

**YEAR 4 (2011)**  
**ANNUAL MONITORING REPORT**  
**JARMANS OAK RESTORATION SITE**  
**ONslow COUNTY, NORTH CAROLINA**

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



**Prepared for:**

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES  
RALEIGH, NORTH CAROLINA

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**October 2011**

## EXECUTIVE SUMMARY

Restoration Systems, L.L.C. has completed restoration of stream and riverine wetlands at the Jarmans Oak Stream and Wetland Restoration Site to assist the North Carolina Ecosystem Enhancement Program in fulfilling stream and wetland mitigation goals in the region. The Site is 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. The Site is located in United States Geological Survey (USGS) Cataloging Unit (CU) and Targeted Local Watershed 03030001010010 (North Carolina Division of Water Quality Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit CU 03030001. This report serves as the Year 4 (2011) annual monitoring report.

Primary activities at the Site included 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration. Project restoration efforts will provide a minimum of 6640 Stream Mitigation Units and 12 riverine Wetland Mitigation Units.

Fourteen vegetation plots (thirteen 10-meter by 10-meter and one 20-meter by 5-meter) were established and permanently monumented. These plots were surveyed in early July 2011 for the Year 4 (2011) monitoring season. Based on the number of stems present, the average density of all plots was 460 planted stems per acre surviving in Year 4 (2011). The dominant species identified at the Site were planted stems of blackgum (*Nyssa biflora*), green ash (*Fraxinus pennsylvanica*), and river birch (*Betula nigra*), and natural recruits of red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). Two of the fourteen plots had low densities of planted stems (plots 1 and 5 with 121 and 243 planted stems per acre, respectively) as the result of ponded water from a previous beaver impoundment. Areas affected by the inundation will be replanted before the start of the 2012 growing season. Beaver management is now occurring on the Site and will continue as necessary. No additional vegetation problem areas were noted during the Year 4 (2011) monitoring season.

Twenty cross-sections and longitudinal profiles within five 600-foot reaches were measured during Year 4 (2011) monitoring. As a whole, monitoring measurements indicate that there have been minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The as-built channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and construction plans. Current monitoring has demonstrated that dimension, pattern, and profile were stable over the course of the monitoring period.

One potential stream problem area was documented within the Site during Year 2 (2009) monitoring, which consisted of an area of reduced bed and bank integrity located on the Main Tributary immediately upstream of Monitoring Reach 2. The area consists of one pool that has scoured; however, erosion does not appear to be progressing and the area is stable at this time. The area should continue to be watched closely throughout the monitoring period. No additional stream problem areas were noted within the Site during the Year 4 (2011) monitoring year.

Four Restoration Site and one reference groundwater monitoring gauges were maintained for the Year 4 (2011) monitoring season. All monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 8 percent of the growing season. No wetland problem areas were noted during Year 4 (2011) monitoring.

In summary, the restoration site achieved success criteria for vegetation, stream, and hydrology attributes in the Fourth Monitoring Year (2011).

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## **1.0 PROJECT BACKGROUND**

### **1.1 Location and Setting**

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 less than 2 miles east of the Onslow/Duplin County line and approximately 3 miles west of the Town of Richlands in Onslow County, will provide a minimum of 6640 Stream Mitigation Units and 12 riverine Wetland Mitigation Units (Figure 1). The Site is located in United States Geological Survey (USGS) Cataloging Unit (CU) and Targeted Local Watershed 03030001010010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit CU 03030001.

Directions to the Site from Richlands, North Carolina, are as follows:

- Travel west on Highway 24 for approximately 3 miles
- The Site is on the right immediately before Haw Branch Road

### **1.2 Project Objectives**

The primary components of the restoration project included 1) construction of a stable, riffle-pool stream channel; 2) enhancement of water quality functions within, upstream, and downstream of the Site 3) creation of a natural vegetated buffer along restored stream channels; 4) restoration of jurisdictional riverine wetlands in the Site; 5) improvement of aquatic habitat and species diversity by enhancing stream bed variability; and 6) restoration of wildlife functions associated with a riparian corridor/stable stream.

### **1.3 Project Structure, Restoration Type, and Approach**

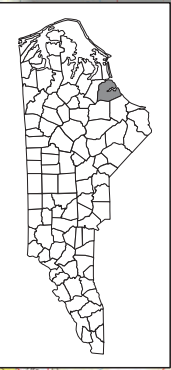
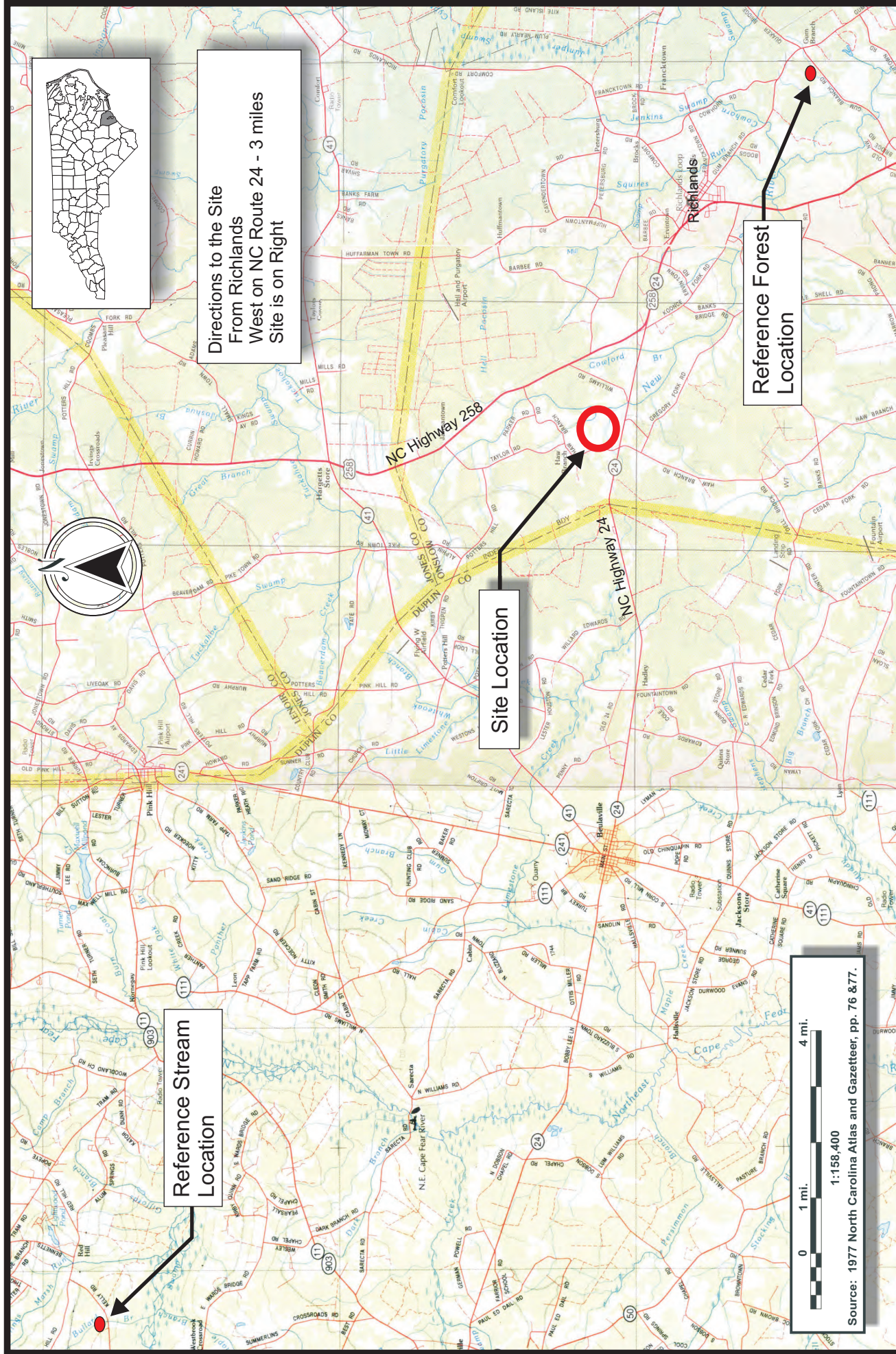
A conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 17.1 acres of hydric soils, three UTs to the New River (main tributary, southern tributary [west] and southern tributary [east]), associated floodplains, and upland slopes. The purpose of this project was to restore stable pattern, dimension, and profile to the UTs; restore hydrology to drained riverine wetlands; and revegetate stream banks, floodplains, and wetlands within the Site. The Site drainage area encompasses approximately 0.59 square mile of land at the downstream Site outfall that is characterized by forest, agricultural land, and sparse industrial/residential development.

Prior to construction, the entire Site was utilized for row crop production. 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. Site agricultural practices contributed to degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and decreased wetland function.

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.





Directions to the Site  
From Richlands  
West on NC Route 24 - 3 miles  
Site is on Right

Reference Forest  
Location

Site Location

Reference Stream  
Location

Dwn. by:	WGL	FIGURE
Ckd by:	WGL	1
Date:	Nov 2006	
Project:	06-018	

**SITE LOCATION**  
**JARMANS OAK RESTORATION SITE**  
Onslow County, North Carolina

20 Enterprise Street  
Suite 7  
Raleigh, NC 27607  
(919) 215-1693

Axion Environmental

0 1 mi. 4 mi.  
1:158,400  
Source: 1977 North Carolina Atlas and Gazetteer, pp. 76 & 77.



- 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.

Primary activities at the Site included 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration.

Table 1 describes the Site restoration structures and objectives, which have provided the minimum of 6640 Stream Mitigation Units and 12 riverine Wetland Mitigation Units.

- Restore 6418 linear feet of stream within three UTs to the New River by constructing meandering, E-type and braided, D-type channels.
- Enhance (level II) 1205 linear feet of stream within three UTs to the New River.
- Restore 11.0 acres of jurisdictional riverine wetland by reestablishing historic water table elevations.
- Enhance an additional 6.1 acres of jurisdictional riverine wetland.
- Reforest the entire floodplain with native forest species.

**Table 1. Site Restoration Structures and Objectives**

Restoration Segment/ Reach ID	Station Range	Restoration Type/Approach*	Designed Linear Footage/Acreage	SMU/WMUs
Main Tributary	10+00 – 57+09	Restoration/PI	4709	4709
Southern UT (east)	--	Restoration/PI	1013	1013
Southern UT (west)	10+00 – 17+96	Restoration/PI	696	696
--	--	Enhancement II	1205	482
Riverine Wetlands	--	Restoration	11.0	11.0
Riverine Wetlands	--	Enhancement	6.1	3.05
<b>Mitigation Unit Summations</b>				
<b>Stream</b>	<b>Riverine Wetland</b>			
6900 SMU's	14.05 WMU's			

\*PI=Priority 1

#### 1.4 Project History and Background

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4.

**Table 2. Project Activity and Reporting History**

<b>Activity or Report</b>	<b>Data Collection Completion</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	December 2006	December 2006
Construction Completion	NA	September 2007
Site Planting	NA	January 2008
Mitigation Plan/As built	November 2007	February 2008
Year 1 Monitoring (2008)	November 2008	November 2008
Year 2 Monitoring (2009)	November 2009	August 2009
Year 3 Monitoring (2010)	November 2010	August 2010
Year 4 Monitoring (2011)	November 2011	October 2011

**Table 3. Project Contacts Table**

<b>Full Delivery Provider</b>	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 George Howard and John Preyer (919) 755-9490
<b>Construction Contractor</b>	Backwater Environmental PO Box 1654 Pittsboro, North Carolina 27312 Wes Newell (919) 523-4375
<b>Planting Contractor</b>	Carolina Silvics 908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (252) 482-8491
<b>Designer and Monitoring Performer</b>	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, North Carolina 27603 Grant Lewis (919) 215-1693

**Table 4. Project Background Table**

Project County	Onslow County, North Carolina
Drainage Area	0.59 square mile
Drainage impervious cover estimate (%)	< 1
Stream Order	First and Second
Physiographic Region	Coastal Plain
Ecoregion	Carolina Flatwoods
Rosgen Classification of As-built	E-/C-type
Dominant Soil Types	Muckalee, Autryville
Reference Site ID	Bullard Branch
USGS HUC	03030001
NCDWQ Subbasin	03-05-02
NCDWQ Classification	C NSW (Stream Index # 19-(1))
Any portion of any project segment 303d listed?	No
Any portion of project upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	0%



## 1.5 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in the monitoring plan view in Appendix D. Site features including vegetation, stream dimension (cross-sections), stream profile and pattern, wetland hydrology, and photographic documentation were monitored.

## 2.0 PROJECT CONDITION AND MONITORING RESULTS

### 2.1 Vegetation Assessment

Following Site construction, fourteen plots (thirteen 10 meter by 10 meter and one 20 meter by 5 meter) were established and monumented with metal fence posts at all plot corners and PVC at each plot origin. Sampling was conducted as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (<http://cvs.bio.unc.edu/methods.htm>); results are included in Appendix A. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). The locations of vegetation monitoring plots were placed to accurately represent the entire Site and are depicted on the monitoring plan view in Appendix D.

#### 2.1.1 Vegetation Success Criteria

Success criteria have been established to verify that vegetation components support 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 the density and growth of “Character Tree Species.” Character Tree Species include planted species, species identified through visual inventory of an approved reference (relatively undisturbed) forest community used to orient the Site design, and appropriate community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) including Coastal Plain Small Stream Swamp and Nonriverine Wet Hardwood Forest. All canopy tree species planted and identified in the reference forest will be utilized to define “Character Tree Species” as termed in the success criteria. Table 5 below outlines planted and reference forest species.

**Table 5. Planted Species and Reference Forest Ecosystem**

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

Success criteria dictate that an average density of 320 stems per acre of Character Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Character Tree Species per acre must be surviving in year 4 and 260 Character Tree Species per acre in year 5.

### **2.1.2 Vegetative Problem Areas**

Vegetation sampling across the Site was above the required average density with an overall average of 460 planted stems per acre. Two of the fourteen plots had low densities of planted stems (plots 1 and 5 with 121 and 243 planted stems per acre, respectively) as the result of ponded water from a previous beaver impoundment. Beaver management is now occurring on the Site and will continue as necessary. No additional vegetation problem areas were noted during the Year 4 (2011) monitoring season. The Site will be replanted in the areas that were affected by the inundation before the start of the 2012 growing season.

## **2.2 Stream Assessment**

Twenty permanent cross-sections within five 600-foot reaches were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system (Rosgen 1996). Longitudinal profile measurements of five 600-foot reaches include thalweg, water surface, and bankfull; with each measurement taken at the head of facets (i.e. riffle, run, pool, and glide) in addition to the maximum pool depth.

### **2.2.1 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 and profile. 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 or borderline E-/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 relatively constant. The field indicator of bankfull 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.

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

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

## 2.2.2 Bankfull Events

**Table 6. Verification of Bankfull Events**

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
March 2009	February 28-March 2, 2009	Total of 2.28 inches of rain documented between February 28-March 2, 2009 at an onsite rain gauge	--
April 2009	April 14, 2009	Total of 3.01 inches of rain documented on April 14, 2009 at an onsite rain gauge	--
May 2009	May 16-18, 2009	Total of 3.05 inches of rain documented between May 16-18, 2009 at an onsite rain gauge	--
April 2010	November 11, 2009	Greater than 5 inches of rain documented between November 10-12, 2009 as the result of Tropical Storm Ida.*	--
April 2010	February 5, 2010	Visual observations of overbank resulting from a 1.65 inch rainfall event on February 5, 2010 that occurred after numerous rainfall events, within the 3 weeks prior, that totaled 4.32 inches*.	Photos 1-2
August 2011	August 26-27, 2011	Total of 8.78 inches of rain documented at an onsite rain gauge between August 26-27, 2011 as the result of Hurricane Irene.	--

\*Weatherunderground 2010

Overbank Photo 1



Overbank Photo 2



## 2.2.3 Stream Problem Areas

One potential stream problem area was documented within the Site during Year 2 (2009) monitoring, which consisted of an area of reduced bed and bank integrity located on the Main Tributary immediately upstream of Monitoring Reach 2. The area consists of one pool that has scoured; however, erosion does not appear to be progressing and the area is stable at this time. The area should continue to be watched closely throughout the monitoring period. No additional stream problem areas were noted within the Site during the Year 4 (2011) monitoring year.

## 2.2.4 Categorical Stream Feature Visual Stability Assessment

Each stream reach was visually inspected during the Year 4 (2011) monitoring period using eight feature categories and various metrics within each category. Assessment features included riffles, pools, thalweg, meanders, channel bed, structures, and root wads/boulders. Tables for semi-quantitative assessments of

each reach are included in Appendix B (Tables B1-B5). The mean percentage of performance for features within each reach is summarized in the tables below.

**Table 7A. Categorical Stream Feature Visual Stability Assessment**

**Jarmans Oak (Reach 1)**

<b>Feature</b>	<b>Year 1 (2008)</b>	<b>Year 2 (2009)</b>	<b>Year 3 (2010)</b>	<b>Year 4 (2011)</b>	<b>Year 5 (2012)</b>
A. Riffles	100%	100%	100%	100%	
B. Pools	100%	98%	100%	100%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	100%	100%	100%	100%	
E. Bed General	100%	100%	100%	100%	
F. Banks	100%	100%	100%	100%	
G. Vanes / J. Hooks, Etc.	NA	NA	NA	NA	
H. Wads and Boulders	NA	NA	NA	NA	

**Table 7B. Categorical Stream Feature Visual Stability Assessment**

**Jarmans Oak (Reach 2)**

<b>Feature</b>	<b>Year 1 (2008)</b>	<b>Year 2 (2009)</b>	<b>Year 3 (2010)</b>	<b>Year 4 (2011)</b>	<b>Year 5 (2012)</b>
A. Riffles	100%	98%	98%	98%	
B. Pools	100%	100%	100%	100%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	100%	100%	100%	100%	
E. Bed General	99%	100%	100%	100%	
F. Banks	99%	100%	100%	100%	
G. Vanes / J. Hooks, Etc.	NA	NA	NA	NA	
H. Wads and Boulders	NA	NA	NA	NA	

**Table 7C. Categorical Stream Feature Visual Stability Assessment**

**Jarmans Oak (Reach 3)**

<b>Feature</b>	<b>Year 1 (2008)</b>	<b>Year 2 (2009)</b>	<b>Year 3 (2010)</b>	<b>Year 4 (2011)</b>	<b>Year 5 (2012)</b>
A. Riffles	100%	100%	94%	94%	
B. Pools	100%	100%	100%	100%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	100%	100%	100%	100%	
E. Bed General	99%	100%	100%	100%	
F. Banks	99%	100%	100%	100%	
G. Vanes / J. Hooks, Etc.	NA	NA	NA	NA	
H. Wads and Boulders	NA	NA	NA	NA	

**Table 7D. Categorical Stream Feature Visual Stability Assessment****Jarmans Oak (Reach 4)**

<b>Feature</b>	<b>Year 1 (2008)</b>	<b>Year 2 (2009)</b>	<b>Year 3 (2010)</b>	<b>Year 4 (2011)</b>	<b>Year 5 (2012)</b>
A. Riffles	96%	100%	100%	100%	
B. Pools	100%	100%	100%	100%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	100%	100%	100%	100%	
E. Bed General	100%	100%	100%	100%	
F. Banks	100%	100%	100%	100%	
G. Vanes / J. Hooks, Etc.	NA	NA	NA	NA	
H. Wads and Boulders	NA	NA	NA	NA	

**Table 7E. Categorical Stream Feature Visual Stability Assessment****Jarmans Oak (Reach 5)**

<b>Feature</b>	<b>Year 1 (2008)</b>	<b>Year 2 (2009)</b>	<b>Year 3 (2010)</b>	<b>Year 4 (2011)</b>	<b>Year 5 (2012)</b>
A. Riffles	100%	100%	100%	100%	
B. Pools	100%	100%	97%	97%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	100%	100%	100%	100%	
E. Bed General	100%	100%	100%	100%	
F. Banks	100%	100%	100%	100%	
G. Vanes / J. Hooks, Etc.	NA	NA	NA	NA	
H. Wads and Boulders	NA	NA	NA	NA	

**2.2.5 Quantitative Stream Measurements**

During the Year 4 (2011) monitoring period 20 cross-sections and longitudinal profiles within five 600-foot reaches were measured. Permanent cross-sections and longitudinal profiles are included in Appendix B; each is graphically depicted for as-built through Year 4 (2011) for analysis. As a whole, monitoring measurements indicate minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and as constructed. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. Tables for quantitative assessments are included below; these tables include data from previous years.

**2.3 Wetland Assessment**

Four Restoration Site and one reference groundwater monitoring gauges were maintained and monitored throughout the Year 4 (2011) growing season. Graphs of groundwater hydrology and precipitation from an onsite rain gauge are included in Appendix C.

**2.3.1 Wetland Success Criteria**

Target hydrological characteristics include saturation or inundation for at least 8 percent of the growing season (17 consecutive days), within Muckalee soils (riverine wetlands), during average climatic conditions. The growing season extends from April 8 to November 5 (212 days). The target hydrological value is based on DRAINMOD simulations for 42 years of rainfall data in an old field stage. In addition,



these areas are expected to support hydrophytic vegetation; if wetland parameters are marginal, a jurisdictional determination will be performed for vegetation and soils in these areas (Environmental Laboratory 1987).

**2.3.2 Wetland Problem Areas**

No wetland problem areas were identified within the Site during Year 4 (2011) monitoring.

**2.3.3 Wetland Criteria Attainment**

All monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 8 percent of the growing season (Table 10). Hydrographs containing groundwater and precipitation data for each gauge can be found in Appendix C.

**Table 10. Wetland Criteria Attainment for Year 4 (2011)**

Gauge ID	Hydrology Threshold Met?	Hydrophytic Vegetation Criteria Met?	Site Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Site Mean
1	Yes	Yes	100 %	1	No	86 %
2	Yes	Yes		2	Yes	
3	Yes	Yes		3	Yes	
4	Yes	Yes		4	Yes	
				5	No	
				6	Yes	
				7	Yes	
				8	Yes	
				9	Yes	
				10	Yes	
				11	Yes	
				12	Yes	
				13	Yes	
				14	Yes	

**Table 8. Baseline Morphology and Hydraulic Summary  
Jarmans Oak**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Stream			Design			As-built				
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med		
Dimension	USGS gage data is unavailable for this project					5.6			9.3	6	8	7	5	9.1	7.5		
BF Width (ft)						8			225	150	250	225					150
Floodprone Width (ft)						5			11.6	3.8	6.5		3		5.9		4.9
BF Cross Sectional Area (ft <sup>2</sup> )						0.9			1.2	0.6	0.8	0.7	0.5		0.8		0.6
BF Mean Depth (ft)						1.3			2.3	1	1.3	1.1	0.9		1.2		1.1
BF Max Depth (ft)						7			7.4			14	8		16		12
Width/Depth Ratio						1.4			24	11	31	28					===
Entrenchment Ratio						4			1			1					1
Bank Height Ratio						===			===			===					===
Wetted Perimeter(ft)						===			===			===					===
Hydraulic radius (ft)			===			===			===					===			
Pattern																	
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activities					34	15	77	31	15	77	31		
Radius of Curvature (ft)									16	15	44	21	15	44	21		21
Meander Wavelength (ft)									71	46	154	75	46	154	75		75
Meander Width ratio									3.7	2	7	4	2	7	4		4
Profile																	
Riffle length (ft)				No pattern of riffles and pools due to straightening activities					===			===			===		
Riffle slope (ft/ft)									1.29%	0.17%	0.97%	0.57%	0.17%	0.97%	0.57%		0.57%
Pool length (ft)									===			===			===		===
Pool spacing (ft)									43	31	77	47	31	77	47		47
Substrate																	
d50 (mm)						===			===			===			===		
d84 (mm)						===			===			===			===		
Additional Reach Parameters																	
Valley Length (ft)						===			===			===			===		
Channel Length (ft)						===			===			===			===		
Sinuosity						1.1			1.37			1.35			1.3		
Water Surface Slope (ft/ft)						0.49%			0.40%			0.44%			0.27%		
BF slope (ft/ft)						===			===			===			===		
Rosgen Classification						G6			E6			C/E6			C/E6		

**Table 9A. Morphology and Hydraulic Monitoring Summary**

**Jarmans Oak**

**Reach 1**

Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4					
	Riffle						Pool						Pool						Riffle					
<b>Dimension</b>	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	9.0	8.9	8.8	9.1			12.8	14.6	13.8	14.8			12.1	12.4	12.5	12.1			7.5	7.2	7.3	8.5		
Floodprone Width (ft) (approx)	150.0						150.0						100.0						100.0					
BF Cross Sectional Area (ft <sup>2</sup> )	6.4	5.6	5.8	5.5			11.4	11.9	10.6	10.4			10.0	10.6	9.8	9.5			5.6	5.2	6.0	5.9		
BF Mean Depth (ft)	0.7	0.6	0.7	0.6			0.9	0.8	0.8	0.7			0.8	0.9	0.8	0.8			0.7	0.7	0.8	0.7		
BF Max Depth (ft)	1.1	1.0	1.0	1.0			1.8	1.8	1.8	1.6			1.7	1.7	1.7	1.7			1.1	1.1	1.3	1.3		
Width/Depth Ratio	12.7	14.0	13.3	15.0			NA	NA	NA	NA			NA	NA	NA	NA			10.2	9.9	8.8	12.1		
Entrenchment Ratio	16.7	16.9	17.1	16.5			NA	NA	NA	NA			NA	NA	NA	NA			13.3	13.9	13.7	11.8		
Bank Height Ratio	1.0	1.0	1.0	1.0			NA	NA	NA	NA			NA	NA	NA	NA			1.0	1.0	1.0	1.0		
Wetted Perimeter(ft)	9.4	9.2	9.1	9.4			13.5	15.2	14.4	15.2			12.9	13.0	13.3	12.9			8.0	7.7	7.9	9.0		
Hydraulic radius (ft)	0.7	0.6	0.6	0.6			0.8	0.8	0.7	0.7			0.8	0.8	0.7	0.7			0.7	0.7	0.8	0.7		
<b>Substrate</b>	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
d50 (mm)																								
d84 (mm)																								
<b>Parameter</b>	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
<b>Pattern</b>	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	32	15	77	32	15	77	32	15	77	32	15	77												
Radius of Curvature (ft)	18	13	44	18	13	44	18	13	44	18	13	44												
Meander Wavelength (ft)	73	46	154	73	46	154	73	46	154	73	46	154												
Meander Width ratio	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0												
<b>Profile</b>	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Riffle length (ft)	14	18	24	10	32	23	7	31	17	7	27	16												
Riffle slope (ft/ft)	NA*	NA*	NA*	0.0%	1.4%	0.7%	0.0%	1.8%	0.4%	0.0%	1.1%	0.5%												
Pool length (ft)	25	30	45	11	60	30	15	44	31	23	47	35												
Pool spacing (ft)	32	45	77	32	45	77	32	45	77	32	45	77												
<b>Additional Reach Parameters</b>	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Valley Length (ft)	569			569			569			569														
Channel Length (ft)	740			744			741			740														
Sinuosity	1.3			1.3			1.3			1.3														
Water Surface Slope (ft/ft)	NA*			0.3%			0.3%			0.3%														
BF slope (ft/ft)	---			---			---			---														
Rosgen Classification	C/E type			C/E type			C/E type			C/E type														
Number of Bankfull Events	0			4			1			1														

**Table 9B. Morphology and Hydraulic Monitoring Summary**

**Jarmans Oak**

**Reach 2**

Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4					
	Pool						Riffle						Pool						Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	13.6	15.5	13.6	11.4			6.6	7.1	6.4	6.6			8.8	9.0	8.8	8.6			8.3	6.1	5.7	6.3		
Floodprone Width (ft) (approx)	150.0						150.0						150.0						150.0					
BF Cross Sectional Area (ft <sup>2</sup> )	11.3	13.2	11.3	11.7			4.6	5.3	4.5	4.5			8.3	8.7	8.3	8.1			3.7	3.2	3.1	3.8		
BF Mean Depth (ft)	0.8	0.9	0.8	1.0			0.7	0.7	0.7	0.7			1.0	1.0	1.0	0.9			0.5	0.5	0.5	0.6		
BF Max Depth (ft)	1.9	2.0	1.9	1.9			1.1	1.2	1.1	1.1			1.8	1.9	1.8	1.8			1.0	1.0	0.9	1.0		
Width/Depth Ratio	NA	NA	NA	NA			9.3	9.6	9.2	9.6			NA	NA	NA	NA			18.3	11.4	10.5	10.3		
Entrenchment Ratio	NA	NA	NA	NA			22.8	21.0	23.3	22.8			NA	NA	NA	NA			18.1	24.7	26.2	23.9		
Bank Height Ratio	NA	NA	NA	NA			1.0	1.0	1.0	1.0			NA	NA	NA	NA			1.0	1.0	1.0	1.0		
Wetted Perimeter(ft)	14.4	16.4	14.4	12.3			7.1	7.7	6.9	7.0			9.7	10.0	9.7	9.5			8.8	6.6	6.2	6.9		
Hydraulic radius (ft)	0.8	0.8	0.8	1.0			0.7	0.7	0.7	0.6			0.9	0.9	0.9	0.8			0.4	0.5	0.5	0.6		
Substrate	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
d50 (mm)																								
d84 (mm)																								
Parameter	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	32	15	77	32	15	77	32	15	77	32	15	77												
Radius of Curvature (ft)	18	13	44	18	13	44	18	13	44	18	13	44												
Meander Wavelength (ft)	73	46	154	73	46	154	73	46	154	73	46	154												
Meander Width ratio	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0												
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Riffle length (ft)	24	29	34	8.4	46	24	7	44	25	6	34	17												
Riffle slope (ft/ft)	NA*	NA*	NA*	0.0%	4.1%	0.9%	0.0%	1.9%	1.1%	0.0%	3.8%	1.1%												
Pool length (ft)	24	33	59	3	19	9	13	42	29	8	31	23												
Pool spacing (ft)	32	45	77	32	45	77	32	45	77	32	45	77												
Additional Reach Parameters	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Valley Length (ft)	507			572			572			572														
Channel Length (ft)	659			743			749			747														
Sinuosity	1.3			1.3			1.3			1.3														
Water Surface Slope (ft/ft)	NA*			0.6%			0.5%			0.5%														
BF slope (ft/ft)	---			---			---			---														
Rosgen Classification	C/E type			C/E type			E type			E type														
Number of Bankfull Events	0			4			1			1														

**Table 9C. Morphology and Hydraulic Monitoring Summary**  
**Jarmans Oak**  
**Reach 3**

Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4					
	Pool						Riffle						Riffle						Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	6.2	8.1	6.4	5.5			6.1	5.9	6.5	6.2			5.2	5.0	5.5	5.0			5.6	6.0	5.4	6.1		
Floodprone Width (ft) (approx)	150.0						150.0						150.0						150.0					
BF Cross Sectional Area (ft <sup>2</sup> )	3.3	3.5	3.5	3.1			2.7	2.4	2.1	2.5			2.2	2.1	2.5	2.3			2.5	2.4	2.5	2.2		
BF Mean Depth (ft)	0.5	0.4	0.5	0.6			0.4	0.4	0.3	0.4			0.4	0.4	0.5	0.5			0.4	0.4	0.5	0.4		
BF Max Depth (ft)	1.0	1.0	1.0	0.9			0.9	0.8	0.7	0.8			0.8	0.7	0.8	0.7			0.7	0.7	0.8	0.6		
Width/Depth Ratio	NA	NA	NA	NA			13.8	14.5	20.0	15.2			12.3	11.8	11.9	10.6			NA	NA	NA	NA		
Entrenchment Ratio	NA	NA	NA	NA			24.7	25.5	23.1	24.2			28.7	30.0	27.4	30.0			NA	NA	NA	NA		
Bank Height Ratio	NA	NA	NA	NA			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			NA	NA	NA	NA		
Wetted Perimeter(ft)	6.7	8.5	6.9	5.9			6.5	6.2	6.8	6.6			5.5	5.3	5.8	5.3			5.9	6.3	5.7	6.3		
Hydraulic radius (ft)	0.5	0.4	0.5	0.5			0.4	0.4	0.3	0.4			0.4	0.4	0.4	0.4			0.4	0.4	0.4	0.4		
Substrate	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
d50 (mm)																								
d84 (mm)																								
Parameter	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	32	15	77	32	15	77	32	15	77	32	15	77												
Radius of Curvature (ft)	18	13	44	18	13	44	18	13	44	18	13	44												
Meander Wavelength (ft)	73	46	154	73	46	154	73	46	154	73	46	154												
Meander Width ratio	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0												
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Riffle length (ft)	19	15	27	5	25	12	3	46	13	2	12	7												
Riffle slope (ft/ft)	NA*	NA*	NA*	0.00%	2.15%	0.87%	0.0%	1.6%	0.5%	0.0%	1.9%	0.5%												
Pool length (ft)	21	13	26	5	18	8	5	17	10	12	33	21												
Pool spacing (ft)	45	32	77	45	32	77	45	32	77	45	32	77												
Additional Reach Parameters	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Valley Length (ft)	555			472			472			454														
Channel Length (ft)	721			614			614			590														
Sinuosity	1.3			1.3			1.3			1.3														
Water Surface Slope (ft/ft)	NA*			0.28%			0.37%			0.33%														
BF slope (ft/ft)	---			---			---			---														
Rosgen Classification	C/E type			C/E type			C/E type			C/E type														
Number of Bankfull Events	0			4			1			1														



**Table 9D. Morphology and Hydraulic Monitoring Summary**  
**Jarmans Oak**  
**Reach 4**

Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4					
	Riffle						Pool						Pool						Riffle					
<b>Dimension</b>	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	6.5	7.8	7.2	6.0			10.3	15.7	15.4	15.9			9.5	10.9	9.1	8.4			5.6	6.1	5.5	6.1		
Floodprone Width (ft) (approx)	150.0						150.0						150.0						150.0					
BF Cross Sectional Area (ft <sup>2</sup> )	5.0	5.2	4.1	4.1			4.8	7.1	6.3	6.4			5.3	5.3	4.8	4.4			3.1	3.1	3.3	3.5		
BF Mean Depth (ft)	0.8	0.7	0.6	0.7			0.5	0.4	0.4	0.4			0.6	0.5	0.5	0.5			0.6	0.5	0.6	0.6		
BF Max Depth (ft)	1.2	1.1	1.1	1.1			0.9	1.0	0.9	0.9			1.3	1.2	1.3	1.1			0.9	1.0	1.2	1.2		
Width/Depth Ratio	8.6	11.6	12.9	8.9			NA	NA	NA	NA			NA	NA	NA	NA			10.0	12.1	9.1	10.5		
Entrenchment Ratio	22.9	19.2	20.7	24.9			NA	NA	NA	NA			NA	NA	NA	NA			26.9	24.6	27.2	24.8		
Bank Height Ratio	1.0	1.0	1.0	1.0			NA	NA	NA	NA			NA	NA	NA	NA			1.0	1.0	1.0	1.0		
Wetted Perimeter(ft)	7.2	8.3	7.8	6.6			10.5	15.9	15.7	16.2			10.0	11.4	9.8	9.0			6.0	6.6	6.2	6.6		
Hydraulic radius (ft)	0.7	0.6	0.5	0.6			0.5	0.4	0.4	0.4			0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
<b>Substrate</b>	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
d50 (mm)																								
d84 (mm)																								
<b>Parameter</b>	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
<b>Pattern</b>	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	15	32	77	15	32	77	15	32	77	15	32	77												
Radius of Curvature (ft)	13	18	44	13	18	44	13	18	44	13	18	44												
Meander Wavelength (ft)	46	73	154	46	73	154	46	73	154	46	73	154												
Meander Width ratio	2.0	3.8	7.0	2.0	3.8	7.0	2.0	3.8	7.0	2.0	3.8	7.0												
<b>Profile</b>	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Riffle length (ft)	5	21	61	5	30	21	8	47	16	5	55	20												
Riffle slope (ft/ft)	0.0%	4.2%	0.9%	0.0%	3.2%	0.9%	0.0%	2.2%	0.7%	0.2%	2.6%	0.7%												
Pool length (ft)	7	21	44	13	34	20	13	48	23	6	59	16												
Pool spacing (ft)	32	45	77	32	45	77	32	45	77	32	45	77												
<b>Additional Reach Parameters</b>	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Valley Length (ft)	505			511			514			506														
Channel Length (ft)	657			664			668			658														
Sinuosity	1.3			1.3			1.3			1.3														
Water Surface Slope (ft/ft)	0.56%			0.58%			0.54%			0.56%														
BF slope (ft/ft)	---			---			---			---														
Rosgen Classification	C/E type			C/E type			C/E type			E type														
Number of Bankfull Events	0			4			1			1														

**Table 9E. Morphology and Hydraulic Monitoring Summary  
Jarmans Oak  
Reach 5**

Parameter	Cross Section 1						Cross Section 2						Cross Section 3						Cross Section 4					
	Pool						Riffle						Pool						Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	7.5	7.1	8.0	7.9			8.9	6.9	8.1	6.9			11.8	10.7	11.4	11.3			5.8	5.5	5.9	7.7		
Floodprone Width (ft) (approx)	150.0						150.0						150.0						150.0					
BF Cross Sectional Area (ft <sup>2</sup> )	5.9	4.9	5.8	5.2			7.4	5.7	6.6	4.6			10.6	9.4	9.4	8.6			3.6	3.0	3.0	3.0		
BF Mean Depth (ft)	0.8	0.7	0.7	0.7			0.8	0.8	0.8	0.7			0.9	0.9	0.8	0.8			0.6	0.5	0.5	0.4		
BF Max Depth (ft)	1.3	1.1	1.5	1.1			1.8	1.6	1.6	1.4			1.8	1.7	1.6	1.4			0.9	0.8	0.9	0.6		
Width/Depth Ratio	NA	NA	NA	NA			10.7	8.4	9.9	10.6			NA	NA	NA	NA			9.2	10.1	11.3	20.0		
Entrenchment Ratio	NA	NA	NA	NA			16.9	21.7	18.4	21.6			NA	NA	NA	NA			26.1	27.5	25.5	19.4		
Bank Height Ratio	NA	NA	NA	NA			1.0	1.0	1.0	1.0			NA	NA	NA	NA			1.0	1.0	1.0	1.0		
Wetted Perimeter(ft)	8.0	7.6	8.7	8.3			9.7	7.9	9.0	7.5			12.4	11.3	12.0	11.8			6.2	5.8	6.2	7.9		
Hydraulic radius (ft)	0.7	0.6	0.7	0.6			0.8	0.7	0.7	0.6			0.9	0.8	0.8	0.7			0.6	0.5	0.5	0.4		
Substrate	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
d50 (mm)																								
d84 (mm)																								
Parameter	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	15	32	77	15	32	77	15	32	77	15	32	77												
Radius of Curvature (ft)	13	18	44	13	18	44	13	18	44	13	18	44												
Meander Wavelength (ft)	46	73	154	46	73	154	46	73	154	46	73	154												
Meander Width ratio	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0	3.8	2.0	7.0	3.8												
Profile	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Riffle length (ft)	4	32	109	14	31	22	5	36	21	7	34	14												
Riffle slope (ft/ft)	0.0%	0.3%	0.1%	0.00%	0.20%	0.05%	0.0%	0.3%	0.1%	0.0%	0.7%	0.1%												
Pool length (ft)	11	52	25	6	48	15	9	37	21	13	37	25												
Pool spacing (ft)	32	45	77	32	45	77	32	45	77	32	45	77												
Additional Reach Parameters	MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)			MY+								
Valley Length (ft)	442			442			449			443														
Channel Length (ft)	574			574			584			576														
Sinuosity	1.3			1.3			1.3			1.3														
Water Surface Slope (ft/ft)	0.06%			0.10%			0.07%			0.08%														
BF slope (ft/ft)	---			---			---			---														
Rosgen Classification	C/E type			C/E type			C/E type			C/E type														
Number of Bankfull Events	0			4			1			1														

### 3.0 CONCLUSIONS

The Site achieved the defined (or targeted) success criteria, with saturation (free water) within one foot of the soil surface for a minimum of 8 percent of the growing season, for all Site groundwater gauges in the Fourth Monitoring Year (Year 2011). A summary of groundwater gauge data for the Year 4 (2011) is included in Table 11. In addition, all but two vegetation plots within the Site were above the required 290 stems per acre with an average of 460 planted tree stems per acre in the Fourth Monitoring Year (Year 2011) (Table 12). The beaver issue is under control and areas affected by the inundation will be replanted before the start of the 2012 growing season.

**Table 11. Summary of Groundwater Gauge Results**

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2008)*	Year 2 (2009)	Year 3 (2010)	Year 4 (2011)	Year 5 (2012)
1	Yes/81 days (38 percent)	Yes/77 days (36 percent)	Yes/25 days (12 percent)	Yes/44 days (20 percent)	
2	Yes/67 days (32 percent)	Yes/84 days (40 percent)	Yes/31 days (15 percent)	Yes/45 days (21 percent)	
3	Yes/63 days (30 percent)	Yes/75 days (35 percent)	Yes/20 days (9 percent)	Yes/41 days (19 percent)	
4	Yes/65 days (31 percent)	Yes/76 days (36 percent)	Yes/21 days (10 percent)	Yes/35 days (16.5 percent)	
Ref 1	Yes/60 days (28 percent)	Yes/64 days (30 percent)	Yes/25 days (12 percent)	Yes/44 days (20 percent)	

**Table 12. Summary of Planted Vegetation Plot Results**

Plot	Planted Stems/Acre Counting Towards Success Criteria				
	Year 1 (2008)	Year 2 (2009)	Year 3 (2010)	Year 4 (2011)	Year 5 (2012)
1	283	283	162	121	
2	526	526	567	567	
3	324	364	324	324	
4	405	445	364	364	
5	647	648	486	243	
6	405	405	405	405	
7	324	324	324	364	
8	324	405	405	405	
9	202	405	405	324	
10	809	729	809	728	
11	890	972	971	971	
12	324	526	486	445	
13	445	567	526	486	
14	688	688	688	688	
<b>Average of All Plots (1-14)</b>	<b>471</b>	<b>520</b>	<b>494</b>	<b>460</b>	

#### 4.0 REFERENCES

- Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
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- Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: <http://www.herbarium.unc.edu/WeakleysFlora.pdf> [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.
- Weather Underground. 2010. Station in Richlands, North Carolina. (online). Available: <http://www.wunderground.com/US/NC/Richlands.html> [April 22, 2010]. Weather Underground.

**APPENDIX A  
VEGETATION DATA**

- 1. Vegetation Survey Data Tables**
- 2. Vegetation Monitoring Plot Photos**



<b>Report Prepared By</b>	Corri Faquin
<b>Date Prepared</b>	7/14/2011 15:48
<b>database name</b>	RestorationSystems-2011-A.mdb
<b>database location</b>	C:\Axiom\Business\CVS
<b>computer name</b>	CORRI-PC
<b>file size</b>	64020480

**DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----**

<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>ALL Stems by Plot and spp</b>	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

**PROJECT SUMMARY-----**

<b>Project Code</b>	Jarmons
<b>project Name</b>	Jarmons Oaks Restoration Site
<b>Description</b>	Stream and Wetland Restoration Site in Onslow County
<b>River Basin</b>	
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	14

Living planted stems, excluding live stakes, per acre: Negative (red) numbers indicate the project failed to reach requirements in a particular year.

Project Code	Project Name	Year 4
Jarmons	Jarmons Oaks Restoration Site	459.61

Total stems, including planted stems of all kinds (including live stakes) and natural/volunteer stems:

Project Code	Project Name	Year 4
Jarmons	Jarmons Oaks Restoration Site	953.9018728

### Plot Info

plot	Plot Level	Year	Latitude/Northing	Longitude/Easting	Zone	Datum	Date Sampled	Planted Living Stems	Planted Living Stems EXCLUDING Live Stakes	Dead/Missing Stems	Natural (Volunteer) Stems	Total Living Stems	Total Living Stems EXCLUDING Live Stakes	Planted Living Stems per ACRE	Planted Living Stems EXCLUDING Live Stakes PER ACRE	Natural (Volunteer) Stems PER ACRE	Total Living Stems PER ACRE	Total Living Stems EXCLUDING Live Stakes PER ACRE	# species
1	2	4	429957	2413835	17N	NAD83/WGS84	7/11/2011	3	3	5	7	10	10	121	121	283	405	405	2
2	2	4	430124	2413823	17N	NAD83/WGS84	7/11/2011	14	14	1	30	44	44	567	567	1214	1781	1781	5
3	2	4	430300	2413722	17N	NAD83/WGS84	7/7/2011	8	8	1	58	66	66	324	324	2347	2671	2671	4
4	2	4	430064	2413655	17N	NAD83/WGS84	7/11/2011	9	9	1	20	29	29	364	364	809	1174	1174	3
5	2	4	430193	2413603	17N	NAD83/WGS84	7/11/2011	6	6	10	4	10	10	243	243	162	405	405	4
6	2	4	430195	2413049	17N	NAD83/WGS84	7/7/2011	10	10	0	5	15	15	405	405	202	607	607	4
7	2	4	430147	2412738	17N	NAD83/WGS84	7/7/2011	9	9	0	4	13	13	364	364	162	526	526	2
8	2	4	430320	2412210	17N	NAD83/WGS84	7/7/2011	10	10	0	0	10	10	405	405	0	405	405	5
9	2	4	429978	2411930	17N	NAD83/WGS84	7/7/2011	8	8	2	1	9	9	324	324	40	364	364	4
10	2	4	430284	2412050	17N	NAD83/WGS84	7/7/2011	18	18	2	7	25	25	728	728	283	1012	1012	5
11	2	4	430627	2411729	17N	NAD83/WGS84	7/7/2011	24	24	0	5	29	29	971	971	202	1174	1174	7
12	2	4	430432	2411160	17N	NAD83/WGS84	7/7/2011	11	11	1	15	26	26	445	445	607	1052	1052	3
13	2	4	430329	2410944	17N	NAD83/WGS84	7/7/2011	12	12	2	5	17	17	486	486	202	688	688	3
14	2	4	430054	2410658	17N	NAD83/WGS84	7/7/2011	17	17	0	10	27	27	688	688	405	1093	1093	3

## Vigor

Vigor	Count	Percent
0	6	3.3
2	6	3.3
3	52	28.3
4	101	54.9
Missing	19	10.3

## Vigor by Species

Species	CommonName	4	3	2	1	0	Missing	Unknown
<i>Betula nigra</i>	river birch	30	1				1	
<i>Celtis laevigata</i>	sugarberry	1	3			1	2	
<i>Cephalanthus occidentalis</i>	common buttonbush	3	1					
<i>Fraxinus pennsylvanica</i>	green ash	20	8			2	3	
<i>Nyssa biflora</i>	swamp tupelo	8	21	4		2	4	
<i>Quercus lyrata</i>	overcup oak	1						
<i>Quercus nigra</i>	water oak	3	5				3	
<i>Quercus pagoda</i>	cherrybark oak	10	6	1		1	5	
<i>Quercus phellos</i>	willow oak	5	4	1			1	
<i>Platanus occidentalis</i>	American sycamore	20	3					
<b>10</b>	<b>10</b>	<b>101</b>	<b>52</b>	<b>6</b>		<b>6</b>	<b>19</b>	

## Damage

Damage	Count	Percent Of Stems
(no damage)	154	83.7
Deer	17	9.2
Vine Strangulation	10	5.4
Unknown	3	1.6

## Damage by Species

Species	CommonName	Count of Damage Categories	(no damage)	Deer	Unknown	Vine Strangulation
<i>Betula nigra</i>	river birch	0	32			
<i>Celtis laevigata</i>	sugarberry	2	5	2		
<i>Cephalanthus occidentalis</i>	common buttonbush	1	3	1		
<i>Fraxinus pennsylvanica</i>	green ash	1	32			1
<i>Nyssa biflora</i>	swamp tupelo	16	23	14	2	
<i>Platanus occidentalis</i>	American sycamore	0	23			
<i>Quercus lyrata</i>	overcup oak	1				1
<i>Quercus nigra</i>	water oak	5	6			5
<i>Quercus pagoda</i>	cherrybark oak	2	21		1	1
<i>Quercus phellos</i>	willow oak	2	9			2
<b>10</b>	<b>10</b>	<b>30</b>	<b>154</b>	<b>17</b>	<b>3</b>	<b>10</b>

### Damage by Plot

plot	Count of Damage Categories	(no damage)	Deer	Unknown	Vine Strangulation
1	0	8			
2	1	14	1		
3	0	9			
4	3	7	2		1
5	2	14	2		
6	4	6	4		
7	0	9			
8	3	7	1	1	1
9	8	2			8
10	3	17	2	1	
11	0	24			
12	4	8	4		
13	2	12	1	1	
14	0	17			
<b>14</b>	<b>30</b>	<b>154</b>	<b>17</b>	<b>3</b>	<b>10</b>



**Planted Stems by Species (excluding Livestakes)**

Species	CommonName	Total Planted Stems	# plots	avg# stems	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Betula nigra</i>	river birch	31	8	3.88		7				2	8			6	1	3	3	1
<i>Celtis laevigata</i>	sugarberry	4	3	1.33			1			1						2		
<i>Cephalanthus occidentalis</i>	common buttonbush	4	2	2		3			1									
<i>Fraxinus pennsylvanica</i>	green ash	28	7	4		1	1		3			3	1		11			8
<i>Nyssa biflora</i>	swamp tupelo	33	11	3	1	2		4	1	3	1	1		6	3	6	5	
<i>Platanus occidentalis</i>	American sycamore	23	7	3.29			1	1		4		2		3	4			8
<i>Quercus lyrata</i>	overcup oak	1	1	1									1					
<i>Quercus nigra</i>	water oak	8	3	2.67									5	2	1			
<i>Quercus pagoda</i>	cherrybark oak	17	7	2.43		1	5		1			3		1	2		4	
<i>Quercus phellos</i>	willow oak	10	5	2	2			4				1	1		2			
<b>10</b>	<b>10</b>	<b>159</b>	<b>10</b>		<b>3</b>	<b>14</b>	<b>8</b>	<b>9</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>8</b>	<b>18</b>	<b>24</b>	<b>11</b>	<b>12</b>	<b>17</b>

**Planted and Naturally Recruited Stems by Plot**

Species	CommonName	Total Stems	# plots	avg# stems	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Acer rubrum</i>	red maple	43	6	7.17	2	22		9								4	2	4
<i>Baccharis halimifolia</i>	eastern baccharis	35	10	3.5	5		15	1		2	3			2	1	4	1	1
<i>Betula nigra</i>	river birch	31	8	3.88		7				2	8			6	1	3	3	1
<i>Celtis laevigata</i>	sugarberry	5	4	1.25			1			1						2		
<i>Cephalanthus occidentalis</i>	common buttonbush	4	2	2		3			1									
<i>Diospyros virginiana</i>	common persimmon	5	1	5				5										
<i>Fraxinus pennsylvanica</i>	green ash	30	7	4.29		1	1		3			3	1		11			8
<i>Liquidambar styraciflua</i>	sweetgum	70	9	7.78		8	40	5	1	3				1	3	7	2	
<i>Morella cerifera</i>	wax myrtle	1	1	1														1
<i>Nyssa biflora</i>	swamp tupelo	35	11	3.18	1	2		4	1	3	1	1		7	3	7	5	
<i>Pinus</i>	pine	1	1	1			1											
<i>Pinus taeda</i>	loblolly pine	1	1	1														1
<i>Platanus occidentalis</i>	American sycamore	23	7	3.29			1	1		4		2		3	4			8
<i>Prunus serotina</i>	black cherry	3	3	1									1	1	1			
<i>Quercus lyrata</i>	overcup oak	1	1	1									1					
<i>Quercus nigra</i>	water oak	8	3	2.67									5	2	1			
<i>Quercus pagoda</i>	cherrybark oak	18	7	2.57		1	5		2			3		1	2		4	
<i>Quercus phellos</i>	willow oak	10	5	2	2			4				1	1		2			
<i>Salix</i>	willow	9	4	2.25					2		1			3				2
<i>Salix nigra</i>	black willow	2	1	2			2											
<i>Ulmus alata</i>	winged elm	1	1	1														1
<b>21</b>	<b>21</b>	<b>336</b>	<b>21</b>		<b>10</b>	<b>44</b>	<b>66</b>	<b>29</b>	<b>10</b>	<b>15</b>	<b>13</b>	<b>10</b>	<b>9</b>	<b>26</b>	<b>29</b>	<b>27</b>	<b>17</b>	<b>27</b>

Jarmans Oak Stream and Wetland Restoration Site  
Year 4 (2011) Annual Monitoring  
Vegetation Plot Photos  
Taken July 2011

Plot 1



Plot 2



Plot 3



Plot 4



Plot 5



Plot 6



Plot 7





Jarmans Oak Stream and Wetland Restoration Site  
Year 4 (2011) Annual Monitoring  
Vegetation Plot Photos  
Taken July 2011  
(continued)



**APPENDIX B  
GEOMORPHOLOGIC DATA**

- 1. Tables B1-B5. Qualitative Visual Stability Assessment**
- 2. Cross-section Plots and Tables**
- 3. Longitudinal Profile Plots**

**Table B1. Visual Morphological Stability Assessment  
Jarman's Oak Reach 1**

Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
<b>A. Riffles</b>	1. Present	10	10	NA	100%	
	2. Armor stable (e.g. no displacement)?	10	10	NA	100%	
	3. Facet grade appears stable?	10	10	NA	100%	
	4. Minimal evidence of embedding / fining?	10	10	NA	100%	
	5. Length appropriate?	10	10	NA	100%	100%
<b>B. Pools</b>	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	12	12	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	12	12	NA	100%	
	3. Length appropriate?	12	12	NA	100%	100%
<b>C. Thalweg</b>	1. Upstream of meander bend (run/inflection) centering?	12	12	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	12	12	NA	100%	100%
<b>D. Meanders</b>	1. Outer bend in state of limited/controlled erosion?	12	12	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	12	12	NA	100%	
	4. Sufficient floodplain access and relief?	12	12	NA	100%	100%
<b>E. Bed General</b>	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
<b>F. Bank</b>	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
	1. Free of back or arm scour?	NA	NA	NA	NA	
<b>G. Vanes</b>	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
	1. Free of scour?	NA	NA	NA	NA	NA
<b>H. Wads / Boulders</b>	2. Footing stable?	NA	NA	NA	NA	NA

**Table B2. Visual Morphological Stability Assessment  
Jarman's Oak Reach 2**

Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
<b>A. Riffles</b>	1. Present	10	10	NA	100%	
	2. Armor stable (e.g. no displacement)?	10	10	NA	100%	
	3. Facet grade appears stable?	10	10	NA	100%	
	4. Minimal evidence of embedding / fining?	10	10	NA	100%	
	5. Length appropriate?	9	10	NA	90%	98%
<b>B. Pools</b>	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	11	11	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkt>1.6?)	11	11	NA	100%	
	3. Length appropriate?	11	11	NA	100%	100%
<b>C. Thalweg</b>	1. Upstream of meander bend (run/inflection) centering?	11	11	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	11	11	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	11	11	NA	100%	
<b>D. Meanders</b>	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	11	11	NA	100%	
	4. Sufficient floodplain access and relief?	11	11	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
<b>E. Bed General</b>	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
<b>F. Bank</b>	1. Free of back or arm scour?	NA	NA	NA	NA	
	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
<b>H. Wads / Boulders</b>	1. Free of scour?	NA	NA	NA	NA	NA
	2. Footing stable?	NA	NA	NA	NA	NA

**Table B3. Visual Morphological Stability Assessment  
Jarman's Oak Reach 3**

Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
<b>A. Riffles</b>	1. Present	10	14	NA	71%	
	2. Armor stable (e.g. no displacement)?	14	14	NA	100%	
	3. Facet grade appears stable?	14	14	NA	100%	
	4. Minimal evidence of embedding / fining?	14	14	NA	100%	
	5. Length appropriate?	14	14	NA	100%	94%
<b>B. Pools</b>	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	16	16	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	16	16	NA	100%	
	3. Length appropriate?	16	16	NA	100%	100%
<b>C. Thalweg</b>	1. Upstream of meander bend (run/inflection) centering?	16	16	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	16	16	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	16	16	NA	100%	
<b>D. Meanders</b>	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	16	16	NA	100%	
	4. Sufficient floodplain access and relief?	16	16	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	100%
<b>E. Bed General</b>	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
<b>F. Bank</b>	1. Free of back or arm scour?	NA	NA	NA	NA	
	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
<b>G. Vanes</b>	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
	1. Free of scour?	NA	NA	NA	NA	
<b>H. Wads / Boulders</b>	2. Footing stable?	NA	NA	NA	NA	NA



**Table B4. Visual Morphological Stability Assessment  
Jarman's Oak Reach 4**

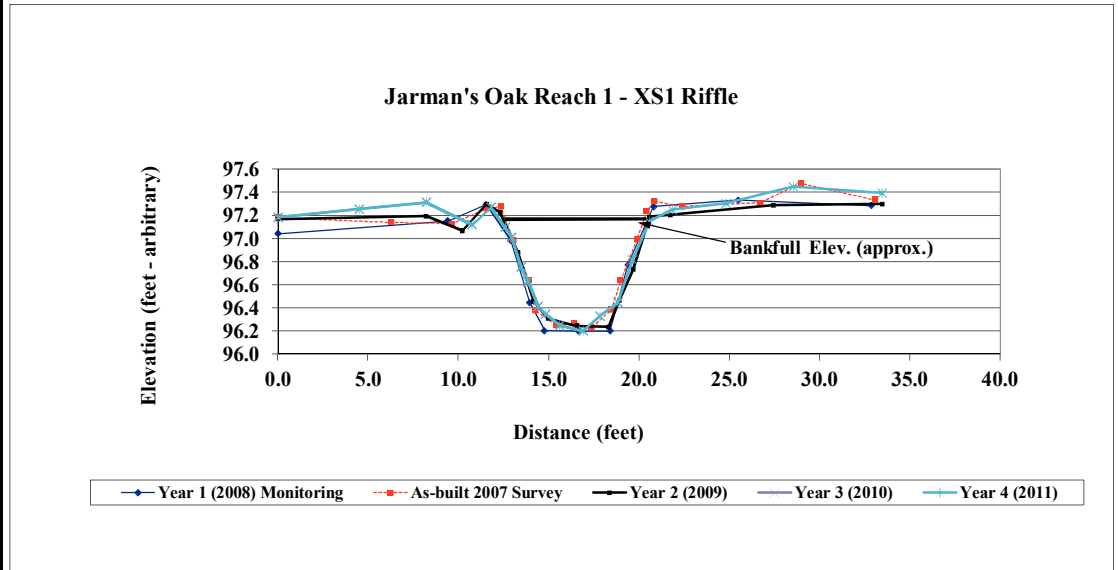
Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
<b>A. Riffles</b>	1. Present	9	9	NA	100%	
	2. Armor stable (e.g. no displacement)?	9	9	NA	100%	
	3. Facet grade appears stable?	9	9	NA	100%	
	4. Minimal evidence of embedding / fining?	9	9	NA	100%	
	5. Length appropriate?	9	9	NA	100%	100%
<b>B. Pools</b>	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	11	11	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	11	11	NA	100%	
	3. Length appropriate?	11	11	NA	100%	100%
<b>C. Thalweg</b>	1. Upstream of meander bend (run/inflection) centering?	11	11	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	11	11	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	11	11	NA	100%	
<b>D. Meanders</b>	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	11	11	NA	100%	
	4. Sufficient floodplain access and relief?	11	11	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
<b>E. Bed General</b>	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
<b>F. Bank</b>	1. Free of back or arm scour?	NA	NA	NA	NA	
	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
<b>H. Wads / Boulders</b>	1. Free of scour?	NA	NA	NA	NA	NA
	2. Footing stable?	NA	NA	NA	NA	NA

**Table B5. Visual Morphological Stability Assessment  
Jarman's Oak Reach 5**

Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
<b>A. Riffles</b>	1. Present	11	11	NA	100%	
	2. Armor stable (e.g. no displacement)?	11	11	NA	100%	
	3. Facet grade appears stable?	11	11	NA	100%	
	4. Minimal evidence of embedding / fining?	11	11	NA	100%	
	5. Length appropriate?	11	11	NA	100%	100%
<b>B. Pools</b>	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	9	10	NA	90%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	10	10	NA	100%	
	3. Length appropriate?	10	10	NA	100%	97%
<b>C. Thalweg</b>	1. Upstream of meander bend (run/inflection) centering?	10	10	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	10	10	NA	100%	100%
<b>D. Meanders</b>	1. Outer bend in state of limited/controlled erosion?	10	10	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	10	10	NA	100%	
	4. Sufficient floodplain access and relief?	10	10	NA	100%	100%
<b>E. Bed General</b>	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
<b>F. Bank</b>	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
	1. Free of back or arm scour?	NA	NA	NA	NA	
	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
<b>G. Vanes</b>	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
	1. Free of scour?	NA	NA	NA	NA	
<b>H. Wads / Boulders</b>	2. Footing stable?	NA	NA	NA	NA	NA

**Project Name** Jarman's Oak  
**Cross Section** R1-XS1  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Dean/Perkinson

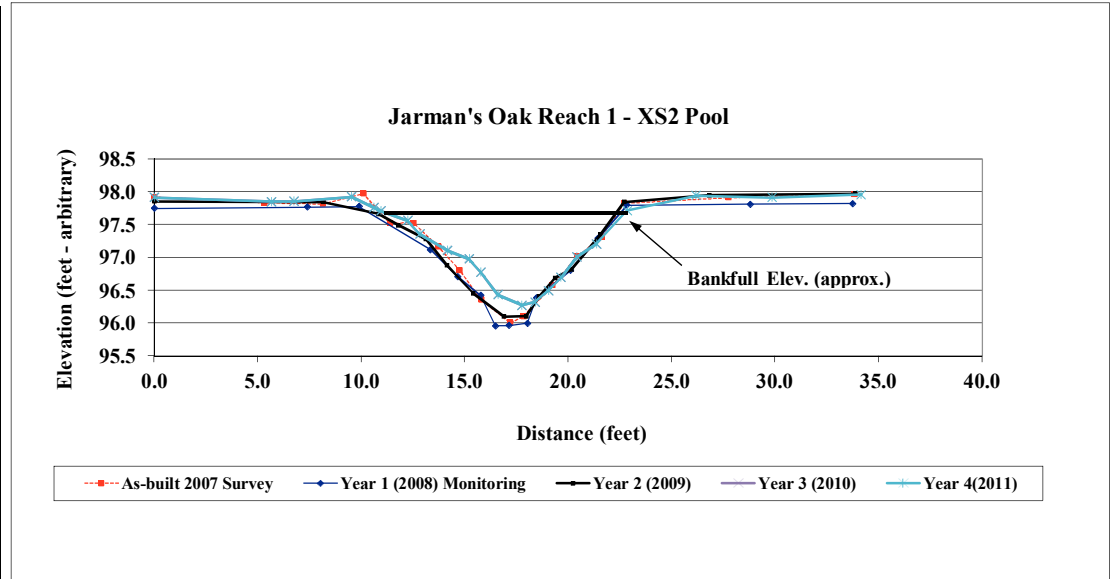
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.2	0.0	97.0	0.0	97.2	0.0	97.2	0.0	97.2
6.3	97.1	9.4	97.2	8.2	97.2	7.6	97.2	4.5	97.3
9.6	97.1	11.5	97.3	10.2	97.1	12.0	97.2	8.2	97.3
11.5	97.3	12.9	97.0	11.6	97.3	13.2	96.9	10.7	97.1
12.3	97.3	13.9	96.4	12.3	97.2	13.8	96.7	11.8	97.3
13.0	97.0	14.8	96.2	13.3	96.9	14.2	96.5	12.6	97.1
13.9	96.6	16.6	96.2	14.2	96.5	15.1	96.2	12.9	97.0
14.3	96.4	18.4	96.2	15.0	96.3	16.8	96.2	13.5	96.8
15.4	96.2	19.4	96.8	16.5	96.2	18.0	96.2	13.8	96.6
16.4	96.3	20.8	97.3	18.3	96.2	18.6	96.4	14.4	96.4
17.4	96.2	25.5	97.3	18.9	96.5	19.5	96.7	14.8	96.3
18.4	96.4	32.8	97.3	19.7	96.7	20.3	97.1	15.6	96.2
19.0	96.6			20.6	97.2	21.2	97.3	16.9	96.2
19.9	97.0			21.7	97.2	26.4	97.3	17.8	96.3
20.4	97.2			27.4	97.3	33.3	97.4	18.8	96.4
20.8	97.3			33.4	97.3			19.6	96.8
22.4	97.3							20.6	97.2
26.7	97.3							21.8	97.3
29.0	97.5							24.8	97.3
33.1	97.3							28.5	97.5
								33.5	97.4



	As-built	2008	2009	2010	2011
Area	5.9	6.4	5.6	5.8	5.5
Width	9.1	9.0	8.9	8.8	9.1
Mean Depth	0.6	0.7	0.6	0.7	0.6
Max Depth	1.1	1.1	1.0	1.0	1.0
W/D Ratio	14.1	12.7	14.0	13.3	15.0

**Project Name** Jarman's Oak  
**Cross Section** R1-XS2  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Dean, Perkinson

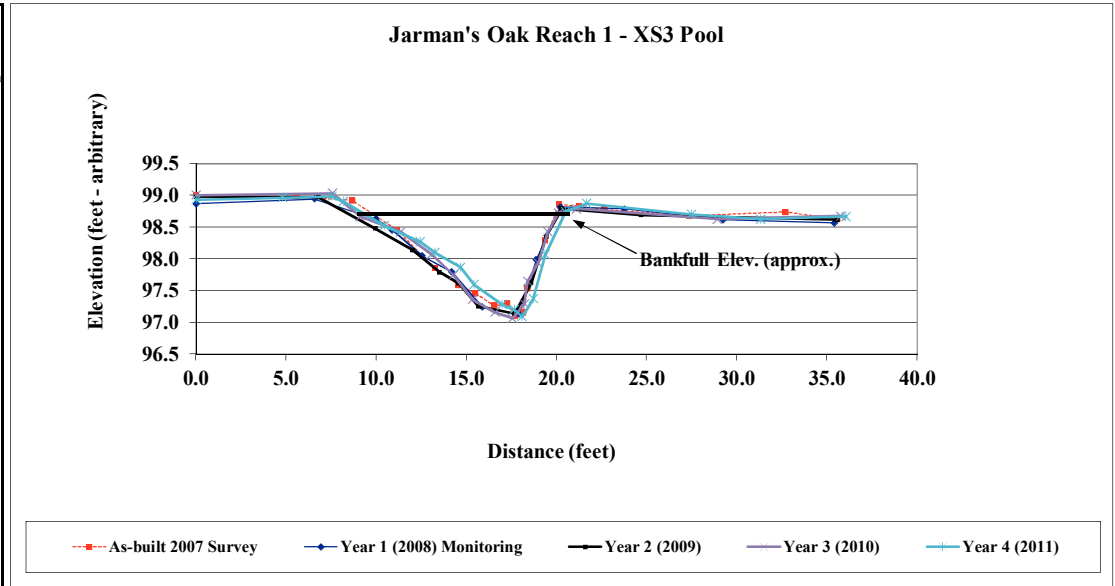
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.9	0.0	97.7	0.0	97.9	0.0	97.9	0.0	97.9
5.3	97.8	7.4	97.8	8.2	97.8	7.3	97.9	5.7	97.8
8.1	97.8	9.9	97.8	10.8	97.7	10.3	97.8	6.7	97.9
10.1	98.0	13.3	97.1	11.8	97.5	12.8	97.3	9.5	97.9
11.4	97.5	14.7	96.7	13.1	97.3	13.8	97.0	10.6	97.8
12.5	97.5	15.8	96.4	14.1	96.9	15.0	96.8	10.9	97.7
13.7	97.2	16.5	96.0	15.4	96.5	15.9	96.7	12.3	97.6
14.8	96.8	17.1	96.0	16.9	96.1	16.8	96.2	12.8	97.4
15.8	96.4	18.0	96.0	18.0	96.1	17.5	96.0	14.2	97.1
17.2	96.0	18.5	96.4	18.6	96.4	18.4	96.4	15.2	97.0
17.8	96.1	20.1	96.8	19.4	96.7	19.2	96.7	15.8	96.8
19.2	96.6	21.4	97.3	20.2	96.8	20.3	97.0	16.6	96.4
20.4	97.0	22.8	97.8	21.6	97.3	20.9	97.3	17.8	96.3
21.6	97.3	28.8	97.8	22.7	97.8	21.9	97.5	18.4	96.3
22.7	97.8	33.7	97.8	26.8	97.9	22.5	97.7	19.1	96.5
27.8	97.9			33.9	98.0	23.1	97.9	19.7	96.7
33.9	98.0					28.0	97.9	20.4	97.0
						34.0	98.0	21.4	97.2
								22.8	97.7
								26.2	97.9
								29.8	97.9
								34.2	98.0



	As-built	2008	2009	2010	2011
Area	7.6	11.4	11.9	10.6	10.4
Width	9.5	12.8	14.6	13.8	14.8
Mean Depth	0.8	0.9	0.8	0.8	0.7
Max Depth	1.5	1.8	1.8	1.8	1.6
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R1-XS3  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Dean, Perkinson

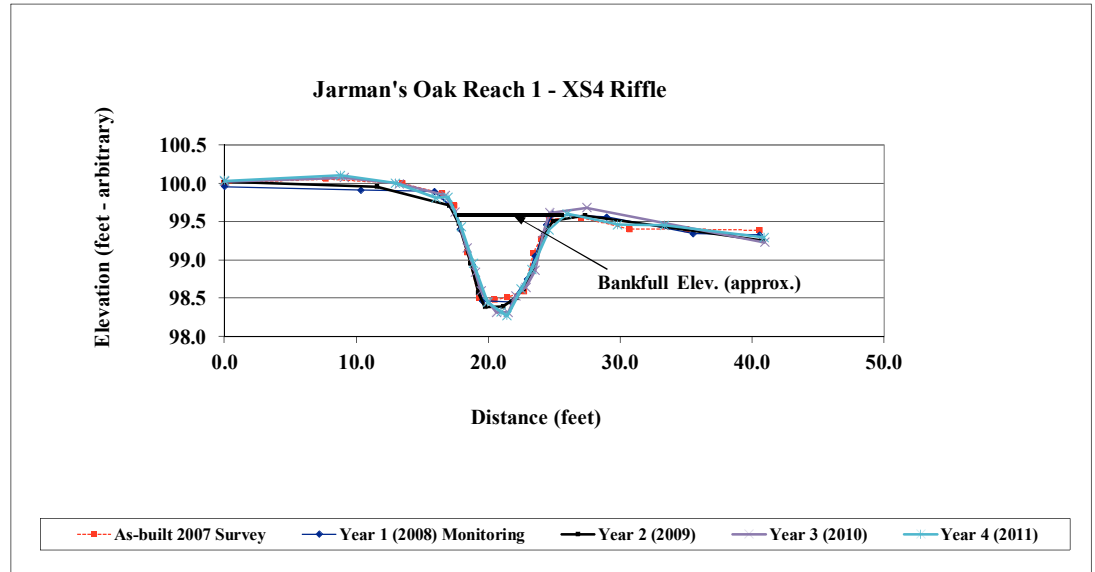
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	99.0	0.0	98.9	0.0	99.0	0.0	99.0	0.0	98.9
5.6	99.0	6.6	98.9	6.8	99.0	7.6	99.0	4.8	99.0
8.7	98.9	10.0	98.6	10.0	98.5	9.1	98.7	7.5	99.0
11.2	98.5	10.9	98.5	12.0	98.1	11.4	98.4	8.2	98.9
13.2	97.9	12.6	98.0	13.5	97.8	13.1	98.1	10.5	98.5
14.5	97.6	14.2	97.8	14.6	97.6	14.3	97.7	12.5	98.3
15.5	97.5	15.9	97.2	15.7	97.3	15.3	97.4	13.3	98.1
16.6	97.3	17.9	97.1	17.7	97.1	16.6	97.2	14.7	97.9
17.3	97.3	18.9	98.0	18.6	97.6	17.6	97.1	15.4	97.6
17.7	97.1	20.2	98.8	19.4	98.4	18.2	97.3	17.0	97.3
18.1	97.1	23.8	98.8	20.3	98.8	18.4	97.6	17.7	97.2
18.4	97.5	29.2	98.6	24.7	98.7	19.0	97.9	18.1	97.1
19.4	98.3	35.4	98.6	35.6	98.6	19.5	98.4	18.7	97.4
20.1	98.9					20.1	98.7	19.4	98.1
21.3	98.8					21.1	98.8	20.5	98.8
22.7	98.8					28.9	98.6	21.7	98.9
27.4	98.7					35.8	98.7	27.5	98.7
32.7	98.7							31.3	98.6
35.6	98.6							36.1	98.7



	As-built	2008	2009	2010	2011
<b>Area</b>	10.4	10.0	10.6	9.8	9.5
<b>Width</b>	12.3	12.1	12.4	12.5	12.1
<b>Mean Depth</b>	0.8	0.8	0.9	0.8	0.8
<b>Max Depth</b>	1.8	1.7	1.7	1.7	1.7
<b>W/D Ratio</b>	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R1-XS4  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Dean, Perkinson

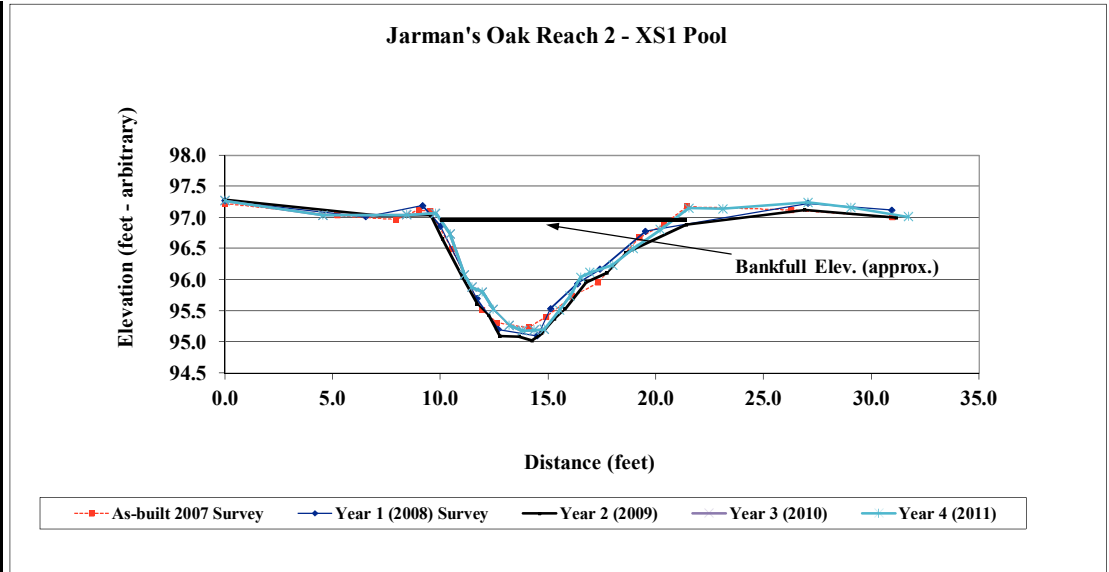
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
7.7	100.1	10.3	99.9	11.6	100.0	9.1	100.1	8.8	100.1
13.5	100.0	15.9	99.9	17.0	99.7	13.2	100.0	12.9	100.0
16.5	99.9	17.1	99.7	17.8	99.5	16.7	99.8	16.0	99.8
17.4	99.7	17.9	99.4	18.6	99.0	17.5	99.6	16.9	99.8
18.4	99.1	18.8	98.9	19.2	98.6	18.4	99.2	17.9	99.4
19.3	98.5	19.6	98.5	19.7	98.4	19.0	98.8	18.9	99.0
20.5	98.5	21.7	98.5	21.1	98.4	19.4	98.6	19.9	98.4
21.4	98.5	22.9	98.8	22.1	98.5	20.0	98.5	21.0	98.3
22.7	98.6	23.5	99.1	22.7	98.6	20.6	98.3	21.4	98.3
23.4	99.1	24.4	99.5	23.4	98.9	21.5	98.3	22.5	98.6
24.0	99.3	24.9	99.6	24.1	99.3	22.1	98.5	23.3	98.9
24.7	99.5	29.0	99.6	24.9	99.5	22.8	98.6	24.6	99.4
27.0	99.6	35.5	99.3	27.3	99.6	23.5	98.9	26.0	99.6
30.7	99.4	40.5	99.3	40.8	99.3	24.1	99.3	29.8	99.5
35.0	99.4					24.6	99.6	33.3	99.5
40.5	99.4					27.5	99.7	40.9	99.3
						40.9	99.2		



	As-built	2008	2009	2010	2011
Area	5.0	5.6	5.2	6.0	5.9
Width	6.9	7.5	7.2	7.3	8.5
Mean Depth	0.7	0.7	0.7	0.8	0.7
Max Depth	1.0	1.1	1.1	1.3	1.3
W/D Ratio	9.6	10.2	9.9	8.8	12.1

**Project Name** Jarman's Oak  
**Cross Section** R2-XS1  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

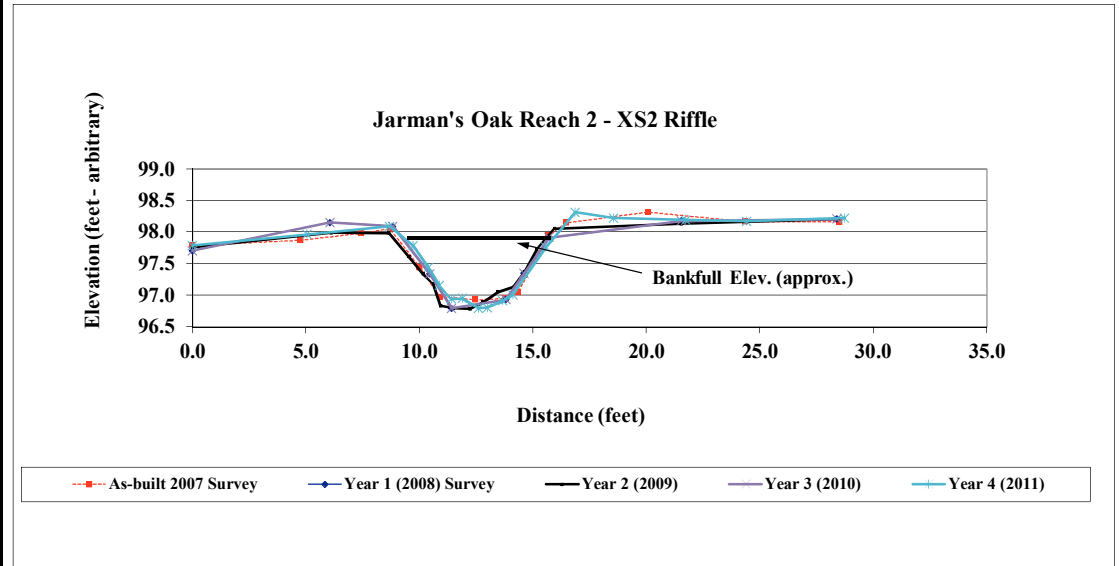
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.2	0.0	97.3	0.0	97.3	0.0	97.3	0.0	97.3
5.2	97.0	6.5	97.0	7.2	97.0	6.5	97.0	4.5	97.0
7.9	97.0	9.2	97.2	9.5	97.0	9.2	97.2	8.4	97.0
9.0	97.1	10.0	96.9	10.1	96.7	10.0	96.9	9.8	97.1
9.5	97.1	11.7	95.7	11.0	96.1	11.7	95.7	10.4	96.7
10.5	96.5	12.7	95.2	11.7	95.6	12.7	95.2	11.1	96.1
11.9	95.5	14.5	95.1	12.2	95.4	14.5	95.1	11.4	95.9
12.6	95.3	15.1	95.5	12.8	95.1	15.1	95.5	11.9	95.8
14.1	95.2	16.4	95.9	13.7	95.1	16.4	95.9	12.5	95.5
14.9	95.4	17.4	96.2	14.2	95.0	17.4	96.2	13.2	95.3
16.1	95.7	19.5	96.8	14.7	95.1	19.5	96.8	13.8	95.2
17.3	96.0	27.1	97.2	15.3	95.4	27.1	97.2	14.4	95.2
19.2	96.7	30.9	97.1	15.8	95.5	30.9	97.1	14.8	95.2
20.4	96.9			16.8	96.0			15.5	95.5
21.4	97.2			17.7	96.1			16.0	95.7
26.3	97.1			18.6	96.4			16.5	96.0
31.0	97.0			21.4	96.9			16.9	96.1
				26.9	97.1			18.0	96.2
				31.1	97.0			19.0	96.5
								20.2	96.8
								21.5	97.1
								23.1	97.1
								27.0	97.2
								29.0	97.2
								31.7	97.0



	As-built	2008	2009	2010	2011
<b>Area</b>	12.7	11.3	13.2	11.3	11.7
<b>Width</b>	11.7	13.6	15.5	13.6	11.4
<b>Mean Depth</b>	1.1	0.8	0.9	0.8	1.0
<b>Max Depth</b>	1.9	1.9	2.0	1.9	1.9
<b>W/D Ratio</b>	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R2-XS2  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.8	0.0	97.7	0.0	97.8	0.0	97.7	0.0	97.8
4.7	97.9	6.1	98.2	6.1	98.0	6.1	98.2	5.0	98.0
7.4	98.0	8.8	98.1	8.7	98.0	8.8	98.1	8.7	98.1
8.7	98.1	10.5	97.3	9.5	97.6	10.5	97.3	9.7	97.8
10.0	97.4	11.4	96.8	10.2	97.3	11.4	96.8	10.4	97.4
10.9	97.0	13.8	96.9	10.6	97.2	13.8	96.9	10.9	97.2
12.5	96.9	14.6	97.3	10.9	96.8	14.6	97.3	11.4	96.9
13.8	97.0	15.7	97.9	11.5	96.8	15.7	97.9	11.9	96.9
14.3	97.1	21.5	98.2	12.2	96.8	21.5	98.2	12.6	96.8
15.7	97.9	28.4	98.2	12.8	96.9	28.4	98.2	13.0	96.8
16.4	98.1			13.4	97.1			13.7	96.9
20.1	98.3			14.1	97.1			14.1	97.0
24.4	98.2			14.6	97.4			15.6	97.8
28.5	98.2			15.2	97.7			16.9	98.3
				15.9	98.1			18.5	98.2
				21.5	98.1			21.7	98.2
				28.3	98.2			24.4	98.2
								28.7	98.2

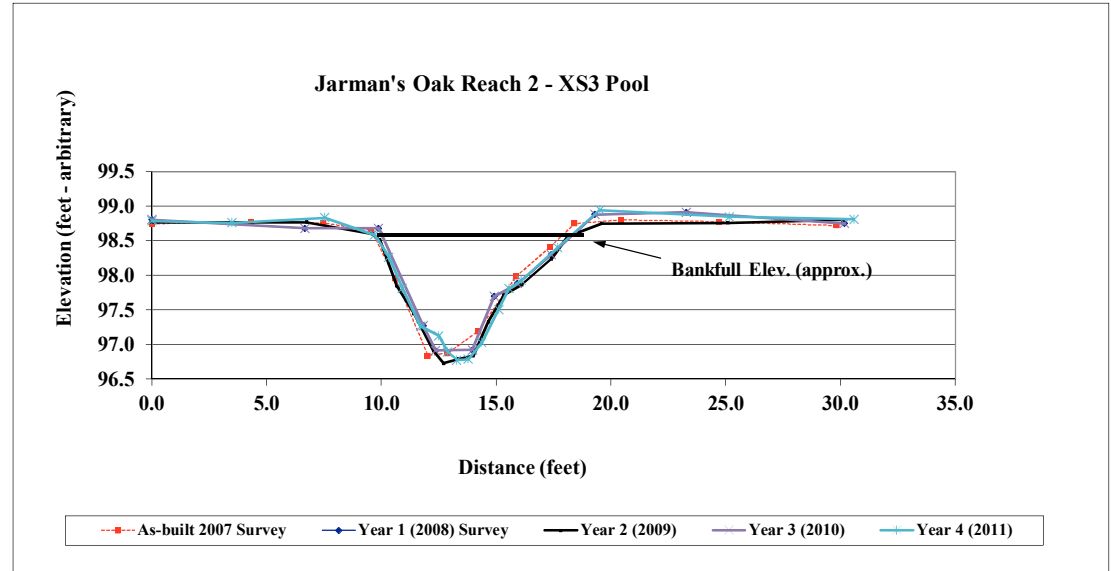


	As-built	2008	2009	2010	2011
Area	5.7	4.6	5.3	4.5	4.5
Width	7.4	6.6	7.1	6.4	6.6
Mean Depth	0.8	0.7	0.7	0.7	0.7
Max Depth	1.1	1.1	1.2	1.1	1.1
W/D Ratio	9.6	9.3	9.6	9.2	9.6



**Project Name** Jarman's Oak  
**Cross Section** R2-XS3  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

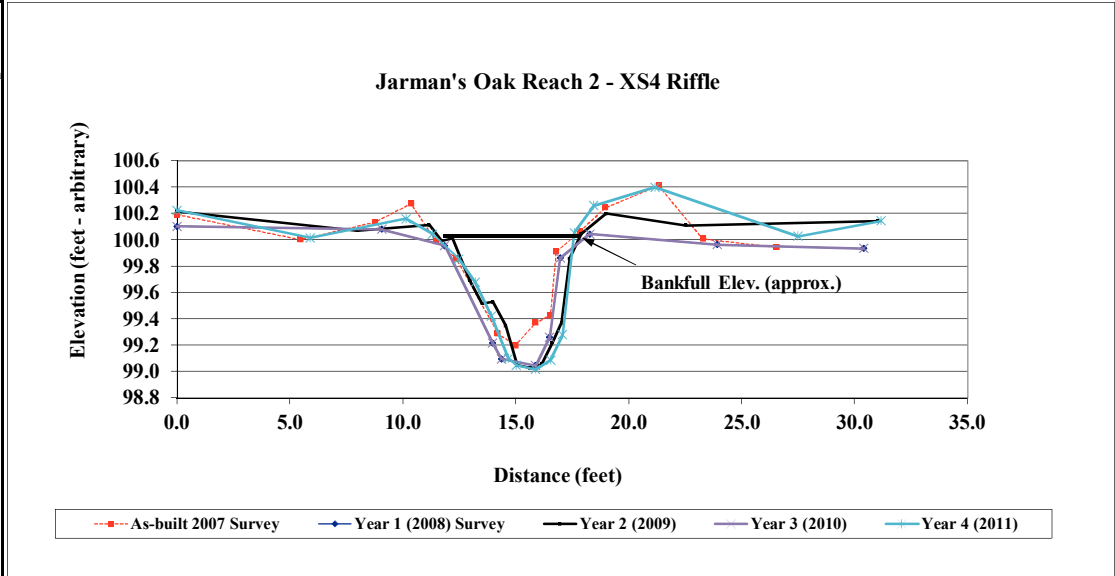
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	98.8	0.0	98.8	0.0	98.8	0.0	98.8	0.0	98.8
4.3	98.8	6.6	98.7	6.7	98.8	6.6	98.7	3.5	98.8
7.5	98.8	9.9	98.7	9.6	98.6	9.9	98.7	7.5	98.8
9.5	98.7	11.8	97.3	9.9	98.5	11.8	97.3	9.7	98.6
10.6	98.0	12.4	96.9	10.7	97.8	12.4	96.9	10.3	98.3
12.0	96.8	14.0	96.9	11.4	97.5	14.0	96.9	10.9	97.8
12.9	96.9	14.9	97.7	12.3	96.9	14.9	97.7	11.7	97.3
14.2	97.2	15.9	97.9	12.7	96.7	15.9	97.9	12.5	97.1
15.9	98.0	17.4	98.3	13.3	96.8	17.4	98.3	12.9	96.9
17.3	98.4	19.3	98.9	14.0	96.8	19.3	98.9	13.3	96.8
18.4	98.8	23.3	98.9	14.7	97.3	23.3	98.9	13.8	96.8
20.4	98.8	30.2	98.8	15.3	97.7	30.2	98.8	14.4	97.0
24.7	98.8			16.1	97.9			15.1	97.5
29.8	98.7			17.4	98.2			15.6	97.8
				18.1	98.6			16.1	97.9
				19.6	98.8			17.7	98.4
				25.1	98.8			19.5	98.9
				30.1	98.8			25.1	98.8
								30.6	98.8



	As-built	2008	2009	2010	2011
Area	8.4	8.3	8.7	8.3	8.1
Width	8.7	8.8	9.0	8.8	8.6
Mean Depth	1.0	1.0	1.0	1.0	0.9
Max Depth	1.8	1.8	1.9	1.8	1.8
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R2-XS4  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

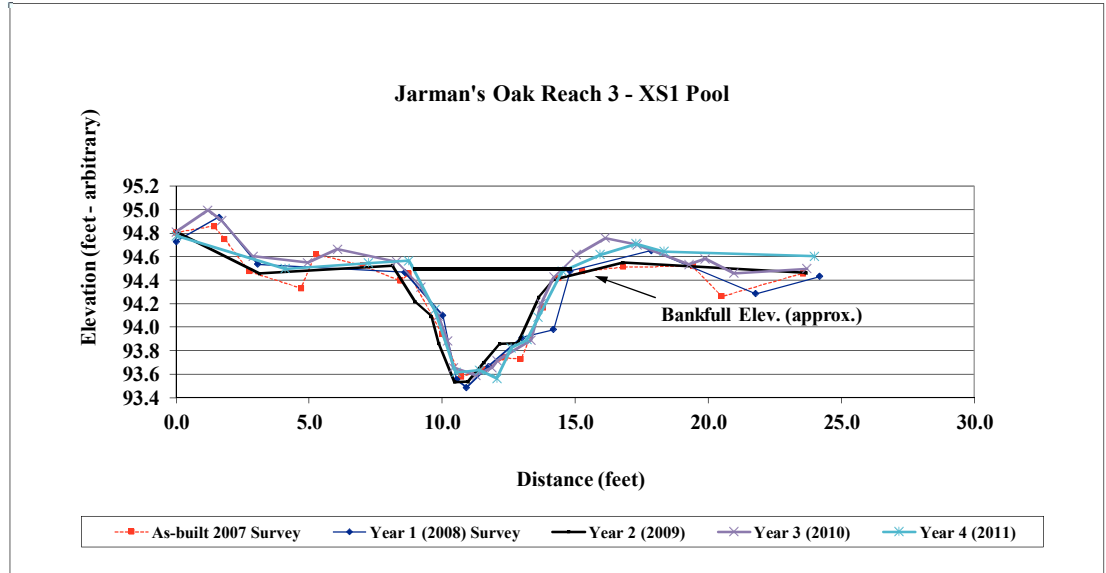
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	100.2	0.0	100.1	0.0	100.2	0.0	100.1	0.0	100.2
5.5	100.0	9.1	100.1	8.0	100.1	9.1	100.1	5.9	100.0
8.7	100.1	11.8	100.0	11.2	100.1	11.8	100.0	10.1	100.2
10.4	100.3	14.0	99.2	11.7	100.0	14.0	99.2	11.3	100.0
11.5	100.0	14.4	99.1	12.2	100.0	14.4	99.1	12.5	99.9
12.4	99.9	15.9	99.0	13.0	99.7	15.9	99.0	13.2	99.7
14.2	99.3	16.5	99.3	13.5	99.5	16.5	99.3	13.9	99.4
15.0	99.2	17.0	99.9	14.0	99.5	17.0	99.9	14.7	99.1
15.9	99.4	18.3	100.0	14.5	99.3	18.3	100.0	15.0	99.0
16.5	99.4	23.9	100.0	15.0	99.0	23.9	100.0	15.9	99.0
16.8	99.9	30.4	99.9	15.6	99.0	30.4	99.9	16.5	99.1
17.8	100.1			16.1	99.1			17.1	99.3
19.0	100.2			16.6	99.2			17.6	100.1
21.3	100.4			17.0	99.4			18.5	100.3
23.3	100.0			17.4	99.9			21.2	100.4
26.6	99.9			17.9	100.0			27.5	100.0
				19.0	100.2			31.2	100.1
				22.5	100.1				
				31.0	100.1				



	As-built	2008	2009	2010	2011
Area	4.7	3.7	3.2	3.1	3.8
Width	8.6	8.3	6.1	5.7	6.3
Mean Depth	0.5	0.5	0.5	0.5	0.6
Max Depth	1.1	1.0	1.0	0.9	1.0
W/D Ratio	15.9	18.3	11.4	10.5	10.3

**Project Name** Jarman's Oak  
**Cross Section** R3-XS1  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

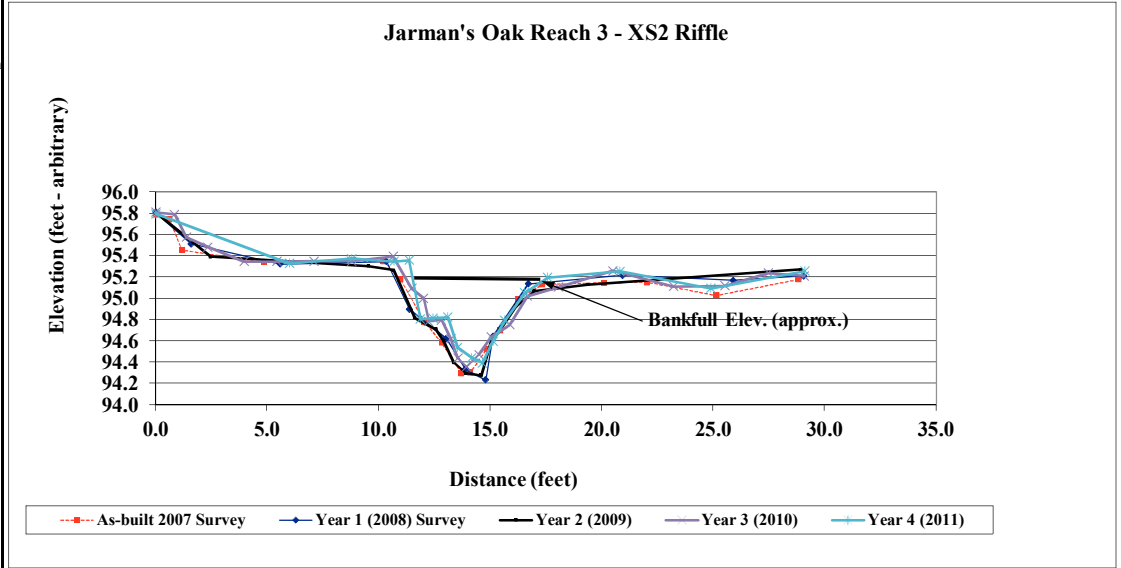
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	94.8	0.0	94.7	0.0	94.8	0.0	94.8	0.0	94.8
1.4	94.9	1.6	94.9	3.1	94.5	1.2	95.0	4.1	94.5
1.8	94.8	3.1	94.5	8.1	94.5	1.7	94.9	7.2	94.5
2.7	94.5	8.6	94.5	9.0	94.2	2.9	94.6	8.8	94.6
4.7	94.3	10.0	94.1	9.6	94.1	4.9	94.5	9.7	94.1
5.2	94.6	10.5	93.6	9.9	93.9	6.1	94.7	10.5	93.6
7.0	94.5	10.9	93.5	10.5	93.5	8.3	94.6	11.4	93.6
8.4	94.4	11.7	93.7	11.0	93.5	9.2	94.3	12.1	93.6
8.7	94.5	13.0	93.9	11.6	93.7	9.9	94.1	12.6	93.8
10.0	93.9	14.2	94.0	12.2	93.9	10.2	93.9	13.2	93.9
10.7	93.6	14.8	94.5	12.8	93.9	10.4	93.7	13.6	94.1
11.6	93.6	17.9	94.7	13.6	94.3	11.3	93.6	14.5	94.5
12.4	93.7	21.8	94.3	14.2	94.4	11.9	93.7	15.9	94.6
13.0	93.7	24.2	94.4	16.8	94.5	12.1	93.7	17.3	94.7
13.8	94.2			23.7	94.5	13.3	93.9	18.3	94.6
14.4	94.4					13.7	94.2	24.0	94.6
15.3	94.5					14.2	94.4		
16.8	94.5					15.1	94.6		
19.4	94.5					16.1	94.8		
20.5	94.3					17.3	94.7		
23.6	94.5					19.3	94.5		
						19.9	94.6		
						21.0	94.5		
						23.7	94.5		



	As-built	2008	2009	2010	2011
Area	2.9	3.3	3.5	3.5	3.1
Width	5.6	6.2	8.1	6.4	5.5
Mean Depth	0.5	0.5	0.4	0.5	0.6
Max Depth	0.8	1.0	1.0	1.0	0.9
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R3-XS2  
**Feature** Riffle  
**Date** 11/5/11  
**Crew** Perkinson, Dean

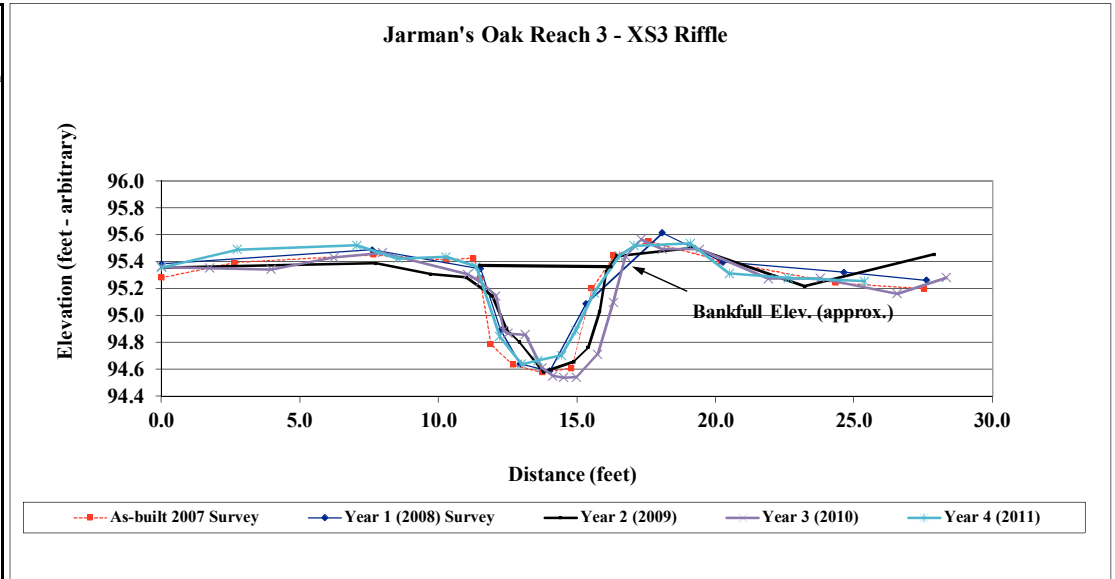
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	95.8	0.0	95.8	0.0	95.8	0.0	95.8	0.0	95.8
0.6	95.7	1.6	95.5	2.5	95.4	0.8	95.8	6.0	95.3
1.2	95.5	5.6	95.3	9.5	95.3	1.4	95.6	8.8	95.4
4.9	95.3	10.4	95.3	10.7	95.3	2.3	95.5	10.7	95.3
8.9	95.4	11.4	94.9	11.6	94.8	4.0	95.3	11.4	95.4
10.2	95.3	13.0	94.6	12.6	94.7	5.4	95.3	11.9	94.8
11.0	95.2	13.9	94.3	12.9	94.6	7.1	95.3	12.4	94.8
12.1	94.8	14.8	94.2	13.4	94.4	8.8	95.4	13.1	94.8
12.8	94.6	15.1	94.6	13.9	94.3	10.6	95.4	13.5	94.5
13.7	94.3	16.7	95.1	14.6	94.3	11.5	95.1	14.2	94.4
14.1	94.3	20.9	95.2	15.0	94.6	12.0	95.0	14.7	94.4
14.8	94.5	25.9	95.2	15.4	94.7	12.2	94.8	15.1	94.6
15.5	94.7	29.1	95.2	16.1	94.9	12.8	94.8	15.7	94.8
16.2	95.0			17.0	95.1	13.2	94.6	16.5	95.1
17.3	95.1			19.4	95.1	13.5	94.4	17.6	95.2
20.1	95.1			28.9	95.3	13.9	94.4	20.8	95.3
22.0	95.2					14.5	94.5	24.9	95.1
25.1	95.0					15.0	94.6	29.1	95.3
28.8	95.2					15.9	94.8		
						16.7	95.0		
						18.1	95.1		
						20.5	95.3		
						23.2	95.1		
						25.5	95.1		
						27.5	95.2		
						29.1	95.2		



	As-built	2008	2009	2010	2011
Area	2.6	2.7	2.4	2.1	2.5
Width	6.2	6.1	5.9	6.5	6.2
Mean Depth	0.4	0.4	0.4	0.3	0.4
Max Depth	0.8	0.9	0.8	0.7	0.8
W/D Ratio	14.9	13.8	14.5	20.0	15.2

**Project Name** Jarman's Oak  
**Cross Section** R3-XS3  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	95.3	0.0	95.4	0.0	95.4	0.0	95.4	0.0	95.4
2.6	95.4	7.6	95.5	7.7	95.4	1.7	95.4	2.7	95.5
7.6	95.5	11.5	95.3	9.7	95.3	4.0	95.3	7.0	95.5
10.3	95.4	12.2	94.9	11.0	95.3	6.2	95.4	8.5	95.4
11.3	95.4	12.9	94.6	11.9	95.1	8.0	95.5	10.3	95.4
11.5	95.3	14.0	94.6	12.5	94.9	11.0	95.3	11.4	95.4
11.9	94.8	15.3	95.1	12.9	94.8	11.5	95.3	12.2	94.8
12.7	94.6	18.1	95.6	13.8	94.6	12.1	95.1	13.0	94.6
13.8	94.6	20.3	95.4	14.9	94.7	12.3	94.9	13.6	94.7
14.8	94.6	24.6	95.3	15.4	94.8	12.5	94.9	14.4	94.7
15.5	95.2	27.6	95.3	15.8	95.0	13.1	94.9	14.9	94.9
16.3	95.4			16.1	95.3	13.7	94.6	15.6	95.2
17.6	95.6			16.4	95.4	14.1	94.5	16.5	95.4
20.2	95.4			19.2	95.5	14.5	94.5	17.1	95.5
24.3	95.2			23.2	95.2	15.0	94.5	19.1	95.5
27.5	95.2			27.9	95.5	15.7	94.7	20.5	95.3
						16.3	95.1	22.6	95.3
						16.7	95.4	25.4	95.3
						17.3	95.6	28.0	95.5
						18.1	95.5		
						19.4	95.5		
						21.9	95.3		
						23.8	95.3		
						26.5	95.2		
						28.3	95.3		

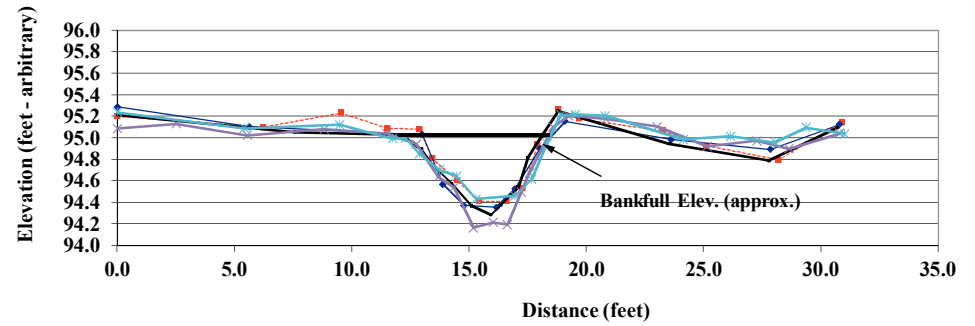


	As-built	2008	2009	2010	2011
Area	3.0	2.2	2.1	2.5	2.3
Width	5.0	5.2	5.0	5.5	5.0
Mean Depth	0.6	0.4	0.4	0.5	0.5
Max Depth	0.9	0.8	0.7	0.8	0.7
W/D Ratio	8.5	12.3	11.8	11.9	10.8

**Project Name** Jarman's Oak  
**Cross Section** R3-XS4  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	95.2	0.0	95.3	0.0	95.2	0.0	95.1	0.0	95.2
6.2	95.1	5.6	95.1	7.6	95.1	2.5	95.1	5.4	95.1
9.5	95.2	13.0	95.0	12.1	95.0	5.5	95.0	9.5	95.1
11.5	95.1	13.9	94.6	13.0	94.9	8.8	95.1	11.7	95.0
12.9	95.1	14.8	94.4	13.4	94.8	11.5	95.0	12.3	95.0
13.4	94.8	16.1	94.4	14.3	94.6	12.7	94.9	12.9	94.9
14.5	94.6	17.0	94.5	15.1	94.4	13.7	94.6	13.7	94.7
15.4	94.4	18.0	94.9	15.9	94.3	14.3	94.5	14.5	94.6
16.6	94.4	19.1	95.2	16.4	94.4	15.2	94.2	15.3	94.4
17.3	94.5	23.6	95.0	17.1	94.5	16.0	94.2	17.0	94.5
17.9	94.9	27.8	94.9	17.5	94.8	16.6	94.2	17.7	94.6
18.8	95.3	30.8	95.1	18.1	95.0	17.2	94.5	18.3	94.9
19.7	95.2			18.8	95.2	17.6	94.7	18.9	95.2
23.2	95.1			23.5	94.9	18.6	95.1	19.5	95.2
25.1	94.9			27.8	94.8	19.2	95.2	20.8	95.2
28.2	94.8			30.7	95.1	20.8	95.2	24.1	95.0
30.9	95.1					23.0	95.1	26.1	95.0
						25.1	94.9	28.0	95.0
						27.3	95.0	29.4	95.1
						28.6	94.9	31.0	95.0
						30.8	95.0		

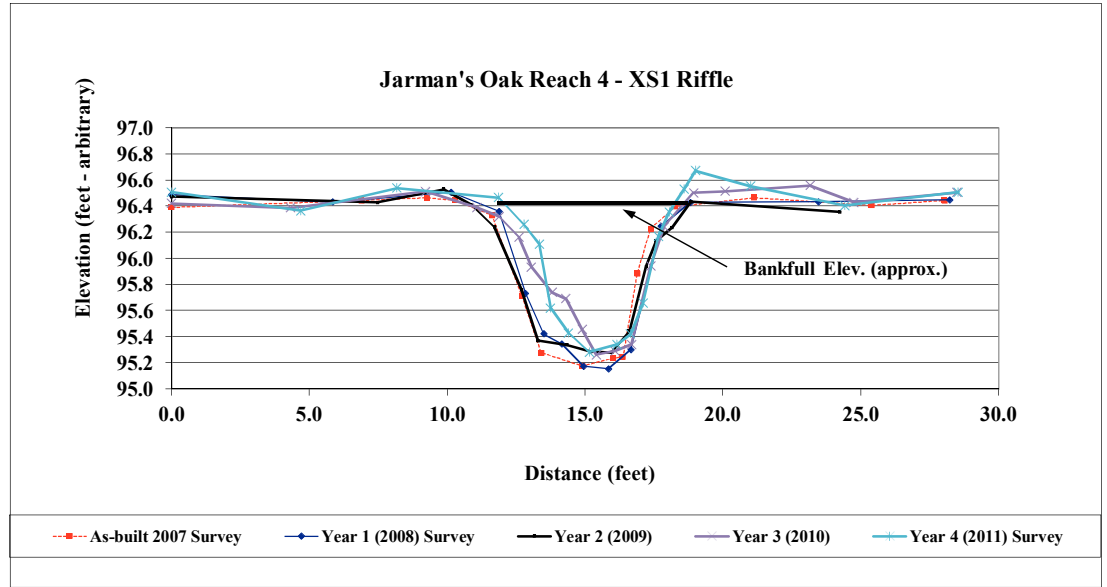
Jarman's Oak Reach 3 - XS4 Pool



	As-built	2008	2009	2010	2011
Area	2.4	2.5	2.4	2.5	2.2
Width	5.4	5.6	6.0	5.4	6.1
Mean Depth	0.5	0.4	0.4	0.5	0.4
Max Depth	0.7	0.7	0.7	0.8	0.6
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R4-XS1  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

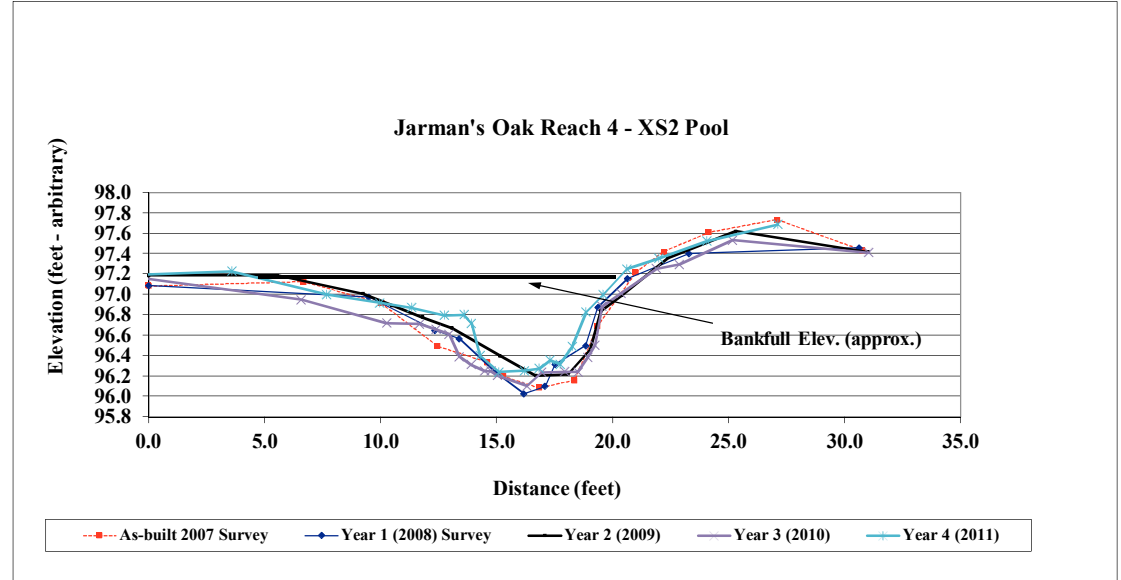
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	96.4	0.0	96.5	0.0	96.5	0.0	96.4	0.0	96.5
6.9	96.4	5.8	96.4	7.5	96.4	4.3	96.4	4.7	96.4
9.3	96.5	10.1	96.5	9.9	96.5	9.2	96.5	8.2	96.5
10.3	96.4	11.9	96.4	10.9	96.4	11.1	96.4	11.9	96.5
11.6	96.3	12.8	95.7	11.7	96.2	11.9	96.3	12.8	96.3
12.7	95.7	13.5	95.4	12.7	95.8	12.6	96.2	13.3	96.1
13.4	95.3	14.2	95.3	13.3	95.4	13.0	95.9	13.7	95.6
14.9	95.2	14.9	95.2	14.3	95.3	13.8	95.7	14.4	95.4
16.0	95.2	15.8	95.2	15.2	95.3	14.3	95.7	15.1	95.3
16.4	95.2	16.7	95.3	16.0	95.3	14.9	95.5	16.2	95.3
16.9	95.9	17.8	96.2	16.6	95.4	15.4	95.3	16.6	95.4
17.4	96.2	18.8	96.4	17.2	95.9	16.1	95.3	17.1	95.7
18.3	96.4	23.5	96.4	17.6	96.1	16.7	95.3	17.7	96.2
21.1	96.5	28.2	96.4	18.2	96.2	17.4	95.9	18.0	96.4
25.4	96.4			18.8	96.4	17.9	96.2	18.6	96.5
28.0	96.4			24.2	96.4	18.9	96.5	19.0	96.7
				28.3	96.4	20.1	96.5	21.0	96.6
						23.2	96.6	24.4	96.4
						24.7	96.4	28.5	96.5
						28.5	96.5		



	As-built	2008	2009	2010	2011
Area	5.2	5.0	5.2	4.1	4.1
Width	7.5	6.5	7.8	7.2	6.0
Mean Depth	0.7	0.8	0.7	0.6	0.7
Max Depth	1.2	1.2	1.1	1.1	1.1
W/D Ratio	10.6	8.6	11.6	12.9	8.9

**Project Name** Jarman's Oak  
**Cross Section** R4-XS2  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	97.1	0.0	97.1	0.0	97.2	-1.0	97.2	-1.0	97.2
6.7	97.1	9.5	97.0	5.5	97.2	6.6	96.9	3.6	97.2
10.0	96.9	12.3	96.6	9.2	97.0	10.2	96.7	7.7	97.0
12.4	96.5	13.4	96.6	10.5	96.9	11.7	96.7	10.0	96.9
14.6	96.3	15.0	96.2	11.8	96.8	12.4	96.7	11.3	96.9
15.3	96.2	16.2	96.0	13.1	96.7	12.9	96.6	12.7	96.8
16.8	96.1	17.1	96.1	15.1	96.4	13.4	96.4	13.6	96.8
18.3	96.2	17.5	96.3	16.7	96.2	13.9	96.3	13.9	96.7
19.3	96.7	18.8	96.5	18.1	96.2	14.5	96.2	14.3	96.4
21.0	97.2	19.3	96.9	19.0	96.5	14.8	96.2	15.1	96.2
22.2	97.4	20.6	97.2	19.5	96.8	15.0	96.2	16.2	96.3
24.1	97.6	23.3	97.4	20.4	97.0	16.3	96.1	16.8	96.3
27.1	97.7	30.6	97.5	22.4	97.4	16.9	96.2	17.3	96.4
30.7	97.4			25.3	97.6	17.9	96.2	17.7	96.3
				31.0	97.4	18.5	96.2	18.3	96.5
						18.9	96.4	18.8	96.8
						19.2	96.5	19.6	97.0
						19.5	96.9	20.6	97.3
						20.4	97.0	22.0	97.4
						21.9	97.3	24.0	97.5
						22.9	97.3	27.1	97.7
						25.2	97.5	30.6	97.4
						31.0	97.4		

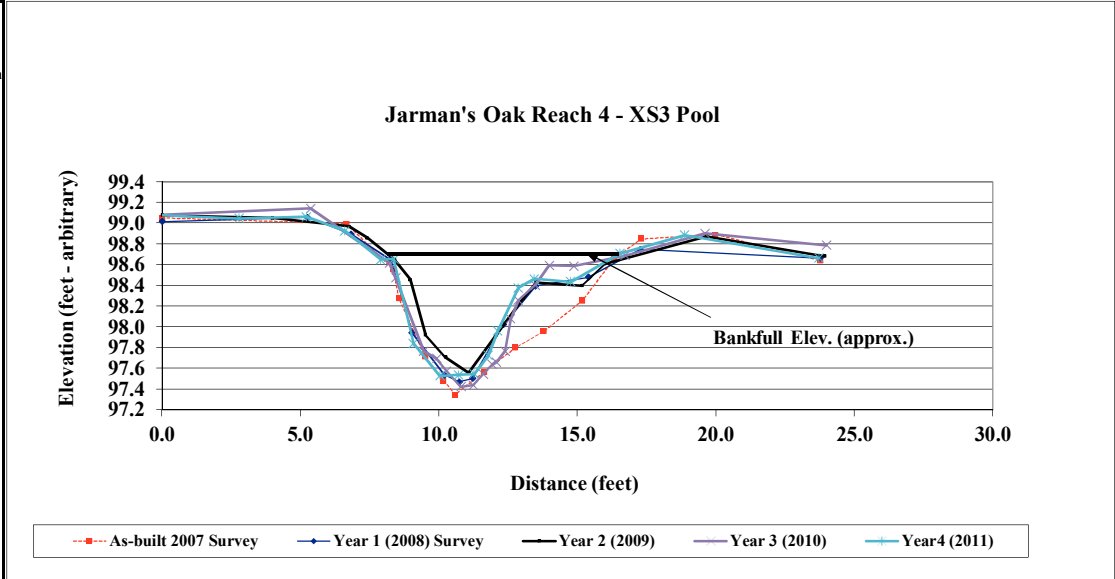


	As-built	2008	2009	2010	2011
Area	7.5	4.8	7.1	6.3	6.4
Width	13.9	10.3	15.7	15.4	15.9
Mean Depth	0.5	0.5	0.4	0.4	0.4
Max Depth	1.0	0.9	1.0	0.9	0.9
W/D Ratio	N/A	N/A	N/A	N/A	N/A



**Project Name** Jarman's Oak  
**Cross Section** R4-XS3  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	99.0	0.0	99.0	0.0	99.1	-0.5	99.1	-0.5	99.1
6.7	99.0	5.2	99.1	4.0	99.0	5.4	99.1	2.8	99.0
8.3	98.6	6.8	98.9	6.8	99.0	8.2	98.6	5.2	99.1
8.5	98.3	8.3	98.6	7.4	98.9	8.4	98.5	6.6	98.9
9.5	97.7	9.0	97.9	8.4	98.6	9.4	97.8	7.9	98.7
10.2	97.5	10.2	97.5	8.9	98.5	9.9	97.7	8.4	98.7
10.6	97.3	10.7	97.5	9.5	97.9	10.3	97.6	9.1	97.8
11.6	97.6	11.2	97.5	10.2	97.7	10.8	97.4	10.0	97.5
12.7	97.8	12.3	98.0	11.1	97.6	11.2	97.4	10.7	97.5
13.8	98.0	13.5	98.4	12.1	97.9	11.6	97.5	11.3	97.5
15.2	98.3	15.4	98.5	13.0	98.3	11.9	97.6	11.8	97.7
16.3	98.7	17.3	98.7	13.5	98.4	12.1	97.7	12.1	98.0
17.3	98.8	23.8	98.7	15.2	98.4	12.4	97.8	12.9	98.4
20.0	98.9			16.0	98.6	12.6	98.1	13.4	98.5
23.8	98.6			19.7	98.9	12.9	98.3	14.8	98.4
				23.9	98.7	13.5	98.4	16.5	98.7
						14.0	98.6	18.9	98.9
						14.9	98.6	23.7	98.7
						16.7	98.7		
						19.6	98.9		
						24.0	98.8		

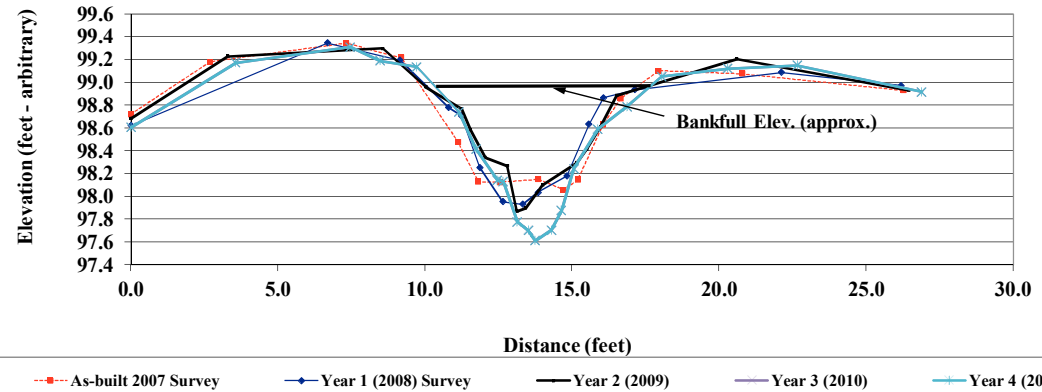


	As-built	2008	2009	2010	2011
Area	7.8	5.3	5.3	4.8	4.4
Width	10.1	9.5	10.9	9.1	8.4
Mean Depth	0.8	0.6	0.5	0.5	0.5
Max Depth	1.5	1.3	1.2	1.3	1.1
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R4-XS4  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	98.7	0.0	98.6	0.0	98.7	0.0	98.6
2.7	99.2	6.7	99.3	3.3	99.2	3.6	99.2
7.3	99.3	9.2	99.2	8.6	99.3	7.5	99.3
9.2	99.2	10.8	98.8	10.0	99.0	8.5	99.2
11.1	98.5	11.2	98.7	11.2	98.8	9.7	99.1
11.8	98.1	11.9	98.3	11.6	98.6	11.2	98.7
12.5	98.1	12.6	98.0	12.1	98.3	11.7	98.4
13.8	98.2	13.3	97.9	12.8	98.3	12.5	98.1
14.7	98.1	13.8	98.0	13.1	97.9	12.7	98.1
15.2	98.1	14.8	98.2	13.4	97.9	13.1	97.8
16.1	98.6	15.6	98.6	14.0	98.1	13.5	97.7
16.6	98.9	16.1	98.9	15.2	98.3	13.7	97.6
17.9	99.1	17.1	98.9	15.5	98.4	14.3	97.7
20.8	99.1	22.1	99.1	16.0	98.6	14.6	97.9
26.3	98.9	26.2	99.0	16.5	98.9	15.1	98.2
				20.6	99.2	15.9	98.6
				26.5	98.9	16.9	98.8
						18.1	99.1
						20.3	99.1
						22.7	99.1
						26.9	98.9

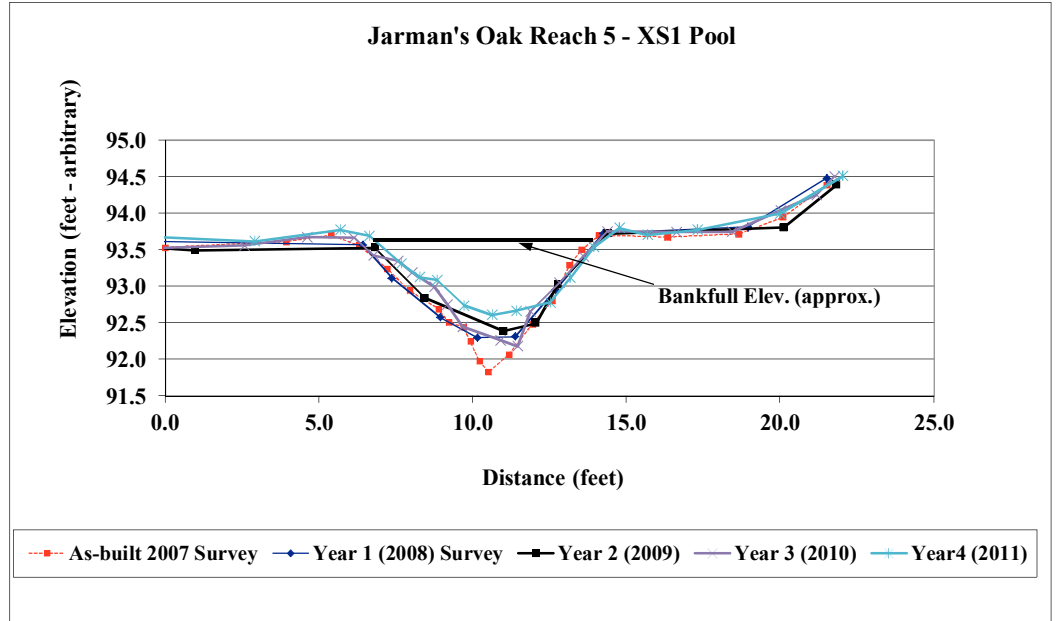
Jarman's Oak Reach 4 - XS4 Riffle



	As-built	2008	2009	2010	2011
Area	5.3	3.1	3.1	3.3	3.5
Width	8.4	5.6	6.4	5.5	6.1
Mean Depth	0.6	0.6	0.5	0.6	0.6
Max Depth	1.0	0.9	1.0	1.2	1.2
W/D Ratio	13.3	10.0	12.1	9.1	10.5

**Project Name** Jarman's Oak  
**Cross Section** R5-XS1  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

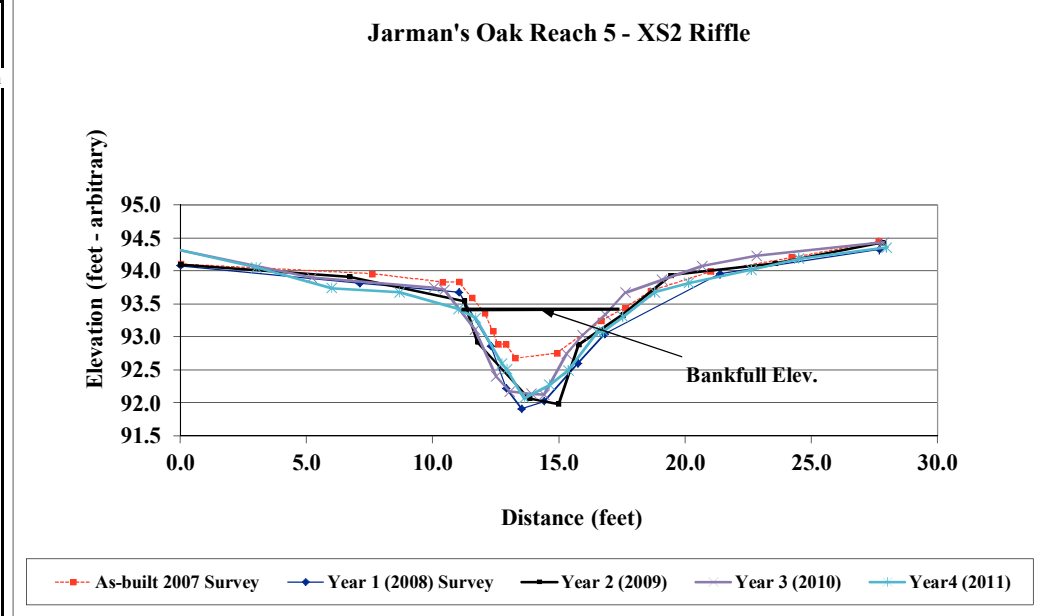
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	93.5	-5.3	93.7	-5.5	93.7	-5.0	93.7	-5.0	93.7
3.9	93.6	6.4	93.6	1.0	93.5	-0.8	93.5	-0.7	93.7
5.4	93.7	7.4	93.1	6.8	93.5	2.6	93.6	2.9	93.6
6.3	93.6	8.9	92.6	8.4	92.8	4.6	93.7	5.7	93.8
7.2	93.2	10.1	92.3	11.0	92.4	6.1	93.7	6.6	93.7
7.9	92.9	11.4	92.3	12.1	92.5	6.8	93.4	7.7	93.3
8.9	92.7	12.7	93.0	12.8	93.0	7.6	93.4	8.3	93.1
9.2	92.5	14.2	93.7	14.4	93.7	8.0	93.2	8.8	93.1
9.7	92.4	19.0	93.8	20.1	93.8	8.8	93.0	9.7	92.7
9.9	92.3	21.5	94.5	21.8	94.4	9.2	92.8	10.6	92.6
10.2	92.0					9.7	92.4	11.4	92.7
10.5	91.8					10.9	92.3	12.5	92.8
11.2	92.1					11.5	92.2	13.2	93.1
11.9	92.5					11.9	92.7	13.9	93.5
12.6	92.8					12.8	93.1	14.8	93.8
13.2	93.3					13.6	93.4	15.7	93.7
13.5	93.5					14.4	93.8	17.3	93.8
14.1	93.7					16.6	93.7	20.0	94.0
16.3	93.7					18.4	93.8	22.0	94.5
18.6	93.7					20.0	94.0		
20.1	94.0					21.2	94.3		
21.5	94.4					21.8	94.5		



	As-built	2008	2009	2010	2011
Area	7.3	5.9	4.9	5.8	5.2
Width	8.7	7.5	7.1	8.0	7.9
Mean Depth	0.8	0.8	0.7	0.7	0.7
Max Depth	1.9	1.3	1.1	1.5	1.1
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R5-XS2  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

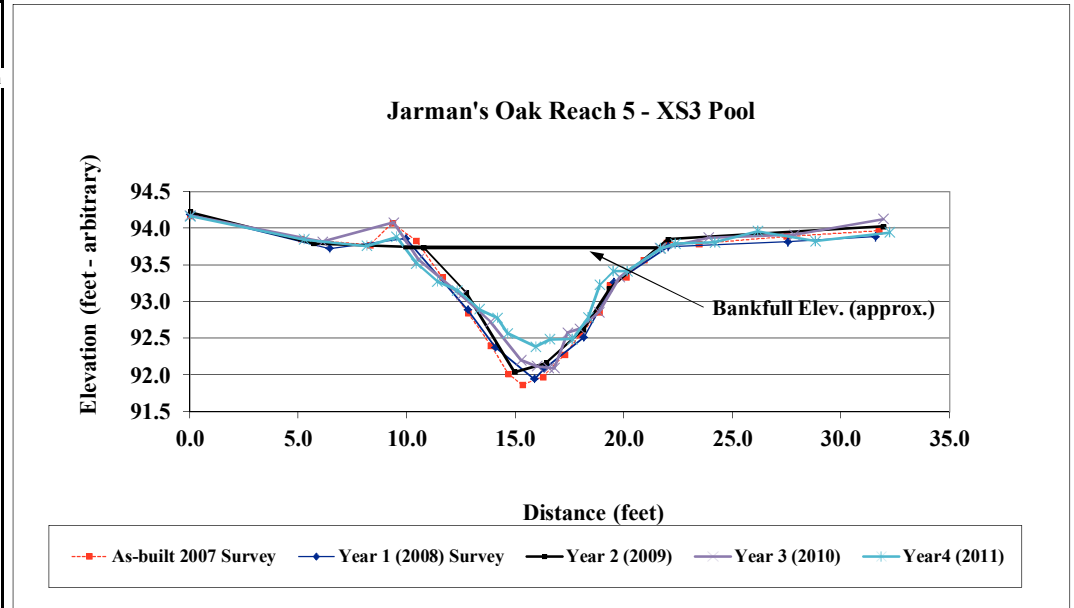
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	94.1	0.0	94.1	0.0	94.1	0.0	94.3	0.0	94.3
7.6	94.0	7.1	93.8	6.7	93.9	5.2	93.9	3.0	94.1
10.4	93.8	11.0	93.7	11.2	93.5	10.1	93.8	6.0	93.7
11.0	93.8	12.3	92.9	11.8	92.9	10.5	93.7	8.7	93.7
11.5	93.6	12.9	92.2	13.8	92.1	11.7	93.1	11.0	93.4
12.1	93.4	13.5	91.9	15.0	92.0	12.5	92.4	11.7	93.3
12.4	93.1	14.4	92.0	15.8	92.9	13.0	92.2	12.7	92.6
12.6	92.9	15.8	92.6	17.5	93.3	13.9	92.1	12.9	92.5
12.9	92.9	16.8	93.1	19.4	93.9	14.4	92.1	13.6	92.1
13.3	92.7	21.4	94.0	23.6	94.1	15.3	92.7	14.6	92.3
14.9	92.8	27.7	94.3	27.8	94.4	15.9	93.0	15.4	92.5
16.7	93.2					16.8	93.3	16.5	93.1
17.6	93.4					17.6	93.7	16.8	93.1
18.6	93.7					19.1	93.9	17.5	93.3
21.0	94.0					20.7	94.1	18.8	93.7
24.2	94.2					22.8	94.2	20.1	93.8
27.6	94.4					27.8	94.4	22.6	94.0
								24.5	94.2
								28.0	94.4



	As-built	2008	2009	2010	2011
<b>Area</b>	5.4	7.4	5.7	6.6	4.6
<b>Width</b>	8.7	8.9	6.9	8.1	6.9
<b>Mean Depth</b>	0.6	0.8	0.8	0.8	0.7
<b>Max Depth</b>	1.2	1.8	1.6	1.6	1.4
<b>W/D Ratio</b>	14.1	10.7	8.4	9.9	10.6

**Project Name** Jarman's Oak  
**Cross Section** R5-XS3  
**Feature** Pool  
**Date** 4/22/11  
**Crew** Perkinson, Dean

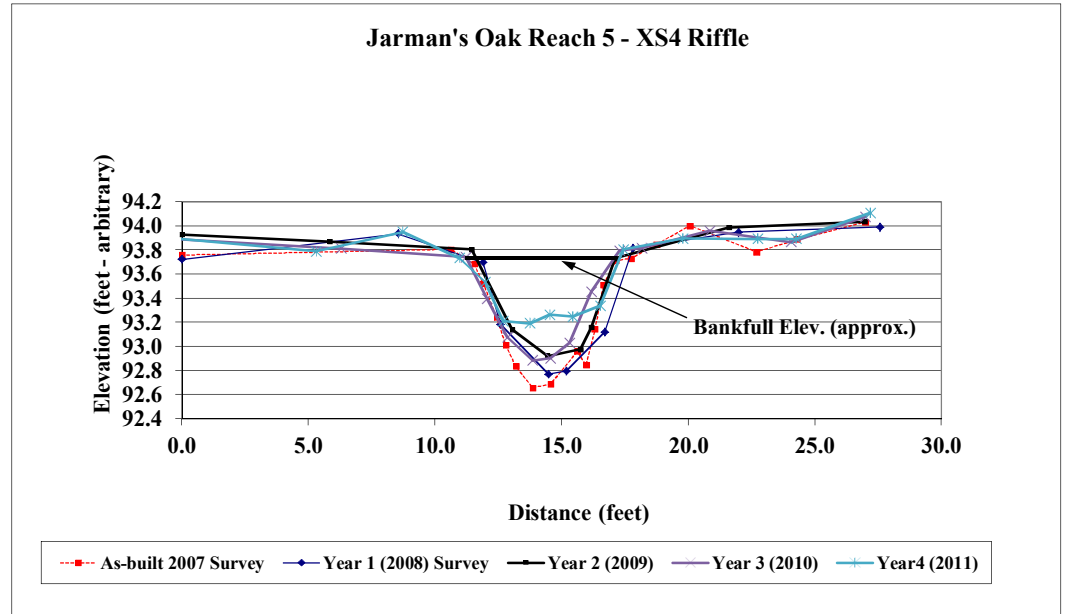
As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	94.2	0.0	94.2	0.0	94.2	0.0	94.2	0.0	94.2
5.1	93.9	6.4	93.7	5.7	93.8	6.1	93.8	5.2	93.8
8.3	93.8	9.9	93.9	10.8	93.7	9.4	94.1	8.1	93.8
9.3	94.1	12.8	92.9	12.7	93.1	10.5	93.6	9.5	93.9
10.4	93.8	14.1	92.4	14.9	92.0	12.5	93.1	10.4	93.5
11.6	93.3	15.9	91.9	16.4	92.2	13.8	92.7	11.4	93.3
12.8	92.8	16.3	92.1	18.1	92.6	15.3	92.2	12.3	93.2
13.8	92.4	18.2	92.5	19.3	93.2	16.0	92.1	13.3	92.9
14.7	92.0	19.5	93.3	22.0	93.9	16.5	92.1	14.1	92.8
15.3	91.9	22.0	93.8	31.9	94.0	16.8	92.1	14.6	92.6
16.3	92.0	27.5	93.8			17.4	92.6	15.9	92.4
17.2	92.3	31.6	93.9			18.0	92.6	16.6	92.5
18.0	92.6					18.8	92.9	17.6	92.5
18.8	92.9					19.8	93.3	18.4	92.8
19.3	93.2					21.6	93.7	18.9	93.2
20.1	93.3					23.9	93.9	19.5	93.4
20.9	93.6					27.9	93.9	20.1	93.4
22.0	93.8					31.9	94.1	21.7	93.7
23.5	93.8							22.4	93.8
27.5	93.9							24.2	93.8
31.7	94.0							26.2	94.0
								28.8	93.8
								32.2	93.9



	As-built	2008	2009	2010	2011
Area	11.5	10.6	9.4	9.4	8.6
Width	11.5	11.8	10.7	11.4	11.3
Mean Depth	1.0	0.9	0.9	0.8	0.8
Max Depth	1.9	1.8	1.7	1.6	1.4
W/D Ratio	N/A	N/A	N/A	N/A	N/A

**Project Name** Jarman's Oak  
**Cross Section** R5-XS4  
**Feature** Riffle  
**Date** 4/22/11  
**Crew** Perkinson, Dean

As-built 2007 Survey		2008 2008 Survey		2009 2009 Survey		2010 2010 Survey		2011 2011 Survey	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.0	93.8	0.0	93.7	0.0	93.9	-0.3	93.9	-0.3	93.9
10.6	93.8	8.5	93.9	5.8	93.9	6.3	93.8	5.3	93.8
11.5	93.7	11.9	93.7	11.4	93.8	11.2	93.7	8.7	94.0
11.9	93.5	12.6	93.2	13.0	93.1	12.0	93.4	11.0	93.7
12.4	93.2	14.5	92.8	14.4	92.9	12.9	93.1	12.0	93.5
12.8	93.0	15.2	92.8	15.7	93.0	13.8	92.9	12.7	93.2
13.2	92.8	16.7	93.1	16.2	93.2	14.6	92.9	13.7	93.2
13.8	92.7	17.8	93.8	17.1	93.7	15.3	93.0	14.5	93.3
14.5	92.7	22.0	94.0	21.6	94.0	16.2	93.5	15.4	93.2
15.6	93.0	27.6	94.0	27.0	94.0	17.3	93.8	16.5	93.3
16.0	92.8					18.2	93.8	17.4	93.8
16.3	93.1					20.8	94.0	19.8	93.9
16.7	93.5					24.1	93.9	22.7	93.9
17.1	93.7					27.0	94.1	24.2	93.9
17.7	93.7							27.2	94.1
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	2011
Area	3.7	3.6	3.0	3.0	3.0
Width	5.6	5.8	5.5	5.9	7.7
Mean Depth	0.7	0.6	0.5	0.5	0.4
Max Depth	1.1	0.9	0.8	0.9	0.6
W/D Ratio	8.3	9.2	10.1	11.3	20.0

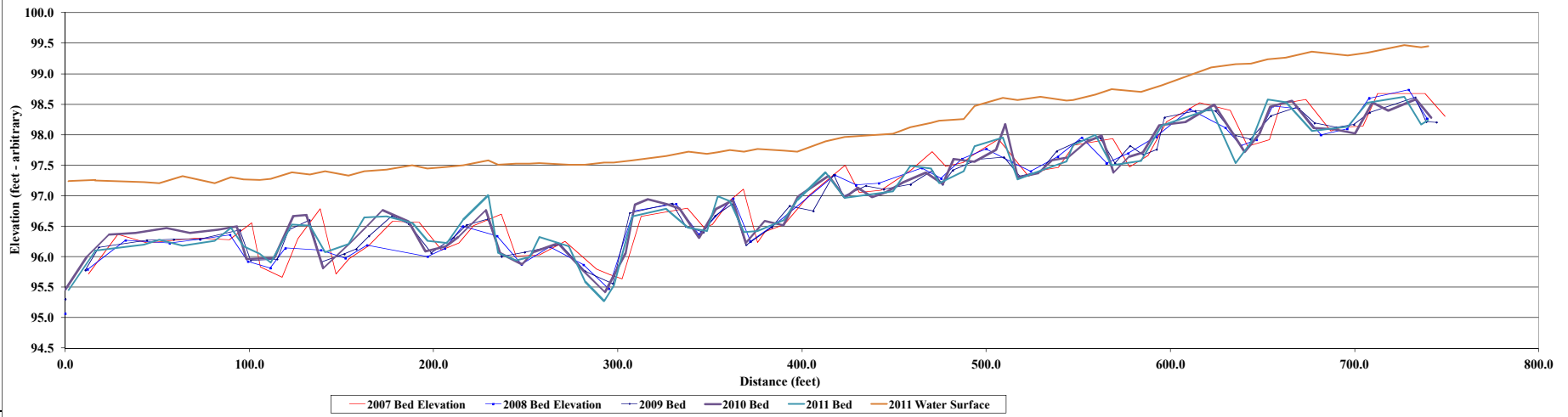
Project Name Jarman's Oak  
 Reach 1  
 Feature Profile  
 Date 11/5/11  
 Crew Lewis, Faquin

As-built 2007 Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey		
Station	Bed Elevation	Water Elevation	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	0.0	95.1	***	0.0	95.3	96.8	0.0	95.5	97.3	2.0	95.5	97.2
12.7	95.7	96.8	12.1	95.8	***	11.0	95.8	96.8	12.0	96.0	97.4	16.2	96.1	97.3
28.6	96.4	96.8	32.8	96.3	***	18.3	96.2	96.8	23.7	96.4	97.4	42.8	96.2	97.2
44.7	96.2	96.8	56.6	96.2	***	44.4	96.3	96.8	38.1	96.4	97.4	51.2	96.3	97.2
71.3	96.3	96.8	73.2	96.3	***	58.9	96.3	96.8	55.0	96.5	97.4	63.8	96.2	97.3
89.2	96.3	96.8	89.5	96.4	***	73.0	96.3	96.8	67.7	96.4	97.3	81.2	96.3	97.2
101.2	96.6	96.8	99.3	95.9	***	94.8	96.4	96.8	83.2	96.4	97.4	90.0	96.5	97.3
105.9	95.8	96.9	111.4	95.8	***	100.7	95.9	96.8	93.3	96.5	97.4	96.9	96.2	97.3
117.7	95.7	96.9	119.5	96.1	***	115.0	96.0	96.8	98.5	96.0	97.4	105.7	96.0	97.3
126.4	96.3	96.9	138.8	96.1	***	121.2	96.4	96.9	113.4	96.0	97.3	111.6	95.9	97.3
138.3	96.8	97.0	152.2	96.0	***	132.5	96.6	97.0	123.9	96.7	97.4	123.0	96.5	97.4
146.9	95.7	97.0	163.8	96.2	***	139.0	95.9	97.0	131.0	96.7	97.3	132.7	96.5	97.3
154.2	96.0	97.0	196.6	96.0	***	151.5	96.0	97.0	139.9	95.8	97.4	141.1	96.1	97.4
164.6	96.2	97.0	206.2	96.1	***	158.0	96.1	97.0	154.9	96.2	97.4	153.8	96.2	97.3
177.7	96.6	97.0	215.9	96.5	***	164.9	96.3	97.0	163.7	96.5	97.4	162.4	96.6	97.4
192.1	96.6	97.1	234.3	96.3	***	177.5	96.7	97.1	172.3	96.8	97.4	174.4	96.7	97.4
204.3	96.1	97.1	247.8	95.9	***	186.6	96.5	97.1	186.6	96.6	97.5	188.3	96.6	97.5
213.8	96.2	97.1	263.1	96.2	***	198.8	96.1	97.1	195.5	96.1	97.5	196.5	96.3	97.4
221.6	96.5	97.1	281.4	95.9	***	210.8	96.3	97.1	206.6	96.2	97.5	207.1	96.2	97.5
236.8	96.7	97.2	295.1	95.5	***	217.9	96.5	97.1	213.6	96.3	97.5	216.1	96.6	97.5
244.9	96.0	97.2	308.6	96.8	***	229.3	96.6	97.1	217.9	96.5	97.5	229.6	97.0	97.6
257.5	96.0	97.2	331.7	96.9	***	236.9	96.0	97.2	228.4	96.8	97.5	235.1	96.1	97.5
271.2	96.3	97.2	344.1	96.4	***	249.5	96.1	97.1	236.1	96.1	97.5	244.9	95.9	97.5
288.6	95.8	97.2	362.7	97.0	***	269.0	96.2	97.1	248.0	95.9	97.5	252.0	96.0	97.5
295.5	95.7	97.2	371.9	96.3	***	282.2	95.8	97.1	254.2	96.1	97.5	257.6	96.3	97.5
302.4	95.6	97.2	386.9	96.6	***	297.3	95.6	97.1	267.7	96.2	97.5	273.3	96.2	97.5
312.6	96.7	97.2	417.7	97.3	***	306.5	96.7	97.1	281.5	95.8	97.5	282.2	95.6	97.5

	As-built	2008	2009	2010	2011
Avg. Water Surface Slope	0.0051	NA***	0.0032	0.0027	0.0033
Avg. Riffle Slope	0.0093	NA***	0.0065	0.0056	0.0051
Avg. Pool Slope	0.0006	NA***	0.0008	0.0010	0.0009
Avg. Run Slope	0.0021	NA***	0.0017	0.0034	0.0077
Avg. Glide Slope	0.0013	NA***	0.0026	0.0020	0.0032

\*\*\* Insufficient water in stream to determine

Jarman's Oak Profile - Reach 1



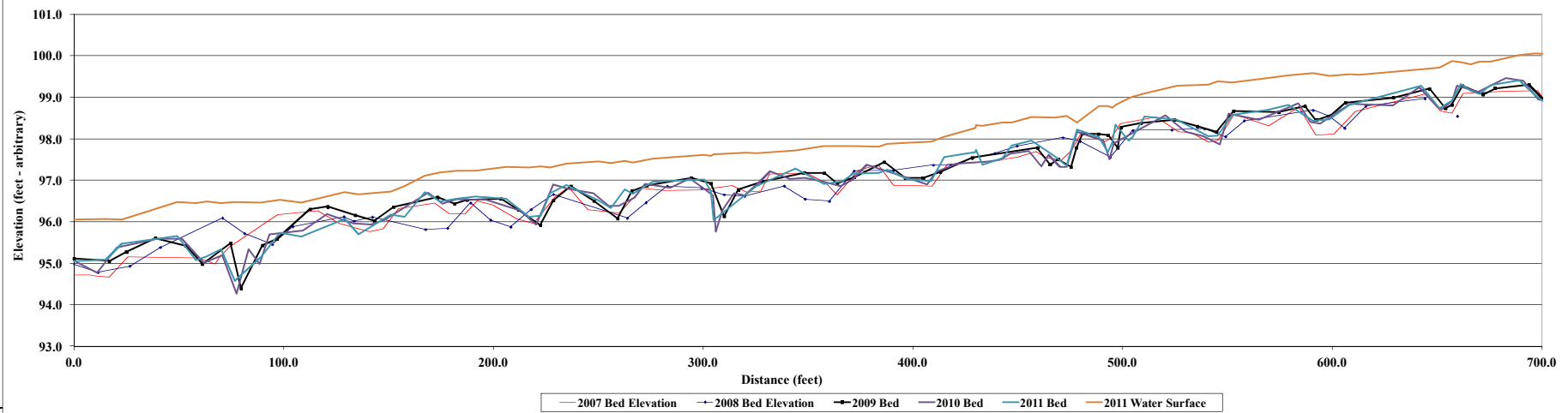
Project Name Jarman's Oak  
 Reach 2  
 Feature Profile  
 Date 11/5/11  
 Crew Perkinson, Dean

As-built 2007 Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey		
Station	Bed Elevation	Water Elevation	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	659.5	98.5	***	0.0	95.1	95.6	749.0	98.7	99.9	0.0	95.0	96.0
8.1	94.7	95.4	644.1	99.0	***	16.7	95.0	95.7	742.8	99.2	99.9	15.1	95.1	96.1
16.7	94.7	95.5	615.8	98.8	***	24.9	95.3	95.6	731.6	98.9	100.0	22.8	95.5	96.1
25.6	95.1	95.5	605.8	98.3	***	38.8	95.6	95.8	720.0	99.4	100.0	49.3	95.7	96.5
59.5	95.1	95.8	598.4	98.6	***	53.3	95.4	95.9	708.1	99.1	99.9	58.2	95.1	96.4
67.3	95.0	95.7	590.8	98.7	***	61.1	95.0	95.9	703.4	98.9	99.9	63.3	95.2	96.5
69.1	95.1	95.8	558.0	98.4	***	74.5	95.5	95.9	698.1	98.9	99.9	70.3	95.3	96.4
74.2	95.4	95.8	549.0	98.1	***	79.6	94.4	95.8	691.0	99.4	99.8	76.7	94.6	96.5
97.1	96.2	96.4	539.0	98.2	***	89.8	95.4	95.9	682.6	99.5	99.8	89.1	95.1	96.5
116.1	96.3	96.6	523.3	98.2	***	96.7	95.6	96.0	669.6	99.1	99.8	98.0	95.7	96.5
126.5	96.0	96.6	504.8	98.2	***	112.5	96.3	96.7	659.4	99.3	99.7	108.5	95.6	96.5
138.8	95.8	96.7	494.1	97.6	***	121.0	96.4	96.7	657.0	98.9	99.6	129.2	96.1	96.7
141.1	95.8	96.7	479.7	97.9	***	134.1	96.2	96.7	652.2	98.7	99.7	135.7	95.7	96.7
147.4	95.8	96.7	471.4	98.0	***	143.3	96.0	96.8	649.9	98.8	99.6	150.9	96.2	96.7
154.7	96.3	96.7	449.6	97.8	***	152.4	96.4	96.7	641.4	99.2	99.6	157.6	96.1	96.9
172.0	96.4	96.8	439.0	97.7	***	173.3	96.6	96.9	628.8	98.8	99.4	167.2	96.7	97.1
178.7	96.2	96.8	428.1	97.5	***	181.3	96.4	96.9	608.7	98.8	99.2	174.5	96.5	97.2
186.4	96.2	96.8	418.0	97.4	***	187.3	96.5	96.9	600.3	98.6	99.2	182.3	96.6	97.2
192.1	96.5	96.8	409.7	97.4	***	203.5	96.6	96.9	594.1	98.4	99.2	191.4	96.6	97.2
199.4	96.4	96.9	390.6	97.2	***	211.7	96.3	97.0	589.5	98.4	99.2	205.9	96.5	97.3
211.1	96.1	96.9	371.9	97.2	***	222.2	95.9	97.0	583.6	98.9	99.2	217.0	96.1	97.3
219.1	96.0	96.9	360.1	96.5	***	228.5	96.5	97.0	564.8	98.5	99.1	222.6	96.1	97.3
229.3	96.6	96.9	348.6	96.5	***	236.9	96.9	97.2	550.5	98.6	99.0	227.0	96.7	97.3
235.8	96.8	97.2	338.5	96.9	***	247.8	96.5	97.2	546.2	97.9	99.0	234.8	96.9	97.4
245.1	96.3	97.2	319.8	96.6	***	259.2	96.1	97.2	538.5	98.1	99.0	250.0	96.5	97.5
255.0	96.2	97.2	309.9	96.7	***	265.9	96.7	97.2	530.1	98.2	98.9	256.0	96.3	97.4
259.9	96.2	97.2	299.2	96.8	***	273.1	96.9	97.2	520.3	98.6	99.0	262.5	96.8	97.5
270.8	96.8	97.2	282.8	96.9	***	294.4	97.1	97.4	509.7	98.3	98.8	266.6	96.7	97.4
281.9	96.8	97.3	272.6	96.5	***	303.7	96.9	97.4	495.7	97.9	98.6	275.8	97.0	97.5
298.5	96.8	97.4	263.8	96.1	***	309.9	96.1	97.4	493.7	97.5	98.6	300.4	97.0	97.6
313.8	96.9	97.4	228.5	96.7	***	316.8	96.8	97.4	490.8	98.0	98.6	303.6	96.7	97.6
320.7	96.7	97.4	217.9	96.3	***	328.1	97.0	97.4	478.3	98.2	98.5	304.9	96.0	97.6
327.4	96.7	97.4	208.2	95.9	***	348.0	97.2	97.5	473.2	97.3	98.3	320.5	96.7	97.7
331.7	97.2	97.4	198.6	96.0	***	357.7	97.2	97.5	470.0	97.3	98.3	325.5	96.9	97.7
349.1	97.2	97.5	189.0	96.5	***	363.8	96.9	97.6	464.7	97.6	98.2	344.0	97.3	97.7
358.4	96.9	97.6	178.0	95.8	***	372.0	97.1	97.5	461.1	97.3	98.3	357.5	96.9	97.8
363.8	96.6	97.6	167.5	95.8	***	386.3	97.4	97.7	455.2	97.7	98.3	366.5	97.0	97.8
374.1	97.2	97.6	142.2	96.1	***	396.4	97.1	97.8	446.2	97.6	98.2	371.6	97.2	97.8
383.5	97.4	97.7	133.5	96.0	***	404.9	97.1	97.7	441.6	97.5	98.2	383.6	97.2	97.8

	As-built	2008	2009	2010	2011
Avg. Water Surface Slope	0.0057	***	0.0058	0.0054	0.0054
Avg. Riffle Slope	0.0143	***	0.0089	0.0089	0.0114
Avg. Pool Slope	0.0020	***	0.0025	0.0014	0.0039
Avg. Run Slope	0.0047	***	0.0004	0.0080	0.0052
Avg. Glide Slope	0.0023	***	0.0024	0.0024	0.0044

\*\*\* Insufficient water in stream to determine

Jarman's Oak Profile - Reach 2



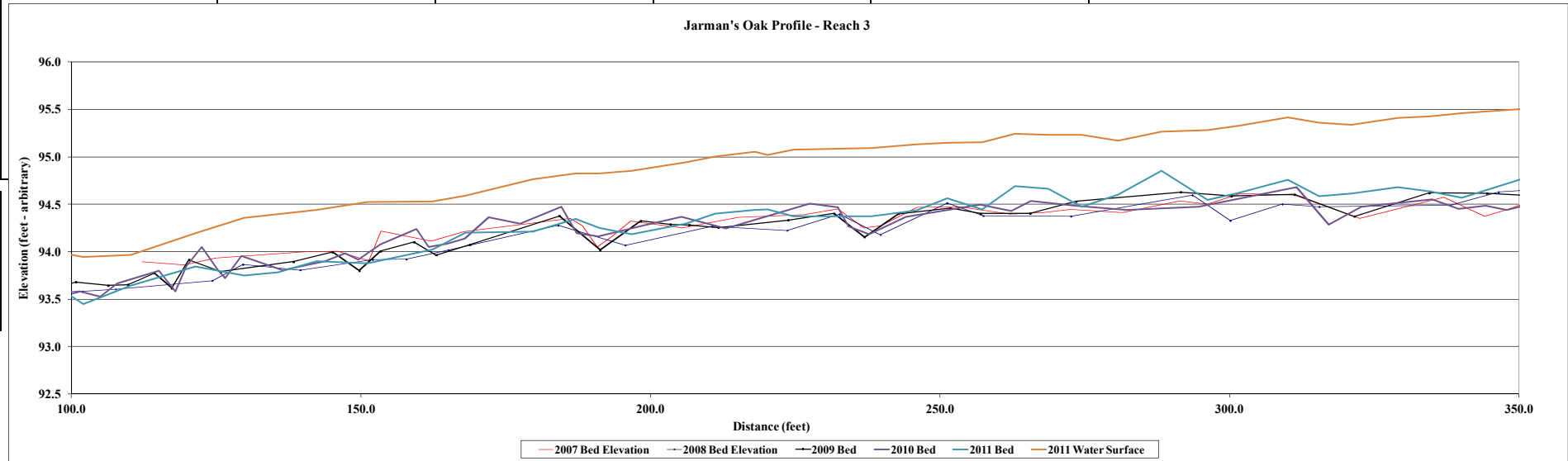


Project Name Jarman's Oak  
 Reach 3  
 Feature Profile  
 Date 11/5/11  
 Crew Perkinson, Dean

As-built 2007 Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
101.9	93.6	94.5	720.9	94.8	***	12.0	92.9	93.3	20.7	93.1	93.6	24.5	93.3	93.7
112.2	93.9	94.5	717.3	94.5	***	17.5	92.8	93.3	29.3	93.3	93.7	44.2	93.3	93.7
119.5	93.9	94.5	693.3	93.4	***	21.5	93.1	93.3	35.8	93.3	93.7	51.4	93.1	93.7
124.9	93.9	94.5	680.1	93.1	***	32.8	93.3	93.5	41.5	93.3	93.7	54.6	93.1	93.7
140.5	94.0	94.5	664.1	93.6	***	41.6	93.3	93.6	47.6	93.1	93.7	63.2	93.1	93.8
146.0	94.0	94.5	657.9	93.9	***	50.9	93.0	93.5	52.7	93.1	93.7	65.9	93.6	93.9
149.4	93.9	94.5	610.9	94.4	***	57.2	93.2	93.5	58.6	93.3	93.7	68.9	93.5	93.8
151.3	93.9	94.5	591.5	94.3	***	61.9	93.3	93.5	65.9	93.4	93.8	77.4	93.2	93.8
153.5	94.2	94.5	587.8	94.5	***	68.4	93.4	93.6	73.6	93.4	93.8	84.0	93.2	93.8
162.1	94.1	94.5	554.1	94.3	***	75.7	93.2	93.7	76.2	93.2	93.8	89.1	93.6	93.9
167.8	94.2	94.5	533.0	94.3	***	81.7	93.2	93.7	80.8	93.4	93.9	97.1	93.6	94.0
186.1	94.3	94.6	524.2	94.3	***	85.4	93.5	93.7	87.4	93.4	93.9	102.0	93.4	93.9
188.2	94.3	94.6	510.4	94.5	***	95.1	93.6	93.8	92.1	93.5	93.9	110.2	93.6	94.0
190.8	94.1	94.6	499.6	94.4	***	100.7	93.7	93.9	101.4	93.6	93.9	121.4	93.8	94.2
193.4	94.2	94.6	469.9	94.4	***	106.3	93.6	93.9	104.9	93.5	94.0	129.8	93.7	94.4
196.5	94.3	94.6	460.3	94.3	***	109.8	93.7	93.9	107.9	93.7	94.0	135.6	93.8	94.4
205.4	94.2	94.6	428.2	94.3	***	114.3	93.8	94.0	115.1	93.8	94.1	142.3	93.9	94.4
215.2	94.4	94.6	419.0	94.4	***	117.3	93.6	94.0	117.9	93.6	94.1	151.0	93.9	94.5
226.5	94.4	94.7	389.6	94.3	***	120.3	93.9	94.0	119.8	93.8	94.2	162.3	94.0	94.5
232.4	94.5	94.7	379.6	94.3	***	125.7	93.8	94.1	122.5	94.1	94.2	168.1	94.2	94.6
236.8	94.3	94.7	369.2	94.4	***	138.3	93.9	94.2	125.2	93.8	94.2	179.7	94.2	94.8
239.7	94.3	94.7	359.2	94.7	***	145.1	94.0	94.2	126.5	93.7	94.2	187.0	94.3	94.8
246.0	94.5	94.7	346.4	94.6	***	149.6	93.8	94.3	129.4	94.0	94.3	191.2	94.3	94.8

	As-built	2008	2009	2010	2011
Avg. Water Surface Slope	0.0015	***	0.0028	0.0037	0.0033
Avg. Riffle Slope	0.0023	***	0.0087	0.0056	0.0069
Avg. Pool Slope	0.0000	***	0.0024	0.0042	0.0048
Avg. Run Slope	0.0045	***	0.0010	0.0112	0.0108
Avg. Glide Slope	0.0037	***	0.0038	0.0052	0.0056

\*\*\* Insufficient water in stream to determine



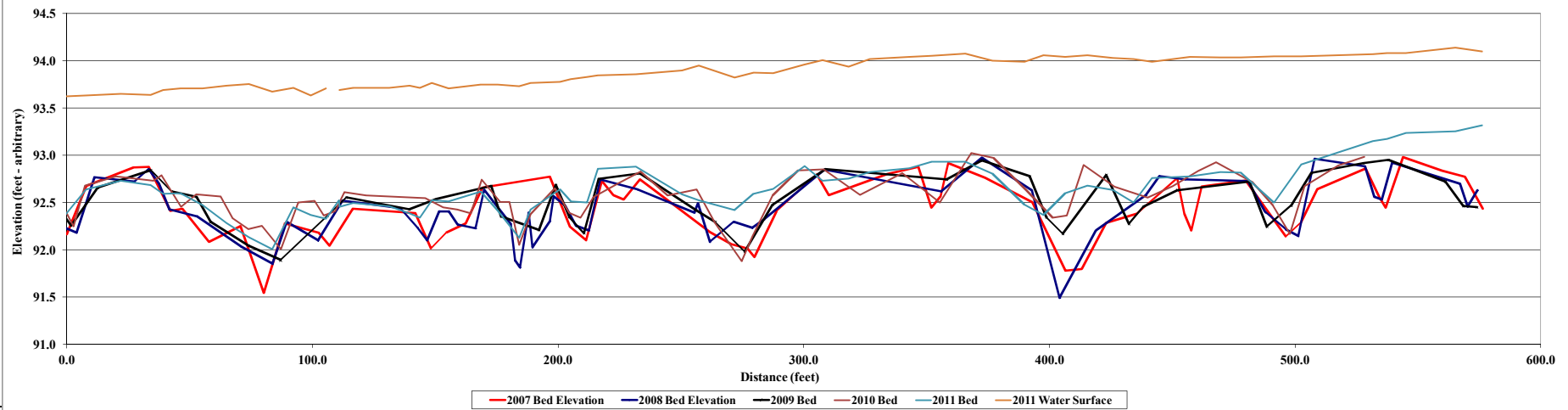


Project Name Jarman's Oak  
 Reach 5  
 Feature Profile  
 Date 11/5/11  
 Crew Perkinson, Dean

As-built 2007 Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	92.2	93.1	-9.2	92.4	93.0	-9.0	92.6	93.3	-45.0	92.6	93.4	-45.0	92.6	93.5
7.9	92.7	93.1	-4.5	92.3	93.0	1.9	92.3	93.3	-30.6	92.7	93.3	-18.8	92.6	93.6
27.2	92.9	93.1	3.9	92.2	93.0	12.5	92.7	93.3	-15.8	92.8	93.4	-8.2	92.5	93.6
33.5	92.9	93.2	11.3	92.8	93.0	34.2	92.8	93.3	-8.5	92.9	93.4	-2.0	92.3	93.6
42.3	92.4	93.2	27.6	92.7	93.0	42.6	92.6	93.4	-1.9	92.5	93.3	7.9	92.6	93.6
47.1	92.4	93.2	33.5	92.9	93.0	52.8	92.6	93.3	2.9	92.2	93.4	22.0	92.7	93.6
57.9	92.1	93.2	37.5	92.7	93.0	58.5	92.3	93.4	7.4	92.7	93.4	34.1	92.7	93.6
70.7	92.3	93.2	41.7	92.4	93.0	74.0	92.0	93.4	20.0	92.8	93.4	39.3	92.6	93.7
80.1	91.5	93.2	53.0	92.4	93.0	87.0	91.9	93.4	35.2	92.7	93.4	46.2	92.6	93.7
88.7	92.3	93.2	71.1	92.0	92.9	106.1	92.4	93.4	38.6	92.8	93.5	55.3	92.5	93.7
102.4	92.2	93.2	83.7	91.9	93.0	113.7	92.6	93.4	46.4	92.5	93.5	65.0	92.3	93.7
107.0	92.0	93.2	89.4	92.3	93.0	139.4	92.4	93.4	52.8	92.6	93.5	74.1	92.1	93.8
110.8	92.2	93.2	102.2	92.1	93.0	150.4	92.5	93.4	62.7	92.6	93.5	83.7	92.0	93.7
116.4	92.4	93.2	112.3	92.5	93.0	172.7	92.7	93.4	67.5	92.3	93.5	92.3	92.5	93.7
141.8	92.4	93.2	135.8	92.4	93.0	176.8	92.4	93.5	74.0	92.2	93.5	99.4	92.4	93.6
148.3	92.0	93.2	142.7	92.2	93.1	192.2	92.2	93.4	79.4	92.3	93.5	105.4	92.3	93.7
154.4	92.2	93.2	146.7	92.1	93.0	199.0	92.7	93.4	87.1	92.0	93.5	110.8	92.5	
162.3	92.3	93.2	151.6	92.4	93.0	204.5	92.4	93.4	94.1	92.5	93.5	111.0	92.5	93.7
169.2	92.7	93.2	155.5	92.4	93.0	210.6	92.2	93.4	100.8	92.5	93.5	116.6	92.5	93.7
196.7	92.8	93.2	159.1	92.3	93.0	216.5	92.8	93.4	104.6	92.4	93.5	131.4	92.5	93.7
204.9	92.2	93.2	166.5	92.2	93.0	233.3	92.8	93.4	109.3	92.4	93.4	139.4	92.4	93.7
211.4	92.1	93.2	169.8	92.6	93.0	256.3	92.4	93.5	113.0	92.6	93.5	143.7	92.3	93.7
217.0	92.7	93.2	180.7	92.2	93.0	262.0	92.2	93.4	131.0	92.6	93.5	148.6	92.5	93.8

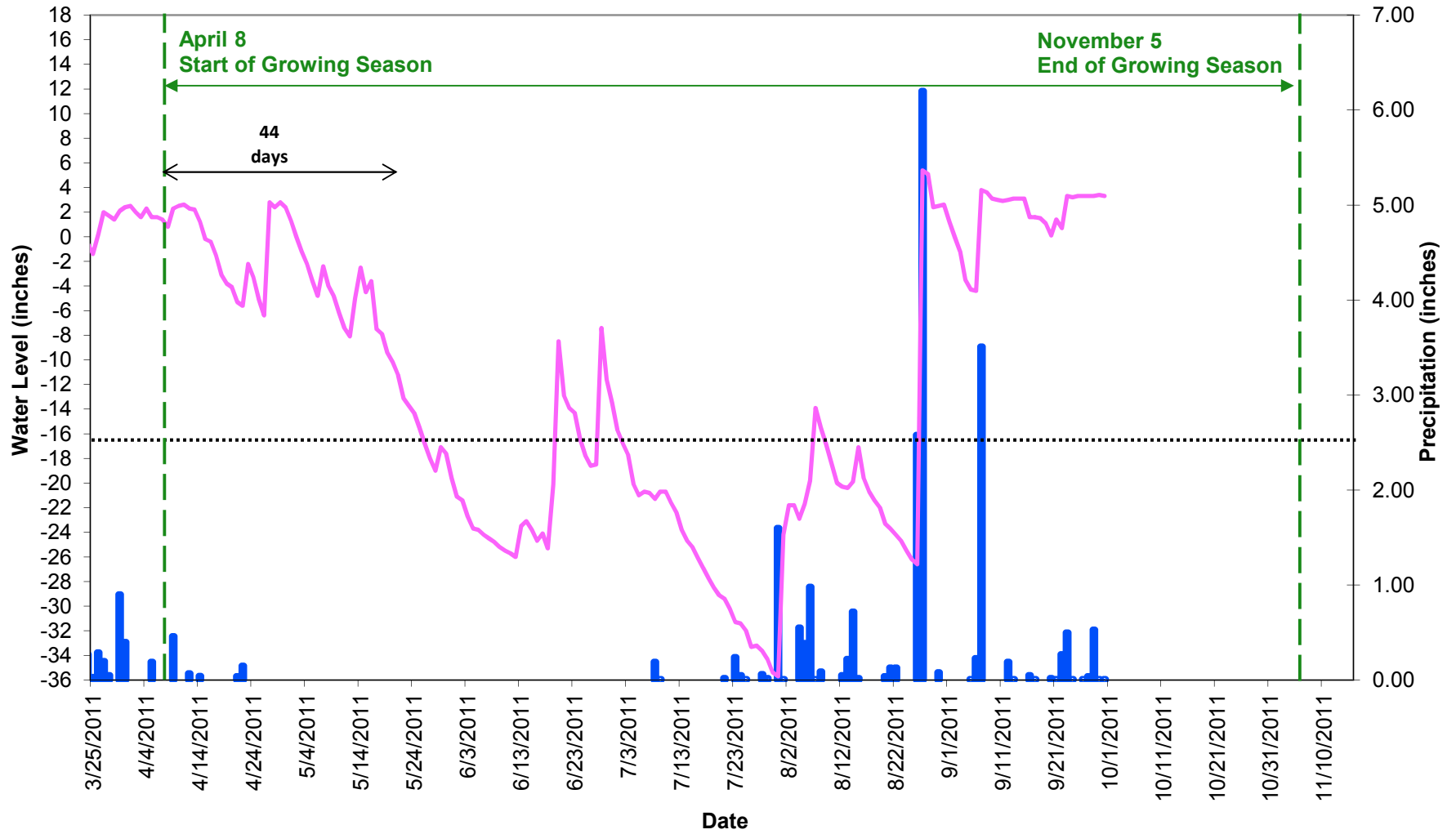
	As-built	2008	2009	2010	2011
Avg. Water Surface Slope	0.0004	0.0006	0.0008	0.0007	0.0008
Avg. Riffle Slope	0.0013	0.0011	0.0005	0.0008	0.0013
Avg. Pool Slope	0.0014	0.0013	0.0006	0.0000	0.0017
Avg. Run Slope	0.0013	0.0030	0.0010	0.0013	0.0033
Avg. Glide Slope	0.0004	0.0039	0.0019	0.0000	0.0042

Jarman's Oak Profile - Reach 5

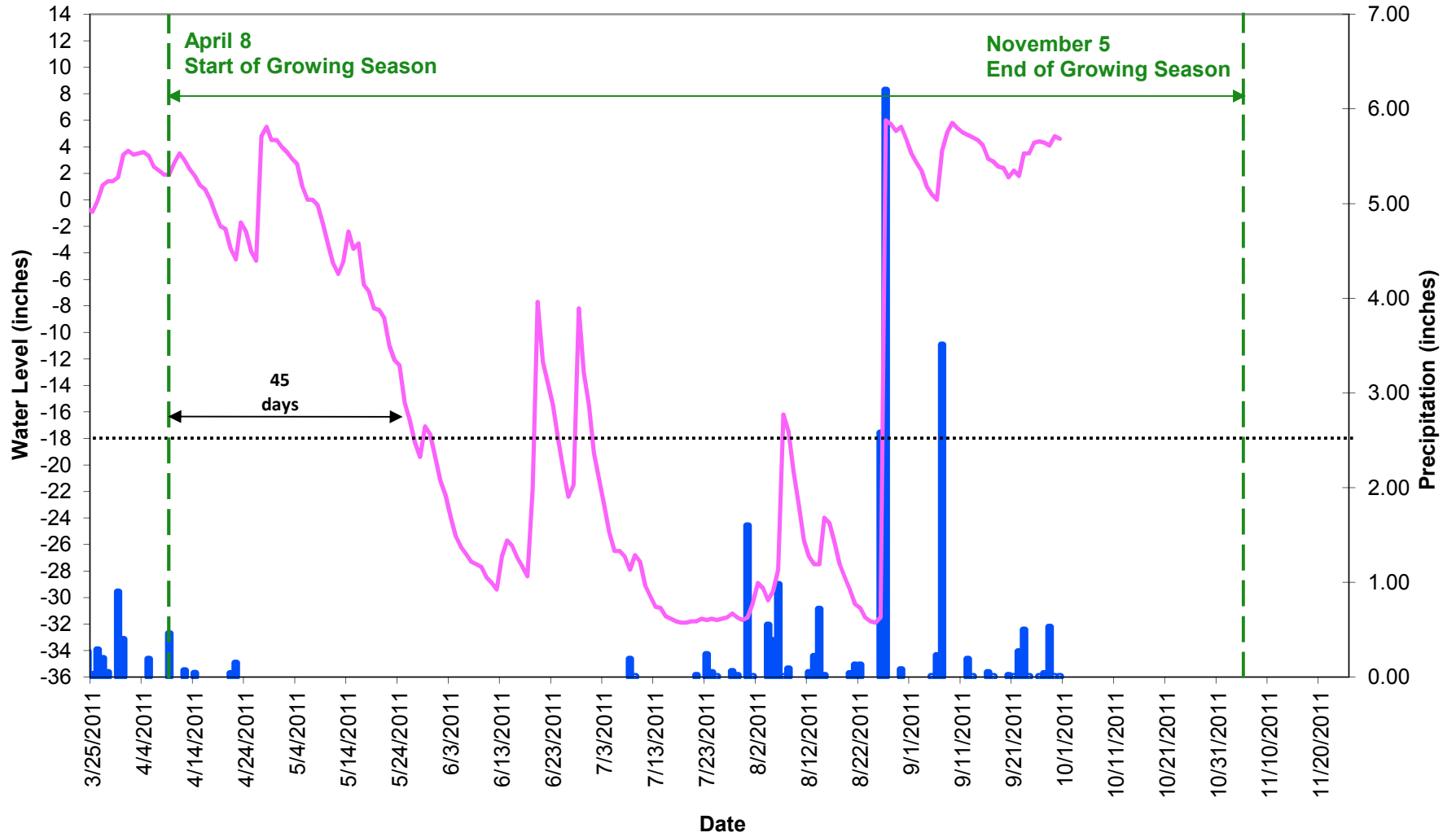


**APPENDIX C**  
**HYDROLOGY DATA**  
**2011 Groundwater Gauge Graphs**

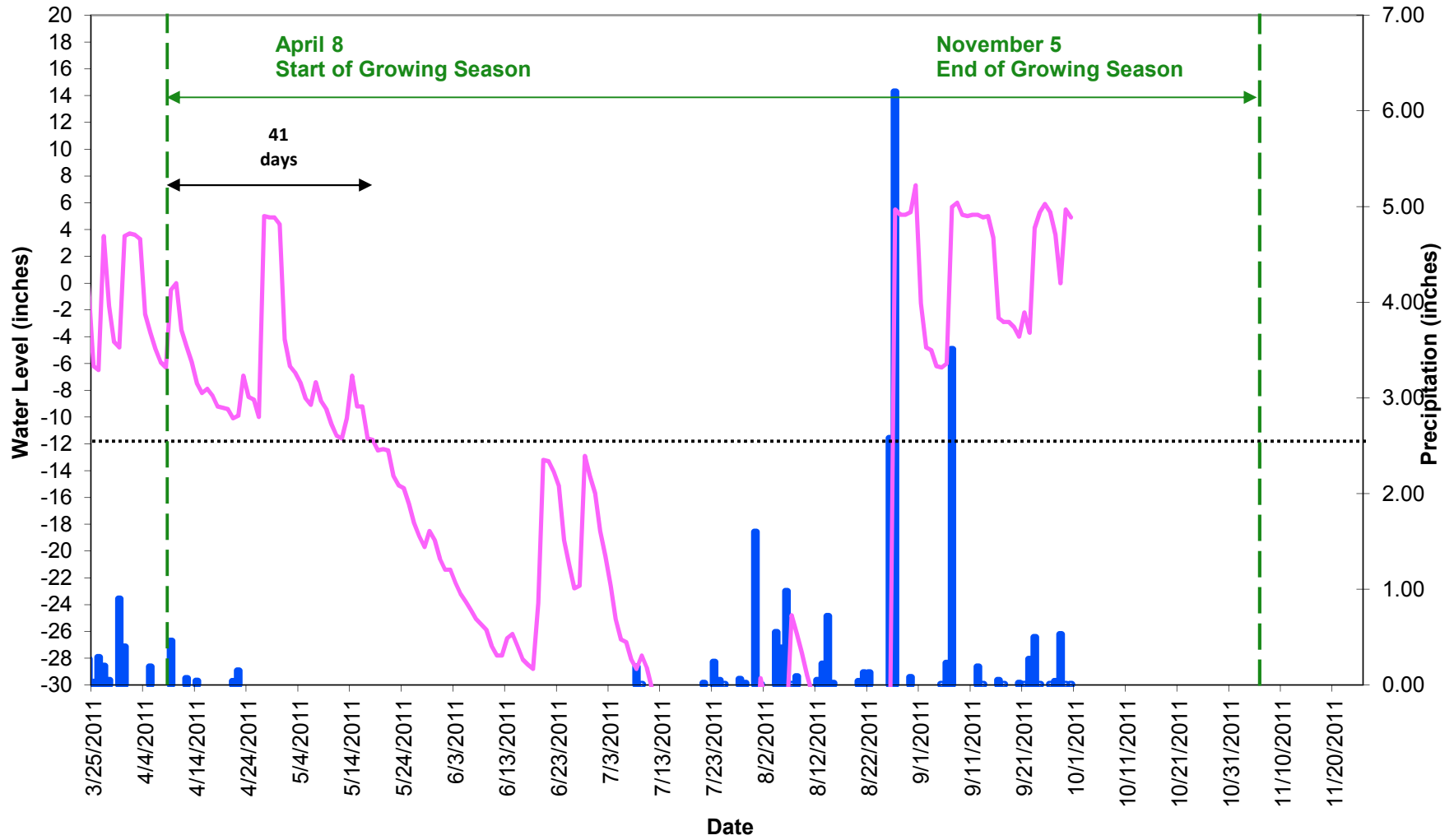
### Jarman's Oak - Groundwater Gauge 1 Year 4 (2011 Data)



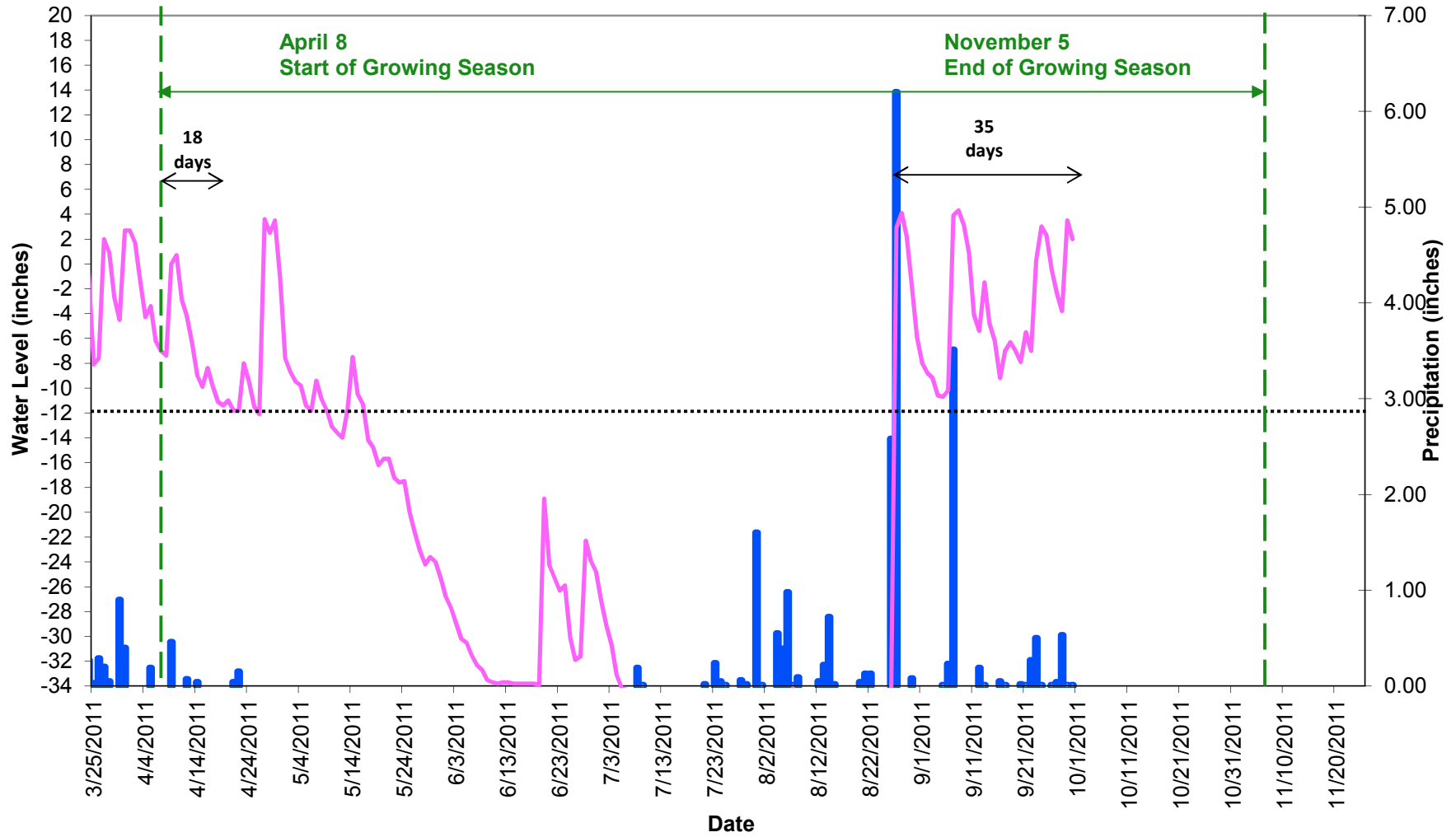
### Jarman's Oak - Groundwaer Gauge 2 Year 4 (2011 Data)



### Jarman's Oak - Groundwater Gauge 3 Year 4 (2011 Data)

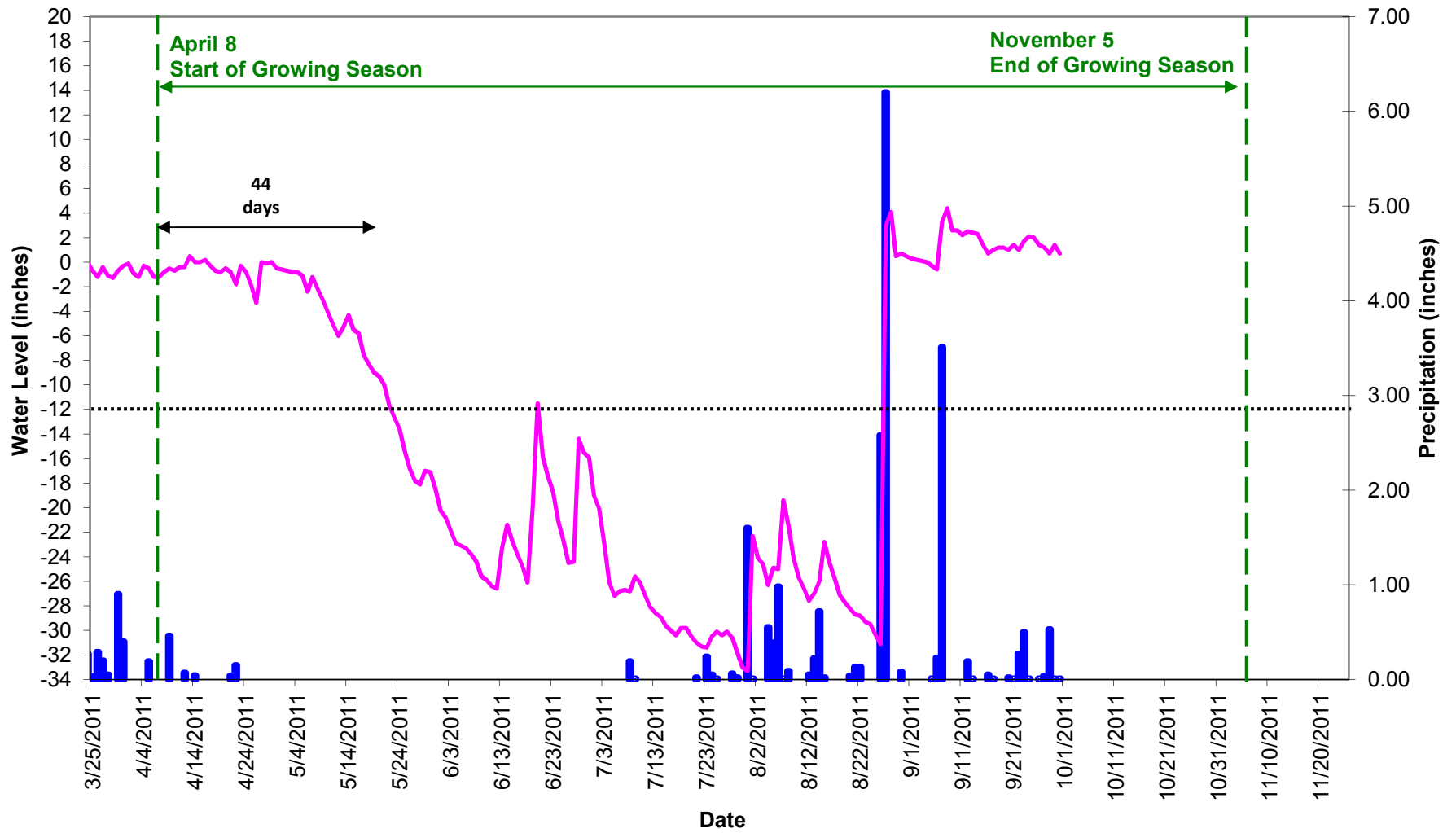


### Jarman's Oak - Groundwater Gauge 4 Year 4 (2011 Data)





### Jarman's Oak - Groundwater Reference Gauge Year 4 (2011 Data)



**APPENDIX D**  
**MONITORING PLAN VIEW**

