FINAL
AS-BUILT BASELINE
MONITORING REPORT (MY0)

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, North Carolina

NCDMS Project ID No. 100019
Full Delivery Contract No. 7188
USACE Action ID No. SAW-2017-01557
NCDWR No. 20171158
RFP No. 16-006991

French Broad River Basin
Cataloging Unit 06010105

Data Collection: January-March 2020
Submission: August 2020

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1652

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Prepared by:

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NCIRT Memorandum

Subject: **Mitigation Plan Addendum**
Warren Wilson College Stream Mitigation Site
DMS Contract #: 7188
DMS Project ID: 100019
RFP # 16-006991
USACE: SAW-2017-01557
NCDWR: 20171158

Dear NCIRT Members,

The As-built Cold Stream Mitigation Units (SMU) for the Warren Wilson College Site located in the French Broad 06010105 have decreased from the IRT approved Mitigation Plan. Accordingly, Restoration Systems and DMS are requesting a mitigation plan addendum for the asset reduction.

Mitigation Plan assets: **10,227 SMUs**
As-Built assets: **10,050.933 SMUs**

The stream mitigation assets have decreased due to the widening of permanent crossing widths on several reaches to encompass the full pipe lengths and accompanying rock aprons for future maintenance needs. This was not fully noticed until As-built surveys were performed. After discussions with the College's Dean of Land Resources (Dave Ellum), DMS Western Regional Supervisor (Paul Wiesner), DMS Stewardship representatives, and the NC State Property Office; it was decided that the best remedy for the encroachment was to widen the conservation easement breaks on the affected crossings. These permanent amendments to the conservation easements will continue to protect the Site while keeping the College's ability to maintain the crossings in the future. The conservation easement modification is currently underway and will be completed as quickly as possible. The amended crossings and locations are documented in the MY0 report and As-built record drawings.

The following table is from the Table 1. Project Mitigation Assets and Components in the MY0 As-built Report. The Mitigation Plan Footage/Acreage column represents proposed assets and the Restoration Footage/Acreage column represents the updated assets. The comment column has the new linear feet of channel that are outside of the conservation easements. The streams in these reaches have been restored, stabilized, or are in culverts.

Please let us know if you have any questions, comments or concerns.

Worth Creech

Table 1. Mitigation Assets and Components
Warren Wilson College Stream Mitigation Site

Project Segment	Stream Stationing/ Wetland Type	Existing Footage / Acreage	Mitigation Plan Footage/ Acreage	Restoration Level	Mitigation Ratio	Restoration Footage/ Acreage^	Calculated Credit^	Comment
UT 1A	0+09-4+92	189	483	Restoration (Priority I)	1:1	483	483.000	
UT 1B	1+09-1+22	13	13	Enhancement (Level II)	2.5:1	12	4.800	
UT 1C	1+22-7+06	554	584-20=564*	Restoration (Priority I)	1:1	584-42=542*	542.000	42 lf is outside of the easement and therefore is non-credit-generating.
UT 3A	0+05-0+50	45	45	Enhancement (Level II)	2.5:1	50	20.000	
UT 3B	0+50-21+66	1901	2116-20-5=2091*	Restoration (Priority I/II)	1:1	2116-52-5=2059*	2059.000	52 lf is outside of the easement and 5 lf is located at a foot crossing within the easement; therefore, are non-credit-generating.
UT 3C	21+66-22+28	62	62	Enhancement (Level I)	1.5:1	62	41.333	
UT 3D	0+00-5+00	428	500	Restoration (Priority I)	1:1	500	500.000	
UT 3E	5+00-8+34	334	334	Enhancement (Level II)	2.5:1	334	133.600	
UT 3F	8+34-9+60	91	126	Restoration (Priority I)	1:1	126	126.000	
UT 3G	9+60-16+81	721	721-21=700*	Enhancement (Level II)	2.5:1	721-21=700*	280.000	21 lf is outside of the easement and therefore is non-credit-generating.
UT 4A	0+00-2+33	70	233	Restoration (Priority I)	1:1	187	187.000	
UT 4B	2+33-4+75	242	242-20=222*	Enhancement (Level II)	2.5:1	288-107=181*	72.400	107 lf is outside of the easement and therefore is non-credit-generating.
UT 5A	0+00-0+48	48	48	Enhancement (Level II)	2.5:1	47	18.800	
UT 5B	0+48-11+58	719	1110-31=1079*	Restoration (Priority I)	1:1	1117-38=1079*	1079.000	38 lf is outside of the easement and therefore is non-credit-generating.
UT 6A	0+08-1+63	155	155	Enhancement (Level II)	2.5:1	155	62.000	
UT 6B	2+16-16+48	713	1432-20=1412*	Restoration (Priority I/II)	1:1	1432-44=1388*	1388.000	44 lf is outside of the easement and therefore is non-credit-generating.
UT 6C	16+48-21+43	495	495	Enhancement (Level II)	2.5:1	495	198.000	
UT 7A	0+00-19+85	2426	1985-36-20-45=1884*	Restoration (Priority I)	1:1	1940-39-54=1847*	1847.000	93 lf is outside of the easement and therefore is non-credit-generating.
UT 8A	0+18-10+65	957	1047-38=1009*	Restoration (Priority I/II)	1:1	1047-38=1009*	1009.000	38 lf is outside of the easement and therefore is non-credit-generating.

*Areas located outside of the easement or at a foot path crossing within the easement and therefore are non-credit generating.
^Several credited stream segments were reduced in length during as-built due to a modification to remove all crossing materials from the easement.

Table 1 (continued). Project Credits
Warren Wilson College Stream Mitigation Site

Restoration Level	Stream			Riparian Wetland		Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-Riv		
Restoration			**9220.000**				
Re-establishment							
Rehabilitation							
Enhancement							
Enhancement I			**41.333**				
Enhancement II			**789.600**				
Creation							
Preservation							
TOTALS			**10,050.933**				

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August 27, 2020

Paul Wiesner
Western Regional Supervisor
Division of Mitigation Services
5 Ravenscroft Drive
Suite 102
Asheville, N.C. 28801

Subject: Warren Wilson College Stream Mitigation Site: As-Built Comment Responses
DMS Contract #: 7188; DMS Project ID: 100019; RFP # 16-006991

Dear Mr. Wiesner:

Restoration Systems, LLC is pleased to provide you with the Final As-Built Baseline Monitoring Report (MY0) for the Warren Wilson College Stream Mitigation Site. We have addressed your comments as follows.

General: Appendix E – As-Built/ Record Drawings: Based on a review of the draft documents provided, five (5) permanent pipe crossings were installed during project implementation/ construction and extend into the recorded conservation easement (Sheets AB-1.0; AB-4.1; AB- 6.0; AB-7.1). This will likely require a conservation easement modification and mitigation plan addendum submitted to the IRT for the applicable credit reduction. Please explain how this issue will be resolved in regards to the conservation easement and project credits.

Efforts to ascertain the extent of encroachment by pipes and rip-rap into the easement at all project crossings were undertaken including GPS location of the pipes and aprons. Once the encroachments were documented, easement modifications were initiated to remove any crossing materials from the conservation easement. Creditable stream removed from the easement were also removed from Table 1 (Mitigation Assets and Components) in this report, as well as all digital submittals. Additionally, an explanatory narrative was added to Section 1.3 (Project Components and Structure), and a footnote was added to Table 1.

General - Project Fencing: High tensile electric fencing has been utilized on a majority of the site to exclude livestock. Based on a review of the draft documents provided, fencing was installed approximately 1-2 feet outside of the conservation easement. Please be aware and notify the landowner that maintenance of the installed fencing (spraying and/ or mowing) cannot extend into the conservation easement and would be considered an easement violation.

The owner has been notified.

General – Section 8.4.4.1 of the IRT approved mitigation plan notes; "*Groundwater gauges installed adjacent to UT-3 have been installed to monitor the groundwater table. Results of the data will be presented in as-built documentation and for comparison with gauges installed post- construction.*" Wetland hydrology parameters are further documented in Table 18 (Monitoring Summary) of the IRT

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approved mitigation plan. In the report text, please discuss and report pre- construction hydrology data collected on the site and establish the anticipated wetland hydrology success criteria documented in the IRT approved mitigation plan. The final electronic support files should be updated to include the pre-construction groundwater gauge locations and associated data/ graphs.

> A discussion of the preconstruction gauge data was provided in section *1.2 Project Background*. Additionally, a figure with preconstruction gauge locations, a summary table, and preconstruction gauge graphs were included as Appendix F.

General: In the report text, please add a section briefly documenting the archaeological monitoring conducted during construction and NC SHPO status. Please reference the final archaeological report and NC SHPO approval letter provided in Appendix F (see comment further below).

> The Final archeological report and SHPO letter have been included in Appendix G.

Cover Page: Please include a project photo on the cover page.

> A project photo was added to the cover page.

Cover Pages: Please include the NC DWR number on both report covers. The project's NC DWR number is: 20171158. Please also include this # on future project monitoring reports.

> This number was added to both cover pages and will be included on future monitoring reports.

Section 1.1 - Goals and Objectives: This section notes "*Site construction eliminates approximately 28 tons per year [tons/year] of sediment…….*" The final mitigation plan indicated 228 tons per year [tons/year]. This is likely a text error; however, please review and confirm that the goals and objectives presented in the MY0 report are consistent with the final IRT approved mitigation plan and update as necessary.

> The final mitigation plan indicates 228 tons/year. This number was double-checked and is correct. The MY0 document was corrected for consistency.

Section 1.3 Project Components and Structure: The report text notes construction changes for two (2) project structures. The draft as-built plans provide callouts that note; "Structure not installed due to field conditions". Please make sure the report text and final as-built/ record drawing annotations coincide.

> The call-outs in the as-built/record drawing set have been updated to match text from the report text.

In this section, please also include information regarding any issues or mitigating factors, which may have arisen during (or the period immediately after) construction (e.g. impoundment changes, extreme precipitation trends or events, beaver activity etc.), which may require consideration or attention during project monitoring (if any).

> None of these apply.

Section 2.1 Monitoring & Monitoring Summary Table: In the report text, please document and justify any monitoring equipment location and/or number of monitoring features that vary from the IRT approved mitigation plan. As an example, the IRT approved mitigation plan notes 8 groundwater gauges in UT-1, UT-6, and UT-3 wetlands while the draft MY0 report identifies 7 post-construction groundwater gauges installed. The IRT approved mitigation plan notes continuous monitoring surface

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water gauges and/or trail cameras on UT-3, UT-6, and UT-8 while the draft MY0 report identifies continuous monitoring surface water gauges and trail cameras on UT3 & UT8 the draft MY0 report identifies continuous monitoring surface water gauges and trail cameras on UT3 & UT8.

A surface water gauge and a camera were installed along UT6. Additionally, ten total groundwater gauges were installed. These were added to the monitoring table and Figure 2.

Table I – Mitigation Assets and Components: In the table, please shift the "Restoration Footage/ Acreage" column to the left that is currently greyed out. Please add a column to the table that shows the calculated credits for each reach. The reach credit cells should equal the total credits reported in the total project credits table. This request varies from the current DMS template but has been requested by the NCIRT. DMS is in the process of updating the template and guidance accordingly.

This column was added.

Table I (continued) – Project Credits: The total Enhancement II credit cell is incorrect. It should be updated to 804.800.

The Enhancement (Level II) credit total was corrected based on the pending easement modification.

Table 2. Project Activity and Reporting History: In the RFP Opening Date cell, please correct/ remove one of the 2017s. Please also update the As-built Baseline Monitoring Report (MY0) completion date as applicable.

These dates were updated.

Table 3: Please update the designer contact name as applicable.

The designer contact name has been updated.

Table 4: Please include the project stream's thermal regime in the table (Cold).

A row for thermal regime was added to Table 4.

Figure 2 – Current Condition Plan View: All existing trails and bridges identified on the signed and recorded conservation easement plat should also be shown and labeled on the CCPV maps in the MY0 report and future project monitoring reports. Please update the maps accordingly. Any trails or bridges not shown on the recorded conservation easement plat are not allowed and should have been removed as part of the project construction. Electronic support files (GIS) should be updated accordingly.

Per the IRT approved mitigation plan, it is understood that mitigation credits have been removed where project streams are bridged. The IRT approved mitigation plan also notes that no maintenance or upgrades will take place on the trails within the conservation easement; including trail widths.

The walking trails depicted on the recorded easement plat are depicted on Figure 2.

Draft Report / Appendices: Please include figures representing the stream profile (longitudinal profile) data. It was not provided in the draft MY0 report submitted to DMS. Please QA/QC the report to confirm that that all required MY0 data has been included in the report as required. The DMS As-built Baseline Monitoring Report - Format, Data and Content Requirement template and guidance is attached.

The stream profile data has been added to Appendix E with the as-built/record drawing set.

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Appendix D - Appendix D has not been provided in the draft MY0 report submitted to DMS. Please include Tables 8x-11x in the Appendix as referenced in the table of contents and Appendix cover. Please also note that the project cross sections are currently located in Appendix E and should be relocated as referenced.

The stream morphology tables (8A-I to 11A-I) have been included as Appendix D. Cross-sections and profile reports are included in Appendix E with the as-built/record drawing set.

Appendix E – As-Built/ Record Drawings: This attachment should be labeled As-Built/ Record Drawings and should follow the DMS template and guidance document: attached (As-built Baseline Monitoring Report Format, Data and Content Requirement). Please update the As-Built/ Record Drawing attachment per the guidance prior to final submittal.

The as-built/record drawing set has been updated.

Appendix E – As-Built/ Record Drawings: Callouts noting deviations from the final design should also be shown in red script. The report text notes that HDPE pipes were replaced with corrugated metal pipes; please include this deviation in the final As-Built/ Record Drawings (in red).

Crossings with pipes that were changed to CMPs were noted in red.

Appendix E – As-Built/ Record Drawings: Please confirm that all existing trails shown on the signed and recorded conservation easement plat are also clearly shown and labeled on the final As-Built/ Record Drawings. Final electronic support files should be updated accordingly.

Trails have been labeled and shown on the as-built/record drawings and in Figure 2 of Appendix B. The electronic submittal has been updated.

Appendix E – As-Built/ Record Drawings: Per a recent IRT request, please also provide an As- Built/ Record Drawing planting sheet noting any planting substitutions/ deviations from the IRT approved mitigation plan's planting plan (Table 16 in the IRT approved mitigation plan). Planting deviations and substitutions should be shown in red.

A planting table has been added to the drawings with changes to the planting plan depicted in red.

Appendix F: Please update and include the final archaeological report in the Appendix (currently labeled DRAFT). Please also include the June 30, 2020 NC SHPO approval letter as the first page in the appendix.

Appendix G "Agency Correspondence" includes the SHPO letter and the final archaeological report.

<u>Additional Electronic Support File Comments:</u>

Please provide PDFs of any permits or associated permit correspondence acquired during design development that wasn't submitted during the Mitigation Plan development (i.e. FEMA Floodplain Compliance permit; DEQ Land Quality permit; etc.). This should be included in a separate "Project Permits" folder in the final electronic submittal.

Relevant permits are included in the digital submittal.

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Please provide the stand alone as-built .pdf and .dwg files with the final electronic submittal. This as-built survey should bear a Professional Land Surveyor (PLS) seal.

As-Built/Record Drawings are included in the digital submittal.

Please provide the final stand alone Anchor QEA of North Carolina, PLLC design plan .pdf and .dwg files with the final electronic submittal. The design plan should bear a Professional Engineer's seal.

Design data are included in the digital submittal.

Please let us know if you have any questions or comments regarding any component of this submittal. Thank you for the opportunity to continue to assist the Division of Mitigation Services with this important project.

Sincerely,

Worth Creech
Restoration Systems, LLC

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APPENDICES

1.0 PROJECT SUMMARY

Restoration Systems, LLC has established the North Carolina Division of Mitigation Services (NCDMS) Warren Wilson College Stream Restoration Site (Site).

1.1 Project Goals & Objectives

Stressors documented in the *French Broad River Basin Restoration Priorities* (RBRP) report (NCEEP 2009) include habitat degradation, poor riparian buffers, nutrient enrichment, channelization, sedimentation, and toxicity primarily attributed to urban and residential runoff and development.

Within the Site, stressors prior to construction could further be attributed to soil instability, increased runoff, and water quality impairments in the receiving watersheds. The project is not located in a Regional or Local Watershed Planning Area; however, the RBRP goals outlined below are addressed by project activities as follows (Site-specific information follows each RBRP goal in parentheses).

1. Reduce sediment inputs (based on the sediment model, Site construction eliminates approximately 228 tons per year [tons/year] of sediment that resulted from streambank erosion, excessive fines from channel straightening, channel incision, lack of cobble substrate in disturbed reaches, and a narrow or absent riparian buffer)
2. Reduce nutrient inputs (based on the nutrient model, Site construction eliminates 657.4 pounds per year [lbs/yr] of nitrogen and 54.5 lbs/yr of phosphorus due to the installation of marsh treatment areas, removal of preconstruction land uses and livestock, and elimination of fertilizer application)
3. Restore riparian buffers (removal of preconstruction land uses and livestock, control of invasive species, and approximately 19.6 acres of woody riparian buffers were planted adjacent to streams)
4. Stabilize streambanks (restored stable channels at the historic floodplain elevation, and enhanced oversized and incised channels by raising the stream invert and using grade control/habitat structures)
5. Restore and/or protect aquatic habitat (restored aquatic habitat in restoration and enhancement [Level I] reaches by installing grade control/habitat structures, coarsening channel bed materials, removing nutrient inputs, and planting woody riparian buffers to provide shade and organic matter to streams)
6. Reduce fecal coliform inputs (based on the nutrient model, Site construction eliminates 31.2 x 1011 colonies [col] of fecal coliform per day by removing preconstruction land uses and livestock and treating agricultural runoff with marsh treatment areas)
7. Implement agricultural best management practices (BMPs) (the easement is fenced to eliminated livestock from accessing the easement and marsh treatment areas were installed).

Site specific mitigation goals and objectives were developed through the use of North Carolina Stream Assessment Method (NC SAM) analyses of preconstruction and reference stream systems at the Site (NC SFAT 2015) (see Table 1).

Stream/Wetland Targeted Functions, Goals, and Objectives

<table>
<tr><th>Targeted Functions</th><th>Goals</th><th>Objectives</th><th>Compatibility of Success Criteria</th></tr>
<tr><td colspan="4">(1) HYDROLOGY</td></tr>
<tr><td>(2) Flood Flow (Floodplain Access)</td><td rowspan="5">• Attenuate flood flow across the Site.
• Minimize downstream flooding to the maximum extent possible.
• Connect streams to functioning wetland systems.</td><td rowspan="5">• Construct new channel at historic floodplain elevation to restore overbank flows and enhance existing jurisdictional wetlands
• Plant woody riparian buffer
• Remove livestock and cease agricultural practices within areas protected by the conservation easement.
• Deep rip floodplain soils to reduce compaction and increase soil surface roughness
• Protect riparian buffers with a perpetual conservation easement</td><td rowspan="5">• BHR not to exceed 1.2
• Document four overbank events in separate monitoring years
• Livestock excluded from the easement
• Attain Wetland Hydrology Success Criteria
• Attain Vegetation Success Criteria
• Conservation Easement recorded</td></tr>
<tr><td>(3) Streamside Area Attenuation</td></tr>
<tr><td>(4) Floodplain Access</td></tr>
<tr><td>(4) Wooded Riparian Buffer</td></tr>
<tr><td>(4) Microtopography</td></tr>
<tr><td>(3) Stream Stability</td><td rowspan="5">• Increase stream stability within the Site so that channels are neither aggrading nor degrading.</td><td rowspan="5">• Construct channels with proper pattern, dimension, longitudinal profile, and substrate
• Remove livestock and cease agricultural practices within areas protected by the conservation easement.
• Construct stable channels with gravel substrate
• Stabilize streambanks
• Plant woody riparian buffer</td><td rowspan="5">• Cross-section measurements and visual assessments indicate stable channels and structures
• BHR not to exceed 1.2
• ER of 1.4 or greater
• < 10% change in BHR and ER
• Livestock excluded from the easement
• Attain Vegetation Success Criteria</td></tr>
<tr><td>(4) Channel Stability</td></tr>
<tr><td>(4) Sediment Transport</td></tr>
<tr><td>(4) Thermoregulation</td></tr>
<tr><td>(4) Stream Geomorphology</td></tr>
<tr><td colspan="4">(1) WATER QUALITY</td></tr>
<tr><td>(2) Streamside Area Vegetation</td><td rowspan="3">• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.</td><td rowspan="3">• Remove livestock and reduce agricultural land/inputs
• Install marsh treatment areas
• Plant woody riparian buffer
• Enhance jurisdictional wetlands adjacent to Site streams
• Provide surface roughness and reduce compaction through deep ripping/plowing
• Restore overbank flooding by constructing channels at historic floodplain elevation</td><td rowspan="3">• Livestock excluded from the easement
• Attain Vegetation Success Criteria</td></tr>
<tr><td>(3) Upland Pollutant Filtration</td></tr>
<tr><td>(2) Indicators of Stressors</td></tr>
<tr><td colspan="4">(1) HABITAT</td></tr>
<tr><td>(2) In-stream Habitat</td><td rowspan="7">• Improve instream and stream-side habitat.</td><td rowspan="7">• Construct stable channels with gravel substrate
• Plant woody riparian buffer to provide organic matter and shade
• Construct new channel at historic floodplain elevation to restore overbank flows
• Protect riparian buffers with a perpetual conservation easement
• Enhance jurisdictional wetlands adjacent to Site streams
• Remove invasive plant species
• Add large woody debris to Site channels</td><td rowspan="7">• Cross-section measurements and visual assessments indicate stable channels and structures.
• Attain Vegetation Success Criteria
• Conservation Easement recorded</td></tr>
<tr><td>(3) Substrate</td></tr>
<tr><td>(3) Stream Stability</td></tr>
<tr><td>(3) In-Stream Habitat</td></tr>
<tr><td>(2) Stream-side Habitat</td></tr>
<tr><td>(3) Stream-side Habitat</td></tr>
<tr><td>(3) Thermoregulation</td></tr>
</table>

1.2 Project Background

The Warren Wilson College Stream Mitigation Site (hereafter referred to as the "Site") encompasses a 25.3-acre easement (pending easement modification) along cold-water, unnamed tributaries (UTs) to the Swannanoa River. Warren Wilson College occupies approximately 1200 acres, and the Site is part of an actively managed farm and forest system on the Warren Wilson College property that includes livestock management areas, pastureland, agricultural row crops, and a sustainably managed forest. The Site is located approximately 2 miles west of Swannanoa and 5 miles east of Asheville in Buncombe County, North Carolina (Figure 1, Appendix A).

Prior to construction, the Site consisted of agricultural and managed forest land accessible to livestock. Site streams were part of an actively managed farm and forest system that included livestock, pastureland, agricultural row crops, and sustainable forest management. Streams were eroded vertically and laterally, received extensive sediment and nutrient inputs, and were dredged and straightened and/or rerouted to the floodplain edge. Preconstruction Site conditions resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities restored riffle-pool morphology, aided in energy dissipation, increased aquatic habitat, stabilized channel banks, and greatly reduced sediment loss from channel banks.

Preconstruction Groundwater Gauges:

Preconstruction groundwater gauges were installed along UT-3 upper (Clingman's) upon the request of IRT members to model pre-construction wetland characteristics. Data was collected for 2018 and the beginning of 2019 within gauges nested in transects perpendicular to the existing channel. In addition, a crest gauge along the existing incised reach was installed to measure overbank events.

Results of preconstruction gauge data, included in Table 12 (Appendix F, indicate that gauges near the incised stream showed reduced hydroperiod as compared to those further from the channel. 2018 exhibited normal rainfall patterns, and one gauge appeared to meet jurisdictional criteria based on groundwater level being within 12 inches of the surface for 12.5% of the growing season (26 days, based on the NRCS growing season of April 2 to November 1). 2019 exhibited wetter than average rainfall patterns, and six gauges appeared to meet the same jurisdictional criteria. In addition, the crest gauge installed on UT-3 showed no overbank events during 2018 and one during 2019 after a 4.56-inch rainfall.

1.3 Project Components and Structure

Proposed Site restoration activities generated 10,050.933 Stream Mitigation Units (SMUs – pending easement modification) as the result of the following.

- Restored 9220 linear feet of perennial stream channel by constructing stable streams in the historic floodplain location and elevation.
- Enhanced (Level I) 62 linear feet of stream by installing in-stream structures, providing proper channel dimension and appropriate floodplain width, reducing shear on eroding

banks, controlling invasive species within the riparian area, and planting with native riparian vegetation.

- Enhanced (Level II) 1974 linear feet of stream channel by removing current land use practices, controlling invasive species within the riparian area, and planting native vegetation.

Additional activities that occurred at the Site included the following.

- Installation of four marsh treatment areas to treat stormwater runoff before it enters Site streams.
- Established a minimum 30-foot-wide woody riparian buffer adjacent to Site streams,
- Fenced the conservation easement boundaries in areas used for livestock management.
- Protected the Site in perpetuity with a conservation easement.

Deviations from the construction plans included the modifications of two grade control structures. A log vane structure along the lower portion of reach UT-6B was constructed with boulders in order to accommodate the culverted crossing just upstream. Additionally, a vane arm was removed from a log vane along the upper portion of reach UT-7A in order to avoid the destruction of a mature black walnut tree. The log sill was constructed as designed and is holding grade. These changes are depicted on the As-built Plan Sheets (Appendix E). Also, HDPE pipe was replaced with corrugated metal pipe throughout the project at the request of USFWS.

Additionally, during the initial DMS as-built review, it was discovered that several culvert pipes extend into the recorded conservation easement. Once the encroachments were located and documented via GPS, easement modifications were initiated to remove any crossing materials from the conservation easement. Creditable stream removed from the easement were also removed from mitigation assets.

Site design was completed on January 10, 2020. Construction started on September 1, 2020 and ended within a final walkthrough on March 4, 2020. Site planting was completed on March 16, 2020. Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 1-4 (Appendix A).

1.4 Success Criteria

Project success criteria have been established per the October 24, 2016 NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. Monitoring and success criteria relate to project goals and objectives. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving success criteria. The following table summarizes Site success criteria.

Success Criteria

Streams

- All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05.
- Continuous surface flow must be documented each year for at least 30 consecutive days.
- Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section.
- Entrenchment ratio (ER) must be no less than 2.2 for E- and C-type channels at any measured riffle cross-section.
- BHR and ER at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period.
- The stream project shall remain stable and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.

Wetland Hydrology

- Groundwater gauge data will be used to observe fluctuations in groundwater hydrology pre- and postconstruction as the result of overbank events; however, no wetland mitigation credit is being acquired and there are no wetland hydrology success criteria proposed at this time.
- Jurisdictional wetland adjacent to UT-3 will demonstrate a 10 to 20% increase in wetland hydrology as compared to pre-construction hydrology, under similar climactic conditions.

Vegetation

- Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5; and a minimum of 210 stems per acre must be present at year 7.
  - Areas of dense river cane (canebrakes) are a natural niche habitat within the Swannanoa River floodplain that contribute native habitat for endangered species. River cane may outcompete woody seedlings during the initial establishment of vegetation. Within the Swannanoa floodplain (UT-6, UT-7, and UT-8), the presence of canebrakes may supersede the vegetative success criteria for planted stems per acre.
- Trees must average 6 feet in height at year 5, and 8 feet in height at year 7 in each plot.
- Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis.

2.0 METHODS

Monitoring requirements and success criteria outlined in this plan follow the October 24, 2016 NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCDMS by Restoration Systems no later than December 31 of each monitoring year data is collected. The monitoring schedule is summarized in the following table.

Monitoring Schedule

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Streams							
Wetlands							
Vegetation							
Visual Assessment							
Report Submittal							

2.1 Monitoring

The monitoring parameters are summarized in the following table.

Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 50 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern to be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Stream Hydrology	Continuous monitoring surface water gauges and trail cameras	Continuous recording through monitoring period	Total of 3 surface water gauges (UT3, UT6, & UT8)	Surface water data for each monitoring period
Bankfull Events	Continuous monitoring surface water gauges and trail cameras	Continuous recording through monitoring period	Total of 3 surface water gauges (UT3, UT6, & UT8)	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	All restored stream channels	Visual evidence, photo documentation, and/or rain data.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Rehabilitation	Groundwater gauges	Preconstruction, As-built, Years 1-7	10 gauges in wetlands adjacent to UT1+, UT3*+, & UT6+	Graphic and tabular data.
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	25 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	Number of randomly selected plots to be determined each year. as needed	Species and height

* Five groundwater monitoring gauges were installed in jurisdictional wetland areas adjacent to UT-3 to take measurements before and after hydrological modifications were performed at the Site. The preconstruction condition of the upper reach of UT-3 was an incised Eg-type channel with bank-height-ratios ranging from 1.8-2.4. The majority of UT-3 upper has been restored (priority I) with construction of channels at the historic floodplain elevation to restore overbank flows to adjacent wetlands. A stream flow gauge and trail camera were installed on UT-3 upper to verify overbank events. Groundwater gauge data will be used to observe fluctuations in groundwater hydrology pre- and post-construction as the result of overbank events; however, no wetland mitigation credit is being acquired and there are no wetland hydrology success criteria proposed at this time.

+ Three groundwater gauges were installed, one adjacent to UT-1, one adjacent to UT-3 lower, and one adjacent to UT-6, in order to show no net loss in function, due to project activities, in existing wetlands along these tributaries. In order to monitor an area of potential wetland creation associated with stream channel restoration, two additional gauges (gauges 4 and 5) were installed along the right bank of UT-3 upper. This area was previously determined non-jurisdictional.

3.0 REFERENCES

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Appendix A
Background Tables

Table 1. Mitigation Assets and Components
Warren Wilson College Stream Mitigation Site

Project Segment	Stream Stationing/ Wetland Type	Existing Footage/ Acreage	Mitigation Plan Footage/ Acreage	Restoration Level	Mitigation Ratio	Restoration Footage/ Acreage^	Calculated Credit^	Comment
UT 1A	0+09-4+92	189	483	Restoration (Priority I)	1:1	483	483.000	
UT 1B	1+09-1+22	13	13	Enhancement (Level II)	2.5:1	12	4.800	
UT 1C	1+22-7+06	554	584-20=564*	Restoration (Priority I)	1:1	584-42=542*	542.000	42 lf is outside of the easement and therefore is non-credit-generating.
UT 3A	0+05-0+50	45	45	Enhancement (Level II)	2.5:1	50	20.000	
UT 3B	0+50-21+66	1901	2116-20-5=2091*	Restoration (Priority I/II)	1:1	2116-52-5=2059*	2059.000	52 lf is outside of the easement and 5 lf is located at a foot crossing within the easement; therefore, are non-credit-generating.
UT 3C	21+66-22+28	62	62	Enhancement (Level I)	1.5:1	62	41.333	
UT 3D	0+00-5+00	428	500	Restoration (Priority I)	1:1	500	500.000	
UT 3E	5+00-8+34	334	334	Enhancement (Level II)	2.5:1	334	133.600	
UT 3F	8+34-9+60	91	126	Restoration (Priority I)	1:1	126	126.000	
UT 3G	9+60-16+81	721	721-21=700*	Enhancement (Level II)	2.5:1	721-21=700*	280.000	21 lf is outside of the easement and therefore is non-credit-generating.
UT 4A	0+00-2+33	70	233	Restoration (Priority I)	1:1	187	187.000	
UT 4B	2+33-4+75	242	242-20=222*	Enhancement (Level II)	2.5:1	288-107=181*	72.400	107 lf is outside of the easement and therefore is non-credit-generating.
UT 5A	0+00-0+48	48	48	Enhancement (Level II)	2.5:1	47	18.800	
UT 5B	0+48-11+58	719	1110-31=1079*	Restoration (Priority I)	1:1	1117-38=1079*	1079.000	38 lf is outside of the easement and therefore is non-credit-generating.
UT 6A	0+08-1+63	155	155	Enhancement (Level II)	2.5:1	155	62.000	
UT 6B	2+16-16+48	713	1432-20=1412*	Restoration (Priority I/II)	1:1	1432-44=1388*	1388.000	44 lf is outside of the easement and therefore is non-credit-generating.
UT 6C	16+48-21+43	495	495	Enhancement (Level II)	2.5:1	495	198.000	
UT 7A	0+00-19+85	2426	1985-36-20-45=1884*	Restoration (Priority I)	1:1	1940-39-54=1847*	1847.000	93 lf is outside of the easement and therefore is non-credit-generating.
UT 8A	0+18-10+65	957	1047-38=1009*	Restoration (Priority I/II)	1:1	1047-38=1009*	1009.000	38 lf is outside of the easement and therefore is non-credit-generating.

*Areas located outside of the easement or at a foot path crossing within the easement and therefore are non-credit generating.
^Several credited stream segments were reduced in length during as-built due to a modification to remove all crossing materials from the easement.

Table 1 (continued). Project Credits
Warren Wilson College Stream Mitigation Site

	Stream			Riparian Wetland		Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Riverine	Non-Riv	Wetland	Marsh
Restoration			**9220.000**				
Re-establishment							
Rehabilitation							
Enhancement							
Enhancement I			**41.333**				
Enhancement II			**789.600**				
Creation							
Preservation							
TOTALS			**10,050.933**				

Table 2. Project Activity and Reporting History
Warren Wilson College Stream Mitigation Site

Activity or Deliverable	**Data Collection Complete**	**Completion or Delivery**
RFP No. 16-006991 Issuance Date	--	September 16, 2016
RFP No. 16-006991 Opening Date	--	February 15, 2017
Institution Date (NCDMS Contract No. 100014)	--	May 22, 2017
Mitigation Plan	March 2018	November 2018
Construction Plans	--	January 10, 2020
404 Permit	--	May 13, 2019
Site Construction	--	March 4, 2020
Planting	--	March 16, 2020
As-built Baseline Monitoring (MY0)	January-March 2020	August 2020

Table 3. Project Contacts Table
Warren Wilson College Restoration Site

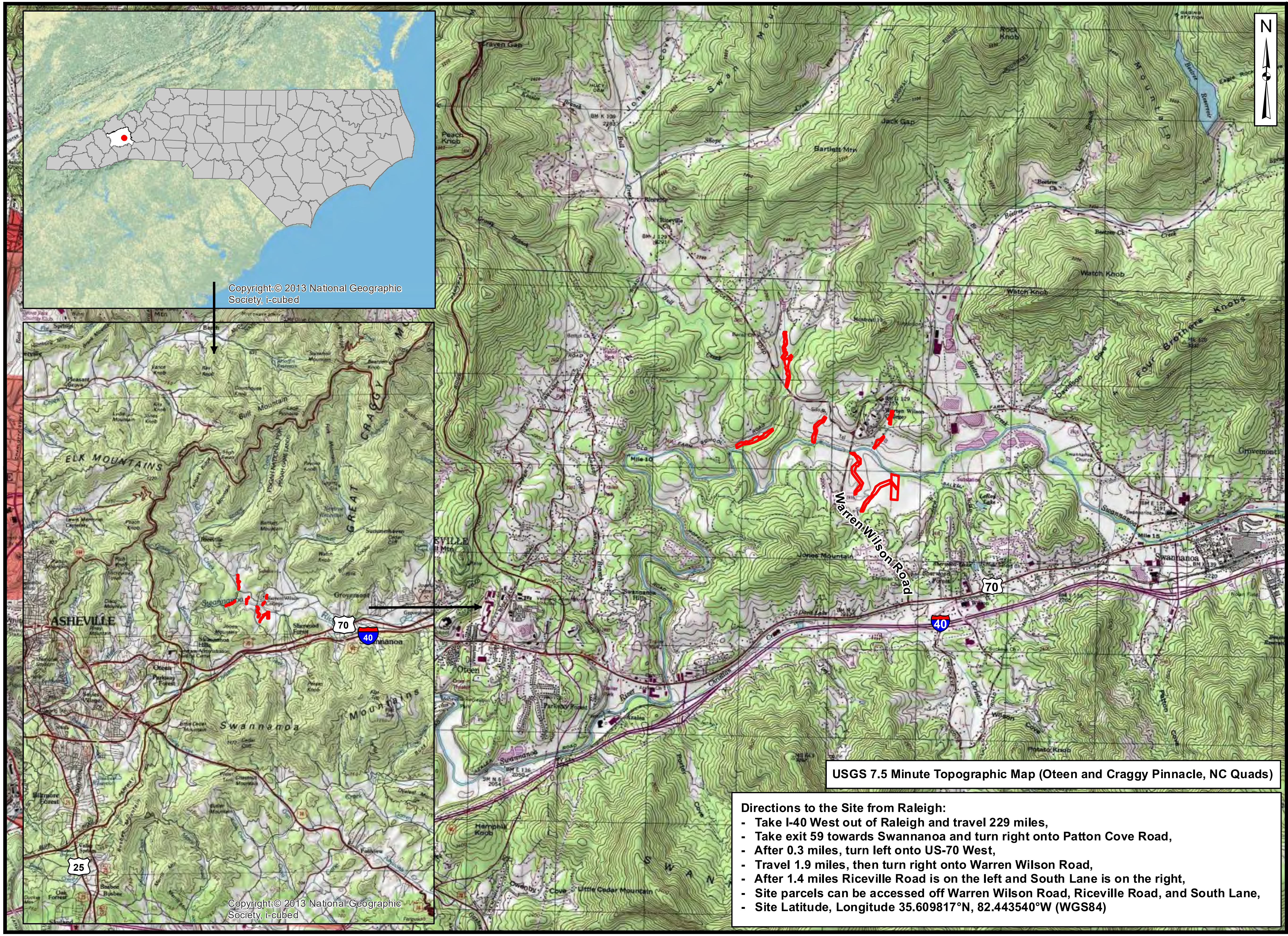
Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490
Designer	Anchor QEA of North Carolina, PLLC 231 Haywood Street Asheville, NC 28801 Sara Stavinoha 828-771-0279
As-built Monitoring Provider	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Attribute Table
Warren Wilson Stream Mitigation Site

Project Information							
Project Name	Warren Wilson Stream Mitigation Site						
Project County	Buncombe County, North Carolina						
Project Area (acres)	25.3 (pending easement modification)						
Project Coordinates (latitude & latitude)	35.609817ºN, 82.443540ºW						
Planted Area (acres)	19.64						
Project Watershed Summary Information							
Physiographic Province	Blue Ridge						
Project River Basin	French Broad						
USGS HUC for Project (14-digit)	06010105070030						
NCDWR Sub-basin for Project	04-03-02						
Project Drainage Area	49.9 to 822.3 acres (0.08 to 1.28 square miles)						
Percentage of Project Drainage Area that is Impervious	<5%						
CGIA Land Use Classification	Cultivated, Managed Herbaceous Vegetation, Unmanaged Herbaceous Vegetation, Hardwood Swamp, Oak/Gum/Cypress						
Reach Summary Information							
Parameters	**UT1**	**UT 3**	**UT4**	**UT 5**	**UT6**	**UT 7**	**UT 8**
Length of reach (linear feet)	756	3582	312	769	1363	2425	957
Valley Classification & Confinement	Moderately confined to somewhat unconfined (UT-3 & UT-5)						
Drainage Area (acres and square miles)	171.3 ac. (0.27 sq. mi.)	822.3 ac. (1.28 sq. mi.)	153.9 ac. (0.24 sq. mi.)	98.3 ac. (0.15 sq. mi.)	49.9 ac. (0.08 sq. mi.)	141.0 ac. (0.22 sq. mi.)	64.4 ac. (0.10 sq. mi.)
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Perennial	Intermittent/ Perennial	Perennial	Perennial
NCDWR Water Quality Classification	C						
Existing Morphological Description (Rosgen 1996)	Cg4	Eg4	G4	G3	G3	Gb4	Eg4
Proposed Stream Classification (Rosgen 1996)	Cb4	Ce4	C4	Ce4	Ce4	Gb4	C4
Existing Evolutionary Stage (Simon and Hupp 1986)	II/III (Channelized/Degraded)						
FEMA Classification	NA	Zone AE	NA	NA	NA	NA	NA
Thermal Regime	Cold						

Appendix B
Visual Assessment Data

Figure 1. Project Location
Figures 2 & 2A-2E. Current Conditions Plan View
Vegetation Plot Photographs



Directions to the Site from Raleigh:
- Take I-40 West out of Raleigh and travel 229 miles,
- Take exit 59 towards Swannanoa and turn right onto Patton Cove Road,
- After 0.3 miles, turn left onto US-70 West,
- Travel 1.9 miles, then turn right onto Warren Wilson Road,
- After 1.4 miles Riceville Road is on the left and South Lane is on the right,
- Site parcels can be accessed off Warren Wilson Road, Riceville Road, and South Lane,
- Site Latitude, Longitude 35.609817°N, 82.443540°W (WGS84)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

Title:

SITE LOCATION

Drawn by: KRJ

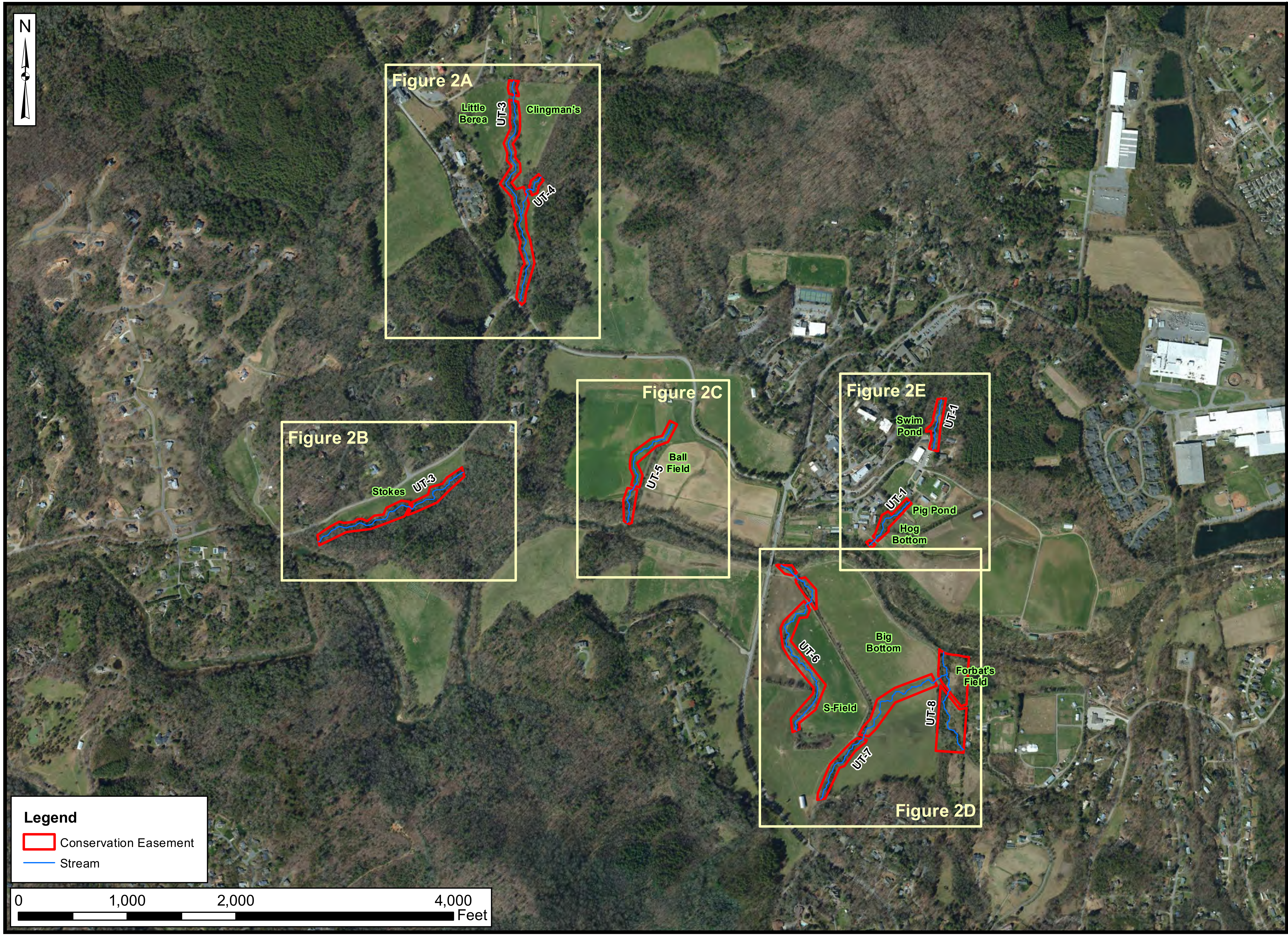
Date: APR 2020

Scale: 1:40000

Project No.: 20-004

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

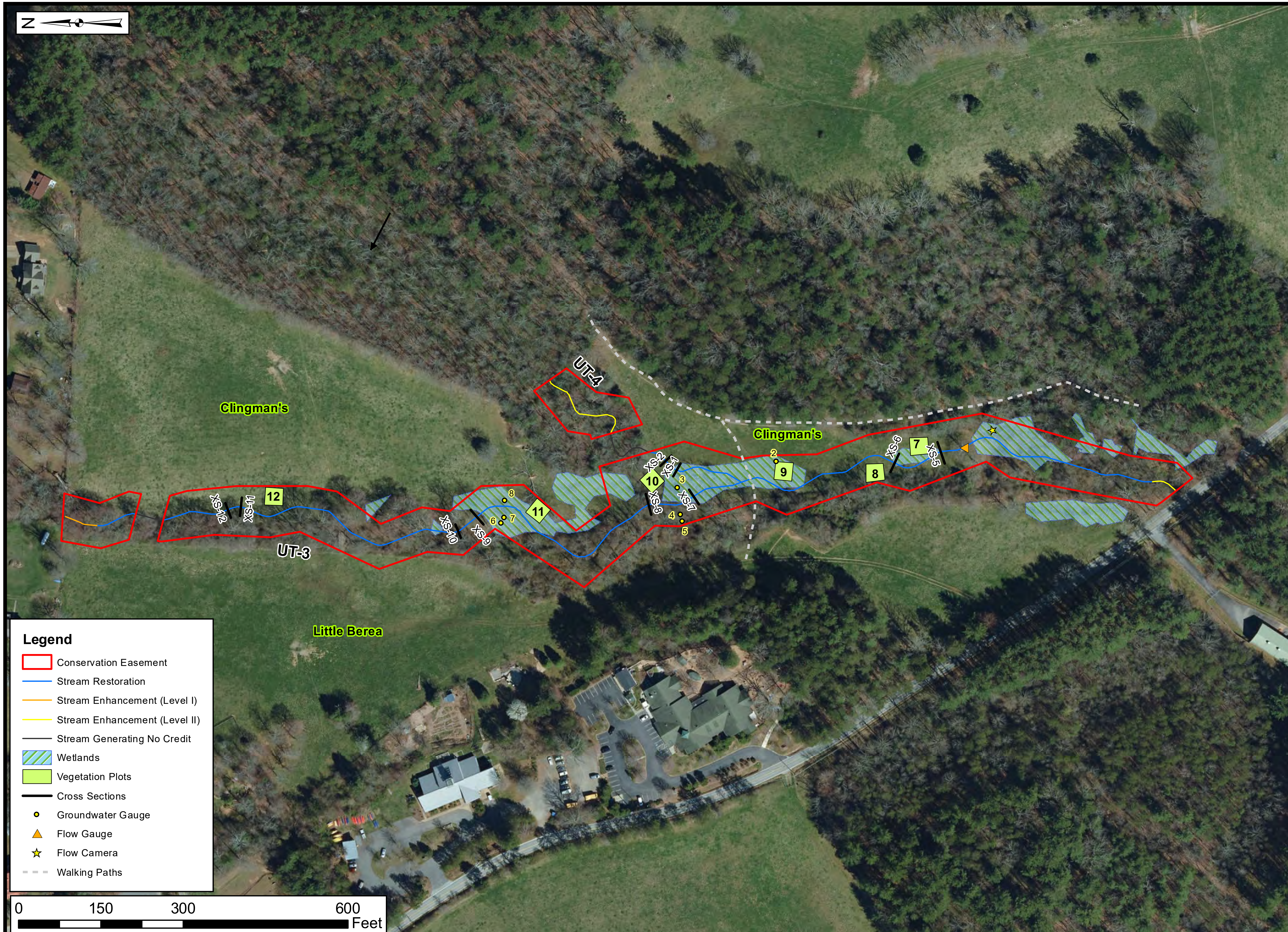
Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by:	KRJ
Date:	AUG 2020
Scale:	1:10,000
Project No.:	20-004

FIGURE

2



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: KRJ

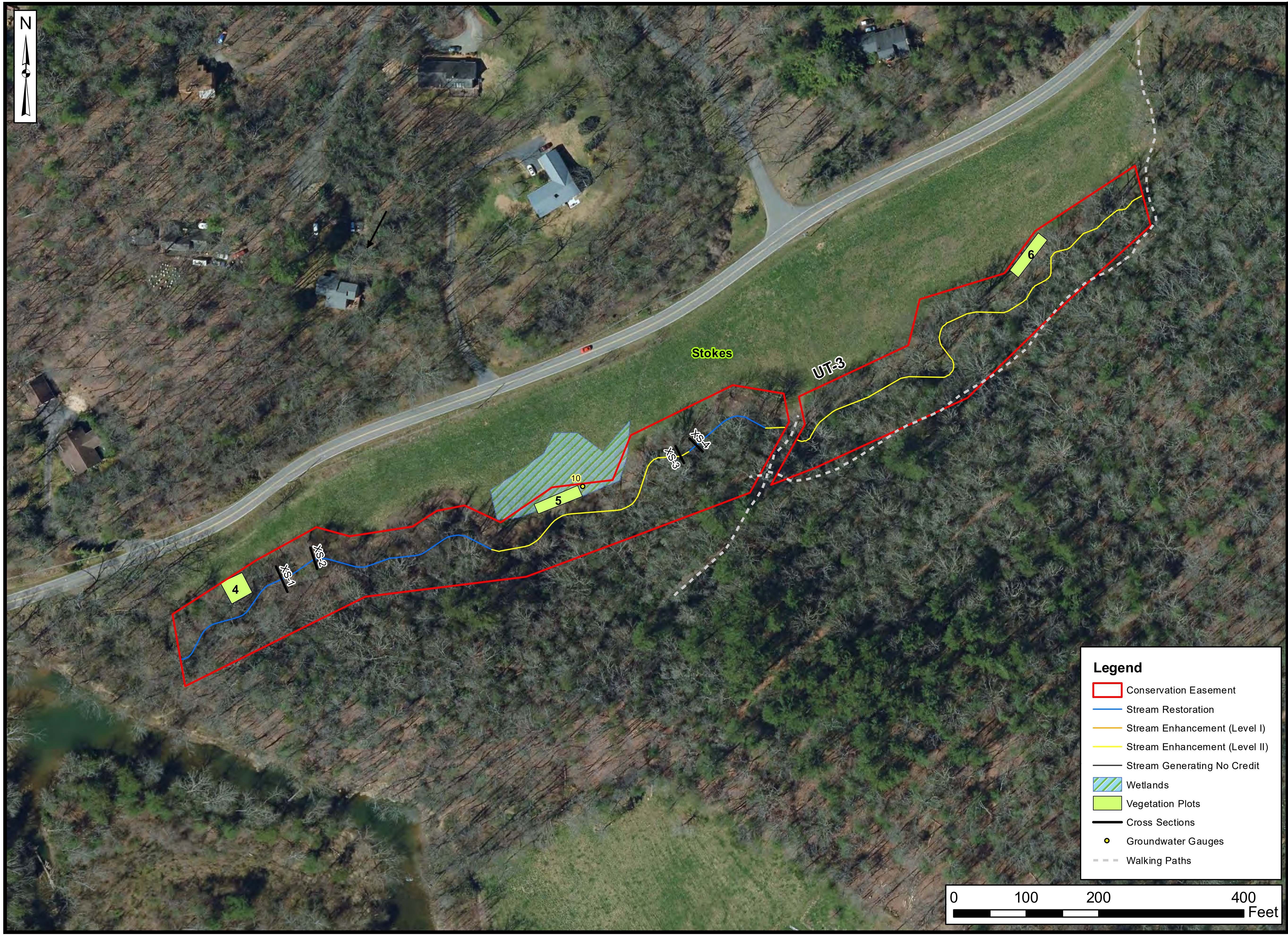
Date: AUG 2020

Scale: 1:2000

Project No.: 20-004

FIGURE

2A



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: KRJ

Date: AUG 2020

Scale: 1:1500

Project No.: 20-004

FIGURE

2B

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

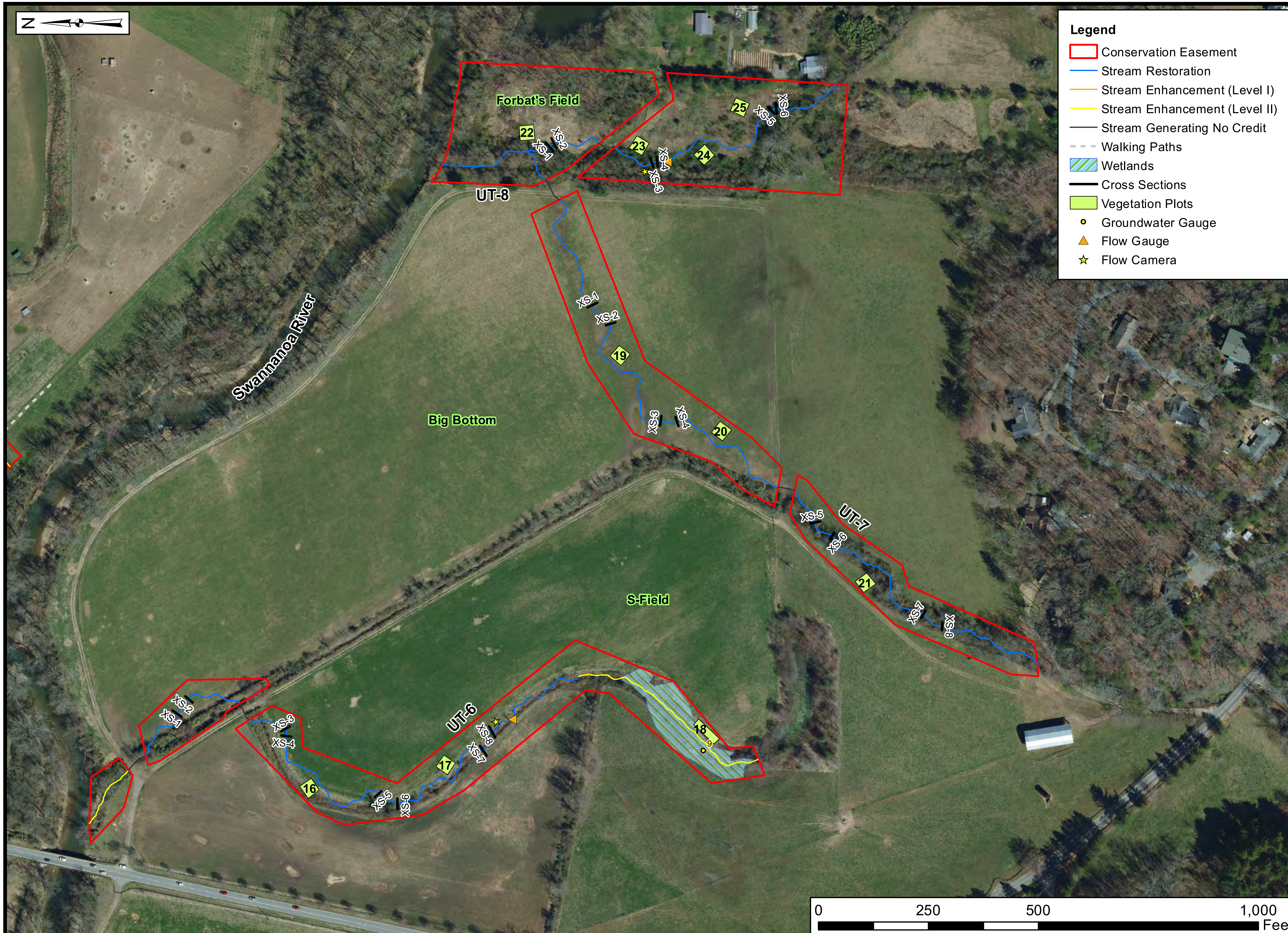
Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by:	KRJ
Date:	AUG 2020
Scale:	1:1200
Project No.:	20-004

FIGURE

2C



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

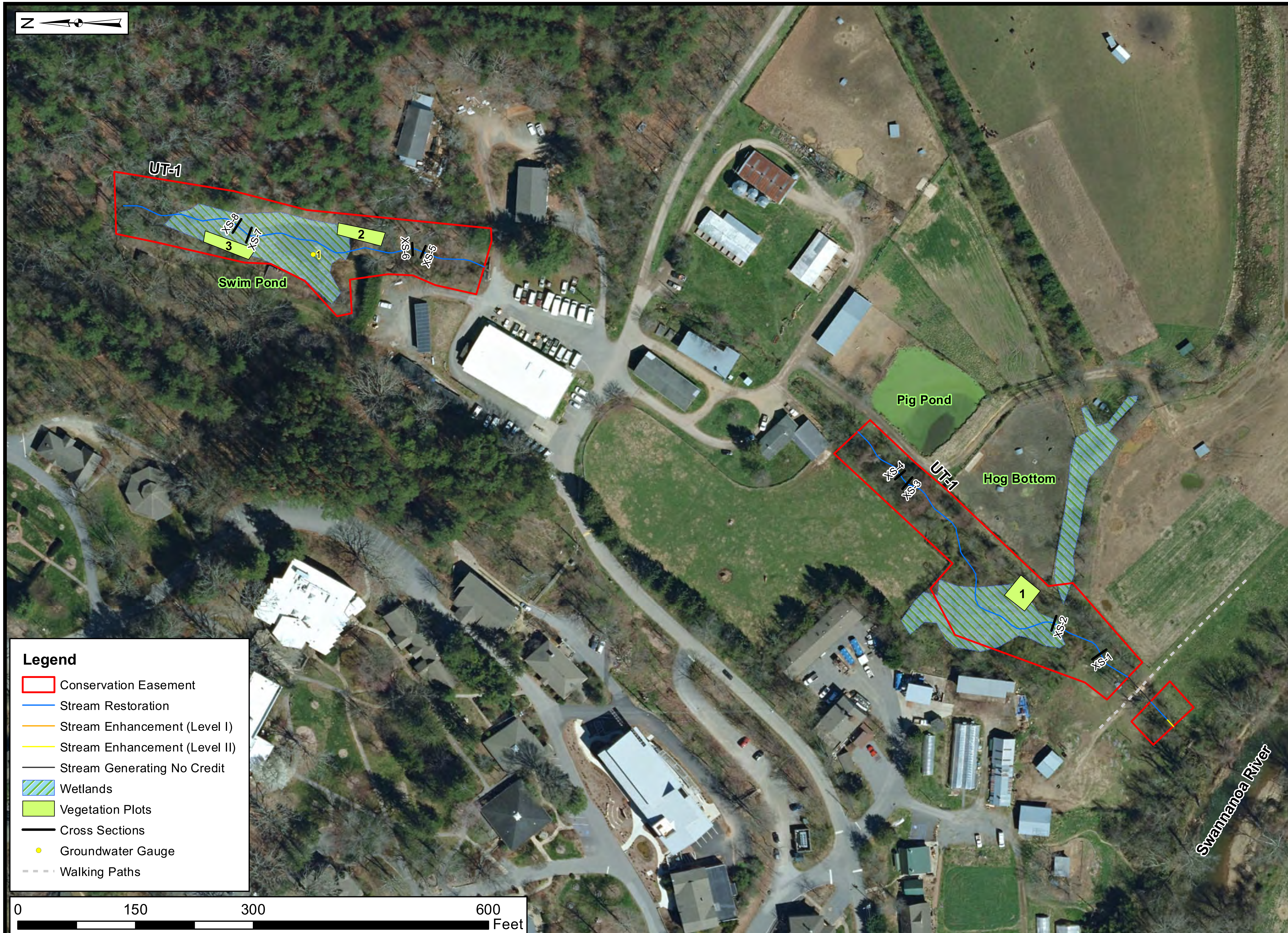
Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by:	KRJ
Date:	AUG 2020
Scale:	1:2500
Project No.:	20-004

FIGURE

2D



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by:	KRJ
Date:	AUG 2020
Scale:	1:1400
Project No.:	20-004

FIGURE

2E

Warren Wilson College
Asbuilt Vegetation Plots
Photos Taken March 16-18, 2020

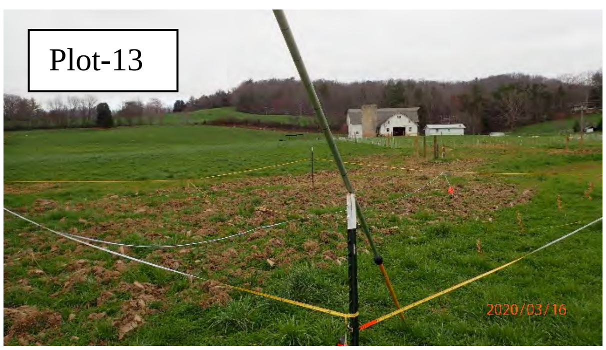
Warren Wilson College
Asbuilt Vegetation Plots
Photos Taken March 16-18, 2020
(continued)

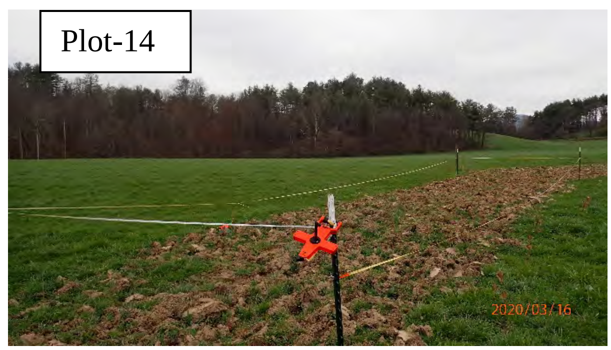

Plot-9


Plot-10

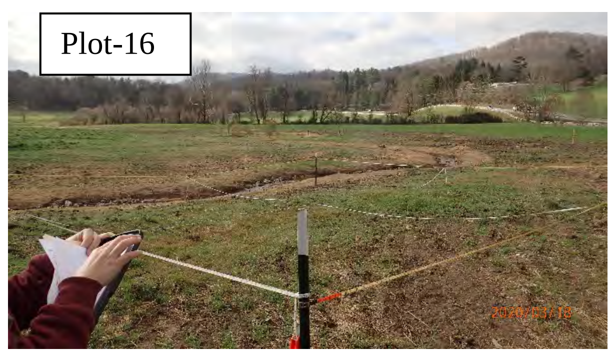

Plot-11


Plot-12


Plot-13


Plot-14


Plot-15

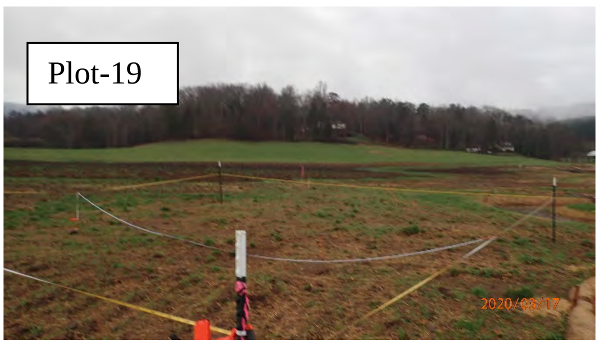

Plot-16

Warren Wilson College
Asbuilt Vegetation Plots
Photos Taken March 16-18, 2020
(continued)

Plot-17

Plot-18

Plot-19

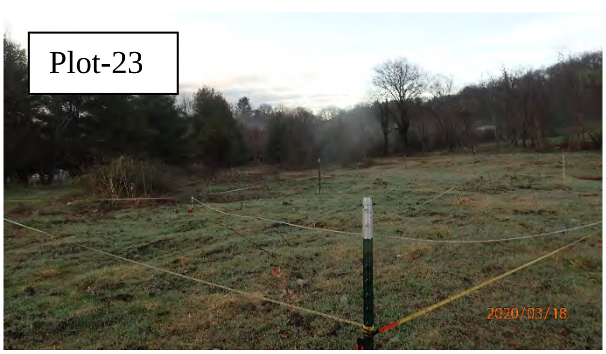


Plot-20

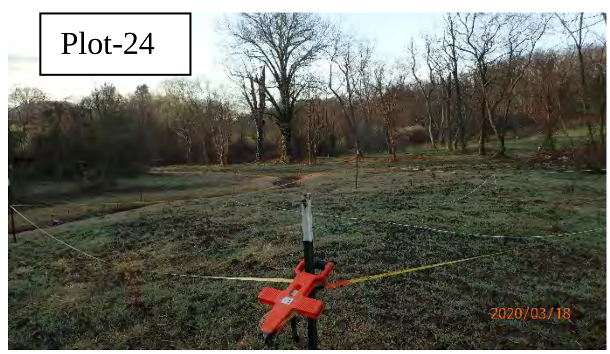
Plot-21

Plot-22

Plot-23



Plot-24



Warren Wilson College
Asbuilt Vegetation Plots
Photos Taken March 16-18, 2020
(continued)

Appendix C
Vegetation Data

Table 5. Planted Bare Root Woody Vegetation
Warren Wilson College Stream Mitigation Site

Species	Total*
Acres	**19.64**
Cephalanthus occidentalis	50
Diospyros virginiana	500
Liriodendron tulipifera	900
Betula nigra	2800
Fraxinus pennsylvanica	3800
Cornus amomum	3900
Quercus alba	4200
Quercus nigra	4200
Platanus occidentalis	5600
TOTALS	**25,950***

**Approximately 5000 live stakes of willow (*Salix* spp.), elderberry (*Sambucus candensis*), silky dogwood (*Cornus amomum*), and ninebark (*Physocarpus opulifolius*) were planted, but are not included in this table.

Table 6. Total Planted Stems by Plot and Species
Warren Wilson College

			Current Plot Data (MY0 2020)																										
			20004-01-0001			20004-01-0002			20004-01-0003			20004-01-0004			20004-01-0005			20004-01-0006			20004-01-0007			20004-01-0008			20004-01-0009		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	1	1	1	1	1	1	12	12	12	12	12	12				2	2	2	5	5	5				2	2	2
Cephalanthus occidentalis	common buttonbush	Shrub																											
Cornus amomum	silky dogwood	Shrub				8	8	8	12	12	12				5	5	5				6	6	6	1	1	1	4	4	4
Diospyros virginiana	common persimmon	Tree				1	1	1													3	3	3				2	2	2
Fraxinus pennsylvanica	green ash	Tree																											
Liriodendron tulipifera	tuliptree	Tree				1	1	1							3	3	3										4	4	4
Platanus occidentalis	American sycamore	Tree				4	4	4	3	3	3	3	3	3				1	1	1	5	5	5	11	11	11			
Quercus	oak	Tree	8	8	8	2	2	2	4	4	4	2	2	2	9	9	9	6	6	6	4	4	4	2	2	2	2	2	2
Quercus alba	white oak	Tree	3	3	3				2	2	2							10	10	10	2	2	2	2	2	2	1	1	1
Quercus nigra	water oak	Tree	3	3	3							6	6	6	1	1	1				2	2	2				1	1	1
Unknown		Shrub or Tree																											
		Stem count	15	15	15	17	17	17	33	33	33	23	23	23	18	18	18	19	19	19	27	27	27	16	16	16	16	16	16
		size (ares)		1			1			1			1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	4	6	6	6	5	5	5	4	4	4	4	4	4	4	4	4	7	7	7	4	4	4	7	7	7
		Stems per ACRE	607	607	607	688	688	688	1335	1335	1335	930.8	930.8	930.8	728.4	728.4	728.4	768.9	768.9	768.9	1093	1093	1093	647.5	647.5	647.5	647.5	647.5	647.5

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%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 6. Total Planted Stems by Plot and Species (continued)
Warren Wilson College

			Current Plot Data (MY0 2020)																										
			20004-01-0010			20004-01-0011			20004-01-0012			20004-01-0013			20004-01-0014			20004-01-0015			20004-01-0016			20004-01-0017			20004-01-0018		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	2	2	2	4	4	4	2	2	2	1	1	1							3	3	3	6	6	6	4	4	4
Cephalanthus occidentalis	common buttonbush	Shrub										1	1	1															
Cornus amomum	silky dogwood	Shrub	3	3	3	1	1	1	2	2	2				2	2	2	3	3	3	3	3	3	5	5	5	1	1	1
Diospyros virginiana	common persimmon	Tree	4	4	4							2	2	2													2	2	2
Fraxinus pennsylvanica	green ash	Tree																											
Liriodendron tulipifera	tuliptree	Tree										5	5	5				2	2	2									
Platanus occidentalis	American sycamore	Tree	4	4	4				3	3	3				17	17	17	12	12	12	8	8	8	2	2	2	1	1	1
Quercus	oak	Tree	1	1	1	7	7	7	1	1	1	1	1	1	2	2	2	2	2	2	5	5	5	6	6	6	12	12	12
Quercus alba	white oak	Tree	2	2	2	3	3	3	1	1	1										2	2	2						
Quercus nigra	water oak	Tree							6	6	6							2	2	2				1	1	1	3	3	3
Unknown		Shrub or Tree				1	1	1																					
		Stem count	16	16	16	16	16	16	15	15	15	10	10	10	21	21	21	21	21	21	21	21	21	20	20	20	23	23	23
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	5	5	5	6	6	6	5	5	5	3	3	3	5	5	5	5	5	5	5	5	5	6	6	6
		Stems per ACRE	647.5	647.5	647.5	647.5	647.5	647.5	607	607	607	404.7	404.7	404.7	849.8	849.8	849.8	849.8	849.8	849.8	849.8	849.8	849.8	809.4	809.4	809.4	930.8	930.8	930.8

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%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 6. Total Planted Stems by Plot and Species (continued)
Warren Wilson College

			Current Plot Data (MY0 2020)																					Annual Means		
			20004-01-0019			20004-01-0020			20004-01-0021			20004-01-0022			20004-01-0023			20004-01-0024			20004-01-0025			MY0 (2020)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	4	4	4	2	2	2	5	5	5	1	1	1	3	3	3	1	1	1	4	4	4	77	77	77
Cephalanthus occidentalis	common buttonbush	Shrub																						1	1	1
Cornus amomum	silky dogwood	Shrub				2	2	2				5	5	5	3	3	3	7	7	7	2	2	2	75	75	75
Diospyros virginiana	common persimmon	Tree	4	4	4							1	1	1				2	2	2	1	1	1	22	22	22
Fraxinus pennsylvanica	green ash	Tree							1	1	1													1	1	1
Liriodendron tulipifera	tuliptree	Tree				2	2	2							1	1	1							18	18	18
Platanus occidentalis	American sycamore	Tree	10	10	10	8	8	8	5	5	5	5	5	5	4	4	4	1	1	1	8	8	8	115	115	115
Quercus	oak	Tree	1	1	1	4	4	4	2	2	2	1	1	1	4	4	4	2	2	2	3	3	3	93	93	93
Quercus alba	white oak	Tree				1	1	1	2	2	2	1	1	1	1	1	1				2	2	2	35	35	35
Quercus nigra	water oak	Tree													2	2	2	2	2	2				29	29	29
Unknown		Shrub or Tree																3	3	3	1	1	1	5	5	5
		Stem count	19	19	19	19	19	19	15	15	15	14	14	14	18	18	18	18	18	18	21	21	21	471	471	471
		size (ares)	1			1			1			1			1			1			1			25		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.62		
		Species count	4	4	4	6	6	6	5	5	5	6	6	6	7	7	7	7	7	7	7	7	7	11	11	11
		Stems per ACRE	768.9	768.9	768.9	768.9	768.9	768.9	607	607	607	566.6	566.6	566.6	728.4	728.4	728.4	728.4	728.4	728.4	849.8	849.8	849.8	762.4	762.4	762.4

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%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 7. Planted Vegetation Totals
Warren Wilson College Stream Mitigation Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	607	Yes
2	688	Yes
3	1335	Yes
4	931	Yes
5	728	Yes
6	769	Yes
7	1093	Yes
8	648	Yes
9	648	Yes
10	648	Yes
11	648	Yes
12	607	Yes
13	405	Yes
14	850	Yes
15	850	Yes
16	850	Yes
17	809	Yes
18	931	Yes
19	769	Yes
20	769	Yes
21	607	Yes
22	567	Yes
23	728	Yes
24	728	Yes
25	850	Yes
Average Planted Stems/Acre	**762**	**Yes**

Appendix D
Stream Geomorphology Data

Tables 8A-8G. Baseline Stream Data Summary
Tables 9A-9G. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Tables 10A-10G. Monitoring Data-Dimensional Morphology Summary (Dimensional Parameters-Cross-sections)
Tables 11A-11G. Monitoring Data-Stream Reach Data Summary

Table 8a. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Lower (572 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					2.6	10.9		19.3			5.1	6.8		9.4			11.3	14.0		15.8			9.2	10.0	10.7	10.6	11.2	11.2	11.9		2.0
Floodprone Width (ft)					27.0	55.0		75.0			15.0	20.0		28.0			16.5	19.0		25.0			25.0	55.0	75.0	100.0	100.0	100.0	100.0		2.0
Bankfull Mean Depth (ft)					0.4	0.6		1.2			0.8	0.9		1.0			0.4	0.6		1.2			0.7	0.7	0.8	0.9	1.0	1.0	1.1		2.0
[1]Bankfull Max Depth (ft)					0.6	1.7		1.7			1.3	1.4		1.5			1.7	1.8		2.0			0.9	1.1	1.3	1.7	1.9	1.9	2.1		2.0
Bankfull Cross Sectional Area (ft^2)					3.2	6.8		7.1			6.2	6.2		6.2			16.7	16.7		16.7			7.1	7.1	7.1	9.4	11.1	11.1	12.8		2.0
Width/Depth Ratio					2.1	17.0		53.2			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	11.1	11.5	11.5	11.9		2.0
Entrenchment Ratio					1.4	6.9		21.2			2.7	2.9		3.0			16.5	19.0		22.0			1.3	2.9	3.0	8.4	8.9	8.9	9.5		2.0
[1]Bank Height Ratio					**1.0**	**1.8**		**5.7**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**2.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					1.9	14.9	8.9	55.2	14.8	20.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0286	0.0457	0.0857	0.0055	0.0201	0.0192	0.0387	0.0095	20.0
Pool Length (ft)																										2.4	10.7	11.2	19.4	4.8	20.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			1.0	1.4	1.4						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			29.9	39.9	69.8	6.9	30.6	28.0	66.9	16.2	19.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			15.0	29.9	39.9	15.0		29.9	39.9		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			19.9	29.9	39.9	15.0		29.9	39.9		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			59.8	84.7	119.6	59.8		84.7	119.6		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2					7.63																		0.78								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					50.82																		49.43								
Additional Reach Parameters																															
Rosgen Classification					Cg 4						Eb 4						B 4						Cb 4			Cb 4					
Bankfull Velocity (fps)					0.6																										
Bankfull Discharge (cfs)					27.7																										
Valley length (ft)					567.0																										
Channel Thalweg length (ft)					578.0																		610.0			601.0					
Sinuosity (ft)					1.0						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0294						0.0226						0.0167						0.0286			0.0163					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).
3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.
4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 8b. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Upper (436 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					2.6	10.9		19.3			5.1	6.8		9.4			11.3	14.0		15.8			9.2	10.0	10.7	8.5	9.1	9.1	9.6		2.0
Floodprone Width (ft)					27.0	55.0		75.0			15.0	20.0		28.0			16.5	19.0		25.0			25.0	55.0	75.0	100.0	100.0	100.0	100.0		2.0
Bankfull Mean Depth (ft)					0.4	0.6		1.2			0.8	0.9		1.0			0.4	0.6		1.2			0.7	0.7	0.8	0.5	0.6	0.6	0.7		2.0
[1]Bankfull Max Depth (ft)					0.6	1.7		1.7			1.3	1.4		1.5			1.7	1.8		2.0			0.9	1.1	1.3	0.8	1.1	1.1	1.4		2.0
Bankfull Cross Sectional Area (ft^2)					3.2	6.8		7.1			6.2	6.2		6.2			16.7	16.7		16.7			7.1	7.1	7.1	4.3	5.4	5.4	6.6		2.0
Width/Depth Ratio					2.1	17.0		53.2			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	14.0	15.5	15.5	16.9		2.0
Entrenchment Ratio					1.4	6.9		21.2			2.7	2.9		3.0			16.5	19.0		22.0			1.3	2.9	3.0	10.4	11.1	11.1	11.8		2.0
[1]Bank Height Ratio					**1.0**	**1.8**		**5.7**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**1.0**
Profile																															
Riffle Length (ft)																										1.9	14.9	8.9	55.2	14.8	20.0
Riffle Slope (ft/ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0286	0.0457	0.0857	0.0055	0.0201	0.0192	0.0387	0.0095	20.0
Pool Length (ft)																										2.4	10.7	11.2	19.4	4.8	20.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			1.0	1.4	1.4						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			29.9	39.9	69.8	6.9	30.6	28.0	66.9	16.2	19.0
Pattern																															
Channel Beltwidth (ft)											15.4	19.0		25.2			13.4	14.7		16.6			15.0	29.9	39.9	15.0		29.9	39.9		
Radius of Curvature (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						8.7	15.8		29.4			0.8	2.2		3.3			19.9	29.9	39.9	15.0		29.9	39.9		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			59.8	84.7	119.6	59.8		84.7	119.6		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2					7.6																		0.8								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					50.8																		49.4								
Additional Reach Parameters																															
Rosgen Classification					Cg 4						Eb 4						B 4						Cb 4			Cb 4					
Bankfull Velocity (fps)					0.6																										
Bankfull Discharge (cfs)					27.7																										
Valley length (ft)					189.0																										
Channel Thalweg length (ft)					193.0																		478.0			458.0					
Sinuosity (ft)					1.0						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0294						0.0226						0.0167						0.0286			0.0372					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8c. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Lower (873 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					11.5	12.1		14.1			5.1	6.8		9.4			11.3	14.0		15.8			14.8	16.0	17.1	10.6	17.0	17.0	23.5		2.0
Floodprone Width (ft)					19.0	29.0		100.0			15.0	20.0		28.0			16.5	19.0		25.0			80.0	100.0	120.0	100.0	100.0	100.0	100.0		2.0
Bankfull Mean Depth (ft)					1.3	1.5		1.6			0.8	0.9		1.0			0.4	0.6		1.2			1.1	1.1	1.2	0.9	1.0	1.0	1.2		2.0
[1]Bankfull Max Depth (ft)					1.6	2.0		2.2			1.3	1.4		1.5			1.7	1.8		2.0			1.4	1.7	2.1	1.7	1.9	1.9	2.1		2.0
Bankfull Cross Sectional Area (ft^2)					18.2	18.2		18.2			6.2	6.2		6.2			16.7	16.7		16.7			18.2	18.2	18.2	9.4	18.3	18.3	27.2		2.0
Width/Depth Ratio					7.3	8.0		10.9			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	11.9	16.1	16.1	20.2		2.0
Entrenchment Ratio					1.3	2.5		8.3			2.7	2.9		3.0			16.5	19.0		22.0			5.4	6.3	7.0	4.3	6.9	6.9	9.5		2.0
[1]Bank Height Ratio					**1.8**	**2.0**		**2.4**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**2.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					16.7	35.3	33.0	65.0	13.7	15.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0141	0.0225	0.0423	0.0081	0.0183	0.0194	0.0276	0.0055	15.0
Pool Length (ft)																										11.3	20.4	20.3	29.2	6.5	15.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			1.6	2.2	2.3						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			47.9	63.8	111.7	32.2	64.0	57.0	104.0	18.9	15.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			23.9	47.9.	63.8	23.9		47.9	63.8		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			31.9	47.9	63.8	31.9		47.9	47.9		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			95.8	135.7	191.5	95.8		165.7	191.5		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f[2]					3.0																		0.9								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					69.1																		66.7								
Additional Reach Parameters																															
Rosgen Classification					Eg 4						Eb 4						B 4						Ce 4			Ce 4					
Bankfull Velocity (fps)					1.5																		4.2			960.0					
Bankfull Discharge (cfs)					75.8																										
Valley length (ft)					1681.0																										
Channel Thalweg length (ft)					3582.0																		971.0			960.0					
Sinuosity (ft)					1.1						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0146						0.0226						0.0167						0.0155			0.0129					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8d. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Upper (1995 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					11.5	12.1		14.1			5.1	6.8		9.4			11.3	14.0		15.8			14.8	16.0	17.1	14.2	16.1	15.7	18.7	2.1	4.0
Floodprone Width (ft)					19.0	29.0		100.0			15.0	20.0		28.0			16.5	19.0		25.0			80.0	100.0	120.0	100.0	100.0	100.0	100.0	0.0	4.0
Bankfull Mean Depth (ft)					1.3	1.5		1.6			0.8	0.9		1.0			0.4	0.6		1.2			1.1	1.1	1.2	1.0	1.0	1.0	1.1	0.1	4.0
[1]Bankfull Max Depth (ft)					1.6	2.0		2.2			1.3	1.4		1.5			1.7	1.8		2.0			1.4	1.7	2.1	1.6	1.8	1.8	1.9	0.1	4.0
Bankfull Cross Sectional Area (ft^2)					18.2	18.2		18.2			6.2	6.2		6.2			16.7	16.7		16.7			18.2	18.2	18.2	13.6	16.8	16.2	21.4	3.3	4.0
Width/Depth Ratio					7.3	8.0		10.9			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	13.3	15.5	15.6	17.4	1.7	4.0
Entrenchment Ratio					1.3	2.5		8.3			2.7	2.9		3.0			16.5	19.0		22.0			5.4	6.3	7.0	5.4	6.3	6.4	7.0	0.8	4.0
[1]Bank Height Ratio					**1.8**	**2.0**		**2.4**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**	**0.0**	**4.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					8.7	33.7	29.5	79.6	18.6	34.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0141	0.0225	0.0423	0.0082	0.0183	0.0176	0.0338	0.0059	34.0
Pool Length (ft)																										10.1	19.3	17.4	42.7	6.6	34.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			1.6	2.2	2.3						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			47.9	63.8	111.7	33.6	65.4	61.3	108.0	17.8	33.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			23.9	47.9.	63.8	23.9		47.9	63.8		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			31.9	47.9	63.8	31.9		47.9	63.8		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			95.8	135.7	191.5	95.8		165.7	191.5		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2					3.0																		0.9								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					69.1																		66.7								
Additional Reach Parameters																															
Rosgen Classification					Eg 4						Eb 4						B 4						Ce 4			**Ce 4**					
Bankfull Velocity (fps)					1.5																		4.2								
Bankfull Discharge (cfs)					75.8																										
Valley length (ft)					2223.0																										
Channel Thalweg length (ft)					3582.0																		2116.0			2195.0					
Sinuosity (ft)					1.1						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0146						0.0226						0.0167						0.0155			0.0139					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8e. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 4 (278 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)											5.1	6.8		9.4			11.3	14.0		15.8			8.6	9.3	10.0	14.0	14.0	14.0	14.0		1.0
Floodprone Width (ft)											15.0	20.0		28.0			16.5	19.0		25.0			20.0	70.0	120.0	100.0	100.0	100.0	100.0		1.0
Bankfull Mean Depth (ft)											0.8	0.9		1.0			0.4	0.6		1.2			0.6	0.7	0.7	1.0	1.0	1.0	1.0		1.0
[1]Bankfull Max Depth (ft)											1.3	1.4		1.5			1.7	1.8		2.0			0.8	1.0	1.2	1.6	1.6	1.6	1.6		1.0
Bankfull Cross Sectional Area (ft^2)											6.2	6.2		6.2			16.7	16.7		16.7			6.2	6.2	6.2	13.3	13.3	13.3	13.3		1.0
Width/Depth Ratio											5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	14.7	14.7	14.7	14.7		1.0
Entrenchment Ratio											2.7	2.9		3.0			16.5	19.0		22.0			2.3	7.5	12.0	7.2	7.2	7.2	7.2		1.0
[1]Bank Height Ratio											**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**1.0**
Profile																															
Riffle Length (ft)																										10.4	25.1	19.3	63.9	19.9	6.0
Riffle Slope (ft/ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0194	0.0311	0.0583	0.0095	0.0338	0.0380	0.0619	0.0189	6.0
Pool Length (ft)																										12.8	15.0	14.8	19.2	2.3	6.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			0.9	1.3	1.3						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			27.9	37.3	65.2	28.3	38.0	42.0	45.3	8.2	6.0
Pattern																															
Channel Beltwidth (ft)											15.4	19.0		25.2			13.4	14.7		16.6			14.0	27.9	37.3	27.9		27.9	37.3		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			18.6	27.9	37.3	18.6		27.9	37.3		
Rc:Bankfull width (ft/ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																										
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			55.9	79.2	111.8	55.9		79.2	111.8		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2																							0.7								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2																							28.9								
Additional Reach Parameters																															
Rosgen Classification					G 4						Eb 4						B 4						C4			C 4					
Bankfull Velocity (fps)					1.2																		3.9								
Bankfull Discharge (cfs)					29.6																										
Valley length (ft)					312.0																										
Channel Thalweg length (ft)					362.0																		233.0			292.0					
Sinuosity (ft)					1.2						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0226						0.0226						0.0167						0.0194			0.0235					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8f. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 5 (1024 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					5.6	6.1		7.6			5.1	6.8		9.4			11.3	14.0		15.8			7.6	8.2	8.8	7.3	10.5	9.9	14.4		3.0
Floodprone Width (ft)					8.0	9.0		9.0			15.0	20.0		28.0			16.5	19.0		25.0			80.0	100.0	120.0	100.0	100.0	100.0	100.0		3.0
Bankfull Mean Depth (ft)					0.6	0.8		0.9			0.8	0.9		1.0			0.4	0.6		1.2			0.5	0.6	0.6	0.6	0.7	0.7	0.8		3.0
[1]Bankfull Max Depth (ft)					0.8	1.2		1.3			1.3	1.4		1.5			1.7	1.8		2.0			0.7	0.9	1.1	1.0	1.3	1.5	1.5		3.0
Bankfull Cross Sectional Area (ft^2)					4.8	4.8		4.8			6.2	6.2		6.2			16.7	16.7		16.7			4.8	4.8	4.8	4.5	7.6	7.9	10.4		3.0
Width/Depth Ratio					6.5	7.8		12.0			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	11.9	14.7	12.5	19.8		3.0
Entrenchment Ratio					1.2	1.4		1.5			2.7	2.9		3.0			16.5	19.0		22.0			10.5	12.2	13.7	7.0	10.3	10.1	13.7		3.0
[1]Bank Height Ratio					**2.4**	**4.8**		**5.8**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**3.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					9.2	17.7	15.2	36.5	7.6	31.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0134	0.0214	0.0401	0.0111	0.0268	0.0248	0.0631	0.0105	31.0
Pool Length (ft)																										5.5	12.1	12.5	18.2	3.0	30.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			0.8	1.1	1.2						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			24.6	32.8	57.4	24.0	34.6	32.5	50.2	6.8	30.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			12.3	24.6	32.8	12.3		24.6	32.8		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			16.4	24.6	32.8	16.4		32.8	47.9		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			49.2	69.7	98.4	49.2		69.7	98.4		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2					7.6																		0.4								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					15.8																		15.1								
Additional Reach Parameters																															
Rosgen Classification					G 3						Eb 4						B 4						Ce 4			Ce 4					
Bankfull Velocity (fps)					0.3																		3.8								
Bankfull Discharge (cfs)					18.1																										
Valley length (ft)					1158.0																										
Channel Thalweg length (ft)					769.0																		1076.0			1076.0					
Sinuosity (ft)					1.1						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.014						0.0226						0.0167						0.0134			0.0221					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8g. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 6 (1265 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					4.2	5.5		6.4			5.1	6.8		9.4			11.3	14.0		15.8			6.1	6.6	7.0	9.5	10.4	10.1	11.7	1.0	4.0
Floodprone Width (ft)					8.0	9.0		9.0			15.0	20.0		28.0			16.5	19.0		25.0			25.0	50.0	75.0	100.0	100.0	100.0	100.0	0.0	4.0
Bankfull Mean Depth (ft)					0.5	0.6		0.7			0.8	0.9		1.0			0.4	0.6		1.2			0.4	0.5	0.5	0.5	0.7	0.7	0.9	0.2	4.0
[1]Bankfull Max Depth (ft)					0.6	1.0		1.3			1.3	1.4		1.5			1.7	1.8		2.0			0.6	0.7	0.9	0.9	1.1	1.1	1.3	0.2	4.0
Bankfull Cross Sectional Area (ft^2)					3.1	3.1		3.1			6.2	6.2		6.2			16.7	16.7		16.7			3.1	3.1	3.1	5.6	7.0	7.1	8.1	1.3	4.0
Width/Depth Ratio					5.7	9.8		13.2			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	11.1	16.0	15.5	22.0	5.1	4.0
Entrenchment Ratio					1.4	1.5		2.1			2.7	2.9		3.0			16.5	19.0		22.0			4.1	7.6	10.6	8.5	9.7	9.9	10.5	0.9	4.0
[1]Bank Height Ratio					**2.8**	**3.9**		**5.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**	**0.0**	**4.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					4.8	16.1	13.5	45.8	8.4	47.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0042	0.0067	0.0125	0.0004	0.0085	0.0066	0.0510	0.0087	36.0
Pool Length (ft)																										2.0	10.3	10.9	15.7	3.5	46.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			0.7	0.9	0.9						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			19.8	26.4	46.1	14.5	30.9	29.5	60.5	8.8	46.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			9.9	19.8	26.4	9.9		19.8	26.4		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			13.2	19.8	26.4	13.2		19.8	26.4		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			39.5	56.0	79.1	39.5		56.0	79.1		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f[2]					1.1																		0.1								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					2.8																		3.0								
Additional Reach Parameters																															
Rosgen Classification					G 3						Eb 4						B 4						Ce 4			Ce 4					
Bankfull Velocity (fps)					0.4																		3.7								
Bankfull Discharge (cfs)					11.5																										
Valley length (ft)					2135.0																										
Channel Thalweg length (ft)					1363.0																		1455.0			1455					
Sinuosity (ft)					1.0						1.2						1.0						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)					0.0039						0.0226						0.0167						0.0042			0.0051					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8h. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 7 (1844 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					7.0	7.4		9.7			5.1	6.8		9.4			11.3	14.0		15.8			8.6	9.3	10.0	10.1	11.9	12.2	13.2	1.4	4.0
Floodprone Width (ft)					10.0	13.0		17.0			15.0	20.0		28.0			16.5	19.0		25.0			20.0	70.0	120.0	100.0	100.0	100.0	100.0	0.0	4.0
Bankfull Mean Depth (ft)					0.6	0.8		0.9			0.8	0.9		1.0			0.4	0.6		1.2			0.6	0.7	0.7	0.5	0.7	0.7	0.8	0.1	4.0
[1]Bankfull Max Depth (ft)					0.9	1.1		1.3			1.3	1.4		1.5			1.7	1.8		2.0			0.8	1.0	1.2	0.8	1.1	1.2	1.3	0.2	4.0
Bankfull Cross Sectional Area (ft^2)					6.2	6.2		6.2			6.2	6.2		6.2			16.7	16.7		16.7			6.2	6.2	6.2	5.2	8.3	8.6	10.7	2.5	4.0
Width/Depth Ratio					7.9	8.8		15.2			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	15.5	17.8	18.0	19.6	1.7	4.0
Entrenchment Ratio					1.4	1.5		2.4			2.7	2.9		3.0			16.5	19.0		22.0			2.3	7.5	12.0	7.6	8.5	8.2	9.9	1.1	4.0
[1]Bank Height Ratio					**1.4**	**1.9**		**2.6**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**	**0.0**	**4.0**
Profile																															
Riffle Length (ft)																										7.7	27.4	24.3	91.3	15.5	44.0
Riffle Slope (ft/ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0194	0.0311	0.0583	0.0003	0.0126	0.0097	0.0396	0.0113	44.0
Pool Length (ft)																										4.0	11.3	11.7	15.8	2.7	44.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			0.9	1.3	1.3						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			27.9	37.3	65.2	22.3	44.2	40.1	107.9	16.3	43.0
Pattern																															
Channel Beltwidth (ft)											15.4	19.0		25.2			13.4	14.7		16.6			14.0	27.9	37.3	27.9		27.9	37.3		
Radius of Curvature (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						8.7	15.8		29.4			0.8	2.2		3.3			18.6	27.9	37.3	18.6		27.9	37.3		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			55.9	79.2	111.8	55.9		79.2	111.8		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f[2]					2.1																		0.7								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					30.1																		28.9								
Additional Reach Parameters																															
Rosgen Classification					Gb 4						Eb 4						B 4						Eb 4			Eb 4					
Bankfull Velocity (fps)					1.6																		3.9								
Bankfull Discharge (cfs)					23.9																										
Valley length (ft)					1985.0																										
Channel Thalweg length (ft)					2426.0																		1973.0			1973					
Sinuosity (ft)					1.0						1.2						1.0						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.0202						0.0226						0.0167						0.0194			0.0103					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 8i. Baseline Stream Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 8 (760 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						UT4 Reference Data						Chemtronics Reference Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					5.6	6.8		9.4			5.1	6.8		9.4			11.3	14.0		15.8			6.6	7.1	7.6	10.3	12.0	12.1	13.7		3.0
Floodprone Width (ft)					11.0	12.0		19.0			15.0	20.0		28.0			16.5	19.0		25.0			25.0	50.0	75.0	100.0	100.0	100.0	100.0		3.0
Bankfull Mean Depth (ft)					0.4	0.5		0.6			0.8	0.9		1.0			0.4	0.6		1.2			0.5	0.5	0.5	0.6	0.7	0.7	0.7		3.0
[1]Bankfull Max Depth (ft)					0.6	0.8		0.9			1.3	1.4		1.5			1.7	1.8		2.0			0.6	0.8	0.9	1.2	1.4	1.4	1.7		3.0
Bankfull Cross Sectional Area (ft^2)					3.6	3.6		3.6			6.2	6.2		6.2			16.7	16.7		16.7			3.6	3.6	3.6	6.4	8.3	8.3	10.2		3.0
Width/Depth Ratio					8.7	12.8		24.5			5.1	7.6		11.8			8.1	12.0		14.8			12.0	14.0	16.0	16.6	17.5	17.7	18.3		3.0
Entrenchment Ratio					1.8	2.0		2.0			2.7	2.9		3.0			16.5	19.0		22.0			3.8	7.0	9.9	7.3	8.4	8.2	9.7		3.0
[1]Bank Height Ratio					**2.3**	**2.7**		**3.8**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**		**1.0**			**1.0**	**1.0**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**		**3.0**
Profile																															
Riffle Length (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities																					7.8	15.9	13.8	32.4	7.2	27.0
Riffle Slope (ft/ft)											0.0090	0.0400		0.0754			0.0156	0.0228		0.0468			0.0144	0.0231	0.0433	0.0002	0.0098	0.0101	0.0231	0.0056	27.0
Pool Length (ft)																										6.8	12.2	12.4	19.9	2.6	27.0
Pool Max depth (ft)											2.0	2.3		2.6			1.9	2.1		2.3			0.7	1.0	1.0						
Pool Spacing (ft)											27.3	37.1		45.8			28.8	50.7		70.7			21.3	28.4	49.7	24.1	32.2	30.6	48.2	6.9	26.0
Pattern																															
Channel Beltwidth (ft)					No distinct repetitive pattern of riffles and pools due to staightening activities						15.4	19.0		25.2			13.4	14.7		16.6			10.6	21.3	28.4	10.6		21.3	28.4		
Radius of Curvature (ft)											8.7	15.8		29.4			0.8	2.2		3.3			14.2	21.3	28.4	14.2		21.3	28.4		
Rc:Bankfull width (ft/ft)																															
Meander Wavelength (ft)											56.5	63.8		76.0			59.8	96.3		117.2			42.6	63.9	85.2	42.6		64.0	85.2		
Meander Width Ratio											2.3	2.8		3.7			1.0	1.1		1.2			1.5	3.0	4.0	1.5		3.0	4.0		
Transport parameters																															
Reach Shear Stress (competency) lb/f^2					1.1																		0.4								
Max part size (mm) mobilized at bankfull																															
Stream Power (transport capacity) W/m^2					3.9																		12.3								
Additional Reach Parameters																															
Rosgen Classification					Eg 4						Eb 4						B 4						C 4			C 4					
Bankfull Velocity (fps)					0.4																		3.8								
Bankfull Discharge (cfs)					13.5																										
Valley length (ft)					1047.0																										
Channel Thalweg length (ft)					957.0																		874.0			874.0					
Sinuosity (ft)					1.0						1.2						1.0						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)					0.0046						0.0226						0.0167						0.0144			0.0063					
BF slope (ft/ft)																															
[3]Bankfull Floodplain Area (acres)																															
[4]% of Reach with Eroding Banks																															
Channel Stability or Habitat Metric																															
Biological or Other																															

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

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

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

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

Table 9a. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Lower (572 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													49	5	39	10			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Upper (436 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													58	5	26	7			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9c. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Lower (873 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													55	3	32	10			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Shaded cells indicate that these will typically not be filled in.
1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates
3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.
The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.
ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-constrution distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 9d. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Upper (1995 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													52	6	30	12			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9e. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 4 (278 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													52	3	31	9			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9f. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 5 (1024 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													51	4	34	11			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Shaded cells indicate that these will typically not be filled in.
1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates
3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.
The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.
ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-constrution distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 9g. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 6 (1265 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													50	6	31	10			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9h. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 7 (1844 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													61	5	25	7			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

Table 9i. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 8 (760 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																													49	5	38	9			
[1]SC% / Sa% / G% / C% / B% / Be%																																			
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)																																			
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																																			
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																																			

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

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.
The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.
ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-constrution distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Lower (572 feet)

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Pool)							Cross Section 4 (Riffle)													
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
Record elevation (datum) used																																			
Bankfull Width (ft)	11.9							8.2							9.2							10.6													
Floodprone Width (ft)	100.0							NA							NA							100.0													
Bankfull Mean Depth (ft)	1.1							1.0							0.8							0.9													
Bankfull Max Depth (ft)	2.1							1.9							1.4							1.7													
Bankfull Cross Sectional Area (ft^2)	12.8							8.3							7.4							9.4													
Bankfull Width/Depth Ratio	11.1							NA							NA							11.9													
Bankfull Entrenchment Ratio	8.4							NA							NA							9.5													
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0													
Cross Sectional Area between end pins (ft^2)	46.9							22.5							23.2							15.8													
d50 (mm)																																			

Table 10b. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Upper (436 feet)

	Cross Section 5 (Riffle)							Cross Section 6 (Pool)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)													
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
Record elevation (datum) used																																			
Bankfull Width (ft)	8.5							6.2							10.0							9.6													
Floodprone Width (ft)	100.0							NA							NA							100.0													
Bankfull Mean Depth (ft)	0.5							0.6							0.9							0.7													
Bankfull Max Depth (ft)	0.8							1.3							2.3							1.4													
Bankfull Cross Sectional Area (ft^2)	4.3							3.8							9.0							6.6													
Bankfull Width/Depth Ratio	16.9							NA							NA							14.0													
Bankfull Entrenchment Ratio	11.8							NA							NA							10.4													
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0													
Cross Sectional Area between end pins (ft^2)	11.6							14.1							17.1							10.3													
d50 (mm)																																			

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: “It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary.”

Table 10c. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Lower (873 feet)

	Cross Section 1 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	23.5						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	1.2						
Bankfull Max Depth (ft)	2.1						
Bankfull Cross Sectional Area (ft^2)	27.2						
Bankfull Width/Depth Ratio	20.2						
Bankfull Entrenchment Ratio	4.3						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	45.6						
d50 (mm)							

	Cross Section 2 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	8.2						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	8.3						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	31.1						
d50 (mm)							

	Cross Section 3 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	9.2						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	0.8						
Bankfull Max Depth (ft)	1.4						
Bankfull Cross Sectional Area (ft^2)	7.4						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	43.1						
d50 (mm)							

	Cross Section 4 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	10.6						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.9						
Bankfull Max Depth (ft)	1.7						
Bankfull Cross Sectional Area (ft^2)	9.4						
Bankfull Width/Depth Ratio	11.9						
Bankfull Entrenchment Ratio	9.5						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	39.2						
d50 (mm)							

	Cross Section 6 (Riffle)	Cross Section 7 (Pool)	Cross Section 8 (Riffle)	Cross Section 9 (Riffle)	Cross Section 10 (Pool)

Table 10d. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Upper (1995 feet)

	Cross Section 5 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	14.3						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.3						
Bankfull Max Depth (ft)	2.2						
Bankfull Cross Sectional Area (ft^2)	19.1						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	61.5						
d50 (mm)							

	Cross Section 6 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	18.7						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	1.1						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	21.4						
Bankfull Width/Depth Ratio	16.3						
Bankfull Entrenchment Ratio	5.4						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	31.0						
d50 (mm)							

	Cross Section 7 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	14.2						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	1.8						
Bankfull Cross Sectional Area (ft^2)	13.6						
Bankfull Width/Depth Ratio	15.0						
Bankfull Entrenchment Ratio	7.0						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	29.5						
d50 (mm)							

	Cross Section 8 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	16.0						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.3						
Bankfull Max Depth (ft)	2.9						
Bankfull Cross Sectional Area (ft^2)	20.8						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	28.5						
d50 (mm)							

	Cross Section 9 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	16.9						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	1.6						
Bankfull Cross Sectional Area (ft^2)	16.4						
Bankfull Width/Depth Ratio	17.4						
Bankfull Entrenchment Ratio	5.9						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	28.5						
d50 (mm)							

	Cross Section 10 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	16.4						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	2.5						
Bankfull Cross Sectional Area (ft^2)	16.7						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	29.3						
d50 (mm)							

	Cross Section 11 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	20.7						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.4						
Bankfull Max Depth (ft)	3.3						
Bankfull Cross Sectional Area (ft^2)	28.8						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	52.7						
d50 (mm)							

	Cross Section 12 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	14.6						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	1.1						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	16.0						
Bankfull Width/Depth Ratio	13.3						
Bankfull Entrenchment Ratio	6.8						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	36.8						
d50 (mm)							

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Table 10e. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 4 (278 feet)

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used														
Bankfull Width (ft)	12.0							14.0						
Floodprone Width (ft)	NA							100.0						
Bankfull Mean Depth (ft)	1.0							1.0						
Bankfull Max Depth (ft)	1.9							1.6						
Bankfull Cross Sectional Area (ft^2)	11.8							13.3						
Bankfull Width/Depth Ratio	NA							14.7						
Bankfull Entrenchment Ratio	NA							7.2						
Bankfull Bank Height Ratio	1.0							1.0						
Cross Sectional Area between end pins (ft^2)	21.1							18.6						
d50 (mm)														

Table 10f. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 5 (1024 feet)

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used														
Bankfull Width (ft)	11.1							9.9						
Floodprone Width (ft)	NA							100.0						
Bankfull Mean Depth (ft)	1.4							0.8						
Bankfull Max Depth (ft)	2.6							1.5						
Bankfull Cross Sectional Area (ft^2)	15.3							7.9						
Bankfull Width/Depth Ratio	NA							12.5						
Bankfull Entrenchment Ratio	NA							10.1						
Bankfull Bank Height Ratio	1.0							1.0						
Cross Sectional Area between end pins (ft^2)	22.2							13.4						
d50 (mm)														

	Cross Section 3 (Pool)							Cross Section 4 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used														
Bankfull Width (ft)	8.6							7.3						
Floodprone Width (ft)	NA							100.0						
Bankfull Mean Depth (ft)	0.9							0.6						
Bankfull Max Depth (ft)	1.5							1.0						
Bankfull Cross Sectional Area (ft^2)	7.4							4.5						
Bankfull Width/Depth Ratio	NA							11.9						
Bankfull Entrenchment Ratio	NA							13.7						
Bankfull Bank Height Ratio	1.0							1.0						
Cross Sectional Area between end pins (ft^2)	10.7							6.1						
d50 (mm)														

	Cross Section 5 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	7.8						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.1						
Bankfull Max Depth (ft)	1.8						
Bankfull Cross Sectional Area (ft^2)	8.7						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	19.7						
d50 (mm)							

	Cross Section 6 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	14.4						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.7						
Bankfull Max Depth (ft)	1.5						
Bankfull Cross Sectional Area (ft^2)	10.4						
Bankfull Width/Depth Ratio	19.8						
Bankfull Entrenchment Ratio	7.0						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	20.0						
d50 (mm)							

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Table 10g. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 6 (1265 feet)

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used																					
Bankfull Width (ft)	9.0							10.2							11.5						
Floodprone Width (ft)	NA							100.0							NA						
Bankfull Mean Depth (ft)	0.9							0.6							0.9						
Bankfull Max Depth (ft)	1.7							0.9							1.7						
Bankfull Cross Sectional Area (ft^2)	8.3							5.6							9.8						
Bankfull Width/Depth Ratio	NA							18.3							NA						
Bankfull Entrenchment Ratio	NA							9.8							NA						
Bankfull Bank Height Ratio	1.0							1.0							1.0						
Cross Sectional Area between end pins (ft^2)	19.4							14.3							25.8						
d50 (mm)																					

	Cross Section 4 (Riffle)							Cross Section 5 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used														
Bankfull Width (ft)	10.1							9.5						
Floodprone Width (ft)	100.0							100.0						
Bankfull Mean Depth (ft)	0.8							0.9						
Bankfull Max Depth (ft)	1.1							1.3						
Bankfull Cross Sectional Area (ft^2)	8.0							8.1						
Bankfull Width/Depth Ratio	12.6							11.1						
Bankfull Entrenchment Ratio	9.9							10.5						
Bankfull Bank Height Ratio	1.0							1.0						
Cross Sectional Area between end pins (ft^2)	16.6							12.8						
d50 (mm)														

	Cross Section 6 (Pool)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used																					
Bankfull Width (ft)	9.6							13.2							11.7						
Floodprone Width (ft)	NA							NA							100.0						
Bankfull Mean Depth (ft)	0.9							0.8							0.5						
Bankfull Max Depth (ft)	1.5							1.8							1.0						
Bankfull Cross Sectional Area (ft^2)	8.4							11.1							6.3						
Bankfull Width/Depth Ratio	NA							NA							22.0						
Bankfull Entrenchment Ratio	NA							NA							8.5						
Bankfull Bank Height Ratio	1.0							1.0							1.0						
Cross Sectional Area between end pins (ft^2)	18.5							26.5							17.4						
d50 (mm)																					

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Table 10h. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 7 (1844 feet)

	Cross Section 1 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	12.9						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.8						
Bankfull Max Depth (ft)	1.3						
Bankfull Cross Sectional Area (ft^2)	10.7						
Bankfull Width/Depth Ratio	15.5						
Bankfull Entrenchment Ratio	7.8						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	18.6						
d50 (mm)							

	Cross Section 2 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	14.2						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.3						
Bankfull Max Depth (ft)	2.1						
Bankfull Cross Sectional Area (ft^2)	18.2						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	34.1						
d50 (mm)							

	Cross Section 3 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	13.2						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.8						
Bankfull Max Depth (ft)	1.3						
Bankfull Cross Sectional Area (ft^2)	9.9						
Bankfull Width/Depth Ratio	17.5						
Bankfull Entrenchment Ratio	7.6						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	20.9						
d50 (mm)							

	Cross Section 4 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	11.4						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.1						
Bankfull Max Depth (ft)	1.8						
Bankfull Cross Sectional Area (ft^2)	13.0						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	23.6						
d50 (mm)							

	Cross Section 5 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	11.6						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.6						
Bankfull Max Depth (ft)	1.1						
Bankfull Cross Sectional Area (ft^2)	7.2						
Bankfull Width/Depth Ratio	18.5						
Bankfull Entrenchment Ratio	8.6						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	20.3						
d50 (mm)							

	Cross Section 6 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	8.8						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.2						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	10.7						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	17.1						
d50 (mm)							

	Cross Section 7 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	9.1						
Floodprone Width (ft)	NA						
Bankfull Mean Depth (ft)	1.3						
Bankfull Max Depth (ft)	2.0						
Bankfull Cross Sectional Area (ft^2)	11.6						
Bankfull Width/Depth Ratio	NA						
Bankfull Entrenchment Ratio	NA						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	21.0						
d50 (mm)							

	Cross Section 8 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used							
Bankfull Width (ft)	10.1						
Floodprone Width (ft)	100.0						
Bankfull Mean Depth (ft)	0.5						
Bankfull Max Depth (ft)	0.8						
Bankfull Cross Sectional Area (ft^2)	5.2						
Bankfull Width/Depth Ratio	19.6						
Bankfull Entrenchment Ratio	9.9						
Bankfull Bank Height Ratio	1.0						
Cross Sectional Area between end pins (ft^2)	11.2						
d50 (mm)							

Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: “It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary.”

Table 10i. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 8 (760 feet)

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used																																			
Bankfull Width (ft)	13.7							11.4							12.1							10.2							10.3						
Floodprone Width (ft)	100.0							NA							100.0							NA							100.0						
Bankfull Mean Depth (ft)	0.7							1.2							0.7							0.9							0.6						
Bankfull Max Depth (ft)	1.7							2.0							1.4							1.7							1.2						
Bankfull Cross Sectional Area (ft^2)	10.2							13.9							8.3							9.1							6.4						
Bankfull Width/Depth Ratio	18.3							NA							17.7							NA							16.6						
Bankfull Entrenchment Ratio	7.3							NA							8.2							NA							9.7						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0							1.0						
Cross Sectional Area between end pins (ft^2)	31.1							38.2							18.8							19.8							13.5						
d50 (mm)																																			
	Cross Section 6 (Pool)																																		
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+																												
Record elevation (datum) used																																			
Bankfull Width (ft)	15.9																																		
Floodprone Width (ft)	NA																																		
Bankfull Mean Depth (ft)	0.8																																		
Bankfull Max Depth (ft)	1.9																																		
Bankfull Cross Sectional Area (ft^2)	13.1																																		
Bankfull Width/Depth Ratio	NA																																		
Bankfull Entrenchment Ratio	NA																																		
Bankfull Bank Height Ratio	1.0																																		
Cross Sectional Area between end pins (ft^2)	25.0																																		
d50 (mm)																																			

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Table 11a. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Lower (572 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	10.56	11.22	11.22	11.88		2																														
Floodprone Width (ft)	100	100	100	100		2																														
Bankfull Mean Depth (ft)	0.888	0.981	0.981	1.075		2																														
[1]Bankfull Max Depth (ft)	1.703	1.895	1.895	2.087		2																														
Bankfull Cross Sectional Area (ft^2)	9.378	11.07	11.07	12.77		2																														
Width/Depth Ratio	11.06	11.47	11.47	11.88		2																														
Entrenchment Ratio	8.416	8.944	8.944	9.472		2																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**2**																														
Profile																																				
Riffle Length (ft)	1.924	14.87	8.897	55.19	14.76	20																														
Riffle Slope (ft/ft)	0.006	0.020	0.019	0.039	0.010	20																														
Pool Length (ft)	2.416	10.68	11.19	19.43	4.772	20																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	6.911	30.62	28.03	66.88	16.18	19																														
Pattern																																				
Channel Beltwidth (ft)	15		29.9	39.9																																
Radius of Curvature (ft)	15		29.9	39.9																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	59.82		84.7	119.6																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Cb 4																																			
Channel Thalweg length (ft)	601																																			
Sinuosity (ft)	1.05																																			
Water Surface Slope (Channel) (ft/ft)	0.0163																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

	Table 11b. Monitoring Data - Stream Reach Data Summary Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 1 Upper (436 feet)																																			
Parameter	**Baseline**						**MY-1**						**MY-2**						**MY- 3**						**MY- 4**						**MY- 5**					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	8.5	9.052	9.052	9.603		2																														
Floodprone Width (ft)	100	100	100	100		2																														
Bankfull Mean Depth (ft)	0.503	0.593	0.593	0.684		2																														
[1]Bankfull Max Depth (ft)	0.831	1.111	1.111	1.391		2																														
Bankfull Cross Sectional Area (ft^2)	4.276	5.421	5.421	6.566		2																														
Width/Depth Ratio	14.05	15.47	15.47	16.9		2																														
Entrenchment Ratio	10.41	11.09	11.09	11.76		2																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**1**																														
Profile																																				
Riffle Length (ft)	12.63	22.14	20.55	43.08	8.919	12																														
Riffle Slope (ft/ft)	0.021	0.040	0.039	0.066	0.014	12																														
Pool Length (ft)	6.968	9.924	8.689	18.48	3.385	12																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	26.4	37.44	34.84	52.16	8.468	11																														
Pattern																																				
Channel Beltwidth (ft)	15		29.9	39.9																																
Radius of Curvature (ft)	15		29.9	39.9																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	59.82		84.7	119.6																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Cb 4																																			
Channel Thalweg length (ft)	458																																			
Sinuosity (ft)	1.05																																			
Water Surface Slope (Channel) (ft/ft)	0.0372																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11c. Monitoring Data - Stream Reach Data Summary

Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Lower (873 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	Mean	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	10.56	17.01	17.01	23.46		2																														
Floodprone Width (ft)	100	100	100	100		2																														
Bankfull Mean Depth (ft)	0.888	1.024	1.024	1.159		2																														
[1]Bankfull Max Depth (ft)	1.703	1.899	1.899	2.094		2																														
Bankfull Cross Sectional Area (ft^2)	9.378	18.28	18.28	27.19		2																														
Width/Depth Ratio	11.88	16.06	16.06	20.24		2																														
Entrenchment Ratio	4.262	6.867	6.867	9.472		2																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**2**																														
Profile																																				
Riffle Length (ft)	16.73	35.32	33.02	64.95	13.72	15																														
Riffle Slope (ft/ft)	0.008	0.018	0.019	0.028	0.006	15																														
Pool Length (ft)	11.32	20.36	20.28	29.23	6.49	15																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	32.17	64.03	56.97	104	18.91	15																														
Pattern																																				
Channel Beltwidth (ft)	23.9		47.9	63.8																																
Radius of Curvature (ft)	31.9		47.9	47.9																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	95.8		165.7	191.5																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Ce 4																																			
Channel Thalweg length (ft)	960																																			
Sinuosity (ft)	1.1																																			
Water Surface Slope (Channel) (ft/ft)	0.0129																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11d. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 3 Upper (1995 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	14.25	16.1	15.75	18.67	2.069	4																														
Floodprone Width (ft)	100	100	100	100	0	4																														
Bankfull Mean Depth (ft)	0.951	1.041	1.033	1.146	0.095	4																														
[1]Bankfull Max Depth (ft)	1.611	1.793	1.83	1.903	0.131	4																														
Bankfull Cross Sectional Area (ft^2)	13.55	16.84	16.2	21.4	3.291	4																														
Width/Depth Ratio	13.34	15.5	15.63	17.38	1.739	4																														
Entrenchment Ratio	5.356	6.286	6.384	7.02	0.783	4																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**	**0**	**4**																														
Profile																																				
Riffle Length (ft)	8.655	33.73	29.5	79.65	18.55	34																														
Riffle Slope (ft/ft)	0.008	0.018	0.018	0.034	0.006	34																														
Pool Length (ft)	10.08	19.26	17.43	42.65	6.576	34																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	33.58	65.36	61.27	108	17.84	33																														
Pattern																																				
Channel Beltwidth (ft)	23.9		47.9	63.8																																
Radius of Curvature (ft)	31.9		47.9	63.8																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	95.8		165.7	191.5																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Ce 4																																			
Channel Thalweg length (ft)	2195																																			
Sinuosity (ft)	1.1																																			
Water Surface Slope (Channel) (ft/ft)	0.0139																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11e. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 4 (278 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	13.97	13.97	13.97	13.97		1																														
Floodprone Width (ft)	100	100	100	100		1																														
Bankfull Mean Depth (ft)	0.952	0.952	0.952	0.952		1																														
[1]Bankfull Max Depth (ft)	1.613	1.613	1.613	1.613		1																														
Bankfull Cross Sectional Area (ft^2)	13.3	13.3	13.3	13.3		1																														
Width/Depth Ratio	14.67	14.67	14.67	14.67		1																														
Entrenchment Ratio	7.158	7.158	7.158	7.158		1																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**1**																														
Profile																																				
Riffle Length (ft)	10.42	25.15	19.31	63.94	19.9	6																														
Riffle Slope (ft/ft)	0.009	0.034	0.038	0.062	0.019	6																														
Pool Length (ft)	12.84	14.96	14.76	19.24	2.287	6																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	28.34	38	42.04	45.35	8.199	6																														
Pattern																																				
Channel Beltwidth (ft)	27.9		27.9	37.3																																
Radius of Curvature (ft)	18.6		27.9	37.3																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	55.9		79.2	111.8																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	C 4																																			
Channel Thalweg length (ft)	292																																			
Sinuosity (ft)	1.05																																			
Water Surface Slope (Channel) (ft/ft)	0.0235																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11f. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 5 (1024 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	7.288	10.52	9.918	14.36		3																														
Floodprone Width (ft)	100	100	100	100		3																														
Bankfull Mean Depth (ft)	0.614	0.711	0.725	0.796		3																														
[1]Bankfull Max Depth (ft)	0.978	1.348	1.528	1.54		3																														
Bankfull Cross Sectional Area (ft^2)	4.475	7.59	7.892	10.4		3																														
Width/Depth Ratio	11.87	14.72	12.47	19.81		3																														
Entrenchment Ratio	6.966	10.26	10.08	13.72		3																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**3**																														
Profile																																				
Riffle Length (ft)	9.158	17.7	15.15	36.54	7.615	31																														
Riffle Slope (ft/ft)	0.011	0.027	0.025	0.063	0.010	31																														
Pool Length (ft)	5.509	12.12	12.54	18.16	3.017	30																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	24.01	34.63	32.47	50.16	6.837	30																														
Pattern																																				
Channel Beltwidth (ft)	12.3		24.6	32.8																																
Radius of Curvature (ft)	16.4		32.8	47.9												Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	49.19		69.7	98.37																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Ce 4																																			
Channel Thalweg length (ft)	1076																																			
Sinuosity (ft)	1.05																																			
Water Surface Slope (Channel) (ft/ft)	0.0221																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11g. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 6 (1265 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	9.483	10.37	10.12	11.74	0.964	4																														
Floodprone Width (ft)	100	100	100	100	0	4																														
Bankfull Mean Depth (ft)	0.533	0.686	0.676	0.857	0.166	4																														
[1]Bankfull Max Depth (ft)	0.865	1.074	1.056	1.319	0.198	4																														
Bankfull Cross Sectional Area (ft^2)	5.639	7.015	7.145	8.131	1.26	4																														
Width/Depth Ratio	11.06	16.01	15.47	22.04	5.078	4																														
Entrenchment Ratio	8.519	9.707	9.882	10.54	0.852	4																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**	**0**	**4**																														
Profile																																				
Riffle Length (ft)	4.81	16.05	13.49	45.77	8.382	47																														
Riffle Slope (ft/ft)	0.000	0.008	0.007	0.051	0.009	36																														
Pool Length (ft)	1.97	10.27	10.89	15.65	3.499	46																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	14.55	30.95	29.52	60.46	8.806	46																														
Pattern																																				
Channel Beltwidth (ft)	9.9		19.8	26.4																																
Radius of Curvature (ft)	13.2		19.8	26.4																																
Rc:Bankfull width (ft/ft)																	Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline																			
Meander Wavelength (ft)	39.5		56	79.1																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Ce 4																																			
Channel Thalweg length (ft)	1455																																			
Sinuosity (ft)	1.15																																			
Water Surface Slope (Channel) (ft/ft)	0.0051																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11h. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 7 (1844 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	10.09	11.92	12.22	13.15	1.402	4																														
Floodprone Width (ft)	100	100	100	100	0	4																														
Bankfull Mean Depth (ft)	0.515	0.681	0.69	0.83	0.139	4																														
[1]Bankfull Max Depth (ft)	0.82	1.123	1.163	1.345	0.235	4																														
Bankfull Cross Sectional Area (ft^2)	5.196	8.26	8.583	10.68	2.517	4																														
Width/Depth Ratio	15.52	17.76	17.95	19.61	1.734	4																														
Entrenchment Ratio	7.602	8.481	8.207	9.908	1.056	4																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**	**0**	**4**																														
Profile																																				
Riffle Length (ft)	7.735	27.4	24.34	91.32	15.53	44																														
Riffle Slope (ft/ft)	0.000	0.013	0.010	0.040	0.011	44																														
Pool Length (ft)	4.044	11.28	11.73	15.84	2.729	44																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	22.31	44.19	40.07	107.9	16.31	43																														
Pattern																																				
Channel Beltwidth (ft)	27.9		27.9	37.3																																
Radius of Curvature (ft)	18.6		27.9	37.3																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	55.9		79.2	111.8																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	Eb 4																																			
Channel Thalweg length (ft)	1973																																			
Sinuosity (ft)	1.07																																			
Water Surface Slope (Channel) (ft/ft)	0.0103																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Table 11i. Monitoring Data - Stream Reach Data Summary
Project Name/Number (Warren Wilson/100019) Segment/Reach: UT 8 (760 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	10.34	12.04	12.13	13.66		3																														
Floodprone Width (ft)	100	100	100	100		3																														
Bankfull Mean Depth (ft)	0.624	0.684	0.684	0.745		3																														
[1]Bankfull Max Depth (ft)	1.197	1.433	1.426	1.677		3																														
Bankfull Cross Sectional Area (ft^2)	6.446	8.305	8.293	10.18		3																														
Width/Depth Ratio	16.57	17.55	17.74	18.34		3																														
Entrenchment Ratio	7.32	8.413	8.244	9.676		3																														
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**3**																														
Profile																																				
Riffle Length (ft)	7.812	15.86	13.77	32.44	7.157	27																														
Riffle Slope (ft/ft)	0.000	0.010	0.010	0.023	0.006	27																														
Pool Length (ft)	6.84	12.15	12.42	19.87	2.569	27																														
Pool Max depth (ft)																																				
Pool Spacing (ft)	24.07	32.15	30.62	48.15	6.855	26																														
Pattern																																				
Channel Beltwidth (ft)	10.65		21.3	28.4																																
Radius of Curvature (ft)	14.2		21.3	28.4																																
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	42.6		64	85.2																																
Meander Width Ratio	1.5		3	4																																
Additional Reach Parameters																																				
Rosgen Classification	C 4																																			
Channel Thalweg length (ft)	874																																			
Sinuosity (ft)	1.15																																			
Water Surface Slope (Channel) (ft/ft)	0.0063																																			
BF slope (ft/ft)	------																																			
[3]Ri% / Ru% / P% / G% / S%																																				
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	**0**																																			
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Appendix E
As-Built/Record Drawings

AS-BUILT/RECORD
DRAWING SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

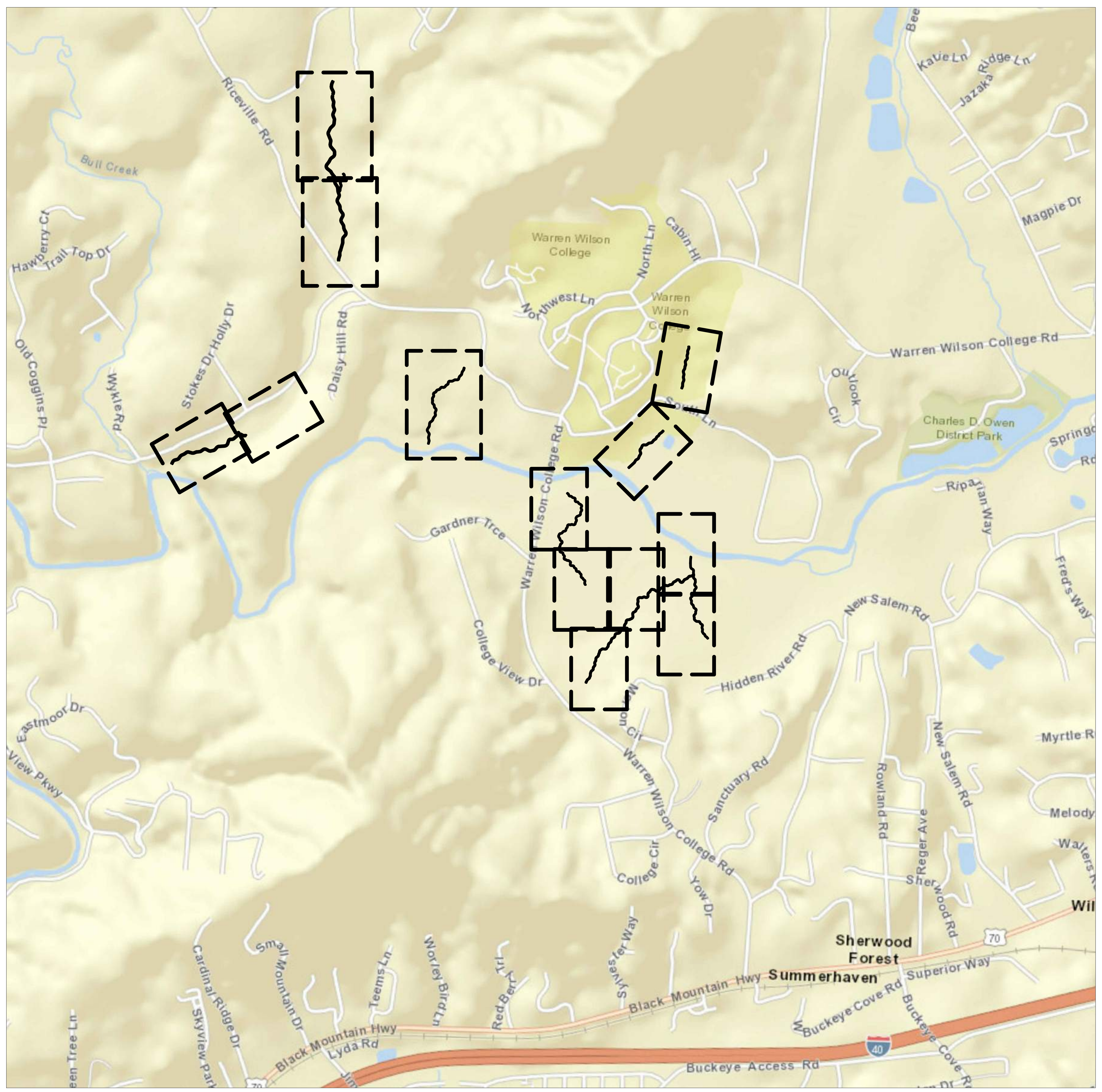
811
Know what's below.
Call before you dig.

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

AS-BUILT/RECORD DRAWINGS

WARREN WILSON COLLEGE STREAM MITIGATION SITE

SWANNANOA, BUNCOMBE COUNTY, NC



SOURCE: BING MAPS

VICINITY MAP

NORTH

0 1000 2000
SCALE IN FEET

DRAWING INDEX

DWG #	TITLE
G-1	COVER SHEET
G-2	SHEET INDEX
P-1	AS-BUILT PLANTING TABLE
AB-1.0	UT-1 LOWER LAYOUT AND STRUCTURES AS-BUILT
AB-2.0	UT-1 UPPER LAYOUT AND STRUCTURES AS-BUILT
AB-3.0	UT-3 LOWER LAYOUT AND STRUCTURES AS-BUILT
AB-3.1	UT-3 LOWER LAYOUT AND STRUCTURES AS-BUILT
AB-4.0	UT-3 UPPER/UT-4 LAYOUT AND STRUCTURES AS-BUILT
AB-4.1	UT-3 UPPER/UT-4 LAYOUT AND STRUCTURES AS-BUILT
AB-5.0	UT-5 LAYOUT AND STRUCTURES AS-BUILT
AB-6.0	UT-6 LAYOUT AND STRUCTURES AS-BUILT
AB-6.1	UT-6 LAYOUT AND STRUCTURES AS-BUILT
AB-7.0	UT-7 & UT-8 LAYOUT AND STRUCTURES AS-BUILT
AB-7.1	UT-7 LAYOUT AND STRUCTURES AS-BUILT
AB-7.2	UT-7 LAYOUT AND STRUCTURES AS-BUILT
AB-7.3	UT-8 LAYOUT AND STRUCTURES AS-BUILT

ABBREVIATIONS

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
CONT	CONTINUED OR CONTINUOUS
CMP	CORRUGATED METAL PIPE
CP	CONTROL POINT (SURVEYED)
DGPS	DIFFERENTIAL GLOBAL POSITIONING SYSTEM
DIA	DIAMETER
DWG	DRAWING
EA	EACH
EL, ELEV	ELEVATION
EX	EXISTING
FT	FOOT OR FEET
HDPE	HIGH-DENSITY POLYETHYLENE
IE	INVERT ELEVATION
IN	INCH OR INCHES
MAX	MAXIMUM
MIN	MINIMUM
NAD	NORTH AMERICAN DATUM
PE	PROFESSIONAL ENGINEER, POLYETHYLENE
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
STA	STATION
TYP	TYPICAL
UT	UNNAMED TRIBUTARY

SURVEYORS CERTIFICATION(S)

Surveyor's disclaimer: No attempt was made to locate any cemeteries, wetlands, hazardous material sites, underground utilities or any other features above, or below ground other than those shown. However, no visible evidence of cemeteries or utilities, aboveground or otherwise, was observed by the undersigned (other than those shown).

I certify that the survey is of an existing parcel or parcels of land or one or more existing easements and does not create a new street or change an existing street.

I JOHN A. RUDOLPH , certify that this plat was prepared under my supervision from an actual field survey made under my supervision, of as-built conditions.

That the boundaries not surveyed are clearly indicated as such and were plotted from information as referenced hereon; That the ratio of precision as calculated was 1:7,500+ and that the global navigational satellite system (GNSS) was used to perform this survey and the following information was used:
Class of Survey: CLASS B (HORIZONTAL) CLASS B (VERTICAL)
Positional Accuracy: 0.12 feet (HORIZONTAL)
Type of GPS field procedure: RTK
Dates of survey: January - June 2020
Datum/Epoch: NAD 1983(2011)
Published/Fixed Control Use: OPUS
Geoid Model: 2018 CONUS
Combined Grid Factor: 0.99990680 GROUND TO GRID
Units: US SURVEY FEET

That this plat meets the requirements of the standards of practice for land surveying in North Carolina. Witness my hand and seal this 24 day of June , 2020

SEAL OR STAMP

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN A. RUDOLPH

Professional Land Surveyor

L-4194
License Number

DATA BLOCK

PROPERTY OWNER: WARREN WILSON COLLEGE
PIN #: 9679-54-4937
RIVER BASIN: FRENCH BROAD
PROPERTY SIZE: 1005.5 ACRES
CONTACT PERSON:
WORTH CREECH
RESTORATION SYSTEMS
(919) 389-3888
DESIGN PROFESSIONAL:
ANCHOR QEA OF NORTH CAROLINA, PLLC
231 HAYWOOD STREET
ASHEVILLE, NC 28801
CONTACT: SARA STAVINOHA
(828) 281-3350
PROJECT NAME: WARREN WILSON COLLEGE STREAM MITIGATION SITE
NCDMS PROJECT ID NO.: 100019
FULL DELIVERY CONTRACT NO.: 7188
USACE ACTION ID NO.: SAW-2017-01557
RFP NO.: 16-006991

DESIGNED BY: A. BREW/M. GIESCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

COVER SHEET

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

G-1

PROJ. #: C71672-01.01

\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Cover.dwg G-1

Aug 27, 2020 2:12pm sstavinoha

AS-BUILT/RECORD DRAWING SET

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

SHEET INDEX

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

G-2

PROJ. #: C71672-01.01

Aug 27, 2020 2:17pm sstavinoha \\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Cover.dwg G-2

AS-BUILT/RECORD DRAWING SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

Know what's **below.** **Call** before you dig.

Planted Bare Root Woody Vegetation

Species	Total*
Acres	**19.64**
Betula nigra	~~2808~~ 2800
~~*Carpinus caroliniana*~~	~~418~~^
Cephalanthus occidentalis	~~54~~ 50
~~*Clethra alnifolia*~~	~~41~~^
Cornus amomum	~~3848~~ 3900*
Diospyros virginiana	~~418~~ 500
Fraxinus pennsylvanica	~~3794~~ 3800
Liriodendron tulipifera	~~836~~ 900
Platanus occidentalis	~~5615~~ 5600
~~*Salix nigra*~~	~~1999~~*
Quercus alba	~~4212~~ 4200
Quercus nigra	~~4212~~ 4200
~~*Sambucus candensis*~~	~~41~~*
~~*Vaccinium corymbosum*~~	~~27~~^
~~*Viburnum nudum*~~	~~27~~^
TOTALS	**~~28,349~~ 25,950***

*Approximately 5000 live stakes of willow (*Salix* spp.), elderberry (*Sambucus candensis*), silky dogwood (*Cornus amomum*), and ninebark (*Physocarpus opulifolius*) were planted, but are not included in this table.
^Unplanted trees were due to unavailable species. Additional species will be added yearly outside of monitoring plots

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

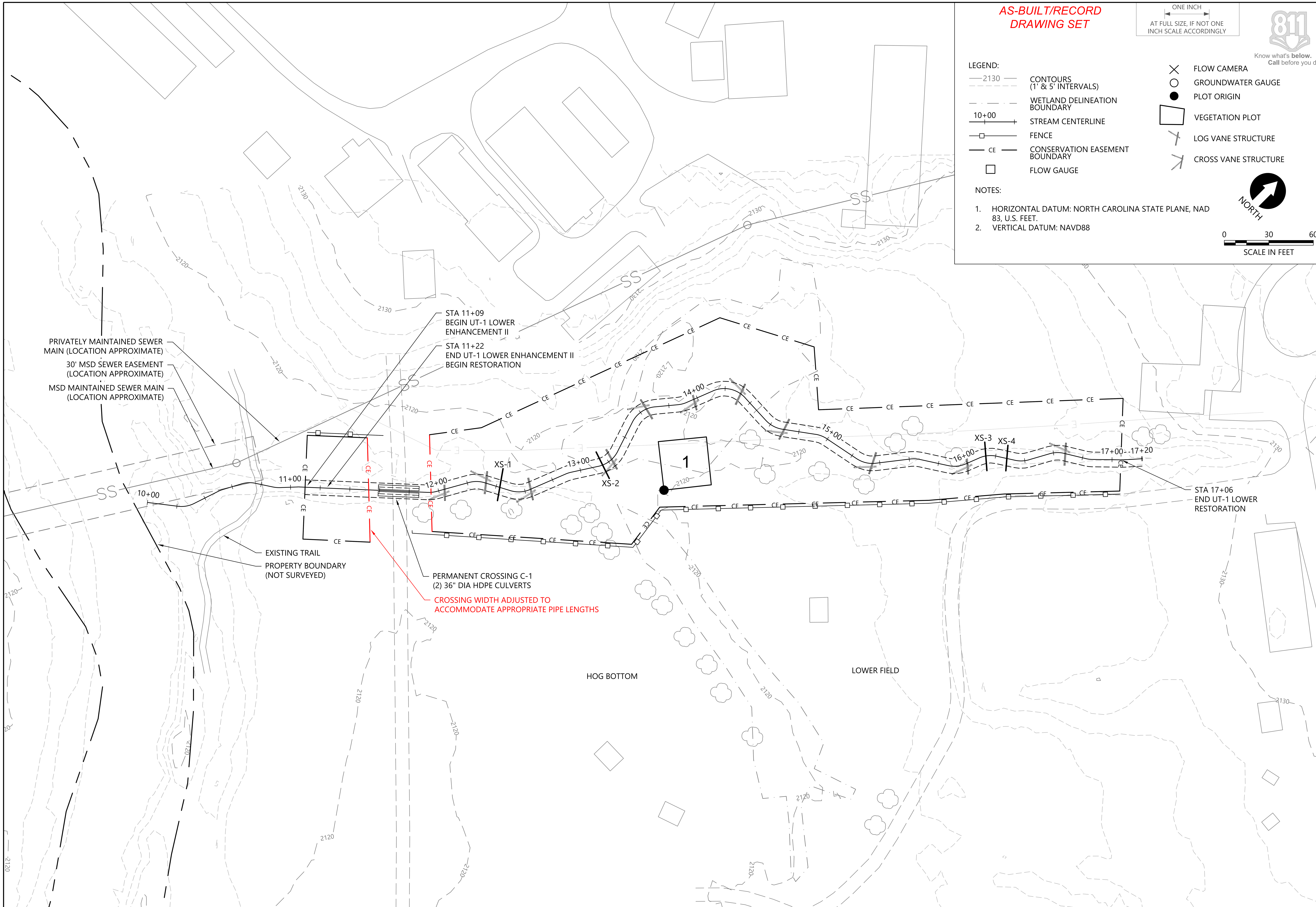
AS-BUILT PLANTING TABLE

WARREN WILSON COLLEGE STREAM MITIGATION SITE SWANNANOA, NORTH CAROLINA

P-1

PROJ. #: C71672-01.01

Aug 27, 2020 2:19pm sstavinoha \\asheville1\Asheville\Projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Cover.dwg P-1



NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GIESCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

UT-1 LOWER LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-1.0

PROJ. #: C71672-01.01

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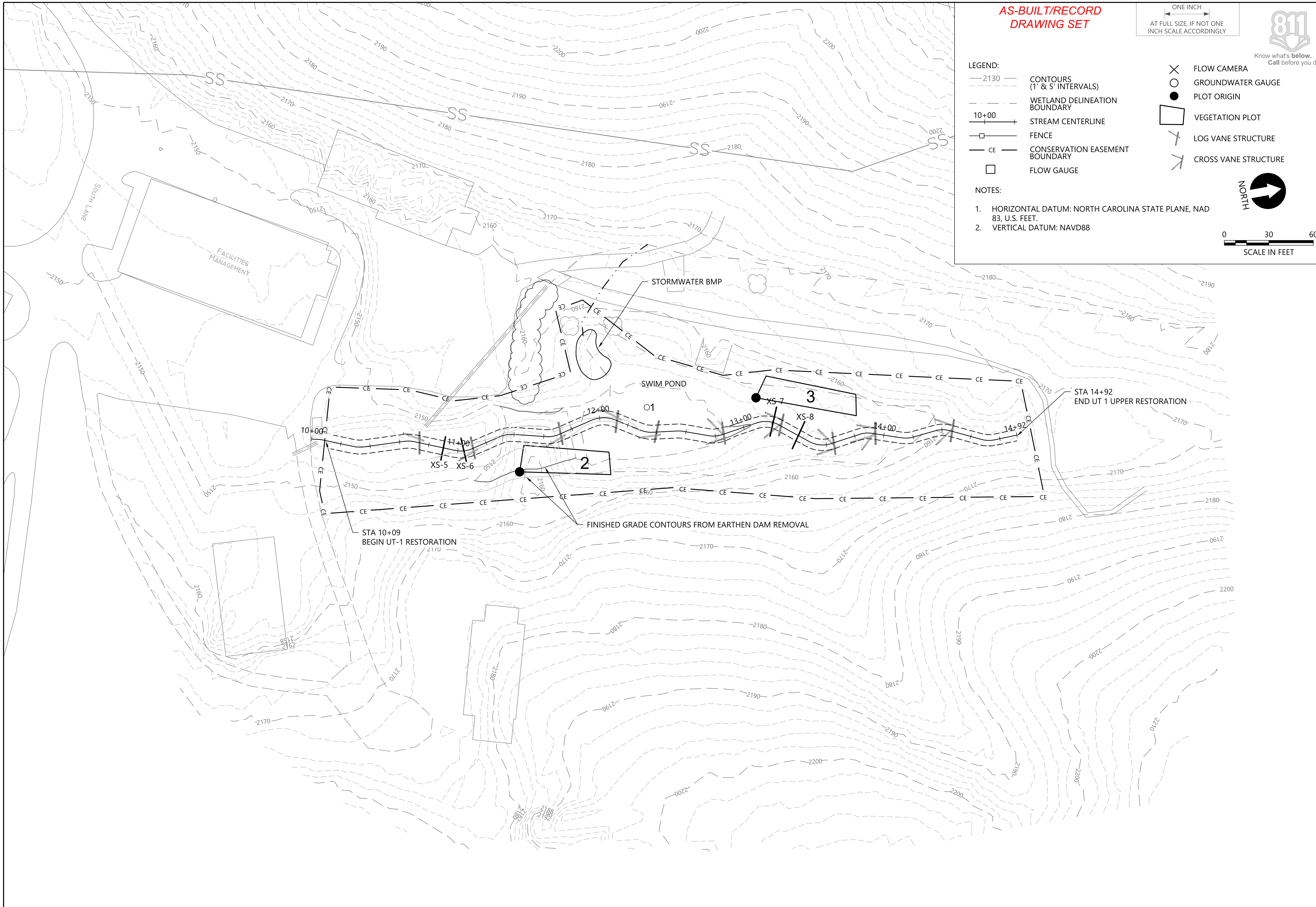
Aug 27, 2020 2:23pm sstavinoha



NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

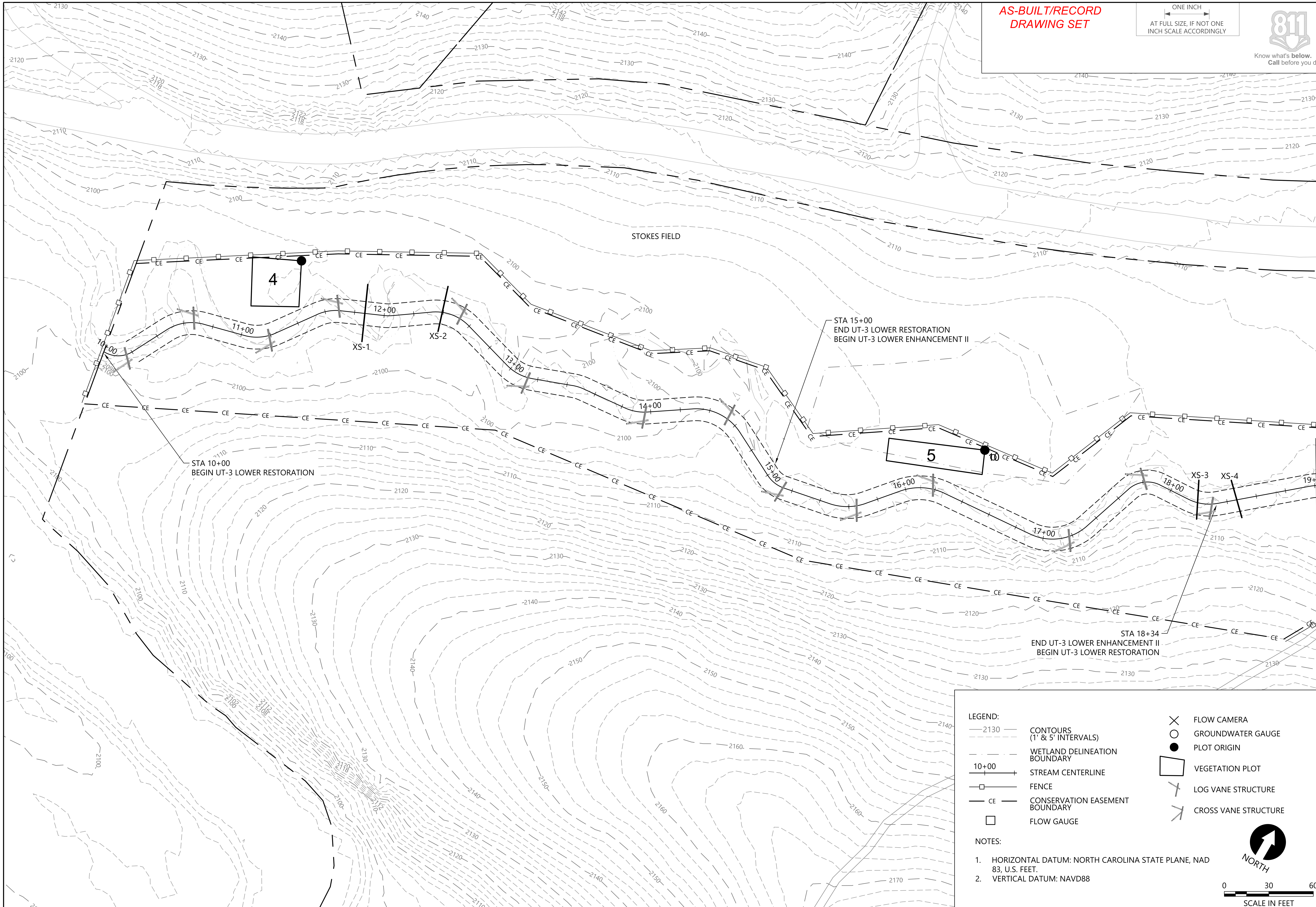
UT-1 UPPER LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-2.0

PROJ. #: C71672-01.01

Aug 27, 2020 2:23pm sstavinoha \\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT1.dwg AB-2.0



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045902 SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

UT-3 LOWER LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-3.0

PROJ. #: C71672-01.01

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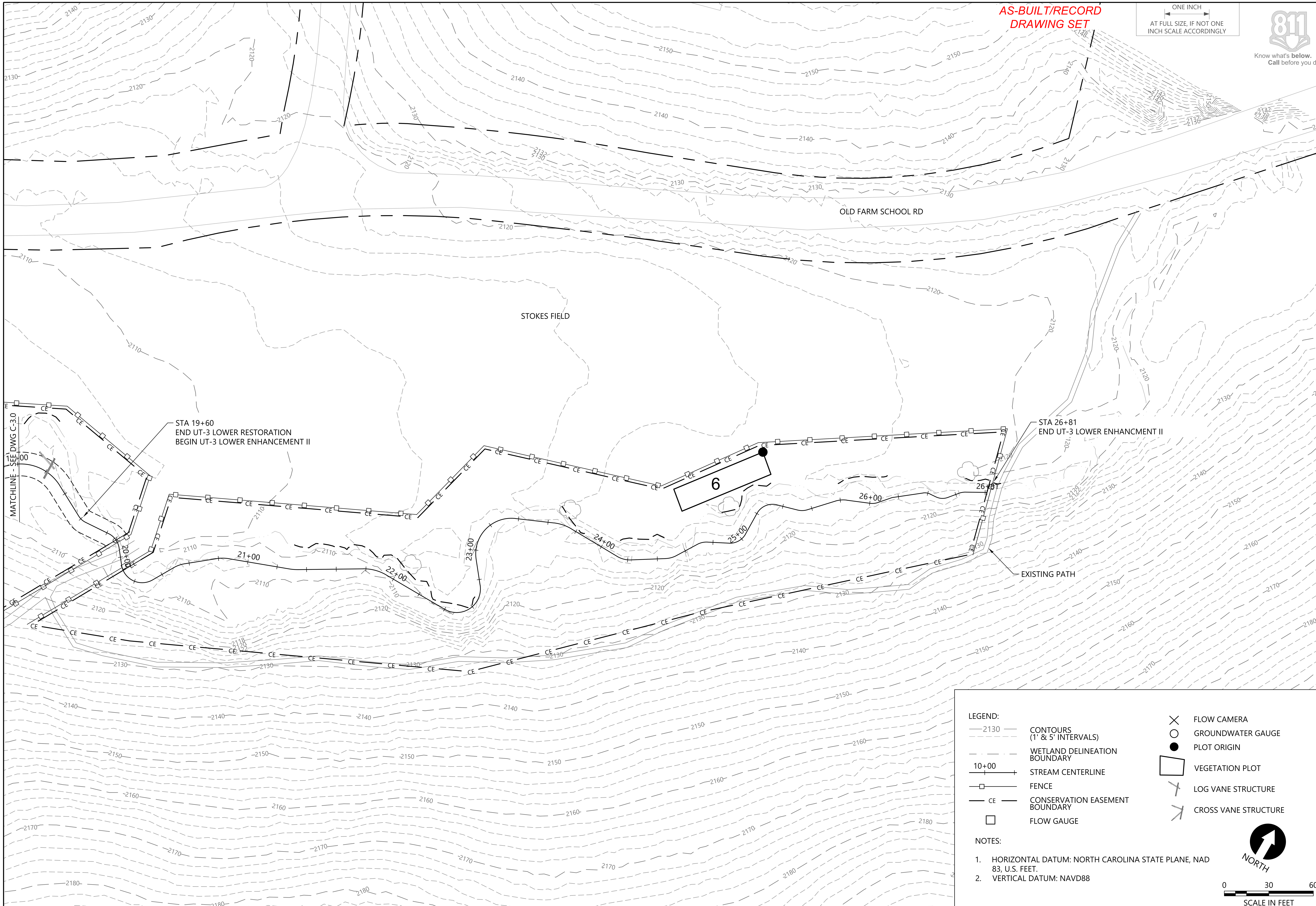
Aug 27, 2020 2:27pm sstavinoha

AS-BUILT/RECORD DRAWING SET

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

811 Know what's below. Call before you dig.



LEGEND:

2130	CONTOURS (1' & 5' INTERVALS)
	WETLAND DELINEATION BOUNDARY
10+00	STREAM CENTERLINE
	FENCE
CE	CONSERVATION EASEMENT BOUNDARY
	FLOW GAUGE
	FLOW CAMERA
	GROUNDWATER GAUGE
	PLOT ORIGIN
	VEGETATION PLOT
	LOG VANE STRUCTURE
	CROSS VANE STRUCTURE

NOTES:

1. HORIZONTAL DATUM: NORTH CAROLINA STATE PLANE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NAVD88

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045902 SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

UT-3 LOWER LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

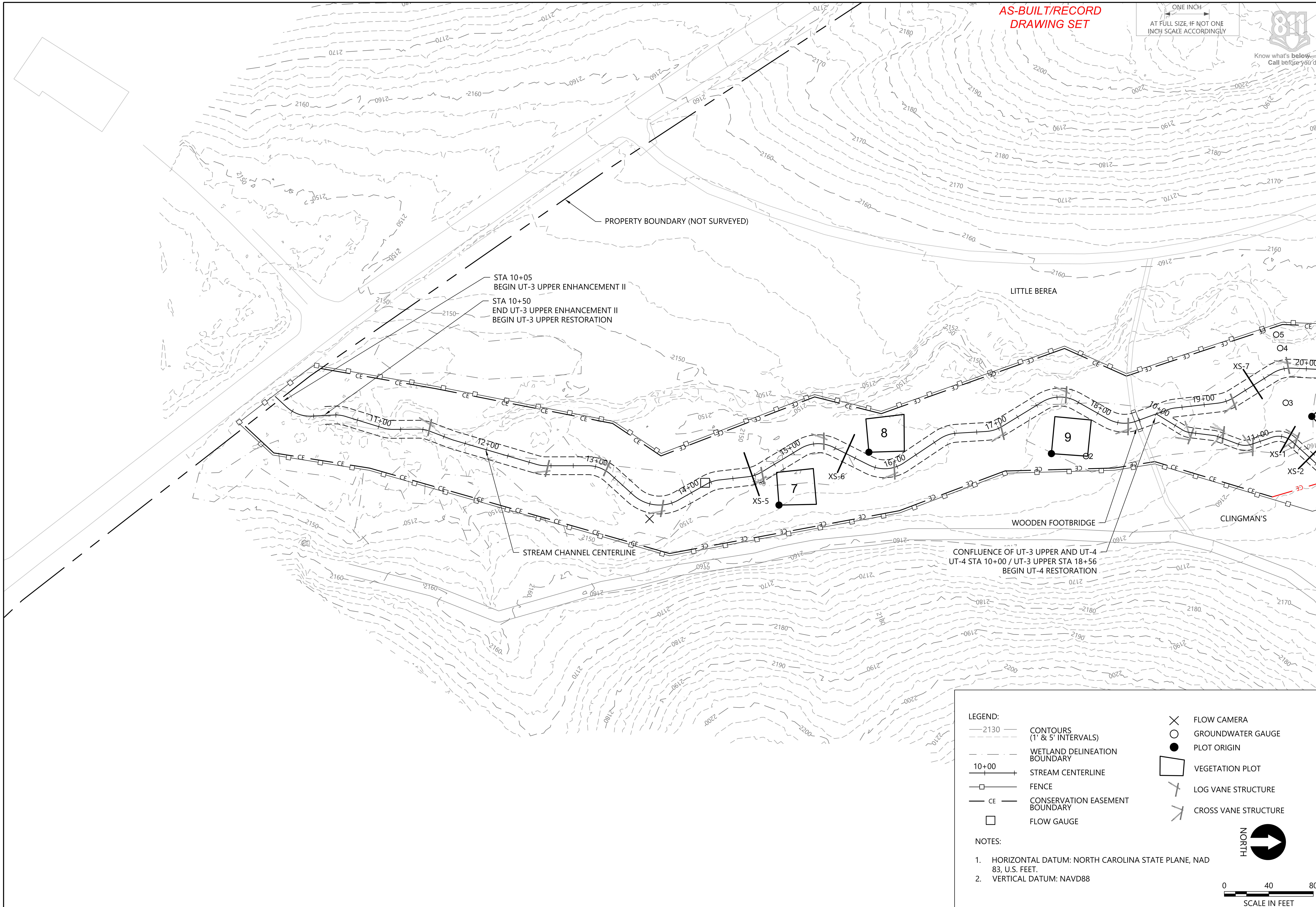
AB-3.1

PROJ. #: C71672-01.01

\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT3_UT4.dwg AB-3.1

Aug 27, 2020 2:27pm sstavinoha

AS-BUILT/RECORD DRAWING SET



NOTES:

1. HORIZONTAL DATUM: NORTH CAROLINA STATE PLANE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NAVD88

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

811 Know what's below. Call before you dig.

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
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REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

UT-3 UPPER/UT-4 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-4.0

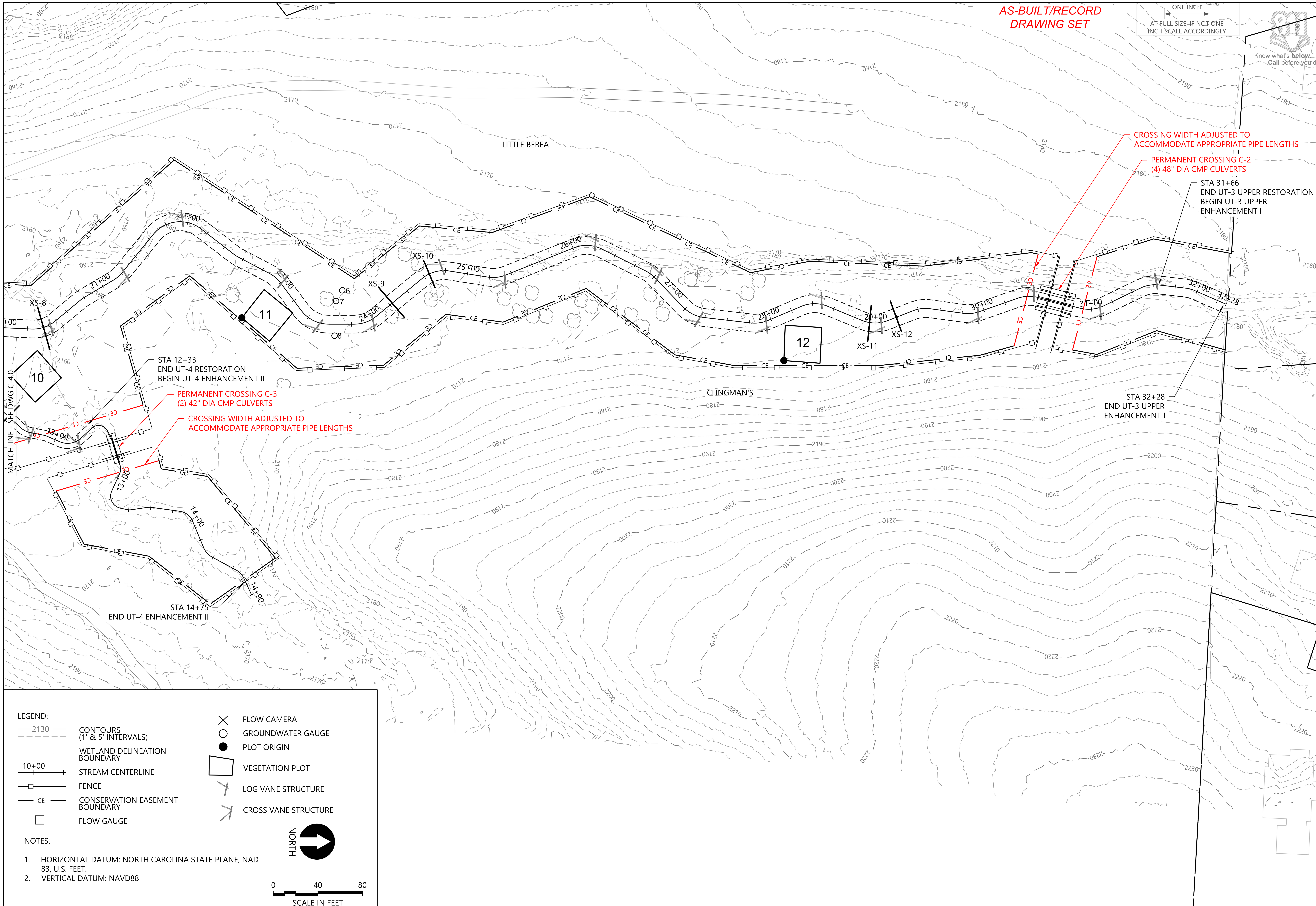
PROJ. #: C71672-01.01

Aug 27, 2020 2:27pm sstavinoha \\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT3_UT4.dwg AB-4.0

AS-BUILT/RECORD DRAWING SET

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY



LEGEND:

2130	CONTOURS (1' & 5' INTERVALS)
	WETLAND DELINEATION BOUNDARY
10+00	STREAM CENTERLINE
	FENCE
CE	CONSERVATION EASEMENT BOUNDARY
	FLOW GAUGE
	FLOW CAMERA
	GROUNDWATER GAUGE
	PLOT ORIGIN
	VEGETATION PLOT
	LOG VANE STRUCTURE
	CROSS VANE STRUCTURE

NOTES:

1. HORIZONTAL DATUM: NORTH CAROLINA STATE PLANE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NAVD88

NORTH

0 40 80

SCALE IN FEET

Know what's below. Call before you dig.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045902 SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA

Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

UT-3 UPPER/UT-4 LAYOUT AND STRUCTURES AS-BUILT

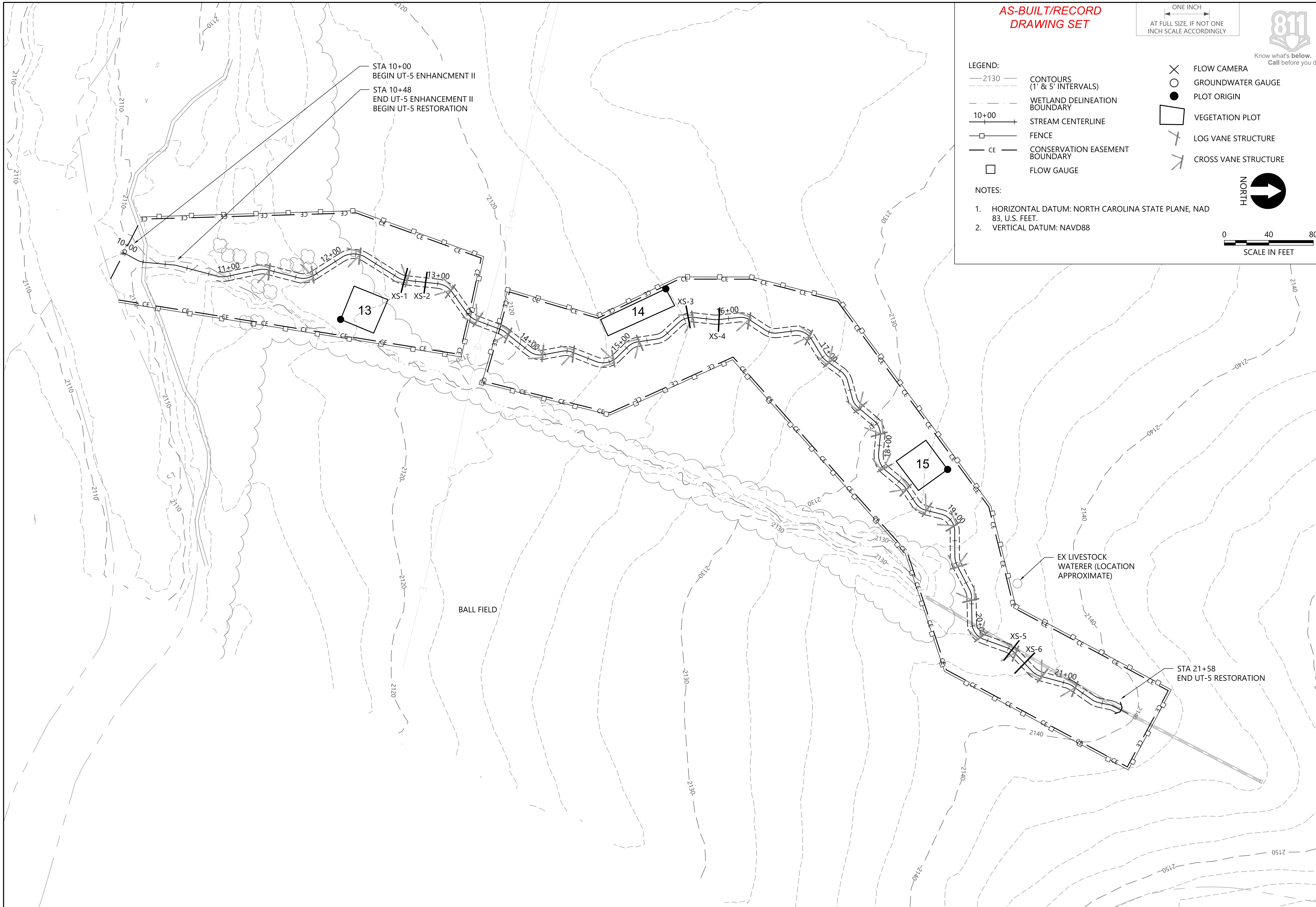
WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-4.1

PROJ. #: C71672-01.01

\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT3_UT4.dwg AB-4.1

Aug 27, 2020 2:27pm sstavinoha



\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT5.dwg AB-5.0

Aug 27, 2020 2:30pm sstavinoha

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

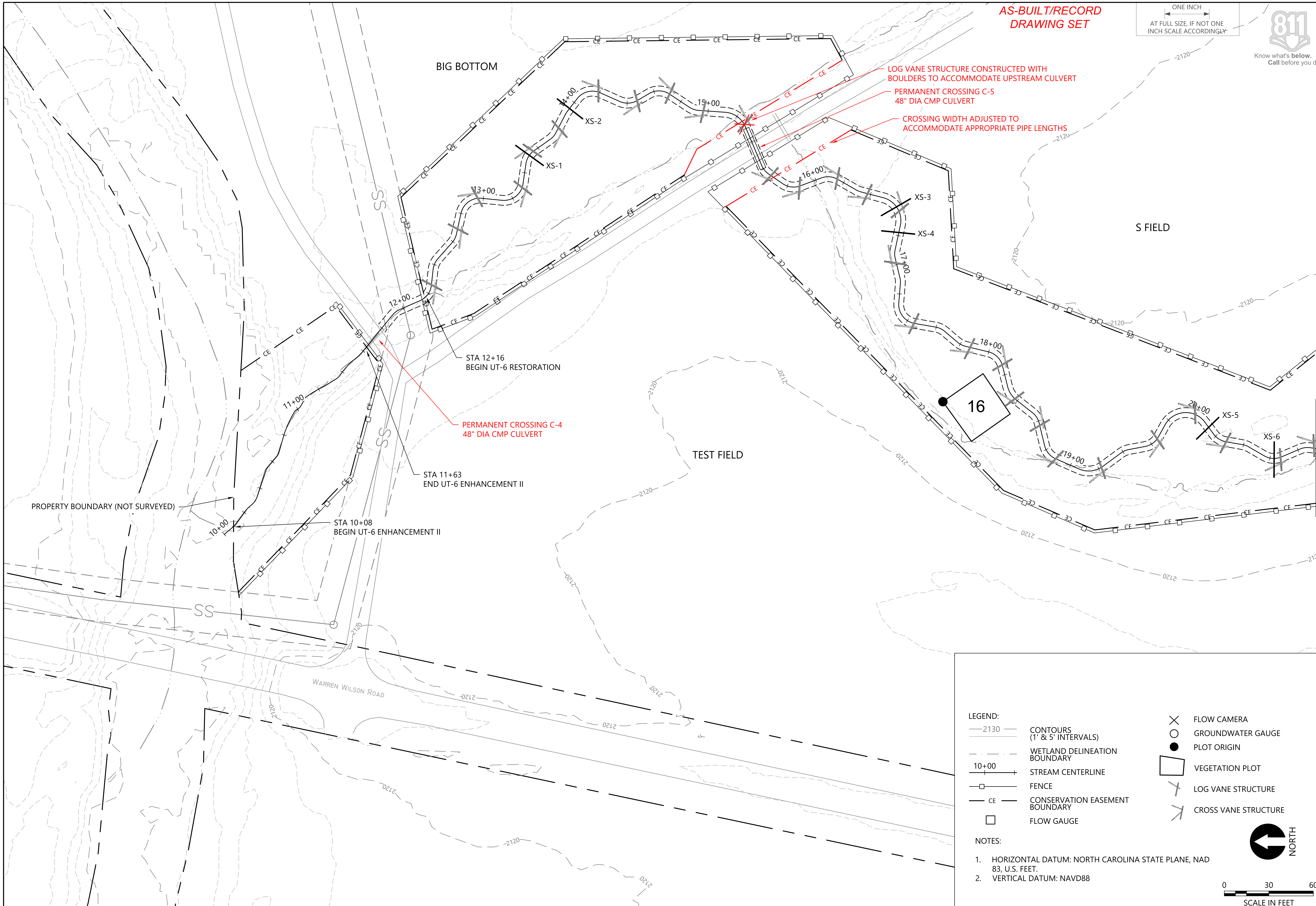
REV	DATE	BY	APP'D	DESCRIPTION

UT-5 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-5.0

PROJ. #: C71672-01.01



NOTES:

1. HORIZONTAL DATUM: NORTH CAROLINA STATE PLANE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NAVD88

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

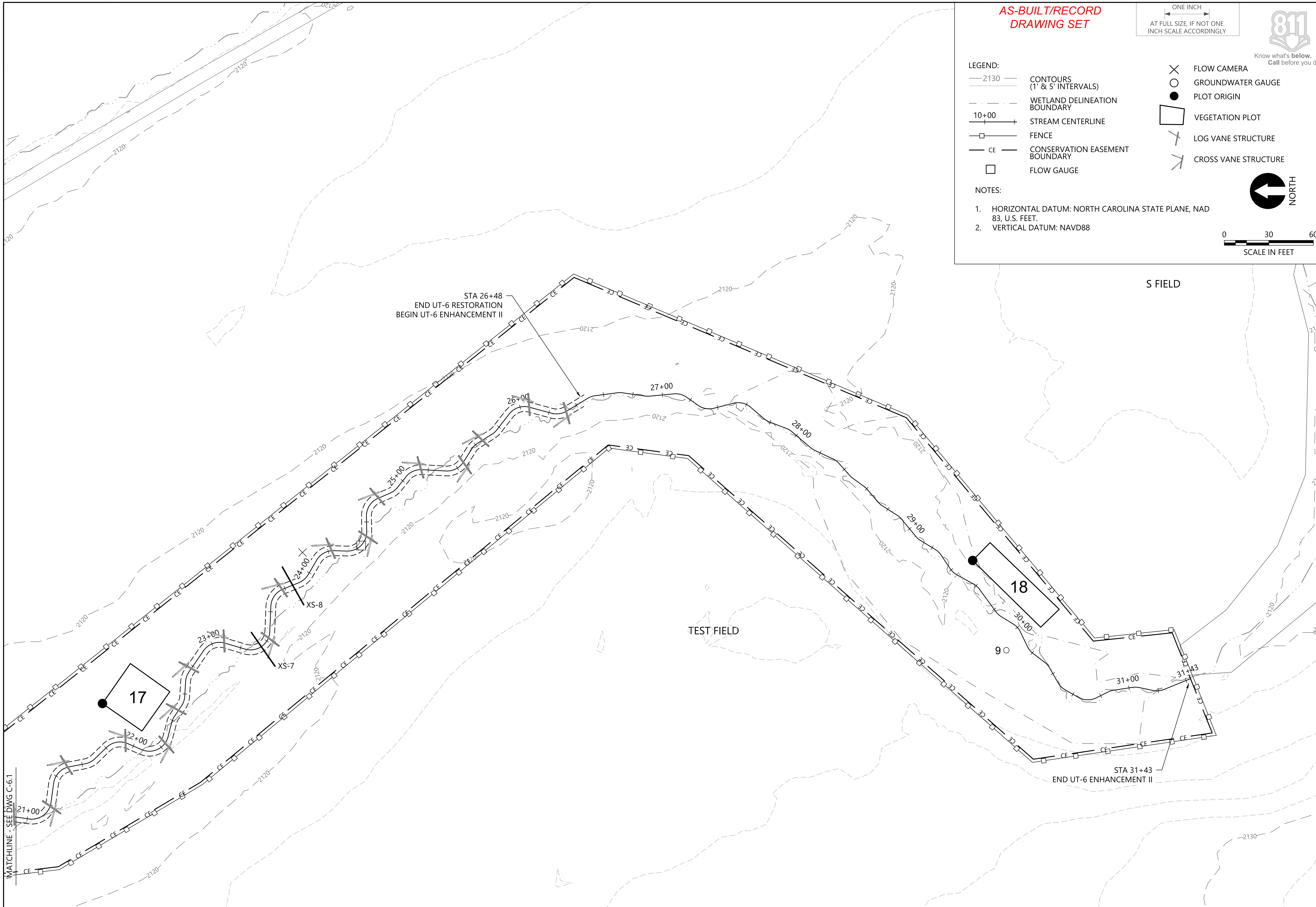
UT-6 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-6.0

PROJ. #: C71672-01.01

Aug 27, 2020 2:33pm sstavinoha \\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT6.dwg AB-6.0



NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: S. STAVINOHA
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

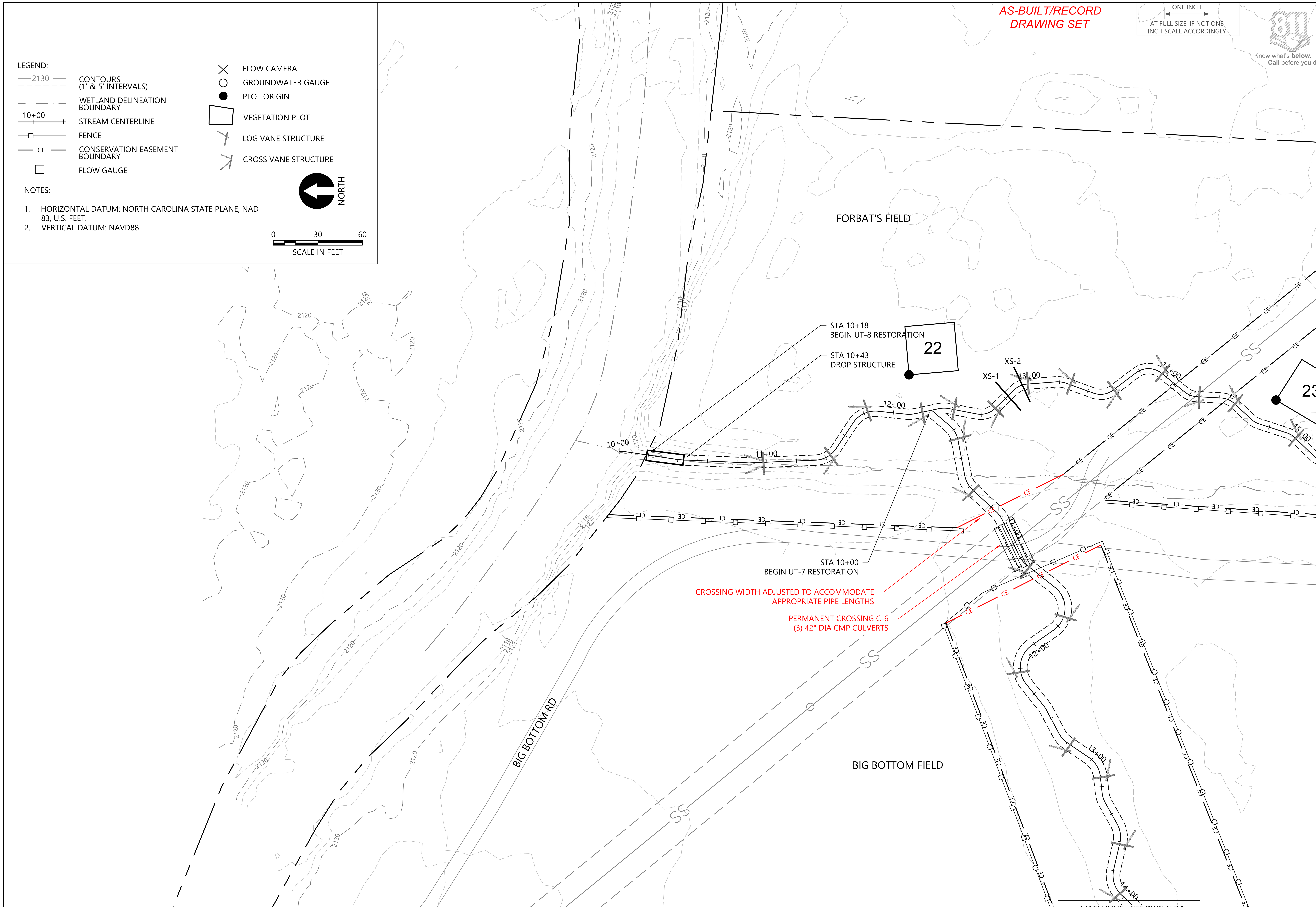
REV	DATE	BY	APP'D	DESCRIPTION

UT-6 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-6.1

PROJ. #: C71672-01.01



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045902 SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REV	DATE	BY	APP'D	DESCRIPTION

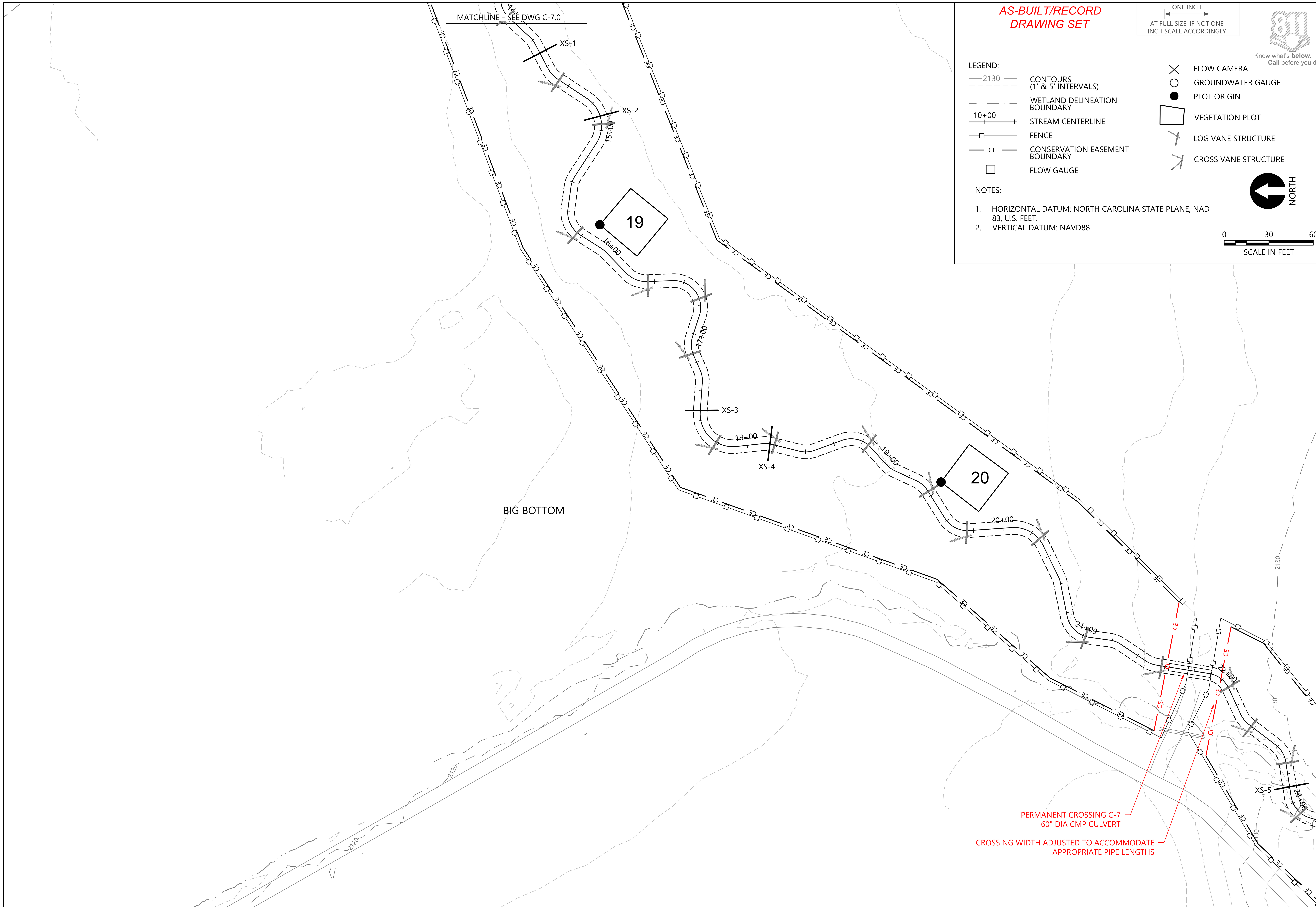
REVISIONS

UT-7 & UT-8 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-7.0

PROJ. #: C71672-01.01



AS-BUILT/RECORD DRAWING SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

811 Know what's below. Call before you dig.

LEGEND:

- 2130 CONTOURS (1' & 5' INTERVALS)
- WETLAND DELINEATION BOUNDARY
- 10+00 STREAM CENTERLINE
- FENCE
- CE CONSERVATION EASEMENT BOUNDARY
- FLOW GAUGE
- FLOW CAMERA
- GROUNDWATER GAUGE
- PLOT ORIGIN
- VEGETATION PLOT
- LOG VANE STRUCTURE
- CROSS VANE STRUCTURE

NORTH

NOTES:

1. HORIZONTAL DATUM: NORTH CAROLINA STATE PLANE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NAVD88

0 30 60
SCALE IN FEET

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

UT-7 LAYOUT AND STRUCTURES AS-BUILT

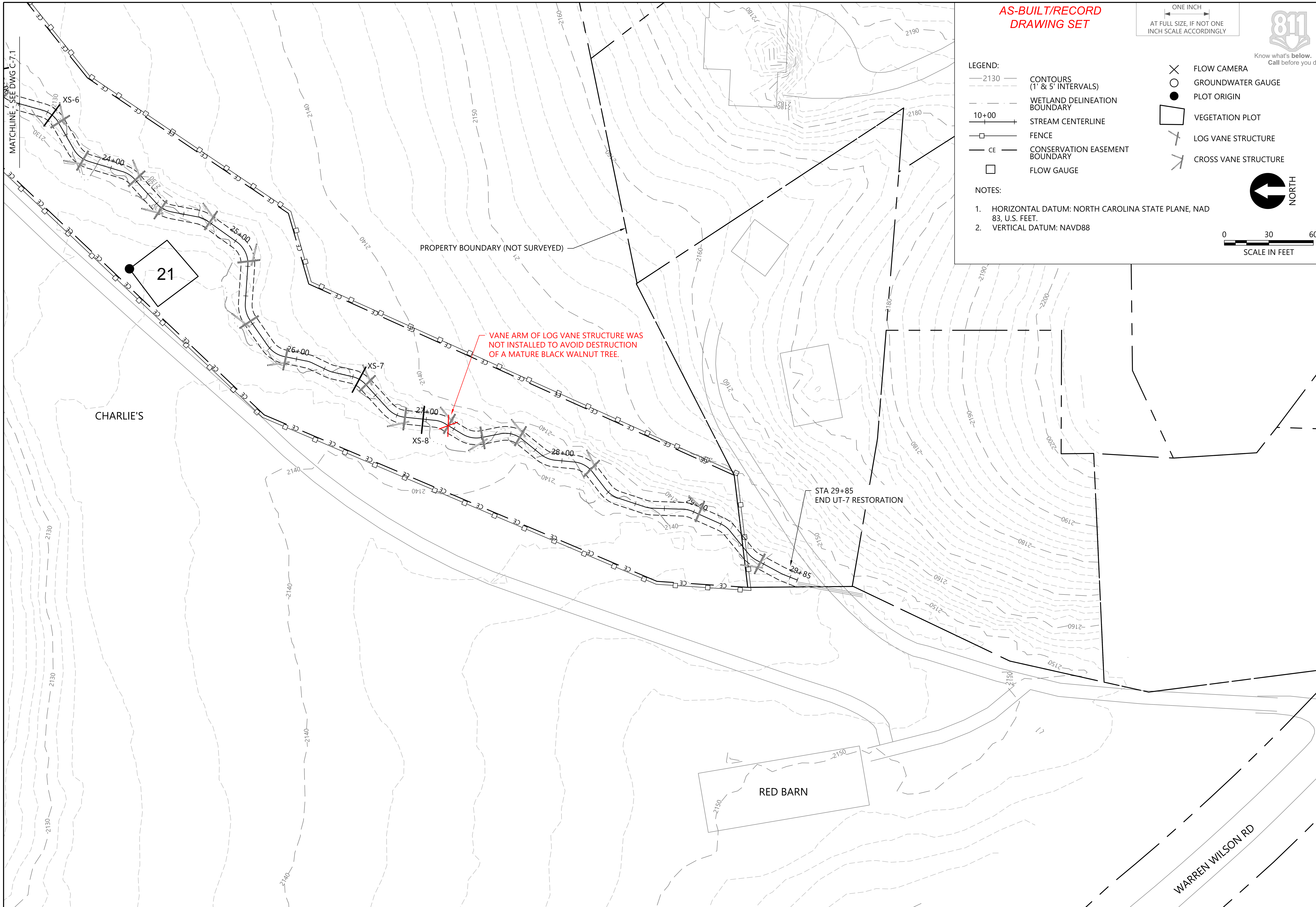
WARREN WILSON COLLEGE STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-7.1

PROJ. #: C71672-01.01

\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT7_UT8.dwg AB-7.1

Aug 27, 2020 2:37pm sstavinoha



NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

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Anchor QEA of North Carolina, PLLC
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Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

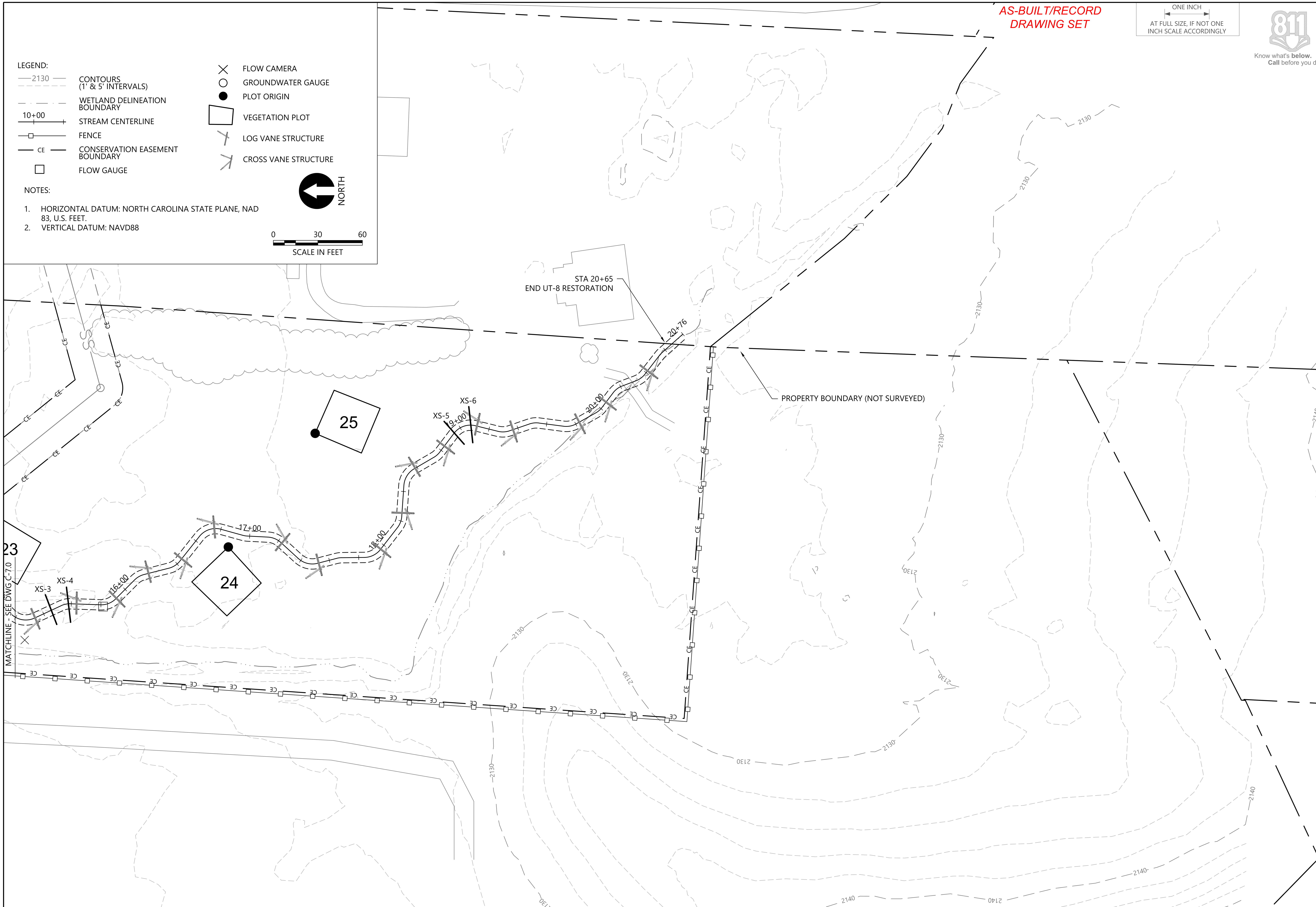
REV	DATE	BY	APP'D	DESCRIPTION

UT-7 LAYOUT AND STRUCTURES AS-BUILT

WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-7.2

PROJ. #: C71672-01.01



\\asheville1\asheville\projects\Restoration Systems\Warren Wilson College Stream Mitigation_CADD\As-Builts\C71672-PL-Design-UT7_UT8.dwg AB-7.3

Aug 27, 2020 2:37pm sstavinoha

NORTH CAROLINA PROFESSIONAL SEAL 045902 ENGINEER SARA L. STAVINOHA 8/27/20

DESIGNED BY: A. BREW/M. GEISCHEN
DRAWN BY: T. GRIGA/S. STAVINOHA
CHECKED BY: S. STAVINOHA
APPROVED BY: T. DRURY
SCALE: AS NOTED
DATE: AUGUST 2020

ANCHOR QEA
Anchor QEA of North Carolina, PLLC
231 Haywood Street
Asheville, North Carolina 28801
(828) 281-3350

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

UT-8 LAYOUT AND STRUCTURES AS-BUILT

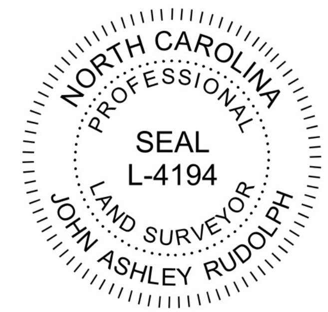
WARREN WILSON COLLEGE
STREAM MITIGATION SITE
SWANNANOA, NORTH CAROLINA

AB-7.3

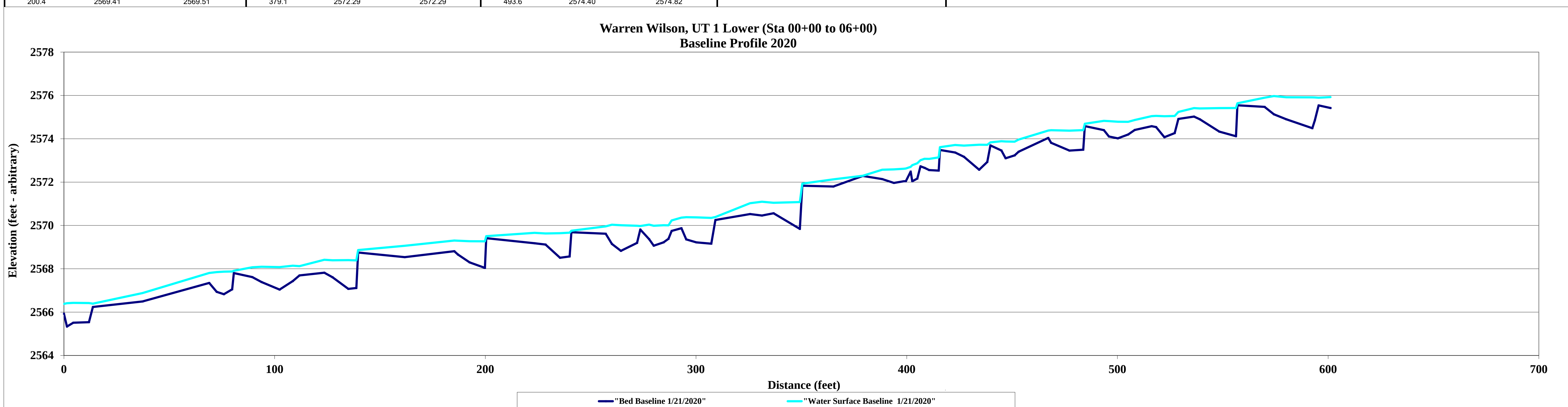
PROJ. #: C71672-01.01

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 1 Lower (Sta 00+00 to 06+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	2565.93	2566.38	223.3	2569.18	2569.66	388.4	2572.14	2572.57	496.0	2574.11	2574.82
1.4	2565.33	2566.41	228.6	2569.12	2569.63	393.9	2571.96	2572.59	500.2	2574.02	2574.79
4.4	2565.51	2566.43	235.5	2568.51	2569.64	398.6	2572.04	2572.62	505.1	2574.20	2574.78
11.9	2565.54	2566.42	240.0	2568.57	2569.67	399.6	2572.04	2572.63	508.2	2574.41	2574.87
13.7	2566.24	2566.39	240.8	2569.69	2569.76	401.9	2572.49	2572.70	516.2	2574.58	2575.04
37.3	2566.49	2566.88	257.1	2569.62	2569.96	402.6	2572.04	2572.78	518.4	2574.54	2575.06
68.9	2567.35	2567.81	260.1	2569.15	2570.03	405.0	2572.16	2572.87	522.3	2574.07	2575.04
72.5	2566.93	2567.85	264.3	2568.83	2570.01	406.5	2572.73	2573.01	527.2	2574.26	2575.05
75.9	2566.83	2567.87	272.0	2569.19	2569.99	408.4	2572.66	2573.07	528.9	2574.91	2575.24
79.9	2567.05	2567.87	273.5	2569.81	2569.98	410.7	2572.56	2573.07	536.3	2575.02	2575.41
80.6	2567.80	2567.91	277.7	2569.37	2570.04	415.2	2572.53	2573.14	539.1	2574.90	2575.40
89.4	2567.62	2568.07	279.9	2569.07	2569.99	415.8	2573.48	2573.61	548.4	2574.33	2575.41
93.8	2567.39	2568.09	284.6	2569.22	2570.01	423.0	2573.37	2573.71	556.3	2574.12	2575.42
102.4	2567.04	2568.08	286.9	2569.38	2570.00	427.2	2573.17	2573.68	557.0	2575.55	2575.64
108.6	2567.43	2568.14	288.4	2569.75	2570.23	434.3	2572.57	2573.73	569.8	2575.47	2575.90
111.8	2567.70	2568.12	293.1	2569.87	2570.36	438.2	2572.93	2573.72	574.3	2575.13	2575.97
123.6	2567.82	2568.42	295.4	2569.36	2570.38	439.7	2573.69	2573.83	580.1	2574.90	2575.92
127.5	2567.61	2568.39	300.1	2569.22	2570.37	444.9	2573.46	2573.89	592.5	2574.49	2575.91
135.0	2567.07	2568.40	307.3	2569.16	2570.35	446.9	2573.10	2573.87	593.7	2574.85	2575.91
138.8	2567.11	2568.39	309.2	2570.25	2570.39	451.2	2573.23	2573.87	595.5	2575.54	2575.89
139.6	2568.75	2568.86	325.6	2570.53	2571.03	453.1	2573.40	2573.96	601.1	2575.42	2575.93
161.8	2568.54	2569.06	331.3	2570.46	2571.10	467.1	2574.04	2574.38			
185.2	2568.81	2569.30	336.8	2570.56	2571.05	468.5	2573.82	2574.40			
187.0	2568.66	2569.30	349.3	2569.84	2571.08	477.2	2573.45	2574.38			
192.5	2568.30	2569.27	350.4	2571.83	2571.93	483.8	2573.49	2574.40			
199.8	2568.04	2569.27	365.2	2571.80	2572.13	484.5	2574.59	2574.69			
200.4	2569.41	2569.51	379.1	2572.29	2572.29	493.6	2574.40	2574.82			



	Baseline	As needed		
Avg. Water Surface Slope	0.0163			
Riffle Length	15			
Avg. Riffle Slope	0.0201			
Pool Length	11			



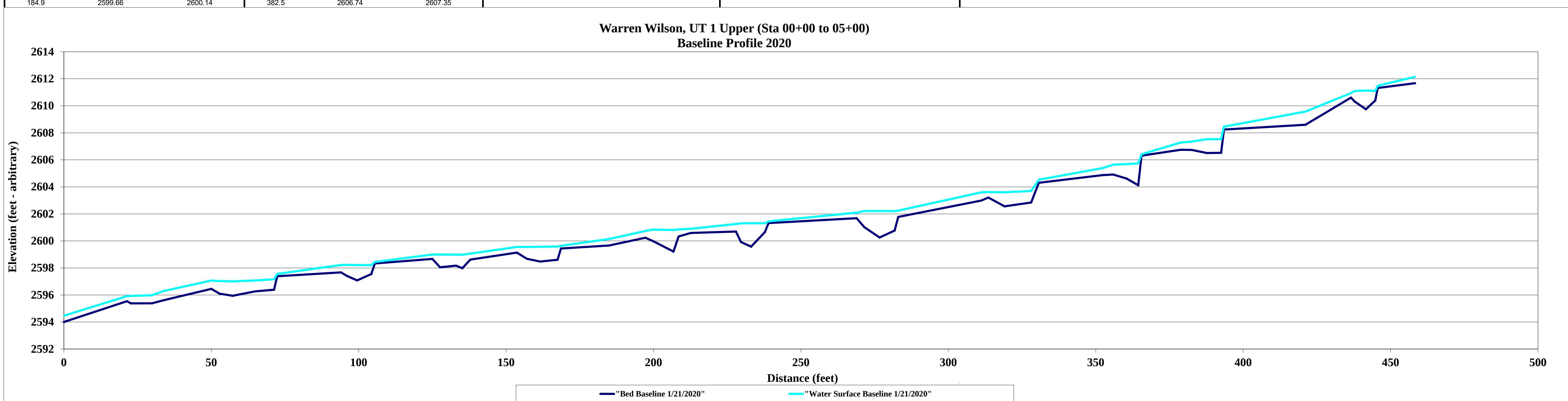
415.8 2573.48 2573.61

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 1 Upper (Sta 00+00 to 05+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed	
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	2594.00	2594.46	197.2	2600.23	2600.73	387.7	2606.51	2607.53			
21.4	2595.54	2595.91	199.7	2600.01	2600.83	392.5	2606.52	2607.53			
22.8	2595.38	2595.93	206.8	2599.21	2600.81	393.5	2608.24	2608.46			
29.9	2595.38	2595.98	208.5	2600.33	2600.85	421.1	2608.60	2609.57			
33.9	2595.61	2596.29	212.6	2600.59	2600.90	436.6	2610.61	2610.94			
50.0	2596.45	2597.06	228.0	2600.69	2601.25	437.8	2610.31	2611.09			
52.8	2596.10	2597.04	229.7	2599.92	2601.30	441.6	2609.75	2611.13			
57.3	2595.94	2597.01	233.1	2599.58	2601.31	444.8	2610.39	2611.10			
64.7	2596.26	2597.07	237.8	2600.66	2601.31	445.6	2611.32	2611.49			
71.3	2596.39	2597.16	239.0	2601.32	2601.45	458.3	2611.67	2612.14			
72.4	2597.39	2597.56	268.9	2601.68	2602.09						
94.0	2597.67	2598.22	271.5	2601.02	2602.21						
96.0	2597.41	2598.23	276.7	2600.25	2602.21						
99.4	2597.08	2598.21	281.8	2600.77	2602.21						
104.3	2597.55	2598.21	283.0	2601.78	2602.25						
105.5	2598.33	2598.44	311.2	2602.99	2603.59						
125.0	2598.67	2598.99	313.6	2603.21	2603.62						
127.6	2598.05	2598.99	319.1	2602.56	2603.60						
133.0	2598.17	2598.98	328.1	2602.84	2603.70						
135.2	2597.98	2598.98	330.7	2604.30	2604.53						
137.9	2598.62	2599.06	352.4	2604.87	2605.39						
153.7	2599.14	2599.55	355.9	2604.92	2605.64						
157.0	2598.68	2599.56	360.5	2604.61	2605.68						
161.5	2598.47	2599.57	364.4	2604.12	2605.74						
167.5	2598.60	2599.58	365.5	2606.31	2606.41						
168.6	2599.44	2599.64	378.8	2606.74	2607.28						
184.9	2599.66	2600.14	382.5	2606.74	2607.35						

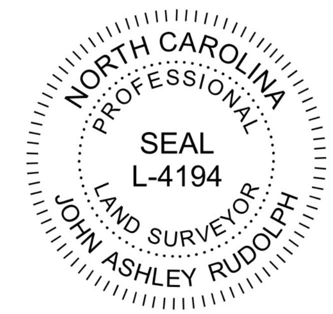
NORTH CAROLINA
PROFESSIONAL
SEAL
L-4194
LAND SURVEYOR
JOHN ASHLEY RUDOLPH

	Baseline	As needed		
Avg. Water Surface Slope	0.0372			
Riffle Length	22			
Avg. Riffle Slope	0.0402			
Pool Length	10			

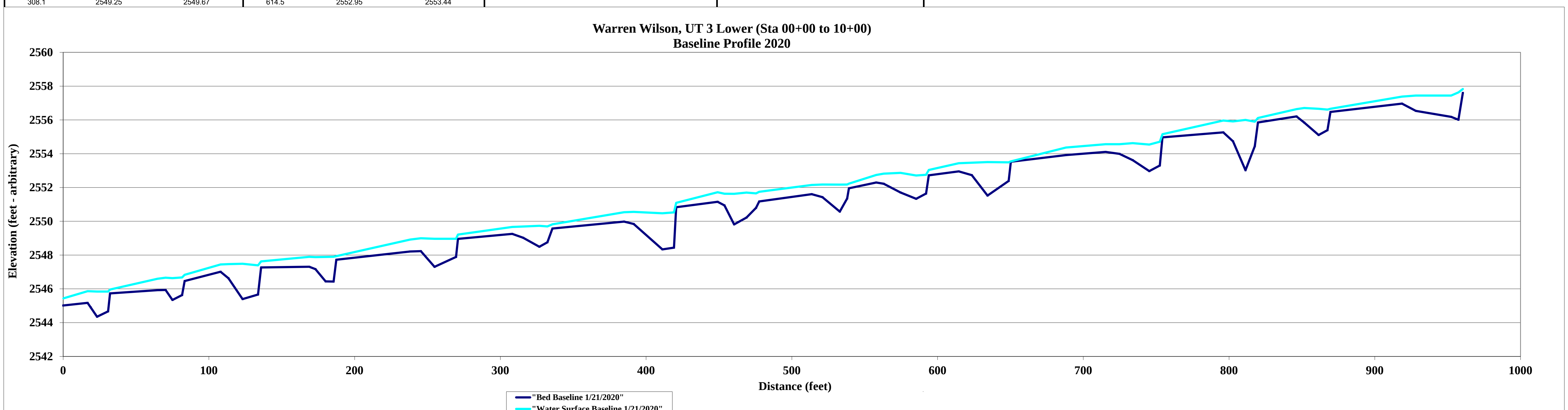


Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 3 Lower (Sta 00+00 to 10+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	2545.01	2545.43	315.6	2549.03	2549.69	623.5	2552.73	2553.47			
16.7	2545.17	2545.86	326.7	2548.49	2549.74	634.3	2551.52	2553.51			
18.9	2544.90	2545.85	332.3	2548.76	2549.70	648.8	2552.39	2553.49			
23.3	2544.35	2545.84	335.7	2549.57	2549.82	650.3	2553.52	2553.55			
30.9	2544.67	2545.84	384.9	2549.98	2550.54	688.1	2553.92	2554.37			
32.2	2545.73	2545.96	391.5	2549.84	2550.56	715.3	2554.11	2554.56			
64.7	2545.92	2546.60	411.2	2548.34	2550.47	724.8	2553.99	2554.56			
70.3	2545.93	2546.66	419.1	2548.44	2550.53	733.9	2553.62	2554.63			
75.0	2545.35	2546.63	420.7	2550.83	2551.09	745.3	2552.97	2554.54			
81.6	2545.63	2546.68	449.1	2551.16	2551.72	752.5	2553.30	2554.71			
83.3	2546.47	2546.83	453.8	2550.94	2551.63	754.3	2554.97	2555.15			
108.0	2547.01	2547.44	460.4	2549.81	2551.63	796.0	2555.26	2555.96			
113.4	2546.63	2547.47	468.9	2550.22	2551.70	802.7	2554.73	2555.91			
123.1	2545.40	2547.49	475.5	2550.80	2551.65	811.3	2553.02	2556.00			
133.7	2545.67	2547.39	477.6	2551.17	2551.75	817.7	2554.44	2555.89			
135.8	2547.27	2547.63	513.6	2551.61	2552.15	819.8	2555.85	2556.12			
168.8	2547.31	2547.90	520.9	2551.43	2552.17	846.3	2556.21	2556.64			
173.1	2547.17	2547.88	532.9	2550.57	2552.17	851.6	2555.85	2556.71			
180.1	2546.44	2547.89	538.0	2551.35	2552.18	861.5	2555.11	2556.66			
185.6	2546.43	2547.90	539.2	2551.95	2552.23	867.5	2555.39	2556.61			
187.4	2547.72	2547.94	557.9	2552.29	2552.74	869.6	2556.47	2556.66			
238.1	2548.21	2548.92	563.0	2552.22	2552.82	918.7	2556.97	2557.38			
245.4	2548.23	2549.00	574.6	2551.70	2552.87	928.2	2556.53	2557.44			
254.8	2547.30	2548.96	585.3	2551.33	2552.71	952.4	2556.18	2557.44			
269.6	2547.89	2548.97	592.1	2551.64	2552.75	957.4	2556.01	2557.63			
270.9	2548.96	2549.21	594.0	2552.72	2553.04	960.4	2557.60	2557.83			
308.1	2549.25	2549.67	614.5	2552.95	2553.44						



	Baseline	As needed		
Avg. Water Surface Slope	0.0129			
Riffle Length	35			
Avg. Riffle Slope	0.0183			
Pool Length	20			

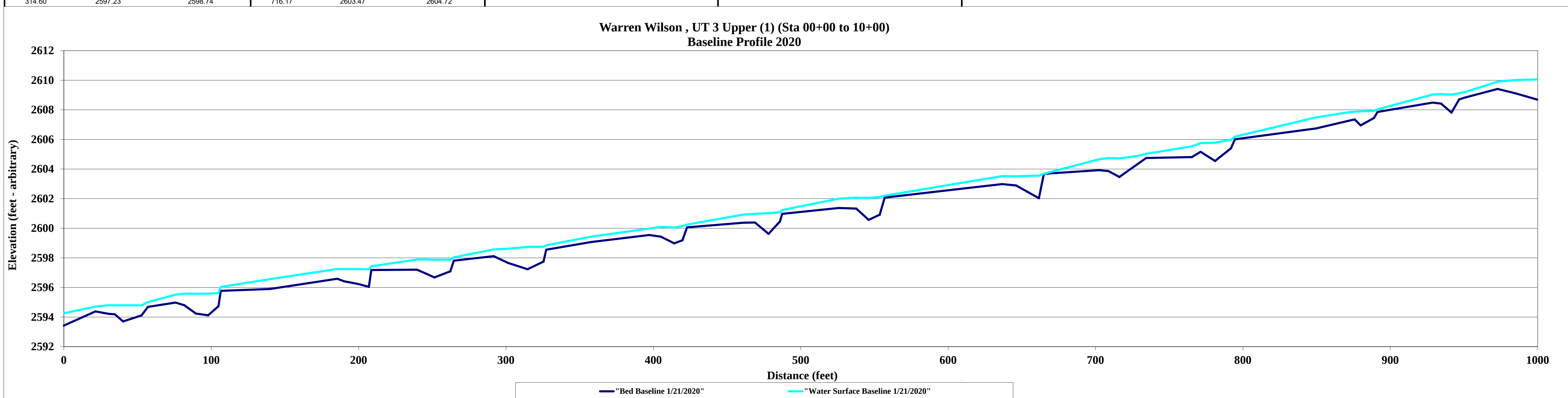


796.0	2555.26	2555.96

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 3 Upper (1) (Sta 00+00 to 10+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.00	2593.43	2594.26	325.41	2597.75	2598.75	728.01	2604.30	2604.87			
21.44	2594.38	2594.70	327.28	2598.55	2598.85	734.38	2604.75	2605.03			
30.48	2594.21	2594.80	358.04	2599.07	2599.43	765.36	2604.81	2605.53			
34.57	2594.19	2594.79	397.22	2599.54	2599.98	771.27	2605.17	2605.75			
40.17	2593.70	2594.80	405.11	2599.43	2600.09	781.08	2604.55	2605.78			
52.69	2594.11	2594.79	414.13	2598.98	2600.05	791.87	2605.40	2605.98			
57.00	2594.69	2595.01	419.71	2599.19	2600.14	794.56	2606.01	2606.18			
75.74	2594.98	2595.51	422.81	2600.06	2600.25	849.59	2606.75	2607.49			
81.69	2594.80	2595.58	461.38	2600.38	2600.93	871.98	2607.26	2607.84			
89.57	2594.24	2595.58	468.89	2600.39	2600.97	875.84	2607.35	2607.87			
97.90	2594.12	2595.58	478.14	2599.63	2601.02	879.87	2606.95	2607.89			
104.88	2594.73	2595.62	485.84	2600.46	2601.07	888.89	2607.45	2607.93			
106.48	2595.77	2596.04	487.42	2600.97	2601.23	891.33	2607.86	2608.03			
139.94	2595.89	2596.57	525.82	2601.37	2602.00	928.69	2608.49	2609.03			
185.42	2596.59	2597.24	537.64	2601.33	2602.07	934.47	2608.42	2609.06			
190.29	2596.41	2597.24	546.08	2600.57	2602.05	941.50	2607.82	2609.02			
199.85	2596.23	2597.24	553.54	2600.92	2602.12	946.73	2608.71	2609.11			
206.96	2596.04	2597.23	556.97	2602.07	2602.19	950.97	2608.84	2609.21			
208.59	2597.18	2597.43	606.74	2602.64	2603.03	972.79	2609.41	2609.90			
239.57	2597.20	2597.88	636.62	2602.98	2603.52	985.01	2609.12	2610.02			
244.98	2596.97	2597.89	646.06	2602.89	2603.51	999.56	2608.70	2610.06			
251.44	2596.68	2597.87	653.56	2602.48	2603.53						
262.24	2597.09	2597.88	661.55	2602.03	2603.55						
264.59	2597.81	2598.03	664.97	2603.68	2603.68						
291.65	2598.11	2598.57	702.30	2603.92	2604.66						
301.34	2597.66	2598.62	708.75	2603.86	2604.74						
314.60	2597.23	2598.74	716.17	2603.47	2604.72						

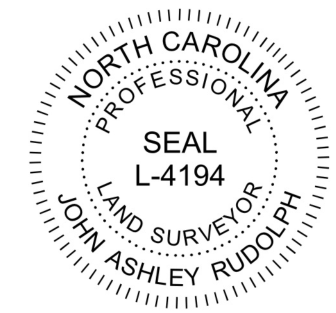
	Baseline	As needed		
Avg. Water Surface Slope	0.0139			
Riffle Length	34			
Avg. Riffle Slope	0.0183			
Pool Length	19			



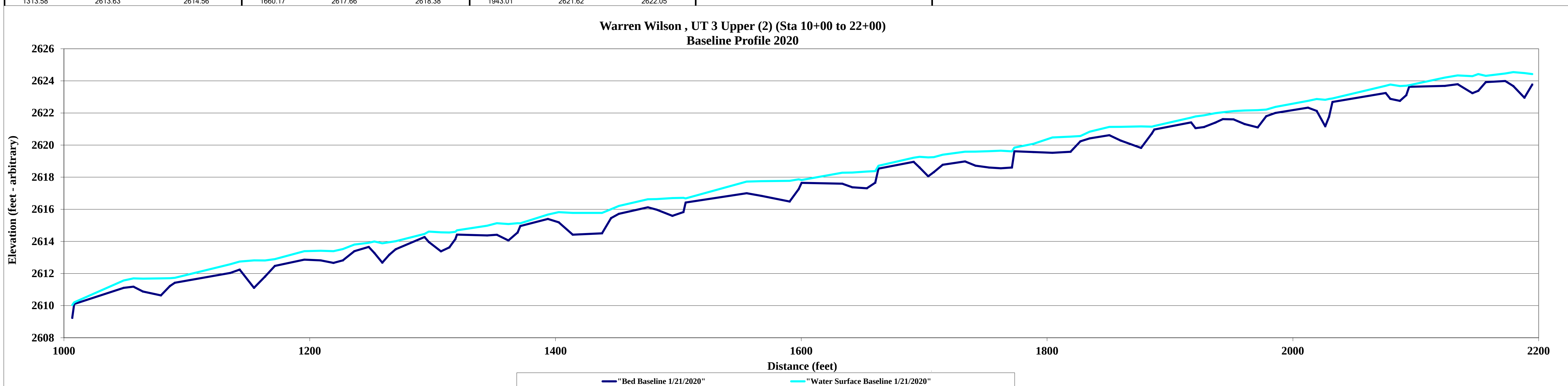
888.89 2607.45 2607.93

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 3 Upper (2) (Sta 10+00 to 22+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
1006.76	2609.24	2610.04	1318.52	2614.14	2614.60	1662.77	2618.54	2618.71	1951.67	2621.60	2622.12			
1008.33	2610.10	2610.20	1319.81	2614.43	2614.69	1691.42	2618.96	2619.21	1960.72	2621.31	2622.15			
1048.62	2611.11	2611.57	1344.36	2614.38	2614.98	1696.26	2618.60	2619.27	1971.41	2621.10	2622.17			
1056.56	2611.18	2611.69	1352.25	2614.42	2615.13	1703.30	2618.06	2619.23	1978.32	2621.80	2622.21			
1064.30	2610.88	2611.68	1361.68	2614.06	2615.08	1707.87	2618.32	2619.25	1985.87	2622.00	2622.38			
1078.92	2610.64	2611.70	1369.18	2614.55	2615.14	1715.07	2618.77	2619.40	2012.34	2622.33	2622.75			
1086.26	2611.22	2611.71	1371.40	2614.96	2615.13	1733.21	2618.98	2619.59	2019.43	2622.13	2622.87			
1090.31	2611.43	2611.74	1393.83	2615.40	2615.67	1741.78	2618.72	2619.60	2026.37	2621.17	2622.82			
1135.40	2612.04	2612.58	1402.56	2615.19	2615.82	1752.82	2618.60	2619.62	2029.51	2621.77	2622.87			
1143.03	2612.25	2612.75	1414.06	2614.42	2615.78	1762.31	2618.55	2619.65	2032.21	2622.69	2622.90			
1154.70	2611.11	2612.82	1437.88	2614.50	2615.78	1771.41	2618.60	2619.61	2075.50	2623.24	2623.69			
1163.69	2611.81	2612.81	1445.21	2615.45	2616.01	1773.38	2619.61	2619.84	2079.34	2622.88	2623.77			
1171.66	2612.48	2612.90	1451.58	2615.72	2616.21	1788.87	2619.57	2620.08	2087.08	2622.76	2623.68			
1195.63	2612.87	2613.39	1475.11	2616.13	2616.62	1804.37	2619.52	2620.48	2092.28	2623.11	2623.70			
1208.93	2612.82	2613.42	1482.25	2615.98	2616.64	1819.08	2619.58	2620.53	2094.59	2623.63	2623.73			
1219.29	2612.66	2613.39	1495.12	2615.59	2616.70	1827.11	2620.24	2620.56	2123.64	2623.69	2624.21			
1226.95	2612.82	2613.52	1504.10	2615.83	2616.71	1834.65	2620.42	2620.83	2134.06	2623.79	2624.34			
1236.37	2613.39	2613.80	1505.89	2616.42	2616.68	1850.64	2620.61	2621.13	2146.10	2623.23	2624.29			
1248.05	2613.66	2613.91	1555.54	2617.00	2617.73	1859.93	2620.28	2621.14	2150.86	2623.38	2624.42			
1252.60	2613.28	2614.00	1567.41	2616.84	2617.75	1876.50	2619.82	2621.16	2157.02	2623.92	2624.31			
1259.04	2612.68	2613.88	1590.54	2616.49	2617.77	1885.28	2620.73	2621.15	2172.82	2623.99	2624.46			
1264.71	2613.17	2613.95	1597.85	2617.26	2617.87	1887.27	2620.97	2621.19	2179.33	2623.68	2624.55			
1269.95	2613.51	2614.01	1600.23	2617.65	2617.82	1917.21	2621.41	2621.71	2188.44	2622.95	2624.48			
1293.46	2614.28	2614.47	1633.32	2617.60	2618.28	1920.78	2621.05	2621.79	2194.80	2623.77	2624.42			
1296.92	2613.97	2614.61	1641.61	2617.37	2618.29	1927.58	2621.12	2621.85						
1306.76	2613.38	2614.57	1653.30	2617.31	2618.35	1936.79	2621.40	2621.99						
1313.58	2613.63	2614.56	1660.17	2617.66	2618.38	1943.01	2621.62	2622.05						



	Baseline	As needed		
Avg. Water Surface Slope	0.0139			
Riffle Length	34			
Avg. Riffle Slope	0.0183			
Pool Length	19			

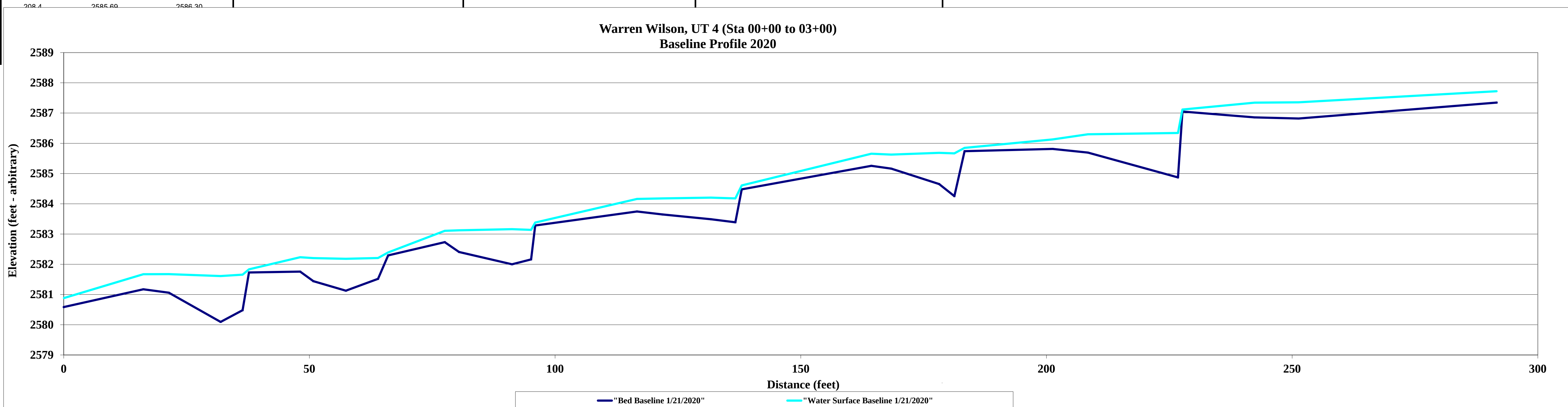


1773.38	2619.61	2619.84

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 4 (Sta 00+00 to 03+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	2580.58	2580.88	208.4	2585.69	2586.30						
16.2	2581.17	2581.67	226.8	2584.87	2586.34						
21.4	2581.06	2581.67	227.7	2587.05	2587.12						
31.9	2580.09	2581.61	242.4	2586.86	2587.35						
36.4	2580.48	2581.66	251.3	2586.82	2587.36						
37.7	2581.73	2581.83	291.6	2587.35	2587.72						
48.1	2581.76	2582.23									
50.8	2581.44	2582.20									
57.4	2581.13	2582.18									
64.0	2581.52	2582.21									
66.0	2582.29	2582.39									
77.5	2582.73	2583.11									
80.5	2582.41	2583.12									
91.2	2582.00	2583.16									
95.1	2582.16	2583.14									
96.0	2583.28	2583.38									
116.7	2583.75	2584.16									
121.8	2583.65	2584.18									
131.7	2583.49	2584.20									
136.7	2583.39	2584.18									
138.0	2584.48	2584.61									
164.4	2585.25	2585.65									
168.4	2585.16	2585.63									
178.2	2584.65	2585.68									
181.3	2584.25	2585.67									
183.3	2585.74	2585.85									
201.3	2585.81	2586.13									
208.4	2585.69	2586.30									

	Baseline	As needed		
Avg. Water Surface Slope	0.0235			
Riffle Length	25			
Avg. Riffle Slope	0.0338			
Pool Length	15			

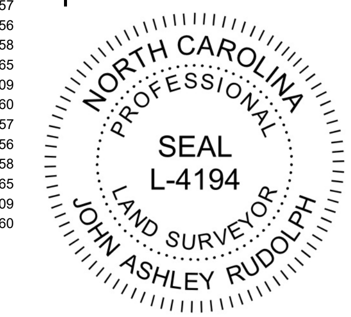


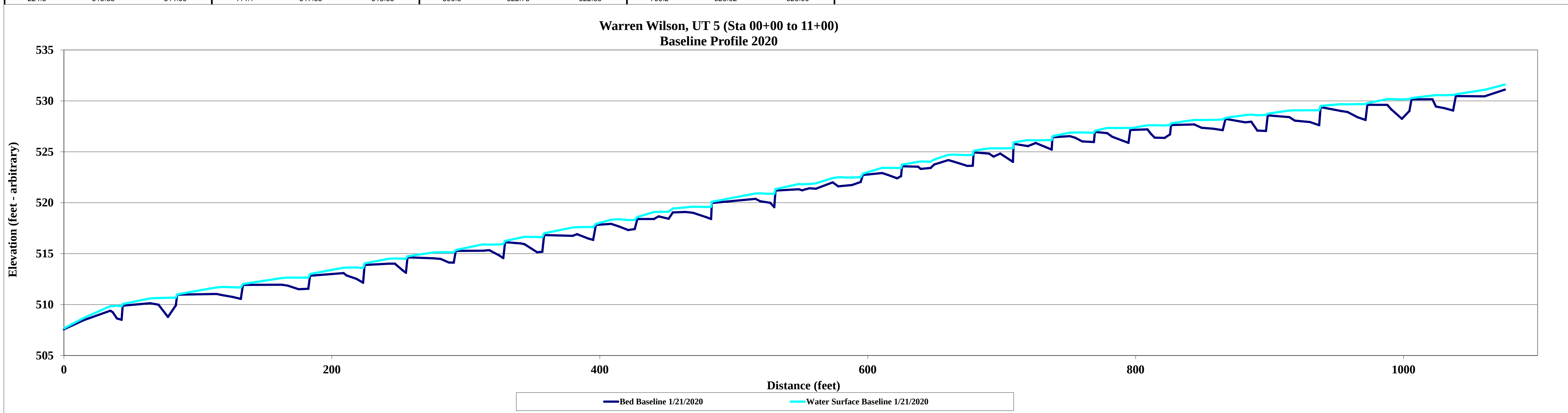
Project Name Warren Wilson - Baseline (2020) Profile
Reach UT 5 (Sta 00+00 to 11+00)
Feature Profile
Date 1/21/20
Crew Perkinson, Radecki

Station	2020 Baseline Survey Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation
0.0	507.58	507.66	242.7	514.02	514.50	421.2	517.32	518.30	610.7	522.91	523.42
14.5	508.46	508.67	247.1	514.01	514.53	426.1	517.42	518.31	614.8	522.75	523.42
34.6	509.40	509.85	252.9	513.36	514.51	428.1	518.40	518.60	622.0	522.39	523.42
36.5	509.25	509.84	255.3	513.13	514.50	440.4	518.40	519.09	624.9	522.62	523.41
39.6	508.64	509.89	256.5	514.64	514.74	444.0	518.66	519.10	625.6	523.58	523.75
43.0	508.51	509.82	275.7	514.54	515.11	451.4	518.42	519.12	637.6	523.54	524.01
43.9	509.89	510.05	281.2	514.48	515.15	454.5	519.05	519.43	639.6	523.32	524.05
64.4	510.13	510.61	287.4	514.13	515.14	464.0	519.09	519.55	647.0	523.41	524.03
70.6	509.98	510.64	291.0	514.12	515.13	469.5	519.02	519.61	649.6	523.76	524.24
77.7	508.79	510.67	292.5	515.27	515.36	479.5	518.58	519.58	660.2	524.19	524.70
83.5	509.92	510.67	312.6	515.28	515.91	483.1	518.40	519.60	663.7	524.06	524.72
84.6	510.98	511.01	317.6	515.34	515.89	483.6	519.97	520.10	674.4	523.62	524.68
113.9	511.04	511.68	324.7	514.85	515.90	516.3	520.38	520.91	678.4	523.63	524.70
118.9	510.91	511.74	327.9	514.56	515.94	519.7	520.14	520.91	679.1	524.94	525.10
126.1	510.75	511.70	329.3	516.13	516.25	527.2	519.99	520.88	690.5	524.83	525.34
132.0	510.56	511.67	340.9	516.01	516.58	530.2	519.57	520.88	693.9	524.53	525.35
133.6	511.94	512.02	343.8	515.92	516.66	531.2	521.20	521.35	698.9	524.83	525.33
162.5	511.95	512.60	353.2	515.14	516.64	548.5	521.32	521.83	708.4	524.01	525.35
167.0	511.86	512.65	357.1	515.18	516.60	551.1	521.22	521.81	708.8	525.79	525.92
175.2	511.51	512.64	358.4	516.83	517.00	553.4	521.31	521.82	719.6	525.56	526.15
182.5	511.55	512.65	379.7	516.75	517.57	556.6	521.42	521.84	725.4	525.86	526.12
183.8	512.83	513.01	383.0	516.92	517.60	561.3	521.37	521.91	732.5	525.48	526.14
208.7	513.10	513.62	391.5	516.48	517.62	573.8	522.00	522.43	737.4	525.21	526.16
211.0	512.86	513.62	395.1	516.35	517.59	578.0	521.61	522.50	737.8	526.42	526.53
218.3	512.53	513.65	397.1	517.83	517.93	588.3	521.74	522.48	750.9	526.54	526.89
223.3	512.15	513.59	408.4	517.92	518.33	594.8	522.04	522.51	754.8	526.38	526.89
224.5	513.88	514.06	414.1	517.68	518.38	596.3	522.73	522.85	760.2	526.02	526.90

Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation
768.8	525.96	526.86	890.8	527.09	528.59	1024.1	529.44	530.57
769.6	526.95	527.06	897.3	527.04	528.62	1030.4	529.29	530.56
778.7	526.84	527.34	898.6	528.58	528.74	1036.9	529.05	530.58
782.4	526.48	527.34	914.7	528.40	529.06	1039.0	530.47	530.65
789.8	526.11	527.33	918.9	528.06	529.07	1060.4	530.45	531.09
794.6	525.88	527.35	930.1	527.92	529.08	1075.5	531.10	531.60
796.0	527.14	527.31	937.0	527.61	529.08	1024.1	529.44	530.57
808.8	527.20	527.60	938.0	529.39	529.51	1030.4	529.29	530.56
811.3	526.76	527.60	953.2	529.01	529.67	1036.9	529.05	530.58
814.2	526.39	527.61	958.1	528.91	529.66	1039.0	530.47	530.65
821.6	526.37	527.58	965.6	528.40	529.68	1060.4	530.45	531.09
825.7	526.71	527.64	971.6	528.13	529.68	1075.5	531.10	531.60
826.5	527.63	527.80	972.9	529.62	529.78	1024.1	529.44	530.57
843.6	527.69	528.13	987.8	529.60	530.18	1030.4	529.29	530.56
849.3	527.36	528.12	990.8	529.16	530.18	1036.9	529.05	530.58
858.0	527.27	528.14	998.7	528.25	530.15	1039.0	530.47	530.65
864.9	527.12	528.17	1004.3	529.01	530.18	1060.4	530.45	531.09
867.1	528.24	528.34	1005.9	530.15	530.28	1075.5	531.10	531.60
881.8	527.90	528.61	1021.5	530.16	530.53			
886.2	527.95	528.65						

	Baseline	As needed		
Avg. Water Surface Slope	0.0221			
Riffle Length	18			
Avg. Riffle Slope	0.0268			
Pool Length	12			





483.6	519.97	520.10

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 6 (Sta 00+00 to 06+00)
Feature	Profile
Date	3/17/20
Crew	Perkinson, Keith

	2020 Baseline Survey	
Station	**Bed Elevation**	**Water Elevation**
0.0	519.52	519.62
53.7	519.21	519.60
55.6	518.52	519.65
63.3	518.86	519.63
64.6	519.80	520.00
80.8	519.65	520.10
98.0	519.99	520.25
99.8	519.17	520.33
108.5	519.22	520.24
109.9	519.94	520.27
120.9	520.35	520.45
122.6	519.45	520.42
127.2	519.49	520.43
133.7	519.29	520.44
137.7	520.18	520.51
152.7	520.56	520.54
155.6	519.63	520.59
162.4	519.72	520.66
170.4	519.59	520.64
171.4	520.58	520.79
183.9	520.19	520.79
184.9	519.88	520.85
188.5	519.77	520.86
196.0	519.59	520.84
198.5	520.45	520.90
212.0	520.46	521.01
219.3	520.86	521.04

	As needed	
Station	**Bed Elevation**	**Water Elevation**
244.3	520.69	521.16
246.4	520.12	521.11
251.7	520.15	521.15
257.3	520.27	521.19
259.0	521.07	521.17
271.9	520.82	521.28
274.2	520.47	521.29
278.5	520.38	521.25
288.1	520.17	521.30
289.1	521.39	521.48
296.3	521.17	521.59
298.5	520.77	521.57
301.8	520.70	521.57
309.4	520.80	521.61
310.9	521.41	521.59
326.3	521.46	521.90
328.7	520.87	521.88
335.2	520.86	521.88
338.1	521.59	521.84
352.2	521.94	522.02
355.9	521.07	522.04
359.8	521.08	522.03
363.8	521.80	522.03
400.5	522.01	522.14
402.3	521.26	522.16
404.2	520.93	522.14
408.8	522.29	522.30

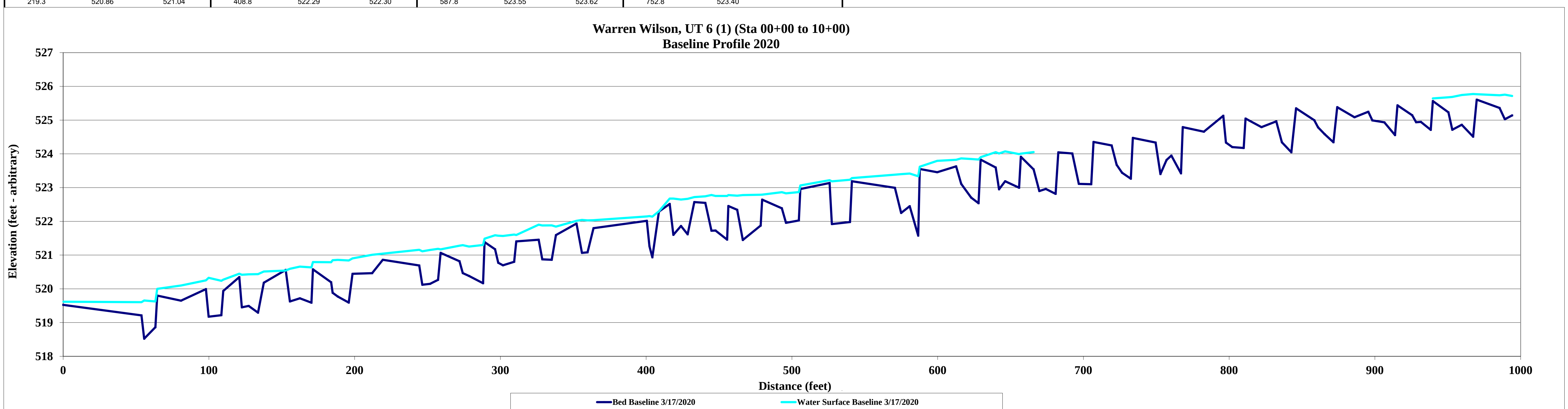
	As needed	
Station	**Bed Elevation**	**Water Elevation**
416.1	522.52	522.68
418.7	521.60	522.68
423.9	521.86	522.64
428.5	521.62	522.67
433.1	522.57	522.72
440.6	522.55	522.74
444.8	521.72	522.78
447.6	521.73	522.75
455.6	521.46	522.75
456.4	522.45	522.78
462.4	522.34	522.76
466.3	521.45	522.78
478.6	521.88	522.79
479.6	522.64	522.79
493.1	522.39	522.86
495.9	521.96	522.83
504.8	522.02	522.87
505.8	522.96	523.06
525.9	523.14	523.22
527.4	521.92	523.19
539.9	521.98	523.23
541.2	523.19	523.28
570.7	522.99	523.38
574.9	522.25	523.40
580.9	522.45	523.42
586.7	521.58	523.34
587.8	523.55	523.62

	As needed	
Station	**Bed Elevation**	**Water Elevation**
599.7	523.46	523.79
612.7	523.63	523.82
616.2	523.11	523.87
623.0	522.70	523.85
628.1	522.54	523.83
629.5	523.83	523.90
639.8	523.60	524.05
642.1	522.95	524.01
646.3	523.19	524.07
655.8	523.00	523.99
657.1	523.92	524.01
665.8	523.54	524.05
669.8	522.90	
674.2	522.96	
680.9	522.81	
682.8	524.04	
692.4	524.01	
696.8	523.11	
705.4	523.10	
706.9	524.35	
719.4	524.25	
722.8	523.68	
726.5	523.44	
732.5	523.26	
733.9	524.47	
749.5	524.33	
752.8	523.40	

	As needed	
Station	**Bed Elevation**	**Water Elevation**
757.1	523.82	
760.4	523.95	
766.9	523.42	
768.2	524.79	
782.7	524.66	
796.0	525.13	
797.8	524.34	
802.2	524.20	
810.0	524.17	
811.2	525.05	
822.2	524.79	
832.3	524.96	
836.1	524.34	
842.7	524.05	
845.9	525.35	
858.4	525.00	
861.0	524.79	
865.5	524.58	
871.6	524.34	
874.1	525.38	

	As needed	
Station	**Bed Elevation**	**Water Elevation**
886.0	525.09	
895.5	525.25	
898.2	524.99	
906.5	524.93	
913.8	524.56	
915.5	525.44	
925.6	525.14	
928.3	524.94	
931.5	524.95	
938.3	524.71	
939.8	525.56	525.64
950.4	525.23	525.68
953.1	524.71	525.69
959.6	524.86	525.74
967.4	524.51	525.77
969.9	525.61	525.77
985.5	525.36	525.74
989.2	525.02	525.75
994.2	525.14	525.72

	Baseline	As needed		
Avg. Water Surface Slope	0.0051			
Riffle Length	16			
Avg. Riffle Slope	0.0085			
Pool Length	10			



466.3	521.45	522.78

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 6 (2) (Sta 10+00 to 15+10)
Feature	Profile
Date	3/17/20
Crew	Perkinson, Keith

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
1001.2	524.76	525.75	1163.1	525.04	526.12	1340.2	525.60	526.43	1492.2	525.76	
1002.2	525.74	525.75	1164.8	526.14	526.15	1341.6	526.44	526.45	1497.0	525.52	
1009.1	525.60	525.85	1181.4	525.78	526.26	1351.0	526.33	526.60	1497.7	526.68	527.09
1010.3	525.07	525.80	1185.3	525.64	526.34	1361.6	526.44	526.70	1508.7	526.26	527.04
1014.5	525.09	525.81	1190.9	525.50	526.18	1365.7	525.82	526.61			
1017.2	525.45	525.83	1199.6	525.54	526.17	1370.8	525.63	526.67			
1029.1	525.55	525.99	1200.9	526.11	526.27	1376.3	525.69	526.80			
1030.9	524.91	525.86	1221.2	526.02	526.35	1378.2	526.47	526.60			
1037.7	525.27	525.91	1225.7	525.72	526.34	1391.6	526.66	526.72			
1045.3	525.18	525.85	1230.0	525.79	526.41	1395.7	525.68				
1046.6	525.87	525.96	1236.1	525.83	526.28	1399.1	525.70				
1062.2	525.69	525.98	1237.1	526.29	526.39	1405.4	525.56				
1066.6	525.30	526.01	1245.4	525.94	526.41	1407.9	526.69				
1069.2	525.15	526.05	1247.8	525.52	526.32	1412.7	526.35				
1072.5	524.95	526.08	1251.0	525.09	526.33	1414.7	525.88				
1075.4	525.89	525.90	1253.5	525.91	526.28	1419.1	525.91				
1088.0	525.14	526.00	1269.6	526.04	526.37	1422.5	525.90				
1091.0	524.88	526.05	1275.3	525.68	526.52	1427.7	525.92				
1099.0	525.02	525.96	1278.0	525.59	526.36	1428.5	526.74				
1103.0	525.92	525.95	1282.8	525.13	526.40	1441.4	526.49				
1123.2	525.60	526.13	1283.9	526.14	526.43	1451.7	526.50				
1127.6	524.85	526.16	1299.5	525.82	526.48	1455.3	526.16				
1131.4	524.87	526.09	1306.0	525.63	526.48	1462.6	526.34				
1134.1	525.95	526.25	1309.9	524.89	526.16	1469.7	526.27				
1147.0	525.70	526.17	1312.0	526.28	526.28	1470.9	526.89				
1149.9	525.41	526.33	1332.8	525.98	526.48	1479.9	526.50				
1155.7	525.47	526.14	1336.2	525.73	526.51	1483.9	525.95				

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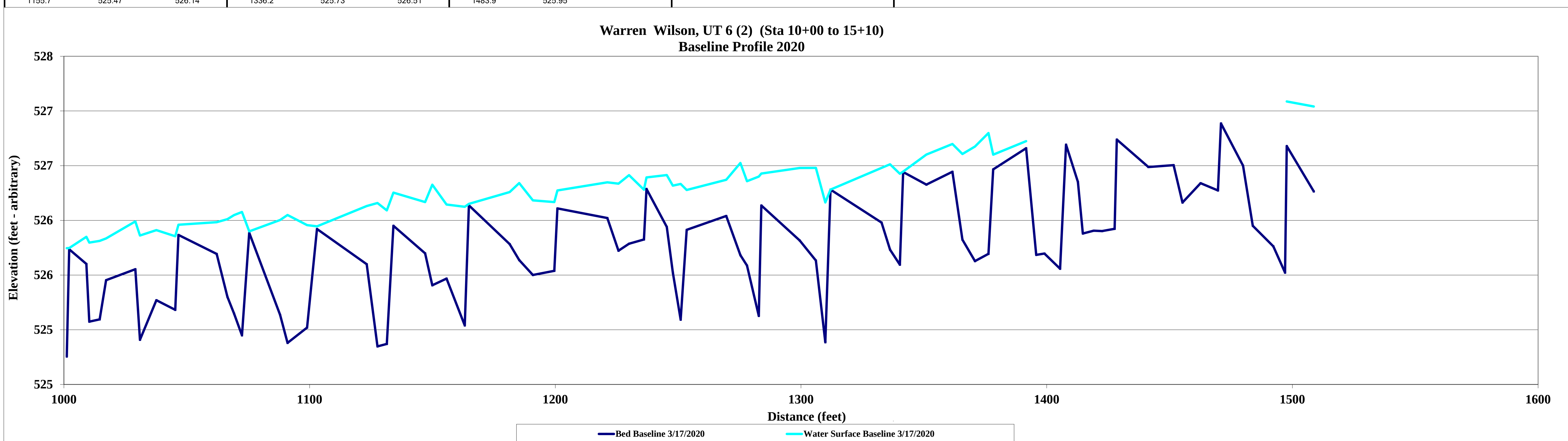
	Baseline	As needed		
Avg. Water Surface Slope	0.0051			
Riffle Length	16			
Avg. Riffle Slope	0.0085			
Pool Length	10			

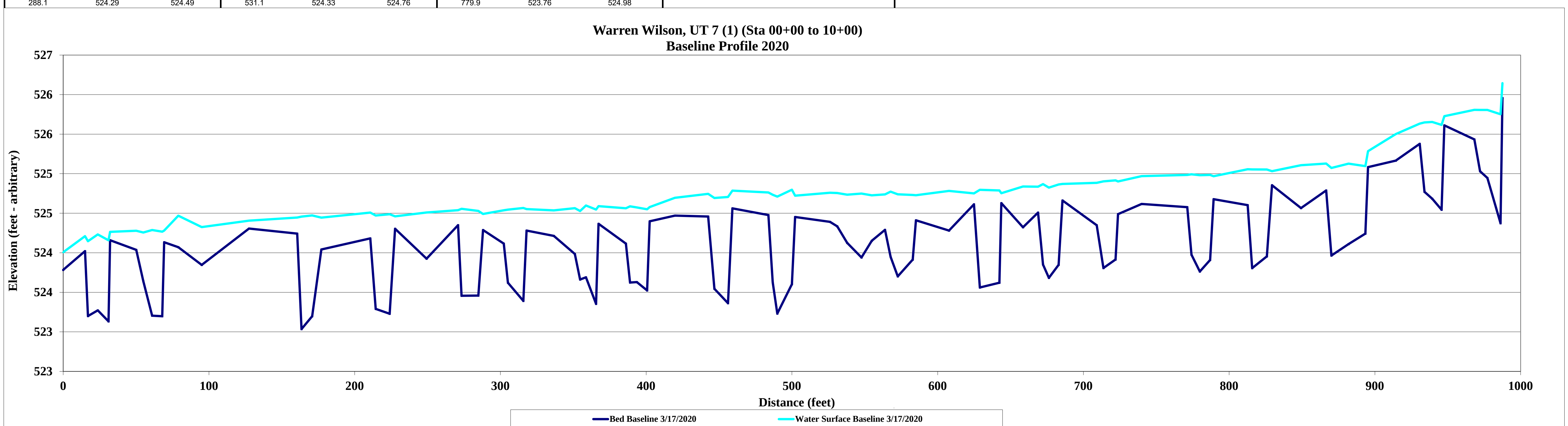


1405.4	525.56

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 7 (1) (Sta 00+00 to 10+00)
Feature	Profile
Date	3/17/20
Crew	Perkinson, Keith

	2020 Baseline Survey			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	523.78	524.01	302.3	524.12	524.54	537.9	524.13	524.74	786.9	523.91	524.98
15.0	524.02	524.21	305.2	523.62	524.55	547.7	523.94	524.75	789.3	524.68	524.97
17.0	523.20	524.15	315.7	523.39	524.57	554.8	524.15	524.73	812.7	524.60	525.06
23.7	523.27	524.23	318.0	524.28	524.55	563.9	524.29	524.74	815.8	523.81	525.05
31.1	523.13	524.16	336.7	524.21	524.54	567.7	523.95	524.77	825.9	523.95	525.05
32.2	524.16	524.26	351.0	523.98	524.56	572.6	523.70	524.74	829.4	524.85	525.03
50.1	524.04	524.28	354.6	523.66	524.53	582.9	523.91	524.73	849.3	524.57	525.11
55.0	523.64	524.26	358.7	523.69	524.60	585.1	524.41	524.73	866.5	524.79	525.13
61.0	523.20	524.29	365.6	523.35	524.55	607.8	524.28	524.78	870.1	523.97	525.07
68.0	523.20	524.27	367.3	524.37	524.59	624.9	524.61	524.75	881.9	524.11	525.13
69.2	524.13	524.28	386.1	524.12	524.56	629.0	523.56	524.80	893.4	524.24	525.10
79.0	524.07	524.47	388.9	523.62	524.59	642.4	523.62	524.79	895.3	525.08	525.29
95.0	523.85	524.32	393.6	523.63	524.57	643.7	524.63	524.75	914.3	525.17	525.50
127.5	524.31	524.41	400.7	523.52	524.55	658.6	524.32	524.84	930.7	525.38	525.63
160.6	524.24	524.45	402.4	524.40	524.58	668.9	524.51	524.84	934.0	524.77	525.65
163.5	523.03	524.46	419.7	524.47	524.70	672.3	523.85	524.87	939.3	524.68	525.65
170.8	523.20	524.47	442.5	524.46	524.74	676.3	523.68	524.82	945.8	524.54	525.62
177.1	524.04	524.44	446.8	523.54	524.69	683.0	523.85	524.86	947.7	525.61	525.73
210.7	524.18	524.51	456.1	523.36	524.71	685.7	524.66	524.87	968.3	525.43	525.81
214.4	523.29	524.47	459.1	524.56	524.79	709.1	524.35	524.88	972.1	525.03	525.81
224.0	523.23	524.49	483.8	524.48	524.76	713.7	523.81	524.90	977.2	524.95	525.81
227.7	524.30	524.46	486.8	523.63	524.73	722.1	523.91	524.92	986.2	524.37	525.75
249.3	523.93	524.51	490.0	523.23	524.71	723.7	524.49	524.90	987.5	525.96	526.14
270.9	524.35	524.54	500.0	523.60	524.80	740.0	524.62	524.97			
273.3	523.46	524.56	502.2	524.45	524.72	771.3	524.58	524.98			
284.8	523.46	524.53	526.1	524.39	524.76	774.1	523.98	524.99			
288.1	524.29	524.49	531.1	524.33	524.76	779.9	523.76	524.98			

	Baseline	As needed		
Avg. Water Surface Slope	0.0103			
Riffle Length	27			
Avg. Riffle Slope	0.0126			
Pool Length	11			



642.4	523.62	524.79

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 7 (2) (Sta 10+00 to 20+00)
Feature	Profile
Date	3/17/20
Crew	Perkinson, Keith

	2020 Baseline Survey			As needed			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
1006.2	525.97	526.26	1247.8	528.60	528.91	1424.6	531.19	532.16	1641.5	535.24	536.55	1798.4	539.44	540.16
1021.4	525.87	526.42	1269.1	529.09	529.22	1433.8	531.40	532.22	1642.8	536.92	537.02	1803.6	539.23	540.23
1023.5	525.60	526.35	1271.0	528.22	529.12	1434.7	532.56	532.66	1661.6	536.99	537.47	1812.4	539.59	540.25
1029.3	525.66	526.38	1276.1	527.91	529.07	1454.4	532.35	532.84	1665.0	536.62	537.58	1813.7	540.59	540.61
1036.5	525.45	526.36	1282.8	527.88	529.11	1456.0	532.04	532.88	1668.9	536.58	537.48	1834.6	540.85	541.26
1037.8	526.36	526.52	1284.3	528.92	529.11	1460.6	532.13	532.84	1676.7	536.84	537.52	1853.7	541.61	541.75
1061.3	526.63	526.92	1285.2	528.43	529.61	1469.3	531.92	532.90	1677.9	537.80	537.97	1879.8	542.03	542.41
1064.2	526.07	526.82	1289.2	528.29	529.59	1470.2	533.20	533.26	1688.7	538.04	538.17	1882.8	541.37	542.38
1068.6	526.10	526.83	1297.8	528.40	529.51	1492.1	533.64	533.75	1691.9	537.30	538.18	1894.7	541.25	542.35
1071.9	526.83	526.89	1299.0	529.50	529.69	1495.6	532.96	533.72	1696.4	536.78	538.23	1896.5	542.25	542.56
1097.5	527.07	527.23	1312.1	529.92	530.02	1501.3	532.72	533.80	1707.8	537.08	538.18	1912.0	542.67	542.95
1100.7	526.32	527.32	1325.1	530.04	530.16	1506.8	532.78	533.73	1708.6	538.38	538.48	1931.3	542.86	543.25
1104.3	526.32	527.22	1326.7	529.22	530.17	1507.6	533.91	534.01	1716.3	538.59	538.70	1936.5	542.22	543.23
1111.9	526.51	527.29	1331.4	528.99	530.16	1534.3	534.64	534.77	1719.4	537.56	538.68	1946.0	542.34	543.29
1114.0	527.32	527.44	1340.2	529.12	530.15	1537.2	533.67	534.81	1724.2	537.75	538.66	1946.9	543.17	543.40
1131.1	527.24	527.49	1340.9	530.30	530.47	1540.9	533.78	534.82	1731.8	537.61	538.66	1958.7	543.47	543.92
1152.3	527.62	527.78	1358.3	530.63	530.83	1549.8	533.46	534.80	1732.7	538.85	539.02	1972.6	544.00	544.33
1153.7	527.00	527.83	1359.7	529.90	530.86	1550.6	534.88	535.02	1742.9	538.93	539.16			
1168.0	526.98	527.83	1363.3	529.84	530.82	1566.7	535.18	535.24	1746.3	538.32	539.15			
1170.0	527.84	528.02	1370.1	529.95	530.81	1568.6	534.26	535.29	1750.2	538.28	539.11			
1204.7	527.32	528.14	1371.4	530.93	530.99	1573.2	534.32	535.29	1759.4	538.39	539.08			
1208.0	527.02	528.12	1392.7	531.40	531.55	1582.4	534.19	535.25	1759.8	539.38	539.42			
1215.2	527.24	528.19	1394.2	530.52	531.54	1583.7	535.58	535.61	1768.0	539.52	539.64			
1218.1	528.45	528.47	1400.0	530.40	531.51	1607.3	535.98	536.30	1770.6	538.93	539.66			
1234.2	528.37	528.95	1408.3	530.48	531.54	1626.5	536.37	536.51	1777.0	539.06	539.69			
1238.2	527.98	528.92	1409.3	531.61	531.63	1627.7	535.58	536.52	1782.1	539.86	539.96			
1245.2	527.92	528.75	1422.4	531.89	532.15	1632.9	535.29	536.56	1796.3	540.00	540.26			

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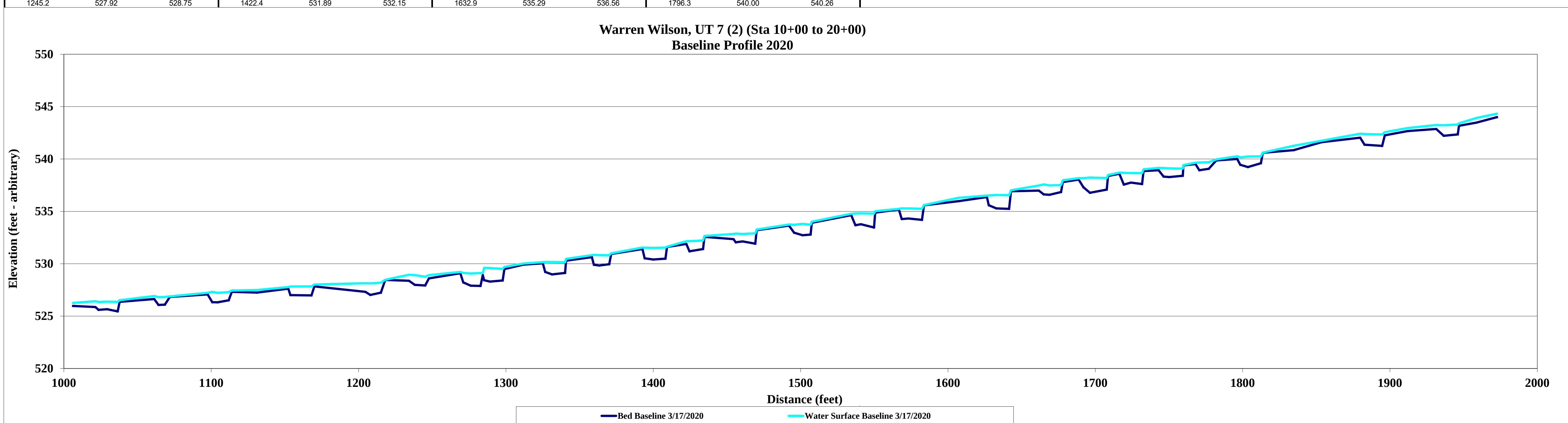
	Baseline	As needed		
Avg. Water Surface Slope	0.0103			
Riffle Length	27			
Avg. Riffle Slope	0.0126			
Pool Length	11			

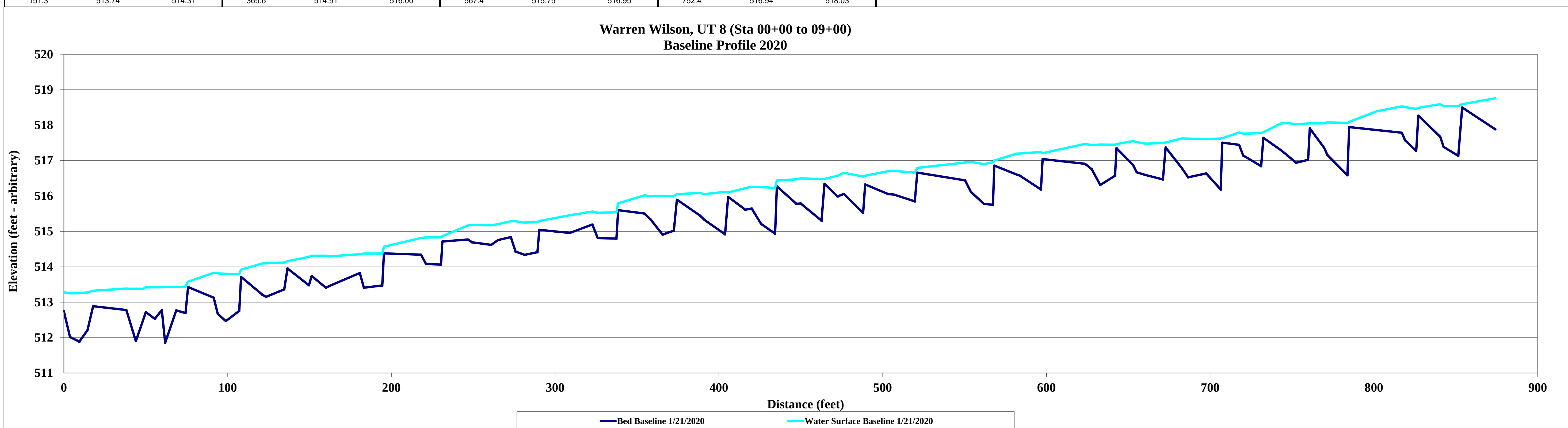


1506.8	532.78	533.73

Project Name	Warren Wilson - Baseline (2020) Profile
Reach	UT 8 (Sta 00+00 to 09+00)
Feature	Profile
Date	1/21/20
Crew	Perkinson, Radecki

	2020 Baseline Survey			As needed			As needed			As needed			As needed	
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	512.74	513.28	160.0	513.41	514.31	372.5	515.02	515.99	568.2	516.86	517.00	759.8	517.02	518.05
3.8	512.02	513.25	161.9	513.45	514.29	374.3	515.90	516.05	581.9	516.60	517.19	760.8	517.91	518.05
9.4	511.89	513.26	180.7	513.83	514.36	388.5	515.45	516.09	583.8	516.57	517.20	769.6	517.36	518.05
14.4	512.21	513.28	183.2	513.41	514.37	391.3	515.32	516.05	596.7	516.18	517.24	771.6	517.16	518.08
17.9	512.89	513.32	194.4	513.47	514.37	403.8	514.92	516.12	597.7	517.04	517.21	783.8	516.58	518.06
38.1	512.78	513.38	195.5	514.38	514.57	405.6	515.97	516.10	623.6	516.91	517.47	784.9	517.95	518.09
39.6	512.56	513.38	218.1	514.34	514.81	416.1	515.61	516.22	627.7	516.76	517.43	801.6	517.86	518.39
43.9	511.90	513.38	221.1	514.08	514.83	420.0	515.65	516.26	632.8	516.31	517.45	817.1	517.78	518.53
48.2	512.47	513.38	230.3	514.06	514.83	425.7	515.21	516.25	641.9	516.57	517.45	819.0	517.57	518.51
50.0	512.72	513.42	231.1	514.71	514.86	434.3	514.93	516.23	642.8	517.35	517.46	825.8	517.27	518.46
55.5	512.53	513.42	246.6	514.77	515.17	435.4	516.27	516.44	652.9	516.87	517.55	827.1	518.27	518.49
59.8	512.78	513.42	249.4	514.69	515.18	447.3	515.78	516.47	655.1	516.67	517.52	840.5	517.67	518.59
61.8	511.85	513.43	261.0	514.62	515.17	450.0	515.79	516.50	660.8	516.59	517.48	842.5	517.38	518.54
68.6	512.77	513.43	265.1	514.75	515.20	462.6	515.30	516.47	671.1	516.47	517.50	851.5	517.13	518.54
74.2	512.69	513.44	272.9	514.84	515.28	464.5	516.34	516.48	672.8	517.37	517.51	853.9	518.50	518.59
75.8	513.43	513.58	275.8	514.43	515.29	472.4	515.98	516.57	682.7	516.79	517.62	874.1	517.88	518.76
91.5	513.13	513.83	281.4	514.34	515.25	476.3	516.06	516.65	686.6	516.53	517.62			
94.0	512.67	513.81	289.2	514.41	515.27	488.1	515.52	516.55	697.6	516.63	517.61			
98.9	512.46	513.80	290.3	515.04	515.29	489.3	516.32	516.57	706.5	516.18	517.62			
107.1	512.75	513.80	309.0	514.96	515.45	503.5	516.05	516.70	707.4	517.51	517.63			
108.2	513.72	513.92	322.8	515.19	515.56	506.8	516.04	516.71	717.7	517.44	517.79			
121.2	513.21	514.09	326.0	514.81	515.52	519.6	515.85	516.66	720.1	517.15	517.76			
123.4	513.15	514.10	337.4	514.80	515.54	521.1	516.66	516.79	731.1	516.84	517.77			
134.6	513.36	514.12	338.5	515.60	515.79	550.4	516.44	516.94	732.5	517.64	517.80			
136.6	513.95	514.16	354.5	515.51	516.02	553.9	516.12	516.96	743.1	517.30	518.04			
149.6	513.48	514.28	358.2	515.34	516.00	561.8	515.77	516.90	747.1	517.15	518.06			
151.3	513.74	514.31	365.6	514.91	516.00	567.4	515.75	516.95	752.4	516.94	518.03			

	Baseline	As needed		
Avg. Water Surface Slope	0.0063			
Riffle Length	16			
Avg. Riffle Slope	0.0098			
Pool Length	12			



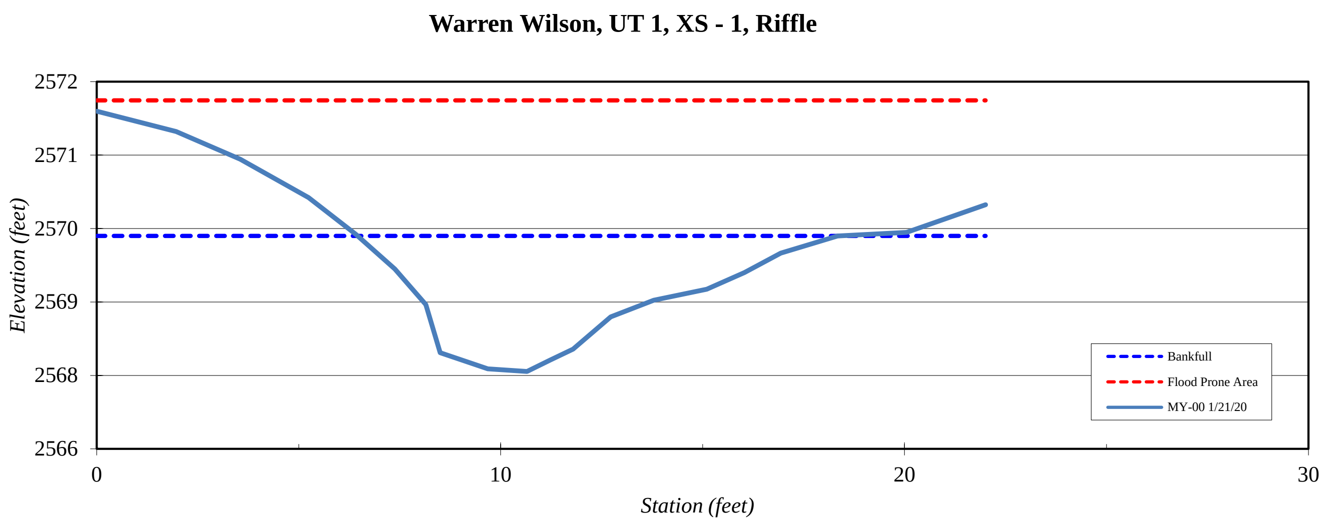
447.3	515.78	516.47

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS -1, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2571.7
2.0	2571.3
3.6	2570.9
5.2	2570.3
6.4	2569.8
7.4	2569.2
8.1	2568.7
8.5	2567.9
9.7	2567.7
10.6	2567.6
11.2	2567.8
11.8	2568.0
12.7	2568.5
13.8	2568.7
15.1	2568.9
16.0	2569.2
16.9	2569.5
18.3	2569.7
20.1	2569.8
22.0	2570.2

SUMMARY DATA	
Bankfull Elevation:	2569.7
Bankfull Cross-Sectional Area:	12.8
Bankfull Width:	11.9
Flood Prone Area Elevation:	2571.8
Flood Prone Width:	100.0
Max Depth at Bankfull:	2.1
Low Bank Height:	2.1
Mean Depth at Bankfull:	1.1
W / D Ratio:	11.1
Entrenchment Ratio:	8.4
Bank Height Ratio:	1.0

Stream Type	Cb 4

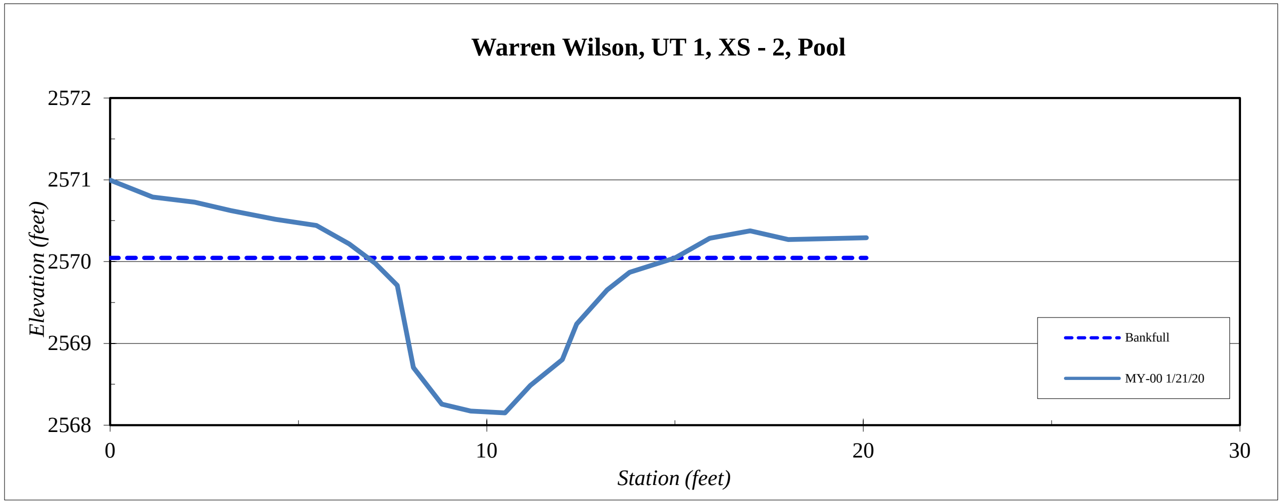


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 2, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2571.0
1.1	2570.8
2.2	2570.7
3.2	2570.6
4.4	2570.5
5.5	2570.4
6.3	2570.2
7.0	2570.0
7.6	2569.7
8.1	2568.7
8.8	2568.3
9.6	2568.2
10.5	2568.2
11.2	2568.5
12.0	2568.8
12.4	2569.2
13.2	2569.7
13.8	2569.9
15.0	2570.0
15.9	2570.3
17.0	2570.4
18.0	2570.3
20.1	2570.3

SUMMARY DATA	
Bankfull Elevation:	2570.0
Bankfull Cross-Sectional Area:	8.3
Bankfull Width:	8.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Cb 4

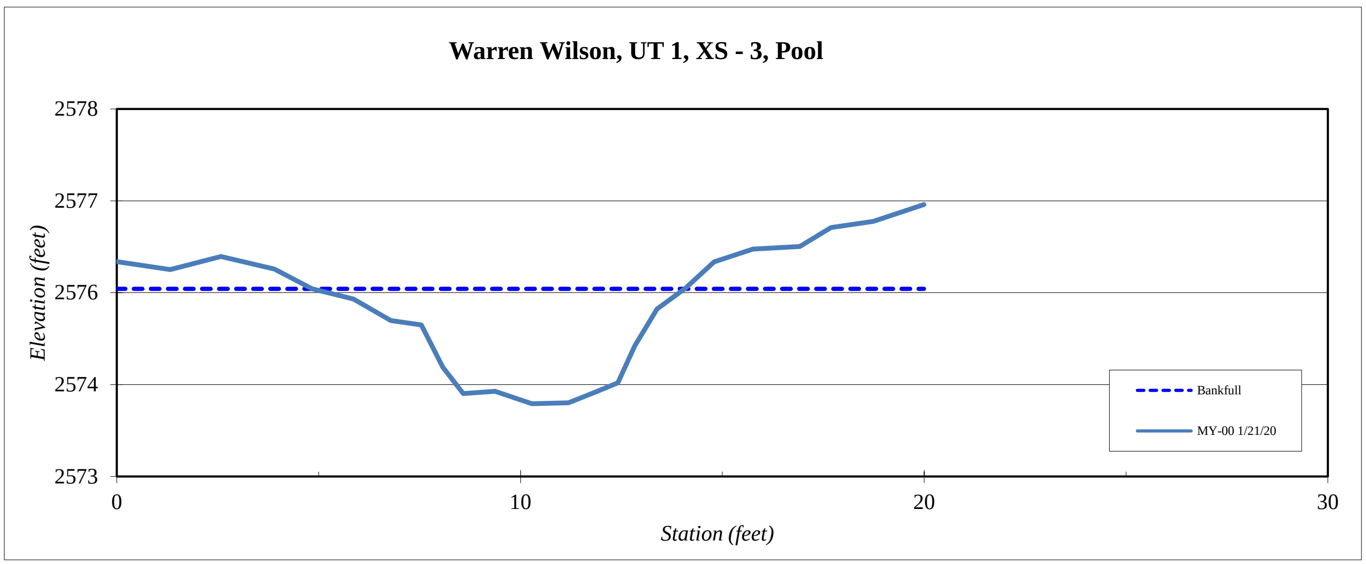


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 3, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2575.9
1.3	2575.8
2.6	2575.9
3.9	2575.8
4.8	2575.6
5.9	2575.4
6.8	2575.2
7.5	2575.1
8.1	2574.6
8.6	2574.3
9.4	2574.3
10.3	2574.1
11.2	2574.1
11.9	2574.3
12.4	2574.4
12.8	2574.8
13.4	2575.3
14.1	2575.6
14.8	2575.9
15.8	2576.0
16.9	2576.1
17.7	2576.3
18.7	2576.4
20.0	2576.6

SUMMARY DATA	
Bankfull Elevation:	2575.6
Bankfull Cross-Sectional Area:	7.4
Bankfull Width:	9.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.4
Low Bank Height:	1.4
Mean Depth at Bankfull:	0.8
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Cb 4

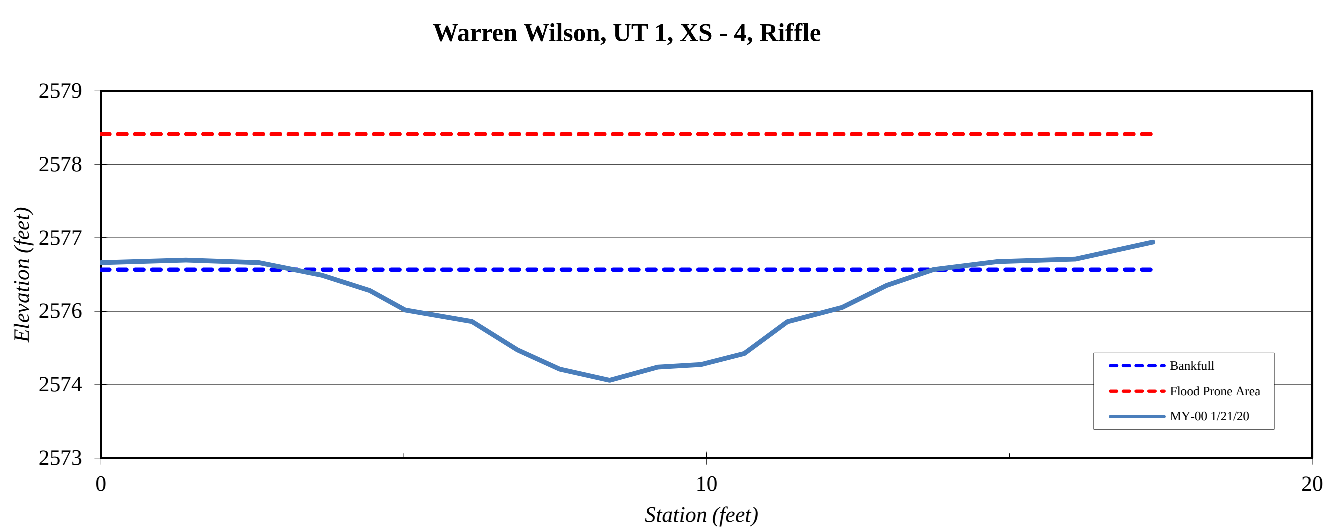


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS -4, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2576.2
1.4	2576.3
2.6	2576.3
3.6	2576.1
4.4	2575.8
5.0	2575.5
6.1	2575.3
6.9	2574.9
7.6	2574.6
8.4	2574.4
9.2	2574.6
9.9	2574.7
10.6	2574.9
11.3	2575.3
12.2	2575.6
13.0	2575.9
13.7	2576.1
14.8	2576.3
16.1	2576.3
17.4	2576.6

SUMMARY DATA	
Bankfull Elevation:	2576.1
Bankfull Cross-Sectional Area:	9.4
Bankfull Width:	10.6
Flood Prone Area Elevation:	2578.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	2.1
Low Bank Height:	2.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	11.9
Entrenchment Ratio:	9.5
Bank Height Ratio:	1.0

Stream Type	Cb 4

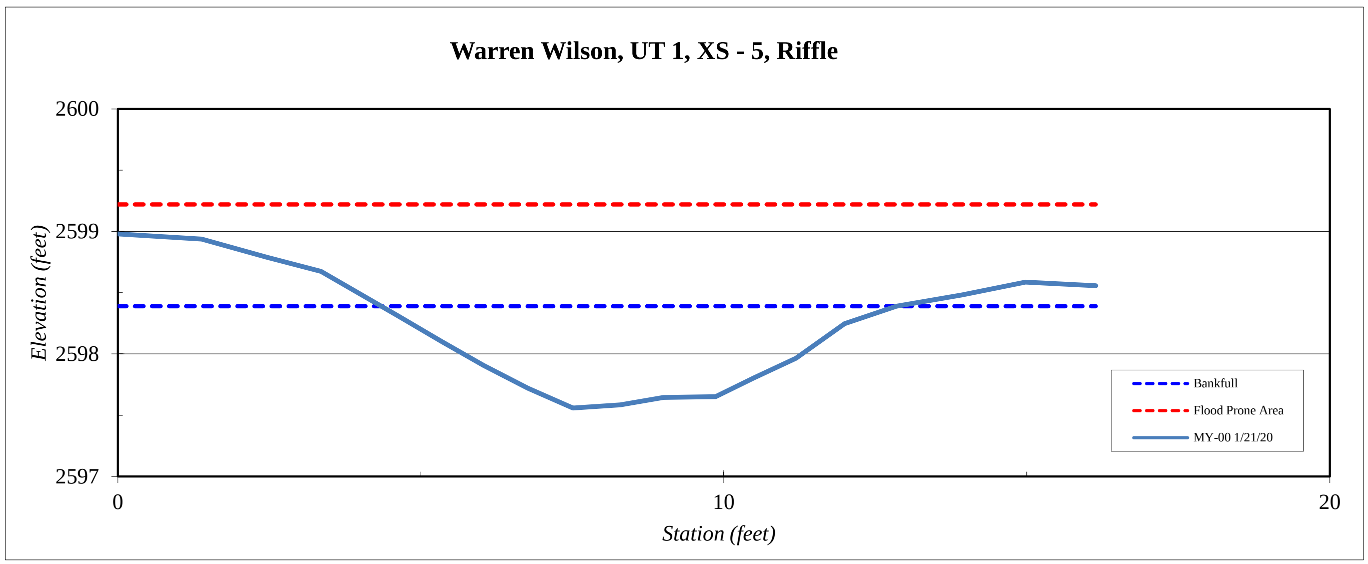


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 5, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2599.0
1.4	2598.9
2.5	2598.8
3.4	2598.7
4.6	2598.3
5.3	2598.1
6.0	2597.9
6.8	2597.7
7.5	2597.6
8.3	2597.6
9.0	2597.6
9.9	2597.7
10.5	2597.8
11.2	2598.0
12.0	2598.2
12.8	2598.4
13.9	2598.5
15.0	2598.6
16.1	2598.6

SUMMARY DATA	
Bankfull Elevation:	2598.4
Bankfull Cross-Sectional Area:	4.3
Bankfull Width:	8.5
Flood Prone Area Elevation:	2599.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	0.8
Low Bank Height:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	16.9
Entrenchment Ratio:	11.8
Bank Height Ratio:	1.0

Stream Type	Cb 4

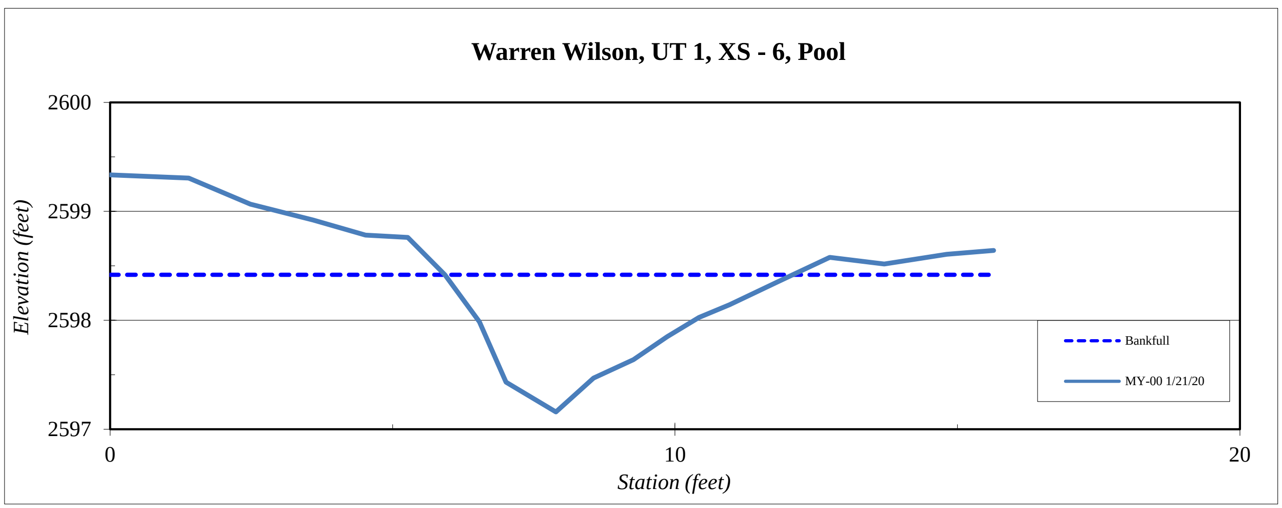


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 6, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2599.3
1.4	2599.3
2.5	2599.1
3.6	2598.9
4.5	2598.8
5.3	2598.8
5.9	2598.4
6.5	2598.0
7.0	2597.4
7.9	2597.2
8.6	2597.5
9.3	2597.6
9.9	2597.8
10.4	2598.0
11.0	2598.1
11.8	2598.4
12.7	2598.6
13.7	2598.5
14.8	2598.6
15.6	2598.6

SUMMARY DATA	
Bankfull Elevation:	2598.4
Bankfull Cross-Sectional Area:	3.8
Bankfull Width:	6.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.3
Low Bank Height:	1.3
Mean Depth at Bankfull:	0.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Cb 4

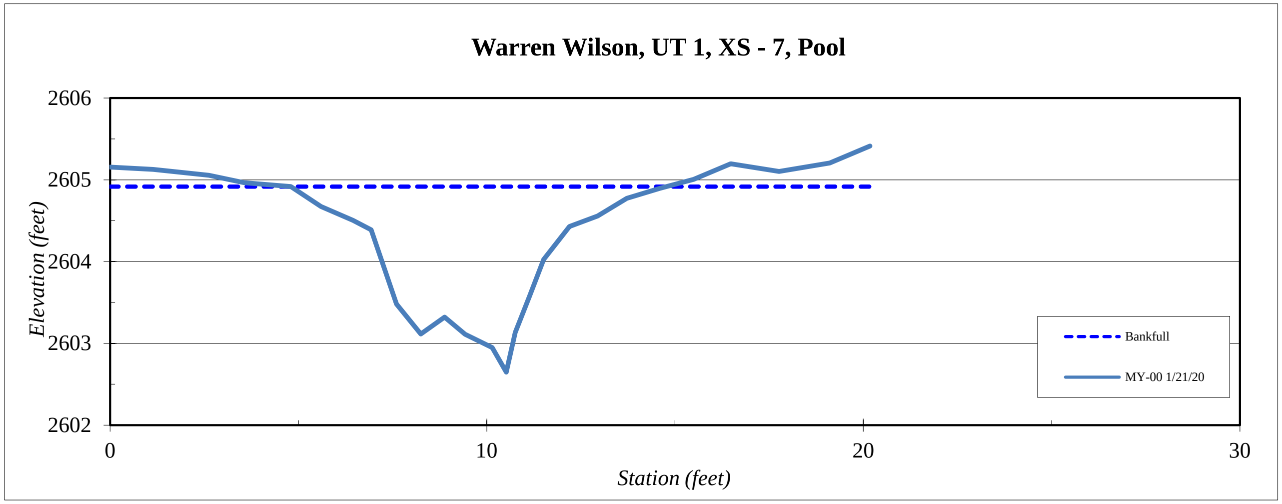


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 7, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2605.2
1.1	2605.1
2.6	2605.1
3.6	2605.0
4.8	2604.9
5.6	2604.7
6.5	2604.5
6.9	2604.4
7.6	2603.5
8.2	2603.1
8.9	2603.3
9.4	2603.1
10.1	2602.9
10.5	2602.6
10.8	2603.1
11.1	2603.6
11.5	2604.0
12.2	2604.4
12.9	2604.6
13.7	2604.8
14.6	2604.9
15.5	2605.0
16.5	2605.2
17.8	2605.1
19.1	2605.2
20.2	2605.4

SUMMARY DATA	
Bankfull Elevation:	2604.9
Bankfull Cross-Sectional Area:	9.0
Bankfull Width:	10.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.3
Low Bank Height:	2.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Cb 4



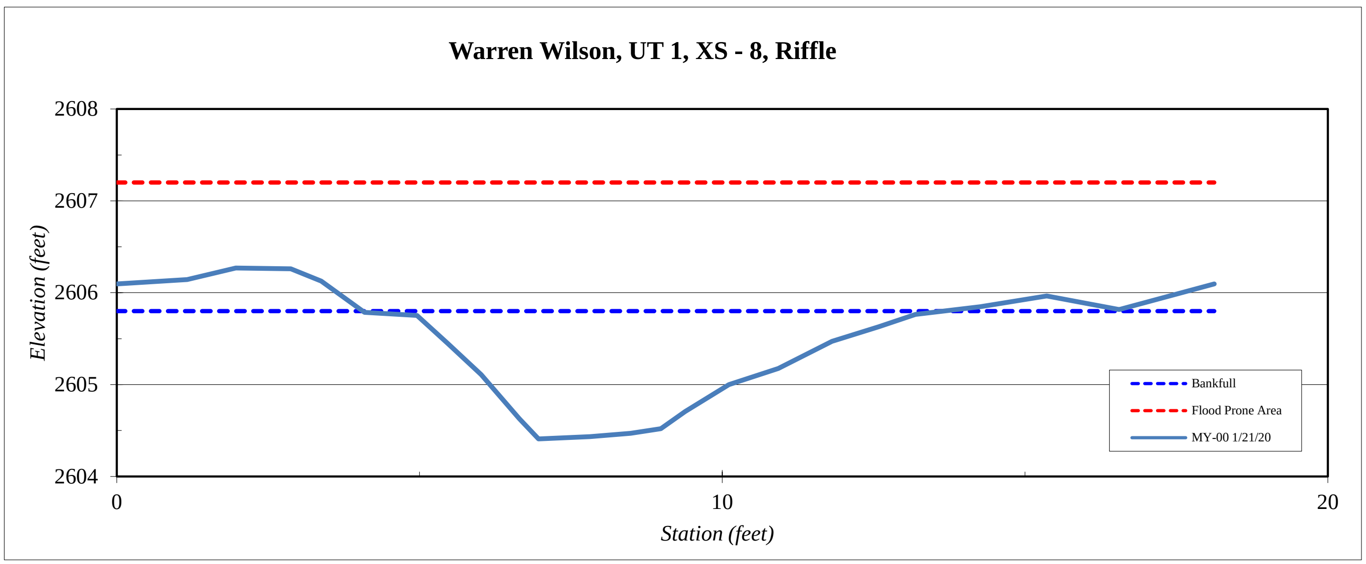
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 1, XS - 8, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2606.1
1.2	2606.1
2.0	2606.3
2.9	2606.3
3.4	2606.1
4.1	2605.8
5.0	2605.8
5.5	2605.4
6.0	2605.1
6.6	2604.6
7.0	2604.4
7.8	2604.4
8.5	2604.5
9.0	2604.5
9.4	2604.7
10.1	2605.0
10.9	2605.2
11.8	2605.5
12.6	2605.6
13.2	2605.8
14.3	2605.8
15.4	2606.0
16.6	2605.8
18.1	2606.1

SUMMARY DATA	
Bankfull Elevation:	2605.8
Bankfull Cross-Sectional Area:	6.6
Bankfull Width:	9.6
Flood Prone Area Elevation:	2607.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.4
Low Bank Height:	1.4
Mean Depth at Bankfull:	0.7
W / D Ratio:	14.0
Entrenchment Ratio:	10.4
Bank Height Ratio:	1.0

Stream Type	Cb 4



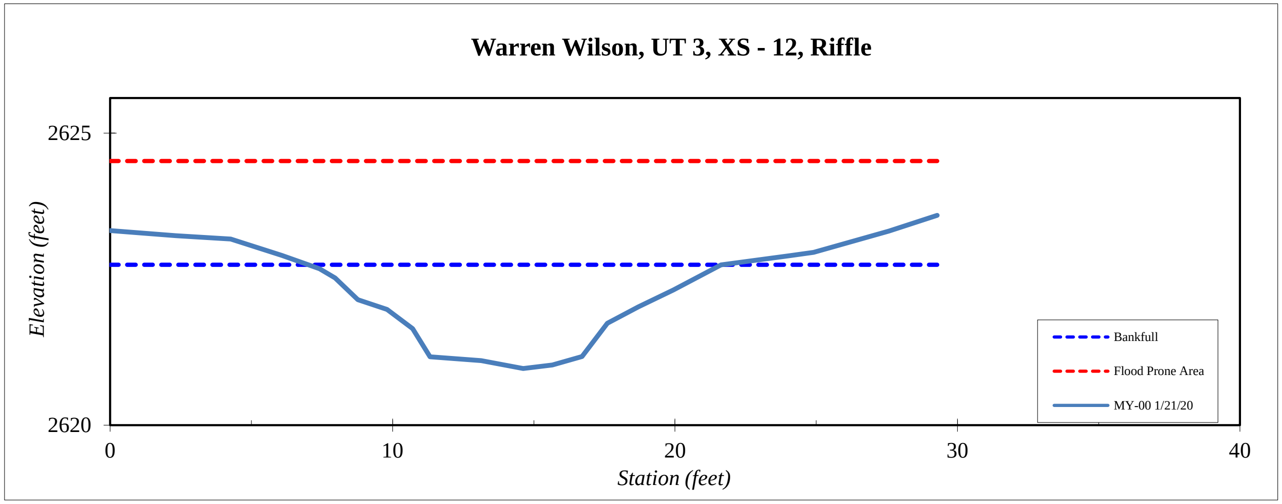
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 12, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2623.6
2.3	2623.5
4.3	2623.4
6.1	2623.1
7.4	2622.9
8.0	2622.7
8.8	2622.3
9.8	2622.1
10.7	2621.8
11.3	2621.3
13.1	2621.2
14.6	2621.0
15.7	2621.1
16.7	2621.3
17.6	2621.9
18.7	2622.2
19.9	2622.5
21.6	2622.9
24.1	2623.1
24.9	2623.2
27.6	2623.6
29.3	2623.8

SUMMARY DATA	
Bankfull Elevation:	2622.9
Bankfull Cross-Sectional Area:	16.0
Bankfull Width:	14.6
Flood Prone Area Elevation:	2624.8
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	13.3
Entrenchment Ratio:	6.8
Bank Height Ratio:	1.0

Stream Type	Ce 4

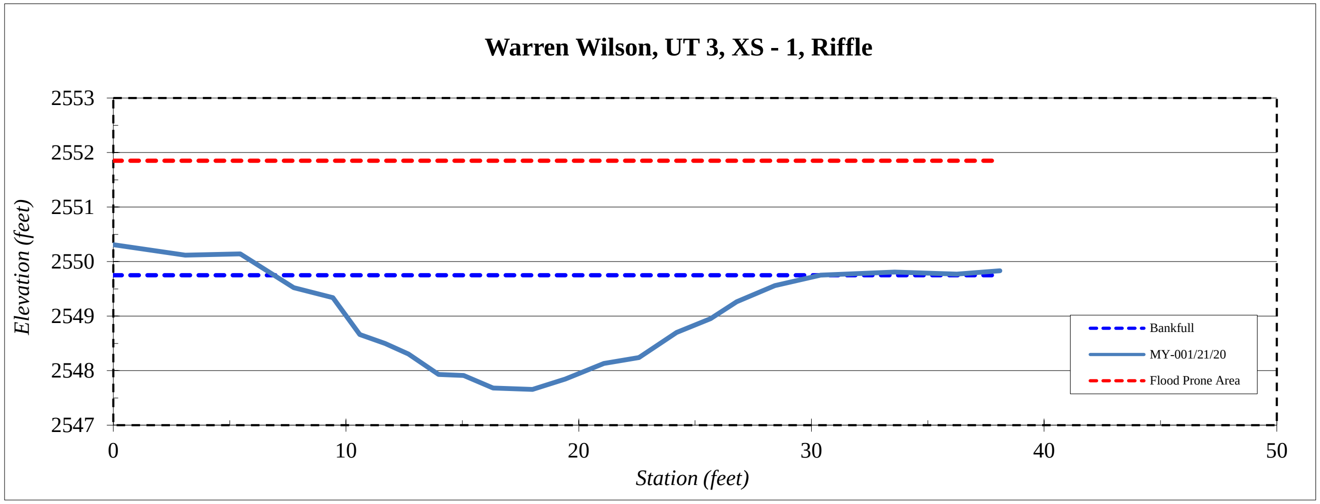


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 1, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2550.3
3.1	2550.1
5.5	2550.1
7.8	2549.5
9.4	2549.3
10.6	2548.7
11.7	2548.5
12.7	2548.3
14.0	2547.9
15.1	2547.9
16.3	2547.7
18.0	2547.7
19.4	2547.8
21.1	2548.1
22.6	2548.2
24.2	2548.7
25.7	2549.0
26.8	2549.3
28.4	2549.6
30.4	2549.8
33.6	2549.8
36.2	2549.8
38.1	2549.8

SUMMARY DATA	
Bankfull Elevation:	2549.8
Bankfull Cross-Sectional Area:	27.2
Bankfull Width:	23.5
Flood Prone Area Elevation:	2551.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	2.1
Low Bank Height:	2.1
Mean Depth at Bankfull:	1.2
W / D Ratio:	20.3
Entrenchment Ratio:	4.3
Bank Height Ratio:	1.0

Stream Type	Ce 4

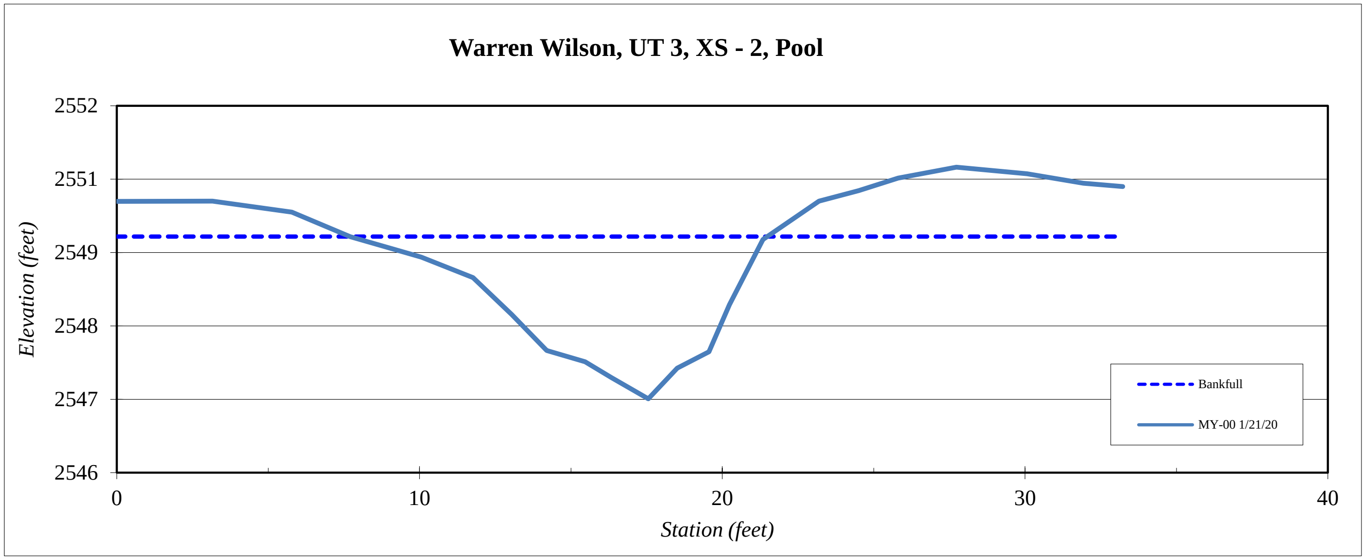


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 2, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2550.3
3.2	2550.3
5.8	2550.1
7.7	2549.7
10.1	2549.4
11.8	2549.1
13.0	2548.5
14.2	2548.0
15.5	2547.8
16.3	2547.6
17.6	2547.2
18.5	2547.7
19.6	2548.0
20.2	2548.7
21.3	2549.7
23.2	2550.3
24.5	2550.5
25.8	2550.6
27.7	2550.8
30.1	2550.7
31.9	2550.6
33.2	2550.5

SUMMARY DATA	
Bankfull Elevation:	2549.7
Bankfull Cross-Sectional Area:	16.7
Bankfull Width:	13.8
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.5
Low Bank Height:	2.5
Mean Depth at Bankfull:	1.2
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

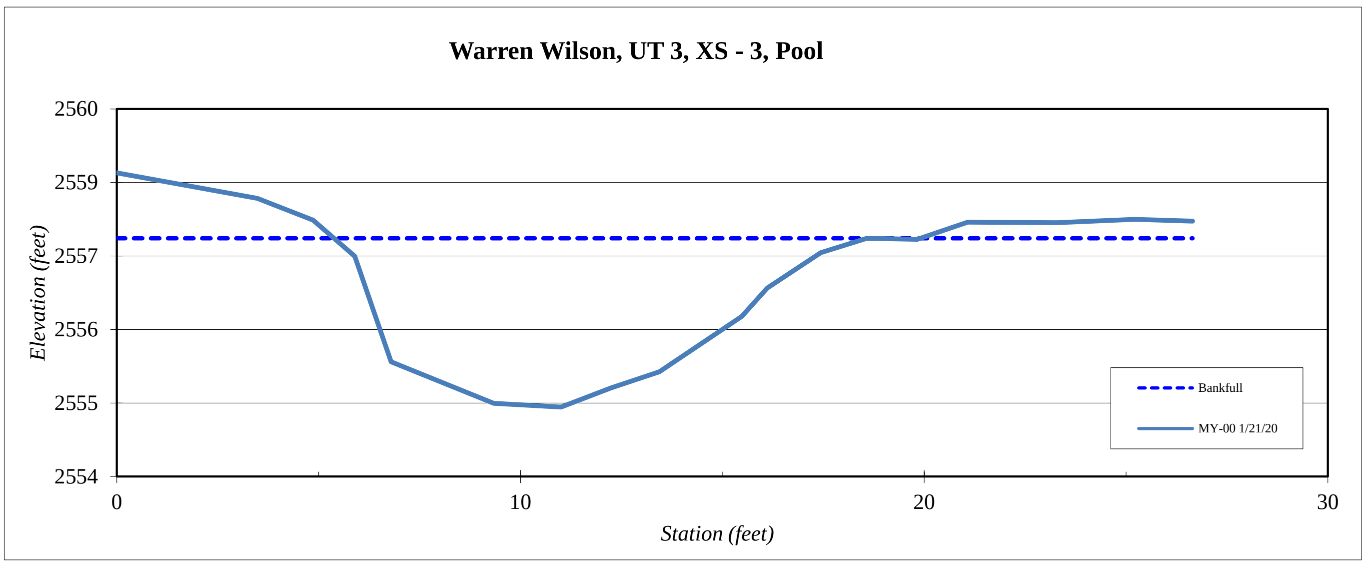


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT3, XS - 3, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2558.7
3.5	2558.3
4.9	2558.0
5.9	2557.4
6.8	2555.8
9.3	2555.1
11.0	2555.1
12.2	2555.4
13.4	2555.6
15.5	2556.5
16.1	2556.9
17.4	2557.5
18.6	2557.7
19.8	2557.7
21.1	2557.9
23.3	2557.9
25.2	2558.0
26.6	2557.9

SUMMARY DATA	
Bankfull Elevation:	2557.7
Bankfull Cross-Sectional Area:	21.3
Bankfull Width:	14.5
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.6
Low Bank Height:	2.6
Mean Depth at Bankfull:	1.5
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

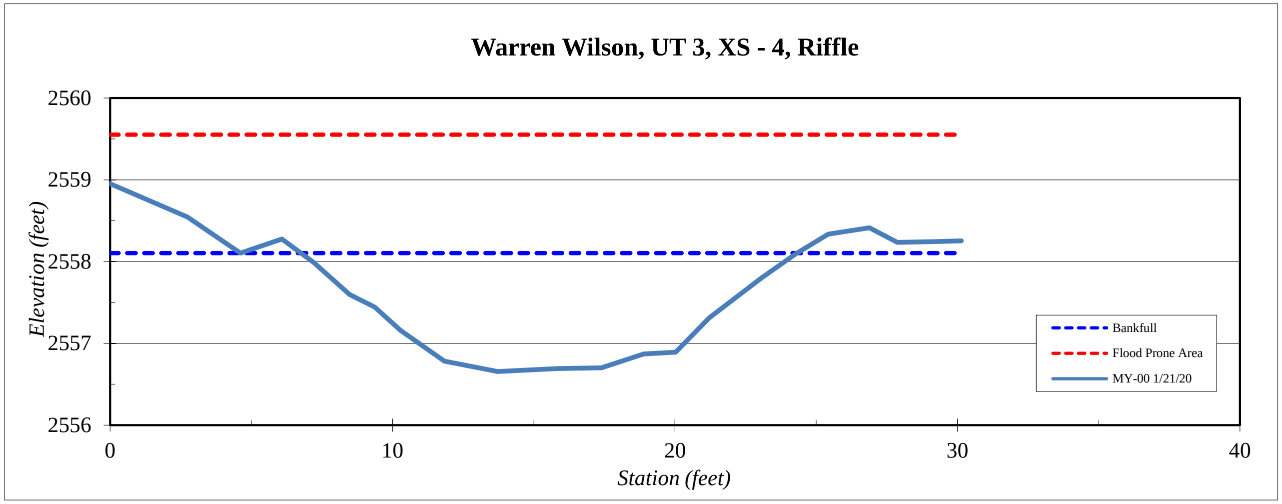


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 4, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2559.0
2.7	2558.5
4.6	2558.1
6.1	2558.3
7.2	2558.0
8.5	2557.6
9.4	2557.4
10.3	2557.2
11.8	2556.8
13.7	2556.7
15.8	2556.7
17.4	2556.7
18.9	2556.9
20.0	2556.9
21.2	2557.3
23.0	2557.8
24.3	2558.1
25.4	2558.3
26.9	2558.4
27.9	2558.2
29.3	2558.2
30.1	2558.3

SUMMARY DATA	
Bankfull Elevation:	2558.1
Bankfull Cross-Sectional Area:	17.0
Bankfull Width:	17.6
Flood Prone Area Elevation:	2559.6
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.4
Low Bank Height:	1.4
Mean Depth at Bankfull:	1.0
W / D Ratio:	18.1
Entrenchment Ratio:	5.7
Bank Height Ratio:	1.0

Stream Type	Ce 4

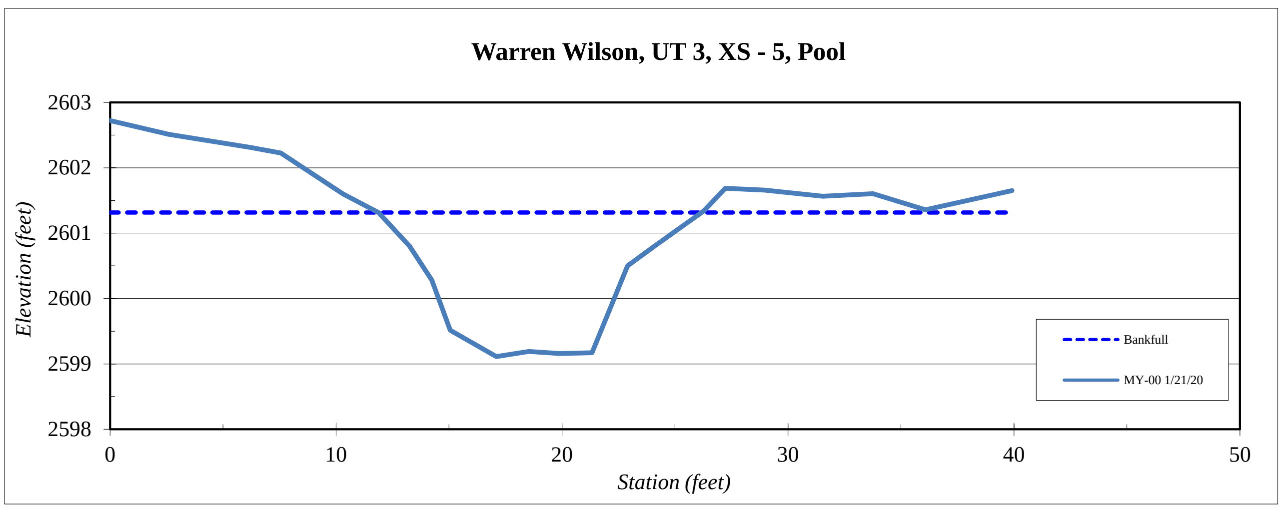


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 5, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2602.7
2.6	2602.5
6.2	2602.3
7.6	2602.2
10.3	2601.6
11.9	2601.3
13.2	2600.8
14.2	2600.3
15.1	2599.5
17.1	2599.1
18.5	2599.2
19.9	2599.2
21.3	2599.2
22.9	2600.5
24.2	2600.8
26.3	2601.3
27.2	2601.7
29.0	2601.7
31.5	2601.6
33.8	2601.6
36.1	2601.4
39.9	2601.7

SUMMARY DATA	
Bankfull Elevation:	2601.3
Bankfull Cross-Sectional Area:	19.1
Bankfull Width:	14.3
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.2
Low Bank Height:	2.2
Mean Depth at Bankfull:	1.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

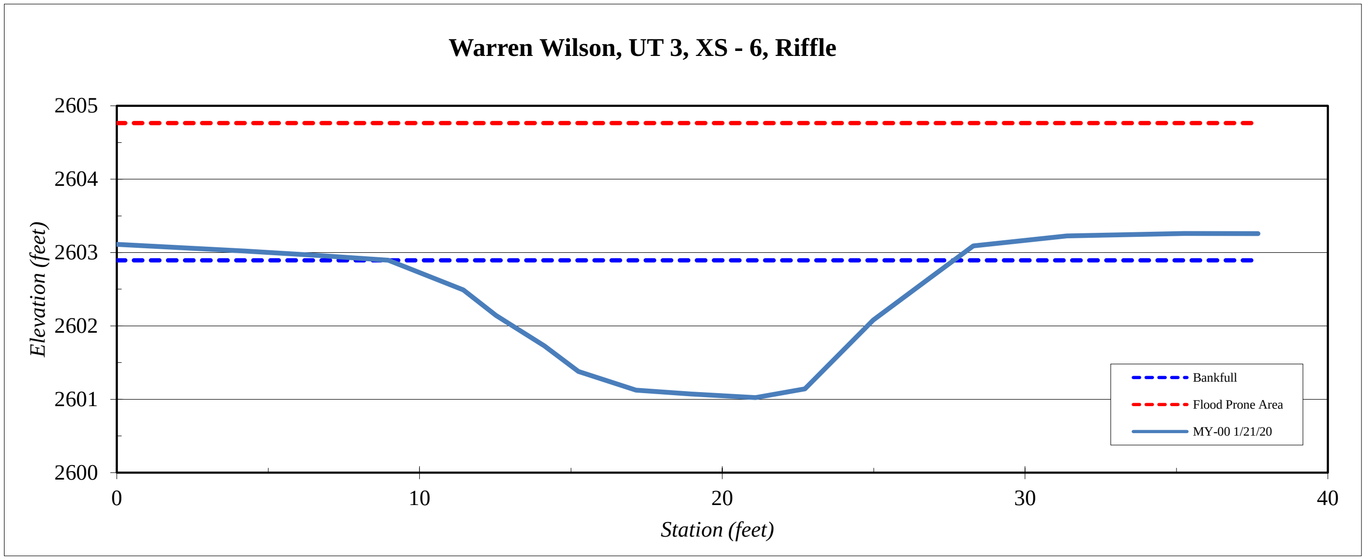


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 6, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2603.1
4.2	2603.0
6.6	2603.0
9.0	2602.9
11.4	2602.5
12.5	2602.1
14.1	2601.7
15.3	2601.4
17.2	2601.1
19.0	2601.1
21.1	2601.0
22.7	2601.1
25.0	2602.1
26.9	2602.7
28.3	2603.1
31.4	2603.2
35.2	2603.3
37.7	2603.3

SUMMARY DATA	
Bankfull Elevation:	2602.9
Bankfull Cross-Sectional Area:	21.4
Bankfull Width:	18.7
Flood Prone Area Elevation:	2604.8
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	16.3
Entrenchment Ratio:	5.4
Bank Height Ratio:	1.0

Stream Type	Ce 4

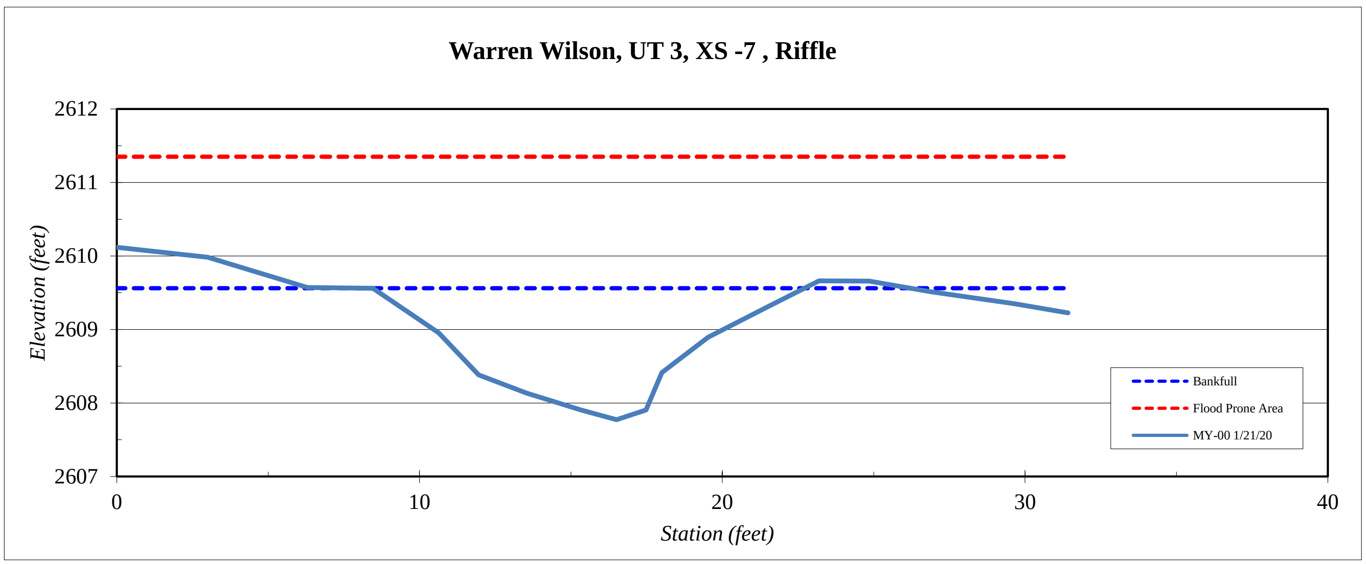


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 7, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2610.1
3.0	2610.0
6.3	2609.6
8.5	2609.6
10.6	2609.0
11.9	2608.4
13.5	2608.1
15.3	2607.9
16.5	2607.8
17.5	2607.9
18.0	2608.4
19.5	2608.9
21.5	2609.3
23.2	2609.7
24.9	2609.7
26.9	2609.5
29.6	2609.4
31.4	2609.2

SUMMARY DATA	
Bankfull Elevation:	2609.6
Bankfull Cross-Sectional Area:	13.6
Bankfull Width:	14.2
Flood Prone Area Elevation:	2611.4
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.8
Low Bank Height:	1.8
Mean Depth at Bankfull:	1.0
W / D Ratio:	15.0
Entrenchment Ratio:	7.0
Bank Height Ratio:	1.0

Stream Type	Ce 4



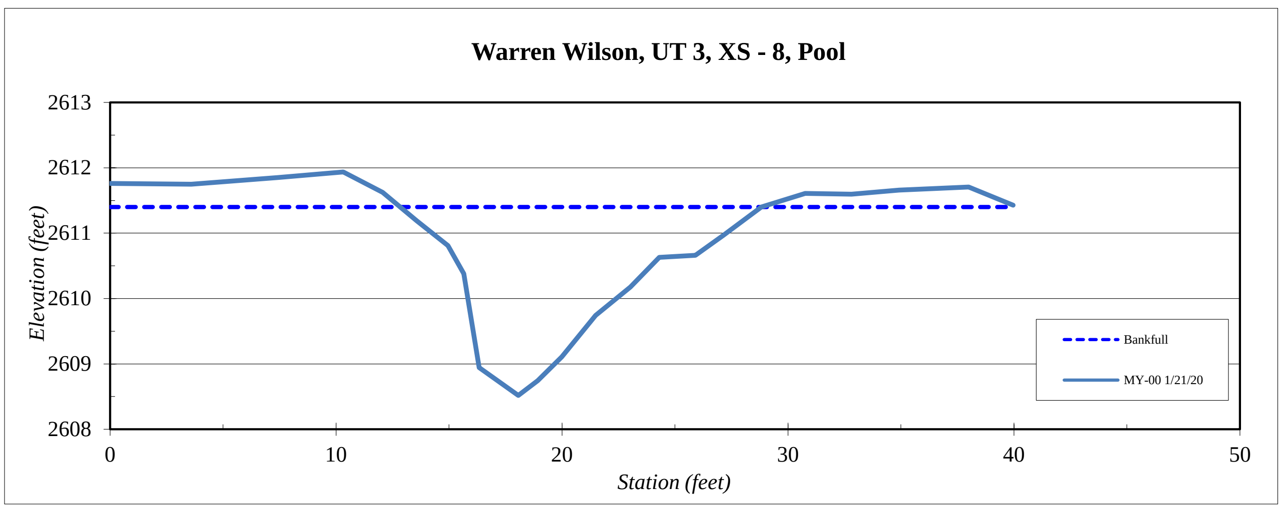
NORTH CAROLINA
PROFESSIONAL
SEAL
L-4194
LAND SURVEYOR
JOHN ASHLEY RUDOLPH

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 8, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2611.8
3.6	2611.7
7.4	2611.9
10.3	2611.9
12.1	2611.6
13.6	2611.2
15.0	2610.8
15.7	2610.4
16.3	2608.9
18.1	2608.5
18.9	2608.7
20.0	2609.1
21.5	2609.7
23.0	2610.2
24.3	2610.6
25.9	2610.7
27.1	2611.0
28.8	2611.4
30.8	2611.6
32.8	2611.6
34.9	2611.7
38.0	2611.7
40.0	2611.4

SUMMARY DATA	
Bankfull Elevation:	2611.4
Bankfull Cross-Sectional Area:	20.8
Bankfull Width:	16.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.9
Low Bank Height:	2.9
Mean Depth at Bankfull:	1.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

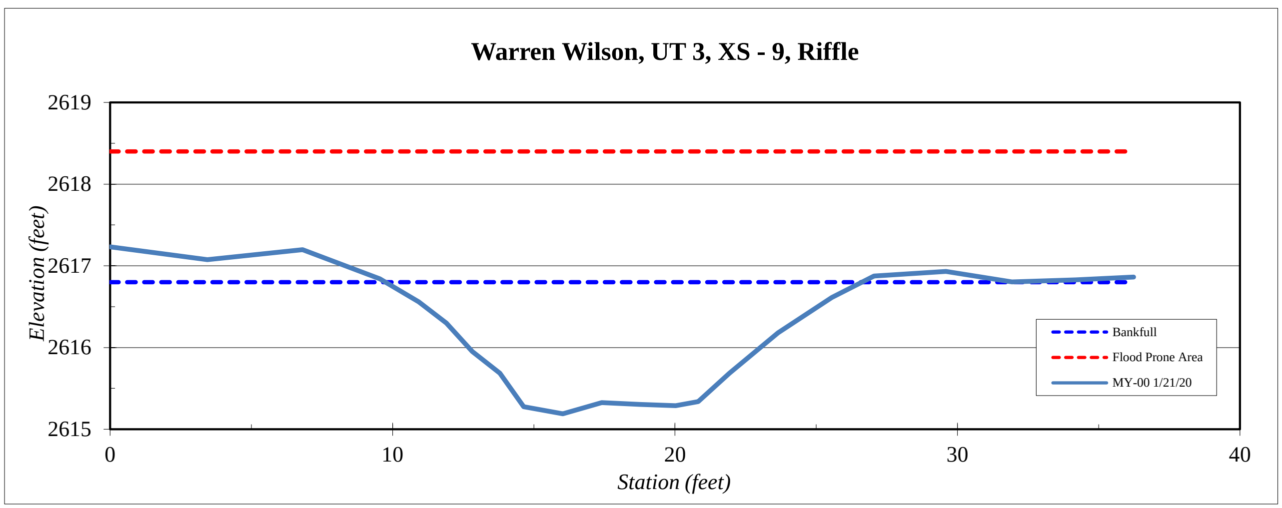


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 9, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2617.2
3.4	2617.1
6.8	2617.2
9.6	2616.8
10.9	2616.6
11.9	2616.3
12.8	2616.0
13.8	2615.7
14.6	2615.3
16.0	2615.2
17.4	2615.3
18.7	2615.3
20.0	2615.3
20.8	2615.3
21.9	2615.7
23.7	2616.2
25.5	2616.6
27.0	2616.9
29.6	2616.9
31.9	2616.8
34.2	2616.8
36.2	2616.9

SUMMARY DATA	
Bankfull Elevation:	2616.8
Bankfull Cross-Sectional Area:	16.4
Bankfull Width:	16.9
Flood Prone Area Elevation:	2618.4
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.6
Low Bank Height:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	17.4
Entrenchment Ratio:	5.9
Bank Height Ratio:	1.0

Stream Type	Ce 4

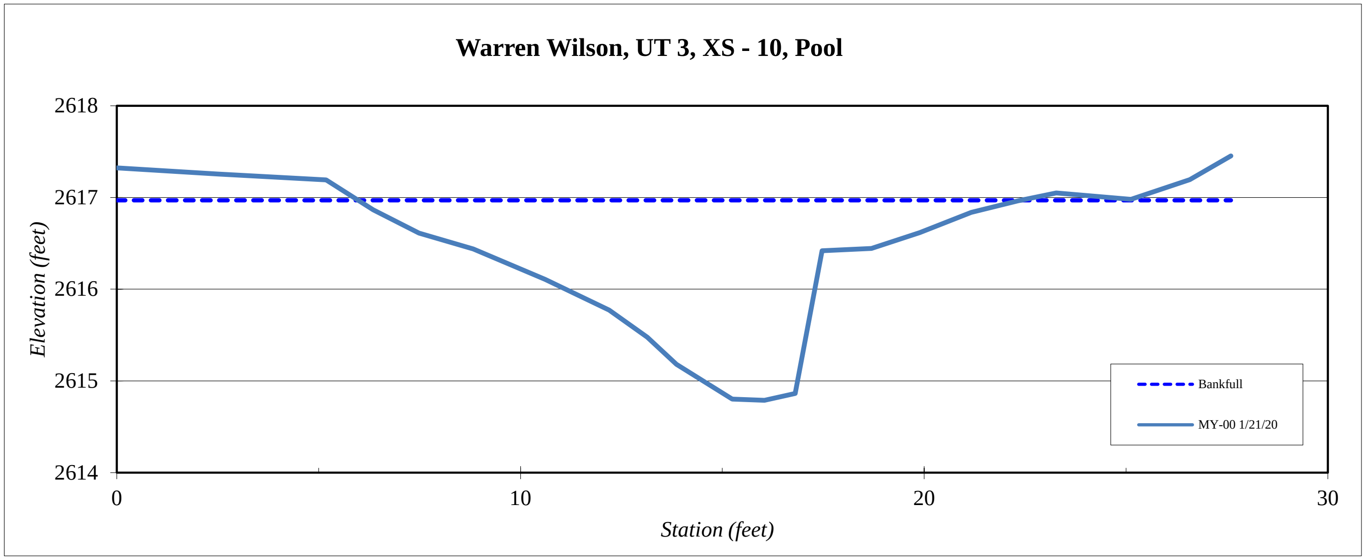


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 10, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2617.7
2.5	2617.6
5.2	2617.6
6.4	2617.2
7.5	2616.9
8.8	2616.7
10.6	2616.3
12.2	2615.9
13.1	2615.6
13.9	2615.3
15.2	2614.8
16.0	2614.8
16.8	2614.9
17.5	2616.7
18.7	2616.7
19.9	2616.9
21.2	2617.2
22.3	2617.3
23.3	2617.4
25.1	2617.3
26.6	2617.6
27.6	2617.8

SUMMARY DATA	
Bankfull Elevation:	2617.3
Bankfull Cross-Sectional Area:	16.7
Bankfull Width:	16.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.5
Low Bank Height:	2.5
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

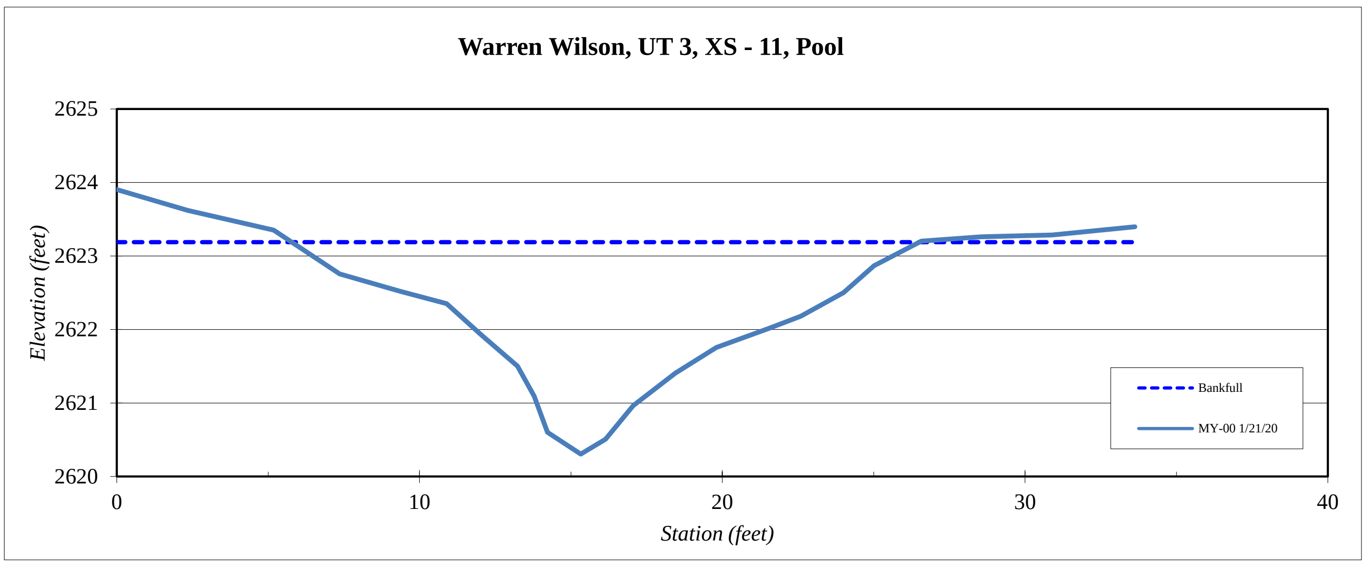


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 3, XS - 11, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2624.0
2.3	2623.7
5.2	2623.4
7.4	2622.7
9.4	2622.4
10.9	2622.3
12.0	2621.8
13.2	2621.3
13.8	2620.8
14.2	2620.3
15.3	2619.9
16.1	2620.2
17.1	2620.7
18.5	2621.2
19.8	2621.6
21.5	2621.9
22.6	2622.1
24.0	2622.4
25.0	2622.8
26.6	2623.2
28.6	2623.3
30.9	2623.3
33.6	2623.4

SUMMARY DATA	
Bankfull Elevation:	2623.2
Bankfull Cross-Sectional Area:	28.8
Bankfull Width:	20.7
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	3.3
Low Bank Height:	3.3
Mean Depth at Bankfull:	1.4
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4



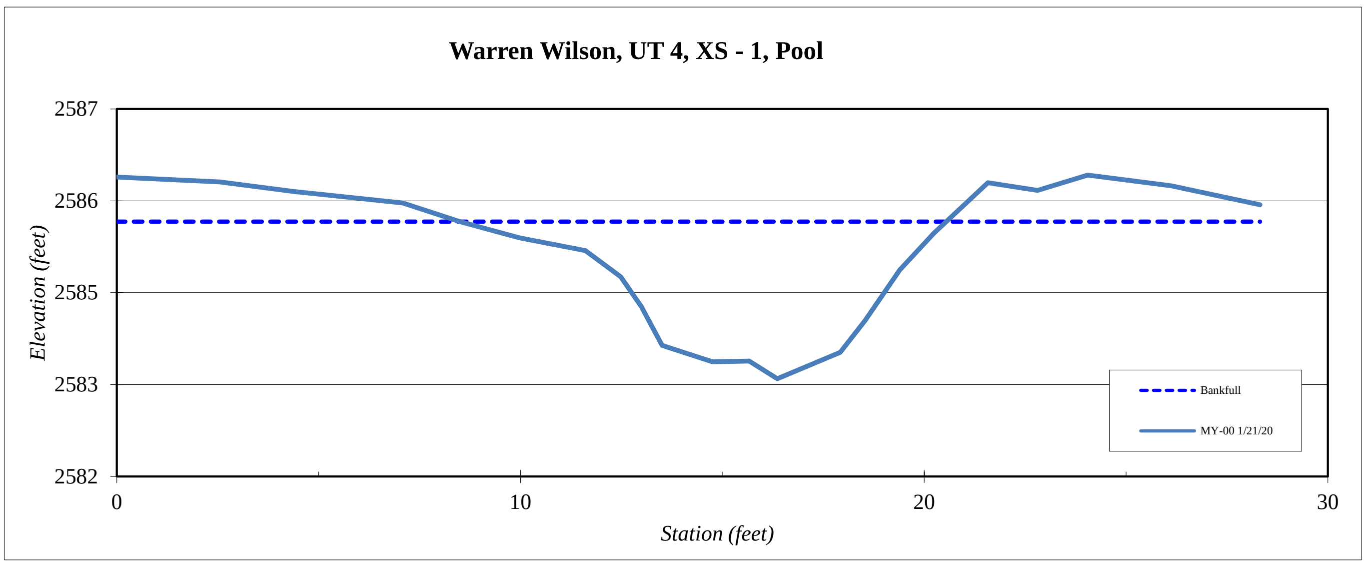
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

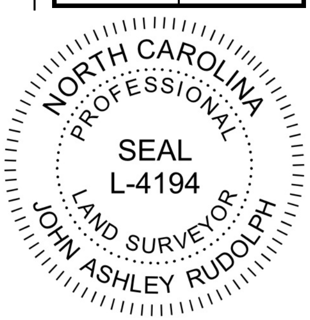
Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 4, XS - 1, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2586.0
2.6	2585.9
4.4	2585.8
7.1	2585.7
8.5	2585.4
10.0	2585.2
11.6	2585.1
12.5	2584.7
13.0	2584.4
13.5	2583.9
14.8	2583.7
15.7	2583.7
16.4	2583.5
17.9	2583.8
18.5	2584.2
19.4	2584.8
20.2	2585.3
21.6	2585.9
22.8	2585.8
24.1	2586.0
26.1	2585.9
28.3	2585.6

SUMMARY DATA	
Bankfull Elevation:	2585.4
Bankfull Cross-Sectional Area:	11.8
Bankfull Width:	12.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C 4



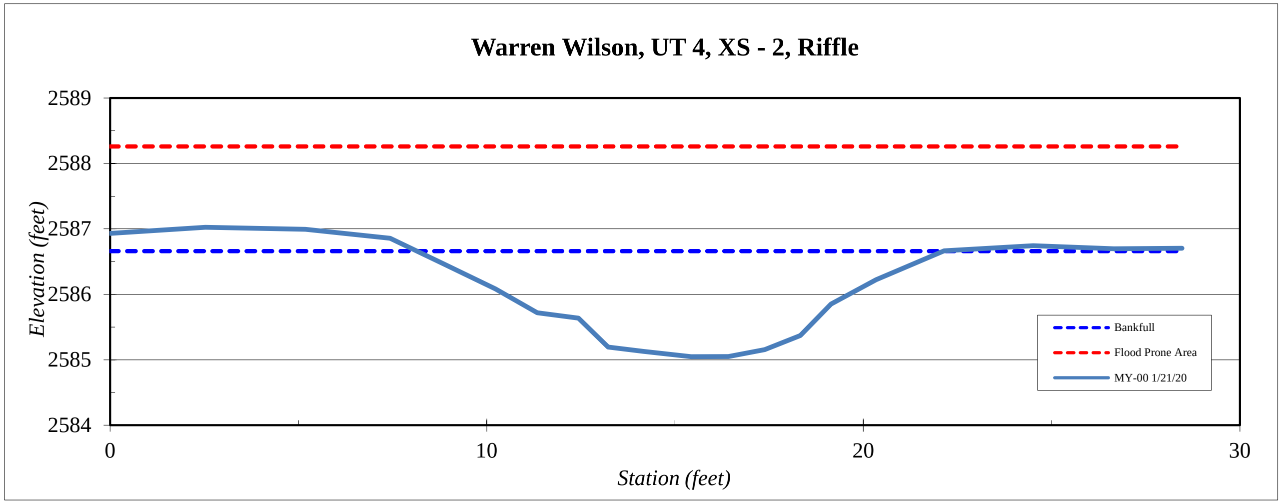


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 4, XS - 2, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	2586.9
2.5	2587.0
5.2	2587.0
7.4	2586.9
8.9	2586.5
10.2	2586.1
11.3	2585.7
12.4	2585.6
13.2	2585.2
14.2	2585.1
15.4	2585.0
16.4	2585.1
17.4	2585.2
18.3	2585.4
19.1	2585.9
20.3	2586.2
22.1	2586.7
24.5	2586.7
26.7	2586.7
28.5	2586.7

SUMMARY DATA	
Bankfull Elevation:	2586.7
Bankfull Cross-Sectional Area:	13.3
Bankfull Width:	14.0
Flood Prone Area Elevation:	2588.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.6
Low Bank Height:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	14.7
Entrenchment Ratio:	7.1
Bank Height Ratio:	1.0

Stream Type	C 4

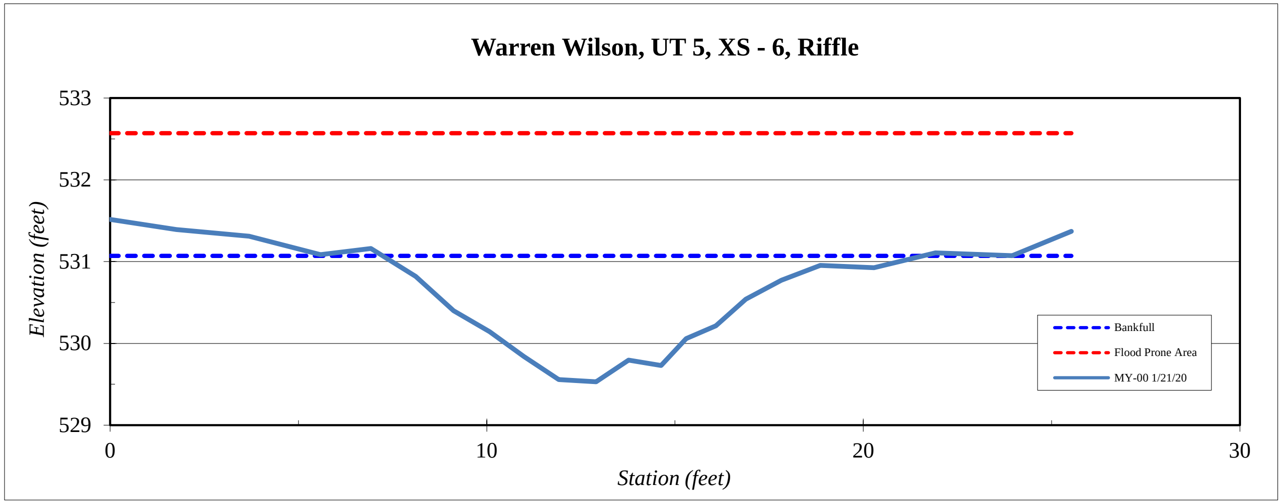


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS -6, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	531.5
1.8	531.4
3.7	531.3
5.6	531.1
6.9	531.2
8.1	530.8
9.1	530.4
10.1	530.1
11.0	529.8
11.9	529.6
12.9	529.5
13.8	529.8
14.6	529.7
15.3	530.1
16.1	530.2
16.9	530.5
17.8	530.8
18.9	531.0
20.3	530.9
21.9	531.1
24.0	531.1
25.5	531.4

SUMMARY DATA	
Bankfull Elevation:	531.1
Bankfull Cross-Sectional Area:	10.4
Bankfull Width:	14.4
Flood Prone Area Elevation:	532.6
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.5
Low Bank Height:	1.5
Mean Depth at Bankfull:	0.7
W / D Ratio:	19.9
Entrenchment Ratio:	6.9
Bank Height Ratio:	1.0

Stream Type	Ce 4

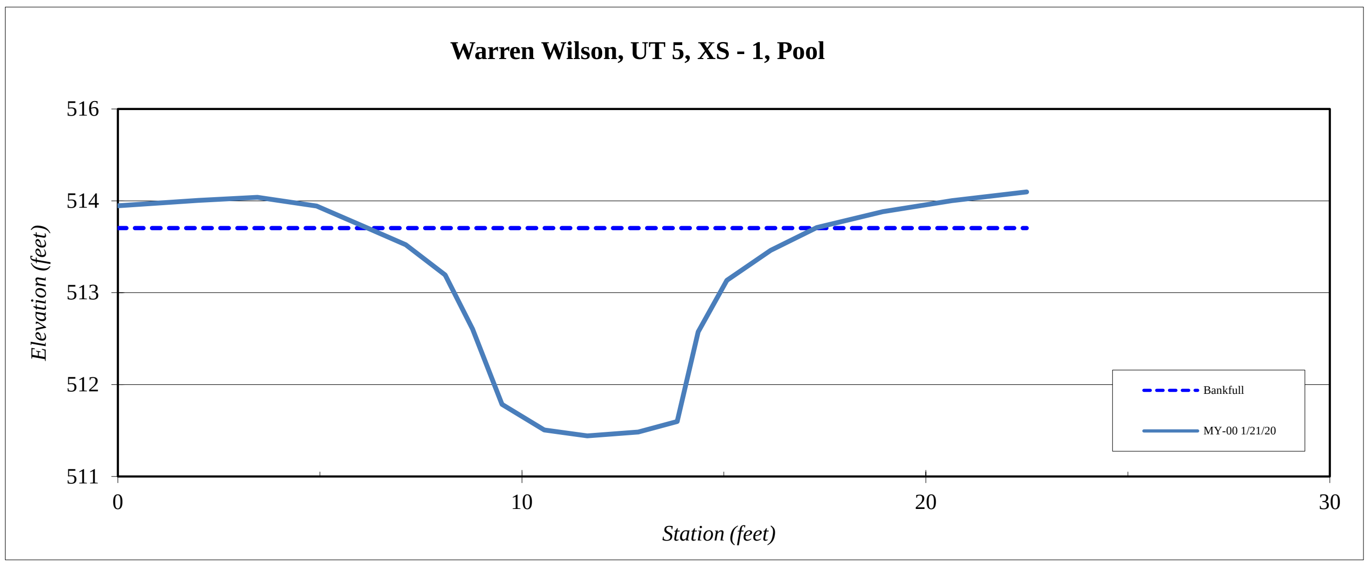


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS - 1, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	514.4
2.0	514.4
3.5	514.5
4.9	514.4
6.2	514.1
7.1	513.9
8.1	513.5
8.8	512.8
9.5	511.9
10.6	511.6
11.6	511.5
12.9	511.6
13.8	511.7
14.4	512.8
15.1	513.4
16.2	513.8
17.3	514.1
18.9	514.3
20.6	514.4
22.5	514.5

SUMMARY DATA	
Bankfull Elevation:	514.1
Bankfull Cross-Sectional Area:	15.3
Bankfull Width:	11.1
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.6
Low Bank Height:	2.6
Mean Depth at Bankfull:	1.4
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4



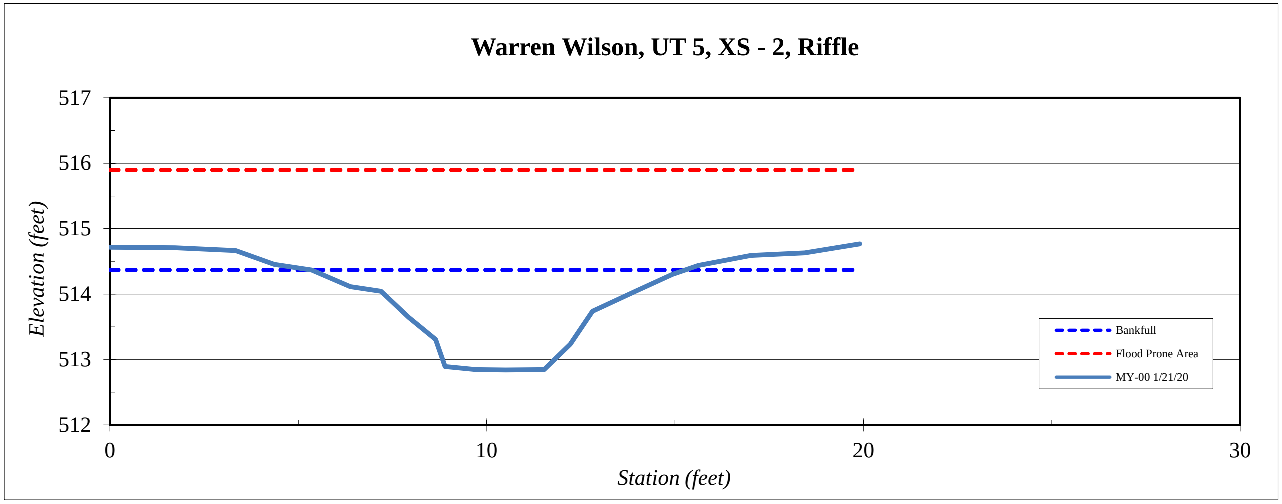
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS - 2, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	514.7
1.7	514.7
3.3	514.7
4.4	514.5
5.4	514.4
6.4	514.1
7.2	514.0
7.9	513.6
8.6	513.3
8.9	512.9
9.7	512.8
10.5	512.8
11.5	512.8
12.2	513.2
12.8	513.7
14.0	514.0
14.9	514.3
15.6	514.4
17.0	514.6
18.4	514.6
19.9	514.8

SUMMARY DATA	
Bankfull Elevation:	514.4
Bankfull Cross-Sectional Area:	7.9
Bankfull Width:	9.9
Flood Prone Area Elevation:	515.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.5
Low Bank Height:	1.5
Mean Depth at Bankfull:	0.8
W / D Ratio:	12.5
Entrenchment Ratio:	10.1
Bank Height Ratio:	1.0

Stream Type	Ce 4

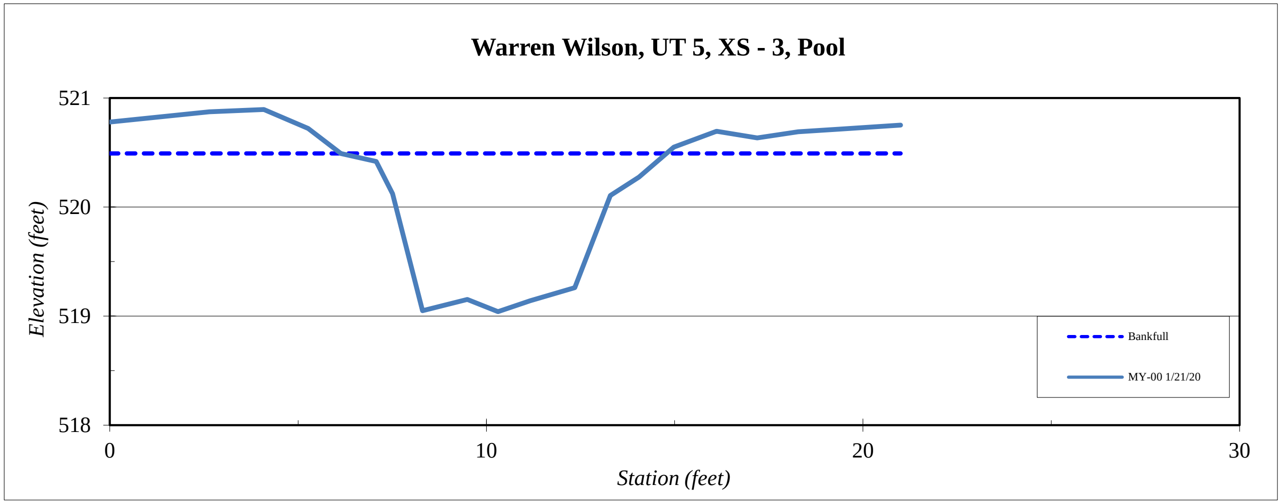


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS - 3, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	520.8
2.6	520.9
4.1	520.9
5.3	520.7
6.1	520.5
7.1	520.4
7.5	520.1
8.3	519.0
9.5	519.2
10.3	519.0
11.2	519.1
12.3	519.3
13.3	520.1
14.1	520.3
15.0	520.5
16.1	520.7
17.2	520.6
18.3	520.7
19.3	520.7
21.0	520.8

SUMMARY DATA	
Bankfull Elevation:	520.5
Bankfull Cross-Sectional Area:	7.4
Bankfull Width:	8.6
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.5
Low Bank Height:	1.5
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

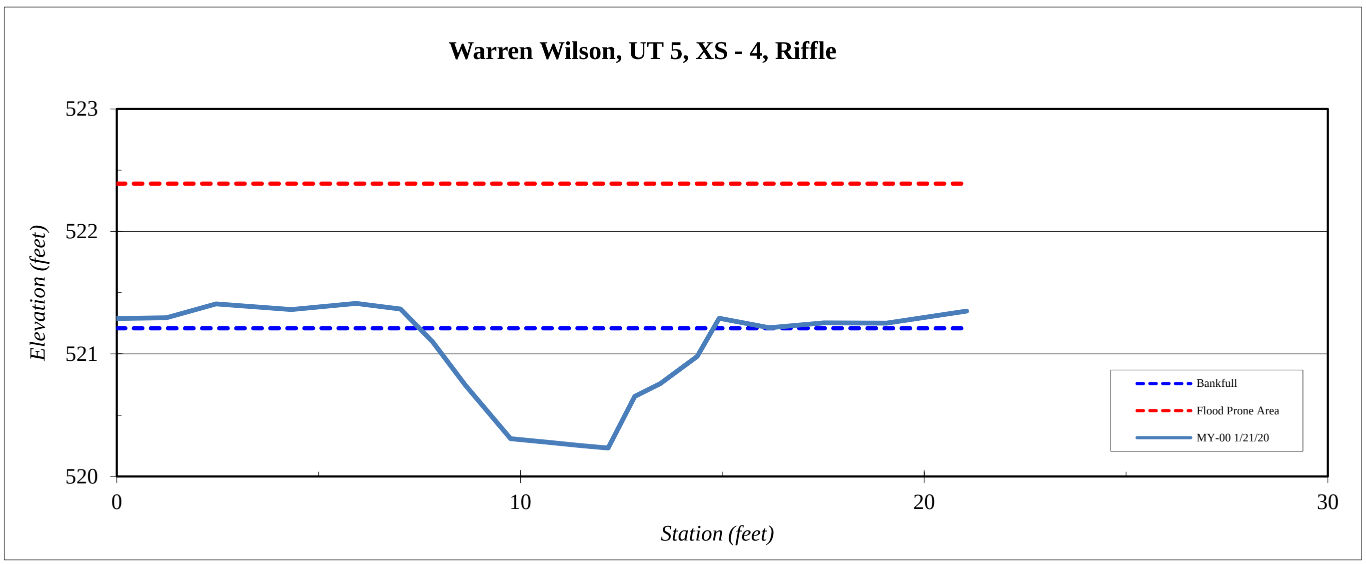


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS - 4, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	521.3
1.2	521.3
2.5	521.4
4.3	521.4
5.9	521.4
7.0	521.4
7.8	521.1
8.6	520.7
9.8	520.3
10.7	520.3
11.5	520.3
12.2	520.2
12.8	520.7
13.5	520.8
14.4	521.0
14.9	521.3
16.2	521.2
17.5	521.3
19.1	521.3
21.1	521.4

SUMMARY DATA	
Bankfull Elevation:	521.2
Bankfull Cross-Sectional Area:	7.3
Bankfull Width:	21.1
Flood Prone Area Elevation:	522.4
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.2
Low Bank Height:	1.2
Mean Depth at Bankfull:	0.3
W / D Ratio:	60.8
Entrenchment Ratio:	4.8
Bank Height Ratio:	1.0

Stream Type	Ce 4

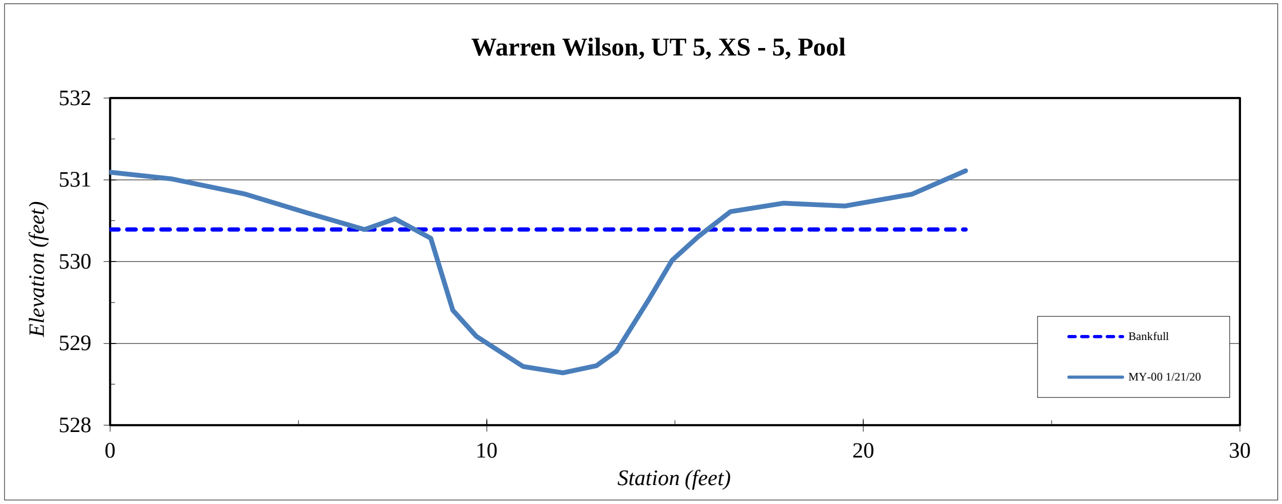


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 5, XS - 5, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	531.1
1.6	531.0
3.6	530.8
5.2	530.6
6.8	530.4
7.6	530.5
8.5	530.3
9.1	529.4
9.7	529.1
11.0	528.7
12.0	528.6
12.9	528.7
13.4	528.9
14.3	529.5
14.9	530.0
15.6	530.3
16.5	530.6
17.9	530.7
19.5	530.7
21.3	530.8
22.7	531.1

SUMMARY DATA	
Bankfull Elevation:	530.4
Bankfull Cross-Sectional Area:	8.7
Bankfull Width:	7.8
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.8
Low Bank Height:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

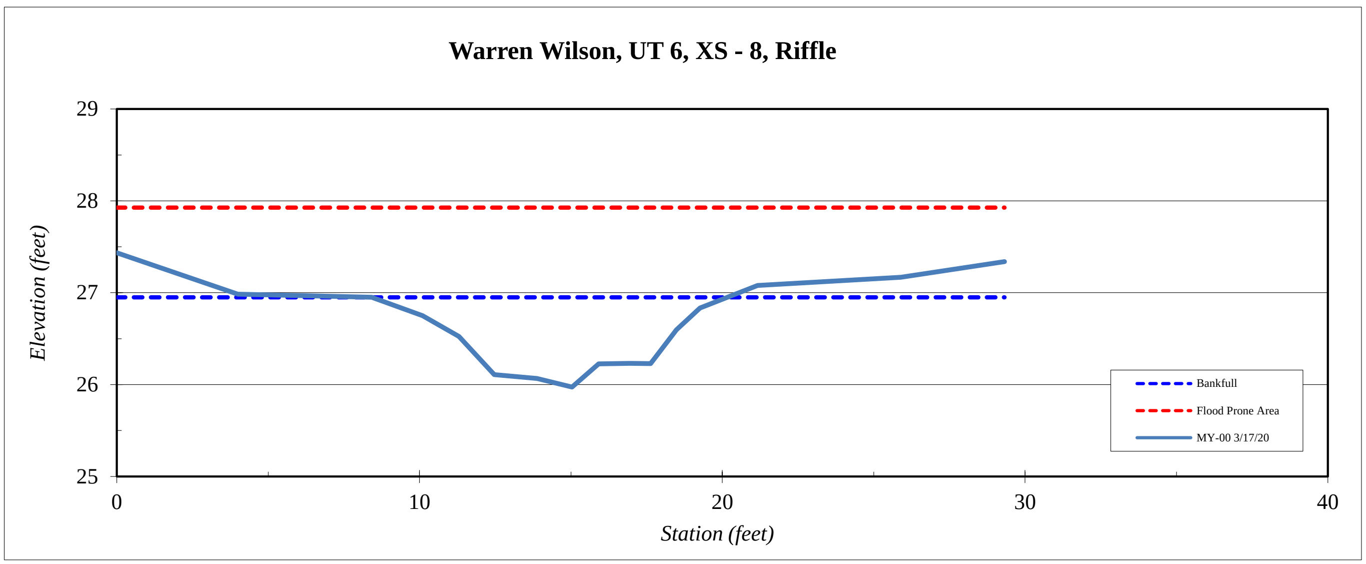


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS -8, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	27.4
4.0	27.0
8.4	27.0
10.1	26.7
11.3	26.5
12.5	26.1
13.9	26.1
15.0	26.0
15.9	26.2
16.9	26.2
17.6	26.2
18.5	26.6
19.3	26.8
21.2	27.1
25.9	27.2
29.3	27.3

SUMMARY DATA	
Bankfull Elevation:	27.0
Bankfull Cross-Sectional Area:	6.3
Bankfull Width:	11.7
Flood Prone Area Elevation:	27.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.0
Low Bank Height:	1.0
Mean Depth at Bankfull:	0.5
W / D Ratio:	22.0
Entrenchment Ratio:	8.5
Bank Height Ratio:	1.0

Stream Type	Ce 4

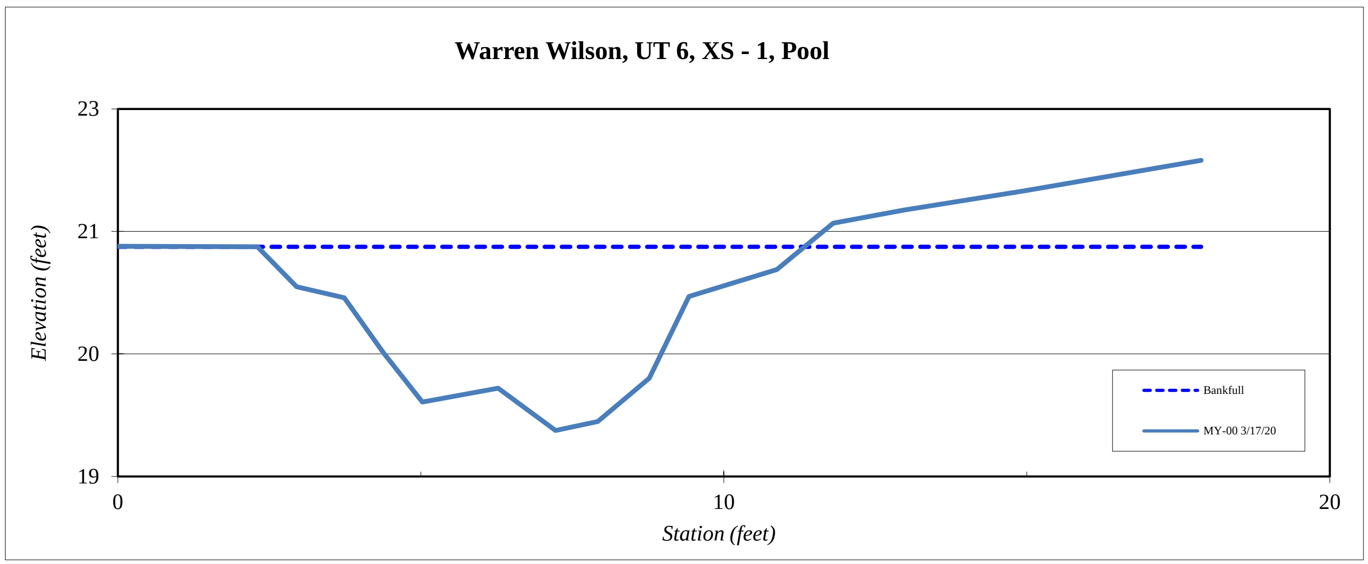


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS - 1, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	21.3
2.3	21.3
2.9	21.0
3.7	20.9
4.4	20.4
5.0	19.9
6.3	20.0
7.2	19.6
7.9	19.7
8.8	20.1
9.4	20.9
10.9	21.1
11.8	21.6
13.0	21.7
15.0	21.9
17.9	22.1

SUMMARY DATA	
Bankfull Elevation:	21.3
Bankfull Cross-Sectional Area:	8.3
Bankfull Width:	9.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Low Bank Height:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

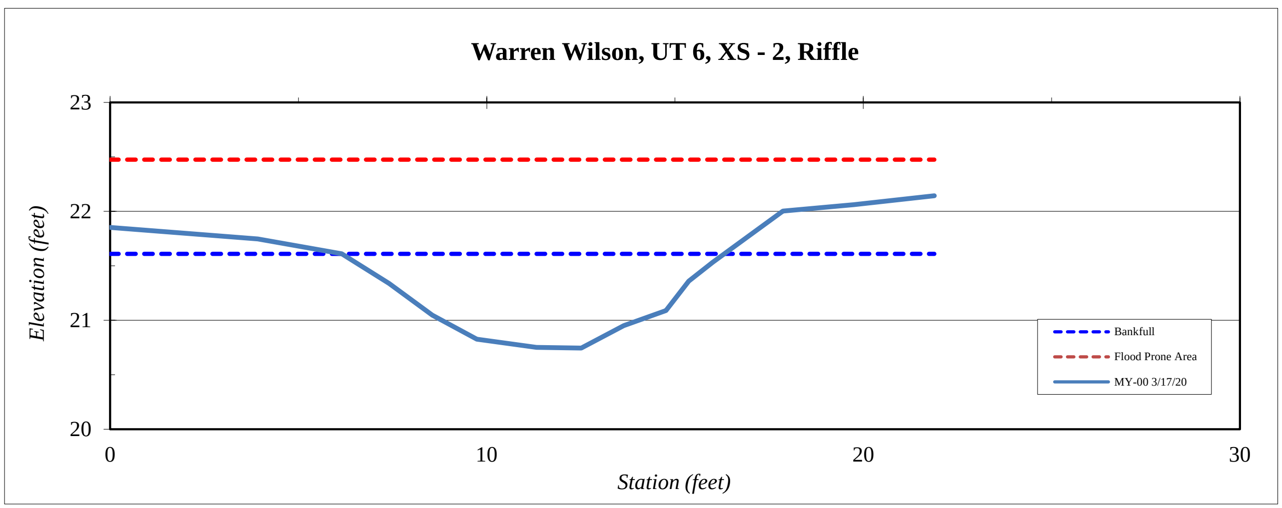


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS -2, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	21.9
3.9	21.7
6.1	21.6
7.4	21.3
8.6	21.0
9.7	20.8
11.3	20.8
12.5	20.7
13.6	20.9
14.8	21.1
15.4	21.4
16.0	21.5
17.9	22.0
19.7	22.1
21.9	22.1

SUMMARY DATA	
Bankfull Elevation:	21.6
Bankfull Cross-Sectional Area:	5.6
Bankfull Width:	10.2
Flood Prone Area Elevation:	22.5
Flood Prone Width:	100.0
Max Depth at Bankfull:	0.9
Low Bank Height:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	18.3
Entrenchment Ratio:	9.8
Bank Height Ratio:	1.0

Stream Type	Ce 4

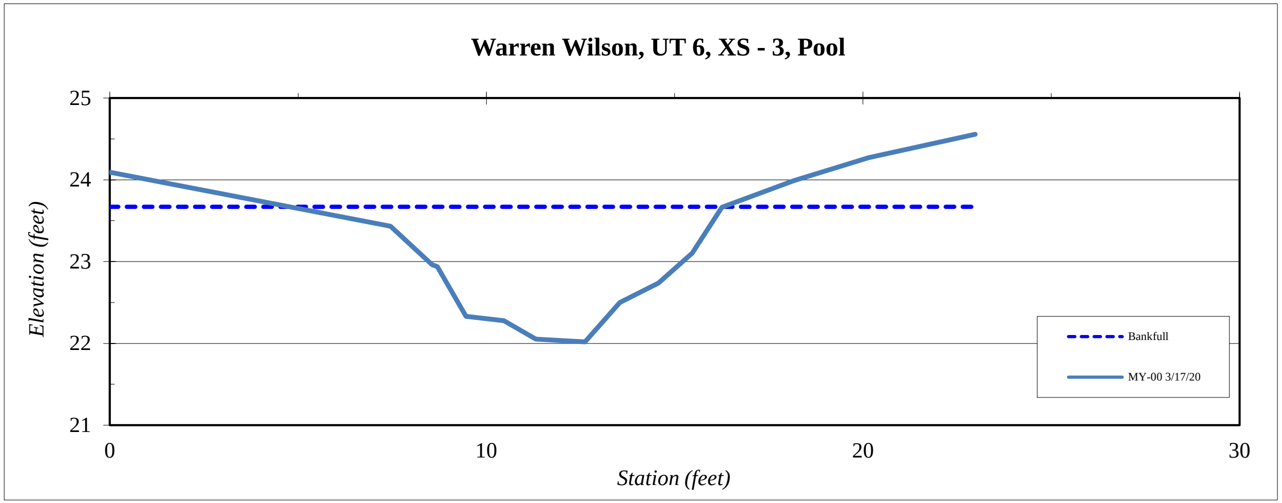


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS - 3, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	24.1
7.5	23.4
8.6	23.0
8.7	22.9
9.5	22.3
10.5	22.3
11.3	22.1
12.6	22.0
13.5	22.5
14.6	22.7
15.5	23.1
16.3	23.7
18.2	24.0
20.2	24.3
23.0	24.6

SUMMARY DATA	
Bankfull Elevation:	23.7
Bankfull Cross-Sectional Area:	9.8
Bankfull Width:	11.5
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Low Bank Height:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

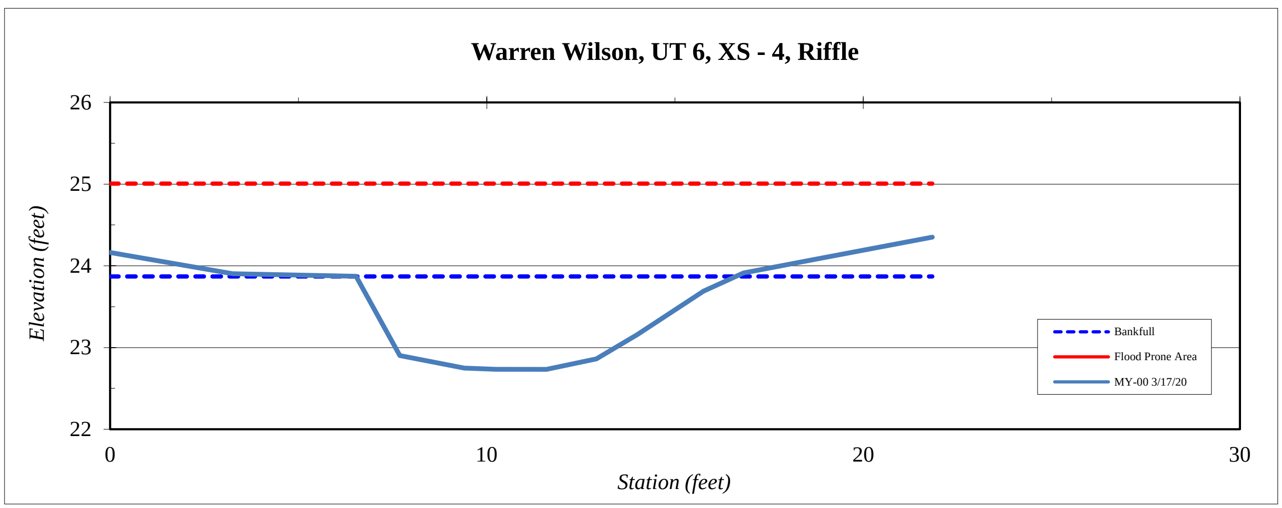


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS -4, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	24.2
3.3	23.9
6.5	23.9
7.7	22.9
9.4	22.7
10.2	22.7
11.6	22.7
12.9	22.9
14.0	23.2
15.8	23.7
16.8	23.9
18.9	24.1
21.8	24.4

SUMMARY DATA	
Bankfull Elevation:	23.9
Bankfull Cross-Sectional Area:	8.0
Bankfull Width:	10.1
Flood Prone Area Elevation:	25.0
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.1
Low Bank Height:	1.1
Mean Depth at Bankfull:	0.8
W / D Ratio:	12.6
Entrenchment Ratio:	9.9
Bank Height Ratio:	1.0

Stream Type	Ce 4

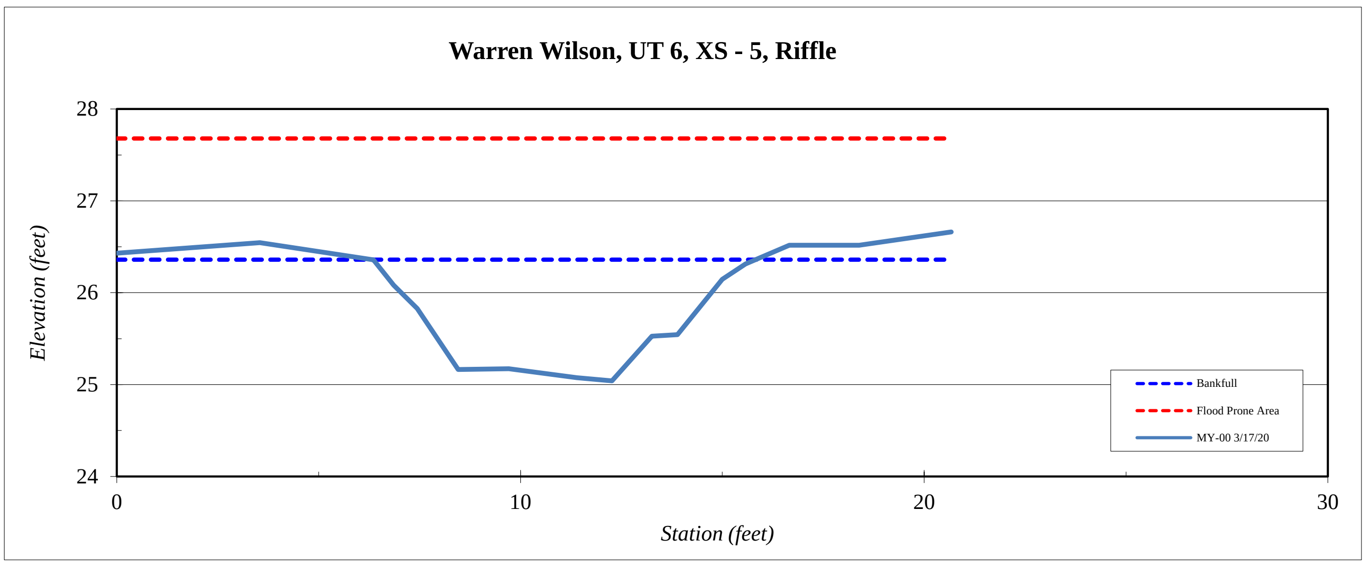


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS -5, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	26.4
3.5	26.5
6.4	26.4
6.9	26.1
7.4	25.8
8.5	25.2
9.7	25.2
11.4	25.1
12.3	25.0
13.3	25.5
13.9	25.5
15.0	26.1
15.6	26.3
16.7	26.5
18.4	26.5
20.7	26.7

SUMMARY DATA	
Bankfull Elevation:	26.4
Bankfull Cross-Sectional Area:	8.1
Bankfull Width:	9.5
Flood Prone Area Elevation:	27.7
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.3
Low Bank Height:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	11.1
Entrenchment Ratio:	10.5
Bank Height Ratio:	1.0

Stream Type	Ce 4

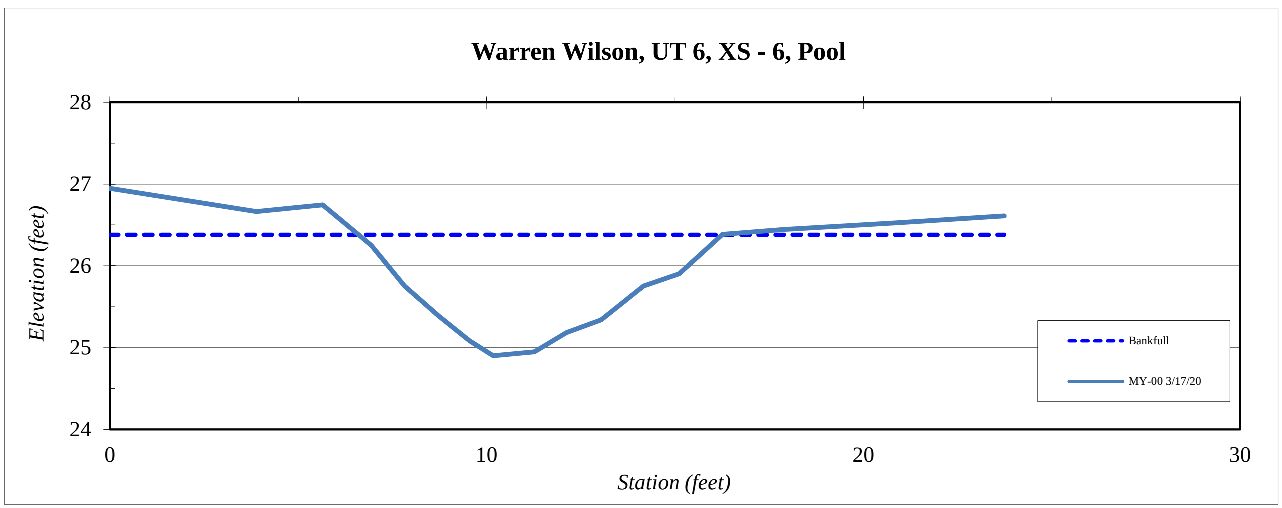


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS - 6, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	26.9
0.0	26.9
3.9	26.7
5.6	26.7
6.9	26.3
7.8	25.8
8.7	25.4
9.6	25.1
10.2	24.9
11.3	24.9
12.1	25.2
13.0	25.3
14.2	25.8
15.1	25.9
16.3	26.4
17.9	26.4
20.9	26.5
23.7	26.6

SUMMARY DATA	
Bankfull Elevation:	26.4
Bankfull Cross-Sectional Area:	8.4
Bankfull Width:	9.6
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.5
Low Bank Height:	1.5
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4

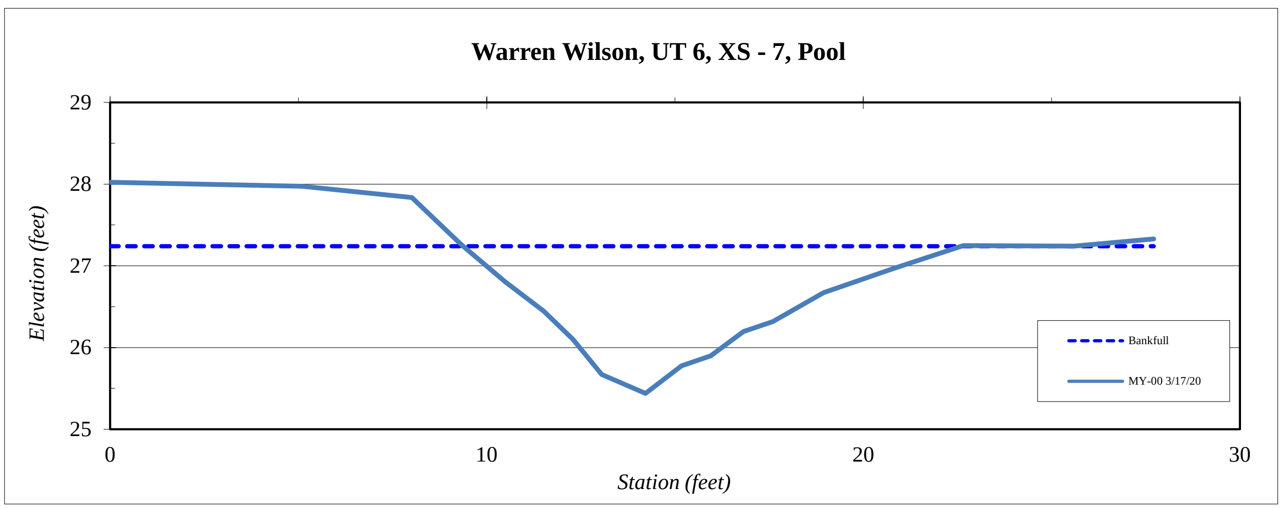


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 6, XS - 7, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	28.0
5.1	28.0
8.0	27.8
9.3	27.3
10.5	26.8
11.5	26.4
12.3	26.1
13.1	25.7
14.2	25.4
15.2	25.8
15.9	25.9
16.8	26.2
17.6	26.3
18.9	26.7
20.8	27.0
22.7	27.2
25.6	27.2
27.7	27.3

SUMMARY DATA	
Bankfull Elevation:	27.2
Bankfull Cross-Sectional Area:	11.1
Bankfull Width:	13.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.8
Low Bank Height:	1.8
Mean Depth at Bankfull:	0.8
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Ce 4



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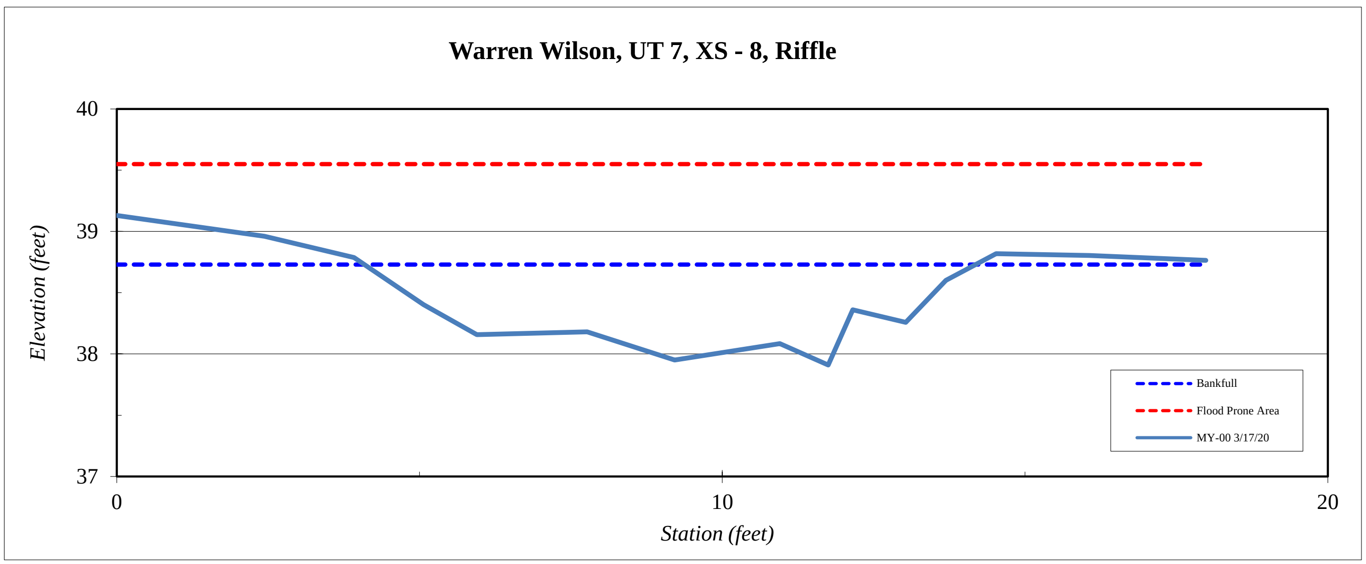
Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS -8, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	39.1
2.4	39.0
3.9	38.8
5.1	38.4
5.9	38.2
7.8	38.2
9.2	38.0
10.9	38.1
11.7	37.9
12.2	38.4
13.0	38.3
13.7	38.6
14.5	38.8
16.1	38.8
18.0	38.8

SUMMARY DATA	
Bankfull Elevation:	38.7
Bankfull Cross-Sectional Area:	5.2
Bankfull Width:	10.1
Flood Prone Area Elevation:	39.5
Flood Prone Width:	100.0
Max Depth at Bankfull:	0.8
Low Bank Height:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	19.6
Entrenchment Ratio:	9.9
Bank Height Ratio:	1.0

Stream Type	Eb 4

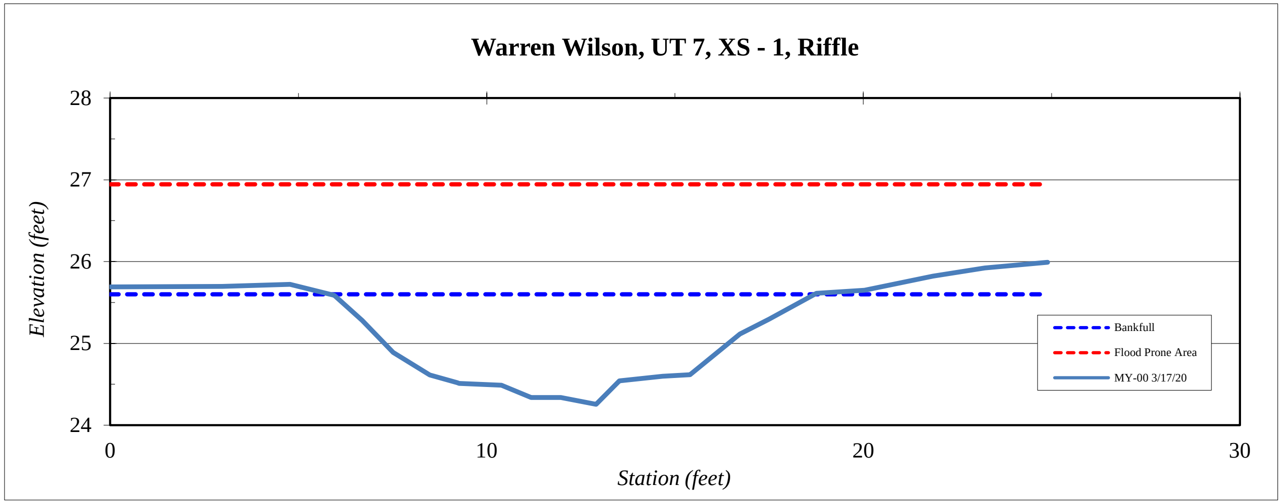


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS -1, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	25.7
3.0	25.7
4.8	25.7
6.0	25.6
6.7	25.3
7.5	24.9
8.5	24.6
9.2	24.5
9.3	24.5
10.4	24.5
11.2	24.3
12.0	24.3
12.9	24.3
13.5	24.5
14.7	24.6
15.4	24.6
16.7	25.1
17.5	25.3
18.8	25.6
20.0	25.6
21.8	25.8
23.2	25.9
24.9	26.0

SUMMARY DATA	
Bankfull Elevation:	25.6
Bankfull Cross-Sectional Area:	10.7
Bankfull Width:	12.9
Flood Prone Area Elevation:	26.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.3
Low Bank Height:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	15.5
Entrenchment Ratio:	7.8
Bank Height Ratio:	1.0

Stream Type	Eb 4

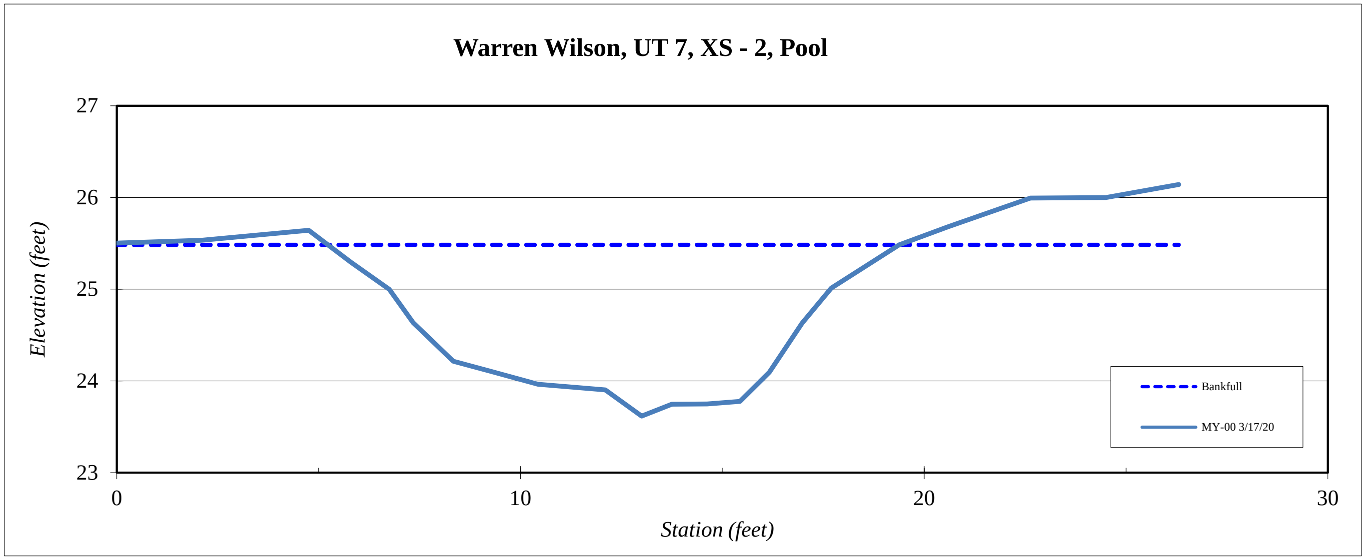


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS - 2, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	25.4
2.1	25.5
4.8	25.6
5.8	25.2
6.8	24.9
7.3	24.5
8.3	24.0
9.2	23.9
10.4	23.7
12.1	23.6
13.0	23.3
13.8	23.5
14.6	23.5
15.4	23.5
16.2	23.8
17.0	24.5
17.7	24.9
19.4	25.4
20.6	25.6
22.6	26.0
24.5	26.0
26.3	26.2

SUMMARY DATA	
Bankfull Elevation:	25.4
Bankfull Cross-Sectional Area:	18.2
Bankfull Width:	14.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.1
Low Bank Height:	2.1
Mean Depth at Bankfull:	1.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Eb 4

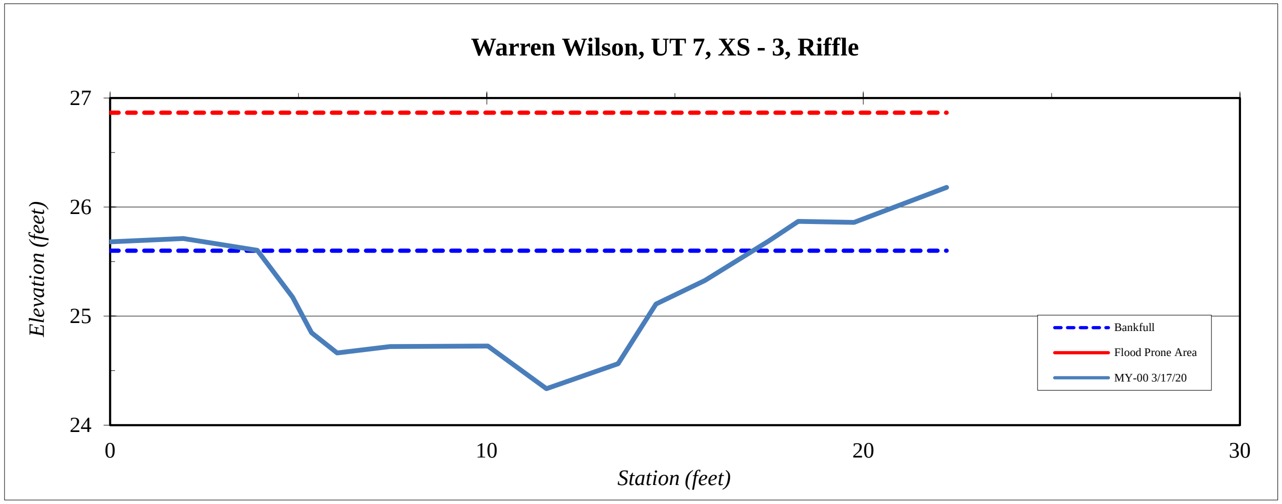


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS -3, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	25.7
1.9	25.7
3.9	25.6
4.8	25.2
5.3	24.8
6.0	24.7
7.4	24.7
10.0	24.7
11.6	24.3
13.5	24.6
14.5	25.1
15.8	25.3
17.5	25.7
18.3	25.9
19.8	25.9
22.2	26.2

SUMMARY DATA	
Bankfull Elevation:	25.6
Bankfull Cross-Sectional Area:	9.9
Bankfull Width:	13.2
Flood Prone Area Elevation:	26.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.3
Low Bank Height:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	17.5
Entrenchment Ratio:	7.6
Bank Height Ratio:	1.0

Stream Type	Eb 4

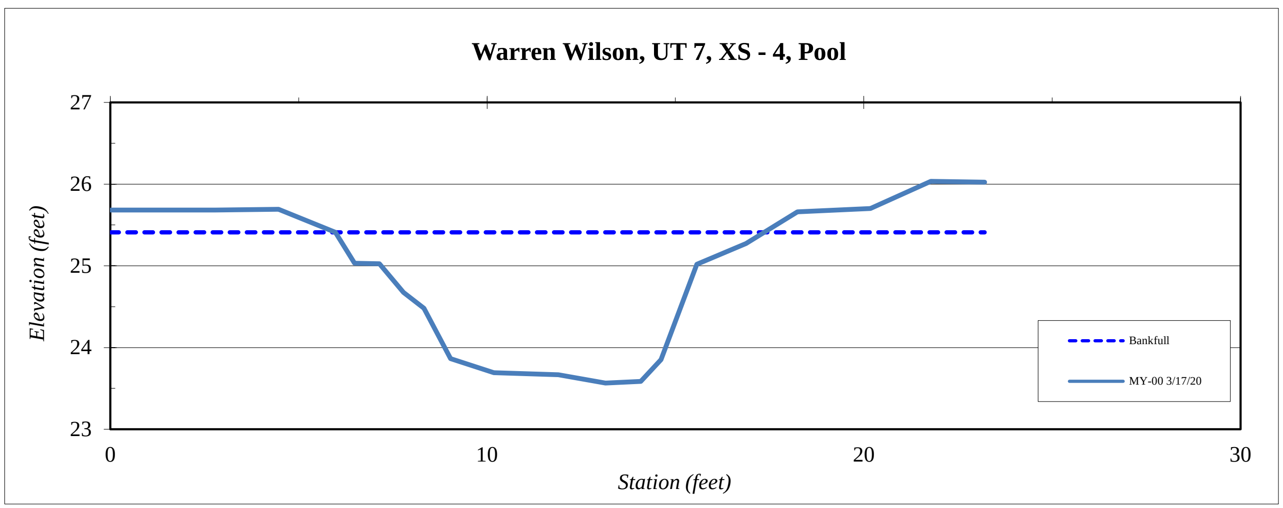


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS - 4, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	25.7
2.8	25.7
4.5	25.7
6.0	25.4
6.5	25.0
7.1	25.0
7.8	24.7
8.3	24.5
9.0	23.9
10.2	23.7
11.9	23.7
13.1	23.6
14.1	23.6
14.6	23.9
15.6	25.0
16.9	25.3
18.2	25.7
20.2	25.7
21.8	26.0
23.2	26.0

SUMMARY DATA	
Bankfull Elevation:	25.4
Bankfull Cross-Sectional Area:	13.0
Bankfull Width:	11.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.8
Low Bank Height:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Eb 4

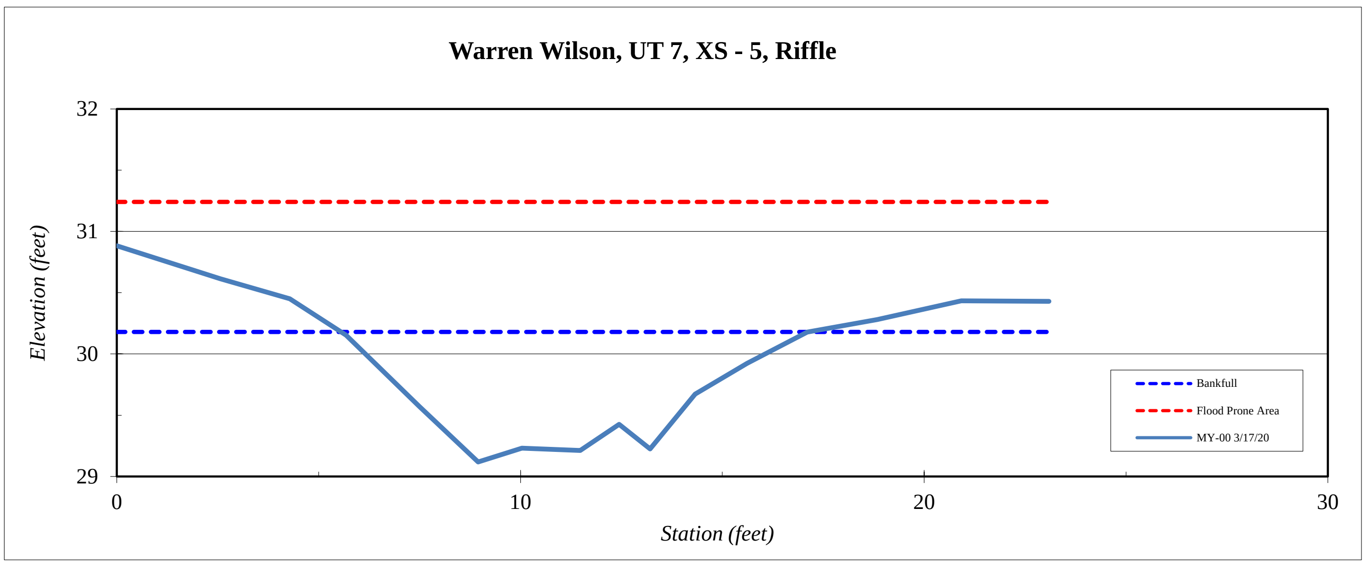


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS -5, Riffle
Feature	Riffle
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	30.9
2.6	30.6
4.3	30.5
5.7	30.2
7.5	29.6
8.9	29.1
10.0	29.2
11.5	29.2
12.4	29.4
13.2	29.2
14.3	29.7
15.6	29.9
17.1	30.2
18.8	30.3
20.9	30.4
23.1	30.4

SUMMARY DATA	
Bankfull Elevation:	30.2
Bankfull Cross-Sectional Area:	7.2
Bankfull Width:	11.6
Flood Prone Area Elevation:	31.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.1
Low Bank Height:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	18.5
Entrenchment Ratio:	8.6
Bank Height Ratio:	1.0

Stream Type	Eb 4

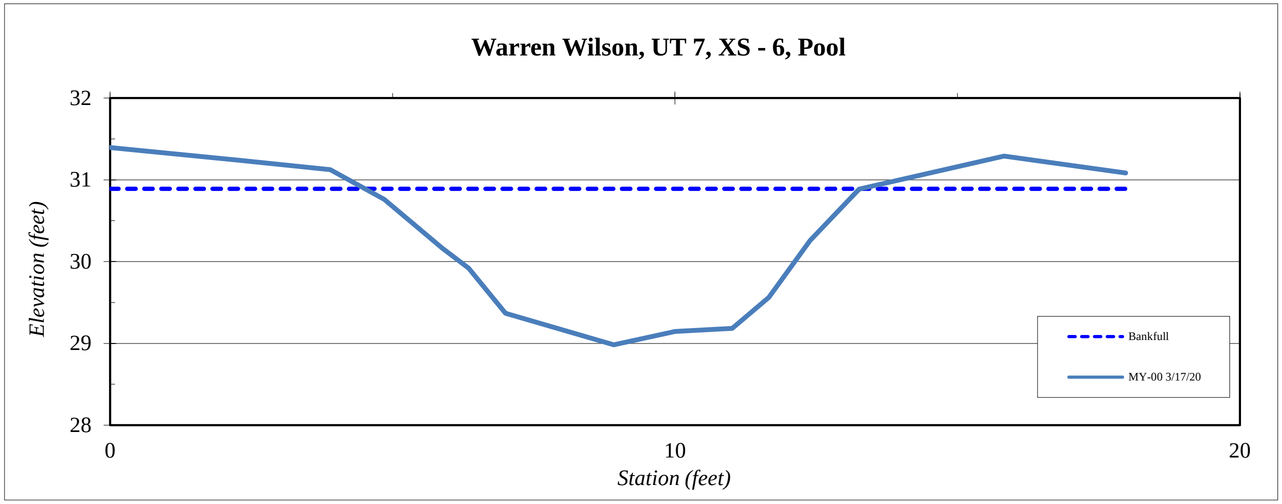


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS - 6, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	31.4
2.3	31.2
3.9	31.1
4.9	30.8
5.9	30.2
6.3	29.9
7.0	29.4
8.9	29.0
10.0	29.1
11.0	29.2
11.7	29.6
12.4	30.3
13.3	30.9
15.8	31.3
18.0	31.1

SUMMARY DATA	
Bankfull Elevation:	30.9
Bankfull Cross-Sectional Area:	10.7
Bankfull Width:	8.8
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Eb 4

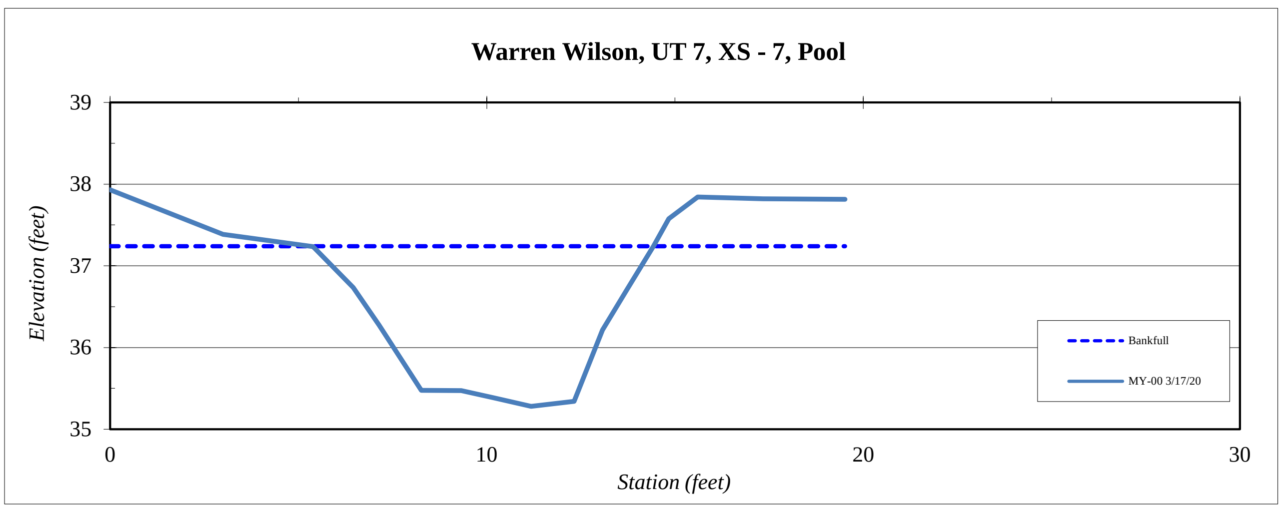


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 7, XS - 7, Pool
Feature	Pool
Date:	3/17/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	37.9
3.0	37.4
5.4	37.2
6.5	36.7
7.1	36.3
8.3	35.5
9.3	35.5
10.2	35.4
11.2	35.3
12.3	35.3
13.1	36.2
13.7	36.7
14.4	37.2
14.8	37.6
15.6	37.8
17.3	37.8
19.5	37.8

SUMMARY DATA	
Bankfull Elevation:	37.2
Bankfull Cross-Sectional Area:	11.6
Bankfull Width:	9.1
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.0
Low Bank Height:	2.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	Eb 4

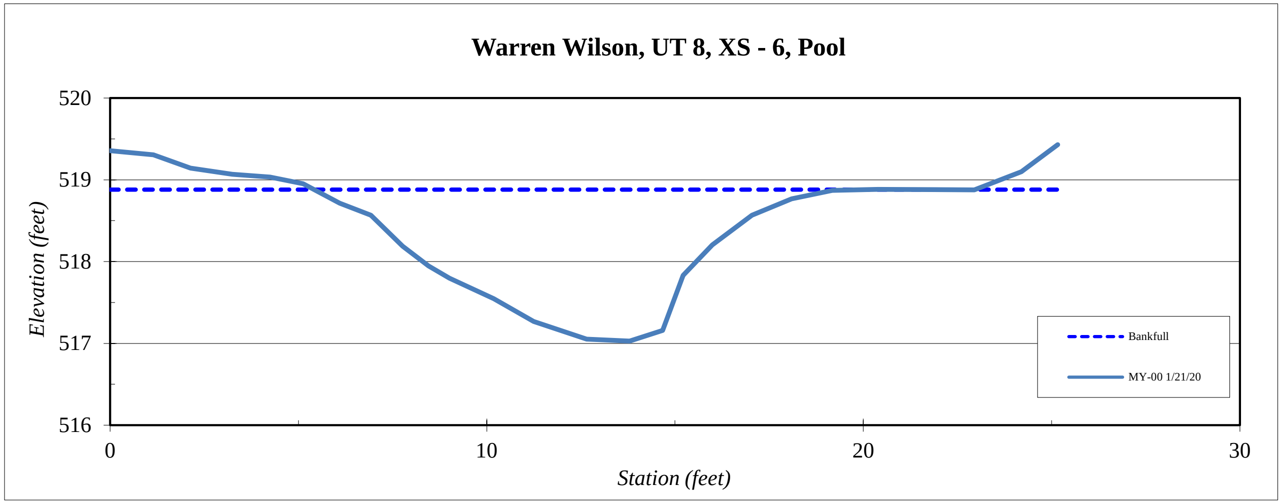


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS - 6, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	519.4
1.1	519.3
2.1	519.1
3.2	519.1
4.2	519.0
5.1	519.0
6.1	518.7
6.9	518.6
7.8	518.2
8.5	517.9
9.0	517.8
10.2	517.5
11.2	517.3
12.7	517.1
13.8	517.0
14.7	517.2
15.2	517.8
16.0	518.2
17.0	518.6
18.1	518.8
19.2	518.9
20.4	518.9
21.9	518.9
22.9	518.9
24.2	519.1
25.2	519.4

SUMMARY DATA	
Bankfull Elevation:	518.9
Bankfull Cross-Sectional Area:	13.1
Bankfull Width:	15.9
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.9
Low Bank Height:	1.9
Mean Depth at Bankfull:	0.8
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C 4

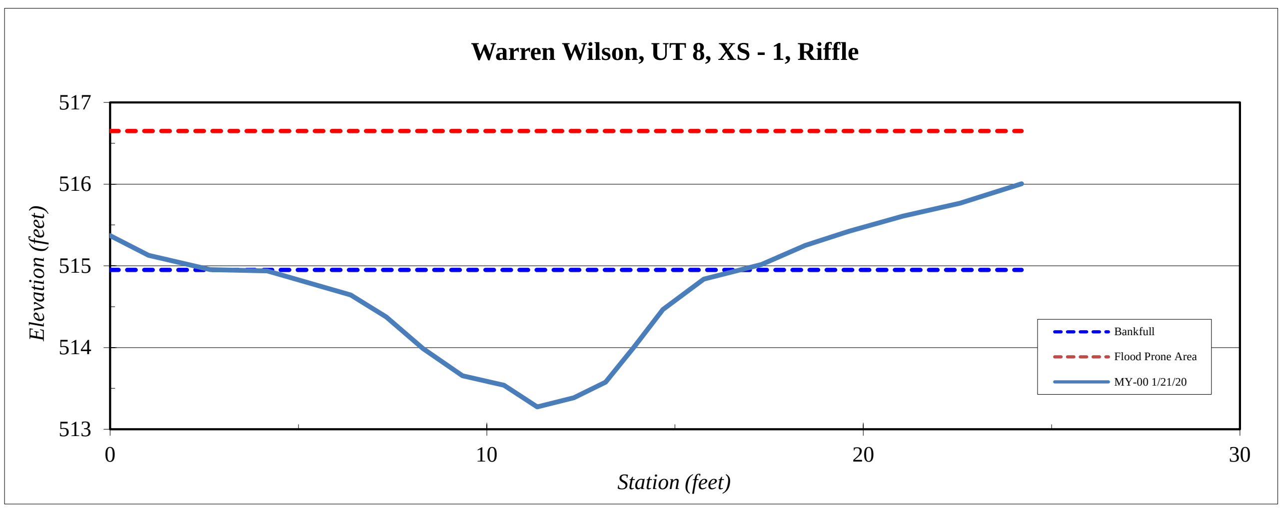


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS -1, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	515.4
1.0	515.1
2.7	515.0
4.2	514.9
6.4	514.6
7.3	514.4
8.3	514.0
9.4	513.7
10.5	513.5
11.3	513.3
12.3	513.4
13.2	513.6
13.9	514.0
14.7	514.5
15.8	514.8
17.3	515.0
18.5	515.2
19.6	515.4
21.0	515.6
22.6	515.8
24.2	516.0

SUMMARY DATA	
Bankfull Elevation:	515.0
Bankfull Cross-Sectional Area:	10.2
Bankfull Width:	13.7
Flood Prone Area Elevation:	516.7
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.7
Low Bank Height:	1.7
Mean Depth at Bankfull:	0.7
W / D Ratio:	18.4
Entrenchment Ratio:	7.3
Bank Height Ratio:	1.0

Stream Type	C 4

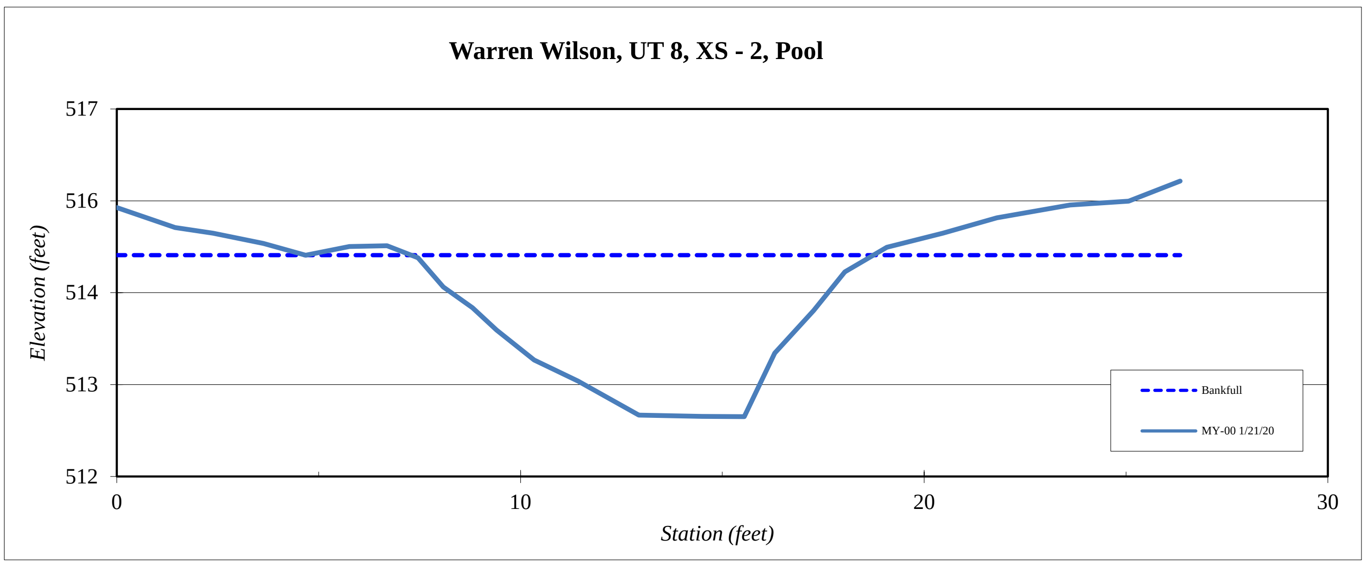


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS - 2, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	515.5
1.4	515.2
2.4	515.2
3.6	515.0
4.7	514.9
5.8	515.0
6.7	515.0
7.5	514.9
8.1	514.5
8.8	514.2
9.4	514.0
10.3	513.6
11.4	513.3
12.9	512.9
14.5	512.9
15.5	512.9
16.3	513.7
17.3	514.2
18.0	514.7
19.1	515.0
20.5	515.2
21.8	515.3
23.6	515.5
25.1	515.5
26.3	515.8

SUMMARY DATA	
Bankfull Elevation:	514.9
Bankfull Cross-Sectional Area:	13.9
Bankfull Width:	11.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.0
Low Bank Height:	2.0
Mean Depth at Bankfull:	1.2
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C 4



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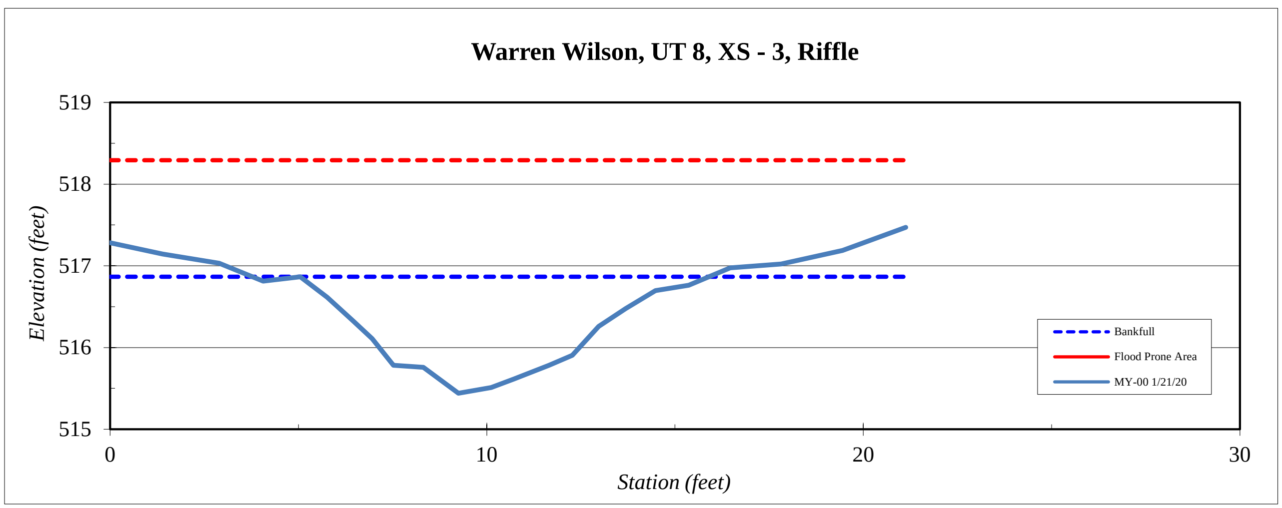
Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS - 3, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	517.3
1.4	517.1
2.9	517.0
4.1	516.8
5.0	516.9
5.8	516.6
6.5	516.3
7.0	516.1
7.5	515.8
8.3	515.8
9.3	515.4
10.1	515.5
10.7	515.6
11.7	515.8
12.3	515.9
13.0	516.3
13.7	516.5
14.5	516.7
15.4	516.8
16.5	517.0
17.8	517.0
19.4	517.2
21.1	517.5

SUMMARY DATA	
Bankfull Elevation:	516.9
Bankfull Cross-Sectional Area:	8.3
Bankfull Width:	12.1
Flood Prone Area Elevation:	518.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.4
Low Bank Height:	1.4
Mean Depth at Bankfull:	0.7
W / D Ratio:	17.7
Entrenchment Ratio:	8.2
Bank Height Ratio:	1.0

Stream Type	C 4

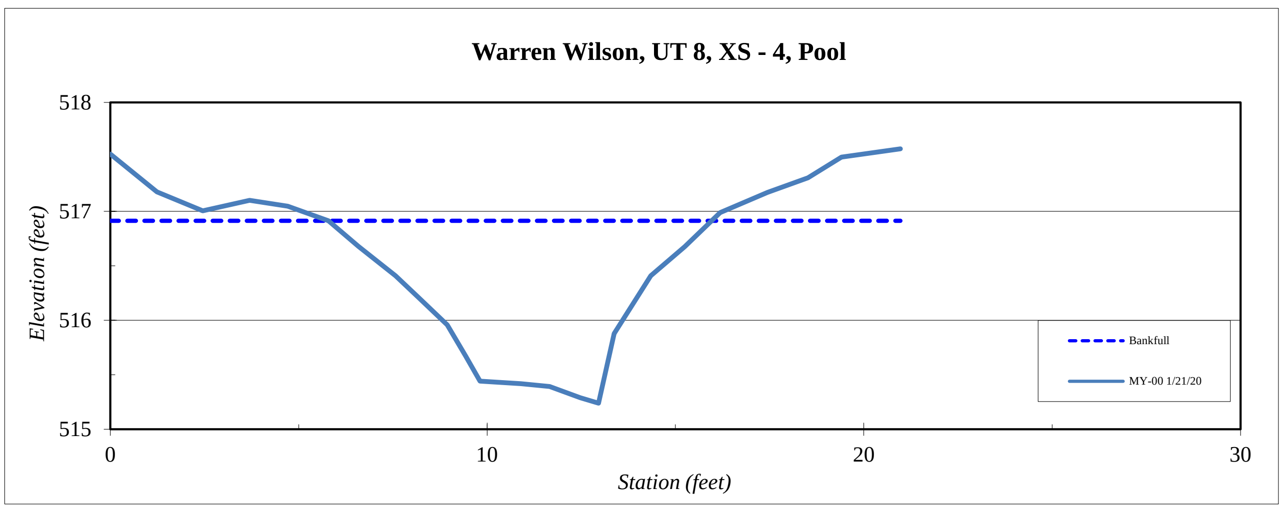


Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS - 4, Pool
Feature	Pool
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	517.5
1.2	517.2
2.5	517.0
3.7	517.1
4.7	517.0
5.8	516.9
6.6	516.7
7.6	516.4
8.2	516.2
8.9	516.0
9.4	515.7
9.8	515.4
10.9	515.4
11.7	515.4
12.5	515.3
13.0	515.2
13.4	515.9
14.3	516.4
15.2	516.7
16.2	517.0
17.4	517.2
18.5	517.3
19.4	517.5
21.0	517.6

SUMMARY DATA	
Bankfull Elevation:	516.9
Bankfull Cross-Sectional Area:	9.1
Bankfull Width:	10.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Low Bank Height:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C 4



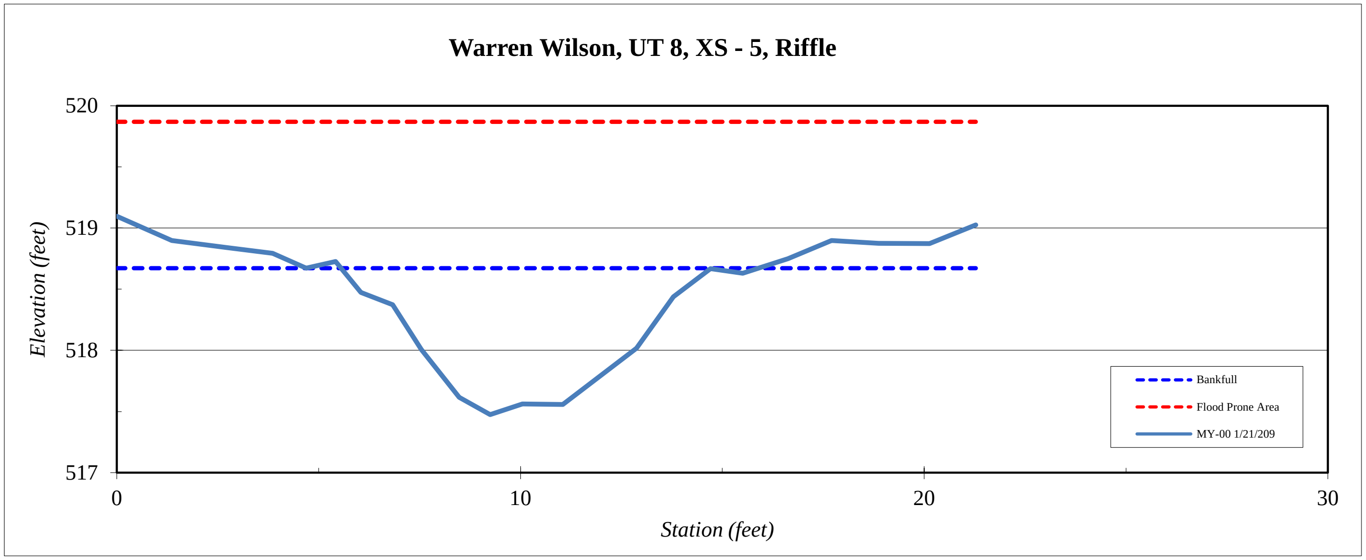
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Warren Wilson
Watershed:	French Broad, 06010105
XS ID	UT 8, XS -5, Riffle
Feature	Riffle
Date:	1/21/2020
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	519.1
1.4	518.9
2.7	518.8
3.9	518.8
4.7	518.7
5.4	518.7
6.1	518.5
6.8	518.4
7.5	518.0
8.5	517.6
9.2	517.5
10.1	517.6
11.0	517.6
12.9	518.0
13.8	518.4
14.7	518.7
15.5	518.6
16.6	518.7
17.7	518.9
18.9	518.9
20.1	518.9
21.3	519.0

SUMMARY DATA	
Bankfull Elevation:	518.7
Bankfull Cross-Sectional Area:	6.4
Bankfull Width:	10.3
Flood Prone Area Elevation:	519.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.2
Low Bank Height:	1.2
Mean Depth at Bankfull:	0.6
W / D Ratio:	16.6
Entrenchment Ratio:	9.7
Bank Height Ratio:	1.0

Stream Type	C 4



Appendix F
Preconstruction Wetland Hydrology Data

Figure 3. Preconstruction Gauge Locations
Table 12. Preconstruction Groundwater Gauge Data Summary
2018 Groundwater Gauge Graphs
2019 Groundwater Gauge Graphs

Axiom Environmental, Inc.

Prepared for:

RS RESTORATION SYSTEMS | LLC

Project:

WARREN WILSON COLLEGE STREAM MITIGATION SITE

Buncombe County, NC

Title:

PRE-CONSTRUCTION GAUGE LOCATIONS

Drawn by: KRJ

Date: Jul 2020

Scale: 1:2000

Project No.: 20-004

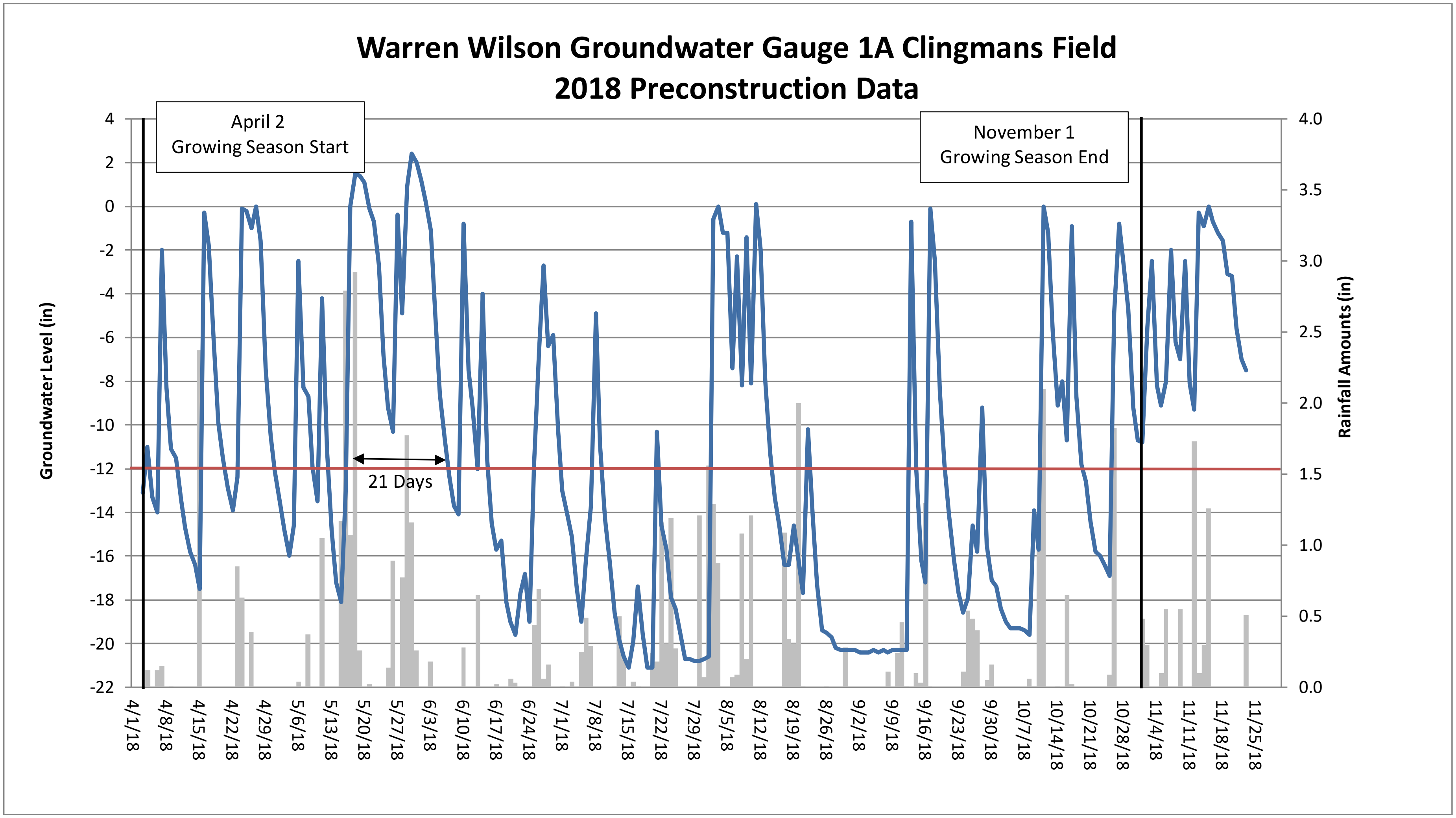
FIGURE

3

Table 12. Preconstruction Groundwater Gauge Data Summary

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)	
	2018 Data	**2019 Data**
1A	No/21 days (9.8 percent)	Yes/57 days (27 percent)
1B	No/9 days (4.2 percent)	Yes/50 days (23 percent)
1C	No/3 days (1.4 percent)	No/3 days (1.4 percent)
2A	NA*	Yes/48 days (22 percent)
2B	No/20 days (9.3 percent)	No/0 days (0 percent)
2C	No/12 days (5.6 percent)	Yes/50 days (23 percent)
3A	No/24 days (11.2 percent)	Yes/124 days (58 percent)
3B	Yes/117 days (54.7 percent)	Yes/140 days (65 percent)
3C	No/4 days (1.9 percent)	No/3 days (1.4 percent)

*Gauge 2A was damaged during 2018 and data was not recoverable. It was replaced in 2019.



Warren Wilson Groundwater Gauge 1A Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
21 Days
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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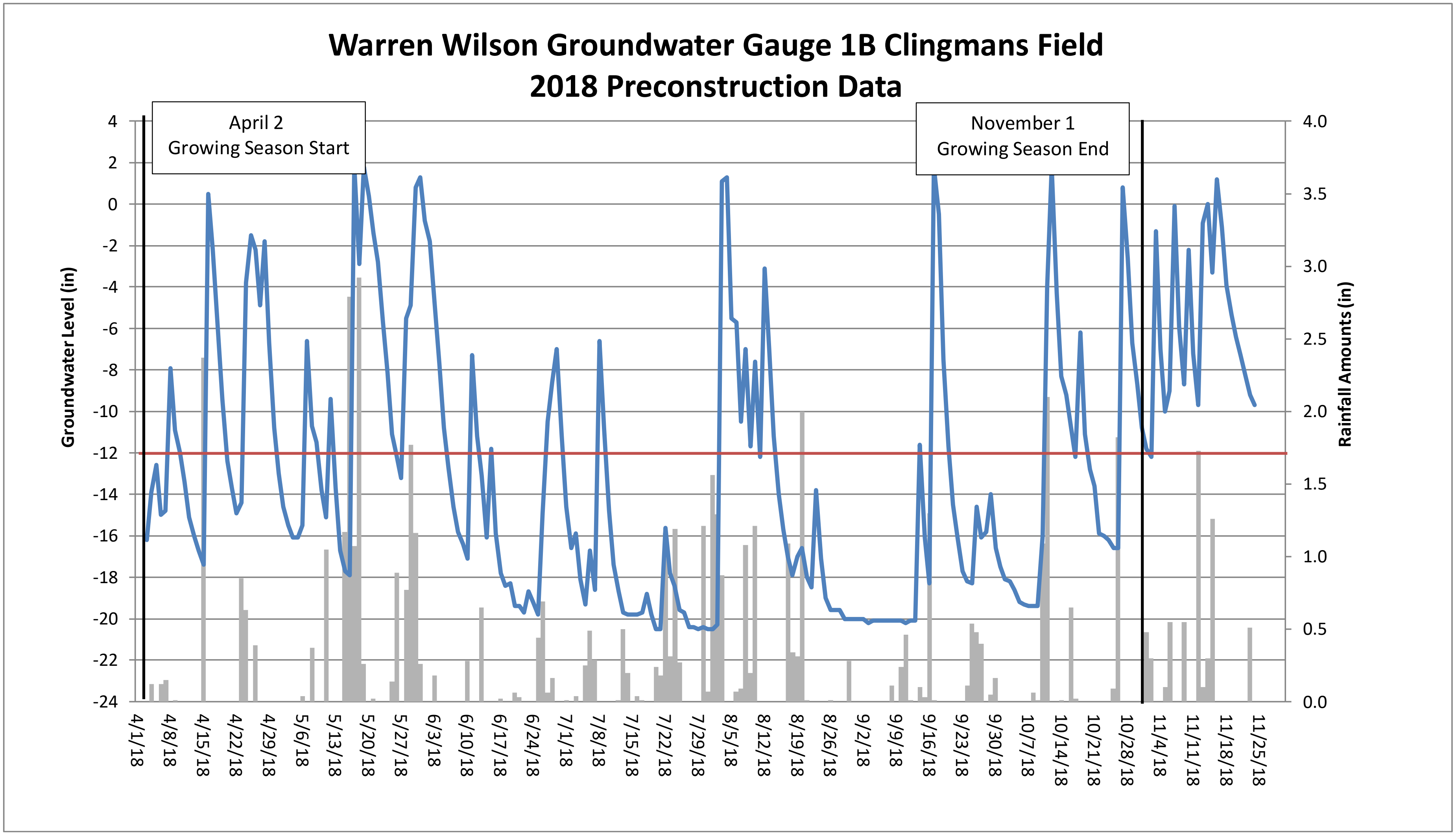
11/11/18
11/18/18
11/25/18



Warren Wilson Groundwater Gauge 1B Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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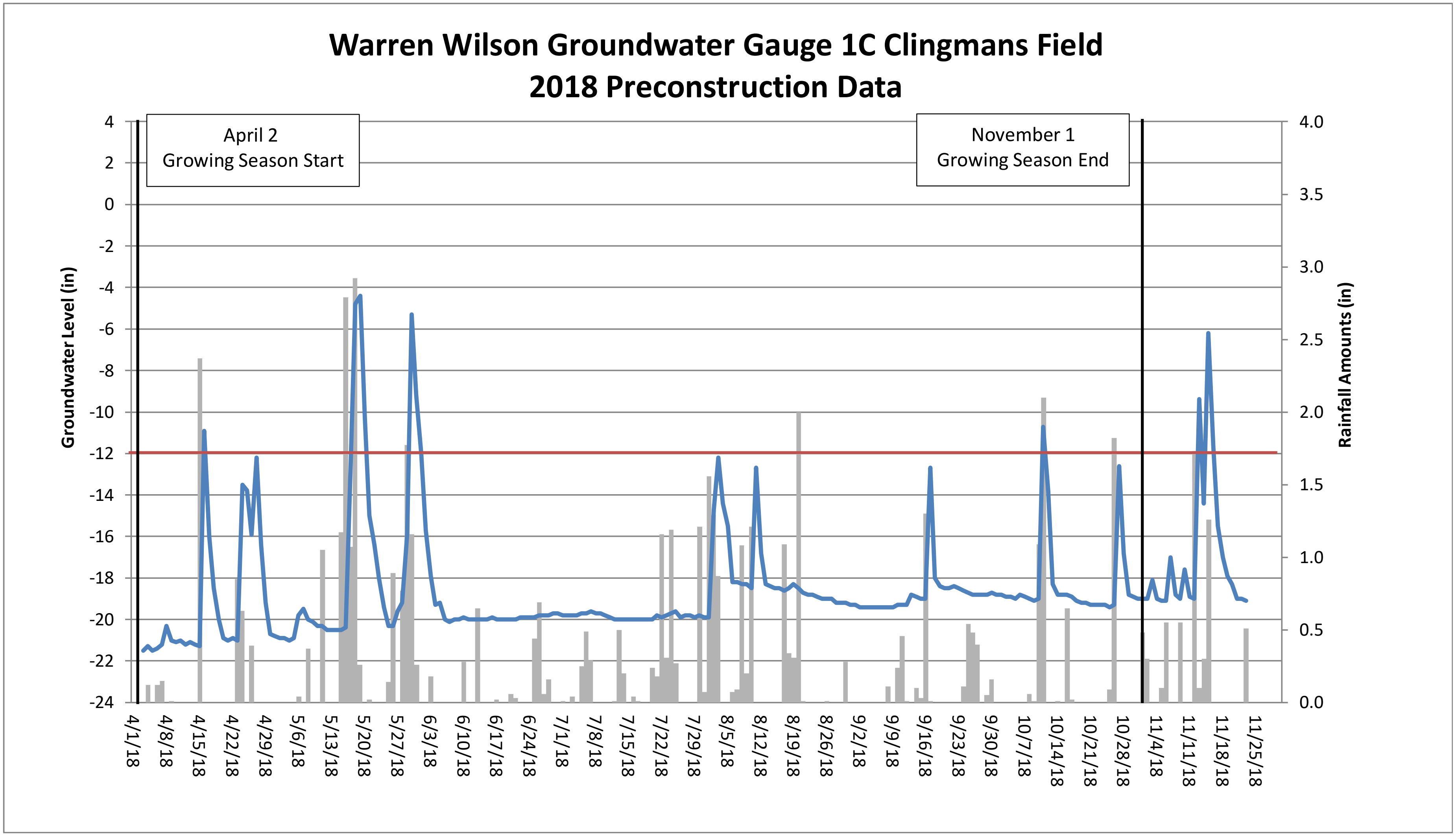
10/28/18
11/4/18
11/11/18
11/18/18
11/25/18



Warren Wilson Groundwater Gauge 1C Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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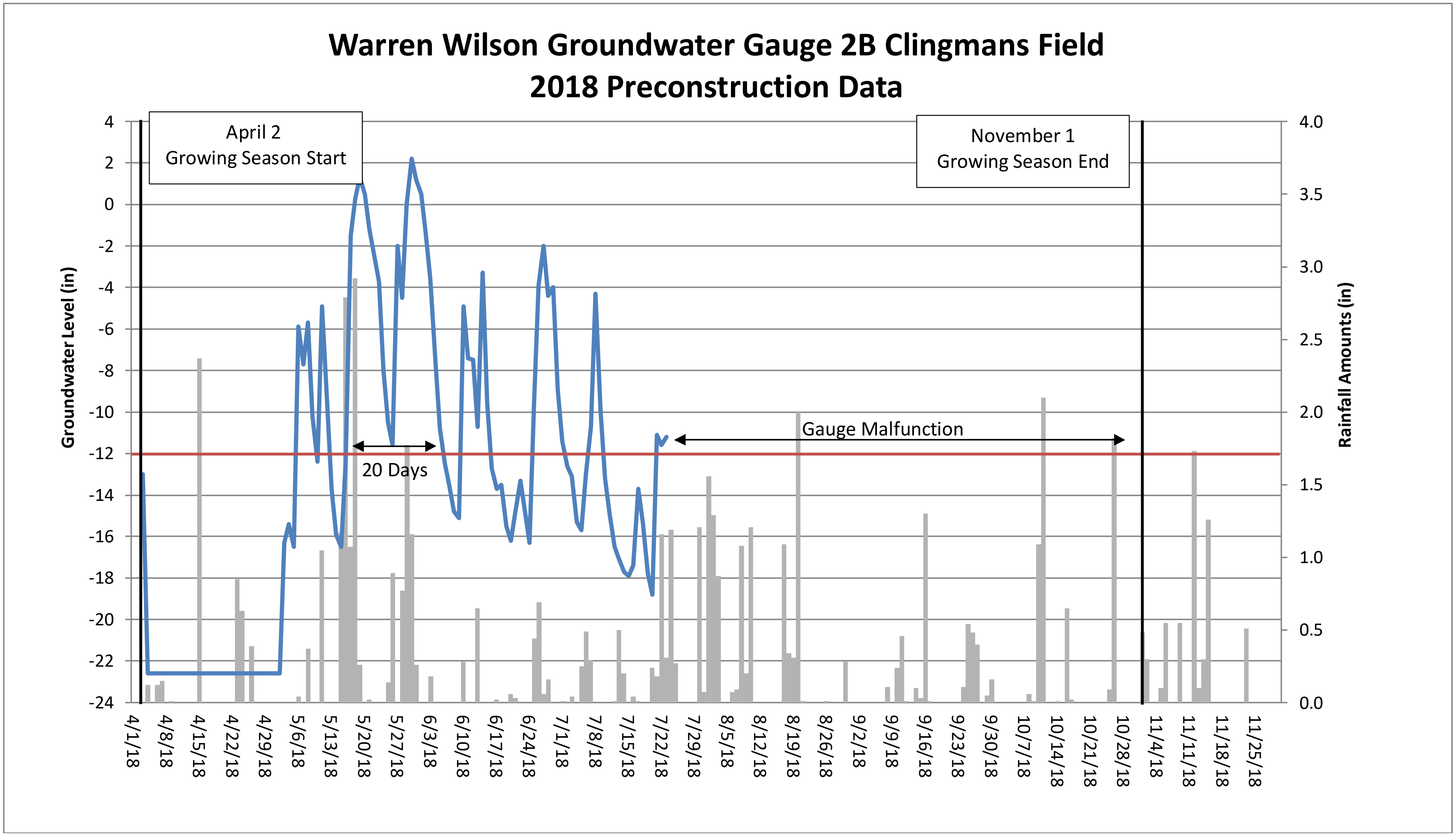
10/21/18
10/28/18
11/4/18
11/11/18
11/18/18
11/25/18


Warren Wilson Groundwater Gauge 2B Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
20 Days
Gauge Malfunction
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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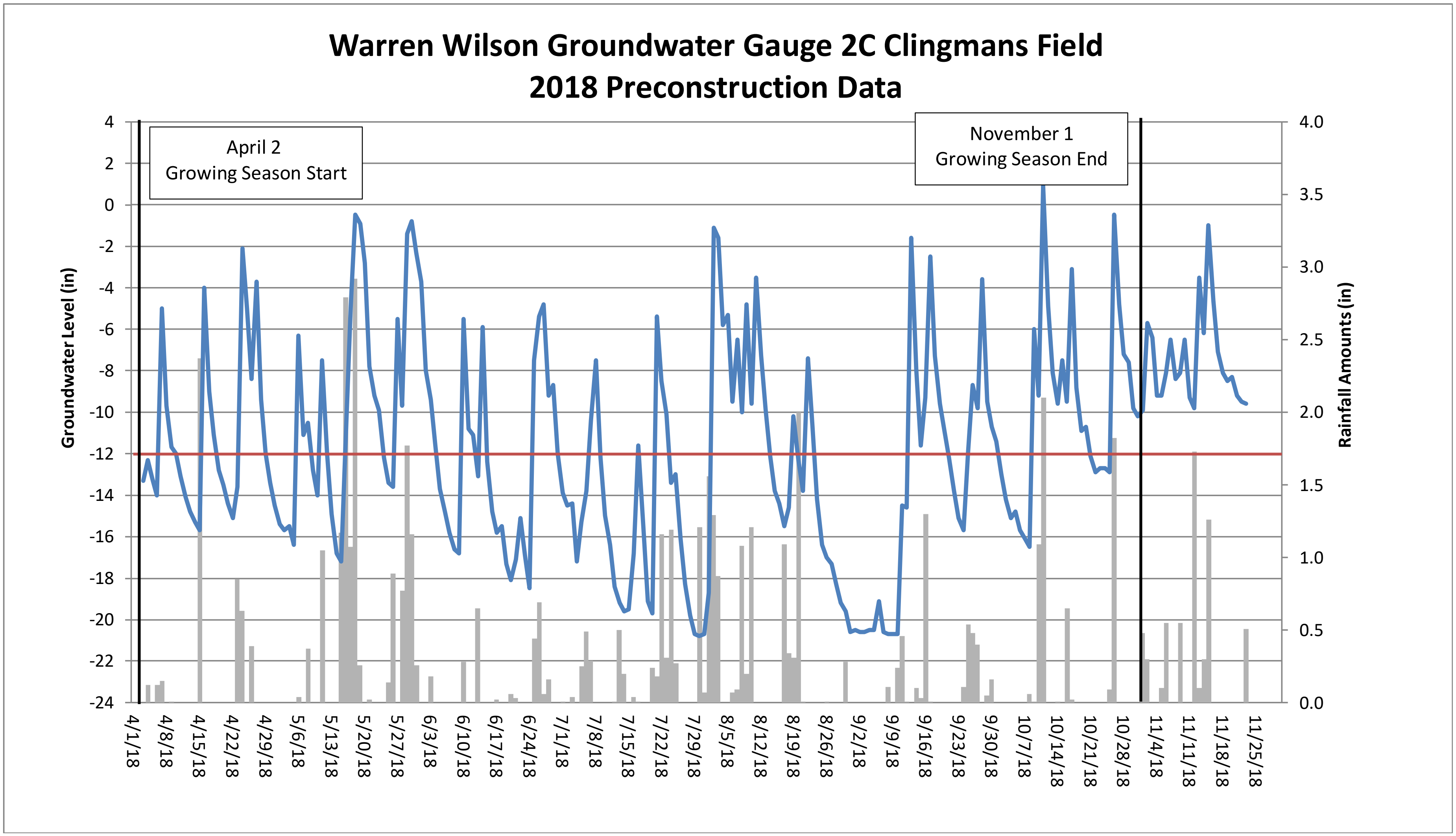
11/4/18
11/11/18
11/18/18
11/25/18



Warren Wilson Groundwater Gauge 2C Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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10/21/18
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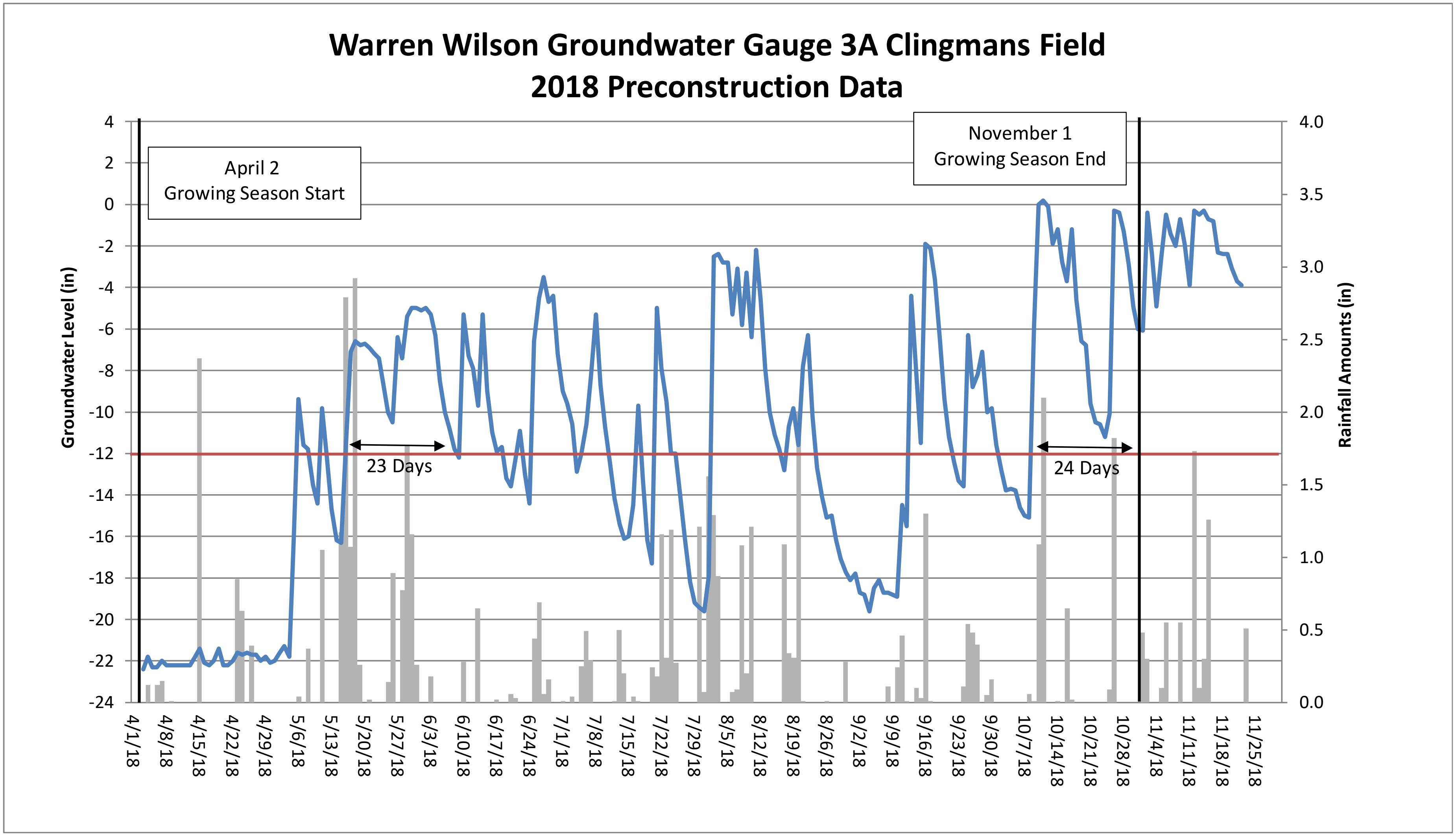
11/4/18
11/11/18
11/18/18
11/25/18


Warren Wilson Groundwater Gauge 3A Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
23 Days
24 Days
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
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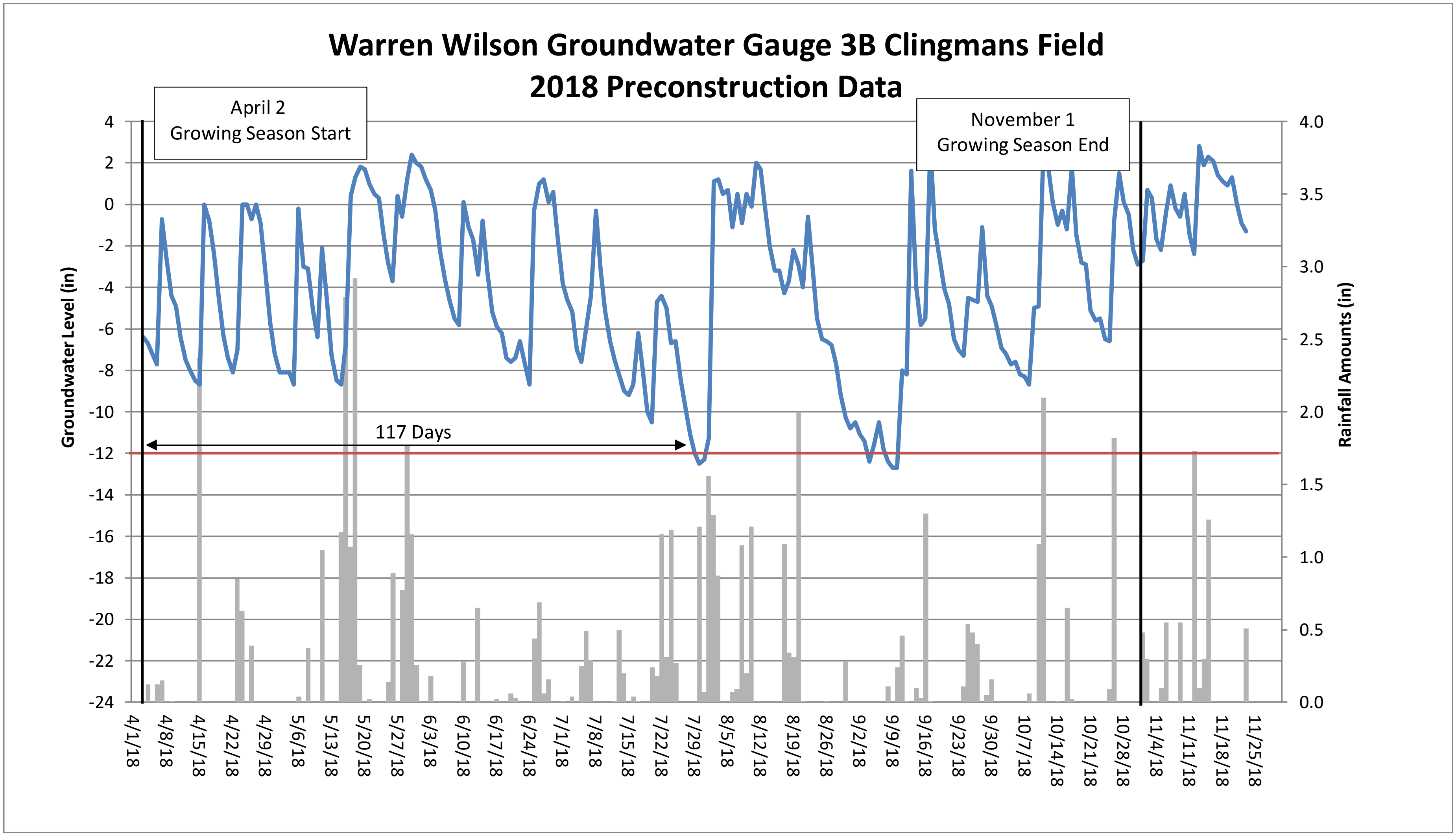
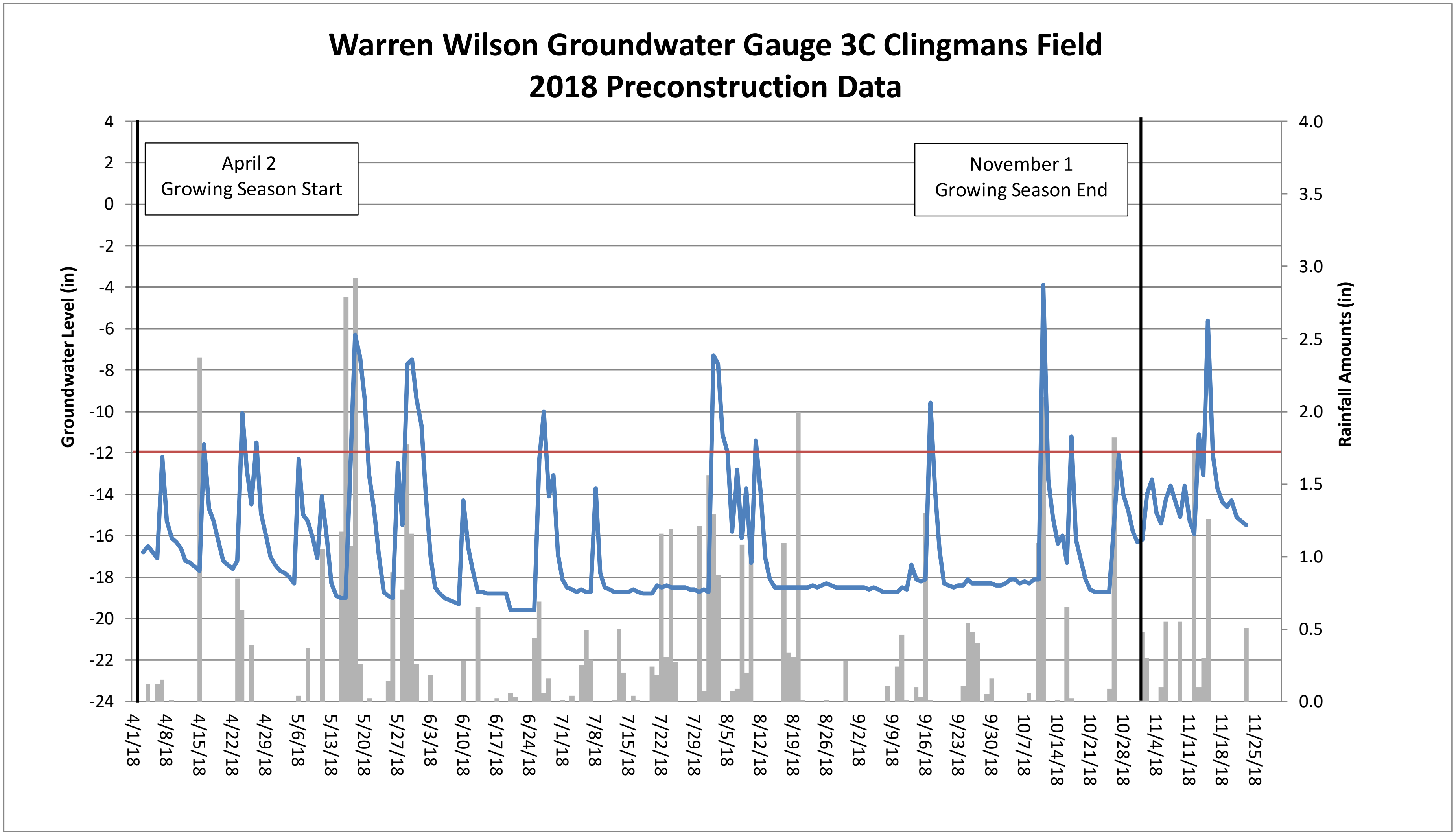
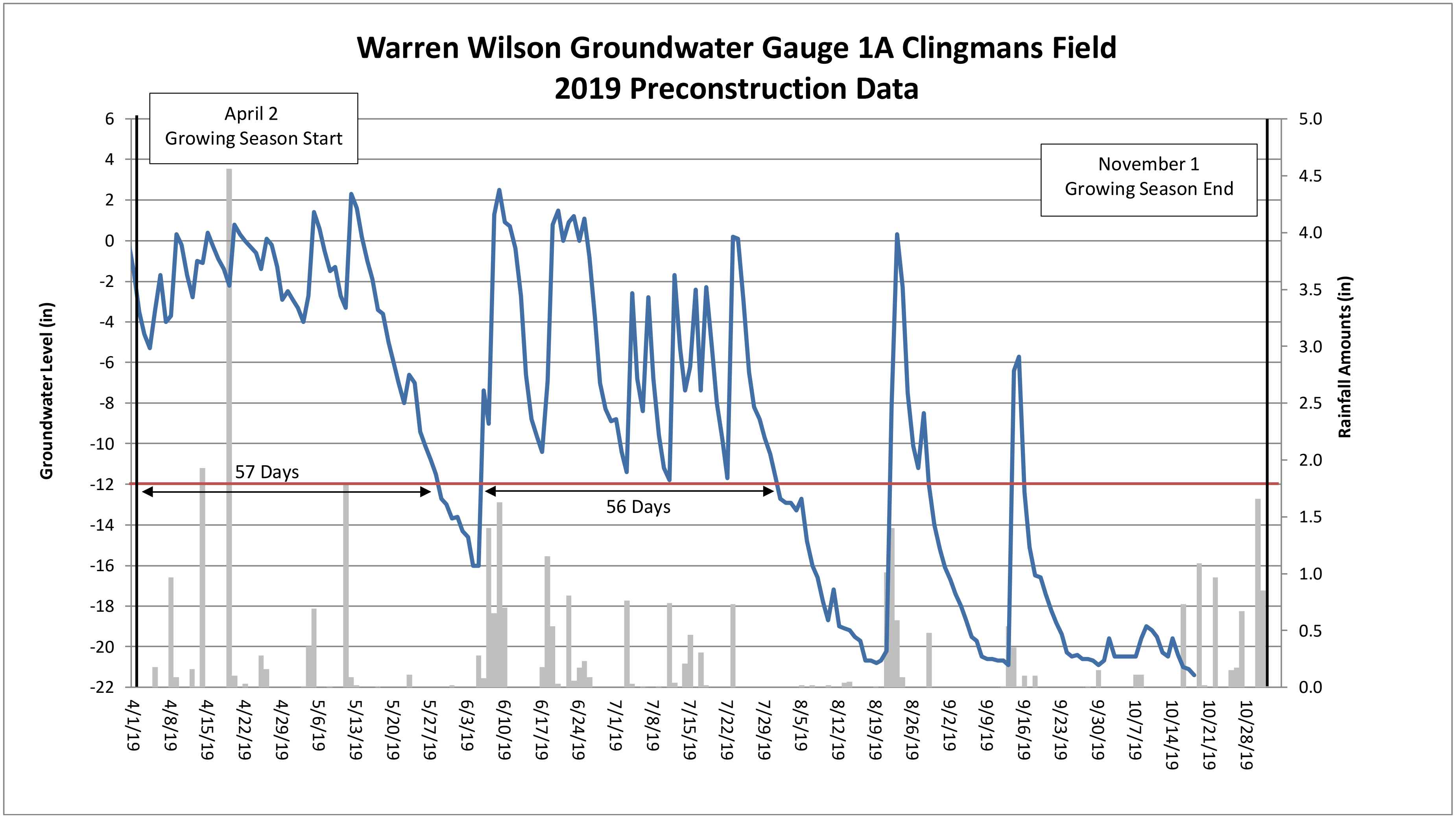
11/11/18
11/18/18
11/25/18

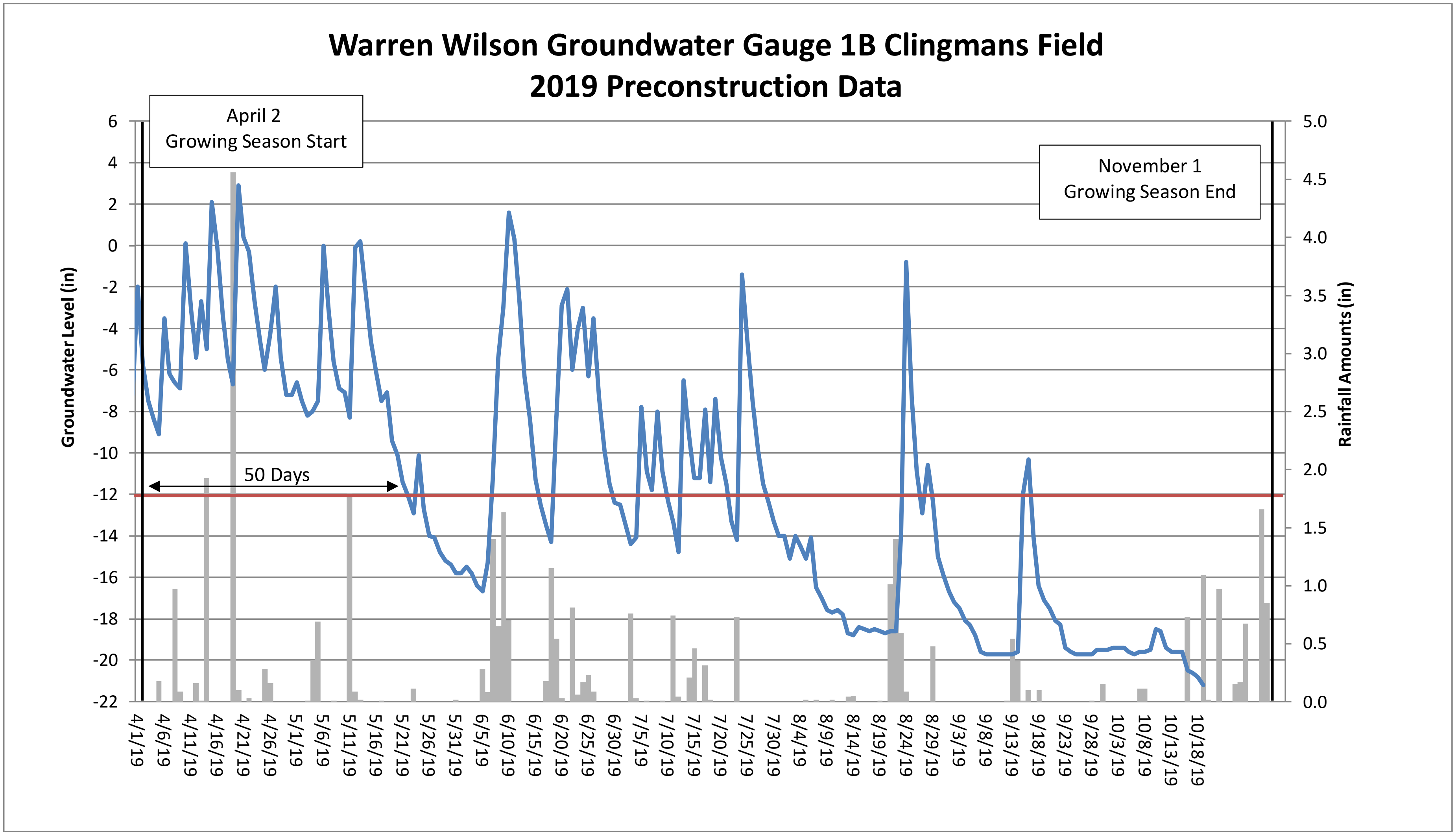


Warren Wilson Groundwater Gauge 3B Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
117 Days
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
10/7/18
10/14/18
10/21/18
10/28/18
11/4/18
11/11/18
11/18/18
11/25/18


Warren Wilson Groundwater Gauge 3C Clingmans Field
2018 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/18
4/8/18
4/15/18
4/22/18
4/29/18
5/6/18
5/13/18
5/20/18
5/27/18
6/3/18
6/10/18
6/17/18
6/24/18
7/1/18
7/8/18
7/15/18
7/22/18
7/29/18
8/5/18
8/12/18
8/19/18
8/26/18
9/2/18
9/9/18
9/16/18
9/23/18
9/30/18
10/7/18
10/14/18
10/21/18
10/28/18
11/4/18
11/11/18
11/18/18
11/25/18



Warren Wilson Groundwater Gauge 1A Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
57 Days
56 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
9/2/19
9/9/19
9/16/19
9/23/19
9/30/19
10/7/19
10/14/19
10/21/19
10/28/19


Warren Wilson Groundwater Gauge 1B Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
50 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/6/19
4/11/19
4/16/19
4/21/19
4/26/19
5/1/19
5/6/19
5/11/19
5/16/19
5/21/19
5/26/19
5/31/19
6/5/19
6/10/19
6/15/19
6/20/19
6/25/19
6/30/19
7/5/19
7/10/19
7/15/19
7/20/19
7/25/19
7/30/19
8/4/19
8/9/19
8/14/19
8/19/19
8/24/19
8/29/19
9/3/19
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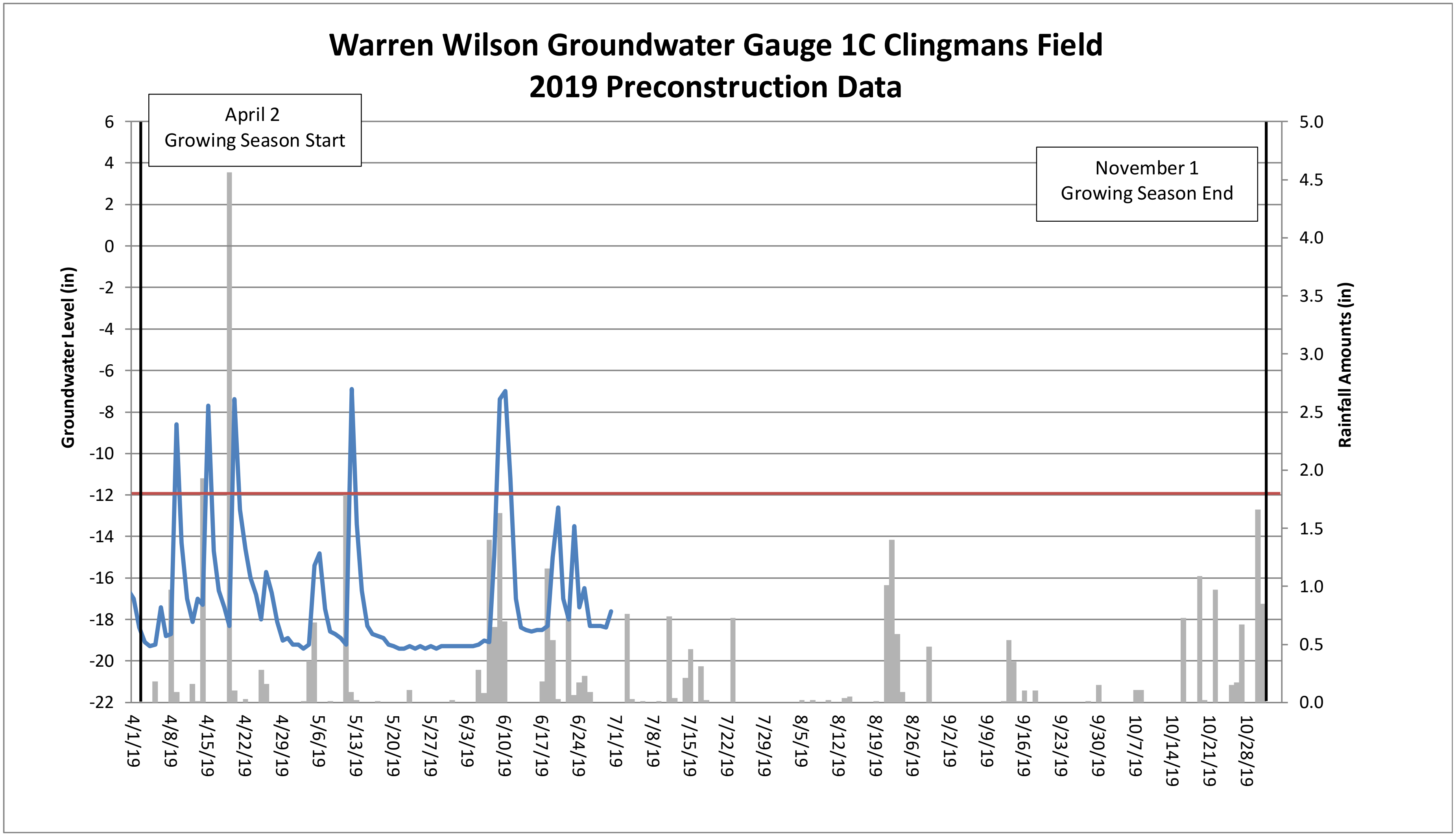
10/13/19
10/18/19



Warren Wilson Groundwater Gauge 1C Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
9/2/19
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9/23/19
9/30/19
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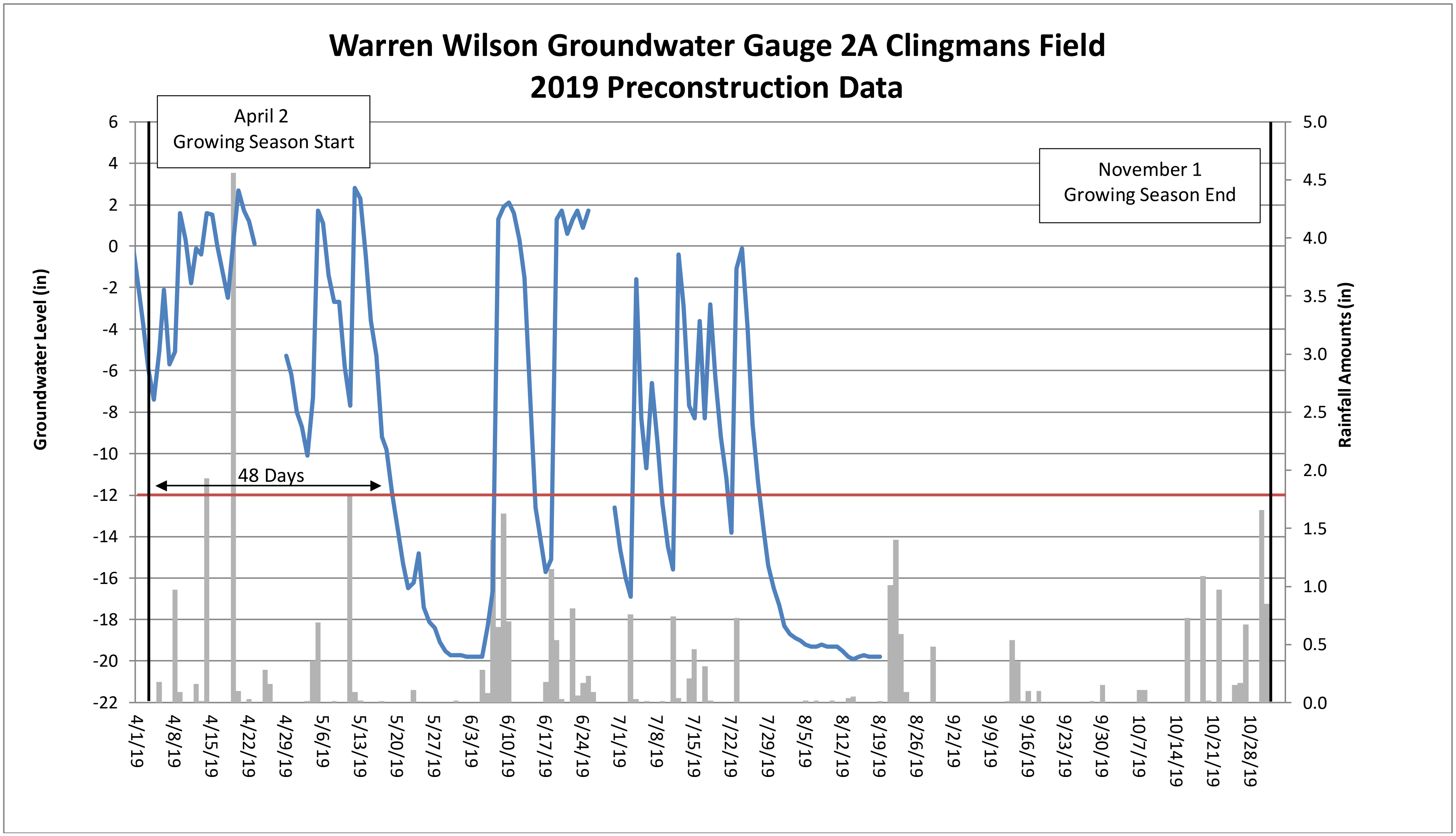
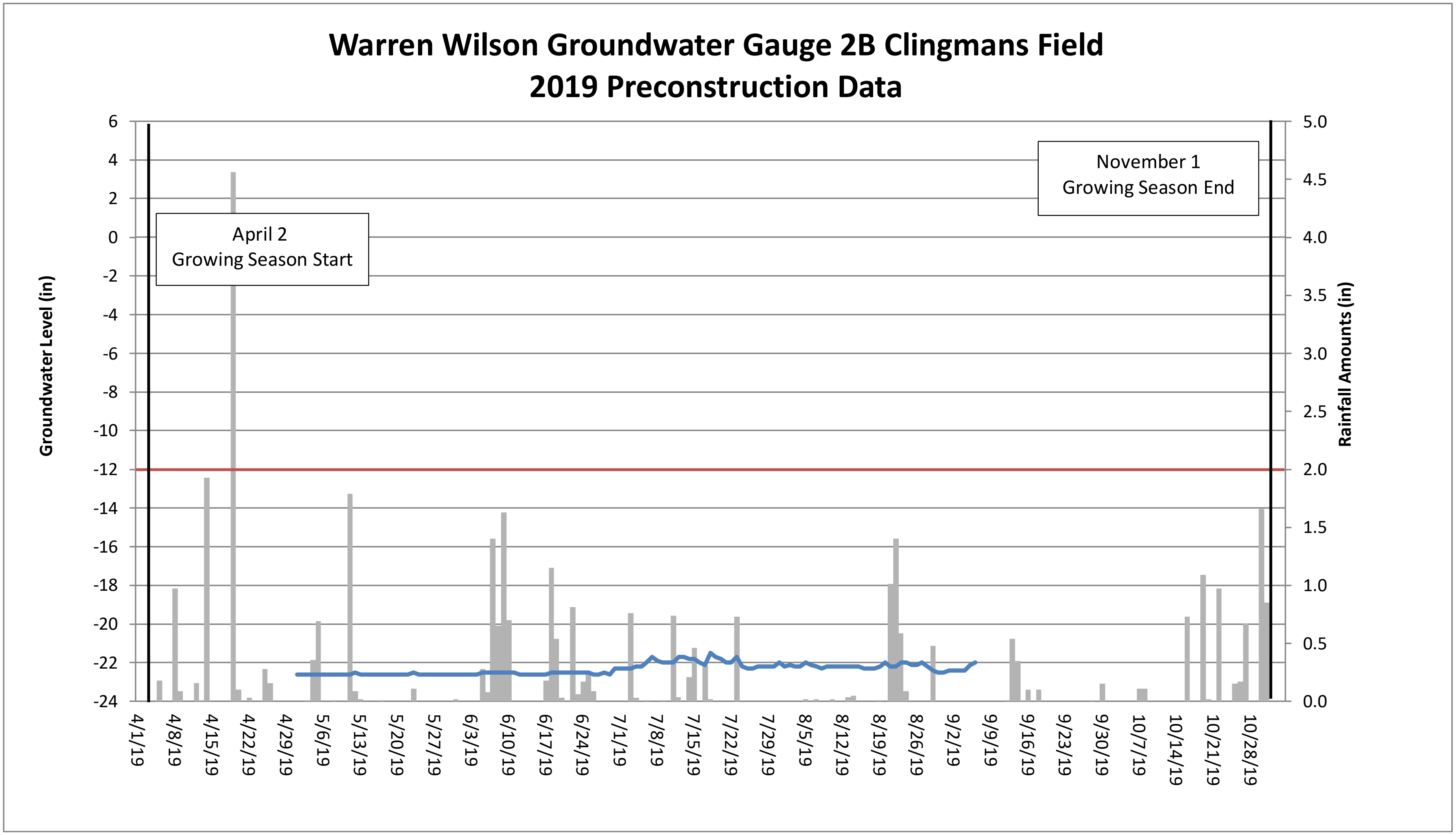
10/14/19
10/21/19
10/28/19



Warren Wilson Groundwater Gauge 2A Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
48 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
9/2/19
9/9/19
9/16/19
9/23/19
9/30/19
10/7/19
10/14/19
10/21/19
10/28/19


Warren Wilson Groundwater Gauge 2B Clingmans Field
2019 Preconstruction Data
Groundwater Level (in)
Rainfall Amounts (in)
April 2
Growing Season Start
November 1
Growing Season End
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
9/2/19
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9/30/19
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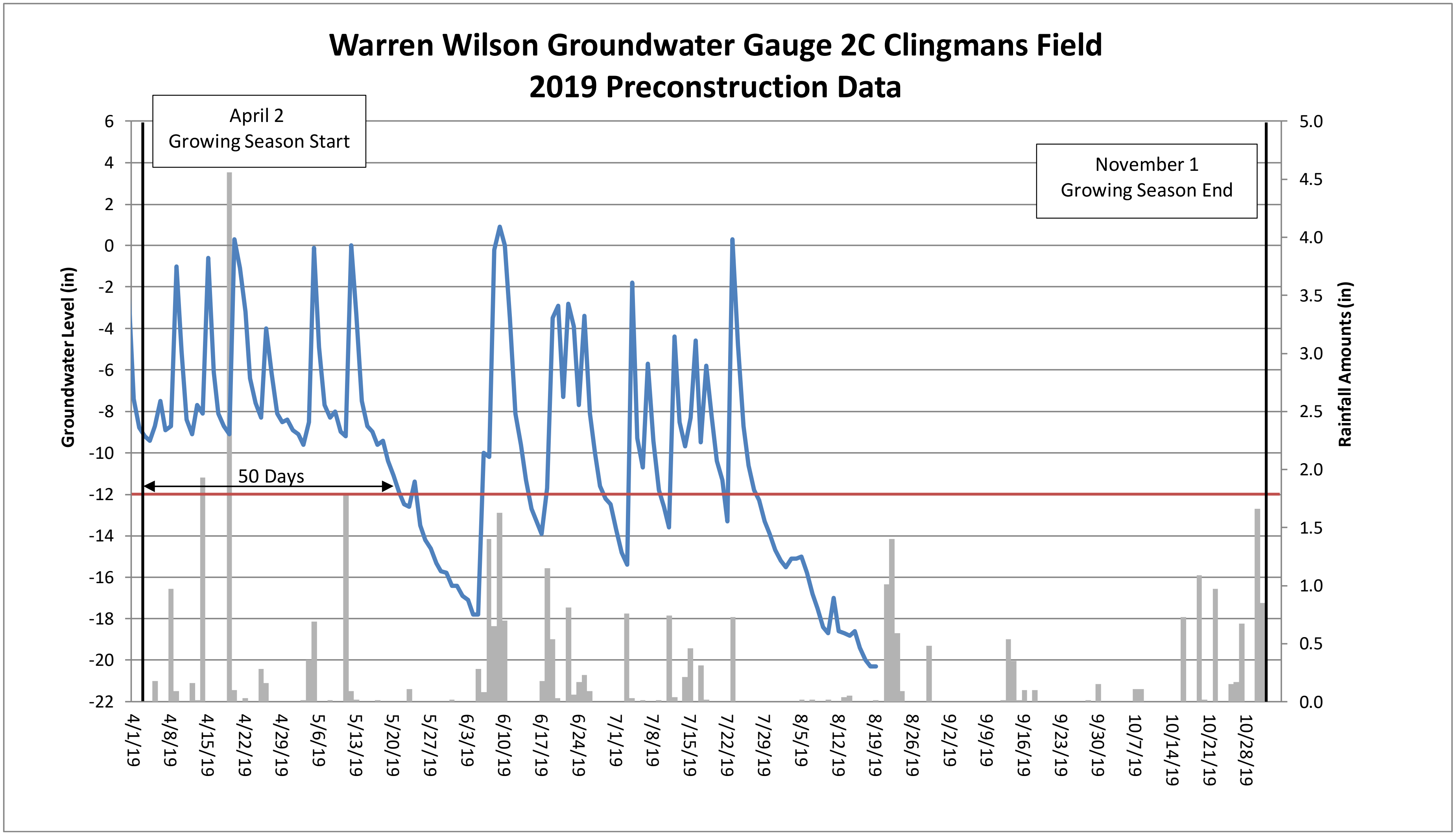
10/14/19
10/21/19
10/28/19



Warren Wilson Groundwater Gauge 2C Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
50 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
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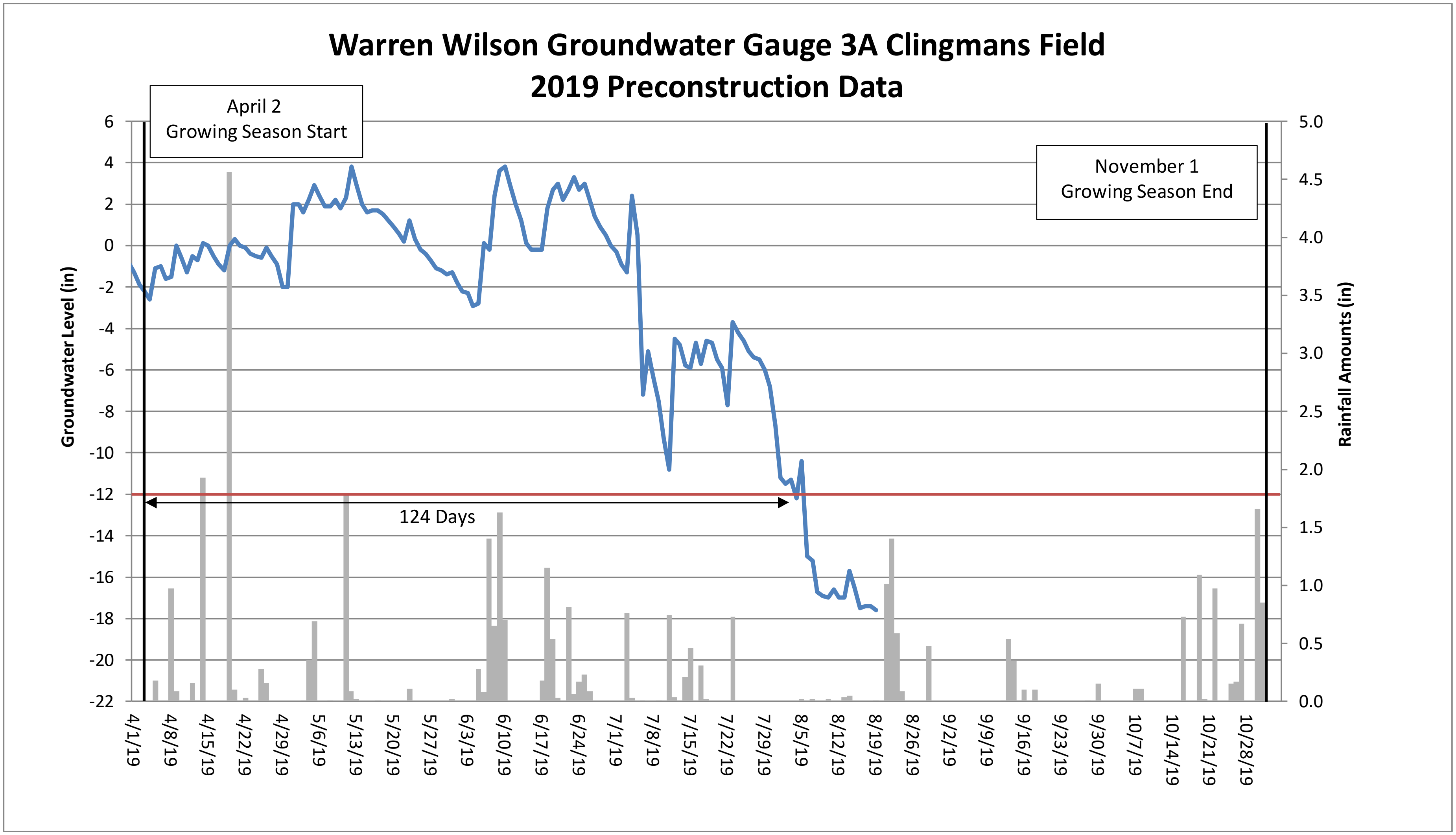
10/21/19
10/28/19


Warren Wilson Groundwater Gauge 3A Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
124 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4/1/19
4/8/19
4/15/19
4/22/19
4/29/19
5/6/19
5/13/19
5/20/19
5/27/19
6/3/19
6/10/19
6/17/19
6/24/19
7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
8/26/19
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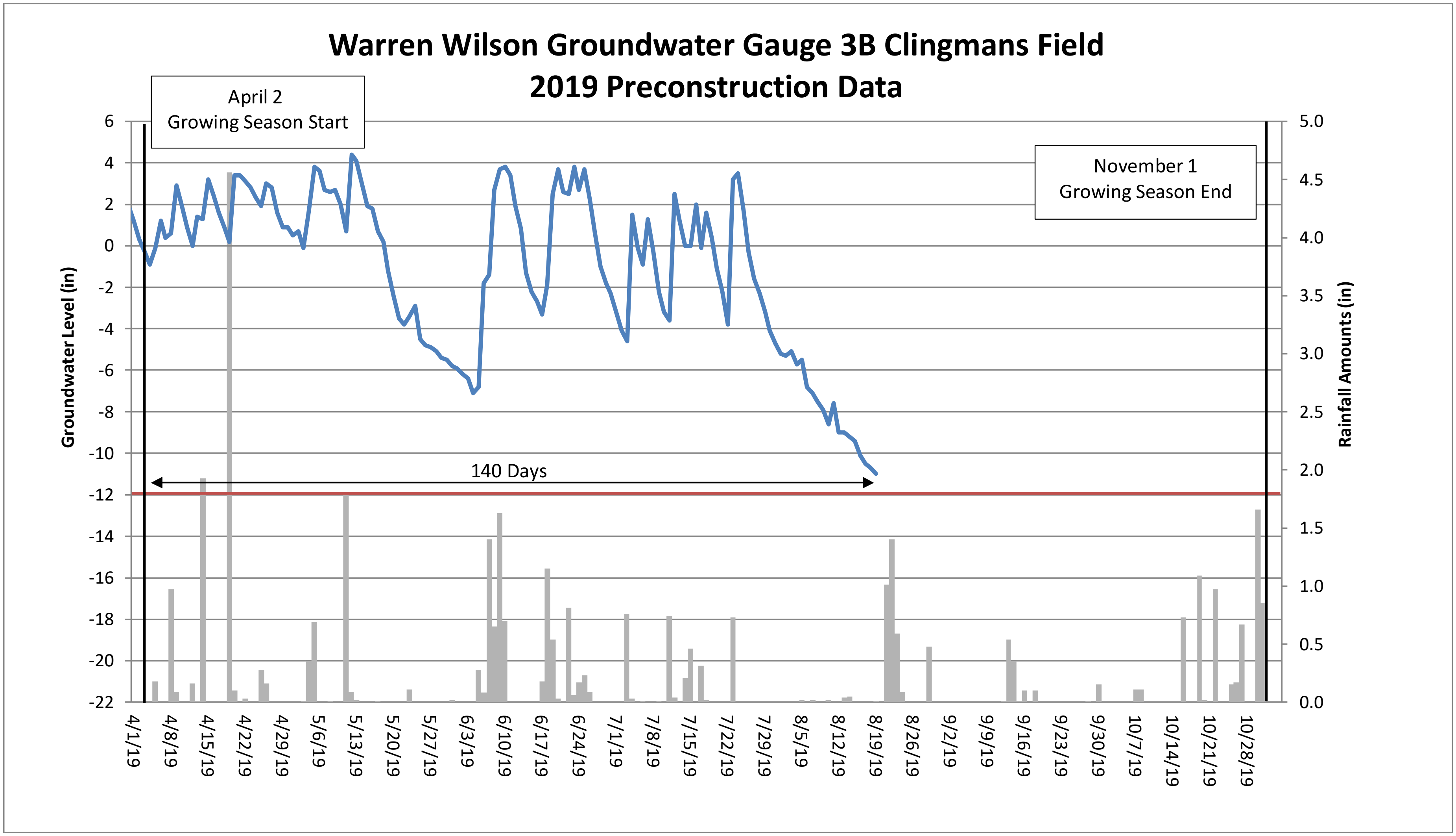
10/21/19
10/28/19



Warren Wilson Groundwater Gauge 3B Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
140 Days
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
5.0
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8/19/19
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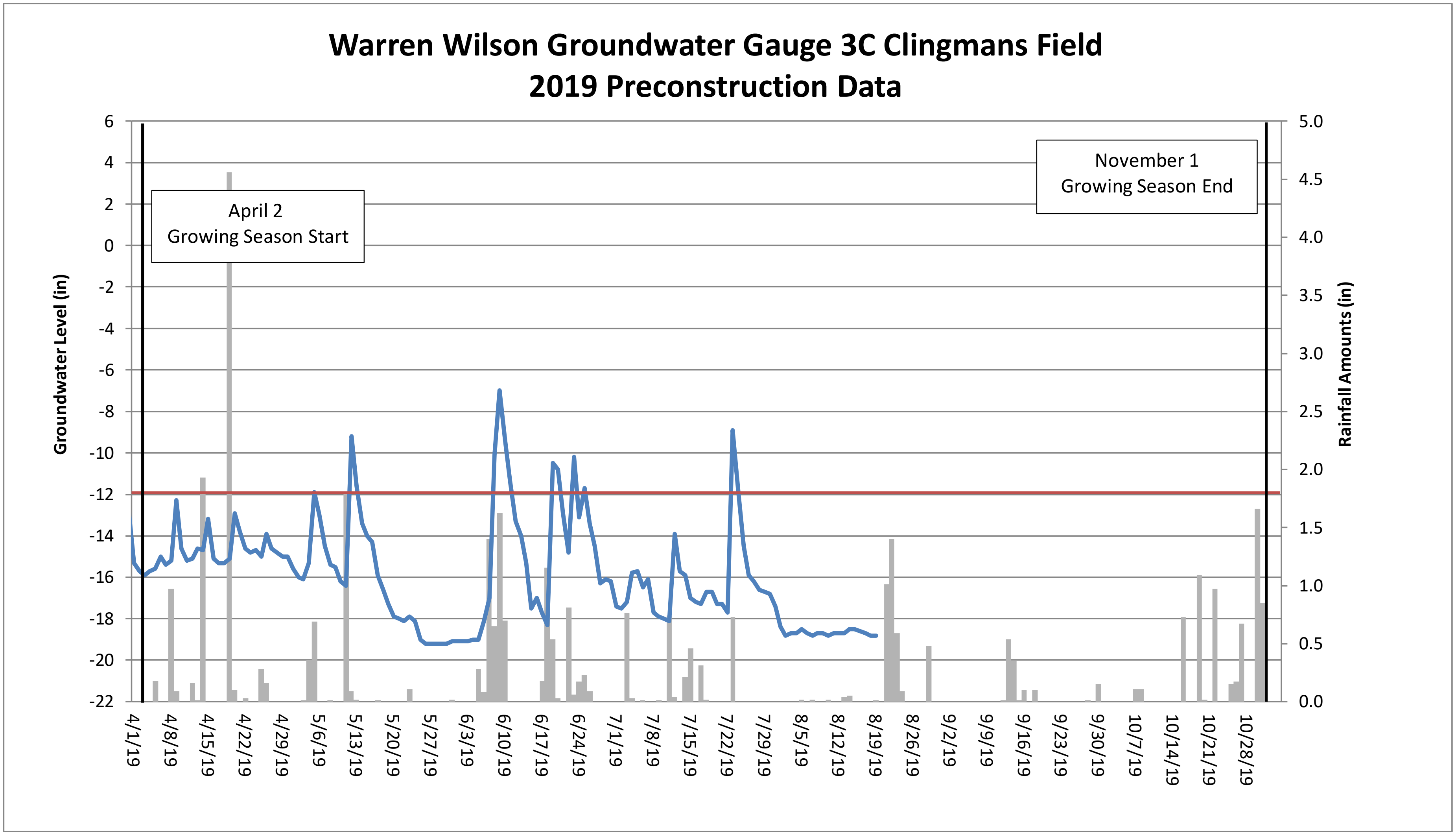
10/21/19
10/28/19



Warren Wilson Groundwater Gauge 3C Clingmans Field
2019 Preconstruction Data
April 2
Growing Season Start
November 1
Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
6
4
2
0
-2
-4
-6
-8
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-12
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7/1/19
7/8/19
7/15/19
7/22/19
7/29/19
8/5/19
8/12/19
8/19/19
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9/16/19
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10/7/19
10/14/19
10/21/19
10/28/19

Appendix G
Agency Correspondence

CR Survey and Monitoring Report
SHPO Approval Letter

FINAL REPORT

ARCHAEOLOGICAL TESTING AND ASSESSMENT OF SITE 31BN28 AND MONITORING OF AREAS NEAR SITES 31BN135 AND 31BN145/491 FOR THE WARREN WILSON STREAM RESTORATION PROJECT, BUNCOMBE COUNTY, NORTH CAROLINA

TRC ENVIRONMENTAL CORPORATION
May 2020

FINAL REPORT

ARCHAEOLOGICAL TESTING AND ASSESSMENT OF SITE 31BN28 AND MONITORING OF AREAS NEAR SITES 31BN135 AND 31BN145/491 FOR THE WARREN WILSON STREAM RESTORATION PROJECT, BUNCOMBE COUNTY, NORTH CAROLINA

ER 17-1683

Submitted to:

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May 2020

ABSTRACT/MANAGEMENT SUMMARY

TRC Environmental Corporation (TRC) has completed archaeological fieldwork for a proposed stream restoration project on the campus of Warren Wilson College in Buncombe County, North Carolina. This work included archaeological testing at site 31BN28 and monitoring of construction in the vicinity of sites 31BN135 and 31BN145/491. The Areas of Potential Effects (APEs) for the various project areas are defined by the easement limits for each unnamed tributary (UT) that were to be modified as part of the stream restoration project.

The project impacted a portion of site 31BN28, an extensive, multicomponent site that was systematically investigated in 2015 (Buchner et al. 2016). The site's National Register of Historic Places (NRHP) eligibility status has not been determined (Buchner et al. 2016:58), and this study was conducted to assess 31BN28 within the project impact area through application of the NRHP Criteria for Evaluation (36CFR 60.4). The fieldwork at 31BN28 was carried out from January 4–11, 2018 and was directed by Bruce Idol.

Project activities within the boundaries of 31BN28 included construction of a new stream channel (UT-5) within a meandering, linear easement measuring ca. 1,008 ft (307 m) in length and 68 ft (21 m) in width that extends northward from a wooded area adjacent to the Swannanoa River into a fallow agricultural field on the west side of an existing artificial drainage. From there, the construction easement extends to a buried culvert situated in a pasture south of Riceville Road. The project also included the removal of trees on both sides of the existing drainage.

The evaluation of 31BN28 within the project APE included the excavation of 123 10-m interval shovel tests and two 1 × 1 m test units, as well as surface inspection. Twenty of the shovel tests (11 shovel tests east of the stream along the treeline and nine west of the stream) within the construction easement produced precontact period lithic or ceramic artifacts. These artifacts include lithic artifacts associated with Middle Woodland (and potential Late Archaic to Woodland and Mississippian) occupations and ceramic artifacts associated with Middle Woodland and potential Mississippian (Pisgah phase) occupations. Most of the precontact period artifacts were found in relatively shallow plowzone contexts, but some lithic (including a variety of Woodland to Mississippian triangular projectile points) and ceramic artifacts were found in similar underlying soils in an isolated area on the east side of the stream.

The origin of that deposit is not completely clear; it may be disturbed (and possibly related to the original construction of the stream channel) or is (in part) a naturally filled swale or slough area that has incorporated a few artifacts present across the terrace. Other artifacts found below the plowzone (including a few pieces of lithic debitage from a thin A horizon that appears to represent a former swale and a few lithic and ceramic artifacts found in a hydric B horizon on the west side of the stream) appear attributable to bioturbation moving artifacts downward. No artifacts were found in any other B horizon context west (or east) of the stream. Most, if not all, of the soil sequences encountered suggest a less than favorable environment for habitation, and there are no deeply buried deposits or evidence for cultural stratification, and local soil conditions, along with low artifact density, suggest that Woodland or other features are unlikely to be present within the project APE.

These investigations are not sufficient to characterize the site in its entirety, and it is very likely that meaningful artifact distributions and cultural features (especially those associated with Middle Woodland to Mississippian period occupations) are present on the broad terrace outside the area of project impacts. Further assessment would be necessary to define the prehistoric occupation of the site in those locations, and overall the site remains unassessed for NRHP eligibility. The present results suggest that construction will not impact any intact or significant deposits, and we recommend that the construction be allowed to proceed as presently designed. At the conclusion of the testing, a management summary with

recommendations was submitted to NCHPO for review (Benyshek and Idol 2018). The HPO concurred with those recommendations in a comment letter dated March 27, 2018 (HPO 2018).

In 2019 and 2020, archaeological monitoring was subsequently conducted near two other archaeological sites (31BN135 and 31BN145/491) that would potentially be impacted by activities associated with construction of three new stream channels (UT-1, UT-6, and UT-7). These were located east of Warren Wilson Road and southeast of the main campus on both sides of the Swannanoa River and were a combined 4,302.2 ft (1,311.3 m) in length and 119.4 ft (36.4 m) to 149.3 ft (45.5 m) in width, encompassing a total area of 9.3 acres. The monitoring was performed over a period from September 17, 2019 to February 3, 2020 and was performed by John Kesler. The fieldwork included limited shovel testing and mechanized excavation as well as photodocumentation. The excavations were largely confined to existing stream beds and mainly encountered hydric or highly disturbed soils. Monitoring for the project has been completed; no intact cultural deposits or non-modern artifacts were observed, and the construction did not impact nearby archaeological sites. No additional archaeological work is necessary for this project.

ACKNOWLEDGMENTS

The authors would like to thank Worth Creech of Restoration Systems, LLC, and Sara Stavinoha of Anchor QEA of North Carolina, PLLC, for their support of this project. Asher Wright and Virginia Hamilton of Warren Wilson College helped facilitate access to the project area. Thanks also go to Warren Wilson archaeologist David Moore for providing information about the project area and also helping to facilitate the work.

For TRC, Fritz Farrow, Blair Heidkamp, Jeff Johnson, and John Kimes conducted the fieldwork at 31BN28 under the direction of Bruce Idol. Monitoring during construction was conducted by John Kesler. The artifacts were processed and prepared for curation by Belinda Cox and Brenda Magouirk-Nelson. Bruce Idol analyzed the ceramic artifacts, and Belinda Cox analyzed the lithic and modern artifacts. The graphics were produced by Belinda Cox and Hannah Smith, and the report was copyedited by Heather Millis.

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CONTENTS

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FIGURES

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TABLES

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1. INTRODUCTION

This report presents the results of TRC's archaeological testing and site assessment for 31BN28 and monitoring of construction activities near 31BN135 and 31BN145/491 in Buncombe County, North Carolina for a proposed stream restoration project (Figure 1.1). The project area within site 31BN28 (UT-5) encompasses ca. 2.87 acres around an artificial drainage located in an agricultural setting on the campus of Warren Wilson College. Proposed construction activities within this area include construction of a new stream channel and the removal of trees on both sides of the existing drainage, which impacted a portion of site 31BN28. Three other stream restoration easements (UT-1, UT-6, and UT-7) are situated in agricultural fields east of Warren Wilson Road and southeast of the main campus. These generally follow existing artificial stream beds (but diverge in some areas) and encompass a total area of 9.3 acres.

This study was conducted to assess the NRHP eligibility of 31BN28 within the project area and to ensure that sites 31BN135 and 31BN145/491 were not impacted by construction activities. These investigations were performed in order to comply with Section 106 of the National Historic Preservation Act. The fieldwork at 31BN28 was carried out from January 4 to 11, 2018 and was directed by Bruce Idol, and the monitoring was conducted by John Kesler from September 17, 2019 to February 3, 2020. The field methods followed those specified in TRC's (2017) technical proposal.

This report is organized in the following way. Chapter 2 provides information on the natural environment. Chapter 3 presents a summary of the cultural history of the project region, including information on local history and previous research in the area. Chapter 4 specifies the research goals and methods for site testing and monitoring. The results of the survey and testing at 31BN28 are presented in Chapter 5, and Chapter 6 presents the results of the archaeological monitoring. The conclusions and recommendations are provided in Chapter 7, which is followed by a list of references cited. Appendix 1 contains the artifact inventory for 31BN28. A new and updated archaeological site form has been submitted under separate cover.

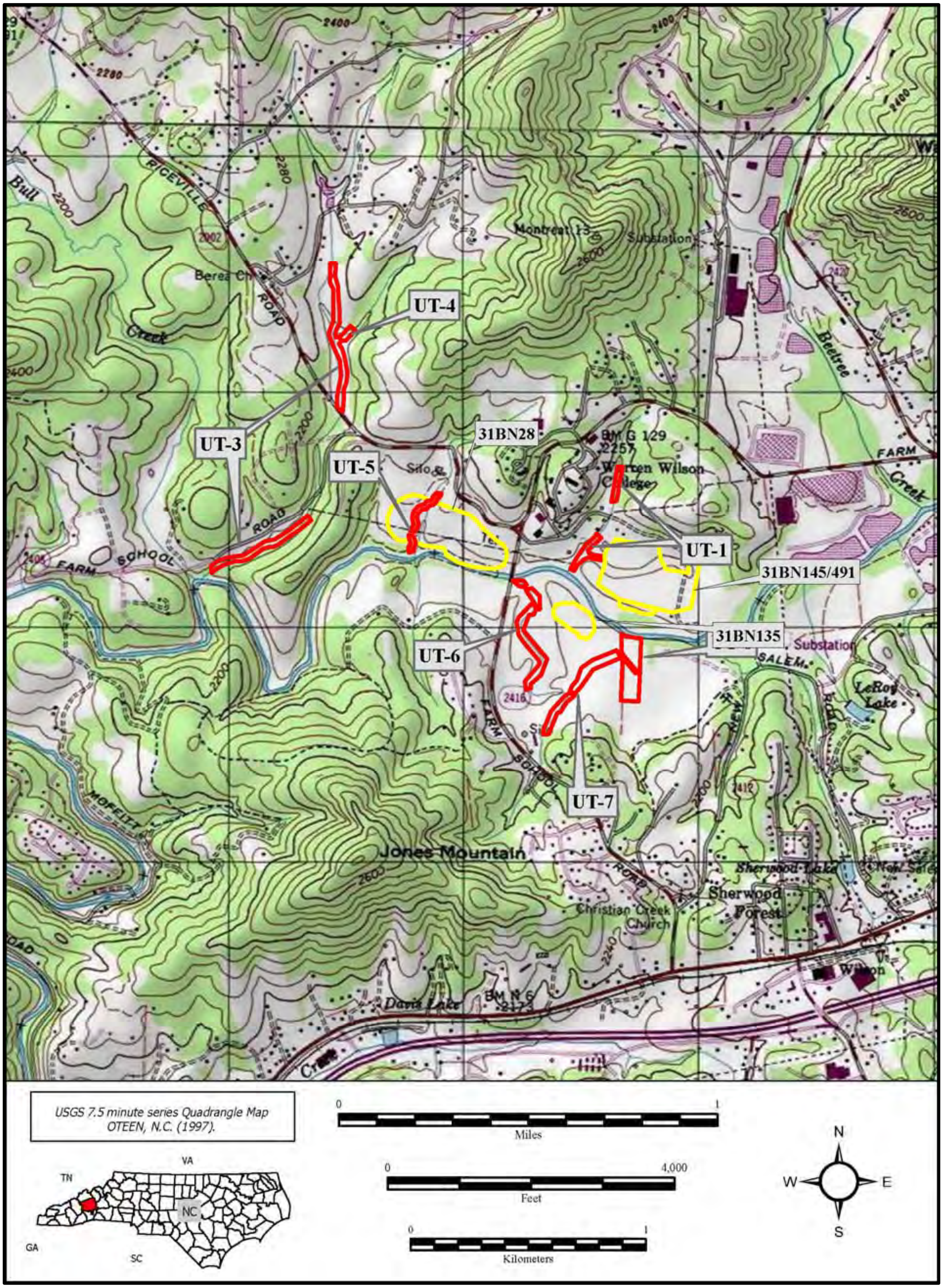

Figure 1.1. Location of proposed stream restoration easements in Buncombe County, North Carolina.

2. ENVIRONMENTAL SETTING

PROJECT SETTING

The archaeological sites are situated on the campus of Warren Wilson College in the Swannanoa valley in Buncombe County, North Carolina. Site 31BN28 is located on the north side of the Swannanoa River and occupies most of the extensive terrace west of Warren Wilson Road and south of Riceville Road. The other stream restoration areas are located east of Warren Wilson Road and occupy terraces north and south of the river.

PHYSIOGRAPHY, GEOLOGY, SOILS, AND HYDROLOGY

The study area is situated in the Blue Ridge Mountains physiographic region and the Blue Ridge geological belt, and lies within the Broad Basins ecoregion, which is drier and has lower elevations and less relief than the more mountainous Blue Ridge regions conditions (Griffith et al. 2002). The topography of the region varies from narrow valleys to steep mountains (Hudson 2009:1). Elevations in Buncombe County range from 1,705 to 6,410 feet above mean sea level (AMSL), and elevations along the Swannanoa in the project area range from about 2,120 to 2,080 feet AMSL.

Geologically, the project area lies within the Blue Ridge Belt (NCGS 1985). The Blue Ridge Belt is an area that has a similar complex geologic history characterized by metamorphosed sedimentary and igneous rock that have been transformed by the intense pressures and temperatures related to internal plate tectonics. The project area falls within the Ashe Metamorphic Suite and Tallulah Falls Formation as mapped by the NCGS (1985), and consists of younger rocks (543–900 my) than the basement rocks, which are biotite gneisses and amphibolites representing the oldest rocks in the region (900–1600 my). The underlying rock in the immediate project area is mapped as metagraywacke, "…interlayered and gradational with mica schist, muscovite-biotite gneiss and rare graphitic gneiss" (NCGS 1985).

The general soil mapping unit along the Swannanoa River is Rosman-Iotla-Biltmore-French, composed of soils with coarse loamy subsoils; formed in residuum and colluvium along major streams, this soil unit is found in floodplains, coves, colluvial fans, and stream terraces along the Swannanoa and its major tributaries (Hudson 2009). At 31BN28, the lower terrace (as well as part of the upper terrace) near the river is mapped as Iotla loam, a very deep, somewhat poorly drained soil found on mountain valley floodplains with 0–2 percent slopes and is formed in alluvium (Hudson 2009:244–245). Iotla loam is characterized by a brown loam surface layer and dark yellowish brown sandy loam subsoil in the upper part and dark grayish brown sandy loam in the lower part (Hudson 2009:244). The remainder of the APE is mapped as Dillard loam, a very deep, moderately well drained soil found on narrow stream terraces with 1–5 percent slopes and is formed in old alluvium (Hudson 2009:145–146). It is characterized by a dark brown loam surface layer and a mottled, yellowish brown, clay loam B horizon in the upper part and light gray sandy loam in the lower part (Hudson 2009:145). Random seeps and springs are occasionally associated with this soil type, as are areas of poorly drained French and Hemphill soils (Hudson 2009:146).

The Swannanoa River flows west and south to meet the French Broad River in Asheville. The French Broad's headwaters are in Transylvania County to the south. From there, it flows north and west through Henderson, Buncombe, and Madison counties before entering Tennessee. In Tennessee, the French Broad heads west and south, joining with the Holston River just east of Knoxville to form the Tennessee River. The Tennessee River flows west and south into Alabama and then turns north back into Tennessee, continuing north into Kentucky and eventually joining the Ohio River. The Ohio River flows west into the Mississippi River, which empties into the Gulf of Mexico to the south.

MODERN CLIMATE

The climate of Buncombe County is temperate and humid but is generally cooler than other parts of the state at lower altitudes. Summers are normally cool and short, while winters are fairly cold (Goldston et al. 1954:8–9). Asheville averages 47 inches of precipitation a year (Hudson 2009:9). The spring and fall months receive the most precipitation, while summer months are the driest. Temperature and precipitation records indicate that the growing season lasts for about 190 days, extending from the beginning of April through mid-October (Goldston et al. 1954:9–10). Seasonal snowfall averages about 13.7 inches per year in the county but varies with elevation and other factors (Hudson 2009:9).

FLORA AND FAUNA

The Broad Basins have a mix of oaks and pines more similar to the Piedmont than the higher mountainous ecoregions, with more shortleaf (*Pinus echinata*) and Virginia pine (*Pinus virginiana*), and white oak (*Quercus alba*), southern red oak (*Quercus falcata*), black oak (*Quercus velutina*), and scarlet oak (*Quercus coccinea*) (Griffith et al. 2002). Although some areas of this rolling foothills region are mostly forested, overall it has more pasture, cropland, industrial land uses, and human settlement than other Blue Ridge ecoregions (Griffith et al. 2002). The pre-20th century vegetation in the river valleys and coves and on the sheltered mountain slopes was dominated by chestnut (*Castanea dentata*), tulip poplar (*Liriodendron tulipifera*), ash (*Fraxinus* spp.), hemlock (*Tsuga* spp.), white basswood (*Tilia* spp.), buckeye (*Aesculus* spp.), oak (*Quercus* spp.), red maple (*Acer rubrum*), and walnut (*Juglans nigra*). The higher elevations supported wild cherry (*Prunus serotina*), oak, maple, birch (*Betula* spp.), and beech (*Fagus grandifolia*), along with Fraser fir (*Abies fraseri*) and rhododendron (*Rhododendron* spp.) (Griffith et al. 2002; Holmes 1911:38; Perkins and Gettys 1947:9).

Extensive logging in the late 19th and early 20th centuries removed much of the virgin timber from the area. The forests supported a variety of undergrowth species, including several varieties of edible berries, such as blackberries and raspberries (*Rubus* spp.) and huckleberries (*Gaylussacia* spp.). These and other non-arborial species, such as river cane (*Arundinaria gigantia*), were used for tools, food, and medicinal purposes by both the Cherokee and later Euro-American settlers (Cozzo 2004; Mooney and Olbrechts 1932; Oliver 1989:29).

The forests supported a substantial and diverse fauna, as indicated by both early postcontact period observations and modern inventories (Davis 1990:32; Stupka 1960). Ecological analysis indicates that white-tailed deer (*Odocoileus virginianus*) would have inhabited the forests at a rate of about 400 head per 10 square miles (Shelford 1963), although densities likely varied by season, topography, and vegetation. Other large and small mammals were also common. Black bear (*Ursus americanus*) were present in densities of about 5 per 10 square miles, and elk (*Cervus canadensis*) also occupied the region (Shelford 1963). Wolves (*Canis* sp.) were also present, along with panthers or mountain lions (*Felis concolor*), bobcats (*Lynx rufus*), gray foxes (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*), beavers (*Castor canadensis*), otters (*Lutra canadensis*), muskrats (*Ondatra zibethica*), minks (*Mustela vison*), opossums (*Didelphis marsupialis*), gray squirrels (*Sciurus carolinensis*), and fox squirrels (*Sciurus niger*) (Linzey 1995; Shelford 1963; Stupka 1960). Avian species of possible economic importance included turkey (*Meleagris gallopavo*) and smaller species; other species may have been valuable non-food resources as well. The Swannanoa and its tributary streams would have provided a variety of fish, including catfish (Ictaluridae), sunfish (Centrarchidae), largemouth (*Micropterus salmoides*) and smallmouth (*Micropterus dolomieui*) bass, and brook trout (*Salvelinus fontinalis*).

3. CULTURAL BACKGROUND

PRECONTACT PERIOD OVERVIEW

This chapter presents an overview of the precontact, contact era, and postcontact occupations of southwestern North Carolina. Much of the earlier part of the cultural sequence for the region is based on Coe's (1964) investigations of the precontact cultures of North Carolina, coupled with more recent research in North Carolina (e.g., Daniel 1998) and across the mountains in Tennessee (e.g., Davis 1990; Kimball 1985). Information on the later Native American occupations of western North Carolina is derived from a variety of sources, including Dickens (1976), Keel (1976), Purrington (1983), Riggs (1988, 1996, 1999); Riggs and Rodning (2002), Rodning (2004), Ward and Davis (1999), and Wetmore (2002). Other data come from recent Cultural Resource Management (CRM) reports for projects in western North Carolina (e.g., Benyshek and Webb 2009a; Shumate and Kimball 2016; Shumate et. al 2005; Tippett et al. 2014).

The precontact history of western North Carolina can be divided into four basic time and cultural periods. These periods—Paleoindian, Archaic, Woodland, and Mississippian—relate to both social and technological factors. Several authors (e.g., Dickens 1976:10; Keel 1976:18; Ward and Davis 1999; Wetmore 2002) divide some or all of these periods into phases, some of which overlap in time and name, but vary in precise definition (Table 3.1).

Table 3.1. Generalized Cultural Chronology for Western North Carolina through 1838.

Period	Phase	Chronology
Postcontact Cherokee	Late Qualla	A.D. 1700–1838
Precontact to Contact-era	Middle Qualla	A.D. 1500–1700
Mississippian	Early Qualla	A.D. 1400–1500
	Late Pisgah*	A.D. 1200–1400
	Early Pisgah*	A.D. 1000–1200
Late Woodland	Undefined (Napier/Woodstock?)	A.D. 800–1000
	Undefined (Late Swift Creek/Cane Creek)	A.D. 600–800
Middle Woodland	Connestee	A.D. 200–600 ↑
	Pigeon	200 B.C. – A.D. 200
Early Woodland	Swannanoa	1000?–200 B.C.
Late Archaic	Otarre	1500–1000 B.C.
	Savannah River	3000–1500 B.C.
Middle Archaic	Guilford	4000–3000 B.C.
	Morrow Mountain	6000–4000 B.C.
	Stanly	6000–5500 B.C.
Early Archaic	LeCroy	7000–6000 B.C.
	Kirk/Palmer	7500–7000 B.C. ↑
	Big Sandy	8000–7500 B.C.
Paleoindian	Undefined (Hardaway-Dalton?)	9000–8000 B.C.
	Clovis	10,500–9000 B.C.
Pre-Paleoindian	Undifferentiated	Unknown

↑ represents overlap into a later period. *The Hiwassee and upper Little Tennessee valleys contain Early and Middle Mississippian ceramic types that are more closely related to the Woodstock, Etowah, and Savannah cultural sequence of northern Georgia (see Benyshek and Webb 2009a; Riggs and Kimball 1996).

Paleoindian Period (ca. 10,500–8000 B.C.)

The earliest, most broadly acknowledged human presence in the continental United States dates to approximately 12,500 B.P., during the Paleoindian period. The most well-known cultural manifestation of this early occupation is called Clovis, which is represented archaeologically by distinctive, fluted projectile points that have been found over a wide geographic area in the United States. There is also an increasing number of sites that indicate (if not conclusively demonstrate) a pre-Clovis occupation in the Americas, however; these include Meadowcroft Rockshelter, Pennsylvania (Adovasio et al. 1990, 1998); Saltville, Virginia (McDonald 2000; Weisner 1996); Cactus Hill, Virginia (McAvoy and McAvoy 1997); the Topper site in South Carolina (Goodyear and Steffy 2003); and the Sloth Hole and Page-Ladson sites in Jefferson County, Florida (Dunbar 2002, 2006; Hemmings 1999, 2004). Although none of these sites is without controversy, these and other sites (e.g., Monte Verde in Chile [Meltzer et al. 1997]) have forced archaeologists to revisit their models for how and when people first arrived in the Americas (e.g., Anderson and Gillam 2000).

Most archaeologists accept that the human occupation of North America began with a migration of people from Asia across the Bering land bridge, which would have been exposed from 20,000 B.P. to a time perhaps as late as 10,000 B.P. due to lower sea levels associated with the Last Glacial Maximum (LGM) (Anderson and Gillam 2000; Dixon 1999, 2001; Fladmark 1979; Hoffecker et al. 1993:48; Meltzer 1988, 2004; Smith 1986). Once in North America, the method and timing of migration south into the Americas remains an issue of debate. Some researchers have argued that an ice-free corridor allowed for movement into the interior of the continent sometime after 11,000 B.P. (e.g., Haynes 1966, 1969, 1971), while others have suggested that early settlers, once having occupied Beringia, followed a coastal route to colonize the Americas (e.g., Dixon 1999; Faught 2008; Fiedel 2000; Fladmark 1979).

Based on a study of Paleoindian settlement patterns, Anderson and Gillam (2000:43) have developed a comprehensive model concerning the colonization of the Western Hemisphere. The study analyzed paths at a continental scale to determine which routes would have afforded the least cost to traveling hunter-gatherers. Factors in the model included topographic relief, locations of ice sheets and pluvial lakes, and the location of known Paleoindian archaeological sites. The findings suggest that initial dispersal occurred in coastal and riverine settings and on plains and that founding populations probably spread and diversified rapidly. In terms of routes, the model implies that now-submerged portions of the continental shelf may have been important for early dispersal, whether by foot or by boat. In eastern North America, this is reflected in the distribution of sites along the Atlantic Coastal Plain and the paucity of sites in the Appalachian Mountains, which were a barrier to mobility.

Diagnostic Paleoindian artifacts include fluted and unfluted lanceolate projectile points (such as Clovis and Cumberland points); flake tools such as end scrapers, gravers, retouched blades, and burins are also found. Almost all of the Paleoindian materials found in the Southeast have come from surface contexts, and as a result few data are available concerning regional subsistence or social organization (Anderson 1990). Hunting of late Pleistocene megafauna is inferred based on evidence from other areas, although direct evidence for use of animals of any kind is rare in the Southeast. Most, if not all, Paleoindian populations probably relied extensively on other animal and plant foods as well (Meltzer and Smith 1986; Purrington 1983). Paleoindian populations were generally highly mobile, and settlements are thought to have included small temporary camps and less common base camps that were occupied by loosely organized bands. Paleoindians selected high-quality lithic materials for tools, and many sites are linked to important source areas.

Paleoindian projectile points are relatively rare in the North Carolina mountains, reflecting their scarcity in the Appalachians as a whole. The later Paleoindian phase appears to include Dalton (Goodyear 1982) and perhaps Hardaway (Ward 1983) points and related cultures, although both of these types of artifacts are very rare in the region as well (Purrington 1983).

Archaic Period (ca. 8000–1000 B.C.)

The Archaic period began with the onset of Holocene, post-glacial climatic conditions in the East, and has been subdivided into Early, Middle, and Late subperiods. Diagnostic projectile points are the primary criteria used to identify and date Archaic manifestations. As a whole, the Archaic may be seen as a relatively long and successful foraging adaptation, with subsistence based on hunting, fishing, and the collection of wild plant resources. The period is also marked by a general increase in the density and dispersal of archaeological remains, more regionally distinct tool forms, and the increased use of locally available lithic raw materials. Group size gradually increased during this period, culminating in relatively large populations by the end of the period. While Archaic groups no doubt used a variety of materials to fashion utilitarian and other items, lithic artifacts are all that remain on most sites in the Southeast due to the lack of preservation in acidic soils. Architectural evidence is rare, suggesting that most structures were not substantial constructions. A number of Archaic sites have now been the focus of intensive excavation in the North Carolina mountains (Benyshek and Webb i.p.; Bissett et al. 2009; Idol 2011b, 2015; Jorgenson et al. 2017; Purrington 1981; Shumate and Kimball 2006a, 2016), and several Archaic sites have been investigated in eastern Tennessee in the Tellico area (e.g. Chapman 1981) and in the North Carolina Piedmont (e.g., Claggett and Cable 1982; Coe 1964).

Early Archaic (ca. 8000–6000 B.C.). During the Early Archaic period, the mixed coniferous forests present in much of the Southeast were replaced by mixed hardwood communities dominated by oak, hemlock, beech, and maple (Claggett and Cable 1982:212), and a modern faunal assemblage was in place following the extinction of the Pleistocene megafauna. Diagnostic markers of the Early Archaic period in western North Carolina and eastern Tennessee include side notched Big Sandy projectile points and later Palmer-Kirk projectile points (ca. 8000–6800 B.C.). Palmer-Kirk projectile points are fairly common and widespread occurrences in the area but are sparse compared to Middle and Late Archaic types. Bifurcate-based points such as the St. Albans, LeCroy, and Kanawha types (ca. 6900–5800 B.C.) are also found in the area (Kimball 1985). Although these appear to occur more rarely in the mountains than Kirk forms (Kimball 1996; Stanyard 2003), a long-term survey of sites near Asheville (Henry 1992) documented more bifurcate-based points than Kirks, perhaps a reflection of the intensive survey coverage up a smaller tributary (Kimball 1996). Other tools that occur on Early Archaic sites include knives, adzes, end and side scrapers, drills, perforators, and expedient tools (Stanyard 2003).

Low regional population densities and a continued high degree of group mobility are inferred for this subperiod in the mountains, where most known sites are located in high upland areas, and over 90 percent of projectile points found are of non-local chert (Bass 1975); it is also possible, however, that site burial in the floodplains could be largely masking Early Archaic period use of these landforms (see Benyshek 2007a; Benyshek and Webb 2004; Kimball 1995). The nature of more general land use patterns and strategies for technological organization remain the subjects of discussion. To the west in Tennessee, Kimball (1996) has proposed an ongoing change from logistical (relatively more permanent base camps from which a variety of other satellite camps and specialized use sites were accessed) to residential (wholesale moving frequently within zones to map onto resources) mobility patterns during the later Early Archaic period, perhaps as a result of the first signs of warming climatic conditions. Kimball (1996:173) notes that settlement patterns (and thus perhaps foraging strategies) for bifurcate and Kirk groups were different, with more bifurcate sites found on T1 terraces and islands compared to Kirk sites, which are more dispersed on various landforms, suggesting a change in foraging strategy in the later Early Archaic.

Middle Archaic (ca. 6000–4000 B.C.). During the Middle Archaic, the cool, moist conditions of the early Holocene are generally considered to have given way to the warmer, drier climate of the Mid-Holocene Hypsithermal interval, although there is increasing evidence that the Mountains may have seen increased rainfall during this period (e.g., Leigh 2002; Leigh and Webb 2006). Extensive estuarine marshes and riverine swamps began to emerge in coastal regions as sea levels ceased their post-Pleistocene rise by 3000

B.C. The northern hardwoods vegetation matrix in those regions was replaced by an oak-hickory forest, which was in turn replaced by a southern hardwoods-pine forest characterized by the species occupying the region today (Claggett and Cable 1982:212–216; Delcourt and Delcourt 1983, 1985). Subsistence economies became increasingly diversified, as is particularly evident in the Mid-South and lower Midwest during the Shell Mound Archaic, where riverine settings were preferred for occupation (Sassaman 1996).

The Middle Archaic witnessed the first substantial occupation of the Smoky Mountains (Bass 1975:109). Site file data indicate a marked increase in site numbers from the Early to the Middle Archaic in the Carolinas and Georgia (Anderson 1996), and Morrow Mountain projectile points increase markedly in frequency when compared to earlier types in western North Carolina (Leftwich 1999). Three subperiods recognized in most of North Carolina are identified by the presence of Stanly (ca. 6000–5000 B.C.), Morrow Mountain (ca. 5000–4200 B.C.), and Guilford (ca. 4200–3500 B.C.) projectile points, following the classic Archaic sequence first identified by Coe (1964). Persistence in the manufacture of certain projectile point forms (including Morrow Mountain and Guilford types, and also several stemmed provisional types recognized from western North Carolina and eastern Tennessee), as suggested at sites in the North Carolina Piedmont to the east, and the recognition that point styles associated with the Middle Archaic and Late Archaic periods are more diverse in western North Carolina (and elsewhere) than initially suggested by Coe (1964), may introduce ambiguity in defining vertical sequences in some instances. Archaeologically, the transition from the Early Archaic to the Middle Archaic is characterized by the appearance of stemmed rather than notched projectile points and an increased incidence of groundstone tools. Reliance on locally available quartz and quartzite rather than higher quality non-local chert for stone tools increased in the Appalachian Summit and other areas, such as other parts of North Carolina, northern Georgia, and South Carolina. (A state-wide distribution study shows that over 77 percent of Middle Archaic projectile points from mountain counties are made of quartz [McReynolds 2005:23]). Atlatl weights make their first appearance in the archaeological record during the Middle Archaic, as do stone net sinkers. The use of a more expedient stone tool technology (see Binford 1977, 1979) predominated during the Middle Archaic (Stanyard 2003).

Based on studies in South Carolina, researchers (e.g., Blanton and Sassaman 1989; Sassaman 1983) have suggested that Morrow Mountain peoples were foragers who resided at a location until local resources were depleted. This idea is consistent with an archaeological pattern characterized by local raw material utilization, the wide distribution of sites in various landscape settings and their small size, the lack of evidence for long-term occupations, and the absence of discernible substantial trade networks (Stanyard 2003:48–49). Morrow Mountain sites are frequently encountered in the uplands of western North Carolina (e.g., Purrington 1981), on smaller drainages (Yu 2001), and in floodplains of major rivers, and are sometimes buried (e.g., Benyshek 2007a, Benyshek and Webb 2004). Bass (1975) found that half of the Middle Archaic sites he analyzed were in the uplands, with the others in valleys and coves.

Late Archaic (ca. 4000–1000 B.C.). Late Archaic sites are common in the study area, although few have been the primary focus of archaeological investigations; local Late Archaic components in the Tuckasegee Valley are of some special interest due to their proximity to Judaculla Rock, a carved soapstone boulder situated in the Caney Fork valley. The lower Southeast in general saw an increase in sites from the Middle to Late Archaic, and most researchers agree that a population increase is reflected in these data (Anderson 1996). During the Late Archaic period, sites occurred in a wide range of environmental zones, although most major settlements were in riverine or estuarine settings (Bass 1975; Ward 1983). The existence of formal base camps occupied seasonally or longer is inferred, together with a range of smaller resource-exploitation sites, such as hunting, fishing, or plant collecting stations (Claggett and Cable 1982; Ward 1983). In particular, many Late Archaic sites in the Smoky Mountains appear to be situated near quartzite sources (Bass 1975:77; Shumate and Kimball 2016). Grinding implements, polished stone tools, and carved soapstone bowls became fairly common, suggesting increased use of plant resources, and possibly changes in subsistence strategies and cooking technologies. Although regional evidence is minimal, the first experiments with horticulture probably occurred at this time, with the cultivation of plants such as squash (*Cucurbita pepo*), sunflower (*Helianthus* sp.), and *Chenopodium* (Cowan 1985; Ford 1981; Smith 1989).

Soapstone vessels, occurring in the form of bowls or crude, shallow pans (see Ferguson 1976) appear to have been most widely used in the eastern United States between 1800 to 1000 B.C. (associated dates extend as far back as ca. 4000 B.C. and extend to ca. A.D. 0) (Truncer 2004:505, 506). The scarcity of earlier dates and wide gaps in geographical distribution suggest that soapstone bowl manufacture occurred continuously at "low levels of production" or was used and discontinued in some areas (Truncer 2004:497). Although soapstone vessel use appears to have preceded ceramic vessel use in some areas, in the central Savannah River valley, South Carolina, and northeastern Florida, use of soapstone slabs and pottery precedes soapstone vessel use by up to 1000 years (Elliott et al. 1994; Sassaman 1997; Stanyard 2003:54). Soapstone vessels were apparently used for slowly cooking certain plant or animal foods over a direct heat source, although ethnographic data from California tribes suggests that such use was commonly reserved for bowl forms; other shallow, open containers were likely used only for a limited range of cooking functions (Sassaman 1993:185) and likely afforded no advantages over alternative methods of cooking.

Another innovation in Late Archaic cooking technology was the use of drilled or perforated soapstone slabs, presumably for use in stone boiling (Anderson et al. 1979; Dagenhardt 1972; Elliott 1981; Trinkley 1974; Wood et al. 1986). These artifacts are abundant at some Late Archaic sites in the Savannah River and Oconee valleys in the Georgia and South Carolina Piedmont to the Fall Zone (Claflin 1931:32); Elliott 1981; Wood et al. 1986), but are rarely encountered in North Carolina, where their distribution is unclear (Dan Elliott, personal communication 2012). In the former areas, these are most abundant near soapstone outcrops (Elliott 1981; Sassaman 1993:78). Single perforated slabs have been found in the Tuckasegee Valley (at site 31JK477 on the Western Carolina University campus [Bissett et al. 2009; Bissett and Garrow 2016], and at 31JK12 [Tippett et al. 2014:325], for example) and at 31JK553 in the Caney Fork valley (Idol 2015).

Late Archaic occupations in the Appalachian Summit region are marked by a variety of large to small stemmed points. The most prominent and recognizable of these is the Savannah River stemmed, a large, broad-bladed, square stemmed point that appeared ca. 3000 B.C. and lasted to ca. 1500 B.C. Subsequent Late Archaic sites frequently contain slightly smaller stemmed points of the Iddins Undifferentiated Stemmed or, perhaps, the Otarre stemmed type (Ward and Davis 1999:71), although these general forms were produced during the Middle Archaic and Early Woodland periods as well and may not be exclusive to the Late Archaic period (Larry Kimball, personal communication 2010). In fact, recent data from the Cold Canyon site in Swain County suggests that there is no lineal shift from larger to smaller stemmed projectile points during the Late Archaic (Jarman 2016:165). Size reduction of stemmed forms, on the average, is indicated over the course of the Late Archaic to Early Woodland periods in the region, however (Oliver 1981, 1985). The most common feature type during the Late Archaic is a shallow, rock-filled pit (Chapman 1981; Keel 1976). Toward the end of the Late Archaic, fiber tempered pottery appeared in the coastal regions (Sassaman 1993); although such pottery was found at Ravensford (Webb et al. 2005), it is a rare occurrence in the Appalachian Summit. There is increased evidence for trade during the Late Archaic period, as indicated by the presence of soapstone, slate, and other materials outside their source areas (Chapman 1985).

Woodland Period (ca. 1000 B.C.–A.D. 1000)

The Woodland period began as early as 1000 B.C. and continued until the appearance of the Mississippian adaptation, around A.D. 1000. Across the eastern Woodlands the period is marked by the appearance of widespread pottery use, a greatly increased role for horticulture in subsistence economies, and an elaboration of mortuary ceremonialism, including the appearance of burial mounds.

Early Woodland (ca. 1000–200 B.C.). Initial Woodland occupations are generally thought to reflect a largely unchanged continuation of Late Archaic lifeways coupled with the first widespread introduction of ceramics. The earliest Early Woodland manifestation in the project area is the Swannanoa phase, which dates to ca. 1000–200 B.C. Regional radiocarbon dates for Swannanoa materials include a corrected, uncalibrated date of 2130±40 B.P. (representing a 2-sigma range of 260–100 B.C.) (Benyshek and Webb 2006) and a corrected, uncalibrated date of 2435±25 B.P. (representing 2-sigma range of 535–435 B.C.) (Benyshek and Webb 2009a).

The hallmark of the Early Woodland is distinctive thick, crushed quartz or coarse sand tempered fabric impressed ceramics; cordmarked, plain, check stamped and simple stamped wares are also thought to occur late in the Early Woodland period (Keel 1976:260–266; Ward and Davis 1999:140–143; Wetmore 2002:254–257). Vessel forms consist of unrestricted conical pots and simple bowls. Eastern Tennessee's Watts Bar and northern Georgia's Kellogg phases are similar stylistically to Swannanoa materials, as are Vinette ceramics from as far away as eastern New York (Ward and Davis 1999:142).

Early Woodland projectile points consist of smaller stemmed point forms including Otarre/Gypsy and Swannanoa stemmed, the terminal expressions of the large stemmed point tradition associated with the Late Archaic. Large triangular varieties are first seen in this period, including Transylvania and Garden Creek types, which are morphologically equivalent to Badin and Yadkin Piedmont types (Keel 1976; Oliver 1985). Although Swannanoa site distributions have not been thoroughly documented, it is apparent that the settlement pattern included large floodplain sites along with numerous small upland extractive camps. Direct evidence is lacking at present, but it seems likely that the Early Woodland inhabitants of the region were engaged in at least some degree of horticulture (Ward and Davis 1999:145). Based on evidence at Phipps Bend in eastern Tennessee, deer, elk, and turkey were the animals primarily hunted in the Early Woodland (Lafferty 1981). To date, no well-defined Early Woodland structures have been identified in the region.

Middle Woodland (ca. 200 B.C.–A.D. 600). The Middle Woodland period in western North Carolina is divided into an earlier Pigeon phase (ca. 200 B.C.–A.D. 200) and a later Connestee phase (ca. A.D. 200–600), each associated with distinct ceramic styles. Because it has proven difficult to isolate Pigeon phase components for study, relatively little is known about the cultural developments that occurred during this period (Ward and Davis 1999:146); this may change with the discovery of an intensive Pigeon phase occupation during excavations at Magic Waters (31JK291) on the Qualla Boundary, however (Tasha Benyshek, personal communication 2018). Much more is known about the lifeways, architecture, and subsistence practices of the subsequent Connestee phase. The Connestee phase is characterized by mound construction and intensified long-distance trade, and it is apparent that some western North Carolina groups participated in the Hopewell exchange network (Chapman and Keel 1979; Keel 1976; Wetmore 2002:263), in which raw materials and finished artifacts were traded over vast areas of eastern North America (Brose and Greber 1979; Seeman 1979). Sites with Middle Woodland components that have been the focus of intensive investigations in the region include Garden Creek in Haywood County (Keel 1976), Biltmore Mound in Buncombe County (Kimball and Shumate 2003; Kimball et al. 2004), Ela in Swain County (Wetmore 1989), Harshaw Bottom in Cherokee County (Robinson 1989), Tuckasegee in Jackson County (Keel 1976; Tippett et al. 2014), the Tyler-Loughridge site in McDowell County (Robinson 1996), the Cherokee EMS site in Swain County (Benyshek 2007b), the Bent Creek site in Buncombe County (Shumate and Kimball 2006b), the Macon County Airport site (Benyshek and Webb 2009a), and the Icehouse Bottom site in Monroe County in eastern Tennessee (Chapman 1973; Cridlebaugh 1981).

Bass (1975:81) reports that while over half of the Middle Woodland sites in his sample occurred on the floodplain, such sites were also numerous above the valley in coves and on benches. Numerous large and small sites dating to this period have been found, suggesting periodic aggregation and dispersion or some kind of settlement dichotomy. By Connestee times, however, sites have been demonstrated to occur most often in the floodplains, and a higher percentage are present on the first rise above the river than in the preceding Pigeon or Swannanoa phases (Wetmore et al. 2000).

Horticulture is believed to have become increasingly important during this period, although mast resources remain the most visible dietary contributor. Possible late Middle Woodland cultigens in the region include maygrass, little barley, sumpweed, maize, squash, and perhaps *Chenopodium* (Benyshek 2007b; Chapman and Crites 1987; Crites 2004; Robinson 1989). Evidence for the use of animal resources is scarce from Middle Woodland sites in the area; an exception is Biltmore Mound, where preservation was excellent. Faunal information from the Connestee phase mound area may not be representative of overall diet and utilization due to the probable ceremonial activities including feasting that took place there, but no information is available from the associated village to date. The assemblage is dominated by terrestrial species (white-tailed deer, turkey, box turtle, raccoon, squirrel), with aquatic resources (fish, mussels) used much less frequently (Whyte 2004).

Diagnostic early Middle Woodland ceramics in western North Carolina include the Pigeon series, which Keel (1976:256–260) defines as including check stamped, simple stamped, plain, brushed, and complicated stamped varieties with crushed quartz temper. Vessel forms include conical jars, hemispherical bowls, and tetrapodal and shouldered jars with flaring/everted rims. Pigeon ceramics are relatively common in the region but are generally found in mixed contexts (Ward and Davis 1999:146), perhaps indicative of stable populations inhabiting the same areas for long periods of time.

Subsequent Middle Woodland ceramics consist of the Connestee series, which are generally thinner, sand tempered wares most often plain or decorated with simple stamped, cordmarked or brushed surfaces. Crushed quartz temper was added in small amounts. Fabric impressed and check stamped sherds are also included in the series. Plain necks are characteristic, with punctated shoulders rarely occurring (Keel 1976:247–255). Swift Creek ceramics are sometimes found as a minority ware on Middle Woodland sites in the area (Kimball and Shumate 2003; Robinson 1989; Ward 1977). Also found, but extremely rare, are Ohio Hopewellian ceramics (both non-local manufacture and locally made copies) and figurines (Keel 1976; Kimball and Shumate 2003). Lithic artifacts characteristic of the late Middle Woodland consist of large triangular and side notched projectile points (Garden Creek and Connestee triangular, Pigeon side notched), bar gorgets, and a prismatic blade and polyhedral core technology that was probably ultimately derived from the Hopewellian Midwest (Chapman and Keel 1979:157). Copper is also found on Middle Woodland sites in the area, but is rare (Benyshek 2007b, Chapman and Keel 1979; Seltzer and Jennings 1941).

Connestee phase populations engaged in mound building, evidenced by such substructure mounds as Garden Creek No. 2 and the Biltmore Mound, and interacted with Hopewellian populations in the Midwest and elsewhere (Keel 1976; Kimball and Shumate 2003; Ward and Davis 1999:151–153; Wright 2014). Connestee series sherds are present on some Hopewellian sites, and small numbers of Hopewellian ceramics and bladelets made of chalcedony from Flint Ridge in Ohio are present at the Garden Creek site, at the Biltmore Mound site, and at Icehouse Bottom (Chapman 1973; Chapman and Keel 1979; Kimball and Shumate 2003; Moore 1984). Marine shell was also traded (Kimball et al. 2004). It has been hypothesized that western North Carolina was one source of the mica that was traded and used widely across the east during this period. Recent investigations at the Garden Creek site have recorded two subrectangular enclosures similar to those found in Midwestern Adena and Hopewell contexts; these appear to result from earlier ritual use of the site, and further illustrate the extent of the ties developed between local and non-local populations (Wright 2014).

Architectural information has been limited, but at Garden Creek Mound No. 2, at the base of the premound layer, a square structure measuring approximately 6 m across was identified and was attributed to the Connestee occupation (Keel 1976:95, 99). At Ela, eight circular structures 7–8 m in diameter were identified as representative of Connestee phase constructions (Wetmore 1989, 2002). More recent excavations at the Macon County Airport site have also uncovered both circular and square to rectangular Connestee structures (Benyshek and Webb 2009a, 2009b).

Late Woodland (ca. A.D. 600–1000). The Late Woodland period in much of the Southeast saw the emergence of sedentary village life and intensive maize (*Zea mays*) horticulture and the development of complex tribal and chiefdom-level political structures. Certainly, by A.D. 1000, many interior Southeastern groups were producing substantial amounts of maize, which continued into the Mississippian period when wild food resources were supplemental to cultivated ones (Scarry 2003:88–89).

In the Appalachian Summit, the Late Woodland has been described as largely invisible, raising questions about its character there (Wetmore 2002). A similar lack of recognition of distinctive Late Woodland components has been described in northern Georgia (Rudolph 1991). Part of the problem may be the lack of specific diagnostic artifacts useful for unequivocally identifying sites of this period (i.e. plain sherds, small triangular projectile points), but it is also possible that the Appalachian Summit region was more lightly populated during this time and that small, dispersed sites were more typical (Rudolph 1991). Robinson et al. (1994, 1996) indicate that the Connestee phase lasted into the Late Woodland period based on work at several sites. One Late Woodland manifestation was identified by Keel and Egloff (1984) at the Cane Creek site in Mitchell County; the distinctive, largely plain-surfaced assemblage from that site is similar to Connestee wares, and an associated radiocarbon date from that site is 1340±90 B.P. (uncorrected). Similarly, an AMS date associated with sand tempered, plain ceramics from a Buncombe County site in an upland setting (31BN943) produced multiple 2-sigma ranges of Cal A.D. 690 to 900 and A.D. 920 to 950 (Idol 2010).

Scattered Napier and Late Swift Creek ceramics and sites (such as the Cullowhee Valley School site [31JK32] [Greene 1996:120–121; Moore 1992], Biltmore II [31BN175] [Hall and Baker 1993], Ravensford [31SW78/136] [Benyshek and Webb i.p.; Webb 2002; Wild 1994], Hominy Creek [31BN828] [Paré et al. 2007], Sneed [31JK466] [Benyshek 2008a], Boundary Tree [31SW494] [Idol 2011a], and 31BN976 [Idol 2018b]) also occur in the region and reflect influences from the south during this period. A radiocarbon date obtained from the Cullowhee Valley School site is similar to those obtained from the Sneed site, which are calibrated at the 2-sigma level to A.D. 660–860 (Benyshek 2008a) and to the one 2-sigma level date from Boundary Tree (A.D. 654 to 769) (Idol 2011a). Mid- to late 8th century dates obtained from 31SW136 in association with Napier and/or Late Swift Creek ceramics are similar to these (Benyshek and Webb i.p.; Wild 1994). More recently, two AMS radiocarbon dates associated with a mixed Swift Creek and Napier assemblage from 31BN976 produced dates of 1190±20 B.P. and 1220±20 B.P., which combined calibrate at the 2-sigma level to A.D. 716–883 (Idol 2018b). Rudolph (1991) suggests that increased regionalization of ceramic styles occurred during this period in northern Georgia and points out that site dispersal seems to be the trend compared to earlier Middle Woodland site aggregation, and this appears be the case for western North Carolina as well.

Mississippian Period (ca. A.D. 1000–1540)

The Mississippian period in the Southeast is marked by the increasing intensification of maize horticulture, the establishment of increasingly hierarchical social structures and settlement systems, and an increase in ceremonialism expressed architecturally in the construction of flat-topped substructure mounds. Increasing evidence exists that territorial boundaries between chiefdoms were closely maintained during the Mississippian period, although individual chiefdoms rose and fell in cyclical patterns. Studies of relations between native chiefdoms and Spanish expeditions suggest that some type of supra-chiefdom level organization was maintained through a system in which paramount chiefs traveled from fief to fief, displaying royal powers and prerogative and receiving gifts and tribute from subservient chiefdoms (Smith and Hally 1992).

The Pisgah phase (ca. A.D. 1000–1400) corresponds with the early centuries of the Mississippian period in at least parts of western North Carolina (Dickens 1976:13–14); sites with Etowah phase (ca. A.D. 1100–1300) components also are present in the Hiwassee River valley (Riggs and Kimball 1996) and in the upper Little Tennessee River valley (Benyshek and Webb 2009a). Sites with high percentages of Pisgah pottery are found primarily in the eastern and central part of the Appalachian Summit region, and range from small sites such as Brunk (Moore 1979, 1981) to nucleated villages with substructure mounds such as Garden Creek (Ward and Davis 1999:160–161). Pisgah pottery is also found in the western part of the summit region as well, and down into northern South Carolina, and into southwestern Virginia and northeastern Tennessee (Dickens 1976). Diagnostic Pisgah artifacts include small triangular projectile points and distinctive rectilinear complicated stamped vessels with collared, punctated rims. There is also increasing evidence of a distinctive earlier Pisgah subphase. Dickens (1976) suggests that finer-lined complicated stamping and lack of rim elaboration characterizes the earlier portion of the phase, and Moore (1981) documents such materials from the Brunk site. More recently, ceramics attributable to an early Pisgah subphase and associated structure evidence have been encountered at Ravensford (Benyshek and Webb 2017, i.p.) and other nearby sites (e.g., Benyshek 2016). Sherds from Early Pisgah contexts include the common rectilinear "ladder" stamped variety as well as those with surfaces resembling woven or "reed" impressions, unidentifiable "woven" surfaces that initially resembles off-set or irregular checking, those with partially smoothed rectilinear stamped surfaces as well as other partly smoothed (or burnished) plain surfaces (cf. Benyshek and Webb 2017, i.p.; Eastman 2017a, 2017b; Idol 2018a). Associated rim samples include a few "collared" rims, but are largely characterized by vessel lips that are thickened and decorated, usually with oblique notches or slash marks, and occasionally with a single deep groove on the surface of the lip (Benyshek and Webb 2017, i.p.; Idol 2018a:216). Similar sherds were also found at the Brunk site (Moore 1979, 1981) and may be masked within other Pisgah assemblages elsewhere.

Early Pisgah phase structure patterns encountered elsewhere are of flexed-pole construction and variously square or rectangular with rounded ends; such buildings have now been encountered at the Ravensford (Benyshek and Webb i.p.), Riverbend (Shumate et al. 2009), Ocona Valley (Benyshek 2008b), Old Elementary School (Benyshek 2016), Tuckasegee (Tippett et al. 2014), and Magic Waters (Tasha Benyshek, personal communication 2018) sites, while later Pisgah structures more closely approximate the typical Southern Appalachian Mississippian forms (Dickens 1976). Maize and other crops were important sources of food, but floral and faunal remains document the persistence of wild resources as major components of the diet (Ward and Davis 1999:171). Warren Wilson is the most extensively explored Pisgah village to date and work there over several field seasons documented at least seven palisade lines and 17 structures (Dickens 1976; Moore 2002; Ward 1986). Garden Creek Mound and Village also contains a Pisgah component, and the main mound (Mound No. 1) there was constructed during the Pisgah phase (Dickens 1976).The Qualla phase represents the final centuries of Native American autonomy in the region, and reflects the close association between the Cherokees and the Appalachian Summit region. Although elements of the material culture, belief systems, place names, and social structure of Mississippian society lingered in the region well into the 19th century (and in some cases to the present day), the Qualla phase is largely one of social change due to increasing Euro-American intrusion and settlement.

CONTACT ERA AND POST CONTACT CHEROKEE OCCUPATIONS

The first Euro-American intrusion into western North Carolina took place in 1540, when Hernando de Soto's expedition passed through the area. Several different reconstructions of de Soto's route have been proposed; in 1939 one scholar (Swanton 1985:201–202) suggested that he crossed Cherokee country by way of the Hiwassee River valley. A later reconstruction (Hudson et al. 1984) proposed that de Soto crossed the Blue Ridge farther to the north at Swannanoa Gap, and then continued along the French Broad River into Tennessee; more recently, Beck (1997) and Hudson (1997:193) have agreed that the expedition probably followed a more northerly route along the Toe River. The route through the Swannanoa Gap may have been taken by Juan Pardo, however, who was a Spanish explorer who traversed much of the same area in 1567–1568 (Beck 1997:167; Hudson 1990:27–46, 1997:193).

Whatever the precise routes of these explorers, it is clear that the ancestral Cherokees' first encounter with Europeans occurred in the mid-16th century. The introduction of European diseases to which the native populations had little resistance caused a major reduction in population levels and extensive changes in political organization. Elsewhere in the Southeast, the fragmentation and reformation of political groups resulted in a general decrease in social complexity and the total disappearance of some precontact societies (Smith 1987). Although the Cherokees underwent substantial disruption, they managed to retain control of their homeland.

The historically documented Cherokee occupation of western North Carolina is known archaeologically as the Qualla phase (ca. A.D. 1450–1838). Although early formulations of the phase (Dickens 1976) divided it into two segments (Early Qualla, ca. A.D. 1450–1650; and Late Qualla, ca. A.D. 1650–1838), more recent analysts (Riggs and Rodning 2002; Ward and Davis 1999) have suggested a tripartite division. Following this scheme, the early Qualla phase predates A.D. 1450, and thus was likely contemporaneous with at least the later part of the Pisgah occupations in the region. These authors suggest that Qualla represents an *in situ* development in the Upper Little Tennessee and Hiwassee basins and likely is not a direct derivative of the Pisgah phase. Early Qualla phase ceramics show affinities to the more southern Savannah and Wilbanks styles, and samples from Coweeta Creek and 31SW291 are characterized by grit tempered, primarily rectilinear complicated-stamped wares (Riggs and Rodning 2002:39). Pisgah-style collared and punctated rims are not an uncommon occurrence with these Early Qualla wares, however, and Early and Late Pisgah ceramics have been identified at Ravensford (Webb and Benyshek 2005). Domestic structure forms during the Early Qualla subphase are the same as Late Pisgah forms (Benyshek and Webb 2008).

Subsequent Middle Qualla phase (ca. A.D. 1500–1700) ceramics are characterized by jar forms with pronounced curvature and folded and pinched rims, and by the presence of carinated or cazuela bowls with incised designs. Curvilinear complicated stamping predominates, although rectilinear designs are also present (Rodning 2004). By the Late Qualla phase (post-A.D. 1700), some variations occurred; incised ceramics became much less common, while rectilinear stamped designs, and check stamping are more common in later, pre-Removal (pre-1838) assemblages. By the Late Qualla phase (post-A.D. 1700), certain incised vessel forms had become much less common, and rectilinear stamped designs more frequent. Check stamping also appears increasingly common in later assemblages (Riggs et al. 1997; Rodning 2008:32; Schroedl 1986:544; Smith et al. 1988:55–56). Rims with notched appliqué strips or fillets are also associated with this subphase.

The Qualla phase subsistence base was mixed and included cultivation of maize, beans, and other foods, as well as wild plant gathering, hunting, and fishing (Dickens 1976:14). The Late Qualla phase is marked by the increasing appearance of European goods at Cherokee sites. Although small triangular projectile points are found in Early and Middle Qualla phase assemblages, their manufacture (and that of most other stone tools) decreased rapidly with the increasing prevalence of European firearms after A.D. 1700 and widespread access to iron tools (Riggs 1999:52). During this time, Cherokee settlements became increasingly less nucleated, often appearing as a linear array of dispersed houses along streams, and agricultural fields were maintained closer to residential areas. European domesticated animals (especially pigs and chickens) and garden crops (notably sweet potatoes) were adopted by the mid-18th century. By this time and in the years after, traditional Cherokee life was increasingly disrupted by depopulation, demographic changes, and alterations to the traditional economies (e.g., Hatley 2000).

Structure forms varied throughout the Qualla phase. Early Qualla phase structures documented at Ravensford include winter-type structures, rounded squares of rigid post construction typically constructed in basins, with central support posts and wall trench entryways. These were accompanied by (but not closely paired with) square to rectangular houses of less regular construction, which lacked central support posts and entryway trenches (Benyshek and Webb 2008, 2009b). These domestic structures generally mimic the patterns documented at a number of late precontact sites in the southern Appalachians (e.g., Hally 1988, 1994, 2008; Moore 2002; Polhemus 1987; Rodning 2009a; Schroedl 1998; Sullivan 1987). A few "rounder" 15th century domestic structures were encountered at Coweeta Creek (Rodning 2009a:13). Larger, rectangular structures of more substantial construction appear to represent contemporary public buildings at Ravensford (Benyshek and Webb 2009b).

Middle Qualla phase architecture, known from Coweeta Creek and the MCA site among others, was also similar to late Mississippian (and Early Qualla phase) patterns. Domestic structures are square with rounded corners, and exhibit side or corner entrances and central hearths flanked by four central support posts (e.g., structures 3, 4, and 6 at Coweeta Creek [Benyshek and Webb 2009b; Rodning 2009a:11]). At MCA these were associated with rectangular summer houses and storage facilities (Benyshek and Webb 2009b). Smaller auxiliary buildings that likely functioned as storehouses are present by the late 17th and early 18th centuries (e.g., Benyshek and Webb 2009b; Idol 2015; Shumate et al. 2005). By the end of the Middle Qualla phase (if not somewhat prior), mounds associated with the cyclical demolishment and reconstruction of public townhouses were a prominent feature of many Cherokee villages and towns (Rodning 2002, 2009b). Contemporary domestic structures in part appear to have been modelled after the designs of the much larger townhouses (Rodning 2009b).

By the end of the 17th century into the 18th century, rectangular summer houses were closely paired with and often connected to winter houses, which were typically octagonal (e.g., Benyshek and Webb 2008; Cable et al. 1997; Marcoux 2010; Shumate et al. 2005; Webb and Benyshek 2008). The late 18th century witnessed a shift toward more European-style architecture (Dickens 1976:15); a final shift from traditional post-in-ground architecture to horizontal cribbed log cabin construction occurred in the 1790s (Riggs 1999:515).

During most of the 18th century, the Cherokees were concentrated in towns and villages throughout much of present-day western North Carolina, eastern Tennessee, and portions of Georgia and South Carolina. The towns in western North Carolina were known as the Middle Towns (along the Little Tennessee), the Out Towns (along the Tuckasegee and Oconaluftee drainages), and the Valley Towns (in the Valley River area to the southwest) (Duncan and Riggs 2003:17; Greene 1996; Smith 1979). The Overhill Towns lay to the west, across the mountains in Tennessee.

The 18th century brought the continuous arrival of Europeans and the resulting loss of Cherokee lands. By the mid-18th century, increased Euro-American settlement began to lead to hostility, and expeditions under Archibald Montgomery and James Grant burned many Cherokee towns in 1760 and 1761. Many Cherokees sided with the British during the American Revolution out of fear of colonial expansion and the loss of more territory. In 1776, after several Cherokee raids, General Griffith Rutherford led a force from Old Fort through present-day Buncombe, Haywood, Jackson, and Macon counties to counter the Cherokee threat. Like the de Soto and Pardo expeditions, the route Rutherford took is open to interpretation. It is believed that his army took a known Native American Indian trail through Swannanoa Gap, down the Swannanoa River, and then a short distance up the east bank of the French Broad River, before crossing at Warrior's Ford (Dickens 1967; Dykeman 1965:34). It is believed that the path then continued on to present-day Waynesville and then to the southwest to the Middle and Valley towns of the Cherokees.

With the signing of the Treaty of Hopewell in 1785, the Cherokees lost much of their lands east of the Blue Ridge (which includes the project area), leading to widespread Euro-American settlements east of Asheville (Mooney 1900:61–62). A subsequent treaty in 1791, the Treaty of Holston, resulted in additional cessions by the Cherokees in the west (Mooney 1900:68–77), and a treaty in 1798 ceded additional land south and southwest of Asheville within present-day Buncombe, Henderson, Transylvania, and Haywood counties (Royce 1884, 1899:660–661).

Most of the remaining Cherokee land claims in North Carolina were abolished with the signing of the Treaty of New Echota in 1835, which set in motion the forced removal of many of the remaining Cherokees to lands in present-day Oklahoma (Mooney 1900:123–133). The cruelty of this forced march, known as the Trail of Tears, has been well documented.

Despite the treaty and the Removal, an estimated 1,100 Cherokees remained in their former lands. Approximately 700 Cherokees living around Quallatown (near the confluence of the Oconaluftee River and Soco Creek, and outside the 1835 treaty area) were allowed to remain, including some of the citizen Cherokees who had been granted (and subsequently lost) reservations some years earlier (Finger 1984:29; Riggs 1988:19). Other Cherokee groups remained in the vicinity of Cheoah (along Buffalo Creek in present-day Graham County) (Duggan 1998), in the Valley River area (Greene 2009), and along Cartoogechaye Creek in Macon County (Alexis 1852; Riggs and Greene 2006). Other Cherokees managed to evade the Army, escaped during the Removal, or, like Junaluska, returned from the Arkansas territory soon afterward. These groups became the nucleus of the Eastern Band of Cherokee Indians (King 1979). After the death of Chief Yonagusta in 1839, they were increasingly assisted by William H. Thomas, a white merchant who was Yonagusta's adopted son. Thomas worked on the Cherokees' behalf for the next 40 years, acquiring land for both individual Cherokees and the tribe. Thomas eventually acquired some 73,000 acres for these communities, mostly within the present-day Qualla Boundary.

The mid-19th through 20th century social and political history of the Eastern Band of Cherokee Indians has been described in detail by Finger (1984, 1991), Hill (1997), Mooney (1900), and others, and is briefly recapped here. The Cherokees' rights to the lands bought by Thomas were confirmed by a federal court decision in 1874, providing some measure of security to the local population. In 1889, the Cherokees in North Carolina were officially incorporated under state law as the Eastern Band of Cherokee Indians (Finger 1984). Most Cherokees continued to practice a farming economy throughout the 19th century, although hunting, fishing, and gathering wild plant foods were also important subsistence activities. Logging became an important source of jobs for a time beginning in the late 1800s, although most logging jobs were gone by the early 1930s. Although the Cherokee population has increasingly become outwardly acculturated since the growth of the modern tourist industry beginning in the 1930s, it has preserved a distinct cultural and ethnic identity through the retention of the Cherokee language and aspects of both day-to-day and ceremonial life (Beard-Moose 2009; Finger 1991).

EURO-AMERICAN SETTLEMENT

Prior to the American Revolutionary War, the Blue Ridge Mountains formed the western terminus of European settlement in North Carolina. The first documented English foray into the French Broad drainage west of the Blue Ridge Escarpment occurred in 1674. This doomed expedition was led by James Needham and included indentured servant Gabriel Arthur and eight native guides. Financed by a wealthy Virginian, Abraham Woods, the expedition did not provide the profits expected by the financier, but it did begin the opening of the vast lands of the Cherokee, which were coveted by the Euro-American settlers for their natural resources and beauty (Alvord and Bidgood 1996; Dykeman 1965:27–41).

After the Revolutionary War, large numbers of settlers (mostly Scots-Irish but also English, Welsh, German, and French) moved into western North Carolina (Ager 1981:10; Blethen and Wood 1987:76; Sondley 1930:398). After 1783, Land Act legislation was approved that allowed land sales for western settlements. In addition, war veterans were rewarded with land grants in the west as compensation for time served.

In 1784 Samuel Davidson, his family, and a single slave became the first known colonial settlers west of the Blue Ridge Mountains, in what was to become Buncombe County. They settled a few miles west of the project area, along the Swannanoa River near Jones Mountain. After Samuel Davidson's death, his brother (Major William Davidson), sister (Rachel Alexander), their families and several friends followed in his footsteps and established a settlement a year later near the confluence of Bee Tree Creek and the Swannanoa River, approximately two to three miles northwest of the project area (Sondley 1930:397–398).

As the settlement at Swannanoa grew, western expansion into the mountains was rapid. By 1792, the County of Buncombe was created, including present-day Buncombe, Cherokee, Clay, Graham, Henderson, Jackson, Macon, Madison, Polk, Swain, Transylvania, and Yancey counties. Eventually, the Buncombe County Court was established between the Bee Tree Creek settlement and the Reems Creek Valley settlement; the court met on the property of Colonel William Davidson (a cousin of Major William Davidson), near the present-day entrance to the Biltmore Estate (Ager 1981:10–11; Sondley 1930:460). The joining of the two settlements was originally known as Morristown in 1792 (Blackmun 1977:162). In 1794, John Burton was granted 200 acres by the State of North Carolina next to William Davidson's property. Forty-two half-acre lots were laid off and sold on Burton's property along two newly formed roads now known as Broadway and Biltmore Avenue (Powell 1981:33). The town was incorporated in 1797 and renamed Asheville after Governor Samuel Ashe (Van Noppen and Van Noppen 1973:379).

Although, the communities along the Swannanoa River were the first establishments in Buncombe County, Asheville became the dominant city and county seat. By 1800, Asheville had a hatter, a tailor, a blacksmith, an inn, a gristmill, and several merchants (Powell 1981:33). A post office was established in 1800, and the Public Square (now known as Pack Square) was laid out in 1805 (Sondley 1930:648–649; Stroupe et al. 1996). A brick courthouse was built in the square between 1825 and 1833 (Sondley 1930:649). By the early 1800s Asheville was a stopping point for livestock, as herders moved cattle from Tennessee and Kentucky to market in Georgia and South Carolina along the Buncombe Turnpike (Powell 1981:34). The road ran from Greeneville, Tennessee, to Hot Springs and then along the French Broad into Asheville. From there, the road headed toward Old Fort and then on to Greenville, South Carolina. Most of the roadway was completed by 1827 and helped to contribute to the growth of the town (Blethen and Wood 1987:88). With a higher traffic flow through the region, Asheville experienced an economic and population boom (Powell 1981:34). In addition to drovers, the turnpike also brought in some of Asheville's first tourists. By 1860, the town had a population of 1,100, while 12,654 people resided in Buncombe County (Blackmun 1977:288; Powell 1981:38; Sondley 1930:827–828).

During the Civil War, a rifle factory was located in the town for a short time, but because of the fear of Union troops in nearby Tennessee it was later moved to Columbia, South Carolina. In April 1865, a small skirmish occurred near Reed Creek north of the town, on land that is now part of the University of North Carolina at Asheville campus (Sondley 1930:691–697; Powell 1981:36–37). Overall, little physical damage from the Civil War occurred in the town, but growth was interrupted and railroad construction was delayed.

In 1880, the railroad (Western North Carolina Railroad) was established to Asheville from Old Fort, connecting towns that had earlier been served by the Buncombe Turnpike. Just the year before, the first telegraph line was built and a public library opened (Bishir et al. 1999:56; Van Noppen and Van Noppen 1973:379). In 1882, the rail line was completed to the Tennessee state line and by 1886 the railroad connected Asheville to points in all directions (Bailey et al. 2000). With new and easier access, Asheville experienced a revival in growth. From a population of about 2,600 in 1880, it had swollen to over 10,000 in 1890. By 1920, nearly 28,500 people resided in the town (Sondley 1930:828). In addition to an increase in industries such as logging in Buncombe County, Asheville grew as a resort for leisure and health. In the years after 1880, several sanitariums were opened in the town, as many doctors recommended the healthy climate of Asheville and the surrounding area (Van Noppen and Van Noppen 1973:379). As tourism grew, many of the people who visited built second or vacation homes in the Asheville area or returned to invest in local industries. The Asheville Farm School was established in 1894 in the Swannanoa Valley; open to high school and later to college students, it was established as Warren Wilson College in 1966 (WWC 2018).

PREVIOUS ARCHAEOLOGICAL RESEARCH

Western North Carolina has been the subject of archaeological research for over a century, and most trends in the history of North American archaeology are reflected in the region. As early as the 1880s, workers from the Valentine Museum in Richmond investigated several mound sites in the region (Dickens 1976:7), and other early investigations were carried out by the Osbornes (Keel 1976; Steere 2013, 2015). The museum's work was primarily oriented toward recovering artifacts, although in some cases the resulting data have been useful in addressing present-day research questions (e.g., Dickens 1976:91). Also in the 1880s, researchers from the Smithsonian Institution's Bureau of Ethnology excavated sites in Buncombe and Henderson counties as part of their investigations into the origin of the "Mound Builders" (Thomas 1894). That research was instrumental in demonstrating that the mounds in western North Carolina and elsewhere had in fact been built by American Indians and were not the products of a mysterious, vanished race.

Early 20th century work in western North Carolina continued to focus on mound explorations. Capt. R.D. Wainwright examined several mounds in the region in 1913 (Steere et al. 2012), including the now-destroyed Cullowhee or Rogers mound (31JK2), and between 1915 and 1919 George Heye and associates excavated at the Garden Creek site in Haywood County and other nearby sites (Harrington 1922; Heye 1919; Heye et al. 1918). Although that work was designed to gather artifacts for Heye's Museum of the American Indian in New York, it did provide some data on the antiquity of the Cherokees in the region (Dickens 1976:7–8). Subsequent work in 1933 and 1934 by the Smithsonian Institution at the Peachtree Mound and Village in Cherokee County was also designed to investigate the relationship between the Cherokees and precontact cultures in the area (Setzler and Jennings 1941). Also in the 1930s, George MacPherson (1936a, 1936b) and Hiram Wilburn conducted surveys of numerous sites in Great Smoky Mountains National Park. Although many of their data were to be incorporated into later research (Bass 1975), at the time their work had little impact on the understanding of the region's prehistory.

PREVIOUSLY IDENTIFIED RESOURCES

Archaeological Sites. The archaeological site files and records at the NC HPO/OSA contain information on 29 previously recorded archaeological sites within a one-mile radius of the project APEs (Table 3.2). A number of sites have been recorded in the Swannanoa Valley on the Warren Wilson College and the surrounding area. Several of these were recorded as part of the University of North Carolina's Cherokee Archaeological Project from 1963–1971. A few others were recorded as part of compliance surveys for road or other improvements in Buncombe County. In addition to 31BN28, which was revisited as part of the current project, several of the sites (including 31BN28) were revisited during a flood risk management study on the Warren Wilson College campus (Buchner et al. 2016).

Many sites in the area are poorly known, have not been assessed, and are only referenced on site forms. A notable exception is the Warren Wilson site (31BN29), which was intensively excavated from 1966–1977 and between 1979–1985 (Ward and Davis 1999:159).

Table 3.2. Previously Recorded Sites within One Mile of the Project APE.

Site	Components	Recorder(s)	NRHP Status
31BN21	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN22	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN23	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN24	Precontact ceramic and lithic	Johnston/1940; Dickens/1966	Unassessed
31BN25	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN28	Middle Archaic, Middle Woodland, Mississippian	Egloff/1964; Buchner et al. 2016	Unassessed
31BN29	Late Archaic, Early Woodland, Middle Woodland, Mississippian	Johnston/1940; Egloff/1964; Dickens 1976; Keel 1976	Eligible
31BN30	Precontact ceramic and lithic	Johnston/1940	Unassessed
31BN31	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN35	Precontact ceramic and lithic	Johnston/1941; Egloff/1964	Unassessed
31BN125	Precontact ceramic and lithic	Egloff/1964	Unassessed
31BN135	Middle Woodland, Mississippian	Dickens/1966; Kimball 1995; Buchner et al. 2016	Unassessed
31BN136	Middle Archaic, Late Archaic	Dickens/1966	Unassessed
31BN138	Archaic, Woodland	Dickens/1968	Unassessed
31BN139	Archaic	Dickens/1968	Unassessed
31BN140	Archaic, Mississippian	Dickens and Dickens/1967	Unassessed
31BN141	Early Archaic, Middle Archaic, Late Archaic, precontact ceramic	Dickens et al./1970	Unassessed
31BN142	Mississippian	Loftfield and Keeler/1970	Unassessed
31BN145	Precontact ceramic and lithic	Egloff/1972; Kimball 1995; Buchner et al. 2016	Unassessed
31BN173	Middle Archaic, Late Archaic, Woodland, Mississippian	Jones and Smith/1983	Unassessed
31BN323	Late Archaic	Henry/1987	Unassessed
31BN491	Middle Woodland, Mississippian	Kimball 1995; Buchner et al. 2016	Unassessed
31BN492	Mississippian	Kimball 1995	Unassessed
31BN662	Early Woodland, Middle Woodland, Mississippian	Joy and O'Connell/1997; Brady and Lautzenheiser/1999	Not eligible
31BN663	20th century historic	Joy and O'Connell/1997	Not eligible
31BN684	Early Archaic, Mississippian; Historic	Hall 1999	Not eligible
31BN698	Precontact lithic	McColgan/2000	Unassessed
31BN1013	Middle Woodland, Mississippian?	Wilson/2015	Not eligible
31BN1014	20th century historic	Wilson/2015	Not eligible

/ indicates site form only

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4. RESEARCH GOALS AND METHODS

RESEARCH GOALS

The primary goals of the project were to investigate the potential for intact cultural deposits at 31BN28 within the project APE and evaluate its eligibility for the NRHP and to ensure that no intact cultural deposits were disturbed during construction activities in the vicinity of sites 31BN135 and 31BN145/491.

RESEARCH METHODS

Specific research methods were utilized for the background studies, field research, analysis, and reporting stages of the project. The methods used in each stage of research are outlined below.

Background Research

Background literature review was conducted to gather information on known cultural resources in and adjacent to the APE and included examination of the following materials:

- Archaeological site files and reports at the North Carolina Office of State Archaeology in Asheville and Raleigh;
- Historical maps, books, and other data available online, the North Carolina State Archives, and in TRC's collection; and
- Cemetery information available in published sources and online.

Field Methods

The archaeological work complied with all pertinent state and federal regulations, including the North Carolina Office of State Archaeology's (OSA) 2017 *Archaeological Investigation Standards and Guidelines*, as well as TRC's technical proposal. The investigation of 31BN28 was conducted by a team of up to five, consisting of the Field Director and up to four Archaeological Technicians. The archaeological monitoring was conducted by a single Field Director.

At 31BN28, the project boundaries were identified in the field using maps and a digital GIS shapefile provided by Anchor QEA of North Carolina, PLLC. Shovel tests were excavated within the boundaries of the stream easement (which was marked in the field using the provided boundary coordinates) and along both sides of the existing artificial drainage.

The subsurface survey included systematic shovel testing at 10-m (ca. 33 ft.) intervals except for areas of standing water. The shovel tests measured at least 30 cm in diameter and were excavated to sterile subsoil, hydric soils, or impenetrable fill (along and over the culvert at the head of the existing artificial drainage). Augering was accomplished at the bases of some shovel tests to assess deeper alluvial deposits. The depth, stratigraphy, and artifact content (when applicable) were recorded for each shovel test. Because the investigation occurred during a period of unusually severe cold conditions, it was necessary to remove the uppermost frozen portions of shovel tests and screen these after sufficient thawing.

Two 1 × 1 m test units were excavated at 31BN28 to gather additional data on stratigraphy and artifact distribution. The test units were excavated in 10-cm levels within natural strata, and detailed notes regarding soil texture, Munsell color (Munsell 2009), artifact recovery, and disturbance were recorded for each level on standard forms. At least one wall profile was photographed and drawn at the completion of the excavation. All soil was screened through ¼ inch mesh for uniform artifact recovery, and all of the excavations were backfilled and the area restored to the previous condition as far as possible. The locations of all shovel tests and test units were recorded with a GPS unit for mapping.

In addition to the shovel testing, that part of the plowed field within the APE was inspected for artifacts. Surface inspection was accomplished by pedestrian survey consisting of a general walkover of isolated exposed surfaces within the project area. Where accessible, the exposed bank of the channelized stream was also inspected for exposed artifacts or cultural features.

Information was recorded on the survey methods and environmental conditions. Representative photographs of the project area were taken with a digital camera to document the general topography and vegetation.

The monitoring included the observation of mechanized excavation, inspection of soils, as well as photodocumentation and mapping.

Laboratory Methods

All artifacts were returned to TRC's Asheville office for processing. Upon arrival in the laboratory, bag numbers were checked, and artifacts were washed and sorted for more detailed analysis.

Prehistoric Ceramic Analysis. Prehistoric ceramics were first sorted into fragments greater and less than 2 cm. Sherds larger than 2 cm were then analyzed according to exterior surface treatment, temper type, vessel portion, and rim form and decoration, and were placed into recognized ceramic types when possible. The specimens in each category were counted and weighed.

Exterior Surface Treatment Types. Most exterior surface treatments in the ceramic assemblage were unidentifiable but some could be categorized as complicated stamped, check stamped, simple stamped, and plain varieties. The hierarchical classification system for classifying stamped sherds developed by Riggs (Shumate et al. 2005) and Rodning (2004) was used for this analysis. This classification method is one that progresses toward greater specificity, from unidentified stamped, to unidentified linear stamped, to identifiable curvilinear or rectilinear complicated stamped patterns. Other categories utilized in the analysis include unidentified and eroded.

Ceramic Type. A few of the ceramic sherds have been assigned to regionally recognized types, including Connestee (plain), and Pigeon (UD, check or simple stamped), following type descriptions and characteristics provided by Dickens (1976) and Keel (1976), and others. Others are described as unidentified.

Temper. Temper types present in the assemblage include sand (sand), crushed quartz, and grit (any subangular mineral additive).

Lithic Artifact Analysis. Lithic artifacts were first sorted into debitage, flaked tool, and non-flaked stone categories. The following categories were utilized in the analysis.

Debitage. Debitage fragments are the byproduct of lithic tool manufacture. Count, weight, and raw material were recorded for debitage, and presence or absence of cortex was noted. Most of the debitage fragments examined are larger than ¼ inch due to the nature of the recovery technique.

Hafted Biface/Projectile Point. Projectile points/knives (PPKs) are defined as bifaces that possess finished hafting attributes and taper to a point at the distal end. Many of these forms are temporally sensitive and can provide chronological information. The points recovered during this project were analyzed according to typologies in use in the Appalachian Summit region of North Carolina. Attributes recorded for formal point types include raw material type, shoulder, stem, and base shape, and the following metric attributes: maximum length, base or shoulder width (for stemmed points), and maximum thickness. Stem length and (neck) width were measured for stemmed points.

Biface/Biface Fragment. This category includes complete and fragmentary specimens of bifacially worked artifacts that do not exhibit fully developed hafting elements. These are grouped by reduction stage category (i.e., early, middle, and late), based on relative thickness and degree of reduction, but these categories are somewhat arbitrary.

Scraper. This category includes unifacially or bifacially retouched flakes or blades that display steep and/or beveled edges on one or more lateral margins. This artifact class encompasses several types, including denticulated, end, side, spurred, and thumbnail. End scrapers display retouching on the distal end. Side scrapers exhibit edge modification along one or both lateral margins.

Fire-Cracked and Miscellaneous Cracked Rock. Fire-cracked rock (FCR) is often difficult to identify definitively because of the varied metamorphic rocks typically present in cultural contexts in the mountains, but is defined as any cobble that exhibits irregular, angular surfaces broken from apparent exposure to fire. Reddening is not a necessary criterion for classification as fire-cracked rock, although it is often associated depending on rock type.

Raw Material Identification. Lithic raw materials were identified based on macroscopic characteristics. Recognized categories in the project collection include chert, quartz, quartzite, and metasiltstone or rhyolite.

<u>Historic Artifact Analysis</u>. Historic artifacts were initially divided into principal categories based on composition (i.e., ceramic, glass, metal, etc.) and then classified according to published artifact descriptions.

Curation

All artifacts, field notes, photographs, and other project materials are temporarily stored at the TRC facility in Asheville. These materials have been packaged for curation according to the OSA’s *Archaeological Curation Standards and Guidelines* (OSA 2017). At the conclusion of this project, the artifacts and records from the project will be curated at the Office of State Archaeology Research Center (OSARC) in Raleigh.

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5. SITE 31BN28 TESTING

INTRODUCTION

Site 31BN28 is located on the north side of the Swannanoa River and occupies most of the extensive terrace west of Warren Wilson Road and south of Riceville Road (Figures 5.1 and 5.2; see Figure 1.1). This terrace is bisected by an unnamed, channelized stream that flows south to the Swannanoa River. The part of the terrace east of the stream is in pasture; the area west of the stream was plowed and had been recently planted in barley at the time of the study; and the area adjacent to the river is wooded (Figures 5.2–5.6). The APE also includes a pasture area near a barn where the stream has been channelized below the surface.

PREVIOUS INVESTIGATIONS

Site 31BN28 was recorded in 1940 by H.E. Johnston; according to the University of North Carolina's Research Laboratory of Archaeology's (RLA's) online database, 58 ceramic sherds, four projectile points, and 37 pieces of debitage (Accession No. 148p1–m3) were collected during that year. A new site form was filed in 1964 as part of the University of North Carolina's Cherokee Archaeological Project (Egloff 1964). The site was later revisited over a period from 1966–1968 during the ongoing excavations at the Warren Wilson site (31BN29). Artifacts collected from the plowed surface during that time included eight projectile points, a core, and 154 pieces of lithic debitage (Accession No. 2135a12–m14). The site was also visited in 1981 by Trawick Ward and Billy Oliver, who collected two projectile points, three bifaces, a worked flake, a soapstone sherd, a ceramic sherd, and 25 pieces of lithic debitage (Accession No. 2412a6–m11). No subsurface investigation was performed during any of these investigations, and none of the artifacts collected during those visits appears to have been subsequently examined.

Site 31BN28 was systematically shovel tested during a 2015 survey for a proposed flood control project, and part of the site was investigated using a gradiometer (Buchner et al. 2016). That investigation included excavation of 533 15-m interval shovel tests on the alluvial terraces north of the river. In total, 173 of these shovel tests generated artifacts, which defined a 127,319 m^2 site area (Figure 5.7).

Shovel tests produced 391 (356 lithic, 35 ceramic) precontact period and 41 Euro-American historic artifacts (Buchner et al. 2016:56). Lithic artifacts from that investigation include five projectile points (one Morrow Mountain stemmed, two Woodland small stemmed, one large triangular, and one Mississippian triangular), eight other bifaces, eight cores, 332 pieces of unmodified debitage, one piece of ground schist, and two soapstone fragments. Precontact period ceramic artifacts include nine assigned to the Connestee series (six plain, two simple stamped, one check stamped), four assigned to the Pisgah series (all plain), 20 small residual sherds, and two pieces of fired clay (Buchner et al. 2016:57 and Appendix B).

When compared to distribution and density maps of the 2015 investigation (cf. Buchner et al. 2016:52, 55, and 56), the current APE is situated within an area of relatively few positive shovel tests and associated low artifact densities (Figure 5.7). The small number of positive shovel tests that produced Connestee sherds during that investigation appear situated west of the present APE but defined no nearby ceramic artifact clusters. In addition to the subsurface artifacts, a rock outcrop with several cupules (apparently pecked and/or ground) is associated with 31BN28 (Buchner et al. 2016:57). Inspection of the stream bank confirmed that this is not situated within or near the current project APE.

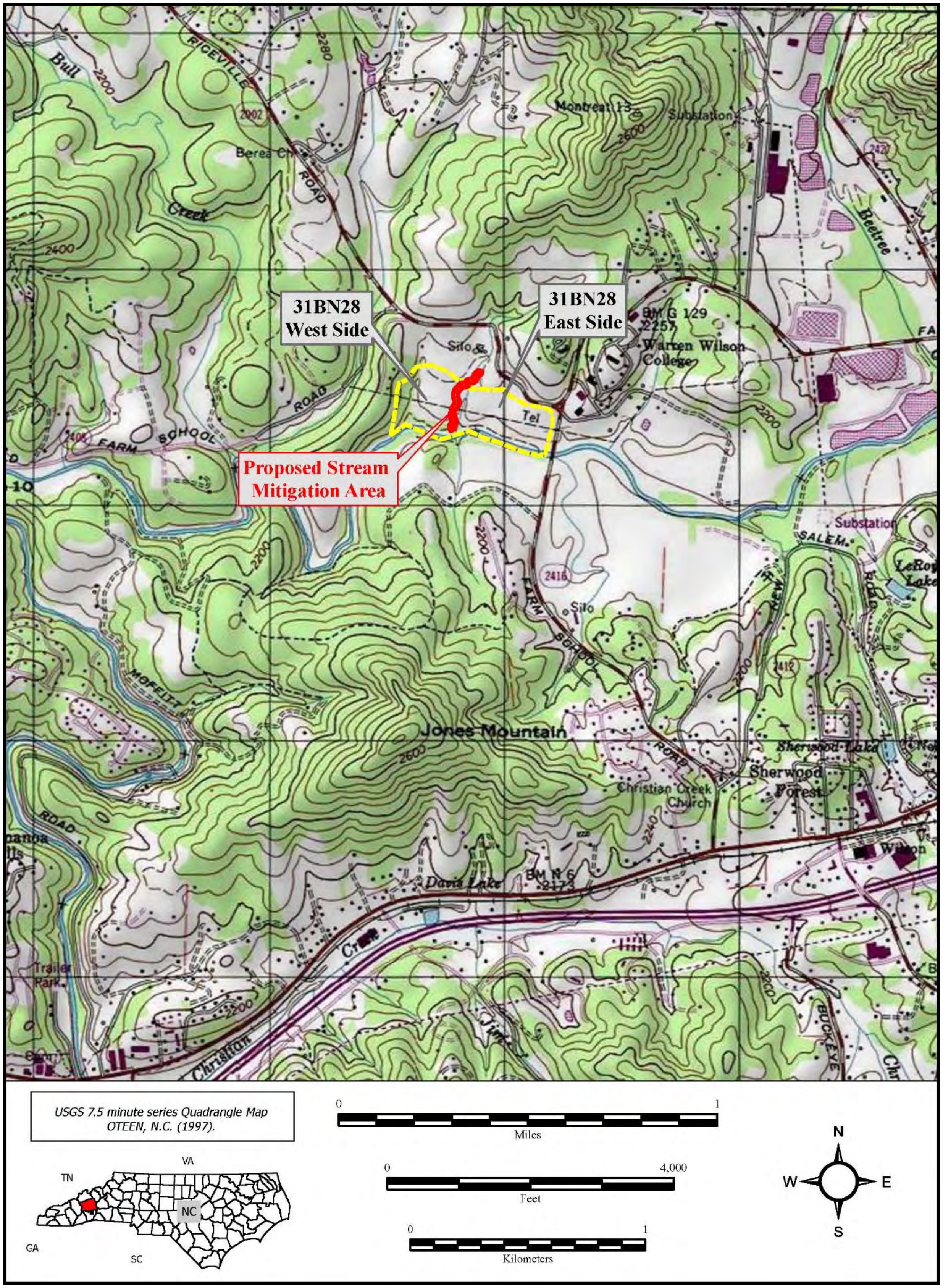

Figure 5.1. Location of 31BN28 and project area on the 1997 Oteen quadrangle map.

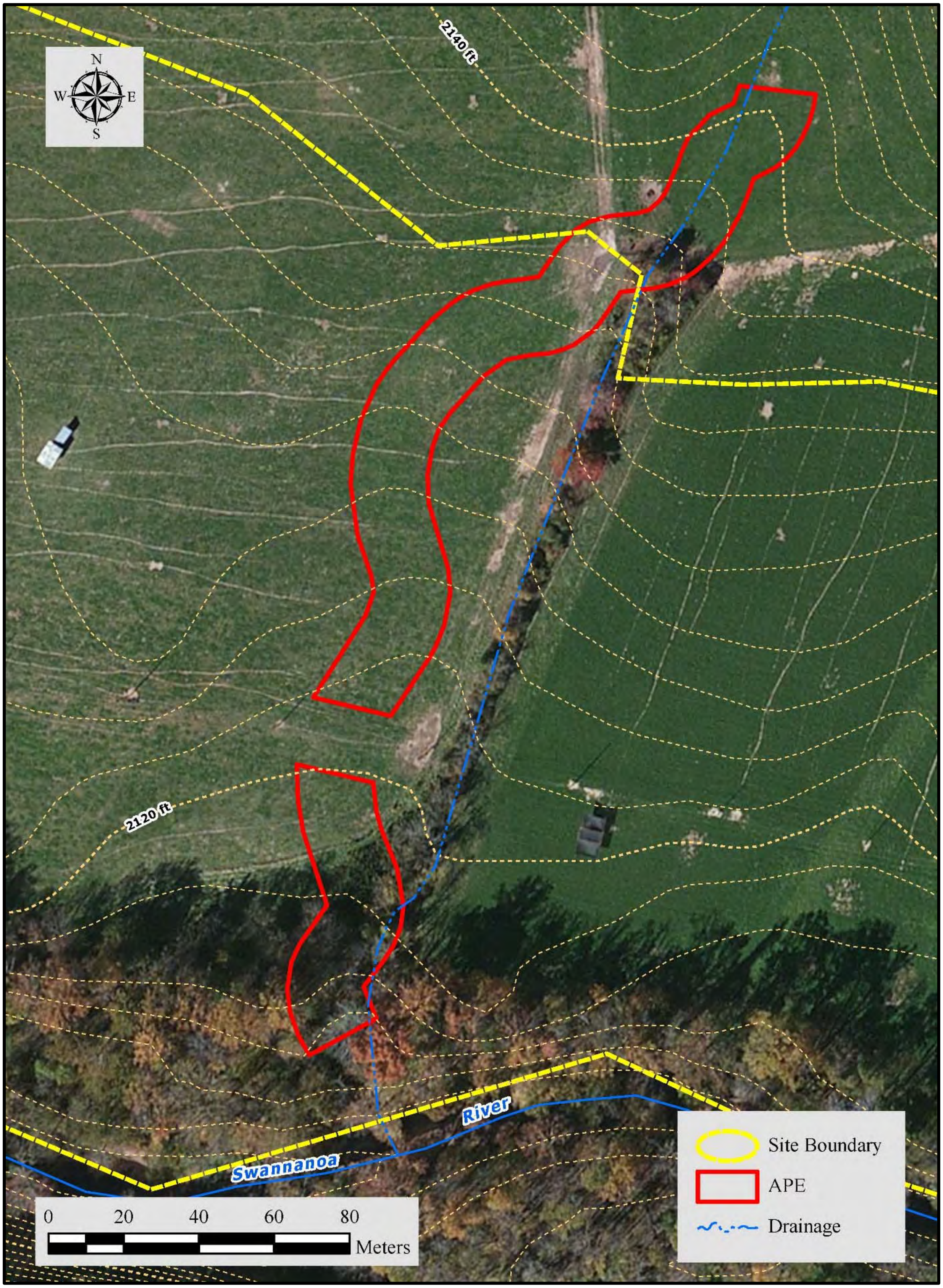

Figure 5.2. Aerial map of 31BN28 and project area.

Figure 5.3. View of site 31BN28, pasture area on the east side of the drainage, facing south.

Figure 5.4. View of site 31BN28, cultivated field on the west side of the drainage, facing north.

Figure 5.5. View of site 31BN28, pasture area at head of canalized drainage, facing south.

Figure 5.6. View of site 31BN28 wooded area near river, facing north

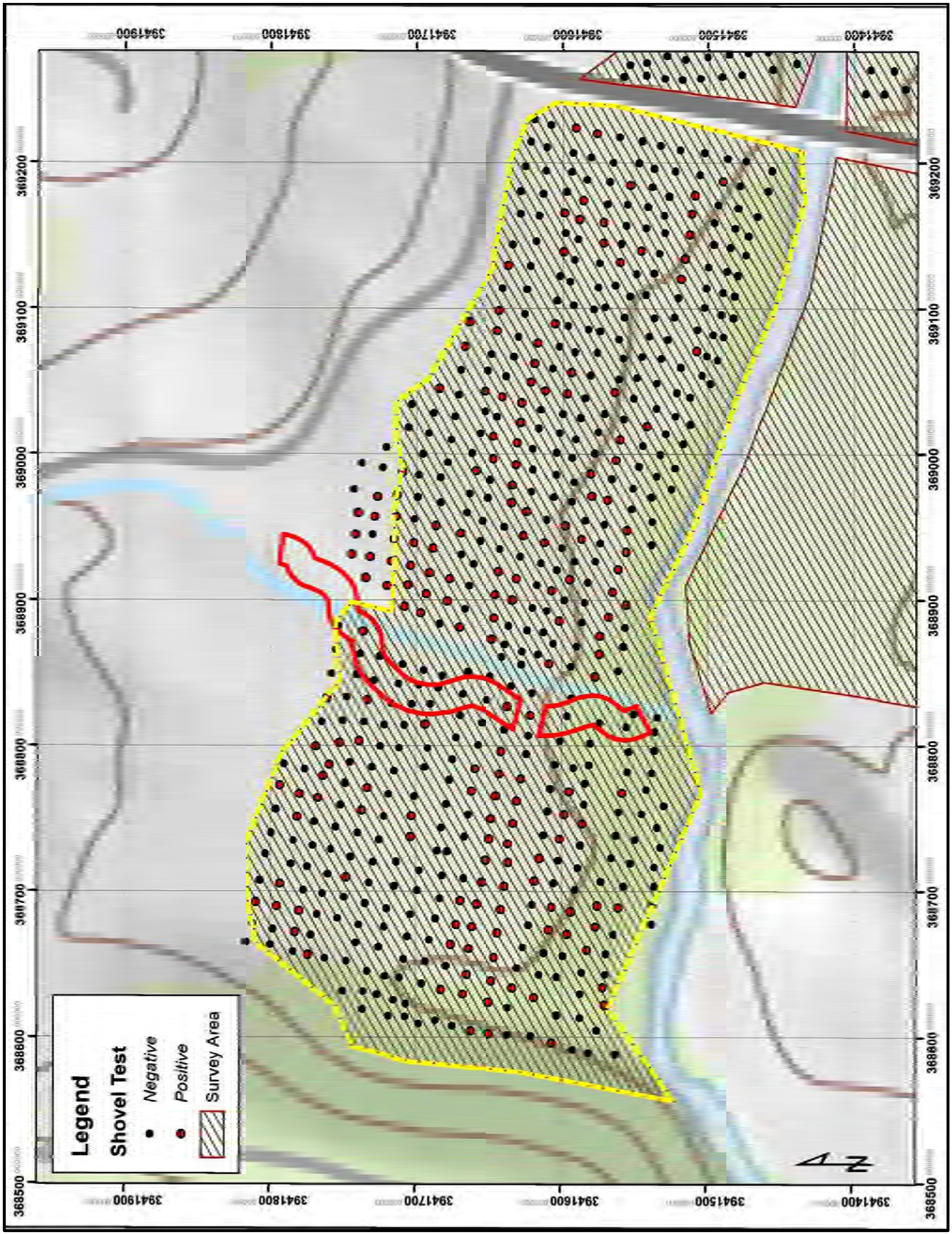

Figure 5.7. Site 31BN28 as shovel tested in 2015 (after Buchner et al. 2016).

Most of the precontact period artifacts recovered during the 2015 work came from the plowzone or the upper 50 cm (Buchner et al. 2016:50). Artifacts encountered at greater depths were dispersed broadly across the terrace (Buchner et al. 2016:50, 56), and these appear to be situated east and west of the present APE. Most of the 41 Euro-American artifacts from the 2015 investigation are attributable to 20th century to modern occupation or activities (flat glass, clear glass, wire nails, plain whiteware, terra cotta pipe fragments, and slag); a potential exception is a possible chert gunflint (Buchner et al. 2016:57, 130).

No structures are shown within or near 31BN28 on the 1921 soils map (Buchner et al. 2016:44; Perkins et al. 1923). In summary, the most recent investigation at 31BN28 prior to the investigation for this project documented an extensive, multi-component site that spans most of the floodplain terrace north of the river and west of Warren Wilson Road. That investigation generally encountered an extensive, low density artifact scatter. The associated artifact assemblage contains diagnostic artifacts minimally of Middle Archaic, Middle Woodland, Mississippian, and late 19th to 20th century Euro-American components. The NRHP status of site 31BN28 was not determined by the 2015 investigation (Buchner et al. 2016:58). The site measures approximately 160–260 m north-south by 600 m east-west and encompasses ca. 31.5 acres; the present APE consists of a ca. 2.87-acre area around the small, canalized drainage.

2018 INVESTIGATION

The assessment of 31BN28 included excavation of 123 shovel tests and two 1 × 1 m test units (TUs), as well as surface inspection in the plowed field west of the drainage within the easement (Figure 5.8). These excavations encountered stratigraphic sequences that varied according to terrace location on the east and west sides of the stream tributary, which are broadly consistent with the mapped soil types (see Chapter 2) (Hudson 2009; USDA NRCS 2013). Inspection of the river bank and river near the project APE found no potentially pecked or ground boulders as documented previously, and it is apparent from the description provided by Buchner et al. (2016) that these are situated at some distance from the present project area and will not be impacted by the associated construction.

Shovel Tests

The single shovel test transect along the treeline east of the stream included 25 tests, extending from the lower terrace (or T1) near the river onto the higher terrace and continuing to the end of the tree line bordering the stream (where the artificial culvert empties into the deeply incised, linear channel). The only shovel test (ST 1) situated on the lower terrace produced no artifacts and encountered dark yellowish brown (10YR 4/6) coarse sand to ca. 82 cmbs, which is interpreted as historic to modern alluvium. This overlay reddish brown (5YR 4/4) loamy sand to 134 cmbs, which was in turn underlain by yellowish brown (10YR 5/6) sandy loam interlayered with grayish brown (10YR 5/2) loam.

Excavations on the broad, higher terrace to the north encountered varied sequences east of the stream. Most shovel tests at the edge of the pasture there encountered a dark yellowish brown (10YR 3/4) sandy loam plowzone. The depth and definition of this varied; in some tests this appeared augmented by redeposited soils from the original channelization of the stream or blurred with buried A horizons associated with former microrelief adjacent to the stream (as discussed below).

Most shovel tests encountered a 30 to 46 cm plowzone overlying dark grayish brown (10YR 4/2) clay loam (flecked with oxidized manganese concretions and clearly related to hydric or semi-hydric conditions), brownish yellow (10YR 6/6 or 6/8) clay loam with gray (10YR 5/1) clay bands, or strong brown (7.5YR 4/6) clay loam (with gray bands in the lower part). Augering (in ST 18) indicates that the B horizon deposit extends uninterrupted to a depth of at least 190 cmbs.

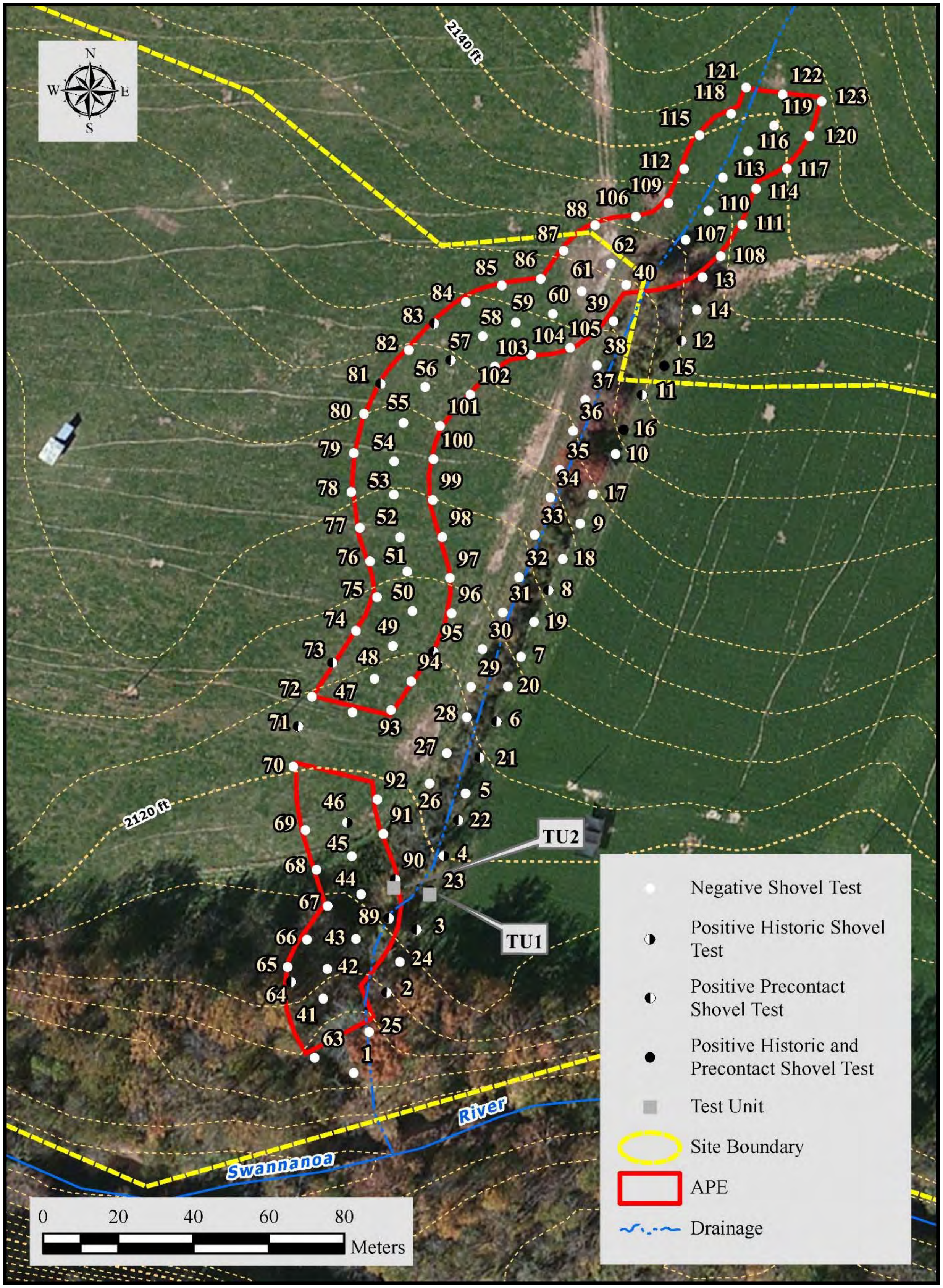

Figure 5.8. Aerial map of 31BN28 showing shovel tests and test units.

As noted above, a few tests (notably ST 23 and the adjacent test unit [TU 1]) situated east of the drainage (roughly encompassing the area from STs 3, 4, 22, and 23 on the terrace) encountered a much thicker A horizon (from 50 to 70 cm thick). In TU 1, the 59–66 cm thick upper layer (dark yellowish brown sandy loam) appeared to represent superimposed disturbed deposits resulting from the construction of the artificial drainage and continuous plowing. This overlay a loamier, slightly darker deposit that was up to 17 cm thick (but not continuous across the test unit) that appeared to have accumulated in a low-lying slump on the terrace (and does not appear to be part of any extensive buried A horizon on the terrace). Up to four non-diagnostic lithic artifacts (and no ceramic sherds) were found in this deposit, and artifacts were entirely absent in the underlying B horizon clay (see later TU 1 discussion).

Excavations west of the dividing stream included 15 shovel tests along the treeline bordering the stream, and 65 shovel tests within the construction easement situated in the plowed field and wooded area west of the stream. Eighteen additional shovel tests were excavated in the pasture located at the head of the exposed portion of the drainage. One shovel test (ST 64) positioned on the edge of the second terrace (in the wooded area adjacent to the river) (see Figure 5.8) encountered a 64 cm thick, dark brown (10YR 3/3) to dark yellowish brown (10YR 4/4) sandy loam A horizon overlying dark grayish brown (10YR 4/2) sandy clay loam that extended to 105 cmbs. Grayish brown (10YR 5/2) sandy clay loam was encountered in the associated auger test to 117 cmbs and was underlain by wet, gray (10YR 6/1) sand. Artifacts (ceramic sherds) were found in the upper 35 cm of that shovel test.

A few shovel tests (e.g., 44–46, 69–71, 92–94) located west of the drainage in the southeastern corner of the plowed field encountered standing water and/or hydric soils at or near the surface (shovel tests were not placed in areas of standing water). This part of the field is drained by a shallow ditch extending to the artificial drainage, and it is likely that this area remains wet for extended periods. Isolated seeps and sizeable areas of poorly drained soils are consistent with Iotla loam and Dillard loam, the two mapped soil types in this area (Hudson 2009:146, 245).

Most shovel tests in the plowed field west of the drainage encountered a 27 to 38 cm thick brown (10YR 4/3), dark brown (10YR 3/3), or dark yellowish brown (10YR 4/4) sandy loam to sandy clay loam plowzone overlying light brownish gray (10YR 6/2) clay loam, very dark gray (10YR 3/1) clay loam, brownish yellow (10YR 6/8) clay loam with gray (10YR 5/1) clay bands or mottles, or strong brown (7.5YR 4/6) clay loam with gray clay bands. ST 101 is typical of the shovel tests in that part of the field (Figure 5.9). Shovel tests in the plowed field were excavated to depths of 15 to 20 cm below the plowzone, and no artifacts were found below the plowzone there. Auger tests were excavated through the bases of some shovel tests. In ST 51 and ST 84, hydric soils were encountered from 43 to 130 cm. In ST 57, dark gray (10YR 4/1) clay was encountered from 42 to 63 cm and overlay light gray (10YR 7/1) clay from 78 to 87 cm where the water table was breached. There does not appear to be any potential for deep artifact burial in the plowed field.

All of the 18 shovel tests situated in the pasture at the head of the artificial drainage encountered strong brown, rock-filled clayey subsoil or similar impenetrable fill associated with the buried cement drainpipe. There is no potential for intact deposits within the APE in that area.

Precontact period artifacts were found in 20 of 105 shovel tests (excluding the 18 tests around the head of the artificial drainage), the two test units, and the surface of the plowed field (Table 5.1). Shovel tests produced 16 ceramic, 33 lithic, and eight Euro-American artifacts.

Figure 5.9. View of ST 101 north profile.

Table 5.1. Distribution of Artifacts from 31BN28.

Provenience	Ceramic	Proj. Pt.	Biface	Scraper	Debitage	FCR	Modern	Total
ST 2	1				2			3
ST 3					2			2
ST 4							1	1
ST 6					2			2
ST 8	1							1
ST 11					1			1
ST 12					1			1
ST 15					2		4	6
ST 16					2		1	3
ST 21	1				1			2
ST 22					2			2
ST 23	2	1			6		1	10
ST 46							1	1
ST 57					2			2
ST 64	5							5
ST 71					2			2
ST 73					1			1
ST 81					1			1
ST 83					2			2
ST 89	1				1			2
ST 90	4				2			6
ST 95	1							1
TU 1	19	4	1	1	33	2		60
TU 2	21			1	40		1	63
Surface					2			2
Total	**56**	**5**	**1**	**2**	**107**	**2**	**9**	**182**

Test Units

Two 1 × 1 m test units were excavated at 31BN28, including one in the pasture on the east side of the drainage (TU 1) and one (TU 2) inside the wooded area west of that stream (Table 5.2; see Figure 5.8).

TU 1 was a 1 × 1 m unit placed adjacent to the shovel test that produced the most artifacts east of the stream (ST 23) and to investigate the distribution of ceramic sherds encountered in that shovel test and in nearby ST 3 (Figures 5.10 and 5.11; see Figure 5.8; Table 5.2). Unit excavation was unable to define the base of the modern plowzone, which graded into similar underlying soils. The upper 30 cm of excavation encountered dark yellowish brown (10YR 4/4) sandy loam, which generated six ceramic sherds (eroded and untyped, but mainly referable to Middle Woodland types), an untyped triangular projectile point made of chert, a quartzite (large) biface or projectile point preform fragment, a unifacially utilized quartzite side scraper, and 12 pieces of unmodified debitage.

Figure 5.10. Test Unit 1, south profile.

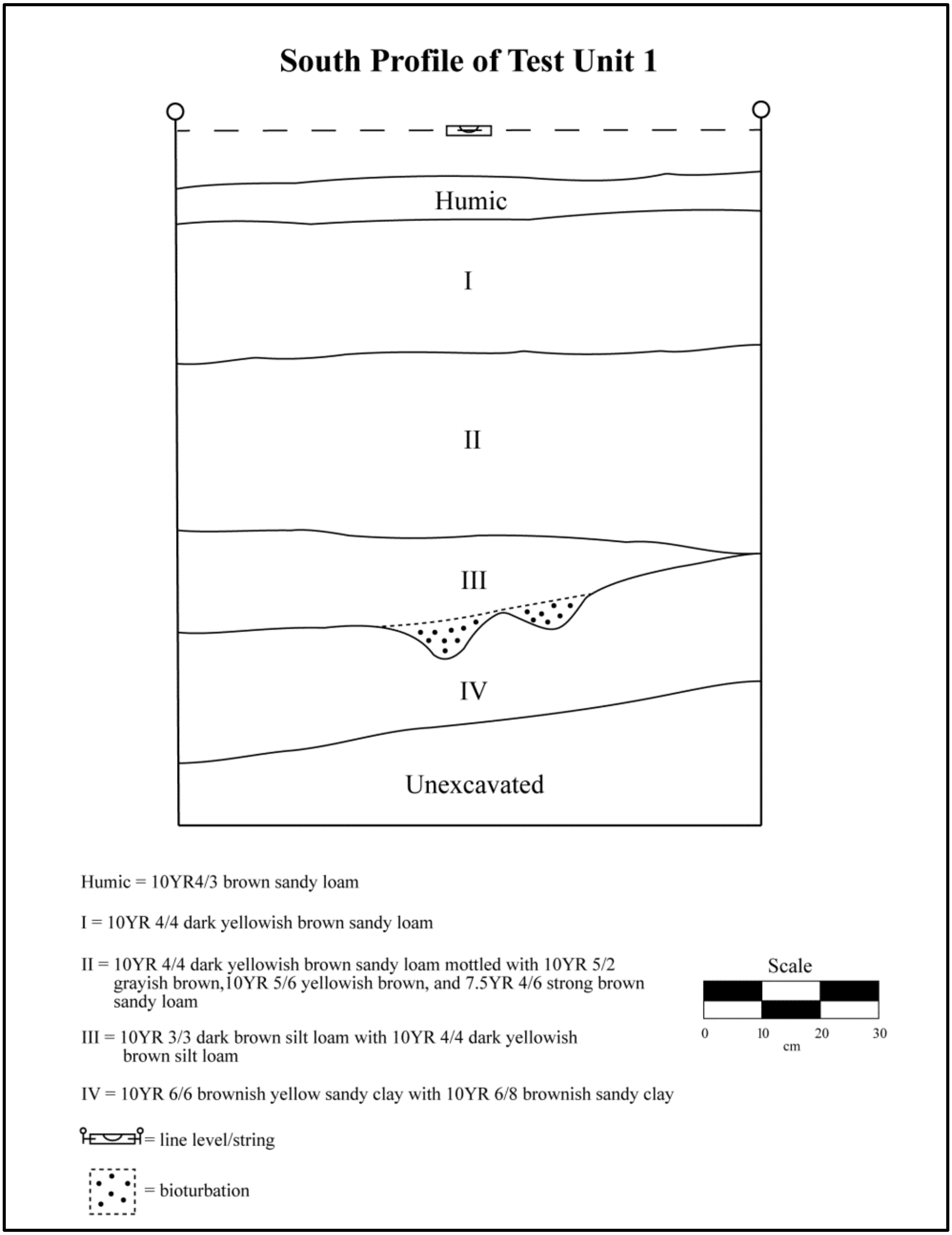

Figure 5.11. Test Unit 1, south profile drawing.

Table 5.2. Test Unit 1 at 31BN28.

Level	Thickness	Depth	Strat.	Horizon	Ceramic	Lithic	Comments
Level 1	30	0–30	I	Ap1	6	15	1 untyped triangular
Level 2	10	30–40	II	Ap2	5	11	1 Garden Creek triangular
Level 3	10	40–50	II	Ap2	1	6	1 M. Woodland triangular
Level 4	10	50–60	II	Ap2	7	5	1 Madison triangular
Level 5	4	60–64	II	Ap2		1	
Level 6	10	64–74	III	A?		3	
Level 7	5	74–79	III	A?			
Level 8	10	79–89	IV	B			
Level 9	10	89–99	IV	B			
Auger	91	99–190	IV	B			
Total					**19**	**41**	

Subsequent levels to a depth of 64 cmbs also encountered similar dark yellowish brown soils but were increasingly mixed with yellowish brown (10YR 5/6), strong brown (7.5YR 4/6), and grayish brown (10YR 5/2) soils of the same texture. This underlying stratum (Stratum II) is of unknown origin and is possibly related to the construction of the stream channel. (A small piece of clear glass was found in this stratum in the adjacent shovel test.) The associated ceramics are small and none is conclusively diagnostic, but mainly resemble Middle Woodland types. Lithic artifacts found in the second stratum include a mix of triangular projectile points referable to Middle Woodland and Late Woodland to Mississippian types.

On the east side of the test unit, an up to 17 cm thick deposit (Stratum III) of dark brown (10YR 3/3) silt loam mixed with dark yellowish brown (10YR 4/4) silt loam was encountered (it was absent on the west side of the unit, where the B horizon directly underlay the overlying stratum). Disturbance at the base of this deposit (which extended into the underlying B horizon) was attributed to bioturbation of unknown origin rather than mechanical disturbance. Three pieces of lithic debitage were recovered from the deposit in this part of the unit. The deposit appears to represent an isolated, low-lying area filled with fine backswamp-like sediment or is related to a former swale. No artifacts were found in the underlying B horizon, which was brownish yellow (10YR 6/6 to 10YR 6/8) sandy clay and similar to the B horizon encountered in areas east and west of the stream where hydric soils were encountered over 50 cmbs.

TU 2 was placed beside ST 90 to investigate the distribution of ceramic sherds there (Table 5.3; Figures 5.12 and 5.13; see Figure 5.8). Excavation encountered a 25 cm thick, dark brown (7.5YR 3/4) sandy loam plowzone that generated 14 precontact period artifacts, including four eroded sherds, 10 pieces of unmodified lithic debitage, and one piece of clear glass. The underlying B horizon graded from brown (7.5YR 4/3) sandy loam to a lighter brown (7.5YR 5/2) silt loam with depth; excavation was terminated due to the volume of groundwater entering from below. The B horizon levels produced five sherds (including one Pigeon UD stamped) and a quartzite end scraper (possibly fashioned from the base of a contracting stemmed projectile point), which given the wet soil conditions and excessive modern root contamination, appear intrusive to those depths.

Table 5.3. Test Unit 2 at 31BN28.

Level	Thickness	Depth	Strat.	Horizon	Lithic	Ceramic	Comments
Level 1	4–7	0–15	I	Ap	10	4	
Level 2	7	15–25	I	Ap	27	12	2 Connestee plain
Level 3	5	25–35	II	B	3	4	1 end scraper; 1 Pigeon stamped
Level 4	5	35–45	II	B		1	Residual sherd
Level 5	20	45–55	II/III	B	1		
Total					**41**	**21**	

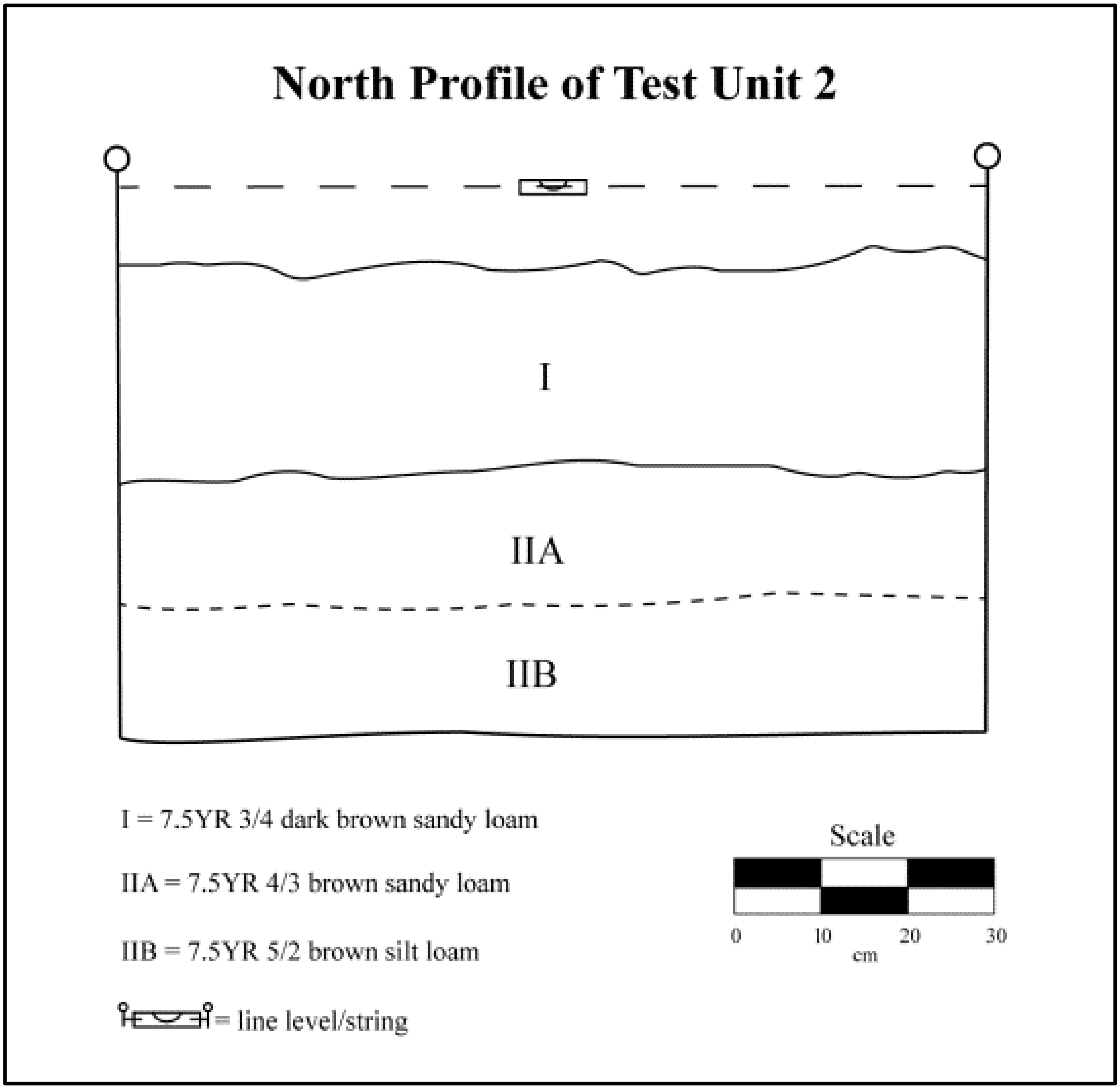

Figure 5.12. Test Unit 2, north profile drawing.

Figure 5.13. Test Unit 2, north profile.

Artifacts and Artifact Distributions

The work at 31BN28 produced a total of 182 artifacts, including 56 Middle Woodland and untyped ceramic sherds, 117 lithic artifacts, and nine historic period artifacts with 20th century to modern dates of manufacture (see Table 5.1). Precontact period artifacts were recovered from 11 of 25 shovel tests east of the drainage, nine of 80 shovel tests west of the drainage, the two TUs, and the surface west of the drainage. No artifacts were found in those shovel tests in the pasture at the head of the artificial drainage, which largely encountered impenetrable fill. With the exception of a small piece of clear glass found just below the modern plowzone, all 20th century to modern Euro-American historic period artifacts were recovered from the plowzone.

Most of the artifacts derive from the modern plowzone (Table 5.4). Much of the remainder derive from the thick deposit (lower plowzone) encountered east of the drainage in TU 1 and the surrounding shovel tests (STs 3 and 23). Four triangular projectile points (representing a variety of Woodland to potential Mississippian types) were found in all except the lowest level of that zone in TU 1, as were relatively small numbers of eroded ceramic sherds. Although artifact counts did not diminish with each level excavated below the modern plowzone, neither were there any dramatic increases in those counts, or any noticeable changes in artifact types or materials with depth. The underlying anomalous dark deposit produced no ceramic sherds and only three pieces of debitage, and the B horizon generated no artifacts. All of the artifacts found in the B horizon were from the hydric B horizon encountered in TU 2, west of the drainage. No other test generated artifacts from the B horizon, and there does not appear to be any potential for deep artifact burial anywhere within the project APE.

Table 5.4. Vertical Distribution of Artifacts from 31BN28.

Lithic	Surface	PZ	Lower PZ	A Horizon	B Horizon	Total
Madison Triangular PPK			1			1
Garden Creek Triangular PPK			1			1
Woodland Triangular PPK			1			1
UD Triangular PPK		1				1
UD Stemmed PPK			1			1
Biface		1				1
End Scraper					1	1
Side Scraper		1				1
Unmodified Debitage	2	77	22	3	3	107
FCR			2			2
Lithic Subtotal	*2*	*80*	*28*	*3*	*4*	*117*
Ceramic						
Connestee		2				2
Pigeon		1			1	2
Untyped other		18	7		2	27
Other (<2 cm)		15	8		2	25
Ceramic Subtotal		*36*	*15*		*5*	*56*
Modern		8	1			9
Total	**2**	**124**	**44**	**3**	**9**	**182**

The prehistoric ceramic artifact assemblage (*n*=56) includes artifacts from shovel tests (*n*=16) and the two test units (*n*=40). The assemblage contains no rim sherds. Thirty-one of the sherds (55.3%) are greater than 2 cm in size, but the sample is generally eroded and typologically ambiguous, and only four sherds were tentatively assigned to established Middle Woodland types (Table 5.5).

Table 5.5. Ceramic Artifacts from 31BN28.

Type/Variety (all body sherds)	Total
Connestee	
Plain	2
Pigeon	
UD stamped	2
Untyped	
Complicated stamped (fine grit)	1
UD stamped (rectilinear or check; burnished interior; grit or quartz)	1
UD stamped (cf. check; coarse grit)	1
UD (plain or smoothed; crushed quartz)	1
UD (crushed quartz)	6
UD (coarse grit)	6
UD (cf. Pisgah or Qualla; burnished interior; fine grit)	1
UD (cf. plain; fine grit)	2
UD (fine grit)	7
UD (sand)	1
Residual	*25*
Total	**56**

Two plain, relatively thin, sand tempered sherds are assigned to the Connestee series (Figures 5.14a and b) and were both found in the TU 2 plowzone. Pigeon series sherds were found in the plowzone (ST 2, east of the drainage) and the upper B horizon in TU 2 (west of the drainage) and are tempered with crushed quartz. Both are either simple stamped or check stamped and are thin and eroded (Figures 5.14c and d). The remaining 27 sherds larger than 2 cm are typologically ambiguous or unidentifiable, and mainly eroded, and may represent a mix of ceramics from Woodland and Mississippian occupations. The sample includes seven tempered primarily with crushed quartz, and most of these resemble eroded Pigeon series varieties (e.g., Figures 5.14e and f). Other sherds in the sample include an eroded complicated stamped sherd with fine grit temper (Figure 5.14g), an eroded fine grit tempered sherd with a burnished interior resembling the Pisgah or Qualla series (Figure 5.14h), and an unidentified stamped sherd tempered with coarse grit or crushed quartz with a burnished interior resembling the Pigeon or Pisgah series (Figure 5.14i).

Figure 5.14. Selected ceramic artifacts from 31BN28. a–b) Connestee plain, TU 2 Level 2 plowzone; c) Pigeon UD stamped, ST 2 plowzone; d) Pigeon UD stamped, TU 2 Level 3 B horizon; e) untyped UD crushed quartz tempered, ST 23 lower plowzone; f) untyped UD crushed quartz tempered, TU 1 Level 4 lower plowzone; g) untyped complicated stamped, ST 64 plowzone; h) UD eroded, ST 64 plowzone; i) UD stamped, ST 64 plowzone

The 31BN28 prehistoric lithic artifact assemblage (*n*=117) includes artifacts from shovel tests (*n*=33), the two test units (*n*=82), and from limited surface collection (*n*=2) (Table 5.6).

Table 5.6. Lithic Artifacts from 31BN28.

Chipped Stone	**Chert**	**Quartz**	**Quartzite**	**Other**	**Total**
Projectile Point					
Madison Triangular	1				1
Garden Creek Triangular	1				1
Woodland Triangular				1	1
UD Triangular	1				1
UD Stemmed	1				1
Biface			1		1
End Scraper			1		1
Side Scraper			1		1
Unmodified Debitage	62	9	33	3	107
Subtotal	*66*	*9*	*36*	*4*	*115*
Chipped Stone Percentage	*57.4*	*7.8*	*31.3*	*3.5*	*100*
FCR			2		2
Total	**66**	**9**	**38**	**4**	**117**

The assemblage includes 115 chipped stone artifacts and two cracked (possibly fire-cracked) cobbles. Five projectile points were recovered, including four from TU 1 and one from the adjacent shovel test (ST 23). These include four triangular points (three complete, one fragmentary) recovered from the upper four levels of TU 1 (Figures 5.15b–e). The first of these is a nearly equilateral chert specimen that is consistent with the Madison triangular type, generally associated with later Woodland to Mississippian occupations (Scully 1951) (Figure 5.15e). (This was the lowest projectile point recovered in TU 1.) A larger and fragmentary triangular point, also made of chert, resembles the Garden Creek triangular type, generally associated with regional Middle Woodland occupation (Figure 5.15d). A large triangular point with a rounded (eared?) base made of metasiltstone or metavolcanic material (rhyo-dacite) resembles a variety of Early to Middle Woodland period types (Figure 5.15b). A fourth such artifact found in the plowzone is a general triangular form made of chert (Figure 5.15c).

The stem of a small stemmed chert point was found in ST 23 in the lower plowzone (Figure 5.15a). It is typologically ambiguous and resembles a variety of projectile points that span the later part of the Archaic period.

The other chipped stone artifacts are more temporally ambiguous and include a biface (possible preform) fragment (Figure 5.15f), a quartzite end scraper from the hydric B horizon in TU 2 (Figure 5.15h), and a unifacial quartzite side scraper from the TU 1 plowzone (Figure 5.15g). The fragmentary biface is a medial fragment from a projectile point preform made of quartzite from the first level (modern plowzone) of TU 1. The end scraper from TU 2 appears to have been made on the base of a contracting stemmed projectile point such as the Morrow Mountain stemmed type.

The 107 unmodified debitage fragments include 62 chert, nine quartz (including one of crystal quartz), 33 quartzite, and three metasiltstone or metavolcanic material specimens. None of the chert debitage is over 3 cm in size, and only five retain any cortex. The assemblage also includes two cracked (possibly fire-cracked) cobbles from upper (presumably disturbed) levels of TU 1.

Euro-American historic artifacts were recovered from five shovel tests (*n*=8) and from one of the two test units (*n*=1). These artifacts include six pieces of glass (five clear glass, mainly representing containers, one piece of light green bottle glass) and two complete and one fragmentary 3-inch wire nails. These artifacts are all attributable to 20th century manufacture.

Figure 5.15. Projectile points and other chipped stone artifacts from 31BN28. a) UD projectile point stem, ST 23, lower plowzone; b) Woodland triangular projectile point, TU 1 Level 3, lower plowzone; c) UD triangular projectile point, TU 1 Level 1, plowzone; d) Garden Creek triangular projectile point, TU 1 Level 2, lower plowzone; e) Madison triangular projectile point, TU 1 Level 4, lower plowzone; f) large biface/preform medial fragment, TU 1 Level 1, plowzone; g) side scraper, TU 1 Level 1 plowzone; h) end scraper, TU 2 Level 3, B horizon

Summary

Site 31BN28 is an extensive site with identified Middle and Late Archaic, Middle Woodland, Mississippian (Pisgah phase), and 20th century Euro-American components. The present investigation was limited to that part of 31BN28 within a linear construction easement that borders a small, canalized drainage, including areas on both sides of that stream that will be affected by tree removal.

Within the project APE, the site is represented by relatively small numbers of lithic and ceramic artifacts, including artifacts diagnostic of Middle Woodland (Pigeon and Connestee phase) and potential Middle Archaic, Late Archaic, and Mississippian period (Pisgah phase) components. Most of these were found in relatively shallow plowzone contexts. The origin of the artifacts found in similar underlying soils east of the stream in and around TU 1 (including a few triangular projectile points referable to a variety of types and time periods and ceramics of potential Middle Woodland manufacture) is not completely clear due to the ambiguous nature of that particular deposit, which is either disturbed (and possibly related to the original construction of the stream channel) or is (in part) a naturally filled swale or slough area that has incorporated a few artifacts present across the terrace. The associated ceramic sherds are all relatively small and similarly eroded.

The thin, dark A horizon present below that in part of the unit appears to represent a former swale environment and the few associated artifacts (small lithic flakes) appear attributable to bioturbation moving artifacts downward. No artifacts were found in underlying B horizon contexts east of the stream. Most artifacts found west of the stream were found in the plowzone. A few lithic and ceramic artifacts were found in the hydric B horizon in TU 2, and these appear intrusive due to bioturbation (including abundant modern tree roots). Most of the soil sequences encountered suggest a less than favorable environment for habitation. There are no deeply buried deposits or evidence for cultural stratification, and local soil conditions, along with low artifact density, suggest that Middle Woodland or other features are unlikely to be present.

These investigations are not enough to characterize the site in its entirety, and it is very likely that meaningful artifact distributions and cultural features (particularly those associated with Middle Woodland to Mississippian period occupations) are present on the broad terrace outside the area of project impacts. Further assessment would be necessary to define the prehistoric occupation of the site in those locations, and overall the site remains unassessed for NRHP eligibility. The present results suggest that construction will not impact any intact or significant deposits, however, and we recommend that the construction be allowed to proceed as presently designed. If design plans change, additional archaeological assessment may be necessary. A management summary with recommendations was submitted to NC HPO/OSA for review at the conclusion of the 2018 testing fieldwork (Benyshek and Idol 2018). The NC HPO/OSA concurred with the recommendations in a comment letter dated March 27, 2018 (NC HPO 2018).

6. SITES 31BN135 AND 31BN145/491 MONITORING

INTRODUCTION

This chapter provides information on the results of the archaeological monitoring of construction in the vicinities of sites 31BN135 and 31BN145/491. Construction within three stream relocation project areas (UT-1, UT-6, and UT-7) located east of Warren Wilson Road was monitored (Figure 6.1). All of these were situated in agricultural fields southeast of the main campus on the north and south sides of the Swannanoa River. The project included the modification of existing stream beds and/or creation of new stream channels (including constructing artificial pools and riffles) in former near-channel locations where these were indicated by historic maps (Figures 6.2 and 6.3). No intact cultural deposits or non-modern artifacts were encountered in any of the stream easements, and construction did not affect any deposits or materials associated with sites 31BN135 or 31BN145/491.

PREVIOUS INVESTIGATIONS

Sites 31BN135 and 31BN145 were initially recorded as part of the University of North Carolina's Cherokee Archaeological Project. Site 31BN135 is situated west of the UT-6 easement and south of the UT-7 easement. The site was recorded in 1966; heavily overgrown at that time, it was not possible to define the extent or density of the surface remains (Dickens 1966). Ceramic sherds, worked blades, a carved piece of soapstone, and a hammerstone were collected according to the site form. The site was revisited in 1991 as part of a buried site survey (Kimball 1995:64–65). That investigation included the mechanical excavation of five trenches, and one of these encountered a buried A horizon that produced a few Pisgah series ceramics (Kimball 1995:64).

Site 31BN135 was systematically shovel tested during the survey for a proposed flood control project in 2015 and was subjected to a gradiometer survey (Buchner et al. 2016). Of the 37 15-m interval shovel tests excavated on the alluvial terraces south of the river, 20 generated artifacts, which defined a site area of 8,818 m^2. Shovel tests produced 32 precontact period artifacts (20 ceramic and 12 lithic) and four Euro-American historic artifacts. Two lithic artifacts were collected from the surface (Buchner et al. 2016:58–59). Lithic artifacts from the 2015 study include three bifaces and 11 pieces of unmodified debitage. Precontact period ceramic artifacts include one Pisgah series sherd, two Connestee series sherds, six Pigeon series sherds, and 11 small residual sherds (Buchner et al. 2016:59). The historic assemblage includes one plain whiteware sherd, a wire nail, a piece of slag, and a bone fragment.

The precontact period artifacts derived from the plowzone or the underlying Ab horizon (Buchner et al. 2016:58). In summary, the most recent investigation at 31BN135 documented a multi-component site characterized by low overall artifact density. The associated artifact assemblage contains diagnostic artifacts of Middle Woodland (Pigeon and Connestee phases) and Mississippian (Pisgah phase) occupations, as well as later materials likely related to late 19th to 20th century Euro-American activities. The NRHP status of site 31BN135 was not determined by the 2015 investigation (Buchner et al. 2016:64).

Site 31BN145 was recorded in 1972 based on a collection by G. Baker that included ceramic sherds, projectile points, and debitage (Egloff 1972). The site form states that the location of the concentration of associated materials was not known. Site 31BN145 was also revisited in 1991 as part of a buried site survey (Kimball 1995). One trench located in that area produced no artifacts or buried cultural deposits (Kimball 1995:56). Site 31BN491 was identified during the buried site survey on a slightly higher terrace setting and was separated from 31BN145 by an intermittent stream (Kimball 1995:45). Three of the four trenches excavated at 31BN491 encountered buried A horizons; one encountered a rock-filled basin and one revealed a stratified Mississippian and Middle Woodland sequence (Kimball 1995:45–54).

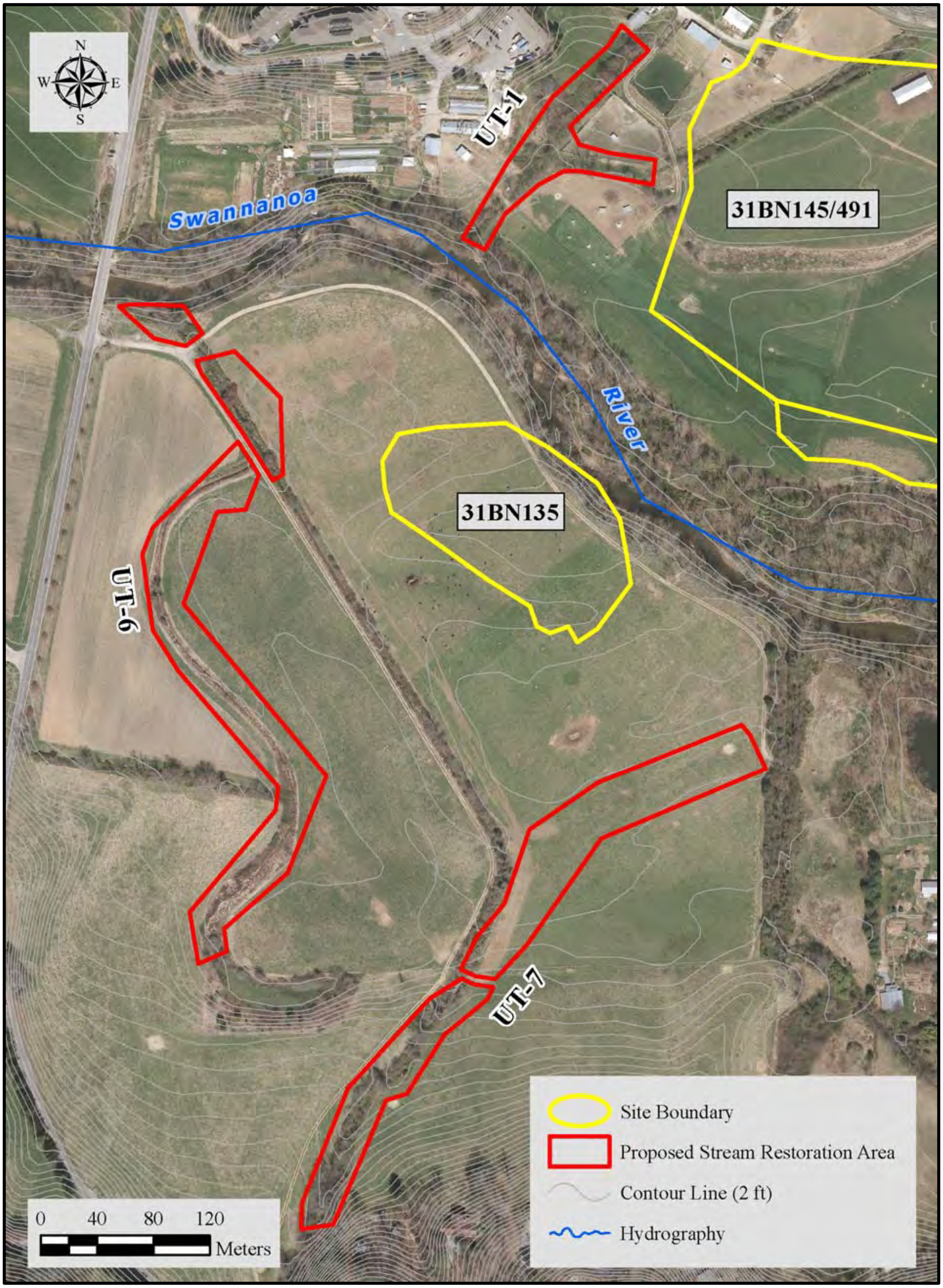

Figure 6.1. Location of UT-1, UT-6, and UT-7 on the Warren Wilson Campus.

The site was systematically shovel tested during the 2015 investigation, which found no separation between sites 31BN145 and 31BN491 as they were defined (the intervening stream no longer existed by the time of that investigation) (Buchner et al. 2016:71). Of the 285 15-m interval shovel tests excavated across the site, 171 generated artifacts, which defined a site area of 70,917 m^2. (Shovel testing was terminated near the mapped boundary of 31BN29–the Warren Wilson site [Buchner et al. 2016:71].) Shovel tests produced 471 precontact period artifacts (284 ceramic and 187 lithic) and 272 Euro-American historic artifacts. Three historic and two lithic artifacts were collected from the surface (Buchner et al. 2016:72, 75). Precontact period ceramic artifacts include 84 Pisgah series sherds, 44 Connestee series sherds, 26 Pigeon series sherds, seven untyped sherds, and 122 small residual sherds (Buchner et al. 2016:75). Lithic artifacts recovered during that investigation include two small triangular projectile points, three bifaces, two cores, 180 pieces of unmodified debitage, and two other items (Buchner et al. 2016:76). Most of the historic artifacts were found in one shovel test and appear associated with a demolished Asheville Farm School or Warren Wilson Junior College structure (Buchner et al. 2016:76).

Over half of the assemblage was recovered from subplowzone contexts, including buried A horizons (Buchner et al. 2016:72). In summary, the most recent investigation at 31BN145/491 documented a multi-component site characterized by high artifact density, buried A horizons, and at least one apparent feature. The combined artifact assemblage contains diagnostic artifacts associated with Middle Woodland (Pigeon and Connestee phases) and Mississippian (Pisgah phase) occupations. The NRHP status of site 31BN135 was not determined (Buchner et al. 2016:78).

2019 AND 2020 MONITORING

UT-1

UT-1 consists of two discontinuous segments; only the southern portion of UT-1 extends onto the floodplain near site 31BN145/491 and was monitored. UT-1 is situated north of the Swannanoa River, and consists of two branches that extend southwest to join the river, and occupies an easement measuring ca. 882.2 ft (268.9 m) in length and up to 119.4 ft (36.4 m) in width (Figure 6.2; see Figure 6.1). Most of the work within this area consisted of enhancing the current stream bed; a new channel was created in one area, however, where the stream bed was diverted into an area of hydric soils. Hydric soils and/or modern alluvium were encountered over most of the easement area, which is largely mapped as Iotla loam, a somewhat poorly drained soil that is occasionally flooded (Hudson 2009:244–245; USDA NRCS 2019). A typical profile displayed the extent of historic sedimentation in one location (Figure 6.3):

0–45 cm yellowish brown (10YR 5/4) sand
45–97 cm brown (10YR 4/3) sand
97–147 cm dark grayish brown (2.5Y 4/2) sand
147+ cm very dark grayish (2.5Y 3/1) sandy clay

Modern debris was encountered over a meter below surface there. A typical wetland sequence encountered upstream was as follows (Figure 6.4):

0–17 cm dark grayish brown (10YR 4/2) loamy sand
17–70 cm greenish gray (10Y 6/1) gley
70–100 cm light yellowish brown (10YR 6/4) sandy clay

No premodern artifacts or other indications of an archaeological site were encountered within the UT-1 stream easement.

UT-6

UT-6 occupies a meandering, linear easement measuring ca. 1,858.6 ft (566.5 m) in length and 128.9 ft (39.3 m) in width; following an existing stream, it extends northward to the Swannanoa River through a fallow agricultural field (see Figure 6.1). As at UT-1, most of the work was confined to the existing stream channel, and the excavations mainly encountered hydric soils in the area in and around the former stream channel, where the water table was elevated (Figures 6.5 and 6.6). Coarser (sandier) soils were encountered in at least one area, as characterized by the following sequence:

> 0–62 cm brown (10YR 4/3) sand
> 62–68 cm dark gray (10YR 4/1) silt with strong brown (7.5YR 4/6) inclusions
> 68–99 cm brown (10YR 5/3) coarse sand

The sandier soils at this location appear to be the result of historic to modern sedimentation. Mapped soils within the easement include moderately well drained (Dillard loam, DrB) somewhat poorly drained (Iotla loam, IoA), and very poorly drained (e.g., Hemphill loam, HpA and Toxoway loam, TsA) soil types (USDA NRCS 2019). No premodern artifacts or other indications of an archaeological site were encountered in UT-6.

Figure 6.2. Modification of existing stream bed in UT-1.

UT-7

UT-7 is situated in an easement south of the Swannanoa River that measures ca. 1,561.4 ft (475.9 m) in length and 149.3 ft (45.5 m) in width and extends northeast to an existing river tributary (Figure 6.7; see Figure 6.1). Much of this area was diverted from the existing stream channel but is situated at the approximate location of a former stream channel. Mapped soils within the easement include moderately well drained types [Dillard loam (DrB), and Dellwood-Reddies complex (DeA)], and somewhat poorly drained Iotla loam (IoA) (USDA NRCS 2019).

In addition to monitoring this area, a series of six shovel tests were excavated at 20- to 40-m intervals along the new stream channel center line. These encountered similar soils, as shown by the profile of ST 2 (Figure 6.8):

0–34 cm dark grayish brown (10YR 4/2) sandy loam
34–60 cm brown (10YR 4/3) silt loam overlying stream cobbles

All the shovel tests in UT-7 encountered the water table at depths of 50 to 65 cmbs, and no premodern artifacts were encountered. As it is largely within or near the former stream channel, little to no potential for any long-term occupation in the vicinity of the project would be expected.

Figure 6.3. Historic alluvium and disturbed soils in UT-1.

Figure 6.4. Hydric soils and terra cotta pipe fragments in UT-1.

Figure 6.5. New stream channel in UT-6.

Figure 6.6. Elevated water table in UT-6.

Figure 6.7. View of UT-7 area.


Figure 6.8. View of ST 2 profile in UT-7.

7. CONCLUSIONS AND RECOMMENDATIONS

TRC Environmental Corporation (TRC) has completed archaeological field work for a stream restoration project on the campus of Warren Wilson College in Buncombe County, North Carolina. This work included archaeological testing at site 31BN28 and monitoring of the construction in the vicinity of sites 31BN135 and 31BN145/491.

The evaluation of 31BN28 within the project APE included the excavation of 123 10-m interval shovel tests and two 1 × 1 m test units. Twenty of the shovel tests, 11 east of the stream along the treeline and nine west of the stream within the construction easement, produced precontact period artifacts. These artifacts include lithic artifacts associated with Middle Woodland, and potential Archaic to Woodland and Mississippian (Pisgah phase) occupations, and ceramic artifacts associated with Middle Woodland and potential Mississippian (Pisgah phase) occupation. Most of the precontact period artifacts were found in relatively shallow plowzone contexts, but some lithic artifacts (including a variety of Woodland to Mississippian triangular projectile points) and ceramic artifacts were found in similar underlying soils in an isolated area on the east side of the stream. The origin of that deposit is not completely clear, but it may be disturbed (and possibly related to the original construction of the stream channel) or alternatively is (in part) a naturally filled swale or slough area that has incorporated a few artifacts that were present across the terrace.

Other artifacts found below the plowzone (including a few pieces of lithic debitage from a thin A horizon that appears to represent a former swale environment and a few lithic and ceramic artifacts found in a hydric B horizon on the west side of the stream) appear attributable to bioturbation moving artifacts downward. No artifacts were found in any other B horizon context west (or east) of the stream. Most (if not all) of the soil sequences encountered suggest a less than favorable environment for habitation, and there are no deeply buried deposits or evidence for cultural stratification. Local soil conditions, along with low artifact density, suggest that Woodland or any later features are unlikely to be present within the project APE.

These investigations are not sufficient to characterize the site in its entirety, and it is very likely that meaningful artifact distributions and cultural features (especially those associated with Middle Woodland to Mississippian period occupations) are present on the broad terrace outside the area of project impacts. Further assessment would be necessary to define the prehistoric occupation of the site in those locations, and overall the site remains unassessed for NRHP eligibility. The results indicated that construction would not impact any intact or significant deposits, and we recommended that the construction be allowed to proceed as presently designed. A management summary for the 31BN28 testing was submitted to the NC /OSA for review (Benyshek and Idol 2018), and the NC HPO/OSA concurred with the recommendations in a comment letter dated March 27, 2018 (NC HPO 2018) and work was allowed to proceed in the 31BN28 area.

Archaeological monitoring was subsequently conducted near two other archaeological sites (31BN135 and 31BN145/491) that would potentially be impacted by construction activities associated with construction of three new stream channels (UT-1, UT-6, and UT-7). The fieldwork included limited shovel testing and mechanized excavation as well as photodocumentation. The construction did not impact any archaeological sites. The excavations mainly encountered hydric or highly disturbed soils, and no intact cultural deposits or non-modern artifacts were encountered in any of the stream easements. This construction did not affect any deposits or materials associated with sites 31BN135 or 31BN145/491, and no additional fieldwork is necessary.

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2001 The Middle Archaic of the Great Smoky Mountains: Upland Adaptation in a Regional Perspective. Presented at the 66th annual meeting of the Society for American Archaeology, New Orleans.

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APPENDIX 1: SITE 31BN28 ARTIFACT CATALOG

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
1	ST 2	east	Ap	L1	LDEB	FLKE	Che		Y	1-3	1	0.3	
1	ST 2	east	Ap	L2	LDEB	FLKE	Che		N	1-3	1	0.1	
1	ST 2	east	Ap	0–38	LDEB	FLKE	Che	NA	Y	1-3	1	0.3	
1	ST 2	east	Ap	0–38	LDEB	FLKE	Che	NA	N	1-3	1	0.1	
1	ST 2	east	Ap	0–38	PCER	BODY	UD stamped	Pigeon	fine quartz	2–4	1	4.9	cf. simple/check
2	ST 3	east	lower Ap	L1	LDEB	FLKE	Che		N	1-3	2	0.4	
2	ST 3	east	lower Ap	35–50	LDEB	FLKE	Che	NA	N	1-3	2	0.4	
3	ST 4	east	Ap	H1	GLAS	Curved	Clear				1	57.4	base of large vessel-bottle or jar with stippled relief
3	ST 4	east	Ap	0–70	GLASS	Curved	Clear	UD container			1	57.4	stippled base
4	ST 6	east	Ap	L1	LDEB	FLKE	Qzite		N	1-3	1	0.5	
4	ST 6	east	Ap	5–20	LDEB	FLKE	Qzite	NA	N	1-3	1	0.5	
4	ST 6	east	Ap	L2	LDEB	SHTR	Qz		N	1-3	1	0.5	may just be natural
4	ST 6	east	Ap	5–20	LDEB	SHTR	Qz	NA	N	1-3	1	0.5	cultural?
5	ST 8	east	Ap	0–20	PCER	BODY	UD	UD	UD	<2	1	0.9	sand/fine grit?
6	ST 11	east	Ap	L1	LDEB	FLKE	Che		N	<1	1	0.1	
6	ST 11	east	Ap	0–50	LDEB	FLKE	Che	NA	N	<1	1	0.1	
7	ST 12	east	Ap	L1	LDEB	FLKE	Che		N	1-3	1	0.1	
7	ST 12	east	Ap	0–17	LDEB	FLKE	Che	NA	N	1-3	1	0.1	
8	ST 15	east	Ap	H2	GLAS	Curved	Clear				2	1.4	thin, vessel glass
8	ST 15	east	Ap	20–30	GLASS	Curved	Clear	UD container			2	1.4	thin
8	ST 15	east	Ap	L1	LDEB	FLKE	Che		N	1-3	2	0.4	
8	ST 15	east	Ap	20–30	LDEB	FLKE	Che	NA	N	1-3	2	0.4	
8	ST 15	east	Ap	H1	METL	Nail	Wire				2	7.9	one complete- 3" length, ome shaft & head frag
8	ST 15	east	Ap	20–30	METL	Nail	Wire	Wire nail			2	7.9	1 complete- 3"
9	ST 16	east	Ap	L1	LDEB	FLKE	Qzite		N	1-3	1	2.5	
9	ST 16	east	Ap	L2	LDEB	FLKE	Che		N	1-3	1	0.2	
9	ST 16	east	Ap	0–30	LDEB	FLKE	Qzite	NA	N	1-3	1	2.5	
9	ST 16	east	Ap	0–30	LDEB	FLKE	Che	NA	N	1-3	1	0.2	
9	ST 16	east	Ap	H1	METL	Nail	Wire				1	7.5	complete, 3" length
9	ST 16	east	Ap	0–30	METL	Nail	Wire	Wire nail			1	7.5	complete, 3"
10	ST 21	east	Ap	L1	LDEB	FLKE	Che		N	<1	1	0.1	
10	ST 21	east	Ap	0–35	LDEB	FLKE	Che	NA	N	<1	1	0.1	
10	ST 21	east	Ap	0–35	PCER	BODY	UD	UD	UD	<2	1	1	crushed qtz /grit?
11	ST 22	east	Ap	L1	LDEB	FLKE	Che		N	1-3	1	0.5	
11	ST 22	east	Ap	L2	LDEB	FLKE	Qzite		N	1-3	1	1.0	
11	ST 22	east	Ap	10–20	LDEB	FLKE	Che	NA	N	1-3	1	0.5	

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
11	ST 22	east	Ap	10–20	LDEB	FLKE	Qzite	NA	N	1-3	1	1.0	
12	ST 23	east	Ap	L1	LDEB	FLKE	Che		N	1-3	2	0.2	
12	ST 23	east	Ap	L2	LDEB	FLKE	Che		N	<1	1	0.1	
12	ST 23	east	Ap	L3	LDEB	FLKE	Qzite		N	1-3	1	0.3	
12	ST 23	east	Ap	5–25	LDEB	FLKE	Che	NA	N	1-3	2	0.2	
12	ST 23	east	Ap	5–25	LDEB	FLKE	Che	NA	N	<1	1	0.1	
12	ST 23	east	Ap	5–25	LDEB	FLKE	Qzite	NA	N	1-3	1	0.3	
13	ST 23	east	lower Ap	H1	GLAS	Curved	Clear				1	0.2	small frag
13	ST 23	east	lower Ap	25–65	GLASS	Curved	Clear	UD container			1	0.2	small frag
13	ST 23	east	lower Ap	L1	LDEB	FLKE	Che		N	1-3	2	0.4	
13	ST 23	east	lower Ap	25–65	LDEB	FLKE	Che	NA	N	1-3	2	0.4	
13	ST 23	east	lower Ap	LT1	LTFL	BIF2	Che	PPK-Frag	N	1-2	1	0.9	str, sm stem w/ str base only; plano-convex x-section
13	ST 23	east	lower Ap	25–65	LTFL	PPK	Che	UD stemmed	N	1-2	1	0.9	fragment
13	ST 23	east	lower Ap	25–65	PCER	BODY	UD	UD	fine quartz	2–4	1	3.3	cf. Pigeon plain
13	ST 23	east	lower Ap	25–65	PCER	BODY	UD	UD	fine grit	2–4	1	3.8	Eroded
14	ST 46	west	Ap	H1	GLAS	Curved	Aqua				1	8.9	base of Coke or other soda bottle
14	ST 46	west	Ap	0–15	GLASS	Curved	Aqua	Bottle			1	8.9	soda bottle base
15	ST 57	west	Ap	L1	LDEB	FLKE	Qz		N	1-3	2	0.6	
15	ST 57	west	Ap	14–42	LDEB	FLKE	Qz	NA	N	1-3	2	0.6	
16	ST 64	west	Ap	0–35	PCER	BODY	UD stamped	UD	UD	2–4	1	8.4	cf. rect./check
16	ST 64	west	Ap	0–35	PCER	BODY	comp. stampe	UD	fine grit	2–4	1	2	cf. curvilinear
16	ST 64	west	Ap	0–35	PCER	BODY	UD	UD	fine grit	2–4	1	4.3	burnished interior
16	ST 64	west	Ap	0–35	PCER	BODY	UD	UD	fine grit	2–4	1	2.7	eroded, cf. plain
16	ST 64	west	Ap	0–35	PCER	BODY	UD	UD	UD	<2	1	1.1	crushed qtz /grit?
17	surface	west	Ap	L1	LDEB	FLKE	Qzite		N	3-5	1	5.3	
17	surface	west	Ap	L2	LDEB	FLKE	Qz		N	3-5	1	5.6	
17	surface	west	Ap	0–0	LDEB	FLKE	Qzite	NA	N	3-5	1	5.3	
17	surface	west	Ap	0–0	LDEB	FLKE	Qz	NA	N	3-5	1	5.6	
18	ST 71	west	Ap	L1	LDEB	FLKE	Che		N	1-3	1	1.0	
18	ST 71	west	Ap	0–30	LDEB	FLKE	Che	NA	N	1-3	1	1.0	
18	ST 71	west	Ap	L2	LDEB	SHTR	Che		N	1-3	1	0.8	
18	ST 71	west	Ap	0–30	LDEB	SHTR	Che	NA	N	1-3	1	0.8	
19	ST 73	west	Ap	L1	LDEB	FLKE	Che		N	1-3	1	0.2	
19	ST 73	west	Ap	0–25	LDEB	FLKE	Che	NA	N	1-3	1	0.2	
20	ST 81	west	Ap	L1	LDEB	FLKE	Rhy		N	1-3	1	0.4	
20	ST 81	west	Ap	0–24	LDEB	FLKE	Rhy	NA	N	1-3	1	0.4	
21	ST 83	west	Ap	L1	LDEB	FLKE	Che		N	1-3	2	1.3	one may be rhy, instead

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
21	ST 83	west	Ap	0–40	LDEB	FLKE	Che	NA	N	1-3	2	1.3	
22	ST 89	west	Ap	L1	LDEB	FLKE	Qzite		N	1-3	1	0.3	
22	ST 89	west	Ap	0–30	LDEB	FLKE	Qzite	NA	N	1-3	1	0.3	
22	ST 89	west	Ap	0–30	PCER	BODY	UD	UD	UD	<2	1	1	sand/fine grit?
23	ST 90	west	Ap	L1	LDEB	FLKE	Qzite		N	1-3	1	0.4	
23	ST 90	west	Ap	7–41	LDEB	FLKE	Qzite	NA	N	1-3	1	0.4	
23	ST 90	west	Ap	L2	LDEB	SHTR	Qzite		N	1-3	1	1.5	
23	ST 90	west	Ap	7–41	LDEB	SHTR	Qzite	NA	N	1-3	1	1.5	
23	ST 90	west	Ap	7–41	PCER	BODY	UD stamped	UD	coarse grit	2–4	1	3.4	cf. check; eroded
23	ST 90	west	Ap	7–41	PCER	BODY	UD	UD	fine grit	2–4	1	1.9	eroded, cf. plain
23	ST 90	west	Ap	7–41	PCER	BODY	UD	UD	fine quartz	2–4	1	2.2	thick
23	ST 90	west	Ap	7–41	PCER	BODY	UD	UD	coarse grit	<2	1	1.7	eroded
24	ST 95	west	Ap	0–15	PCER	BODY	UD	UD	NVT	<2	1	0.6	eroded
25	TU 1 Lev 1	east	Ap	L1	LDEB	FLKE	Che		N	1-3	9	1.6	
25	TU 1 Lev 1	east	Ap	L2	LDEB	FLKE	Qzite		N	1-3	1	2.8	
25	TU 1 Lev 1	east	Ap	0–30	LDEB	FLKE	Che	NA	N	1-3	9	1.6	
25	TU 1 Lev 1	east	Ap	0–30	LDEB	FLKE	Qzite	NA	N	1-3	1	2.8	
25	TU 1 Lev 1	east	Ap	L3	LDEB	SHTR	Che		N	1-3	2	1.6	
25	TU 1 Lev 1	east	Ap	0–30	LDEB	SHTR	Che	NA	N	1-3	2	1.6	
25	TU 1 Lev 1	east	Ap	LT3	LTFL	BIF1	Qzite	Preform-Frag	N	3-4	1	7.9	medial frag near contracting base; minimal retouch; plano-convex x-section
25	TU 1 Lev 1	east	Ap	0–30	LTFL	BIF1	Qzite	Preform	N	3-4	1	7.9	fragment
25	TU 1 Lev 1	east	Ap	LT1	LTFL	BIF2	Che	Traingular PPK	N	2-3	1	1.6	sm-med iso triang; str edges-one compromised; convex base; broad tip-likely compromised; plano-convex to lent x-section
25	TU 1 Lev 1	east	Ap	0–30	LTFL	PPK	Che	UD Traingular PPK	N	2-3	1	1.6	crude isoceles
25	TU 1 Lev 1	east	Ap	LT2	LTFL	UTFL	Qzite	Side Scraper	N	4-5	1	12.1	FF w/ unif util, RLM, dorsal
25	TU 1 Lev 1	east	Ap	0–30	LTFL	UTFL	Qzite	Side Scraper	N	4-5	1	12.1	unifacial utilized
25	TU 1 Lev 1	east	Ap	0–30	PCER	BODY	UD	UD	coarse grit	2–4	2	7.7	eroded; some qtz
25	TU 1 Lev 1	east	Ap	0–30	PCER	BODY	UD	UD	coarse grit	2–4	1	1.6	eroded; thin
25	TU 1 Lev 1	east	Ap	0–30	PCER	BODY	UD	UD	UD	<2	3	1.9	grit/UD temper
26	TU 1 Lev 2	east	lower Ap	L1	LDEB	FLKE	Che		N	1-3	6	1.8	
26	TU 1 Lev 2	east	lower Ap	L2	LDEB	FLKE	Rhy		N	1-3	1	0.4	
26	TU 1 Lev 2	east	lower Ap	L3	LDEB	FLKE	Qzite		N	1-3	2	0.8	
26	TU 1 Lev 2	east	lower Ap	30–40	LDEB	FLKE	Che	NA	N	1-3	6	1.8	
26	TU 1 Lev 2	east	lower Ap	30–40	LDEB	FLKE	Rhy	NA	N	1-3	1	0.4	

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
26	TU 1 Lev 2	east	lower Ap	30–40	LDEB	FLKE	Qzite	NA	N	1-3	2	0.8	
26	TU 1 Lev 2	east	lower Ap	-	LFCR	FCR	Qzite		-	-	1	1.5	<3cm; discarded
26	TU 1 Lev 2	east	lower Ap	30–40	LFCR	FCR	Qzite	NA	-	-	1	1.5	<3cm; discarded
26	TU 1 Lev 2	east	lower Ap	LT1	LTFL	BIF2	Che	Traingular PPK	N	2-3	1	1.7	prox & medial frag of med triang; one, intact str edge; concave base; lent x-section
26	TU 1 Lev 2	east	lower Ap	30–40	LTFL	PPK	Che	Garden Creek PPK	N	2-3	1	1.7	fragment
26	TU 1 Lev 2	east	lower Ap	30–40	PCER	BODY	UD	UD	sand	2–4	1	15.8	fine grit; eroded
26	TU 1 Lev 2	east	lower Ap	30–40	PCER	BODY	UD	UD	fine quartz	2–4	2	3.1	cf. Woodland
26	TU 1 Lev 2	east	lower Ap	30–40	PCER	BODY	UD	UD	coarse grit	<2	2	3.4	eroded
27	TU 1 Lev 3	east	lower Ap	L1	LDEB	FLKE	Che		N	1-3	3	1.1	
27	TU 1 Lev 3	east	lower Ap	L2	LDEB	FLKE	Qzite		N	1-3	1	1.0	
27	TU 1 Lev 3	east	lower Ap	40–50	LDEB	FLKE	Che	NA	N	1-3	3	1.1	
27	TU 1 Lev 3	east	lower Ap	40–50	LDEB	FLKE	Qzite	NA	N	1-3	1	1.0	
27	TU 1 Lev 3	east	lower Ap	-	LFCR	FCR	Qzite		-	-	1	4.1	<3cm; discarded
27	TU 1 Lev 3	east	lower Ap	40–50	LFCR	FCR	Qzite	NA	-	-	1	4.1	<3 cm; discarded
27	TU 1 Lev 3	east	lower Ap	LT1	LTFL	BIF2	Rhy	Traingular PPK	N	4-5	1	3.9	narrow, iso triang; one sl excurv, one recurv edge; concave base-sl (rounded) eared appearance; missing extreme tip; plano-convex x-section
27	TU 1 Lev 3	east	lower Ap	40–50	LTFL	PPK	Rhy	Woodland PPK	N	4-5	1	3.9	near complete
27	TU 1 Lev 3	east	lower Ap	40–50	PCER	BODY	UD	UD	coarse grit	<2	1	1.4	eroded
28	TU 1 Lev 4	east	lower Ap	L1	LDEB	FLKE	Che		N	1-3	2	1.0	
28	TU 1 Lev 4	east	lower Ap	L2	LDEB	FLKE	Che		Y	1-3	1	0.6	
28	TU 1 Lev 4	east	lower Ap	50–60	LDEB	FLKE	Che	NA	N	1-3	2	1.0	
28	TU 1 Lev 4	east	lower Ap	50–60	LDEB	FLKE	Che	NA	Y	1-3	1	0.6	
28	TU 1 Lev 4	east	lower Ap	L3	LDEB	SHTR	Qzite		N	1-3	1	1.9	
28	TU 1 Lev 4	east	lower Ap	50–60	LDEB	SHTR	Qzite	NA	N	1-3	1	1.9	
28	TU 1 Lev 4	east	lower Ap	LT1	LTFL	BIF2	Che	Traingular PPK	N	2-3	1	0.9	sm-med, nearly equi triang; incurv edges; sloped, concave base-one long 'leg'/tang; acute tip; flat x-section
28	TU 1 Lev 4	east	lower Ap	50–60	LTFL	PPK	Che	Madison PPK	N	2-3	1	0.9	near equilateral
28	TU 1 Lev 4	east	lower Ap	50–60	PCER	BODY	UD	UD	fine quartz	2–4	2	6	cf. Pigeon check
28	TU 1 Lev 4	east	lower Ap	50–60	PCER	BODY	UD	UD	coarse grit	<2	5	6.3	some quartz
29	TU 1 Lev 5	east	lower Ap	L1	LDEB	FLKE	Che		Y	1-3	1	0.4	
29	TU 1 Lev 5	east	lower Ap	60–64	LDEB	FLKE	Che	NA	Y	1-3	1	0.4	

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
30	TU 1 Lev 6	east	A	L1	LDEB	FLKE	Che		N	1-3	1	0.6	
30	TU 1 Lev 6	east	A	L3	LDEB	FLKE	Qzite		N	3-5	1	7.7	dk gray
30	TU 1 Lev 6	east	A	64–74	LDEB	FLKE	Che	NA	N	1-3	1	0.6	
30	TU 1 Lev 6	east	A	64–74	LDEB	FLKE	Qzite	NA	N	3-5	1	7.7	
30	TU 1 Lev 6	east	A	L2	LDEB	SHTR	Che		N	1-3	1	0.4	
30	TU 1 Lev 6	east	A	64–74	LDEB	SHTR	Che	NA	N	1-3	1	0.4	
31	TU 2	west	Ap	H1	GLAS	Curved	Clear				1	0.2	small frag
31	TU 2	west	Ap	0–15	GLASS	Curved	Clear	UD container			1	0.2	small frag
31	TU 2 Lev 1	west	Ap	L1	LDEB	FLKE	Che		N	1-3	1	0.2	
31	TU 2 Lev 1	west	Ap	L3	LDEB	FLKE	Che		N	<1	5	0.3	
31	TU 2 Lev 1	west	Ap	L4	LDEB	FLKE	Qzite		N	1-3	2	4.4	
31	TU 2 Lev 1	west	Ap	L5	LDEB	FLKE	Qzite		N	3-5	1	5.6	
31	TU 2 Lev 1	west	Ap	0–15	LDEB	FLKE	Che	NA	N	1-3	1	0.2	
31	TU 2 Lev 1	west	Ap	0–15	LDEB	FLKE	Che	NA	N	<1	5	0.3	
31	TU 2 Lev 1	west	Ap	0–15	LDEB	FLKE	Qzite	NA	N	1-3	2	4.4	
31	TU 2 Lev 1	west	Ap	0–15	LDEB	FLKE	Qzite	NA	N	3-5	1	5.6	
31	TU 2 Lev 1	west	Ap	L2	LDEB	SHTR	Che		Y	1-3	1	3.3	
31	TU 2 Lev 1	west	Ap	0–15	LDEB	SHTR	Che	NA	Y	1-3	1	3.3	
31	TU 2 Lev 1	west	Ap	0–15	PCER	BODY	UD	UD	coarse grit	2–4	2	5.3	eroded
31	TU 2 Lev 1	west	Ap	0–15	PCER	BODY	UD	UD	coarse grit	<2	2	2	eroded
32	TU 2 Lev 2	west	Ap	L1	LDEB	FLKE	Che		Y	1-3	1	0.3	tan
32	TU 2 Lev 2	west	Ap	L2	LDEB	FLKE	Che		N	1-3	6	2.1	one Flint Ridge
32	TU 2 Lev 2	west	Ap	L3	LDEB	FLKE	Rhy		N	1-3	1	0.2	
32	TU 2 Lev 2	west	Ap	L4	LDEB	FLKE	Qzite		N	1-3	9	4.8	
32	TU 2 Lev 2	west	Ap	L5	LDEB	FLKE	Qzite		Y	1-3	1	3.9	
32	TU 2 Lev 2	west	Ap	L6	LDEB	FLKE	CQz		N	1-3	1	0.4	
32	TU 2 Lev 2	west	Ap	L7	LDEB	FLKE	Qz		N	1-3	2	4.4	
32	TU 2 Lev 2	west	Ap	L8	LDEB	FLKE	Qzite		N	3-5	3	11.7	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Che	NA	Y	1-3	1	0.3	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Che	NA	N	1-3	6	2.1	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Rhy	NA	N	1-3	1	0.2	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Qzite	NA	N	1-3	9	4.8	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Qzite	NA	Y	1-3	1	3.9	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	CQz	NA	N	1-3	1	0.4	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Qz	NA	N	1-3	2	4.4	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	FLKE	Qzite	NA	N	3-5	3	11.7	
32	TU 2 Lev 2	west	Ap	L9	LDEB	SHTR	Qz		N	3-5	1	5.3	
32	TU 2 Lev 2	west	Ap	L10	LDEB	SHTR	Qzite		N	1-3	1	0.5	
32	TU 2 Lev 2	west	Ap	L11	LDEB	SHTR	Qz		N	1-3	1	0.1	

Bag#	Prov	Side	Vertical	Uni#	MatClass	PrimClass	SecDesc	Type	Ctx	Size_ cm	Qty	Wt_g	Comments
32	TU 2 Lev 2	west	Ap	15–25	LDEB	SHTR	Qz	NA	N	3-5	1	5.3	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	SHTR	Qzite	NA	N	1-3	1	0.5	
32	TU 2 Lev 2	west	Ap	15–25	LDEB	SHTR	Qz	NA	N	1-3	1	0.1	
32	TU 2 Lev 2	west	Ap	15–25	PCER	BODY	plain	Connestee	sand	2–4	2	10.2	cf. plain
32	TU 2 Lev 2	west	Ap	15–25	PCER	BODY	UD	UD	fine grit	2–4	4	22.1	eroded; crushed qtz
32	TU 2 Lev 2	west	Ap	15–25	PCER	BODY	UD	UD	fine grit	2–4	2	4	eroded
32	TU 2 Lev 2	west	Ap	15–25	PCER	BODY	UD	UD	UD	<2	4	2.3	eroded
33	TU 2 Lev 3	west	B	L1	LDEB	FLKE	Che		N	1-3	1	0.2	
33	TU 2 Lev 3	west	B	L2	LDEB	FLKE	Qzite		N	1-3	1	0.8	
33	TU 2 Lev 3	west	B	25–35	LDEB	FLKE	Che	NA	N	1-3	1	0.2	
33	TU 2 Lev 3	west	B	25–35	LDEB	FLKE	Qzite	NA	N	1-3	1	0.8	
33	TU 2 Lev 3	west	B	LT1	LTFL	UTFR	Qzite	End Scraper	N	2-3	1	4.1	prox frag of rounded stem PPK w/ exp shldrs; bif util along obl, trans fracture; prob RECY MMII base
33	TU 2 Lev 3	west	B	25–35	LTFL	UTFR	Qzite	End Scraper	N	2-3	1	4.1	bifacial utilized
33	TU 2 Lev 3	west	B	25–35	PCER	BODY	UD	UD	coarse grit	2–4	1	3.5	eroded
33	TU 2 Lev 3	west	B	25–35	PCER	BODY	UD stamped	Pigeon	fine quartz	2–4	1	1.4	cf. simple/check
33	TU 2 Lev 3	west	B	25–35	PCER	BODY	UD	UD	UD	<2	2	1.7	eroded
34	TU 2 Lev 4	west	B	35–45	PCER	BODY	UD	UD	fine quartz	2–4	1	1.3	cf. Pigeon
35	TU 2 Lev 5	west	B	L1	LDEB	SHTR	Qzite		N	1-3	1	3.4	
35	TU 2 Lev 5	west	B	45–55	LDEB	SHTR	Qzite	NA	N	1-3	1	3.4	

North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

June 30, 2020

Tasha Benyshek
TRC Solutions
50101 Governor's Drive, Suite 250
Chapel Hill, NC 27517

tbenyshek@trcsolutions.com

Re: Warren Wilson College Stream Mitigation Project, 701 Warren Wilson Road, Swannanoa, Buncombe County, ER 17-1683

Dear Ms. Benyshek:

Thank you for your letter of May 19, 2020, forwarding copies of the draft report documenting the archaeological testing and monitoring for the above-referenced project. We have reviewed the report and offer the following comments:

Archaeological investigations at 31BN28 found that the proposed stream mitigation project will not impact any intact or significant deposits. However, given the likelihood that significant, intact portions of the site are located outside of the project area into areas that were not investigated, the overall site remains unassessed for listing in the National Register of Historic Places (NRHP). We concur with this finding and agree with the recommendation that construction within the site vicinity be allowed to proceed as presently designed.

According to the report, no intact cultural deposits or non-modern artifacts were observed during archaeological monitoring in the vicinity of sites 31BN135 and 31BN145/491 during project construction. We concur with the recommendation that no further archaeological work is necessary for this project.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-814-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley
for Ramona Bartos, Deputy
State Historic Preservation Officer

cc: Worth Creech, Restoration Systems, LLC wcreech@restorationsystems.com