MONITORING YEAR 4 ANNUAL REPORT

Final

Mangum Homestead Mitigation Site
Orange County, NC
NCDEQ Contract No. 7859
DMS ID No. 100107
DWR No. 2019-0645

Jordan Lake-Upper New Hope
Cape Fear River Basin
HUC 03030002

RFP #: 16-007702

Data Collection Period: September 2023
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PREPARED FOR:

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Division of Mitigation Services
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TABLE OF CONTENTS

APPENDICES

Section 1: Project Overview

1.1 Project Description

The Mangum Homestead Mitigation Site (Site) is in Orange County approximately three miles northwest of the Town of Carrboro (Figure 1). The Site involved riparian area restoration, enhancement, and preservation activities on four unnamed tributaries and three ephemeral channels that flow to New Hope Creek upstream of Jordan Lake. The Site was completed for buffer mitigation credit and nutrient offset credit in the Cape Fear River Basin HUC 03030002, Upper New Hope Watershed of Jordan Lake in accordance with the Consolidated Buffer Mitigation Rules (15A NCAC 02B .0295), the Jordan Water Supply Nutrient Strategy (15A NCAC 02B .0262) and the Nutrient Offset Payments Rule (15A NCAC 02B .0703). See Figure 2 for the Service Area of the Site. The Site is expected to generate 36,933.600 riparian buffer credits, 19,985.729 Nitrogen offset credits, and 1,259.783 Phosphorous Offset credits.

The project is located within the Cape Fear River Basin Hydrologic Unit Code (HUC) 03030002060110, Upper New Hope – Jordan Lake Sub-watershed, and NCDWR Subbasin 03-06-05. Project features flow approximately one mile to the confluence with New Hope Creek, which is classified as Nutrient Sensitive Waters (NSW) by the North Carolina Division of Water Resources (NCDWR). The project supports specific goals identified in the 2009 Cape Fear River Basin Restoration Priorities Plan (RBRP) by addressing nutrient reductions through buffer restoration and improving habitat for the native mussel species present in the HUC.

This nutrient offset and buffer mitigation project is reducing sediment and nutrient loading and improving terrestrial habitat. The area surrounding the streams prior to restoration was primarily open agricultural fields used for hay production. The restored vegetative riparian areas up to 200 feet from the streams are removing sediment and fertilizer inputs within the project area. The full establishment of riparian areas will create shading to minimize thermal pollution. Finally, invasive vegetation will be treated within the project area as needed and the planted native vegetation provides cover and food for wildlife.

Tables 2 and 4 in Appendix 1 provide more detailed watershed and Site background information for this project. Project history, location, and design are presented in the Mangum Homestead Baseline Monitoring Report (Wildlands, 2020).

1.2 Project Goals and Objectives

The major goals of the nutrient offset and buffer restoration project are to provide ecological and water quality enhancements to Jordan Lake in the Cape Fear River Basin by creating a functional riparian corridor and restoring the riparian area.

Goals	Objectives
Decrease nutrient levels	Nutrient input will be decreased by filtering runoff from the agricultural fields through restored native buffer zones. The off-site nutrient input will also be absorbed on-site by dispersing flood flows through native vegetation.
Decrease sediment input	Sediment from off-site sources will be deposited on restored floodplain areas where native vegetation will slow overland flow velocities.
Reduce thermal pollution	Water temperature will decrease, and dissolved oxygen concentrations will increase with the establishment and maintenance of riparian areas creating additional long-term shading of the channel flow.
Reduce peak flows	Establishment of a riparian area that will slow flood flows and allows for greater infiltration, reducing peak flows downstream.
Create appropriate terrestrial habitat	Buffer areas will be restored by removing invasive vegetation and planting native vegetation.
Permanently protect the Site from harmful uses	Establish a conservation easement on the Site.

Mitigation credits are presented in Table 1 and Figure 3 in Appendix 1 and are based upon the as-built survey included in the Mangum Homestead Baseline Monitoring Report (Wildlands, 2020).

Section 2: Performance Criteria and Monitoring Protocols

The performance criteria for the Site follows approved performance criteria presented in the Mangum Homestead Mitigation Site Mitigation Plan (Wildlands Engineering, Inc., 2020), the NC DMS Riparian Buffer and Nutrient Offset Buffer Baseline & Annual Monitoring Report Template, Version 2.0 (May 2017) and the Consolidated Buffer Rule (15A NCAC 02B .0295).

The nutrient offset and buffer restoration project has been assigned specific performance criteria components for vegetation. The monitoring period will extend for five years beyond the completion of construction or until performance criteria have been met.

The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor at the end of monitoring year 5. The final performance standard shall include a minimum of four native hardwood tree species or four native shrub species, where no one species is greater than 50 percent of stems. Native hardwood and native shrub volunteer species may be included to meet the final performance standard of 260 stems per acre. Performance criteria will be evaluated throughout the five-year post-construction monitoring or until performance criteria have been met. Methodology for annual monitoring is presented in the Mangum Homestead Baseline Monitoring Report (Wildlands, 2020).

Section 3: Results of Year 4 Monitoring

The result of vegetative sampling shows an average planted stem density of 405 stems per acre, with individual plot densities ranging from 283 to 567 stems per acre. When including volunteers, the average stem density is 753 stems per acre, with individual plots ranging from 283 to 2,104 total stems per acre. Additionally, most recorded stems appear healthy, scoring either 3 (good) or 4 (excellent) on

vigor. All vegetation plots exceed the final stem density success criteria of 260 stems per acre for MY5. See Table 9 in Appendix 3 for additional information.

Vegetation plots 1 and 2 have 30 or more sweetgum (*Liquidambar styraciflua*) stems. Most of these stems are under 100 centimeters in height and do not appear to be negatively affecting planted stems; however, the plot will be monitored in future years to ensure that volunteer stems do not begin to out-compete planted stems.

Refer to Appendix 2 for visual assessment data and Appendix 3 for vegetation plot data and vegetation plot photographs.

3.1 Parcel Maintenance

To ensure better tree survival and growth across the Site, Wildlands implemented several management actions throughout the year. Ring sprays were conducted across the Site on April 10th to reduce herbaceous competition. Soil amendments were applied in a localized manner around the base of each tree on May 17th and August 8th to support a higher nutrient content that aids in tree growth and survival. The contents used for the soil amendments were a blend of macronutrients, micronutrients, and ingredients that promote microbial and mycorrhizal community development. A Site wide invasive removal was conducted in June 2023 to target scattered populations of Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), and callery pear (*Pyrus calleryana*). Soil amendments and removal of invasive species will continue to be implemented as necessary across the Site in MY5.

Additional adaptive measures will be developed, or appropriate remedial actions will be implemented if the Site or a specific component of the Site fails to achieve the success criteria outlined in the Mitigation Plan. Site maintenance will be performed to correct any identified problems on the Site that have a high likelihood of affecting project success. Such items include but are not limited to excess tree mortality caused by fire, flooding, drought, or insects. Any actions implemented will be designed to achieve the success criteria and will include a work schedule and updated monitoring criteria.

3.2 Conclusions

The 2023 vegetation monitoring data reflects that the Site is on track to exceed the final criterium of 260 stems per acre. There is an average planted stem density of 405 stems per acre, with individual plots ranging from 283 to 567 stems per acre. When including volunteer stems, the average stem density is 753 stems per acre. Stems appear to be healthy, and herbaceous vegetation is well established across the Site. Adaptive management actions were implemented during MY4 to ensure better tree survival and growth. Actions included ring sprays, applying localized soil amendments, and a site wide invasive removal.

Section 4: References

Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf

North Carolina Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009.

North Carolina Division of Mitigation Services (DMS). 2017. Riparian Buffer and Nutrient Offset Buffer Baseline & Annual monitoring Report Template (Version 2.0, 05-2017). Raleigh, North Carolina.

North Carolina Interagency Review Team. 2016. Wilmington District Stream and Wetland Compensatory Mitigation Update. October 24, 2016.

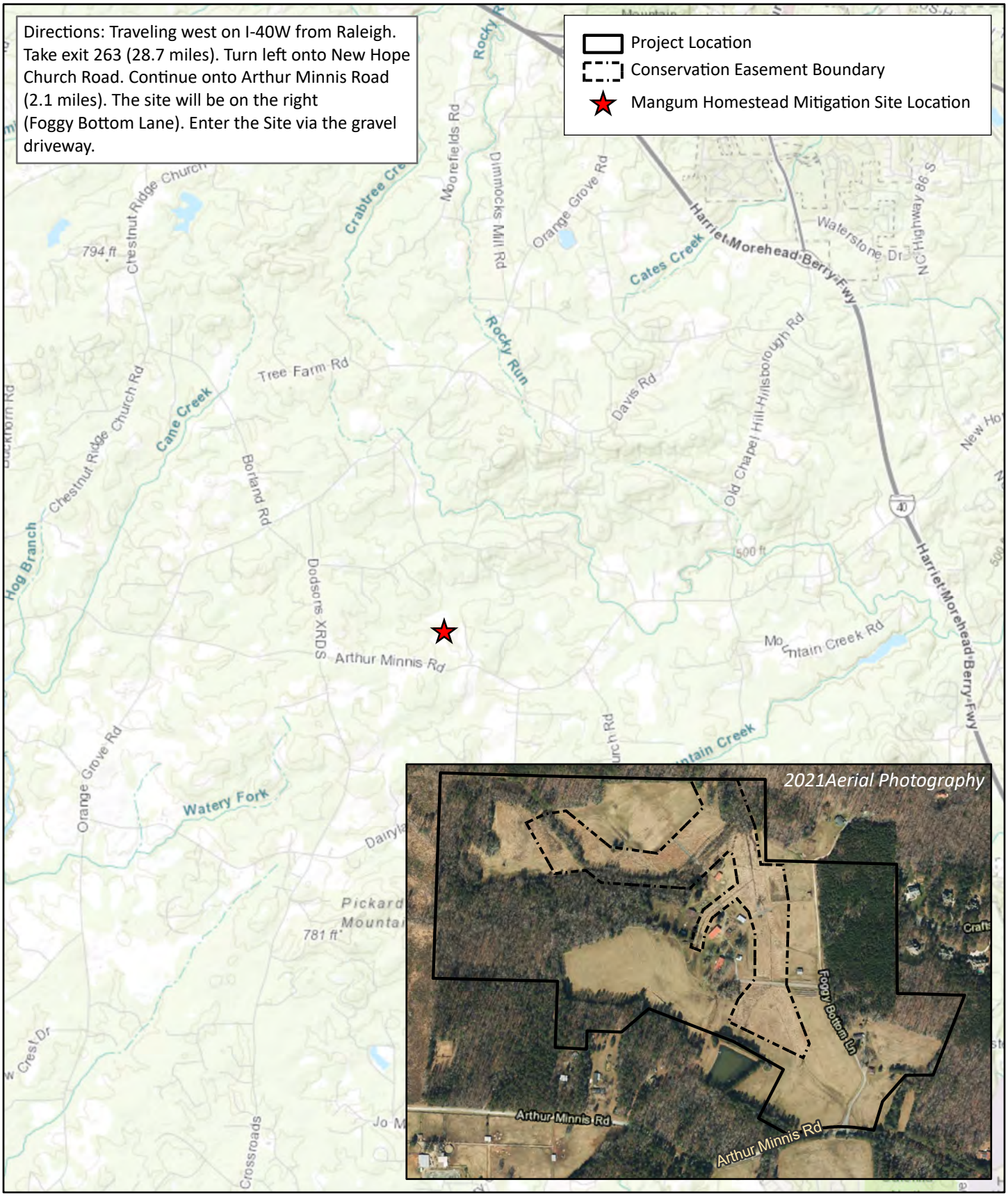
Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd approx. North Carolina Natural Heritage Program, Raleigh, North Carolina.

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

Wildlands Engineering, Inc. 2020. Mangum Homestead Mitigation Plan. DMS, Raleigh, NC. January, 2020.

Wildlands Engineering, Inc. 2020. Mangum Homestead Baseline Monitoring Report. DMS, Raleigh, NC. June, 2020.

APPENDIX 1. General Tables and Figures



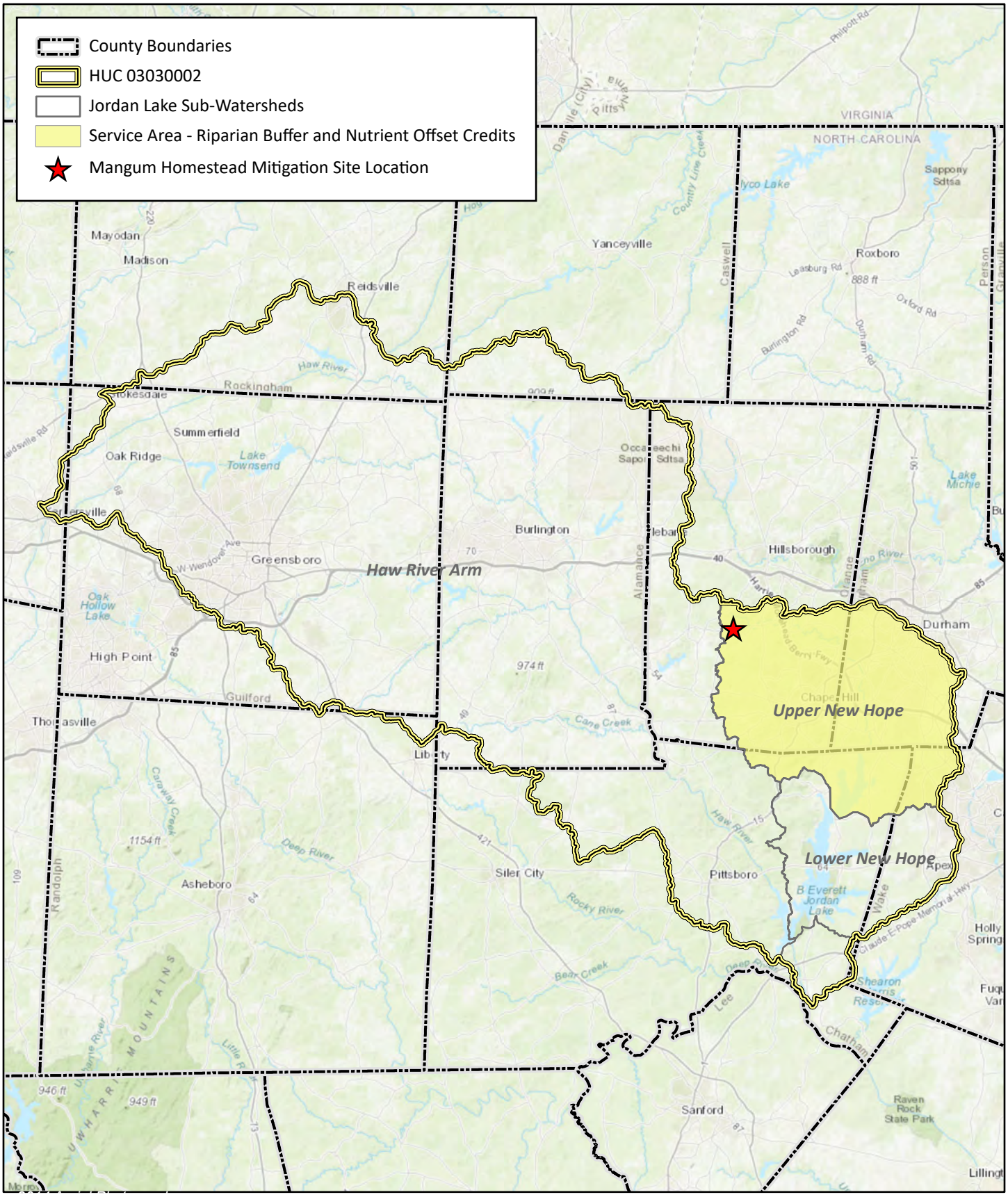
WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Vicinity Map
Mangum Homestead Mitigation Site
Monitoring Year 4 Report
Cape Fear River Basin (03030002)

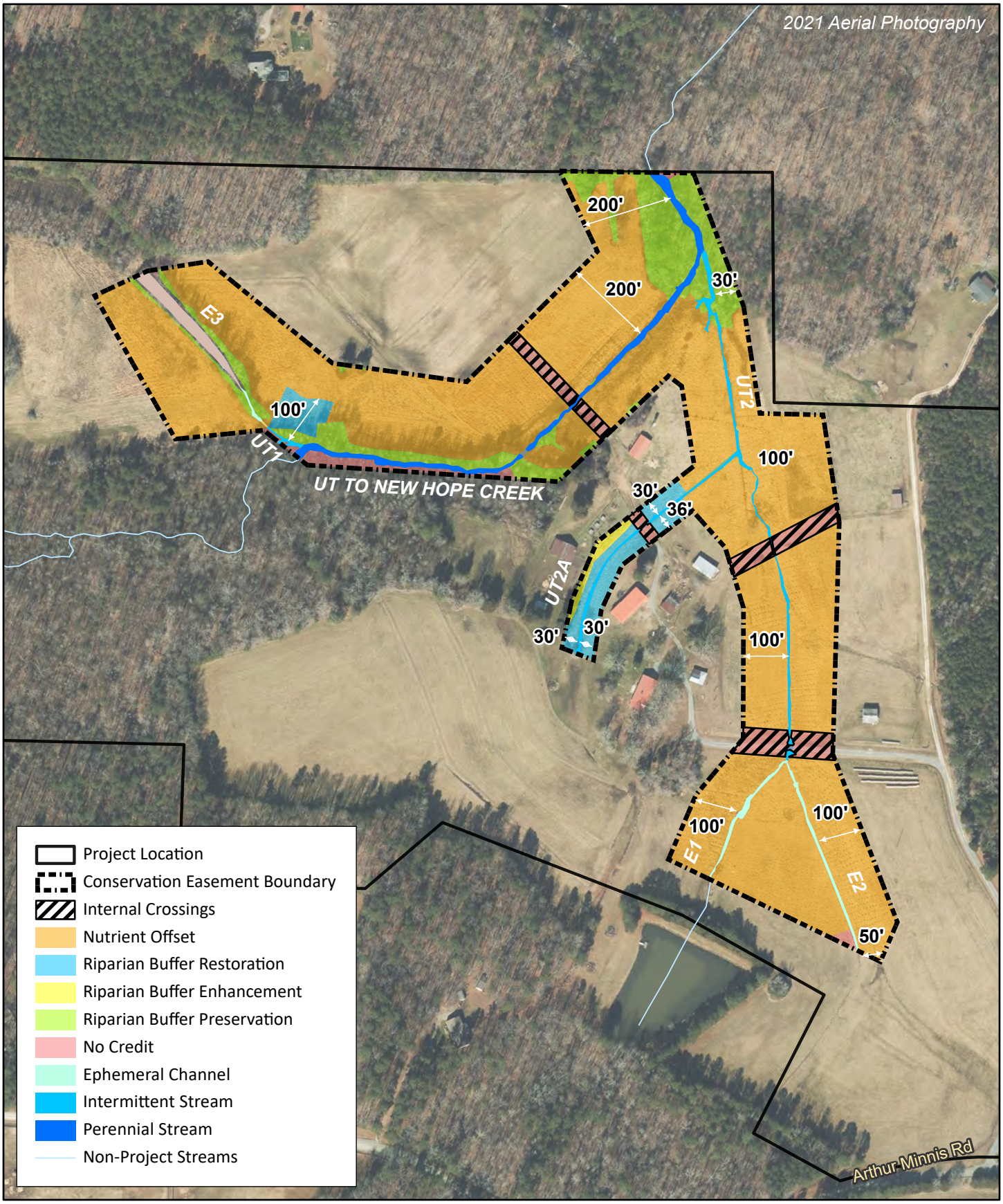
Orange County, NC



WILDLANDS ENGINEERING

Figure 2 Service Area Map
Mangum Homestead Mitigation Site
Monitoring Year 4 Report
Cape Fear River Basin (03030002)

Orange County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3 Project Component/Asset Map
Mangum Homestead Mitigation Site
Monitoring Year 4 Report
Cape Fear River Basin (03030002)

Orange County, NC

Table 1. Buffer Project Areas and Assets

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Cape Fear - Jordan Upper New Hope 03030002060110	**Project Area**
32.91899	**N Credit Conversion Ratio (ft^2/pound)**
522.2408	**P Credit Conversion Ratio (ft^2/pound)**

Credit Type	Location	Subject? (enter NO if ephemeral or ditch [1])	Feature Type	Mitigation Activity	Min-Max Buffer Width (ft)	Feature Name	Total Area (ft^2)	Total (Creditable) Area of Buffer Mitigation (ft^2)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Convertible to Riparian Buffer?	Riparian Buffer Credits	Convertible to Nutrient Offset?	Delivered Nutrient Offset: N (lbs)	Delivered Nutrient Offset: P (lbs)
Buffer	Rural	Yes	I / P	Restoration	0-50	UT2A	23,810	23,810	1	100%	1.00000	Yes	23,810.000	No	—	—
Buffer	Rural	Yes	I / P	Restoration	0-100	UT1	9,445	9,445	1	100%	1.00000	Yes	9,445.000	Yes	286.916	18.086
Buffer	Rural	Yes	I / P	Enhancement	0-100	UT2A	4,819	4,819	2	100%	2.00000	Yes	2,409.500	No	—	—
Nutrient Offset	Rural	No	Ephemeral	Restoration	0-100	UT to New Hope Creek, UT2, E1, E2, E3	503,726	503,726	1	100%	1.00000	Yes	503,726.000	Yes	15,301.988	964.547
Nutrient Offset	Rural	No	Ephemeral	Restoration	101-200	UT to New Hope Creek, UT2, E1, E2, E3	154,184	154,184	1	33%	3.03030	Yes	50,880.771	Yes	4,683.740	295.235
						Totals:	695,984	695,984								

Enter Preservation Credits Below

Eligible for Preservation (ft^2): 12,691

Credit Type	Location	Subject?	Feature Type	Mitigation Activity	Min-Max Buffer Width (ft)	Feature Name	Total Area (sf)	Total (Creditable) Area for Buffer Mitigation (ft^2)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits
Buffer	Rural	Yes	I / P	Preservation	0-100	UT to New Hope Creek, UT2	74,537	12,691	10	100%	10.00000	1,269.100
	Rural	Yes	I / P		101-200	UT to New Hope Creek	4,922		10	33%		—
												—
												—
												—
												—
						Preservation Area Subtotal (ft^2):		12,691				
						Preservation as % Total Area of Buffer Mitigation:		25.0%				
						Ephemeral Reaches as % Total Area of Buffer Mitigation:		0.0%				

TOTAL AREA OF BUFFER MITIGATION (TABM)			
Mitigation Totals		**Square Feet**	**Credits**
Restoration:		33,255	33,255.000
Enhancement:		4,819	2,409.500
Preservation:		12,691	1,269.100
Total Riparian Buffer:		50,765	36,933.600
TOTAL NUTRIENT OFFSET MITIGATION			
Mitigation Totals		**Square Feet**	**Credits**
Nutrient Offset:	**Nitrogen:**	657,910	19,985.729
	Phosphorus:		1,259.783

Table 2. Project Activity and Reporting History
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan Date	-	January 2020
Bare Roots Planting	-	April 2020
As-Built & Baseline Monitoring Document	April 2020	June 2020
Competitive Vegetation Treatment[1]	-	May 2020
Year 1 Monitoring Report Date	October 2020	December 2020
Year 2 Monitoring Report Date	October 2021	December 2021
Supplemental Planting	-	February 2022
Competitive Vegetation Treatment[1]	-	February 2022
Year 3 Monitoring Report Date	September 2022	December 2022
Competitive Vegetation Treatment[1]	-	April 2023
Soil Amendments	-	May & August 2023
Invasive Removal	-	June 2023
Year 4 Monitoring Report Date	September 2023	December 2023
Year 5 Monitoring Report Date	2024	December 2024

[1]Ring sprays conducted around planted stems

Table 3. Project Contact Table
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Designers	**Wildlands Engineering, LLC** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Planting Contractor	**Bruton Natural Systems, Inc**
Nursery Stock Suppliers	**Dykes and Son Nursery**
Monitoring Performers	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986, ext. 107

Table 4. Project Information and Attributes
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

PROJECT INFORMATION	
Project Name	Mangum Homestead Mitigation Site
USGS Hydrologic Unit 14-digit	03030002060110
River Basin	Cape Fear - Jordan Upper New Hope
Project Coordinates	35° 59’ 49.23’’ N, 79° 8’ 44.77’’ W
Total Credits (BMU)	36,933.600
Total Credits (Nitrogen Offset)	19,985.729
Total Credits (Phosphorous Offset)	1,259.783
Types of Credits	Riparian Buffer & Nutrient Offset

Table 5. Monitoring Components Summary

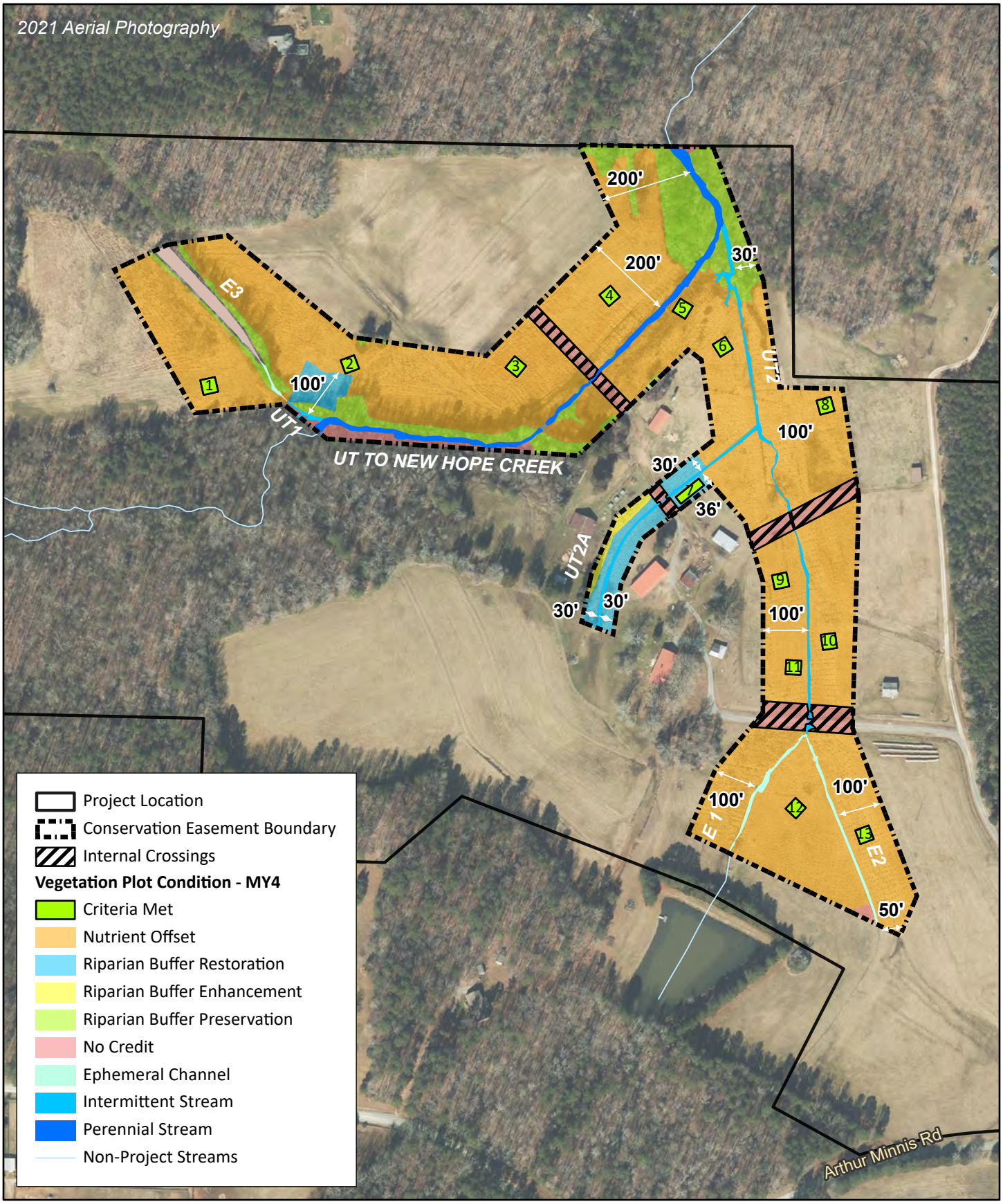
Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 4 - 2023

Parameter	Monitoring Feature	Quantity/Length By Reach							Frequency
		UT to New Hope Creek	UT1	UT2	UT3	E1	E2	E3	
Vegetation	**CVS Level 1**	13							Annual
Visual Assessment	Y	Y	Y	Y	Y	Y	Y	Y	Semi- Annual
Exotic and Nuisance Vegetation	Y	Y	Y	Y	Y	Y	Y	Y	Semi- Annual
Project Boundary	Y	Y	Y	Y	Y	Y	Y	Y	Semi- Annual
Reference Photographs	Overview Photographs								Annual

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 4 Integrated Current Condition Plan View
Mangum Homestead Mitigation Site
Monitoring Year 4 Report
Cape Fear River Basin (03030002)
Orange County, NC

Table 6. Vegetation Condition Assessment Table

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Planted Acreage **17.14**

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	0	0	0%
		Total	**0**	**0**	**0%**
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 Ac	0	0	0%
		Cumulative Total	**0**	**0.0**	**0%**

Easement Acreage **19.89**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	0	0	0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0.0%

OVERVIEW PHOTOGRAPHS

10/04/2023

10/04/2023

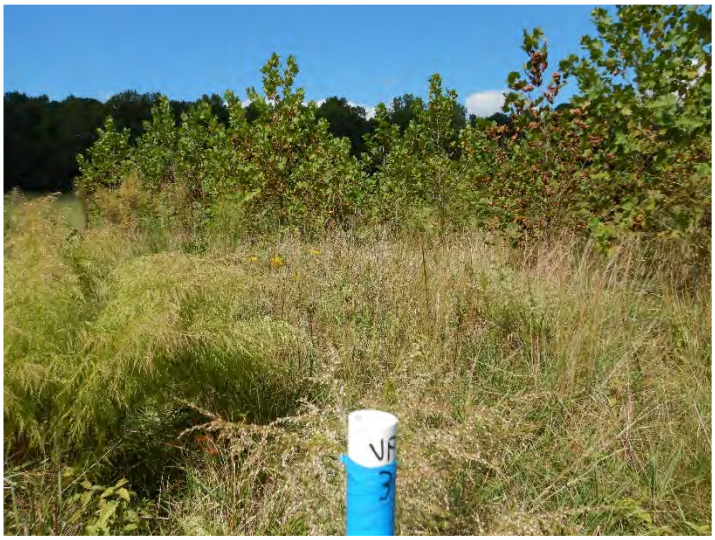
10/04/2023

10/04/2023

VEGETATION PLOT PHOTOGRAPHS

VEG PLOT 1 *(10/4/2023)*

VEG PLOT 2 *(10/4/2023)*



VEG PLOT 3 *(10/4/2023)*

VEG PLOT 4 *(10/4/2023)*

VEG PLOT 5 *(10/4/2023)*

VEG PLOT 6 *(10/4/2023)*

VEG PLOT 7 *(10/4/2023)*

VEG PLOT 8 *(10/4/2023)*

VEG PLOT 9 *(10/4/2023)*

VEG PLOT 10 *(10/4/2023)*

VEG PLOT 11 *(10/4/2023)*

VEG PLOT 12 *(10/4/2023)*

VEG PLOT 13 *(10/4/2023)*

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Success Criteria	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	Yes	
8	Yes	
9	Yes	
10	Yes	
11	Yes	
12	Yes	
13	Yes	

Table 8. CVS Vegetation Tables - Metadata
Mangum Homestead Mitigation Site
DMS Project No.100107
Monitoring Year 4 - 2023

Report Prepared By	Savannah Seeber
Date Prepared	10/5/2023 13:03
Database Name	Mangum- CVS v2.5.0- MY4.mdb
Database Location	F:\Monitoring\Mangum\MY4
Computer Name	CINDY-PC
File Size	77819904
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	100107
project Name	Mangum Homestead
Description	Buffer Restoration Site
Sampled Plots	13

Table 9. Planted and Total Stem Counts
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

			Current Plot Data (MY4 2023)																	
			VP 1			VP 2			VP 3			VP 4			VP 5			VP 6		
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**
Acer negundo	Boxelder	Tree	1	1	1	2	2	2												
Betula nigra	River Birch	Tree	3	3	3	2	2	2	3	3	3	3	3	3	2	2	2	1	1	1
Carya tomentosa	Mockernut Hickory	Tree																		
Cephalanthus occidentalis	Buttonbush	Shrub Tree																		
Diospyros virginiana	American Persimmon	Tree	1	1	5	3	3	3	1	1	1	1	1	1			4	2	2	3
Juniperus virginiana	Eastern Red Cedar	Tree																		
Liquidambar styraciflua	Sweet Gum	Tree			30			31			4			1						
Liriodendron tulipifera	Tulip Poplar	Tree																		
Nyssa sylvatica	Black Gum	Tree																		
Pinus taeda	Loblolly Pine	Tree			4			4			1			3						
Platanus occidentalis	Sycamore	Tree	5	5	6	1	1	2	2	2	2	5	5	5	7	7	7	5	5	5
Quercus michauxii	Swamp Chestnut Oak	Tree							2	2	2	1	1	1						
Quercus phellos	Willow Oak	Tree	1	1	1	1	1	1												
Quercus rubra	Northern Red Oak	Tree																		
Quercus shumardii	Shumard Oak	Shrub Tree				2	2	2				3	3	3	1	1	1	1	1	1
Ulmus	Elm	Tree																		
Ulmus alata	Winged Elm	Tree			2						1									2
		Stem count	11	11	52	11	11	47	8	8	14	13	13	17	10	10	14	9	9	12
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	5	5	8	6	6	8	4	4	7	5	5	7	3	3	4	4	4	5
		Stems per ACRE	445	445	2,104	445	445	1,902	324	324	567	526	526	688	405	405	567	364	364	486

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteers

PnoLS - Planted Stems Excluding Live Stakes
P-all - All Planted Stems
T - All Woody Stems

Table 9. Planted and Total Stem Counts
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

			Current Plot Data (MY4 2023)																				
			VP 7			VP 8			VP 9			VP 10			VP 11			VP 12			VP 13		
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**
Acer negundo	Boxelder	Tree				1	1	1	2	2	2	1	1	1									
Betula nigra	River Birch	Tree	4	4	4	1	1	1	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2
Carya tomentosa	Mockernut Hickory	Tree																					
Cephalanthus occidentalis	Buttonbush	Shrub Tree																					
Diospyros virginiana	American Persimmon	Tree	3	3	3	3	3	3	5	5	5	2	2	2	1	1	1	2	2	2			
Juniperus virginiana	Eastern Red Cedar	Tree															1			1			
Liquidambar styraciflua	Sweet Gum	Tree												1						8			
Liriodendron tulipifera	Tulip Poplar	Tree																					
Nyssa sylvatica	Black Gum	Tree													1	1	1						
Pinus taeda	Loblolly Pine	Tree															1			4			
Platanus occidentalis	Sycamore	Tree	2	2	2	1	1	1	2	2	2	2	2	2				5	5	5	5	5	5
Quercus michauxii	Swamp Chestnut Oak	Tree							1	1	1				2	2	2				1	1	1
Quercus phellos	Willow Oak	Tree																					
Quercus rubra	Northern Red Oak	Tree																					
Quercus shumardii	Shumard Oak	Shrub Tree				1	1	1	2	2	2							2	2	2	3	3	3
Ulmus	Elm	Tree																					1
Ulmus alata	Winged Elm	Tree																		1			
		Stem count	9	9	9	7	7	7	14	14	14	8	8	9	7	7	9	12	12	26	11	11	12
		size (ares)		1			1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	3	3	3	5	5	5	6	6	6	4	4	5	4	4	6	4	4	8	4	4	5
		Stems per ACRE	364	364	364	283	283	283	567	567	567	324	324	364	283	283	364	486	486	1,052	445	445	486

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteers

PnoLS - Planted Stems Excluding Live Stakes
P-all - All Planted Stems
T - All Woody Stems

Table 9. Planted and Total Stem Counts
Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

			Annual Means														
			MY4 (2023)			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**
Acer negundo	Boxelder	Tree	7	7	7	7	7	7	11	11	11	12	12	12	14	14	14
Betula nigra	River Birch	Tree	32	32	32	30	30	30	39	39	39	40	40	40	45	45	45
Carya tomentosa	Mockernut Hickory	Tree							1	1	1						
Cephalanthus occidentalis	Buttonbush	Shrub Tree						1									
Diospyros virginiana	American Persimmon	Tree	24	24	33	20	20	27	19	19	24	20	20	25	18	18	18
Juniperus virginiana	Eastern Red Cedar	Tree			2			1			1						
Liquidambar styraciflua	Sweet Gum	Tree			75			24			8						
Liriodendron tulipifera	Tulip Poplar	Tree						1									
Nyssa sylvatica	Black Gum	Tree	1	1	1				1	1	1						
Pinus taeda	Loblolly Pine	Tree			17			5									
Platanus occidentalis	Sycamore	Tree	42	42	44	43	43	44	44	44	44	47	47	47	48	48	48
Quercus michauxii	Swamp Chestnut Oak	Tree	7	7	7	6	6	6	16	16	16	21	21	21	23	23	23
Quercus phellos	Willow Oak	Tree	2	2	2	2	2	2	4	4	4	20	20	20	26	26	26
Quercus rubra	Northern Red Oak	Tree							3	3	3						
Quercus shumardii	Shumard Oak	Shrub Tree	15	15	15	13	13	13	9	9	9	10	10	10	10	10	10
Ulmus	Elm	Tree			1												
Ulmus alata	Winged Elm	Tree			6			2			1						
		Stem count	130	130	242	121	121	163	147	147	162	170	170	175	184	184	184
		size (ares)	13			13			13			13			13		
		size (ACRES)	0.32			0.32			0.32			0.32			0.32		
		Species count	8	8	13	7	7	13	10	10	13	7	7	7	7	7	7
		Stems per ACRE	405	405	753	377	377	507	458	458	504	529	529	545	573	573	573

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteers

PnoLS - Planted Stems Excluding Live Stakes
P-all - All Planted Stems
T - All Woody Stems

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
1	*Acer negundo*	boxelder	0.2	0.3	3.4	3
1	*Platanus occidentalis*	American sycamore	0.2	7.1	3.4	4
1	*Platanus occidentalis*	American sycamore	2.2	8.0	13.1	4
1	*Betula nigra*	river birch	2.3	4.7	3.3	3
1	*Quercus phellos*	willow oak	5.2	2.3	3.1	4
1	*Diospyros virginiana*	common persimmon	4.4	5.2	8.5	4
1	*Platanus occidentalis*	American sycamore	4.8	8.5	12.5	4
1	*Platanus occidentalis*	American sycamore	7.1	9.6	12.8	4
1	*Platanus occidentalis*	American sycamore	6.8	3.1	12.5	4
1	*Betula nigra*	river birch	9.9	0.3	2.4	3
1	*Betula nigra*	river birch	8.7	3.8	2.6	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
2	*Diospyros virginiana*	common persimmon	1.2	3.6	4.8	3
2	*Acer negundo*	boxelder	1.2	7.4	2.7	4
2	*Betula nigra*	river birch	1.0	9.2	1.9	4
2	*Betula nigra*	river birch	3.4	2.3	2.2	4
2	*Quercus shumardii*	Shumard oak	2.8	0.2	0.8	2
2	*Platanus occidentalis*	American sycamore	5.7	0.0	8.5	4
2	*Quercus phellos*	willow oak	6.1	2.0	2.1	3
2	*Diospyros virginiana*	common persimmon	7.2	3.9	3.3	4
2	*Quercus shumardii*	Shumard oak	7.6	6.2	1.0	3
2	*Acer negundo*	boxelder	7.7	9.1	1.1	3
2	*Diospyros virginiana*	common persimmon	9.4	1.1	5.4	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
3	*Betula nigra*	river birch	0.1	0.3	1.2	4
3	*Diospyros virginiana*	common persimmon	4.0	4.0	5.6	3
3	*Quercus michauxii*	swamp chestnut oak	3.9	2.0	Missing	M
3	*Platanus occidentalis*	American sycamore	7.6	1.2	13.8	4
3	*Platanus occidentalis*	American sycamore	7.6	3.3	12.5	4
3	*Betula nigra*	river birch	7.6	8.0	1.0	4
3	*Quercus michauxii*	swamp chestnut oak	1.1	6.2	1.7	2
3	*Betula nigra*	river birch	0.9	8.3	1.6	4
3	*Quercus michauxii*	swamp chestnut oak	7.2	7.5	1.9	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
4	*Platanus occidentalis*	American sycamore	1.1	2.5	13.8	4
4	*Platanus occidentalis*	American sycamore	0.7	4.9	8.2	4
4	*Betula nigra*	river birch	0.3	7.0	0.8	2
4	*Platanus occidentalis*	American sycamore	0.0	9.0	8.9	4
4	*Platanus occidentalis*	American sycamore	3.7	9.6	6.5	4
4	*Quercus shumardii*	Shumard oak	3.6	5.8	0.6	4
4	*Platanus occidentalis*	American sycamore	3.8	4.3	12.8	4
4	*Quercus shumardii*	Shumard oak	7.2	0.6	1.8	4
4	*Quercus michauxii*	swamp chestnut oak	7.2	4.8	0.9	3
4	*Betula nigra*	river birch	3.8	3.8	1.3	4
4	*Quercus shumardii*	Shumard oak	3.9	7.8	1.8	3
4	*Betula nigra*	river birch	7.5	9.3	1.0	2
4	*Diospyros virginiana*	common persimmon	7.5	7.4	2.5	3

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
5	*Platanus occidentalis*	American sycamore	0.2	0.5	20.0	4
5	*Platanus occidentalis*	American sycamore	2.7	0.7	20.0	4
5	*Platanus occidentalis*	American sycamore	5.4	0.5	20.0	4
5	*Betula nigra*	river birch	7.6	0.7	20.0	4
5	*Betula nigra*	river birch	9.8	5.1	14.1	4
5	*Quercus shumardii*	Shumard oak	7.6	5.2	11.8	4
5	*Platanus occidentalis*	American sycamore	5.3	5.2	21.3	4
5	*Platanus occidentalis*	American sycamore	0.2	9.0	21.0	4
5	*Platanus occidentalis*	American sycamore	5.8	8.7	18.4	4
5	*Platanus occidentalis*	American sycamore	8.3	8.6	16.4	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
6	*Platanus occidentalis*	American sycamore	0.9	1.0	6.6	4
6	*Platanus occidentalis*	American sycamore	1.1	4.0	11.5	4
6	*Betula nigra*	river birch	0.8	7.1	Dead	0
6	*Platanus occidentalis*	American sycamore	3.0	4.3	12.8	4
6	*Betula nigra*	river birch	3.3	0.2	Missing	M
6	*Diospyros virginiana*	common persimmon	4.5	3.3	8.9	4
6	*Platanus occidentalis*	American sycamore	4.7	4.7	12.5	4
6	*Betula nigra*	river birch	6.5	5.0	4.1	3
6	*Platanus occidentalis*	American sycamore	9.7	7.4	11.8	4
6	*Diospyros virginiana*	common persimmon	3.2	0.2	Dead	0
6	*Diospyros virginiana*	common persimmon	7.1	9.1	2.9	4
6	*Quercus shumardii*	Shumard oak	4.6	9.2	3.3	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
7	*Diospyros virginiana*	common persimmon	1.5	0.3	8.2	3
7	*Diospyros virginiana*	common persimmon	44.5	0.6	5.7	4
7	*Quercus michauxii*	swamp chestnut oak	19.0	0.3	Missing	M
7	*Platanus occidentalis*	American sycamore	19.6	2.1	13.8	4
7	*Platanus occidentalis*	American sycamore	11.1	2.2	Missing	M
7	*Quercus phellos*	willow oak	7.7	1.6	Missing	M
7	*Diospyros virginiana*	common persimmon	4.9	2.6	5.5	4
7	*Betula nigra*	river birch	1.7	4.4	8.5	4
7	*Betula nigra*	river birch	8.0	3.6	2.9	3
7	*Betula nigra*	river birch	11.2	3.9	4.9	4
7	*Platanus occidentalis*	American sycamore	15.3	4.5	13.4	4
7	*Betula nigra*	river birch	19.6	4.1	3.4	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
8	*Quercus shumardii*	Shumard oak	5.5	1.4	3.0	3
8	*Platanus occidentalis*	American sycamore	8.5	1.4	9.5	4
8	*Acer negundo*	boxelder	9.5	4.4	3.9	4
8	*Quercus shumardii*	Shumard oak	7.5	4.4	Missing	M
8	*Quercus michauxii*	swamp chestnut oak	5.3	4.6	Missing	M
8	*Betula nigra*	river birch	3.2	4.8	3.6	4
8	*Diospyros virginiana*	common persimmon	1.3	8.9	4.0	4
8	*Diospyros virginiana*	common persimmon	3.2	8.9	4.6	4
8	*Diospyros virginiana*	common persimmon	9.6	8.7	4.4	4

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
9	*Quercus shumardii*	Shumard oak	2.8	1.2	2.4	1
9	*Acer negundo*	boxelder	5.1	1.3	Dead	0
9	*Diospyros virginiana*	common persimmon	7.8	1.3	5.5	4
9	*Diospyros virginiana*	common persimmon	9.6	1.2	5.7	4
9	*Diospyros virginiana*	common persimmon	9.9	6.2	4.3	4
9	*Platanus occidentalis*	American sycamore	2.7	6.2	8.9	4
9	*Diospyros virginiana*	common persimmon	1.1	8.9	3.8	4
9	*Platanus occidentalis*	American sycamore	2.8	9.0	13.4	4
9	*Acer negundo*	boxelder	4.8	9.4	2.5	4
9	*Acer negundo*	boxelder	6.9	9.6	Missing	M
9	*Acer negundo*	boxelder	5.1	1.4	3.4	4
9	*Diospyros virginiana*	common persimmon	8.1	4.0	1.7	4
9	*Quercus michauxii*	swamp chestnut oak	0.6	4.6	1.8	3
9	*Betula nigra*	river birch	1.8	7.5	1.7	4
9	*Betula nigra*	river birch	4.1	7.8	Dead	0
9	*Betula nigra*	river birch	6.7	7.9	1.8	3
9	*Quercus shumardii*	Shumard oak	8.8	6.9	1.4	2

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
10	*Platanus occidentalis*	American sycamore	2.5	0.8	9.2	4
10	*Platanus occidentalis*	American sycamore	6.3	0.9	7.9	4
10	*Betula nigra*	river birch	8.2	1.3	Missing	M
10	*Diospyros virginiana*	common persimmon	7.8	4.3	2.5	3
10	*Quercus phellos*	willow oak	7.4	4.1	Dead	0
10	*Acer negundo*	boxelder	0.4	3.6	1.8	4
10	*Betula nigra*	river birch	1.7	8.0	Missing	M
10	*Betula nigra*	river birch	3.9	8.0	1.6	3
10	*Betula nigra*	river birch	6.3	8.1	2.1	4
10	*Betula nigra*	river birch	8.6	8.5	Missing	M
10	*Betula nigra*	river birch	0.8	0.9	1.7	3
10	*Betula nigra*	river birch	4.6	1.2	Dead	0
10	*Quercus rubra*	northern red oak	8.0	0.4	Missing	M
10	*Acer negundo*	boxelder	9.3	5.4	Missing	M
10	*Acer negundo*	boxelder	6.0	4.6	Missing	M
10	*Diospyros virginiana*	common persimmon	4.0	4.3	3.3	4
10	*Betula nigra*	river birch	3.1	9.9	Dead	0

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
11	*Betula nigra*	river birch	0.1	0.3	1.8	2
11	*Betula nigra*	river birch	3.6	1.7	2.8	3
11	*Betula nigra*	river birch	8.3	7.1	2.2	3
11	*Quercus michauxii*	swamp chestnut oak	0.8	9.1	1.5	4
11	*Diospyros virginiana*	common persimmon	2.8	9.9	1.8	3
11	*Quercus michauxii*	swamp chestnut oak	7.3	2.6	1.9	1
11	*Nyssa sylvatica*	black gum	4.6	5.7	2.4	4
11	*Carya tomentosa*	mockernut hickory	1.3	5.0	Dead	0

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
12	*Platanus occidentalis*	American sycamore	1.4	1.1	9.0	4
12	*Diospyros virginiana*	common persimmon	3.5	1.5	1.5	3
12	*Diospyros virginiana*	common persimmon	5.9	2.7	2.1	4
12	*Platanus occidentalis*	American sycamore	7.4	3.6	7.9	4
12	*Platanus occidentalis*	American sycamore	9.9	4.5	9.0	4
12	*Betula nigra*	river birch	8.6	7.6	2.5	2
12	*Betula nigra*	river birch	6.8	6.7	2.3	3
12	*Betula nigra*	river birch	4.7	5.9	1.6	3
12	*Quercus shumardii*	Shumard oak	2.3	5.2	0.6	2
12	*Platanus occidentalis*	American sycamore	0.1	4.4	7.9	4
12	*Betula nigra*	river birch	0.4	8.2	Missing	M
12	*Platanus occidentalis*	American sycamore	8.4	0.6	8.3	4
12	*Quercus shumardii*	Shumard oak	9.9	1.4	0.4	1

Table 10. Vegetation Height Data

Mangum Homestead Mitigation Site
DMS Project No. 100107
Monitoring Year 4 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (Ft)	Vigor
13	*Betula nigra*	river birch	0.1	1.8	2.2	4
13	*Platanus occidentalis*	American sycamore	2.7	2.0	10.5	4
13	*Platanus occidentalis*	American sycamore	7.5	2.2	10.8	4
13	*Betula nigra*	river birch	9.9	2.4	2.4	3
13	*Quercus shumardii*	Shumard oak	9.2	6.4	1.4	3
13	*Quercus shumardii*	Shumard oak	7.2	6.5	1.0	2
13	*Platanus occidentalis*	American sycamore	24.0	6.0	12.5	4
13	*Quercus michauxii*	swamp chestnut oak	0.0	9.1	1.0	4
13	*Platanus occidentalis*	American sycamore	2.8	9.6	12.1	4
13	*Quercus shumardii*	Shumard oak	5.0	9.7	1.2	2
13	*Platanus occidentalis*	American sycamore	9.9	9.8	12.1	4