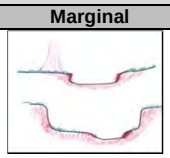
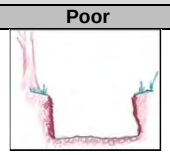
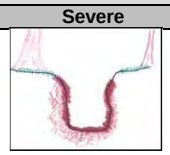
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	3	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	**CV**
Score	**5**	**4**	**3**	**2**	**1**	**2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**	

Right Bank	% Riparian Area>	**100%**						**100%**		
	Score >	**3**								**BV**
									CI= (Sum % RA * Scores*0.01)/2	**3.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**3.00**
	Score >	**3**							**Lt Bank CI >**	**3.00**

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**2.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

The site is within an active pine plantation. The channel is considerably more widened here than at other sampling locations. This is a highly aggraded C channel, but does still possess evidence of bed and banks, although it is 20' wide ephemeral stream. Vegetation is cleared over the channel. The soil is not as sandy in the channel as on the banks with more redox concentrations. Within the channel, there were relic beaver dams and log debris. The widening and deepening in places is a result of relic beaver dams and pine plantation activities. Stream does not have a natural pattern and is aggrading, but no riprap, culverts, or other manmade diversions. Most sediment input is from runoff from surrounding silvicultural activities, and bank instability is compounded by heavy equipment moving during past harvests. The channel condition and channel alteration scores are less due to the anthropogenic influences of the pine plantation.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

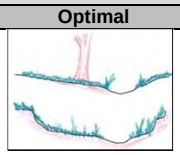
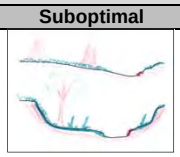
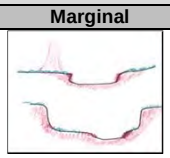
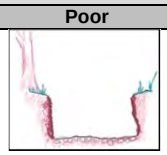
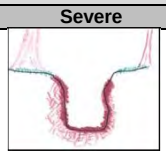
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	4	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	**5**	**4**	**3**	**2**	**1**	**CV** **2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**3**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**3.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**3.00**	
	Score >	**3**							**Lt Bank CI >**	**3.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**2.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.00**

NOTES:

The site is within an active pine plantation. The channel is considerably more widened here than at other sampling locations. This is a highly aggraded C channel, but does still possess evidence of bed and banks, although it is 20' wide ephemeral stream. Vegetation is cleared over the channel. The soil is not as sandy in the channel as on the banks with more redox concentrations. Within the channel, there were relic beaver dams and log debris. The widening and deepening in places is a result of relic beaver dams and pine plantation activities. Stream does not have a natural pattern and is aggrading, but no riprap, culverts, or other manmade diversions. Most sediment input is from runoff from surrounding silvicultural activities, and bank instability is compounded by heavy equipment moving during past harvests. The channel condition and channel alteration scores are less due to the anthropogenic influences of the pine plantation.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

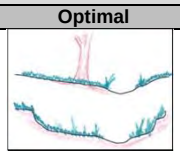
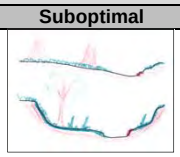
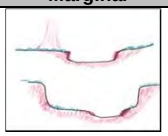
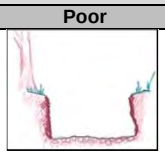
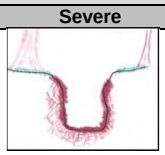
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	7/11/2014	5	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe
					
Visual Channel Condition Parameter	**Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	**Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	**Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	**Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	**Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	**CV**
Score	**5**	**4**	**3**	**2**	**1**	**2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**3**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**3.15**
Left Bank	% Riparian Area>	**80%**	**20%**					**100%**	**Rt Bank CI >**	**3.00**	
	Score >	**3**	**4.5**						**Lt Bank CI >**	**3.30**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**1.79**

NOTES:

The site is within an active pine plantation. The channel is considerably more widened here than at other sampling locations. This is a highly aggraded C channel, but does still possess evidence of bed and banks, although it is 20' wide ephemeral stream. Vegetation is cleared over the channel and an abundance of logging debris within the channel. The soil is not as sandy in the channel as on the banks with more redox concentrations. Within the channel, there were relic beaver dams and log debris. There were pile ups of debris and sediment with plunges before and after. The widening and deepening in places is a result of relic beaver dams and pine plantation activities. Stream does not have a natural pattern and is aggrading, but no riprap, culverts, or other manmade diversions. Most sediment input is from runoff from surrounding silvicultural activities, and bank instability is compounded by heavy equipment moving during past harvests. The channel condition and channel alteration scores are less due to the anthropogenic influences of the pine plantation.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

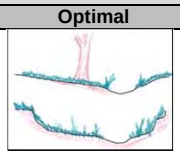
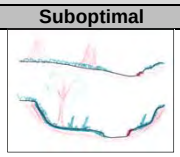
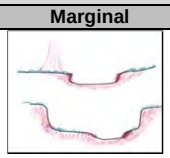
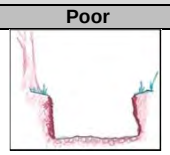
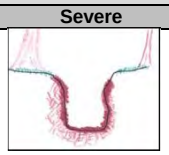
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	6	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	5	4	3	2	1	**CV** 3.0

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	5	High = 4.5	Low = 4	3	2	1

Right Bank	% Riparian Area>	100%						100%			
	Score >	4.5									**BV**
									CI= (Sum % RA * Scores*0.01)/2		4.50
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	4.50	
	Score >	4.5							Lt Bank CI >	4.50	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**4.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**3.13**

NOTES:

This is the stream channel extending upstream of beaver pond. Aggradation is present as northern limits of transect is near pine plantation boundary, but bed and banks are obvious, and aggradation does not appear to be happening as rapidly as at other locations, even though silviculture is having an effect. The riparian corridor is young hardwood stand, which does not appear to be actively managed, but was cleared in the late 1980's reducing the riparian corridor CI slightly.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

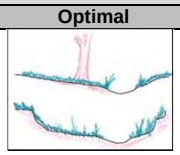
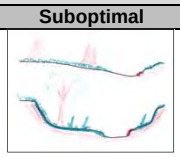
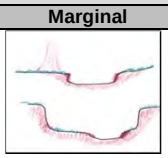
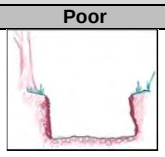
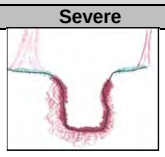
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	1	343	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	West Fork C - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	**5**	**4**	**3**	**2**	**1**	**CV** **3.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe	
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.	
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**	

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4.5**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.50**
Left Bank	% Riparian Area>	**100%**					**100%**		**Rt Bank CI >**	**4.50**	
	Score >	**4.5**							**Lt Bank CI >**	**4.50**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**1.00**

CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.38**

NOTES:

This reach is upstream of beaver pond extending north and west. There is tallow in the riparian buffer, but no evidence of thinning or harvesting. There is a road upstream of the site, and its position would imply the channel may be an old 4-wheeler track. The channel is straight and obviously modified by man, but is neither aggrading or degrading. The channel is well defined and established; probably was not the "original" channel. Width to depth ratio is 13.5.

PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

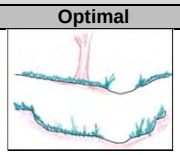
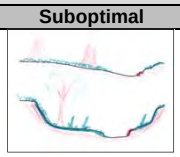
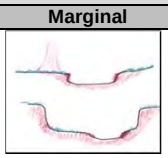
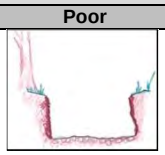
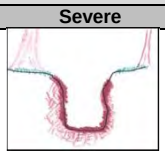
Routine Stream Assessment Data Form for Level 1 Streams

May 2013 Revision - U.S. Army Corps of Engineers Galveston District

File Number	Applicant	Stahler Stream Order	8 Digit HUC	Date	Transect #	Transect Length (ft)	Impact Factor
SWG-2011-00719	Forestar	N/A	12040103	07/11/2014	1	350	

Name(s) of Evaluator(s)	Steam Name and Type
Kate Lindekugel & Neil Boitnott	East Fork - Orange Branch (Ephemeral)

1. CHANNEL CONDITION: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Optimal	Suboptimal	Marginal	Poor	Severe	
Visual Channel Condition Parameter	 **Channel Geometry**: These channels show very little incision or widening and little or no evidence of active erosion or unprotected banks. Entrenchment ratio should be greater than 2.2. **Channel Stability**: Visual indicators of this stability include: 1) vegetative surface protection or natural rock stability present along 80% or more of the banks; 2) stable point bars and bankfull benches may be present; and 3) mid-channel bars and transverse bars are rare and if transient sediment deposition is present, it covers less than 10% of the stream bottom. **Floodplain Connection**: The channel has access to the active floodplain or has fully developed wide bankfull benches. **Additional Information**: In addition, no bulkheading or riprap may be present along the Transect for an Optimal score, regardless of channel profile.	 **Channel Geometry**: These channels are slightly incised and contain a few areas of active erosion or unprotected banks. Entrenchment ratio should be equal to or between 1.8 and 2.2. **Channel Stability**: Visual indicators of this slight instability include: 1) vegetative surface protection or natural rock stability present along 60-79% of both banks; 2) depositional features such as point bars and bankfull benches are likely present; and 3) if transient sediment is present, it affects or buries 10-40% of the stream bottom. **Active Floodplain**: The stream has access to bankfull benches, or newly developed floodplains along portions of the reach. **Additional Information**: Suboptimal channels may show evidence of past channel alteration, but should exhibit notable recovery to a natural channel. In addition, a stream channel is visually characterized as Suboptimal if 1-25% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are often incised or their course has been widened, but to a lesser degree than the Severe and Poor channel conditions. Entrenchment ratio should be equal to or between 1.4 and 1.8. **Channel Stability**: Visual indicators of a marginal stream include: 1) erosional scars present on 40-59% of both banks; 2) vegetative surface protection may be present on 40-59% of the banks; 3) the streambanks may consist of some vertical or undercut banks or nickpoints associated with headcuts; 4) portions of the bankfull channel may still widen while some portions are beginning to narrow; and 5) temporary and transient sediment deposit covers 41-60% of the natural stream bed or bottom. However, streams that have degraded channel profiles which are recovering will exhibit different characteristics, including: 1) presence of depositional features such as point bars, mid-channel bars, transverse bars, and bankfull benches may be forming or present; 2) channels have a V-shape; 3) vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. **Active Floodplain**: Marginal streams have no connection to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Marginal if 26-50% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: These channels are over-widened or are incised. These channels are vertically and/or laterally unstable and are more likely to widen rather than incise further. Entrenchment ratio should be equal to or between 1.2 and 1.4. **Channel Stability**: Visual indicators of over-widening and incision include: 1) both banks are near vertical with shallow to moderate root depths; 2) erosional scars present on 60-80% of the banks; 3) vegetative surface protection present on 20-39% of both banks and is insufficient to prevent significant erosion from continuing; 4) between 61-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition, often uniformed-sized materials; and 5) depositional features such as point bars and bankfull benches are absent. **Active Floodplain**: Poor streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Poor if 51-80% of the Transect is bulkhead or riprap, regardless of channel profile.	 **Channel Geometry**: Severe channels are deeply incised (or excavated) with vertical and/or lateral instability and may likely continue to incise or widen. Entrenchment ratio is greater than 1.2. **Channel Stability**: Visual indications of a deeply incised stream include: 1) the streambed elevation is below the average rooting depth; 2) both banks are vertical or undercut; 3) vegetative surface protection present on less than 20% of the banks and is not preventing erosion from continuing; 4) bank sloughing present; 5) erosional scars or raw banks present on 81-100% of the banks; 6) 81% or more of the natural streambed or bottom (pools and riffles) is covered by substantial sediment deposition; and 7) Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a Severe Parameter Condition score. **Active Floodplain**: Severe streams are not connected to the active floodplain. **Additional Information**: In addition, a stream channel is visually characterized as Severe if the channels have been altered or channelized or the entire Transect is bulkhead or riprap, regardless of stream profile. An altered channel may be straight, with high banks, has dikes or berms, lack flow diversity, often has uniform-sized bed materials, and is missing or has non-native or invasive riparian vegetation along the bank.	
Score	**5**	**4**	**3**	**2**	**1**	**CV** **2.0**

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR.

	Optimal	Suboptimal		Marginal	Poor	Severe
Riparian Buffers	Native woody community species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer.	Native woody community species represent greater than 60% coverage with no wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-60% aerial coverage with wetlands present and no maintenance or grazing within the buffer.	Native woody community species between 30-60% aerial coverage with no wetlands present and no maintenance or grazing activities present within the buffer.	Native woody community represents less than aerial 30% coverage with no maintenance or grazing activities present.	The area is dominated by one or more of the following: lawns; mowed or maintained right-of-way; no-till cropland; actively grazed pasture; sparsely vegetated non-maintained area; recently seeded and stabilized; or other comparable condition.	The area is dominated by: impervious surfaces; mine spoil lands; denuded surfaces; conventional tillage; active feed lots; or other comparable conditions.
Condition Scores	**5**	**High = 4.5**	**Low = 4**	**3**	**2**	**1**

Right Bank	% Riparian Area>	**100%**						**100%**			
	Score >	**4**									**BV**
									CI= (Sum % RA * Scores*0.01)/2		**4.00**
Left Bank	% Riparian Area>	**100%**						**100%**	**Rt Bank CI >**	**4.00**	
	Score >	**4**							**Lt Bank CI >**	**4.00**	

3. AQUATIC USE: Desktop evaluation using data provided by TCEQ under the Texas Surface Water Quality Standards (TSWQS). For any channels not listed, aquatic life use is presumed based upon stream flow type.						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Instream Habitat/ Available Cover	Aquatic Life Score of *Exceptional*	Aquatic Life Score of *High*. Perennial streams which have not been assessed are also assumed to have an Aquatic Life Score of *High*.	Aquatic Life Score of *Intermediate*	Aquatic Life Score of *Limited.* Intermittent streams with perennial pools which have not been assessed are also assumed to have an Aquatic Life Score of *Limited.*	Aquatic Life Score of *Minimal.* Intermittent and ephemeral streams which have not been assessed are also assumed to have an Aquatic Life Score of *Minimal.*	
Score	**5**	**4**	**3**	**2**	**1**	**UV**
						1.00

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock						
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures found on the Transect.	Less than 100 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. Evidence of past alteration may be present, but if the stream pattern and stability have recovered and no other recent alteration is present then it should not be counted as adverse impact.	Between 101-200 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Between 201-300 feet of Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. If the stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 300 feet of the Transect is adversely impacted by channelization, dams, dikes, levees, culverts, riprap, bulkheads, armor, hoof tread, drop structures or withdrawal structures. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.	
						AV
SCORE	**5**	**4**	**3**	**2**	**1**	**2.00**

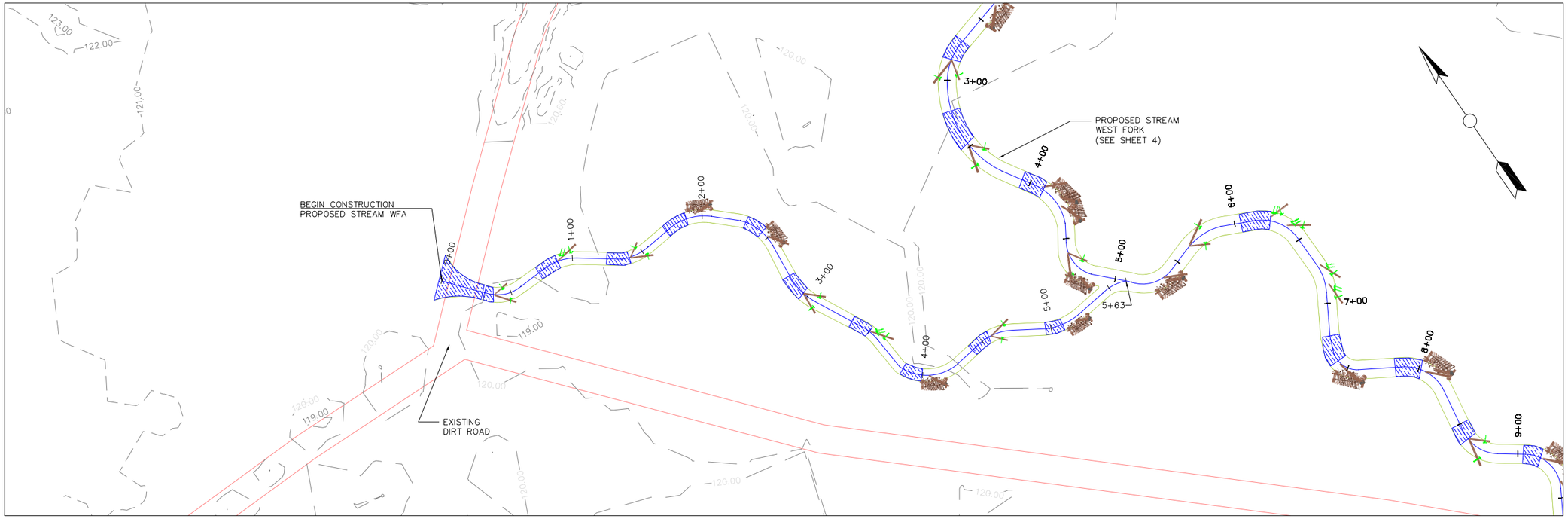
CONDITION INDEX FOR THIS TRANSECT		
	CONDITION INDEX (CI) >>	**2.25**

NOTES:

The logging activity has obfuscated the channel most everywhere, and it is having a definite impact, but no diversion structures present. Hydrex point EF5 on the East Branch tributary is where the channel resumes with bed and banks and not swale. Thinning of large hardwoods has occurred and the land is under active management. Even though the logging is having the most obvious impact, the channel is almost unrecognizable from the road until the assessment reach starts. The road is having a more lasting impact by impounding flows at the road crossing and imparing the connection between the downstream reaches of the stream and its watershed. The aggradation is severe enough the stream has access to the floodplain, but the stream is at risk of no longer being bound by the banks. Because of these factors, the scores for channel condition, riparian buffers, and channel alteration are less.

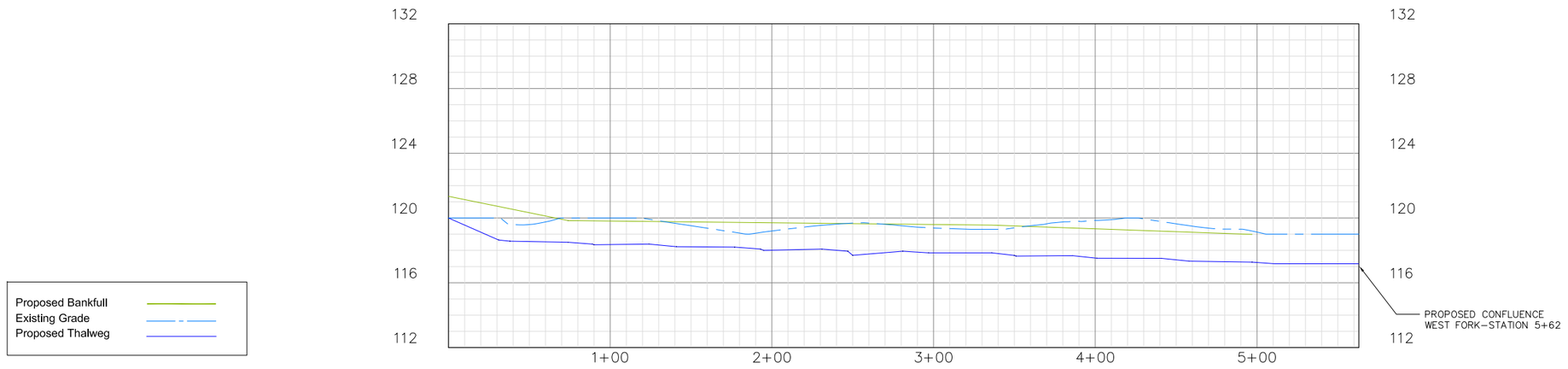
PHOTOS: Clockwise - Upstream, Downstream, Left Bank, Right Bank

APPENDIX H – STREAM CHANNEL DESIGN



PROPOSED PLAN
ORANGE BRANCH - WFA

0 40' 80'



PROPOSED PROFILE

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 4'

General Notes

- Root Wad
- Scour Log
- Log J-Hook
- Toe Wood with Scour Log
- Log Rock and Roll
- Flow-Through Cross Vane
- Tree
- Riffle
- Fill Areas
- Bankfull Bench
- Point Bar/Low-Flow Bench
- Minor Existing Contour
- Major Existing Contour
- Proposed Bankfull
- Proposed Centerline

60% Design Plans

No.	Revision/Issue	Date

Firm Name and Address

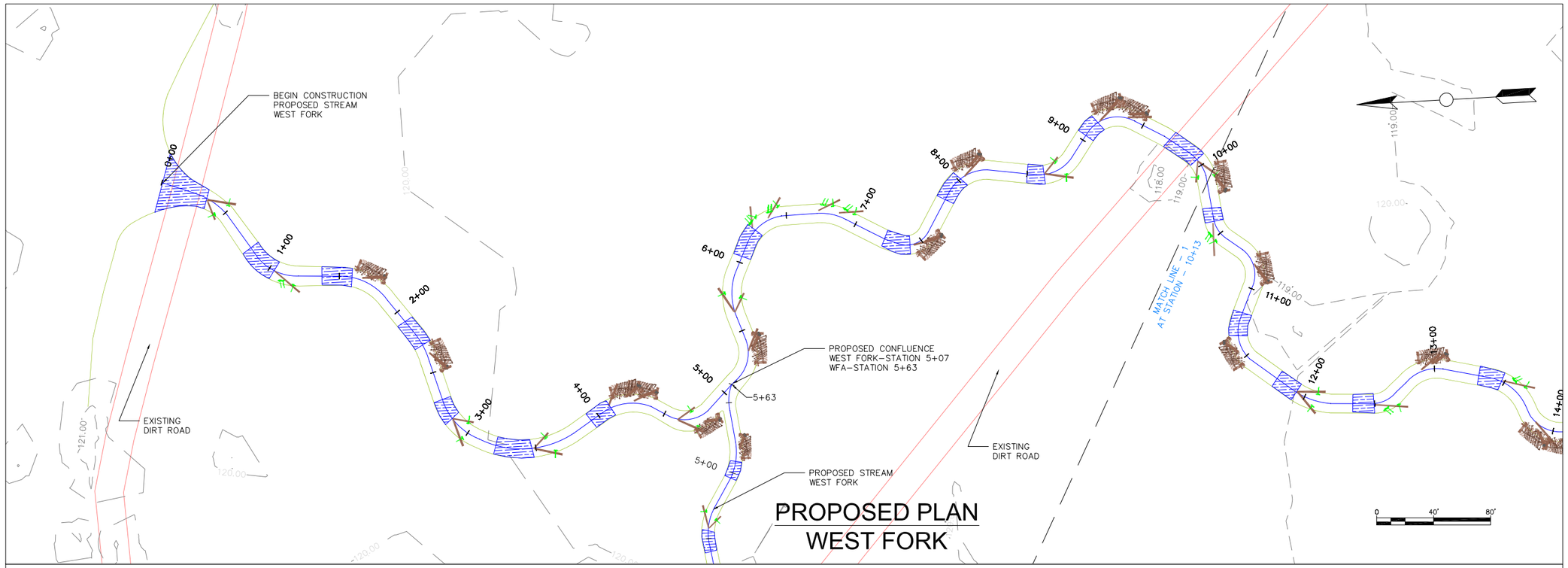
Meanders River Restoration, Inc.

Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

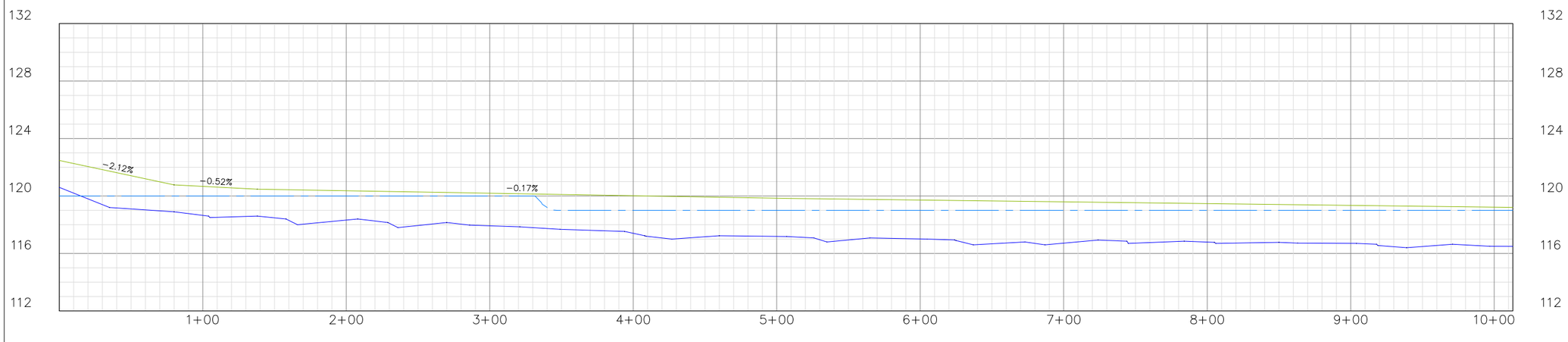
Project Name and Address

Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, TX 77098

Project	Sheet
HCMB	3
Date: 6/30/2013	
Scale: 1" = 40'	



PROPOSED PLAN
WEST FORK



Proposed Bankfull
Existing Grade
Proposed Thalweg

PROPOSED PROFILE

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 4'

General Notes

- Root Wad
- Scour Log
- Log J-Hook
- Toe Wood with Scour Log
- Log Rock and Roll
- Flow-Through Cross Vane
- Tree
- Riffle
- Fill Areas
- Bankfull Bench
- Point Bar/Low-Flow Bench
- Minor Existing Contour
- Major Existing Contour
- Proposed Bankfull
- Proposed Centerline

60% Design Plans

No.	Revision/Issue	Date

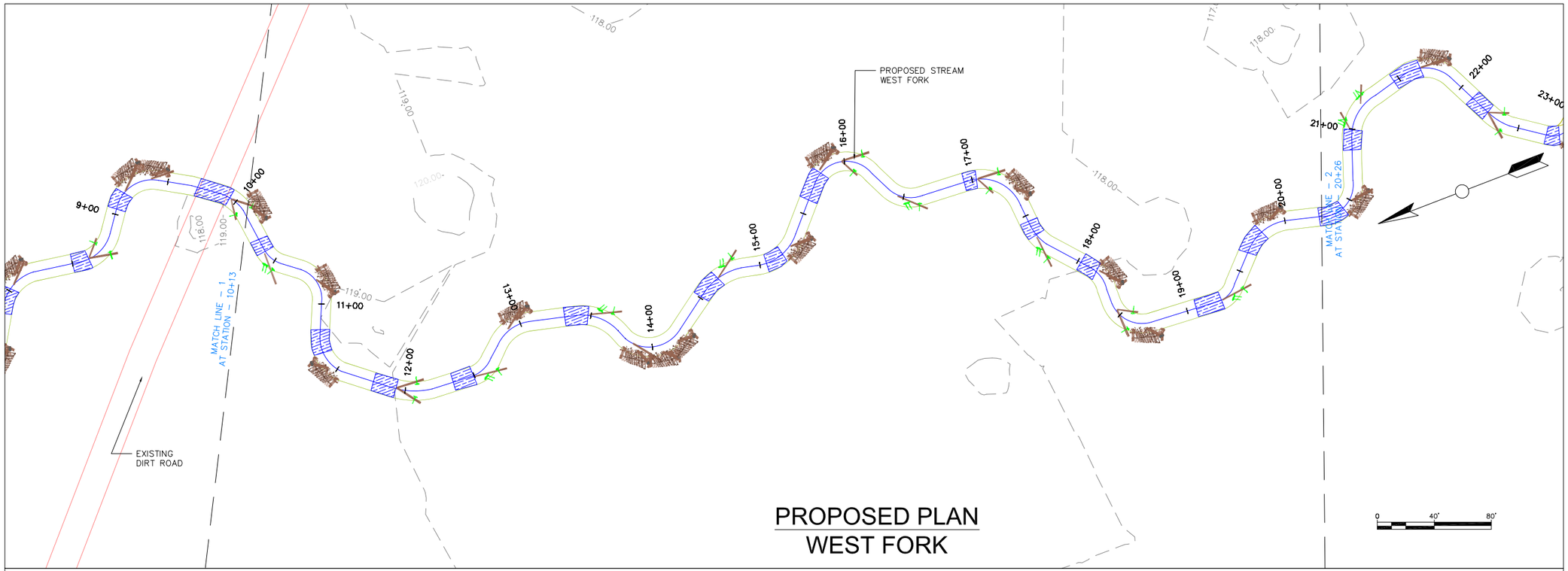
Firm Name and Address

Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

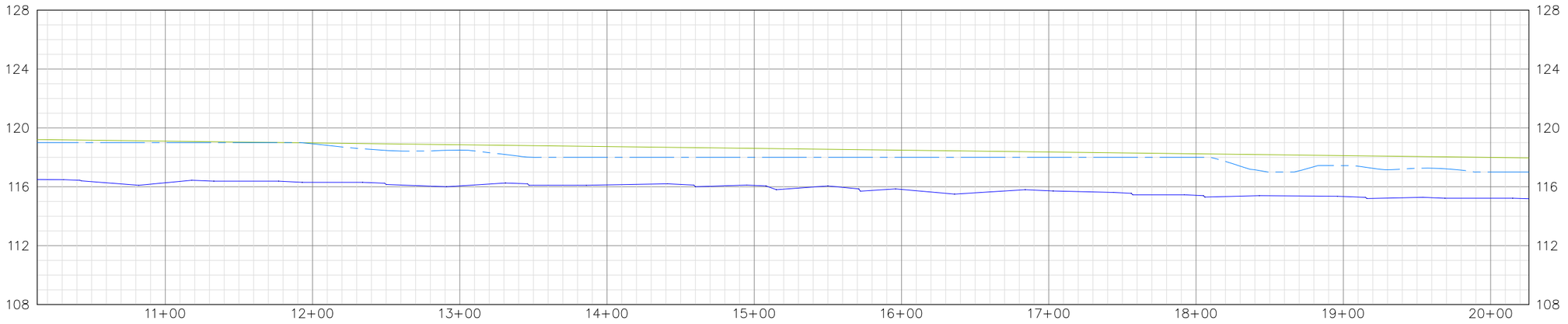
Project Name and Address

Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, TX 77098

Project	HCMB	Sheet
Date	6/30/2013	4
Scale	1" = 40'	



PROPOSED PLAN
WEST FORK



Proposed Bankfull
Existing Grade
Proposed Thalweg

PROPOSED PROFILE

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 4'

General Notes

- Root Wad
- Scour Log
- Log J-Hook
- Toe Wood with Scour Log
- Log Rock and Roll
- Flow-Through Cross Vane
- Tree
- Riffle
- Fill Areas
- Bankfull Bench
- Point Bar/Low-Flow Bench
- Minor Existing Contour
- Major Existing Contour
- Proposed Bankfull
- Proposed Centerline

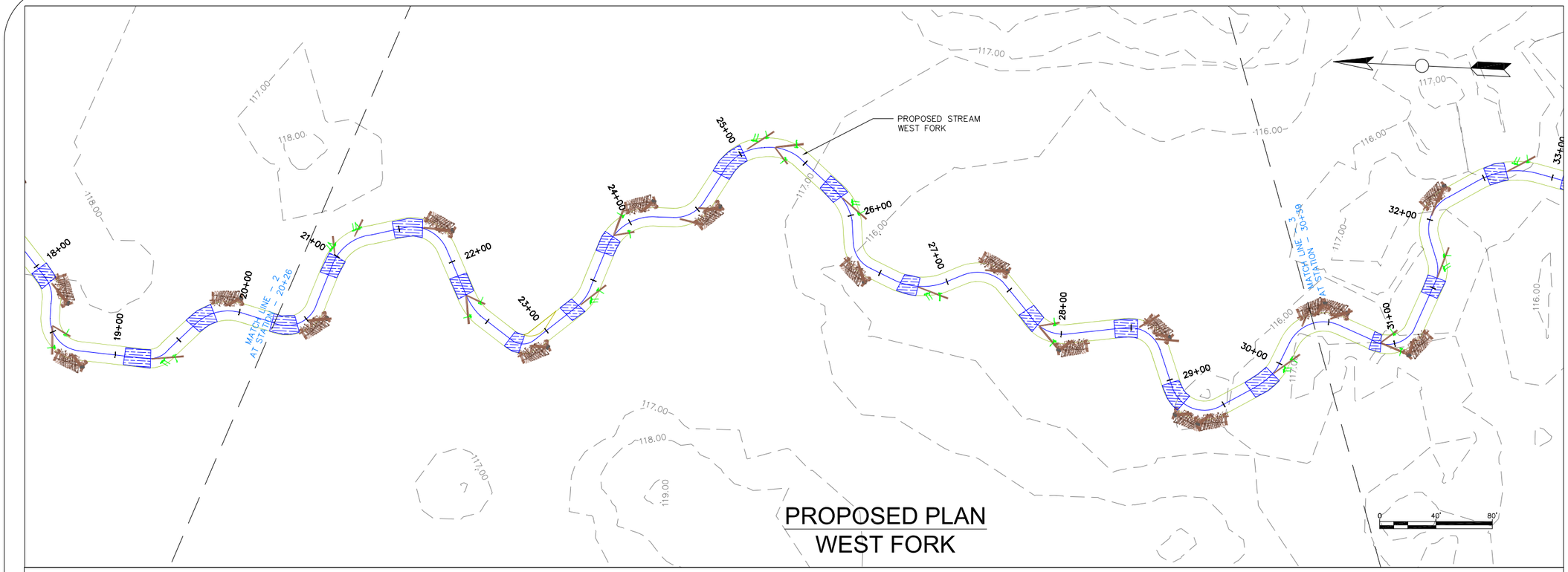
60% Design Plans

No.	Revision/Issue	Date

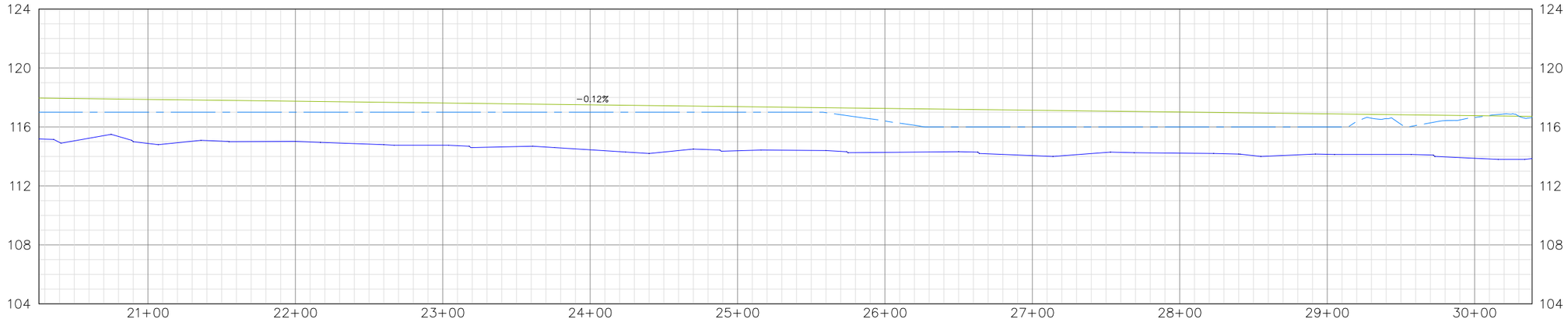
Firm Name and Address
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

Project Name and Address
Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, TX 77098

Project	HCMB
Date	6/30/2013
Scale	1" = 40'
Sheet	5



PROPOSED PLAN
WEST FORK



Proposed Bankfull
Existing Grade
Proposed Thalweg

PROPOSED PROFILE

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 4'

General Notes

- Root Wad
- Scour Log
- Log J-Hook
- Toe Wood with Scour Log
- Log Rock and Roll
- Flow-Through Cross Vane
- Tree
- Riffle
- Fill Areas
- Bankfull Bench
- Point Bar/Low-Flow Bench
- Minor Existing Contour
- Major Existing Contour
- Proposed Bankfull
- Proposed Centerline

60% Design Plans

No.	Revision/Issue	Date

Firm Name and Address

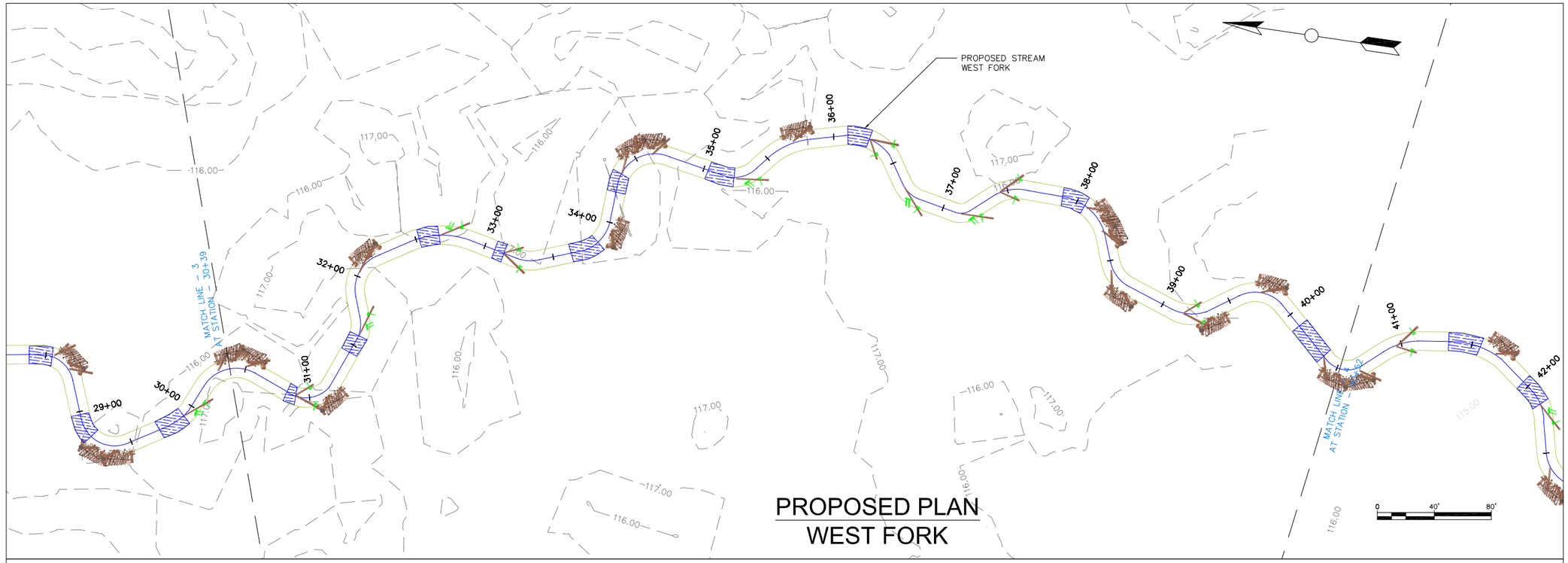
Meanders River Restoration, Inc.

Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

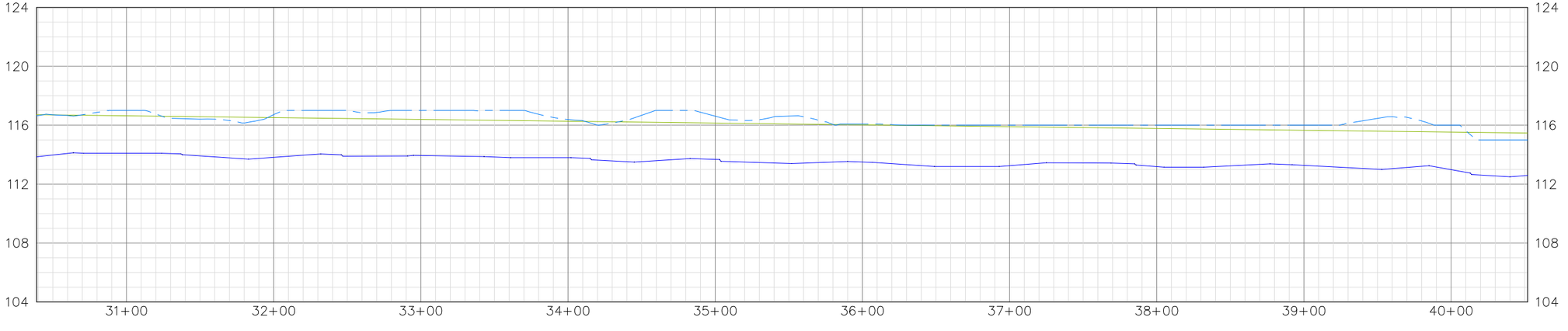
Project Name and Address

Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, TX 77098

Project	Sheet
HCMB	6
Date: 6/30/2013	
Scale: 1" = 40'	



PROPOSED PLAN
WEST FORK



Proposed Bankfull
Existing Grade
Proposed Thalweg

PROPOSED PROFILE

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 4'

General Notes

- Root Wad
- Scour Log
- Log J-Hook
- Toe Wood with Scour Log
- Log Rock and Roll
- Flow-Through Cross Vane
- Tree
- Riffle
- Fill Areas
- Bankfull Bench
- Point Bar/Low-Flow Bench
- Minor Existing Contour
- Major Existing Contour
- Proposed Bankfull
- Proposed Centerline

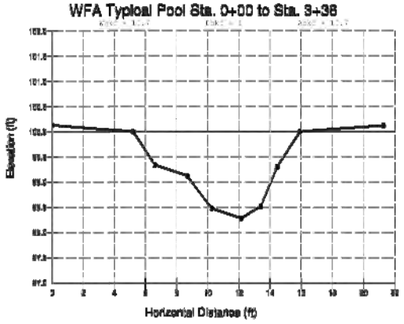
60% Design Plans

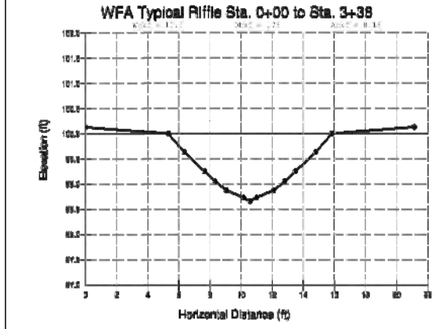
No.	Revision/Issue	Date

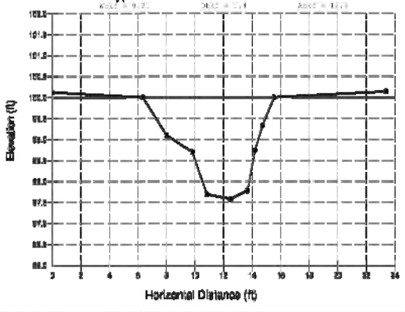
Firm Name and Address
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

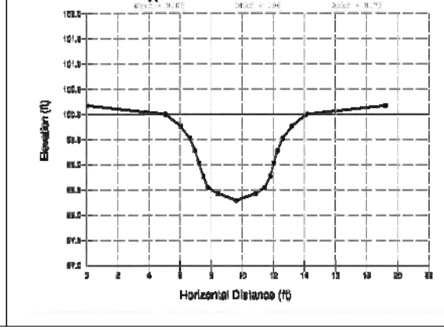
Project Name and Address
Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, TX 77098

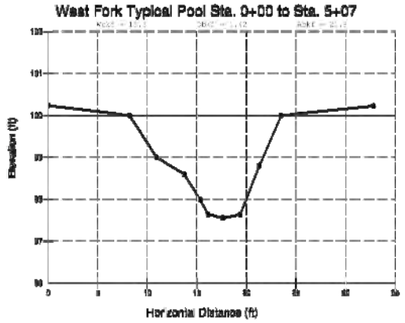
Project	Sheet
HCMB	7
Date: 6/30/2013	
Scale: 1" = 40'	

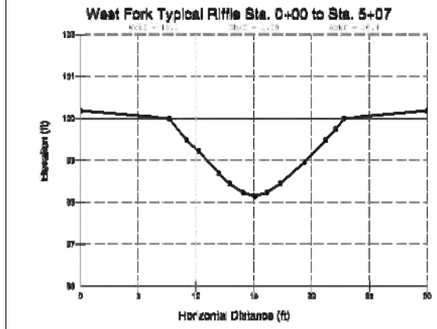


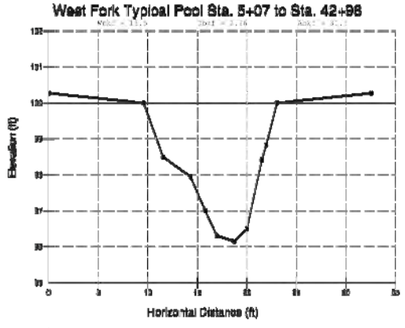


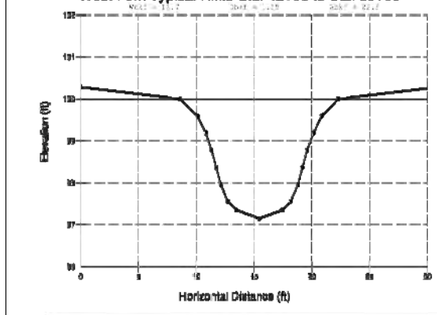


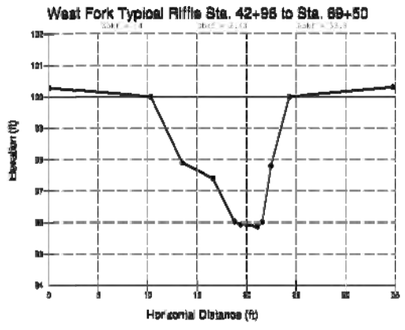


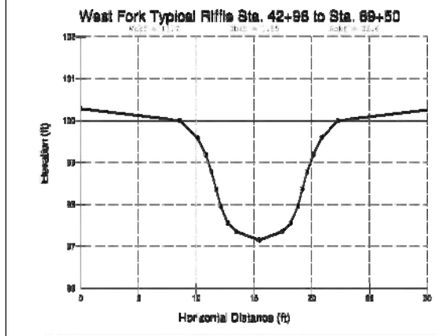


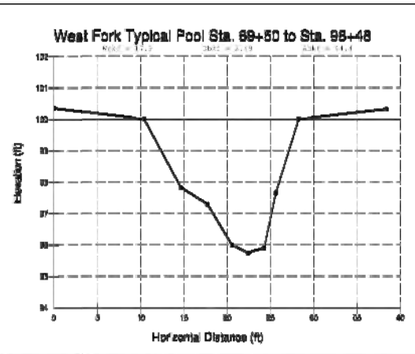


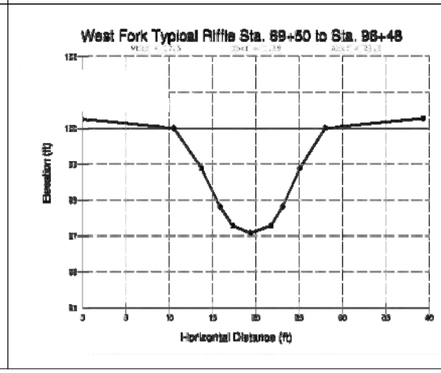


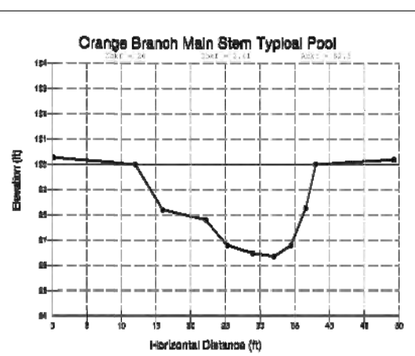


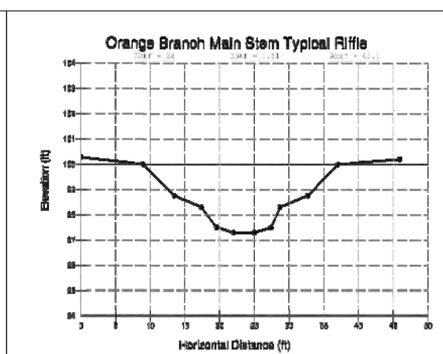












General Notes

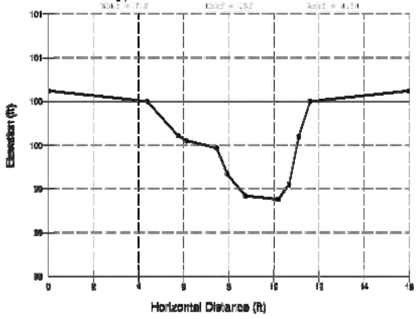
No.	Revision/Issue	Date

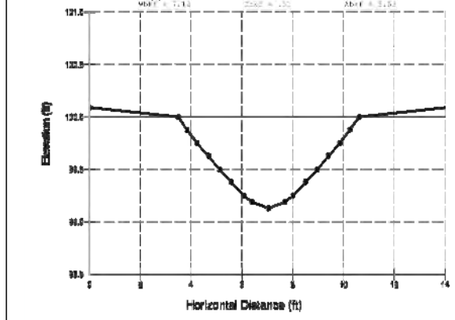
Meanders
River Restoration, Inc.
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, Presldent
404-245-5497

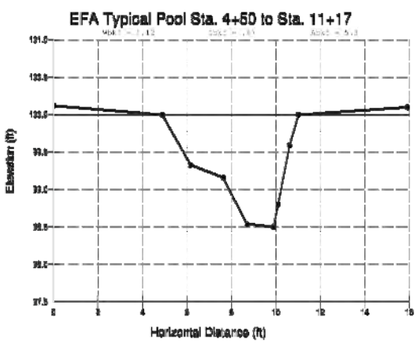
Project Name and Address

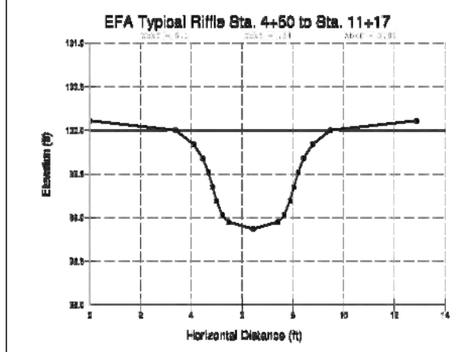
Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, Texas 77098

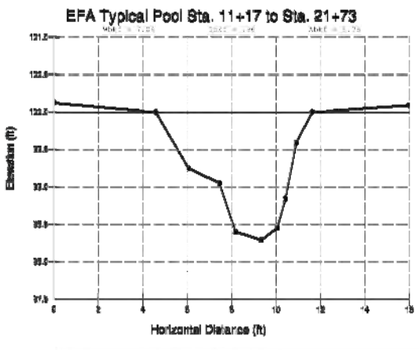
Project	Sheet
HCMB	34
Date: 6/30/2013	
Scale:	

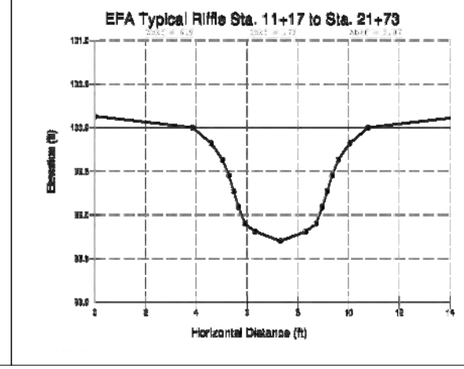


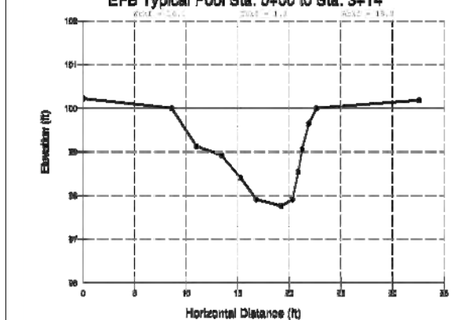


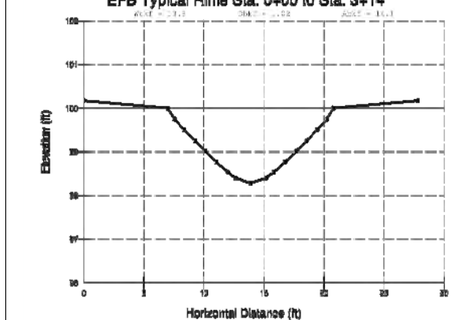


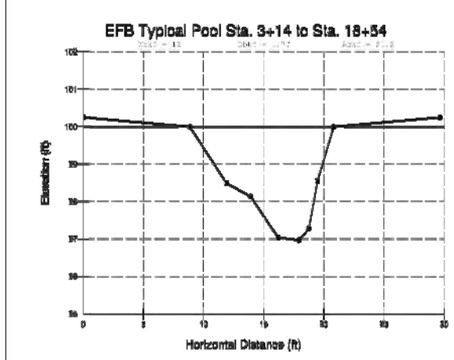


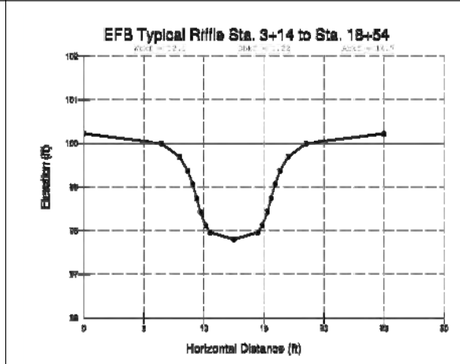


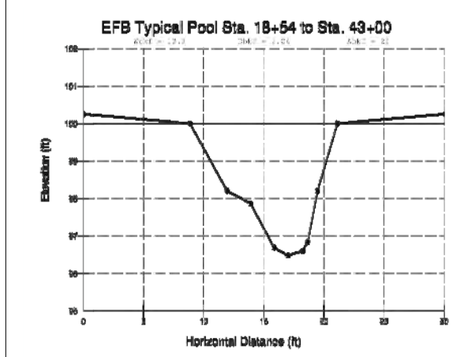


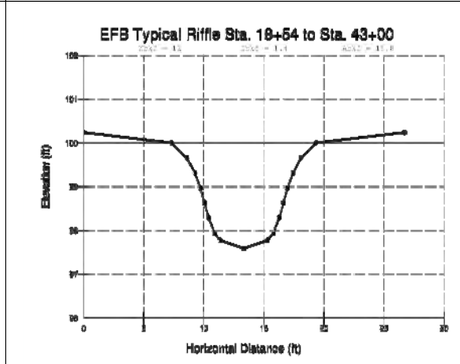












General Notes

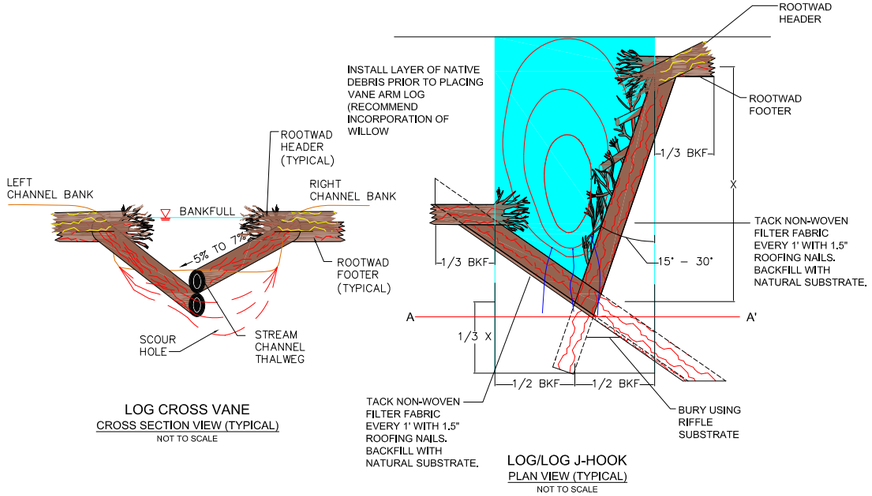
No.	Revision/Issue	Date

Meanders
River Restoration, Inc.
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

Project Name and Address

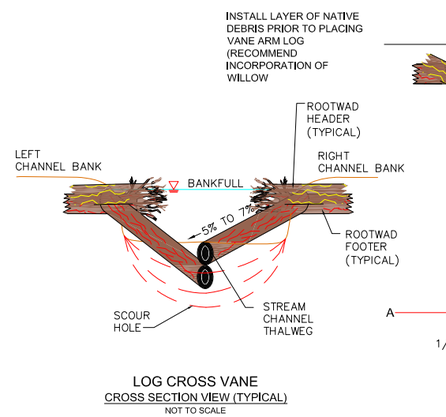
Houston Conroe Mitigation Bank Forestar
3355 West Alabama, Suite 1240
Houston, Texas 77098

Project	Sheet
HCMB	35
Date: 6/30/2013	
Scale:	

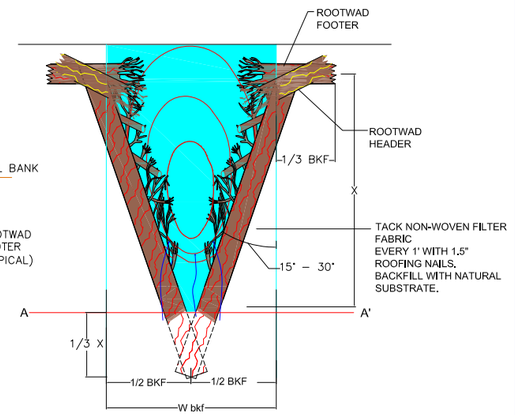


LOG CROSS VANE
CROSS SECTION VIEW (TYPICAL)
NOT TO SCALE

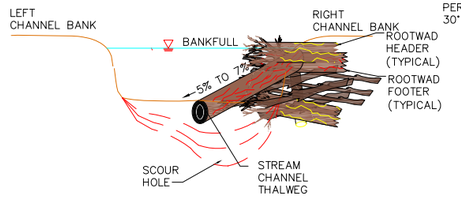
LOG/LOG J-HOOK
PLAN VIEW (TYPICAL)
NOT TO SCALE



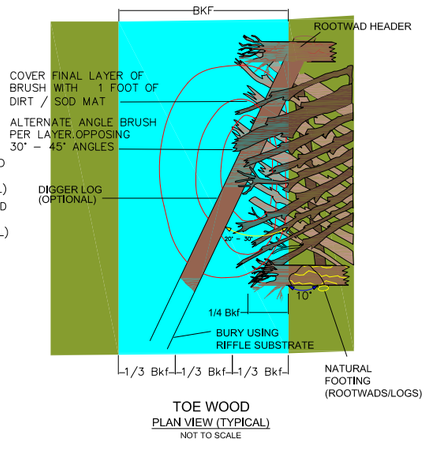
LOG CROSS VANE
CROSS SECTION VIEW (TYPICAL)
NOT TO SCALE



LOG CROSS VANE
PLAN VIEW (TYPICAL)
NOT TO SCALE



TOE WOOD
CROSS SECTION VIEW (TYPICAL)
NOT TO SCALE



TOE WOOD
PLAN VIEW (TYPICAL)
NOT TO SCALE

General Notes

No.	Revision/Issue	Date

Meanders
River Restoration, Inc.
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

Project Name and Address

Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, Texas 77098

Project	Sheet
HCMB	37
Date: 6/30/2013	
Scale:	

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 15+20			"C5" Reference Condition Long Branch		
Stream Name: Orange Main Stem	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	4.48	4.39	4.60	0.80	N/A	N/A
Stream Type (Rosgen)	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES						
Wbkf (Bankfull width in feet)	28.00	26.00	32.00	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.60	1.50	1.70	1.09	-	-
Wfpa (Width of floodplain area)	650.0	550.0	800.0	30.00	-	-
Abkf (Cross-sectional Area)	45.00	38.25	51.75	6.00	-	-
Wbkf / Dbkf ratio	17.5	15.3	19.3	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	23.2	21.2	30.8	4.30	-	-
Dmax (Max depth at bankfull)	2.70	2.5	3.0	1.30	-	-
Dmaxtob (Max depth at top of bank)	2.70	1.6	3.5	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.70	1.55	1.85	1.82	-	-
Dmaxtob/Dmax (Bank height ratio)	1.00	1.00	1.10	1.00	-	-
PATTERN VARIABLES						
Lm (Meander length in feet)	168.0	84.0	248.0	133.0	118.0	153.0
Lw (Linear Wave length in feet)	151.0	98.0	230.0	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	56	49	98	20.7	16.7	23.9
Larc (Arc length in feet)	59.0	20.0	100.0	30.3	24.7	42.0
Wblt (Belt width in feet)	103	60	160	38.4	36.7	44.0
K (Sinuosity)	1.27	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	6.6	3.0	12.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	5.4	3.0	8.2	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	2.0	1.8	3.3	1.5	1.2	1.6
Larc/Wbkf (Arc length ratio)	2.1	0.7	3.6	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	3.7	2.1	5.7	2.8	2.6	3.1
PROFILE VARIABLES						
Sval (Valley slope, ft/ft)	0.00142	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.00112	N/A	N/A	0.00128	N/A	N/A
Sriff (Riffle slope, ft/ft)	0.0083	0.0050	0.0100	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.0001	0.4E-05	0.0002	0.0003	0.00008	0.001
Sriff/Schan (Riffle slope ratio)	7.41	4.36	8.93	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.09	0.02	0.18	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	4.00	2.72	4.80	2.14	-	-
Wpool (Width of pool in feet)	25.20	22.40	32.20	18.80	-	-
Lriffle (Length of riffle in feet)	14.00	8.00	25.00	7.50	4.42	11.30
Lpool (Length of pool in feet)	27.12	18.00	140.00	18.45	11.30	27.00
Lglide (Length of glide in feet)	53.07	21.44	93.80	10.14	7.32	12.81
Lps (Pool-pool spacing in feet)	90.00	70.00	130.00	41.30	30.00	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.50	1.70	3.00	1.96	-	-
Wpool/Wbkf (Pool width ratio)	0.90	0.80	1.15	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	0.52	0.29	0.89	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	0.97	0.38	5.00	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.97	0.77	3.35	0.72	0.52	0.92
** Lps/Wbkf (Pool-pool spacing ratio)	3.21	2.50	4.64	2.96	2.21	4.93
MATERIALS				Reach	Riffle	Pro. Ht.
D16 (mm)				-	-	-
D35 (mm)				-	-	-

General Notes

No.	Revision/Issue	Date

Meanders River Restoration, Inc.
Meanders Restoration, Inc.
7065 Shakerag Road
Ellijay, GA 30540
Steve Jones, President
404-245-5497

Project Name and Address

Houston Conroe Mitigation Bank
Forestar
3355 West Alabama, Suite 1240
Houston, Texas 77098

Project HCMB

Date 6/30/2013

Scale

Sheet 38

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 3+36			Design Criteria Sta. 3+36 to Sta. 5+63			"C5" Reference Condition UT to Peach Ck. 2			"E5" Reference Condition Shell Branch		
Stream Name: WFA	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.26	0.25	0.27	0.29	0.28	0.30	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES												
Wbkf (Bankfull width in feet)	10.50	9.45	11.55	9.05	8.15	9.96	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	0.78	0.66	0.90	0.96	0.82	1.10	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	31.50	20.79	52.50	27.15	17.92	45.25	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	8.19	6.96	9.42	8.69	7.38	9.99	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.46	11.46	15.46	9.43	7.43	11.43	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.34	1.21	1.44	1.71	1.54	1.82	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.41	1.61	1.59	1.79	1.61	2.01	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.33	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES												
Lm (Meander length in feet)	99.8	73.5	120.8	99.6	81.5	117.7	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	67.2	52.5	89.3	65.2	54.3	81.5	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	31.5	18.4	N/A	20.8	13.6	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	21.0	13.1	36.8	23.5	15.8	40.7	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	23.1	13.7	36.8	36.2	24.9	45.3	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.17	N/A	N/A	1.1	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	11.0	9.0	13.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	6.4	5.0	8.5	7.2	6.0	9.0	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES												
Sval (Valley slope, ft/ft))	0.0075	N/A	N/A	0.0034	N/A	N/A	0.00363	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0064	N/A	N/A	0.0032	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0176	0.0128	0.0256	0.0088	0.0064	0.0128	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.00096	0.00048	0.00128	0.00048	0.00024	0.00064	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	1.72	1.33	2.50	2.40	1.63	3.84	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	10.71	9.45	12.60	9.23	8.15	10.86	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	10.50	5.25	17.85	9.05	4.53	15.39	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	18.38	10.50	31.50	22.63	15.39	36.20	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	10.50	8.40	15.75	10.86	8.15	13.58	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	47.25	39.90	68.25	49.78	40.73	63.35	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS							Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)							0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)							0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)							0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)							0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)							0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)							4.00	N/A	22.60	1.00	0.50	32.00

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 5+07			Design Criteria Sta. 5+07 to Sta. 42+96			Design Criteria Sta. 42+96 to Sta. 69+50			Design Criteria Sta. 69+50 to Sta. 97+55			"C5" Reference Condition UT to Peach Ck. 2			"E5" Reference Condition Shell Branch			"E5" Reference Condition Rocky Branch			"C5" Reference Condition Long Branch		
Stream Name: West Fork	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.8	N/A	N/A	1.15	1.12	1.19	1.30	1.27	1.33	2.01	1.97	2.05	0.07	N/A	N/A	0.28	N/A	N/A	3.86	N/A	N/A	0.85	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES																								
Wbkf (Bankfull width in feet)	15.01	13.51	16.51	13.20	11.88	14.52	13.70	12.33	15.07	17.50	15.75	20.13	7.10	6.59	7.61	7.39	6.96	7.81	18.80	18.80	18.90	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.09	0.93	1.25	1.54	1.31	1.77	1.65	1.40	1.90	1.70	1.45	1.96	0.50	0.47	0.52	0.83	0.79	0.87	2.29	2.14	2.44	1.09	-	-
Wfpa (Width of floodprone area)	45.03	29.72	75.05	39.60	29.04	66.00	41.10	27.13	68.50	52.50	34.65	87.50	25.98	21.00	31.00	26.30	26.10	26.50	73.10	68.10	78.00	30.00	-	-
Abkf (Cross-sectional Area)	16.36	13.91	18.82	20.33	17.28	23.38	22.61	19.21	26.00	29.75	25.29	34.21	3.55	3.10	3.96	6.09	6.03	6.14	43.10	40.11	46.09	6.09	-	-
Wbkf / Dbkf ratio	13.77	11.77	15.77	8.57	6.57	10.57	8.30	6.30	10.30	10.29	8.29	13.79	14.20	12.67	16.19	8.90	8.00	9.89	8.26	7.75	8.77	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.44	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81	3.89	3.60	4.15	3.58	-	-
Dmax (Max. depth at bankfull)	1.87	1.69	2.02	2.65	2.39	2.85	2.84	2.56	3.05	2.92	2.64	3.15	0.92	0.85	0.98	1.59	1.55	1.62	4.12	4.08	4.15	1.59	-	-
Dmaxtob (Max depth at top of bank)	1.97	1.77	2.22	2.78	2.50	3.13	2.98	2.68	3.36	3.07	2.76	3.46	0.92	0.85	0.98	1.90	1.80	2.10	4.19	4.08	4.37	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05	1.80	1.67	1.94	1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.05	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.00	1.05	1.00	-	-
PATTERN VARIABLES																								
Lm (Meander length in feet)	142.6	105.1	172.6	145.2	118.8	184.8	150.7	123.3	191.8	192.5	157.5	245.0	59.7	46.7	72.1	83.6	75.3	89.3	178.0	145.9	194.7	135.9	118.0	153.0
Lw(Linear Wave length in feet)	105.1	75.1	150.1	99.0	66.0	125.4	102.8	82.2	130.2	131.3	105.0	166.3	36.1	30.5	48.7	46.5	43.1	52.1	144.6	128.4	160.8	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	45.0	26.3	N/A	30.4	19.8	N/A	31.5	20.6	N/A	40.3	26.3	N/A	20.9	12.6	29.8	11.0	9.8	13.8	29.5	22.9	34.5	20.7	16.7	25.9
Larc(Arc length in feet)	30.0	18.8	52.5	34.3	23.1	59.4	35.6	24.0	61.7	45.5	30.6	78.8	17.9	14.9	20.5	22.2	12.9	30.5	65.3	59.9	71.3	30.3	24.7	42.0
Wblt (Belt width in feet)	33.0	19.5	52.5	66.0	42.2	85.8	68.5	54.8	89.1	87.5	70.0	113.8	13.3	9.2	16.4	38.8	35.3	45.2	9.8	5.4	21.4	39.4	36.7	44.0
K (Sinuosity)	1.07	N/A	N/A	1.31	N/A	N/A	1.41	N/A	N/A	1.36	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A	1.49	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	11.0	9.0	14.0	11.0	9.0	14.0	11.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1	9.5	7.8	10.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	5.0	9.5	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0	7.7	6.8	8.6	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9	1.6	1.2	1.8	1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1	3.5	3.2	3.8	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	5.0	3.2	6.5	5.0	4.0	6.5	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1	0.5	0.3	1.1	2.8	2.6	3.1
PROFILE VARIABLES																								
Sval (Valley slope, ft/ft))	0.0073	N/A	N/A	0.0017	N/A	N/A	0.0023	N/A	N/A	0.0012	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A	0.0051	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.0068	N/A	N/A	0.0013	N/A	N/A	0.0016	N/A	N/A	0.0009	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A	0.0036	N/A	N/A	0.0013	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0187	0.0136	0.0272	0.0036	0.0026	0.0052	0.0045	0.0033	0.00652	0.0024	0.0018	0.00352	0.008	0.0075	0.01	0.011	0.008	0.014	0.011	0.006	0.018	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.001	0.0005	0.00136	0.0002	1E-04	0.00026	0.0002	0.0001	0.000326	0.0001	7E-05	0.000176	0.0004	0.0002	0.0007	0.0005	3E-05	0.0011	0.001	0.00	0.0009	0.0003	8E-05	0.001
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26	3.03	1.65	4.96	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26	0.28	0.00	0.25	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	2.40	1.85	3.49	3.85	2.62	6.16	4.13	2.81	6.60	4.25	2.89	6.80	0.96	0.73	1.38	1.66	1.47	1.87	4.60	4.50	4.60	2.14	-	-
Wpool (Width of pool in feet)	15.31	13.51	18.01	13.46	11.88	15.84	13.97	12.33	16.44	17.85	15.75	21.00	7.35	7.15	7.55	9.03	7.97	10.10	19.26	19.00	19.60	18.80	-	-
Lriffle (Length of riffle in feet)	15.01	7.51	25.52	13.20	6.60	22.44	13.70	6.85	23.29	17.50	8.75	29.75	6.30	2.70	11.60	6.88	5.61	8.35	9.79	5.39	21.40	7.59	4.42	11.30
Lpool (Length of pool in feet)	26.27	15.01	45.03	33.00	22.44	52.80	34.25	23.29	54.80	43.75	29.75	70.00	11.70	6.00	21.40	25.31	17.40	33.70	29.67	12.73	44.20	18.45	11.30	27.00
Lglide (Length of glide in feet)	15.01	12.01	22.52	15.84	11.88	19.80	16.44	12.33	20.55	21.00	15.75	26.25	6.96	6.14	8.67	9.04	7.21	11.04	14.32	12.70	21.50	10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	67.55	57.04	97.57	72.60	59.40	92.40	75.35	61.65	95.90	96.25	78.75	122.50	22.60	17.50	31.30	44.70	41.30	48.20	67.82	47.03	92.80	41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25	2.01	1.97	2.01	1.96	-	-
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37	1.02	1.01	1.04	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	0.89	0.38	1.63	0.93	0.76	1.13	0.52	0.29	1.14	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56	1.58	0.68	2.35	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49	0.76	0.68	1.14	0.72	0.52	0.92
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52	3.61	2.50	4.94	2.96	2.21	4.93
MATERIALS													Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)													0.03	N/A	5.91	0.03	0.03	4.71	0.03	0.04	N/A	-	-	-
D35 (mm)													0.06	N/A	9.65	0.06	0.07	9.40	0.07	0.09	N/A	-	-	-
D50 (mm)													0.09	N/A	12.18	0.09	0.09	11.99	0.11	0.15	N/A	-	-	-
D84 (mm)													0.20	N/A	18.20	0.22	0.19	21.46	0.28	4.68	N/A	-	-	-
D95 (mm)													0.38	N/A	21.23	0.36	0.24	28.04	9.18	8.66	N/A	-	-	-
D100 (mm)													4.00	N/A	22.60	1.00	0.50	32.00	16.00	16.00	N/A	-	-	-

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 14+83				"C5" Reference Condition Long Branch		
Stream Name: Orange Main Stem	Mean	Min	Max		Mean	Min	Max
Drainage Area (square miles)	4.48	4.39	4.60		0.85	N/A	N/A
Stream Type (Rosgen)	E5	N/A	N/A		C5	N/A	N/A
DIMENSION VARIABLES							
Wbkf (Bankfull width in feet)	28.00	26.00	32.00		14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.60	1.50	1.70		1.09	-	-
Wfpa (Width of floodprone area)	650.0	550.0	800.0		30.00	-	-
Abkf (Cross-sectional Area)	45.00	38.25	51.75		6.09	-	-
Wbkf / Dbkf ratio	17.5	15.5	19.5		12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	23.2	21.2	30.8		3.58	-	-
Dmax (Max. depth at bankfull)	2.70	2.5	3.0		1.59	-	-
Dmaxtob (Max depth at top of bank)	2.70	1.6	3.3		1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.70	1.55	1.85		1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.00	1.00	1.10		1.00	-	-
PATTERN VARIABLES							
Lm (Meander length in feet)	186.0	84.0	348.0		135.9	118.0	153.0
Lw(Linear Wave length in feet)	151.0	80.0	230.0		109.2	97.0	123.0
Rc (Radius of Curvature in feet)	56	49	98		20.7	16.7	25.9
Larc(Arc length in feet)	59.0	20.0	100.0		30.3	24.7	42.0
Wblt (Belt width in feet)	103	60	160		39.4	36.7	44.0
K (Sinuosity)	1.27	N/A	N/A		1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	6.6	3.0	12.4		9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	5.4	2.9	8.2		7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	2.0	1.8	3.5		1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.1	0.7	3.6		2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	3.7	2.1	5.7		2.8	2.6	3.1
PROFILE VARIABLES							
Sval (Valley slope, ft/ft))	0.00142	N/A	N/A		0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.00112	N/A	N/A		0.00128	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0083	0.0060	0.0100		0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.0001	8.4E-05	0.0002		0.0003	0.00008	0.001
Srif/Schan (Riffle slope ratio)	7.41	5.36	8.93		5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.09	0.08	0.18		0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	4.00	2.72	4.80		2.14	-	-
Wpool (Width of pool in feet)	25.20	22.40	32.20		18.80	-	-
Lriffle (Length of riffle in feet)	14.60	8.00	25.00		7.59	4.42	11.30
Lpool (Length of pool in feet)	27.12	10.60	140.00		18.45	11.30	27.00
Lglide (Length of glide in feet)	55.07	21.44	93.80		10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	90.00	70.00	130.00		41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.50	1.70	3.00		1.96	-	-
Wpool/Wbkf (Pool width ratio)	0.90	0.80	1.15		1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	0.52	0.29	0.89		0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	0.97	0.38	5.00		1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.97	0.77	3.35		0.72	0.52	0.92
** Lps/Wbkf (Pool-pool spacing ratio)	3.21	2.50	4.64		2.96	2.21	4.93
MATERIALS					Reach	Riffle	Prot. Ht.
D16 (mm)					-	-	-
D35 (mm)					-	-	-
D50 (mm)					-	-	-
D84 (mm)					-	-	-
D95 (mm)					-	-	-
D100 (mm)					-	-	-

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 10+50			Design Criteria Sta. 10+50 to Sta. 21+73			Design Criteria Sta. 21+73 to 50+76			"C5" Reference Condition UT to Peach Ck. 2			"E5" Reference Condition Shell Branch		
Stream Name: EFC	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.71	N/A	N/A	0.72	N/A	N/A	0.9	N/A	N/A	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	14.70	13.23	16.17	12.30	11.07	13.53	12.30	11.07	13.53	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	1.04	0.88	1.20	1.25	1.06	1.44	1.45	1.23	1.67	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	44.10	29.11	73.50	36.90	24.35	61.50	36.90	24.35	61.50	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	15.29	12.99	17.58	15.38	13.07	17.68	17.84	15.16	20.51	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	14.13	12.13	16.13	9.84	7.84	11.84	8.48	6.48	10.48	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.79	1.61	1.92	2.23	2.00	2.38	2.49	2.25	2.68	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.88	1.61	2.12	2.34	1.61	2.61	2.62	1.61	2.95	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	139.7	102.9	176.4	147.6	110.7	172.2	147.6	110.7	172.2	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	102.9	73.5	147.0	92.3	73.8	116.9	92.3	73.8	116.9	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	44.1	25.7	N/A	28.3	18.5	N/A	28.3	18.5	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	29.4	18.4	51.5	32.0	21.5	55.4	32.0	21.5	55.4	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	32.3	19.1	51.5	49.2	33.8	61.5	61.5	49.2	80.0	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.13	N/A	N/A	1.31	N/A	N/A	1.42	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	12.0	12.0	9.0	14.0	12.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0014	N/A	N/A	0.0016	N/A	N/A	0.0011	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0012	N/A	N/A	0.0012	N/A	N/A	0.0008	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0033	0.0024	0.0048	0.0034	0.0025	0.00492	0.0022	0.0016	0.00316	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.0002	9E-05	0.00024	0.0002	9.2E-05	0.000246	0.0001	6E-05	0.000158	0.0004	0.0002	0.0007	0.0005	3E-05	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	2.29	1.77	3.33	3.13	2.13	5.00	3.63	2.47	5.80	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	14.99	13.23	17.64	12.55	11.07	14.76	12.55	11.07	14.76	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	14.70	7.35	29.40	12.30	6.15	23.37	12.30	6.15	22.14	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	25.73	14.70	44.10	30.75	20.91	49.20	30.75	20.91	49.20	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	14.70	11.76	22.05	14.76	11.07	18.45	14.76	11.07	18.45	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	66.15	55.86	95.55	67.65	55.35	86.10	67.65	55.35	86.10	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.50	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 3+14			Design Criteria Sta. 3+14 to Sta. 18+54			Design Criteria Sta. 18+54 to Sta. 43+36			"C5" Reference Condition UT to Peach Ck. 2			"E5" Reference Condition Shell Branch		
Stream Name: EFB	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.62	N/A	N/A	0.65	0.63	0.67	0.81	0.72	0.90	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	13.83	12.45	15.21	11.80	10.62	12.98	12.00	10.80	13.20	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	1.02	0.87	1.17	1.25	1.06	1.44	1.40	1.19	1.61	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	41.49	27.38	69.15	35.40	23.36	59.00	36.00	23.76	60.00	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	14.11	11.99	16.22	14.75	12.54	16.96	16.80	14.28	19.32	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.56	11.56	15.56	9.44	7.44	11.44	8.57	6.57	10.57	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	1.75	1.58	1.89	2.23	2.00	2.38	2.41	2.17	2.59	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	1.84	1.58	2.08	2.34	2.00	2.61	2.53	2.17	2.85	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.72	1.55	1.85	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	131.4	96.8	159.0	141.6	106.2	165.2	144.0	108.0	168.0	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	96.8	69.2	138.3	88.5	70.8	112.1	90.0	72.0	114.0	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	41.5	24.2	N/A	27.1	17.7	N/A	27.6	18.0	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	27.7	17.3	48.4	30.7	20.7	53.1	31.2	21.0	54.0	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	30.4	18.0	48.4	47.2	32.5	59.0	60.0	48.0	78.0	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.10	N/A	N/A	1.31	N/A	N/A	1.40	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	11.5	12.0	9.0	14.0	12.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	5.0	4.0	6.5	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0033	N/A	N/A	0.0016	N/A	N/A	0.0021	N/A	N/A	0.0036	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.0030	N/A	N/A	0.0012	N/A	N/A	0.0015	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0082	0.0060	0.0120	0.0033	0.0024	0.0048	0.0041	0.0030	0.0060	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.0004	0.0002	0.0006	0.0002	0.0001	0.0002	0.0002	0.0001	0.0003	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	2.24	1.73	4.08	3.06	2.13	5.00	3.50	2.38	5.60	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	14.11	12.45	16.60	12.04	10.62	14.16	12.24	10.80	14.40	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	13.83	6.92	27.66	11.80	5.90	22.42	12.00	6.00	21.60	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	24.20	13.83	41.49	29.50	20.06	47.20	30.00	20.40	48.00	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	13.83	11.06	20.75	14.16	10.62	17.70	14.40	10.80	18.00	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	62.24	52.55	89.90	64.90	53.10	82.60	66.00	54.00	84.00	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	4.00	2.45	1.70	4.00	2.50	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 4+50			Design Criteria Sta. 4+50 to Sta. 11+17			Design Criteria Sta. 11+17 to Sta. 22+06			"C5" Reference Condition UT to Peach Ck. 2			"E5" Reference Condition Shell Branch		
Stream Name: EFA	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	0.07	N/A	N/A	0.08	N/A	N/A	0.12	N/A	N/A	0.07	N/A	N/A	0.28	N/A	N/A
Stream Type (Rosgen)	C5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A	E5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	7.10	6.39	7.81	6.10	5.49	6.71	6.90	6.21	7.59	7.10	6.59	7.61	7.39	6.96	7.81
Dbkf (Bankfull mean depth in feet)	0.51	0.43	0.59	0.64	0.54	0.74	0.73	0.62	0.84	0.50	0.47	0.52	0.83	0.79	0.87
Wfpa (Width of floodprone area)	21.30	14.06	35.50	18.30	12.08	30.50	20.70	13.66	34.50	25.98	21.00	31.00	26.30	26.10	26.50
Abkf (Cross-sectional Area)	3.62	3.08	4.16	3.90	3.32	4.49	5.04	4.28	5.79	3.55	3.10	3.96	6.09	6.03	6.14
Wbkf / Dbkf ratio	13.92	11.92	15.92	9.53	7.53	11.53	9.45	7.45	11.45	14.20	12.67	16.19	8.90	8.00	9.89
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.66	2.76	4.70	3.58	3.34	3.81
Dmax (Max. depth at bankfull)	0.88	0.79	0.94	1.14	1.02	1.22	1.30	1.17	1.39	0.92	0.85	0.98	1.59	1.55	1.62
Dmaxtob (Max depth at top of bank)	0.92	0.79	1.04	1.20	1.02	1.34	1.36	1.17	1.53	0.92	0.85	0.98	1.90	1.80	2.10
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.78	1.60	1.90	1.78	1.60	1.90	1.84	1.81	1.88	1.92	1.78	2.05
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00
PATTERN VARIABLES															
Lm (Meander length in feet)	67.5	49.7	85.2	67.1	54.9	85.4	75.9	62.1	96.6	59.7	46.7	72.1	83.6	75.3	89.3
Lw(Linear Wave length in feet)	49.7	35.5	71.0	45.8	36.6	58.0	51.8	41.4	65.6	36.1	30.5	48.7	46.5	43.1	52.1
Rc (Radius of Curvature in feet)	21.3	12.4	N/A	14.0	9.2	N/A	15.9	10.4	N/A	20.9	12.6	29.8	11.0	9.8	13.8
Larc(Arc length in feet)	14.2	8.9	24.9	15.9	10.7	27.5	17.9	12.1	31.1	17.9	14.9	20.5	22.2	12.9	30.5
Wblt (Belt width in feet)	15.6	9.2	24.9	24.4	16.8	30.5	27.6	19.0	34.5	13.3	9.2	16.4	38.8	35.3	45.2
K (Sinuosity)	1.15	N/A	N/A	1.48	N/A	N/A	1.42	N/A	N/A	1.1	N/A	N/A	1.65	N/A	N/A
Lm/Wbkf (Meander length ratio)	9.5	7.0	12.0	11.0	9.0	14.0	11.0	9.0	14.0	8.4	6.6	10.2	11.3	10.2	12.1
Lw/Wbkf (Linear wave length ratio)	7.0	5.0	10.0	7.5	6.0	9.5	7.5	6.0	9.5	5.1	4.3	6.9	6.3	5.8	7.0
Rc/Wbkf (Radius of Curve ratio)	3.0	1.8	N/A	2.3	1.5	N/A	2.3	1.5	N/A	2.9	1.8	4.2	1.5	1.3	1.9
Larc/Wbkf (Arc length ratio)	2.0	1.3	3.5	2.6	1.8	4.5	2.6	1.8	4.5	2.5	2.1	2.9	3.0	1.7	4.1
Wblt/Wbkf (Meander width ratio)	2.2	1.3	3.5	4.0	2.8	5.0	4.0	2.8	5.0	1.9	1.3	2.3	5.3	4.8	6.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0012	N/A	N/A	0.0023	N/A	N/A	0.00458	N/A	N/A	0.00363	N/A	N/A	0.0071	N/A	N/A
Schan (Channel slope, ft/ft)	0.00104	N/A	N/A	0.00156	N/A	N/A	0.00322	N/A	N/A	0.0034	N/A	N/A	0.0043	N/A	N/A
Srif (Riffle slope, ft/ft)	0.00286	0.00208	0.00416	0.00428	0.00311	0.00622	0.00886	0.00644	0.01288	0.008	0.0075	0.01	0.011	0.008	0.014
Spool (Pool slope, ft/ft)	0.00016	7.8E-05	0.000208	0.00023	0.00012	0.000311	0.00048	0.00024	0.000644	0.0004	0.0002	0.0007	0.0005	0.00003	0.0011
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	2.35	2.21	2.94	2.56	1.86	3.26
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.12	0.06	0.21	0.12	0.01	0.26
Dmaxpool (Max Pool depth in feet)	1.12	0.87	1.63	1.47	1.09	2.56	1.72	1.24	2.92	0.96	0.73	1.38	1.66	1.47	1.87
Wpool (Width of pool in feet)	7.24	6.39	8.52	6.22	5.49	7.32	7.04	6.21	8.28	7.35	7.15	7.55	9.03	7.97	10.10
Lriffle (Length of riffle in feet)	7.10	3.55	14.20	6.10	3.05	11.59	6.90	3.45	12.42	6.30	2.70	11.60	6.88	5.61	8.35
Lpool (Length of pool in feet)	12.43	7.10	21.30	15.25	10.37	24.40	17.25	11.73	27.60	11.70	6.00	21.40	25.31	17.40	33.70
Lglide (Length of glide in feet)	7.10	5.68	10.65	7.32	5.49	9.15	8.28	6.21	10.35	6.96	6.14	8.67	9.04	7.21	11.04
Lps (Pool-pool spacing in feet)	31.95	26.98	46.15	33.55	27.45	42.70	37.95	31.05	48.30	22.60	17.50	31.30	44.70	41.30	48.20
Dmaxpool/Dbkf (Max pool depth ratio)	2.20	1.70	3.20	2.30	1.70	4.00	2.35	1.70	4.00	1.92	1.46	2.76	2.00	1.77	2.25
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.04	1.01	1.06	1.22	1.08	1.37
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	2.00	1.00	0.50	1.90	1.00	0.50	1.80	0.89	0.38	1.63	0.93	0.76	1.13
*Lpool/Wbkf (Pool length ratio)	1.75	1.00	3.00	2.50	1.70	4.00	2.50	1.70	4.00	1.65	0.85	3.01	3.42	2.35	4.56
Lglide/Wbkf (Glide length ratio)	1.00	0.80	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.98	0.86	1.22	1.22	0.98	1.49
** Lps/Wbkf (Pool-pool spacing ratio)	4.50	3.80	6.50	5.50	4.50	7.00	5.50	4.50	7.00	3.18	2.46	4.41	6.05	5.59	6.52
MATERIALS										Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)										0.03	N/A	5.91	0.03	0.03	4.71
D35 (mm)										0.06	N/A	9.65	0.06	0.07	9.40
D50 (mm)										0.09	N/A	12.18	0.09	0.09	11.99
D84 (mm)										0.20	N/A	18.20	0.22	0.19	21.46
D95 (mm)										0.38	N/A	21.23	0.36	0.24	28.04
D100 (mm)										4.00	N/A	22.60	1.00	0.50	32.00

Geomorphic Variables	Design Criteria Sta. 0+00 to Sta. 30+76			Design Criteria Sta. 30+76 to Sta. 41+45			Design Criteria Sta. 41+45 to Sta. 60+52			"E5" Reference Condition Rocky Branch			"C5" Reference Condition Long Branch		
Stream Name: East Fork	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Drainage Area (square miles)	1.95	1.83	2.07	2.34	N/A	N/A	2.36	N/A	N/A	3.86	N/A	N/A	0.85	N/A	N/A
Stream Type (Rosgen)	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	E5	N/A	N/A	C5	N/A	N/A
DIMENSION VARIABLES															
Wbkf (Bankfull width in feet)	14.90	13.41	16.39	15.90	14.31	17.49	19.55	17.60	22.48	18.80	18.80	18.90	14.00	-	-
Dbkf (Bankfull mean depth in feet)	1.85	1.57	2.13	2.00	1.70	2.30	1.64	1.39	1.89	2.29	2.14	2.44	1.09	-	-
Wfpa (Width of floodprone area)	44.70	29.50	74.50	47.70	31.48	79.50	58.65	38.71	97.75	73.10	68.10	78.00	30.00	-	-
Abkf (Cross-sectional Area)	27.57	23.43	31.70	31.80	27.03	36.57	32.06	27.25	36.87	43.10	40.11	46.09	6.09	-	-
Wbkf / Dbkf ratio	8.05	6.05	10.05	7.95	5.95	9.95	11.92	9.92	14.81	8.26	7.75	8.77	12.84	-	-
Wfpa/Wbkf (Entrenchment ratio)	3.00	2.20	5.56	3.00	2.20	5.56	3.00	2.20	5.56	3.89	3.60	4.15	3.58	-	-
Dmax (Max. depth at bankfull)	3.18	2.87	3.42	3.44	3.10	3.70	2.82	2.54	3.03	4.12	4.08	4.15	1.59	-	-
Dmaxtob (Max depth at top of bank)	3.34	1.61	3.76	3.61	1.61	4.07	2.96	1.61	3.34	4.19	4.08	4.37	1.90	-	-
Dmax/Dbkf (Max depth ratio)	1.72	1.55	1.85	1.72	1.55	1.85	1.72	1.55	1.85	1.80	1.67	1.94	1.92	-	-
Dmaxtob/Dmax (Bank ht ratio)	1.05	1.00	1.10	1.05	1.00	1.10	1.05	1.00	1.10	1.02	1.00	1.05	1.00	-	-
PATTERN VARIABLES															
Lm (Meander length in feet)	163.9	134.1	208.6	174.9	143.1	222.6	215.1	176.0	273.7	178.0	145.9	194.7	135.9	118.0	153.0
Lw(Linear Wave length in feet)	107.3	89.4	149.0	114.5	95.4	151.1	140.8	117.3	185.7	144.6	128.4	160.8	109.2	97.0	123.0
Rc (Radius of Curvature in feet)	34.3	22.4	N/A	36.6	23.9	N/A	45.0	29.3	N/A	29.5	22.9	34.5	20.7	16.7	25.9
Larc(Arc length in feet)	38.7	26.1	67.1	41.3	27.8	71.6	50.8	34.2	88.0	65.3	59.9	71.3	30.3	24.7	42.0
Wblt (Belt width in feet)	74.5	59.6	96.9	79.5	63.6	103.4	97.8	78.2	127.1	9.8	5.4	21.4	39.4	36.7	44.0
K (Sinuosity)	1.59	N/A	N/A	1.47	N/A	N/A	1.41	N/A	N/A	1.49	N/A	N/A	1.17	N/A	N/A
Lm/Wbkf (Meander length ratio)	11.0	9.0	14.0	11.0	9.0	14.0	11.0	9.0	14.0	9.5	7.8	10.4	9.7	8.4	10.9
Lw/Wbkf (Linear wave length ratio)	7.2	6.0	10.0	7.2	6.0	9.5	7.2	6.0	9.5	7.7	6.8	8.6	7.8	6.9	8.8
Rc/Wbkf (Radius of Curve ratio)	2.3	1.5	N/A	2.3	1.5	N/A	2.3	1.5	N/A	1.6	1.2	1.8	1.5	1.2	1.9
Larc/Wbkf (Arc length ratio)	2.6	1.8	4.5	2.6	1.8	4.5	2.6	1.8	4.5	3.5	3.2	3.8	2.2	1.8	3.0
Wblt/Wbkf (Meander width ratio)	5.0	4.0	6.5	5.0	4.0	6.5	5.0	4.0	6.5	0.5	0.3	1.1	2.8	2.6	3.1
PROFILE VARIABLES															
Sval (Valley slope, ft/ft))	0.0013	N/A	N/A	0.0010	N/A	N/A	0.0012	N/A	N/A	0.0051	N/A	N/A	0.0015	N/A	N/A
Schan (Channel slope, ft/ft)	0.0008	N/A	N/A	0.0007	N/A	N/A	0.0009	N/A	N/A	0.0036	N/A	N/A	0.0013	N/A	N/A
Srif (Riffle slope, ft/ft)	0.0022	0.0016	0.00316	0.0019	0.0014	0.00272	0.0023	0.0017	0.0034	0.011	0.006	0.018	0.007	0.006	0.008
Spool (Pool slope, ft/ft)	0.0001	6E-05	0.000158	0.0001	5E-05	0.000136	0.0001	6E-05	0.00017	0.001	0.00	0.0009	0.0003	8E-05	0.001
Srif/Schan (Riffle slope ratio)	2.75	2.00	4.00	2.75	2.00	4.00	2.75	2.00	4.00	3.03	1.65	4.96	5.47	4.69	6.25
Spool/Schan (Pool slope ratio)	0.15	0.08	0.20	0.15	0.08	0.20	0.15	0.08	0.20	0.28	0.00	0.25	0.23	0.06	0.78
Dmaxpool (Max Pool depth in feet)	4.63	3.15	5.92	5.00	3.40	8.00	3.94	2.79	6.56	4.60	4.50	4.60	2.14	-	-
Wpool (Width of pool in feet)	15.20	13.41	17.88	16.22	14.31	19.08	19.94	17.60	23.46	19.26	19.00	19.60	18.80	-	-
Lriffle (Length of riffle in feet)	14.90	7.45	25.33	15.90	7.95	27.03	19.55	9.78	33.24	9.79	5.39	21.40	7.59	4.42	11.30
Lpool (Length of pool in feet)	37.25	25.33	59.60	39.75	27.03	63.60	48.88	33.24	78.20	29.67	12.73	44.20	18.45	11.30	27.00
Lglide (Length of glide in feet)	17.88	13.41	22.35	19.08	14.31	23.85	23.46	17.60	29.33	14.32	12.70	21.50	10.14	7.22	12.91
Lps (Pool-pool spacing in feet)	81.95	67.05	104.30	87.45	71.55	111.30	107.53	87.98	136.85	67.82	47.03	92.80	41.50	30.90	69.00
Dmaxpool/Dbkf (Max pool depth ratio)	2.50	1.70	3.20	2.50	1.70	4.00	2.40	1.70	4.00	2.01	1.97	2.01	1.96	-	-
Wpool/Wbkf (Pool width ratio)	1.02	0.90	1.20	1.02	0.90	1.20	1.02	0.90	1.20	1.02	1.01	1.04	1.34	-	-
Lriffle/Wbkf (Riffle length ratio)	1.00	0.50	1.70	1.00	0.50	1.70	1.00	0.50	1.70	0.52	0.29	1.14	0.54	0.32	0.81
*Lpool/Wbkf (Pool length ratio)	2.50	1.70	4.00	2.50	1.70	4.00	2.50	1.70	4.00	1.58	0.68	2.35	1.32	0.81	1.93
Lglide/Wbkf (Glide length ratio)	1.20	0.90	1.50	1.20	0.90	1.50	1.20	0.90	1.50	0.76	0.68	1.14	0.72	0.52	0.92
** Lps/Wbkf (Pool-pool spacing ratio)	5.50	4.50	7.00	5.50	4.50	7.00	5.50	4.50	7.00	3.61	2.50	4.94	2.96	2.21	4.93
MATERIALS										Reach	Riffle	Prot. Ht.	Reach	Riffle	Prot. Ht.
D16 (mm)										0.03	0.04	N/A	-	-	-
D35 (mm)										0.07	0.09	N/A	-	-	-
D50 (mm)										0.11	0.15	N/A	-	-	-
D84 (mm)										0.28	4.68	N/A	-	-	-
D95 (mm)										9.18	8.66	N/A	-	-	-
D100 (mm)										16.00	16.00	N/A	-	-	-

APPENDIX I – DRAFT CASUALTY INSURANCE POLICY

Policy Number: N/A **Previous Policy Number:** N/A

MITIGATION BANK INSURANCE POLICY DECLARATIONS

INSURER	UNDERWRITING OFFICE	PRODUCER
Catlin Specialty Insurance Company 160 Greentree Drive Suite 101 Dover, DE 19904	1600 Market Street Suite 1616 Philadelphia, PA 19103	Beacon Hill Services Inc P O Box 1532 Charlottesville, VA 22902

CLAIMS MADE AND REPORTED COVERAGE

NOTICE: THIS IS A CLAIMS-MADE POLICY. THIS POLICY HAS CERTAIN PROVISIONS AND REQUIREMENTS UNIQUE TO IT AND MAY BE DIFFERENT FROM OTHER POLICIES A "NAMED INSURED" MAY HAVE PURCHASED. FOR THERE TO BE COVERAGE UNDER THIS POLICY, A "CLAIM" MUST FIRST BE MADE BY THE "REGULATORY BODY" DURING THE "POLICY PERIOD". THIS POLICY INCLUDES NO DUTY TO DEFEND OR PAY DEFENSE COSTS.

PLEASE READ THE ENTIRE POLICY CAREFULLY

ITEM 1:

Named Insured:	Forestar (USA) Real Estate Group, Inc.
Mailing Address:	6300 Bee Cave Road, Building 2, Suite 500 Texas, 78746

A.)	Mitigation Bank	Houston/Conroe Mitigation Bank
B.)	Insured Property	The proposed HCMB is 396 acres (Ac) and is located within a larger parent tract, wholly owned by Forestar, located in the U.S. Geological Survey (USGS) East Fork San Jacinto 8-digit Hydrologic Unit Code (HUC) 12040103, near Cleveland, Liberty County, Texas. Specifically, the proposed Bank site is located at Latitude 30.2406° North and Longitude 95.0596° West on the Plum Grove, USGS 7.5 minute quadrangle topographic map, and is situated within the South Central Plains Level III Ecoregion.

ITEM 2:

Policy Period: From: TBD/2015 To: TBD/2024

At 12:01 A.M. both dates at your mailing address shown above.

Note: The following, or similar language, will be stamped to the policy. This is a state regulatory requirement for all non-standard (surplus lines) policies. Surplus Lines Policies all require that agents have separate state licenses. This stamp is placed on the policy by the surplus lines licensed agent to identify the surplus lines license and to identify the Non-admitted status of the insurer.

This Company is not licensed to do business in _____(State), and is not subject to the _____(State) Insurance Guarantee Act.

Excess & Surplus Lines Broker _____(Name)_____(Address)_____(License #)

ITEM 3: LIMIT OF LIABILITY

The Limit of Liability shown below are for the respective terms. Please refer to the endorsement attached to this policy "Amendment of Limit of Liability Endorsement" (EGWL 401) for the actual limit in force.

Limit of Liability beginning at 12:01 am on the beginning date listed and ending date 12:01 on the ending date listed in the EGWL 401:

LIMIT:	$ 1,017,579.00	Year 1
	$ 684,969.00	Year 2
	$ 972,499.00	Year 3
	$ 81,729.00	Year 4
	$ 86,944.00	Year 5
	$ 50,889.00	Year 6
	$ 50,889.00	Year 7
	$ 40,669.00	Year 8
	$ 34,244.00	Year 9

ITEM 4: DEDUCTIBLE $ 5,000.00 Per Claim

ITEM 5: RETROACTIVE DATE: Policy Inception, no retrospective coverage is offered.

ITEM 6:

POLICY PREMIUM	**$**	**100% minimum and earned on the inception date of the policy**
TRIA PREMIUM	**$** Included	
STATE TAX OR OTHER (IF APPLICABLE):	**$** -0-	
TOTAL PREMIUM	**$**	**Total Premium 100% minimum and earned on the inception date of the policy.**

ITEM 7: REGULATORY BODY:

Name:	Army Corps of Engineers- Galveston District Regulatory Body
Address:	USACE Galveston District P.O. Box 1229 Galveston, TX 77553-1229

The name and address above will be used for all notices to the "regulatory body".

ITEM 8:

FORMS AND ENDORSEMENTS FORMING A PART OF THIS POLICY AS OF THE INCEPTION DATE:
See attached schedule of forms and endorsement:

STATE AND FEDERAL REQUIRED AMENDATORY ENDORSEMENTS:

THESE DECLARATIONS, TOGETHER WITH THE COMMON POLICY CONDITIONS AND COVERAGE FORM(S) AND ANY ENDORSEMENT(S), COMPLETE THE ABOVE NUMBERED POLICY.

Countersigned:	By:
Date:	Authorized Representative:

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

SCHEDULE OF FORMS AND ENDORSEMENTS

Named Insured: Forestar (USA) Real Estate Group, Inc.	
Policy Number: N/A	**Policy Period From: TBD/215 To: TBD/2024**

Forms and Endorsements

PNAP 002 0112	Privacy Policy
PNAP 003 1208	US Treasury Dept office of Foreign Assets Control (OFAC)
PNAP 041 1211	Mitigation Bank Insurance Coverage Forms (USACE Notice)
PNAP 004 0213	Texas Policy Holder Notice
ABAP 900 1008	Service of Suit
ABAP 401 0807	In Witness Endorsement
ABAP 302 1007	Schedule of Forms and Endorsements
EGWL 001 0312	Mitigation Bank Insurance Policy Declarations
EGWL 050 0312	Mitigation Bank Insurance Coverage Form
EGWL 600 0311	Nuclear Energy Exclusion Endorsement
EGWL 403 0911	Notice to Named Insured Endorsement
EGWL 401 0312	Amendment of Limit of Liability Endorsement
EGWL 402 0911	Minimum Premium Endorsement
EGWL 300 0911	Scheduled Insured Property and Mitigation Banking Instrument Endorsement
EGWL 601 0611	Exclusion of Certified Nuclear, Biological, Chemical or Radiological Acts of Terrorism and Exclusion of other Acts Terrorism Committed Outside the United States; Cap on losses from Certifies Acts of Terrorism
PNCL N12 0811	Claims Notice

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

MINIMUM PREMIUM ENDORSEMENT

This endorsement modifies insurance provided as follows;

It is understood and agreed the premium designated in the declarations is the minimum premium that applies to the policy period shown in the declarations and is 100% earned at inception.

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

NUCLEAR ENERGY EXCLUSION ENDORSEMENT

In consideration of the payment of the premium for this Policy, it is hereby understood and agreed that the following is added to the Policy:

NUCLEAR ENERGY EXCLUSION

The Company shall not be liable to make any payment in connection with any "claim":

(a) arising out of, based upon or in consequence of, directly or indirectly resulting from or in any way involving "**HAZARDOUS PROPERTIES"** of "**NUCLEAR MATERIAL";** or

(b) which coverage is provided under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability underwriters, or Nuclear Insurance Association of Canada, or would be insured under any such policy but for its termination or exhaustion of its limit of liability; or

(c) with respect to which:

1. any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof; or

2. the "Named Insured**"** is, or had this Policy not been issued, would be entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization.

For the purpose of this Endorsement, the following is added to Section **VII**. **DEFINITIONS**:

- "**BYPRODUCT MATERIAL**" shall have the meaning given in the Atomic Energy Act of 1954 or in any law amendatory thereof.

- "**HAZARDOUS PROPERTIES**" shall mean radioactive, toxic or explosive properties.

- "**NUCLEAR FACILITY**" means:

  1. any "**NUCLEAR REACTOR"**;

  2. any equipment or device designed or used for:

     i. separating the isotopes of uranium or plutonium;

     ii. processing or utilizing "**SPENT FUEL"**; or

     iii. handling, processing or packaging "**WASTE"**;

  3. any equipment or device used for the processing, fabricating or alloying of "**SPECIAL NUCLEAR MATERIAL"** if at any time the total amount of such "**SPECIAL NUCLEAR MATERIAL"** in the custody of the "Named Insured" at the

premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235; or

4. any structure, basin, excavation, premises or place prepared or used for the storage or disposal of "**WASTE"**, and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations.

- "**NUCLEAR REACTOR**" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material.

- "**NUCLEAR MATERIAL**" means "**SOURCE MATERIAL"**, "**SPECIAL NUCLEAR MATERIAL"** and/or "**BYPRODUCT MATERIAL"**.

- "**SOURCE MATERIAL**" shall have the meaning given in the Atomic Energy Act of 1954 or in any law amendatory thereof.

- "**SPECIAL NUCLEAR MATERIAL**" shall have the meaning given in the Atomic Energy Act of 1954 or in any law amendatory thereof.

- "**SPENT FUEL**" means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a "**NUCLEAR REACTOR"**.

- "**WASTE**" means any waste material:

  1. containing "**BYPRODUCT MATERIAL"**; or

  2. resulting from the operation by any person or organization of any "**NUCLEAR FACILITY"** included within Paragraph 1. or 2. of the definition of "**NUCLEAR FACILITY"**.

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

EXCLUSION OF CERTIFIED NUCLEAR, BIOLOGICAL, CHEMICAL OR RADIOLOGICAL ACTS OF TERRORISM AND EXCLUSION OF OTHER ACTS OF TERRORISM COMMITTED OUTSIDE THE UNITED STATES; CAP ON LOSSES FROM CERTIFIED ACTS OF TERRORISM

This endorsement modifies insurance provided as follows:

A. The following exclusion is added:

This insurance does not apply to:

TERRORISM

1. "Any Claim" arising, directly or indirectly, out of a "certified act of terrorism". However, this exclusion applies only when one or more of the following are attributed to such act:

a. The terrorism involves the use, release or escape of nuclear materials, or directly or indirectly results in nuclear reaction or radiation or radioactive contamination; or

b. The terrorism is carried out by means of the dispersal or application of pathogenic or poisonous biological or chemical materials; or

c. Pathogenic or poisonous biological or chemical materials are released, and it appears that one purpose of the terrorism was to release such materials.

2. "Any Claim" arising, directly or indirectly, out of an "other act of terrorism" that is committed outside of the United States (including its territories and possessions and Puerto Rico), but within the "coverage territory". However, this exclusion applies only when one or more of the following are attributed to such act:

a. The total of insured damage to all types of property exceeds $25,000,000 (valued in U.S. dollars). In determining whether the $25,000,000 threshold is exceeded, we will include all insured damage sustained by property of all persons and entities affected by the terrorism and business interruption losses sustained by owners or occupants of the damaged property. For the purpose of this provision, insured damage means damage that is covered by any insurance plus damage that would be covered by any insurance but for the application of any terrorism exclusions; or

b. Fifty or more persons sustain death or serious physical injury. For the purposes of this provision, serious physical injury means:

(1) Physical injury that involves a substantial risk of death; or

(2) Protracted and obvious physical disfigurement; or

(3) Protracted loss of or impairment of the function of a bodily member or organ; or

c. The terrorism involves the use, release or escape of nuclear materials, or directly or indirectly results in nuclear reaction or radiation or radioactive contamination; or

d. The terrorism is carried out by means of the dispersal or application of pathogenic or poisonous biological or chemical materials; or

e. Pathogenic or poisonous biological or chemical materials are released, and it appears that one purpose of the terrorism was to release such materials.

With respect to this exclusion, Paragraphs **a.** and **b.** describe the thresholds used to measure the magnitude of an incident of an "other act of terrorism" and the circumstances in which the threshold will apply for the purpose of determining whether this exclusion will apply to that incident

B. The following definitions are added:

1. For the purposes of this endorsement, "any claim" means a written notice given by the “regulatory body” to the Company setting forth in detail the information required by Section V.A. under this Coverage Part to which this endorsement is applicable, and includes but is not limited to “any claim” as may be defined in this Coverage Part.

2. "Certified act of terrorism" means an act that is certified by the Secretary of the Treasury, in concurrence with the Secretary of State and the Attorney General of the United States, to be an act of terrorism pursuant to the federal Terrorism Risk Insurance Act. The criteria contained in the Terrorism Risk Insurance Act for a "certified act of terrorism" include the following:

a. The act resulted in insured losses in excess of $5 million in the aggregate, attributable to all types of insurance subject to the Terrorism Risk Insurance Act; and

b. The act resulted in damage:

(1) Within the United States (including its territories and possessions and Puerto Rico); or

(2) Outside of the United States in the case of:

(a) An air carrier (as defined in Section 40102 of title 49, United States Code) or United States flag vessel (or a vessel based principally in the United States, on which United States income tax is paid and whose insurance coverage is subject to regulation in the United States), regardless of where the loss occurs; or

(b) The premises of any United States mission; and

c. The act is a violent act or an act that is dangerous to human life, property or infrastructure and is committed by an individual or individuals as part of an effort to coerce the civilian population of the United States or to influence the policy or affect the conduct of the United States Government by coercion.

3. "Other act of terrorism" means a violent act or an act that is dangerous to human life, property or infrastructure that is committed by an individual or individuals and that appears to be part of an effort to coerce a civilian population or to influence the policy or affect the conduct of any government by coercion, and the act is not a "certified act of terrorism".

Multiple incidents of an "other act of terrorism" which occur within a seventy-two hour period and appear to be carried out in concert or to have a related purpose or common leadership shall be considered to be one incident

C. In the event of any incident of a "certified act of terrorism" or an “other act of terrorism: that is not subject to this exclusion, coverage does not apply to any loss or damage that is otherwise excluded under this Coverage Part.

D. If aggregate insured losses attributable to terrorist acts certified under the federal Terrorism Risk Insurance Act exceed $100 billion in a Program Year (January 1 through December 31) and we have met our insurer deductible under the Terrorism Risk Insurance Act, we shall not be liable for the payment of any portion of the amount of such losses that exceeds $100 billion, and in such case insured losses up to that amount are subject to pro rata allocation in accordance with procedures established by the Secretary of the Treasury.

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

SERVICE OF SUIT

The following service of suit provision is added and replaces any other Service of Suit provision contained elsewhere in this policy:

> The Superintendent, Commissioner or Director of Insurance of the State is hereby designated the true and lawful attorney of the Company upon whom may be served all lawful process in any action, suit or proceeding arising out of this policy. The Company further designates:
>
> **Steve Adams**
> **Legal Counsel**
> **3340 Peachtree Road N.E.**
> **Suite 2950**
> **Atlanta, GA 30326**
>
> as its agent to whom such process shall be forwarded by the Director of Insurance.

For Illinois exposures, the Insurer further designates the Director of the Illinois Division of Insurance and his successors in office, as its true and lawful attorney upon whom may be served any lawful process in any action, suit or proceeding instituted by or on behalf of the insured or any beneficiary hereunder arising out of an Illinois exposure and this contract of insurance.

All other terms, conditions and exclusions remain unchanged.

IN WITNESS ENDORSEMENT
CATLIN SPECIALTY INSURANCE COMPANY

ADMINISTRATIVE OFFICE: 3340 Peachtree Road N.E.
Tower Place 100
Suite 2950
Atlanta, GA 30326

STATUTORY HOME OFFICE: 160 Greentree Drive
Suite 101
Dover, Delaware 19904

It is hereby agreed and understood that the following In Witness Clause supercedes any and all other In Witness clauses in this policy.

All other provisions remain unchanged.

IN WITNESS WHEREOF, the Company has caused this policy to be executed and attested, and, if required by state law, this policy shall not be valid unless countersigned by a duly authorized representative of the Company.

Richard S. Banas
President

Steven C. Adams
Secretary

CLAIMS NOTICE

All claims must be reported to Catlin at:

Catlin
Attn: Claims
P.O. Box 8049
Scottsdale, AZ 85252

E-mail: CatlinClaims.Energy@catlin.com

Phone: 888-443-4910
Fax: 404-443-4912

U.S. TREASURY DEPARTMENT'S OFFICE OF FOREIGN ASSETS CONTROL ("OFAC")

No coverage is provided by this Policyholder Notice nor can it be construed to replace any provisions of your policy. You should read your policy and review your Declarations page for complete information on the coverages you are provided.

This Policyholder Notice provides information concerning the possible impact on your insurance coverage provided under your policy due to directives issued by OFAC. Please read this Policyholder Notice carefully.

OFAC administers and enforces economic and trade sanctions based on US foreign policy and national security goals based on Presidential declarations of "national emergency." OFAC has identified and listed numerous:

- Foreign agents
- Front organizations
- Terrorists
- Terrorist organizations
- Narcotics traffickers

as "Specially Designated Nationals and Blocked Persons." This list can be found on the United States Treasury's web site – http://www.treas.gov/ofac.

In accordance with OFAC regulations, if it is determined that you or any other insured, or any person or entity claiming the benefits of this insurance has violated US sanctions law or is a Specially Designated National and Blocked Person, as identified by OFAC, this insurance will be considered a blocked or frozen contract and all provisions of this insurance will be immediately subject to OFAC. When an insurance policy is considered to be such a blocked or frozen contract, neither payments nor premium refunds may be made without authorization from OFAC. Other limitations on the premiums and payments may also apply.

PRIVACY POLICY

Catlin insurance group [the "Companies"], believes personal information that we collect about our customers, potential customers, and proposed insureds [referred to collectively in this Privacy Policy as "customers"] must be treated with a high degree of confidentiality. For this reason and in compliance with the Title V of the Gramm-Leach-Bliley Act ["GLBA"], we have developed a Privacy Policy that applies to all of our U.S. based companies. For purposes of our Privacy Policy, the term "personal information" includes all nonpublic information we obtain about a customer and maintain in a personally identifiable way. In order to assure the confidentiality of the personal information we collect and in order to comply with applicable laws, all individuals with access to personal information about our customers are required to follow this policy.

Our Privacy Statement

Your privacy and the confidentiality of your business records are important to us. Information and the analysis of information is essential to the business of insurance and critical to our ability to provide to you excellent, cost-effective service and products. We understand that gaining and keeping your trust depends upon the security and integrity of our records concerning you. Accordingly, our practice is to:

1. Follow appropriate standards of security and confidentiality to protect any information you share with us or information that we receive about you;
2. Verify and exchange information regarding your credit and financial status only for the purposes of underwriting, policy administration, risk management, or claims handling and only with reputable references and clearinghouse services;
3. Collect and use information about you and your business to advise you about and deliver to you excellent service and products and to administer our business;
4. Train our employees to handle personal information about you or your business in a secure and confidential manner and maintain reasonable access controls. Not disclose personal information about you or your business to any organization outside the Catlin insurance group of Companies or to third party service providers unless we disclose to you our intent to do so or we are permitted to do so by law;
5. Not disclose medical information about you, your employees, or any claimants under any policy of insurance, unless you provide us with written authorization to do so, or unless the disclosure is for any specific business exception provided in the law;
6. Attempt, with your help, to keep our records regarding you and your business complete and accurate, and will advise you how and where to access your account information [unless prohibited by law], and will advise you how to correct errors or make changes to that information; and
7. Audit and assess our operations, personnel and third party service providers to assure that your privacy is respected.

Collection and Sources of Information

We collect from a customer or potential customer only the personal information that is necessary for [a] determining eligibility for the product or service sought by the customer, [b] administering the product or service obtained, and [c] advising the customer about our products and services. The information we collect generally comes from the following sources:

> Submission – During the submission process, you provide us with information about you and your business, such as your name, address, phone number, e-mail address, and other types of personal identification information;
>
> Quotes – We collect information to enable us to determine your eligibility for the particular insurance product and to determine the cost of such insurance to you. The information we collect will vary with the type of insurance you seek. We collect most of our information directly from you through our agents or broker. Depending on the nature of your insurance transaction we may need additional information from outside sources such as motor vehicle records, loss information

reports, court records or other public records. In some instances, we may send someone to inspect your property and verify information about its value and condition, and a photo of the property may be taken;

Transactions – We will maintain records of all transactions with us, our affiliates, and our third party service providers, including your insurance coverage selections, premiums, billing and payment information, claims history, and other information related to your account;

Claims – If you obtain insurance from us, we will maintain records related to any claims that may be made under your policies. The investigation of a claim necessarily involves collection of a broad range of information about many issues, some of which does not directly involve you. We will share with you any facts that we collect about your claim unless we are prohibited by law from doing so. The process of claim investigation, evaluation, and settlement also involves, however, the collection of advice, opinions, and comments from many people, including attorneys and experts, to aid the claim specialist in determining how best to handle your claim. In order to protect the legal and transactional confidentiality and privileges associated with such opinions, comments and advice, we will not disclose this information to you; and

Credit and Financial Reports – We may receive information about you and your business regarding your credit. We use this information to verify information you provide during the submission and quote processes and to help underwrite and provide to you the most accurate and cost-effective insurance quote we can provide. If coverage is declined or the charge for coverage is increased because of information contained in a consumer report, we will tell you as required by law. We will also give you the name and address of the consumer reporting agency making the report.

Retention and Correction of Personal Information

We retain personal information only as long as required by our business practices and applicable law. If we become aware that an item of personal information may be materially inaccurate, we will make reasonable effort to re-verify its accuracy and correct any error as appropriate.

Storage of Personal Information

We have in place safeguards to protect electronic data and paper files containing personal information.

Sharing/Disclosing of Personal Information

We maintain procedures to assure that we do not share personal information with an unaffiliated third party for marketing purposes unless such sharing is permitted by law. Personal information may be disclosed to an unaffiliated third party for necessary servicing of the product or service or for other normal business transactions as permitted by law.

We do not disclose personal information to an unaffiliated third party for servicing purposes or joint marketing purposes unless a contract containing a confidentiality/non-disclosure provision has been signed by us and the third party. Unless a consumer consents, we do not disclose “consumer credit report” type information obtained from an application or a credit report regarding a customer who applies for a financial product to any unaffiliated third party for the purpose of serving as a factor in establishing a consumer’s eligibility for credit, insurance or employment. “Consumer credit report type information” means such things as net worth, credit worthiness, lifestyle information [piloting, skydiving, etc.] solvency, etc. We also do not disclose to any unaffiliated third party a policy or account number for use in marketing. We may share with our affiliated companies information that relates to our experience and transactions with the customer.

Policy for Personal Information Relating to Nonpublic Personal Health Information

We do not disclose nonpublic personal health information about a customer unless an authorization is obtained from the customer whose nonpublic personal information is sought to be disclosed. However, an authorization shall not be prohibited, restricted or required for the disclosure of certain insurance functions, including, but not limited to, claims administration, claims adjustment and management, detection, investigation or reporting of actual or potential fraud, misrepresentation or criminal activity, underwriting, policy placement or issuance, loss control and/or auditing.

Access to Your Information

Our employees, employees of our affiliated companies, and third party service providers will have access to information we collect about you and your business as is necessary to effect transactions with you. We may also disclose information about you to the following categories of person or entities:

Your independent insurance agent or broker;

An independent claim adjuster or investigator, or an attorney or expert involved in the claim;

Persons or organizations that conduct scientific studies, including actuaries and accountants;

An insurance support organization;

Another insurer if to prevent fraud or to properly underwrite a risk;

A state insurance department or other governmental agency, if required by federal, state or local laws; or

Any persons entitled to receive information as ordered by a summons, court order, search warrant, or subpoena.

Lienholder, mortgagee, assignee, lessor, or other person shown on our records or our agent's as having a legal or beneficial interest in a policy of insurance.

Parties acting in a fiduciary or representative capacity to you or parties administering transactions as requested or authorized by you.

Violation of the Privacy Policy

Any person violating the Privacy Policy will be subject to discipline, up to and including termination.

For more information or to address questions regarding this privacy statement, please contact your broker.

MITIGATION BANK INSURANCE COVERAGE FORM

The US Army Corps of Engineers (Corps) has the authority to require financial assurances for the establishment of mitigation banks, which are designed to offset unavoidable impacts to the waters of the United States authorized through the issuance of Department of the Army permits pursuant to section 404 of the Clean Water Act (33U.S.C. 1344) and/or sections 9 or 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401,403).

The Named Insured proposed a Mitigation Banking Instrument for Corps approval, as described more specifically attached hereto Wetland Mitigation Bank Insurance Coverage Form and affixed endorsements.

The “regulatory body” has the sole obligation, responsibility and accountability for determining compliance with “compensatory mitigation” requirements for the aforementioned mitigation bank.

MITIGATION BANK INSURANCE COVERAGE FORM

CLAIMS MADE AND REPORTED COVERAGE

NOTICE: THIS IS A CLAIMS-MADE POLICY. THIS POLICY HAS CERTAIN PROVISIONS AND REQUIREMENTS UNIQUE TO IT AND MAY BE DIFFERENT FROM OTHER POLICIES A "NAMED INSURED" MAY HAVE PURCHASED. FOR THERE TO BE COVERAGE UNDER THIS POLICY, A "CLAIM" MUST FIRST BE MADE BY THE "REGULATORY BODY" DURING THE "POLICY PERIOD". THIS POLICY INCLUDES NO DUTY TO DEFEND OR PAY DEFENSE COSTS.

PLEASE READ THE ENTIRE POLICY CAREFULLY.

Various provisions in this Policy restrict coverage. Read the entire Policy carefully to determine rights, duties, and what is and is not covered.

Words and phrases that appear in quotation marks have special meaning. Refer to **DEFINITIONS (Section VII.)** The word "Company" when used throughout this policy refers to the Company identified as the insurer in the Declarations.

In consideration of the payment of the premium by the "Named Insured", in reliance upon the statements in the Application made a part hereof, and subject to the Limits of Liability of this insurance as set forth in the Declarations, and the exclusions, conditions, and other terms of this Policy, the Company agrees with the "Named Insured" as follows:

I. INSURING AGREEMENT

In the event of the "Named Insured's" failure during the "policy period" to meet "performance standards" under the "mitigation banking instrument" at the "insured property," the Company agrees to undertake and complete or secure through payment, whether directly or through a "Third Party," the 'compensatory mitigation' for which the 'Named Insured' is legally responsible under the '"Mitigation Banking Instrument," provided the 'regulatory body' first makes a 'claim' to the Company in writing and during the 'policy period'."

II. TERRITORY

This Policy only applies to a "claim" made or brought in the United States of America.

III. EXCLUSIONS

This insurance does not apply to "claims" or to any costs arising out of any "claims" based upon, arising out of, or to any extent comprised of any of the following:

A. An Act of God, including any natural catastrophe or disaster;

B. Any property or location other than the "insured property"

C. Liability of the "Named Insured" under or pursuant to any document, contract or agreement other than (i) the "mitigation banking instrument," (ii) any contract entered into to perform work required by the "mitigation banking instrument" and/or (iii) any other contract required by the "regulatory body" to provide for restoration, rehabilitation, adaptive management and/or any contingency plan at the "insured property."

D. Any legal fees, attorneys' fees, costs, or expenses including expert or consultant fees incurred in the defense of the "Named Insured" for any reason other than for liability under the mitigation banking instrument;

E. Fluctuation in, short fall of, or devaluation (in whole or in part) of, the monetary value of, or marketability of, mitigation credits or other equivalent credits;

F. Any "claim" (i) not first made during the "policy period" or (ii) for which notice thereof was not provided by the "regulatory body" to the Company in writing during the "policy period."

IV. LIMIT OF LIABILITY AND DEDUCTIBLE

A. The Company's total liability for all costs shall not exceed the Limit of Liability set forth (i) in Item 3. of the Declarations or (ii) in any endorsement to this Policy modifying or reducing that Limit of Liability in force at the time when the "claim" is first made.

B. Regardless of the number of "claims" made to the Company the total liability of the Company for any and all "claim(s)" for costs shall be considered a single "claim" subject to the Limit of Liability set forth (i) in Item 3. of the Declarations or (ii) in any endorsement to this Policy modifying or reducing that Limit of Liability in force at the time when the "claim" is first made.

C. The Limit of Liability set forth (i) in Item 3. of the Declarations or (ii) in any endorsement to this Policy modifying or reducing that Limit of Liability in force at the time when the "claim" is first made, shall remain unchanged unless the "regulatory body" approves in writing a modification or reduction in the Limit of Liability. In that case, the Company shall reduce or adjust the Limit of Liability accordingly by issuing an endorsement to the Policy setting forth the new Limit of Liability.

D. The Company's financial obligation under this Policy is, at its sole discretion, to undertake and complete or secure through payment "compensatory mitigation" pursuant to a "claim" , which financial obligation extends only to such "compensatory mitigation" or its payment as may be undertaken and completed with the difference between (i) the value of the deductible stated in the Declarations and (ii)(a) the Limit of Liability set forth in Item 3. of the Declarations or (ii)(b) in any endorsement to this Policy modifying or reducing that Limit of Liability in force at the time when the "claim" is first made. However, the "Named Insured's" failure to satisfy the deductible does not release the Company's obligation to respond, investigate, adjust or settle any claim including the Company's obligation to pay deductible amount(s) on behalf of the "Named Insured". Thereby; The Company at its sole election and option, may either:

1) Undertake and complete, or pay any amount or all of the deductible amount to a third party to secure, the "compensatory mitigation" and upon notification of the action taken, the "Named Insured" shall promptly reimburse the Company for such part of the deductible amount as had been paid by the Company; or

2) Simultaneously upon receipt of notice of any "compensatory mitigation" or at any time thereafter, call upon the "Named Insured" to pay or deposit with the Company all or any part of the deductible amount, to be held and applied by the Company as herein provided.

The deductible amount indicated is on a per "claim" basis. A separate deductible amount will be applied to each "claim." The deductible will erode the Limits of Liability

V. NOTICE PROVISIONS

A. NOTICE OF CLAIM

The "regulatory body" shall provide written notice to the Company of a "claim" as soon as practicable. Such "claim" notification must be in writing and shall contain the following information:

a brief explanation of the events and circumstances that resulted in the "claim";

any other information the “regulatory body” deems relevant to the "claim".

The "Named Insured" shall make all responsible personnel and all available information of the “Named Insured” available to the Company upon reasonable request.

B. NOTICES

1. All notices required by this Item V. Notice Provisions shall be provided in writing and sent to the Company at the address stated on the Claims Notice.

2. The Company shall provide notice to the “Named Insured” and “regulatory body” of all changes, amendments, endorsements to the policy and shall provide all written correspondence to the “regulatory body”, including correspondence regarding any “claim” to the “regulatory body” noted in form EGWL 403 Notice to the Named Insured Endorsement.

VI. CONDITIONS

A. ASSIGNMENT — This Policy is not assignable except with the prior written consent of the Company, which consent shall be granted at the Company’s sole discretion.

B. BANKRUPTCY — Bankruptcy or insolvency of a “Named Insured”, or its agents, contractors, or subcontractors, shall not relieve the Company or the “Named Insured” of their obligations under this Policy, including the obligation of the Company to pay "claims" not to exceed the Limit of Liability set forth (i) in Item 3. of the Declarations or (ii) in any endorsement to this Policy modifying or reducing that Limit of Liability in force at the time when the “claim” is first made.

C. CANCELLATION, TERMINATION AND RELEASE — Except as provided in paragraph 2 below, the Policy shall remain in effect until cancellation and release is approved by the “regulatory body”. The Company shall notify the “regulatory body” of a proposed cancellation and release of the Policy no less than 120 days prior to the proposed cancellation and release date. To approve cancellation of this Policy and a release of the Company, the “regulatory body" shall provide written notice to the Company as soon as practicable that the "regulatory body" has accepted a replacement financial assurance mechanism, deems that such mechanism is no longer required, or has otherwise determined that this Policy is no longer required by law within its authority. The "regulatory body’s" written notice to the Company shall include an effective date for the cancellation and release.

On the effective date of the “regulatory body’s” approved cancellation and release of the Company, the Company shall be released from any and all liability or obligations under the Policy to the "Named Insured", the "regulatory body” or its designee, including any existing or future liability or obligations arising from “claim(s)” previously reported or pending under the Policy if the "regulatory body" has expressly approved such release from pending "claims" in accordance with the above provisions.

D. TERMINATION OTHER THAN BY CANCELLATION — Coverage shall also terminate at the earlier of the following times without “regulatory body” approval:

1. the “policy period” expiration as shown in Item 2. of the Declarations; or

2. a written acknowledgement, certification or other legally equivalent determination by the “regulatory body” that the “Named Insured” has met the ”success criteria” set forth in the " mitigation banking instrument" or in the “contingency plan”, if the regulatory body determined in writing that the criteria contained in such “contingency plan” have replaced the “success criteria” contained in the “mitigation banking instrument.”

Immediately upon termination of the Policy under this paragraph, the Company is released from all liability or obligations under the Policy, except as to any existing liability or obligations arising from “claim(s)” previously reported or pending under the Policy unless the regulatory body has expressly approved in writing the Company’s release from such previously reported and/or pending "claims."

E. CHANGES — Notice to any broker or knowledge possessed by any broker or by any other person or entity shall not affect a waiver or change in any part of this Policy or stop the Company from asserting any right under the terms of this Policy. The terms of this Policy shall not be waived or changed except by endorsement issued to form a part of this Policy.

F. CLAIM ADJUSTMENT — Upon notice of a "Claim" the Company will, as soon as reasonably practicable, perform its due diligence to identify, undertake and complete or secure through payment the "compensatory mitigation" subject to the Limit of Liability. The Company will work with the "Regulatory Body" in good faith to foster agreement concerning all "compensatory mitigation" to be undertaken and completed or secured through payment, including approval of a third party to receive payment, pursuant to a "Claim" and will undertake and complete or secure through payment such "compensatory mitigation" as soon as reasonably practical after notice of a “Claim.”

The "Named Insured" shall not be released from any of its obligations to the Company under this Policy by virtue of any such "compensatory mitigation" undertaken and/or completed or secured through payment by the Company or a third party authorized to receive the payment, including the "Named Insured's" duties to pay or reimburse any deductible amount.

G. CONFLICTS — In the event of a conflict between (i) any state or federal laws or regulations (including the “Mitigation Banking Instrument”) applicable to the “bank” named in this policy and (ii) the “Named Insured’s” rights under this policy, the former shall prevail In no event shall the Company be liable to the “Named Insured” for failure to perform an act precluded by the applicable laws or regulations. Furthermore, any changes in applicable state or federal law or regulations made after the commencement of the “policy period” shall not be deemed to affect the Company’s obligations under the Policy unless and until agreed to by the Company and endorsed in writing on this Policy.

H. LIMIT OF LIABILITY CHANGE — Any increase in the Limit of Liability shall only occur by endorsement to the Policy upon the Company's consent in its sole discretion. The Company may request as a condition to increasing the Limit of Liability that the "Named Insured" pay an additional premium and/or provide collateral to the Company, including providing funds in a nominal commutation account as specified in an endorsement if and when endorsed hereto.

I. DECLARATIONS — By acceptance of this Policy, the "Named Insured" agrees that the statements in the Declarations and Application are its agreements and representations, that this Policy is issued in reliance upon the truth of such representations and that this Policy embodies all agreements existing between the "Named Insured" and the Company or any of its agents relating to this insurance. The "Named Insured" expressly agrees that in entering into this Policy it has not relied on any statement by any person, agent, or broker not directly employed by the Company regarding the terms, provisions, coverage or interpretation of this Policy. Misrepresentations by the "Named Insured" do not invalidate the Company's obligation to the "regulatory body" in the event of a claim. Any misrepresentation may result in a dispute between the "Named Insured" and the Company.

J. INDEPENDENT AGREEMENT — This Policy is a separate, independent agreement between the Company and the "Named Insured." Notwithstanding any other provision of this Policy, the Company and the "Named Insured" hereby agree that no other contract or agreement shall be used to interpret any provision of this Policy nor shall this Policy be used to interpret any other contract or agreement.

K. INSPECTION, REVIEW AND AUDIT — The Company shall be permitted but not obligated to inspect, sample, audit, review, and monitor on a continuing basis the "Named Insured", or the "insured property" upon providing reasonable advance notice with consideration for the timing of such notice and any site access requirements. The Company's actions permitted hereunder shall not interfere with or delay the completion of the "remedial action" as set forth in the "mitigation banking instrument" and/or the "contingency plan".

L. MODIFICATION — The policy shall remain unchanged unless the "regulatory body" approves in writing any endorsement or modification.

M. NO THIRD PARTY BENEFICIARY — No third party beneficiaries are created as a result of this Policy, except to the extent that specific rights are conferred on the "regulatory body" by the Policy. This Policy creates no rights by or on behalf of any other third parties. Should the Company elect to undertake and complete any required "compensatory mitigation" any contracts or agreement between the Company and a party or parties undertaking and completing such "compensatory mitigation" shall be a separate, independent agreement from this Policy, and this Policy shall confer no specific or general rights or benefits to any party to such contract or agreement. The Company has no obligation under this Policy to any third party whatsoever (other than the "regulatory body") and specifically, without limitation, has no obligation to undertake and complete or otherwise secure through payment "compensatory mitigation" for anyone other than the "regulatory body" or its designee as set forth in Item E. above. Nothing in this paragraph shall be construed to restrict any other interests and rights of the "regulatory body" under this Policy as such interests and rights may exist hereunder or may be conferred under applicable law at the time of issuance of the Policy. However, any changes in the applicable regulations shall not be deemed to affect the Company's obligations under the Policy, unless agreed to and endorsed in writing on this Policy.

N. OTHER INSURANCE — The insurance provided under this Policy is primary insurance, except this insurance shall be excess:

1. Over any surety bond or other financial assurance instrument applicable to the "claim" covered under this Policy.

When this insurance is excess over any surety bond, or other financial assurance instrument, the Company shall be obligated to undertake and complete or otherwise secure through payment "compensatory mitigation" of a value up to the amount which exceeds the total amount of that other surety bond or other financial assurance instrument available to pay for the "claim" in the absence of this insurance.

When this insurance is primary and the "Named Insured" has other insurance which is applicable on an excess basis to any "claim", the amount of the Company's liability under this Policy shall not be reduced by the existence of such excess insurance.

When both this insurance and other insurance apply to the "claim" on the same basis, whether primary, excess, or contingent, the Company shall not be liable under this Policy for a greater proportion than that set out in the declarations or the following contribution provision, whichever method is lower:

a. Contribution by Equal Shares — Under this approach, each insurer contributes equal amounts measured by the actual value of (i) "compensatory mitigation" work undertaken or completed or otherwise secured through payment by the company or (ii) any funds paid by any other insurer, until it has paid its applicable limit of insurance; or

b. Contribution by Limits — Each insurer's share is based on the ratio of its applicable limit of insurance to the total applicable limits of insurance of all insurers.

O. PREMIUM — the Policy Premium stated in Item 6. of the Declarations is fully earned on the inception date of this Policy, and any cancellation or termination of the Policy either by the "Named Insured" or by the Company shall not result in the return of any Policy Premium.

P. SUBROGATION — In the event of any payment under this Policy, the Company shall be subrogated to any right of recovery that a "Named Insured"' may have against any person or organization other than the "regulatory body" or its designee. A "Named Insured" to the extent permitted by applicable law shall execute and deliver instruments and papers and do whatever else is necessary to secure and protect such rights. The "Named Insured" shall do nothing to prejudice such rights under this paragraph and shall cooperate with respect to any subrogation efforts. In the event that the "Named Insured" commits fraud, the Company and the "Named Insured" agree that the Company may subrogate and/or bring suit against the "Named Insured" who commits such fraud. In the event the Company notifies the "Named Insured" that it intends to assert a claim against the "Named Insured" arising out of fraud, the "Named Insured" shall, upon receipt of such notification, be released from its duty of further cooperation with the Company concerning subrogation as set forth in this paragraph solely concerning matters that are the subject of such fraud claims.

VII. DEFINITIONS

A. "Mitigation Bank" means the mitigation project referenced in the "mitigation banking instrument" and set forth in Item 1. of the Declarations.

B. "Claim" means a written notice given by the "regulatory body" to the Company setting forth in detail the information required by Section V.A. of this Policy.

C. "Adaptive Management plan" as defined in 33 CFR 332.4(c)(12) means the written plan that specifies the remedial actions or adaptive management measures that must be taken to meet the "Performance Standards" set forth in the " mitigation banking instrument" and/or approved

mitigation plans for the "mitigation bank", provided that such plan is prepared, documented, approved and filed in compliance with applicable law, including “regulatory body” approval.

D. “Inception date” means the beginning of the “policy period” set forth in the Item 2. of the Declarations.

E. “Named Insured” means the person or entity set forth in Item 1. of the Declarations.

F. "Policy period” means the period set forth in Item 2. of the Declarations, or any shorter period arising as a result of cancellation or termination of the policy.

G. “Regulatory body” means the lead agency or entity set forth in Item 7 of the Declarations.

H. “Remedial or Adaptive Management measures” means those expenses necessary to implement the "Adaptive Management plan” endorsed to the Policy.

The “remedial action” shall include:

a. All costs incurred including costs billed by and paid to any contractor(s) or subcontractor(s);

b. Administrative and management costs incurred by designated contractor(s) and approved subcontractor(s) directly and exclusively in furtherance of the items set forth in Item a. above, including but not limited to the preparation of mitigation monitoring reports;

c. A deposit of sums of money, subject to the limit of liability or remaining limit of liability, sufficient to cover costs described in this section VII(K) into an account with or controlled by the designee of the “regulatory body;” and/or

d. The cost to purchase appropriate replacement mitigation credits at another mitigation bank.

I. “Performance Standards” as defined in 33 CFR 332.2 means those specific performance criteria for restoration set forth in the “mitigation banking instrument” or the “Adaptive Management Plan”.

J. “Mitigation banking instrument” as defined in 33 CFR 332.2 means the written instrument that is set forth in the declarations or endorsed to the Policy, provided that such plan is prepared, approved, filed, and documented in compliance with applicable law.

K. “Compensatory Mitigation” as defined in 33 CFR 332.2 means the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved."

L. Insured Property” means the property where coverage solely responds to and that is scheduled to this policy.

M. “Third party” means the party selected from a list of qualified vendors provided by the Company and approved by and subject to the regulatory oversight of the U.S. Army Corps of Engineers as the District’s designee (as used in 33 C.F.R 332.3(n)(6)) to receive payment from the Company, within the limits of the Policy, to secure or complete the “compensatory mitigation” agreed to within the “Mitigation Banking Instrument.”

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

NOTICE TO NAMED INSURED ENDORSEMENT

This endorsement modifies insurance provided as follows;

The Company shall provide notice to the “Named Insured” and “regulatory body” of all changes, amendments, endorsements to the policy and shall provide all written correspondence to the “regulatory body”, including correspondence regarding any claim to the “regulatory body” at:

To the Regulatory Body at:
Army Corps of Engineers Galveston District
P.O. Box 1229
Galveston, TX 77553-1229

To the: Named Insured:
Forestar (USA) Real Estate Group, Inc.
6300 Bee Cave Road, Building 2, Suite 500
Texas, 78746

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

AMENDMENT OF LIMIT OF LIABILITY ENDORSEMENT

This endorsement modifies insurance provided as follows:

It is agreed the Limit of Liability shown in Item 3.of the Declarations page is revised as follows:

ITEM 3: LIMIT OF LIABILITY

Limit of Liability beginning at 12:01 am on the beginning date listed and ending 12:01 on the ending date listed:

Limit:	Limit Endorsement	$1,017,579.00

Beginning Date: TBD/2015
Ending Date: TBD/2024

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

SCHEDULED INSURED PROPERTY
AND
MITIGATION BANKING INSTRUMENT ENDORSEMENT

This endorsement modifies insurance provided as follows;

It is agreed the following are considered scheduled "Insured Property" under the policy and the applicable coverage as noted:

Mitigation Bank and Property Location	Mitigation Banking Instrument
Houston/Conroe Mitigation Bank	The proposed HCMB is 396 acres (Ac) and is located within a larger parent tract, wholly owned by Forestar, located in the U.S. Geological Survey (USGS) East Fork San Jacinto 8-digit Hydrologic Unit Code (HUC) 12040103, near Cleveland, Liberty County, Texas. Specifically, the proposed Bank site is located at Latitude 30.2406° North and Longitude 95.0596° West on the Plum Grove, USGS 7.5 minute quadrangle topographic map, and is situated within the South Central Plains Level III Ecoregion.

All other terms, conditions and exclusions remain unchanged.

This endorsement changes the policy to which it is attached and is effective on the date issued unless otherwise stated.

(The information below is required only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective:_____ Policy No.: _____ Endorsement No. _____

Insured: _____ Premium:_____

Insurance Company:_____

Authorized Signature: _____