SOUTH FORK HOPPERS CREEK STREAM AND WETLAND RESTORATION PROJECT

ANNUAL MONITORING REPORT FOR 2010 (YEAR 5)

Project Number: D04006-4

Submitted to:

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SUMMARY

This Annual Report details the monitoring activities during the 2010 growing season on the South Fork Hoppers Creek Wetland and Stream Restoration Site ("Site"). Construction of the Site, including planting of trees, was completed in April 2006. In order to document project success, 10 vegetation monitoring plots, 16 permanent cross-sections, 3,549 linear feet (LF) of longitudinal profile, a rain gauge, a crest gauge, and 8 hydrologic monitoring gauges (5 automated and 3 manual) were installed and assessed across the Site. The 2010 data represents results from the fifth and final year of vegetation, geomorphic, and hydrologic monitoring for both wetlands and streams.

Prior to restoration, wetland, stream, and buffer functions on the Site were impaired as a result of agricultural conversion. Streams flowing through the Site had been channelized to reduce flooding and provide drainage for adjacent farm fields. After construction it was determined that 5.6 acres of riverine wetlands and 7,229 LF of stream were restored, and 1.4 acres of riverine wetlands were enhanced.

Weather station data from the Natural Resources Conservation Service (NRCS) National Climate and Water Center (Marion WETS Station in McDowell County – NC 5340) and the US Geological Survey (USGS) Water Data for North Carolina (USGS 03451500 French Broad River at Asheville, NC) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. Though rainfall for the 2010 growing season was below average, the monitoring well data documented that all 8 of the hydrologic monitoring gauges recorded hydroperiods of at least 12 percent before the end of the growing season.

A total of 10 monitoring plots that were 10 meters by 10 meters or 0.025 of an acre in size were used to assess survivability of the woody vegetation planted on site. These plots were randomly located to represent the different zones within the project. The vegetation monitoring documented a survivability range of 440 stems per acre to 600 stems per acre with an overall average of 548 stems per acre. The site had earlier met the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season and has now met the final vegetation survival criteria of 260 stems per acre surviving after the fifth growing season.

Over the five-year monitoring period, both cross-section and profile data shows a dynamic system that is able to adjust its dimension, pattern, and profile while maintaining stability by accommodating for fluctuations in inputs from the contributing drainage area. In 2010, two additional bankfull events were observed and documented during the months of March and September of 2010. In general, dimension, pattern, profile and in-stream structures continue to maintain stability and function as a stable "C" type channel.

In summary, the Site has successfully met all hydraulic, vegetative, and stream success criteria specified in the Site's Restoration Plan.

PROJECT BACKGROUND

The South Fork Hoppers Creek Restoration Site "Site" is located in McDowell County, North Carolina (Figure 1). The Site lies in the Catawba River Basin within North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-30 and US Geologic Survey (USGS) hydrologic unit 03050101040020. The Site has a recent history of pasture and general agricultural usage. The streams of the Site were channelized and riparian vegetation was cleared in most locations. Stream and riparian functions on the Site had been severely impacted as a result of agricultural conversion.

The project involved the restoration of 5.6 acres of riverine wetlands, enhancement of 1.4 acres of riverine wetlands, and restoration of 7,229 linear feet (LF) of stream along South Fork Hoppers Creek (the mainstem) and an unnamed tributary (UT 1). A total of 33.8 acres of stream, wetland, and riparian buffer are protected on-site through a permanent conservation easement.

I Project Location

The Site is located approximately 30 miles northwest of the town of Shelby in McDowell County, North Carolina (Figures 1 & 2). From Shelby take NC Highway 226 north towards Dysartsville. Approximately 3 miles past the Rutherford/McDowell County line, turn left onto Walker Road. Take the next right onto Pierce Road. The Site is divided into two separate sections by Pierce Road. Access for the downstream section is northeast of the culvert crossing. The conservation easement gate for the upstream section is southwest of the culvert crossing.

II Mitigation Goals and Objectives

The specific goals for the South Fork Hoppers Creek Restoration Project were as follows:

- Restoration of 7,229 LF of stream channel.
- Restoration of 5.6 acres of riverine wetlands.
- Enhancement of 1.4 acres of existing riverine wetlands.
- Removal of cattle access to the stream channel, wetland and riparian buffer areas.
- Improvement of floodplain functionality by matching floodplain elevations with the bankfull stage.
- Establishment of native wetland and floodplain vegetation within the conservation easement.
- Improvement of wildlife habitat functions of the Site.

III Project Description and Restoration Approach

For assessment and analysis purposes, the on-site streams were divided into five reaches: four along the mainstem, and one on UT 1 that flows into the mainstem downstream of Pierce Road (Figure 3). The following paragraphs describe the Site's pre-construction conditions and the selected restoration approach.

The mainstem entered the Site from the southwest and flowed east through a 48-inch corrugated metal pipe (CMP) culvert. Reach 1 continued east through a pasture for approximately 1,500 LF and then entered a second 48-inch CMP culvert. Reach 2 began 1,000 LF downstream of the second 48-inch culvert, at the confluence of a small tributary, and continued east and north for 578 LF to twin, 72-inch CMP culverts under Pierce Road. Reach 3 began downstream of the twin culverts and continued approximately 1,200 LF north through an abandoned pasture. Reach 4 extended the final 900 LF to the north project boundary and was characterized by a flatter slope, finer bed material, and a lower bank height ratio than the other 3 reaches.

UT 1 entered the Site through a 36-inch culvert under Pierce Road, then flowed east to west, parallel to

Pierce Road, and entered Reach 3 approximately 80 LF downstream of the twin, 72-inch culverts. UT 1 had a reach length of 306 LF on the project Site.

For design purposes, the mainstem was divided into two reaches. From the assessment, Reach 1 correlates to Design Reach 1, while Reaches 2, 3, and 4 were combined for Design Reach 2.

It is likely that much of the project area once existed as a wetland ecosystem, as evidenced by hydric soil areas across the bottomland fields of the Site, as well as landowner accounts of wet areas of the Site prior to drainage activities. Wetland areas that once existed on the Site were drained and manipulated to promote agricultural uses. The stream was channelized within the project site to improve surface and subsurface drainage and to decrease flooding. Subsurface drain tiles were also installed in floodplain areas of the project Site, particularly the field downstream of Pierce Road. As a result, wetland functions were impacted within the project area. The channelization of the stream impaired its ability to function naturally, resulting in areas of active bank erosion and an overall poor habitat condition.

Design for the restored stream involved the construction of a new channel meandering through the agricultural fields. The restored mainstem was a Rosgen "C" stream type channel with a low width/depth cross-sectional area approaching typical Rosgen "E" type dimensions (Rosgen, 1994). A Rosgen "B" stream type was used for the restored UT 1 channel. The design dimensions of each stream were based on nearby reference reaches. Wetland restoration of the agricultural fields on the Site involved raising the local water table to restore a natural flooding regime. The stream through the Site was restored to a stable dimension, pattern, and profile, such that riverine wetland functions were restored to the adjacent hydric soil areas. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. Total stream length across the Site was increased from approximately 5,579 LF to 7,229 LF. Total wetland acreage was increased from 2.17 acres to 5.6 acres. Assessment of the restored site determined that 7,229 stream mitigation units (SMU) were provided for the stream restoration and a total of 6.3 wetlands mitigation units (WMU) were achieved for wetland restoration and enhancement.

The design allows stream flows larger than the bankfull to spread onto the floodplain, dissipating flow energies and reducing stress on stream banks. In-stream structures were used to control streambed grade, reduce stress on stream banks, and promote bedform sequences and habitat diversity. The in-stream structures consisted of root-wads, cover logs and log vanes, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles or rock cross vanes were installed to provide long-term stability. Stream banks were stabilized using a combination of erosion control matting, live stakes, bare-root planting, and transplants. Transplants provide living root mass to increase stream bank stability and create holding areas for fish and aquatic biota. Native vegetation was planted across the Site, and the entire restoration site is protected through a permanent conservation easement.

Table 1. Project Mitigation Approach

South Fork Hoppers Creek Restoration Site: Project No. D04006-4								
Existing Segment or Reach ID	**Existing Feet / Acreage**	**Mitigation Type ***	**Approach****	**Mitigation Footage / Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
UT1	306 LF	R	P1	203 LF	1	203	200+00 - 202+03	Restoration of dimension, pattern, and profile to a "B" stream type.
South Fork Hoppers Reach 1	2,595 LF	R	P1 & P2	3,528 LF	1	3528	110+85 - 146+17	Restoration to a "C" approaching "E" stream type and P2 used to tie into the Pierce Road culvert.
South Fork Hoppers Reach 2	2,678 LF	R	P1 & P2	3,498 LF	1	3498	146+17 - 181+70	Restoration to a "C" approaching "E" stream type and P2 used to tie channel into the Pierce Road culvert.
Wetland Enhancement	2.53 Ac	E	---	1.4 Ac	0.5	0.7	164+50 - 166 + 90 (R) 171+05 - 176+79 (R) 175+91 - 179+52 (L) 178+31 - 179+52 (R)	Planting, and raising water table
Wetland Restoration		R	---	5.6 Ac	1	5.6	135+79 - 139+00 (L) 154+53 - 167+80 (L) 166+89 - 174+25 (R) 175+50 - 177+67 (R) 175+70 - 180+43 (L)	Grading, soil roughing, planting, and raising water table

Total linear feet of channel restored:	7,229	**Total Stream Mitigation Units:**		7,229
Total acres of wetlands restored:	5.6	**Total Wetland Mitigation Units:**		6.3
Total acres of wetland enhanced:	1.4			

* R = Restoration
E = Enhancement
S = Stabilization

** P1 = Priority I
P2 = Priority II
P3 = Priority III
EI = Enhancement I
EII = Enhancement II

IV Project History and Background

The chronology of the South Fork Hoppers Creek Restoration Project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is presented in Table 4.

Table 2. Project Activity and Reporting History

South Fork Hoppers Creek Restoration Site: Project No. D04006-4		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan Prepared	N/A	Mar-05
Restoration Plan Amended	N/A	Apr-05
Restoration Plan Approved	N/A	
Final Design – (at least 90% complete)	N/A	Aug-05
Construction Begins	N/A	Jun-05
Temporary S&E mix applied to entire project area	N/A	N/A
Permanent seed mix applied to entire project area	N/A	Apr-06
Planting of live stakes	N/A	Apr-06
Planting of bare root trees	N/A	Apr-06
End of Construction	N/A	May-06
Survey of As-built conditions (Year 0 Monitoring-baseline)	Jun-06	Jul-06
Repair work	Oct-06	Oct-06
Year 1 Monitoring	Oct-06	Nov-06
Year 2 Monitoring	Oct-07	Nov-07
Year 3 Monitoring	Oct-08	Nov-08
Year 4 Monitoring	Oct-09	Dec-09
Year 5 Monitoring	Sept-10	Nov-10

Table 3. Project Contact Table

South Fork Hoppers Creek Restoration Site : Project No.D04006-4	
Full Service Delivery Contractor	
EBX-Neuse I, LLC	909 Capability Drive, Suite 3100 Raleigh, NC 27606 Contact: Norton Webster, Tel. 919-829-9909
Designer	
Michael Baker Engineering, Inc.	1447 S. Tryon Street, Suite 200 Charlotte, NC 28203 Contact: Eng. Chris Yow, Tel 704-334-4454
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Planting Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seed Mix Sources	Mellow Marsh Farm, 919-742-1200
Nursery Stock Suppliers	International Paper, 1-888-888-7159
Monitoring Performers	
Michael Baker Engineering, Inc.	1447 S. Tryon Street, Suite 200 Charlotte, NC 28203
Stream Monitoring Point of Contact:	Ian Eckardt, Tel.704-334-4454
Wetland Monitoring Point of Contact:	Ian Eckardt, Tel.704-334-4454
Vegetation Monitoring Firm: Wetland and Natural Resource Consultants	3674 Pine Swamp Road Sparta, NC 28675 Chris Hysman, Tel. 336-406-0906

Table 4. Project Background

South Fork Hoppers Creek Restoration Site: Project No. D04006-4	
Project County:	McDowell County, NC
Drainage Area:	
South Fork Hoppers Reach 1	0.93 mi^2
South Fork Hoppers Reach 2	1.38 mi^2
UT1	0.07 mi^2
Estimated Drainage % Impervious Cover:	
Reach: South Fork Hoppers Reach 1	< 5%
Reach: South Fork Hoppers Reach 2	< 5%
Reach: UT1	< 5%
Stream Order:	
South Fork Hoppers Reach 1	2
South Fork Hoppers Reach 2	2
UT1	1
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	
South Fork Hoppers Reach 1	C
South Fork Hoppers Reach 2	C
UT-1	B
Cowardin Classification	Riverine, Upper Perennial, Unconsolidated Bottom, Cobble-Gravel
Dominant Soil Types	
South Fork Hoppers Reach 1	IoA, EwE, HeD, HcC1
South Fork Hoppers Reach 2	IoA, EwE, HeD, HcC2
UT1	IoA
Reference Site ID	Spencer Creek, Craig Creek, Big Branch, Sals Branch
USGS HUC for Project and Reference Sites	03050101040020
NCDWQ Sub-basin for Project and Reference	03-08-30
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor?	N/A
Percent of project easement fenced	50%

V Project Monitoring Plan

Plans depicting the as-built conditions of the major project elements, location of permanent monitoring cross-sections, locations of hydrologic monitoring stations, and locations of permanent vegetation monitoring plots are presented in Appendix C of this Report.

VEGETATION MONITORING

I Soil Data

The soil data for the Site are presented in Table 5.

Table 5. Soil Data for Project

South Fork Hoppers Creek Restoration Site: Project No. D04006-4					
Series	**Max Depth (in)**	**% Clay on Surface**	**K**	**T**	**OM %**
(IaA) - Iotla Sandy Loam, 0 to 3 percent slopes	60	12-18	0.2	5	2-5
(EwE) - Evard-Cowee Complex, 2 to 95 percent slopes	65	5-20	0.24	5	1-5
(HcC2) -Hayesville Clay Loam, 2 to 60 percent slopes	62	10-25	0.24	4	1-3
(HeD) -Hayesville-Evard Complex, 2 to 60 percent slopes	62	5-25	0.24	5	1-5

USDA, NRCS 2006. Official Soil Series Descriptions (http://soils.usda.gov/soils/technical/classification/osd/index.html)

General taxonomy of Site soils:

Iotla:

The Iotla series (IaA) consists of very deep, somewhat poorly-drained soils with moderately rapid permeability on floodplains. They formed in loamy, recent alluvium. Slopes range from 0 to 3 percent (NRCS, 2006).

Evard-Cowee:

The Evard-Cowee complex (EwE) is composed of very deep, well-drained, moderately permeable soils on ridges and side slopes. They formed in residuum affected by soil creep in the upper part and weathered from felsic to mafic, igneous and high-grade metamorphic rocks. Slopes range from 2 to 95 percent (NRCS, 2006).

Hayesville:

The Hayesville Series (HcC2 and HeD) consists of very deep well-drained soils on gently sloping to very steep ridges. They most commonly formed in residuum weathered from igneous and high-grade metamorphic rocks such as granite, granodiorite, mica gneiss and schist; but in some places formed from thickly-bedded metagraywacke and metasandstone. On steeper slopes the upper part of some pedons may have some colluvial influence. Slopes range from 2 to 60 percent (NRCS, 2006).

II Description of Species and Monitoring Protocol

The Site was planted in bottomland hardwood forest species in March and April 2006. The following tree species were planted in the restoration area:

Table 6. Tree Species Planted

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
ID	**Scientific Name**	**Common Name**	**FAC Status**
1	*Betula nigra*	River Birch	FACW
2	*Fraxinus pennsylvanica*	Green Ash	FACW
3	*Platanus occidentalis*	Sycamore	FACW-
4	*Quercus phellos*	Willow Oak	FACW-
5	*Quercus rubra*	Northern Red Oak	FACU
6	*Quercus michauxii*	Swamp Chestnut Oak	FACW-
7	*Liriodendron tulipifera*	Tulip Poplar	FAC
8	*Celtis laevigata*	Sugarberry	FACW
9	*Diospyros virginiana*	Persimmon	FAC
10	*Nyssa sylvatica*	Blackgum	FAC

The following monitoring protocol was designed to predict vegetative survivability. Ten plots were established on the South Fork Hoppers Site, to monitor approximately 1.5 percent of the Site. All plots were 0.025 acre in size, or 10 meters by 10 meters. Six plots were established in areas that included both the wetlands and stream buffer. The remaining four plots were located adjacent to the newly constructed streambed to monitor the vegetation in the stream restoration buffer. The plots were randomly located within each zone and randomly oriented within the wetland restoration area.

Plot construction involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Then ropes were hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees on the boundary and trees just outside of the boundary that appear to have greater than 50 percent of their canopy inside the boundary were counted inside the plot. A piece of white PVC pipe ten feet tall was placed over the metal post on one corner to facilitate visual location of plot throughout the five-year monitoring period.

All of the planted stems inside the plot were flagged with orange flagging and marked with a three-foot tall piece of half-inch PVC to identify them as the planted stems (vs. any colonizers) and to help in locating them in the future. Each stem was then tagged with a permanent, numbered aluminum tag.

III Vegetation Success Criteria

The interim measure of vegetative success for the South Fork Hoppers Mitigation Plan was the survival of at least 320 3-year old planted trees per acre at the end of year three of the monitoring period, which was met. The final vegetative success criteria in the Mitigation Plan was the survival of 260, 5-year old planted trees per acre at the end of Year Five of the monitoring period.

Up to 20 percent of the site species composition may be comprised of invaders. Remedial action may be required should these (i.e. loblolly pine, red maple, sweetgum, etc.) present a problem and exceed 20 percent composition.

IV Results of Vegetative Monitoring

The following tables present stem counts for each of the monitoring plots. Each planted tree species is identified down the left column, and each plot is identified across the top row. Trees are flagged in the field on an as-needed basis before the flags degrade Flags are utilized as opposed to an alternative

identification method because they will not interfere with the growth of the tree. Volunteer species are also flagged during this process.

Vegetation monitoring efforts have documented the average number of stems per acre on site to be 548, which is a survival rate of greater than 82 percent based on the initial planting count of 664 stems per acre. The Site has achieved the vegetative success criteria of at least 260 stems per acre at the end of Year 5.

Table 7. Year 5 Stem Counts for Each Species Arranged by Plot

South Fork Hoppers Creek Restoration Site: Project No. D04006-4											Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	% Survival
	Year 5 Plot Counts																
Tree Species	**1**	**2**	**3**	**4**	**5**	6	**7**	**8**	**9**	**10**							
Betula nigra	1	0	0	0	0	0	0	0	0	0	2	2	2	1	1	1	50
Fraxinus pennsylvanica	7	1	3	4	0	2	0	0	0	4	24	25	23	24	21	21	88
Platanus occidentalis	2	0	8	4	3	8	0	0	3	0	30	31	32	29	29	28	93
Quercus phellos	4	0	3	6	4	1	0	0	5	4	25	32	32	29	26	27	108
Quercus rubra	0	0	0	0	0	0	0	0	2	0	2	3	2	2	2	2	100
Quercus michauxii	0	0	0	0	4	0	0	0	0	7	7	10	11	11	10	11	157
Liriodendron tulipifera	0	7	0	0	0	2	5	5	4	0	23	27	24	24	23	23	100
Celtis laevigata	0	0	0	0	2	0	0	0	0	0	18	4	3	3	2	2	11
Diospyros virginiana	0	0	0	0	0	0	2	0	0	0	16	5	5	5	4	2	13
Nyssa sylvatica	0	6	0	0	0	0	4	10	0	0	10	22	21	20	21	20	200
Quercus spp.	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0
Stems per plot	14	14	14	14	13	13	11	15	14	15	165	161	155	148	139	137	83
Stems per acre	**560**	**560**	**560**	**560**	**520**	**520**	**440**	**600**	**560**	**600**						**548**	**Average**

Average Stems per Acre for Year 5: **548**

Range of Stems per Acre for Year 5: **440-600**

Volunteer species were also monitored throughout the five-year monitoring period. Table 8 depicts the most commonly found woody volunteer species.

Table 8. Volunteers within Wetland Restoration Area

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
ID	**Scientific Name**	**Common Name**	**FAC Status**
A	*Liquidambar styraciflua*	Sweetgum	FAC+
B	*Acer rubrum*	Red Maple	FAC

Few volunteer woody species were observed in any of the vegetation plots, and were deemed too small to tally. Red maple (*Acer rubrum*) is the most common volunteer, though sweetgum (*Liquidambar styraciflua*) was also observed.

V Vegetation Observations

After construction of the mitigation site, a permanent ground cover seed mixture of Virginia wild rye (*Elymus virginicus*), switch grass (*Panicum virgatum*), and fox sedge (*Carex vulpinoidea*) was broadcast on the site at a rate of 10 pounds per acre. These species are present on the site. Hydrophytic herbaceous vegetation, including rush (*Juncus effusus*), spike-rush (*Eleocharis obtusa*), boxseed (*Ludwigia spp*.), and sedge (*Carex spp*.), are observed across the site, particularly in areas of periodic inundation. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the site.

The vegetation of both woody and herbaceous species has proliferated throughout the site. No additional plantings were needed throughout the five-year monitoring period. The average range in height for woody species ranges from 8 to 15 feet. Willows, sycamore, and tag Alders are well established along the channel and are providing bank stabilization as designed. Herbaceous species are also, well established along the channel and within the floodplain area. Wetland species such as tear thumb, sedge species, and rush species are flourishing within the designated wetland areas as well as in ephemeral pools within the floodplain.

Invasive species occurring on site consisted of kudzu, lespedeza, and bamboo. These species have been monitored and treated throughout the five-year monitoring period to allow the desirable vegetation time to become established.

VI Vegetation Conclusions

The site was planted in bottomland hardwood forest species in April and May 2006. There were ten vegetation-monitoring plots established throughout the planting areas. The data reflect that the overall site had earlier met the minimum success interim criteria of 320 trees per acre by the end of Year Three and has now met the final success criteria of 260 trees per acre by the end of Year Five as specified in the Mitigation Plan.

VII Vegetation Photos

Photos of the project showing the on-site vegetation are included in Appendix A of this report.

STREAM MONITORING

I Description of Stream Monitoring

To document the success criteria as per the Mitigation Plan, the following monitoring program was instituted following construction completion on the Site:

Bankfull Events: The occurrence of bankfull events within the monitoring period was documented by the use of a crest gauge and photographs. One crest gauge was installed on the floodplain within 10 feet of the restored channel, near As-built Station 176+00. The crest gauge recorded the highest watermark between site visits and was checked at each site visit to determine if a bankfull event had occurred. Photographs were taken to document the occurrence of these bankfull events and are included in Appendix A.

Cross-sections: Two permanent cross-sections were installed per 1,000 LF of stream restoration work, with one located at a riffle cross-section and one located at a pool cross-section. A total of 16 cross-sections were established. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. A common benchmark was used for cross-sections and consistently referenced to facilitate comparison of year-to-year data. The annual cross-sectional survey included points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, water surface, and thalweg, if the features are present. Riffle cross-sections were classified using the Rosgen stream classification system (Rosgen, 1994). Permanent cross-sections for 2010 (Year 5) were surveyed in September 2010 and are included in Appendix B.

Longitudinal Profiles: A partial longitudinal profile was surveyed for 2010 (Year 5). The profile was conducted for approximately 3,549 LF of South Fork Hoppers Creek, beginning upstream of the bridge at As-built Station 125+09 and continuing down to As-built Station 160+58. Measurements included thalweg, water surface, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool, glide). In addition, maximum pool depth was recorded. All survey was tied to a single permanent benchmark. These data are included in Appendix B of this report.

Bed Material Analysis: Pebble counts were conducted for the permanent cross-sections (100 counts per cross-section) on the Site. Pebble count data were plotted on a semi-log graph and are included in Appendix B.

Photo Reference Stations: Photographs were used to visually document restoration success. As total of 70 reference stations were established to document conditions at the constructed grade control structures across the Site. These photos are provided in Appendix A. Additional photo stations were established at each of the 16 permanent cross-sections and hydrologic monitoring stations. Each streambank was photographed at each permanent cross-section photo station. For each streambank photo, the photo view line followed a survey tape placed across the channel, perpendicular to flow (representing the cross-section line). The photograph was framed so that the survey tape is centered in the photo (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame. These photos are presented along with the cross-section monitoring data in Appendix B.

The GPS coordinates of each photo station were noted as additional reference to ensure the same photo location was used throughout the monitoring period. These stations are included in the As-built Plan Sheets in Appendix C. Reference photos were taken once per year.

II Stream Restoration Success Criteria

The approved Mitigation Plan requires the following criteria be met to achieve stream restoration success:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring

period. The two bankfull events must occur in separate years.

- *Cross-sections:* There should be little change in as-built cross-sections. If changes to channel cross-section take place, they should be minor changes representing an increase in stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio).
- *Longitudinal Profiles:* The longitudinal profiles should show that the bedform features are remaining stable (not aggrading or degrading). The pools should remain deep with flat water surface slopes and the riffles should remain steeper and shallower than the pools.
- *Bed Material Analysis:* Pebble counts should indicate maintenance of bed material.
- *Photo Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photos should indicate the absence of developing bars within the channel, no excessive bank erosion or increase in channel depth over time, and maturation of riparian vegetation. These stations are included in the As-built Plan Sheets in Appendix C.

III Bankfull Discharge Monitoring Results

The on-site crest gauge documented the occurrence of two bankfull flow events during the fifth year (2009 - 2010) of the post-construction monitoring period. Table 9 shows, bankfull flows that were documented during each of the five years of monitoring). Inspection of site conditions following these events revealed visual evidence of out-of-bank flow, confirming the crest gauge reading. The largest stream flow documented by the crest gauge during Year 5 of monitoring was approximately 2.12 feet (25.44 inches) above the bankfull stage.

A photo of the crest gauge reading for March 2010 is not available; however, a photo of the crest gauge reading for September of 2010 is located in Appendix A.

Table 9. Verification of Bankfull Events

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Gage Height (feet)
5/11/2006	Unknown	Crest Gage	0.23
7/17/2006	Unknown	Crest Gage	0.16
8/18/2006	Unknown	Crest Gage	1.09
11/29/2006	Unknown	Crest Gage	0.28
1/16/2007	Unknown	Crest Gage	0.73
3/13/2007	Unknown	Crest Gage	1.13
5/22/2007	Unknown	Crest Gage	0.1
7/17/2007	Unknown	Crest Gage	0.08
9/17/2007	Unknown	Crest Gage	1.63
1/16/2008	Unknown	Crest Gage	0.16
4/1/2008	Unknown	Crest Gage	0.17
7/25/2008	Unknown	Crest Gage	0.22

Table 9. Verification of Bankfull Events

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Gage Height (feet)
3/31/2009	Unknown	Crest Gage	0.63
7/23/2009	Unknown	Crest Gage	0.97
3/31/2010	Unknown	Crest Gage	2.12
9/30/2010	Unknown	Crest Gage	0.69

IV Stream Monitoring Data and Photos

A photo log of the project showing each of the 70 permanent photo locations is included in Appendix A of this report. Survey data and photos from each permanent cross-section are included in Appendix B of this report.

V Stream Stability Assessment

Table 10 presents a summary of the results obtained from the visual inspection of in-stream structures performed during Year 5 of post-construction monitoring. The percentages noted are a general overall field evaluation of the how the features were performing at the time of the last photo point survey on October 29, 2010. These percentages are solely based on the visual assessment of the field evaluator at the time of the site visit.

Visual observations of the various structures throughout the Year 5 growing season indicated that structures were functioning as designed and holding their elevation grade. Cover logs placed in meander pool areas allowed scour to keep pools deep and provide cover for fish. Root wads placed on the outside of meander bends provided bank stability and in-stream cover for fish and other aquatic organisms.

Issues discovered during Year 2 monitoring were closely observed during Year 3 and Year 4 investigations. During Year 2 monitoring a few isolated pockets of scour were observed along the upstream end of rootwads located at stations 124+50, 126+75, and 133+50. The scour appeared to have taken place before vegetation established along the streambanks. These areas of minor scour were only partially visible during Year 5 monitoring, and have stabilized with the maturation of the riparian vegetation. Three minor areas of scour were observed at stations 131+25, 141+85, and 173+40, in Year 5; however they should not affect channel stability.

Beaver activity, downstream of the site and within the downstream extents of the project, were documented in Monitoring Years 2 and 3, respectively, and were removed in the subsequent year. No beaver activity was documented in Year 4; however, beaver activity has returned to the site with beaver impoundments located at stations 178+40 and 181+60.

Table 10. Categorical Stream Feature Visual Stability Assessment

South Fork Hoppers Creek Restoration Site: Project No. D04006-4						
	Performance Percentage					
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%	100%	100%
Pools	100%	100%	100%	100%	100%	100%
Thalweg	100%	100%	100%	100%	100%	100%

Table 10. Categorical Stream Feature Visual Stability Assessment

South Fork Hoppers Creek Restoration Site: Project No. D04006-4						
	Performance Percentage					
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
Meanders	100%	100%	100%	100%	100%	95%
Bed General	100%	100%	100%	100%	100%	100%
Vanes / J Hooks etc.	100%	100%	100%	100%	100%	100%
Wads and Boulders	100%	100%	95%	95%	95%	95%

VI Cross-section, Longitudinal Profile, and Bed Material Analysis Monitoring Results

Cross-sections

Year 5 cross-section monitoring data for stream stability were collected during September 2010 and compared to as-built conditions, Year 1 (collected October 2006), Year 2 (collected October - November 2007), Year 3 data (collected October 2008), Year 4 data (collected September 2009). The 16 permanent cross-sections along the restored channels (8 located across riffles and 8 located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 5. Cross-sections are provided in Appendix B, and data from the cross-sections are summarized in Appendix E.

Previous monitoring years have noted slight variations among the monitored cross-sections. The changes in dimension observed are positive changes, mostly from pools decreasing in depth and riffles narrowing from vegetative growth. The channel continues to successfully move sediment through the system and maintain stability. Throughout the monitoring period, point bars continue to develop and become more defined along the inside of meander bends showing that flow velocity vectors are functioning as designed.

The cross-section data, over the five-year monitoring period, continue to show a dynamic system that is able to adjust its dimension and maintain stability while accommodating for fluctuations in external environment inputs.

Longitudinal Profiles

The Year 5 longitudinal profile was conducted during September 2010. A representative 3,549 LF section of the channel was surveyed, beginning at As-built Station 125+09 and ending at As-built Station 160+58. The representative longitudinal profile along the restored channel was resurveyed to document stream profile at the end of monitoring Year 5. Placement of the rock cross-vanes upstream of the bridge at Pierce Rd, as well as, natural migration of the thalweg accounts for the 50 LF discrepancy between the post-construction survey length and the as-built conditions.

Monitoring data show that pool spacing on Reach 1 has slightly increased and that riffle slopes and sinuosity have continued to slightly increase and decrease, respectively, for Reach 2 throughout the monitoring period. Though present, these changes seem to be minor and are not adversely affecting the stability of the channel. All other profile data on both Reach 1 and Reach 2 have maintained consistent throughout the monitoring period.

The longitudinal profile is included in Appendix B. A summary of parameters measured are provided in Appendix E. Please note that this summary represents only the portion of the project that was surveyed.

Bed Material Analysis

Year 5 bed material samples were collected at each permanent cross-section during September 2010. Both pools and riffles along the main channel have shown the ability to effectively move fine sediments through the system while maintaining coarser bed material in the riffles and finer sediments in the pools. Riffles within the mainstem continue to be dominated by very coarse gravel and small cobbles, while

pools are dominated by a mix of coarse sand and fine gravels.

UT 1 continues to receive influxes of fines to the system from it contributing drainage area. Cross-section 8 (riffle) has continued to coarsen throughout the monitoring period exhibiting its ability to effectively move finer sediments, from the contributing drainage area, through the system. Cross-section 7 did contain more silts and clays in Year 5 than previous years, however, the cross-section's mean and max pool depths are deeper and resemble those of as-built conditions. Therefore, this accumulation of fines is likely to be a temporary influx of silts and clays from the contributing drainage area just prior to sampling.

All pebble count data are provided in Appendix B.

HYDROLOGY MONITORING

Weather station data from the NRCS National Climate and Water Center (Marion WETS Station in McDowell County – NC 5340) and the USGS Water Data for North Carolina (USGS 03451500 French Broad River at Asheville, NC) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. Rainfall was below average for the majority of the growing season. Precipitation fluctuated greatly from October 2009 to February 2010. Though precipitation seemed to stabilize in amounts recorded from March through September of 2010, rainfall was still significantly below average. When on-site rainfall data was unavailable, total monthly rainfall data was calculated using the rain gauge data from the aforementioned USGS gauge site.

The Restoration Plan for the Site specifies that eight monitoring gauges (five automated and three manual) would be established across the restored site. These eight monitoring gauges were installed during early-March 2006 to document water table hydrology in all required monitoring locations. The wells were located across the site to document the variability in site hydrology, and the locations of monitoring gauges are shown on the as-built plan sheets. As stated in the Restoration Plan, the well monitoring data should show that the Site has been saturated within 12 inches of the soil surface for at least 5 percent of the growing season, and that the site has exhibited an increased frequency of flooding.

Hydrologic monitoring results are shown in Tables 11 and 12. Figure 5 compares historic rainfall events to rainfall observed during this monitoring year.

Table 11. Comparison of Historic Rainfall to Observed Rainfall (Inches)

South Fork Hoppers Creek Restoration Site: EEP Contract No. D04006-4					
Year	**Month**	**Average[A]**	**30%[A]**	**70%[A]**	**Observed 2010 Precipitation**
2009	October	3.95	2.17	5.43	9.51**
2009	November	4.43	2.96	5.29	0.02**
2009	December	3.96	2.20	5.00	5.67***
2010	January	4.23	3.10	5.35	0.06
2010	February	15.46	2.09	5.36	2.92*
2010	March	5.43	3.45	6.52	4.10
2010	April	4.41	2.54	6.00	0.02
2010	May	5.40	3.88	6.41	2.88
2010	June	4.70	2.91	5.98	0.57
2010	July	4.28	2.87	5.53	0.62
2010	August	4.24	2.88	5.44	2.77
2010	September	4.48	2.22	5.45	2.74*

(NRCS National Climate and Water Center, 2000 and USGS, 2009 & 2010)

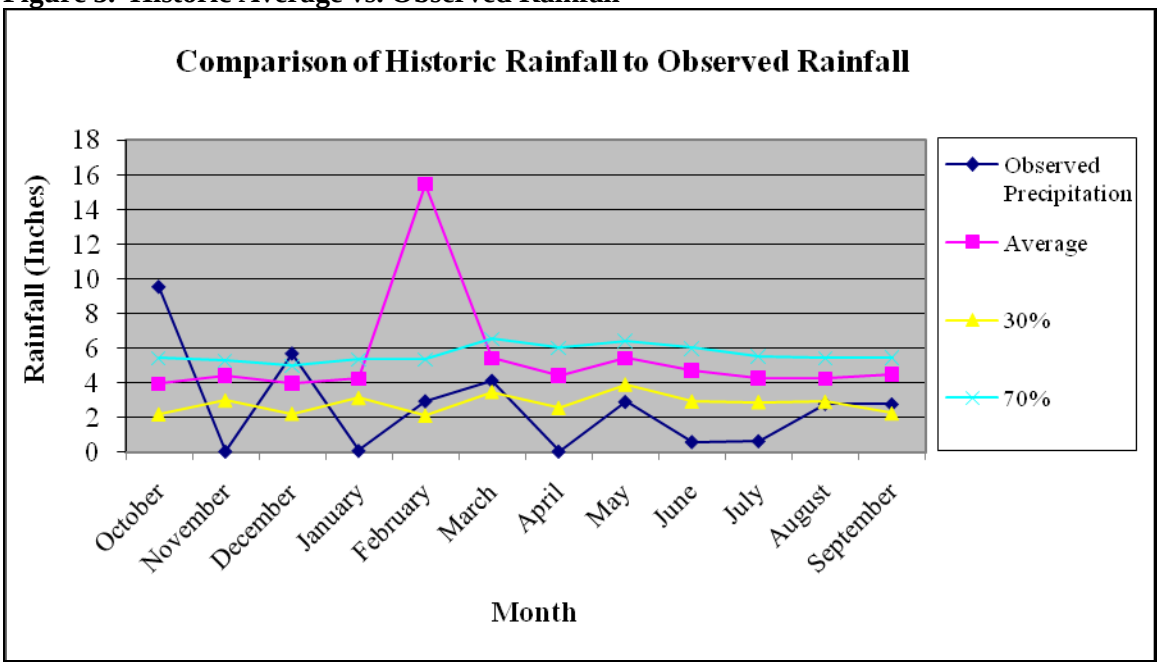
[A]Data in these columns presented exactly as reported by the NRCS National Climate and Water Center. (Marion WETS Station in McDowell County – NC5340)

*Monthly on-site rainfall data unavailable, so total monthly rainfall data was calculated using the nearest USGS rain gauge data (USGS 03451500 FRENCH BROAD RIVER AT ASHEVILLE, NC) to the project site. (USGS, 2009 & 2010)

**Rainfall recorded on-site from 2009

***2009 data from USGS 03451500 rain gauge

Figure 5. Historic Average vs. Observed Rainfall



To meet reporting deadlines, results for the Year 5 monitoring period were collected from the first 186 days of the growing season (3/28/2010 - 9/30/2010). However, the percentage of days in which water as present within 12 inches of the soil surface for each well is still based on a 222-day growing season. Though the growing season data collection was shortened by 36 days, all eight wells had already met the hydroperiod success criteria with a minimum of 26 consecutive days (7 percent) with water present within 12 inches of the soil surface (WRP, 2005). Hydrologic data collected from the existing wetland reference sites indicate that the reference sites experienced hydroperiods considerably less than the hydroperiods recorded by all eight wells at the restoration site.

Table 12. Comparison of Hydrologic Monitoring Results for Year 5, Year 4, Year 3, Year 2, and Year 1

South Fork Hoppers Creek Restoration Site: EEP Contract No. D04006-4										
Monitoring Station	Most Consecutive Days Meeting Criteria[1]					Cumulative Days Meeting Criteria[2]				
	Year 5 Monitoring[7]	Year 4 Monitoring	Year 3 Monitoring	Year 2 Monitoring	Year 1 Monitoring	Year 5 Monitoring	Year 4 Monitoring	Year 3 Monitoring	Year 2 Monitoring	Year 1 Monitoring
AW1	186 (100%)	222 (100%)	222 (100%)	222 (100%)	222 (100%)	186 (100%)	222 (100%)	222 (100%)	222 (100%)	222 (100%)
AW2	26 (14%)	89 (40%)	80 (36%)	222 (100%)	222 (100%)	34 (18%)	93 (42%)	173 (78%)	222 (100%)	222 (100%)
AW3	94 (51%)	113 (51%)	76 (35%)	133 (60%)	75 (34%)	139 (75%)	210 (95%)	131 (59%)	218 (98%)	178 (77%)
AW4	33 (18%)	27 (12%)	13 (6%)	33 (15%)	16 (7%)	68 (37%)	80 (36%)	43 (20%)	58 (26%)	58 (26%)
AW5	186 (100%)	222 (100%)	166 (75%)	222 (100%)	175 (79%)	186 (100%)	222 (100%)	166 (75%)	222 (100%)	190 (86%)
MW1[4]	186 (100%)	222 (100%)	222 (100%)	222 (100%)	222 (100%)	186 (100%)	222 (100)	222 (100%)	222 (100%)	222 (100%)
MW2[5]	26 (14%)	89 (40%)	80 (36%)	222 (100%)	222 (100%)	34 (18%)	91 (41%)	173 (78%)	222 (100%)	222 (100%)
MW3[4]	186 (100%)	222 (100%)	222 (100%)	222 (100%)	222 (100%)	186 (100%)	222 (100%)	222 (100%)	222 (100%)	222 (100%)
REF1[6]	10 (5%)	8 (4%)	7 (4%)	5 (2%)	5 (2%)	13 (7%)	52 (25%)	10 (5%)	26 (12%)	39 (18%)
REF2[6]	3 (2%)	6 (3%)	5 (3%)	4 (2%)	4 (2%)	3 (2%)	25 (12%)	10 (5%)	13 (6%)	17 (8%)

1 Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches from the soil surface.

2 Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.

3 Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.

4 Groundwater gauges MW1 and MW3 are manual gauges. Hydrologic parameters are estimated based on observations and correlation with automated gauge AW1.

5 Groundwater gauge MW2 is a manual gauge. Hydrologic parameters are estimated based on observations and correlation with automated gauge AW2.

6 Reference ground water gauges are located on an Unnamed Tributary to Little Silver Creek in Morganton, NC

7 Growing season for the Year 5 monitoring period was shortened to meet reporting deadline. Monitoring data is based on a 186 day growing season (3/28/2010 - 9/30/2010)

CONCLUSIONS AND RECOMMENDATIONS

Vegetation Monitoring

Vegetation monitoring have documented that the average number of stems per acre on site to be 548, which is a survival rate of greater than 82 percent based on the initial planting count of 664 stems per acre. Kudzu, bamboo, and lespedeza have been treated throughout the monitoring period and do not seem to currently pose potential problems. The Site has achieved the final vegetative success criteria of at least 260 stems per acre at Year 5.

Stream Monitoring

The total length of stream channel restored on the Site was 7,229 LF. This entire length was inspected during Year 5 of the monitoring period (2010) to assess stream performance. Based on the data collected and a visual assessment, riffles, pools, and other constructed features along the restored channel are stable and functioning as designed. Remnant isolated scour, noted in Years 2 through 4, along the outer bank of a few pools upstream of Pierce Road have not shown any further signs of degradation and are becoming more stable due to maturation of the riparian vegetation. Additional minor areas of scour were observed at Station 131+25, 141+85, and 173+40 and should stabilize on their own over time. Beaver impoundments located at Stations 178+40 and 181+60 should be removed.

Overall, the lack of problem areas along the length of the restored channel through five years of post-construction monitoring supports the functionality of the design. It is expected that stability and in-stream habitat of the system will continue to improve in the coming years as permanent vegetation matures. The Site has achieved the stream stability success criteria specified in the Restoration Plan.

Hydrologic Monitoring

Data collected during the 2010 growing season by the eight monitoring gauges showed that hydrology varied across the Site. The hydrology of these areas is expected to be more variable throughout the growing season, with the wettest periods during the early spring and late fall. Groundwater levels at all eight gauges recorded hydroperiods above the specified success criteria specified in the Restoration Plan throughout the five-year monitoring period, except for one gauge in one year. The groundwater inventory data documents that all wetland areas within the site met the hydrologic success criteria specified in the Restoration Plan.

WILDLIFE OBSERVATIONS

Throughout the year, frogs, turtles, snakes, aquatic insects, and three- to four-inch long fish have been observed at the Site. Deer and raccoon tracks were commonly observed. Two dams at Stations 178+40 and 181+60 indicate the presence of beavers. Blue herons have also been documented during monitoring activities.

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APPENDIX A

PHOTO LOG

CREST GAUGE PHOTOS

CREST GAUGE PHOTOS OF BANKFULL

Crest Gauge – 9/30/10

PHOTO ID LOG

S. Fork Hoppers – PID 1

S. Fork Hoppers – PID 2

S. Fork Hoppers – PID 3

S. Fork Hoppers – PID 4

S. Fork Hoppers – PID 5

S. Fork Hoppers – PID 6

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S. Fork Hoppers – PID 8

S. Fork Hoppers – PID 9

S. Fork Hoppers – PID 10

S. Fork Hoppers – PID 11

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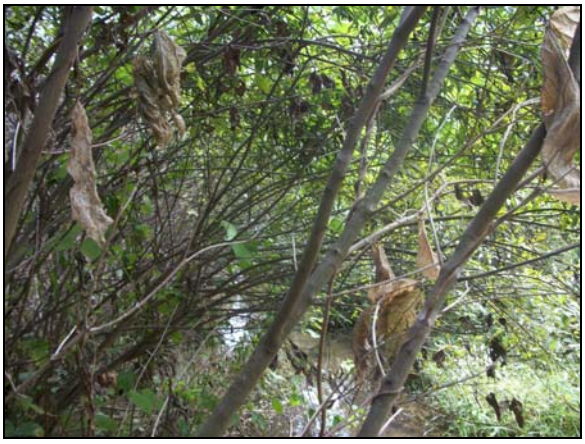

S. Fork Hoppers – PID 28

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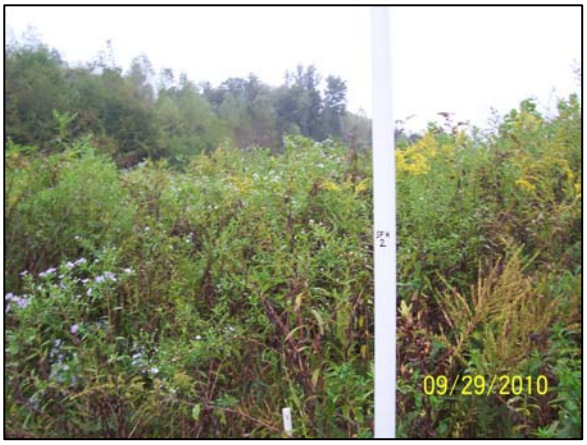
S. Fork Hoppers – PID 70

VEG PLOT PHOTOS

Veg Plot #1



Veg Plot #2

Veg Plot #3

Veg Plot #4

Veg Plot #5

Veg Plot #6

Veg Plot #7

Veg Plot #8

Veg Plot #9

Veg Plot #10

APPENDIX B

STREAM MONITORING DATA

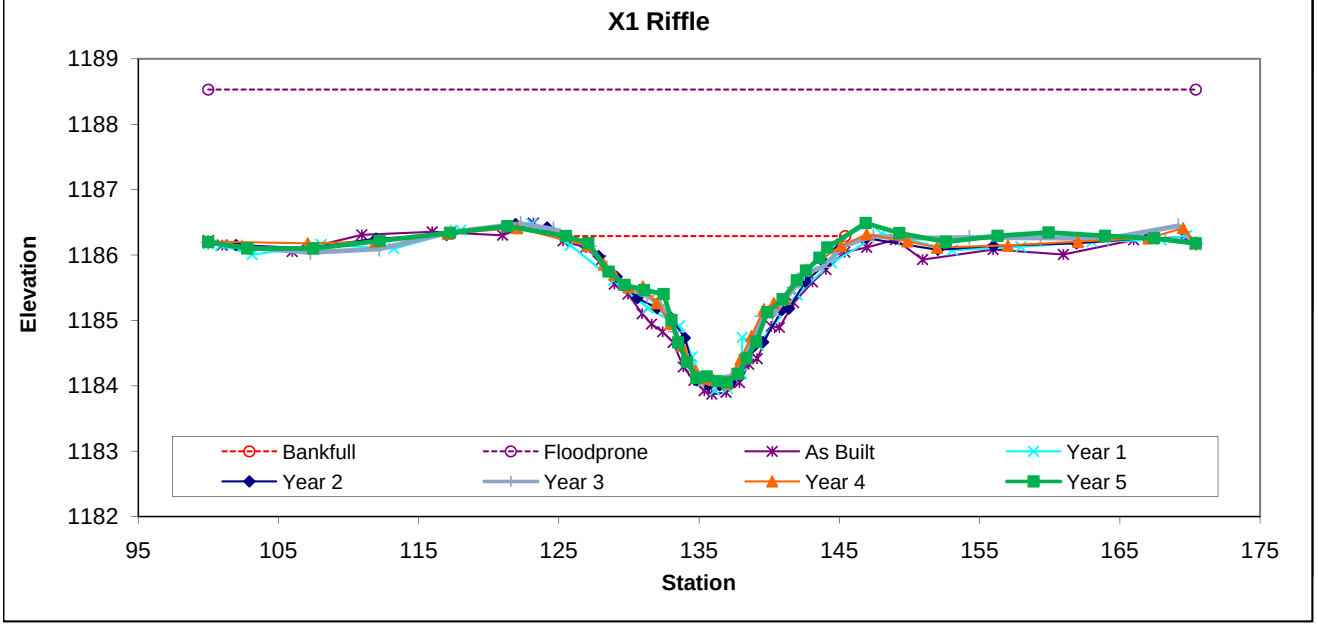
Permanent Cross Section X1

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	20.4	19.88	1.03	2.24	19.37	1	3.5	1186.29	1186.29



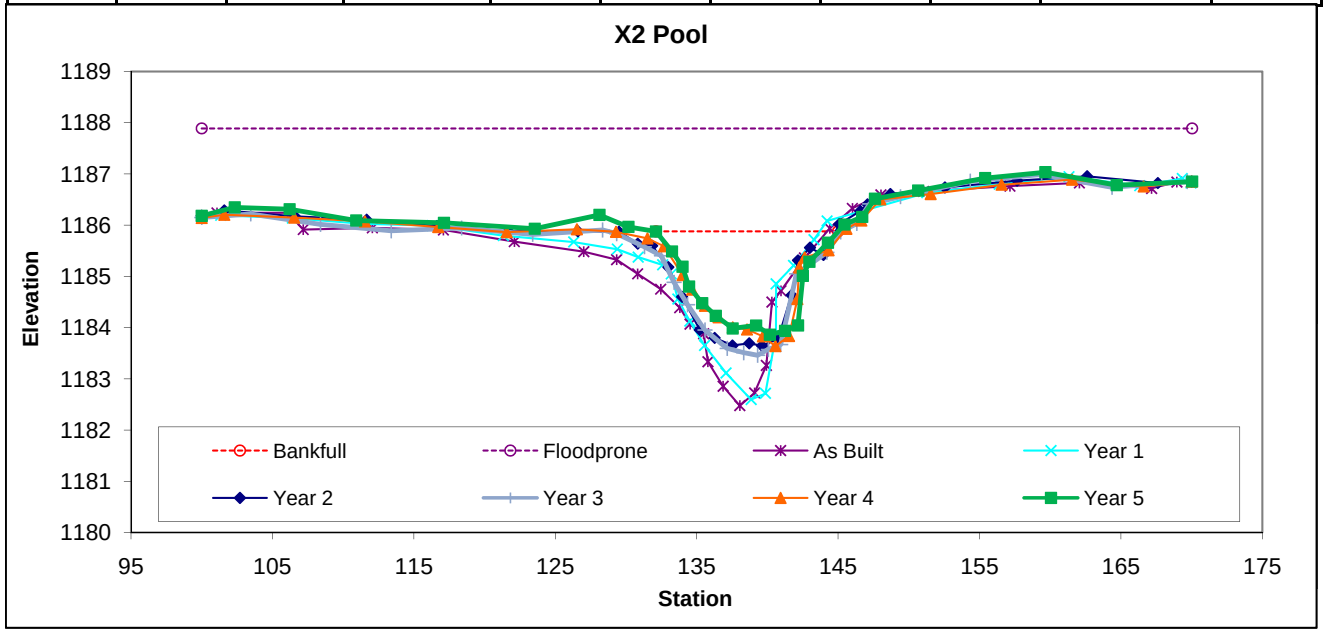
Permanent Cross Section X2

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16	12.88	1.24	2.01	10.39	1	5.4	1185.88	1185.88



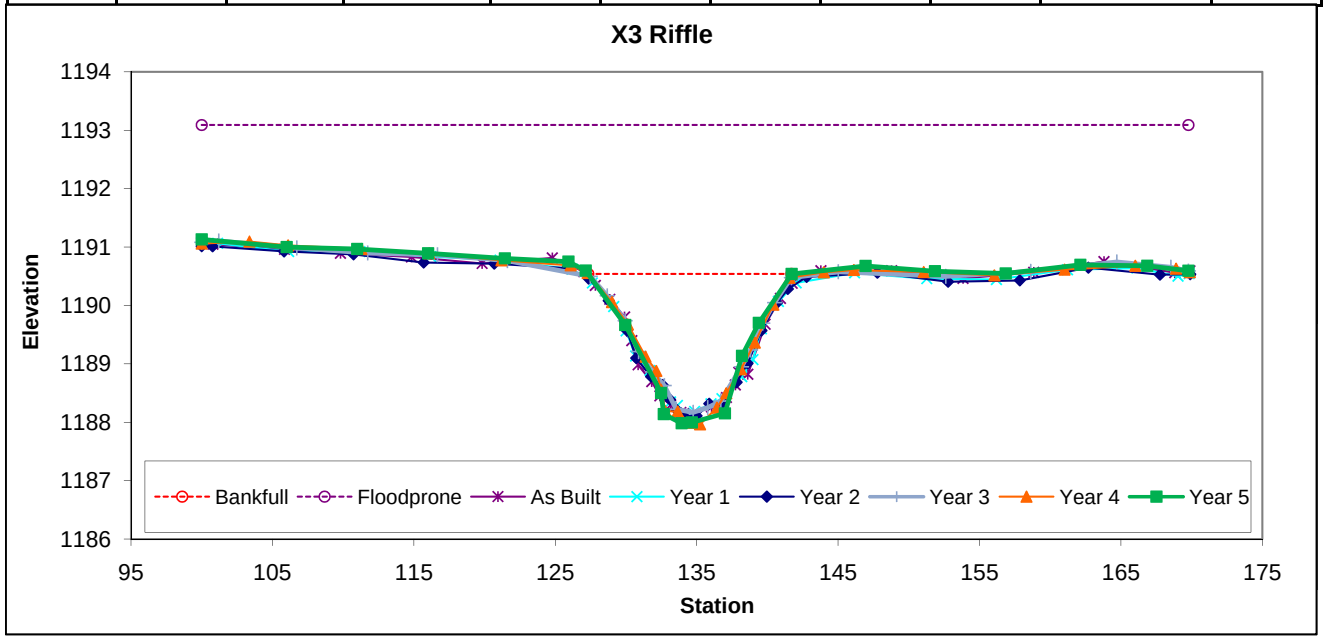
Permanent Cross Section X3

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	20.6	14.39	1.43	2.56	10.06	1	4.9	1190.54	1190.54



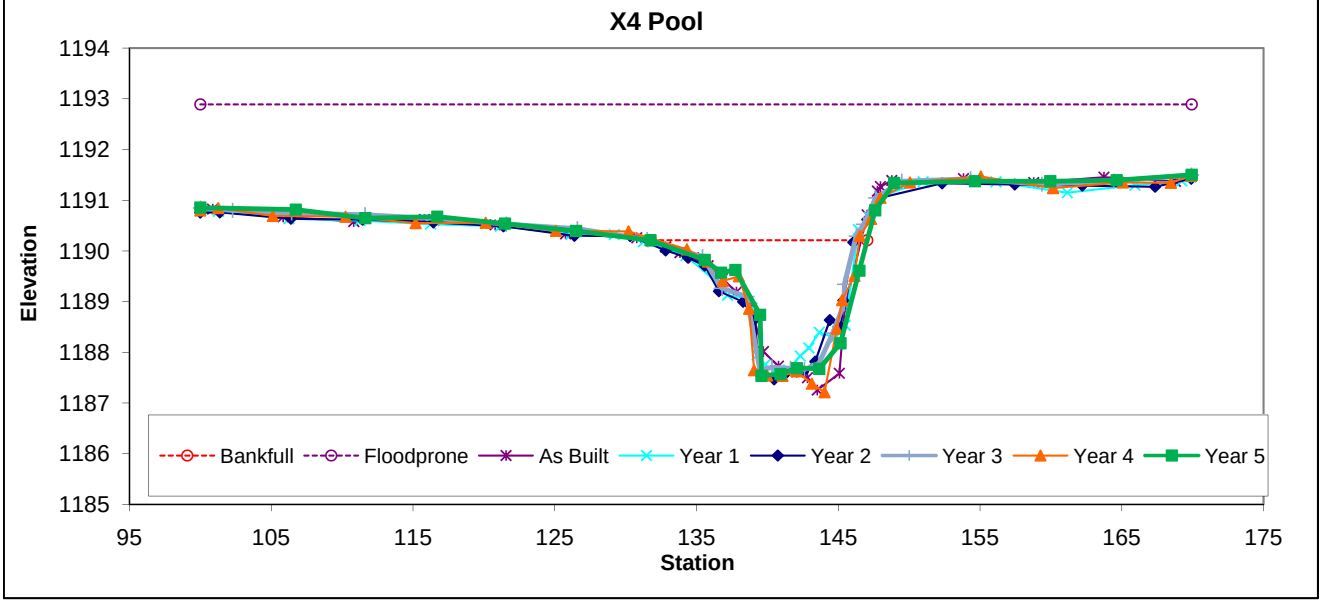
Permanent Cross Section X4

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		19.8	15.29	1.3	2.68	11.78	1	4.6	1190.21	1190.21



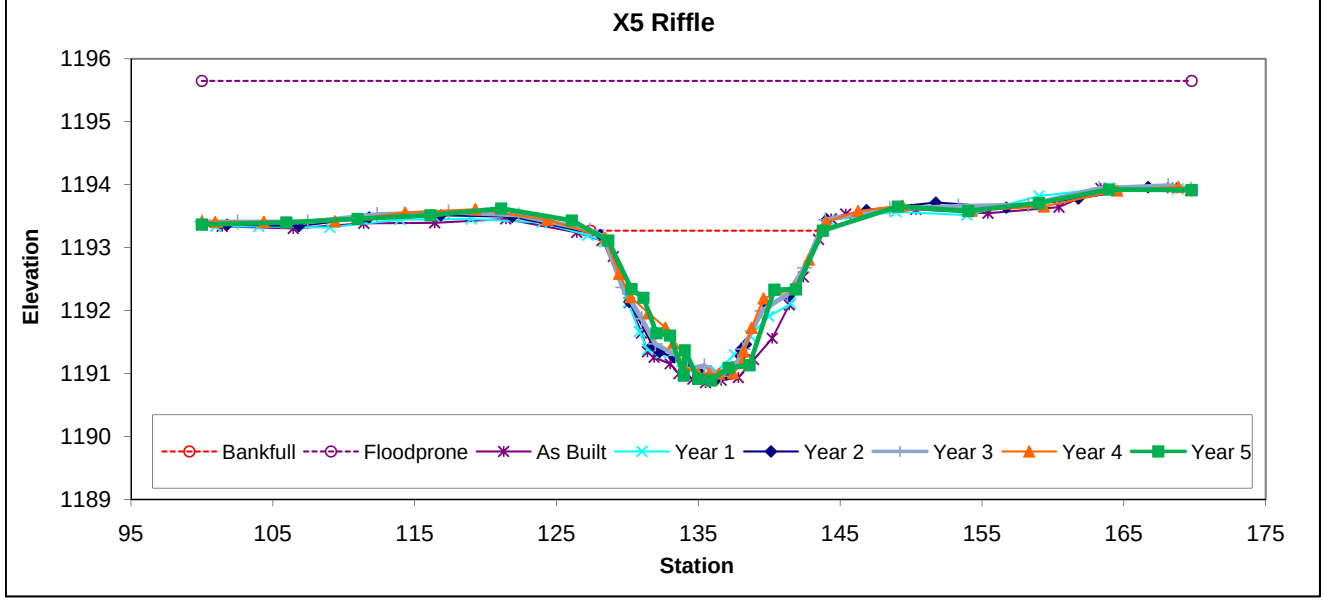
Permanent Cross Section X5

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	21.9	16.38	1.33	2.38	12.28	1	4.3	1193.27	1193.27



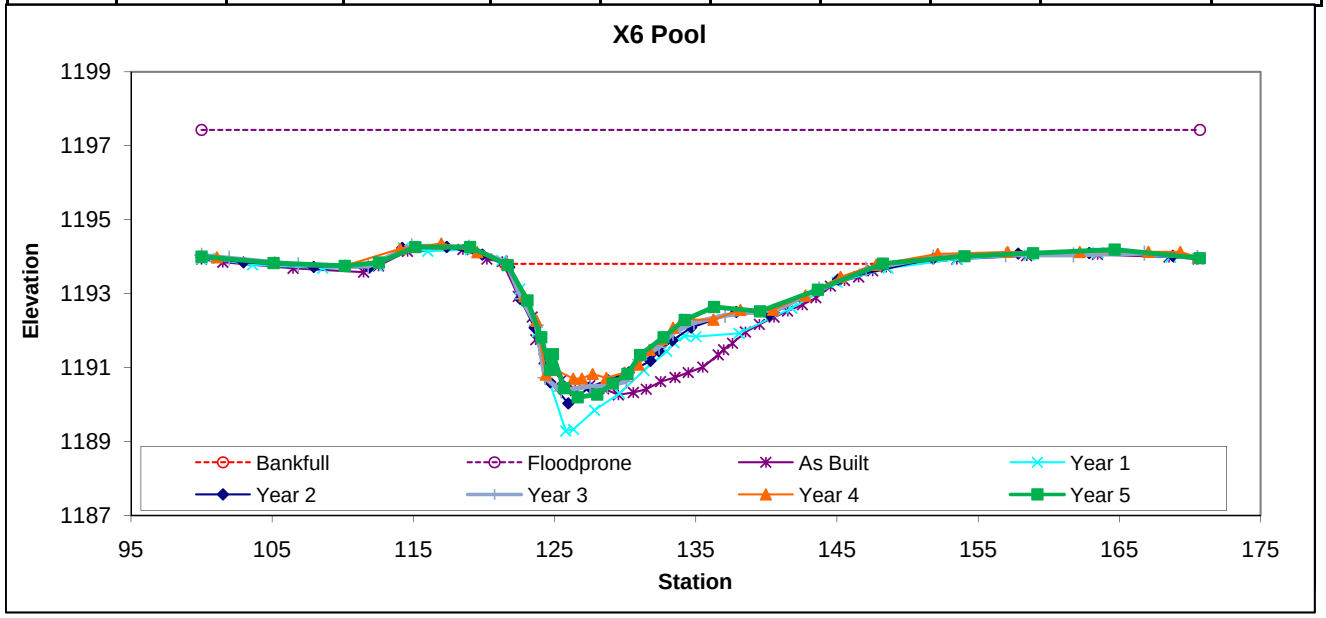
Permanent Cross Section X6

(Year 5 Monitoring Data - collected October 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		43.1	26.78	1.61	3.61	16.64	1	2.6	1193.81	1193.81



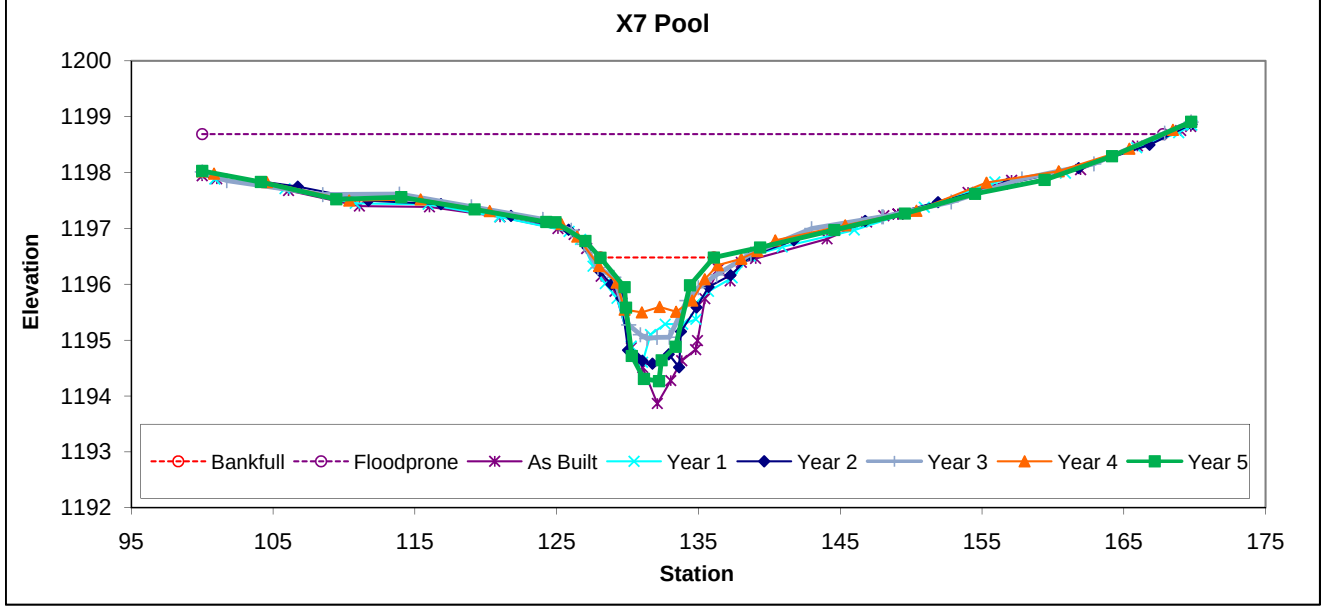
Permanent Cross Section X7

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		8.6	8.01	1.08	2.21	7.43	1	8.5	1196.48	1196.48



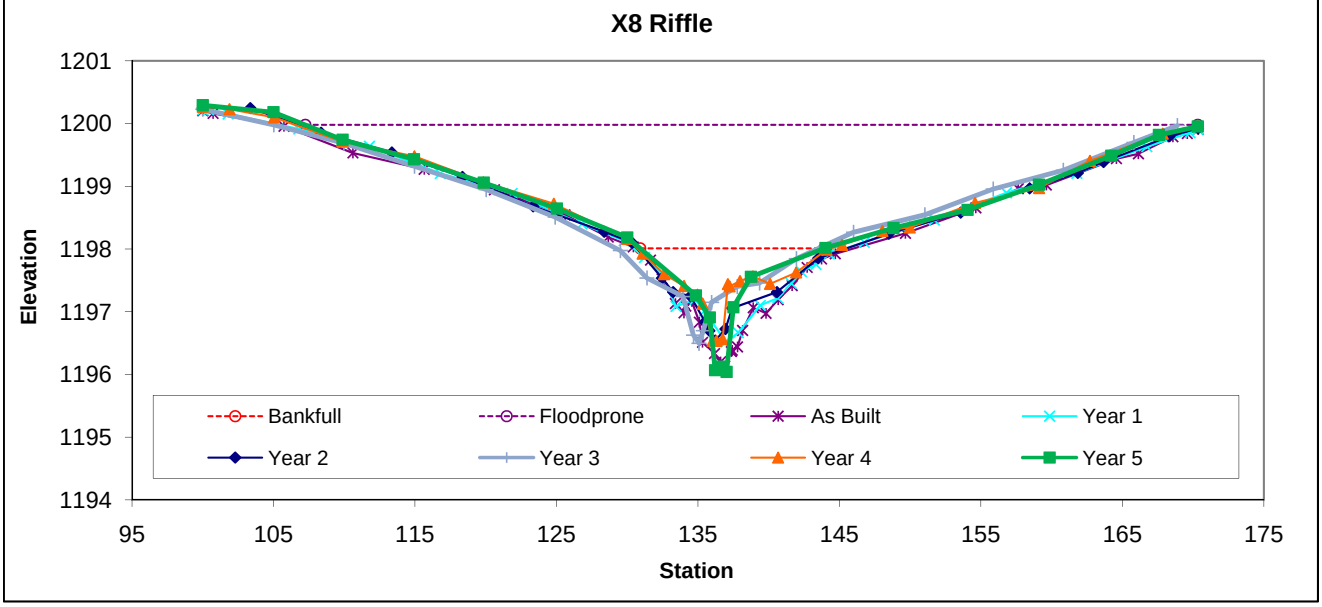
Permanent Cross Section X8

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	7.2	13.01	0.56	1.97	23.36	1	4.8	1198.01	1198.02



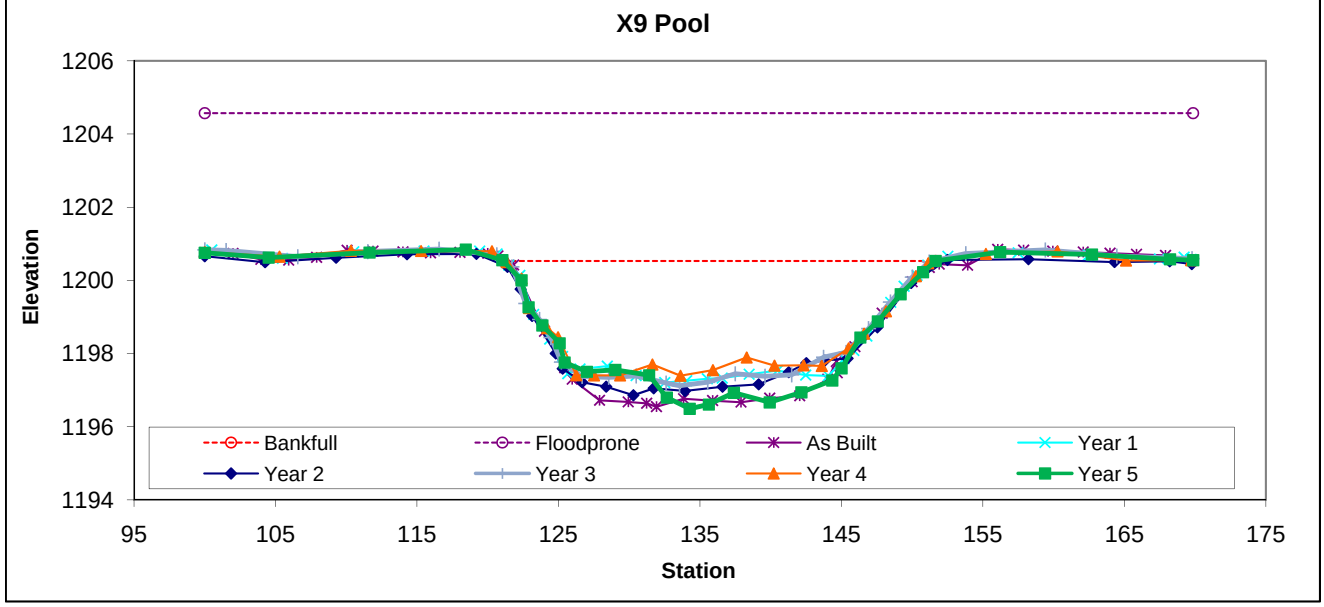
Permanent Cross Section X9

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		82.2	30.57	2.69	4.04	11.36	1	2.3	1200.53	1200.53



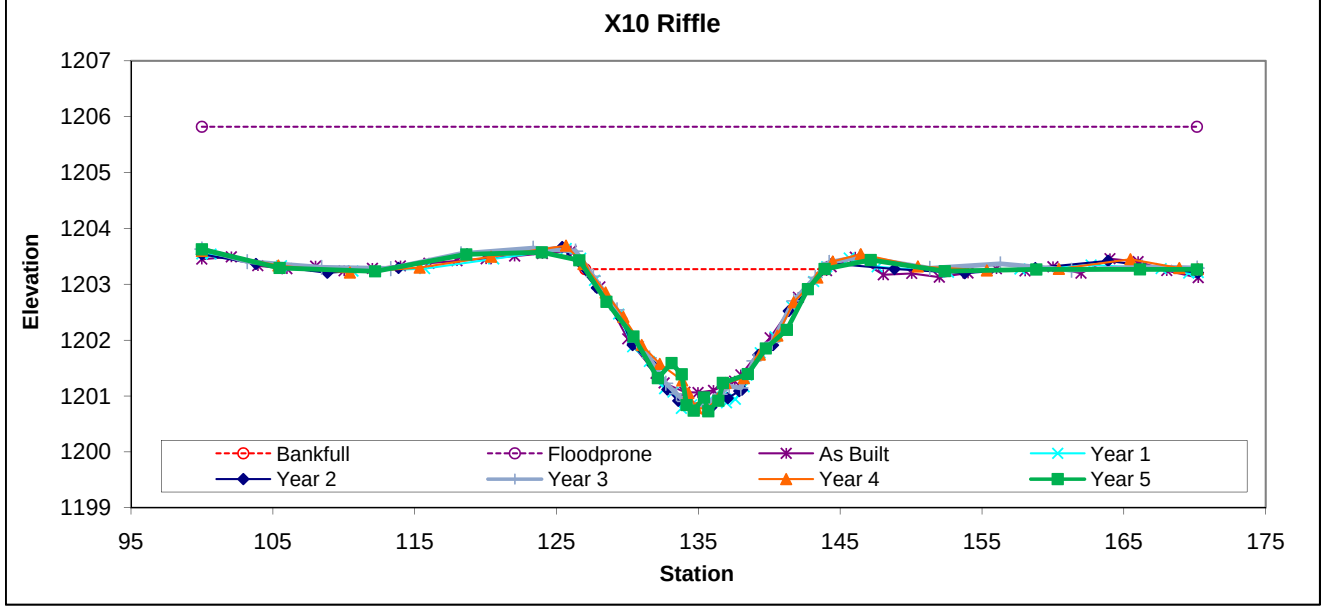
Permanent Cross Section X10

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	23.5	16.89	1.39	2.55	12.13	1	4.2	1203.27	1203.27



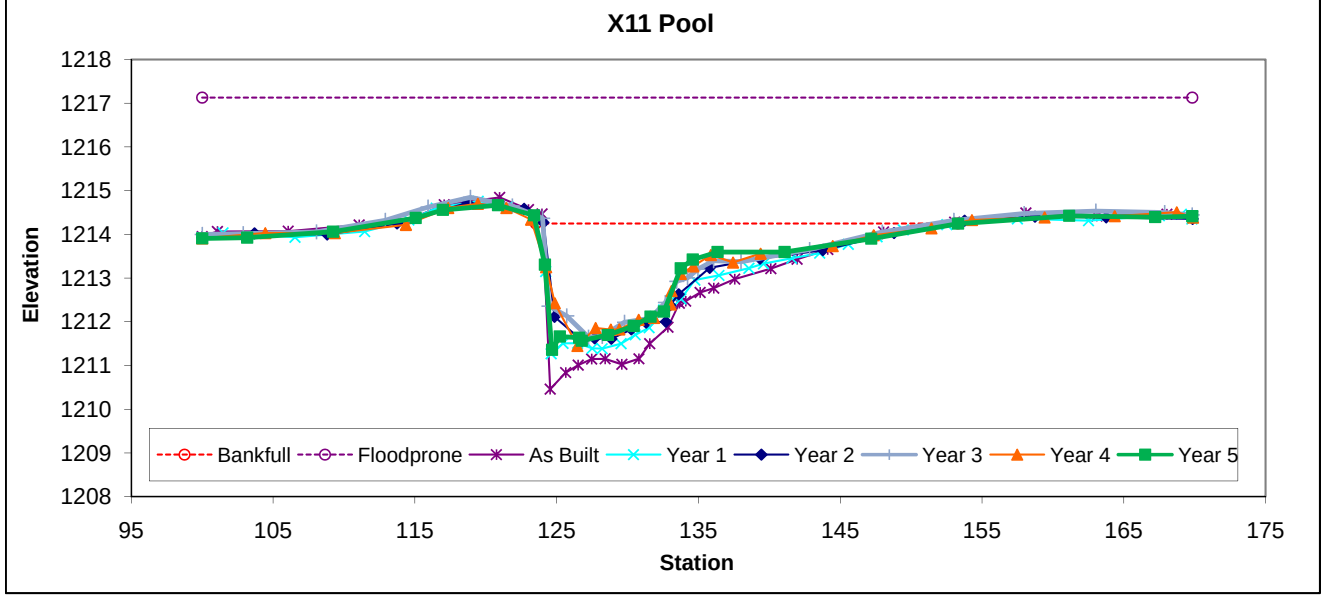
Permanent Cross Section X11

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		31.7	29.77	1.06	2.89	27.98	1	2.3	1214.25	1214.25



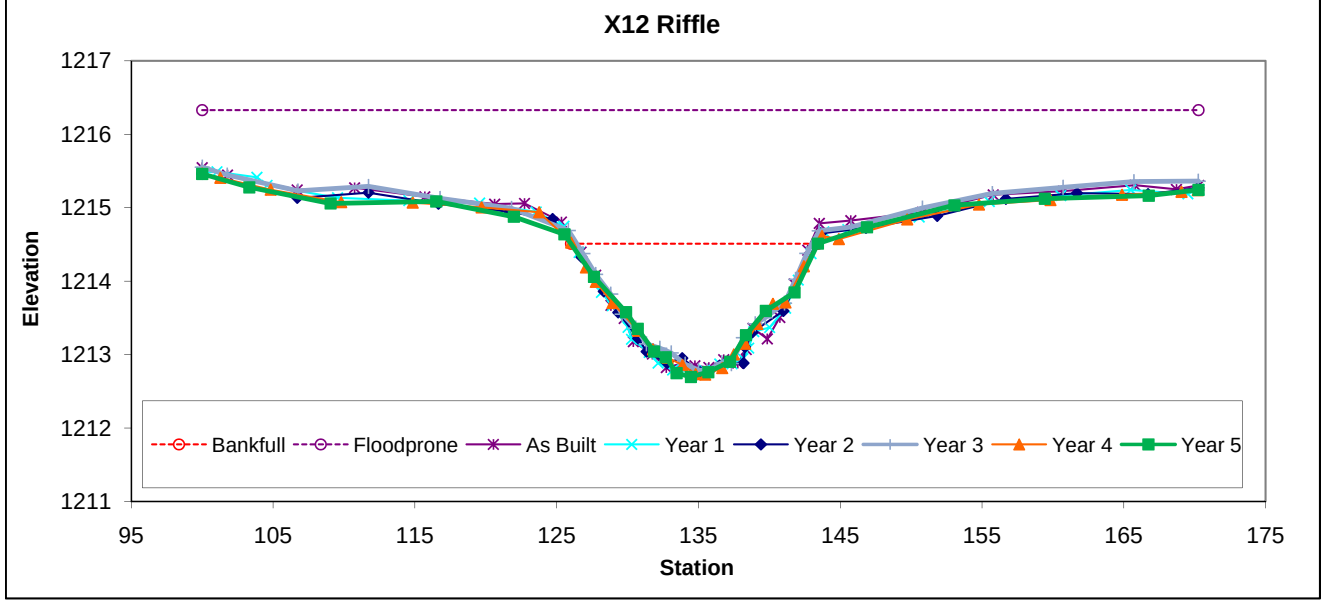
Permanent Cross Section X12

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	18.7	17.41	1.07	1.82	16.26	1	4	1214.51	1214.51



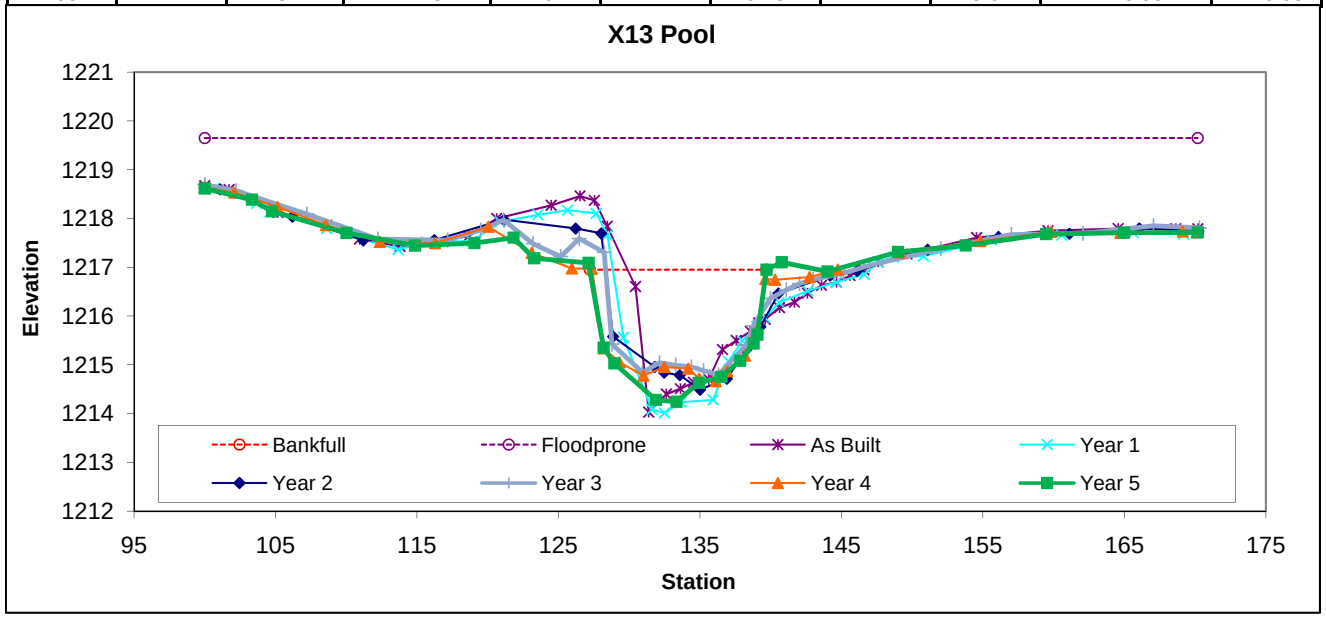
Permanent Cross Section X13

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		25.4	12.48	2.04	2.71	6.13	1	5.6	1216.95	1216.95



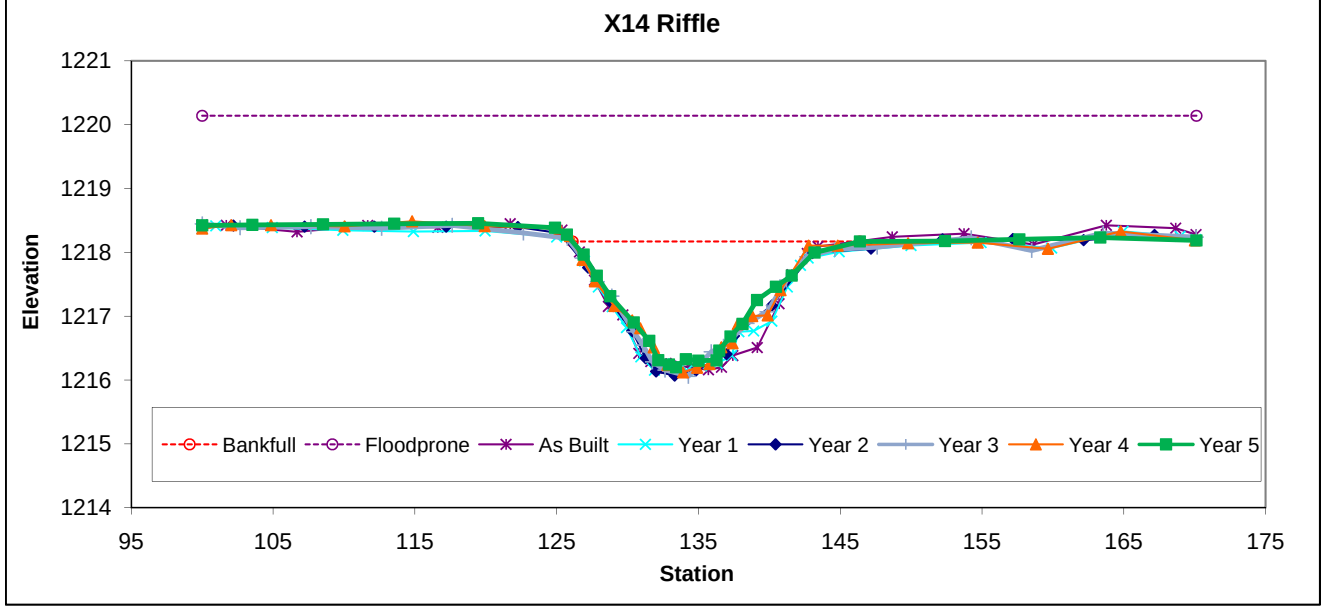
Permanent Cross Section X14

(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	19.8	20.26	0.98	1.97	20.77	1	3.5	1218.17	1218.17



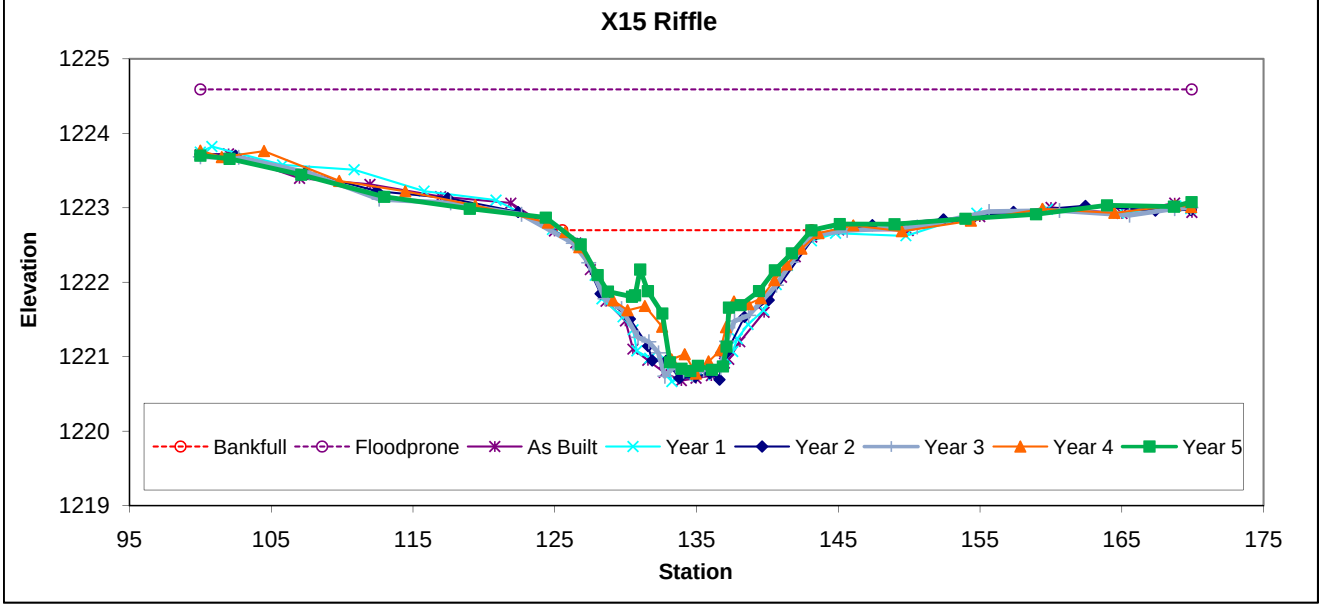
Permanent Cross Section X15

(Year 5 Monitroing Data - collected September 2010)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	16.2	17.58	0.92	1.89	19.08	1	4	1222.7	1222.7



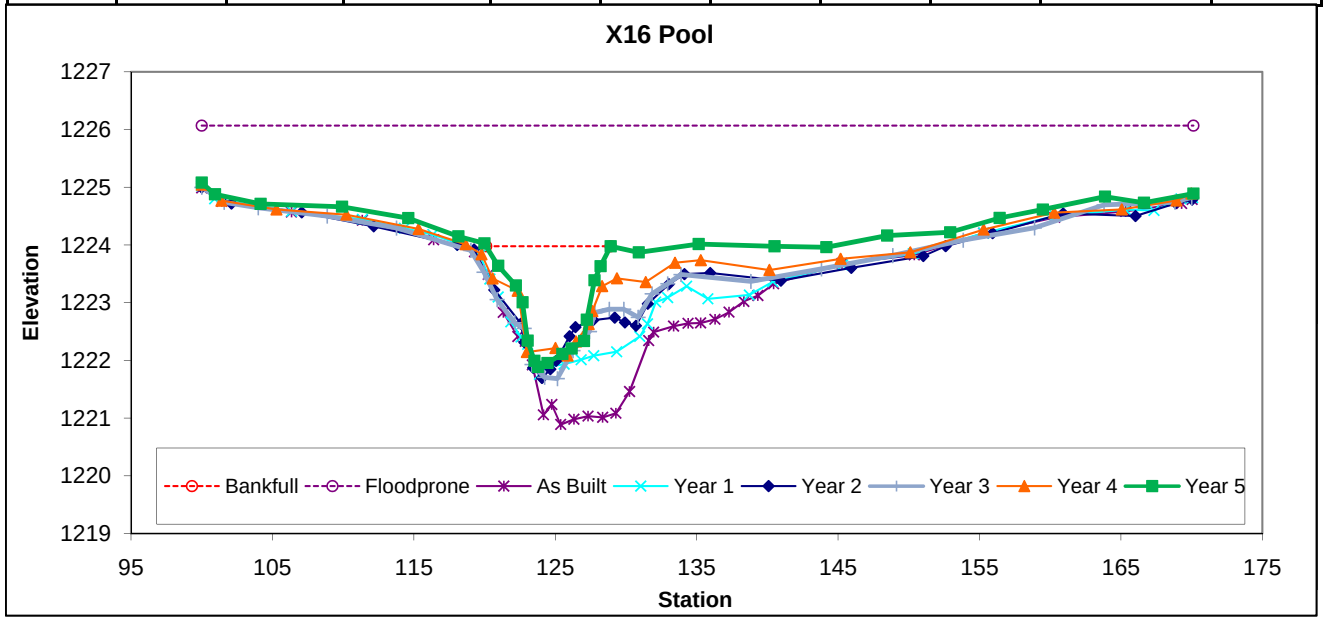
Permanent Cross Section X16

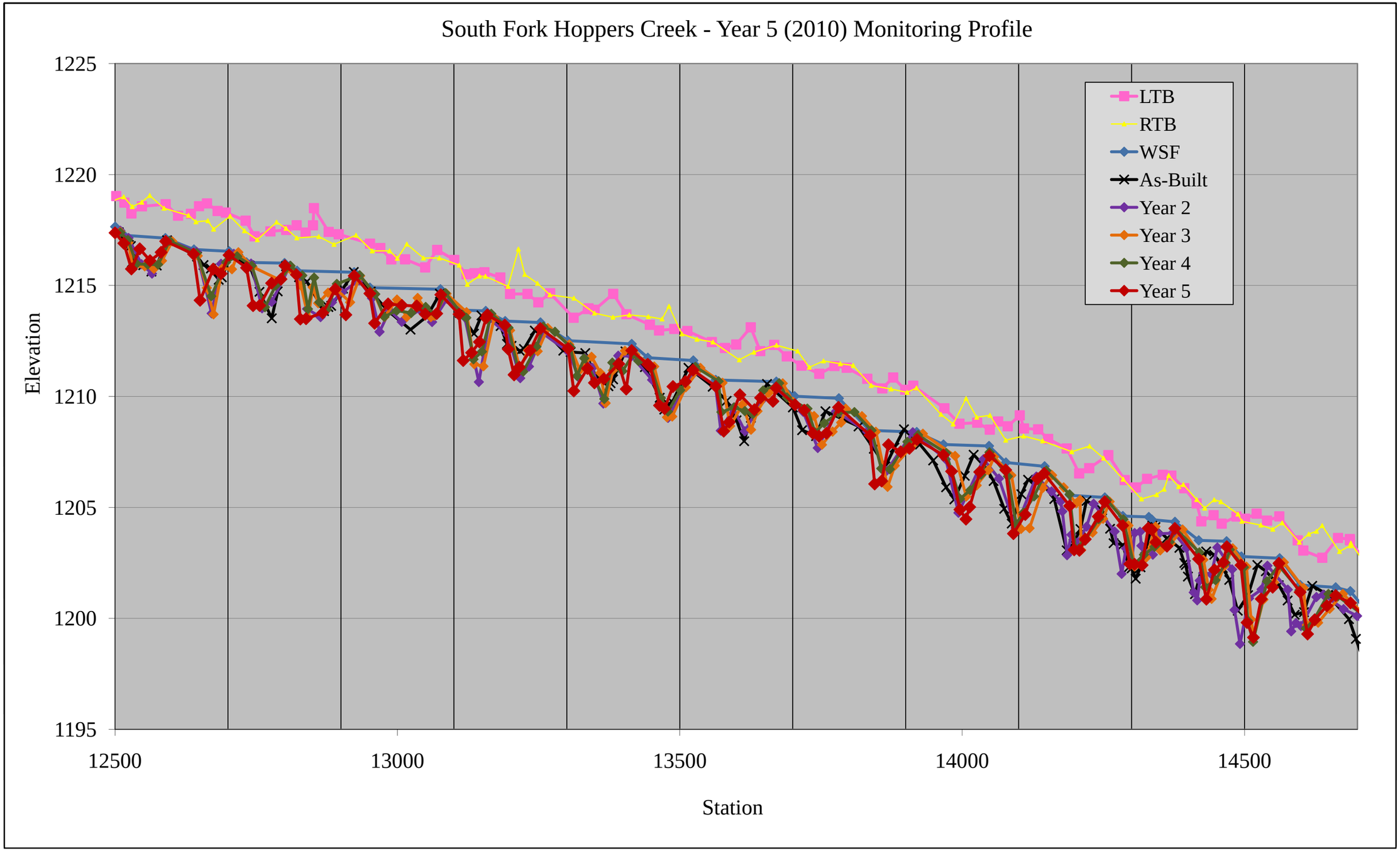
(Year 5 Monitoring Data - collected September 2010)

Looking at the Left Bank

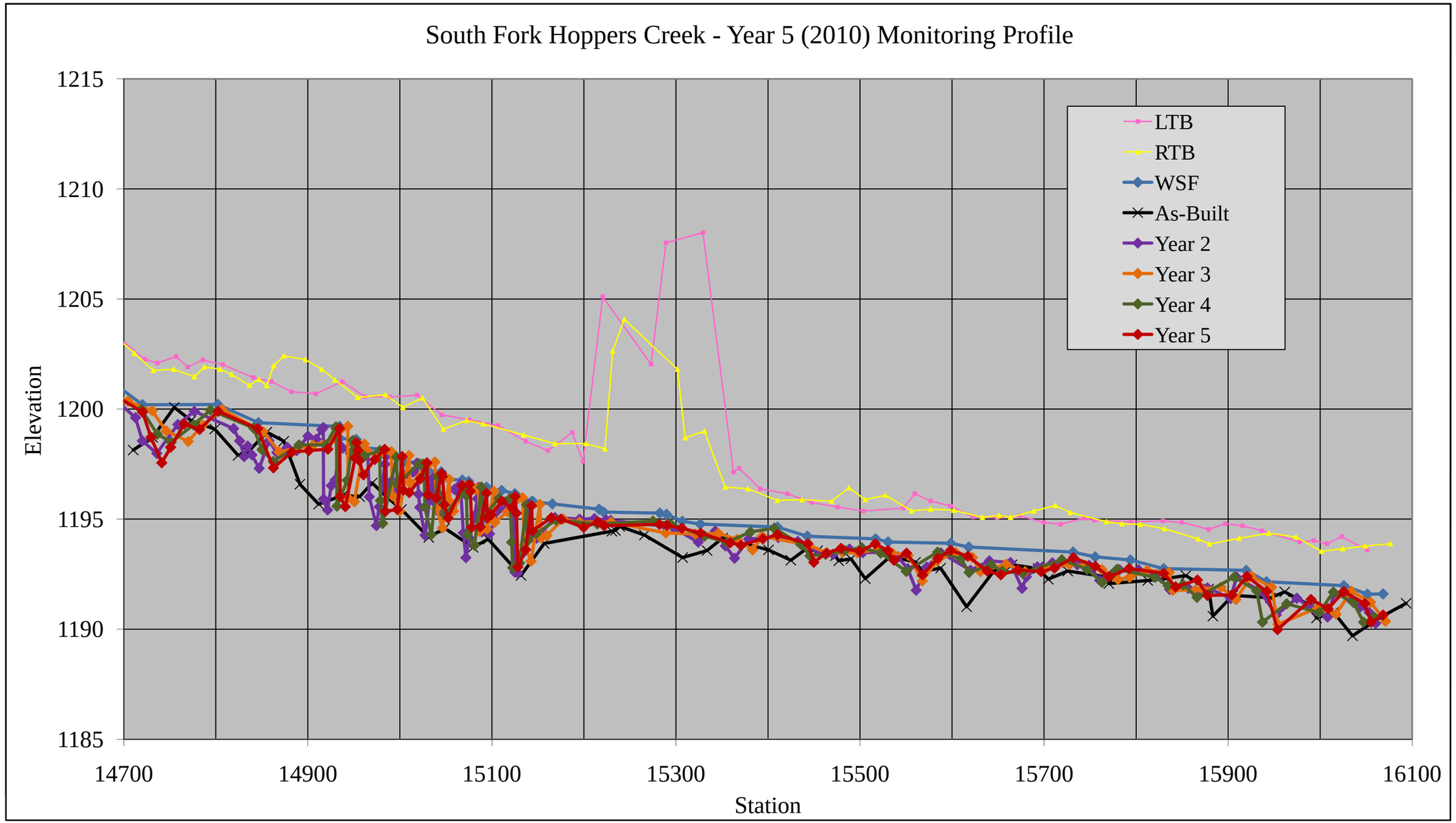
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		10.2	8.8	1.16	2.09	7.55	1	8	1223.98	1223.98





South Fork Hoppers, EEP Contract No. D04006-4, EBX NEUSE-I, LLC
December 2010, Monitoring Year 5


South Fork Hoppers Creek - Year 5 (2010) Monitoring Profile
1215
1210
1205
1200
1195
1190
1185
Elevation
14700
14900
15100
15300
15500
15700
15900
16100
Station
LTB
RTB
WSF
As-Built
Year 2
Year 3
Year 4
Year 5

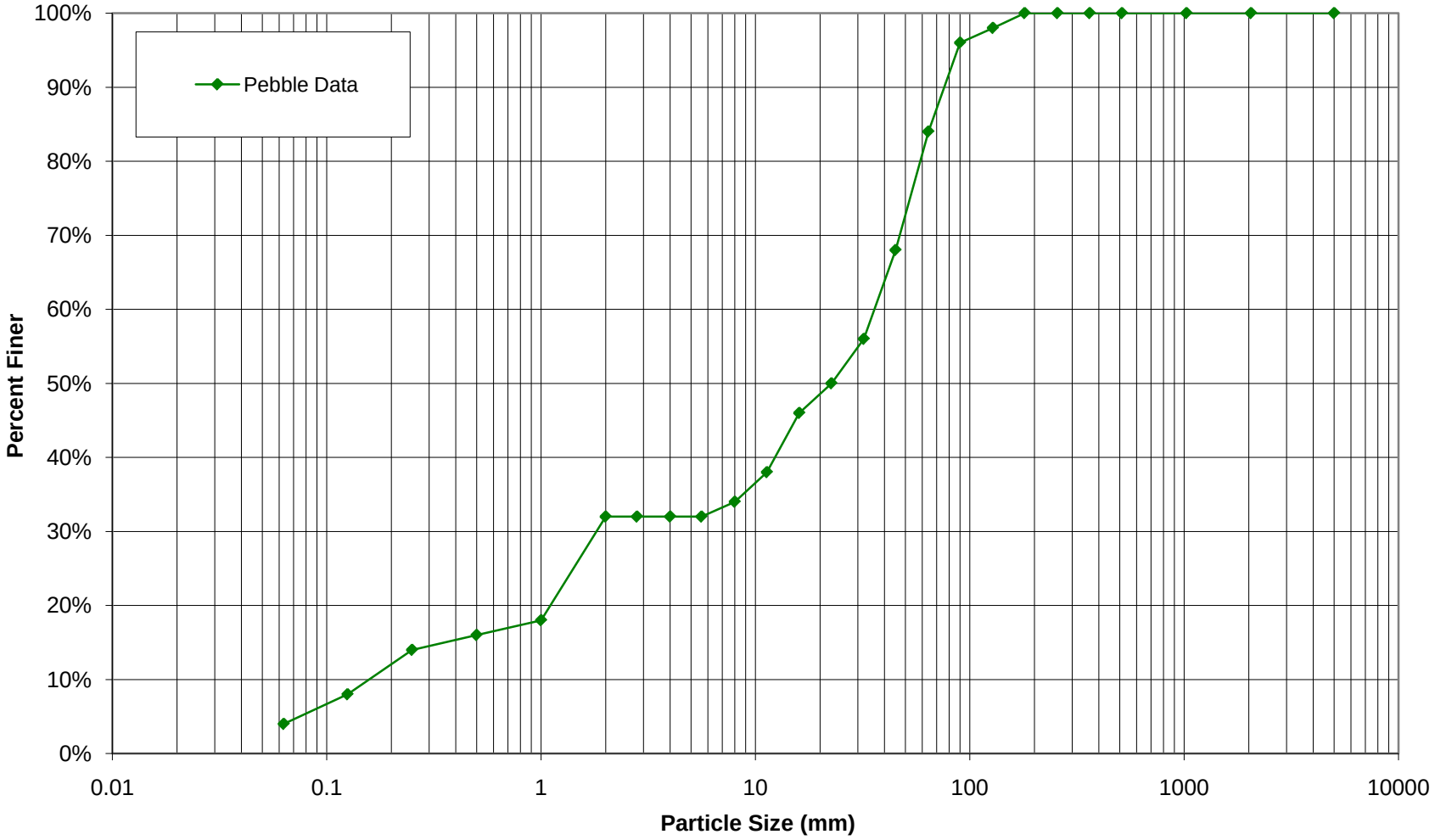
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X1 Riffle
DATE COLLECTED:	9/8/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

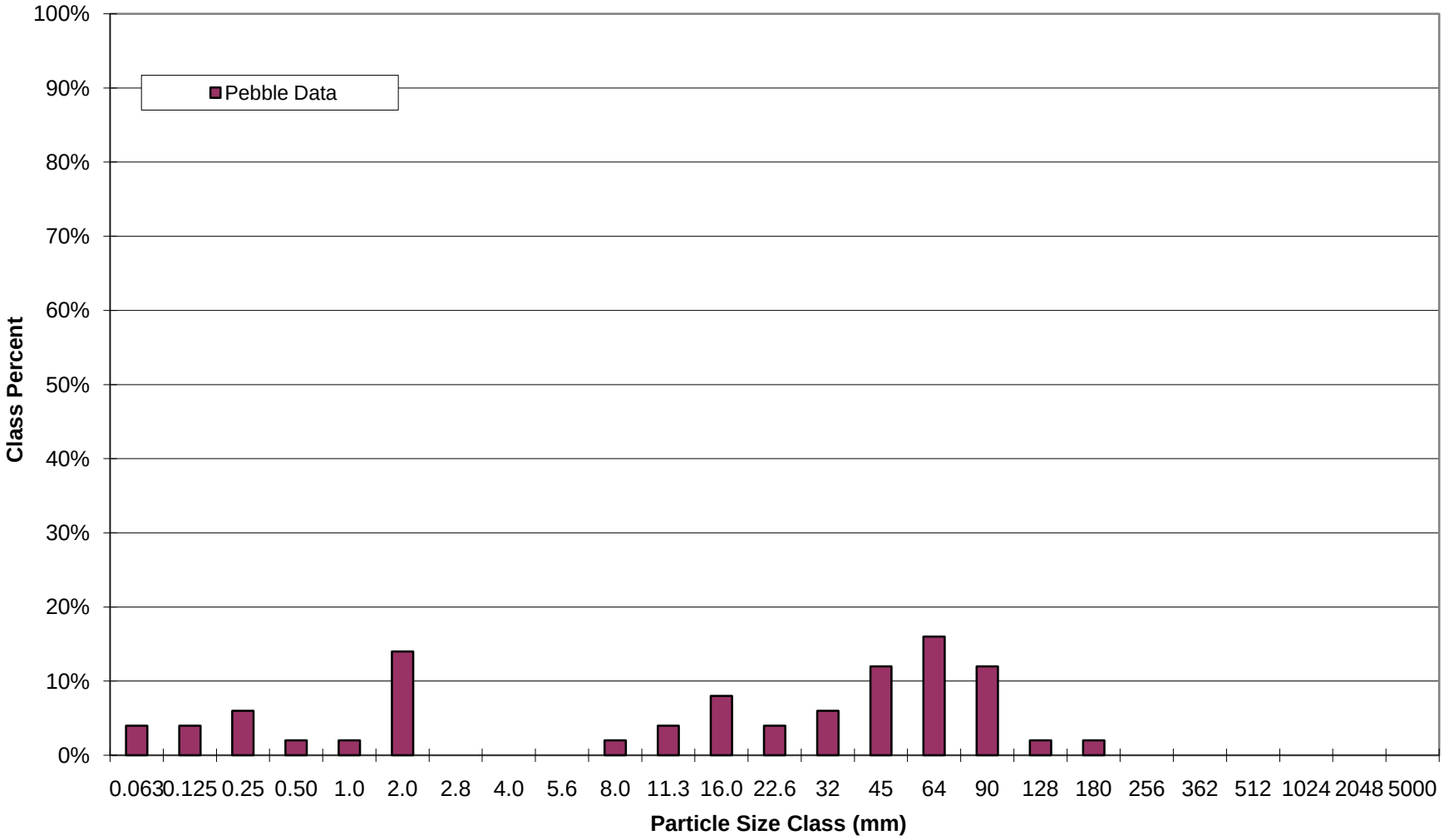
			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	4	4%	4%	0.063
SAND	Very Fine	.063 - .125	4	4%	8%	0.125
	Fine	.125 - .25	6	6%	14%	0.25
	Medium	.25 - .50	2	2%	16%	0.50
	Coarse	.50 - 1.0	2	2%	18%	1.0
	Very Coarse	1.0 - 2.0	14	14%	32%	2.0
GRAVEL	Very Fine	2.0 - 2.8			32%	2.8
	Very Fine	2.8 - 4.0			32%	4.0
	Fine	4.0 - 5.6			32%	5.6
	Fine	5.6 - 8.0	2	2%	34%	8.0
	Medium	8.0 - 11.0	4	4%	38%	11.3
	Medium	11.0 - 16.0	8	8%	46%	16.0
	Coarse	16.0 - 22.6	4	4%	50%	22.6
	Coarse	22.6 - 32	6	6%	56%	32
	Very Coarse	32 - 45	12	12%	68%	45
	Very Coarse	45 - 64	16	16%	84%	64
COBBLE	Small	64 - 90	12	12%	96%	90
	Small	90 - 128	2	2%	98%	128
	Large	128 - 180	2	2%	100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	**100**	**100%**		

Largest particles: 150 mm
(riffle)

South Fork Hoppers Creek
X1 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X1 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

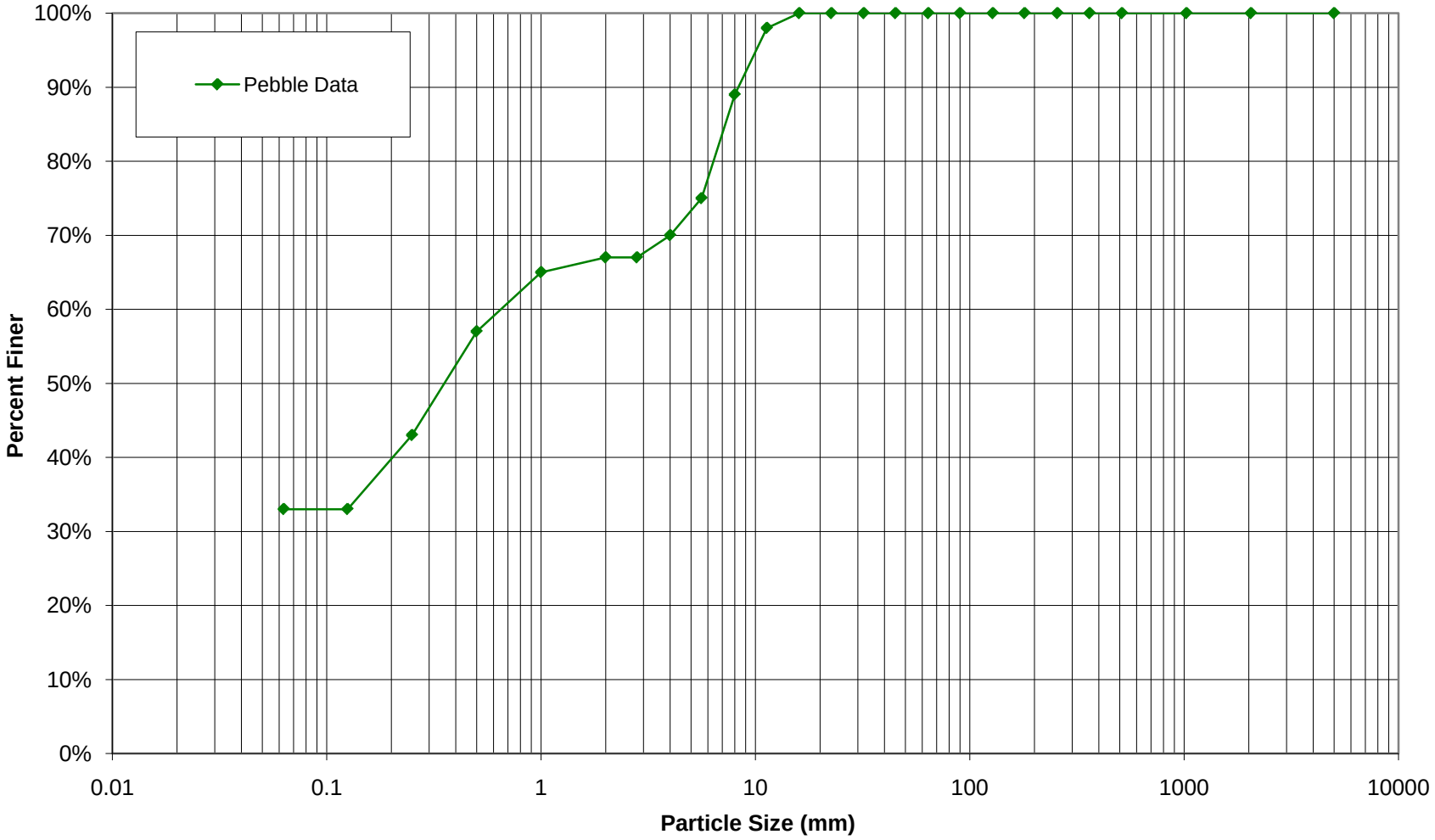
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X2 Pool
DATE COLLECTED:	9/8/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	33	33%	33%	0.063
SAND	Very Fine	.063 - .125			33%	0.125
	Fine	.125 - .25	10	10%	43%	0.25
	Medium	.25 - .50	14	14%	57%	0.50
	Coarse	.50 - 1.0	8	8%	65%	1.0
	Very Coarse	1.0 - 2.0	2	2%	67%	2.0
GRAVEL	Very Fine	2.0 - 2.8			67%	2.8
	Very Fine	2.8 - 4.0	3	3%	70%	4.0
	Fine	4.0 - 5.6	5	5%	75%	5.6
	Fine	5.6 - 8.0	14	14%	89%	8.0
	Medium	8.0 - 11.0	9	9%	98%	11.3
	Medium	11.0 - 16.0	2	2%	100%	16.0
	Coarse	16.0 - 22.6			100%	22.6
	Coarse	22.6 - 32			100%	32
	Very Coarse	32 - 45			100%	45
	Very Coarse	45 - 64			100%	64
COBBLE	Small	64 - 90			100%	90
	Small	90 - 128			100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	**100**	**100%**		

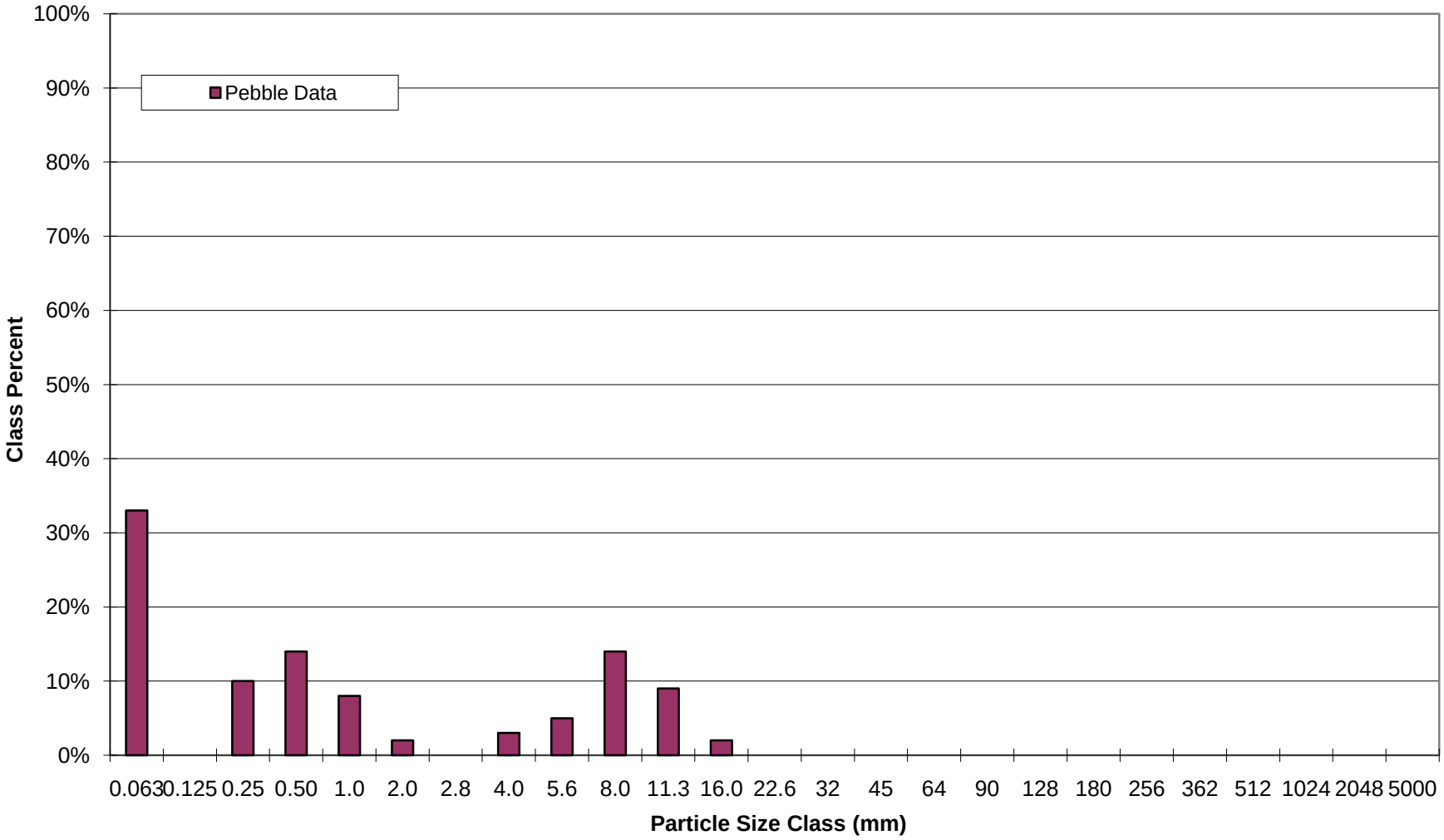
Largest particles: _____

(pool)

South Fork Hoppers Creek
X2 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X2 - Pool
Pebble Count Size Class Distribution



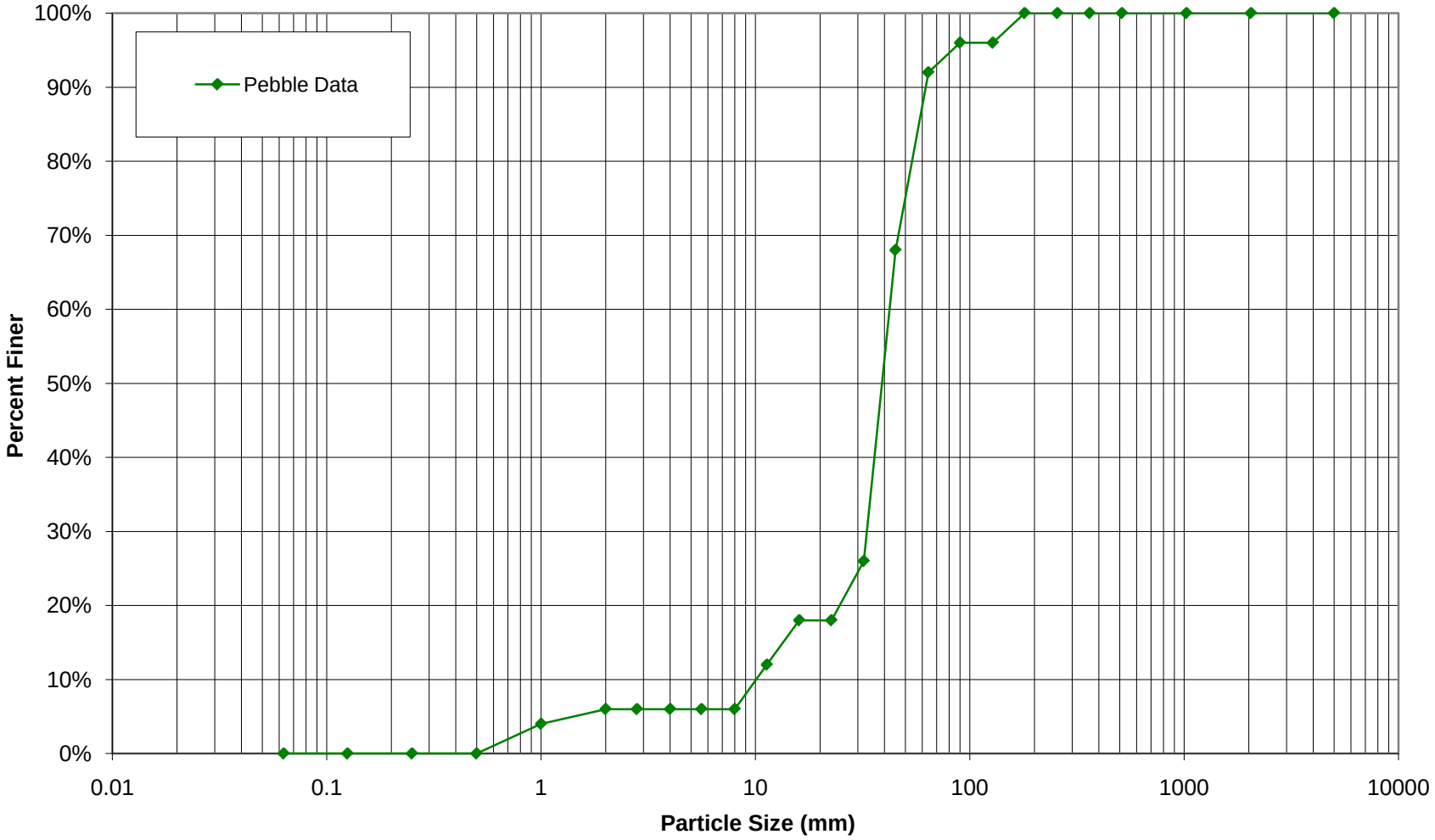
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X3 Riffle
DATE COLLECTED:	9/8/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

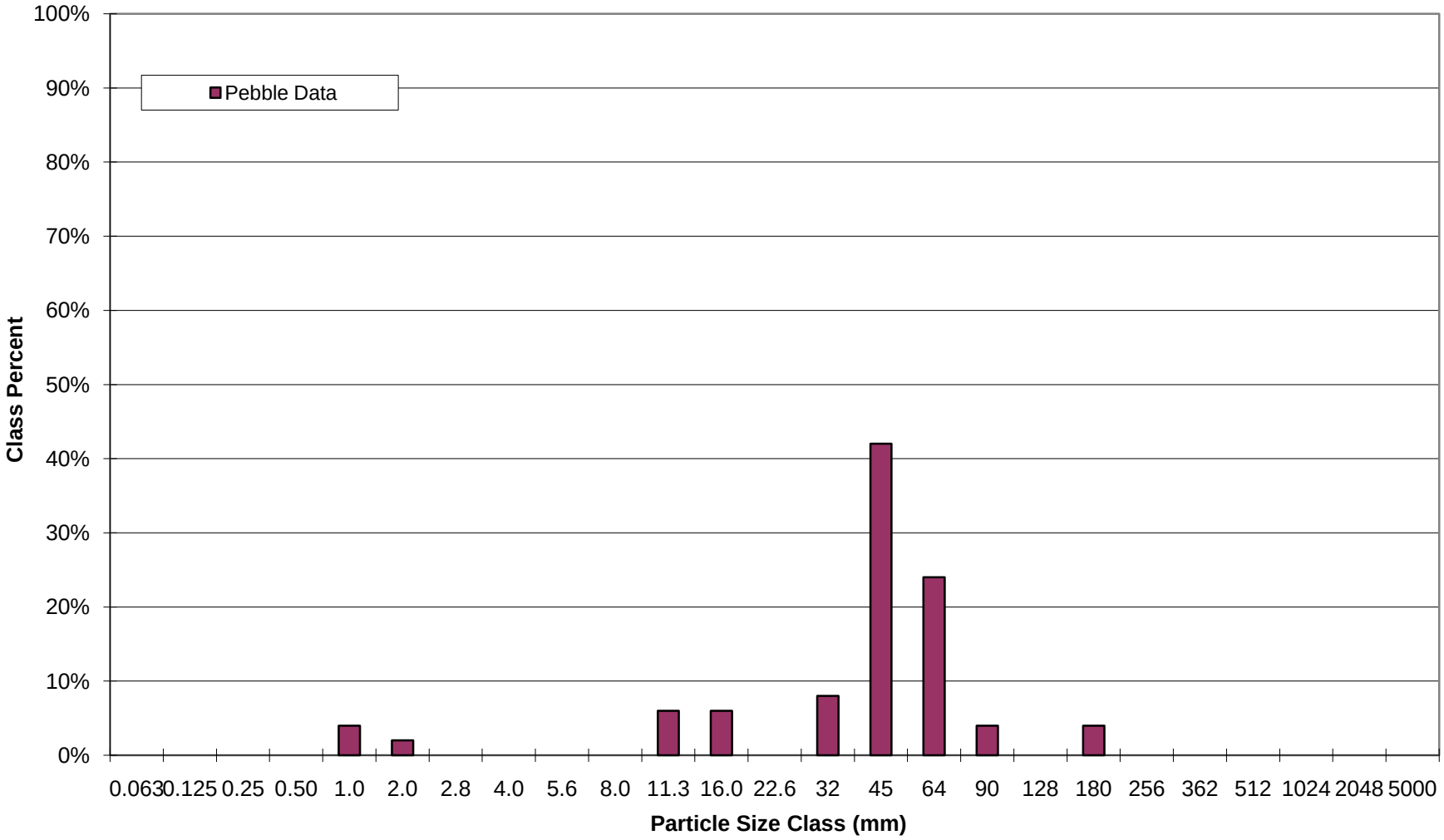
			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063			0%	0.063
SAND	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25			0%	0.25
	Medium	.25 - .50			0%	0.50
	Coarse	.50 - 1.0	4	4%	4%	1.0
	Very Coarse	1.0 - 2.0	2	2%	6%	2.0
GRAVEL	Very Fine	2.0 - 2.8			6%	2.8
	Very Fine	2.8 - 4.0			6%	4.0
	Fine	4.0 - 5.6			6%	5.6
	Fine	5.6 - 8.0			6%	8.0
	Medium	8.0 - 11.0	6	6%	12%	11.3
	Medium	11.0 - 16.0	6	6%	18%	16.0
	Coarse	16.0 - 22.6			18%	22.6
	Coarse	22.6 - 32	8	8%	26%	32
	Very Coarse	32 - 45	42	42%	68%	45
	Very Coarse	45 - 64	24	24%	92%	64
COBBLE	Small	64 - 90	4	4%	96%	90
	Small	90 - 128			96%	128
	Large	128 - 180	4	4%	100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	**100**	**100%**		

Largest particles: 150 mm
(riffle)

South Fork Hoppers Creek
X3 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X3 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

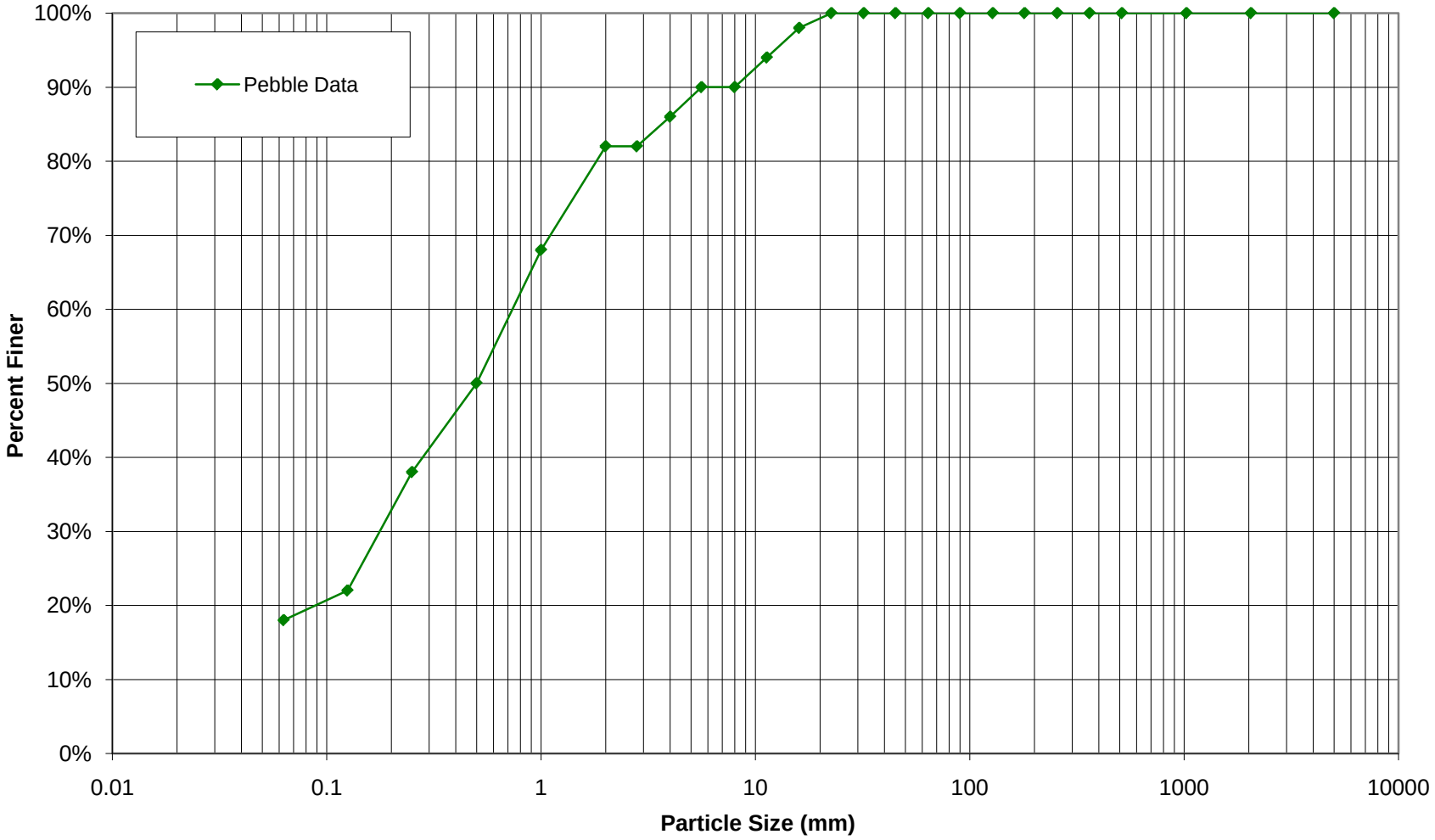
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X4 Pool
DATE COLLECTED:	9/10/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	18	18%	18%	0.063
SAND	Very Fine	.063 - .125	4	4%	22%	0.125
	Fine	.125 - .25	16	16%	38%	0.25
	Medium	.25 - .50	12	12%	50%	0.50
	Coarse	.50 - 1.0	18	18%	68%	1.0
	Very Coarse	1.0 - 2.0	14	14%	82%	2.0
GRAVEL	Very Fine	2.0 - 2.8			82%	2.8
	Very Fine	2.8 - 4.0	4	4%	86%	4.0
	Fine	4.0 - 5.6	4	4%	90%	5.6
	Fine	5.6 - 8.0			90%	8.0
	Medium	8.0 - 11.0	4	4%	94%	11.3
	Medium	11.0 - 16.0	4	4%	98%	16.0
	Coarse	16.0 - 22.6	2	2%	100%	22.6
	Coarse	22.6 - 32			100%	32
	Very Coarse	32 - 45			100%	45
	Very Coarse	45 - 64			100%	64
COBBLE	Small	64 - 90			100%	90
	Small	90 - 128			100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	100	100%		

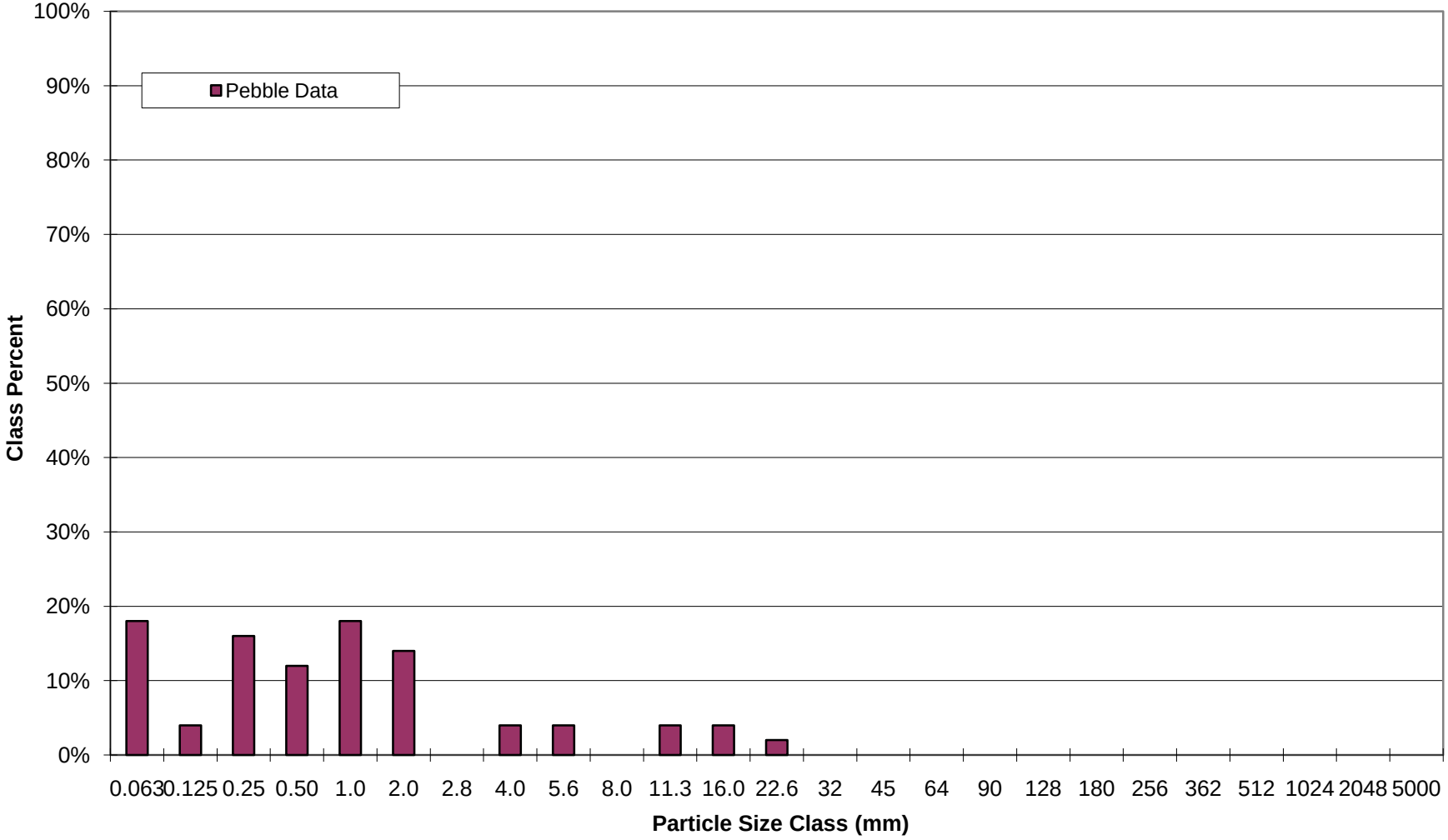
Largest particles: _____

(pool)

South Fork Hoppers Creek
X4 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X4 - Pool
Pebble Count Size Class Distribution



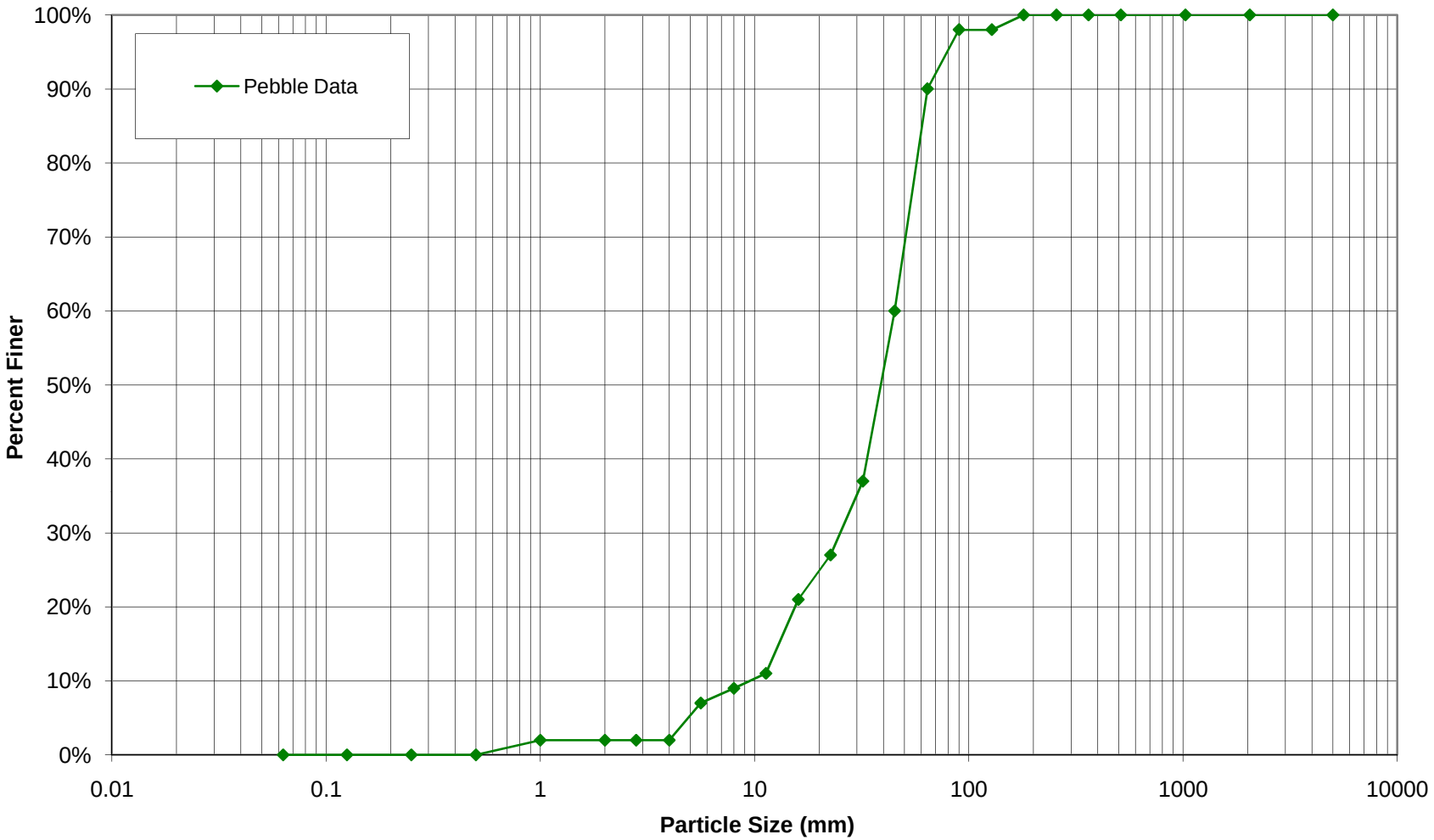
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X5 Riffle
DATE COLLECTED:	9/8/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

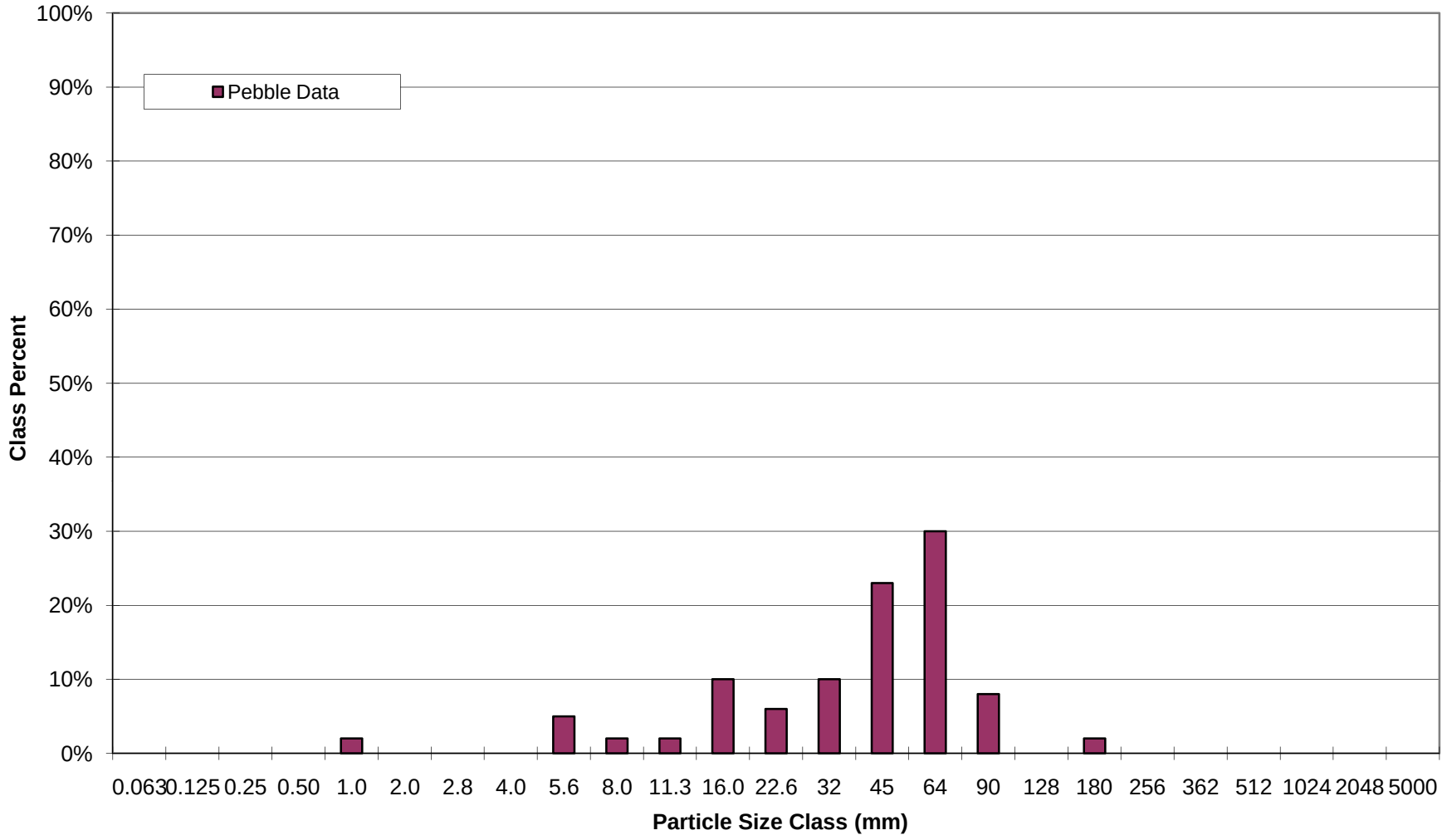
			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063			0%	0.063
SAND	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25			0%	0.25
	Medium	.25 - .50			0%	0.50
	Coarse	.50 - 1.0	2	2%	2%	1.0
	Very Coarse	1.0 - 2.0			2%	2.0
GRAVEL	Very Fine	2.0 - 2.8			2%	2.8
	Very Fine	2.8 - 4.0			2%	4.0
	Fine	4.0 - 5.6	5	5%	7%	5.6
	Fine	5.6 - 8.0	2	2%	9%	8.0
	Medium	8.0 - 11.0	2	2%	11%	11.3
	Medium	11.0 - 16.0	10	10%	21%	16.0
	Coarse	16.0 - 22.6	6	6%	27%	22.6
	Coarse	22.6 - 32	10	10%	37%	32
	Very Coarse	32 - 45	23	23%	60%	45
	Very Coarse	45 - 64	30	30%	90%	64
COBBLE	Small	64 - 90	8	8%	98%	90
	Small	90 - 128			98%	128
	Large	128 - 180	2	2%	100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	**100**	**100%**		

Largest particles: 150 mm
(riffle)

South Fork Hoppers Creek
X5 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X5 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

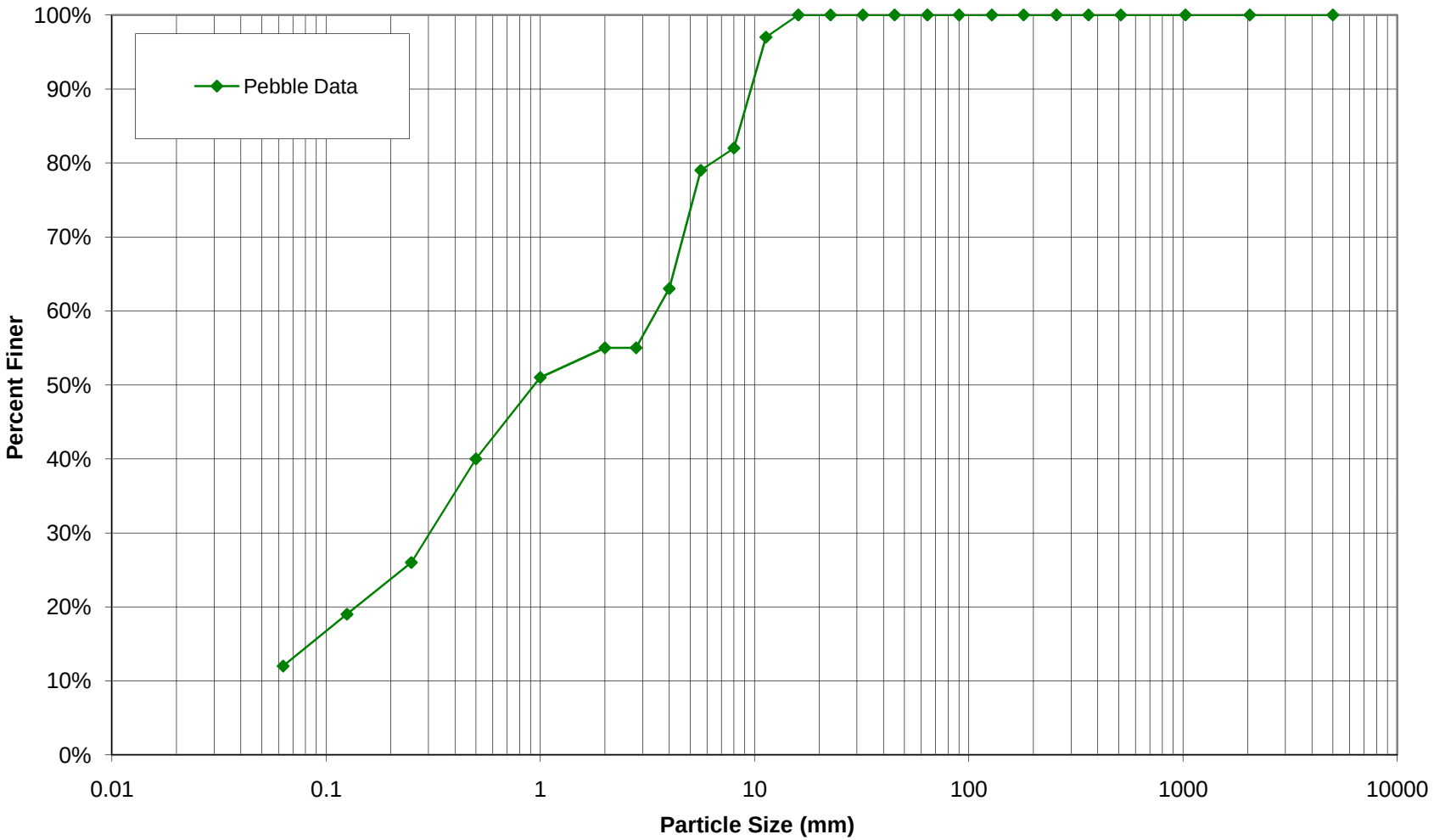
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X6 Pool
DATE COLLECTED:	9/8/2010
FIELD COLLECTION BY:	KS/CT
DATA ENTRY BY:	KS

			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	12	12%	12%	0.063
SAND	Very Fine	.063 - .125	7	7%	19%	0.125
	Fine	.125 - .25	7	7%	26%	0.25
	Medium	.25 - .50	14	14%	40%	0.50
	Coarse	.50 - 1.0	11	11%	51%	1.0
	Very Coarse	1.0 - 2.0	4	4%	55%	2.0
GRAVEL	Very Fine	2.0 - 2.8			55%	2.8
	Very Fine	2.8 - 4.0	8	8%	63%	4.0
	Fine	4.0 - 5.6	16	16%	79%	5.6
	Fine	5.6 - 8.0	3	3%	82%	8.0
	Medium	8.0 - 11.0	15	15%	97%	11.3
	Medium	11.0 - 16.0	3	3%	100%	16.0
	Coarse	16.0 - 22.6			100%	22.6
	Coarse	22.6 - 32			100%	32
	Very Coarse	32 - 45			100%	45
	Very Coarse	45 - 64			100%	64
COBBLE	Small	64 - 90			100%	90
	Small	90 - 128			100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	100	100%		

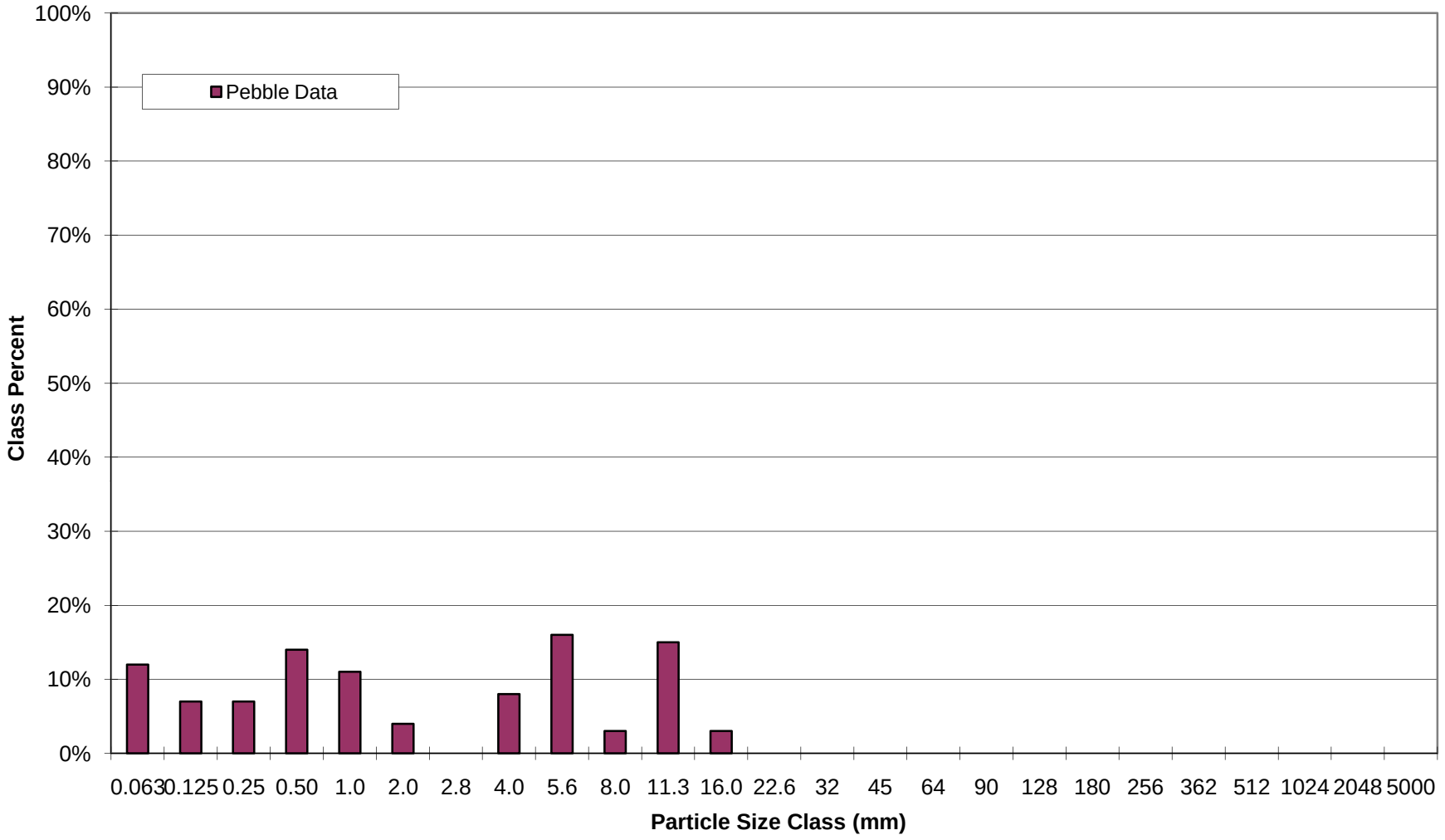
Largest particles: _____

(pool)

South Fork Hoppers Creek
X6 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X6 - Pool
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

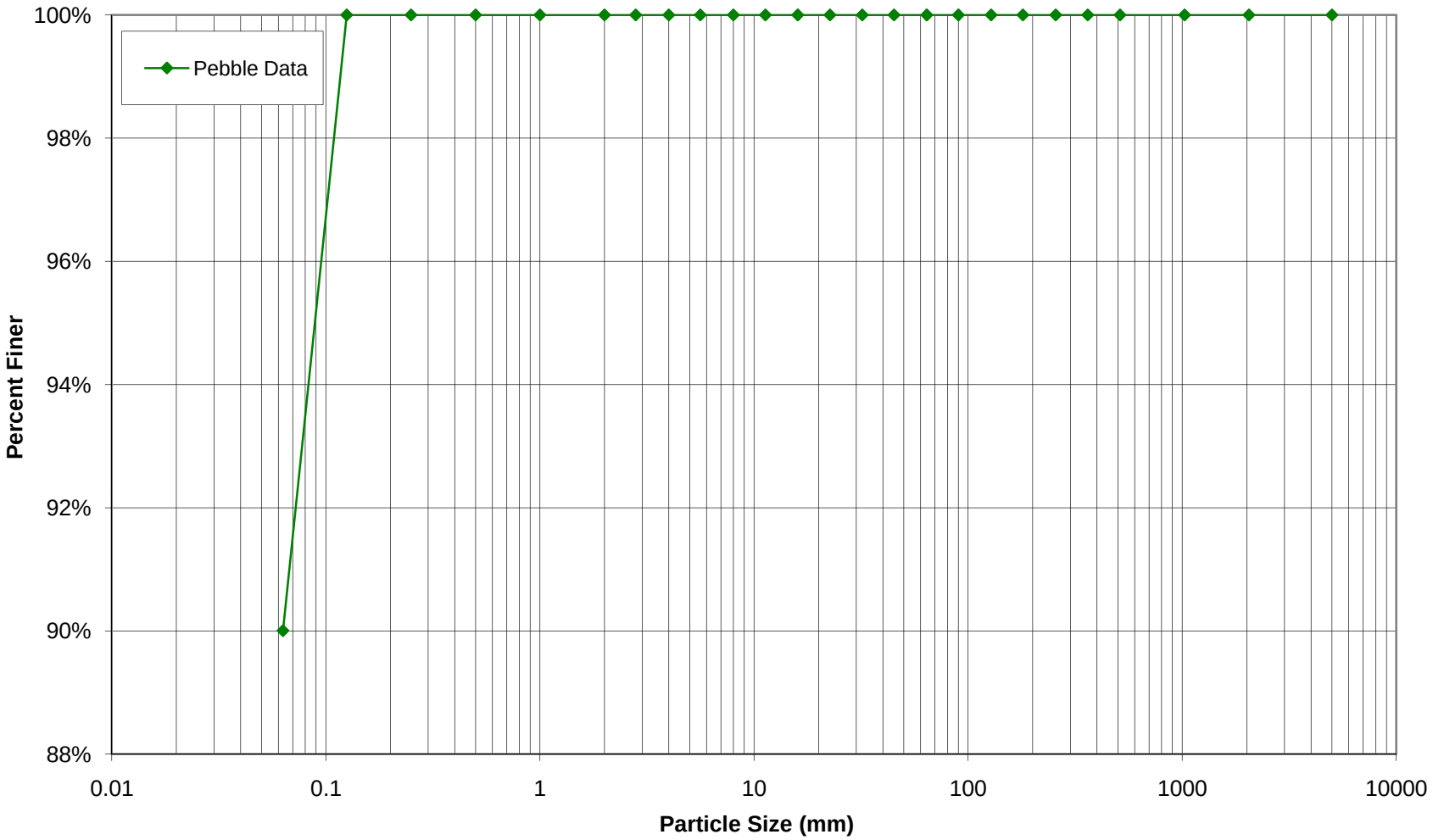
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X7 Pool
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	90	90%	90%	0.063
SAND	Very Fine	.063 - .125	10	10%	100%	0.125
	Fine	.125 - .25			100%	0.25
	Medium	.25 - .50			100%	0.50
	Coarse	.50 - 1.0			100%	1.0
	Very Coarse	1.0 - 2.0			100%	2.0
GRAVEL	Very Fine	2.0 - 2.8			100%	2.8
	Very Fine	2.8 - 4.0			100%	4.0
	Fine	4.0 - 5.6			100%	5.6
	Fine	5.6 - 8.0			100%	8.0
	Medium	8.0 - 11.0			100%	11.3
	Medium	11.0 - 16.0			100%	16.0
	Coarse	16.0 - 22.6			100%	22.6
	Coarse	22.6 - 32			100%	32
	Very Coarse	32 - 45			100%	45
	Very Coarse	45 - 64			100%	64
COBBLE	Small	64 - 90			100%	90
	Small	90 - 128			100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	100	100%		

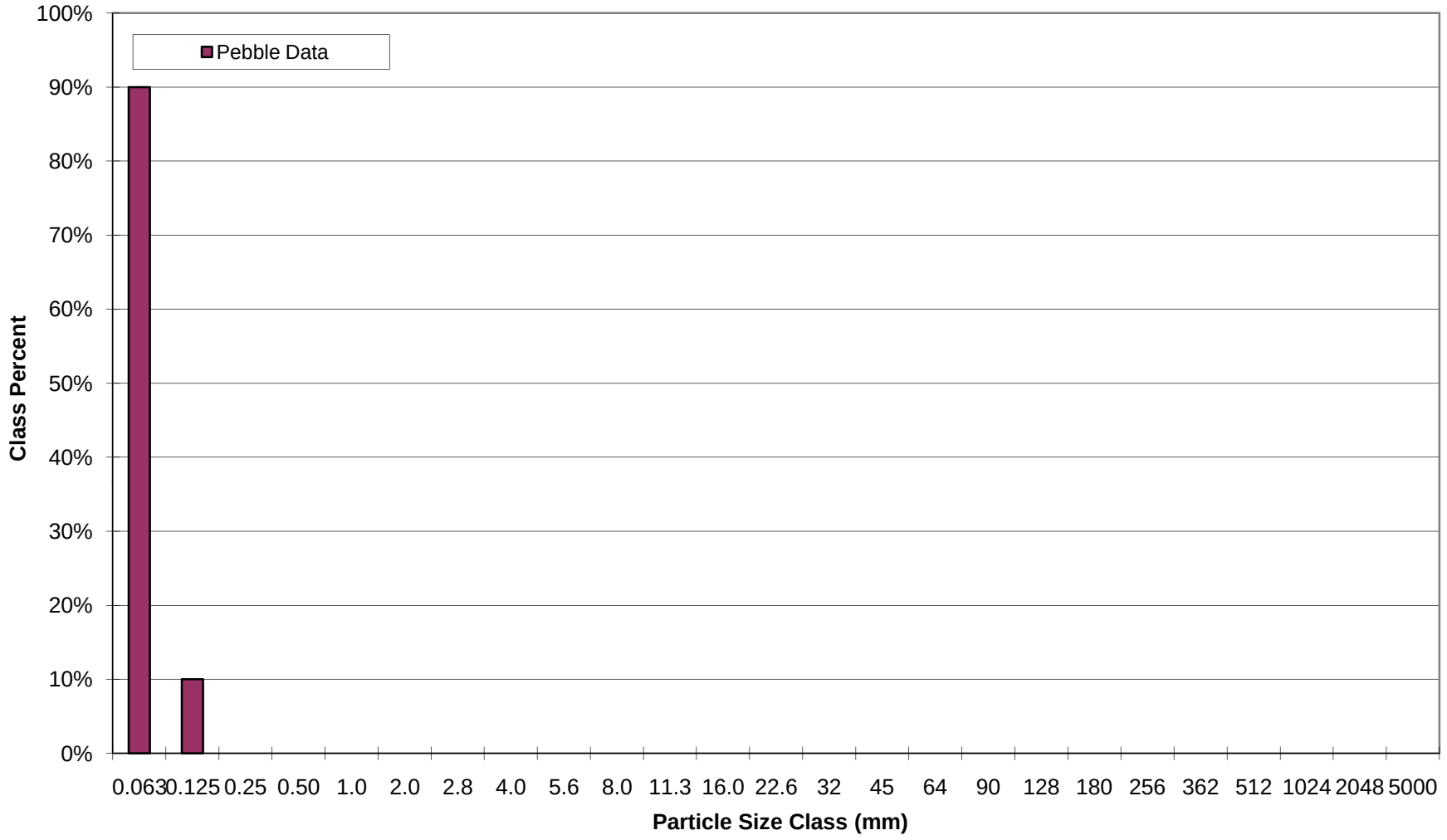
Largest particles: _____

(pool)

South Fork Hoppers Creek
X7 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X7 - Pool
Pebble Count Size Class Distribution



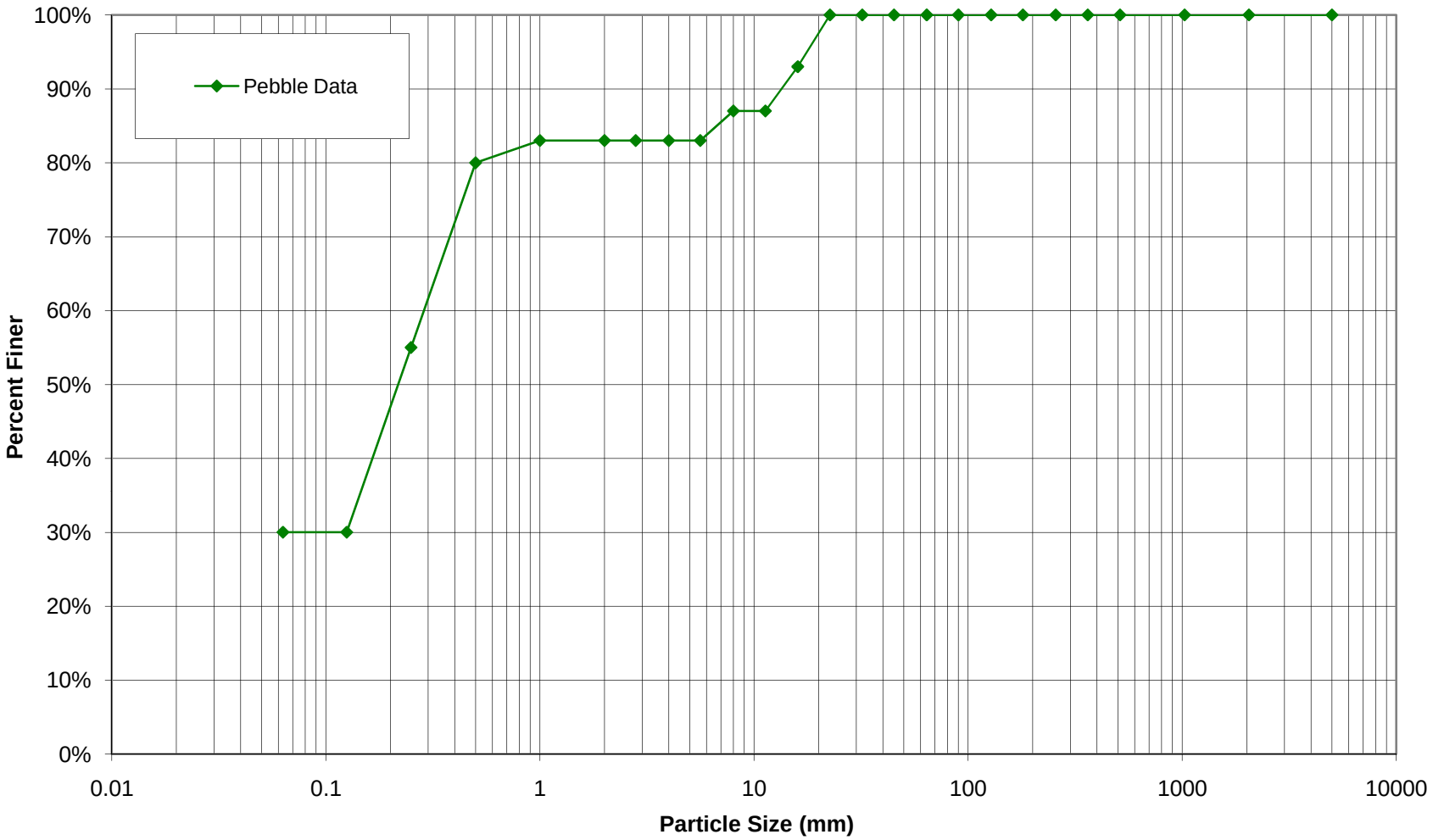
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X8 Riffle
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

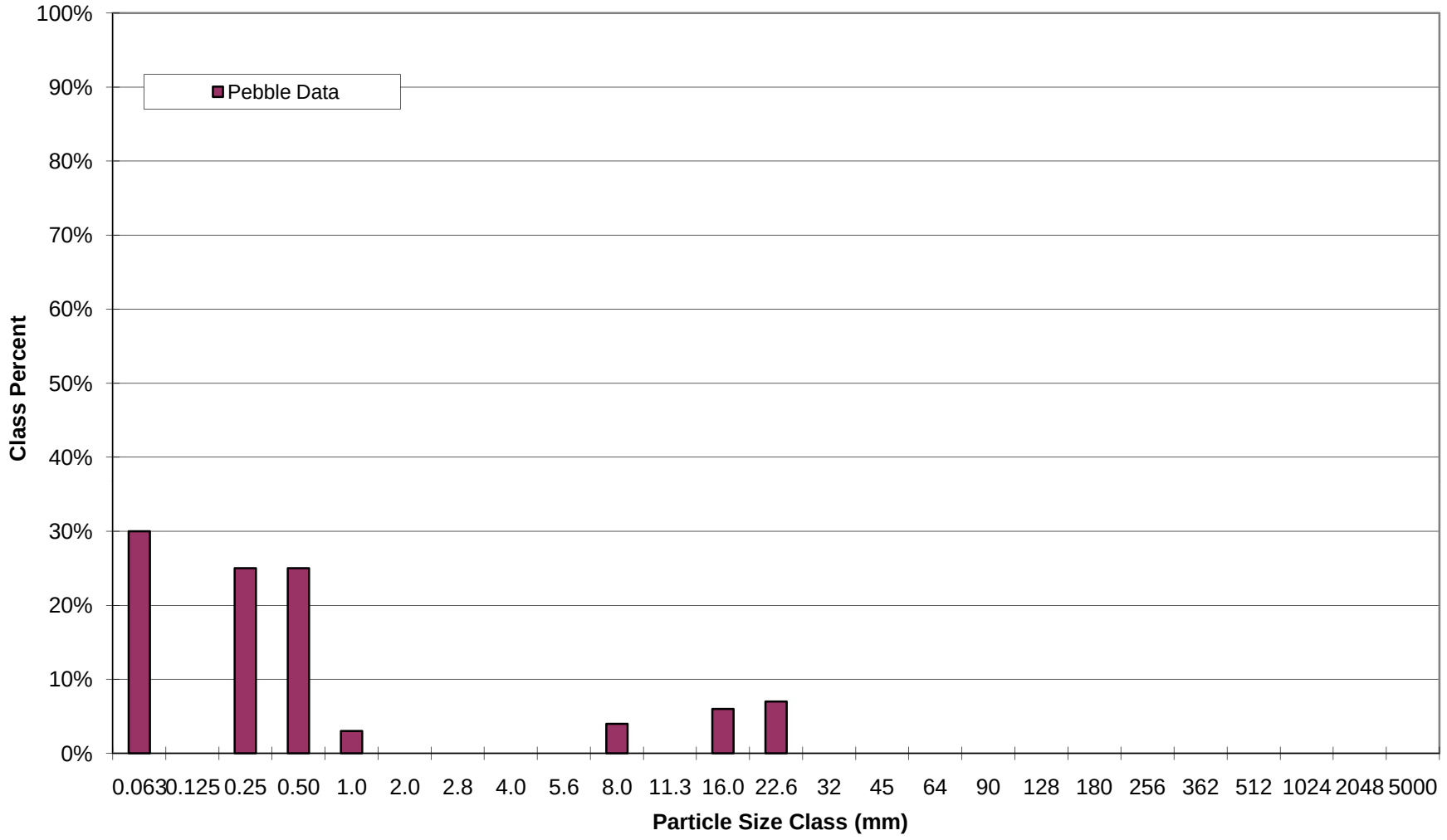
			PARTICLE CLASS COUNT	Summary		Distribution
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum	Plot Size (mm)
SILT/CLAY	Silt / Clay	< .063	30	30%	30%	0.063
SAND	Very Fine	.063 - .125			30%	0.125
	Fine	.125 - .25	25	25%	55%	0.25
	Medium	.25 - .50	25	25%	80%	0.50
	Coarse	.50 - 1.0	3	3%	83%	1.0
	Very Coarse	1.0 - 2.0			83%	2.0
GRAVEL	Very Fine	2.0 - 2.8			83%	2.8
	Very Fine	2.8 - 4.0			83%	4.0
	Fine	4.0 - 5.6			83%	5.6
	Fine	5.6 - 8.0	4	4%	87%	8.0
	Medium	8.0 - 11.0			87%	11.3
	Medium	11.0 - 16.0	6	6%	93%	16.0
	Coarse	16.0 - 22.6	7	7%	100%	22.6
	Coarse	22.6 - 32			100%	32
	Very Coarse	32 - 45			100%	45
	Very Coarse	45 - 64			100%	64
COBBLE	Small	64 - 90			100%	90
	Small	90 - 128			100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			100%	256
BOULDER	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
BEDROCK	Bedrock	> 2048			100%	5000
		Total	**100**	**100%**		

Largest particles: 19 mm
(riffle)

South Fork Hoppers Creek
X8 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X8 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

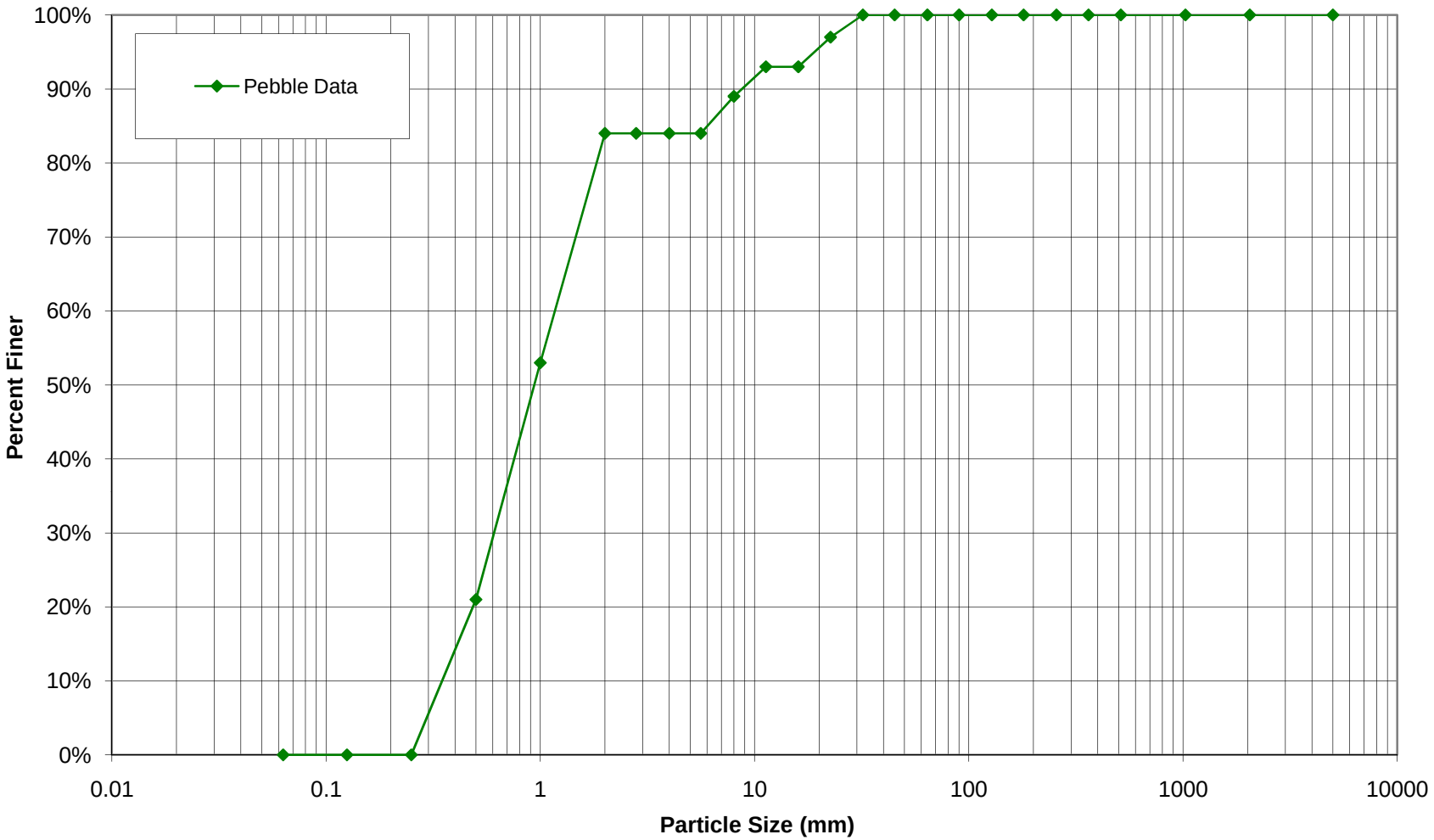
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X9 Pool
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25			0%
	Medium	.25 - .50	21	21%	21%
	Coarse	.50 - 1.0	32	32%	53%
	Very Coarse	1.0 - 2.0	31	31%	84%
GRAVEL	Very Fine	2.0 - 2.8			84%
	Very Fine	2.8 - 4.0			84%
	Fine	4.0 - 5.6			84%
	Fine	5.6 - 8.0	5	5%	89%
	Medium	8.0 - 11.0	4	4%	93%
	Medium	11.0 - 16.0			93%
	Coarse	16.0 - 22.6	4	4%	97%
	Coarse	22.6 - 32	3	3%	100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

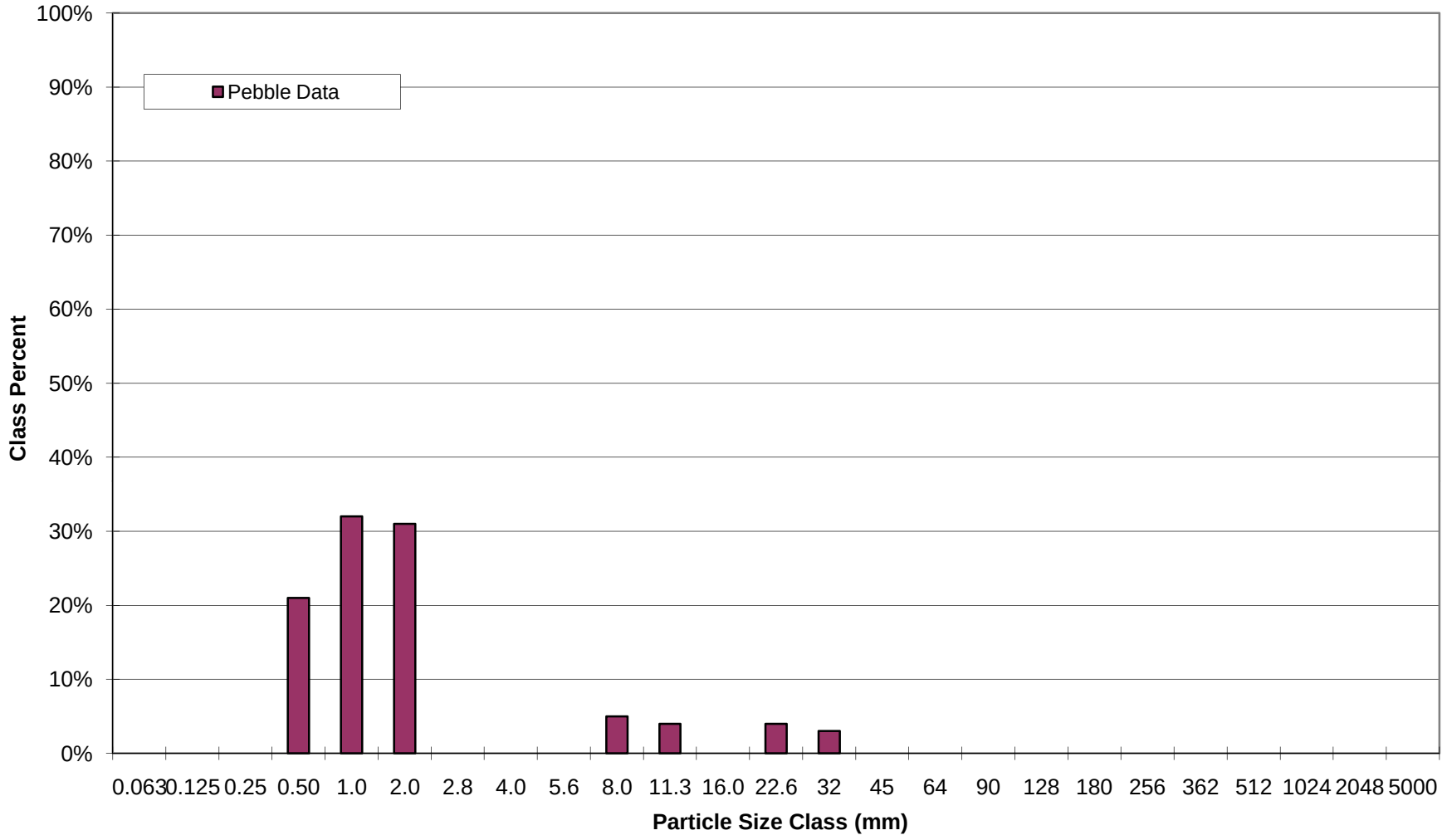
Largest particles: _____

(pool)

South Fork Hoppers Creek
X9 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X9 - Pool
Pebble Count Size Class Distribution



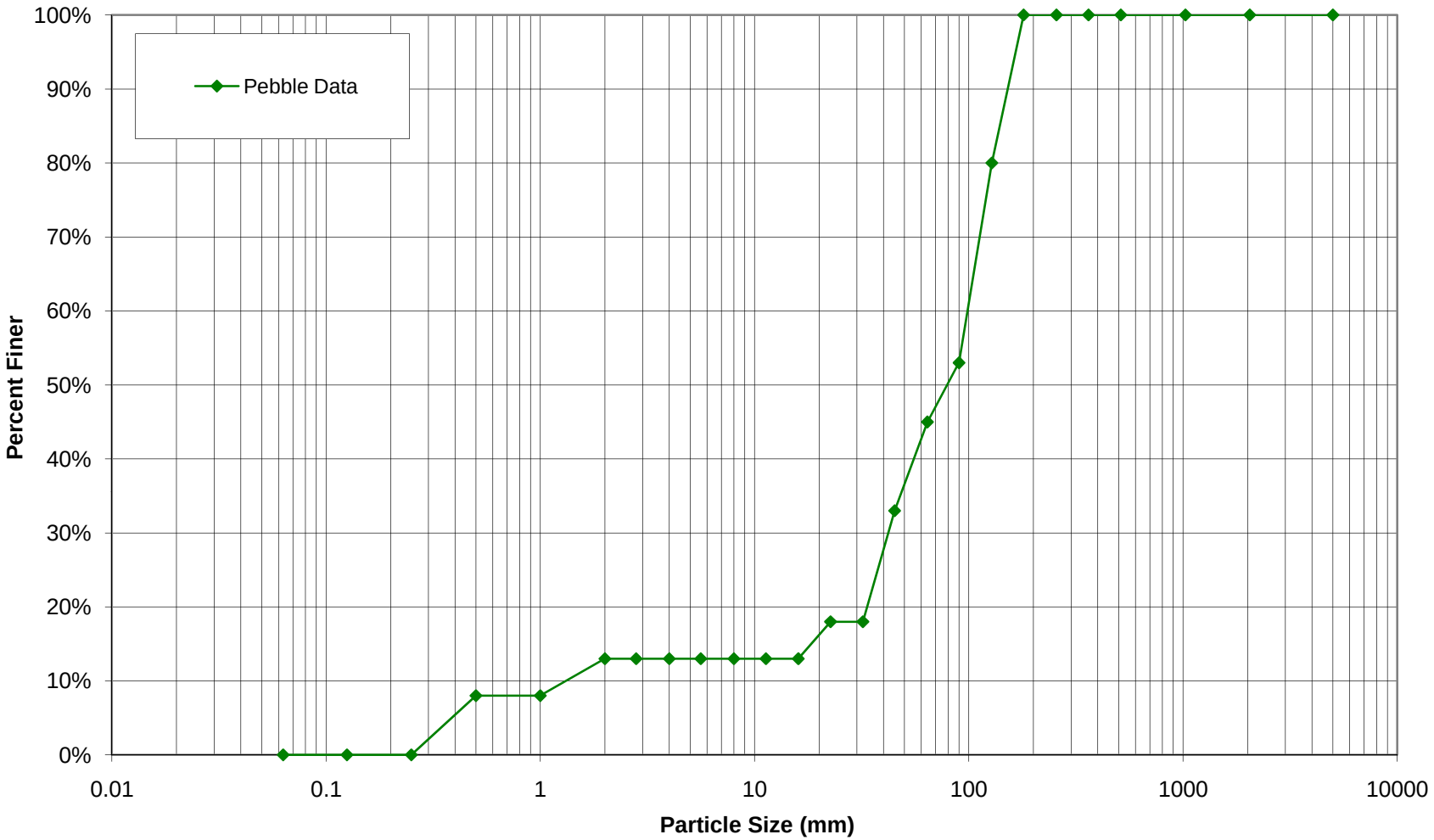
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X10 Riffle
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

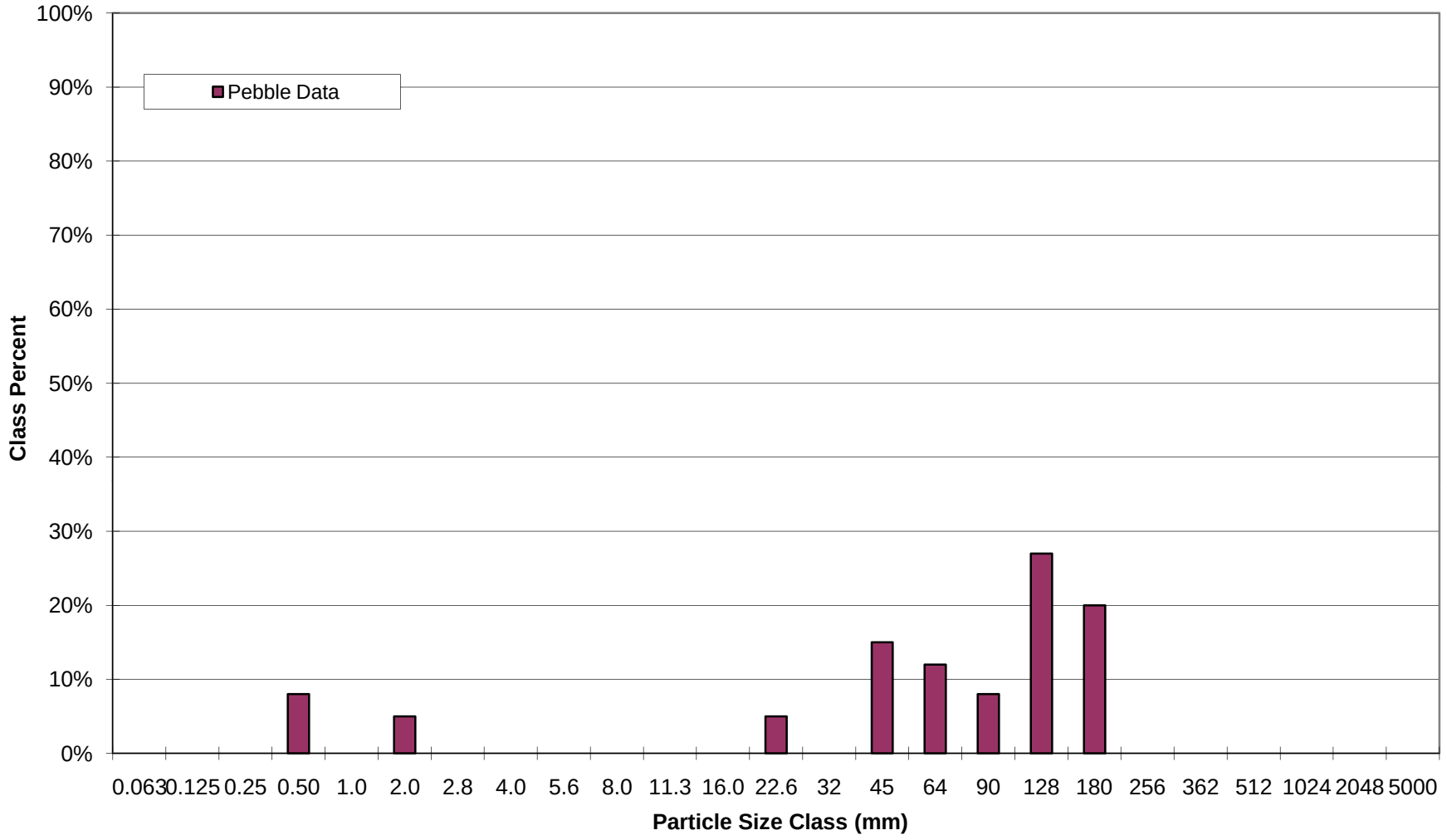
			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25			0%
	Medium	.25 - .50	8	8%	8%
	Coarse	.50 - 1.0			8%
	Very Coarse	1.0 - 2.0	5	5%	13%
GRAVEL	Very Fine	2.0 - 2.8			13%
	Very Fine	2.8 - 4.0			13%
	Fine	4.0 - 5.6			13%
	Fine	5.6 - 8.0			13%
	Medium	8.0 - 11.0			13%
	Medium	11.0 - 16.0			13%
	Coarse	16.0 - 22.6	5	5%	18%
	Coarse	22.6 - 32			18%
	Very Coarse	32 - 45	15	15%	33%
	Very Coarse	45 - 64	12	12%	45%
COBBLE	Small	64 - 90	8	8%	53%
	Small	90 - 128	27	27%	80%
	Large	128 - 180	20	20%	100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: 180 mm
(riffle)

South Fork Hoppers Creek
X10 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X10 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

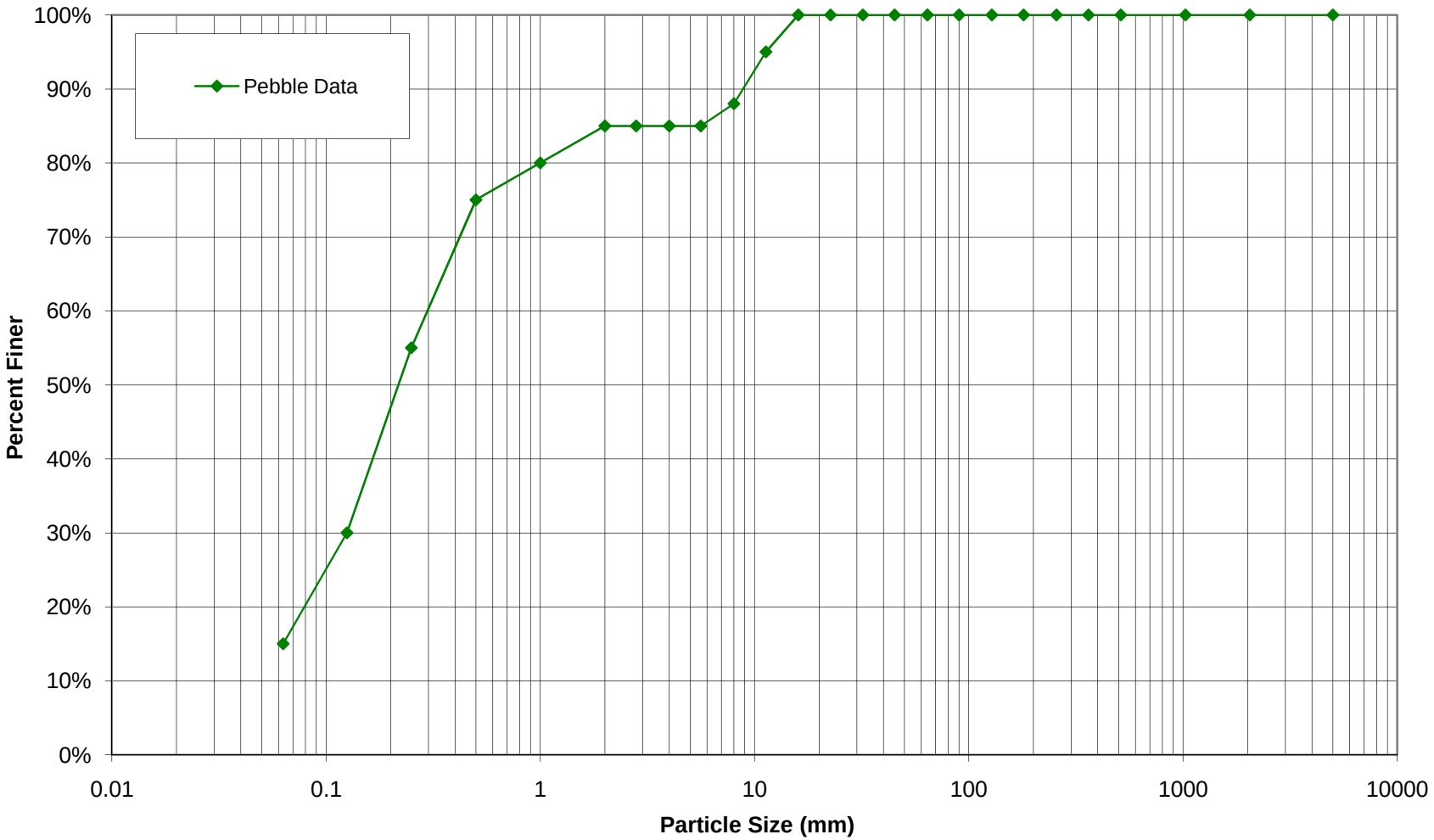
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X11 Pool
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	15	15%	15%
SAND	Very Fine	.063 - .125	15	15%	30%
	Fine	.125 - .25	25	25%	55%
	Medium	.25 - .50	20	20%	75%
	Coarse	.50 - 1.0	5	5%	80%
	Very Coarse	1.0 - 2.0	5	5%	85%
GRAVEL	Very Fine	2.0 - 2.8			85%
	Very Fine	2.8 - 4.0			85%
	Fine	4.0 - 5.6			85%
	Fine	5.6 - 8.0	3	3%	88%
	Medium	8.0 - 11.0	7	7%	95%
	Medium	11.0 - 16.0	5	5%	100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

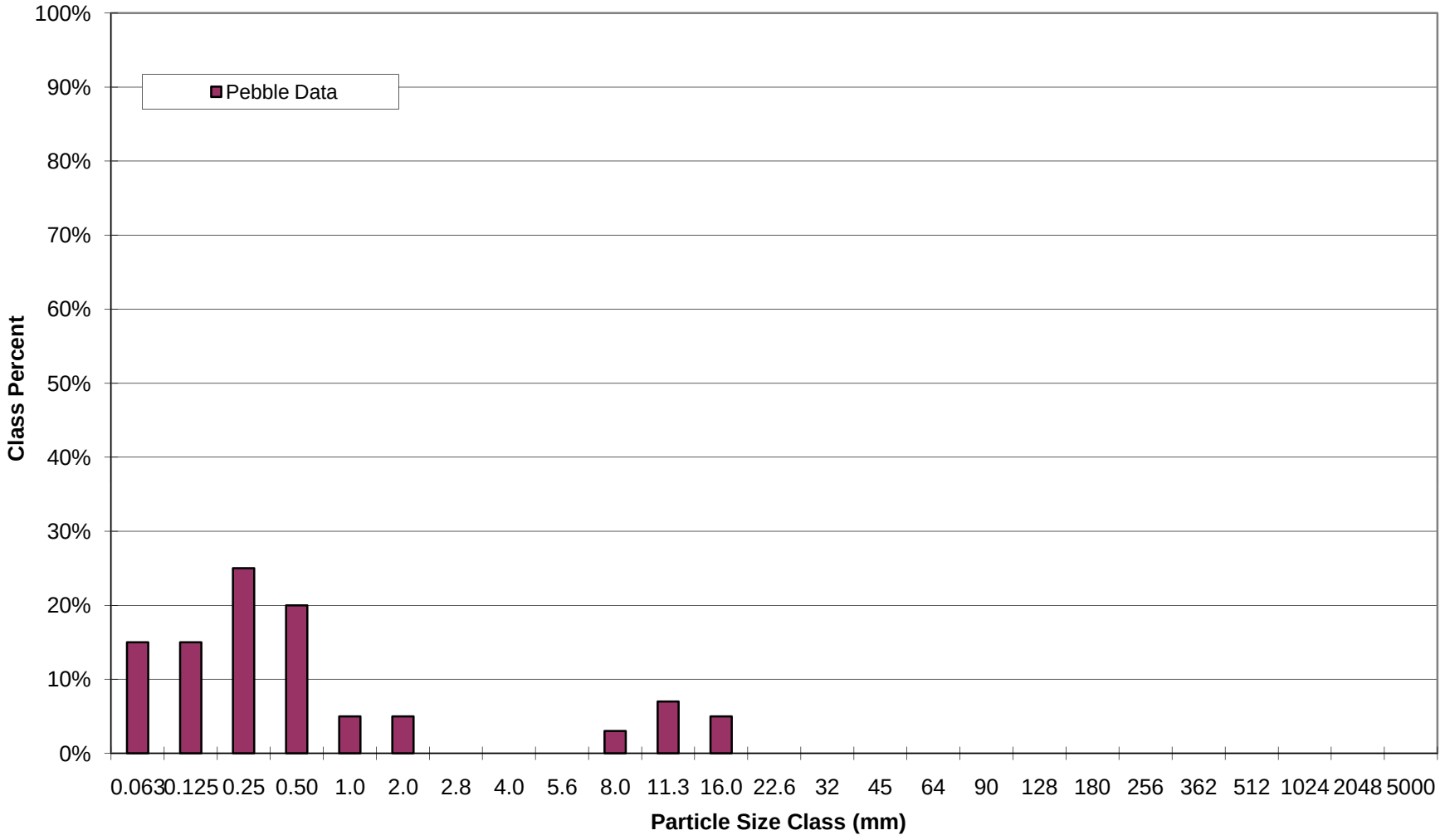
Largest particles: _____

(pool)

South Fork Hoppers Creek
X11 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X11 - Pool
Pebble Count Size Class Distribution



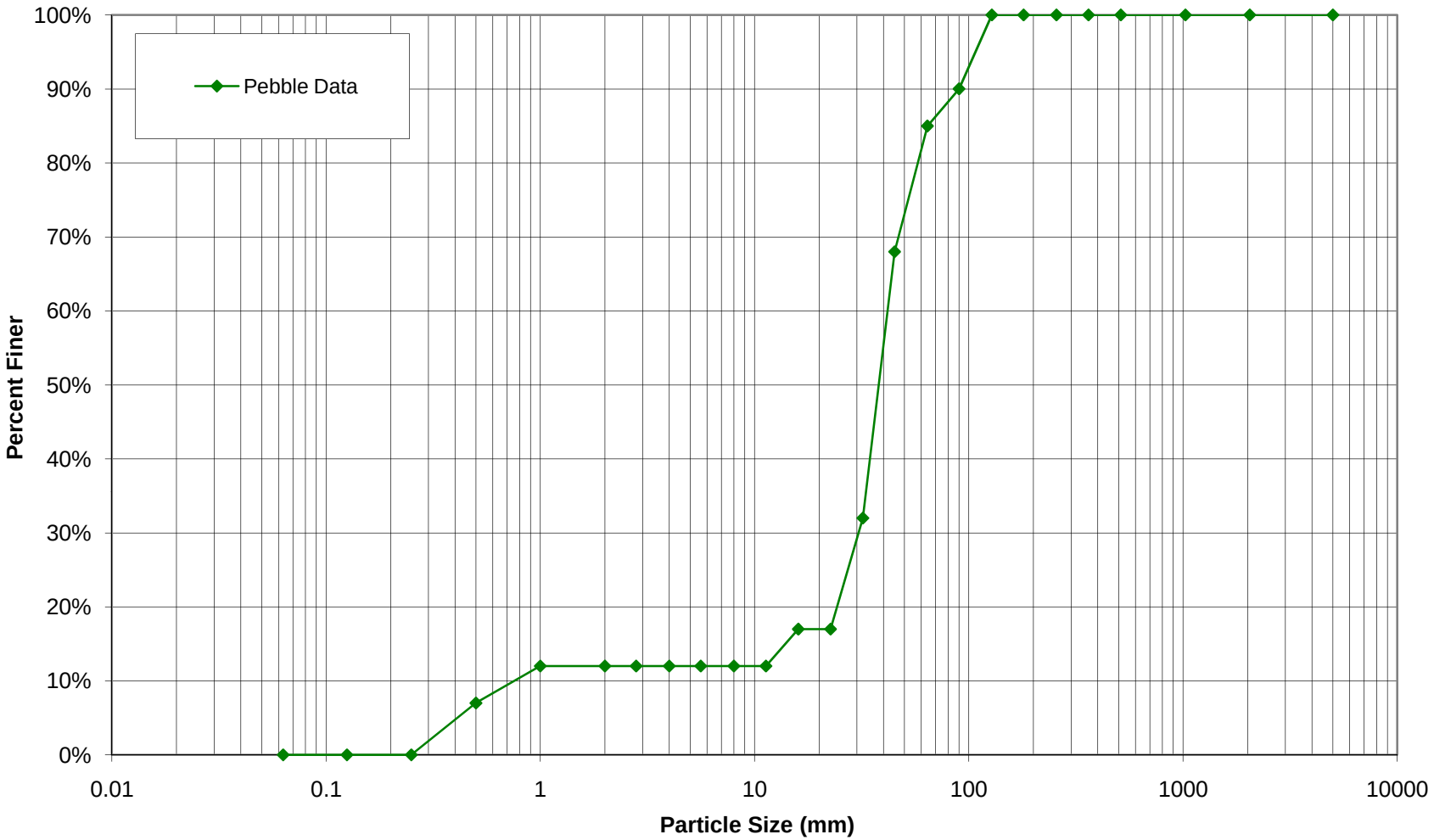
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X12 Riffle
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

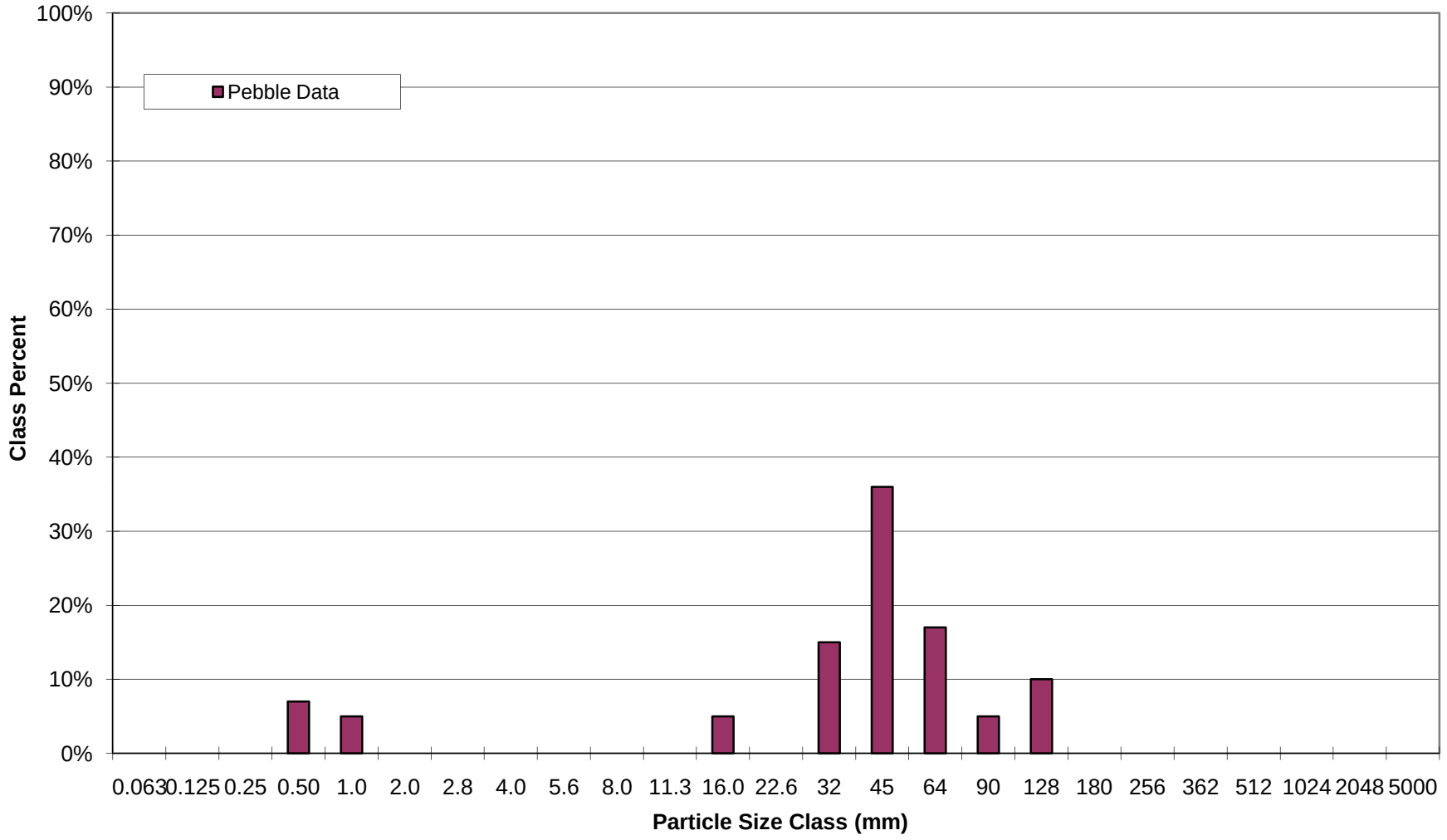
			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25			0%
	Medium	.25 - .50	7	7%	7%
	Coarse	.50 - 1.0	5	5%	12%
	Very Coarse	1.0 - 2.0			12%
GRAVEL	Very Fine	2.0 - 2.8			12%
	Very Fine	2.8 - 4.0			12%
	Fine	4.0 - 5.6			12%
	Fine	5.6 - 8.0			12%
	Medium	8.0 - 11.0			12%
	Medium	11.0 - 16.0	5	5%	17%
	Coarse	16.0 - 22.6			17%
	Coarse	22.6 - 32	15	15%	32%
	Very Coarse	32 - 45	36	36%	68%
	Very Coarse	45 - 64	17	17%	85%
COBBLE	Small	64 - 90	5	5%	90%
	Small	90 - 128	10	10%	100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: 130 mm
(riffle)

South Fork Hoppers Creek
X12 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X12 - Riffle
Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

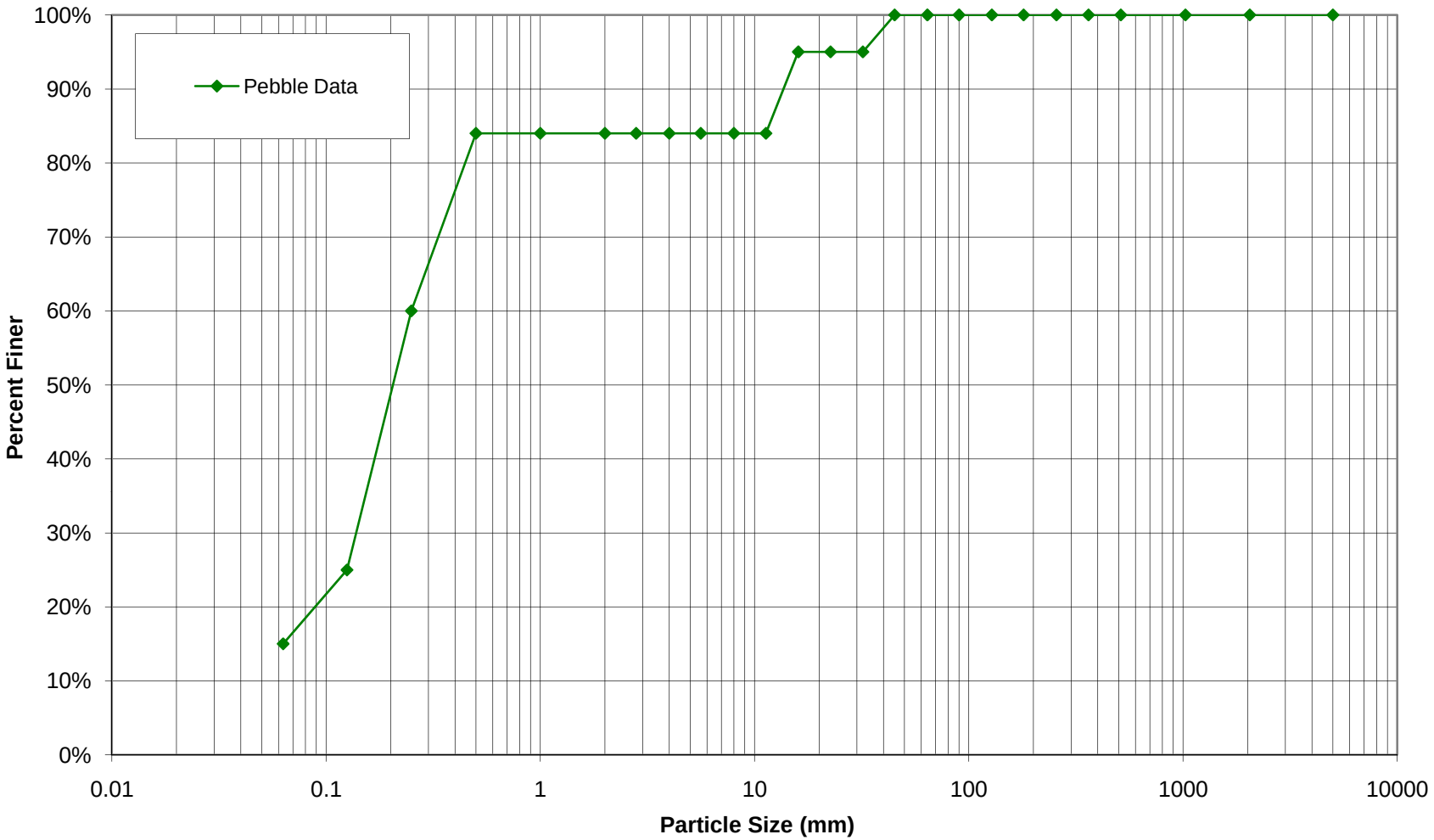
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X13 Pool
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Pool	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	15	15%	15%
SAND	Very Fine	.063 - .125	10	10%	25%
	Fine	.125 - .25	35	35%	60%
	Medium	.25 - .50	24	24%	84%
	Coarse	.50 - 1.0			84%
	Very Coarse	1.0 - 2.0			84%
GRAVEL	Very Fine	2.0 - 2.8			84%
	Very Fine	2.8 - 4.0			84%
	Fine	4.0 - 5.6			84%
	Fine	5.6 - 8.0			84%
	Medium	8.0 - 11.0			84%
	Medium	11.0 - 16.0	11	11%	95%
	Coarse	16.0 - 22.6			95%
	Coarse	22.6 - 32			95%
	Very Coarse	32 - 45	5	5%	100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

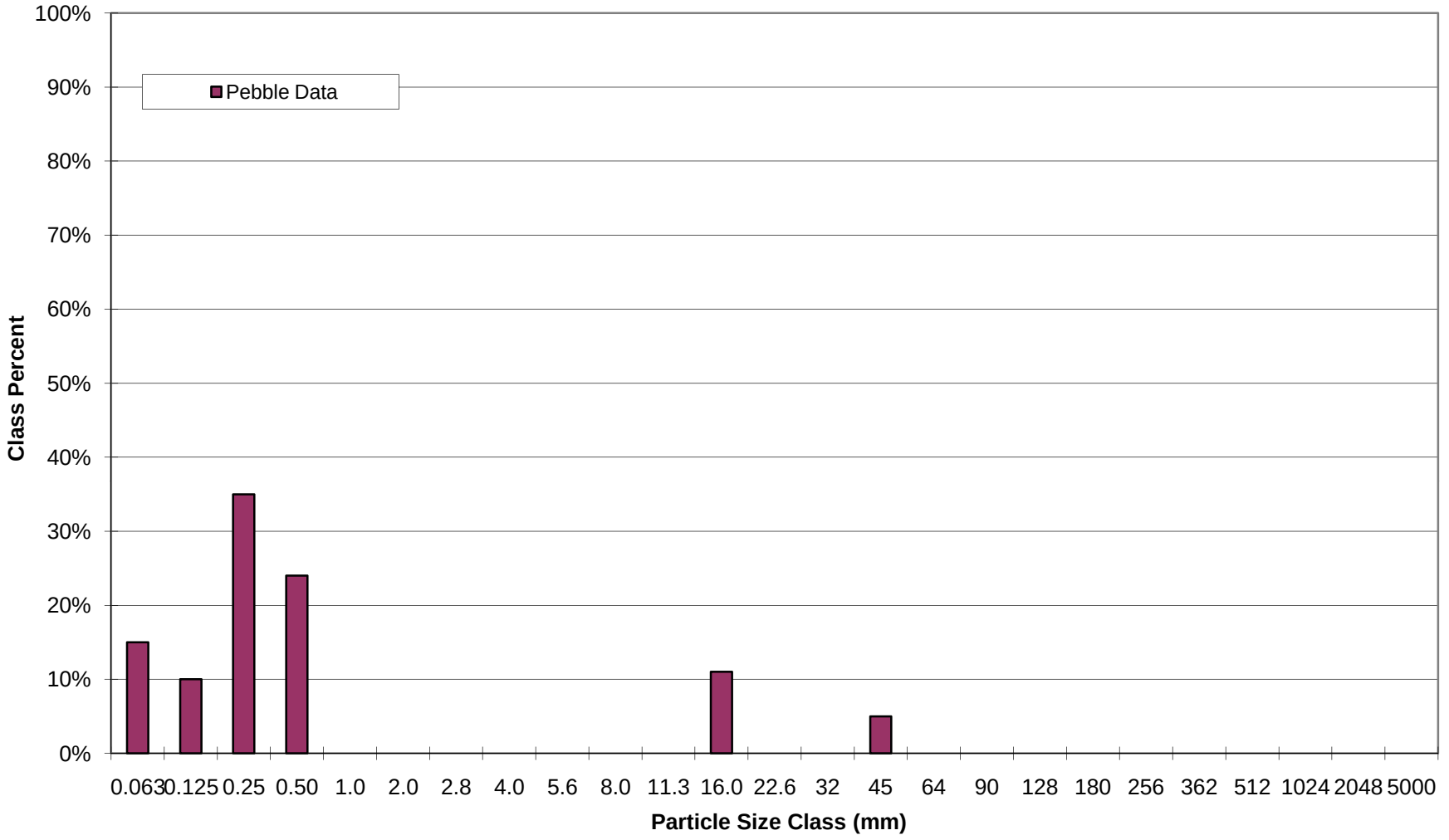
Largest particles: _____

(pool)

South Fork Hoppers Creek
X13 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X13 - Pool
Pebble Count Size Class Distribution



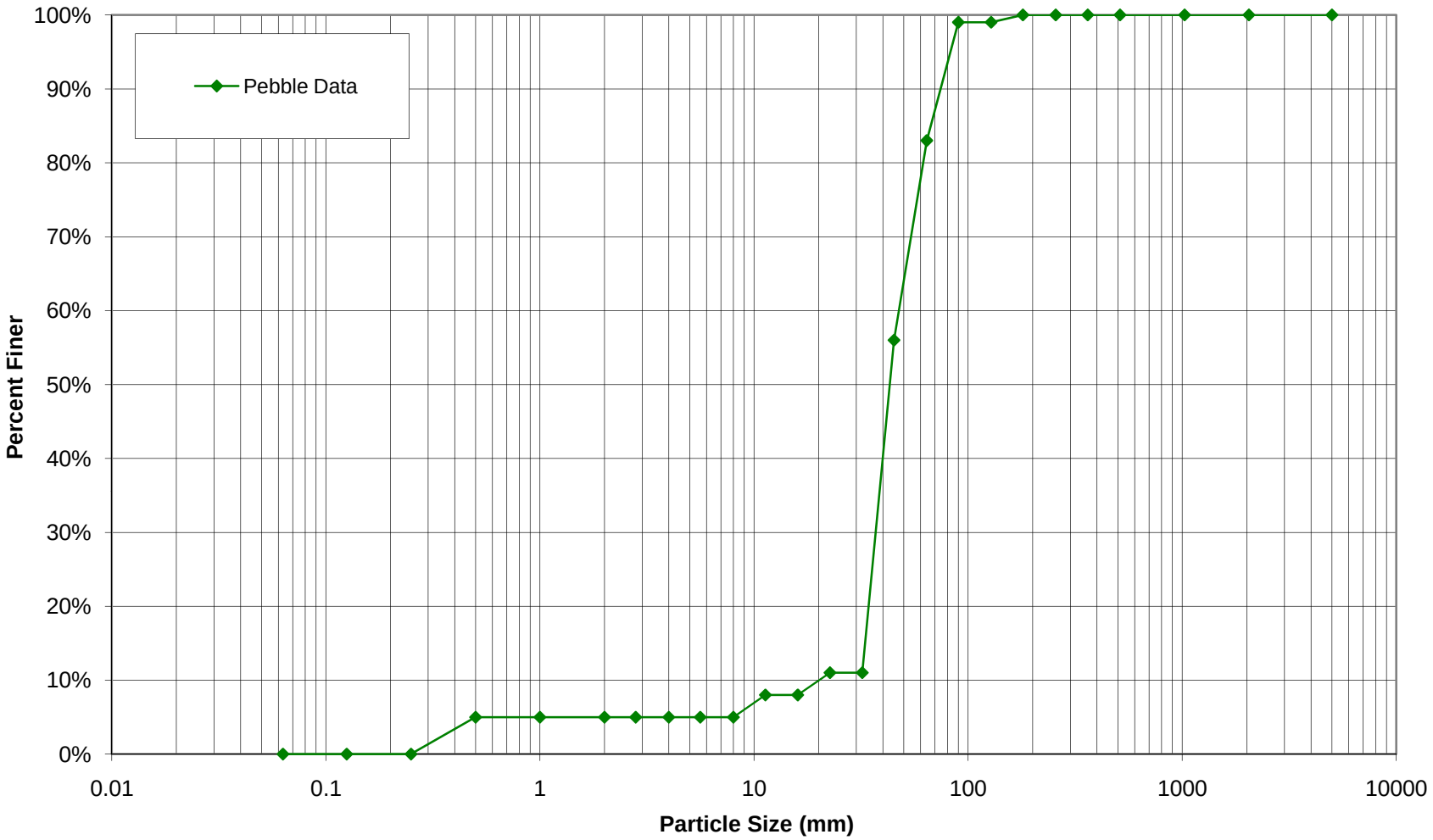
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X14 Riffle
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

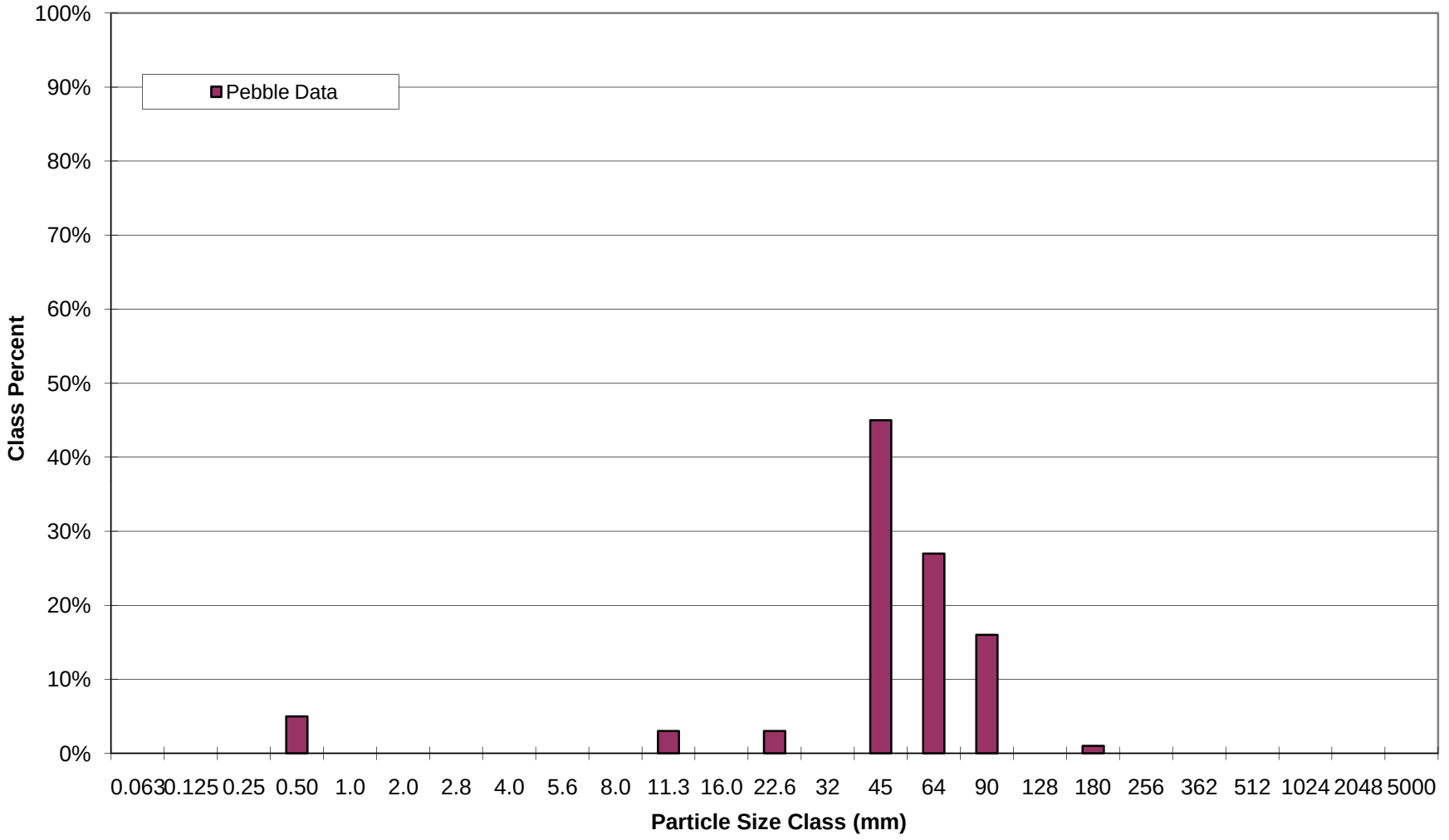
			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25			0%
	Medium	.25 - .50	5	5%	5%
	Coarse	.50 - 1.0			5%
	Very Coarse	1.0 - 2.0			5%
GRAVEL	Very Fine	2.0 - 2.8			5%
	Very Fine	2.8 - 4.0			5%
	Fine	4.0 - 5.6			5%
	Fine	5.6 - 8.0			5%
	Medium	8.0 - 11.0	3	3%	8%
	Medium	11.0 - 16.0			8%
	Coarse	16.0 - 22.6	3	3%	11%
	Coarse	22.6 - 32			11%
	Very Coarse	32 - 45	45	45%	56%
	Very Coarse	45 - 64	27	27%	83%
COBBLE	Small	64 - 90	16	16%	99%
	Small	90 - 128			99%
	Large	128 - 180	1	1%	100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: 150 mm
(riffle)

South Fork Hoppers Creek
X14 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X14 - Riffle
Pebble Count Particle Size Distribution



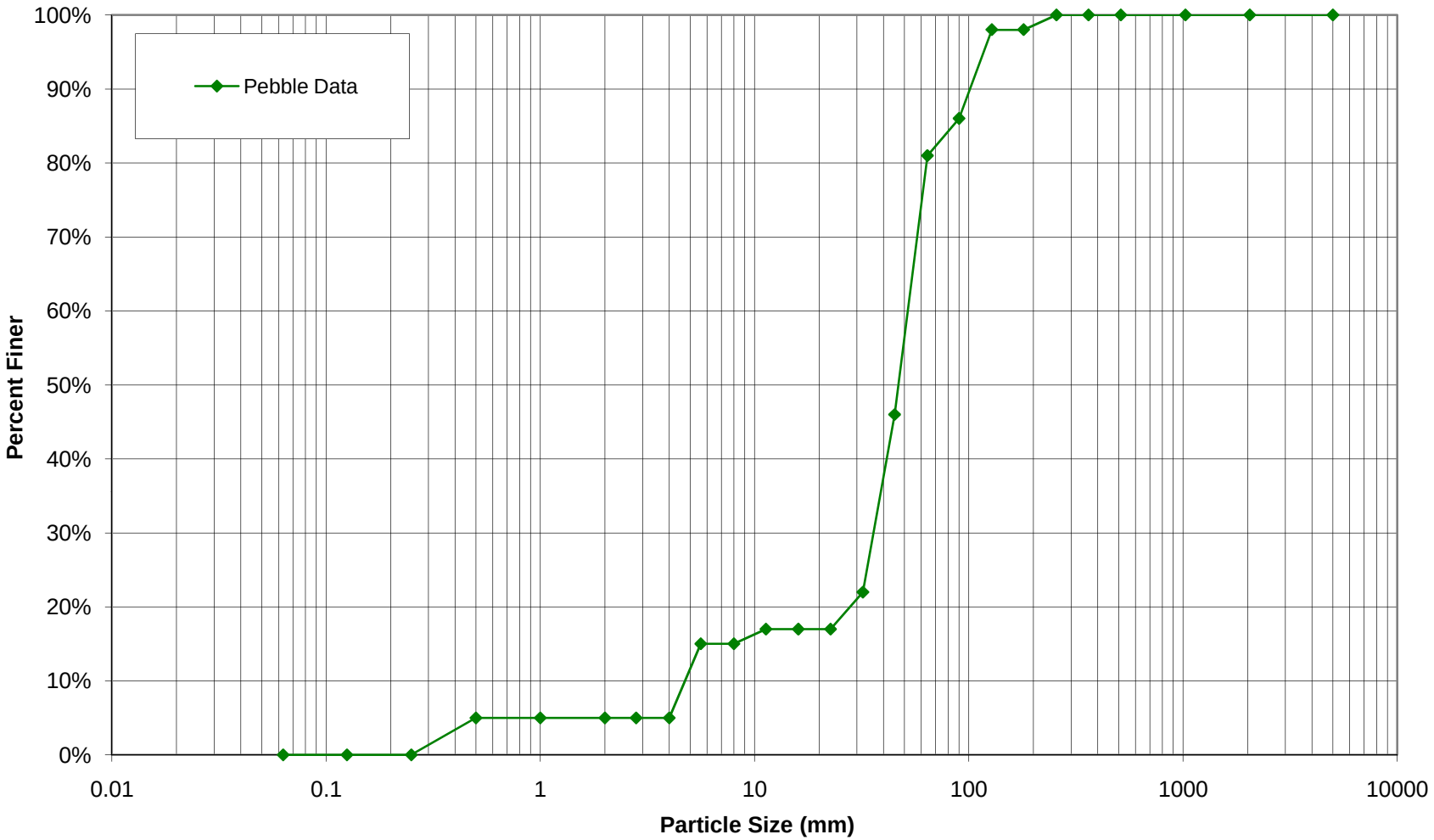
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X15 Riffle
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

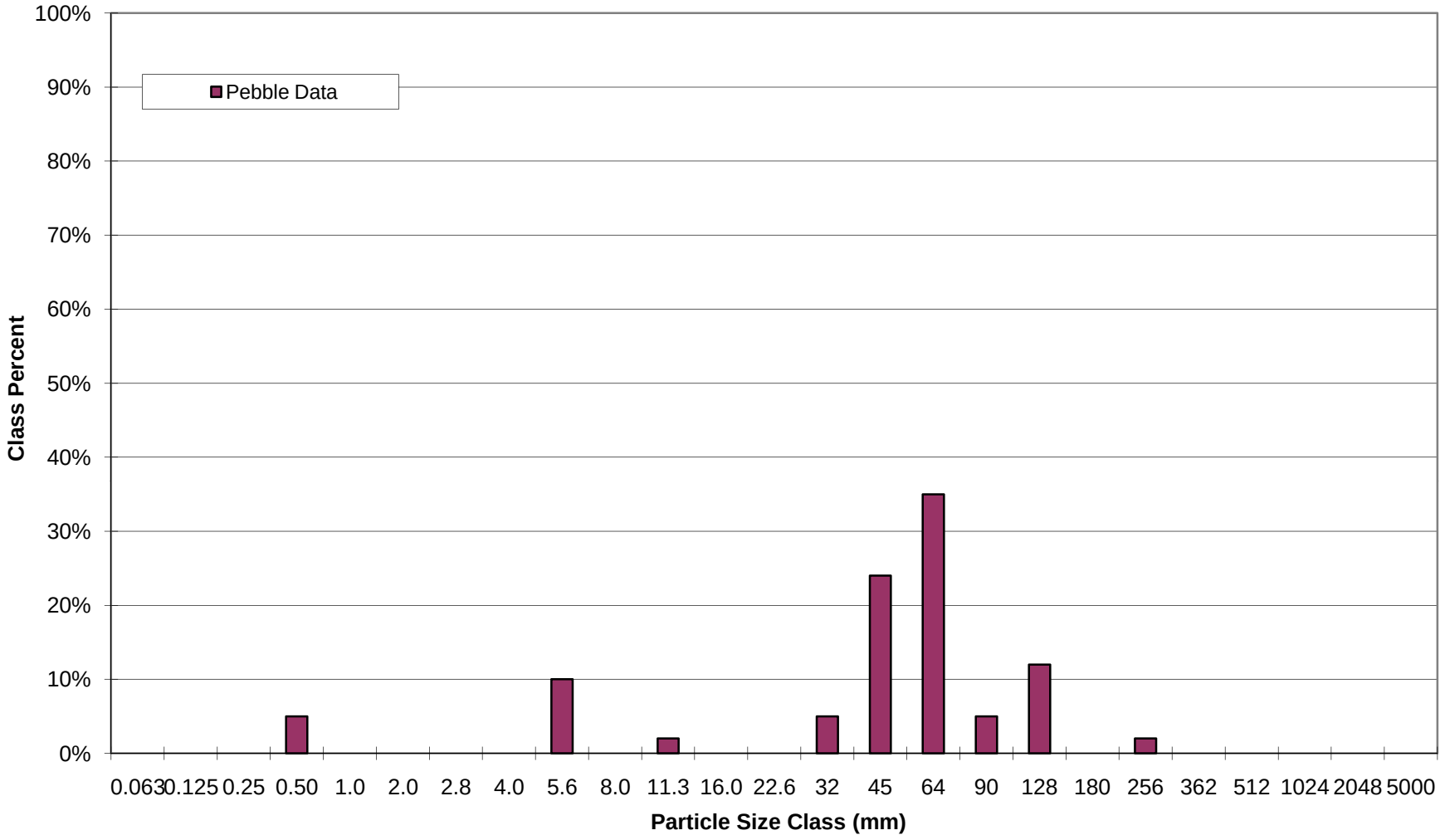
			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25			0%
	Medium	.25 - .50	5	5%	5%
	Coarse	.50 - 1.0			5%
	Very Coarse	1.0 - 2.0			5%
GRAVEL	Very Fine	2.0 - 2.8			5%
	Very Fine	2.8 - 4.0			5%
	Fine	4.0 - 5.6	10	10%	15%
	Fine	5.6 - 8.0			15%
	Medium	8.0 - 11.0	2	2%	17%
	Medium	11.0 - 16.0			17%
	Coarse	16.0 - 22.6			17%
	Coarse	22.6 - 32	5	5%	22%
	Very Coarse	32 - 45	24	24%	46%
	Very Coarse	45 - 64	35	35%	81%
COBBLE	Small	64 - 90	5	5%	86%
	Small	90 - 128	12	12%	98%
	Large	128 - 180			98%
	Large	180 - 256	2	2%	100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: 220 mm
(riffle)

South Fork Hoppers Creek
X15 - Riffle
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X15 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

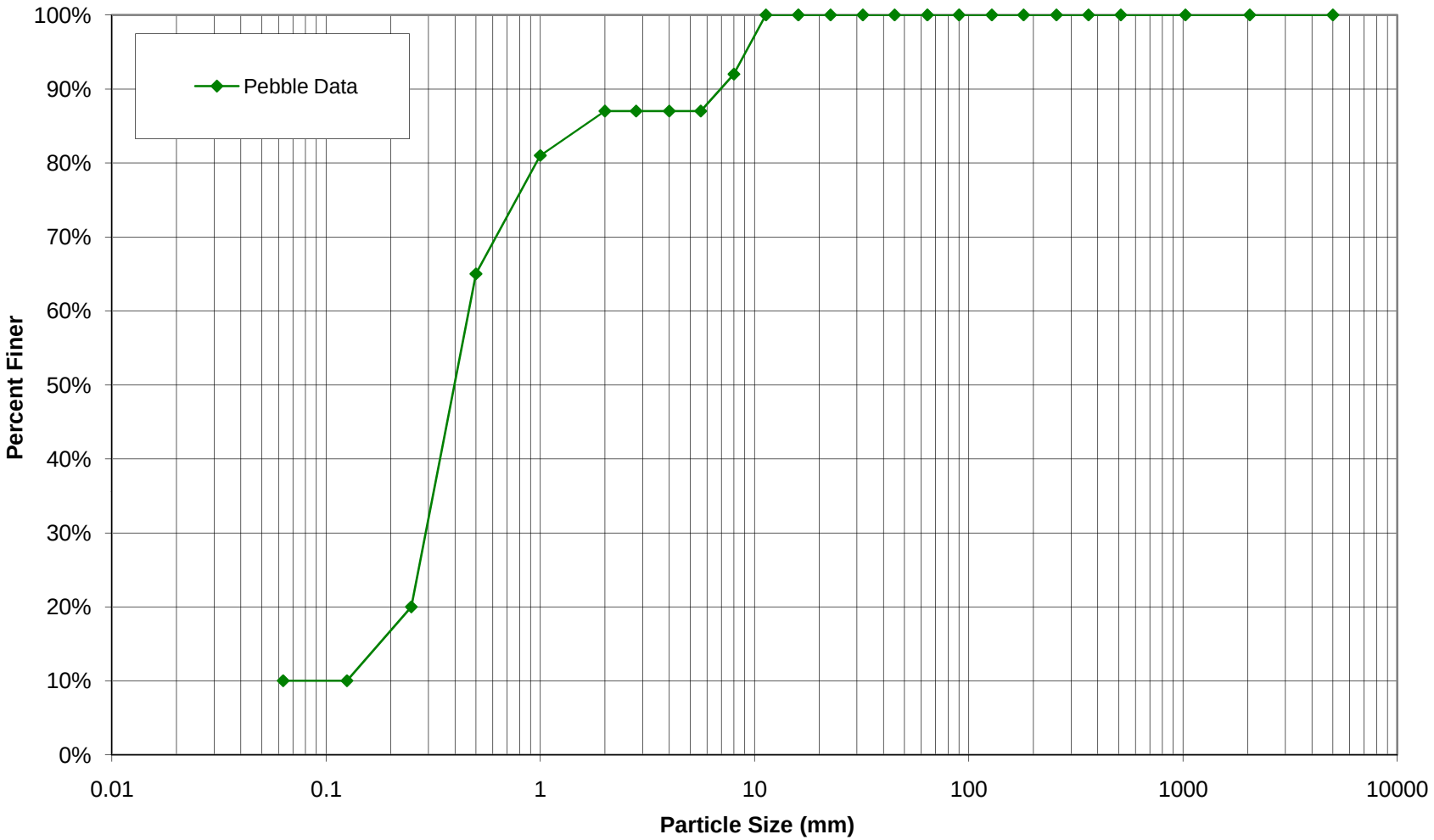
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 5 Monitoring
REACH/LOCATION:	X16 Pool
DATE COLLECTED:	9/22/2010
FIELD COLLECTION BY:	IE/PL
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	10	10%	10%
SAND	Very Fine	.063 - .125			10%
	Fine	.125 - .25	10	10%	20%
	Medium	.25 - .50	45	45%	65%
	Coarse	.50 - 1.0	16	16%	81%
	Very Coarse	1.0 - 2.0	6	6%	87%
GRAVEL	Very Fine	2.0 - 2.8			87%
	Very Fine	2.8 - 4.0			87%
	Fine	4.0 - 5.6			87%
	Fine	5.6 - 8.0	5	5%	92%
	Medium	8.0 - 11.0	8	8%	100%
	Medium	11.0 - 16.0			100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

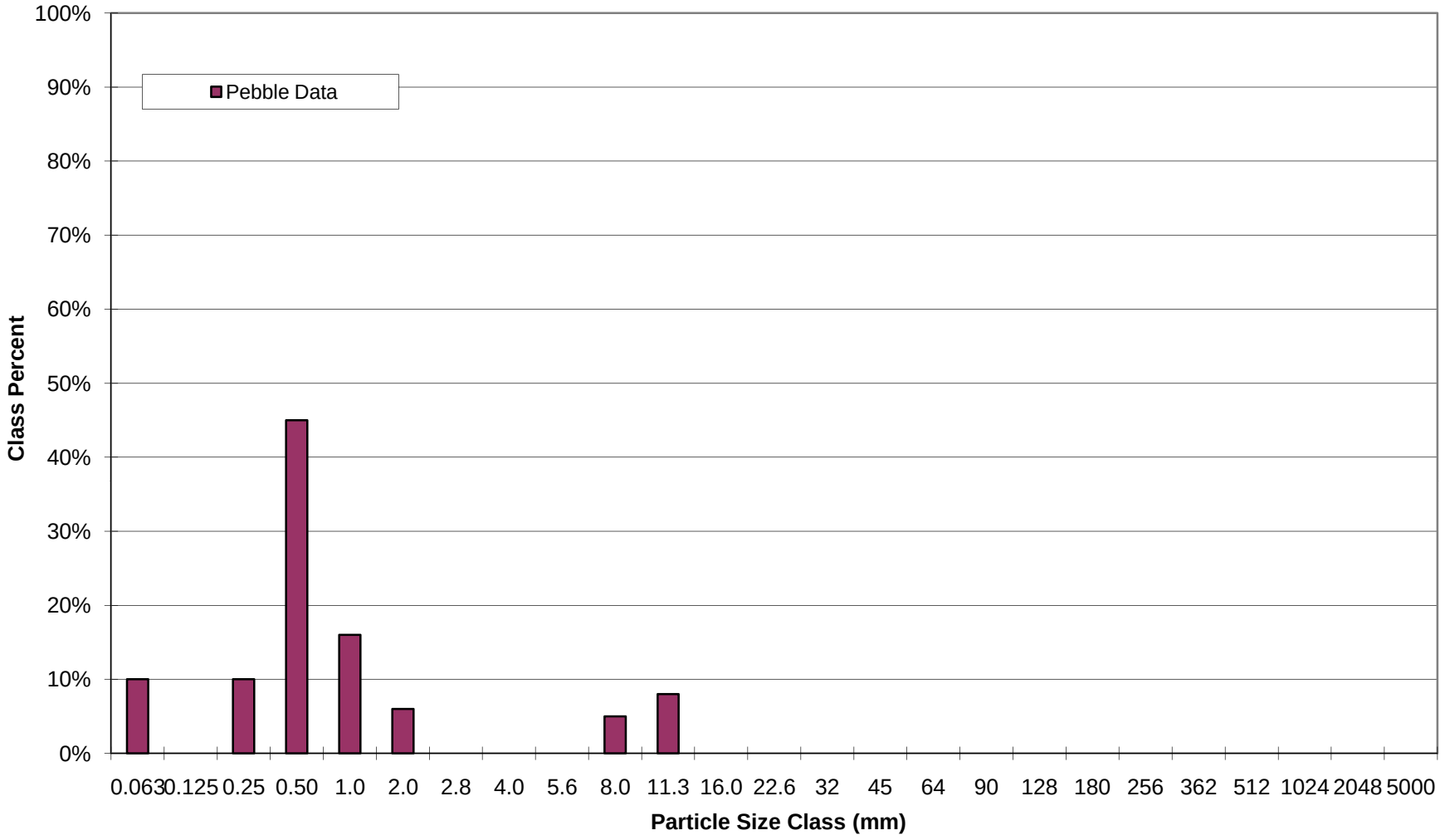
Largest particles: _____

(pool)

South Fork Hoppers Creek
X16 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek
X16 - Pool
Pebble Count Particle Size Distribution



APPENDIX C

AS-BUILT PLAN SHEETS

PROJECT REFERENCE NO.	SHEET NO.
0224C	T1

PROJECT ENGINEER
CLY

APPROVED BY
EGR

DATE
06/30/2006

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Buck Engineering
A Unit of Michael Baker
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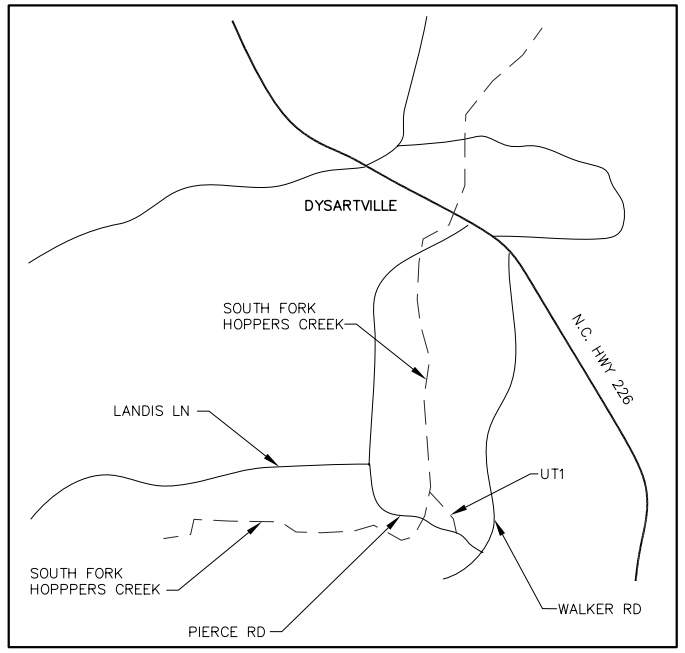
Charlotte, NC 28203
Phone: 704.334.4454
Fax: 704.334.4492



VICINITY MAP – NTS

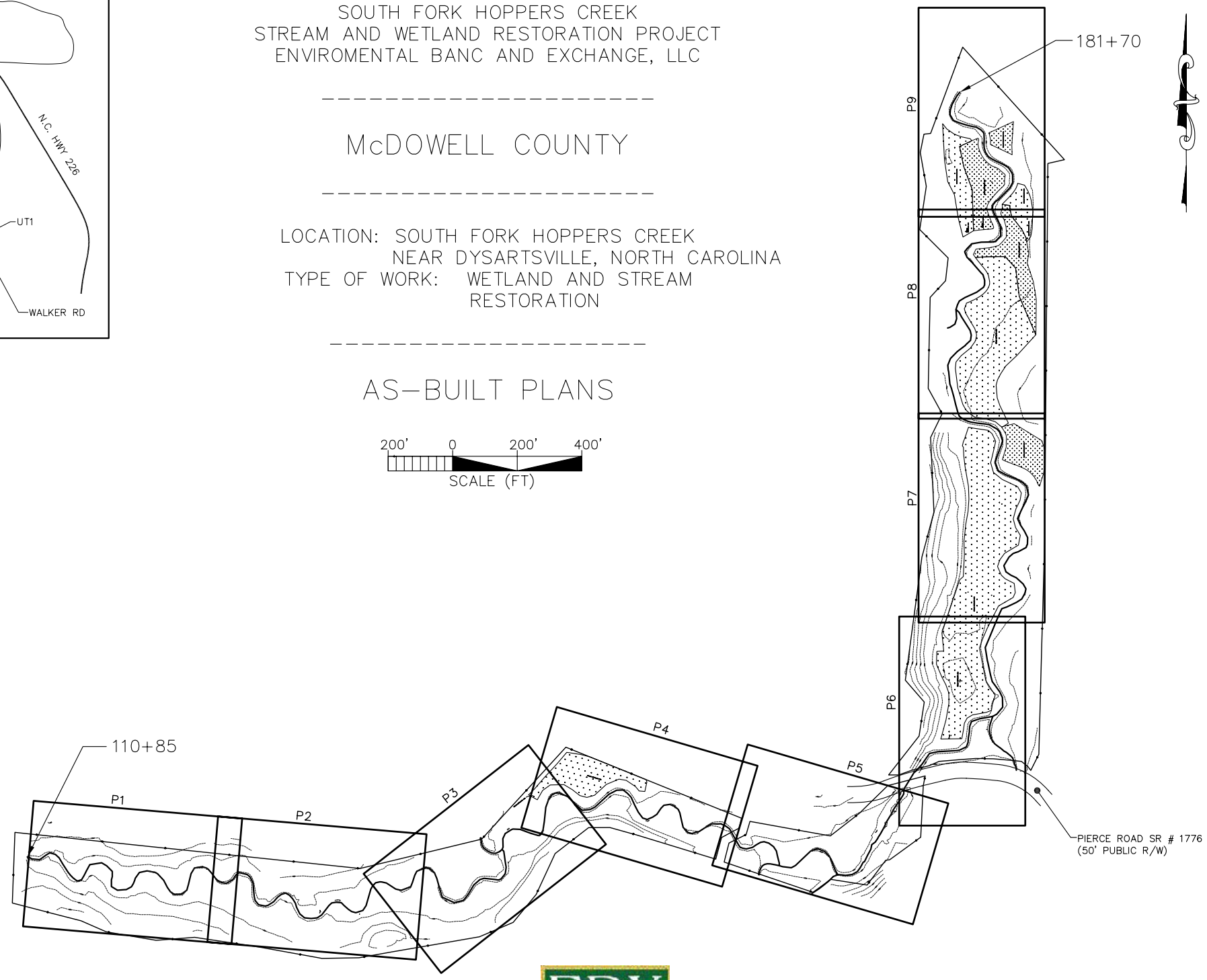
SOUTH FORK HOPPERS CREEK
STREAM AND WETLAND RESTORATION PROJECT
ENVIROMENTAL BANC AND EXCHANGE, LLC

McDOWELL COUNTY

LOCATION: SOUTH FORK HOPPERS CREEK
NEAR DYSARTSVILLE, NORTH CAROLINA
TYPE OF WORK: WETLAND AND STREAM
RESTORATION

AS–BUILT PLANS

200' 0 200' 400'
SCALE (FT)



INDEX OF SHEETS

NOTE:

1. PHOTO ID POINTS AND VEGETATION PLOTS LOCATED USING GPS
2. THESE PLANS WERE ORGINIIALLY SEALED ON 06/30/06 AND ARE PROVIDED WITH THIS MONITORING REPORT FOR REFERENCE ONLY.

EBX

PREPARED FOR THE OFFICE OF:
ENVIROMENTAL BANC AND EXCHANGE, LLC
2530 MERIDIAN PARKWAY, SUITE 200
DURHAM, NC 27713

EBX CONTACT:
THOMAS RINKER
PROJECT MANAGER

SOUTH FORK
HOPPERS AS–BUILT

TITLE SHEET

L:\Projects\0224C\Design\LD-0224-ASBUILT\dwg\PLANSHEETS.dwg Nov 12, 2007

PROJECT REFERENCE NO.	SHEET NO.
0224C	S1

PROJECT ENGINEER
CLY

APPROVED BY
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DATE
06/30/2006

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LEGEND

110+00 — AS-BUILT THALWEG (STA 100+85 TO 181+70)

10+00 — DESIGN THALWEG ALIGNMENT (STA 10+85 TO 82+00)

900 — MAJOR (INDEX) CONTOUR

MINOR CONTOUR

CE — CONSERVATION EASEMENT

CONSERVATION EASEMENT FENCE

BAMBOO BARRIER

X12 CROSS SECTION — CROSS SECTION

ROOTWAD

CONSTRUCTED RIFFLE

PHOTO ID POINT

SURVEY CONTROL POINT

CROSS VANE

LOG VANE

VEGETATION TRANSPLANT

COVER LOG

BAMBOO TREATMENT AREA

VEGETATION PLOT

FORD STREAM CROSSING

WETLAND RESTORATION

WETLAND ENHANCEMENT

SOUTH FORK
HOPPERS AS-BUILT

SYMBOL SHEET

SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P2 – 119+50

BCP #220L
REBAR/CAP
N 673516.00
E 1148134.90
ELEV= 1230.97

VEG PLOT #10

PHOTO ID
POINT #64

LOG VANE

PHOTO ID
POINT #66

PHOTO ID
POINT #68

LOG VANE

BEGIN CONSTRUCTION
110+85

PHOTO ID
POINT #70

X15 CROSS SECTION

COVER LOG

COVER LOG

X16 CROSS SECTION

PHOTO ID
POINT #65

PHOTO ID
POINT #67

PHOTO ID
POINT #63

PHOTO ID
POINT #63

1240
1235
1230
1225
1230
1225

19+00
18+00
17+00
16+00
15+00
14+00
13+00
12+00
11+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00

110+85

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PROJECT ENGINEER	
CLY	
APPROVED BY	
EGR	
DATE	
06/30/2006	
PROJECT REFERENCE NO.	SHEET NO.
0224C	P1

PROJECT REFERENCE NO.	SHEET NO.
0224C	P2

PROJECT ENGINEER
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MATCHLINE – P1 – 119+50

MATCHLINE – P3 – 128+00

CONSERVATION EASEMENT FENCE

PHOTO ID POINT #61

PHOTO ID POINT #62

PHOTO ID POINT #59

PHOTO ID POINT #60

PHOTO ID POINT #57

PHOTO ID POINT #58

PHOTO ID POINT #55

PHOTO ID POINT #54

PHOTO ID POINT #56

COVER LOG

X14 CROSS SECTION

VEG PLOT #9

BAMBOO TREATMENT AREA

BCP #2900
REBAR/CAP
N 677253.99
E 1147190.52
ELEV.= 1223.87

1225

1220

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

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PROJECT REFERENCE NO.	SHEET NO.
0224C	P3

PROJECT ENGINEER
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DATE
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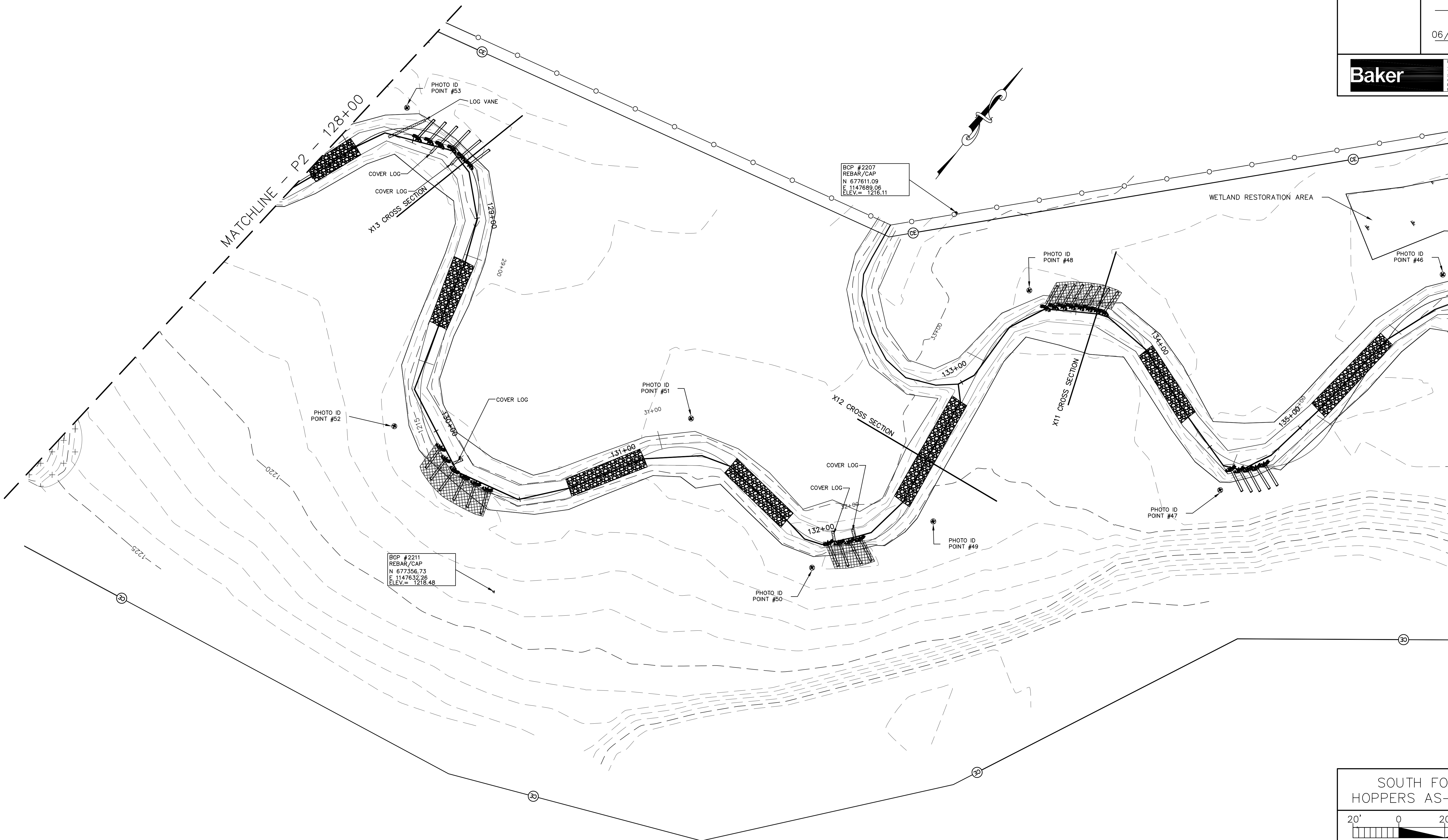
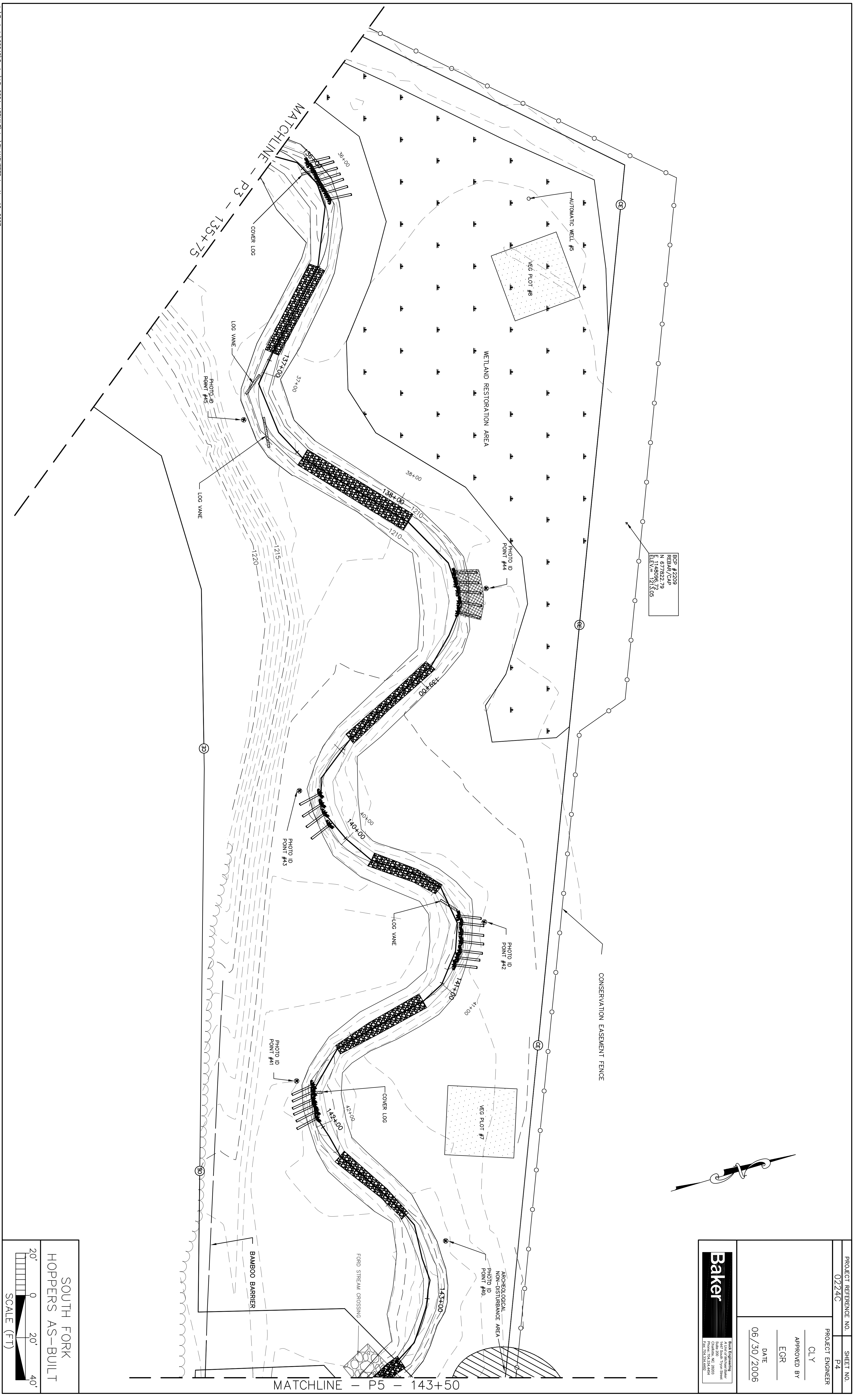


SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

L:\Projects\0224C\Design\LD-0224-ASBUILT\dwg\PLANSHEETS.dwg Nov 12, 2007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MATCHLINE – P3 – 135+75
MATCHLINE – P5 – 143+50
WETLAND RESTORATION AREA
AUTOMATIC WELL #5
VEG PLOT #8
VEG PLOT #7
COVER LOG
LOG VANE
LOG VANE
LOG VANE
COVER LOG
PHOTO ID POINT #45
PHOTO ID POINT #44
PHOTO ID POINT #43
PHOTO ID POINT #42
PHOTO ID POINT #41
PHOTO ID POINT #40
136+00
137+00
138+00
139+00
140+00
141+00
142+00
143+00
36+00
37+00
38+00
40+00
41+00
42+00
1210
1210
1215
1220
CE
BCP #2209
REBAR/CAP
N 677822.79
E 1148096.72
ELEV.= 1213.05
CONSERVATION EASEMENT FENCE
BAMBOO BARRIER
FORD STREAM CROSSING
ARCHEOLOGICAL NON-DISTURBANCE AREA
SOUTH FORK
HOPPERS AS-BUILT
20' 0 20' 40'
SCALE (FT)
PROJECT REFERENCE NO.
0224C
SHEET NO.
P4
PROJECT ENGINEER
CLY
APPROVED BY
EGR
DATE
06/30/2006
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PROJECT REFERENCE NO.	SHEET NO.
0224C	P5

PROJECT ENGINEER
CLY

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DATE
06/30/2006

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Phone: 704.334.4454
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MATCHLINE – P6 – 151+80

MATCHLINE – P4 – 143+50

PIERCE ROAD SR # 1776
(50' PUBLIC R/W)

ARCHAEOLOGICAL
NON-DISTURBANCE AREA

FORD STREAM CROSSING

VEG PLOT #6

X9 CROSS SECTION

X10 CROSS SECTION

COVER LOG

COVER LOG

BCP #5963
REBAR/CAP
N 677453.68
E 1148706.25
ELEV.= 1206.05

PHOTO ID
POINT #33

PHOTO ID
POINT #34

PHOTO ID
POINT #35

PHOTO ID
POINT #36

PHOTO ID
POINT #37

PHOTO ID
POINT #38

PHOTO ID
POINT #39

BAMBOO BARRIER

BAMBOO BARRIER

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

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SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P7 – 159+20

MATCHLINE – P5 – 151+80

PIERCE ROAD SR # 1776
(50' PUBLIC R/W)

EXISTING 24" CMP

EXIST. 72" CMP

RAIN GAUGE

LOG VANE

BCP #2102
REBAR/CAP
N 6781777.31
E 1149316.15
ELEV.= 1199.02

MAIN TRIB: 54+92.30
END OF TRIB: 202+02.79

X1 CROSS SECTION

X2 CROSS SECTION

WETLAND RESTORATION AREA

VEG PLOT #5

OHE

PHOTO ID POINT #22
PHOTO ID POINT #23
PHOTO ID POINT #24
PHOTO ID POINT #25
PHOTO ID POINT #26
PHOTO ID POINT #27
PHOTO ID POINT #28
PHOTO ID POINT #29
PHOTO ID POINT #30
PHOTO ID POINT #31
PHOTO ID POINT #32

PROJECT REFERENCE NO.	SHEET NO.
0224C	P6

PROJECT ENGINEER
CLY
APPROVED BY
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DATE
06/30/2006

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PROJECT REFERENCE NO.	SHEET NO.
0224C	P7

PROJECT ENGINEER
CLY

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DATE
06/30/2006

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MATCHLINE – P6 – 159+20

MATCHLINE – P8 – 168+15

WETLAND RESTORATION AREA

WETLAND ENHANCEMENT AREA

AUTOMATIC WELL #4

VEG PLOT #4

X6 CROSS SECTION

X5 CROSS SECTION

X4 CROSS SECTION

X3 CROSS SECTION

COVER LOG

COVER LOG

LOG VANE

LOG VANE

LOG VANE

LOG VANE

PHOTO ID POINT #14

PHOTO ID POINT #15

PHOTO ID POINT #16

PHOTO ID POINT #17

PHOTO ID POINT #18

PHOTO ID POINT #19

PHOTO ID POINT #20

PHOTO ID POINT #21

BCP #33
REBAR/CAP
N 678848.23
E 1149181.83
ELEV.= 1190.89

1193.2

1194.5

1193.4

1192.8

1215

1210

1205

1200

1195

60+00

61+00

62+00

63+00

64+00

65+00

66+00

67+00

168+00

167+00

166+00

165+00

164+00

163+00

162+00

161+00

160+00

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

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SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P9 – 176+60

MATCHLINE – P7 – 168+15

WETLAND RESTORATION AREA

WETLAND ENHANCEMENT AREA

MONITORING WELL #1

CREST GAUGE

PHOTO ID POINT #7

VEG PLOT #2

AUTOMATIC WELL #2

MONITORING WELL #2

PHOTO ID POINT #8

PHOTO ID POINT #9

PHOTO ID POINT #10

PHOTO ID POINT #11

PHOTO ID POINT #12

PHOTO ID POINT #13

VEG PLOT #3

LOG VANE

1187.15

PROJECT REFERENCE NO.	0224C
SHEET NO.	P8

PROJECT ENGINEER
CLY
APPROVED BY
EGR
DATE
06/30/2006

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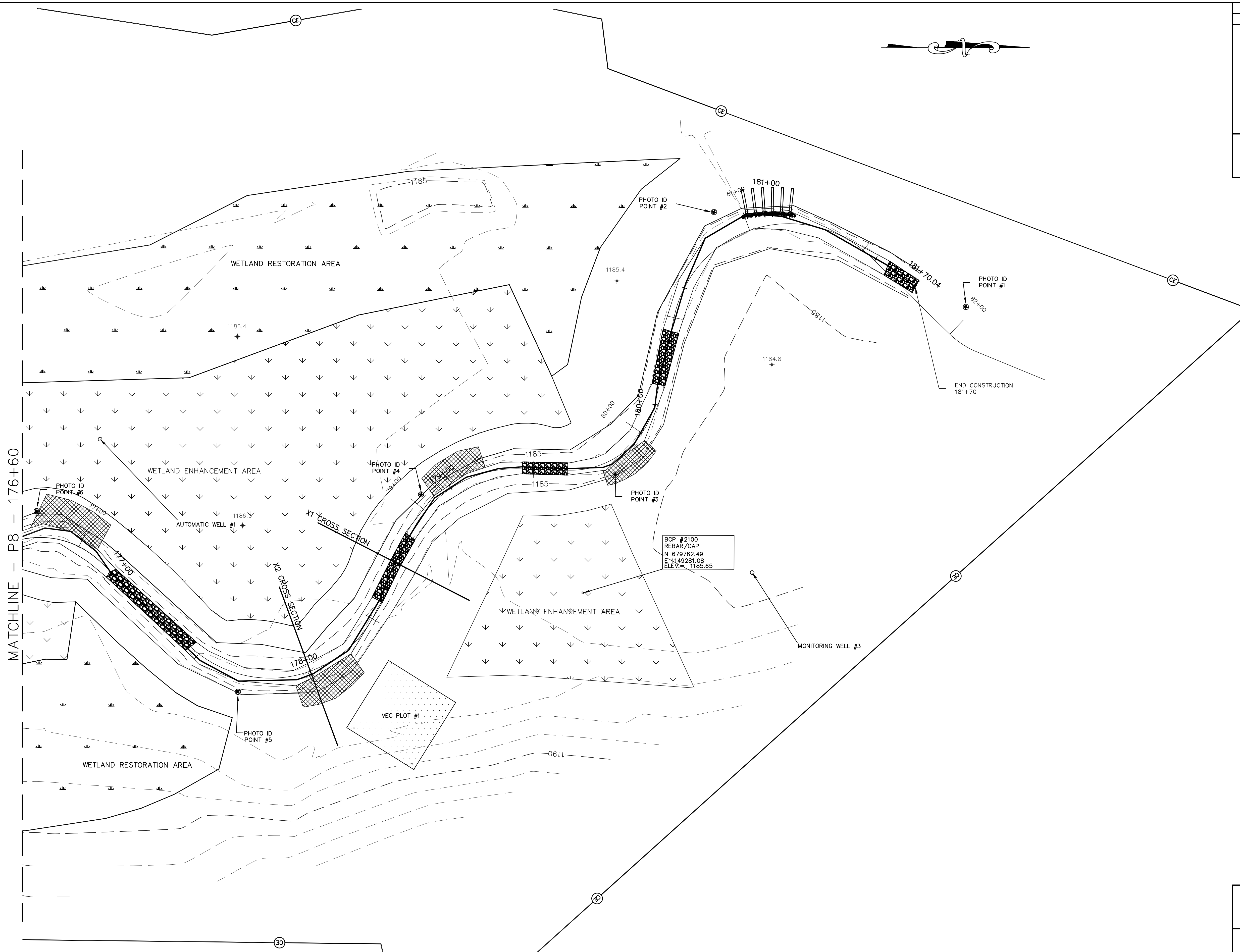

PROJECT REFERENCE NO.	SHEET NO.
0224C	P9

PROJECT ENGINEER
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DATE
06/30/2006

Baker

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SOUTH FORK
HOPPERS AS–BUILT

20' 0 20' 40'
SCALE (FT)

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APPENDIX D

BASELINE STREAM SUMMARY FOR RESTORATION REACHES

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - UT1

Parameter	Design			As-built			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
Dimension - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	7.0	-----	9.0	-----	13.6	-----	-----	13.4	-----	-----	12.2	-----	-----	11.9	-----	-----	13.3	-----	-----	13.0	-----
Floodprone Width (ft)	-----	23.0	-----	-----	59.5	-----	-----	47.0	-----	-----	43.0	-----	-----	43.3	-----	-----	47.8	-----	-----	63.1	-----
Bankfull Mean Depth (ft)	-----	0.6	-----	-----	0.8	-----	-----	0.7	-----	-----	0.6	-----	-----	0.5	-----	-----	0.5	-----	-----	0.6	-----
Bankfull Max Depth (ft)	-----	0.8	-----	-----	1.8	-----	-----	1.4	-----	-----	1.3	-----	-----	1.4	-----	-----	1.5	-----	-----	2.0	-----
Bankfull Cross Sectional Area (ft2)	4.2	-----	4.8	-----	10.5	-----	-----	9.1	-----	-----	7.1	-----	-----	5.7	-----	-----	6.9	-----	-----	7.3	-----
Width/Depth Ratio	12.0	-----	16.0	-----	17.7	-----	-----	19.6	-----	-----	20.9	-----	-----	24.9	-----	-----	25.8	-----	-----	23.4	-----
Entrenchment Ratio	-----	>1.4	-----	-----	4.4	-----	-----	3.6	-----	-----	3.5	-----	-----	3.6	-----	-----	3.6	-----	-----	4.9	-----
Bank Height Ratio	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----
Bankfull Velocity (fps)	-----	<5	-----	-----	<3	-----	-----	<3	-----	-----	<3	-----	-----	<3	-----	-----	<3	-----	-----	<3	-----
Pattern																					
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																					
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	8	12	15	8	12	15	8	12	15	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	10	15	20	10	15	20	10	15	20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																					
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	-----	<0.063 / 0.125 / 0.25 / 0.9 / 6			<0.063 / 0.16 / 0.26 / 0.8 / 5			0.20 / 0.32 / 0.43 / 5.4 / 14			<0.063 / 0.15 / 0.225 / 6.2 / 17.5		
Reach Shear Stress (competency) lb/f2	-----	1.07	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																					
Channel length (ft)	-----	208	-----	-----	203	-----	-----	203	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----	----	-----
Drainage Area (SM)	-----	0.07	-----	-----	0.07	-----	-----	0.07	-----	-----	0.07	-----	-----	0.07	-----	-----	0.07	-----	-----	0.07	-----
Rosgen Classification	-----	B4	-----	-----	B	-----	-----	B	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----	----	-----
Bankfull Discharge (cfs)	-----	16	-----	-----	-----	-----	-----	-----	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----	----	-----
Sinuosity	-----	-----	-----	-----	1.1	-----	-----	1.1	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----	----	-----
BF slope (ft/ft)	-----	-----	-----	-----	0.030	-----	-----	0.030	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----	----	-----

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 2, 3, & 4

Parameter	Design			As-built			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
Dimension - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	-----	18.0	-----	16.6	17.3	18.1	14.4	19.4	23.7	15.6	18.3	21	15	18.4	21.8	13.98	18.3	22.4	14.39	16.9	19.9
Floodprone Width (ft)	----	39.6+	-----	69.6	69.7	69.9	69.8	70.0	70.4	69.8	70.1	70.4	69.7	70.1	70.4	69.7	70.0	70.4	69.8	70.0	70.4
Bankfull Mean Depth (ft)	-----	1.5	-----	1.1	1.2	1.3	1.0	1.2	1.3	1.0	1.2	1.3	1.0	1.1	1.3	0.9	1.2	1.4	1.0	1.3	1.4
Bankfull Max Depth (ft)	-----	2.3	-----	2.2	2.4	2.6	2.3	2.4	2.5	2.2	2.4	2.5	2.3	2.4	2.5	2.3	2.4	2.5	2.2	2.4	2.6
Bankfull Cross Sectional Area (ft2)	-----	27.0	-----	20.3	24.9	29.5	18.4	22.9	26.1	19.9	22.6	25.2	19.0	22.1	25.3	19.1	20.9	23.9	20.4	20.9	21.9
Width/Depth Ratio	-----	12.0	-----	12.7	15.2	17.7	11.3	16.7	23.1	12.2	16.4	20.6	11.9	17.1	22.4	10.2	16.7	24.3	10.1	13.9	19.4
Entrenchment Ratio	-----	>2.2	-----	3.1	3.6	4.2	3.0	3.8	4.8	3.4	3.9	4.5	3.2	3.9	4.7	3.2	4.0	5.0	3.5	4.2	4.9
Bank Height Ratio	-----	1.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bankfull Velocity (fps)	-----	2.9	-----	-----	3.1	-----	-----	2.6	-----	-----	2.6	-----	-----	2.5	-----	-----	3.7	-----	-----	2.4	-----
Pattern																					
Channel Beltwidth (ft)	63	-----	108	63	-----	108	63	-----	108	----	-----	----	----	-----	----	----	-----	----	----	-----	----
Radius of Curvature (ft)	36	-----	61.2	36	-----	61	36	-----	61	----	-----	----	----	-----	----	----	-----	----	----	-----	----
Meander Wavelength (ft)	126	-----	198	126	-----	198	126	-----	198	----	-----	----	----	-----	----	----	-----	----	----	-----	----
Meander Width Ratio	3.5	-----	6	3.5	-----	6.0	3.5	-----	6.0	----	-----	----	----	-----	----	----	-----	----	----	-----	----
Profile																					
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	0.0045	0.00675	0.009	0.0045	0.00675	0.009	0.0045	0.00675	0.009	0.003	0.0065	0.010	0.006	0.008	0.010	0.003	0.012	0.021	0.006	0.017	0.032
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	72	99	126	72	99	126	72	99	126	58	93	128	63	96	128	71	100	125	76	101	121
Substrate and Transport Parameters																					
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	-----	<0.063-0.12 / 0.063-1.5 / 0.16-7.5 / 30-35 / 45-50			<0.063-0.18 / 0.22-8 / 27-36 / 53-55 / 64-80			5-15 / 27-34 / 36-40 / 57-58 / 73-80			0.45-14.5 / 8.5-34 / 22.5-39 / 57-65 / 75-88		
Reach Shear Stress (competency) lb/f2	0.25	-----	0.57	0.25	-----	0.57	0.25	-----	0.57	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																					
Channel length (ft)	-----	3,340	-----	-----	3,301	-----	-----	3,301	-----	-----	1,432	-----	-----	1,396	-----	-----	1,410	-----	-----	1,339	-----
Drainage Area (SM)	0.93	1.155	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38
Rosgen Classification	-----	C4	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----
Bankfull Discharge (cfs)	80	100	120	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sinuosity	-----	1.4	-----	-----	1.4	-----	-----	1.4	-----	-----	1.3	-----	-----	1.3	-----	-----	1.2	-----	-----	1.1	-----
BF slope (ft/ft)	-----	0.004	-----	0.003	-----	0.004	0.003	-----	0.004	----	0.007	----	----	0.004	----	----	0.0077	----	----	0.006	----

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 1

Parameter	Design			As-built			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
Dimension - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	-----	16.0	-----	16.3	18.0	19.7	15.9	17.3	18.9	16.3	17.3	18.2	16.5	17.5	18.4	16.4	17.5	18.2	16.9	18.0	20.3
Floodprone Width (ft)	-----	35.2+	-----	69.9	70.1	70.3	69.9	70.1	70.3	69.9	70.1	70.3	69.9	70.1	70.3	69.9	70.1	70.2	69.9	70.1	70.3
Bankfull Mean Depth (ft)	-----	1.4	-----	1.1	1.3	1.4	1.1	1.2	1.5	1.1	1.3	1.5	1.0	1.2	1.5	0.9	1.2	1.4	0.9	1.1	1.4
Bankfull Max Depth (ft)	-----	2.0	-----	1.9	2.1	2.4	1.8	2.1	2.7	1.8	2.2	2.6	1.8	2.2	2.6	1.9	2.1	2.6	1.8	2.1	2.6
Bankfull Cross Sectional Area (ft2)	-----	22.0	-----	18.6	22.7	26.8	17.7	21.6	27.7	17.1	21.7	26.3	16.7	21.0	25.3	16.4	20.2	24.8	16.2	19.5	23.5
Width/Depth Ratio	10.0	-----	12.0	13.6	14.0	14.5	12.9	14.1	15.0	12.3	13.9	15.5	11.9	14.9	18.0	12.7	15.6	19.3	12.1	17.1	20.8
Entrenchment Ratio	-----	>2.2	-----	3.6	3.9	4.3	3.7	4.1	4.4	3.9	4.1	4.3	3.8	4.0	4.2	3.9	4.0	4.3	3.5	3.9	4.2
Bank Height Ratio	-----	1.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bankfull Velocity (fps)	-----	3.8	-----	-----	3.5	-----	-----	3.6	-----	-----	3.6	-----	-----	3.9	-----	-----	4.1	-----	-----	4.1	-----
Pattern																					
Channel Beltwidth (ft)	56	-----	96	56	-----	96	56	-----	96	----	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----
Radius of Curvature (ft)	32	-----	54.5	32	-----	55	32	-----	54.5	----	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----
Meander Wavelength (ft)	112	-----	176	112	-----	176	112	-----	176	----	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----
Meander Width Ratio	3.5	-----	6	3.5	-----	6.0	3.5	-----	6	----	-----	-----	----	-----	-----	----	-----	-----	----	-----	-----
Profile																					
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	0.01	0.015	0.02	0.01	0.015	0.02	0.01	0.015	0.02	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.04
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	64	88	112	64	88	112	64	88	112	60	91	122	52	94	135	76	111	157	83	116	169
Substrate and Transport Parameters																					
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.1-23 / 17-35 / 34-40 / 54-80 / 65-130			<0.063-9.5 / 0.32-27 / 0.9-44 / 44-125 / 58-160			0.7-10 / 11.5-12.8 / 40-55 / 56-150 / 61-170			5.7-33 / 33-47 / 38-80 / 52-148 / 80-175		
Reach Shear Stress (competency) lb/f2	-----	0.52	-----	-----	0.52	-----	-----	0.52	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																					
Channel length (ft)	-----	3665	-----	-----	3725	-----	-----	3725	-----	-----	2130	-----	-----	2164	-----	-----	2139	-----	-----	2220	-----
Drainage Area (SM)	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93
Rosgen Classification	-----	C4	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----
Bankfull Discharge (cfs)	80	100	120	80	100	120	80	100	120	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sinuosity	-----	>1.2	-----	-----	1.5	-----	-----	1.5	-----	-----	1.4	-----	-----	1.4	-----	-----	1.42	-----	-----	1.42	-----
BF slope (ft/ft)	-----	0.005	-----	-----	0.005	-----	-----	0.005	-----	-----	0.008	-----	-----	0.008	-----	-----	0.008	-----	-----	0.007	-----

APPENDIX E

MORPHOLOGY AND HYDRAULIC MONITORING SUMMARY – YEAR 5

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

Reach: Unnamed Tributary 1 (UT1)

I. Cross-Section Parameters	Cross Section 7 Pool					Cross Section 8 Riffle				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension										
BF Width (ft)	11.4	11.3	11.1	13.8	8.0	13.4	12.2	11.9	13.3	13.0
Floodprone Width (ft)	65.5	66.9	59.6	61.1	67.8	47.9	43.0	43.3	47.8	63.1
BF Cross Sectional Area (ft2)	10.1	11.2	8.2	9.9	8.6	9.1	7.1	5.7	6.9	7.3
BF Mean Depth (ft)	0.9	1.0	0.7	0.7	1.1	0.7	0.6	0.5	0.5	0.6
BF Max Depth (ft)	1.9	2.0	1.5	1.3	2.2	1.4	1.3	1.4	1.5	2.0
Width/Depth Ratio	13.0	11.3	14.9	19.2	7.4	19.6	20.9	24.9	25.8	23.4
Entrenchment Ratio	5.7	6.0	5.4	4.4	8.5	3.6	3.5	3.6	3.6	4.9
Wetted Perimeter (ft)	13.2	13.2	12.6	15.2	10.2	14.7	13.4	12.9	14.3	14.1
Hydraulic Radius (ft)	0.8	0.8	0.7	0.7	0.8	0.6	0.5	0.4	0.5	0.5
Substrate										
d50 (mm)	-	0.25	0.16	0.26	<0.063	-	0.19	0.26	0.43	0.23
d84 (mm)	-	0.9	0.33	0.48	<0.063	-	0.8	0.8	5.4	6.2

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (20010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Length (ft)	8	15	12	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	10	20	15	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters															
Valley Length (ft)	-	-	179.3	-	-	-	-	-	-	-	-	-	-	-	-
Channel Length (ft)	-	-	203	-	-	-	-	-	-	-	-	-	-	-	-
Sinuosity	-	-	1.13	-	-	-	-	-	-	-	-	-	-	-	-
Water Surface Slope (ft/ft)	-	-	0.0314	-	-	-	-	-	-	-	-	-	-	-	-
BF Slope (ft/ft)	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Rosgen Classification	-	-	B	-	-	-	-	-	-	-	-	-	-	-	-

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

Reach: South Fork Hoppers Reach 2

I. Cross-Section Parameters	Cross Section 1 Riffle					Cross Section 2 Pool					Cross Section 3 Riffle					Cross Section 4 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	23.7	21	21.76	22.35	19.88	13.38	15.3	15.76	16.1	12.88	14.43	15.56	15.01	13.98	14.39	15.05	16.02	14.63	16.52	15.29
Floodprone Width (ft)	70.42	70.42	70.41	70.37	70.42	69.95	70	69.69	70.01	70.03	69.83	69.9	69.77	69.88	69.77	69.88	69.9	69.92	69.9	69.94
BF Cross Sectional Area (ft2)	24.2	21.46	21.19	20.5	20.41	17.17	18.68	19.34	16.5	15.98	18.41	19.9	18.98	19.1	20.57	19.07	21.2	19.27	23.2	19.83
BF Mean Depth (ft)	1.0	1.02	0.97	0.92	1.03	1.28	1.22	1.23	1.03	1.24	1.28	1.28	1.26	1.37	1.43	1.27	1.32	1.32	1.41	1.3
BF Max Depth (ft)	2.4	2.24	2.28	2.25	2.24	2.94	2.23	2.37	2.23	2.01	2.25	2.37	2.33	2.51	2.56	2.55	2.83	2.58	3.17	2.68
Width/Depth Ratio	23.1	20.55	22.35	24.34	19.37	10.42	12.52	12.84	15.67	10.39	11.31	12.16	11.88	10.21	10.06	11.87	12.1	11.11	11.75	11.78
Entrenchment Ratio	3.0	3.35	3.24	3.1	3.54	5.23	4.58	4.42	4.35	5.44	4.84	4.49	4.65	5	4.85	4.64	4.36	4.78	4.23	4.58
Wetted Perimeter (ft)	25.71	23.04	23.7	24.19	21.94	15.94	17.74	18.22	18.16	15.36	16.99	18.12	17.53	16.72	17.25	17.59	18.66	17.27	19.34	17.89
Hydraulic Radius (ft)	0.94	0.93	0.89	0.85	0.93	1.08	1.05	1.06	0.91	1.04	1.08	1.10	1.08	1.14	1.19	1.08	1.14	1.12	1.20	1.11
Substrate																				
d50 (mm)	-	0.16	30	40	22.5	-	0.095	0.2	0.5	0.35	-	0.7	36	38	38	-	0.19	0.24	0.55	0.4
d84 (mm)	-	0.35	54	57	65	-	0.35	0.75	4.9	7	-	34	55	58	57	-	15	11	14	3.6

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	63	108	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	36	61.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	126	198	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	3.5	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	0.005	0.009	0.007	0.003	0.02	0.011	0.006	0.01	0.008	0.003	0.021	0.012	0.006	0.032	0.017
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	72	126	90	58	128	93	63	128	96	71	125	100	76	121	101
Additional Reach Parameters															
Valley Length (ft)	-	-	2447	-	-	1150	-	-	1150	-	-	1150	-	-	1251
Channel Length (ft)	-	-	3301	-	-	1432	-	-	1396	-	-	1410	-	-	1339
Sinuosity	-	-	1.35	-	-	1.25	-	-	1.2	-	-	1.23	-	-	1.07
Water Surface Slope (ft/ft)	-	-	0.0047	-	-	0.0067	-	-	0.004	-	-	0.0045	-	-	0.006
BF Slope (ft/ft)	-	-	0.0035	-	-	0.0073	-	-	0.008	-	-	0.0077	-	-	0.006
Rosgen Classification	-	-	C	-	-	C	-	-	C	-	-	C	-	-	C

Reach: South Fork Hoppers Reach 2 (cont'd)

I. Cross-Section Parameters	Cross Section 5 Riffle					Cross Section 6 Pool					Cross Section 9 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	15.14	20.09	19.99	19.19	16.38	22.76	31.33	28.01	26.11	26.78	29.6	30.33	29.9	29.67	30.57
Floodprone Width (ft)	69.77	69.8	69.73	69.71	69.78	70.52	70.5	70.51	70.56	70.7	69.71	69.76	69.78	69.72	69.86
BF Cross Sectional Area (ft2)	26.1	25.2	25.28	23.9	21.85	50.2	51.22	46.36	41.6	43.09	74.07	75.57	74.07	68.6	82.24
BF Mean Depth (ft)	1.37	1.25	1.26	1.24	1.33	1.79	1.63	1.66	1.59	1.61	2.42	2.49	2.48	2.31	2.69
BF Max Depth (ft)	2.17	2.5	2.48	2.42	2.38	4.02	3.92	3.47	3.08	3.61	3.21	3.51	3.38	3.07	4.04
Width/Depth Ratio	11.03	16.01	15.81	15.43	12.28	12.72	19.16	16.92	16.39	16.64	12.25	12.18	12.07	12.83	11.36
Entrenchment Ratio	4.61	3.48	3.49	3.6	4.26	3.1	2.25	2.52	2.7	2.64	2.35	2.3	2.33	2.35	2.29
Wetted Perimeter (ft)	17.88	22.59	22.51	21.67	19.04	26.34	34.59	31.33	29.29	30	34.44	35.31	34.86	34.29	35.95
Hydraulic Radius (ft)	1.4597	1.11554	1.123	1.103	1.148	1.91	1.481	1.48	1.42	1.436	2.15	2.1402	2.12	2.00	2.288
Substrate															
d50 (mm)	-	7.5	27	36	39	-	0.15	0.2	0.49	0.93	-	0.32	0.38	0.68	0.93
d84 (mm)	-	30	53	57	60	-	2	0.8	2.2	8.3	-	12	3	4.8	5.7

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

Reach: South Fork Hoppers Reach 1

I. Cross-Section Parameters	Cross Section 10 Riffle					Cross Section 11 Pool					Cross Section 12 Riffle					Cross Section 13 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	18.93	18.01	17.32	17.75	16.89	25.8	29.89	30.6	31.08	29.77	18.1	18.15	17.63	18.18	17.41	19.98	22.93	22.78	17.55	12.48
Floodprone Width (ft)	70.24	70.22	70.17	70.21	70.15	69.81	69.85	69.83	69.89	69.83	70.29	70.26	70.26	70.21	70.27	70.2	70.22	70.3	70.11	70.18
BF Cross Sectional Area (ft2)	27.68	26.27	25.25	24.8	23.51	38.8	35.29	34.2	33.5	31.68	22.71	21.75	20.84	20.5	18.65	30.69	31.55	29.05	23.7	25.43
BF Mean Depth (ft)	1.46	1.46	1.46	1.39	1.39	1.29	1.18	1.12	1.08	1.06	1.25	1.20	1.18	1.13	1.07	1.54	1.38	1.27	1.35	2.04
BF Max Depth (ft)	2.69	2.57	2.58	2.64	2.55	2.84	2.74	2.72	2.88	2.89	1.95	1.89	1.9	1.89	1.82	3.19	2.87	2.52	2.3	2.71
Width/Depth Ratio	12.94	12.34	11.88	12.72	12.13	20.06	25.24	27.38	28.82	27.98	14.43	15.14	14.92	16.11	16.26	13	16.67	17.87	13.01	6.13
Entrenchment Ratio	3.71	3.9	4.05	4	4.15	2.71	2.34	2.28	2.25	2.35	3.88	3.87	3.98	3.9	4.04	3.51	3.06	3.09	3.99	5.62
Wetted Perimeter (ft)	21.85	20.93	20.24	20.53	19.67	28.38	32.25	32.84	33.24	31.89	20.6	20.55	19.99	20.44	19.55	23.06	25.69	25.32	20.25	16.56
Hydraulic Radius (ft)	1.27	1.26	1.25	1.21	1.195	1.37	1.09	1.04	1.01	0.993	1.10	1.06	1.04	1.00	0.954	1.33	1.23	1.15	1.17	1.536
Substrate																				
d50 (mm)	-	34	44	55	80	-	0.27	0.07	0.27	0.22	-	36	27	45	38	-	0.3	0.17	0.8	0.21
d84 (mm)	-	80	125	150	148	-	0.9	0.7	4.9	1.8	-	55	44	65	52	-	0.52	0.65	7.4	13

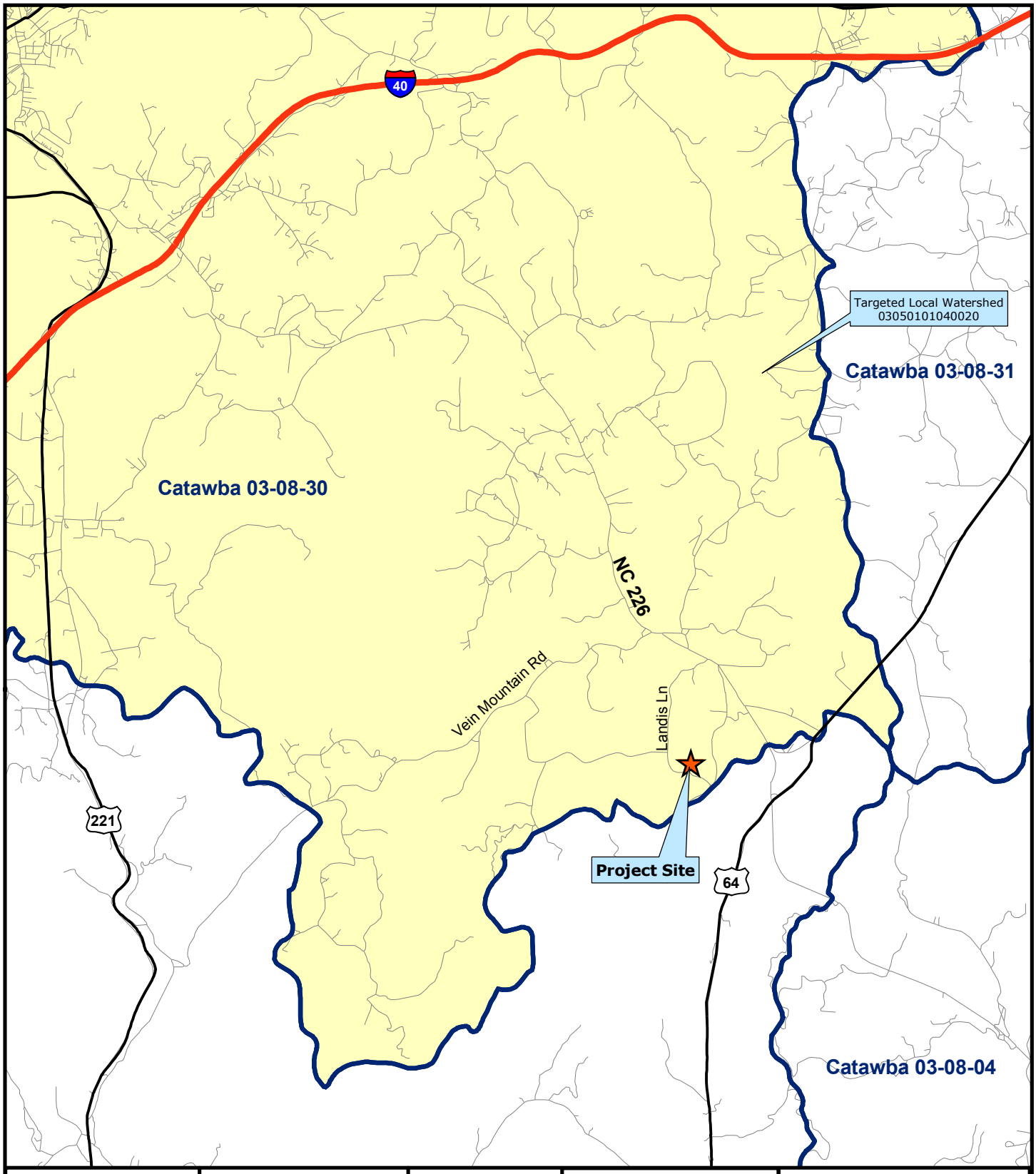
II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	56	96	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	32	54.4	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	112	176	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	3.5	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	0.01	0.02	0.015	0.01	0.03	0.02	0.01	0.03	0.02	0.011	0.03	0.022	0.012	0.035	0.024
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	64	112	88	60	122	91	52	135	94	85	158	114	83	169	116
Additional Reach Parameters															
Valley Length (ft)	-	-	2527	-	-	1508	-	-	1508	-	-	1508	-	-	1565
Channel Length (ft)	-	-	3725	-	-	2130	-	-	2164	-	-	2139	-	-	2220
Sinuosity	-	-	1.47	-	-	1.4	-	-	1.4	-	-	1.42	-	-	1.42
Water Surface Slope (ft/ft)	-	-	0.0068	-	-	0.0076	-	-	0.0076	-	-	0.0074	-	-	0.008
BF Slope (ft/ft)	-	-	0.005	-	-	0.0078	-	-	0.008	-	-	0.0077	-	-	0.007
Rosgen Classification	-	-	C	-	-	C	-	-	C	-	-	C	-	-	C

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

Reach: South Fork Hoppers Reach 1 (Cont'd)

I. Cross-Section Parameters	Cross Section 14 Riffle					Cross Section 15 Riffle					Cross Section 16 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	15.92	16.71	18.44	16.44	20.26	16.33	16.29	16.46	17.78	17.58	13.68	14.01	13.78	13.38	8.8
Floodprone Width (ft)	70.08	70.07	70.11	70.01	70.12	69.86	69.88	69.88	69.91	69.93	69.01	70.03	70.01	69.98	70.12
BF Cross Sectional Area (ft2)	18.18	18.91	18.94	19.2	19.77	17.74	17.13	16.67	16.4	16.2	12.16	11.35	11.43	9.7	10.25
BF Mean Depth (ft)	1.14	1.13	1.03	1.17	0.98	1.09	1.05	1.01	0.92	0.92	0.89	0.81	0.83	0.73	1.16
BD Max Depth (ft)	1.76	1.93	1.99	1.98	1.97	1.85	1.82	1.79	1.89	1.89	1.53	1.8	1.79	1.61	2.09
Width/Depth Ratio	13.94	14.77	17.95	14.08	20.77	15.03	15.49	16.26	19.28	19.08	15.39	17.29	16.6	18.45	7.55
Entrenchment Ratio	4.4	4.19	3.8	4.3	3.46	4.28	4.29	4.24	3.9	3.98	5.04	5	5.08	5.23	7.97
Wetted Perimeter (ft)	18.2	18.97	20.5	18.78	22.22	18.51	18.39	18.48	19.62	19.42	15.46	15.63	15.44	14.84	11.12
Hydraulic Radius (ft)	1.00	1.00	0.92	1.02	0.89	0.96	0.93	0.90	0.84	0.83	0.79	0.73	0.74	0.65	0.92
Substrate															
d50 (mm)	-	35	33	40	43	-	40	0.9	43	47	-	0.52	0.18	0.17	0.4
d84 (mm)	-	54	54	56	68	-	60	52	61	70	-	7.5	0.85	0.35	16

FIGURES



Ecosystem Enhancement Program

Map Vicinity

McDowell County, NC

Legend

Interstate
NC Primary Roads
US Route
8 Digit HUC

0 0.5 1 2 Miles

December 2010

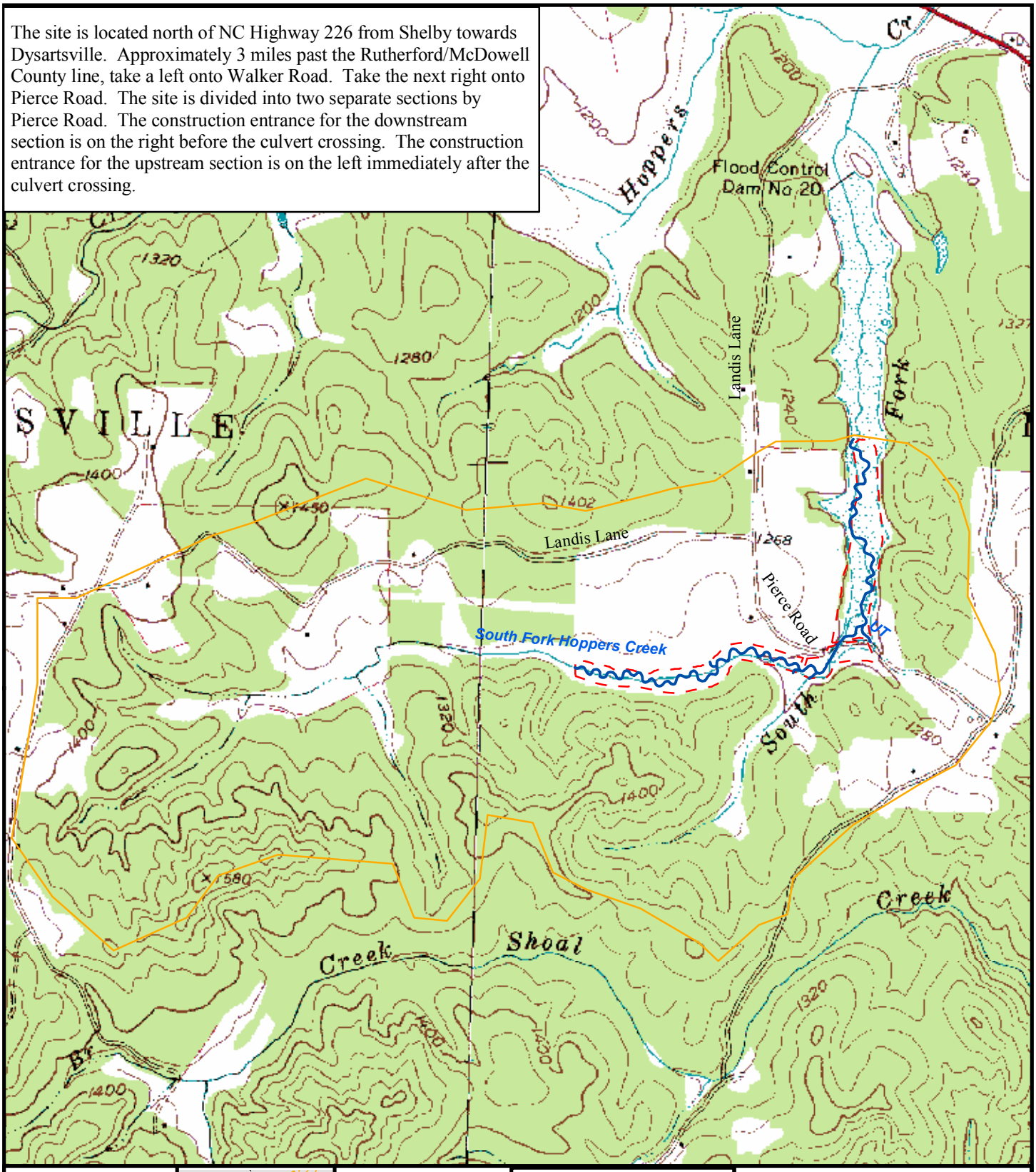
EEP Contract No.: D04006-4

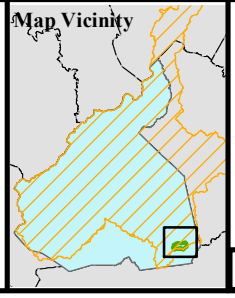
Figure 1. Project Vicinity Map
Restoration Project
South Fork Hoppers Creek

EBX

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606

The site is located north of NC Highway 226 from Shelby towards Dysartsville. Approximately 3 miles past the Rutherford/McDowell County line, take a left onto Walker Road. Take the next right onto Pierce Road. The site is divided into two separate sections by Pierce Road. The construction entrance for the downstream section is on the right before the culvert crossing. The construction entrance for the upstream section is on the left immediately after the culvert crossing.





Legend

- Watershed Boundary
- Project Boundary
- Project Reaches

0 500 1,000 Feet

December 2010

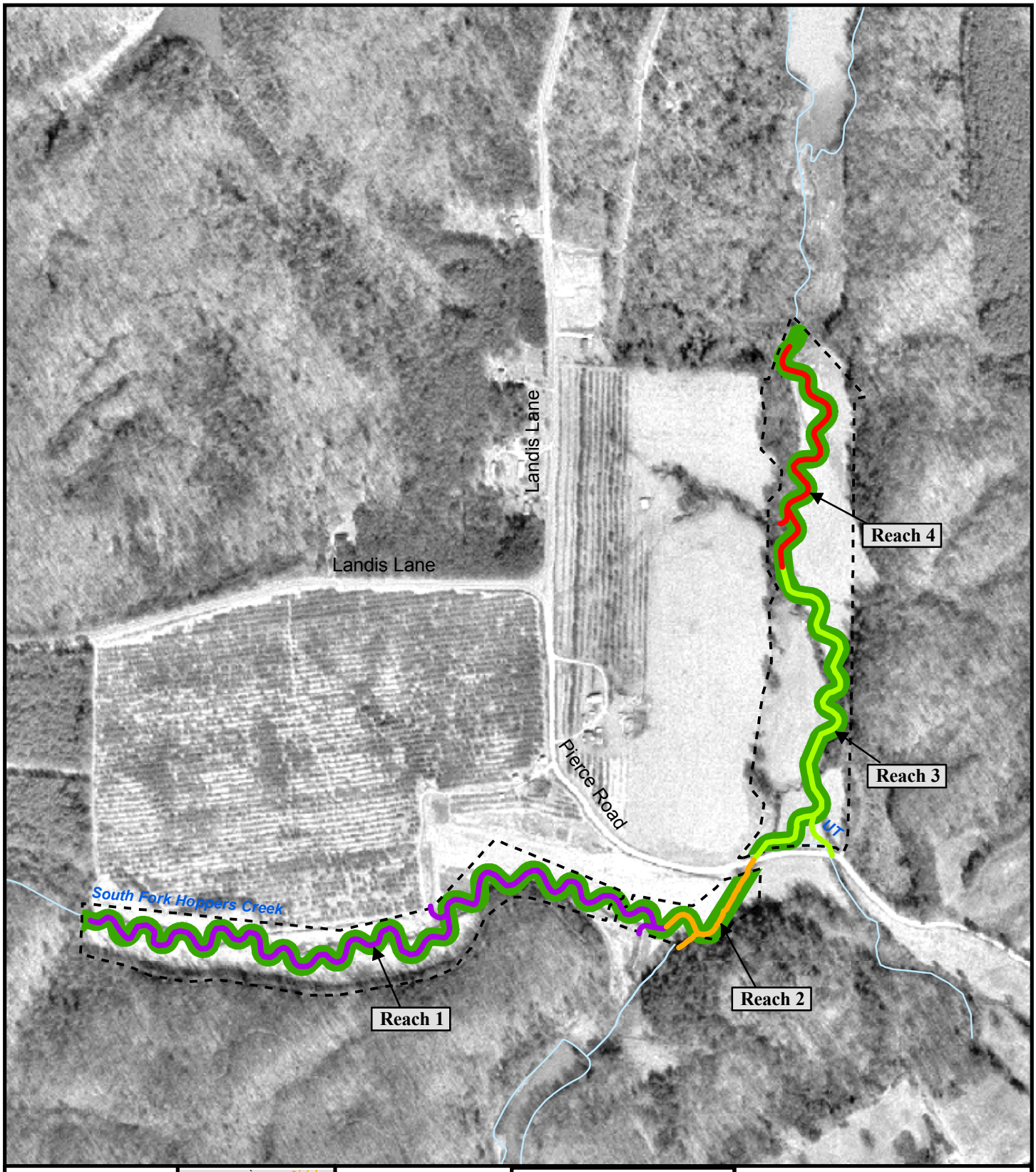
EEP Contract No.: D04006-4

Figure 2. Site Topographic Map
Restoration Project
South Fork Hoppers Creek

Ecosystem Enhancement Program

EBX

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606



Ecosystem Enhancement PROGRAM

Map Vicinity

Legend

Conservation Easement

30' Stream Buffer

Existing Streams

0 400 800 Feet

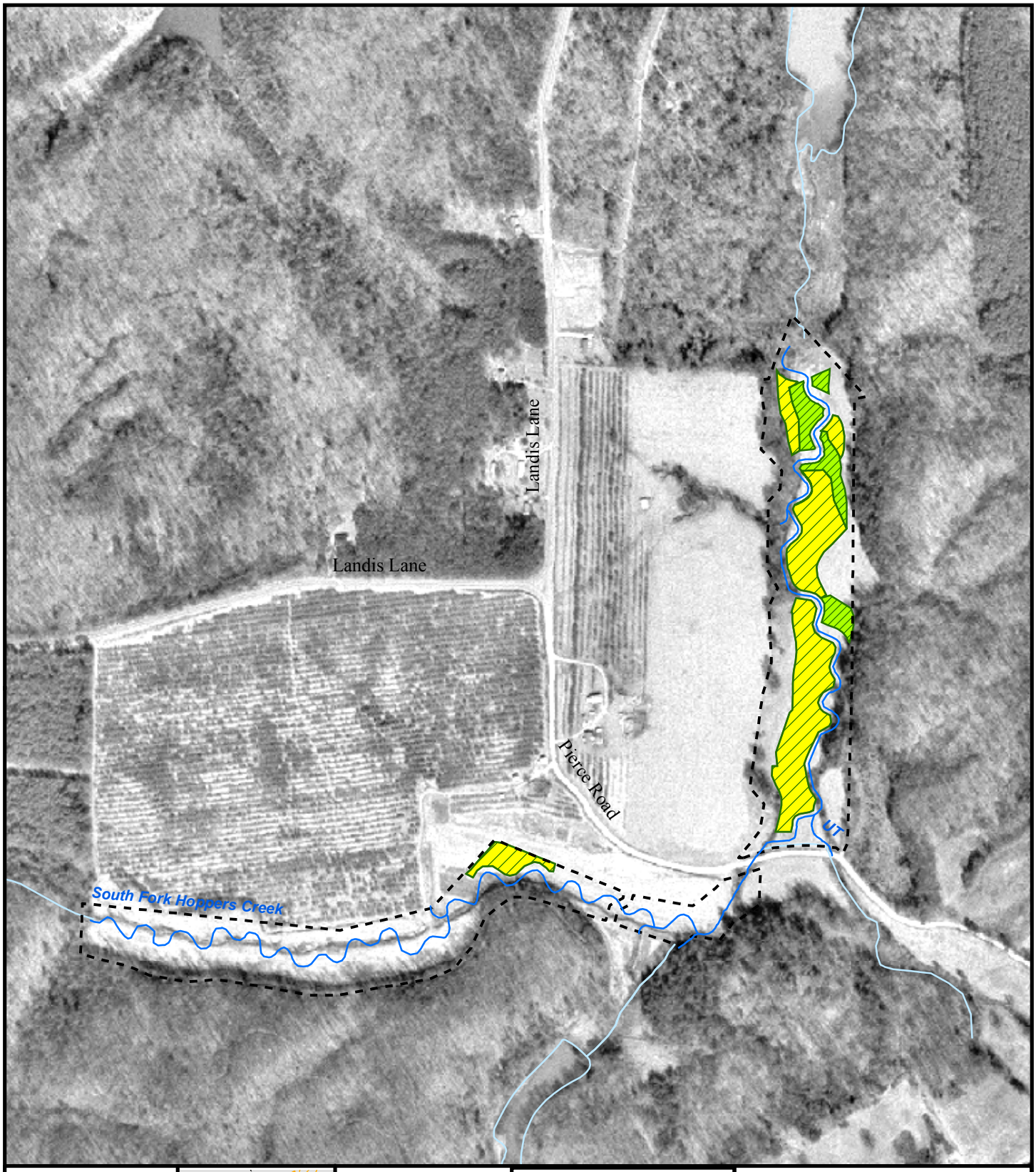
December 2010

EEP Contract No.: D04006-4

Figure 3. Restoration Summary Map
Restoration Project
South Fork Hoppers Creek

EBX

EBX Neuse-I, LLC
Capability Drive
Suite 3100
Raleigh, NC 27606



Ecosystem Enhancement PROGRAM

Map Vicinity

Legend

- Conservation Easement
- Existing Streams
- Project Reaches
- Enhancement
- Restoration

0 400 800 Feet

December 2010

EEP Contract No.: D04006-4

Figure 4. Wetland Summary Map
Restoration Project
South Fork Hoppers Creek

EBX

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606