Year 4 Monitoring Report

CATBIRD SITE

NCDMS Project #100022 (Contract #7186)
USACE Action ID: SAW-2017-01506
DWR Project #20171039

Davie County, North Carolina
Yadkin River Basin
HUC 03040101

Provided by:

Resource Environmental Solutions, LLC
For Environmental Banc & Exchange, LLC

Provided for:
NC Department of Environmental Quality
Division of Mitigation Services

December 2023

3600 Glenwood Avenue, Suite 100
Raleigh, NC 27612

Corporate Headquarters
6575 W Loop S #300
Bellaire, TX 77401
Main: 713.520.5400

December 4, 2023

Harry Tsomides
NC DEQ Division of Mitigation Services
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

RE: Catbird Site: Year 4 Monitoring Report (NCDMS ID 100022)

Listed below are comments provided by DMS on October 10, 2023 regarding the Catbird Site: Year 4 Report and RES' responses.

- As a reminder, full delivery providers are required to walk the entire boundary of all DMS projects and report any property issues in the project's annual monitoring reports. Please confirm the integrity of the boundary and easement, or note any issues present and follow up actions.
  The easement is intact, and no issues are known at this time, this has been noted in the first paragraph of section 1.7 of the report.

Table of Contents

1.0 Project Summary

1.1 Project Location and Description

The Catbird Site (the "Project") is located in Davie County, North Carolina, approximately eight miles west of Clemmons and five miles northwest of Bermuda Run. Water quality stressors affecting the Project included livestock production, agricultural production, and lack of riparian buffer. The Project presents stream restoration and enhancement generating 2,075.600 Warm Stream Mitigation Units (SMU).

The Project's total easement area is 6.33 acres within the overall drainage area of 53 acres. Grazing livestock historically had access to all the stream reaches within the Project. The lack of riparian buffer vegetation, deep-rooted vegetation, and unstable channel characteristics contributed to the degradation of stream banks throughout the Project area.

The stream design approach for the Project was to combine the analog method of natural channel design with analytical methods to evaluate stream flows and hydraulic performance of the channel and floodplain. The analog method involved the use of a reference reach, or "template" stream, adjacent to, nearby, or previously in the same location as the design reach. The template parameters of the analog reach were replicated to create the features of the design reach. The analog approach is useful when watershed and boundary conditions are similar between the design and analog reaches. Hydraulic geometry was developed using analytical methods to identify the design discharge.

The Project has been constructed and planted and will be monitored on a regular basis throughout the seven-year post-construction monitoring period, or until performance standards are met. The Project will be transferred to the NCDEQ Stewardship Program. This party shall serve as conservation easement holder and long-term steward for the property and will conduct periodic inspection of the site to ensure that restrictions required in the conservation easement are upheld. Funding will be supplied by the responsible party on a yearly basis until such time an endowment is established.

1.2 Project Goals and Objectives

Through the comprehensive analysis of the Project's maximum functional uplift using the Stream Functions Pyramid Framework, specific, attainable goals and objectives were realized by the Project. These goals clearly address the degraded water quality and nutrient input from farming that were identified as major watershed stressors in the 2009 Upper Yadkin Pee-Dee River RBRP. These goals also reflect the goals and objectives as stated in the Catbird Site Final Mitigation Plan.

The Project goals are:

- Improve water transport from watershed to the channel in a non-erosive manner in a stable channel;
- Improve flood flow attenuation on site and downstream by allowing for overbank flows and connection to the floodplain;
- Improve instream habitat;
- Reduce sediment, nutrient and fecal coliform inputs into stream system;
- Restore and enhance native floodplain vegetation;
- Indirectly support the goals of the 2009 Upper Yadkin Pee-Dee RBRP to improve water quality and to reduce sediment and nutrient loads; and
- Protect Water Supply Watersheds (WSW).

The Project objectives to address the goals are:

- Design and reconstruct stream channels sized to convey bankfull flows that will maintain a stable dimension, profile, and planform;
- Add in-stream structures and bank stabilization measures to protect restored streams;
- Install habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored streams;
- Increase forested riparian buffers to at least 50 feet on both sides of the channel along the Project reaches with a hardwood riparian plant community;
- Install approximately 4,200 linear feet of livestock exclusion fencing along the easement boundary to ensure livestock will no longer have stream access;
- Implement one agricultural BMP structure in order to limit inputs of sediment, nutrients, and fecal coliform to streams from surrounding farming operations;
- Treat exotic invasive species; and
- Establish a permanent conservation easement on the Project that will exclude future livestock from stream channels and their associated buffers.

Functional uplift, benefits, and improvements within the Project area, as based on the Function Based Framework, are outlined in the Mitigation Plan**.**

1.3 Project Success Criteria

The success criteria for the Project follows the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update, the Catbird Site Final Mitigation Plan, and subsequent agency guidance. Cross section and vegetation plot monitoring takes place in Years 0, 1, 2, 3, 5, and 7. Stream hydrology and visual monitoring takes place annually. Specific success criteria components are presented below.

Stream Restoration Success Criteria

Four bankfull flow events must be documented within the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years. Stage recorders were installed on DS1 and DS2-B to document bankfull events.

There should be little change in as-built cross sections. If changes do take place, they should be evaluated to determine if they represent a movement toward a less stable condition (for example down-cutting or erosion) or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross sections shall be classified using the Rosgen stream classification method, and all monitored cross sections should fall within the quantitative parameters defined for channels of the design stream type. Bank height ratio shall not exceed 1.2, and the entrenchment ratio shall be above 2.2 within restored riffle cross sections (for C and E streams). Channel stability should be demonstrated through a minimum of four bankfull events documented in the seven-year monitoring period.

Digital images are used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal images should not indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral images should not indicate excessive erosion or continuing degradation of the banks over time. A series of images over time should indicate successional maturation of riparian vegetation.

Stream restoration reaches will be monitored to document intermittent or seasonal surface flow. This will be accomplished through direct observation and the use of hydraulic pressure transducers with data loggers.

Intermittent reaches must demonstrate a minimum of 30 consecutive days of flow. A flow gauge was installed in the upper portion of DS1.

Vegetation Success Criteria

Specific and measurable success criteria for plant density within the riparian buffers on the Project follow IRT Guidance. The interim measures of vegetative success for the Project is the survival of at least 320 planted three-year old trees per acre at the end of Year 3, 260 trees per acre with an average height of seven feet at the end of Year 5, and the final vegetative success criteria is 210 trees per acre with an average height of ten feet at the end of Year 7. Volunteer trees are counted, identified to species, and included in the yearly monitoring reports, but are not be counted towards the success criteria of total planted stems. Moreover, any single species can only account for up to 50 percent of the required number of stems within any vegetation plot. Any stems in excess of 50 percent will be shown in the monitoring table but will not be used to demonstrate success.

Level	Treatment	Objective	Monitoring Metric	Performance Standard
1 ***Hydrology***	Converted land-use of Project reaches from pasture to riparian forest Installed one agricultural sediment load attenuation structure to limit inputs of sediment from surrounding farming operations coming into the reach (DS1)	Improve the transport of water from the watershed to the Project reaches in a non-erosive way	NA	NA
			Visually monitor integrity of runoff attenuation structure: Performed semiannually (*indirect measurement*)	Identify and document instability and/or flaws to the structure
2 ***Hydraulic***	Reduced bank height ratios and increased entrenchment ratios by reconstructing channels to mimic reference reach conditions	Improve flood bank connectivity by reducing bank height ratios and increase entrenchment ratios	Stage recorders and flow gauges: Inspected semiannually	Four bankfull events occurring in separate years
				At least 30 days of continuous flow each year
			Cross sections: Surveyed in Years 1, 2, 3, 5 and 7	Entrenchment ratio shall be above 2.2 within restored reaches (C and E)
				Bank height ratio shall not exceed 1.2
3 ***Geomorphology***	Established a riparian buffer to reduce erosion and sediment transport into project streams. Established stable banks with livestakes, erosion control matting, and other in stream structures.	Reduce erosion rates and channel stability to reference reach conditions Improve bedform diversity (pool spacing, percent riffles, etc. Increase buffer width to 50 feet	As-built stream profile	NA
			Cross sections: Surveyed in Years 1, 2, 3, 5 and 7	Entrenchment ratio shall be no less than 2.2 within restored reaches
			Visual monitoring	Bank height ratio shall not exceed 1.2
			Visual monitoring: Performed at least semiannually	Identify and document significant stream problem areas; i.e. erosion, degradation, aggradation, etc.
			Vegetation plots: Surveyed in Years 1, 2, 3, 5 and 7	MY 1-3: 320 trees/acre MY 5: 260 trees/acre (7 ft. tall) MY 7: 210 trees/acre (10 ft. tall)
4 ***Physicochemical***	Excluded livestock from riparian areas with exclusion fence and conservation easement, and planted a riparian buffer	*Unmeasurable Objective/Expected Benefit* Establish native hardwood riparian buffer and exclude livestock.	Vegetation plots: Surveyed in Years 1, 2, 3, 5 and 7 (*indirect measurement*)	MY 1-3: 320 trees/acre MY 5: 260 trees/acre (7 ft. tall) MY 7: 210 trees/acre (10 ft. tall)
			Visual assessment of established fencing and conservation signage: Performed at least semiannually (*indirect measurement*)	Inspect fencing and signage. Identify and document any damaged or missing fencing and/or signs

1.4 Project Components

The restoration reaches were significantly impacted by livestock production, agricultural practices, and a lack of riparian buffer. Improvements to the Project help meet the river basin needs expressed in the 2009 Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) as well as ecological improvements to the riparian corridor within the easement.

Through stream restoration and enhancement, the Project presents 2,223 LF of stream, generating 2,075.6 Warm Stream Mitigation Units (SMU) (**Table 1**). This is 19.4 SMU below the contract amount (2,095 SMU). Following As-Built Report review, the IRT requested the credit ratio on DS2-A reduce from 2.5:1 to 3:1 due to the easement change and subsequent buffer reduction. This change resulted in a 5.2 SMU loss.

Mitigation Approach	Linear Feet	Ratio	Warm SMU
Restoration	1,986	1	1,986
Enhancement II	159	2.5	63.6
Enhancement II	78	3	26
Total	**2,223**		**2,075.6**

1.5 Stream Design/Approach

The Project includes Priority I and II Restoration and Enhancement Level II. Stream restoration incorporates the design of a single-thread meandering channel, with parameters based on data taken from reference sites, published empirical relationships, regional curves developed from existing project streams, and NC Regional Curves. Analytical design techniques were also a crucial element of the project and were used to determine the design discharge and to verify the design as a whole.

The Project is broken into the following reaches:

Reach DS1– Priority I and II Restoration was used for Reach DS1. The upstream portion of this reach required Priority II floodplain excavation as the profile transitions from the existing entrenched channel to the Priority I channel at the downstream end. To prevent any hydrology loss, the transition from Priority II to Priority I takes place over several hundred feet and includes multiple channel plugs. Both in-line and offline restoration was used, and locations were driven by valley constraints. In-stream structures such as rock sills, log sills and cross vanes were installed for vertical stability and to improve bedform diversity. The restoration of the riparian areas included planting wider riparian buffers and excluding cattle. A self-maintaining sediment pack was installed at the upper end of the reach to provide sediment load attenuation from the adjacent pasture.

Reach DS2-A – Enhancement Level II was used for Reach DS2-A. Enhancement activities included livestock exclusion and riparian buffer plantings. Livestock fencing follows current NRCS specifications.

Reach DS2-B – A combination of Priority I Restoration and Enhancement Level II was used for Reach DS2-B. Restoration activities realigned the existing channel to improve stability and floodplain connection. Rock and log structures were used to provide vertical stability and improve bedform diversity. Log toe structures were installed on the outside of certain meander bends to provide bank stability. The restoration of the riparian areas included planting wider riparian buffers and excluding cattle. The Enhancement Level II portion of the reach contains a diverse channel bed profile, and this portion of the reach does contain localized areas of bank erosion caused by hoof shear. The Enhancement of this reach involved livestock exclusion and buffer planting.

1.6 Construction and As-Built Conditions

Stream construction and planting was completed in March 2020. The Catbird Site was built to design plans and guidelines. Two structures were identified as needing repair during the initial post-construction site visit with DMS. The first was located at the top of DS-B (Lower) and included resetting a rock sill. The second was on the bottom of DS2-B (Lower) (below the confluence with DS-1) where a rock drop structure was repaired, and the left bank was graded to alleviate shear stress. The first area was repaired in April 2020 and the second was repaired in June 2020.

Following Mitigation Plan approval, RES adjusted the easement to allow for an existing farm path (per landowner request). This 0.19-acre reduction only affected ephemeral stream channel therefore there was no change in credits.

Planting plan changes included removing black gum (*Nyssa sylvatica*) and adding silky dogwood (*Cornus amomum*), sugarberry (*Celtis laevigata*), elderberry (*Sambucus canadensis*), and eastern redbud (*Cercis canadensis*). Planting plan changes were based on bare root availability. Black walnut (*Juglans nigra)* and Southern crabapple (*Malus angustifolia)* were originally included in the planting plan but are being treated when possible, throughout the monitoring year. Minor monitoring device location changes were made during as-built installation, however, the quantities remained as proposed in the Mitigation Plan.

1.7 Year 4 Monitoring Performance (MY4)

The Catbird Year 4 Monitoring activities were performed in July and September 2023. All Year 4 Monitoring data is presented below and in the appendices. The Site is on track to meeting vegetation and stream interim success criteria, and the easement boundary is intact with no encroachments or issues present.

Vegetation

Vegetation data was not required for MY4. Monitoring of the four permanent vegetation plots and one random vegetation plot for MY3 was completed on, October 5th 2022. Vegetation data is in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project. Small, localized areas of Chinese privet and Multiflora rose were observed in late MY3, these areas will be treated this year (MY4). RES continued to remove black walnut and southern crabapple stems in MY4 and will continue as needed throughout the monitoring period.

Stream Geomorphology

Geomorphology data was not required for MY4. Cross section setup and geomorphology data collection for MY3 was collected on June 22, 2022. Summary tables and cross section plots are in **Appendix D**.
Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. The channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation. The rock drop structure below the confluence of DS2-B and DS-1 that was repaired in April 2021 is stable and functioning as intended.

Stream Hydrology

Two stage recorders and one flow gauge were installed on March 4, 2020: one stage recorder on DS1 (Lower), one stage recorder on DS2-B (Lower), and one flow gauge on DS1 (Upper). The stage recorder on DS1 (Lower) recorded 11 bankfull events in MY4 with the highest reading being 1.06 feet above top of bank. The stage recorded on DS2-B (Lower) recorded four bankfull events with the highest reading being 2.64 feet above top of bank. The flow gauge on DS1 (Upper) recorded two flow events with the longest flow event lasting 165 consecutive days. Gauge locations can be found on Figure 2 and data is located in **Appendix E**.

2.0 Methods

Stream monitoring was conducted using a Topcon GTS-312 Total Station. Three-dimensional coordinates associated with cross-section data were collected in the field (NAD83 State Plane feet FIPS 3200). Morphological data were collected at 12 cross-sections. Survey data were imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. The stage recorders include an automatic pressure transducer placed in PVC casing in a pool. The elevation of the bed and top of bank at each stage recorder are used to detect bankfull events. The flow gauge was also installed in a pool and records flow conditions at an hourly interval. Water level data from the flow gauge is corrected using the height of the downstream riffle to detect stream flow events.

Vegetation success is being monitored at four permanent monitoring plots and one random monitoring plot. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data are processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with PVC at the origin and metal conduit at the other corners. Photos of each plot are to be taken from the origin each monitoring year. The random plots are to be collected in locations where there are no permanent vegetation plots. Random plots are being collected in the form of 25x4 square meter belt transects.Tree species and height will be recorded for each planted stem and the transects will be mapped and new locations will be monitored in subsequent years.

3.0 References

Griffith, G.E., J.M.Omernik, J.A. Comstock, M.P. Schafale, W.H.McNab, D.R.Lenat, T.F.MacPherson, J.B. Glover, and V.B. Shelburne. (2002). Ecoregions of North Carolina and South Carolina, (color Poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Lee Michael T., Peet Robert K., Roberts Steven D., and Wentworth Thomas R., 2008. *CVS-EEP Protocol for Recording Vegetation Level*. Version 4.2

Resource Environmental Solutions (2019). Catbird Site Final Mitigation Plan.

Schafale, M.P. 2012. Classification of the Natural Communities of North Carolina, Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, NCDENR, Raleigh, NC.

USACE. (2016). Wilmington District Stream and Wetland Compensatory Mitigation Update. NC: Interagency Review Team (IRT).

Appendix A

Background Tables

Table 1. Catbird (100022) - Mitigation Assets and Components

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits		As-Built Footage or Acreage	Comments
DS1 (Upper)	300	288	Warm	R	2	1.00000	288.00000		288	Channel restoration, planting, livestock exclusion
DS1 (Lower)	668	661	Warm	R	1 & 2	1.00000	661.00000		661	Channel restoration, planting, livestock exclusion
DS2-A*	78	78	Warm	EII	N/A	3.00000	26.00000		78	Planting, livestock exclusion
DS2-B (Upper)	515	526	Warm	R	1 & 2	1.00000	526.00000		526	Channel restoration, planting, livestock exclusion
DS2-B (Middle)	181	159	Warm	EII	N/A	2.50000	63.60000		159	Planting, livestock exclusion
DS2-B (Lower)	522	511	Warm	R	1	1.00000	511.00000		511	Channel restoration, planting, livestock exclusion

*After as-built review, IRT reduced the credit ratio from 2.5:1 to 3:1 on DS2-A due to the easement change and reduced buffer

Project Credits

Restoration Level	Stream			Riparian Wetland		Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-Riv		
Restoration	**1986.000**						
Re-establishment							
Rehabilitation							
Enhancement							
Enhancement I							
Enhancement II	**89.600**						
Creation							
Preservation							
Total	**2075.600**						

Table 2. Project Activity and Reporting History
Catbird Mitigation Site

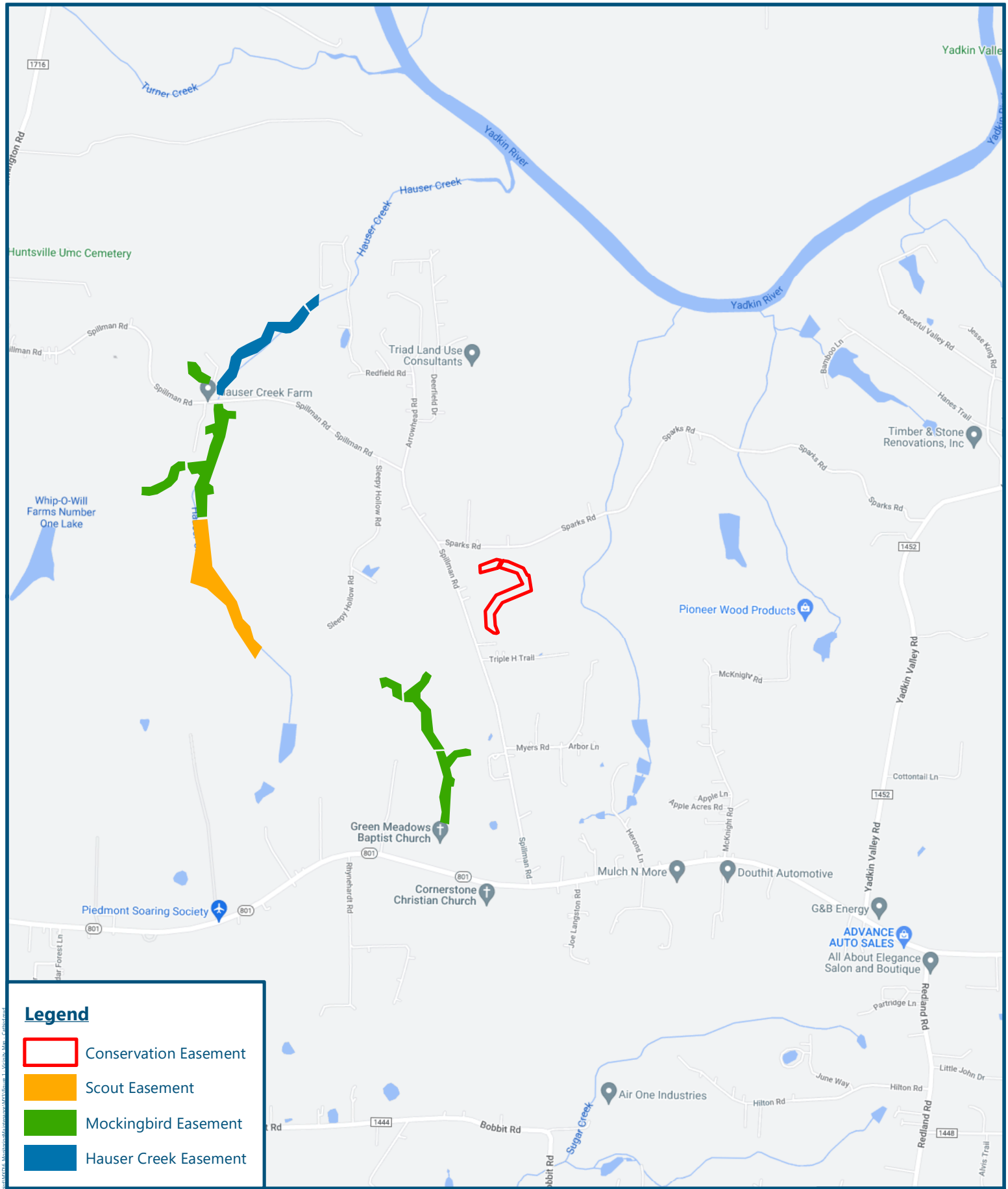
Elapsed Time Since grading complete: **3 years 8 months**
Elapsed Time Since planting complete: **3 years 7 months**
Number of reporting Years[1]: **4**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	NA	Jan-19
Final Design – Construction Plans	NA	Oct-19
Stream Construction	NA	Jan-20
Site Planting	NA	Feb-20
DS2-B Structure Repair 1	NA	Apr-20
DS2-B Structure Repair 2	NA	Jun-20
As-built (Year 0 Monitoring – baseline)	Mar-20	Jul-20
Year 1 Monitoring	XS: Oct-20 VP: Oct-20	Nov-20
DS2-B Structure Repair 3	NA	Apr-21
Year 2 Monitoring	XS: Jul-21 VP: Oct-21	Oct-21
Supplemental Planting/Seeding	NA	Mar-22
Invasive Treatment	NA	Aug-22
Year 3 Monitoring	XS: Jun-22 VP: Oct-22	Nov-22
Year 4 Monitoring	Sep-23	Sep-23
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

1 = The number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table Catbird Mitigation Site	
Designer Primary project design POC	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612 Ben Carroll
Construction Contractor Construction contractor POC	KBS Earthwork Inc. / 5616 Coble Church Rd., Julian, NC 27283 Kory Strader
Survey Contractor Survey contractor POC	Matrix East, PLLC / 906 N. Queen St., Suite A, Kinston, NC 28501 Chris Paderick, PLS
Planting Contractor Planting contractor POC	H&J Forestry Matt Hitch
Monitoring Performers	RES / 3600 Glenwood Ave, Suite 100, Raleigh, NC 27612
Stream Monitoring POC	Daniel Dixon (864) 567-7761
Vegetation Monitoring POC	Daniel Dixon (864) 567-7761

Table 4. Project Background Information				
Project Name		Catbird		
County		Davie		
Project Area (acres)		6.33		
Project Coordinates (latitude and longitude)		Latitude: 36.030644 Longitude: -80.500865		
Planted Acreage (Acres of Woody Stems Planted)		5.26		
Project Watershed Summary Information				
Physiographic Province		Southern Outer Piedmont		
River Basin		Yadkin Pee-Dee		
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	03040101160010	
DWR Sub-basin		3/7/2002		
Project Drainage Area (Acres and Square Miles)		53 ac (0.083 sqmi)		
Project Drainage Area Percentage of Impervious Area		4%		
CGIA Land Use Classification		Managed Herbaceous Cover and Mixed Upland Hardwoods		
Reach Summary Information				
Parameters		**DS1**	**DS2-A**	**DS2-B**
Length of reach (linear feet)		968	78	1218
Valley confinement (Confined, moderately confined, unconfined)		mod. confined	mod. unconfined	confined
Drainage area (Acres and Square Miles)		26 (0.041)	12 (0.019)	27 (0.042)
Perennial, Intermittent, Ephemeral		Intermittent	Intermittent	Perennial
NCDWR Water Quality Classification		C, WS-IV	C, WS-IV	C, WS-IV
Stream Classification (existing)		G4	F5b	G5
Stream Classification (proposed)		E4	F5b	E4
Evolutionary trend (Simon)		III/IV	III/IV	III/IV
FEMA classification		N/A	N/A	N/A
Regulatory Considerations				
Parameters		**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404		Yes	Yes	SAW-2017-01506
Water of the United States - Section 401		Yes	Yes	DWR # 17-1039
Endangered Species Act		Yes	Yes	Mit Plan
Historic Preservation Act		Yes	Yes	Mit Plan
Coastal Zone Management Act (CZMA or CAMA)		No	N/A	N/A
FEMA Floodplain Compliance		Yes	Yes	N/A
Essential Fisheries Habitat		No	N/A	N/A



Legend

- Conservation Easement
- Scout Easement
- Mockingbird Easement
- Hauser Creek Easement

N
W E
S

0 1,000 2,000

Feet

Figure 1 - Project Location

Catbird Mitigation Project

Davie County, North Carolina

Date: 10/27/2022

Drawn by: GDS

Checked by: RTM

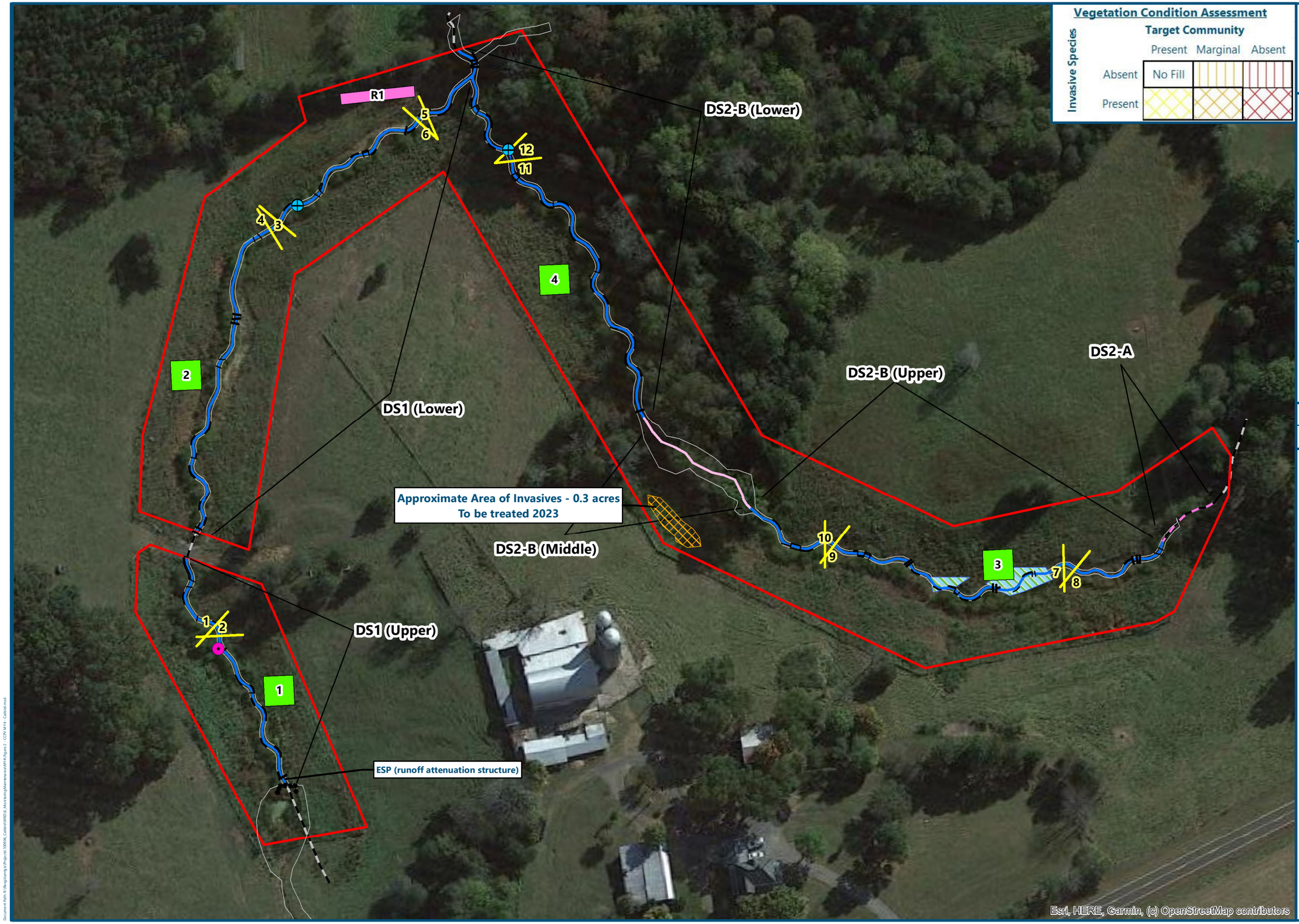
1 inch = 2,000 feet

res

Restoring a resilient earth for a modern world

Appendix B

Visual Assessment Data



Vegetation Condition Assessment

Invasive Species	Target Community: Present	Target Community: Marginal	Target Community: Absent
Absent	No Fill		
Present			

res

Restoring a resilient earth for a modern world

N E S W

0 50 100

Feet

Figure 2 - CCPV MY4

Catbird Mitigation Project

Davie County, North Carolina

Date: 9/22/2023	Drawn by: DGD
1 in = 100 feet	Checked by:

Legend

- Conservation Easement
- Approximate Area Invasives MY4
- Existing Wetland

MY3 Fixed VP

- >320 stems/acre

MY3 Random VP

- >320 stems/acre

Mitigation Approach

- Restoration
- Enhancement II
- Enhancement II (3:1)
- No Credit
- Top of Bank
- Cross Section
- Structure
- Flow Gauge
- Stage Recorder

Document Path: K:\Projects\100906_Catbird\MXD\6_Monitoring\Maintenance\MY4\Figure 2 - CCPV MY4 - Catbird.mxd

Table 5. Visual Stream Morphology Stability Assessment
Catbird Site - DS1
Assessed Length 288 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	12	12			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth≥ 1.6).	13	13			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	13	13			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	6	6			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	6	6			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesNOT exceed 15%.	6	6			100%			
	4. Habitat	Pool forming structures maintaining~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	6	6			100%			

Date of last site inspection - 09/11/2023

Table 5. Cont'd Visual Stream Morphology Stability Assessment
Catbird Site - DS1
Assessed Length 665 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	23	23			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth≥ 1.6).	25	25			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	25	25			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesNOT exceed 15%.	15	15			100%			
	4. Habitat	Pool forming structures maintaining~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	15	15			100%			

Date of last site inspection - 09/11/2023

Table 5 Cont'd. Visual Stream Morphology Stability Assessment
Catbird Site - DS2
Assessed Length 526 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	22	22			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth≥ 1.6).	23	23			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	23	23			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	14	14			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	14	14			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	14	14			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	14	14			100%			
	4. Habitat	Pool forming structures maintaining~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	14	14			100%			

Date of last site inspection - 09/11/2023

Table 5 Cont'd. Visual Stream Morphology Stability Assessment
Catbird Site - DS2
Assessed Length 511 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	22	22			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth≥ 1.6).	19	19			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	19	19			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	11	11			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	11	11			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	11	11			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesNOT exceed 15%.	11	11			100%			
	4. Habitat	Pool forming structures maintaining~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	11	11			100%			

Date of last site inspection - 09/11/2023

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **5.76**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Red Simple Hatch	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Orange Simple Hatch	0	0.00	0.0%
			Total			0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Orange Simple Hatch	0	0.00	0.0%
			Cumulative Total			0.0%

Easement Acreage[2] **6.33**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Areas or points (if too small to render as polygons at map scale).	1000 SF	Yellow Crosshatch	1	0.03	0.4%
5. Easement Encroachment Areas[3]	Areas or points (if too small to render as polygons at map scale).	none	Red Simple Hatch	0	0.00	0.0%

Date of last site inspection - 09/11/2023

1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

2 = The acreage within the easement boundaries.

3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

4 = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern spcies are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likley trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly ealry in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolzing invasives polygons, particulalry for situations where the conditon for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

Catbird MY3 Vegetation Monitoring Plot Photos

Vegetation Plot 1 (10/5/2022)

Vegetation Plot 2 (10/5/2022)

Vegetation Plot 3 (10/5/2022)

Vegetation Plot 4 (10/5/2022)

Catbird MY3 Random Vegetation Monitoring Plot Photo

Random Vegetation Plot 1 (10/5/2022)

Catbird Monitoring Device Photos (07/26/2023)

Flow Gauge DS1

Stage Recorder DS2-B

Ambient Gauge

Stage Recorder DS1

Vegetation Problem Areas Catbird	
Feature Category / Location / Size	**Photo**
Multiflora Rose Patch/ DS1/ 0.03 acres	

Appendix C

Vegetation Plot Data

MY3 (2022)

Table 7. Planted Species Summary

Common Name	Scientific Name	Total Stems Planted
Persimmon	*Diospyros virginiana*	1,100
Water Oak	*Quercus nigra*	800
Willow Oak	*Quercus phellos*	800
River Birch	*Betula nigra*	800
Sycamore	*Platanus occidentalis*	800
Crab Apple	*Malus angustifolia*	800
Green Ash	*Fraxinus pennyslvanica*	600
Northern Red Oak	*Quercus rubra*	600
Yellow Poplar	*Liriodendron tulipifera*	600
Silky Dogwood	*Cornus amomum*	400
Sugarberry	*Celtis laevigata*	350
Black Walnut	*Juglans nigra*	300
Elderberry	*Sambucus canadensis*	300
Eastern Redbud	*Cercis canadensis*	300
	Total	8,550
	Planted Area	5.26
	As-built Planted Stems/Acre	1,625

Table 8. Vegetation Plot Mitigation Success Summary

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Planted Stem Height (ft)
1	850	0	850	Yes	8.2
2	567	0	567	Yes	5.0
3	809	0	809	Yes	2.8
4	850	0	850	Yes	5.6
R1	526	0	526	Yes	5.2
Project Avg	**720**	**0**	**720**	**Yes**	**5.4**

Table 9. Stem Count Total and Planted by Plot Species

Catbird			Current Plot Data (MY3 2022)														Annual Means											
			100022-01-0001			100022-01-0002			100022-01-0003			100022-01-0004			100022-01-R1			MY3 (2022)			MY2 (2021)			MY1 (2020)			MY0 (2020)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																					6			5		
Betula nigra	river birch	Tree				3	3	3				7	7	7	2	2	2	12	12	12	10	10	10	11	11	11	17	17	17
Celtis laevigata	sugarberry	Tree																									1	1	1
Cephalanthus occidentalis	buttonbush	Shrub													2	2	2	2	2	2									
Cercis canadensis	eastern redbud	Tree										1	1	1				1	1	1	3	3	3	3	3	3	4	4	4
Cornus amomum	silky dogwood	Shrub				2	2	2										2	2	2	2	2	2	2	2	2	4	4	4
Diospyros virginiana	common persimmon	Tree							9	9	9	1	1	1				10	10	10	11	11	11	13	13	13	15	15	15
Fraxinus pennsylvanica	green ash	Tree	9	9	9	2	2	2	5	5	5				2	2	2	18	18	18	20	20	20	17	17	17	18	18	18
Juglans nigra	black walnut	Tree																									4	4	4
Liriodendron tulipifera	tuliptree	Tree							1	1	1							1	1	1	1	1	1	1	1	1	8	8	8
Malus angustifolia	southern crabapple	Tree																									3	3	3
Platanus occidentalis	American sycamore	Tree	3	3	3	5	5	5				4	4	4	1	1	1	13	13	13	16	16	16	13	13	13	8	8	8
Quercus	oak	Tree	1	1	1													1	1	1	1	1	1				31	31	31
Quercus lyrata	overcup oak	Tree													1	1	1	1	1	1									
Quercus nigra	water oak	Tree	1	1	1							5	5	5	3	3	3	9	9	9	7	7	7	7	7	7	5	5	5
Quercus phellos	willow oak	Tree	6	6	6	1	1	1	5	5	5	2	2	2				14	14	14	14	14	14	15	15	15	9	9	9
Quercus rubra	northern red oak	Tree	1	1	1	1	1	1				1	1	1	2	2	2	5	5	5	3	3	3	3	3	3	7	7	7
Salix nigra	black willow	Tree																					2			6			
Ulmus americana	American elm	Tree																					4						
		Stem count	21	21	21	14	14	14	20	20	20	21	21	21	13	13	13	89	89	89	88	88	100	85	85	96	134	134	134
		size (ares)	1			1			1			1			1			5			5			4			4		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.12			0.12			0.10			0.10		
		Species count	6	6	6	6	6	6	4	4	4	7	7	7	7	7	7	13	13	13	11	11	14	10	10	12	14	14	14
		Stems per ACRE	850	850	850	567	567	567	809	809	809	850	850	850	526	526	526	720	720	720	712	712	809	860	860	971	1356	1356	1356

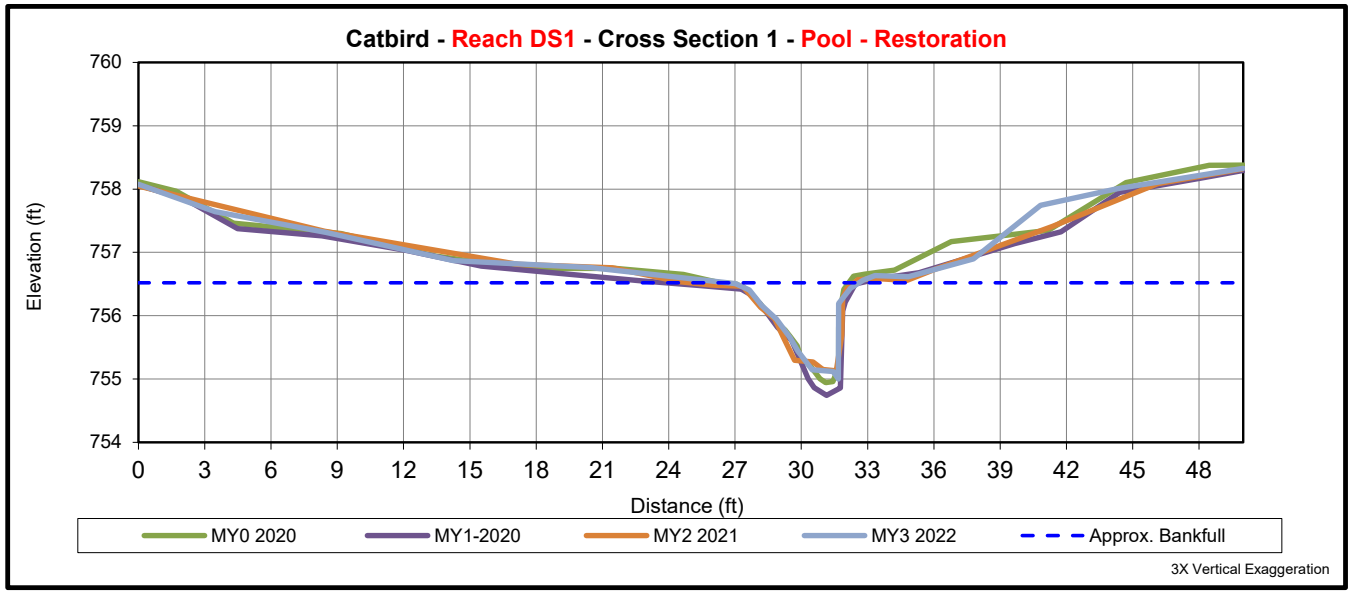
Appendix D

Stream Measurement and

Geomorphology Data

MY3 (2022)

Upstream **Downstream**

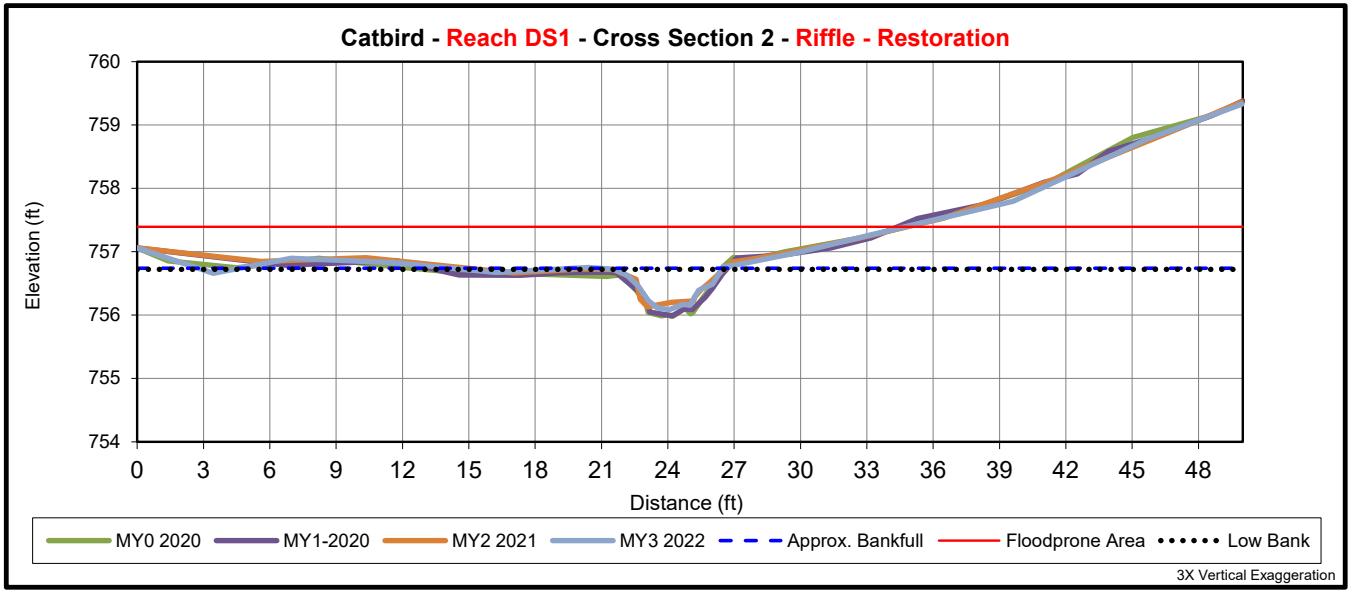


	Cross Section 1 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	756.50	756.4	756.5	756.5			
Bankfull Width (ft)[1]	5.0	4.7	6.1	5.9			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.6	1.7	1.4	1.5			
Low Bank Elevation (ft)	756.50	756.4	756.5	756.5			
Bankfull Cross Sectional Area (ft^2)[2]	3.9	4.2	3.9	3.8			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

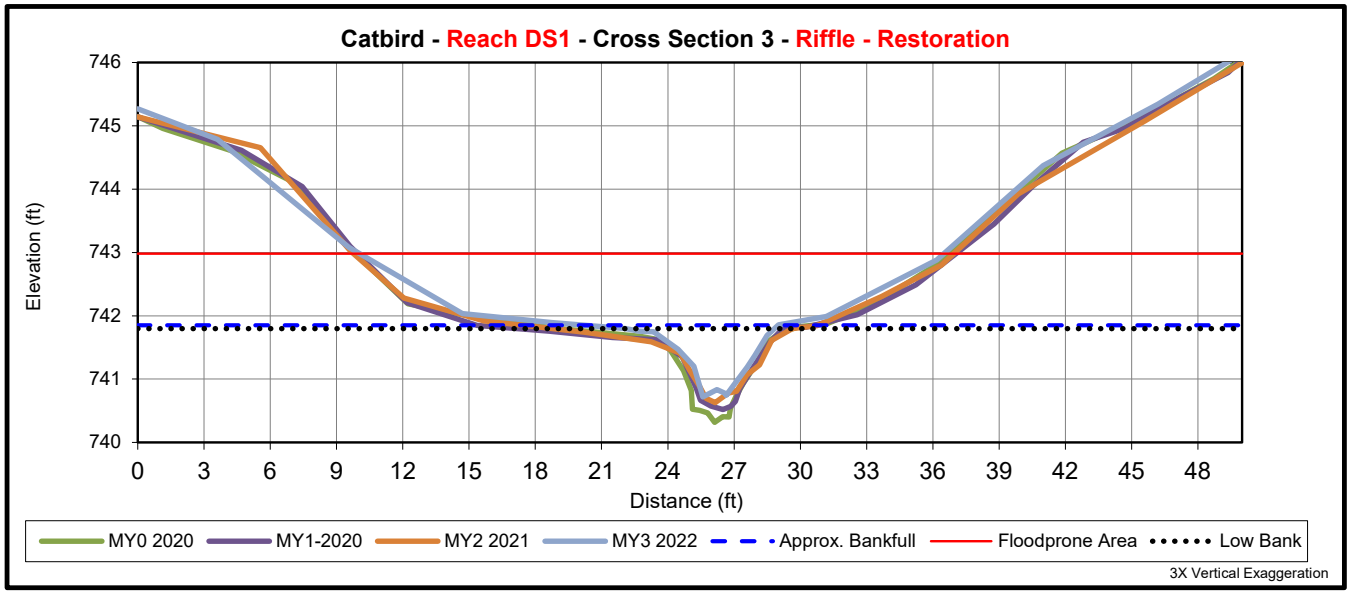
Downstream



	Cross Section 2 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	756.64	756.6	756.8	756.7			
Bankfull Width (ft)[1]	7.3	4.7	6.5	4.9			
Floodprone Width (ft)[1]	>33.6	>33.7	>34.5	>34.7			
Bankfull Max Depth (ft)[2]	0.7	0.7	0.6	0.6			
Low Bank Elevation (ft)	756.64	756.7	765.7	756.7			
Bankfull Cross Sectional Area (ft^2)[2]	1.9	2.1	1.8	1.8			
Bankfull Entrenchment Ratio[1]	>6.9	>7.2	>5.3	>7.0			
Bankfull Bank Height Ratio[1]	1.0	1.1	1.0	1.0			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

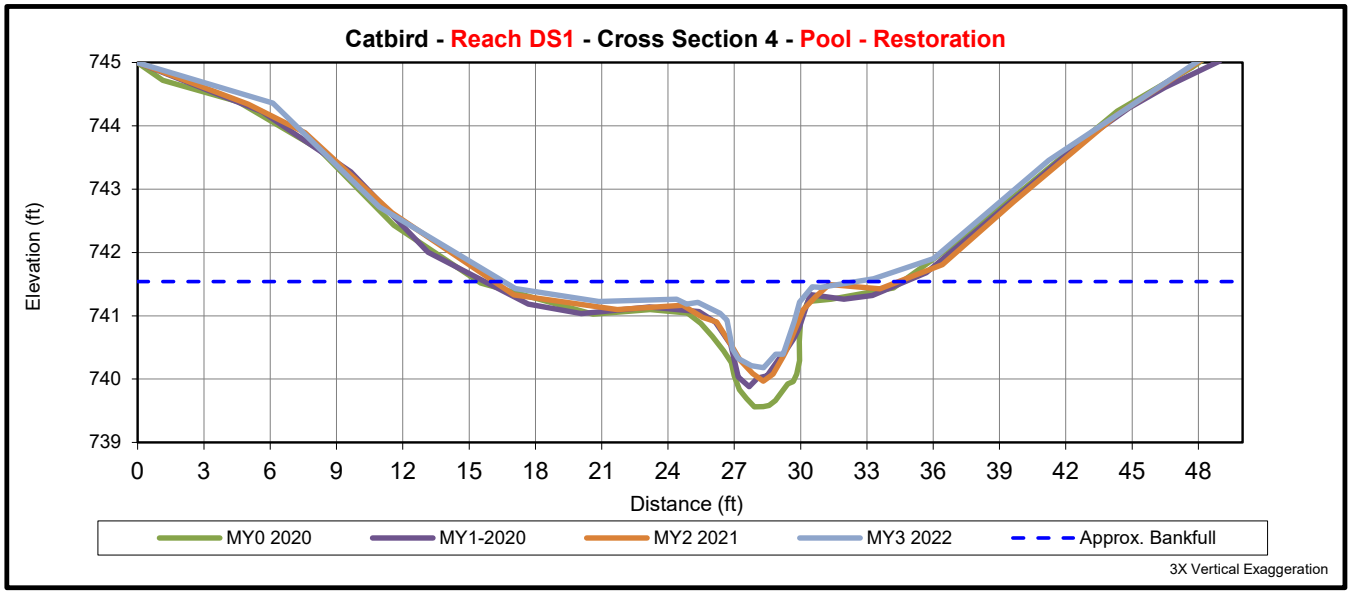
Upstream **Downstream**



	Cross Section 3 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	741.62	741.7	741.7	741.9			
Bankfull Width (ft)[1]	5.1	5.4	8.6	6.9			
Floodprone Width (ft)[1]	26	26.6	26.1	>26.5			
Bankfull Max Depth (ft)[2]	1.3	1.1	1.0	1.1			
Low Bank Elevation (ft)	741.62	741.6	741.6	741.8			
Bankfull Cross Sectional Area (ft^2)[2]	3.5	3.0	2.6	3.1			
Bankfull Entrenchment Ratio[1]	9.9	4.9	3.0	3.8			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9	1.0			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

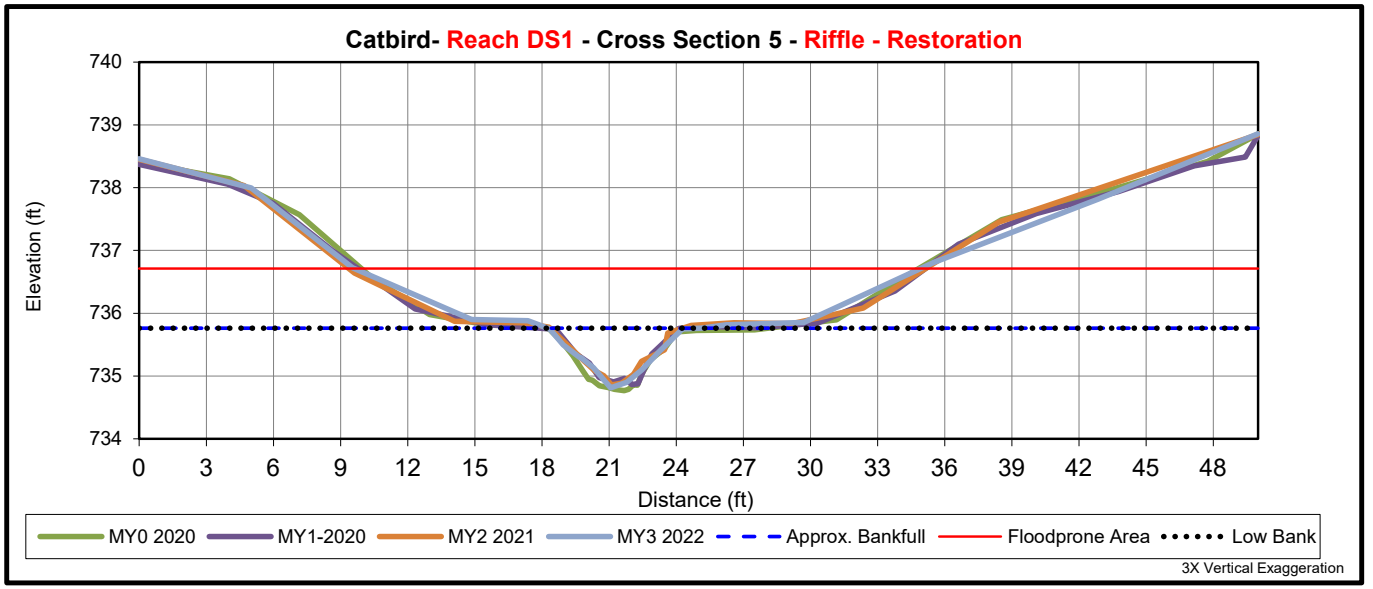
Upstream **Downstream**



	Cross Section 4 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	741.04	741.4	741.4	741.5			
Bankfull Width (ft)[1]	5.6	5.0	6.3	6.1			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.5	1.2	1.2	1.0			
Low Bank Elevation (ft)	741.04	741.1	741.2	741.2			
Bankfull Cross Sectional Area (ft^2)[2]	4.6	3.0	3.3	2.6			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

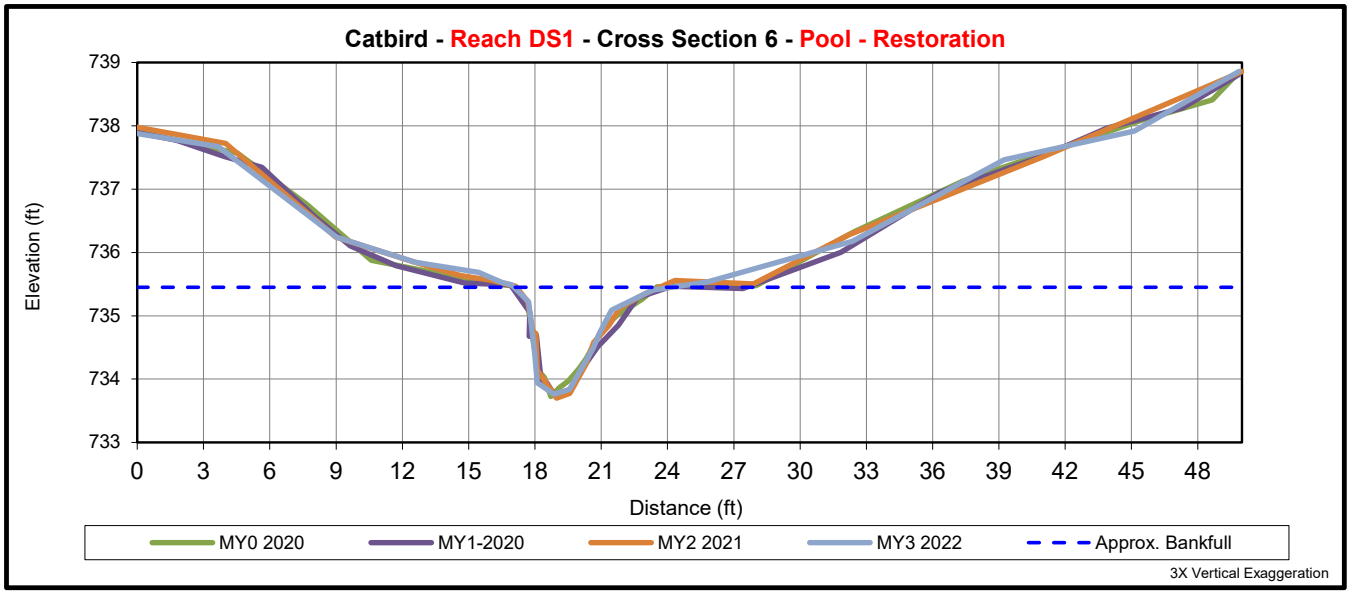
Upstream **Downstream**



	Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	735.70	735.8	735.8	735.8			
Bankfull Width (ft)[1]	5.6	5.5	6.7	6.9			
Floodprone Width (ft)[1]	24	25.5	26.0	>25.3			
Bankfull Max Depth (ft)[2]	0.9	0.9	0.9	0.9			
Low Bank Elevation (ft)	735.70	735.7	735.8	735.8			
Bankfull Cross Sectional Area (ft^2)[2]	3.1	2.8	2.9	3.1			
Bankfull Entrenchment Ratio[1]	9.0	4.6	3.9	3.6			
Bankfull Bank Height Ratio[1]	1.0	0.9	1.0	1.0			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

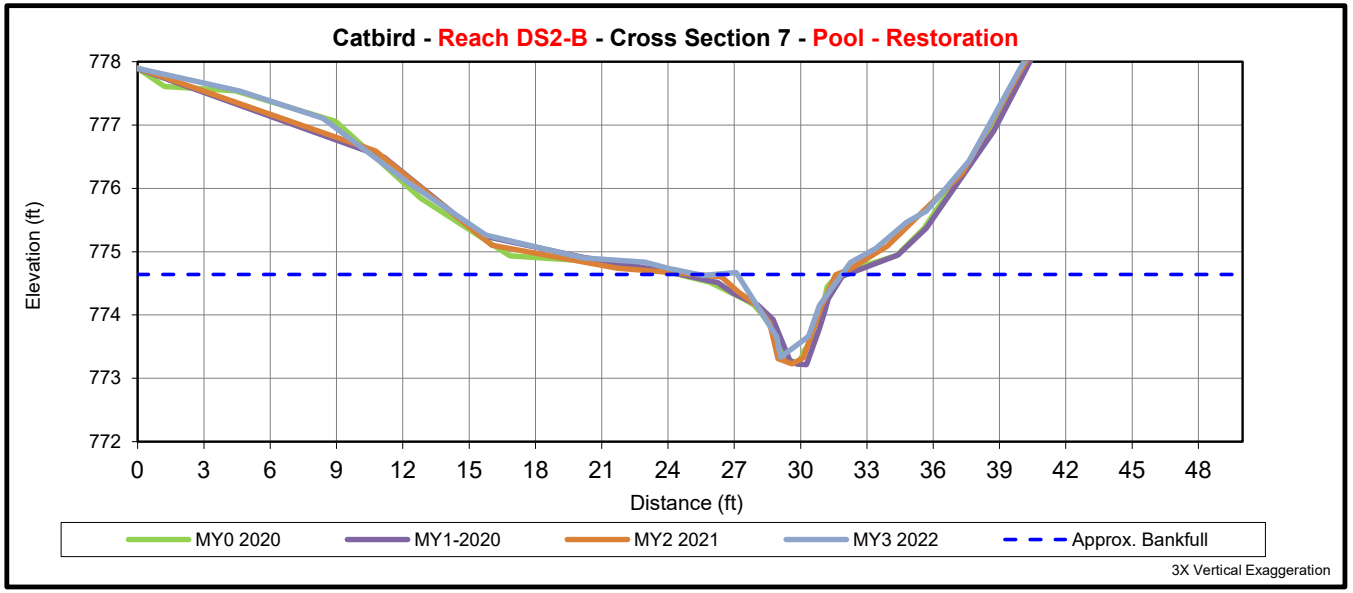
Upstream **Downstream**



	Cross Section 6 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	735.46	735.4	735.5	735.5			
Bankfull Width (ft)[1]	6.5	6.4	6.5	6.3			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.7	1.7	1.9	1.6			
Low Bank Elevation (ft)	735.46	735.5	735.6	735.4			
Bankfull Cross Sectional Area (ft^2)[2]	5.1	5.6	6.0	4.8			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

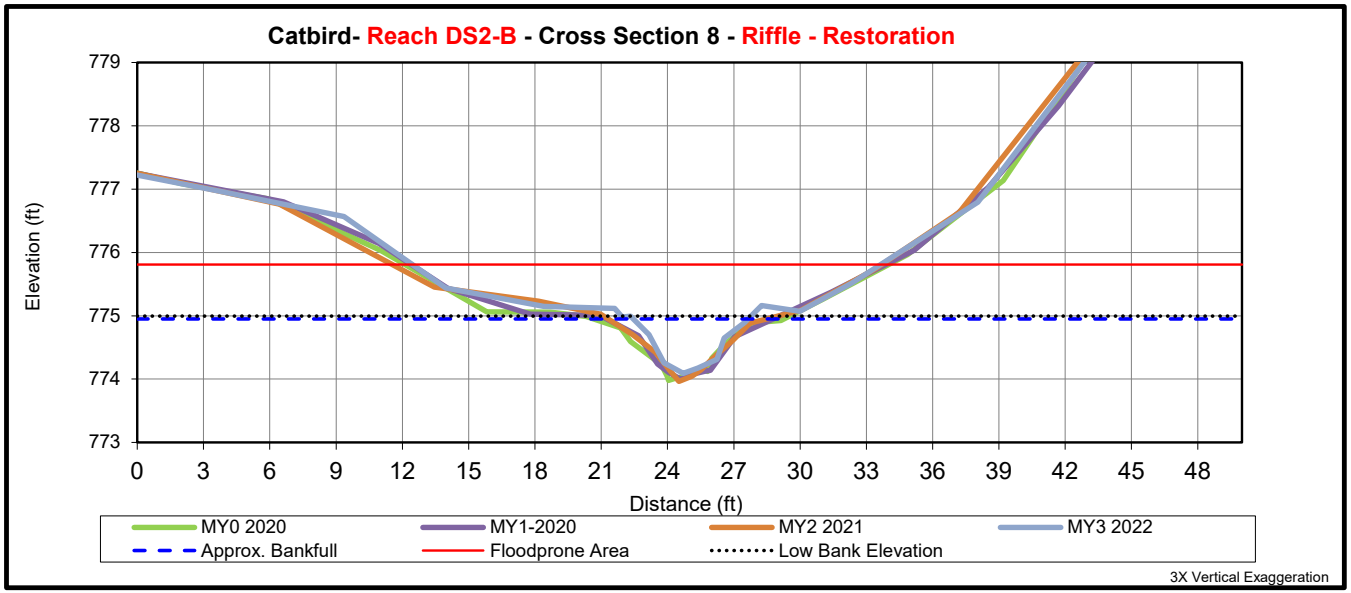
Upstream **Downstream**



	Cross Section 7 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	774.52	774.5	774.5	774.6			
Bankfull Width (ft)[1]	5.5	5.4	4.7	4.7			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.3	1.3	1.4	1.5			
Low Bank Elevation (ft)	774.52	774.5	774.6	774.7			
Bankfull Cross Sectional Area (ft^2)[2]	3.1	3.2	3.7	4.7			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

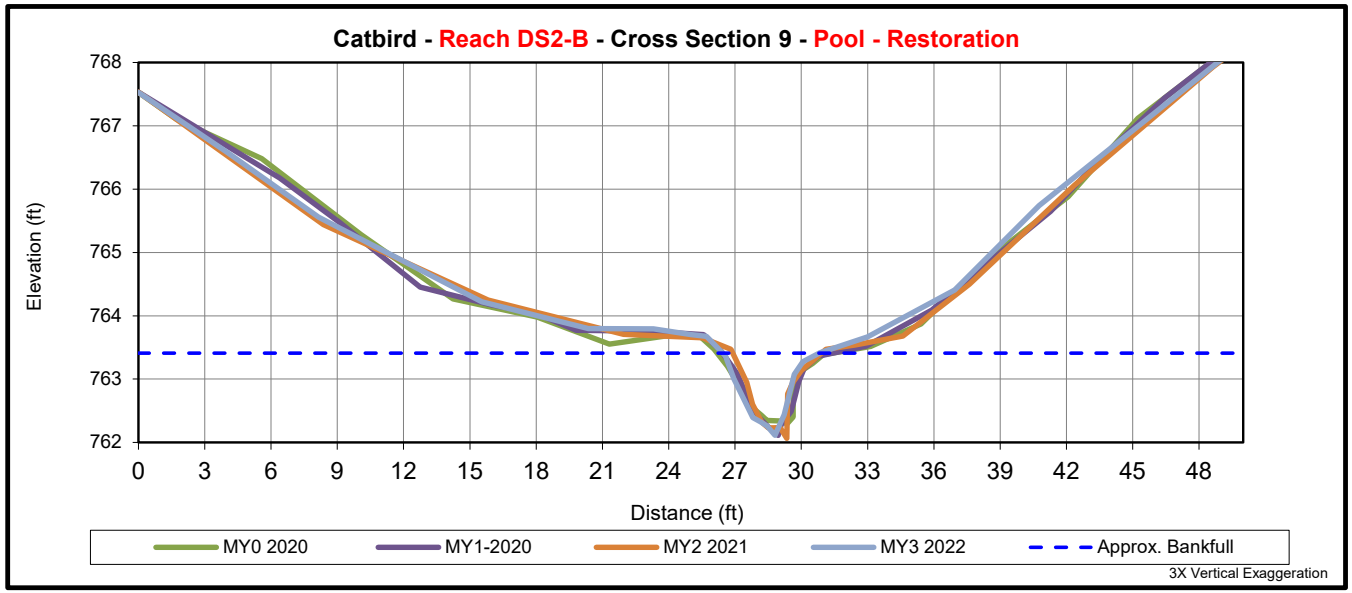
Upstream **Downstream**



	Cross Section 8 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	774.81	774.8	774.9	775.0			
Bankfull Width (ft)[1]	5.6	5.1	5.9	5.2			
Floodprone Width (ft)[1]	20	19.8	21.5	21.2			
Bankfull Max Depth (ft)[2]	0.8	0.7	0.9	0.9			
Low Bank Elevation (ft)	774.81	774.7	774.9	775.0			
Bankfull Cross Sectional Area (ft^2)[2]	2.6	1.8	2.6	2.8			
Bankfull Entrenchment Ratio[1]	8.8	3.9	3.7	4.1			
Bankfull Bank Height Ratio[1]	1.0	0.8	1.0	1.1			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

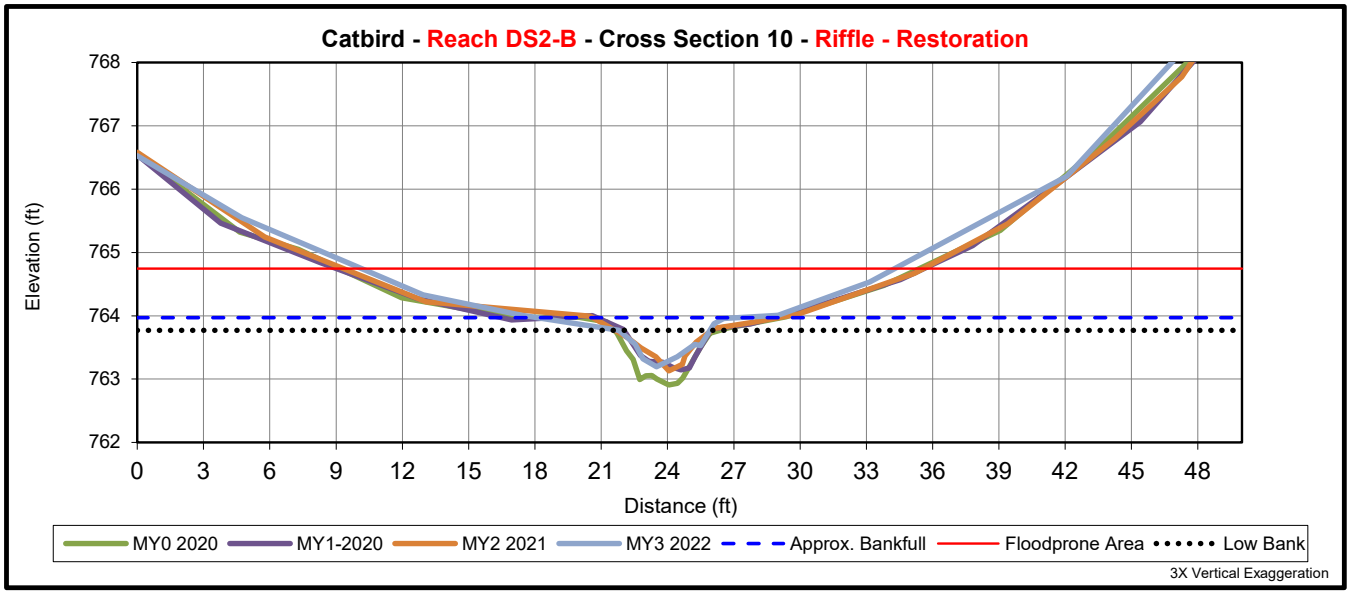
Upstream **Downstream**



	Cross Section 9 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	763.39	763.4	763.5	763.4			
Bankfull Width (ft)[1]	4.8	4.5	4.2	4.4			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.1	1.3	1.4	1.3			
Low Bank Elevation (ft)	763.39	763.4	763.5	763.4			
Bankfull Cross Sectional Area (ft^2)[2]	2.7	2.7	2.7	2.8			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream **Downstream**

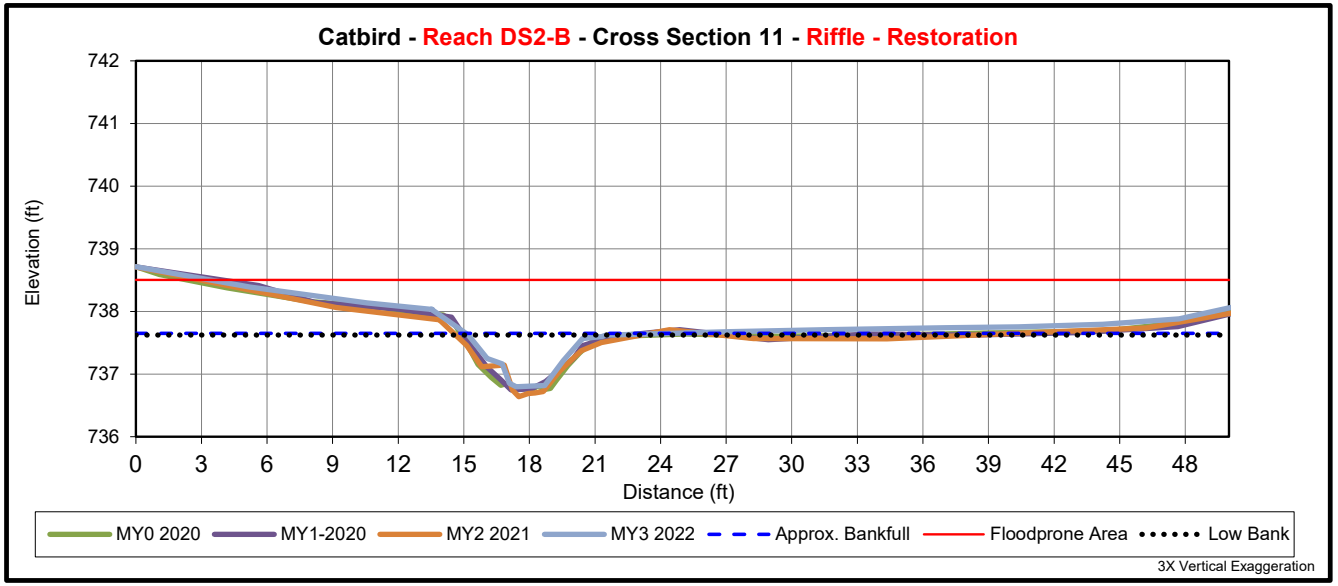


	Cross Section 10 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	763.73	763.9	763.9	764.0			
Bankfull Width (ft)[1]	4.2	4.7	3.5	4.3			
Floodprone Width (ft)[1]	24	25.3	25.8	>24.1			
Bankfull Max Depth (ft)[2]	0.8	0.6	0.7	0.6			
Low Bank Elevation (ft)	763.73	763.8	763.8	763.8			
Bankfull Cross Sectional Area (ft^2)[2]	2.2	1.7	1.5	1.3			
Bankfull Entrenchment Ratio[1]	11.8	5.4	3.5	5.6			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.8	0.7			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

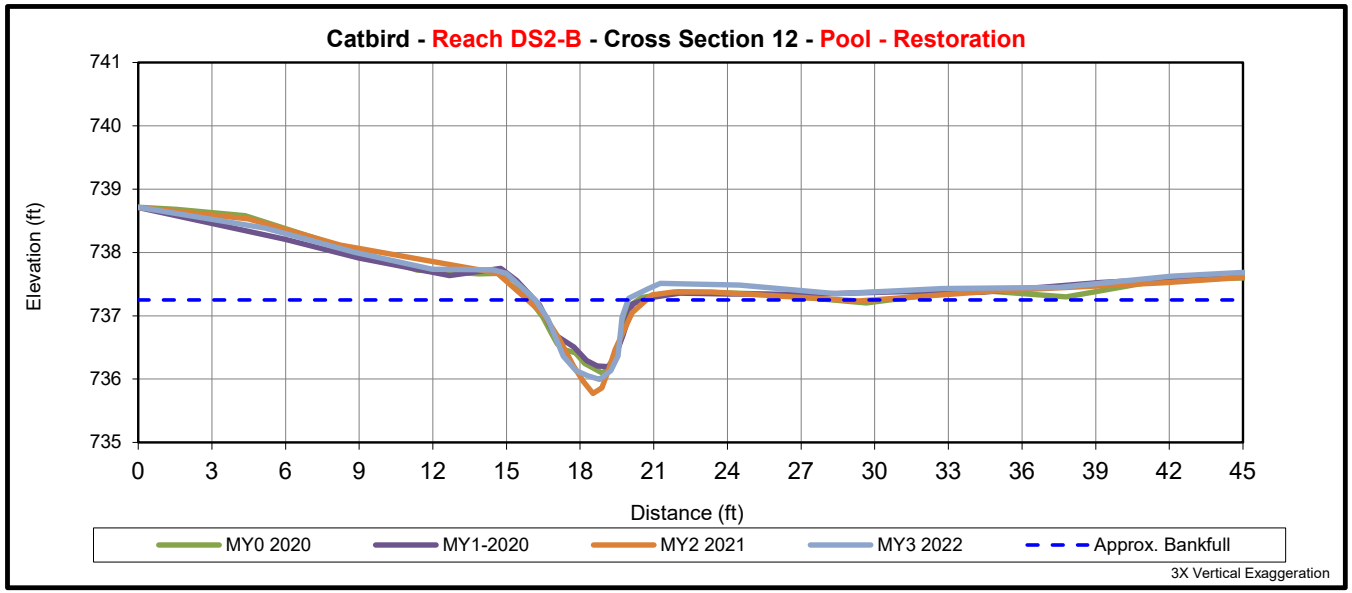
Downstream



	Cross Section 11 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	737.51	737.6	737.5	737.7			
Bankfull Width (ft)[1]	5.7	5.3	6.8	6.4			
Floodprone Width (ft)[1]	>43.9	>44.2	>46.1	>46.7			
Bankfull Max Depth (ft)[2]	0.8	0.7	1.1	0.8			
Low Bank Elevation (ft)	737.51	737.5	737.7	737.6			
Bankfull Cross Sectional Area (ft^2)[2]	2.9	2.3	4.4	2.7			
Bankfull Entrenchment Ratio[1]	>8.7	>8.7	>6.8	>7.3			
Bankfull Bank Height Ratio[1]	1.0	0.9	1.2	1.0			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream **Downstream**



	Cross Section 12 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	737.29	737.3	737.2	737.3			
Bankfull Width (ft)[1]	4.6	5.0	4.5	3.8			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.2	0.7	1.6	1.5			
Low Bank Elevation (ft)	737.29	737.3	737.4	737.5			
Bankfull Cross Sectional Area (ft^2)[2]	3.1	2.3	4.4	4.3			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Table 10. Baseline Stream Data Summary
Catbird Mitigation Site - Reach DS1

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	3.0	---	5.4	7.4	---	3	4.4	---	---	6.6	---	2	---	4.5	---	5.1	6.0	5.6	7.3	1.2	3
Floodprone Width (ft)					5.4	---	6.8	10.0	---	3	10.0	---	---	15.0	---	2	---	30.0	---	50.0	50.0	50.0	50.0	0.1	3
Bankfull Mean Depth (ft)		---	---	---	0.5	---	0.7	0.8	---	3	0.6	---	---	0.6	---	2	---	0.5	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.8	---	1.1	1.1	---	3	0.9	---	---	1.2	---	2	---	0.7	---	0.7	1.0	0.9	1.3	0.3	3
Bankfull Cross Sectional Area (ft^2)		---	---	---	2.3	---	3.4	3.7	---	3	2.8	---	---	3.9	---	2	---	2.1	---	1.9	2.8	3.1	3.5	0.8	3
Width/Depth Ratio					3.9	---	7.8	16.1	---	3	6.9	---	---	10.9	---	2	---	9.7	---	---	---	---	---	---	---
Entrenchment Ratio					1.3	---	1.4	1.8	---	3	2.2	---	---	2.2	---	2	---	6.7	---	6.9	8.6	9.0	9.9	1.5	3
[1]Bank Height Ratio					1.0	---	1.8	2.5	---	3	1.0	---	---	1.2	---	2	---	1.0	---	1.0	1.0	1.0	1.0	0.0	3
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	4	---	---	18	---	---	3	---	15	2.2	8.7	7.2	17.9	4.3	35
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.4	2.5	1.7	8.0	1.8	35
Pool Length (ft)					---	---	---	---	---	---	3	---	---	10	---	---	3	---	7	2.1	6.4	6.0	17.1	2.5	38
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	12	---	---	35	---	---	10	---	30	5.9	25.6	20.9	75.2	16.4	37
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	18	---	---	35	---	---	13	---	30	---	---	---	---	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	19	---	---	5	---	15	---	---	---	---	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.6	---	---	4.3	---	---	1.1	---	3.3	---	---	---	---	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	30	---	---	44	---	---	20	---	37	---	---	---	---	---	---
Meander Width Ratio					---	---	---	---	---	---	4.1	---	---	8	---	---	2.9	---	6.7	---	---	---	---	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G4						E4						E4			E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---								
Valley length (ft)					1136						146						924			---					
Channel Thalweg length (ft)					1179						185						1211			1211					
Sinuosity (ft)					1.04						1.27						1.31			---					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.0305						0.013						0.017			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10. Baseline Stream Data Summary (continued)
Catbird Mitigation Site - Reach DS2-B (Upper)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	4.3	---	---	4.8	---	2	4.4	---	---	6.6	---	2	---	4.5	---	4.2	4.9	4.9	5.6	1.0	2
Floodprone Width (ft)					5.6	---	---	7.6	---	2	10.0	---	---	15.0	---	2	---	30.0	---	50.0	50.0	50.0	50.0	0.1	2
Bankfull Mean Depth (ft)		---	---	---	0.5	---	---	0.7	---	2	0.6	---	---	0.6	---	2	---	0.5	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.7	---	---	1.2	---	2	0.9	---	---	1.2	---	2	---	0.7	---	0.8	0.8	0.8	0.8	0.0	2
Bankfull Cross Sectional Area (ft^2)		---	---	---	2.1	---	---	3.1	---	2	2.8	---	---	3.9	---	2	---	2.2	---	2.2	2.4	2.4	2.6	0.3	2
Width/Depth Ratio					7.3	---	---	9.0	---	2	6.9	---	---	10.9	---	2	---	9.3	---	---	---	---	---	---	---
Entrenchment Ratio					1.3	---	---	1.6	---	2	2.2	---	---	2.2	---	2	---	6.7	---	8.8	10.3	10.3	11.8	2.1	2
[1]Bank Height Ratio					0.8	---	---	8.4	---	2	1.0	---	---	1.2	---	2	---	1.0	---	1.0	1.0	1.0	1.0	0.0	2
Profile																									
Riffle Length (ft)					---	---	---	---	---	---		---	---		---	---		---		2.4	6.6	5.8	18.2	3.2	44
Riffle Slope (ft/ft)					---	---	---	---	---	---		---	---		---	---		---		0.3	4.1	3.7	14.8	3.1	45
Pool Length (ft)					---	---	---	---	---	---		---	---		---	---		---		1.1	5.1	5.0	13.7	2.4	50
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---		---	---		---	---		---		3.1	19.2	19.1	40.5	7.5	48
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	18	---	---	35	---	---	13	---	30		---		---	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	19	---	---	5	---	15		---		---	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.6	---	---	4.3	---	---	1.1	---	3.3		---		---	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	30	---	---	44	---	---	20	---	37		---		---	---	---
Meander Width Ratio					---	---	---	---	---	---	4.1	---	---	8	---	---	2.9	---	6.7		---		---	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						E4						E4			E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---								
Valley length (ft)					990						146						482			---					
Channel Thalweg length (ft)					1051						185						526			526					
Sinuosity (ft)					1.06						1.27						1.09			---					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.0383						0.013						0.02			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10. Baseline Stream Data Summary (continued)
Catbird Mitigation Site - Reach DS2-B (Lower)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	4.3	---	---	4.8	---	2	4.4	---	---	6.6	---	2	---	5.2	---	---	---	5.7	---	---	---
Floodprone Width (ft)					5.6	---	---	7.6	---	2	10.0	---	---	15.0	---	2	---	30.0	---	---	---	50.0	---	---	---
Bankfull Mean Depth (ft)		---	---	---	0.5	---	---	0.7	---	2	0.6	---	---	0.6	---	2	---	0.5	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.7	---	---	1.2	---	2	0.9	---	---	1.2	---	2	---	0.8	---	---	---	0.8	---	---	---
Bankfull Cross Sectional Area (ft^2)		---	---	---	2.1	---	---	3.1	---	2	2.8	---	---	3.9	---	2	---	2.8	---	---	---	2.9	---	---	---
Width/Depth Ratio					7.3	---	---	9.0	---	2	6.9	---	---	10.9	---	2	---	9.7	---	---	---	---	---	---	---
Entrenchment Ratio					1.3	---	---	1.6	---	2	2.2	---	---	2.2	---	2	---	5.8	---	---	---	8.7	---	---	---
[1]Bank Height Ratio					0.8	---	---	8.4	---	2	1.0	---	---	1.2	---	2	---	1.0	---	---	---	1.0	---	---	---
Profile																									
Riffle Length (ft)					---	---	---	---	---	---		---	---		---	---		---		2.4	6.6	5.8	18.2	3.2	44
Riffle Slope (ft/ft)					---	---	---	---	---	---		---	---		---	---		---		0.3	4.1	3.7	14.8	3.1	45
Pool Length (ft)					---	---	---	---	---	---		---	---		---	---		---		1.1	5.1	5.0	13.7	2.4	50
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---		---	---		---	---		---		3.1	19.2	19.1	40.5	7.5	48
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	18	---	---	35	---	---	13	---	30		---		---	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	19	---	---	5	---	15		---		---	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.6	---	---	4.3	---	---	1.1	---	3.3		---		---	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	30	---	---	44	---	---	20	---	37		---		---	---	---
Meander Width Ratio					---	---	---	---	---	---	4.1	---	---	8	---	---	2.9	---	6.7		---		---	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						E4						E4			E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---								
Valley length (ft)					990						146						450			---					
Channel Thalweg length (ft)					1051						185						512			512					
Sinuosity (ft)					1.06						1.27						1.14			---					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.0383						0.013						0.0175			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Appendix D. Table 11 - Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

Project Name/Number: Catbird #100022

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	756.5	756.4	756.5	756.5				756.6	756.6	756.8	756.7				741.6	741.7	741.7	741.9				741.0	741.4	741.4	741.5				735.7	735.8	735.8	735.8			
Bankfull Width (ft)[1]	5.0	4.7	6.1	5.9				7.3	4.7	6.5	4.9				5.1	5.4	8.6	6.9				5.6	5.0	6.3	6.1				5.6	5.5	6.7	6.9			
Floodprone Width (ft)[1]	-	-	-	-	-	-	-	>33.6	>33.7	>34.5	>34.7				26	26.6	26.1	>26.5				-	-	-	-	-	-	-	24	25.5	26.0	>25.3			
Bankfull Max Depth (ft)[2]	1.6	1.7	1.4	1.5				0.7	0.7	0.6	0.6				1.3	1.1	1.0	1.1				1.5	1.2	1.2	1.0				0.9	0.9	0.9	0.9			
Low Bank Elevation (ft)	756.50	756.4	756.5	756.5				756.6	756.7	765.7	756.7				741.6	741.6	741.6	741.8				741.0	741.1	741.2	741.2				735.7	735.7	735.8	735.8			
Bankfull Cross Sectional Area (ft^2)[2]	3.9	4.2	3.9	3.8				1.9	2.1	1.8	1.8				3.5	3.0	2.6	3.1				4.6	3.0	3.3	2.6				3.1	2.8	2.9	3.1			
Bankfull Entrenchment Ratio[1]	-	-	-	-	-	-	-	>6.9	>7.2	>5.3	>7.0				9.9	4.9	3.0	>3.8				-	-	-	-	-	-	-	9.0	4.6	3.9	>3.6			
Bankfull Bank Height Ratio[1]	-	-	-	-	-	-	-	1.0	1.1	1.0	1.0				1.0	0.9	0.9	1.0				-	-	-	-	-	-	-	1.0	0.9	1.0	1.0			

	Cross Section 6 (Pool)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)							Cross Section 9 (Pool)							Cross Section 10 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	735.5	735.4	735.5	735.5				774.5	774.5	774.5	774.6				774.8	774.8	774.9	775.0				763.4	763.4	763.5	763.4				763.7	763.9	763.9	764.0			
Bankfull Width (ft)[1]	6.5	6.4	6.5	6.3				5.5	5.4	4.7	4.7				5.6	5.1	5.9	5.2				4.8	4.5	4.2	4.4				4.2	4.7	3.5	4.3			
Floodprone Width (ft)[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	19.8	21.5	21.2				-	-	-	-	-	-	-	24	25.3	25.8	>24.1			
Bankfull Max Depth (ft)[2]	1.7	1.7	1.9	1.6				1.3	1.3	1.4	1.5				0.8	0.7	0.9	0.9				1.1	1.3	1.4	1.3				0.8	0.6	0.7	0.6			
Low Bank Elevation (ft)	735.5	735.5	735.6	735.4				774.5	774.5	774.6	774.7				774.8	774.7	774.9	775.0				763.4	763.4	763.5	763.4				763.73	763.8	763.8	763.8			
Bankfull Cross Sectional Area (ft^2)[2]	5.1	5.6	6.0	4.8				3.1	3.2	3.7	4.7				2.6	1.8	2.6	2.8				2.7	2.7	2.7	2.8				2.2	1.7	1.5	1.3			
Bankfull Entrenchment Ratio[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.8	3.9	3.7	4.1				-	-	-	-	-	-	-	11.8	5.4	3.5	>5.6			
Bankfull Bank Height Ratio[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.8	1.0	1.1				-	-	-	-	-	-	-	1.0	0.9	0.8	0.7			

	Cross Section 11 (Riffle)							Cross Section 12 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	737.5	737.6	737.5	737.7				737.3	737.3	737.2	737.3			
Bankfull Width (ft)[1]	5.7	5.3	6.8	6.4				4.6	5.0	4.5	3.8			
Floodprone Width (ft)[1]	>43.9	>44.2	>46.1	>46.7				-	-	-	-	-	-	-
Bankfull Max Depth (ft)[2]	0.8	0.7	1.1	0.8				1.2	0.7	1.6	1.5			
Low Bank Elevation (ft)	737.51	737.5	737.7	737.6				737.3	737.3	737.4	737.5			
Bankfull Cross Sectional Area (ft^2)[2]	2.9	2.3	4.4	2.7				3.1	2.3	4.4	4.3			
Bankfull Entrenchment Ratio[1]	>8.7	>8.7	>6.8	>7.3				-	-	-	-	-	-	-
Bankfull Bank Height Ratio[1]	1.0	0.9	1.2	1.0				-	-	-	-	-	-	-

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Appendix E

Hydrology Data

Table 12. MY4 Rainfall Summary

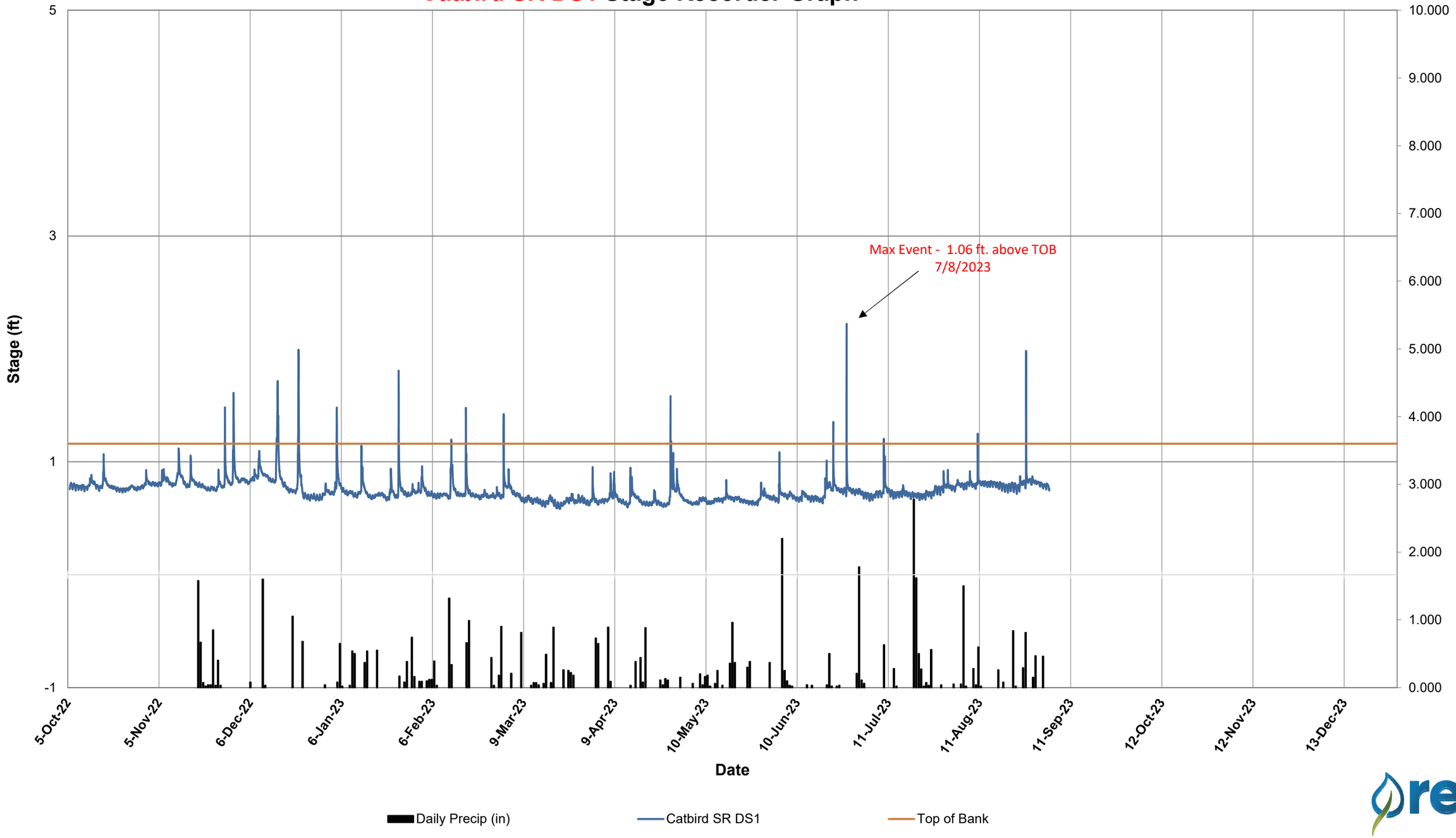
Month	Average	Normal Limits		Project Location Precipitation*
		30 Percent	70 Percent	
September (2022)	4.32	2.73	5.21	3.81
October (2022)	3.27	1.96	3.94	3.48
November (2022)	3.18	1.71	3.89	4.37
December (2022)	3.72	2.55	4.44	4.41
January	3.64	2.62	4.30	4.55
February	3.32	2.35	3.93	3.42
March	3.83	2.64	4.56	2.60
April	3.96	2.52	4.77	5.63
May	3.89	2.55	4.68	2.89
June	4.27	3.13	5.01	6.78
July	4.90	3.51	5.79	3.80
August	4.44	3.09	5.28	3.57
Total Annual **	45.64	41.65	49.09	49.31
Above Normal Limits	Below Normal Limits			

WETS Station: Yadkinville, NC. Approximately 13 miles from the site.
*Project Location Precipitation is a location-weighted average of surrounding gauged data retrieved by the USACE Antecedent Precipitation Tool. Gauges used include Elkin, King, Yadkinville 6 E.
**Total Annual represents the average total precipitation, annually, as calculated by the 30-year period.

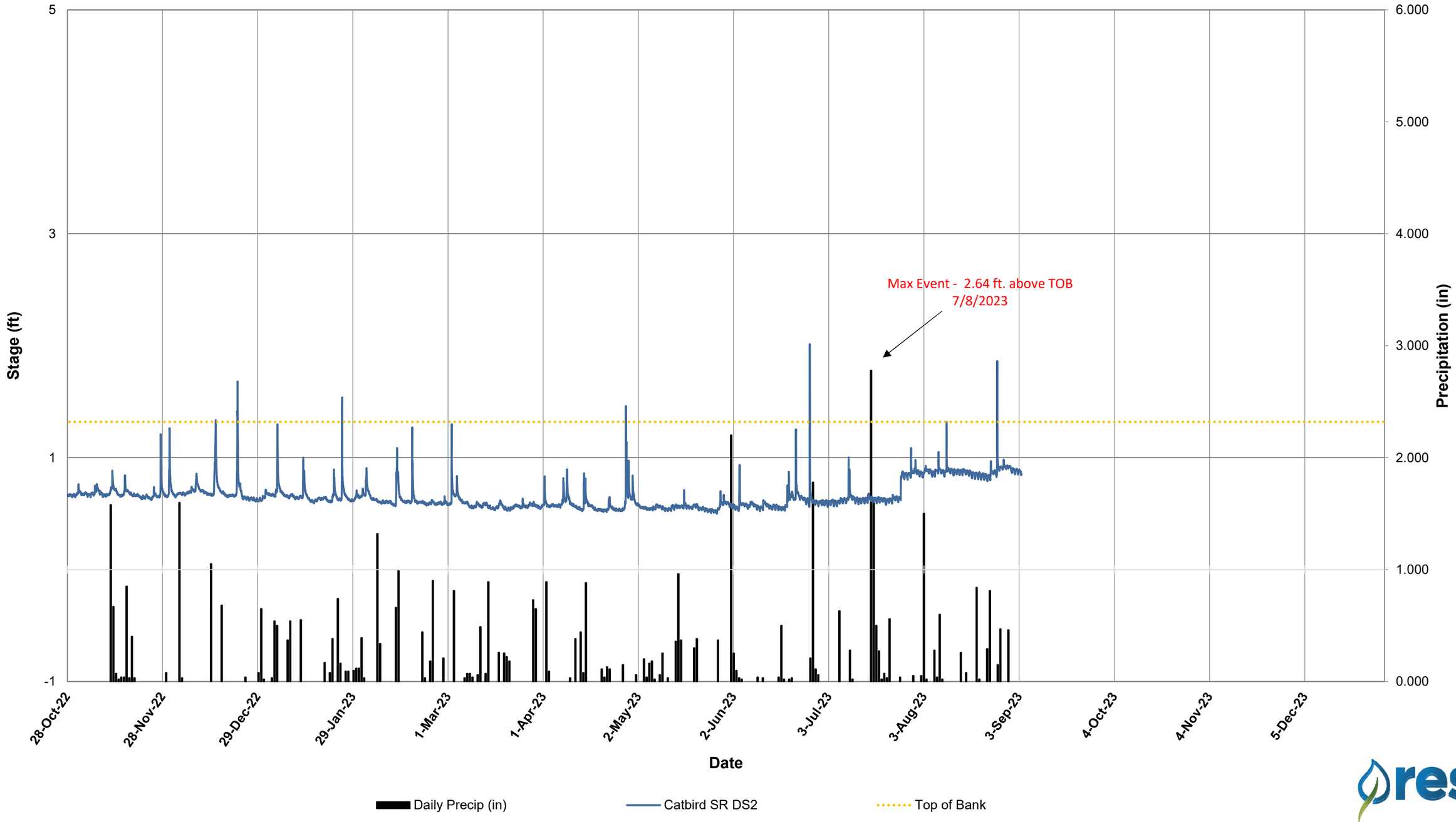
Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Maximum Bankfull Height (ft above TOB)	Date of Maximum Bankfull Event
Stage Recorder DS1 (Lower)			
MY1 2020	8	0.92	8/15/2020
MY2 2021	16	0.61	5/3/2021
MY3 2022	6	0.36	2/23/2022
MY4 2023	11	1.06	7/8/2023
Stage Recorder DS2-B (Lower)			
MY1 2020	8	0.62	8/15/2020
MY2 2021	1	0.08	5/3/2021
MY3 2022	4	0.23	2/23/2022
MY4 2023	4	2.64	7/8/2023
Year	**Number of Flow Events**	**Maximum Consecutive Flow Days**	**Maximum Cummlative Flow Days**
Flow Gauge DS1 (Upper)			
MY1 2020	1	215	215
MY2 2021	1	278	278
MY3 2022	11	86	140
MY3 2023	2	165	243

Catbird SR DS1 Stage Recorder Graph



Catbird SR DS2 Stage Recorder Graph



Catbird FG DS1 Flow Gauge Graph