MONITORING YEAR 2 ANNUAL REPORT
Final

January 2023

LYON HILLS MITIGATION SITE
Wilkes County, NC
Yadkin River Basin
HUC 03040101

DMS Project No. 100085
NCDEQ Contract No. 7620
USACE Action ID No. SAW-2018-01784
DWR Project No. 2018-1274 v1
Data Collection Dates: January-November 2022

DMS RFP No. 16-007406
June 19, 2018

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

January 16, 2023

Mr. Kelly Phillips
Project Manager
NCDEQ – Division of Mitigation Services
610 East Center Avenue, Suite 301
Mooresville, NC 28115

RE: Lyon Hills Mitigation Site – Monitoring Year 2 Report
Yadkin River Basin – CU# 03040101
Wilkes County
DMS Project ID No. 100085
Contract #7620

Dear Mr. Phillips:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft MY2 Monitoring Report for the Lyon Hills Mitigation Site. The report has been updated accordingly. The Final MY2 Report and digital files are included. Wildlands' responses to DMS' report comments are noted below in *italics*.

DMS comment: Section 2 - Monitoring Year 2 Data Assessment: The Table 2 goal of protecting the site from harmful uses includes visual inspection of the perimeter as the measurement criteria. Please summarize the monitoring activities and results associated with this goal and indicate if the entire easement boundary was observed during MY2 and marked in accordance with the marking specifications.

Wildlands' response: Throughout the year several portions of the site boundary were visually inspected and during MY3 a full boundary inspection will be completed.

DMS comment: 2.2 Stream Areas of Concern: Please reference if the in-stream vegetation treatment and the perched culvert repair were coordinated with IRT.

Wildlands' response: The MY1 Report noted the culvert on Hanks Branch became perched shortly after construction. During MY2 the perched culvert was repaired. In-Stream vegetation was treated during MY2 and will continue to be monitored in subsequent years. Any future in-stream vegetation treatments will be coordinated with DMS and the IRT.

DMS comment: 2.5 Hydrology Assessment: Barometric gage data was used from a nearby site due to a malfunction of the onsite gage. Please indicate the approximate difference in accuracy expected by using this substitution.

Wildlands' response: The approximate difference in atmospheric pressure between the two sites is expected to be very minimal. The sites are approximately two miles apart and the difference in elevation range is approximately 200 feet.

DMS comment: Table 4 Visual Assessment: Thank you for including the data collection dates in the table.

Wildlands' response: Noted.

DMS comment: Digital Deliverable: There is a discrepancy in the summary table for bankfull events likely due to gauge malfunction associated with Ut 1 gauge 2; the report table indicated a single bankfull event in MY 2 on 8/06, the digital summary table indicates 9 bankfull events. Please verify the single event is the intended data submission.

Wildlands' response: Only one bankfull event could be verified for MY2. The gauge had erratic readings during the winter, most likely due to freezing water. It is possible that some of these readings could have been due to a bankfull event; however, we cannot verify them. The spreadsheet has been manually updated to show one bankfull event for the year.

As requested, Wildlands has included two hard copies of the Final Monitoring Year 2 Annual Report, with a copy of our comment response letter inserted after the report's cover page. In addition, a USB drive with the full final electronic copy of the report, our response letter, and all the electronic support files has been included.

Sincerely,

Jason Lorch
Monitoring Coordinator
jlorch@wildlandseng.com

PREPARED BY:

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LYON HILLS MITIGATION SITE

Monitoring Year 2 Annual Report

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Section 1: PROJECT OVERVIEW

The Lyon Hills Mitigation Site (Site) is located in Wilkes County, approximately eleven miles northwest of the Town of Elkin. The Site contains a network of streams that range in drainage area from five acres to 9.58 square miles. These include a portion of Sparks Creek, Hanks Branch (tributary to Sparks Creek), five unnamed tributaries to Hanks Branch; four of which originate within the project limits, and two unnamed tributaries to Sparks Creek. Sparks Creek and its tributaries are located within the East Prong Roaring River 12-digit HUC (030401010600). The site is within a targeted local watershed (TLW) but is not in a local watershed planning (LWP) area. The HUC is described in the 2009 Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) document (NC EEP, 2009).

1.1 Project Quantities and Credits

A conservation easement was recorded on 20.72 acres. Mitigation work within the Site included restoration, enhancement I, and enhancement II of 9,363 linear feet of perennial and intermittent stream channels. The project is expected to provide 5,304.783 stream credits at closeout.

Table 1: Project Quantities and Credits

PROJECT MITIGATION QUANTITIES							
Project Segment	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Credits**	**Comments**
STREAMS							
Spark Creek - Not For Credit	215	215	Cool	EII	2.5	0	No buffer on right side
Sparks Creek	405	405	Cool	EII	2.5	162.000	Fenced Out Cattle, Planted Buffer
Sparks Creek - Not For Credit	42	42	Cool	EII	2.5	0	Ford Crossing
Sparks Creek	332	332	Cool	EII	2.5	132.800	Fenced Out Cattle, Planted Buffer
Hanks Branch Reach 1	1,678	1,659	Cool	EII	2.5	671.200	Localized Bank Repairs, Floodplain Bench at Upstream End, Fenced Out Cattle
Hanks Branch Reach 2	1,065	1,012	Cool	EII	2.5	426.000	Fenced Out Cattle, Localized Bank Repairs, Planted Buffer, Add Wood to Channel
Hanks Branch Reach 2 - Not for Credit	42	42	Cool	EII	2.5	0	Culvert Crossing
Hanks Branch Reach 3	581	585	Cool	EI	1.5	387.333	Fenced Out Cattle, Floodplain Bench, Planted Buffer
UT1 - Not for Credit	60	57	Cool	R	1	0	TCE to work above property line
UT1	659	657	Cool	R	1	659.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT1 - Not for Credit	40	40	Cool	R	1	0	Culvert Crossing
UT1	106	105	Cool	R	1	106.000	Restored Dimension, Pattern, and Profile, Planted Buffer

UT2	78	78	Cool	EII	3	26.000	Fenced Out Cattle
UT3 Reach 1	655	652	Cool	R	1	655.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 2	447	436	Cool	EII	2.5	178.800	Fenced Out Cattle, Localized Bank Repairs, Planted Buffer
UT3 Reach 3	513	512	Cool	R	1	513.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 3 - Not for Credit	45	45	Cool	R	1	0	Culvert Crossing
UT3 Reach 3	74	74	Cool	R	1	74.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 4	272	271	Cool	EII	4	68.000	Fenced Out Cattle, Planted Buffer
UT3A	253	252	Cool	EII	2.5	101.200	Fenced Out Cattle, Planted Buffer
UT4 Reach 1	233	233	Cool	R	1	233.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT4 Reach 2	323	319	Cool	EII	2.5	129.200	Fenced Out Cattle, Stabilize Headcuts, Planted Buffer
UT4 Reach 3	140	139	Cool	R	1	140.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT4 Reach 3 - Not for Credit	40	40	Cool	R	1	0	Culvert Crossing
UT4 Reach 3	100	100	Cool	R	1	100.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT5 Reach 1	437	437	Cool	EII	4	109.250	Fenced Out Cattle
UT5 Reach 2	220	221	Cool	R	1	220.000	Restored Dimension, Pattern, and Profile, Planted Buffer, Removed Impoundment
UT5 Reach 2 - Not for Credit	35	35	Cool	R	1	0	Culvert Crossing
UT5 Reach 2	107	107	Cool	R	1	107.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT5A	318	318	Cool	EII	3	106.000	Fenced Out Cattle
					Total	5,304.783	

Restoration Level	**Stream**		
	Warm	**Cool**	**Cold**
Restoration		2,807.000	
Enhancement I		387.333	
Enhancement II		2,110.450	
Preservation		---	
Totals		5,304.783	
Total Stream Credit	**5,304.783**		

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits within the Yadkin River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. Table 2 below describes expected outcomes to water quality and ecological processes associated with the project goals and objectives. These goals were established and completed with careful consideration of goals and objectives described in the RBRP and to meet the DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed.

Table 2: Goals, Performance Criteria, and Functional Improvements

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve the stability of stream channels	Construct stream channels that will maintain a stable pattern and profile considering hydrologic and sediment inputs to the system; install bank revetments and grade control; install bank vegetation.	Reduce erosion and sediment inputs; maintain appropriate bed forms and sediment size distribution.	ER stays over 2.2 and BHR below 1.2 with visual assessments showing progression towards stability.	Cross-section monitoring and visual inspections.	Minor deviations from design due to in-stream vegetation. Will continue to be treated in MY3.
Reconnect channels with floodplains and riparian wetlands	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the existing floodplain.	Reduce shear stress on channel; hydrate adjacent wetland areas; filter pollutants out of overbank flows; provide surface storage of water on floodplain; increase groundwater recharge while reducing outflow of stormwater; support water quality and habitat goals.	Four bankfull events in separate years within monitoring period. 30 consecutive days of flow for intermittent channel.	Crest gauges and/or pressure transducers recording flow elevations.	Hanks Branch Reach 3 and UT4 Reach 3 had no bankfull events, UT1, UT3 Reach 3, and UT5 Reach 2 all obtained bankfull events in MY2. UT4 Reach 1 obtained 130 days of consecutive flow during MY2.
Improve instream habitat	Install habitat features such as cover logs, log sills, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct a variety of riffle features and pools of varying depth. Fence out livestock.	Support biological communities and processes. Provide aquatic habitats for diverse populations of aquatic organisms.	There is no required performance standard for this metric.	N/A	N/A

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve water quality	Stabilize stream banks. Plant riparian buffers with native trees. Construct BMPs to treat pasture runoff. Fence out livestock.	Reduce sediment and nutrient inputs from stream banks; reduce sediment, nutrient, and bacteria inputs from pasture runoff; keep livestock out of streams, further reducing pollutants in project streams.	There is no required performance standard for this metric.	N/A	N/A
Restore/improve riparian buffers	Plant native tree species in riparian zone where currently insufficient.	Provide a canopy to shade streams and reduce thermal loadings; stabilize stream banks and floodplain; support water quality and habitat goals.	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7.Height requirement is 7 feet at MY5 and 10 feet at MY7.	One hundred square meter vegetation plots are placed on 2% of the planted area of the Site and monitored annually.	All 9 vegetation plots have a planted stem density greater than 320 stems per acre.
Permanently protect the project site from harmful uses	Establish conservation easements on the Site.	Ensure that development and agricultural uses that would damage the Site or reduce the benefits of the project are prevented.	Prevent easement encroachment.	Visually inspect the perimeter of the Site to ensure no easement encroachment is occurring.	No easement encroachments. Several portions of the Site boundary were visually inspected. A full boundary inspection will be completed in MY3.

1.3 Project Attributes

According to the RBRP, agricultural land use, including 30 animal operations, is a major stressor to aquatic resources in the lower portion of the HUC. Degraded riparian buffers are also noted as a significant stressor. Stressors described for the 8- digit CU include erosion and sedimentation (including erosion from pasture lands), which lead to aquatic habitat degradation. Turbidity and fecal coliform bacteria violations have been documented across the CU. The Site is located in DWR Subbasin 03-07-01. The 2008 Yadkin Pee-Dee River Basinwide Water Quality Plan (NC DWR, 2008) indicates that fecal coliform concentrations often exceeded the maximum regulatory limit in the CU which creates a potential health risk. The plan also notes major stressors in the Yadkin River Basin include excessive sedimentation and changes in hydrology and geomorphology due to urban development and agriculture. Agriculture was identified in the plan as the most significant stressor leading to water quality degradation in the Yadkin River basin.

Table 3: Project Attributes

PROJECT INFORMATION			
Project Name	Lyon Hills Mitigation Site	County	Wilkes County
Project Area (acres)	20.72	Project Coordinates	36.32924° N, 81.01018° W
PROJECT WATERSHED SUMMARY INFORMATION			
Physiographic Province	Piedmont	River Basin	Yadkin
USGS HUC 8-digit	03040101	USGS HUC 14-digit	03040101060030
DWR Sub-basin	03-07-01	Land Use Classification	66% forested, 28% agriculture, 6%developed,
Project Drainage Area (acres)	6,131	Percentage of Impervious Area	<1%

RESTORATION TRIBUTARY SUMMARY INFORMATION					
Parameters	**Hanks Branch**	**UT1**	**UT3**	**UT4**	**UT5**
Pre-project length (feet)	3,384	930	2,112	836	793
Post-project (feet)	3,298	802	1,990	831	800
Valley confinement (Confined, moderately confined, unconfined)	Unconfined		Confined		Unconfined
Drainage area (acres)	669	37	46	12	13
Perennial, Intermittent, Ephemeral	Perennial				
DWR Water Quality Classification	C				
Dominant Stream Classification (existing)	C4	B4	B4	B4	B4
Dominant Stream Classification (proposed)	C4	B4	B4	B4	C4b
Dominant Evolutionary class (Simon) if applicable	Stage I		Stage IV		

REGULATORY CONSIDERATIONS			
Parameters	**Applicable?**	**Resolved?**	**Supporting Documentation**
Water of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.
Water of the United States - Section 401	Yes	Yes	
Endangered Species Act	Yes	Yes	Categorical Exclusion in Mitigation Plan (Wildlands, 2019)
Historic Preservation Act	Yes	Yes	
Coastal Zone Management Act (CZMA or CAMA)	N/A	N/A	N/A
Essential Fisheries Habitat	N/A	N/A	N/A

Section 2: Monitoring Year 2 Data Assessment

Annual monitoring and site visits were conducted during MY2 to assess the condition of the project. The vegetation and stream success criteria for the Site follow the approved success criteria presented in the Mitigation Plan (Wildlands, 2020). Performance criteria for vegetation, stream, and hydrologic assessment are located in Section 1.2 Table 2: Goals, Performance Criteria, and Functional Improvements. Methodology for annual monitoring is presented in the MY0 Annual Report (Wildlands, 2021).

2.1 Vegetative Assessment

The MY2 vegetative survey was completed in August 2022. Vegetation monitoring resulted in a stem density range of 324 to 607 planted stems per acre which is well above the interim requirement of 320 stems per acre required at MY2. Average stem density was 459 planted stems per acre. All 9 vegetation plots exceeded the interim success criteria and are on track to meet the final success criteria required for MY7. Along with a successful tree growth, the herbaceous vegetation is dense and includes native pollinator species indicating a healthy riparian habitat. The riparian habitat is helping to reduce nutrient runoff from the cattle fields outside the easement and stabilizing the stream banks. Refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table and Appendix B for Vegetation Plot Data.

2.2 Vegetation Areas of Concern

No vegetation areas of concern were identified during MY2.

2.3 Stream Assessment

Morphological surveys for MY2 were conducted in May 2022. All streams within the Site are stable and functioning as designed. All 11 cross-sections at the Site show little to no change in the bankfull area and width-to-depth ratio, and bank height ratios are less than 1.2. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table, and Stream Photographs. Refer to Appendix C for Stream Geomorphology Data.

2.4 Stream Areas of Concern

During MY2 in-stream vegetation was only observed sporadically along UT5 Reach 2 (Figure 1c). This area of in-stream vegetation should continue to become less problematic as trees continue to grow and ultimately shade the stream and suppress the in-stream vegetation. After a chemical and manual in-stream vegetation treatment in August 2022, most of the accumulated sediment flushed through UT5. Wildlands will continue to monitor in-stream vegetation growth and will continue to treat it as necessary.

There are no culvert crossing issues noted for MY2. The perched culvert on Hanks Branch Reach 3 that was noted in MY1 was repaired in August 2022. This culvert was repaired mechanically by building a series of boulder sills downstream in order to back water into the outlet of the culvert allowing for aquatic passage to occur. Wildlands will continue to monitor all six culverts on Site annually to assess their continued stability. While equipment was on Site, an unstable J-Hook at approximately STA 219+80 along Hanks Branch Reach 2, was mechanically repaired. This J-Hook is currently stable and functioning as intended. Refer to Appendix F for Repair Photographs and CCPV Figure 1b.

The drum barrel that can be seen in photo point 9 was removed in April 2022 after the photo point picture was taken.

2.5 Hydrology Assessment

During a portion of MY2 the barotroll data logger malfunctioned; however, Wildlands was able to obtain barotroll data from the Bug Headwaters Mitigation Site located approximately five miles from Lyon Hills. Wildlands has ordered a replacement barotroll which will be installed for MY3. Bankfull events were recorded on UT1, UT3 Reach 3, and UT5 Reach 2. The crest gauges on Hanks Branch Reach 3 and UT4 Reach 3 did not receive any bankfull events in MY2. All channels have recorded at least one bankfull event during MY1 or MY2 and are on track to meet the hydrologic success criteria of four bankfull events in separate years.

In addition, the presence of baseflow must be documented on restored intermittent reaches (UT4 Reach 1) for a minimum of 30 consecutive days during a normal precipitation year. In-stream flow gauges equipped with pressure transducers were installed to monitor continuity of baseflow. UT4 Reach 1 maintained baseflow for 130 consecutive days. During MY1 this stream recorded 365 days of consecutive flow and is on track to meet baseflow success criteria. Refer to Appendix D for hydrologic data.

2.6 Monitoring Year 2 Summary

All vegetation plots are on track to exceed the MY3 interim requirement of 320 planted stems per acre, and all streams within the Site are stable and meeting project goals. In-stream vegetation was noted sporadically on UT5 Reach 2 and will continue to be treated as necessary in MY3. The perched culvert noted in MY1 has now been repaired along with a J-Hook on Hanks Branch Reach 2 in August 2022. Bankfull events were documented on three of the stream reaches in MY2; UT1, UT3 Reach 3, and UT5 Reach 2. Greater than 30 days of consecutive flow was recorded on the intermittent section of UT4 Reach 1 fulfilling MY2 success criteria. Overall, the Site is meeting its goals of preventing excess nutrients and sediment from entering the Yadkin River tributaries and is on track to meet final success criteria.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 3: REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

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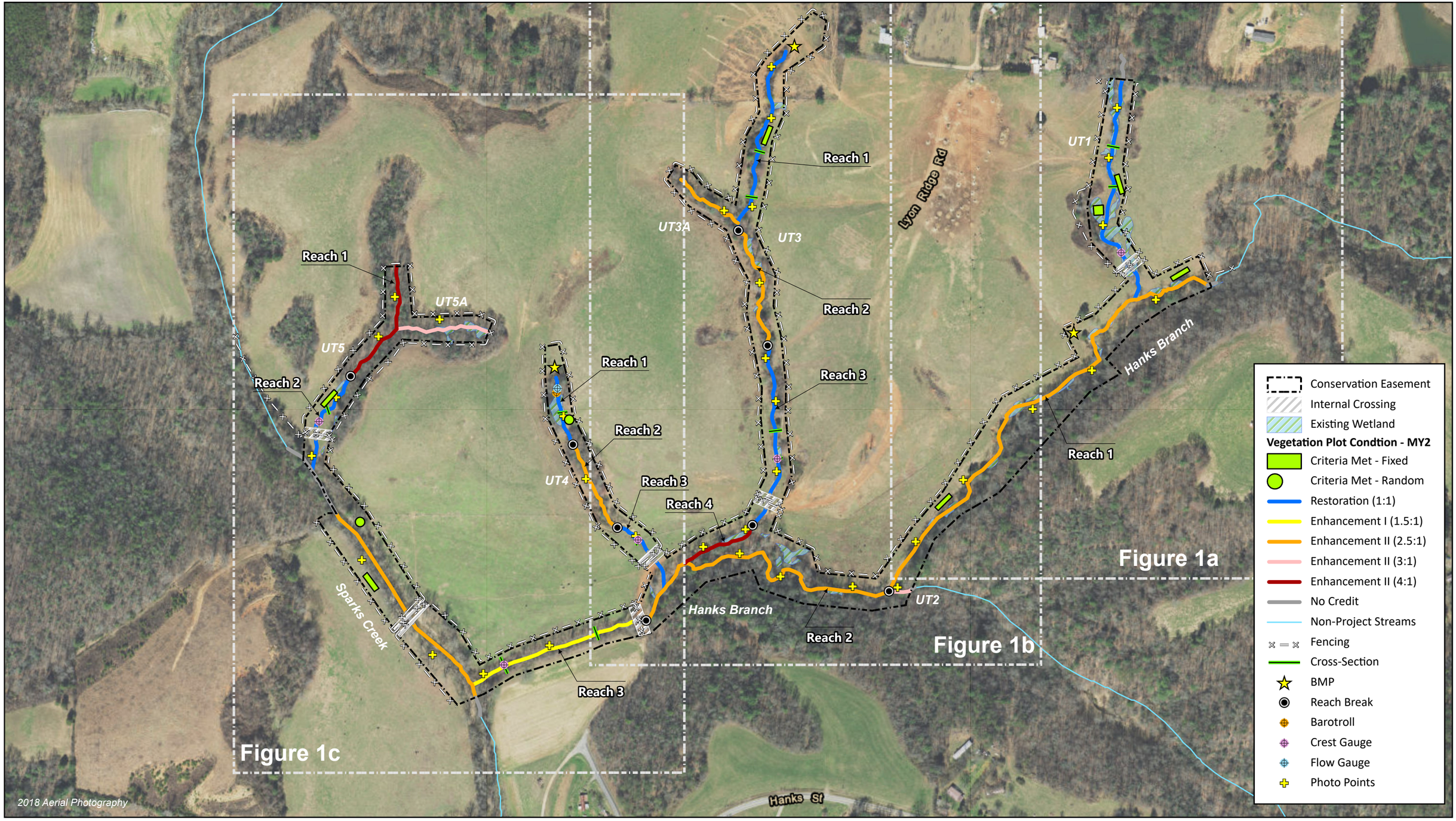
Rosgen, D. L. 1994. A classification of natural rivers. Catena 22:169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

United States Army Corps of Engineers (USACE). 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Wildlands Engineering, Inc. (2020). Lyon Hills Mitigation Project Mitigation Plan. DMS, Raleigh, NC.

Wildlands Engineering, Inc. (2021). Lyon Hills Mitigation Project Monitoring Year 0. DMS, Raleigh, NC.



WILDLANDS ENGINEERING

0 300 600 Feet

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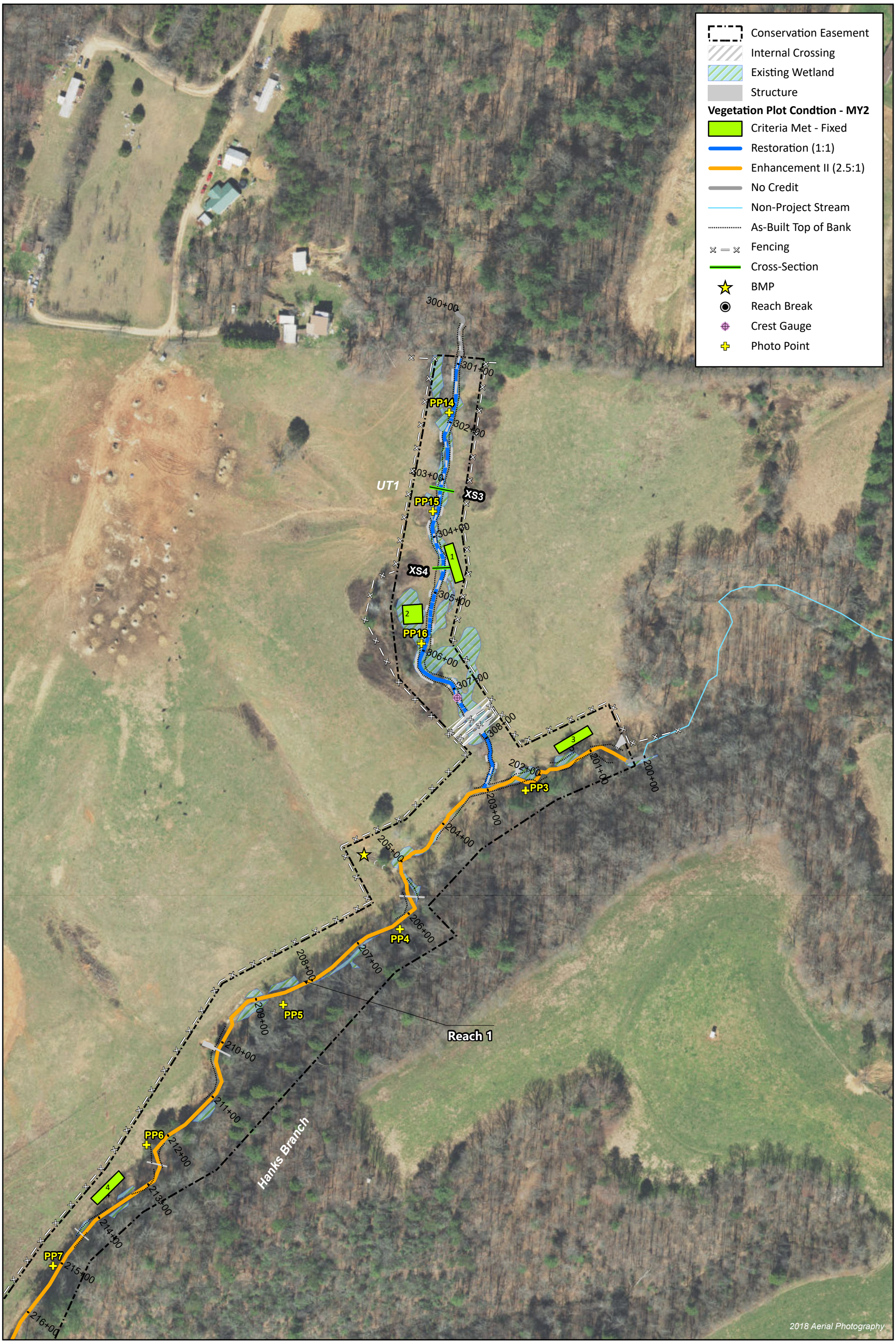
Figure 1. Current Condition Plan View Key
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 -2022

Wilkes County, NC



WILDLANDS ENGINEERING

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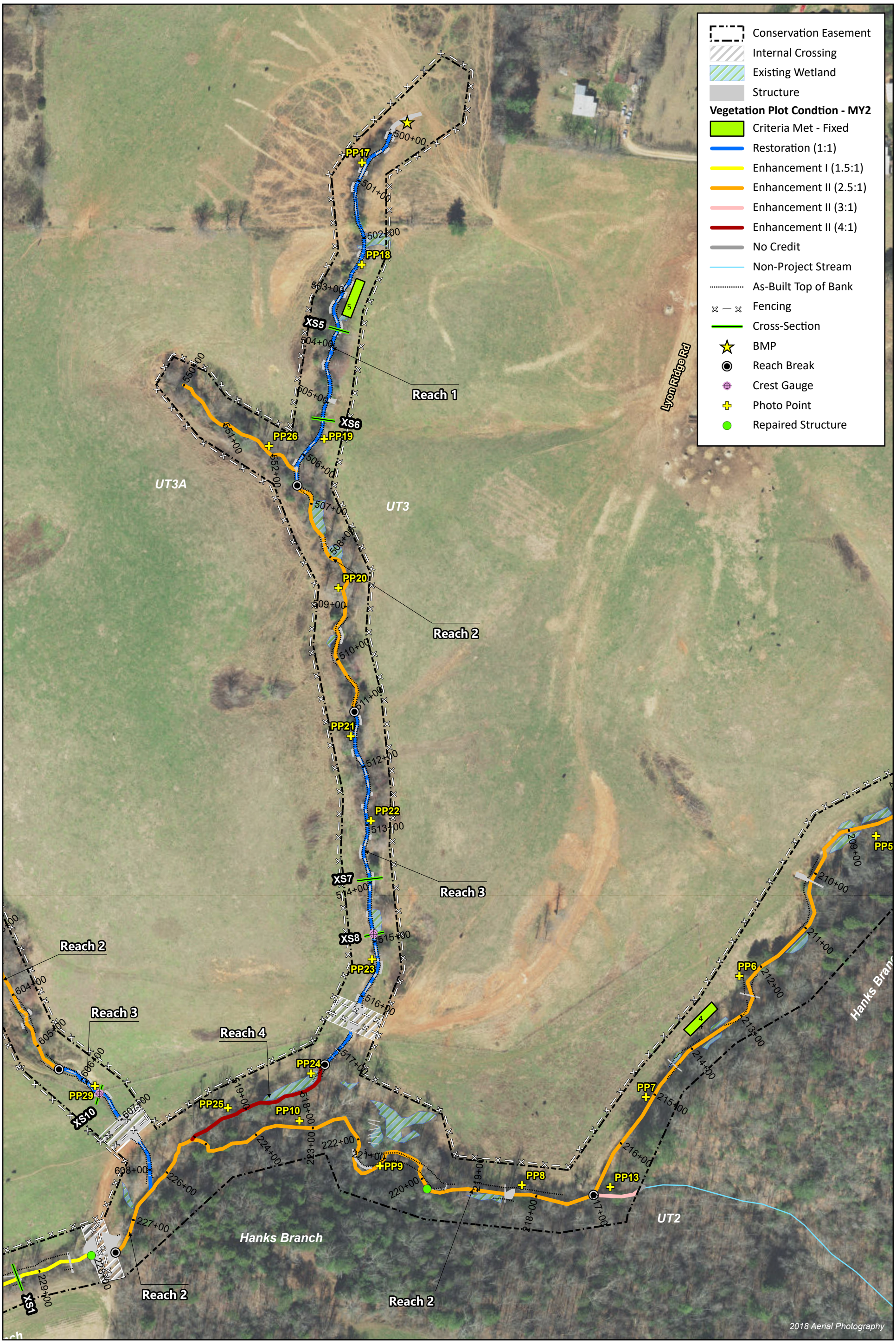
Figure 1a. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Wilkes County, NC



WILDLANDS ENGINEERING

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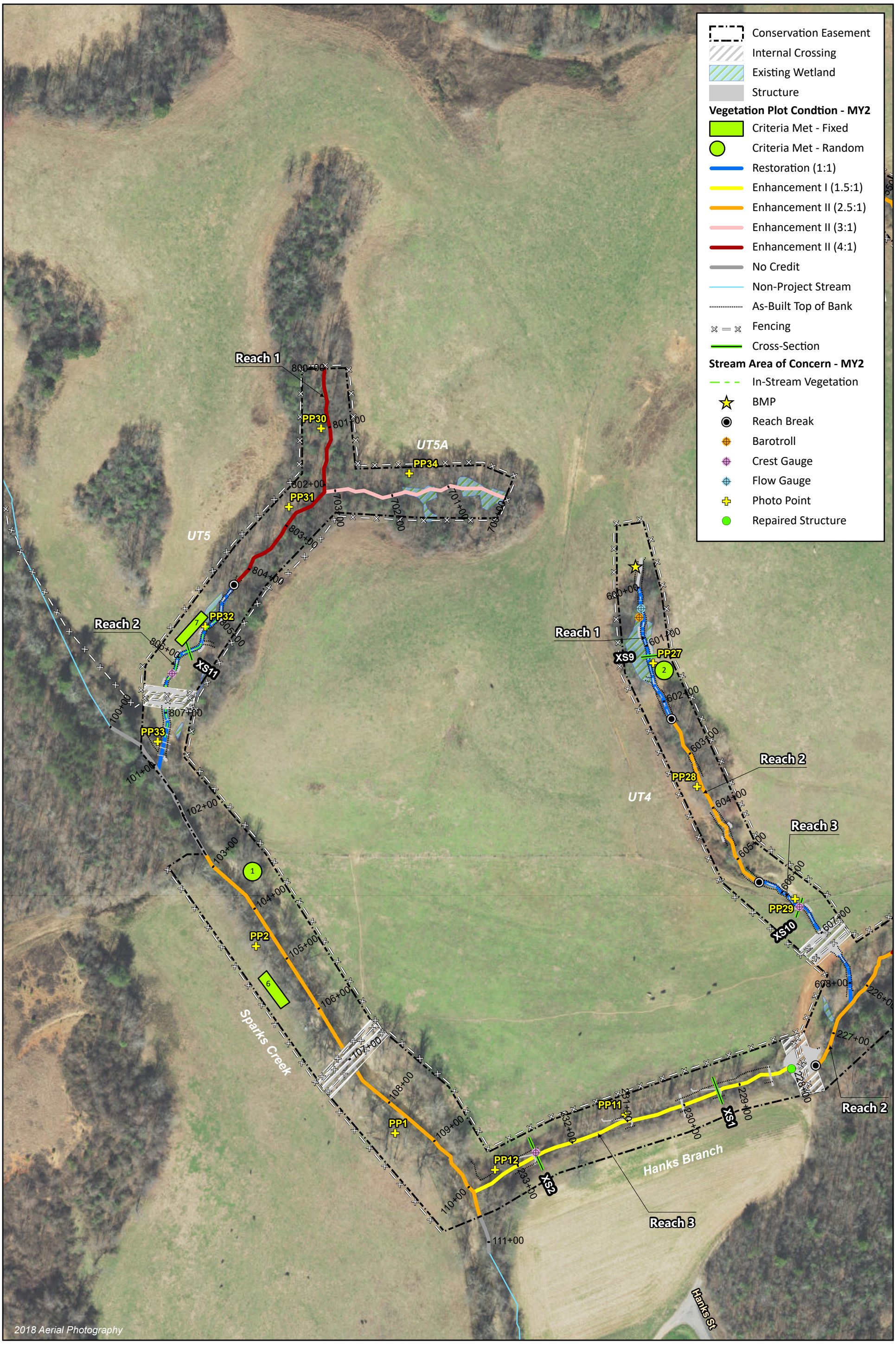
Figure 1b. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Wilkes County, NC



WILDLANDS ENGINEERING

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Figure 1c. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Wilkes County, NC

APPENDIX A. Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Hanks Branch Reach 3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	585
					Assessed Bank Length	1,170
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	5	5		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0		0%

Visual assessment was completed October 17, 2022.

UT1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	802
					Assessed Bank Length	1,604
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	25	25		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	15	15		100%

Visual assessment was completed October 17, 2022.

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

UT3 Reach 1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	625
					Assessed Bank Length	1,250
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	36	36		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	11	11		100%

Visual assessment was completed October 17, 2022.

UT3 Reach 3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	586
					Assessed Bank Length	1,172
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	31	31		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	10	10		100%

Visual assessment was completed October 17, 2022.

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

UT4 Reach 1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	233
					Assessed Bank Length	466
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	14	14		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2		100%

Visual assessment was completed October 17, 2022.

UT4 Reach 3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	239
					Assessed Bank Length	478
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	11	11		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4		100%

Visual assessment was completed October 17, 2022.

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

UT5 Reach 2

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	328
					Assessed Bank Length	656
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	15	15		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	6	6		100%

Visual assessment was completed October 17, 2022.

Table 5. Vegetation Condition Assessment Table
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Planted Acreage **10.80**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	0	0%
		Total	**0**	**0%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10	0	0%
		Cumulative Total	**0.0**	**0%**

Visual assessment was completed October 17, 2022.

Easement Acreage **20.72**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Invasive species included in summation above should be identified in report summary.	0.10	0	0%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0 Encroachments Noted / 0 ac	

STREAM PHOTOGRAPHS

PHOTO POINT 1 Spark's Creek – upstream *(3/24/2022)*

PHOTO POINT 1 Spark's Creek – downstream *(3/24/2022)*

PHOTO POINT 2 Spark's Creek – upstream *(3/24/2022)*

PHOTO POINT 2 Spark's Creek – downstream *(3/24/2022)*

PHOTO POINT 3 Hank's Branch R1 – upstream *(3/24/2022)*

PHOTO POINT 3 Hank's Branch R1 – downstream *(3/24/2022)*

PHOTO POINT 4 Hank's Branch R1 – upstream *(3/24/2022)*

PHOTO POINT 4 Hank's Branch R1 – downstream *(3/24/2022)*

PHOTO POINT 5 Hank's Branch R1 – upstream *(3/24/2022)*

PHOTO POINT 5 Hank's Branch R1 – downstream *(3/24/2022)*

PHOTO POINT 6 Hank's Branch R1 – upstream *(3/24/2022)*

PHOTO POINT 6 Hank's Branch R1 – downstream *(3/24/2022)*

PHOTO POINT 7 Hank's Branch R1 – upstream *(3/24/2022)*

PHOTO POINT 7 Hank's Branch R1 – downstream *(3/24/2022)*

PHOTO POINT 8 Hank's Branch R2 – upstream *(3/24/2022)*

PHOTO POINT 8 Hank's Branch R2 – downstream *(3/24/2022)*

PHOTO POINT 9 Hank's Branch R2 – upstream *(3/24/2022)*

PHOTO POINT 9 Hank's Branch R2 – downstream *(3/24/2022)*

PHOTO POINT 10 Hank's Branch R2 – upstream *(3/24/2022)*

PHOTO POINT 10 Hank's Branch R2 – downstream *(3/24/2022)*

PHOTO POINT 11 Hank's Branch R3 – upstream *(3/24/2022)*

PHOTO POINT 11 Hank's Branch R3 – downstream *(3/24/2022)*

PHOTO POINT 12 Hank's Branch R3 – upstream *(3/24/2022)*

PHOTO POINT 12 Hank's Branch R3 – downstream *(3/24/2022)*

	
PHOTO POINT 13 UT2 – upstream *(3/24/2022)*	**PHOTO POINT 13 UT2 – downstream *(3/24/2022)***
	
PHOTO POINT 14 UT1 – upstream *(3/24/2022)*	**PHOTO POINT 14 UT1 – downstream *(3/24/2022)***
	
PHOTO POINT 15 UT1 – upstream *(3/24/2022)*	**PHOTO POINT 15 UT1 – downstream *(3/24/2022)***

	
PHOTO POINT 16 UT1 – upstream *(3/24/2022)*	**PHOTO POINT 16 UT1 – downstream *(3/24/2022)***
	
PHOTO POINT 17 UT3 R1 – upstream *(3/24/2022)*	**PHOTO POINT 17 UT3 R1 – downstream *(3/24/2022)***
	
PHOTO POINT 18 UT3 R1 – upstream *(3/24/2022)*	**PHOTO POINT 18 UT3 R1 – downstream *(3/24/2022)***

	
PHOTO POINT 19 UT3 R1 – upstream *(3/24/2022)*	**PHOTO POINT 19 UT3 R1 – downstream *(3/24/2022)***
	
PHOTO POINT 20 UT3 R2 – upstream *(3/24/2022)*	**PHOTO POINT 20 UT3 R2 – downstream *(3/24/2022)***
	
PHOTO POINT 21 UT3 R3 – upstream *(3/24/2022)*	**PHOTO POINT 21 UT3 R3 – downstream *(3/24/2022)***

	
PHOTO POINT 22 UT3 R3 – upstream *(3/24/2022)*	**PHOTO POINT 22 UT3 R3 – downstream *(3/24/2022)***
	
PHOTO POINT 23 UT3 R3 – upstream *(3/24/2022)*	**PHOTO POINT 23 UT3 R3 – downstream *(3/24/2022)***
	
PHOTO POINT 24 UT3 R3 – upstream *(3/24/2022)*	**PHOTO POINT 24 UT3 R3 – downstream *(3/24/2022)***

	
PHOTO POINT 25 UT3 R4 – upstream *(3/24/2022)*	**PHOTO POINT 25 UT3 R4 – downstream *(3/24/2022)***
	
PHOTO POINT 26 UT3A – upstream *(3/24/2022)*	**PHOTO POINT 26 UT3A – downstream *(3/24/2022)***
	
PHOTO POINT 27 UT4 R1 – upstream *(3/24/2022)*	**PHOTO POINT 27 UT4 R1 – downstream *(3/24/2022)***

PHOTO POINT 28 UT4 R2 – upstream *(3/24/2022)*

PHOTO POINT 28 UT4 R2 – downstream *(3/24/2022)*

PHOTO POINT 29 UT4 R3 – upstream *(3/24/2022)*

PHOTO POINT 29 UT4 R3 – downstream *(3/24/2022)*

PHOTO POINT 30 UT5 R1 – upstream *(3/24/2022)*

PHOTO POINT 30 UT5 R1 – downstream *(3/24/2022)*

	
PHOTO POINT 31 UT5 R1 – upstream *(3/24/2022)*	**PHOTO POINT 31 UT5 R1 – downstream *(3/24/2022)***
	
PHOTO POINT 32 UT5 R2 – upstream *(3/24/2022)*	**PHOTO POINT 32 UT5 R2 – downstream *(3/24/2022)***
	
PHOTO POINT 33 UT5 R2 – upstream *(3/24/2022)*	**PHOTO POINT 33 UT5 R2 – downstream *(3/24/2022)***

	
PHOTO POINT 34 UT5A – upstream *(3/24/2022)*	**PHOTO POINT 34 UT5A – downstream *(3/24/2022)***

CULVERT CROSSING PHOTOGRAPHS

	
Hanks Branch R3 - Looking Upstream *(10/17/2022)*	**Hanks Branch R3 - Looking Downstream *(10/17/2022)***
	
UT1 - Looking Upstream *(10/17/2022)*	**UT1 - Looking Downstream *(10/17/2022)***
	
UT3 R3 - Looking Upstream *(10/17/2022)*	**UT3 R3 - Looking Downstream *(10/17/2022)***

	
UT4 R3 - Looking Upstream *(10/17/2022)*	**UT4 R3 - Looking Downstream *(10/17/2022)***
	
UT5 R2 - Looking Upstream *(10/17/2022)*	**UT5 R2 - Looking Downstream *(10/17/2022)***

VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(08/28/2022)*

FIXED VEG PLOT 2 *(08/28/2022)*

FIXED VEG PLOT 3 *(08/28/2022)*

FIXED VEG PLOT 4 *(08/28/2022)*

FIXED VEG PLOT 5 *(08/28/2022)*

FIXED VEG PLOT 6 *(08/28/2022)*

FIXED VEG PLOT 7 *(08/28/2022)*

RANDOM VEG PLOT 1 *(08/28/2022)*

RANDOM VEG PLOT 2 *(08/28/2022)*

APPENDIX B. Vegetation Plot Data

Table 6. Vegetation Plot Data

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022

Planted Acreage	10.80
Date of Initial Plant	2021-03-22
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	NA
Date of Current Survey	2022-08-29
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC			1	1				
	Acer rubrum	red maple	Tree	FAC								
	Betula nigra	river birch	Tree	FACW	3	3	2	2	3	3		
	Diospyros virginiana	common persimmon	Tree	FAC	1	1			1	1	1	1
	Liriodendron tulipifera	tuliptree	Tree	FACU							1	1
	Morus rubra	red mulberry	Tree	FACU	1	1						
	Nyssa sylvatica	blackgum	Tree	FAC	2	2	2	2	1	1	3	3
	Platanus occidentalis	American sycamore	Tree	FACW	1	1	2	2	5	5	3	3
	Prunus serotina	black cherry	Tree	FACU					1	1		
	Quercus phellos	willow oak	Tree	FAC	3	3	1	1	1	1	3	3
	Quercus rubra	northern red oak	Tree	FACU	1	1			2	2	1	1
	Ulmus americana	American elm	Tree	FACW	1	1			1	1	2	2
Sum	Performance Standard				13	13	8	8	15	15	14	14
Mitigation Plan Performance Standard	Current Year Stem Count					13		8		15		14
	Stems/Acre					526		324		607		567
	Species Count					8		5		8		7
	Dominant Species Composition (%)					23		25		33		21
	Average Plot Height (ft.)					3		5		2		4
	% Invasives					0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					13		8		15		14
	Stems/Acre					526		324		607		567
	Species Count					8		5		8		7
	Dominant Species Composition (%)					23		25		33		21
	Average Plot Height (ft.)					3		5		2		4
	% Invasives					0		0		0		0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.

2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).

3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 6. Vegetation Plot Data

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Planted Acreage	10.80
Date of Initial Plant	2021-03-22
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	NA
Date of Current Survey	2022-08-29
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 5 F		Veg Plot 6 F		Veg Plot 7 F		Veg Plot 1 R	Veg Plot 2 R
					Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC								
	Acer rubrum	red maple	Tree	FAC								1
	Betula nigra	river birch	Tree	FACW	1	1	1	1	3	3		2
	Diospyros virginiana	common persimmon	Tree	FAC	1	1			1	1	1	
	Liriodendron tulipifera	tuliptree	Tree	FACU								2
	Morus rubra	red mulberry	Tree	FACU								
	Nyssa sylvatica	blackgum	Tree	FAC	1	1	1	1	1	1	1	1
	Platanus occidentalis	American sycamore	Tree	FACW	2	2	3	3	2	2	4	3
	Prunus serotina	black cherry	Tree	FACU								
	Quercus phellos	willow oak	Tree	FAC	2	2	1	1	3	3		1
	Quercus rubra	northern red oak	Tree	FACU	1	1	2	2	2	2	3	
	Ulmus americana	American elm	Tree	FACW	1	1	2	2			2	
Sum	Performance Standard				9	9	10	10	12	12	11	10
Mitigation Plan Performance Standard	Current Year Stem Count					9		10		12	11	10
	Stems/Acre					364		405		486	445	405
	Species Count					7		6		6	5	6
	Dominant Species Composition (%)					22		30		25	36	30
	Average Plot Height (ft.)					3		3		4	2	3
	% Invasives					0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					9		10		12	11	10
	Stems/Acre					364		405		486	445	405
	Species Count					7		6		6	5	6
	Dominant Species Composition (%)					22		30		25	36	30
	Average Plot Height (ft.)					3		3		4	2	3
	% Invasives					0		0		0	0	0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 7. Vegetation Performance Standards Summary Table

Lyon Hills Mitigation Site

DMS Project No. 100085

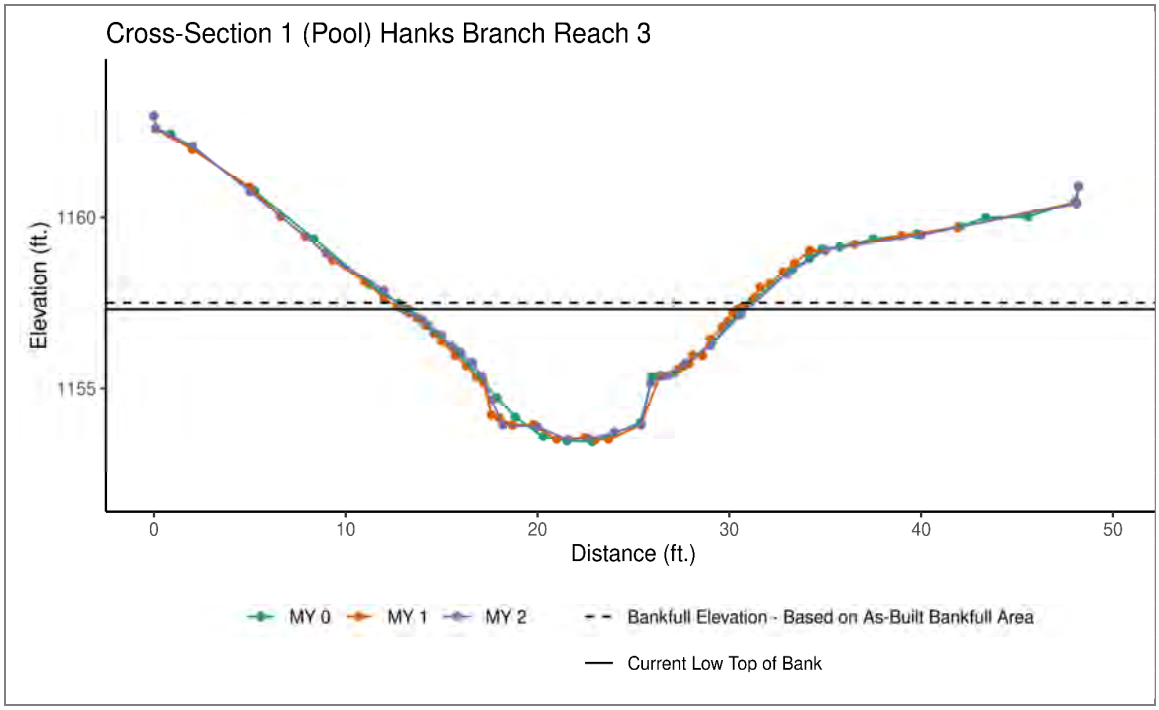
Monitoring Year 2 - 2022

	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	526	3	8	0	324	5	5	0	607	2	8	0
Monitoring Year 1	567	2	8	0	486	3	6	0	607	2	8	0
Monitoring Year 0	607	2	8	0	607	3	6	0	607	2	8	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot 6 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	567	4	7	0	364	3	7	0	405	3	6	0
Monitoring Year 1	607	3	8	0	486	3	8	0	567	3	7	0
Monitoring Year 0	607	2	8	0	526	2	8	0	607	2	7	0
	Veg Plot 7 F				Veg Plot Group 1 R				Veg Plot Group 2 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	486	4	6	0	445	2	5	0	405	3	6	0
Monitoring Year 1	486	3	6	0	324	2	5	0	364	2	5	0
Monitoring Year 0	526	2	6	0	445	2	9	0	607	3	9	0

*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

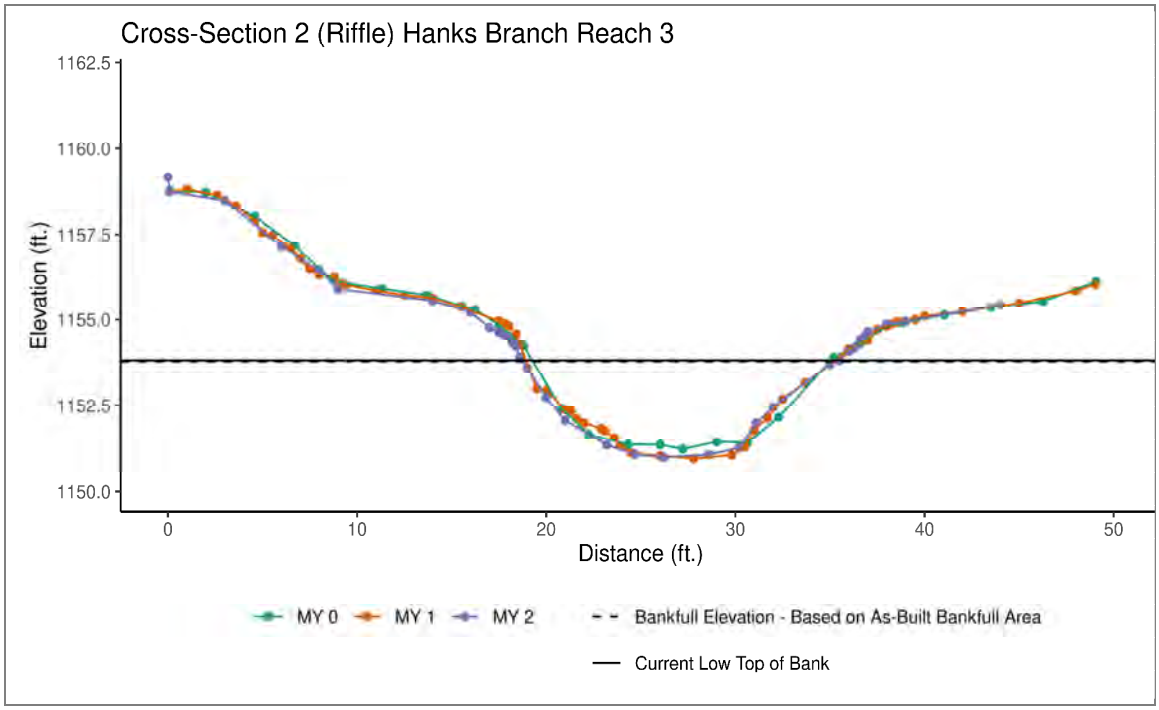
APPENDIX C. Stream Geomorphology Data

Cross-Section Plots



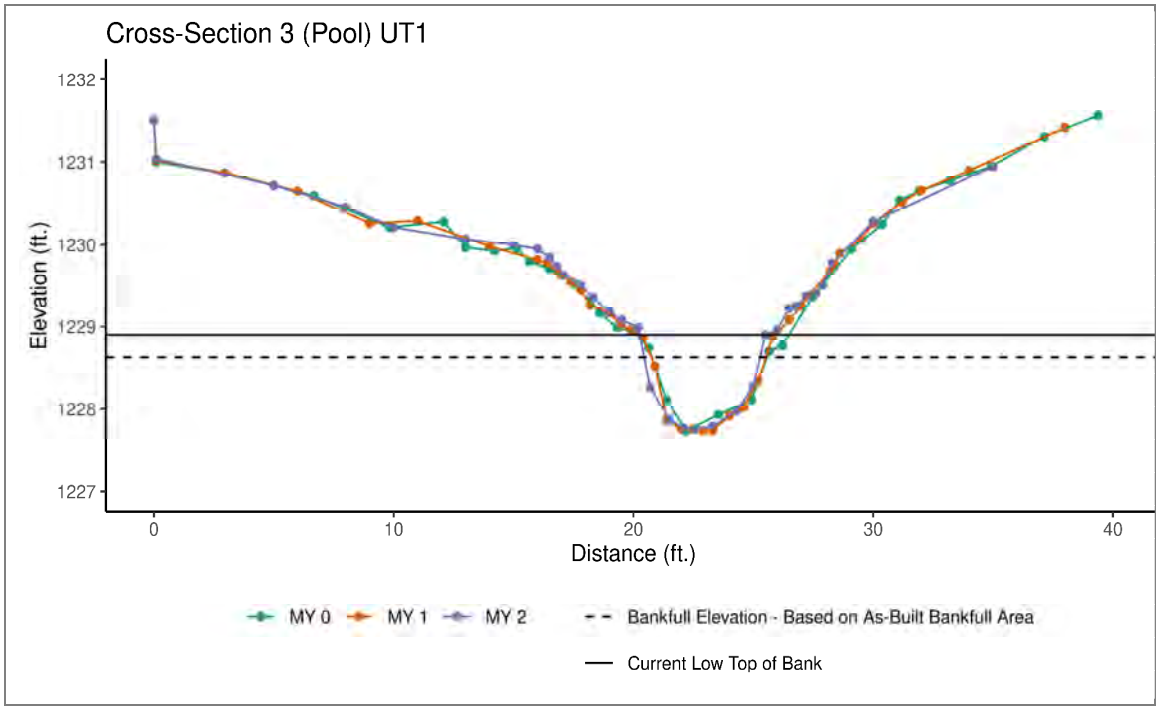
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A			
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A			
Thalweg Elevation	1,153.44	1,153.50	1,153.52			
LTOB Elevation	1,157.57	1,157.39	1,157.29			
LTOB Max Depth	4.13	3.89	3.77			
LTOB Cross-Sectional Area	44.10	41.91	39.27			

Downstream *(05/03/2022)*



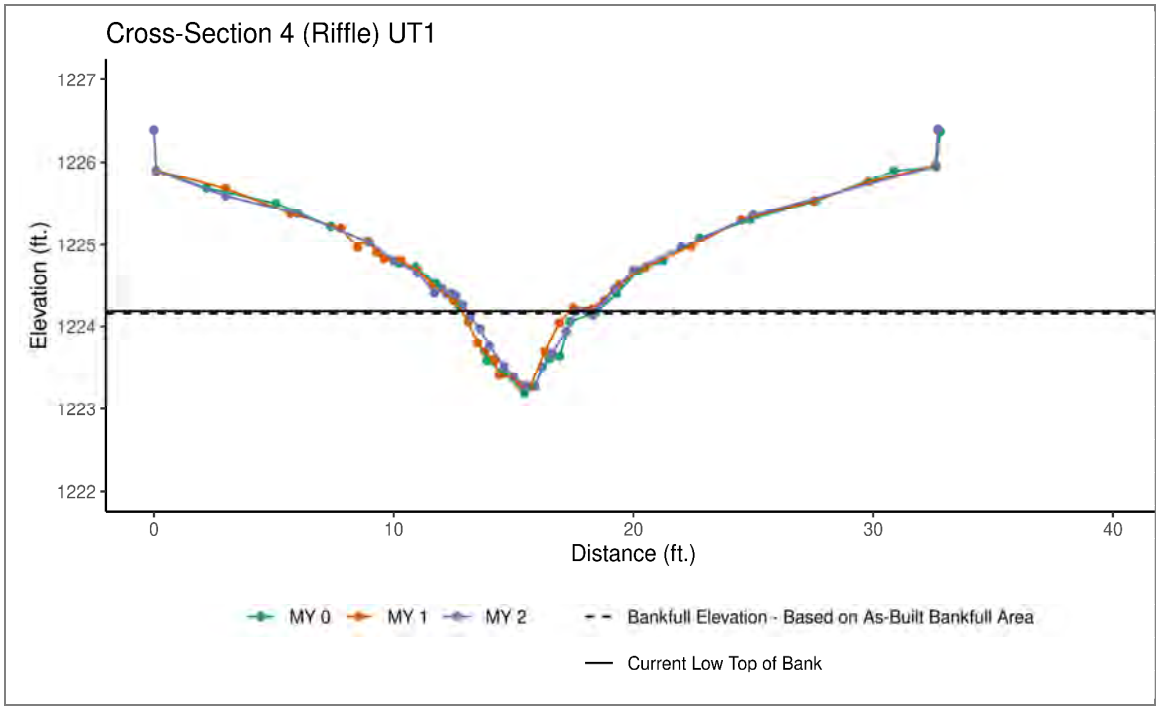
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,153.89	1,153.82	1,153.78			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.00	1.01			
Thalweg Elevation	1,151.24	1,150.96	1,151.00			
LTOB Elevation	1,153.89	1,153.82	1,153.81			
LTOB Max Depth	2.65	2.86	2.81			
LTOB Cross-Sectional Area	30.70	30.69	31.26			

Downstream *(05/03/2022)*



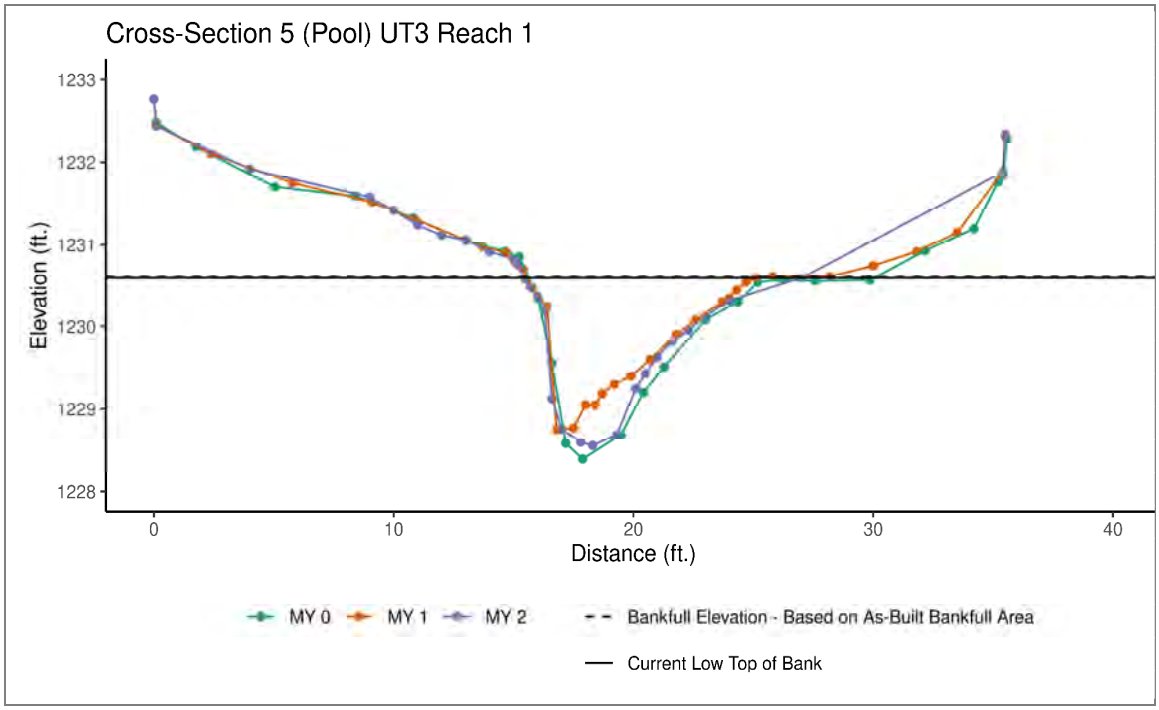
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A			
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A			
Thalweg Elevation	1,227.74	1,227.74	1,227.76			
LTOB Elevation	1,228.70	1,228.86	1,228.90			
LTOB Max Depth	1.00	1.12	1.14			
LTOB Cross-Sectional Area	3.20	4.30	4.53			

Downstream *(05/03/2022)*



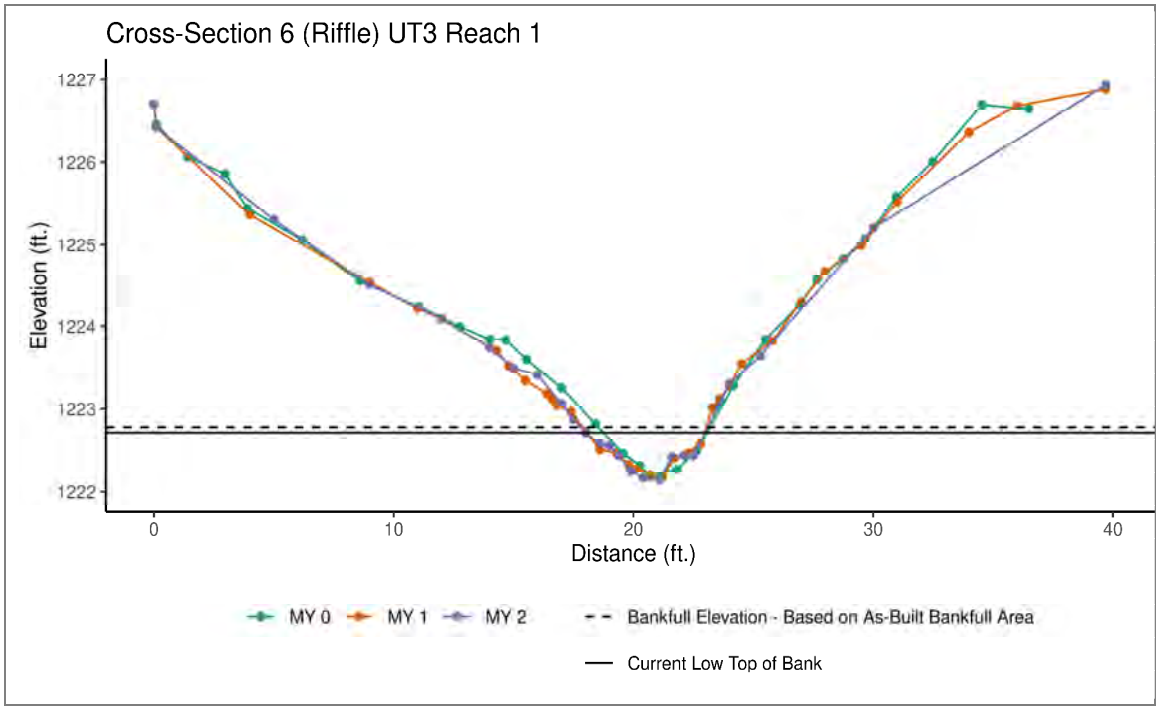
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,224.06	1,224.15	1,224.15			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	1.03			
Thalweg Elevation	1,223.19	1,223.27	1,223.27			
LTOB Elevation	1,224.06	1,224.23	1,224.18			
LTOB Max Depth	0.90	0.96	0.91			
LTOB Cross-Sectional Area	2.20	2.56	2.33			

Downstream *(05/03/2022)*



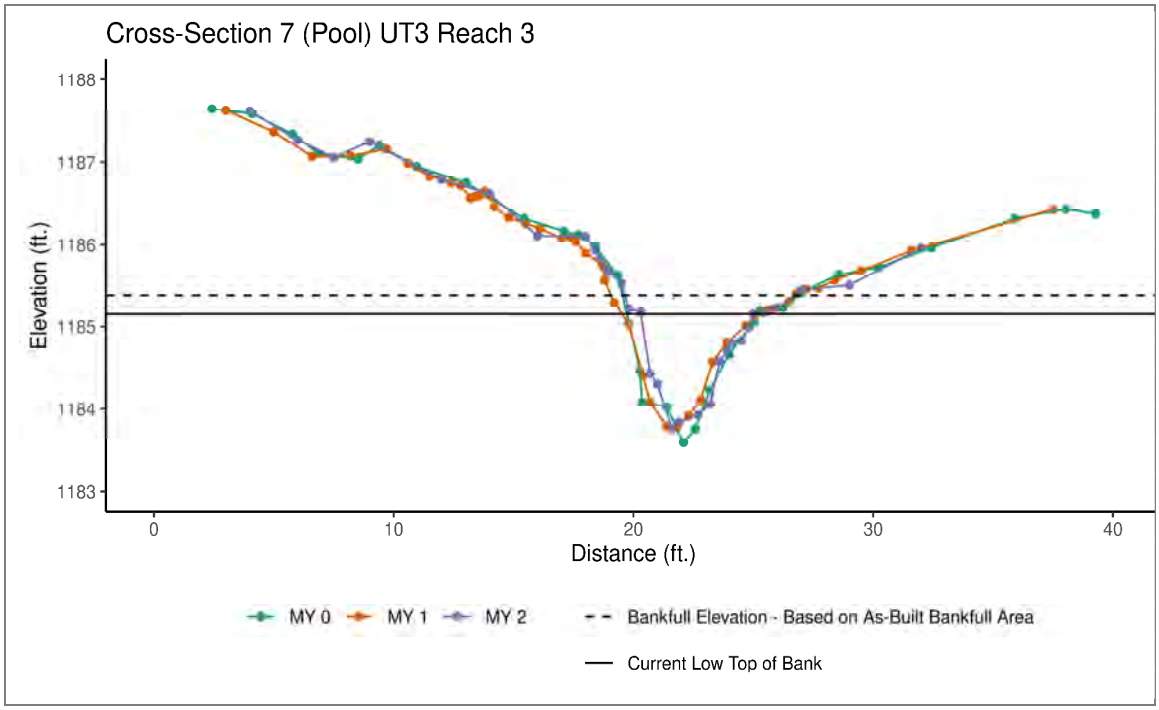
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A			
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A			
Thalweg Elevation	1,228.40	1,228.75	1,228.56			
LTOB Elevation	1,230.54	1,230.60	1,230.60			
LTOB Max Depth	2.10	1.85	2.04			
LTOB Cross-Sectional Area	10.20	8.30	10.18			

Downstream *(05/03/2022)*



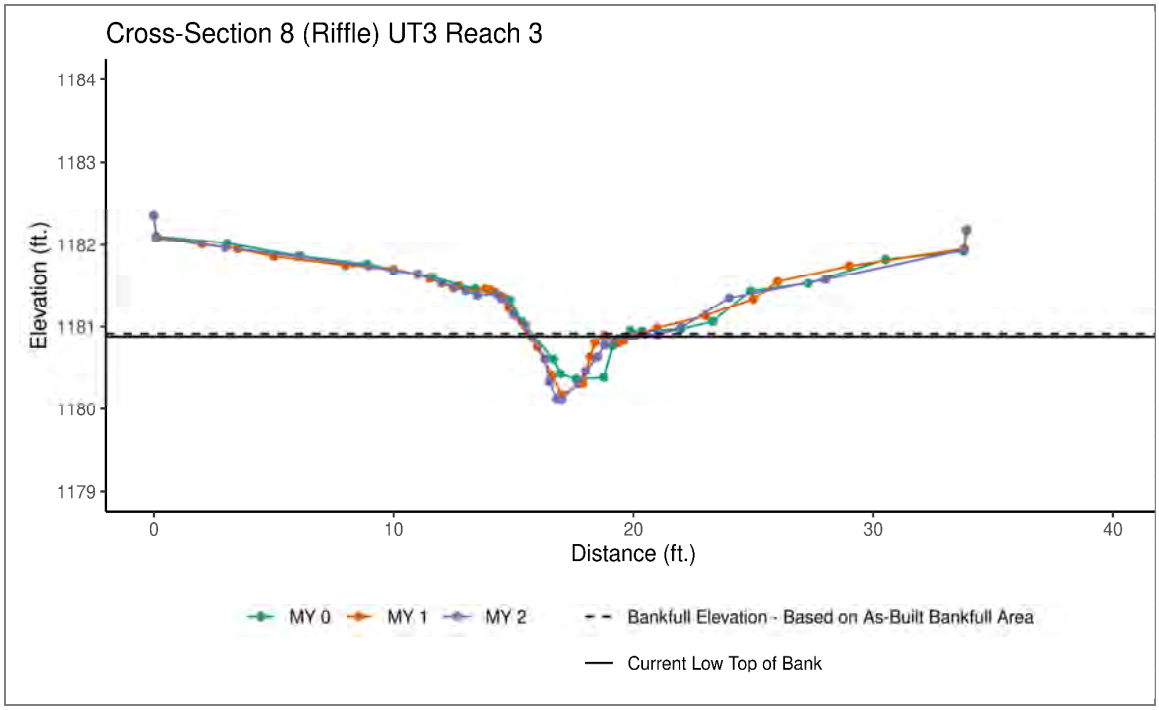
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,222.82	1,222.79	1,222.78			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.90	0.90			
Thalweg Elevation	1,222.18	1,222.17	1,222.15			
LTOB Elevation	1,222.82	1,222.73	1,222.72			
LTOB Max Depth	0.60	0.56	0.57			
LTOB Cross-Sectional Area	1.90	1.61	1.57			

Downstream *(05/03/2022)*



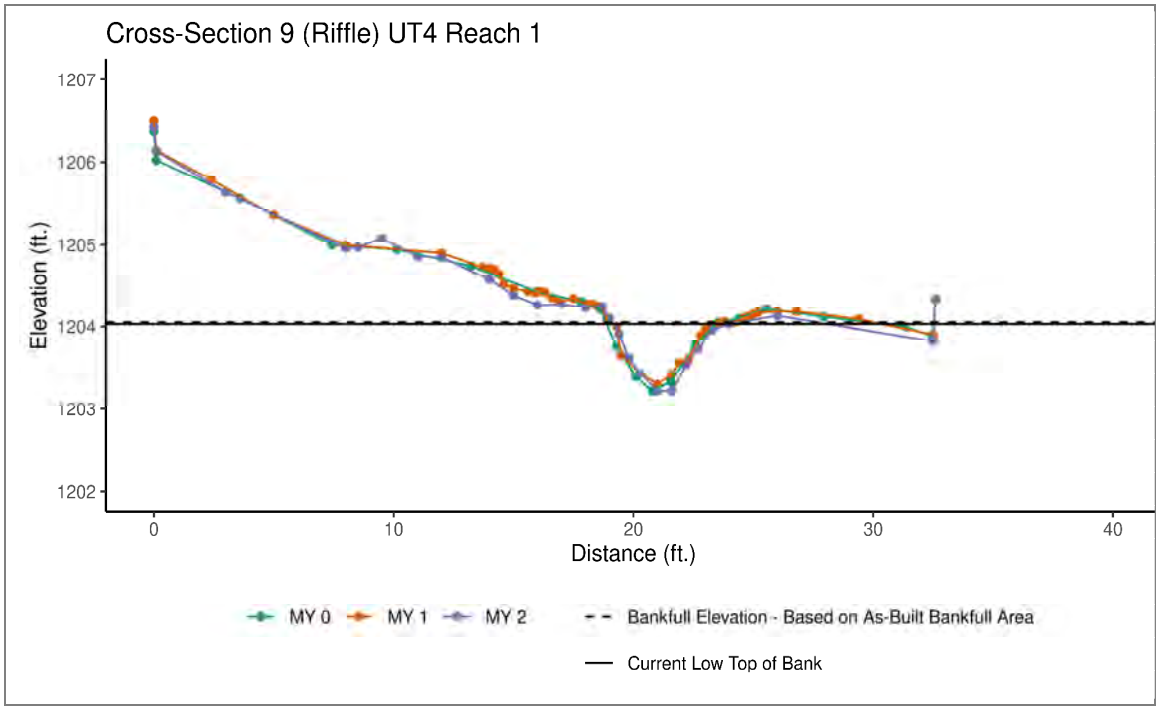
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A			
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A			
Thalweg Elevation	1,183.59	1,183.79	1,183.77			
LTOB Elevation	1,185.20	1,185.21	1,185.15			
LTOB Max Depth	1.60	1.43	1.38			
LTOB Cross-Sectional Area	4.90	4.45	3.82			

Downstream *(05/03/2022)*



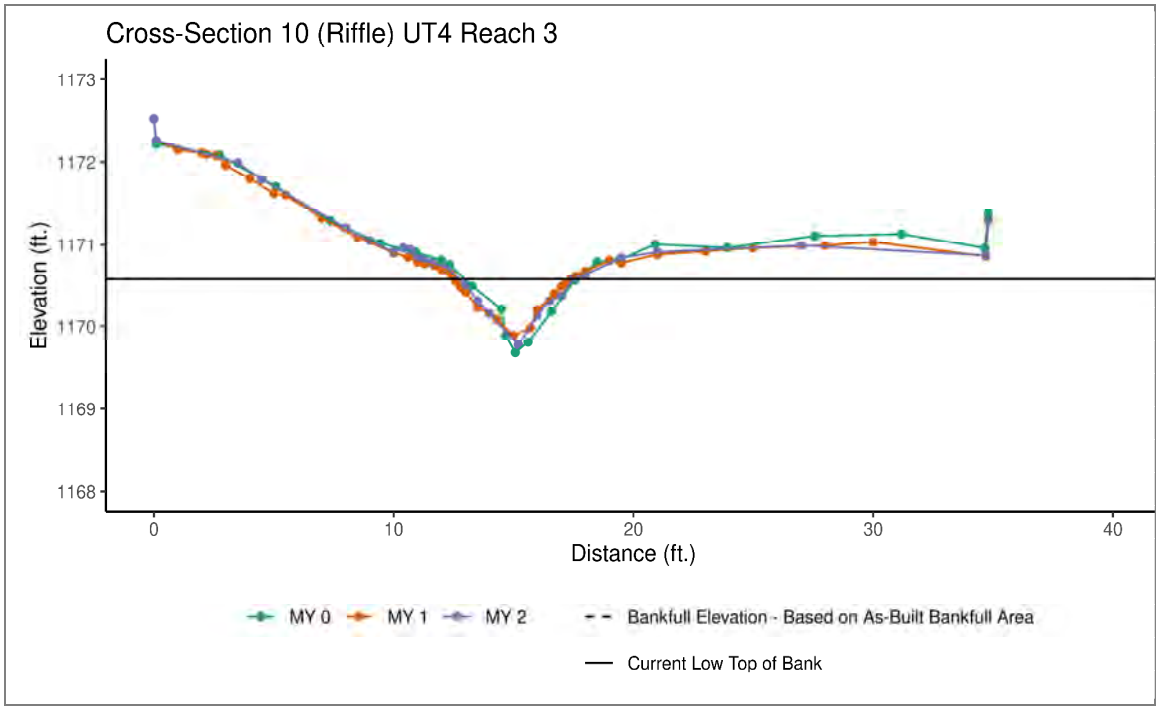
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,180.95	1,180.94	1,180.91			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.96			
Thalweg Elevation	1,180.36	1,180.17	1,180.12			
LTOB Elevation	1,180.95	1,180.98	1,180.88			
LTOB Max Depth	0.60	0.72	0.76			
LTOB Cross-Sectional Area	1.50	1.20	1.39			

Downstream *(05/03/2022)*



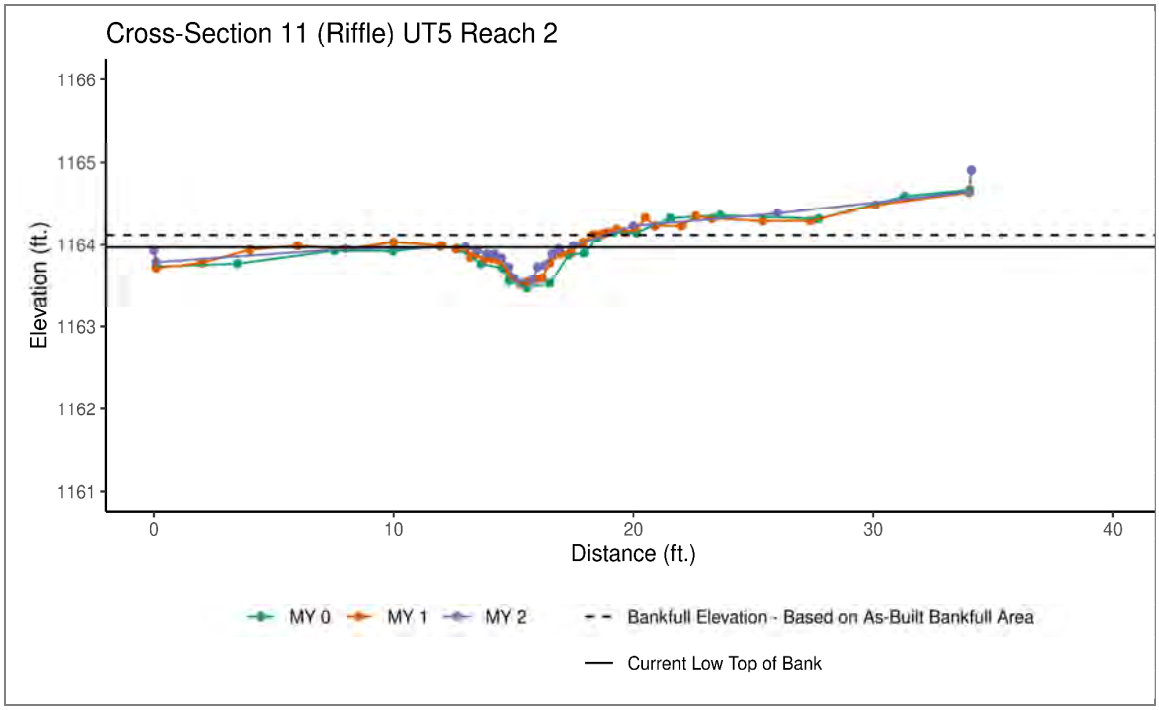
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,204.05	1,204.11	1,204.05			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.97			
Thalweg Elevation	1,203.22	1,203.30	1,203.22			
LTOB Elevation	1,204.05	1,204.06	1,204.03			
LTOB Max Depth	0.80	0.76	0.81			
LTOB Cross-Sectional Area	2.20	1.95	2.08			

Downstream *(05/03/2022)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,170.57	1,170.61	1,170.59			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01	1.00			
Thalweg Elevation	1,169.68	1,169.89	1,169.77			
LTOB Elevation	1,170.57	1,170.62	1,170.58			
LTOB Max Depth	0.90	0.73	0.81			
LTOB Cross-Sectional Area	1.90	1.96	1.87			

Downstream *(05/03/2022)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,163.95	1,164.03	1,164.12			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.84	0.74			
Thalweg Elevation	1,163.47	1,163.52	1,163.54			
LTOB Elevation	1,163.95	1,163.95	1,163.97			
LTOB Max Depth	0.50	0.43	0.43			
LTOB Cross-Sectional Area	1.30	0.92	0.73			

Downstream *(05/03/2022)*

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**Hanks Branch Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	13		1	15.5			16		1
Floodprone Width (ft)	---		1	34	78		38		1
Bankfull Mean Depth	1		1	1.1			1.9		1
Bankfull Max Depth	1.2		1	1.7			2.7		1
Bankfull Cross Sectional Area (ft^2)	13.4		1	17.7			30.7		1
Width/Depth Ratio	12.6		1	14.0			8.4		1
Entrenchment Ratio	1.2		1	2.2	5.0		2.3		1
Bank Height Ratio	4.8		1	14.0			1.0		1
Max part size (mm) mobilized at bankfull	95			79			93		
Rosgen Classification	C4			C4			C4		
Bankfull Discharge (cfs)	68.8			85.0			145.0		1
Sinuosity	1.06			---			---		
Water Surface Slope ($ft/ft)^2$	0.0210		1	0.017	0.020		0.012		1
Other	---			---			---		
Parameter	**UT1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	7		1	6.6			4.3		1
Floodprone Width (ft)	---		1	9	15		12		1
Bankfull Mean Depth	0.5		1	0.5			0.5		1
Bankfull Max Depth	1.2		1	0.6	0.7		0.9		1
Bankfull Cross Sectional Area (ft^2)	3.3		1	3.2			2.2		1
Width/Depth Ratio	13.5		1	14.0			8.4		1
Entrenchment Ratio	6.7		1	>1.4			2.9		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	54			99			117		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	13.2			13.0			10.0		1
Sinuosity	1.10			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.051		1	0.051	0.056		0.052		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT3 Reach 1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	7.3		1	5.9			4.9		1
Floodprone Width (ft)	10.4		1	8	13		8		1
Bankfull Mean Depth	0.4		1	0.5			0.4		1
Bankfull Max Depth	0.6		1	0.7			0.6		1
Bankfull Cross Sectional Area (ft^2)	3.1		1	2.7			1.9		1
Width/Depth Ratio	17.5		1	13.0			12.5		1
Entrenchment Ratio	1.4		1	>1.4			1.7		1
Bank Height Ratio	2.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	114			87			75		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	15.0			10.0			6.6		1
Sinuosity	1.02			1.10			1.10		
Water Surface Slope ($ft/ft)^2$	0.056		1	0.036	0.040		0.042		1
Other	---			---			---		
Parameter	**UT3 Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	6.0		1	6.8			4.7		1
Floodprone Width (ft)	8.7		1	10	15		15		1
Bankfull Mean Depth	0.8		1	0.5			0.3		1
Bankfull Max Depth	1.0		1	0.8			0.6		1
Bankfull Cross Sectional Area (ft^2)	4.8		1	3.5			1.5		1
Width/Depth Ratio	7.5		1	13.0			14.4		1
Entrenchment Ratio	1.4		1	>1.4			3.2		1
Bank Height Ratio	2.6		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	128			102			64		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	27.5			15.0			4.8		1
Sinuosity	1.03			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.039		1	0.042	0.053		0.044		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT4 Reach 1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	6.2		1	4.0			4.7		1
Floodprone Width (ft)	7.4		1	6	9		35		1
Bankfull Mean Depth	0.5		1	0.3			0.5		1
Bankfull Max Depth	0.7		1	0.5			0.8		1
Bankfull Cross Sectional Area (ft^2)	3.1		1	1.3			2.2		1
Width/Depth Ratio	12.5		1	13.0			10.2		1
Entrenchment Ratio	1.2		1	>1.4			7.4		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	122			74			159		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	15.5			4.0			11.3		1
Sinuosity	1.10			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.053		1	0.054	0.059		0.073		1
Other	---			---			---		
Parameter	**UT4 Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	7.3		1	4.9			4.5		1
Floodprone Width (ft)	9.0		1	7	11		35		1
Bankfull Mean Depth	0.3		1	0.4			0.4		1
Bankfull Max Depth	0.4		1	0.6			0.9		1
Bankfull Cross Sectional Area (ft^2)	1.8		1	1.9			1.9		1
Width/Depth Ratio	29.1		1	13.0			11.0		1
Entrenchment Ratio	1.2		1	>1.4			7.7		1
Bank Height Ratio	2.3		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	140			67			86		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	5.6			6.0			7.0		1
Sinuosity	1.00			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.044		1	0.045	0.049		0.046		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT5 Reach 2**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	5.4		1	5.0			5.4		1
Floodprone Width (ft)	11.0		1	11	25		35		1
Bankfull Mean Depth	0.4		1	0.4			0.2		1
Bankfull Max Depth	0.6		1	0.6			0.5		1
Bankfull Cross Sectional Area (ft^2)	2.2		1	1.9			1.3		1
Width/Depth Ratio	13.0		1	13.0			21.6		1
Entrenchment Ratio	2.1		1	2.2	5.0		6.5		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	79			49			39		
Rosgen Classification	C4b			C4b			C4b		
Bankfull Discharge (cfs)	9.0			6.0			4.9		1
Sinuosity	1.10			1.20			1.20		
Water Surface Slope ($ft/ft)^2$	0.051		1	0.028	0.033		0.035		1
Other	---								

Table 9. Cross-Section Morphology Monitoring Summary
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

	Hanks Branch Reach 3												UT1					
	Cross-Section 1 (Pool)						Cross-Section 2 (Riffle)						Cross-Section 3 (Pool)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A				1,153.89	1,153.82	1,153.78				N/A	N/A	N/A			
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A				1.00	1.00	1.01				N/A	N/A	N/A			
Thalweg Elevation	1,153.44	1,153.50	1,153.52				1,151.24	1,150.96	1,151.00				1,227.74	1,227.74	1,227.76			
LTOB[2] Elevation	1,157.57	1,157.39	1,157.29				1,153.89	1,153.82	1,153.81				1,228.70	1,228.86	1,228.90			
LTOB[2] Max Depth (ft)	4.13	3.89	3.77				2.65	2.86	2.81				1.00	1.12	1.14			
LTOB[2] Cross Sectional Area (ft^2)	44.10	41.91	39.27				30.70	30.69	31.26				3.20	4.30	4.53			
	UT1						UT3 Reach 1											
	Cross-Section 4 (Riffle)						Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,224.06	1,224.15	1,224.15				N/A	N/A	N/A				1,222.82	1,222.79	1,222.78			
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.09	1.03				N/A	N/A	N/A				1.00	0.90	0.90			
Thalweg Elevation	1,223.19	1,223.27	1,223.27				1,228.40	1,228.75	1,228.56				1,222.18	1,222.17	1,222.15			
LTOB[2] Elevation	1,224.06	1,224.23	1,224.18				1,230.54	1,230.60	1,230.60				1,222.82	1,222.73	1,222.72			
LTOB[2] Max Depth (ft)	0.90	0.96	0.91				2.10	1.85	2.04				0.60	0.56	0.57			
LTOB[2] Cross Sectional Area (ft^2)	2.20	2.56	2.33				10.20	8.30	10.18				1.90	1.61	1.57			
	UT3 Reach 3												UT4 Reach 1					
	Cross-Section 7 (Pool)						Cross-Section 8 (Riffle)						Cross-Section 9 (Riffle)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A				1,180.95	1,180.94	1,180.91				1,204.05	1,204.11	1,204.05			
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A				1.00	0.94	0.96				1.00	0.94	0.97			
Thalweg Elevation	1,183.59	1,183.79	1,183.77				1,180.36	1,180.17	1,180.12				1,203.22	1,203.30	1,203.22			
LTOB[2] Elevation	1,185.20	1,185.21	1,185.15				1,180.95	1,180.98	1,180.88				1,204.05	1,204.06	1,204.03			
LTOB[2] Max Depth (ft)	1.60	1.43	1.38				0.60	0.72	0.76				0.80	0.76	0.81			
LTOB[2] Cross Sectional Area (ft^2)	4.90	4.45	3.82				1.50	1.20	1.39				2.20	1.95	2.08			
	UT4 Reach 3						UT5 Reach 2											
	Cross-Section 10 (Riffle)						Cross-Section 11 (Riffle)											
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**						
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,170.57	1,170.61	1,170.59				1,163.95	1,164.03	1,164.12									
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.01	1.00				1.00	0.84	0.74									
Thalweg Elevation	1,169.68	1,169.89	1,169.77				1,163.47	1,163.52	1,163.54									
LTOB[2] Elevation	1,170.57	1,170.62	1,170.58				1,163.95	1,163.95	1,163.97									
LTOB[2] Max Depth (ft)	0.90	0.73	0.81				0.50	0.43	0.43									
LTOB[2] Cross Sectional Area (ft^2)	1.90	1.96	1.87				1.30	0.92	0.73									

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[2]LTOB Area and Max depth - These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

APPENDIX D. Hydrology Data

Table 10. Bankfull Events
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Reach	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Hanks Branch Reach 3	2/17/2021 2/20/2021 8/18/2021	---					
UT1	*	8/6/2022					
UT3 Reach 3	1/26/2021 8/15/2021 8/18/2021	1/3/2022 2/28/2022 8/6/2022 8/15/2022 8/25/2022 8/28/2022					
UT4 Reach 3	8/15/2021	---					
UT5 Reach 2	2/16/2021 2/21/2021 3/3/2021 3/20/2021 6/12/2021 7/26/2021 8/15/2021 8/17/2021 8/25/2021 9/1/2021 10/6/2021	1/3/2022 2/4/2022 2/18/2022 5/26/2022 7/5/2022 7/8/2022 7/13/2022 7/18/2022 8/6/2022 8/15/2022					

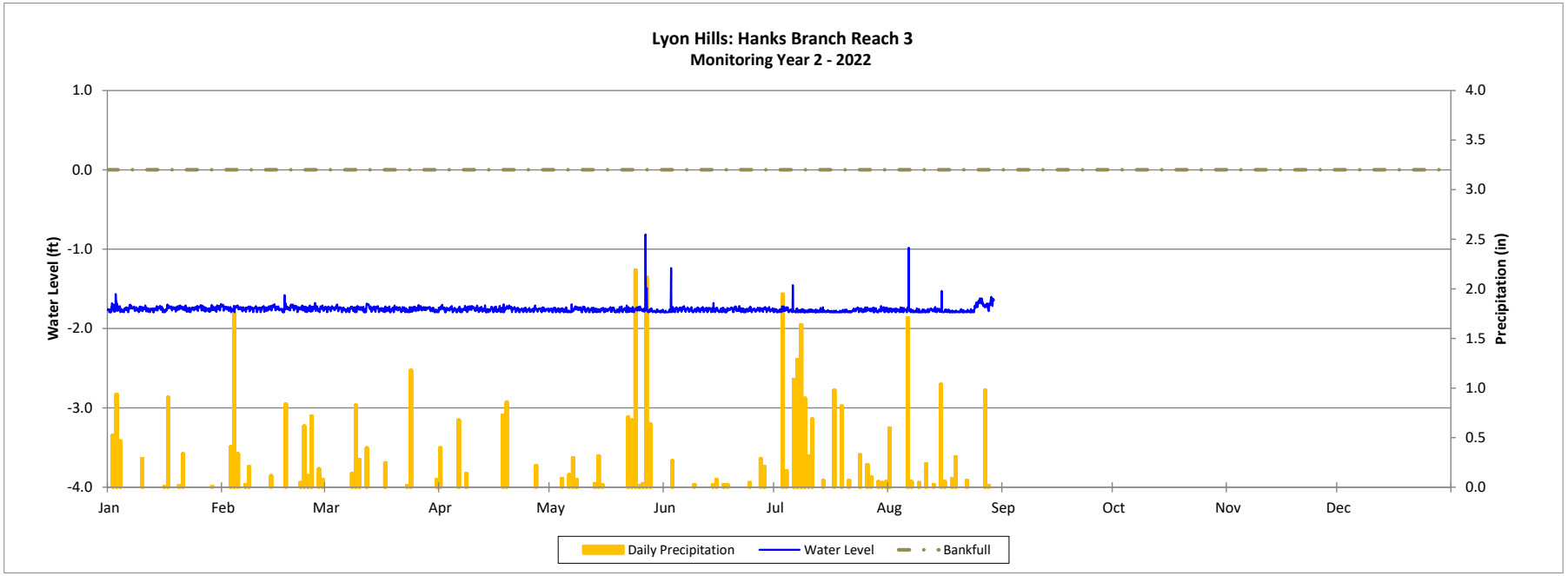
*Gauge malfunction
--- - No Bankfull events

Table 11. Rainfall Summary
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

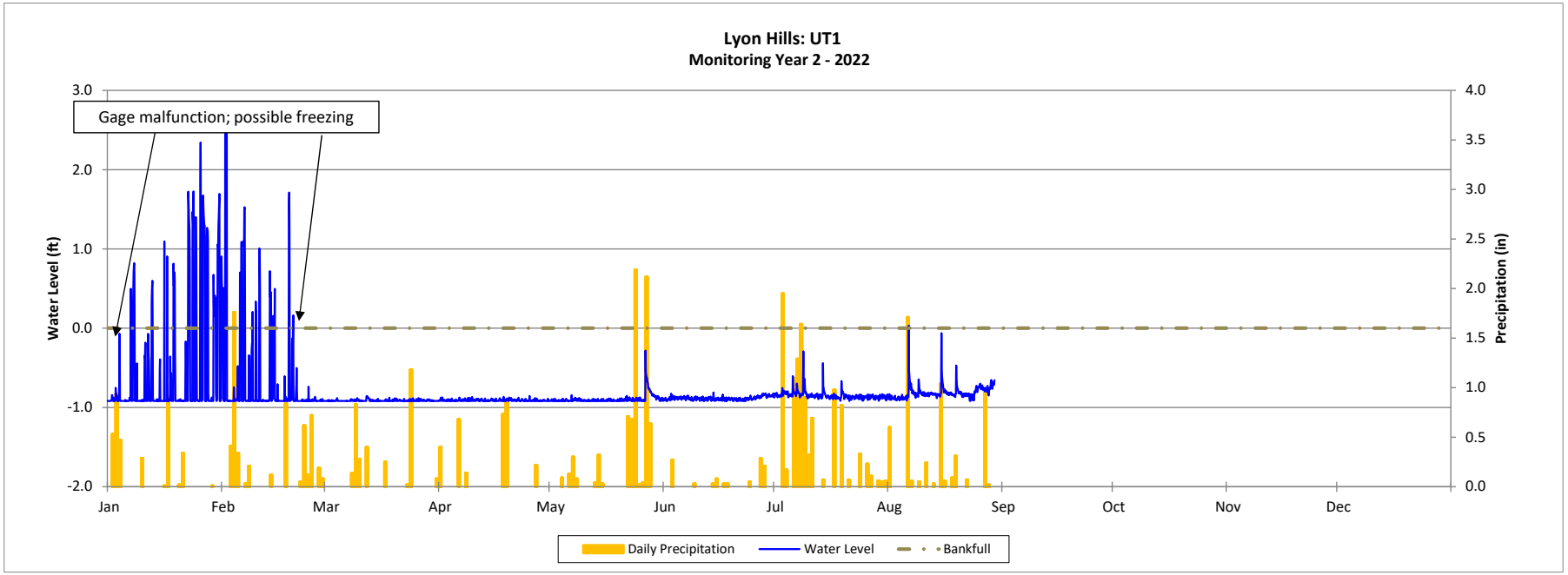
	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Annual Precip Total	41.71	48.23*					
WETS 30th Percentile	43.05	42.70					
WETS 70th Percentile	53.13	52.76					
Normal	L	*					

*Annual precipitation total was collected up until 11/1/2022. Data will be updated in MY3.

Recorded Bankfull Events Plot
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

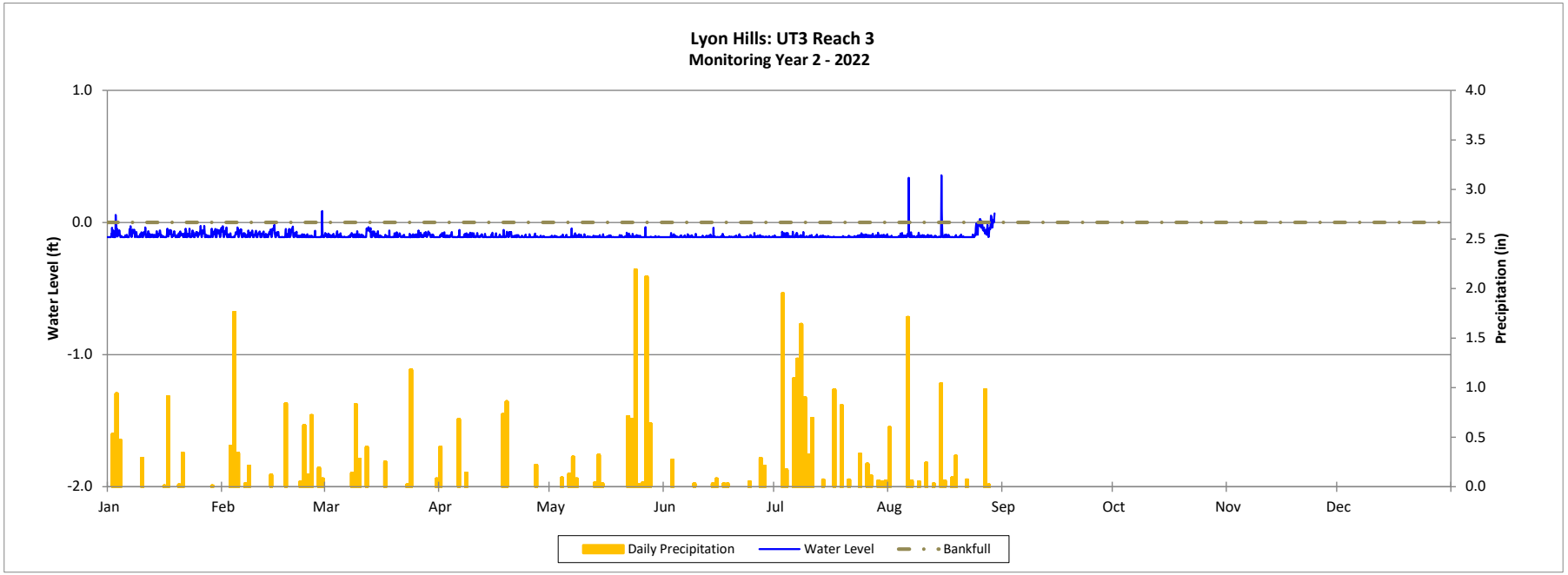


Recorded Bankfull Events Plot
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022



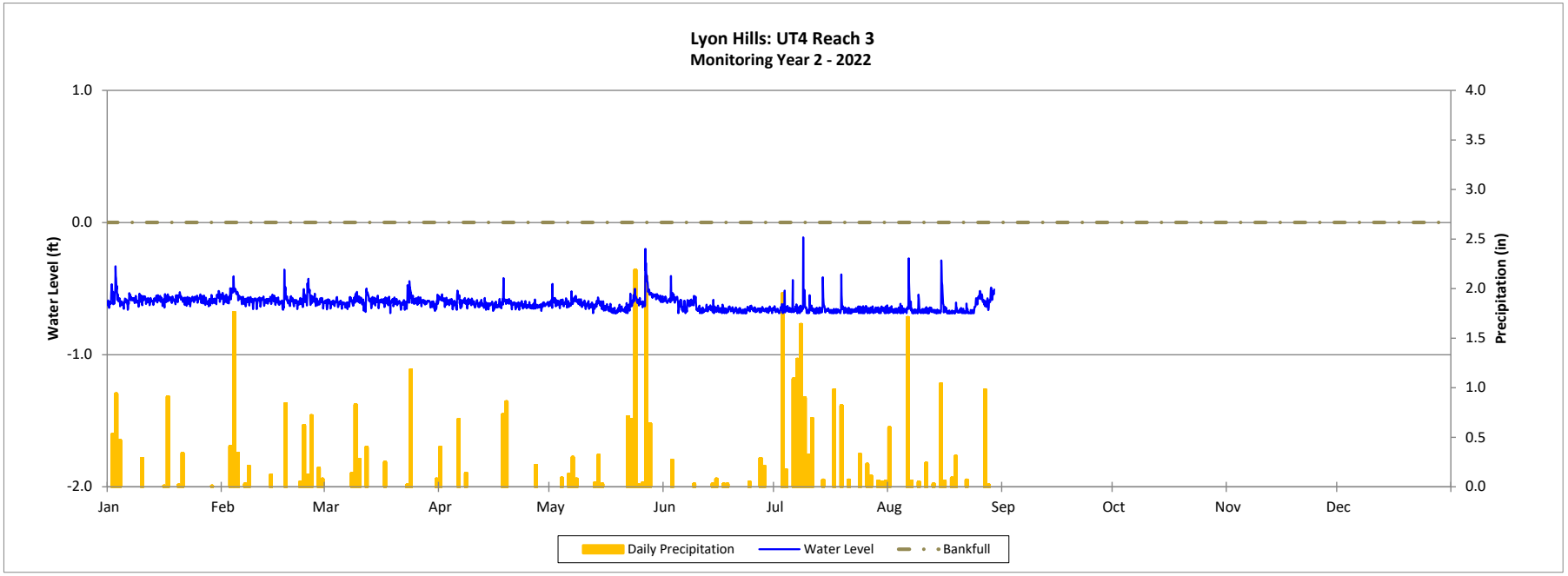
Recorded Bankfull Events Plot

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022



Recorded Bankfull Events Plot

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022



Recorded Bankfull Events Plot
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

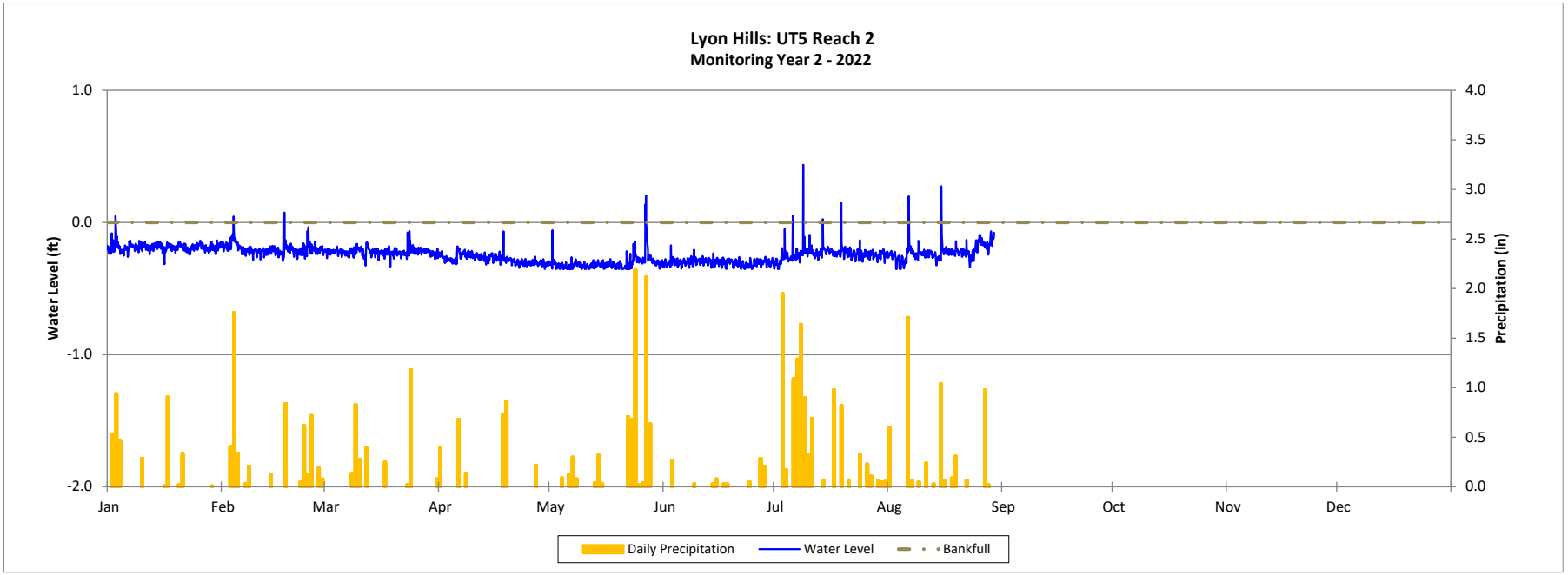


Table 12. Recorded In-Stream Flow Events Summary
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Reach	Max Consecutive Days/Total Days Meeting Success Criteria*						
	MY1 (2021)	MY2 (2022)**	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
UT4 Reach 1	365 Days/ 365 Days	130 Days/ 241 Days					

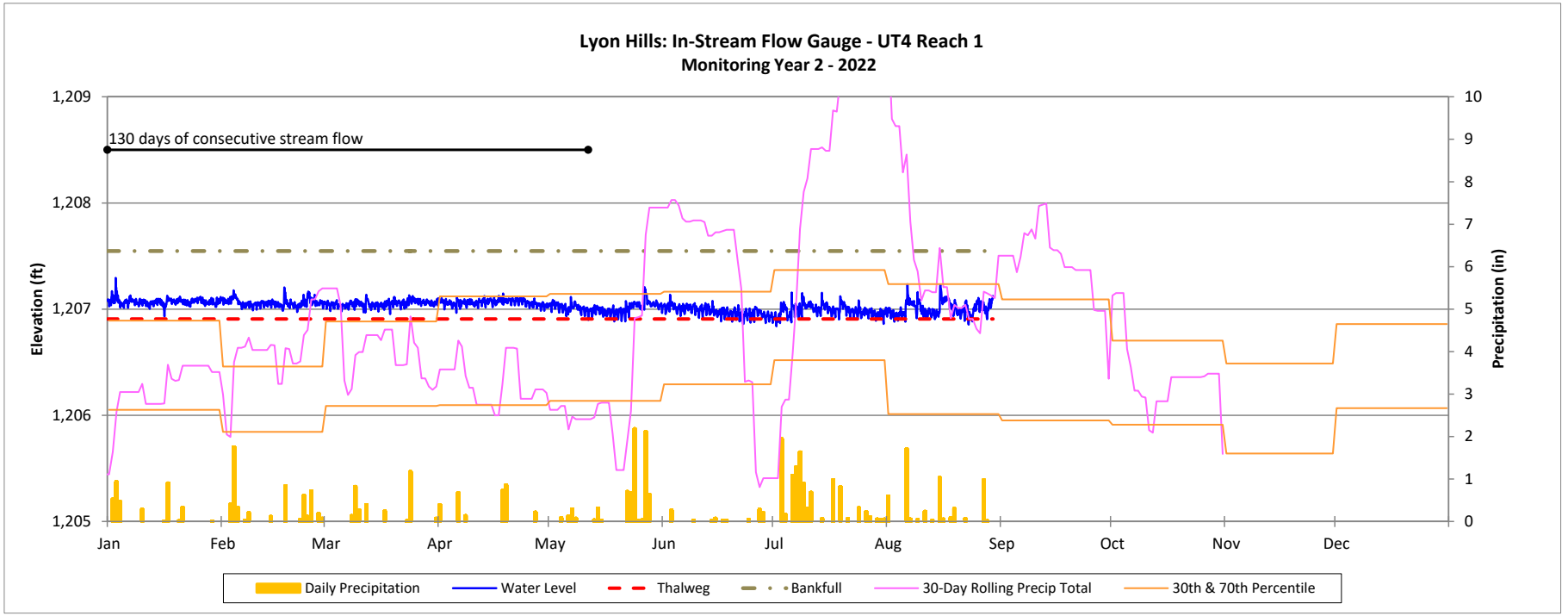
*Success criteria is 30 consecutive days of flow.
**Data colleted through August 29, 2022.

Recorded In-Stream Flow Events Plot

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 2 - 2022



APPENDIX E. Project Timeline and Contact Info

Table 13. Project Activity and Reporting History

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		NA	June 2018
Mitigation Plan Approved		July 2020	July 2020
Construction (Grading) Completed		NA	January 2021
Planting Completed		NA	March 2021
As-Built Survey Completed		Febuary 2021	Febuary 2021
Baseline Monitoring Document (Year 0)	Stream Survey	February 2021	June 2021
	Vegetation Survey	March 2021	
Year 1 Monitoring	Stream Survey	September 2021	December 2021
	Vegetation Survey	September 2021	
Year 2 Monitoring	Stream Survey	May 2022	November 2022
	J-Hook and Perched Culvert Repair	August 2022	
	In-stream Vegetation Treatment		
	Vegetation Survey		
Year 3 Monitoring	Stream Survey	2023	December 2023
	Vegetation Survey	2023	
Year 4 Monitoring			December 2024
Year 5 Monitoring	Stream Survey	2025	December 2025
	Vegetation Survey	2025	
Year 6 Monitoring			December 2026
Year 7 Monitoring	Stream Survey	2027	December 2027
	Vegetation Survey	2027	

Table 14. Project Contact Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 2 - 2022

Designer Nicole Macaluso Millns, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Wildlands Construction** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

APPENDIX F. Additional Documentation

REPAIR PHOTOGRAPHS

	
Hanks Branch R2 – J-Hook Before *(3/25/2022)*	**Hanks Branch R2 – Repaired J-Hook *(8/17/2022)***
	
Hanks Branch R3 – Perched Culvert Outlet *(9/27/2021)*	**Hanks Branch R3 – Repaired Culvert Outlet *(10/17/2022)***