Bank Stabilization Pilot Study: Technical Briefing Paper

This briefing paper summarizes key findings from performance monitoring studies conducted between 2010 and 2013 as part of the Bank Stabilization Pilot Study. Study findings resulting from the physical, chemical, and biological sampling efforts are summarized below. The information reviewed and presented herein are not comprehensive; additional details regarding the scope of work, methodologies, assessments, and conclusions are documented in URS (2012, 2011a, 2011b, and 2010) and Turner and Jensen (2008).

Introduction

In the fall of 2009, a section of stream bank (Pilot Site) along the South River in Waynesboro, Virginia was physically stabilized and re-planted with a native vegetative community to abate localized bank erosion. The bank stabilization pilot design incorporated three main components: 1. A rock toe at the base of the bank for slope protection; 2. Soil lifts to engineer a more stable and gradually sloping bank and 3. Native vegetation on both the slope and top of the bank, providing further stability and habitat. The objective of the Bank Stabilization Pilot Study monitoring program is to assess whether control of mercury (Hg) loading to the water column and sediment from eroding bank soil will result in reductions of Hg concentrations in the aquatic environmental media (i.e., pore water, sediment, surface water, and biological tissue). Monitoring also included a geomorphic assessment based on cross sectional information, and plant stock survival, as well as an assessment of the re-established vegetative community. This briefing paper describes key findings of the physical, chemical and biological monitoring thru the 2013 annual monitoring event. Additional monitoring is scheduled for the fall of 2013.

References

- ✓ Bateman, J., 2009. Topographic As Built, South River Bank Stabilization. November 3, 2009
- ✓ Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water, Washington, D.C.
- ✓ Turner, R. and R. Jensen. 2008. Plant Reach Characterization; Results of 2006-2007 Investigations of Mercury in the South River at Waynesboro, Virginia. February.
- ✓ URS. 2012. Memorandum: South River Pilot Bank Stabilization-3Q Monitoring Activities. October 5, 2012.
- ✓ URS. 2011a. Memorandum: South River Pilot Bank Stabilization-Year-Two Update. September 30, 2011.
- ✓ URS. 2011b. Monitoring Report: Year One South River Bank Stabilization Pilot Study. Waynesboro, Virginia. February 2011.
- ✓ URS. 2010. Monitoring Work Plan-South River Bank Stabilization Pilot Study-Waynesboro, Virginia. Revised October 29, 2010.

Physical

Pre- and post-stabilization channel morphology monitoring was conducted by evaluating eight stream cross sections within the project area: two upstream of the Pilot Site, five within the Pilot Site area, and two downstream of the Pilot Site. Erosion monitoring was also conducted along both the stabilized and opposite banks utilizing erosion pins to determine erosion rates. Monitoring data collected to date demonstrate that the pilot bank has remained stable, withstanding a near 10-year recurrence storm event. However, minor changes to channel morphology within the wetted channel and opposing bank have occurred. These changes included deposition of coarse sand attributed to active floodplain bedload transport, and deposition occurring along the left bank upstream of the Pilot Site (Transect Up-3) where a historical side channel/floodplain bench is located. Additionally, mid-channel deposition of

boulder material was documented, likely from movement of constructed launchable rock toe material at the Pilot Site.

Chemical

Sediment, pore water, and Asiatic clam (*Corbicula fluminea*) tissue samples were collected and analyzed to detect potential changes in mercury concentrations before and after stabilization.

Sediment

Collection of sediment samples associated with the Bank Stabilization Pilot Study monitoring occurred in 2008 as part of a near-bank characterization event, and in 2009 to provide pre-stabilization data. Post-stabilization monitoring included data collections in November 2009, June 2010, June 2011, March and June 2012, and June 2013 (Table 1; Figure 1). Results of the sediment component of the monitoring program indicate the following:

- Total mercury (THg) concentrations in sediment collected post-stabilization are generally lower than concentrations of THg in pre-stabilization sediment samples (Table 1). THg reduction in nearbank sediment is thought to be a result of decreased erosion due to bank stabilization and partial capping through placement of the rock toe. Additionally, Hg concentrations in fine-grained sediments accumulating within the rock toe reflect the concentration of Hg on solids within the water column.
- Variability among post-stabilization near-bank THg concentrations has been reduced compared to pre-stabilization sampling events.
- THg concentrations in sediment are generally similar to those measured on suspended particles.

Pore Water

Pore water samples associated with Bank Stabilization Pilot Study monitoring were collected in June, July, and August 2009 to provide pre-stabilization data. Post-stabilization data were collected in June 2010, June 2011, June 2012, and June 2013 (Table 2; Figure 2). The pore water component of the monitoring program indicates the following:

- Filtered inorganic mercury (FIHg) concentrations in pore water have generally declined on an average basis; however, these declines are not statistically significant due to the high variability observed in the area adjacent to the rock toe (Table 2).
- Filtered methylmercury (FMeHg) concentrations in pore water are highly variable at the Pilot Site, and have not declined over time (Table 2).

Asiatic Clam Tissue

Previous studies have demonstrated the utility of using transplanted Asiatic clams to measure mercury uptake; clams were deployed along the Pilot Site as part of the monitoring program using these same methods. To measure Hg uptake rates by Asiatic clams, tissue data were collected from seeded clams in 2009 (pre-stabilization), and 2010, 2011, 2012, and 2013 (post-stabilization) (Figure 3; Figure 4). The Asiatic clam tissue monitoring program indicates the following:

- Asiatic clam uptake data indicate significant decreases in IHg uptake in 2010; increases in IHg uptake were observed in 2011 and 2012, and in 2013 significant decreases were observed (Figure 4). These increases in 2011 and 2012 are thought to be related to increased IHg loading from the plant outfall associated with perturbations to the on-site sewer system during remedial activities.

- No significant differences in MeHg concentrations over time were observed; however, higher concentrations in the near-bank area compared to mid-channel were identified (Figure 4).

Biological

Biological monitoring included an assessment of the vegetative community and a structural habitat quality assessment following USEPA Rapid Bioassessment Protocols.

Vegetative Community

Prior to construction, opportunistic species, including Grape vine (*Vitis* sp.), Virginia creeper (*Parthenocissus quinquefolia*) and Poison ivy (*Toxicodendron radicans*), dominated the Pilot Site vegetative community. Removal of these species occurred during construction, and they were replaced by a community of native grasses and trees post-stabilization. Results of post-stabilization vegetative community monitoring indicate the following:

- First year growth upstream and downstream of the Pilot Site reached 100% coverage, while maximum Pilot Site bank cover reached 70%. Additional plant stock that was planted at the Pilot Site in 2011 continues to thrive.
- Non-native species have become established along the Pilot Site, representing a minimal portion vegetative community.
- Natural recruitment of herbaceous and woody species such as sycamore saplings, have colonized the rock toe of the Pilot Site in a similar manner to naturally occurring gravel bar islands.

Habitat Quality

Habitat quality assessments were performed along the Pilot Site following USEPA Rapid Bioassessment Protocols (Barbour et al., 1999) in order to assess bank stability, vegetative protection, epifaunal substrate/available cover, embeddedness, and substrate characterization within the river channel. Results indicate the following:

- Baseline bank stability and vegetative protection within the Pilot Site were both suboptimal prior to stabilization.
- Immediately following construction, the Pilot Site bank was categorized as suboptimal or optimal in terms of stability, and poor or suboptimal in terms of vegetative protection. This assessment occurred shortly after construction, during the winter, prior to plant growth.
- Post-construction surveys in late Spring 2010 identified that vegetative protection had returned to pre-construction levels of suboptimal.
- Surveys conducted through 2012 identified bank stability and vegetative protection as optimal. Epifaunal substrate/available cover and pool substrate characterization were both suboptimal, while embeddedness was optimal.
- Surveys conducted in 2013 identified an area at the edge of the bank where the geotextile fabric is visible. This area and the area along Rockfish Run will be closely monitored for potential changes that might impact the integrity of the bank stabilization.

Summary of Preliminary Findings

A summary of preliminary findings from the Bank Stabilization Pilot Study monitoring program through the 2013 annual monitoring event are as follows:

- The stabilized bank has withstood a 10-year flood event, and exhibits signs of continued stability; however, minor changes in channel morphology are evident. These changes are

most notably in the near bank area associated with the launchable toe as well as in movement of fine sediments below the confluence of Rockfish Run associated with a historical snag being washed away during the 10-year flood event.

- Chemical monitoring suggests that mercury concentrations in sediment and pore water have declined on an average basis since stabilization, but that the high variance in the pre-stabilization data set prevents detecting significant differences. The 2013 chemical monitoring data indicate a reduction in THg in all media in comparison to previous years monitoring data.
- Biological tissue data demonstrated an initial decrease in IHg in transplanted *Corbicula* following stabilization. An increase in IHg concentrations, however, was observed in 2011 and 2012, which is thought to be related to temporal perturbations to the system associated with remedial activities at the former DuPont plant site. Decreases in IHg concentrations in transplanted *Corbicula* were observed in 2013.
- The vegetative community is well established and aids in stabilization of the Pilot Site.

Table 1
Mercury Concentrations in Sediment
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Sample ID	Sediment Type	Sample Date	THg (mg/kg)	Average THg (mg/kg)	Standard Deviation	Relative Standard Deviation
Pre-Stabilization						
T1	Interstitial	August 2008	54	19	24	128%
T3_T5			19			
T6			1.2			
C	Bulk	March 2009	2.4			
Post-Stabilization						
A	Interstitial	November 2009	0.4	0.43	0.15	34%
B			0.3			
C			0.6			
UP		June 2010	1.9	1.1	0.8	78%
A			1.6			
B			0.3			
C			0.4			
UP		June 2011	3.9	3.8	1.1	28%
A			2.6			
B			3.6			
C			5.2			
UP		March 2012	1.7	3.1	1.9	62%
A			2.2			
B			2.6			
C			6.0			
UP		June 2012	4.1	3.1	0.8	27%
A			2.1			
B			3.2			
C			3.1			
UP		June 2013	1.3	1.3	0.40	30%
A			1.1			
B			1.9			
C			1.0			

Table 2
Pore Water FIHg and FMeHg Monitoring Summary
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Sampling Date	Mean FIHg (ng/L)	FIHG Range (ng/L)	SD	Mean FMeHg (ng/L)	FMeHG Range (ng/L)	SD
June 2009	53	2.26 - 131	42	10	1.04 - 40.5	11
July 2009	51	5.23 - 292	83	3.9	0.36 - 14.4	4.0
August 2009	82	2.73 - 510	153	2.3	0.04 - 6.83	2.0
June 2010	27	2.94 - 176	48	4.4	0.14 - 20.9	6.6
June 2011	27	14.1 - 47.8	13	3.3	0.13 - 13.7	4.5
June 2012	25	5.37 - 32.7	9	3.4	1.1 - 7.18	2.0
June 2013	9	4.48 - 21.1	4	2.1	0.26 - 4.49	1.4

Notes:

Samples were collected at transects A-C".

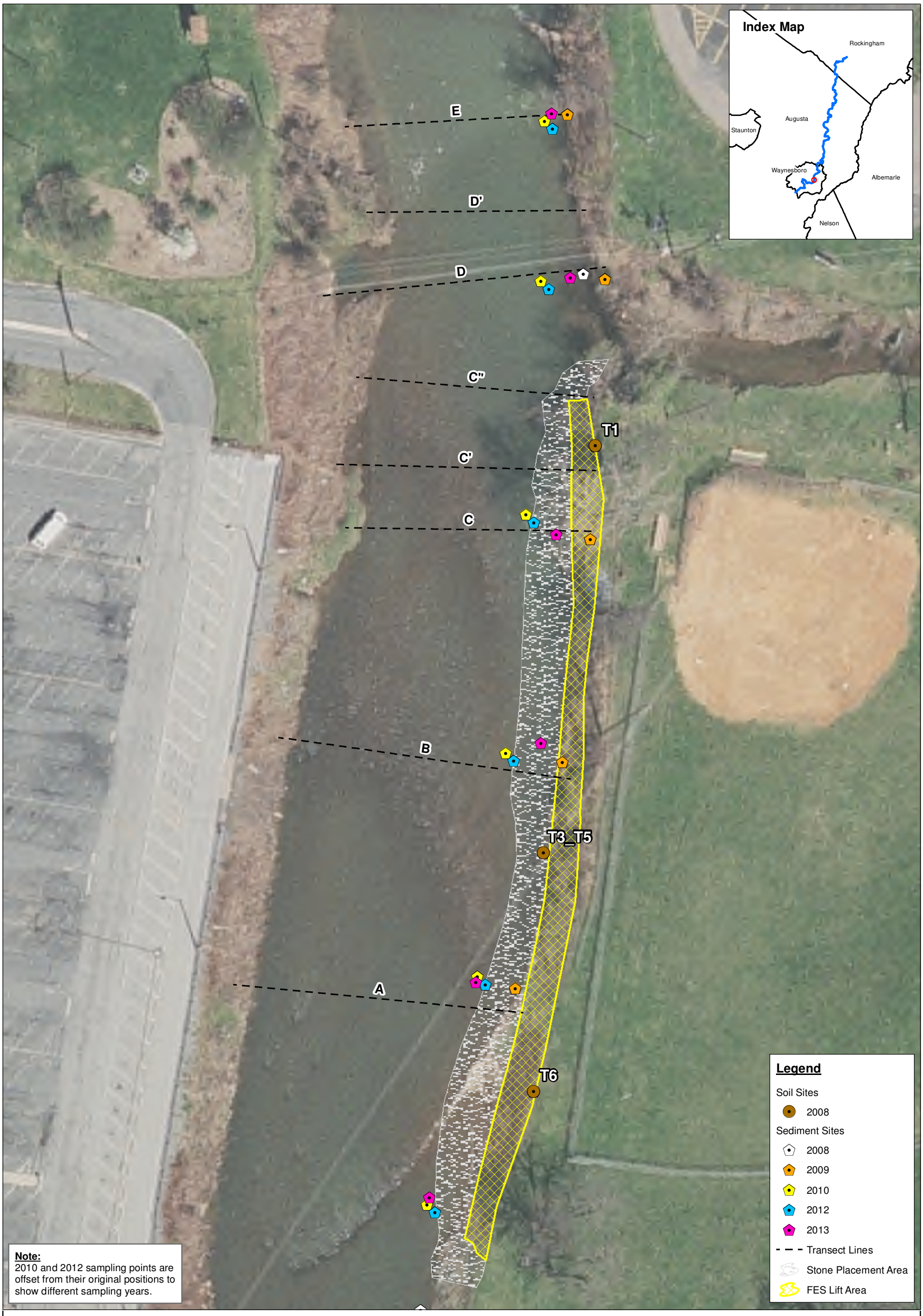
FIHg: Filtered inorganic mercury

FMeHg: Filtered methylmercury.

SD: Standard deviation.

Bank Stabilization occurred in Fall 2009

10-Yr Storm event occurred April 2010



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SOUTH RIVER PROJECT

PROJECT NO. 18985624

0 20 40 80 Feet

1 inch = 40 feet

Figure 1
Sediment Sampling Locations
Bank Stabilization Pilot Study
Revised Technical Briefing Paper

Source: Aerial Photography - SURDEX 2005

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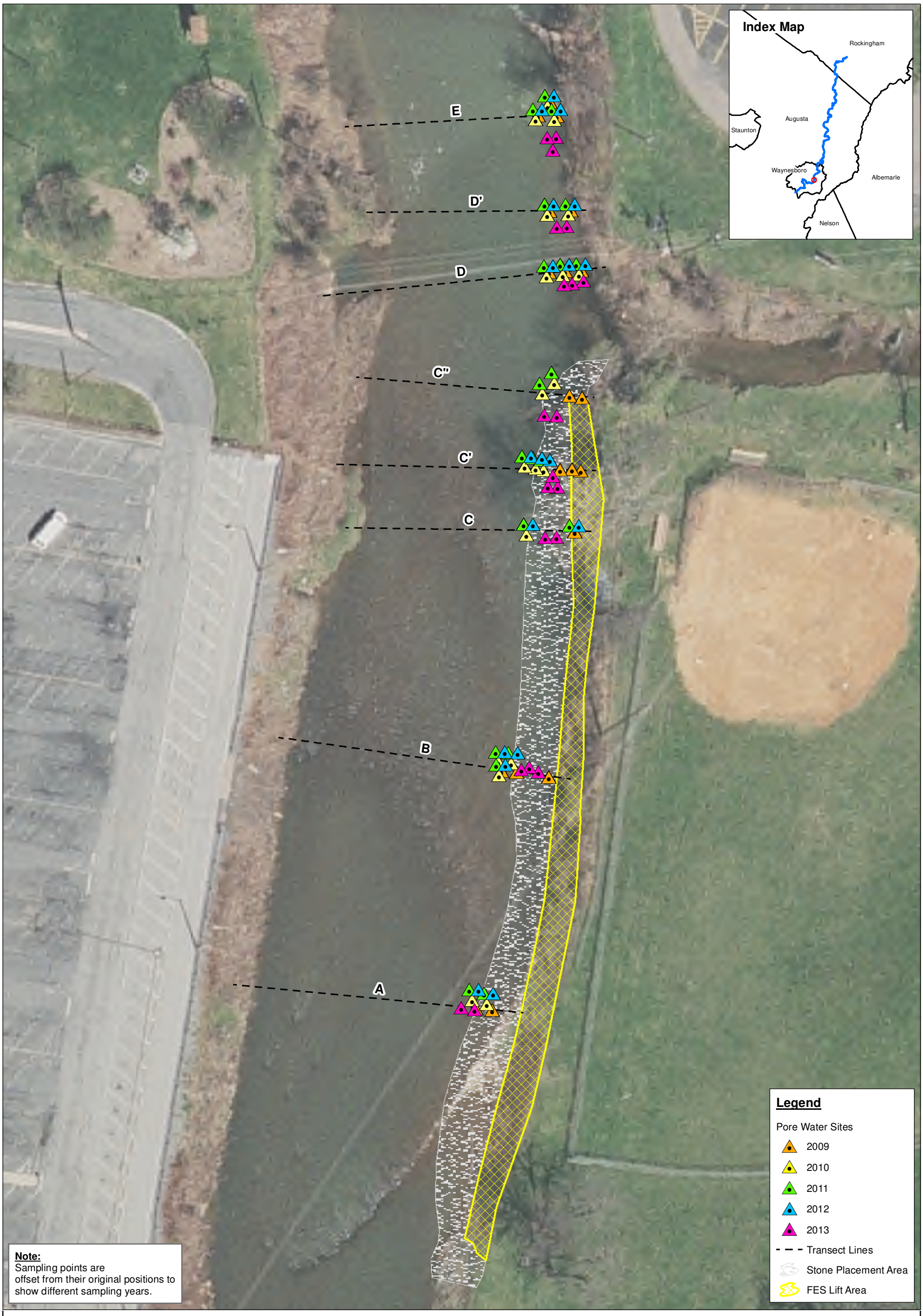

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Figure 2
Pore Water Sampling Locations
Bank Stabilization Pilot Study
Technical Briefing Paper

Source: Aerial Photography - SURDEX 2005

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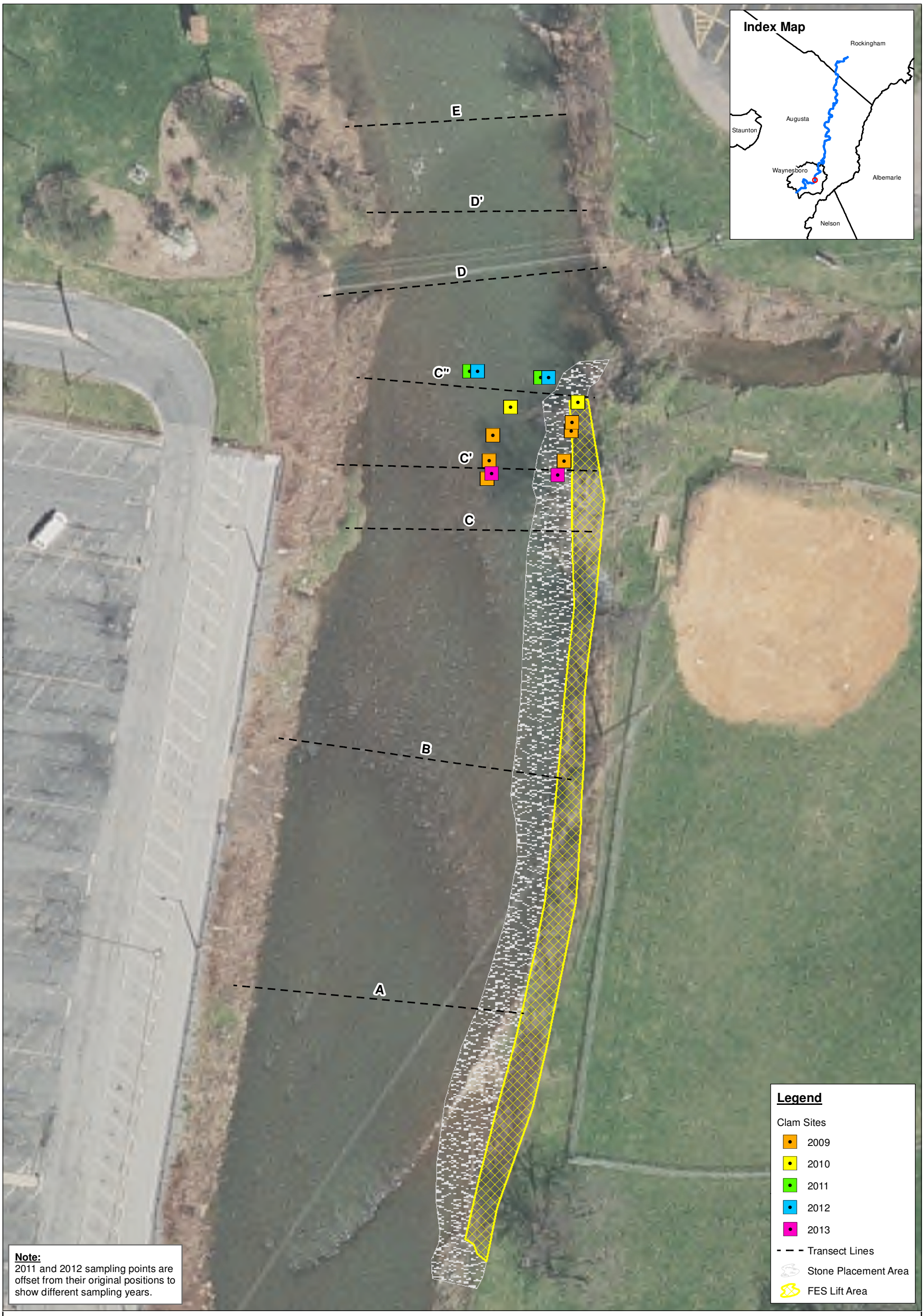

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Figure 3
Asiatic Clam Sampling Locations
Bank Stabilization Pilot Study
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Source: Aerial Photography - SURDEX 2005

S:\Projects\IMS\DUPONT\STHRIVER\Projects\WaynesboroPilot\TechnicalBriefingPaper2013\Revised\Figure 3 Asiatic Clam Sampling Locations Revised.mxd

Figure 4
Asiatic Clam IHg and MeHg Uptake
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