MITIGATION PLAN WITH AS-BUILT DRAWINGS
JARMANS OAK RESTORATION SITE
ONSLOW COUNTY, NORTH CAROLINA

(CONTRACT #D06069-A)
FULL DELIVERY PROJECT
WHITE OAK RIVER BASIN
CATALOGING UNIT 03030001

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JARMANS OAK STREAM AND WETLAND RESTORATION SITE
AS-BUILT MITIGATION PLAN
ONSLOW COUNTY

EXECUTIVE SUMMARY

Restoration Systems, L.L.C. (Restoration Systems) has completed restoration of stream and riverine wetlands at the Jarmans Oak Stream and Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling stream and wetland mitigation goals in the region. The Site, located approximately two miles east of the Onslow/Duplin County line and approximately three miles west of the Town of Richlands in Onslow County, provides 6701 stream mitigation units (SMU's) and 13 riverine wetland mitigation units (WMU's). The Site is located in United States Geological Survey (USGS) Cataloging Unit (CU) 03030001 and Targeted Local Watershed 0303001010010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-05-02) of the White Oak River Basin. This subbasin of the White Oak River Basin is entirely contained within Onslow County and consists of the New River and its tributaries, several small Coastal Plain streams, and the Intracoastal Waterway.

A Detailed Stream and Wetland Restoration Plan was completed for the Site in December 2006. The plan outlined methods to complete stream and wetland restoration activities at the Site. An approximately 35-acre conservation easement was placed on the Site to incorporate all restoration activities. The Site contains 24 acres of hydric soil, three unnamed tributaries (UTs) to the New River, and adjacent floodplains. An undisturbed reach of Bullard Branch, approximately 15 miles northwest of the Site in Duplin County, was utilized as the reference reach. Prior to implementation, the Site was characterized by agricultural land utilized primarily for row crop production. Riparian vegetation adjacent to Site streams was sparse and disturbed due to plowing and regular maintenance, and row crop areas were subject to the broadcast application of various agricultural chemicals.

The primary goals of this stream and wetland restoration project focused on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat and were accomplished by:

- Removing nonpoint sources of pollution associated with agricultural production a) cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and wetlands and b) providing a vegetative buffer adjacent to streams and wetlands to treat surface runoff.
- Reducing sedimentation within onsite and downstream receiving waters through a) a reduction of bank erosion, vegetation maintenance, and agricultural plowing to Site streams and b) providing a forested vegetative buffer adjacent to Site streams and wetlands.
- Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring stable dimension, pattern, and profile.
- Promoting floodwater attenuation through a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, entrenched tributaries thereby reducing floodwater velocities within smaller catchment basins; c) restoring depressional floodplain wetlands and increasing storage capacity for floodwaters within the Site; and d) revegetating Site floodplains to increase frictional resistance on floodwaters crossing Site floodplains.

- Improving aquatic habitat by enhancing stream bed variability.
- Providing wildlife habitat including a forested riparian corridor within a region of the state highly dissected by agricultural land use.

As constructed, the Site restored historic stream and wetland functions, which existed onsite prior to channel straightening and dredging, agricultural impacts, and vegetation removal. Stream construction of meandering, E-type stream channel and braided, D-type channel resulted in 6219 linear feet of stream restoration, 1205 linear feet of stream enhancement (level II), 11 acres of riverine wetland restoration, and 6.1 acres of riverine wetland enhancement.

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JARMANS OAK STREAM AND WETLAND RESTORATION SITE
AS-BUILT MITIGATION PLAN
ONSLOW COUNTY

1.0 INTRODUCTION

Restoration Systems, L.L.C. (Restoration Systems) has completed restoration of stream and riverine wetlands at the Jarmans Oak Stream and Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling stream and wetland mitigation goals in the region. The Site, located approximately two miles east of the Onslow/Duplin County line and approximately three miles west of the Town of Richlands in Onslow County, provides 6701 stream mitigation units (SMU's) and 13 riverine wetland mitigation units (WMU's) (Figure 1, Appendix A). The Site is located in United States Geological Survey (USGS) Cataloging Unit (CU) 03010001 and Targeted Local Watershed 03030001010010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-05-02) of the White Oak River Basin (Figure 2, Appendix A). This subbasin of the White Oak River Basin is entirely contained within Onslow County and consists of the New River and its tributaries, several small Coastal Plain streams, and the Intracoastal Waterway.

A Detailed Stream and Wetland Restoration Plan was completed for the Site in December 2006. The plan outlined methods to complete stream and wetland restoration activities at the Site. An approximately 35-acre conservation easement was placed on the Site to incorporate all restoration activities. The Site contains 24 acres of hydric soil, three unnamed tributaries (UTs) to the New River, and adjacent floodplains. The three UTs to the New River and adjacent floodplain represent the primary hydrologic features of the Site. The drainage basin size is approximately 0.59 square mile at the Site outfall. The Site watershed is characterized by forest, agricultural land, and sparse industrial/residential development; less than ten percent of the upstream watershed is composed of impervious surface. Residential development becomes more concentrated southeast of the watershed in the Town of Richlands. An undisturbed reach of Bullard Branch, approximately 15 miles northwest of the Site in Duplin County, was utilized as the reference reach.

Prior to implementation the Site was characterized by agricultural land utilized primarily for row crop production (Figure 3, Appendix A). Riparian vegetation adjacent to Site streams was sparse and disturbed due to plowing and regular maintenance, and row crop areas were subject to the broadcast application of various agricultural chemicals. In addition, stream channels had been straightened and dredged. These factors resulted in degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and decreased wetland function.

The following objectives were proposed to provide mitigation credit requested under the EEP Request For Proposal (RFP) #16-D06069 dated December 19, 2005.

- Restore 6219 linear feet of stream within three UTs to the New River.
- Enhance 1205 linear feet of stream within three UTs to the New River
- Restore 11 acres of jurisdictional riverine wetland.
- Enhance an additional 6.1 acres of jurisdictional riverine wetland.
- Reforest the entire floodplain within the easement area with native forest species.

The primary goals of this stream and wetland restoration project focus on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat and will be accomplished by:

- Removing nonpoint and point sources of pollution associated with agriculture including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to Site streams and b) restoration of a forested riparian buffer adjacent to streams to treat surface runoff.
- Reducing sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with vegetation maintenance and agricultural plowing to Site streams and b) planting a forested riparian buffer adjacent to Site streams.
- Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring stable dimension, pattern, and profile supported by natural in-stream habitat and grade/bank stabilization structures.
- Promoting floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, dredged, straightened, and entrenched tributaries, thereby reducing floodwater velocities within smaller catchment basins; c) increasing storage capacity for floodwaters within the Site; and d) revegetating Site floodplains to increase frictional resistance on floodwaters.
- Restoring onsite wetlands, thereby promoting flood storage, nutrient cycling, and aquatic wildlife habitat.
- Improving aquatic habitat with bed variability and the use of in-stream structures.
- Providing a terrestrial wildlife corridor and refuge in an area developed for agricultural production.

Construction of the Site resulted in restoration of historic stream and wetland functions which, prior to construction, no longer existed because of channel straightening and dredging, agricultural impacts, and vegetation removal. Stream construction of meandering, E-type stream channel and braided, D-type channel resulted in approximately 6219 linear feet of stream restoration, 1205 linear feet of stream enhancement (level II), 11 acres of riverine wetland restoration, and 6.1 acres of riverine wetland enhancement. Restoration Systems was contracted to supply 6640 stream mitigation units and 12 riverine wetland mitigation units.

2.0 PROJECT BACKGROUND

2.1 Preconstruction Conditions

Prior to construction, the entire Site was utilized for row crop production (Figure 3, Appendix A). In order to maximize useable field acreage streams were channelized and riparian vegetation was removed. Site streams were subject to contamination from the broadcast application of agricultural chemicals. The agricultural practices of the Site were contributory factors to degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and decreased wetland function.

Streams

The Site encompasses three UTs to the New River (main tributary, southern tributary [west] and southern tributary [east]) as well as the adjacent floodplain and hydric soils. The tributaries converge onsite and drain an approximately 0.59-square mile watershed at the Site outfall. The main tributary is a first- and second-order stream; the southern tributaries are first-order streams. Onsite streams are bank-to-bank systems that were previously impacted by ditching, vegetative clearing, and erosive flows and were characterized by excessive incision.

Hydric Soils

Detailed soil mapping of the Site indicates that hydric soils of the Muckalee series encompass 24 acres (68 percent of the Site) adjacent to Site stream channels targeted for restoration and extend into the immediate floodplain. Soils of the Muckalee series are characterized by light gray to dark gray or gley colored matrix with mottles consisting of sandy loam textured surface soils underlain by sandy loam or sandy clay textured soils. In general, areas of hydric soils of the Muckalee series were disturbed by stream alterations including dredging, straightening, rerouting, and downcutting of streams; floodplain ditching; deforestation; and soil compaction due to annual plowing. Based on preliminary studies, onsite soils of the Muckalee series appear to have historically supported jurisdictional riverine wetlands that were intermittently flooded by over-bank stream flows, upland runoff, groundwater migration into the Site, and, to a lesser extent, direct precipitation.

Plant Communities

Distribution and composition of plant communities reflected landscape-level variations in topography, soils, hydrology, and past or present land use practices. The Site was characterized entirely by agricultural land that was regularly maintained and plowed for row crops, leaving soils disturbed and exposed to the edges of Site stream banks. Riparian vegetation adjacent to Site streams was predominantly characterized by an herbaceous assemblage of planted grasses and invasive annuals.

Drainage Area

This hydrophysiographic region is considered characteristic of the Coastal Plain Physiographic Province and is located within the Carolina Flatwoods ecoregion of North Carolina. The region is characterized by Carolina bays, swamps, and low-gradient streams with silty or sandy substrate (Griffith 2002). This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 56 inches per year (USDA 1992). The Site occurs within USGS 14-digit CU 03030001010010 (NCDWQ Subbasin 03-05-02) of the White Oak River Basin (Figure 2, Appendix A) (USGS 1974).

The Site drainage area encompasses approximately 0.59 square mile of land at the downstream Site outfall. The drainage area is characterized by forest, agricultural land, and sparse industrial/residential development. Site streams ultimately drain to a section of the New River which has been assigned Stream Index Number 19-(1), a Best Usage Classification of **C NSW**, and is partially supporting its intended uses (NCDWQ 2001, NCDWQ 2005).

2.2 Project History

On July 10, 2006, the EEP entered into a contract with Restoration Systems to restore the Site. A Detailed Stream and Wetland Restoration Plan was completed for the project in December 2006. Upon completion of the detailed plan, construction schematics were developed and construction was initiated in June 2007. Backwater Environmental completed earthwork and grading at the Site on September 20, 2007. Carolina Silvics completed planting of the Site on January 9, 2007.

Information on project managers, owners, and contractors follows:

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3.0 RESTORATION ACTIVITIES

Primary activities at the Site included 1) stream restoration/enhancement, 2) wetland restoration/enhancement, 3) soil scarification, and 4) plant community restoration (Sheets P1-P4, Appendix A). Restoration plans constructed 6219 linear feet of stream, enhanced (level II) 1205 linear feet of stream, restored 11 acres of riverine wetland, and enhanced 6.1 acres of riverine wetland. As constructed, the Site provides 6701 SMUs and 13 riverine WMUs.

3.1 Stream Restoration

The entire Site is located within a floodplain suitable for channel relocation. The stream was constructed on new location and the old, dredged and straightened channel was abandoned and backfilled. Primary activities designed to restore the channel on new location included 1) belt-width preparation and grading, 2) floodplain bench excavation, 3) channel excavation, 4) installation of channel plugs, 5) backfilling of the abandoned channel, 6) ditch rerouting, 7) installation of in-stream structures and a drop structure at the Site outfall, and 8) construction of a forded channel crossing.

3.1.1 Belt-width Preparation and Grading

The belt-width was prepared and graded; material excavated during grading was stockpiled immediately adjacent to channel segments to be abandoned and backfilled. These segments were backfilled after stream diversion was completed. After preparation of the corridor, the design channel and updated profile survey was developed and the location of each meander wavelength plotted and staked along the profile.

3.1.2 Floodplain Bench Excavation

A bankfull, floodplain bench was created to 1) remove eroding material and collapsing banks, 2) promote overbank flooding during bankfull flood events, 3) reduce the erosive potential of flood waters, and 4) increase the width of the active floodplain. Bankfull benches were created by excavating the adjacent floodplain to bankfull elevations or filling eroded/abandoned channel areas with suitable material. After excavation, or filling of the bench, a relatively level floodplain surface was stabilized with suitable erosion control measures. Planting of the bench with native floodplain vegetation is expected to reduce erosion of bench sediments, reduce flow velocities in flood waters, filter pollutants, and provide wildlife habitat.

3.1.3 Channel Excavation

The channel was constructed within the range of values depicted in Sheet D-1 (Appendix A), which provides geometry and elevation data for the constructed channel.

The stream banks and local belt-width area of constructed channels were planted with shrub and herbaceous vegetation. Deposition of shrub and woody debris into and/or overhanging the constructed channel was encouraged.

Particular attention was directed toward providing vegetative cover and root growth along the outer bends of each stream meander. Live willow stake revetments, available root mats, and/or biodegradable, erosion-control matting were embedded into the break-in-slope to promote more rapid development of an overhanging bank.

3.1.4 Channel Plugs

Impermeable plugs were installed along abandoned channel segments. The plugs consist of low-permeability materials designed to be of sufficient strength to withstand the erosive energy of surface flow events across the Site. Dense clays imported from off-site and existing material, compacted within the channel, were used for plug construction. The plugs were of sufficient width and depth to form an imbedded overlap in the existing banks and channel bed.

3.1.5 Channel Backfilling

After impermeable plugs were installed, the abandoned channels were backfilled. Backfilling was performed primarily by pushing stockpiled materials into the channel. The channels were filled to the extent that onsite material was available and compacted to maximize microtopographic variability, including ruts, ephemeral pools, and hummocks in the vicinity of the backfilled channel.

Borrow material was generated through excavation of groundwater storage depressions throughout the Site landscape. The primary purpose of these depressions was to provide suitable, low permeability material for ditch plugs and backfilling, to increase water storage potential within the wetland restoration area, and to increase potential for biological diversity within the complex.

3.1.6 In-Stream Structures

In-stream structures were used within the Site for bank stabilization, grade control, and habitat improvement. This included the installation of two log vanes and a TerraCell drop structure at the bottom of the Site.

Log Vanes

Log vanes were used to direct high velocity flows during bankfull events towards the center of the channel. Log vanes were constructed utilizing large tree trunks harvested from the Site. The tree stem harvested for a log cross-vane arm were long enough to be imbedded into the stream channel and extend several feet into the floodplain. Logs create an arm that slopes from the center of the channel upward at approximately 5 to 7 degrees, tying in at the bankfull floodplain elevation. Logs extend from each stream bank at an angle of 20 to 30 degrees. A trench was dug into the stream channel that was deep enough for the head of the log to be at or below the channel invert. The trench was then extended into the floodplain and the log was set into the trench such that the log arm was below the floodplain elevation. Once the vane was in place, filter fabric was toed into a trench on the upstream side of the vane and draped over the structure to force water over the vane. The upstream side of the structure was then backfilled with suitable material.

TerraCell Outfall Structure

A TerraCell drop structure was installed at the Site outfall to lower Site hydrology to its preconstruction elevation. The drop structure was installed approximately 150 feet from the downstream Site outfall. The structure was constructed to resist erosive forces associated with hydraulic drops proposed at the Site. TerraCell is a light weight, flexible mat made of high density polyethylene strips. The strips are bonded together to form a honeycomb configuration. The honeycomb mat was fixed in place and filled with gravel or sand. Material in the TerraCell structure was be planted with grasses and shrubs for additional erosion protection. The TerraCell structure forms a nickpoint that approximates geologic controls in stream beds.

3.1.7 Forded Channel Crossing

Landowner constraints necessitated the installation of one channel ford to allow access to portions of the property isolated by the conservation easement and stream restoration activities. The location of the channel ford is depicted on Sheet P-1 (Appendix A). The ford was constructed of hydraulically stable rip-rap or suitable rock and is large enough to handle the weight of anticipated vehicular traffic. Approach grades to the ford are at an approximate 15:1 slope and constructed of hard, scour-resistant crushed rock or other permeable material, which is free of fine materials. The bed elevation of the ford is equal to the floodplain elevation above and below the ford to reduce the risk of headcutting.

3.2 Wetland Restoration

Wetland restoration activities focused on 1) the reestablishment of historic water table elevations, 2) excavation and grading of elevated spoil and sediment embankments, 3) reestablishment of hydrophytic vegetation, and 4) reconstruction of stream corridors.

3.2.1 Reestablishment of Historic Groundwater Elevations

Preconstruction channel depths averaged 5 feet, while the depth for the constructed restoration channels average approximately 1 foot. Hydric soils adjacent to the incised channels were drained due to lowering of the groundwater tables and a lateral drainage effect from preconstruction stream reaches. Reestablishment of channel inverts is expected to rehydrate hydric Muckalee soils adjacent to Site streams, resulting in the restoration of jurisdictional hydrology to riverine wetlands within the Site.

3.2.2 Excavation and Grading of Elevated Spoil and Sediment Embankments

Spoil/sediment deposition adjacent to the preconstruction channel and area ditches were removed. Spoil materials were used to fill onsite ditches, which represented a critical element of onsite wetland restoration.

3.2.3 Hydrophytic Vegetation

Onsite wetland areas endured significant disturbance from land use activities prior to construction such as land clearing and other anthropogenic maintenance. Wetland areas were revegetated with native vegetation typical of wetland communities in the region. Emphasis focused on developing a diverse plant assemblage. Plant Community Restoration is discussed in more detail in Section 4.0.

3.2.4 Reconstruction of Stream Corridors

The stream restoration plan involved the reconstruction of three UTs to the New River by diverting stream flow through its historic floodplain. Existing channels were backfilled to restore the water table to historic conditions. However, some portions of the existing channels remain open for the creation of wetland "oxbow lake-like" features. These features were plugged on each side of the open channel and will function as open water systems. They are expected to provide habitat for a variety of wildlife as well as create open water/freshwater marsh within the Site.

4.0 PLANT COMMUNITY RESTORATION

On January 7-9, 2008, the Site was planted with native, wetland-adapted tree and shrub species (Sheet P-3, Appendix A). Onsite observations, reference forest, and pertinent community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community association promoted during restoration efforts. Approximately 32.5 acres of the Site was planted with species characteristic of the Coastal Plain Small Stream Swamp.

Before plant community restoration was implemented, the entire Site was scarified. Scarification was performed as linear bands directed perpendicular to the land slope. Subsequently, community restoration was initiated on scarified surfaces.

Ten tree species were planted at the Site; they are as follows (with planted quantity).

Table 1. Planted Tree Species

Vegetation Association (Planting Area)	**Coastal Plain Small Stream Swamp**	
Area (acres)	**32.5**	
SPECIES	**Total Number Planted**	**Percentage of Total**
River birch (*Betula nigra*)	3300	10.8
Sugarberry (*Celtis laevigata*)	3300	10.8
Buttonbush (*Cephalanthus occidentalis*)	3300	10.8
Green ash (*Fraxinus pennsylvanica*)	3300	10.8
Swamp black gum (*Nyssa biflora*)	3300	10.8
Sycamore (*Platanus occidentalis*)	3300	10.8
Cherrybark oak (*Quercus pagodaefolia*)	3300	10.8
Water oak (*Quercus nigra*)	3300	10.8
Willow oak (*Quercus phellos*)	3300	10.8
Elderberry (*Sambucus canadensis*)	800	2.6
TOTAL	**30,500**	**100**

Bare-root seedlings of shrubs and canopy and understory tree species were planted within the Site at a density of 938 stems per acre (9-foot centers). Planting was performed during winter to allow plants to stabilize during the dormant period and develop root systems during the spring season. Bare-root seedlings were hand planted to minimize wetland soil disturbance. A total of 30,500 character tree and shrub seedlings were planted in support of Site wetland restoration.

5.0 MONITORING PLAN

The Jarmans Oak Stream and Wetland Restoration Site monitoring plan will entail analysis of the stream channel, hydrology, and vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. The detailed monitoring plan is depicted in Sheet P-4 (Appendix A).

5.1 Stream

Five stream reaches will be monitored for geometric activity; four reaches on the main tributary and one reach on the southern tributary (west). Each stream reach extends for approximately 600 linear feet for a total monitoring length of 3,000 linear feet along the restored channel. After completion of Site construction 20 stream cross-sections were established; two riffle cross-sections and two pool cross-sections were established on each stream monitoring reach:

Annual fall monitoring will include development of channel cross-sections on riffles and pools, and a water surface profile of the channel. The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, 5) width-to-depth ratio, 6) water surface slope, and 9) facet slope. The stream will subsequently be classified according to stream geometry and substrate (Rosgen 1996). Significant changes in channel morphology will be tracked and reported by comparing data in each successive monitoring year. A photographic record that will include preconstruction and postconstruction pictures has been initiated (Appendix B).

Baseline/as-built measurements were preformed in October and November 2007. As-built channels emulated the proposed channel morphology; cross-section and longitudinal profile plots can be found in Appendix C.

5.2 Hydrology

After hydrological modifications were completed at the Site, continuously recording, surficial monitoring gauges were installed in accordance with specifications in *Installing Monitoring Wells/Piezometers in Wetlands* (NCWRP 1993). Monitoring gauges were set to a depth of approximately 24 inches below the soil surface. Screened portions of each gauge were surrounded by filter fabric, buried in screened well sand, and sealed with a bentonite cap to prevent siltation and surface flow infiltration during floods.

Four monitoring gauges were installed in wetland restoration areas to provide representative coverage of the Site (Sheet P-4, Appendix A). One additional gauge was placed in a reference wetland area just north of the Site for comparison with onsite conditions. Hydrological sampling will be performed in restoration and reference areas during the growing season (April 8 through November 5) at daily intervals necessary to satisfy the hydrology success criteria within each physiographic landscape area (USDA 1992).

5.3 Vegetation

Following Site planting, fourteen (13 - 10-meter by 10-meter and one -20-meter by 5-meter) vegetation monitoring plots were established within the Site (Sheet P-4, Appendix A). During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed each year using the CVS-EEP Protocol for Recording Vegetation Level 1-2 Plot Sampling Only (Version 4.0) (Lee et al. 2006 between June 1and September 30 until the vegetation success criteria are achieved.

A photographic record of plant growth will be included in each annual monitoring report.

6.0 SUCCESS CRITERIA

6.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system.

The channel configuration will be measured on an annual basis in order to track changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability. Specifically, the width-to-depth ratio should characterize an E-type and/or a borderline E-type/C-type channel, bank-height ratios indicative of a stable or moderately unstable channel, and minimal changes in cross-sectional area, channel width, and/or bank erosion along the monitoring reach. In addition, channel abandonment and/or shoot cutoffs must not occur and sinuosity values must remain at approximately 1.3 (thalweg distance/straight-line distance). The field indicator of bankfull events will be described in each monitoring year and indicated on a representative channel cross-section figure. If the stream channel is down-cutting or the channel width is enlarging due to bank erosion, additional bank or slope stabilization methods will be employed.

Some areas within the design channel may be expected to form low-slope, braided, stream/swamp complexes similar to Muckalee swamps in the area. These stream/swamp complexes would not be considered unstable; however, footage of stream channel restoration in these reaches will be recalculated from distance along the thalweg (1.3 sinuosity) to distance along the valley (1.0 to 1.1 sinuosity).

Stream substrate is not expected to coarsen over time; therefore, pebble counts are not proposed as part of the stream success criteria.

6.2 Hydrologic Success Criteria

Target hydrological characteristics include saturation or inundation for 8 to 12 percent within Muckalee soils (riverine wetlands) of the growing season, during average climatic conditions. This value is based on DRAINMOD simulations for 42 years of rainfall data in an old field stage. These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed in these areas.

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

6.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species, species identified through inventory of a reference (relatively undisturbed) forest community used to orient the planting plan, and appropriate Schafale and Weakley (1990) community descriptions (Coastal Plain Small Stream

Swamp). All canopy tree species planted and identified in the reference forest will be utilized to define "Characteristic Tree Species" as termed in the success criteria.

Table 2. Characteristic Tree Species

PLANTED SPECIES	REFERENCE SPECIES
River birch (*Betula nigra*)	Red maple (*Acer rubrum*)
Sugarberry (*Celtis laevigata*)	Ironwood (*Carpinus carolinia*)
Buttonbush (*Cephalanthus occidentalis*)	Pignut hickory (*Carya glabra*)
Green ash (*Fraxinus pennsylvanica*)	Dogwood (*Cornus* sp.)
Swamp black gum (*Nyssa biflora*)	Ash (*Fraxinus* sp.)
Sycamore (*Platanus occidentalis*)	American holly (*Ilex opaca*)
Cherrybark oak (*Quercus pagodaefolia*)	Sweetgum (*Liquidambar styraciflua*)
Water oak (*Quercus nigra*)	Yellow poplar (*Liriodendron tulipifera*)
Willow oak (*Quercus phellos*)	White oak (*Quercus alba*)
Elderberry (*Sambucus canadensis*)	Water oak (*Quercus nigra*)
	Laurel oak (*Quercus laurifolia*)
	Swamp chestnut oak (*Quercus michauxii*)
	Cherrybark oak (*Quercus pagoda*)

An average density of 320 stems per acre of Characteristic Tree Species must be surviving at the end of the third monitor year. Subsequently, 290 Characteristic Tree Species per acre must be surviving at the end of year 4 and 260 Characteristic Tree Species per acre at the end of year 5.

If vegetation success criteria are not achieved, based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

7.0 MONITORING REPORT SUBMITTAL

An Annual Stream and Wetland Monitoring Report will be prepared at the end of each monitoring year (growing season). The monitoring report will depict the sample plot and quadrant locations and include photographs which illustrate Site conditions. Data compilation and analyses will be presented including graphic and tabular format, where practicable.

8.0 CONTINGENCY

In the event that success criteria are not fulfilled, a mechanism for contingency will be implemented.

<u>Stream</u>

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success include 1) headcut migration through the Site, and/or 2) bank erosion.

Headcut Migration Through the Site

In the event that a headcut occurs within the Site (identified visually or through onsite measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

Bank Erosion

In the event that severe bank erosion occurs at the Site resulting in elevated width-to-depth ratios, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of cross-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated which will reduce shear stress to stable values.

Hydrology

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

Vegetation

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

9.0 REFERENCES

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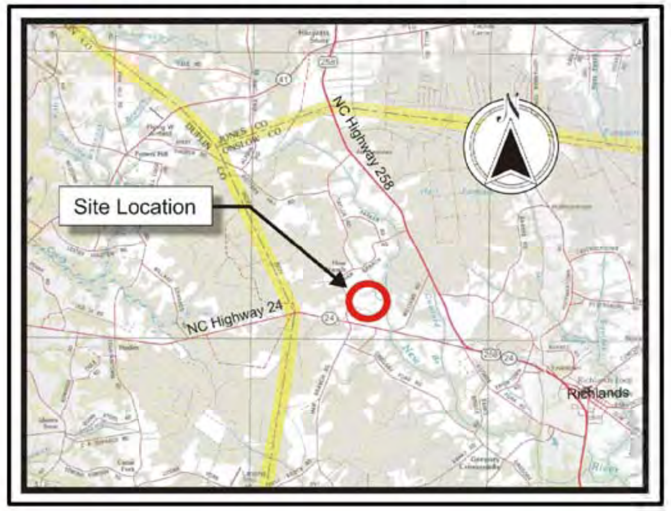
United States Geological Survey (USGS). 1974. Hydrologic Unit Map - 1974. State of North Carolina.

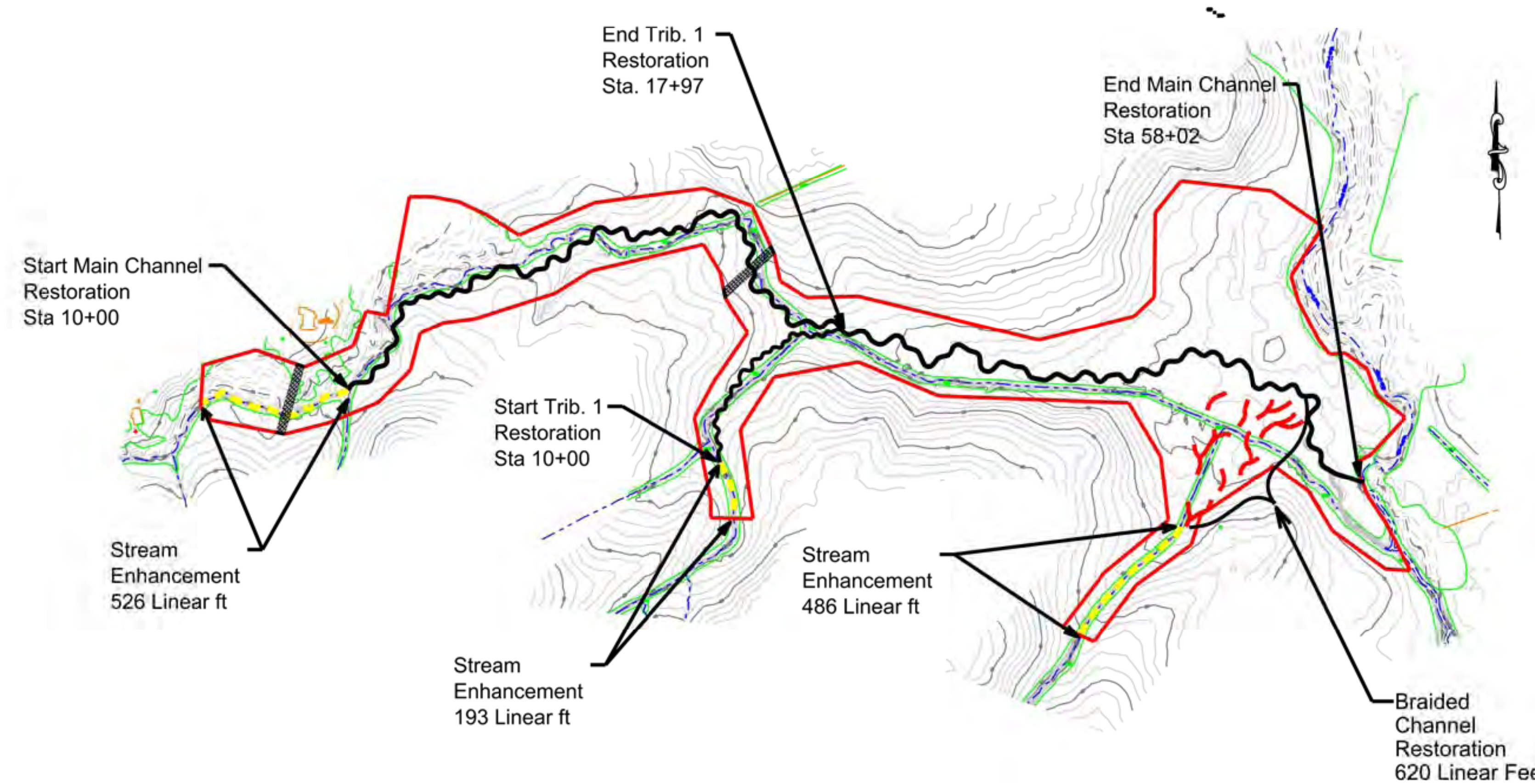
Appendix A.
Figures

AS-BUILT DRAWINGS

JARMANS OAK STREAM AND WETLAND RESTORATION SITE
ONSLOW COUNTY, NORTH CAROLINA

SITE LOCATION





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General
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- Sheet P-2: Site Construction
- Sheet P-3: Vegetation Planting
- Sheet P-4: Monitoring Plan

Line Data
- Sheet L-1: Line Data Upstream
- Sheet L-2: Line Data Downstream
- Sheet L-3: Line Curve Data
- Sheet L-4: Line Profile Data

Details
- Sheet D-1: Details

PROJECT DESCRIPTION

The Jarmans Oak Stream and Wetland Restoration Site, located less than 2 miles east of the Onslow/Duplin County line and approximately 3 miles west of the Town of Richlands, in Onslow County, provieds 6701 stream mitigation units and 13 riverine wetland mitigation units. An approximately 35-acre conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 24 acres of hydric soil, three unnamed tributaries (UTs) to the New River, and adjacent floodplains. Site streams had been degraded by dredging and straightening of the stream channels. Additional evidence of stream deterioration included bank collapse and erosion, channel incision, changes in stream power and sediment transport, and loss of characteristic riffle/pool complex morphology. Site floodplains and wetlands had been impacted by deforestation, vegetation maintenance, and groundwater draw-down from ditching and stream channel downcutting. The primary components of this restoration project include 1) establishing a conservation easement encompassing the floodplain; 2) elevating a restored system of streams and wetlands back onto the historic (abandoned) floodplain surfaces; 3) construction of a stable, riffle-pool stream channel; 4) backfilling the old entrenched ditch/stream system; 5) reforestation of 32.5 acres of agricultural fields with native forest vegetation; 6) installation of a monitoring program to track stream and wetland development on the Site. Earthwork and grading at the Site was performed over a four month period from early June to late September 2007. Site planting occurred during the week of January 7, 2008.

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

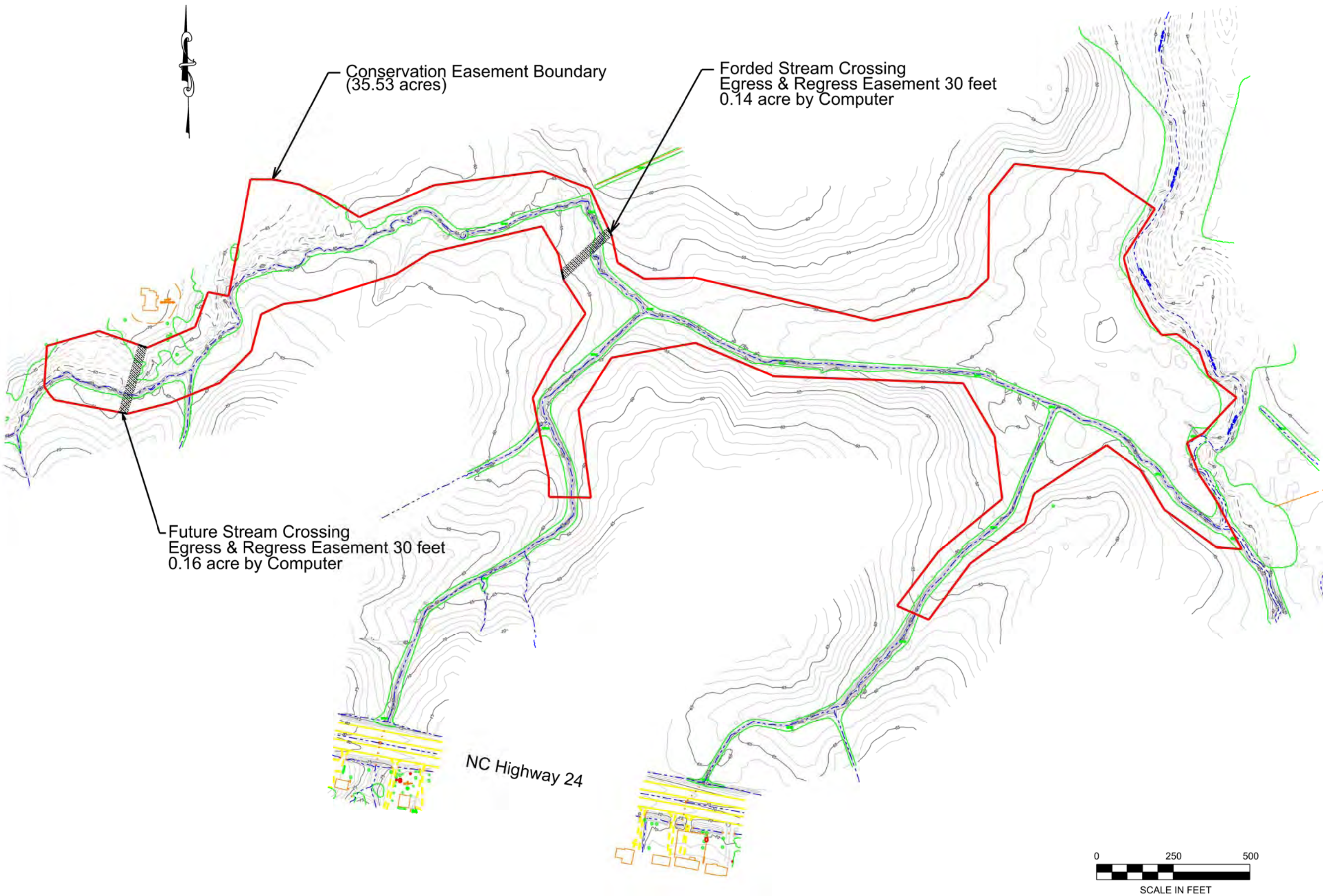
Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

TITLE
INDEX OF SHEETS

Scale: NA	FIGURE NO.
Date: DEC 2007	T-1
Project No.: 06-018	



NOTES/REVISIONS

Project:

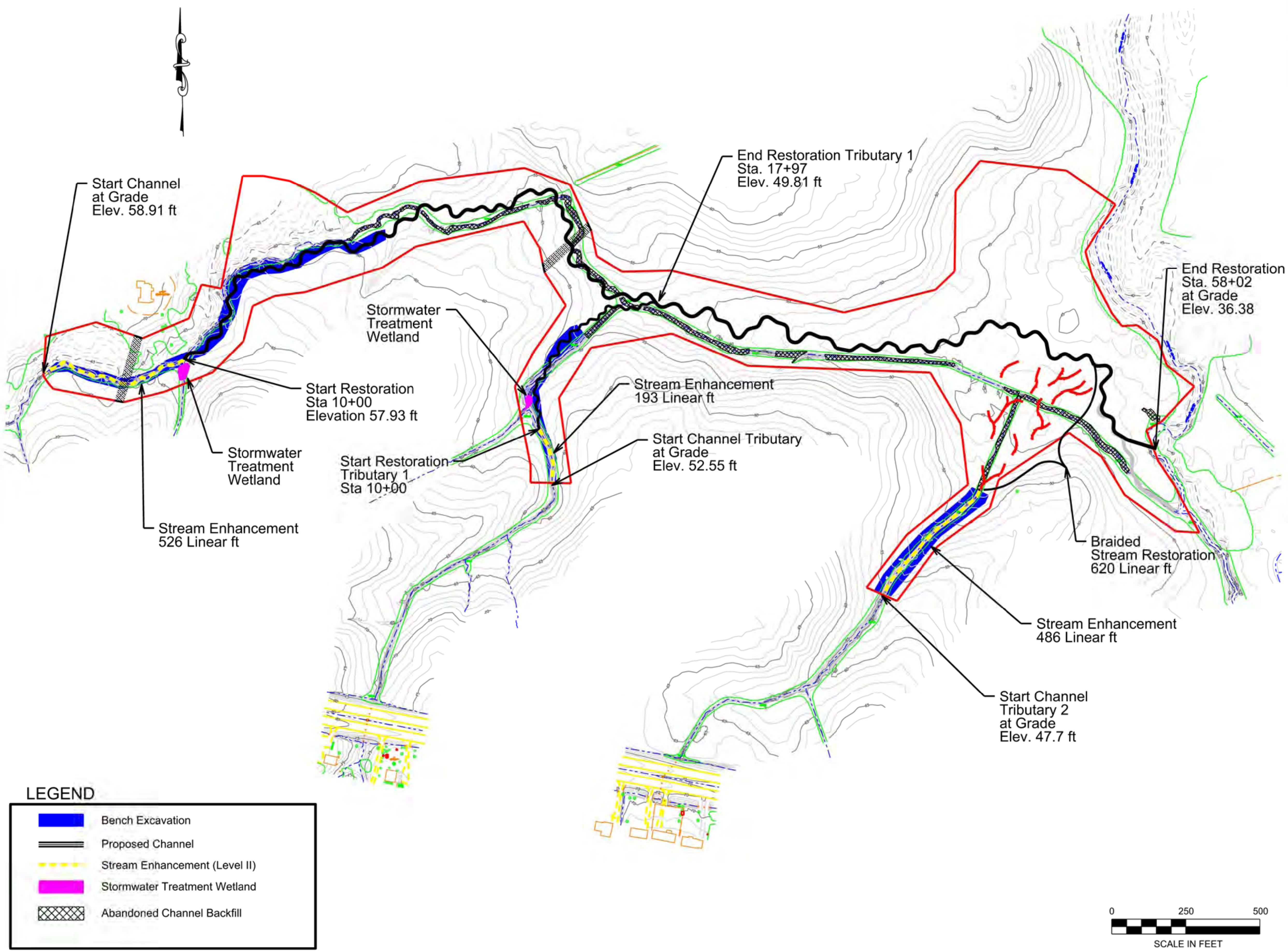
Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

CONSERVATION AREA

Scale: 1 IN = 335 FT	FIGURE NO.
Date: DEC 2007	P-1
Project No.: 06-018	



BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

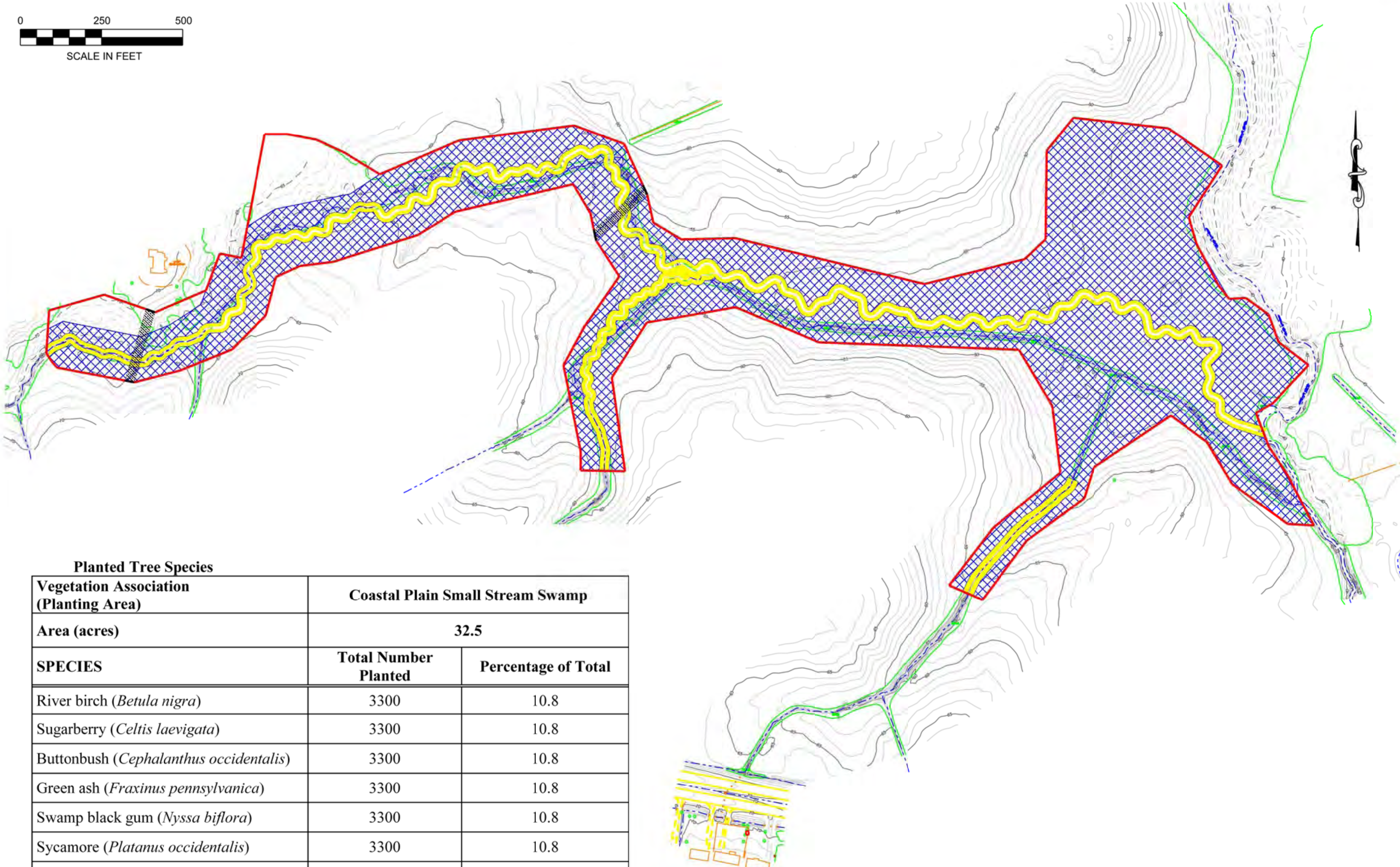
SITE CONSTRUCTION

Scale: 1 IN = 335 FT

Date: DEC 2007

Project No.: 06-018

FIGURE NO. P-2



Planted Tree Species

Vegetation Association (Planting Area)	**Coastal Plain Small Stream Swamp**	
Area (acres)	**32.5**	
SPECIES	**Total Number Planted**	**Percentage of Total**
River birch (*Betula nigra*)	3300	10.8
Sugarberry (*Celtis laevigata*)	3300	10.8
Buttonbush (*Cephalanthus occidentalis*)	3300	10.8
Green ash (*Fraxinus pennsylvanica*)	3300	10.8
Swamp black gum (*Nyssa biflora*)	3300	10.8
Sycamore (*Platanus occidentalis*)	3300	10.8
Cherrybark oak (*Quercus pagodaefolia*)	3300	10.8
Water oak (*Quercus nigra*)	3300	10.8
Willow oak (*Quercus phellos*)	3300	10.8
Elderberry (*Sambucus canadensis*)	800	2.6
TOTAL	**30,500**	**100**

Legend

- Site Boundary
- Small Stream Swamp Forest = 28.7 Acres
- Stream-side Assemblage = 3.8 Acres

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

VEGETATION PLANTING

Scale: 1 IN = 335 FT

Date: DEC 2007

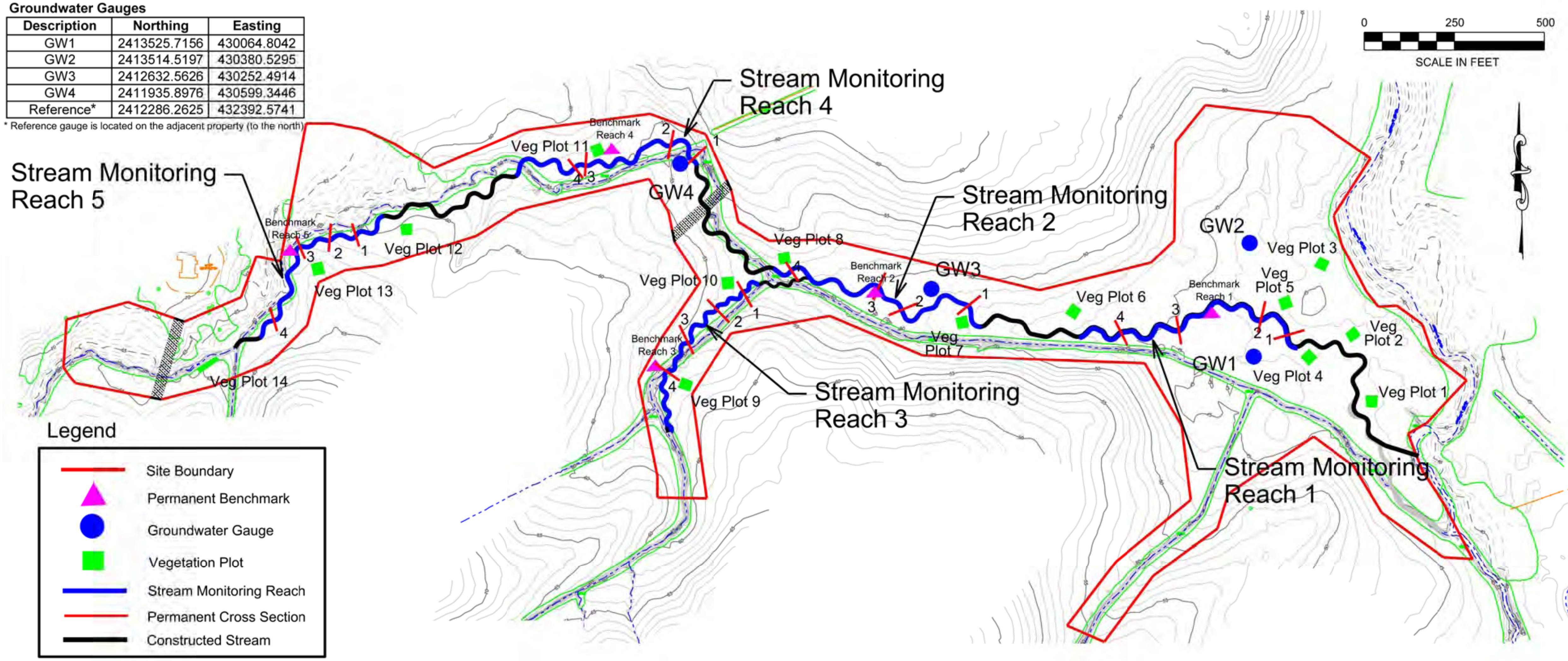
Project No.: 06-018

FIGURE NO. P-3

Groundwater Gauges

Description	Northing	Easting
GW1	2413525.7156	430064.8042
GW2	2413514.5197	430380.5295
GW3	2412632.5626	430252.4914
GW4	2411935.8976	430599.3446
Reference*	2412286.2625	432392.5741

* Reference gauge is located on the adjacent property (to the north)



Stream Reaches/Cross-sections

Description	Northing	Easting
start reach 1	430093.7267	2413647.7787
R1-XS1R	430126.2162	2413607.3028
R1-XS1R	430135.3266	2413638.9224
R1-XS2P	430157.4338	2413541.9976
R1-XS2P	430190.2373	2413549.2122
R1-XS3P	430124.2744	2413319.9627
R1-XS3P	430158.4163	2413313.5504
R1-XS4R	430113.2513	2413164.1445
R1-XS4R	430148.2992	2413146.4336
end reach 1	430127.1266	2413044.5401
start reach 2	430152.2962	2412770.9984
R2-XS1P	430197.3952	2412722.0428
R2-XS1P	430217.2678	2412746.0071
R2-XS2R	430202.7034	2412565.4195
R2-XS2R	430191.2646	2412539.0389
R2-XS3P	430245.7953	2412478.9592
R2-XS3P	430273.7678	2412491.2251
R2-XS4R	430289.6992	2412252.3333
R2-XS4R	430313.8240	2412237.4801
end reach 2	430308.7049	2412193.9601
R3-XS1P	430234.4825	2412117.1620
R3-XS1P	430254.0574	2412104.9363
R3-XS2R	430185.7018	2412046.7879
R3-XS2R	430206.6997	2412027.2225
R3-XS3R	430111.1233	2411951.3344
R3-XS3R	430087.5783	2411965.1523
R3-XS4P	430013.9301	2411913.5511
R3-XS4P	430031.4856	2411889.6842
end reach 3	429859.3747	2411909.3746

Stream Reaches/Cross-sections

Description	Northing	Easting
start reach 4	430599.7354	2411988.3921
R4-XS1R	430602.2209	2411964.5521
R4-XS1R	430621.3637	2411984.1885
R4-XS2P	430634.8438	2411904.4977
R4-XS2P	430668.4012	2411911.3323
R4-XS3P	430609.6915	2411671.1280
R4-XS3P	430585.8661	2411670.3979
R4-XS4R	430577.2425	2411653.0998
R4-XS4R	430597.4064	2411636.6176
end reach 4	430566.2762	2411479.8096
start reach 5	430450.8228	2411114.0086
R5-XS1R	430387.2783	2411038.3312
R5-XS1R	430413.2441	2411031.3049
R5-XS2P	430407.2693	2410964.3448
R5-XS2P	430378.9043	2410963.6319
R5-XS3P	430356.0676	2410887.7939
R5-XS3P	430379.9865	2410877.0846
R5-XS4R	430177.9257	2410803.4790
R5-XS4R	430154.0829	2410812.0633
end reach 5	430115.9333	2410774.5277

Vegetation Plots

Description	Northing	Easting
veg plot 1	429957.0794	2413835.1602
veg plot 1	429925.4763	2413836.7323
veg plot 1	429956.9765	2413869.9535
veg plot 1	429922.9545	2413866.6703
veg plot 2	430123.9211	2413822.5320
veg plot 2	430103.6517	2413793.8502
veg plot 2	430129.1503	2413779.4344
veg plot 2	430149.1822	2413803.8525
veg plot 3	430300.3929	2413722.0653
veg plot 3	430341.7098	2413707.7886
veg plot 3	430328.8858	2413735.3831
veg plot 3	430315.0431	2413691.2075
veg plot 4	430063.8761	2413654.7930
veg plot 4	430086.7946	2413678.7938
veg plot 4	430062.5237	2413701.6484
veg plot 4	430038.8176	2413677.6039
veg plot 5	430192.6736	2413603.3470
veg plot 5	430223.2083	2413592.5482
veg plot 5	430236.0562	2413623.1145
veg plot 5	430203.4437	2413634.5804
veg plot 6	430194.5689	2413048.6970
veg plot 6	430213.1956	2413022.4641
veg plot 6	430185.0407	2413002.9632
veg plot 6	430166.5270	2413029.6368
veg plot 7	430146.6218	2412737.6983
veg plot 7	430179.5155	2412730.0134
veg plot 7	430171.6394	2412698.9100
veg plot 7	430140.5384	2412705.3911

Vegetation Plots

Description	Northing	Easting
veg plot 8	430319.8816	2412210.3114
veg plot 8	430324.4388	2412242.5557
veg plot 8	430351.0120	2412205.8185
veg plot 8	430356.6507	2412236.9981
veg plot 9	429978.3189	2411929.6730
veg plot 9	430007.6750	2411940.8159
veg plot 9	429995.5651	2411971.5294
veg plot 9	429967.5953	2411962.7811
veg plot 10	430284.2654	2412049.8633
veg plot 10	430287.1348	2412083.7488
veg plot 10	430253.8616	2412085.4613
veg plot 10	430250.6449	2412053.6031
veg plot 11	430627.3287	2411729.0074
veg plot 11	430658.0475	2411714.6956
veg plot 11	430646.6545	2411685.1754
veg plot 11	430616.1621	2411697.3212
veg plot 12	430431.7267	2411159.6299
veg plot 12	430401.3307	2411163.3512
veg plot 12	430402.6181	2411193.1361
veg plot 12	430434.6749	2411193.7574
veg plot 13	430328.6356	2410943.9349
veg plot 13	430294.8668	2410953.1250
veg plot 13	430288.7899	2410920.2712
veg plot 13	430321.5799	2410913.0535
veg plot 14	430054.2795	2410657.9532
veg plot 14	430066.5505	2410650.3076
veg plot 14	430031.5062	2410595.6140
veg plot 14	430017.4452	2410604.7982

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

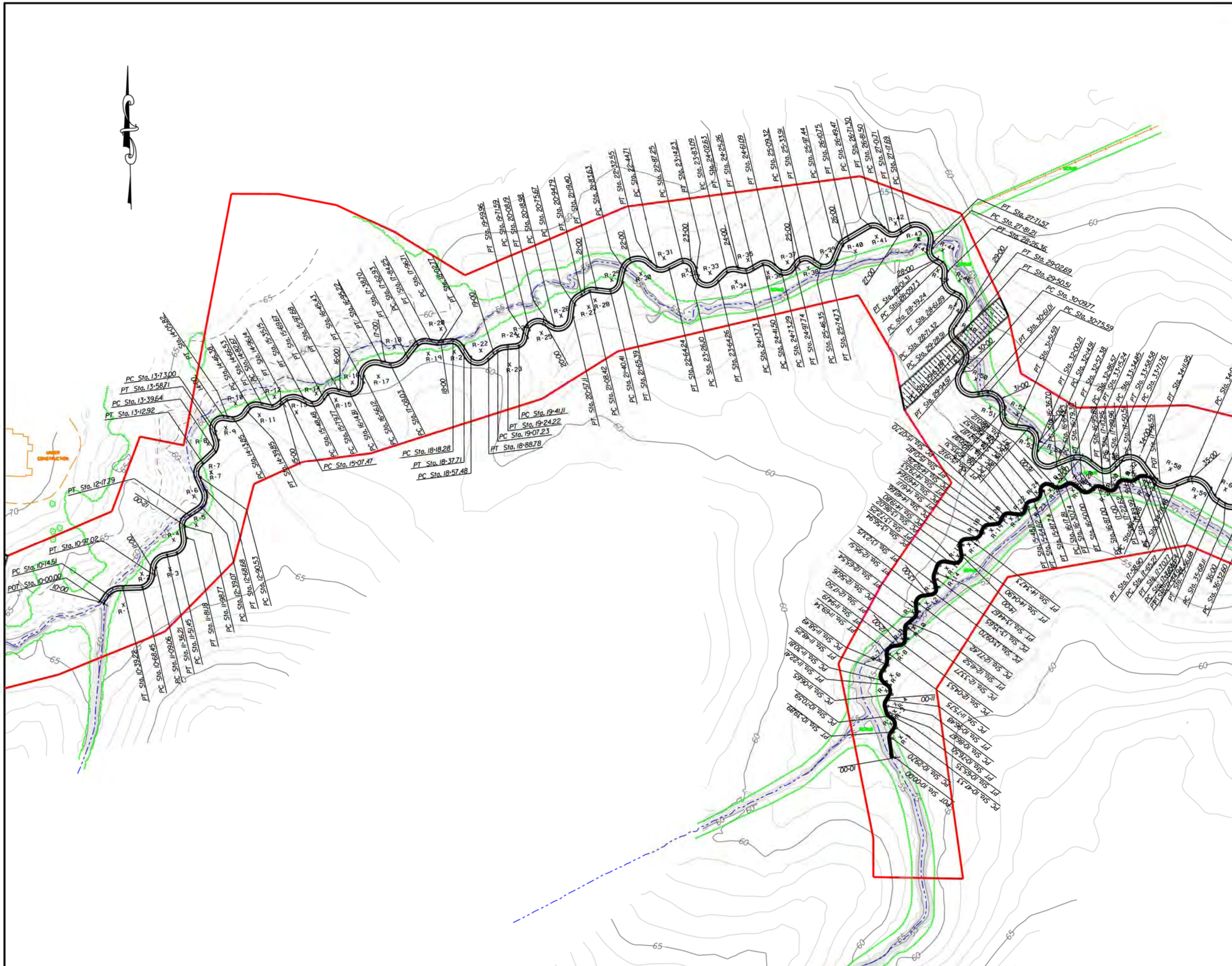
MONITORING PLAN

Scale: 1 IN = 335 FT

Date: DEC 2007

Project No.: 06-018

FIGURE NO. P-4



BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

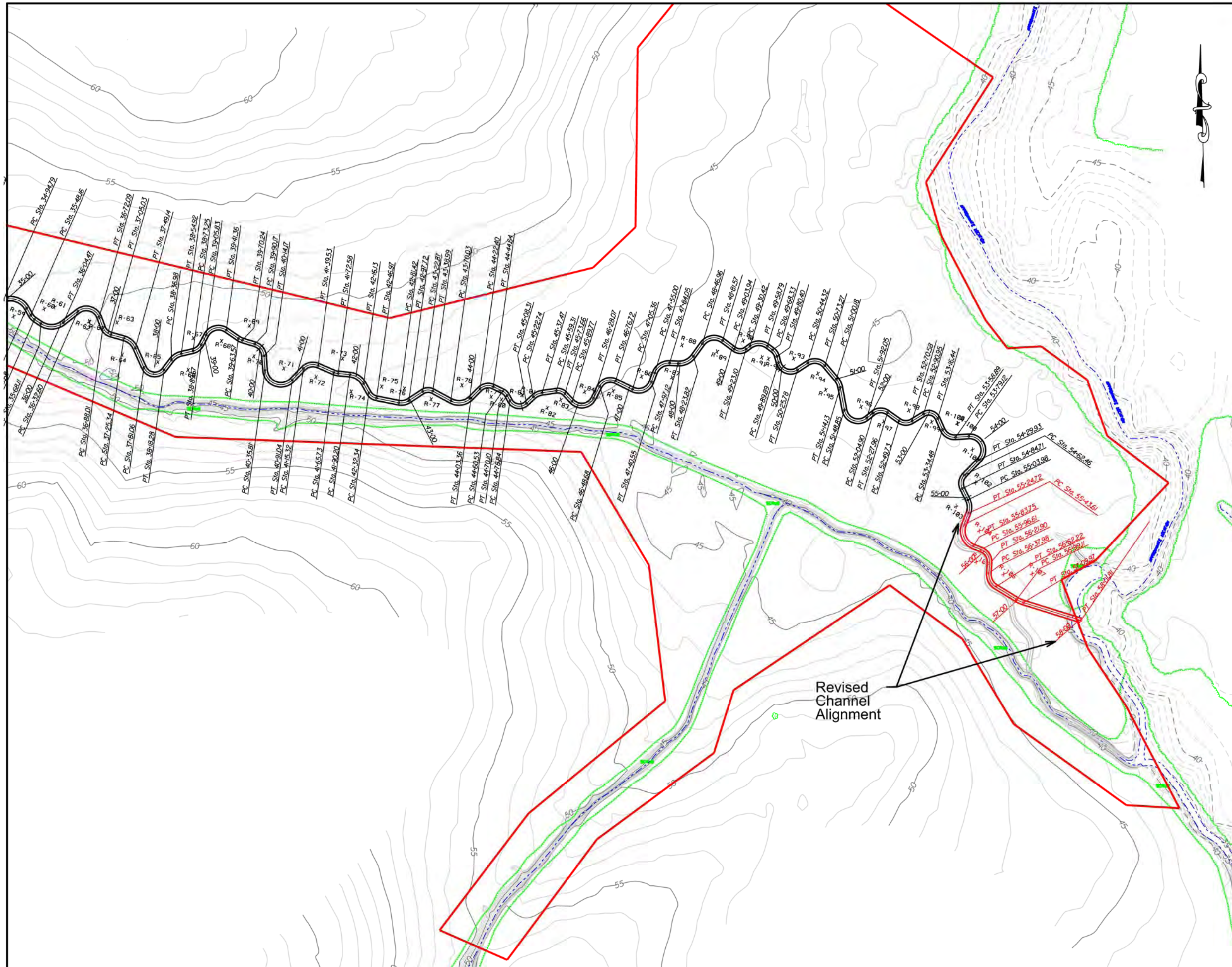
LINE DATA UPSTREAM

Scale: 1 IN = 144 FT

Date: DEC 2007

Project No.: 06-018

FIGURE NO. L-1



BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

LINE DATA DOWNSTREAM

Scale: 1 IN = 144 FT	FIGURE NO.
Date: DEC 2007	L-2
Project No.: 06-018	

PROPOSED CURVE DATA TABLE MAIN CHANNEL

CURVE DATA			
RADIUS (#)	NORTHING	EASTING	RADIUS (FT)
R-1	430,086.7712	2,410,731.6671	26.00'
R-2	430,133.6701	2,410,759.4236	20.00'
R-3	430,141.0080	2,410,802.4939	22.00'
R-4	430,185.3545	2,410,807.9176	20.00'
R-5	430,208.0063	2,410,842.0548	17.00'
R-6	430,251.4098	2,410,838.4288	21.00'
R-7	430,287.6076	2,410,864.6646	18.00'
R-8	430,331.3820	2,410,859.9247	17.00'
R-9	430,355.0815	2,410,886.9699	16.00'
R-10	430,392.1642	2,410,901.4685	23.00'
R-11	430,374.5987	2,410,937.9935	17.00'
R-12	430,402.2016	2,410,960.8566	15.00'
R-13	430,378.7809	2,410,994.0358	24.00'
R-14	430,407.2203	2,411,023.8693	15.00'
R-15	430,397.4617	2,411,053.9816	15.00'
R-16	430,423.9494	2,411,078.7963	17.00'
R-17	430,433.4292	2,411,118.1096	22.00'
R-18	430,478.0399	2,411,142.0879	27.00'
R-19	430,467.7237	2,411,193.9479	20.00'
R-20	430,505.0852	2,411,212.9075	20.00'
R-21	430,470.5119	2,411,233.2612	17.00'
R-22	430,472.4636	2,411,273.4109	18.00'
R-23	430,451.2735	2,411,317.1852	27.00'
R-24	430,494.7690	2,411,329.7320	15.00'
R-25	430,498.9513	2,411,365.4207	19.00'
R-26	430,525.1601	2,411,394.9753	19.00'
R-27	430,538.2645	2,411,437.0767	21.00'
R-28	430,548.5808	2,411,446.8353	17.00'
R-29	430,579.8633	2,411,471.7151	17.00'
R-30	430,588.7305	2,411,515.7033	24.00'
R-31	430,612.7088	2,411,551.1131	17.00'
R-32	430,594.3068	2,411,585.9652	15.00'
R-33	430,590.4034	2,411,620.8174	18.00'
R-34	430,576.7413	2,411,660.9671	20.00'
R-35	430,609.9206	2,411,678.8114	16.00'
R-36	430,590.4034	2,411,708.9237	16.00'
R-37	430,606.2960	2,411,738.1996	15.00'
R-38	430,597.0950	2,411,769.9847	16.00'
R-39	430,616.3334	2,411,798.4241	16.00'
R-40	430,622.7462	2,411,841.3620	21.00'
R-41	430,645.0516	2,411,873.1472	18.00'
R-42	430,665.1264	2,411,902.4230	16.00'
R-43	430,641.4270	2,411,937.2752	23.00'
R-44	430,624.6979	2,411,973.8003	16.00'
R-45	430,593.4704	2,411,966.2722	15.00'
R-46	430,579.2507	2,411,999.7303	19.00'
R-47	430,541.6103	2,411,993.3175	18.00'
R-48	430,501.4606	2,412,006.1431	15.00'
R-49	430,464.0991	2,411,991.0870	23.00'
R-50	430,428.9681	2,412,024.2662	23.00'
R-51	430,385.7514	2,412,045.7352	23.00'
R-52	430,375.7139	2,412,087.0002	18.00'
R-53	430,337.7948	2,412,102.3351	18.00'
R-54	430,317.1623	2,412,137.4661	20.00'
R-55	430,284.8195	2,412,182.3557	27.00'
R-56	430,306.2884	2,412,224.4572	16.00'
R-57	430,289.0017	2,412,261.8187	23.00'
R-58	430,292.3475	2,412,318.9763	25.00'
R-59	430,250.5249	2,412,356.3378	28.00'
R-60	430,261.9564	2,412,402.6215	18.00'
R-61	430,264.7446	2,412,418.2353	29.00'
R-62	430,242.7180	2,412,471.2106	21.00'

CURVE DATA			
RADIUS (#)	NORTHING	EASTING	RADIUS (FT)
R-63	430,241.3239	2,412,513.3120	18.00'
R-64	430,192.5309	2,412,520.8401	27.00'
R-65	430,181.6570	2,412,574.9307	18.00'
R-66	430,169.6679	2,412,621.2144	26.00'
R-67	430,217.6245	2,412,629.0212	19.00'
R-68	430,213.4422	2,412,671.9591	21.00'
R-69	430,236.3052	2,412,714.6182	22.00'
R-70	430,190.3004	2,412,721.3098	20.00'
R-71	430,171.8984	2,412,766.7571	24.00'
R-72	430,158.7940	2,412,815.2713	20.00'
R-73	430,186.9545	2,412,855.9786	22.00'
R-74	430,136.4886	2,412,868.8042	27.00'
R-75	430,144.0167	2,412,915.0879	17.00'
R-76	430,141.2285	2,412,949.6613	21.00'
R-77	430,124.9001	2,412,990.4258	15.00'
R-78	430,146.2472	2,413,037.2100	26.00'
R-79	430,128.6817	2,413,081.8208	18.00'
R-80	430,124.4994	2,413,097.4345	15.00'
R-81	430,131.1911	2,413,128.9409	16.00'
R-82	430,111.9527	2,413,166.8601	24.00'
R-83	430,123.9418	2,413,187.2137	15.00'
R-84	430,136.2098	2,413,223.7388	20.00'
R-85	430,137.3250	2,413,266.9555	18.00'
R-86	430,159.6304	2,413,309.8934	21.00'
R-87	430,157.9575	2,413,356.1771	23.00'
R-88	430,207.3082	2,413,371.5121	27.00'
R-89	430,197.2708	2,413,424.7662	22.00'
R-90	430,213.9998	2,413,464.6371	15.00'
R-91	430,188.9063	2,413,492.7976	22.00'
R-92	430,186.3969	2,413,502.8351	18.00'
R-93	430,186.6757	2,413,541.0331	19.00'
R-94	430,164.0915	2,413,577.8370	20.00'
R-95	430,138.9979	2,413,589.8261	27.00'
R-96	430,113.6256	2,413,643.3591	21.00'
R-97	430,091.0414	2,413,677.6536	18.00'
R-98	430,108.0492	2,413,716.1304	18.00'
R-99	430,090.4837	2,413,750.7038	15.00'
R-100	430,088.2532	2,413,790.0170	20.00'
R-101	430,048.7488	2,413,813.0312	21.00'
R-102	429,998.1951	2,413,817.8988	18.00'
R-103	429,961.9489	2,413,787.7865	25.00'
R-104	429,925.9085	2,413,827.9245	25.50'
R-105	429,878.7324	2,413,823.2480	20.00'
R-106	429,860.0743	2,413,864.5816	22.30'
R-107	429,860.7748	2,413,907.9208	45.50'
~~R-108~~	~~429,800.7083~~	~~2,413,904.3952~~	~~26.00'~~
~~R-109~~	~~429,749.7500~~	~~2,413,879.29[illegible]~~	~~27.00'~~
~~R-110~~	~~429,721.6088~~	~~2,413,935.5786~~	~~33.00'~~
~~R-111~~	~~429,678.8312~~	~~2,413,964.6056~~	~~37.00'~~
~~R-112~~	~~429,602.7769~~	~~2,413,956.6835~~	~~35.00'~~

PROPOSED CURVE DATA TABLE UNNAMED TRIBUTARY 1

CURVE DATA			
RADIUS (#)	NORTHING	EASTING	RADIUS (FT)
R-1	429,886.2544	2,411,909.9640	13.00'
R-2	429,906.4569	2,411,895.0243	11.00'
R-3	429,925.3013	2,411,900.7965	8.00'
R-4	429,936.1665	2,411,901.9849	12.00'
R-5	429,956.8783	2,411,887.7243	11.00'
R-6	429,979.9669	2,411,895.8732	12.00'
R-7	430,003.7345	2,411,877.8777	16.00'
R-8	430,013.0718	2,411,905.0407	12.00'
R-9	430,035.3115	2,411,912.3408	9.00'
R-10	430,051.7791	2,411,930.1665	9.00'
R-11	430,075.7165	2,411,928.6386	10.00'
R-12	430,089.4678	2,411,949.5201	12.00'
R-13	430,111.3680	2,411,960.5551	8.00'
R-14	430,129.3635	2,411,979.5692	15.00'
R-15	430,142.2660	2,411,979.9088	11.00'
R-16	430,160.7708	2,411,996.8857	10.00'
R-17	430,178.4267	2,412,013.3533	9.00'
R-18	430,199.3083	2,412,025.9162	11.00'
R-19	430,199.9874	2,412,047.6466	9.00'
R-20	430,219.1713	2,412,058.5118	9.00'
R-21	430,217.4736	2,412,077.3561	9.00'
R-22	430,232.7528	2,412,095.1819	8.00'
R-23	430,234.2462	2,412,114.3388	11.00'
R-24	430,257.3693	2,412,115.7239	11.00'
R-25	430,260.9344	2,412,136.4357	10.00'
R-26	430,278.2509	2,412,153.4126	13.00'
R-27	430,260.7647	2,412,170.8988	11.00'
R-28	430,269.2531	2,412,195.6851	11.00'
R-29	430,259.7461	2,412,213.8504	8.00'
R-30	430,268.7438	2,412,233.3738	8.00'
R-31	430,268.7177	2,412,250.9763	8.00'
R-32	430,286.3998	2,412,263.5926	11.00'
R-33	430,275.1080	2,412,280.1480	8.00'
R-34	430,272.8183	2,412,287.6998	10.00'

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

LINE CURVE DATA

Scale: NA

Date: DEC 2007

Project No.: 06-018

FIGURE NO. L-3

PROPOSED PROFILE DATA TABLE MAIN CHANNEL

CHANNEL STATION		NORTHING	EASTING	CHANNEL Elevation
~~[illegible]~~	~~PT~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~PC~~	~~[illegible]~~	~~[illegible]~~	~~41.04~~
~~[illegible]~~	~~PT~~	~~[illegible]~~	~~[illegible]~~	~~41.06~~
~~[illegible]~~	~~PC~~	~~[illegible]~~	~~[illegible]~~	~~41.18~~
~~[illegible]~~	~~PT~~	~~[illegible]~~	~~2,413,954.6058~~	~~41.25~~
~~5837.47~~	~~PC~~	~~[illegible]~~	~~2,413,900.9109~~	~~41.51~~
~~5815.15~~	~~PT~~	~~[illegible]~~	~~[illegible]~~	~~41.57~~
~~[illegible]~~	~~PC~~	~~429,745.5145~~	~~[illegible]~~	~~41.67~~
~~5771.82~~	~~PT~~	~~429,749.7500~~	~~2,413,879.2563~~	~~41.74~~
~~[illegible]~~	~~PC~~	~~429,763.0793~~	~~2,413,885.2545~~	~~[illegible]~~
5801.81	PT	429,790.0088	2,413,982.0032	36.38
5709.97	PC	429,817.3178	2,413,894.3131	41.94
5699.11	PT	429,821.8205	2,413,884.4575	42.00
5662.22	PC	429,841.0382	2,413,852.9648	42.02
5637.98	PT	429,861.4988	2,413,842.3264	42.02
5621.90	PC	429,877.5482	2,413,843.3540	42.04
5596.61	PT	429,897.4691	2,413,830.6365	42.04
5583.75	PC	429,902.1229	2,413,818.6555	42.06
5543.61	PT	429,935.2055	2,413,804.1400	42.06
5524.72	PC	429,952.8187	2,413,811.0596	42.07
5503.98	PT	429,961.9489	2,413,787.7865	42.07
5484.71	PC	429,990.2660	2,413,801.7393	42.08
5462.46	PT	429,998.1951	2,413,817.8988	42.08
5429.93	PC	430,033.9863	2,413,827.9666	42.09
5379.12	PT	430,048.7488	2,413,813.0312	42.09
5358.89	PC	430,068.3010	2,413,791.3986	42.10
5334.48	PT	430,088.2532	2,413,790.0170	42.10
5316.43	PC	430,096.5902	2,413,764.4045	42.11
5290.95	PT	430,090.4837	2,413,750.7038	42.11
5270.58	PC	430,092.6825	2,413,725.5040	42.12
5249.72	PT	430,108.0492	2,413,716.1304	42.12
5227.96	PC	430,105.7868	2,413,687.9770	42.13
5204.90	PT	430,091.0414	2,413,677.6536	42.13
5192.05	PC	430,097.1669	2,413,656.4018	42.14
5148.85	PT	430,113.6256	2,413,643.3591	42.14
5114.13	PC	430,143.9281	2,413,616.3722	42.17
5100.18	PT	430,138.9979	2,413,589.8261	42.17
5073.27	PC	430,176.9782	2,413,593.1319	42.26
5044.32	PT	430,164.0915	2,413,577.8370	42.34
5025.78	PC	430,170.7491	2,413,551.3936	42.40
4989.89	PT	430,186.6757	2,413,541.0331	42.50
4980.39	PC	430,190.9985	2,413,520.2370	42.53
4968.33	PT	430,186.3969	2,413,502.8351	42.56
4958.79	PC	430,206.5270	2,413,505.9700	42.59
4930.42	PT	430,188.9063	2,413,492.7976	42.67
4923.09	PC	430,202.0350	2,413,473.6837	42.70
4903.94	PT	430,213.9998	2,413,464.6371	42.75
4881.56	PC	430,215.0516	2,413,437.7216	42.82
4846.96	PT	430,197.2708	2,413,424.7662	42.92
4823.81	PC	430,191.4537	2,413,393.3669	42.99
4797.11	PT	430,207.3082	2,413,371.5121	43.07
4784.05	PC	430,180.9335	2,413,357.2283	43.13
4755.00	PT	430,157.9575	2,413,356.1771	43.22
4740.55	PC	430,152.3593	2,413,329.5944	43.36
4705.36	PT	430,159.6304	2,413,309.8934	43.47
4676.72	PC	430,153.4677	2,413,274.9190	43.75
4648.68	PT	430,137.3250	2,413,266.9555	43.83
4628.07	PC	430,127.1299	2,413,241.5589	43.94
4589.77	PT	430,136.2098	2,413,223.7388	44.05
4573.66	PC	430,134.2261	2,413,198.1332	44.13
4559.31	PT	430,123.9418	2,413,187.2137	44.17
4537.46	PC	430,135.7130	2,413,163.4766	44.28
4522.73	PT	430,111.9527	2,413,166.8601	44.32
4508.31	PC	430,119.5415	2,413,139.9085	44.39
4478.84	PT	430,131.1911	2,413,128.9409	44.48
4470.10	PC	430,131.4813	2,413,110.7106	44.52
4460.53	PT	430,124.4994	2,413,097.4345	44.55
4444.64	PC	430,144.9023	2,413,089.6240	44.60
4422.40	PT	430,128.6817	2,413,081.8208	44.66
4403.36	PC	430,127.8959	2,413,055.6282	44.72
4370.03	PT	430,146.2472	2,413,037.2100	44.82
4338.99	PC	430,138.1017	2,412,997.5476	44.97
4322.87	PT	430,124.9001	2,412,990.4258	45.02
4297.72	PC	430,123.6637	2,412,961.1712	45.15
4281.42	PT	430,141.2285	2,412,949.6613	45.19
4246.97	PC	430,127.3423	2,412,911.7764	45.47
4232.34	PT	430,144.0167	2,412,915.0879	45.51
4216.12	PC	430,149.7699	2,412,892.3118	45.64
4190.20	PT	430,136.4886	2,412,868.8042	45.72
4172.58	PC	430,165.0564	2,412,853.8646	45.89
4165.72	PT	430,186.9545	2,412,855.9786	45.91
4139.53	PC	430,177.1525	2,412,823.2063	46.18
4115.31	PT	430,158.7940	2,412,815.2713	46.25
4091.04	PC	430,155.2257	2,412,784.0203	46.49
4035.81	PT	430,171.8984	2,412,766.7571	46.65
4014.17	PC	430,191.7444	2,412,741.2576	46.87
3990.17	PT	430,190.3004	2,412,721.3098	46.94
3970.24	PC	430,215.2789	2,412,708.1456	47.14
3963.57	PT	430,236.3052	2,412,714.6182	47.16
3941.35	PC	430,230.7512	2,412,683.8502	47.38
3905.83	PT	430,213.4422	2,412,671.9591	47.48
3889.67	PC	430,208.8329	2,412,645.8649	47.64
3873.24	PT	430,217.6245	2,412,629.0212	47.69
3854.92	PC	430,195.0106	2,412,615.4052	47.87
3836.98	PT	430,169.6679	2,412,621.2144	47.93
3818.27	PC	430,170.6857	2,412,589.2006	48.08
3781.06	PT	430,181.6570	2,412,574.9307	48.18
3749.14	PC	430,203.5061	2,412,545.5088	48.34
3725.34	PT	430,192.5309	2,412,520.8401	48.41
3705.03	PC	430,223.9802	2,412,508.4960	48.58
3688.01	PT	430,241.3239	2,412,513.3120	48.63
3672.09	PC	430,250.0072	2,412,490.9050	48.75
3632.60	PT	430,242.7180	2,412,471.2106	48.87
3604.47	PC	430,241.9100	2,412,436.1121	49.09
3568.10	PT	430,264.7446	2,412,418.2353	49.20
3556.68	PC	430,246.9963	2,412,392.6118	49.29
3548.16	PT	430,261.9564	2,412,402.6215	49.32
3535.64	PC	430,264.1442	2,412,380.8024	49.42
3494.78	PT	430,250.5249	2,412,356.3378	49.53
3476.45	PC	430,269.2836	2,412,328.6227	49.72
3443.16	PT	430,292.3475	2,412,318.9763	49.81
3411.94	PC	430,302.6452	2,412,280.3351	50.13
3371.76	PT	430,289.0017	2,412,261.8187	50.24
3358.58	PC	430,295.2743	2,412,236.0628	50.24
3334.85	PT	430,306.2884	2,412,224.4572	50.44
3315.24	PC	430,305.9589	2,412,199.1523	50.64
3286.57	PT	430,284.8195	2,412,182.3557	50.72
3257.37	PC	430,298.6691	2,412,145.0821	51.02
3214.90	PT	430,317.1623	2,412,137.4661	51.14
3200.21	PC	430,334.8902	2,412,120.0992	51.29
3171.00	PT	430,337.7948	2,412,102.3351	51.37
3151.59	PC	430,357.8234	2,412,085.0181	51.53
3125.75	PT	430,375.7139	2,412,087.0002	51.60
3114.68	PC	430,386.3288	2,412,068.7279	51.64
3075.59	PT	430,385.7514	2,412,045.7352	51.75
3061.00	PC	430,406.2407	2,412,027.7967	51.76
3009.77	PT	430,428.9681	2,412,024.2662	51.91
2994.97	PC	430,453.0183	2,412,011.2418	51.93
2963.87	PT	430,464.0991	2,411,991.0870	52.02
2950.51	PC	430,490.1957	2,411,996.2385	52.03
2928.91	PT	430,501.4606	2,412,006.1431	52.10
2902.69	PC	430,531.5930	2,412,008.2725	52.23
2871.32	PT	430,541.6103	2,411,993.3175	52.32
2861.89	PC	430,561.8888	2,411,992.0124	52.41
2839.23	PT	430,579.2507	2,411,999.7303	52.48
2826.36	PC	430,592.8705	2,411,981.2602	52.61
2809.73	PT	430,593.4704	2,411,966.2722	52.66
2801.31	PC	430,610.6693	2,411,966.1062	52.74
2781.21	PT	430,624.6979	2,411,973.8003	52.80
2771.57	PC	430,637.1473	2,411,959.8735	52.90
2717.69	PT	430,641.4270	2,411,937.2752	53.05
2701.71	PC	430,651.7849	2,411,911.2550	53.21
2681.50	PT	430,665.1264	2,411,902.4230	53.27
2671.30	PC	430,659.0680	2,411,884.4405	53.35
2649.47	PT	430,645.0516	2,411,873.1472	53.42
2610.75	PC	430,640.8165	2,411,830.6632	53.73
2597.44	PT	430,622.7462	2,411,841.3620	53.76
2574.73	PC	430,610.0695	2,411,813.1470	53.99
2546.35	PT	430,616.3334	2,411,798.4241	54.07
2533.90	PC	430,610.2542	2,411,779.0861	54.20
2509.31	PT	430,597.0950	2,411,769.9847	54.27
2497.74	PC	430,597.3489	2,411,750.2391	54.39
2473.28	PT	430,606.2960	2,411,738.1996	54.46
2461.09	PC	430,602.6538	2,411,719.2158	54.58
2441.49	PT	430,590.4034	2,411,708.9237	54.64
2425.26	PC	430,596.0846	2,411,686.8467	54.80
2413.73	PT	430,609.9206	2,411,678.8114	54.83
2402.63	PC	430,596.3651	2,411,664.8282	54.94
2383.09	PT	430,576.7413	2,411,660.9671	55.00
2364.25	PC	430,577.6412	2,411,633.5110	55.19
2326.10	PT	430,590.4034	2,411,620.8174	55.30
2314.23	PC	430,597.7815	2,411,600.5572	55.42
2287.25	PT	430,594.3068	2,411,585.9652	55.50
2264.24	PC	430,597.4884	2,411,558.6855	55.73
2244.71	PT	430,612.7088	2,411,551.1131	55.78
2232.55	PC	430,607.2817	2,411,530.9299	55.91
2183.63	PT	430,588.7305	2,411,515.7033	56.05
2165.39	PC	430,576.1599	2,411,488.3068	56.23
2140.41	PT	430,579.8633	2,411,471.7151	56.30
2119.40	PC	430,565.4620	2,411,448.8415	56.51
2108.42	PT	430,548.5808	2,411,446.8353	56.55
2094.79	PC	430,556.4086	2,411,426.5036	56.68
2075.67	PT	430,538.2645	2,411,437.0767	56.74
2057.11	PC	430,522.6488	2,411,413.8086	56.92
2018.98	PT	430,525.1601	2,411,394.9753	57.03
2008.19	PC	430,514.9606	2,411,375.6530	57.14
1971.59	PT	430,498.9513	2,411,365.4207	57.25
1959.96	PC	430,491.6006	2,411,344.3936	57.37
1941.11	PT	430,494.7690	2,411,329.7320	57.37
1924.22	PC	430,478.1345	2,411,314.4489	57.45
1907.23	PT	430,451.2735	2,411,317.1852	57.45
1888.78	PC	430,459.0621	2,411,285.4275	57.54
1857.48	PT	430,472.4636	2,411,273.4109	57.54
1837.71	PC	430,479.5813	2,411,247.6399	57.60
1818.28	PT	430,470.5119	2,411,233.2612	57.60
1802.77	PC	430,485.2675	2,411,215.6016	57.62
1796.71	PT	430,505.0852	2,411,212.9075	57.62
1784.25	PC	430,487.4437	2,411,197.2830	57.63
1762.93	PT	430,467.7237	2,411,193.9479	57.63
1738.70	PC	430,461.2250	2,411,163.2127	57.65
1708.03	PT	430,478.0399	2,411,142.0879	57.65
1695.22	PC	430,454.8116	2,411,123.2856	57.67
1656.12	PT	430,433.4292	2,411,118.1096	57.67
1645.43	PC	430,423.4216	2,411,095.7881	57.68
1614.81	PT	430,423.9494	2,411,078.7963	57.68
1597.68	PC	430,411.9523	2,411,057.8574	57.69
1579.77	PT	430,397.4617	2,411,053.9816	57.69
1569.67	PC	430,398.2853	2,411,035.9178	57.70
1548.48	PT	430,407.2203	2,411,023.8693	57.70
1535.15	PC	430,400.0705	2,411,005.1153	57.72
1507.47	PT	430,378.7809	2,410,994.0358	57.72
1496.14	PC	430,390.4758	2,410,970.2110	57.73
1482.67	PT	430,402.2016	2,410,960.8566	57.73
1466.53	PC	430,391.1721	2,410,941.7781	57.75
1446.38	PT	430,374.5987	2,410,937.9935	57.75
1439.85	PC	430,378.9870	2,410,920.3195	57.75
1413.84	PT	430,392.1642	2,410,901.4685	57.75
1405.82	PC	430,370.8512	2,410,889.6748	57.76
1373.00	PT	430,355.0815	2,410,886.9699	57.76
1358.71	PC	430,336.5840	2,410,876.1092	57.77
1339.64	PT	430,331.3820	2,410,859.9247	57.77
1312.92	PC	430,300.6572	2,410,852.2666	57.80
1290.53	PT	430,287.6076	2,410,864.6646	57.80
1268.68	PC	430,260.2188	2,410,857.4919	57.82
1239.07	PT	430,251.4098	2,410,838.4288	57.82
1217.79	PC	430,222.0951	2,410,832.5414	57.84
1198.77	PT	430,208.0063	2,410,842.0548	57.84
1181.18	PC	430,188.1856	2,410,827.7162	57.86
1151.44	PT	430,185.3545	2,410,807.9176	57.86
1136.21	PC	430,162.4474	2,410,797.5593	57.88
1109.06	PT	430,141.0080	2,410,802.4939	57.88
1097.02	PC	430,131.4671	2,410,779.3019	57.89
1068.44	PT	430,133.6701	2,410,759.4236	57.89
1039.22	PC	430,112.7583	2,410,730.8470	57.92
1014.51	PT	430,086.7712	2,410,731.6671	57.92
1000.00	PT	430,089.1420	2,410,701.9860	57.93

PROPOSED PROFILE DATA TABLE UNNAMED TRIBUTARY 1

CHANNEL STATION		NORTHING	EASTING	CHANNEL INVERT
1796.55	PT	430,273.1068	2,412,303.0140	49.81
1784.95	PC	430,280.5146	2,412,294.0847	50.01
1778.40	PT	430,272.8183	2,412,287.6998	50.04
1770.77	PC	430,283.1021	2,412,280.4531	50.17
1765.28	PT	430,275.1080	2,412,280.1480	50.20
1758.91	PC	430,277.6342	2,412,270.2383	50.24
1750.52	PT	430,286.3998	2,412,263.5926	50.29
1739.99	PC	430,276.6660	2,412,251.8844	50.36
1729.97	PT	430,268.7177	2,412,250.9763	50.41
1722.63	PC	430,265.3980	2,412,240.6405	50.46
1710.25	PT	430,268.7438	2,412,233.3738	50.53
1695.90	PC	430,267.0906	2,412,217.0217	50.63
1687.01	PT	430,259.7461	2,412,213.8504	50.67
1679.30	PC	430,260.8639	2,412,202.7999	50.73
1664.23	PT	430,269.2531	2,412,195.6851	50.81
1650.00	PC	430,269.4085	2,412,177.7021	50.91
1636.71	PT	430,260.7647	2,412,170.8988	50.97
1630.75	PC	430,267.1137	2,412,160.1181	51.02
1617.81	PT	430,278.2509	2,412,153.4126	51.08
1610.13	PC	430,269.9258	2,412,140.8123	51.21
1588.58	PT	430,260.9344	2,412,136.4357	51.32
1587.75	PC	430,258.8056	2,412,126.6297	51.34
1571.87	PT	430,257.3693	2,412,115.7239	51.42
1564.62	PC	430,244.8804	2,412,111.5258	51.54
1550.98	PT	430,234.2462	2,412,114.3388	51.61
1548.11	PC	430,232.1777	2,412,103.1612	51.66
1535.31	PT	430,232.7528	2,412,095.1819	51.73
1519.12	PC	430,226.4277	2,412,078.2643	52.01
1507.70	PT	430,217.4736	2,412,077.3561	52.06
1501.87	PC	430,215.6410	2,412,066.7905	52.16
1492.26	PT	430,219.1713	2,412,058.5118	52.16
1479.53	PC	430,208.9422	2,412,046.7457	52.25
1469.64	PT	430,199.9874	2,412,047.6466	52.25
1461.12	PC	430,195.3133	2,412,036.1651	52.26
1448.66	PT	430,199.3083	2,412,025.9162	52.26
1434.74	PC	430,187.4068	2,412,012.7548	52.27
1419.80	PT	430,178.4267	2,412,013.3533	52.27
1404.90	PC	430,162.3173	2,412,006.7654	52.28
1386.02	PT	430,160.7708	2,411,996.8857	52.28
1372.25	PC	430,153.1220	2,411,981.6824	52.29
1356.95	PT	430,142.2660	2,411,979.9088	52.29
1344.68	PC	430,134.3858	2,411,965.4350	52.30
1335.66	PT	430,129.3635	2,411,979.5692	52.30
1323.15	PC	430,113.4238	2,411,968.2865	52.30
1309.71	PT	430,111.3680	2,411,960.5551	52.30
1295.52	PC	430,101.3324	2,411,947.7225	52.31
1277.43	PT	430,089.4678	2,411,949.5201	52.31
1265.55	PC	430,076.5876	2,411,938.6006	52.31
1256.17	PT	430,075.7165	2,411,928.6386	52.31
1241.53	PC	430,058.5438	2,411,924.2303	52.32
1233.78	PT	430,051.7791	2,411,930.1665	52.32
1217.50	PC	430,035.4073	2,411,921.3402	52.33
1204.53	PT	430,035.3115	2,411,912.3408	52.33
1194.19	PC	430,024.9538	2,411,903.3622	52.34
1175.75	PT	430,013.0718	2,411,905.0407	52.34
1169.35	PC	430,005.4312	2,411,893.7875	52.34
1158.49	PT	430,003.7345	2,411,877.8777	52.34
1148.26	PC	429,986.4658	2,411,885.7854	52.34
1130.81	PT	429,979.9669	2,411,895.8732	52.34
1122.41	PC	429,965.3670	2,411,894.7202	52.35
1106.65	PT	429,956.8783	2,411,887.7243	52.35
1096.48	PC	429,942.4555	2,411,891.7649	52.35
1086.68	PT	429,936.1665	2,411,901.9849	52.35
1076.50	PC	429,923.2004	2,411,893.0773	52.36
1070.59	PT	429,925.3013	2,411,900.7965	52.36
1065.36	PC	429,915.7404	2,411,900.9250	52.36
1047.34	PT	429,906.4569	2,411,895.0243	52.36
1039.90	PC	429,893.9500	2,411,899.4865	52.36
1029.70	PT	429,886.2544	2,411,909.9640	52.36
1000.00	PT	429,854.9418	2,411,901.5787	52.36

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

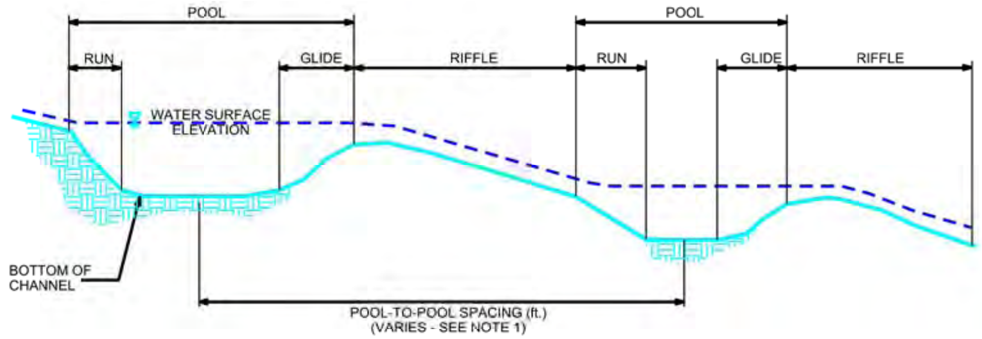
LINE PROFILE DATA

Scale: NA

Date: DEC 2007

Project No.: 06-018

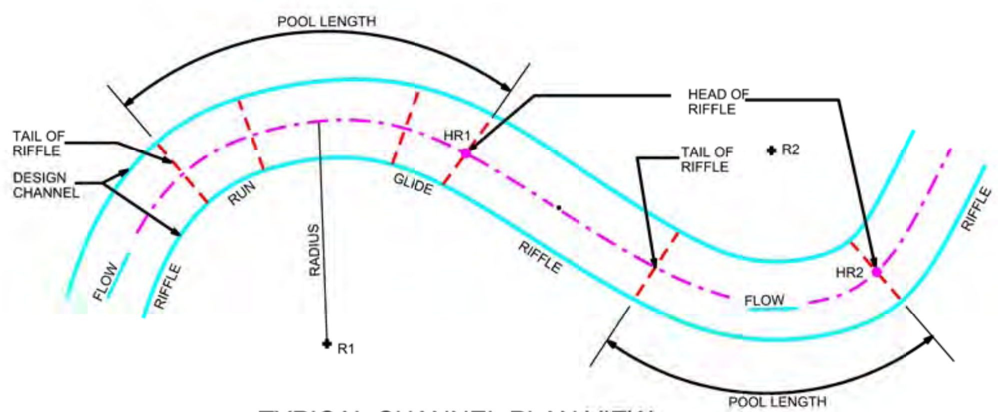
FIGURE NO. L-4



TYPICAL CHANNEL PROFILE

NOTES:

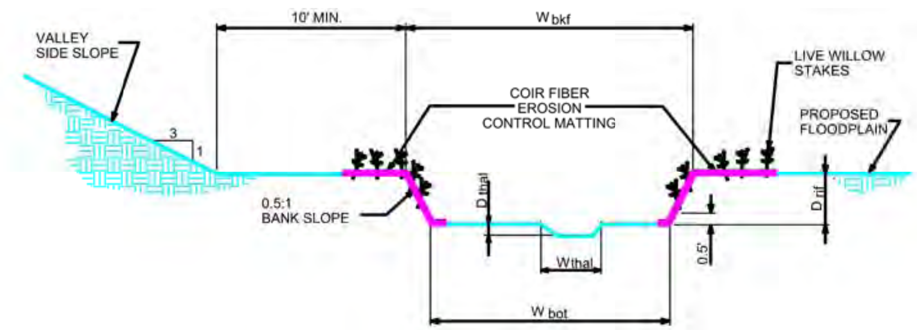
1. POOL-TO-POOL SPACING IS MEASURED FROM CENTER OF POOL BEND TO CENTER OF POOL BEND.



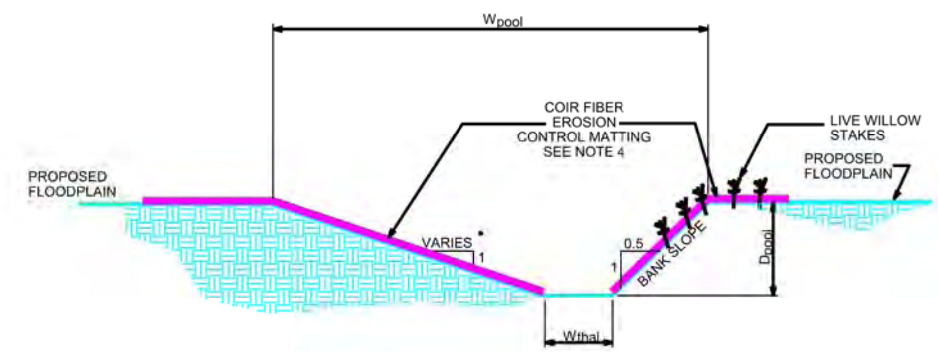
TYPICAL CHANNEL PLAN VIEW

CHANNEL PLAN VIEW NOTES:

1. CHANNEL ALIGNMENT LAYOUT INCLUDED LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS WERE UTILIZED TO COMPLETE THE CHANNEL LAYOUT.



TYPICAL RIFFLE CROSS-SECTION



* MAX. 1:1 SLOPE

TYPICAL POOL CROSS-SECTION

CHANNEL CONSTRUCTION NOTES:

1. MATERIAL EXCAVATED FROM CHANNEL AND FLOODPLAIN WAS USED TO BACKFILL EXISTING CHANNEL.

2. BANK PROTECTION CONSISTED OF NATURAL COIR FIBER MATTING.

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
Main Channel Upstream	6.1	2.1	1.0	0.2	1.5	8.5	0.5
Main Channel Downstream	7.9	2.7	1.3	0.2	2.0	11.1	1.1
Unnamed Tributary	4.1	0.9	0.8	0.1	1.3	5.7	0.5

BACKWATER ENVIRONMENTAL

RESTORATION SYSTEMS, LLC

NOTES/REVISIONS

Project:

Jarmans Oak Restoration Site

Onslow County North Carolina

Title:

DETAILS

Scale: NA

Date: DEC 2007

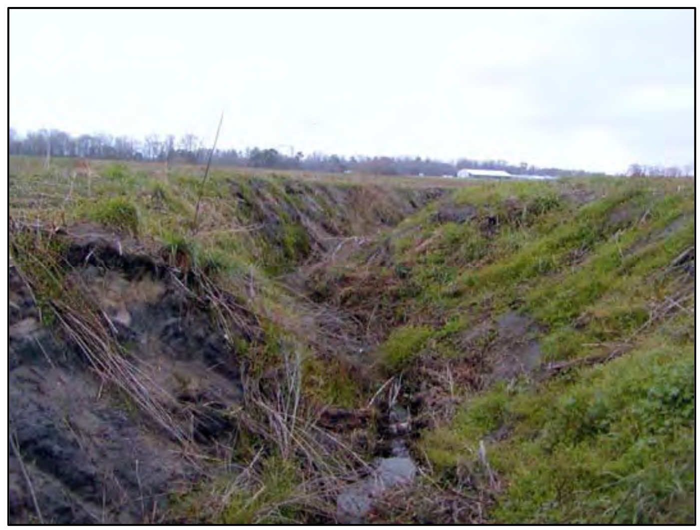
Project No.: 06-018

FIGURE NO.

D-1

Appendix B.
Preconstruction and
Construction Photographs

Jarmans Oak Preconstruction Conditions



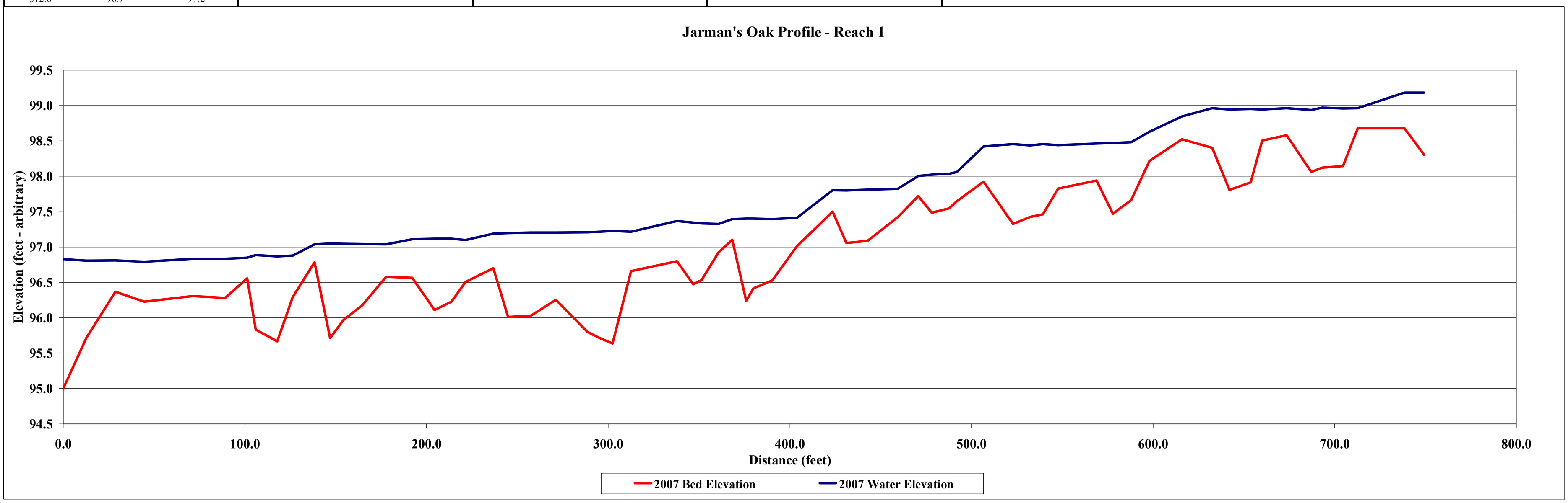
Jarmans Oak During Construction

Appendix C.
As-built Stream Measurements

Project Name	Jarman's Oak
Reach	1
Feature	Profile
Date	10/24/07
Crew	Adasme, Jeffers

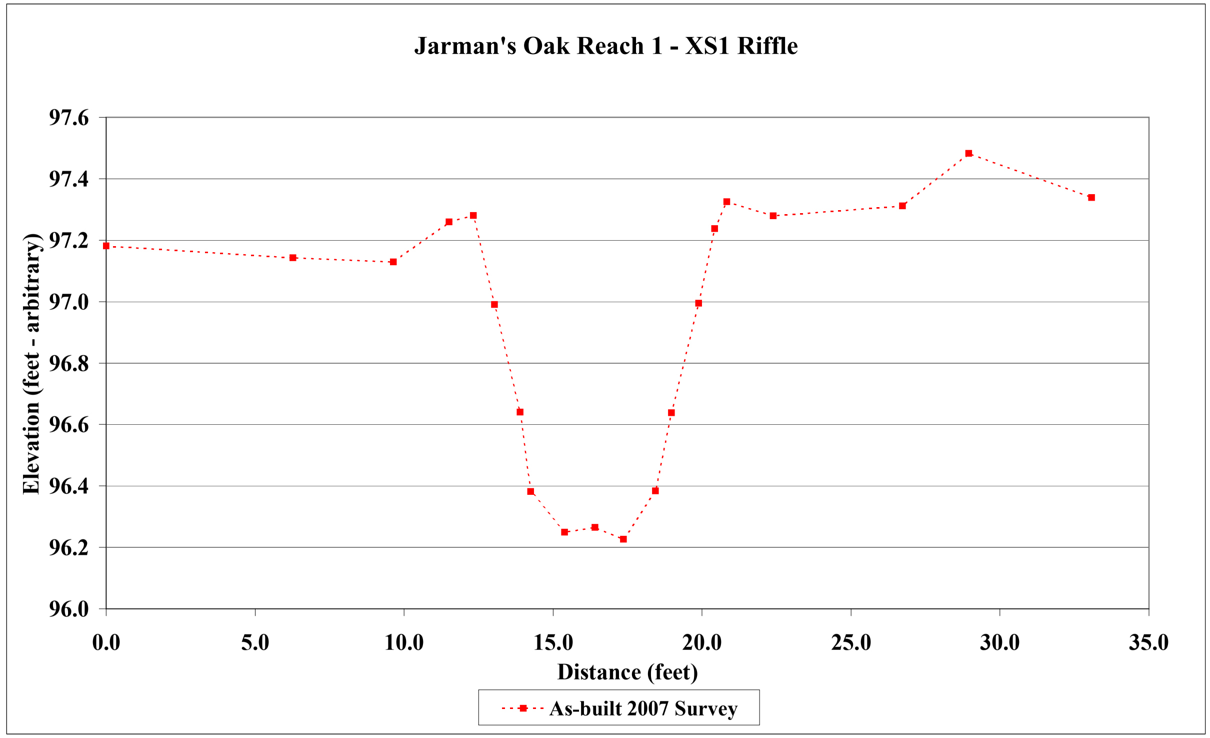
	As-built 2007 Survey		2008 2008 Survey			2009 2009 Survey			2010 2010 Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	95.0	96.8									
12.7	95.7	96.8									
28.6	96.4	96.8									
44.7	96.2	96.8									
71.3	96.3	96.8									
89.2	96.3	96.8									
101.2	96.6	96.8									
105.9	95.8	96.9									
117.7	95.7	96.9									
126.4	96.3	96.9									
138.3	96.8	97.0									
146.9	95.7	97.0									
154.2	96.0	97.0									
164.6	96.2	97.0									
177.7	96.6	97.0									
192.1	96.6	97.1									
204.3	96.1	97.1									
213.8	96.2	97.1									
221.6	96.5	97.1									
236.8	96.7	97.2									
244.9	96.0	97.2									
257.5	96.0	97.2									
271.2	96.3	97.2									
288.6	95.8	97.2									
295.5	95.7	97.2									
302.4	95.6	97.2									
312.6	96.7	97.2									

	As-built	2008	2009	2010
Avg. Water Surface Slope	0.0031			
Avg. Riffle Slope	0.0093			
Avg. Pool Slope	0.0006			
Avg. Run Slope	0.0021			
Avg. Glide Slope	0.0013			



Project Name	Jarman's Oak
Cross Section	R1-XS1
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

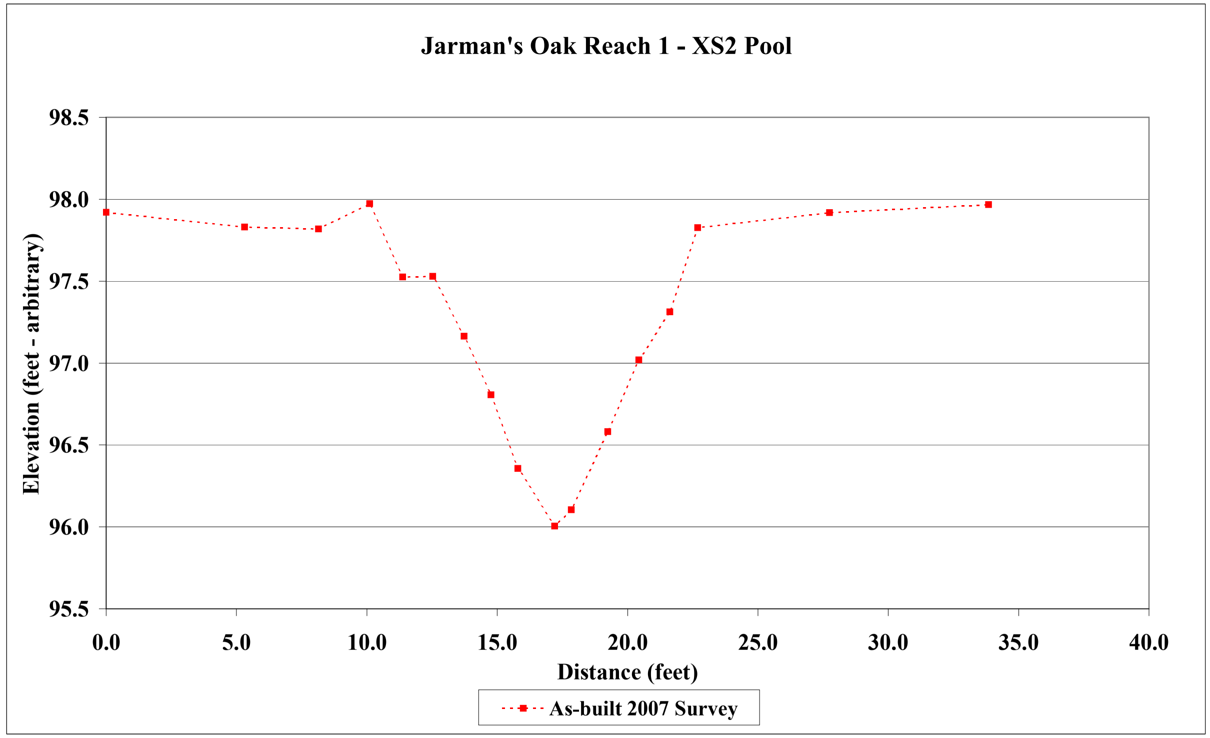
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	97.2						
6.3	97.1						
9.6	97.1						
11.5	97.3						
12.3	97.3						
13.0	97.0						
13.9	96.6						
14.3	96.4						
15.4	96.2						
16.4	96.3						
17.4	96.2						
18.4	96.4						
19.0	96.6						
19.9	97.0						
20.4	97.2						
20.8	97.3						
22.4	97.3						
26.7	97.3						
29.0	97.5						
33.1	97.3						



	As-built	2008	2009	2010
Area	5.9			
Width	9.1			
Mean Depth	0.6			
Max Depth	1.1			
W/D Ratio	14.1			

Project Name	Jarman's Oak
Cross Section	R1-XS2
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

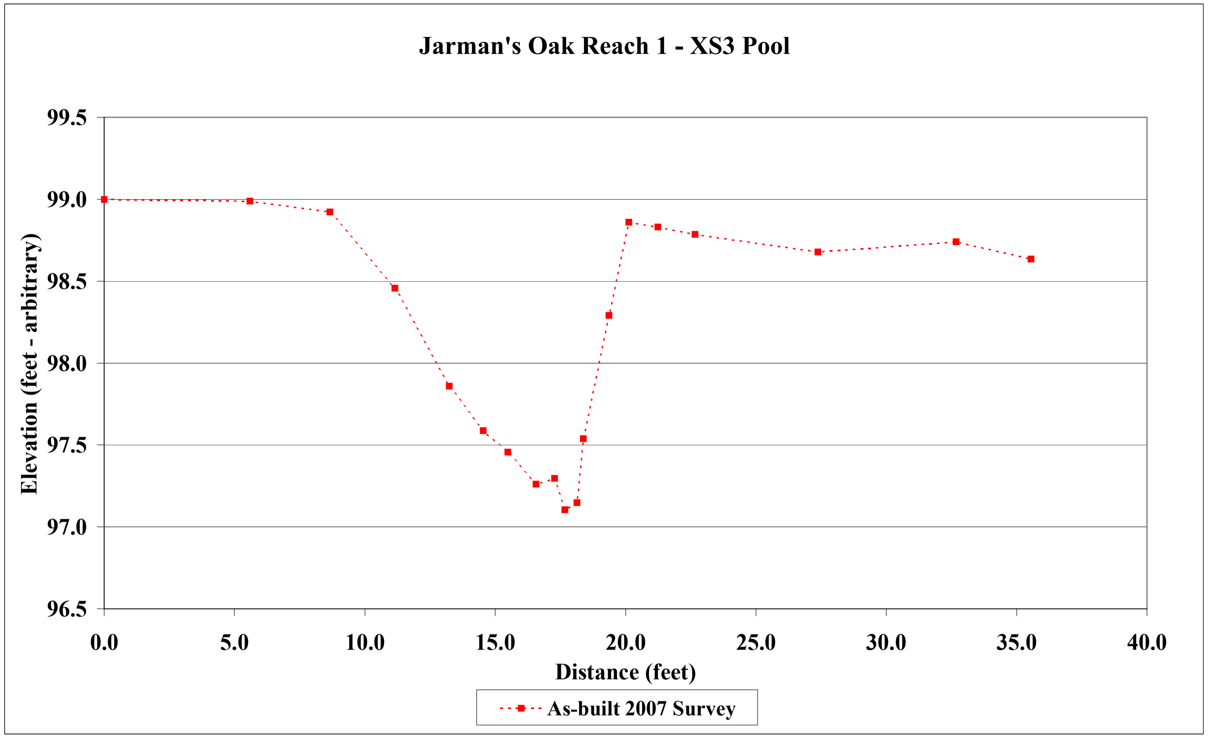
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	97.9						
5.3	97.8						
8.1	97.8						
10.1	98.0						
11.4	97.5						
12.5	97.5						
13.7	97.2						
14.8	96.8						
15.8	96.4						
17.2	96.0						
17.8	96.1						
19.2	96.6						
20.4	97.0						
21.6	97.3						
22.7	97.8						
27.8	97.9						
33.9	98.0						



	As-built	2008	2009	2010
Area	7.6			
Width	9.5			
Mean Depth	0.8			
Max Depth	1.5			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R1-XS3
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

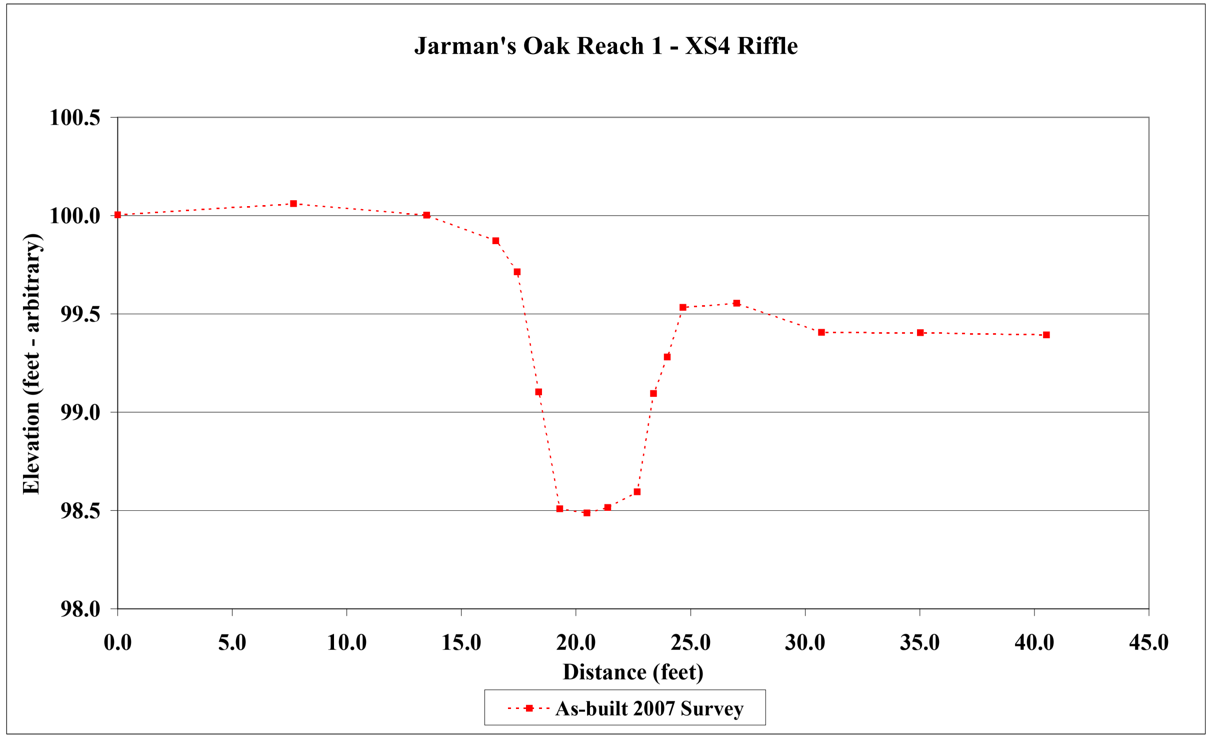
As-built		**2008**		**2009**		**2010**	
2007 Survey		**2008 Survey**		**2009 Survey**		**2010 Survey**	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	99.0						
5.6	99.0						
8.7	98.9						
11.2	98.5						
13.2	97.9						
14.5	97.6						
15.5	97.5						
16.6	97.3						
17.3	97.3						
17.7	97.1						
18.1	97.1						
18.4	97.5						
19.4	98.3						
20.1	98.9						
21.3	98.8						
22.7	98.8						
27.4	98.7						
32.7	98.7						
35.6	98.6						



	As-built	**2008**	**2009**	**2010**
Area	10.4			
Width	12.3			
Mean Depth	0.8			
Max Depth	1.8			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R1-XS4
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

As-built		2008		2009		2010	
2007 Survey		2008 Survey		2009 Survey		2010 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	100.0						
7.7	100.1						
13.5	100.0						
16.5	99.9						
17.4	99.7						
18.4	99.1						
19.3	98.5						
20.5	98.5						
21.4	98.5						
22.7	98.6						
23.4	99.1						
24.0	99.3						
24.7	99.5						
27.0	99.6						
30.7	99.4						
35.0	99.4						
40.5	99.4						

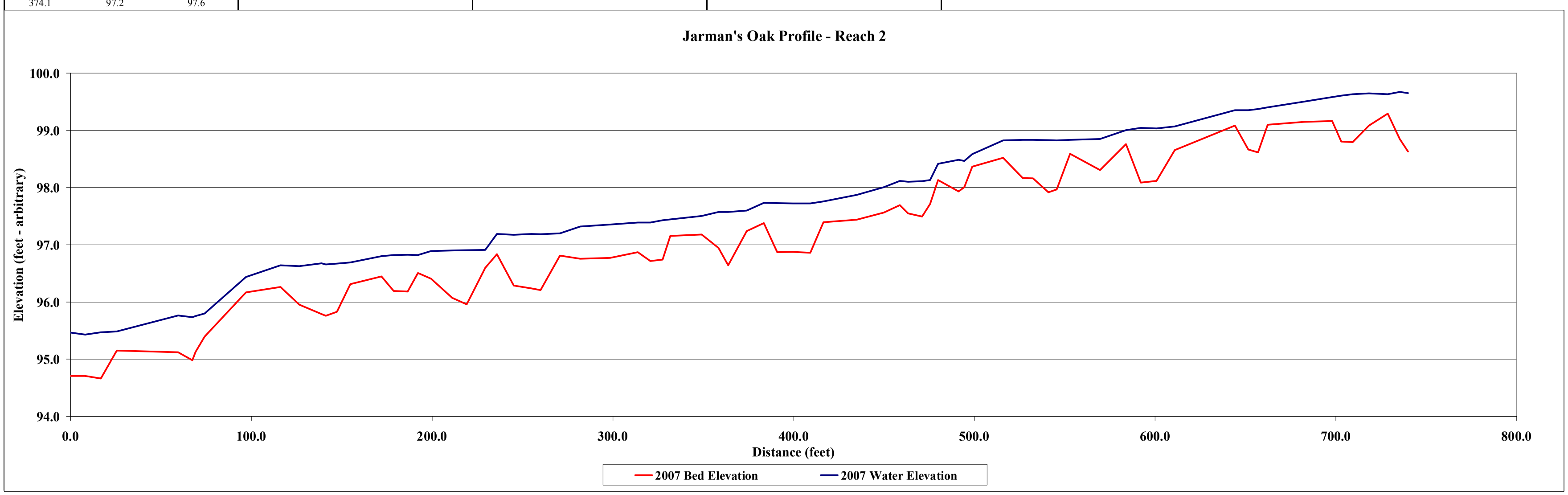


	As-built	2008	2009	2010
Area	5.0			
Width	6.9			
Mean Depth	0.7			
Max Depth	1.0			
W/D Ratio	9.6			

Project Name	Jarman's Oak
Reach	2
Feature	Profile
Date	10/24/07
Crew	Adasme, Jeffers

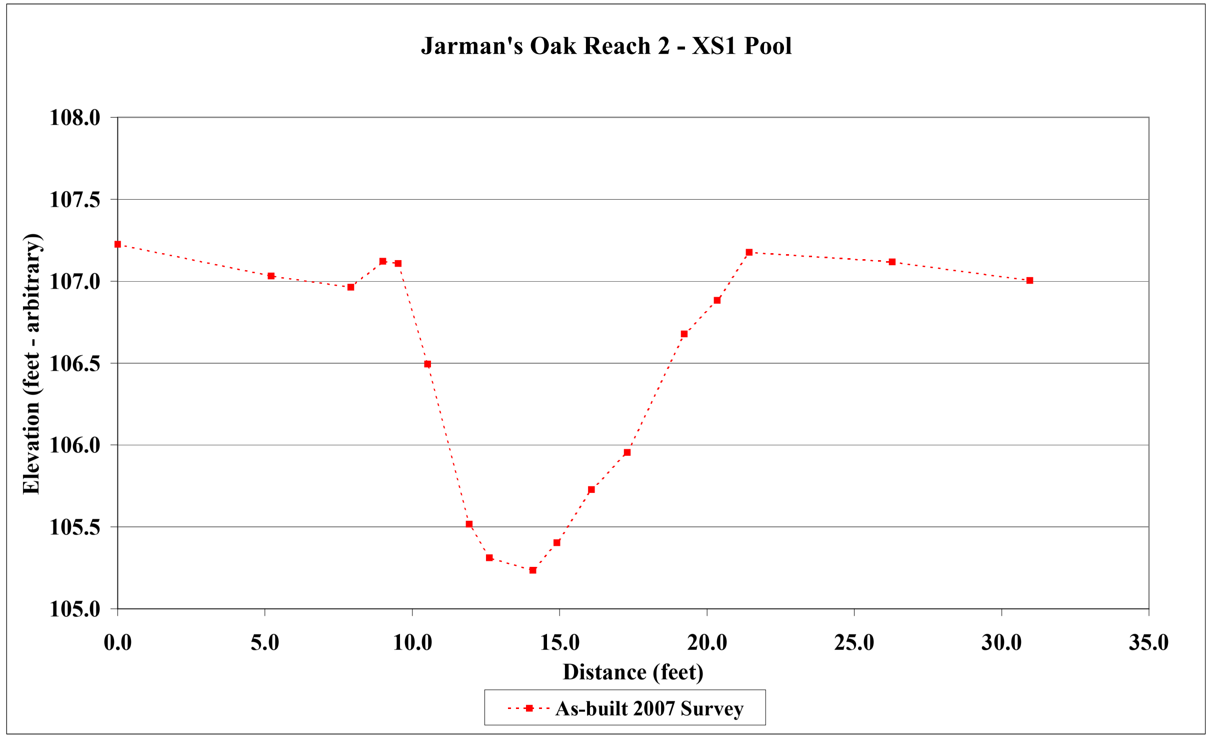
	As-built 2007 Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	94.7	95.5									
8.1	94.7	95.4									
16.7	94.7	95.5									
25.6	95.1	95.5									
59.5	95.1	95.8									
67.3	95.0	95.7									
69.1	95.1	95.8									
74.2	95.4	95.8									
97.1	96.2	96.4									
116.1	96.3	96.6									
126.5	96.0	96.6									
138.8	95.8	96.7									
141.1	95.8	96.7									
147.4	95.8	96.7									
154.7	96.3	96.7									
172.0	96.4	96.8									
178.7	96.2	96.8									
186.4	96.2	96.8									
192.1	96.5	96.8									
199.4	96.4	96.9									
211.1	96.1	96.9									
219.1	96.0	96.9									
229.3	96.6	96.9									
235.8	96.8	97.2									
245.1	96.3	97.2									
255.0	96.2	97.2									
259.9	96.2	97.2									
270.8	96.8	97.2									
281.9	96.8	97.3									
298.5	96.8	97.4									
313.8	96.9	97.4									
320.7	96.7	97.4									
327.4	96.7	97.4									
331.7	97.2	97.4									
349.1	97.2	97.5									
358.4	96.9	97.6									
363.8	96.6	97.6									
374.1	97.2	97.6									

	As-built	2008	2009	2010
Avg. Water Surface Slope	0.0057			
Avg. Riffle Slope	0.0143			
Avg. Pool Slope	0.0020			
Avg. Run Slope	0.0047			
Avg. Glide Slope	0.0023			



Project Name	Jarman's Oak
Cross Section	R2-XS1
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

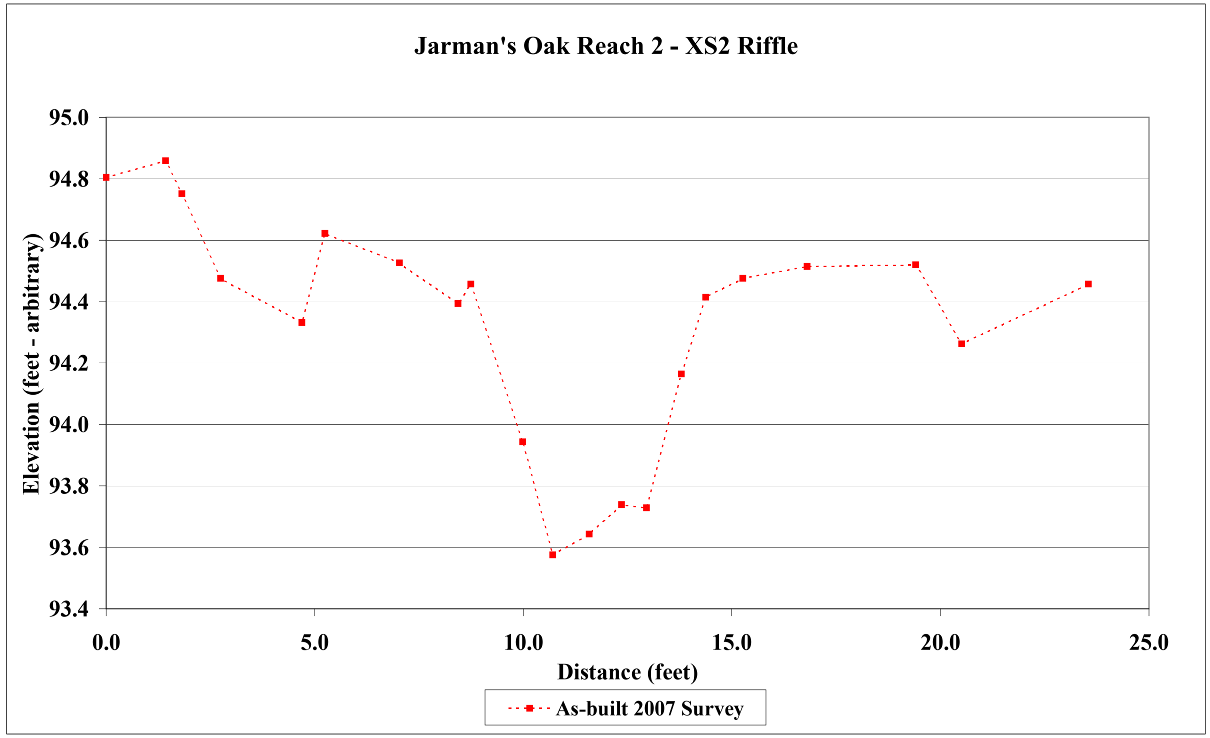
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	107.2						
5.2	107.0						
7.9	107.0						
9.0	107.1						
9.5	107.1						
10.5	106.5						
11.9	105.5						
12.6	105.3						
14.1	105.2						
14.9	105.4						
16.1	105.7						
17.3	106.0						
19.2	106.7						
20.4	106.9						
21.4	107.2						
26.3	107.1						
31.0	107.0						



	As-built	2008	2009	2010
Area	12.7			
Width	11.7			
Mean Depth	1.1			
Max Depth	1.9			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R2-XS2
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

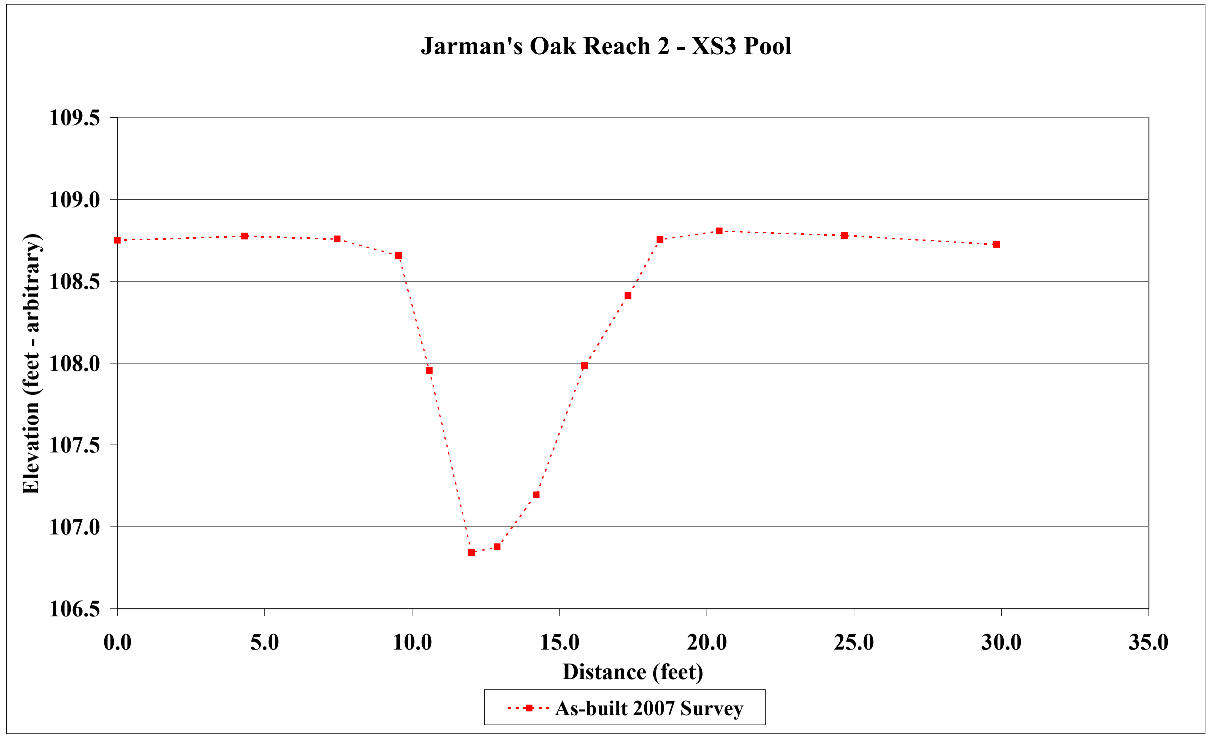
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	94.8						
1.4	94.9						
1.8	94.8						
2.7	94.5						
4.7	94.3						
5.2	94.6						
7.0	94.5						
8.4	94.4						
8.7	94.5						
10.0	93.9						
10.7	93.6						
11.6	93.6						
12.4	93.7						
13.0	93.7						
13.8	94.2						
14.4	94.4						
15.3	94.5						
16.8	94.5						
19.4	94.5						
20.5	94.3						
23.6	94.5						



	As-built	2008	2009	2010
Area	5.7			
Width	7.4			
Mean Depth	0.8			
Max Depth	1.1			
W/D Ratio	9.6			

Project Name	Jarman's Oak
Cross Section	R2-XS3
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

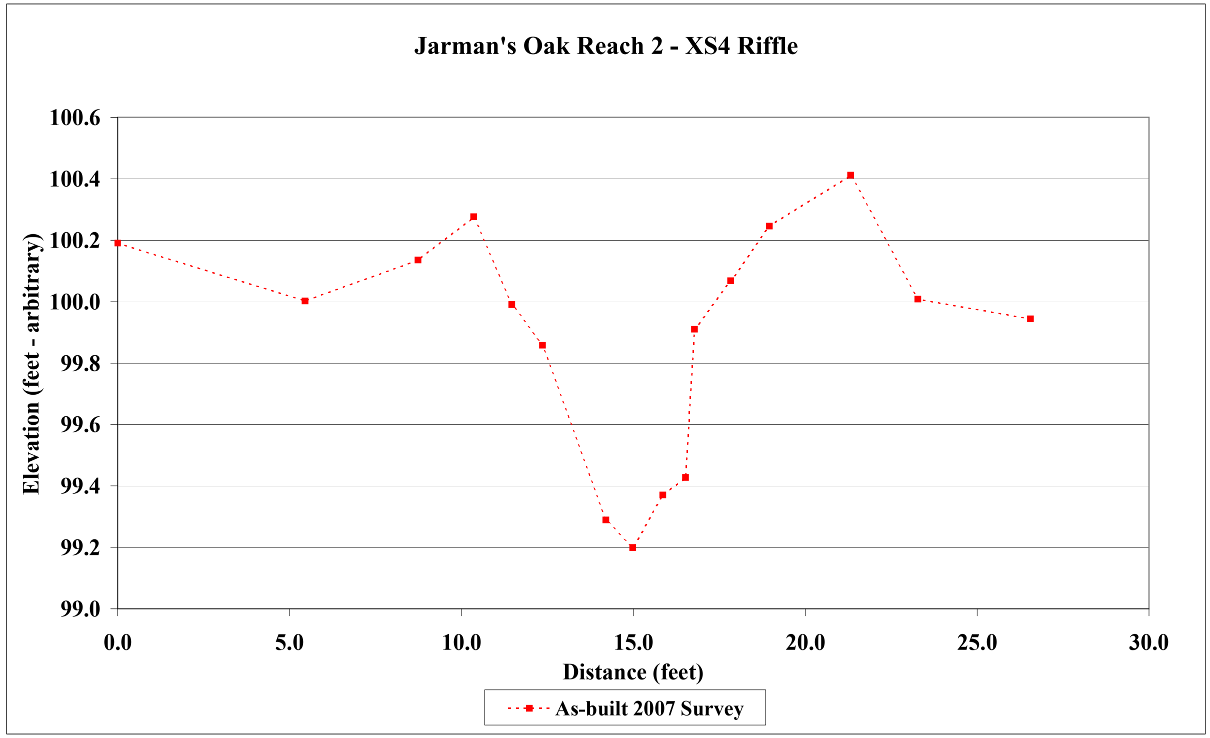
As-built 2007 Survey		**2008 2008 Survey**		**2009 2009 Survey**		**2010 2010 Survey**	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	108.8						
4.3	108.8						
7.5	108.8						
9.5	108.7						
10.6	108.0						
12.0	106.8						
12.9	106.9						
14.2	107.2						
15.9	108.0						
17.3	108.4						
18.4	108.8						
20.4	108.8						
24.7	108.8						
29.8	108.7						



	As-built	2008	2009	2010
Area	8.4			
Width	8.7			
Mean Depth	1.0			
Max Depth	1.8			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R2-XS4
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	100.2						
5.5	100.0						
8.7	100.1						
10.4	100.3						
11.5	100.0						
12.4	99.9						
14.2	99.3						
15.0	99.2						
15.9	99.4						
16.5	99.4						
16.8	99.9						
17.8	100.1						
19.0	100.2						
21.3	100.4						
23.3	100.0						
26.6	99.9						

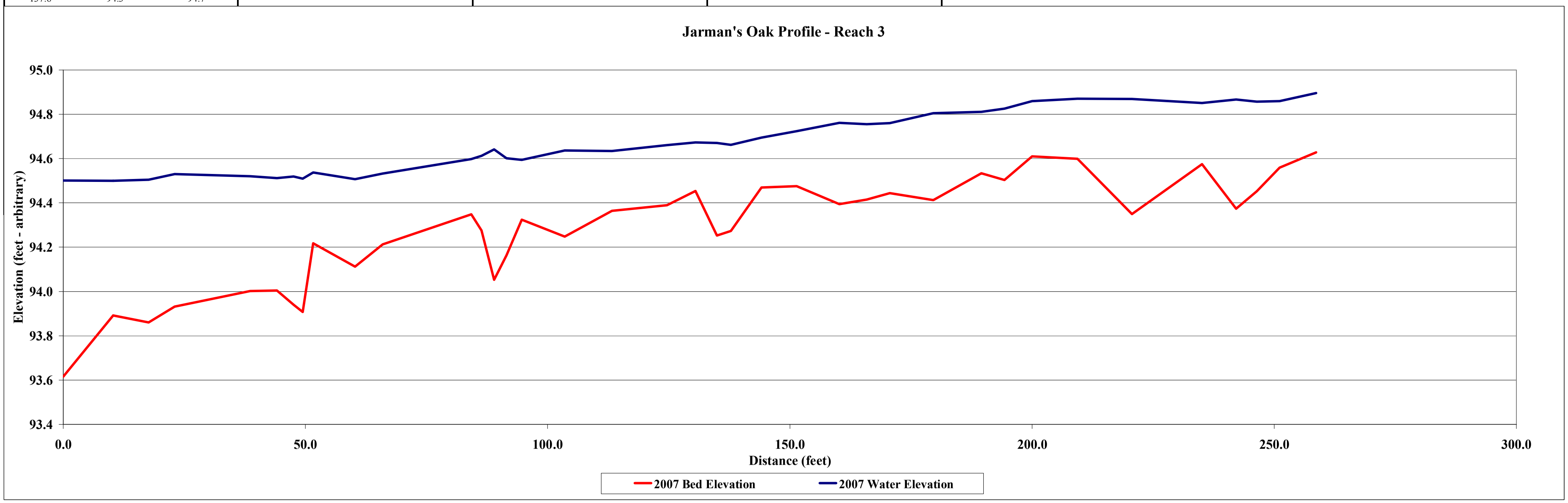


	As-built	2008	2009	2010
Area	4.7			
Width	8.6			
Mean Depth	0.5			
Max Depth	1.1			
W/D Ratio	15.9			

Project Name	Jarman's Oak
Reach	3
Feature	Profile
Date	10/24/07
Crew	Adasme, Jeffers

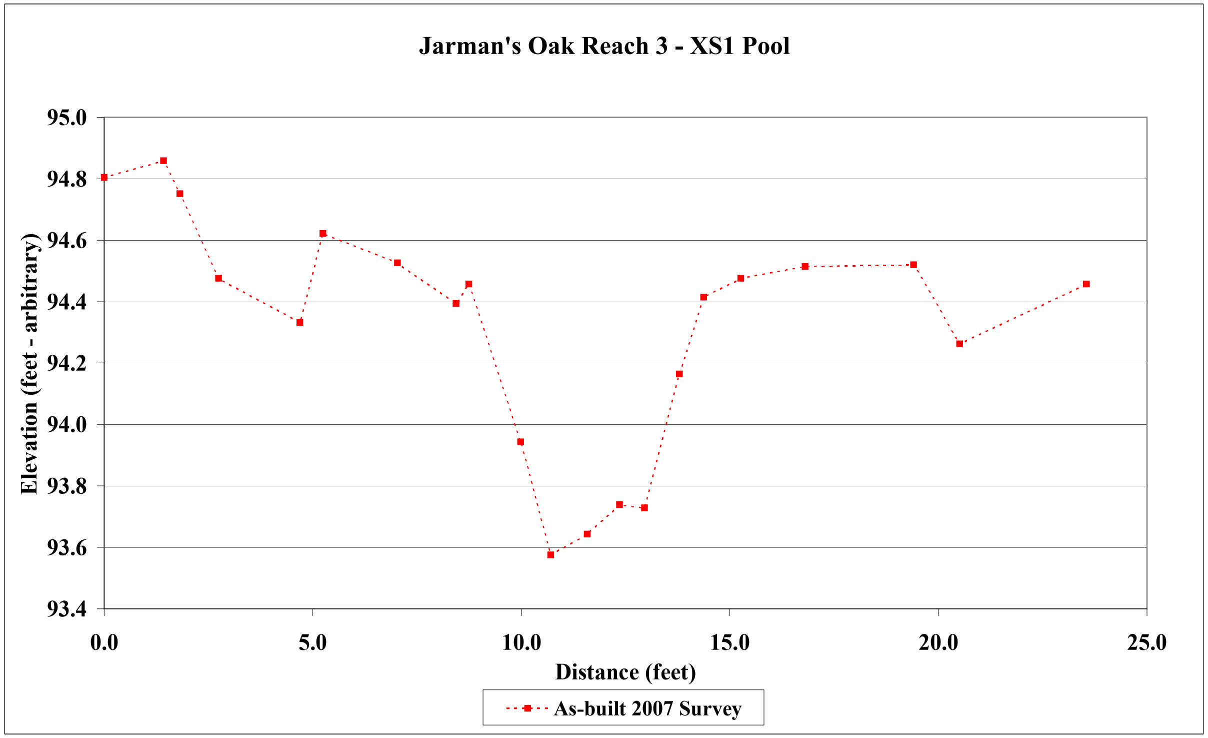
Station	As-built 2007 Survey Bed Elevation	Water Elevation	Station	2008 2008 Survey Bed Elevation	Water Elevation	Station	2009 2009 Survey Bed Elevation	Water Elevation	Station	2010 2010 Survey Bed Elevation	Water Elevation
0.0	93.6	94.5									
10.3	93.9	94.5									
17.6	93.9	94.5									
23.0	93.9	94.5									
38.6	94.0	94.5									
44.1	94.0	94.5									
47.5	93.9	94.5									
49.4	93.9	94.5									
51.6	94.2	94.5									
60.2	94.1	94.5									
65.9	94.2	94.5									
84.2	94.3	94.6									
86.3	94.3	94.6									
88.9	94.1	94.6									
91.5	94.2	94.6									
94.6	94.3	94.6									
103.5	94.2	94.6									
113.3	94.4	94.6									
124.6	94.4	94.7									
130.5	94.5	94.7									
134.9	94.3	94.7									
137.8	94.3	94.7									

	As-built	2008	2009	2010
Avg. Water Surface Slope	0.0015			
Avg. Riffle Slope	0.0023			
Avg. Pool Slope	0.0000			
Avg. Run Slope	0.0045			
Avg. Glide Slope	0.0037			



Project Name	Jarman's Oak
Cross Section	R3-XS1
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

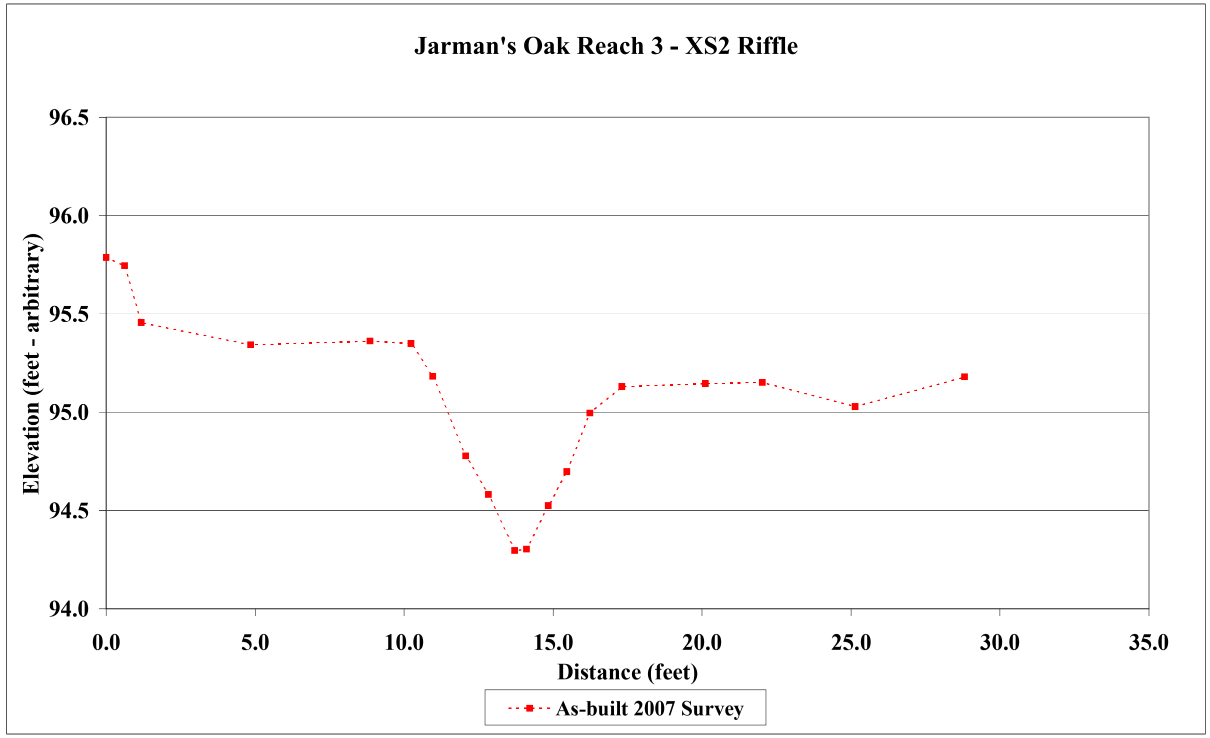
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	94.8						
1.4	94.9						
1.8	94.8						
2.7	94.5						
4.7	94.3						
5.2	94.6						
7.0	94.5						
8.4	94.4						
8.7	94.5						
10.0	93.9						
10.7	93.6						
11.6	93.6						
12.4	93.7						
13.0	93.7						
13.8	94.2						
14.4	94.4						
15.3	94.5						
16.8	94.5						
19.4	94.5						
20.5	94.3						
23.6	94.5						



	As-built	2008	2009	2010
Area	2.9			
Width	5.6			
Mean Depth	0.5			
Max Depth	0.8			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R3-XS2
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

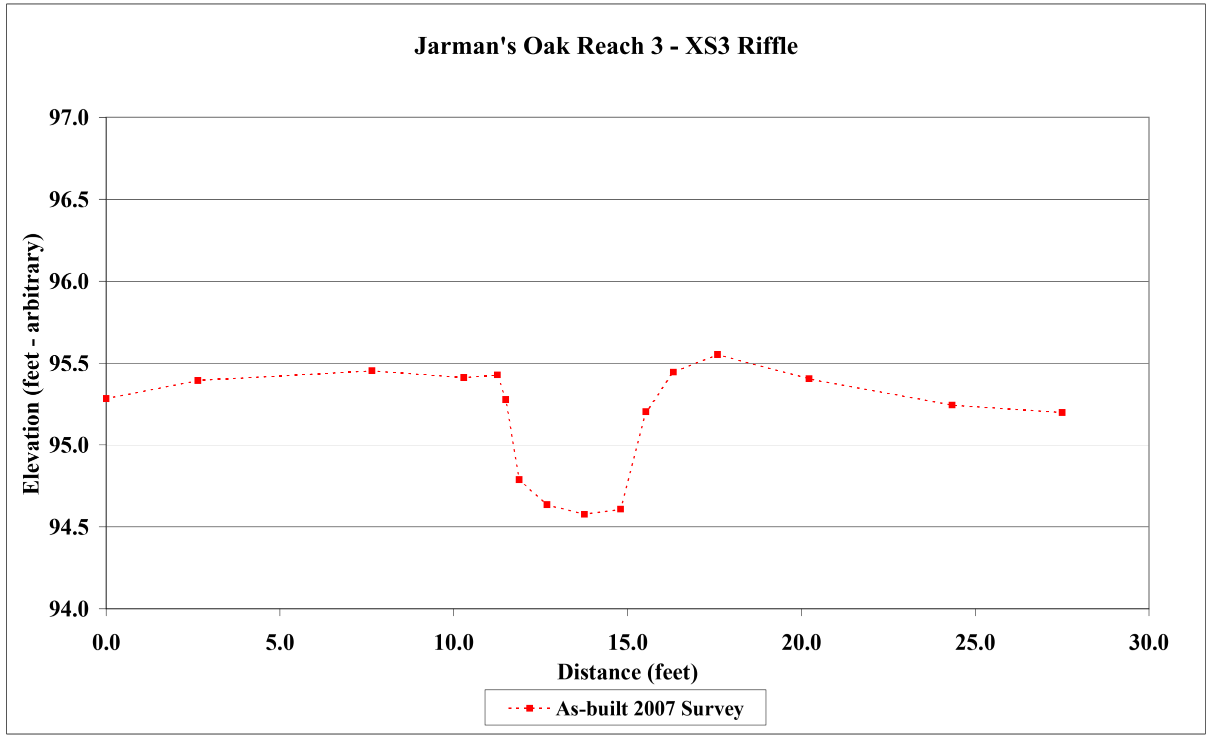
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	95.8						
0.6	95.7						
1.2	95.5						
4.9	95.3						
8.9	95.4						
10.2	95.3						
11.0	95.2						
12.1	94.8						
12.8	94.6						
13.7	94.3						
14.1	94.3						
14.8	94.5						
15.5	94.7						
16.2	95.0						
17.3	95.1						
20.1	95.1						
22.0	95.2						
25.1	95.0						
28.8	95.2						



	As-built	2008	2009	2010
Area	2.6			
Width	6.2			
Mean Depth	0.4			
Max Depth	0.8			
W/D Ratio	14.9			

Project Name	Jarman's Oak
Cross Section	R3-XS3
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

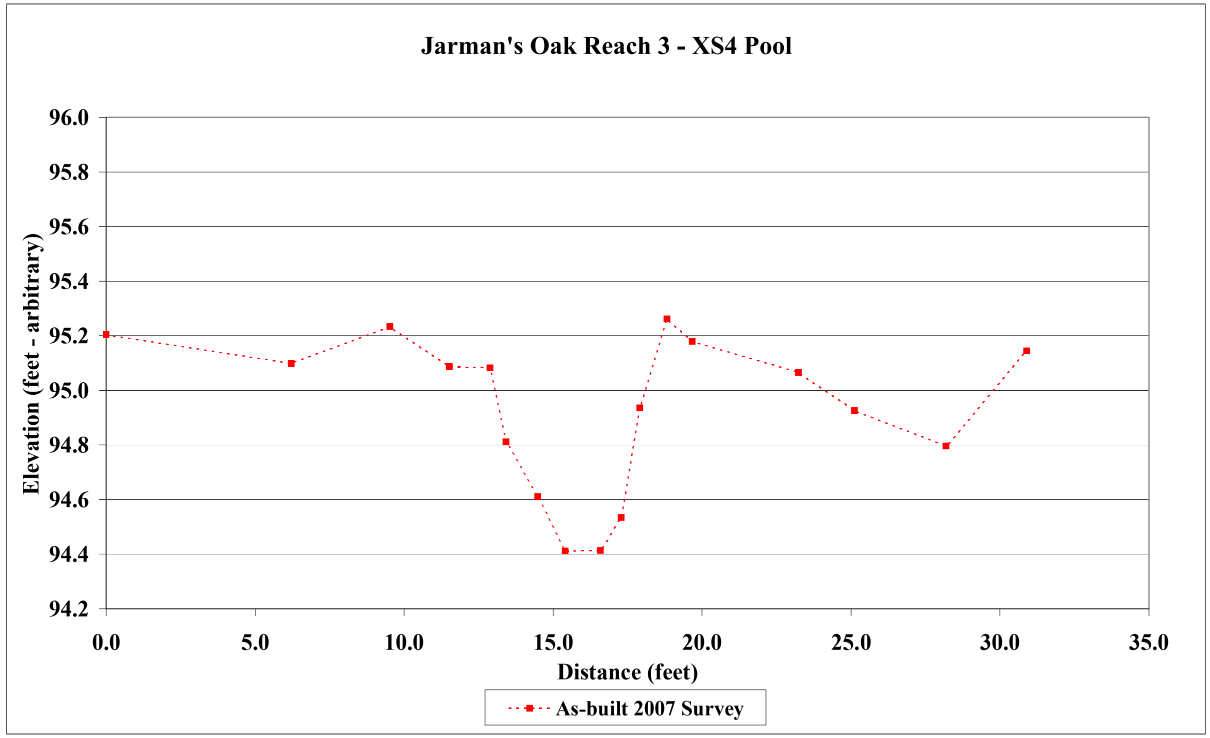
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	95.3						
2.6	95.4						
7.6	95.5						
10.3	95.4						
11.3	95.4						
11.5	95.3						
11.9	94.8						
12.7	94.6						
13.8	94.6						
14.8	94.6						
15.5	95.2						
16.3	95.4						
17.6	95.6						
20.2	95.4						
24.3	95.2						
27.5	95.2						



	As-built	2008	2009	2010
Area	3.0			
Width	5.0			
Mean Depth	0.6			
Max Depth	0.9			
W/D Ratio	8.5			

Project Name	Jarman's Oak
Cross Section	R3-XS4
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	95.2						
6.2	95.1						
9.5	95.2						
11.5	95.1						
12.9	95.1						
13.4	94.8						
14.5	94.6						
15.4	94.4						
16.6	94.4						
17.3	94.5						
17.9	94.9						
18.8	95.3						
19.7	95.2						
23.2	95.1						
25.1	94.9						
28.2	94.8						
30.9	95.1						



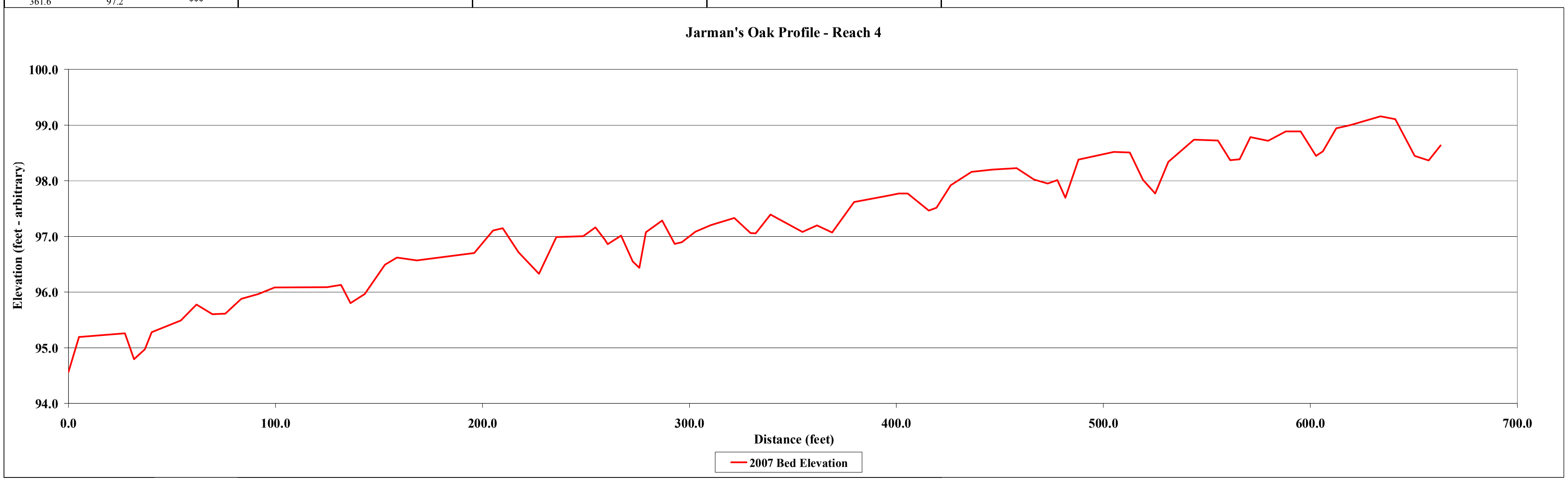
	As-built	2008	2009	2010
Area	2.4			
Width	5.4			
Mean Depth	0.5			
Max Depth	0.7			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Reach	4
Feature	Profile
Date	10/24/07
Crew	Adasme, Jeffers

As-built			2008			2009			2010		
	2007 Survey			2008 Survey			2009 Survey			2010 Survey	
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	94.6	***									
5.1	95.2	***									
27.3	95.3	***									
31.7	94.8	***									
37.0	95.0	***									
40.2	95.3	***									
54.2	95.5	***									
61.9	95.8	***									
69.6	95.6	***									
75.8	95.6	***									
83.5	95.9	***									
91.8	96.0	***									
99.6	96.1	***									
125.0	96.1	***									
131.7	96.1	***									
136.3	95.8	***									
143.2	96.0	***									
153.0	96.5	***									
158.8	96.6	***									
168.3	96.6	***									
196.0	96.7	***									
205.1	97.1	***									
209.9	97.1	***									
217.3	96.7	***									
227.4	96.3	***									
235.7	97.0	***									
248.6	97.0	***									
254.6	97.2	***									
259.1	96.9	***									
260.6	96.9	***									
267.0	97.0	***									
272.7	96.5	***									
275.8	96.4	***									
279.0	97.1	***									
286.8	97.3	***									
292.9	96.9	***									
296.3	96.9	***									
302.9	97.1	***									
310.5	97.2	***									
321.7	97.3	***									
329.6	97.1	***									
332.0	97.1	***									
339.2	97.4	***									
354.6	97.1	***									
361.6	97.2	***									

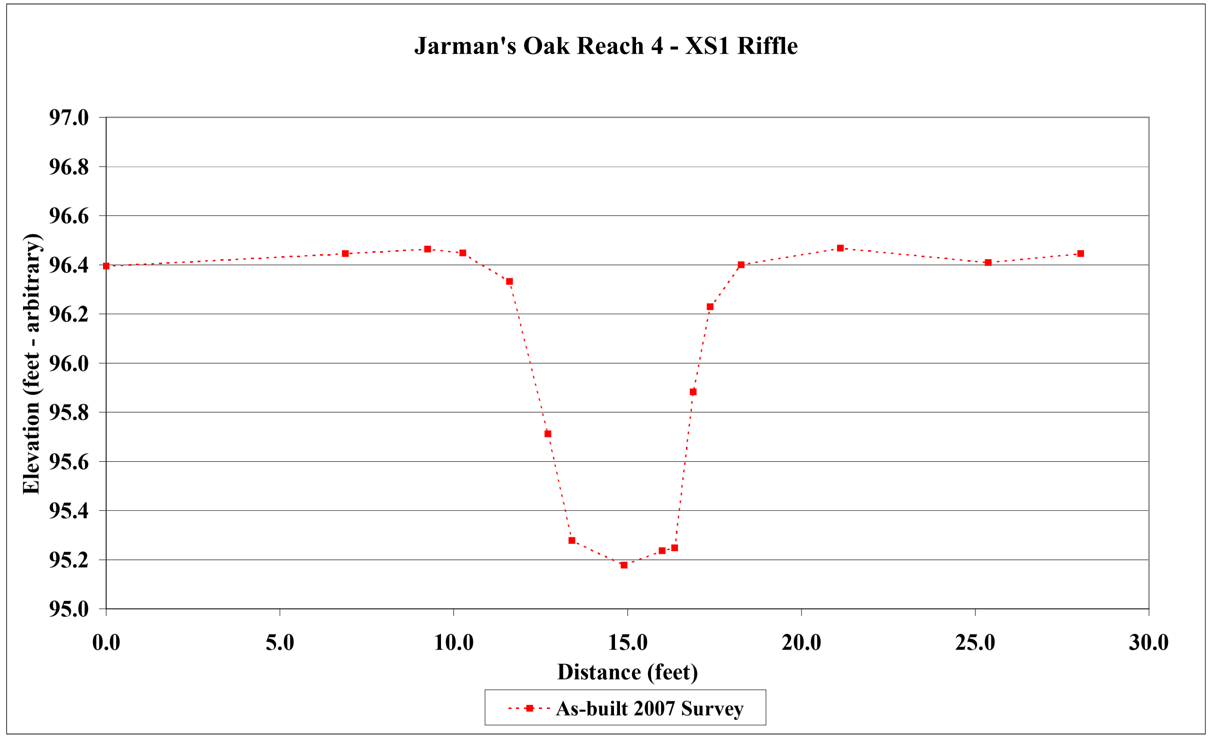
	As-built	2008	2009	2010
Avg. Water Surface Slope	***			
Avg. Riffle Slope	***			
Avg. Pool Slope	***			
Avg. Run Slope	***			
Avg. Glide Slope	***			

*** Insufficent water in stream to determine



Project Name	Jarman's Oak
Cross Section	R4-XS1
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

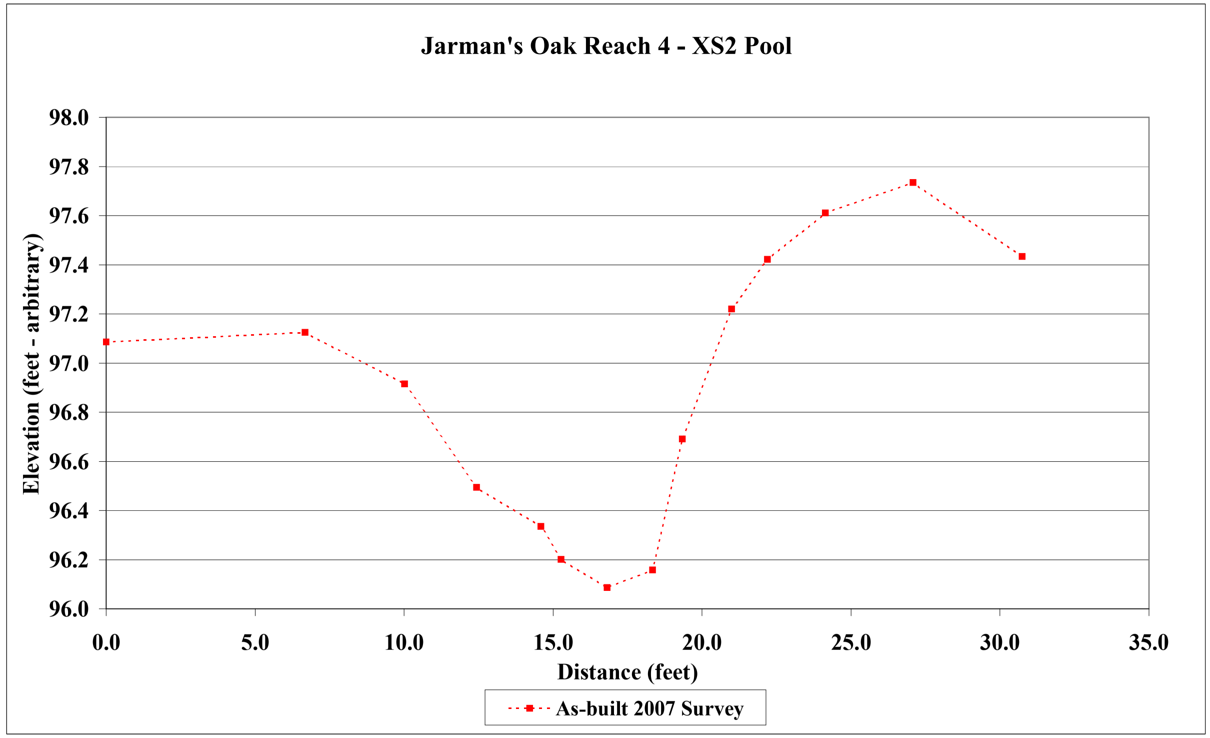
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	96.4						
6.9	96.4						
9.3	96.5						
10.3	96.4						
11.6	96.3						
12.7	95.7						
13.4	95.3						
14.9	95.2						
16.0	95.2						
16.4	95.2						
16.9	95.9						
17.4	96.2						
18.3	96.4						
21.1	96.5						
25.4	96.4						
28.0	96.4						



	As-built	2008	2009	2010
Area	5.2			
Width	7.5			
Mean Depth	0.7			
Max Depth	1.2			
W/D Ratio	10.6			

Project Name	Jarman's Oak
Cross Section	R4-XS2
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

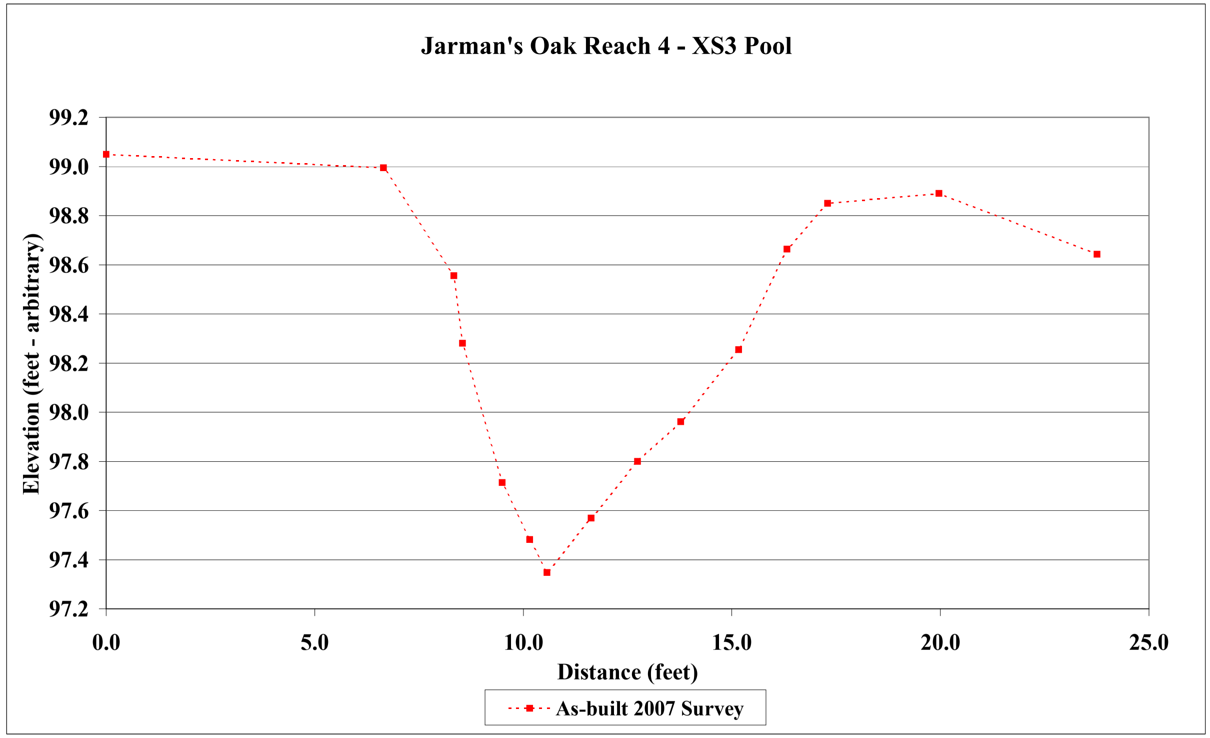
As-built		2008		2009		2010	
2007 Survey		2008 Survey		2009 Survey		2010 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.1						
6.7	97.1						
10.0	96.9						
12.4	96.5						
14.6	96.3						
15.3	96.2						
16.8	96.1						
18.3	96.2						
19.3	96.7						
21.0	97.2						
22.2	97.4						
24.1	97.6						
27.1	97.7						
30.7	97.4						



	As-built	2008	2009	2010
Area	7.5			
Width	13.9			
Mean Depth	0.5			
Max Depth	1.0			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R4-XS3
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

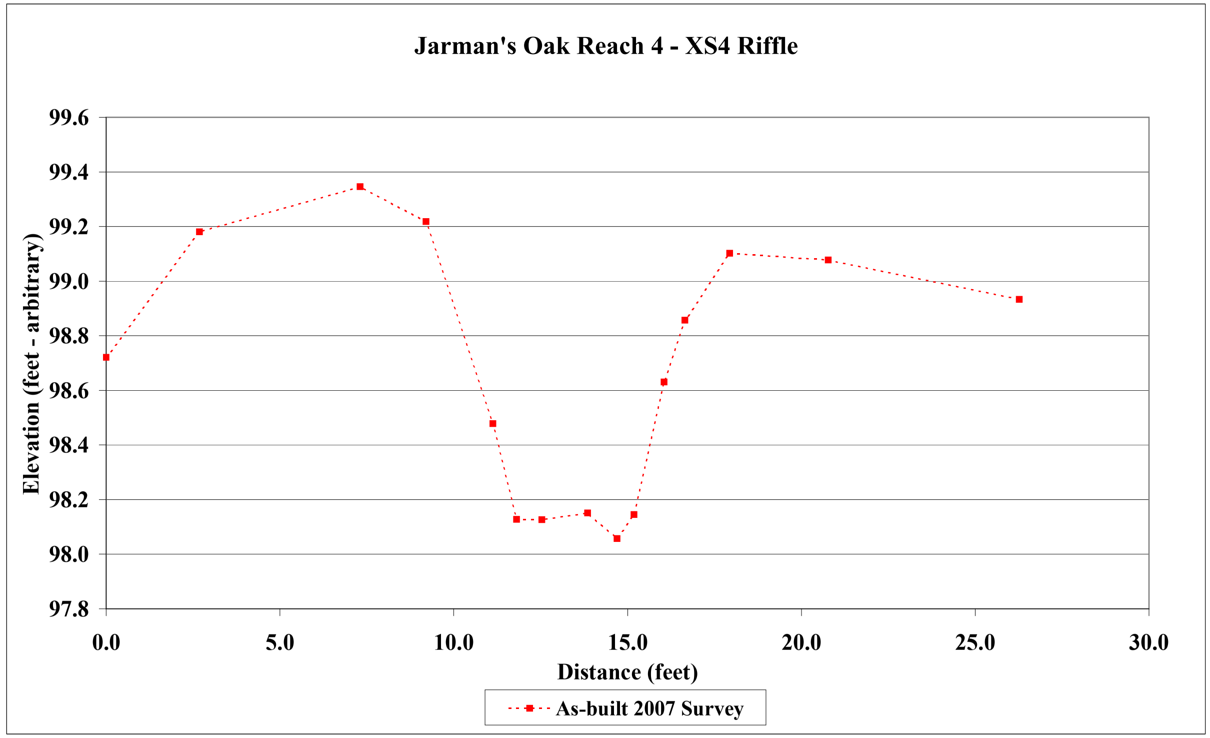
As-built		**2008**		**2009**		**2010**	
2007 Survey		**2008 Survey**		**2009 Survey**		**2010 Survey**	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	99.0						
6.7	99.0						
8.3	98.6						
8.5	98.3						
9.5	97.7						
10.2	97.5						
10.6	97.3						
11.6	97.6						
12.7	97.8						
13.8	98.0						
15.2	98.3						
16.3	98.7						
17.3	98.8						
20.0	98.9						
23.8	98.6						



	As-built	**2008**	**2009**	**2010**
Area	7.8			
Width	10.1			
Mean Depth	0.8			
Max Depth	1.5			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R4-XS4
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	98.7						
2.7	99.2						
7.3	99.3						
9.2	99.2						
11.1	98.5						
11.8	98.1						
12.5	98.1						
13.8	98.2						
14.7	98.1						
15.2	98.1						
16.1	98.6						
16.6	98.9						
17.9	99.1						
20.8	99.1						
26.3	98.9						

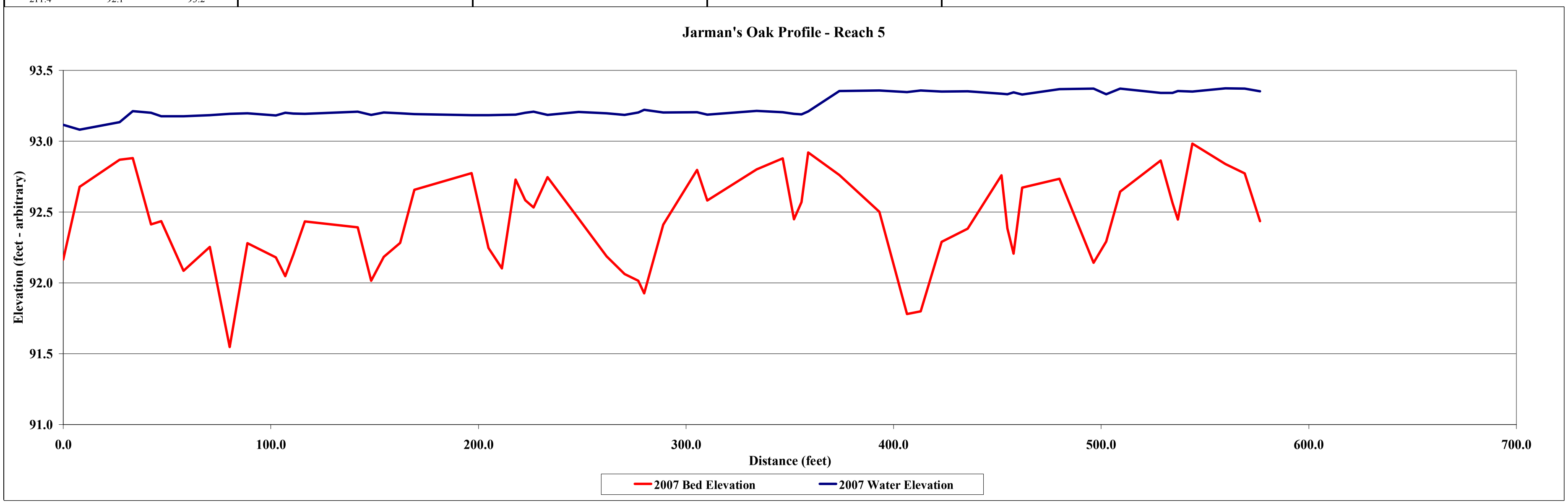


	As-built	2008	2009	2010
Area	5.3			
Width	8.4			
Mean Depth	0.6			
Max Depth	1.0			
W/D Ratio	13.3			

Project Name	Jarman's Oak
Reach	5
Feature	Profile
Date	10/24/07
Crew	Adasme, Jeffers

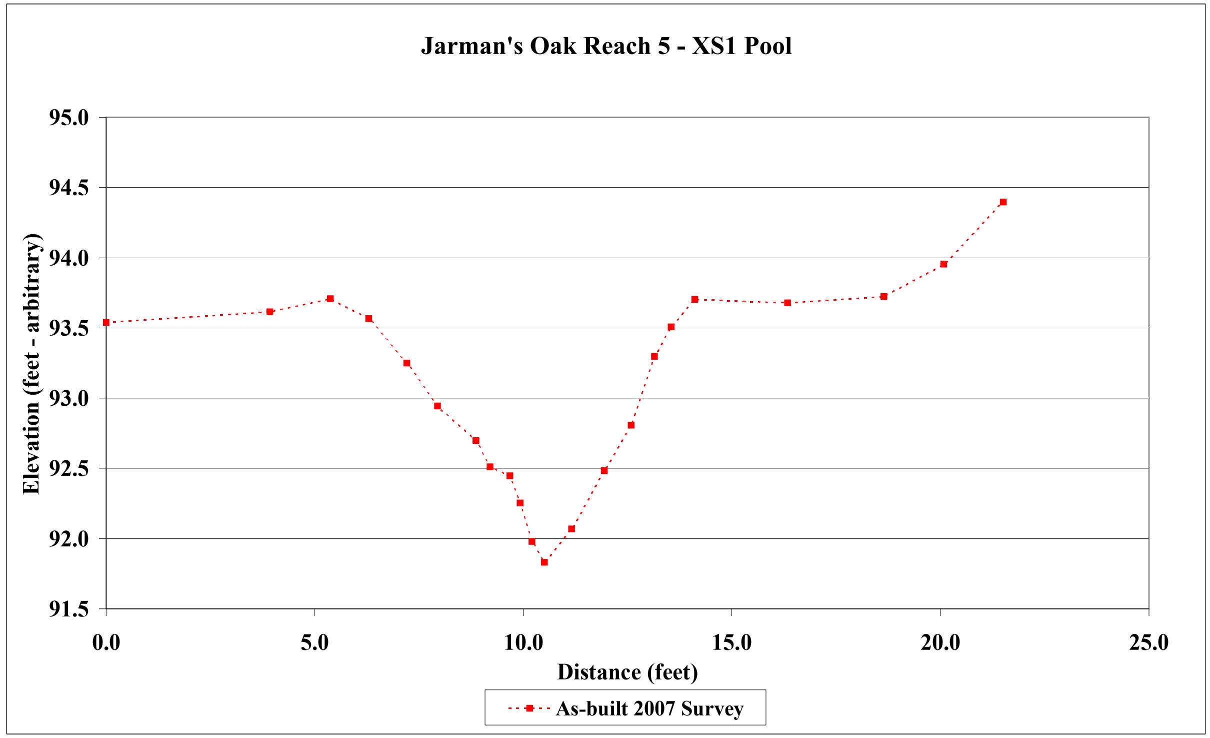
As-built 2007 Survey Station	As-built 2007 Survey Bed Elevation	As-built 2007 Survey Water Elevation	2008 2008 Survey Station	2008 2008 Survey Bed Elevation	2008 2008 Survey Water Elevation	2009 2009 Survey Station	2009 2009 Survey Bed Elevation	2009 2009 Survey Water Elevation	2010 2010 Survey Station	2010 2010 Survey Bed Elevation	2010 2010 Survey Water Elevation
0.0	92.2	93.1									
7.9	92.7	93.1									
27.2	92.9	93.1									
33.5	92.9	93.2									
42.3	92.4	93.2									
47.1	92.4	93.2									
57.9	92.1	93.2									
70.7	92.3	93.2									
80.1	91.5	93.2									
88.7	92.3	93.2									
102.4	92.2	93.2									
107.0	92.0	93.2									
110.8	92.2	93.2									
116.4	92.4	93.2									
141.8	92.4	93.2									
148.3	92.0	93.2									
154.4	92.2	93.2									
162.3	92.3	93.2									
169.2	92.7	93.2									
196.7	92.8	93.2									
204.9	92.2	93.2									
211.4	92.1	93.2									

	As-built	2008	2009	2010
Avg. Water Surface Slope	0.0004			
Avg. Riffle Slope	0.0013			
Avg. Pool Slope	0.0014			
Avg. Run Slope	0.0013			
Avg. Glide Slope	0.0004			



Project Name	Jarman's Oak
Cross Section	R5-XS1
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

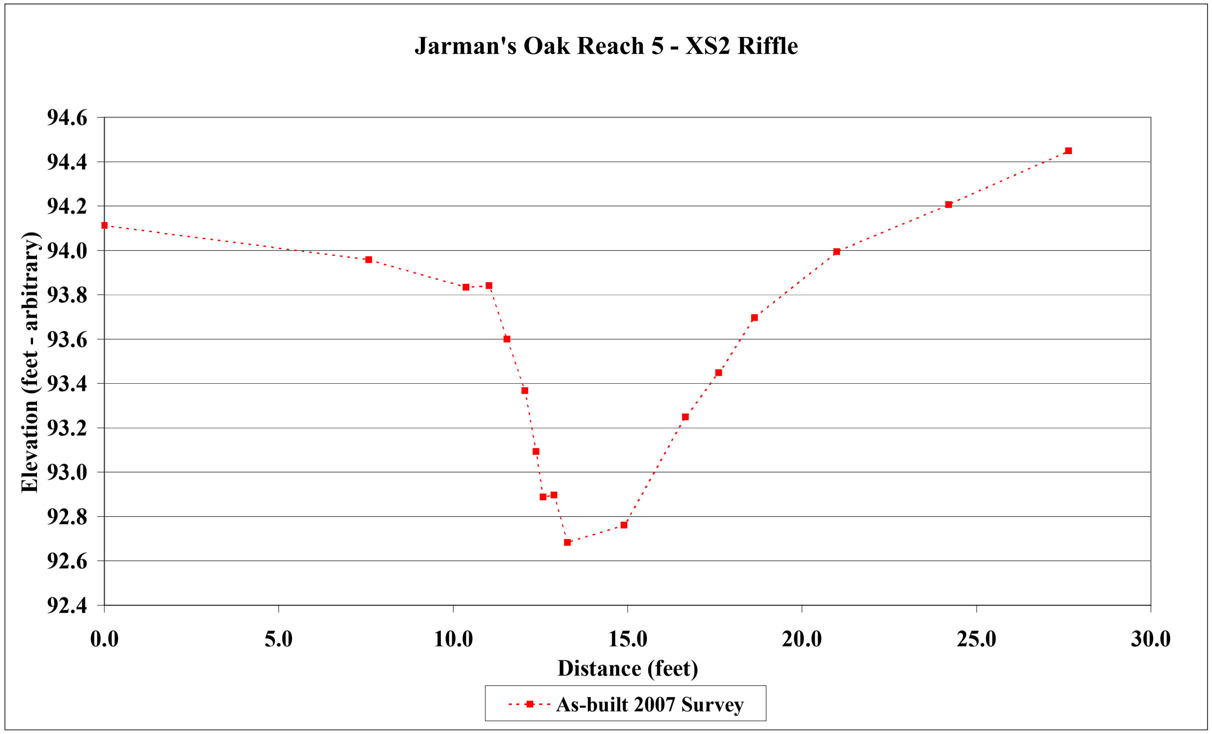
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	93.5						
3.9	93.6						
5.4	93.7						
6.3	93.6						
7.2	93.2						
7.9	92.9						
8.9	92.7						
9.2	92.5						
9.7	92.4						
9.9	92.3						
10.2	92.0						
10.5	91.8						
11.2	92.1						
11.9	92.5						
12.6	92.8						
13.2	93.3						
13.5	93.5						
14.1	93.7						
16.3	93.7						
18.6	93.7						
20.1	94.0						
21.5	94.4						



	As-built	2008	2009	2010
Area	7.3			
Width	8.7			
Mean Depth	0.8			
Max Depth	1.9			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R5-XS2
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

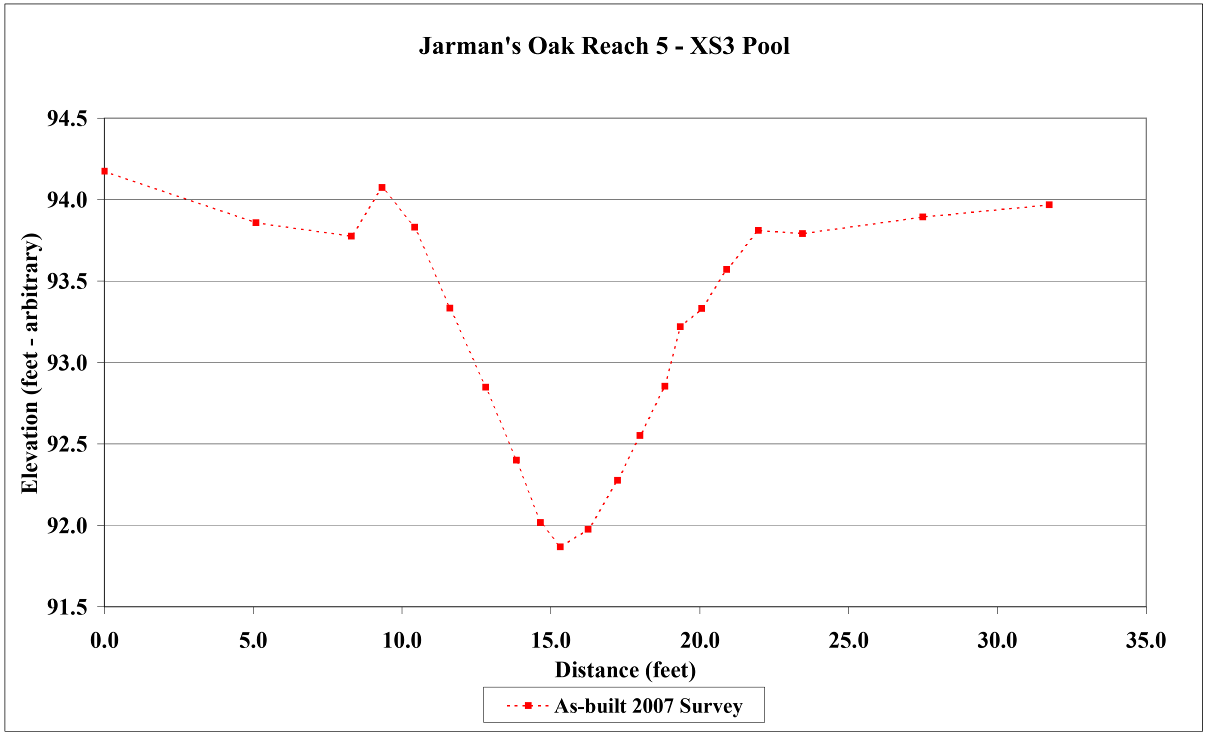
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	94.1						
7.6	94.0						
10.4	93.8						
11.0	93.8						
11.5	93.6						
12.1	93.4						
12.4	93.1						
12.6	92.9						
12.9	92.9						
13.3	92.7						
14.9	92.8						
16.7	93.2						
17.6	93.4						
18.6	93.7						
21.0	94.0						
24.2	94.2						
27.6	94.4						



	As-built	2008	2009	2010
Area	5.4			
Width	8.7			
Mean Depth	0.6			
Max Depth	1.2			
W/D Ratio	14.1			

Project Name	Jarman's Oak
Cross Section	R5-XS3
Feature	Pool
Date	10/24/07
Crew	Adasme, Jeffers

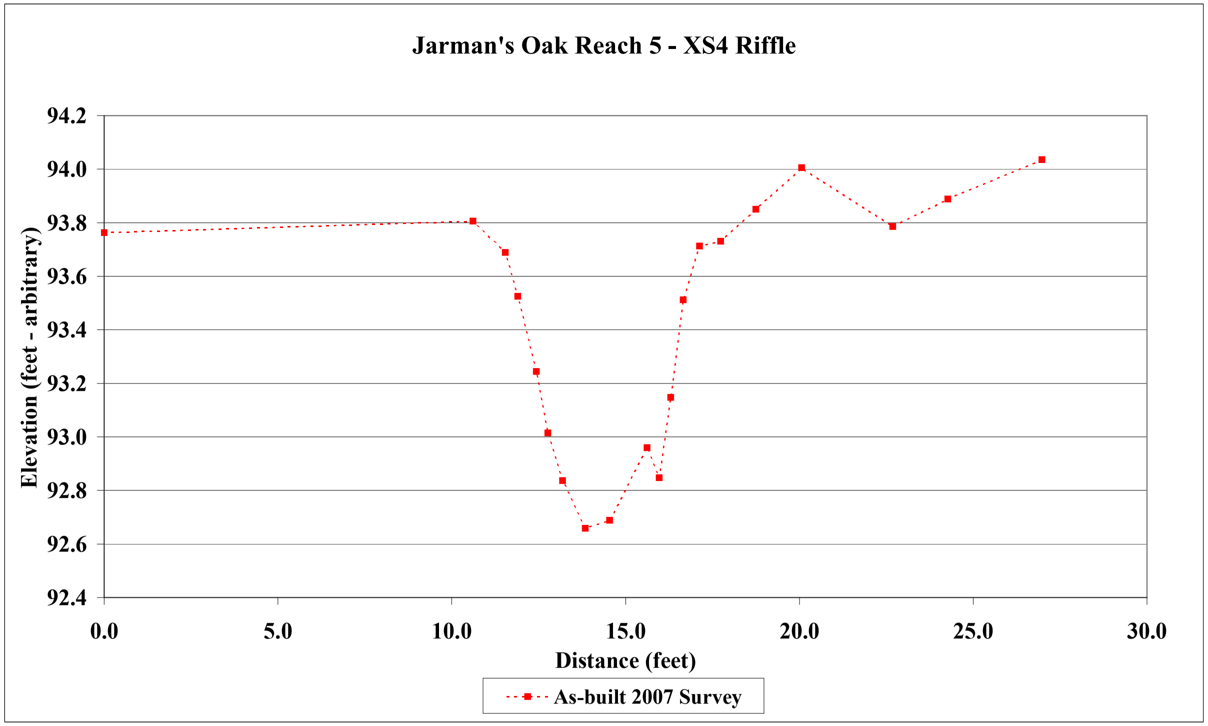
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	94.2						
5.1	93.9						
8.3	93.8						
9.3	94.1						
10.4	93.8						
11.6	93.3						
12.8	92.8						
13.8	92.4						
14.7	92.0						
15.3	91.9						
16.3	92.0						
17.2	92.3						
18.0	92.6						
18.8	92.9						
19.3	93.2						
20.1	93.3						
20.9	93.6						
22.0	93.8						
23.5	93.8						
27.5	93.9						
31.7	94.0						



	As-built	2008	2009	2010
Area	11.5			
Width	11.5			
Mean Depth	1.0			
Max Depth	1.9			
W/D Ratio	N/A			

Project Name	Jarman's Oak
Cross Section	R5-XS4
Feature	Riffle
Date	10/24/07
Crew	Adasme, Jeffers

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey	
Station	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**	**Station**	**Elevation**
0.0	93.8						
10.6	93.8						
11.5	93.7						
11.9	93.5						
12.4	93.2						
12.8	93.0						
13.2	92.8						
13.8	92.7						
14.5	92.7						
15.6	93.0						
16.0	92.8						
16.3	93.1						
16.7	93.5						
17.1	93.7						
17.7	93.7						
18.8	93.8						
20.1	94.0						
22.7	93.8						
24.3	93.9						
27.0	94.0						



	As-built	2008	2009	2010
Area	3.7			
Width	5.6			
Mean Depth	0.7			
Max Depth	1.1			
W/D Ratio	8.3			