MONITORING YEAR 2 ANNUAL REPORT

Final

KEY MILL MITIGATION SITE
Surry County, NC
NCDEQ Contract No. 7180
DMS Project No. 100025
USACE Action ID No. SAW-2017-01504
NCDEQ DWR Certification No. 17-1045
RFP #: 16-006993

Yadkin River Basin
HUC 03040101

Data Collection Period: January 2021 – November 2021
Final Submission Date: February 1, 2022

PREPARED FOR:

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

February 01, 2022

Mr. Matthew Reid
Project Manager
NCDEQ – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Final MY2 Report Review
Key Mill Mitigation Site, Surry County
Yadkin River Basin – HUC 03040101
DMS Project ID No. 100025 / DEQ Contract #7180

Dear Mr. Reid:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft MY2 Monitoring report for the Key Mill Mitigation Site. The report has been updated to reflect those comments. The Final As-built Baseline Monitoring Document and Record Drawings are included. Wildlands' responses to DMS' report comments are noted below in *italics*.

DMS comment: Please ensure the Monitoring Phase Performance Bond has been updated and approved by Kristie Corson before invoicing for Task 8.

Wildlands' response: Wildlands received an email confirmation from Kristie Corson on January 24, 2022, that she had received the updated bond for Task 8 (MY3) and that it has been approved. Wildlands is requesting an email confirmation from DMS that we may invoice for Task 8 upon the receipt of the Final Monitoring Year 2 Annual Report for the Key Mill Mitigation Site.

DMS comment: Executive Summary: Paragraphs following project goals list need to be reviewed and revised for incomplete sentences, dates and MY2 activity inconsistencies.

- **"systems were Channel maintenance"**
- **"November 2021 and July 2022"**
- **Section states that additional planting will occur in winter 2021/2022, but in the following paragraph it states that there are no areas of low stem density or bare ground.**

Please ensure section summary time line follows Table 2 and accurately depicts the site based on the MY2 site assessment and CCPV.

Wildlands' response: As requested, Wildlands has reviewed and revised the Executive Summary and Table 2, as necessary.

DMS comment: Table of Contents: Please add Table 15 Verification of 30 Days Consecutive Flow to Appendix 5 list after Table 14.

Wildlands' response: Wildlands has added Table 15 Verification of 30 Days Consecutive Flow to the Table of Contents.

DMS comment: Section 2: Second paragraph mentions a replanting occurring in early 2022. If this replant is to occur, please update CCPV to show these bare/low density areas and add discussion regarding planting area, type of planting material, species, etc. As mentioned above, no bare or low stem areas are depicted for MY2.

Wildlands' response: Wildlands has reviewed and revised the second paragraph of Section 2. Replanting is to occur only in the areas that were disturbed during the implementation of the measures outlined in the July 13th IRT Credit Release Meeting Minutes' Site Action Plan (Action Plan) and not because of bare/low stem density areas.

DMS comment: 2.1 Vegetation Assessment: Please include a short discussion regarding the current monitoring year vegetation height as it relates to the height requirement success criteria.

Wildlands' response: Wildlands has included a short discussion regarding the MY2 vegetation height as it relates to the height requirement success criteria.

DMS comment: Last paragraph page 2-1: Please revise second sentence for clarity.

Wildlands' response: Wildlands has revised the first and second sentence in the last paragraph on page 2-1 to improve clarity.

DMS comment: 2.4 Stream Areas of Concern and Management Activity: Along with XS7 and XS8, additional cross-sections were included in the repair areas. XS2, XS3 and XS14 were all in areas depicted in the AMP for bank or bed repairs.

Wildlands' response: That is correct. This paragraph was incorrectly referencing two different actions as the same action, which was confusing. Upon further review, Wildlands deemed this paragraph and its contents as unnecessary because the work conducted in the Action Plan did not geomorphically alter any of the cross-sections from MY1. Therefore, this paragraph has been removed from Section 2.4.

DMS comment: 2.7 MY2 Summary: Additional planting in 2022 is discussed in this section again. Please ensure MY2 report is consistent when finalizing.

Wildlands' response: Wildlands has reviewed and revised Section 2.7 MY2 Summary. The supplemental planting is for the areas disturbed during the implementation of the Site Action Plan in July and not for reasons of bare/low stem density areas.

DMS comment: 2.6 Stream Hydrology Assessment: Thank you for including discussion regarding the crest gage malfunction. Please continue to verify gages are functioning correctly to ensure the bankfull success criteria can be met by MY7.

Wildlands' response: Thank you. Wildlands will continue to verify gages are functioning correctly to ensure the bankfull success criteria can be met by MY7.

DMS comment: Tables 6a-6l and Table 7: Section 2.4 states that stream assessment occurred on 8/27/2021. Please include dates that field assessment occurred for streams and vegetation for each table. The IRT has requested this information be included at the 2021 Credit Release Meeting.

Wildlands' response: Wildlands has updated Tables 6a-6l and Table 7 to include the date that field assessments were conducted in MY2.

DMS comment: Table 6d: Table shows 1 section or degradation, but it does not occur on the CCPV. Also, the piping structure identified on the site is located on this reach and is shown on the CCPV, but

this structure is not accounted for on the table. Please review and revise the table and CCPV as necessary.

Wildlands' response: The degradation and the piping structure are referring to the same thing and were inadvertently depicted as two different issues. Therefore, the structure shown on the CCPV map was changed to a line in the CCPV map to correctly reflect a length of degradation.

DMS comment: Cross-section Plots: Consider adding a note to the cross-section plots that were affected by the repairs.

Wildlands' response: Wildlands has added a note to all cross-section plots that have been affected by repairs throughout post-construction monitoring. Please note that the implementation of the Site Action Plan did not geomorphically alter any cross-section from that recorded in MY1.

Digital Deliverable Comments:

DMS comment: Please include a feature representing the 7 feet of degradation along Bull Creek Reach 3.

Wildlands' response: Wildlands has included the line feature representing the 7 feet of degradation along Bull Creek Reach 3.

DMS comment: Note that for Plot 7, the CVS Table 7 export and simple export both produce PnoLs of 324 vs the 364 listed in the report. Please ensure the mdb has values that support the values reported in Table 10.

Wildlands' response: The "All Stem Plot" worksheet on the CVS "Simple Table" export is counting the dead stems; however, Table 10 in the report does not include dead stems. The CVS mdb included in the final electronic report files has been reviewed to ensure that the Table 7 export matches Table 10 included in the report.

DMS comment: If available, please submit the line features that capture the areas where repairs occurred and include polygon features that represent the supplemental planting areas.

Wildlands' response: Wildlands has included the line features that capture the areas where repairs occurred. Wildlands has not included the polygon features that represent the supplemental planting areas since these areas are being replanted due to construction access and repairs and not bare/low stem density.

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

Sincerely,

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EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a full-delivery stream mitigation project at the Key Mill Mitigation Site (Site) for the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS). The project restored, enhanced, and preserved a total of 7,437 linear feet (LF) of perennial and intermittent stream in Surry County, NC. The Site is located within the DMS targeted watershed for the Yadkin River Basin Hydrologic Unit Code (HUC) 03040101110040 and the NC Division of Water Resources (NCDWR) Sub-basin 03-07-03. The project is providing 6,107.300 cool stream mitigation units (SMUs) for the Yadkin River Basin HUC 03040101 (Yadkin 01).

The Site has a long history of agricultural activity and most of the stressors to stream functions are related to this historic and current land use practices. The major stream stressors for the Site were concentrated agricultural runoff inputs, degraded instream habitat, active stream incision, lack of stabilizing streamside vegetation, bank erosion and failure, and the lack of bedform diversity. The effects of these stressors resulted in degraded water quality and habitat throughout the Site when compared to reference conditions. The project approach for the Site focused on evaluating the Site's existing functional condition and evaluating its potential for recovery and need for intervention.

The project goals defined in the mitigation plan (Wildlands, 2019) were established with careful consideration of 2009 Upper Yadkin Pee Dee River Basin Restoration Priorities (RBRP) goals and objectives to address stressors identified in the watershed. The established project goals include:

- Improve stream channel stability,
- Stabilize eroding stream banks,
- Exclude livestock from stream channels,
- Reconnect channels with historic floodplains,
- Improve instream habitat,
- Reduce sediment and nutrient input from adjacent farm fields,
- Restore and enhance native floodplain vegetation, and
- Permanently protect the project site from degradational impacts.

Monitoring year (MY) 2 assessments and site visits were completed between January and November 2021 to assess the conditions of the project. Sitewide measures were implemented in late July of 2021 to iiaddress issues identified during the MY1 IRT Credit Release Site Walk on July 13,2021. All measures were implemented as discussed during the Site walk and described in the Site Action Plan included in the meeting minutes. Replanting will occur in early 2022 to address the areas that were disturbed during the construction/implementation of these measures. A post-implementation photolog is included in Appendix 7 of the report, as well as the meeting minutes for the Site walk.

Overall, the Site has met the required stream, hydrology, and vegetation success criteria for MY2, and most of the Site is performing as intended. Herbaceous vegetation has become well established throughout the Site. Supplemental planting that was implemented in early 2021 has increased the overall average planted stem density in MY2 to 461 stems per acre, and the Site is on track to meet the MY3 requirement of 320 stems per acre. Geomorphic surveys show that cross-sectional dimensions closely match baseline conditions with only minor adjustments. The MY2 visual assessment did not identify any areas of low stem density or bare ground and only one new stream area of concern.

One bankfull event occurred on UT1C, UT2C, and UT3C; however, none were documented on Bull Creek. The in-stream flow gage located on UT2 recorded 351 days of consecutive baseflow in 2021 or 100% of the monitored period for MY2. A few small areas of invasive species were noted and treated, and no areas of encroachment were observed. Wildlands will continue to monitor these areas throughout the

seven-year monitoring period. If necessary, adaptive maintenance measures will be implemented to benefit the ecological health of the Site.

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Section 1: PROJECT OVERVIEW

The Key Mill Mitigation Site (Site) is located in Surry County approximately 7.2 miles south of City of Mount Airy, NC in the Yadkin River Basin HUC 03040101110040 and NCDWR Sub-basin 03-07-03 (Figure 1). Located in the Smith River Allochthon of the Piedmont physiographic province (NCGS, 1985), the project watershed is predominately forested land with some areas of agriculture including the Site.

The Site is located on one parcel, bisected by Key Road creating a western side and an eastern side (herein referenced as the West side and the East side) to the project. The Site is predominantly actively grazed pasture with the downstream extent of the Site forested. Bull Creek is the primary stream, which flows southeast through the center of the Site. There are five unnamed tributaries (UT1, UT2, UT2A-C, UT3, and UT3A-C) that join Bull Creek within the Site limits (Figure 2). Valleys throughout the Site have moderately steep walls with alluvial bottoms, whereas valleys along the upstream extents of the project's East side tributaries are narrow with colluvial bottoms.

The West side of the project contains the upstream portion of Bull Creek (Reaches 1A, 1B, and 2), as well as UT1A, UT1B, and UT1C. UT1C joins Bull Creek Reach 2 near the bottom of the West Side of the Site and flows through a culvert under Key Road into the eastern side of the Site. The East Side of the site contains the downstream portion of Bull Creek (Reach 3 and 4), as well as UT2, UT2A-C, UT3, UT3A-C. The Site drains approximately 2.15 square miles of rural land. Downstream of the Site, Bull Creek continues southeast to join the Ararat River near the Cedar Hill community.

Prior to construction, the Site had been primarily used for agriculture. Lands upstream and downstream of the Site are predominantly forested though there are some areas of agricultural lands and small residential areas within the watershed. Agricultural activities within the Site had led to streams in various stages of impairment. Most of the streams on the Site were impaired from limited to non-existent buffers, concentrated agricultural runoff inputs, degraded instream habitat, active stream incision, bank erosion and failure, and the lack of bedform diversity. Pre-construction conditions are outlined in Table 4 of Appendix 1 and Table 11 of Appendix 4.

The final mitigation plan was submitted and accepted by DMS in October of 2018 and the IRT in January of 2019. Construction activities were completed in April 2020 by Carolina Environmental Contracting, Inc. Kee Mapping & Surveying, PLLC. completed the as-built survey in June 2020. Planting was completed following construction in April 2020 by Bruton Natural Systems, Inc. A conservation easement has been recorded and is in place on 20.8 acres.

The project is providing 6,107.300 cool stream mitigation units (SMUs) in the Yadkin River Basin Hydrologic Unit Code (HUC) 03040101110040 (Yadkin 01). Annual monitoring will be conducted for seven years with close-out anticipated to commence in 2027 given the success criteria are met.

Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figure 2.

1.1 Project Goals and Objectives

The Site is providing numerous ecological benefits within the Yadkin Valley Basin. The project goals were established with careful consideration to address stressors that were identified in the RBRP (EEP, 2009). The project has improved stream functions through stream restoration and the conversion of maintained agricultural fields into riparian buffer within the Yadkin Valley River Basin, while creating a functional riparian corridor at the Site.

The following project specific goals and objectives outlined in the Mitigation Plan (Wildlands, 2019) include:

Goals	Objectives
Improve stream channel stability.	Restore stream channels that will maintain a stable pattern and profile considering the hydrologic and sediment inputs to the system, the landscape setting, and the watershed conditions. Create stable tie-ins for tributaries joining restored channels. Add bank revetments and in-stream structures to protect restored streams.
Stabilize eroding stream banks.	Reconstruct stream channels slated for restoration with stable dimensions. Add bank revetments and in-stream structures to reaches to protect restored/enhanced streams.
Exclude livestock from stream channels.	Install livestock fencing and watering systems as needed to exclude livestock from stream channels and riparian areas.
Reconnect channels with historic floodplains.	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the floodplain.
Improve instream habitat.	Remove man-made impoundments and culvert crossings within easement. Install habitat features such as constructed riffles, cover logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.
Reduce sediment and nutrient input from adjacent farm fields.	Restore the streams' riparian buffers. Construct a BMP to slow and treat runoff from farm fields before entering Site streams.
Restore and enhance native floodplain vegetation.	Plant native tree species in riparian zone where currently insufficient.
Permanently protect the project site from degradational impacts.	Record a conservation easement on the Site and install livestock exclusion fencing.

Section 2: MONITORING YEAR 2 DATA ASSESSMENT

Annual monitoring for MY2 was conducted between January and November 2021 to assess the condition of the project. The stream, vegetation, and hydrologic success criteria for the Site follows the approved success criteria presented in the Key Mill Mitigation Plan (Wildlands, 2019). Monitoring features and locations are shown in Figures 3.0 - 3.3. Refer to Table 2 for the project's activity and reporting history.

As of July 2021, all areas have been repaired from the Adaptive Management Plan. Repair areas outlined in the Site's Action Plan that were conducted during late summer of 2021 will be replanted in early 2022. Photographs showing areas of repair are included in Appendix 7. Wildlands will continue assessing these areas throughout the seven-year monitoring period for the project. Further details are discussed in Sections 2.1 through 2.5.

2.1 Vegetation Assessment

Vegetation plot monitoring is being conducted in post-construction monitoring years 1, 2, 3, 5, and 7. Permanent plots are monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008) and the 2016 USACE Stream and Wetland Mitigation Guidance to assess the vegetation success. A total of 8 permanent vegetation plots were established within the project easement area using either a 10-meter by 10-meter square plot or a 5-meter by 20-meter rectangular plot. In addition, 5 mobile vegetation plots were relocated in MY2 throughout the planted conservation easement, as described in the Site's Baseline Conditions Report (Wildlands, 2020). To evaluate the random vegetation performance for the Site, mobile plots will continue to be reestablished in different random locations in monitoring years 3, 5, and 7. Mobile vegetation plot assessments will document stems, species, and height using 100-meter^2 circular, square, or rectangular plots. The final vegetative performance standard will be the survival of 210 planted stems per acre in the planted riparian areas at the end of the required seven-year monitoring period. The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of MY3 and at least 260 stems per acre at the end of MY5.

The MY2 vegetation survey was completed in August 2021, resulting in an average planted stem density of 461 stems per acre for all monitored permanent and mobile vegetation plots (MPs). The Site is on track to meet the interim MY3 requirement of 320 planted stems per acre, with all 13 plots individually exceeding this requirement with densities ranging from 324 to 728. The average stem height for all monitored permanent and mobile plots is 2.6 feet for MY2, which is 0.6 feet taller than in MY1. All of the plots are expected to meet the interim MY5 height requirement of an average of 7 feet per plot. In the permanent vegetation plots (VPs), the majority of the surviving stems appear to be thriving with a vigor of 3 or greater indicating a plant health of good or better. Please refer to Appendix 2 for vegetation plot photographs and Appendix 3 for vegetation data tables.

The implementation of the MY1 Adaptive Management Plan (AMP) has been successful. Bare roots and herbaceous vegetation are doing well and no areas of bare ground or low stem density were noted in MY2. This year's vegetative results in permanent plots 1, 4, and 8 with planted stem densities of 607, 405, and 486, in comparison to the same MY1 plot densities of 445, 41, and 283, respectively, indicate that the supplemental planting was successful. Additional information about the supplementally planted areas is outlined in Section 2.5.

2.2 Vegetation Areas of Concern and Management Activity

Overall, herbaceous ground cover has become well established throughout the Site and wetland vegetation has started to fill in the wet seeps, stabilizing the soil. In MY2, there were no areas of

encroachment within the conservation easement boundary nor were there any populations of invasive species above the mapping threshold. Areas of low stem density and/or of bare or poor herbaceous cover that were noted during MY1, were supplementally planted and seeded in early MY2. These areas were no longer noted as areas of vegetative concern in MY2.

2.3 Stream Assessment

Morphological surveys and reach-wide pebble counts will be performed on each restoration reach for monitoring years 1, 2, 3, 5 and 7 and will follow the 2016 USACE Stream and Wetland Mitigation Guidance. Riffle cross-sections on the restoration reaches should be stable and show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. All riffle cross-sections should fall within the parameters defined for the designated stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg and/or eroding channel banks. Remedial action would not be taken if channel changes indicate a movement toward stability. Substrate materials should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

Fifteen permanent cross-sections were installed to assess channel dimensions over time. Morphological surveys for MY2 were conducted in late July 2021 after repairs were completed on the Site. (See Section 2.5 and the 2021 AMP As-built/Record Drawings and the Meeting Minutes from the NCIRT Credit Release Site Walk in July 2021 in Appendix 6.) Overall, cross-section survey results indicate that most of the channels' dimensions are stable and functioning as designed with minimal adjustments. Changes occurring within a few cross-sections include slight variations in cross-sectional areas and widths, as well as mean depths. Bank height ratios (BHR) at surveyed cross-sections were at or near 1.0 for all reaches, except for cross-section 10 (XS10) on UT1C, and XS14 on UT3B; however, both cross-sections seem to have stabilized or improved with the redistribution of bed material within the riffle. Minor changes in cross-sectional profiles are normal for newly restored streams and are examples of how a channel adjusts to maintain stability from natural processes like rain events, a lack of mature woody vegetation along the stream bank, herbaceous growth along the banks, and/or sediment transport processes or to grading of repair areas. These minor changes do not indicate channel instability. See Section 2.4 and 2.5 for further discussion about stream areas of concern and repair areas.

Reachwide pebble counts along the restoration reaches continue to indicate the maintenance of coarser materials in riffle features and finer particles in the pool features. This shows that the stream continues to successfully move sediment through its system and access its floodplain.

Please refer to Appendix 2 for the visual stability assessment tables, CCPV Figures 3.0 – 3.3, and stream photographs, and Appendix 4 for the morphological tables and plots.

2.4 Stream Areas of Concern and Management Activity

MY2 stream and visual assessments revealed that over 98% of the Site's reaches are stable and performing as intended. Stream areas of concern include localized instances of aggradation, as well as structure piping within a log roller riffle. Areas of concern noted in Figures 3.0-3.3 are based on data collected during the Site assessment walk that was conducted on August 27, 2021. See Appendix 2 for pictures pertaining to the Areas of Concern.

2.5 Credit Release Site Walk Action Plan

In 2021, an Adaptive Management Plan – As-built/Record Drawings (AMP) document was submitted to document activities conducted in November 2020 and March 2021 to repair areas of concern reported in the Site's MY1 Report. On June 7, 2021, Wildland's received review comments from the NC IRT

referencing the Site's MY1 AMP document. At this time, NC Division of Water Resources (DWR) expressed concerns with the construction of berms and rip rap channels within the conservation easement and requested an earlier Credit Release Site Visit than previously requested during the Credit Release Meeting on May 10, 2021. On July 13, 2021, Wildlands met on-site with members of the NC IRT and DMS to review repairs documented in the AMP document. Upon completion of the meeting, the meeting attendees agreed that if the action items outlined in the meeting minutes were completed in MY2; thereby bringing the Site back into compliance, the MY1 credits would be released, and no additional monitoring years would be required. Construction, to address action items, began on July 26, 2021, and post-construction repair photo documentation was subsequently submitted to the NC IRT and DMS to confirm that action items were addressed as proposed. See Appendix 7 for the meeting minutes from this Site visit on July 13, 2021, the Site Action Plan, and the repair photo log.

2.6 Stream Hydrology Assessment

Six automated pressure transducers were installed to document stream hydrology throughout the seven-year monitoring period. Henceforth, these devices are referred to as "crest gages (CG)" for those recording bankfull events and "stream gages (SG)" for those documenting consecutive days of baseflow. At the end of the seven-year monitoring period, four or more bankfull flow events must have occurred in separate years on each of the restoration reaches. At as-built, the pressure transducers were programmed to record data every 2 hours and captured many high flow events throughout the first year of monitoring.

Average rainfall in MY2 was considerably less than the amount recorded in MY1; however, crest cages (CG)1 – 3 recorded multiple large spikes in stream flow that would indicate multiple bankfull events on Bull Creek Reach 2, UT1C, and UT2C early in 2021. Upon further review Wildlands noticed that these large rises in stream flow did not seem to correlate with rainfall amounts received at the Site during the same time frame but did seem to correlate when air temperatures fell below freezing. Wildlands contacted a Technical Support Specialist at In-Situ on 11/18/2021, to confirm whether or not freezing temperatures may cause false readings and/or erratic spikes in recorded data. In-situ did confirm that the spikes were likely the result of freezing water around the pressure transducer's diaphragm and referred Wildlands to the specification sheet for the type of gage, Rugged TROLL ® 100 Data Loggers, that we commonly use in the field (Haynes, 2021). Therefore, Wildlands decided to ignore the irregular bankfull event spikes on CG1, CG2, and CG3 between 1/1/2021 and 4/1/2021, when air temperature is more likely to fall below freezing (32° F or 0°C). Though four months of data was deemed unreliable and excluded from use, at least one bankfull event was still recorded on September 21-22, 2021, for UT1C, UT2C, and UT3C. In order to ensure accurate readings in subsequent monitoring years, each gage will be checked for accuracy and replaced if needed. Additionally, UT2, which is monitored to confirm the continuation of intermittent baseflow conditions on the restored channel, recorded 351 days of consecutive flow, exceeding the 30-day consecutive flow requirement. Please refer to Appendix 5 for hydrology summary data and gage plots.

2.7 MY2 Summary

Overall, the Site has met the required stream, hydrology, and vegetation success criteria for MY2. Herbaceous ground cover is well established throughout most of the Site, and the overall average planted stem density for the Site is 461 stems per acre, which is exceeding the MY3 requirement of 320 stems per acre by more than 10%. Overall, geomorphic surveys indicate that cross-sectional dimensions closely match baseline conditions with some minor adjustments, and the streams are functioning as intended. One bankfull event was documented on 3 of the 5 monitored reaches in MY2, and UT2's baseflow exceeded the 30-day requirement for intermittent streams, with a total of 351 days of consecutive flow. The MY2 visual assessment identified a few isolated areas of aggradation on Bull Creek

Reach 1A and UT3C, as well as piping structure in a log roller riffle on Bull Creek Reach 3. No areas of encroachment were noted during MY2, and only a few small areas of invasive species populations were treated. The Site Action Plan was successfully implemented as proposed by the end of July 2022, which put the site back into compliance allowing for the release of the MY1 credits by the IRT. Replanting to address areas where work was conducted during the Site Action Plan's implementation will be completed in early 2022. Wildlands will continue to monitor the Site, and adaptive maintenance measures will be implemented as necessary throughout the seven-year monitoring period to benefit the ecological health and geomorphic stability of the Site.

Section 3: METHODOLOGY

Geomorphic data was collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gages and groundwater gages are monitored quarterly. Monitoring instrument installation and methods are in accordance with the 2016 NC IRT Stream and Wetland Compensatory Mitigation Update and NC DMS Annual Monitoring and Closeout Template (2015). Vegetation monitoring protocols followed the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 4: REFERENCES

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

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

Haynes, Kaylie. Phone conversation. 18 November. 2021

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

National Oceanic and Atmospheric Association (NOAA).2021. Precipitation Data from October 2020. Mount Airy 2 W, NC US USC00315890. https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00315890/detail

North Carolina Climate Retrieval and Observations Network of the Southeast Database (NCCRONOS). 2020. State Climate Office of North Carolina. Version 2.7.2. Station ID Mt Airy 2 W, NC. Accessed December 2020.

North Carolina Ecosystem Enhancement Program (EEP). February 2009. Upper Yadkin Pee-Dee River Basin Restoration Priorities.

North Carolina Division of Mitigation Services (DMS). October 2015. DMS Stream and Wetland Mitigation Plan Template and Guidance.

North Carolina DMS, April 2015. DMS Annual Monitoring and Closeout Reporting Template.

North Carolina Division of Water Resources (NCDWR), 2015. Surface Water Classifications. https://deq.nc.gov/about/divisions/water- resources/planning/classification-standards.

North Carolina Geological Survey (NCGS), 1985. Geologic Map of North Carolina: North Carolina Survey, General Geologic Map, scale 1:500,000. https://deq.nc.gov/about/divisions/energy-mineral-land- resources/north-carolina-geological-survey/ncgs-maps/1985-geologic-map-of-nc4.

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

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

Simon, A. 1989. A model of channel response in disturbed alluvial channels. Earth Surface Processes and Landforms 14(1):11-26.

Insitu. 2021. Spec Sheet Reference: Rugged TROLL Registered 100 and 200 Data Loggers, In-Situ Registered, Fort Collins, CO, Jan 2021. https://insitu.com/pub/media/support/documents/Rugged_TROLL_100_and_200_Data_Loggers.pdf. (Accessed Nov 18, 2021)

United States Geological Survey (USGS). 2020. National Water Information System. Station ID USGS 362416080334345 Ararat, NC. Accessed December 2020.

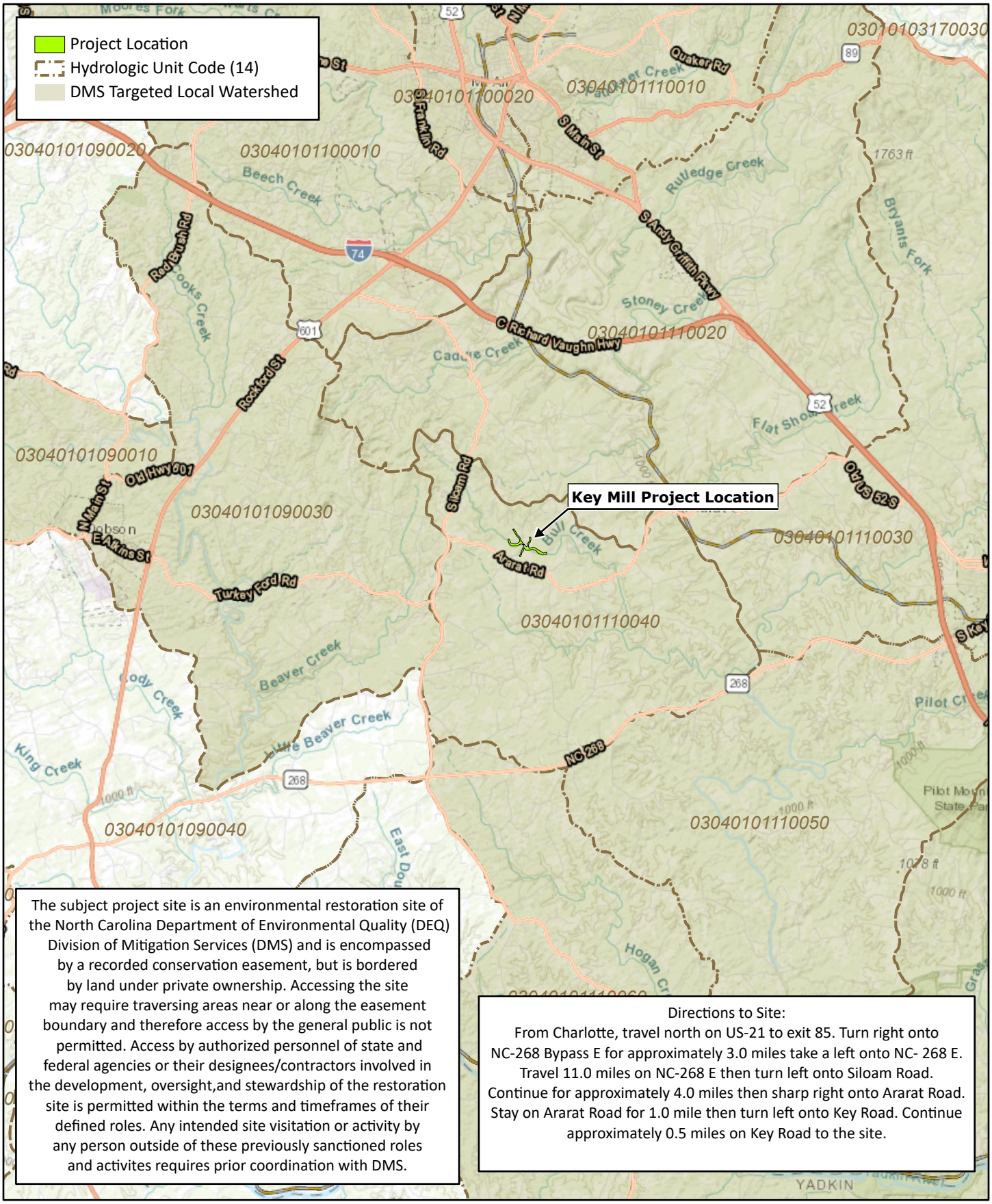
USACE. 2016. Stream and Wetland Compensatory Mitigation Update. USACE, NCDENR-DWQ, USEPA, NCWRC.

Wildlands Engineering, Inc (Wildlands), 2019. Key Mill Mitigation Site Mitigation Plan. DMS, Raleigh, NC.

Wildlands, 2020. Key Mill Mitigation Site As-built Baseline Monitoring Report. DMS, Raleigh, NC.

Wildlands, 2020. Key Mill Mitigation Site Monitoring Year 1 Annual Report. DMS, Raleigh, NC.

APPENDIX 1. General Tables & Figures



The subject project site is an environmental restoration site of the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight,and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with DMS.

Directions to Site:
From Charlotte, travel north on US-21 to exit 85. Turn right onto NC-268 Bypass E for approximately 3.0 miles take a left onto NC- 268 E. Travel 11.0 miles on NC-268 E then turn left onto Siloam Road. Continue for approximately 4.0 miles then sharp right onto Ararat Road. Stay on Ararat Road for 1.0 mile then turn left onto Key Road. Continue approximately 0.5 miles on Key Road to the site.

WILDLANDS ENGINEERING

0 1 2 Mile

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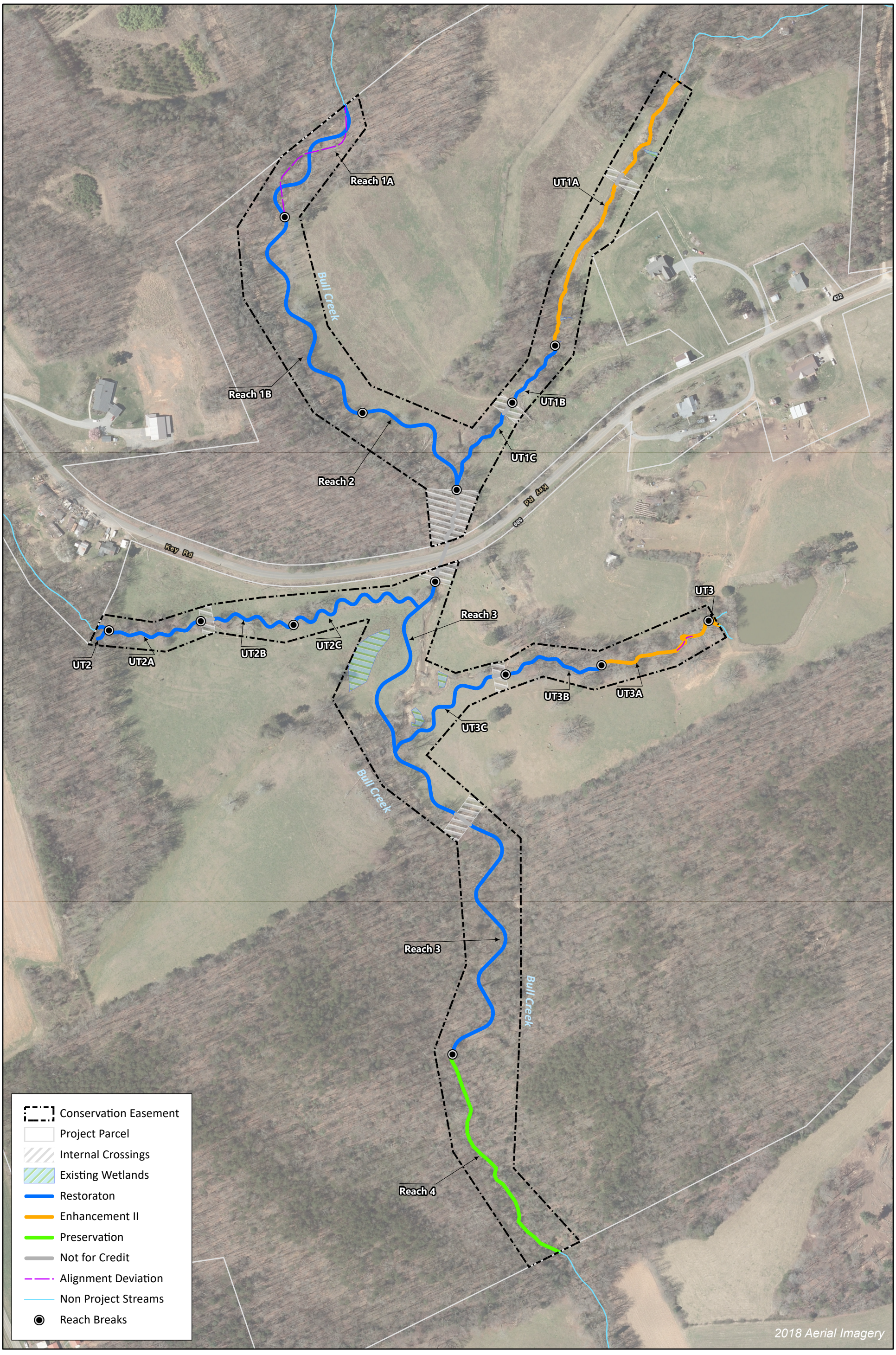
Figure 1 Project Vicinity Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

Figure 2 Project Component/ Asset Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC

Table 1. Mitigation Assets and Components

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Project								
Project Area/Reach	**Existing Footage (LF) or Acreage**	**Mitigation Plan Footage/ Acreage**	**Mitigation Category**	**Restoration Level**	**Priority Level**	**Mitigation Ratio (X:1)**	**As-Built Footage/ Acreage**	**Notes/Comments**
Bull Creek Reach 1A	435	444	Cool	Restoration	P1	1.000	421	N/A
Bull Creek Reach 1B	876	722	Cool	Restoration	P1	1.000	722	N/A
Bull Creek Reach 2	403	418	Cool	Restoration	P2	1.000	418	N/A
Bull Creek Reach 3	2,291	1,674	Cool	Restoration	P2	1.000	1,676	N/A
Bull Creek Reach 4	683	683	Cool	Preservation	N/A	10.000	683	N/A
UT1A	866	829	Cool	Enhancement II	N/A	2.500	832	N/A
UT1B	188	212	Cool	Restoration	P2	1.000	212	N/A
UT1C	332	257	Cool	Restoration	P2	1.000	257	N/A
UT2	61	42	Cool	Restoration	P2	1.000	42	N/A
UT2A	349	315	Cool	Restoration	P2	1.000	315	N/A
UT2B	299	263	Cool	Restoration	P2	1.000	263	N/A
UT2C	223	469	Cool	Restoration	P2	1.000	469	N/A
UT3	21	18	Cool	Enhancement II	N/A	2.500	18	N/A
UT3A	249	413	Cool	Enhancement II	N/A	2.500	390	N/A
UT3B	414	307	Cool	Restoration	P2	1.000	307	N/A
UT3C	296	412	Cool	Restoration	P1, P2	1.000	412	N/A

Project Credits							
Restoration Level	**Stream**			**Riparian Wetland**		**Non-Riparian Wetland**	**Coastal Marsh**
	Warm	**Cool**	**Cold**	**Riverine**	**Non-Riv**		
Restoration	N/A	5,535.000	N/A	N/A	N/A	N/A	N/A
Re-establishment				N/A	N/A	N/A	N/A
Rehabilitation				N/A	N/A	N/A	N/A
Enhancement				N/A	N/A	N/A	N/A
Enhancement I	N/A		N/A				
Enhancement II	N/A	504.000	N/A				
Creation				N/A	N/A	N/A	N/A
Preservation	N/A	68.300	N/A	N/A	N/A	N/A	N/A
Totals	**N/A**	**6,107.300**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 2. Project Activity and Reporting History

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Activity or Report		Data Collection Complete	Completion or Delivery
404 Permit		May 2019	May 2019
Mitigation Plan		January 2017 - January 2019	January 2019
Final Design - Construction Plans		May 2019	May 2019
Construction		June 2019 - April 2020	April 2020
Temporary S&E mix applied to entire project area[1]		June 2019 - April 2020	April 2020
Permanent seed mix applied to reach/segments[1]		April 2020	April 2020
Bare root and live stake plantings for reach/segments		April 2020	April 2020
Baseline Monitoring Document (Year 0)		July 2020	October 2020
Year 1 Monitoring	Invasive Treatment	August 2020	August 2020
	Stream Repairs (West Side)	November 2020	November 2020
	Stream Survey	December 2020	February 2021
	Vegetation Survey	October 2020	
Year 2 Monitoring	Seeding (Sitewide)	February 2021	February 2021
	Soil Amendments	March 2021	March 2021
	Stream Repairs (East Side)		
	Supplemental Plantings		
	Live Stake Install		
	Invasive Treatments (Sitewide)	June 2021	November 2021
	Implementation of the IRT Credit Release Site Action Plan	July 2021	August 2021
	Stream Survey	August 2021	November 2021
	Vegetation Survey		
Year 3 Monitoring	Stream Survey		
	Vegetation Survey		
Year 4 Monitoring	Stream Survey		
	Vegetation Survey		
Year 5 Monitoring	Stream Survey		
	Vegetation Survey		
Year 6 Monitoring	Stream Survey		
	Vegetation Survey		
Year 7 Monitoring	Stream Survey		
	Vegetation Survey		

[1]Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Designers Aaron Earley, PE, CFM	**Wildlands Engineering, Inc.** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Construction Contractors	**Carolina Environmental Contracting, Inc.** 150 Pine Ridge Rd Mt Airy, NC 27030
Planting Contractor	**Bruton Natural Systems, Inc.** PO Box 1197 Fremont, NC 27830
Seeding Contractor	**Carolina Environmental Contracting, Inc.** 150 Pine Ridge Rd Mt Airy, NC 27030
Seed Mix Sources	**Carolina Environmental Contracting, Inc.**
Nursery Stock Suppliers Bare Roots Live Stakes	**Bruton Natural Systems, Inc.**
Herbaceous Plugs	**Wetland Plants, Inc.**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kristi Suggs (704) 332.7754 x.110

Table 4. Project Information and Attributes
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Project Information	
Project Name	Key Mill Mitigation Site
	Surry County
Project Area (acres)	20.8
Project Coordinates (latitude and longitude)	36° 23' 57.4794"N -80° 36' 11.88"W
Planted Acreage (Acre of Woody Stems Planted)	9.8
Project Watershed Summary Information	
Physiographic Province	Piedmont Physiographic Province
River Basin	Yadkin River
USGS Hydrologic Unit 8-digit	3040101
USGS Hydrologic Unit 14-digit	3040101110040
DWR Sub-basin	03-07-03
Project Drainage Area (acres)	Bull Creek Reach 1A, 1B, & 2: (1,146); Bull Creek Reach 3 & 4: (1,293); UT1A-C: (102); UT2A-C: (32); UT2: (6); UT3 & UT3-C: (45)
Project Drainage Area Percentage of Impervious Area	1%
2011 NLCD Land Use Classification	Bull Creek- Forest (58%), Cultivated (33%), Urban (9%) UT1A-C - Forest (70%), Cultivated (21%), Urban (9%) UT2A-C - Forest (32%), Cultivated (49%), Urban (19%) UT2 - Forest (55%), Cultivated (45%), Urban (0%) UT3/UT3A-C - Forest (22%), Cultivated (74%), Urban (4%)

Reach Summary Information

Parameters	Bull Creek Reach 1A	Bull Creek Reach 1B	Bull Creek Reach 2	Bull Creek Reach 3	Bull Creek Reach 4	UT1A	UT1B	UT1C
Length of reach (linear feet) - Post-Restoration	421	722	418	1,676	683	832	212	257
Valley confinement (Confined, moderately confined, unconfined)	Confined to Moderately Confined			Moderately Confined		Confined		
Drainage area (acres)	1,146			1,293		102		
Perennial, Intermittent, Ephemeral	P	P	P	P	P	P	P	P
NCDWR Water Quality Classification	C							
Morphological Description (stream type) - Pre-Restoration	F3			F3/G3c	---	---	G4c	G4
Morphological Description (stream type) - Post-Restoration	C3		C3b	C3	---	---	B4	B4a
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V				VI	III/IV		
FEMA classification	Outside SFHA							

Parameters	UT2	UT2A	UT2B	UT2C	UT3	UT3A	UT3B	UT3C
Length of reach (linear feet) - Post-Restoration	42	315	263	469	18	390	307	412
Valley confinement (Confined, moderately confined, unconfined)	Confined		Moderatley Confined		Confined		Moderatley Confined	
Drainage area (acres)	6	32			45			
Perennial, Intermittent, Ephemeral	I	P	P	P	I	I/P	P	P
NCDWR Water Quality Classification	C							
Morphological Description (stream type) - Pre-Restoration	G4	G5	G5c	G5	---	---	G5	G5c
Morphological Description (stream type) - Post-Restoration	B4	B4	C4b	C4	---	---	B4	C4
Evolutionary trend (Simon's Model) - Pre- Restoration	III/IV							
FEMA classification	Outside SFHA							

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	Yes	Yes	USACE Action ID# SAW-2017-01504
Waters of the United States - Section 401	Yes	Yes	DWR# 17-1045
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	NPDES Construction Stormwater General Permit NCG010000
Endangered Species Act	Yes	Yes	Categorical Exclusion Document in Mitigation Plan
Historic Preservation Act	Yes	Yes	Categorical Exclusion Document in Mitigation Plan
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	N/A	Not located in a Special Flood Hazard Area
Essential Fisheries Habitat	No	N/A	N/A

Table 5a. Monitoring Component Summary

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		Bull Creek Reach 1A	Bull Creek Reach 1B	Bull Creek Reach 2	Bull Creek Reach 3	UT1B	UT1C		
Dimension	Riffle Cross-Section	1	1	1	2	1	1	Year 1, 2, 3, 5, and 7	1
	Pool Cross-Section	---	1	---	2	---	---		
Pattern	Pattern	N/A						N/A	2
Profile	Longitudinal Profile	N/A						N/A	
Substrate	Reach Wide (RW) Pebble Count	1 RW	1 RW	1 RW	1 RW	1 RW	1 RW	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	1 CG			1 CG	1 CG		Quarterly	4
Vegetation	CVS Level 2	8 (5 permanent, 3 mobile)						Year 1, 2, 3, 5, and 7	5
Visual Assessment		Yes						Semi-Annually	
Exotic and Nuisance Vegetation								Semi-Annually	6
Project Boundary								Annually	7
Reference Photos	Photographs	12						Annually	

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		UT2	UT2A	UT2B	UT2C	UT3B	UT3C		
Dimension	Riffle Cross-Section	---	1	1	1	1	1	Year 1, 2, 3, 5, and 7	1
	Pool Cross-Section	---	---	---	---	---	---		
Pattern	Pattern	N/A						N/A	2
Profile	Longitudinal Profile	N/A						N/A	
Substrate	Reach Wide (RW) Pebble Count	---	1 RW	1 RW	1 RW	1 RW	1 RW	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	1 SG	1 CG			1 CG		Quarterly	4
Vegetation	CVS Level 2	3 (1 permanent, 2 mobile)						Year 1, 2, 3, 5, and 7	5
Visual Assessment		Yes						Semi-Annually	
Exotic and Nuisance Vegetation								Semi-Annually	6
Project Boundary								Annually	7
Reference Photos	Photographs	9						Annually	

Notes:

1. Cross-sections have been permanently marked with rebar to establish location. Surveys include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.
2. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile data was collected during as-built baseline monitoring survey only, unless observations indicate widespread lack of vertical stability (greater than 10% of reach is affected) and profile survey is warranted in additional years to monitor adjustments or survey repair work.
3. Reach wide pebble counts will be conducted each year a monitoring report is submitted. Riffle (100) pebble counts have been conducted during as-built baseline monitoring only unless observations indicate otherwise during post-construction monitoring.
4. Crest gages(CG) and/or stream gages (SG) will be monitored using automated pressure transducers. CGs are to record bank full events at least twice a day, while SGs are to record baseflow at least every 2 - 3 hours. Both will be inspected quarterly or semi-annually. Evidence of bankfull and stream flow events will be documented with a photo when possible. In some cases both bankfull events and baseflow are monitored on a channel. When this occurs, the gage will still be shown as SG on corresponding documentation and maps to designate that baseflow is also being monitored.
5. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the areas planted. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m2 square/rectangular plot.
6. Locations of exotic and nuisance vegetation will be mapped.
7. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

Table 5b. Monitoring Component Summary

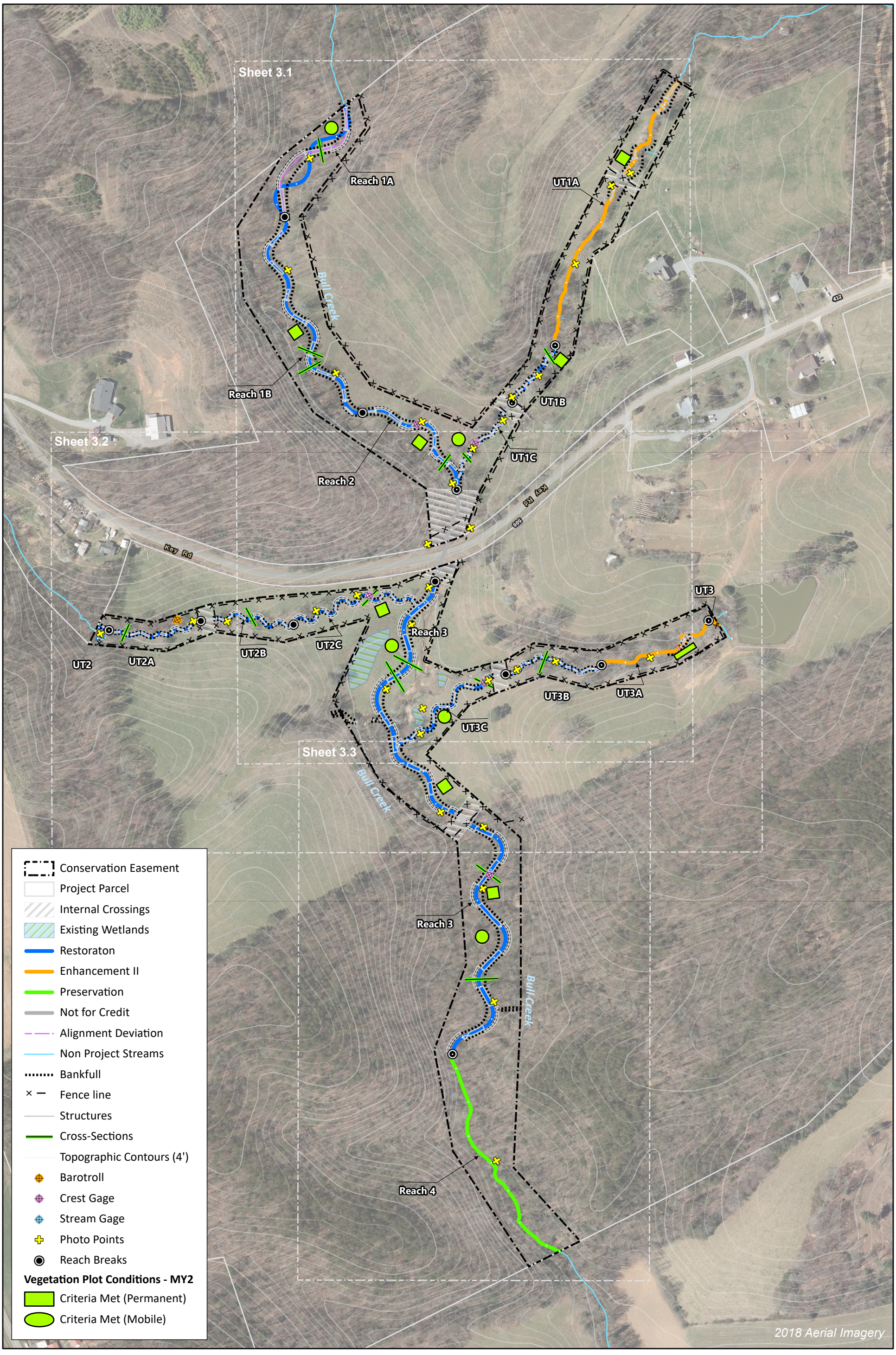
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Parameter	Monitoring Feature	Quantity / Length by Reach				Frequency	Notes
		UT1A	UT3	UT3A	Bull Creek Reach 4		
Dimension	Riffle Cross-Section	---	---	---	---	Year 1, 2, 3, 5, and 7	
	Pool Cross-Section	---	---	---	---		
Pattern	Pattern	N/A				N/A	
Profile	Longitudinal Profile	N/A				N/A	
Substrate	Reach Wide (RW) Pebble Count	---	---	---	---	Year 1, 2, 3, 5, and 7	
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	---	---	---	---	Quarterly	
Vegetation	CVS Level 2	2 (2 permanent)			---	Year 1, 2, 3, 5, and 7	1
Visual Assessment		Yes				Semi-Annually	
Exotic and Nuisance Vegetation						Semi-Annually	2
Project Boundary						Annually	3
Reference Photos	Photographs	4				Annually	

Notes:

1. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the areas planted. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m2 square/rectangular plot.
2. Locations of exotic and nuisance vegetation will be mapped.
3. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

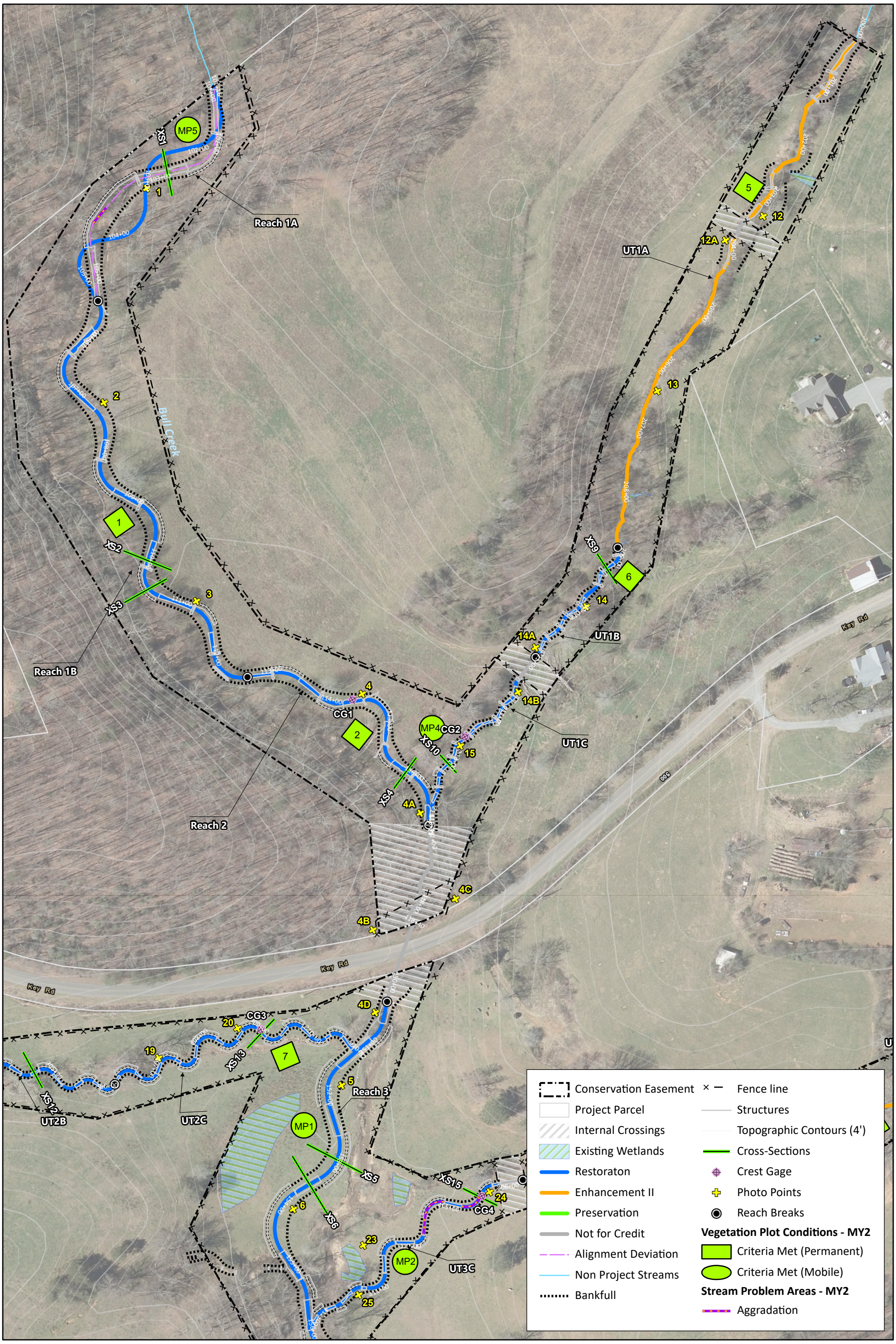
APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 250 500 Feet

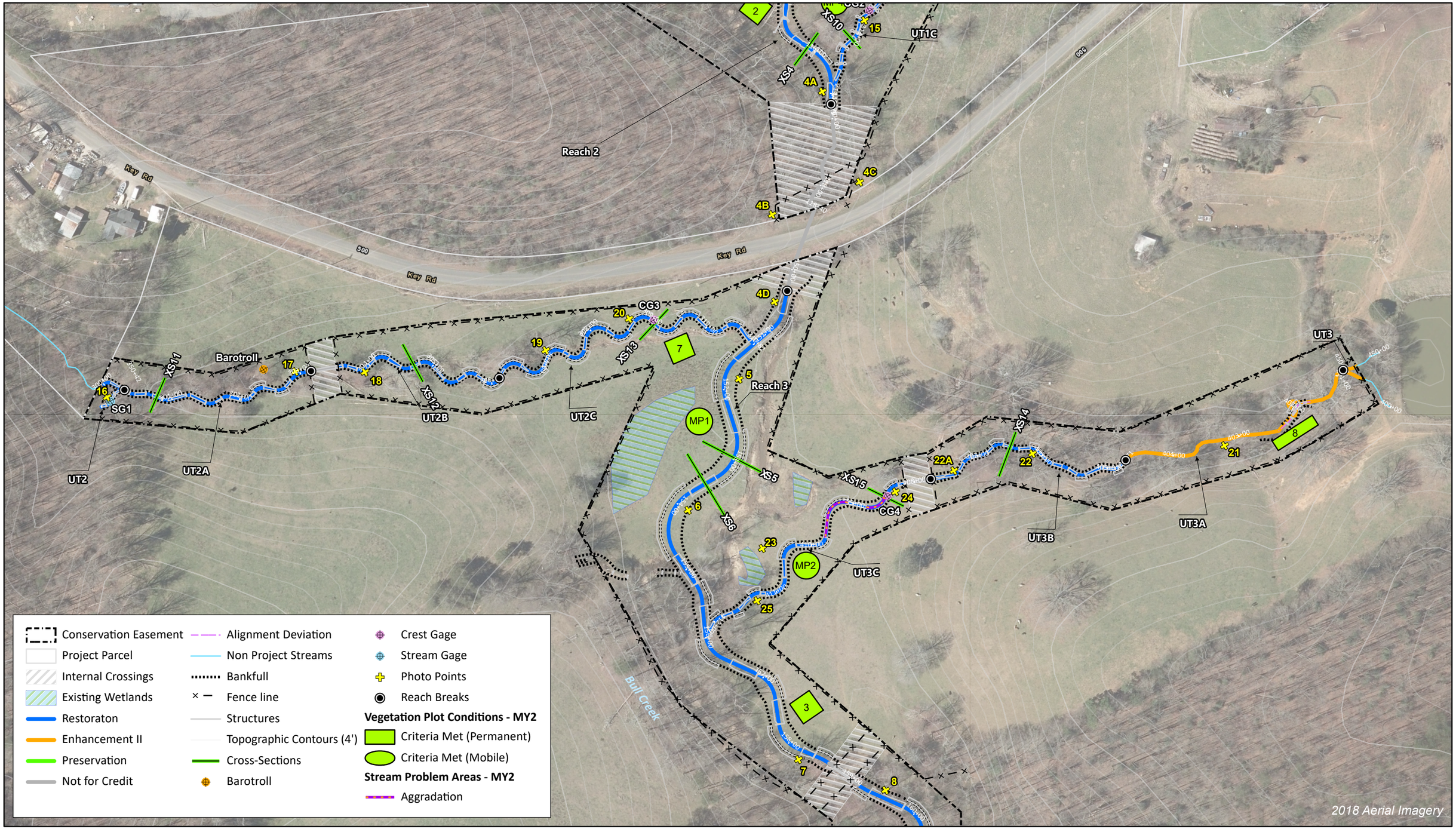
Figure 3.0 Current Conditions Plan View Map (Key)
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC



WILDLANDS ENGINEERING

0 130 260 Feet

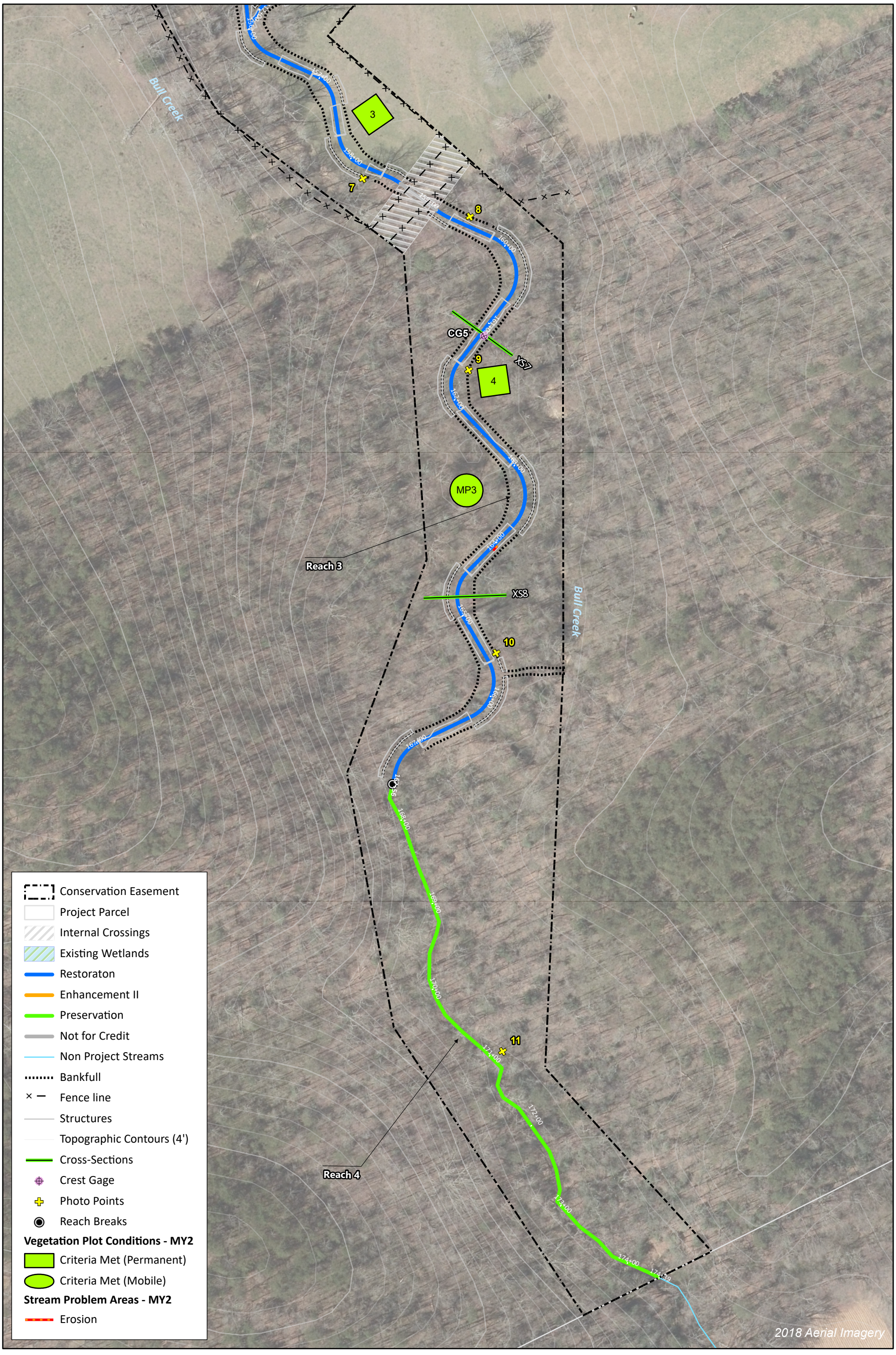
Figure 3.1 Current Condition Plan View Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

Figure 3.2 Current Conditions Plan View Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

Figure 3.3 Current Conditions Plan View Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021
Surry County, NC

Table 6a. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: Bull Creek Reach 1A
Assessed Length: 421

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			1	30	93%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	1	2			50%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	5	5			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6b. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: Bull Creek Reach 1B
Assessed Length: 722

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	6	6			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	6	6			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	12	12			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6c. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: Bull Creek Reach 2
Assessed Length: 418

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	6	6			100%			
	3. Meander Pool Condition	Depth Sufficient	5	5			100%			
		Length Appropriate	5	5			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		Thalweg centering at downstream of meander bend (Glide)	5	5			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	10	10			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	10	10			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6d. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: Bull Creek Reach 3
Assessed Length: 1,676

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			1	7	100%			
	2. Riffle Condition	Texture/Substrate	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	16	16			100%			
		Length Appropriate	16	16			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		Thalweg centering at downstream of meander bend (Glide)	16	16			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	28	28			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	11	11			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	11	11			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	17	17			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	28	28			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6e. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT1B
Assessed Length: 212

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	9	9			100%			
	3. Meander Pool Condition	Depth Sufficient	9	9			100%			
		Length Appropriate	9	9			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	8	8			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6f. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT1C
Assessed Length: 257

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	9	9			100%			
	3. Meander Pool Condition	Depth Sufficient	10	10			100%			
		Length Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	11	11			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	3	3			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	11	11			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6g. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT2
Assessed Length: 42

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6h. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT2A
Assessed Length: 315

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	11	11			100%			
	3. Meander Pool Condition	Depth Sufficient	11	11			100%			
		Length Appropriate	11	11			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	11	11			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	10	10			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	12	12			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6i. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT2B
Assessed Length: 263

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	12	12			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6j. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT2C
Assessed Length: 469

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12			100%			
	3. Meander Pool Condition	Depth Sufficient	11	11			100%			
		Length Appropriate	11	11			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	11	11			100%			
		Thalweg centering at downstream of meander bend (Glide)	11	11			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	13	13			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	11	11			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	13	13			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6k. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT3B
Assessed Length: 307

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12			100%			
	3. Meander Pool Condition	Depth Sufficient	11	11			100%			
		Length Appropriate	11	11			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	11	11			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	16	16			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	11	11			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	11	11			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	16	16			100%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 6l. Visual Stream Morphology Stability Assessment Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021
Reach: UT3C
Assessed Length: 412

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			2	102	75%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	10			80%			
	3. Meander Pool Condition	Depth Sufficient	7	9			78%			
		Length Appropriate	9	9			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	13	15			87%			

[1]Excludes constructed riffles since they are evaluated in Section 1.

Table 7. Vegetation Condition Assessment Table

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 2 - 2021

Date of visual assessment: August 27, 2021

Planted Acreage **9.8**

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0.0	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 5, or 7 stem count criteria.	0.1	0	0.0	0.0%
		Total	**0**	**0.0**	**0.0%**
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.1	0	0.0	0.0%
		Cumulative Total	**0**	**0.0**	**0.0%**

Easement Acreage **20.8**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000	0	0.00	0.0%
Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	0	0.00	0.0%

STREAM PHOTOGRAPHS

Bull Creek Reach 1A – Reach 4

Monitoring Year 2

	
Photo Point 1 – looking upstream (08/10/2021)	**Photo Point 1** – look downstream (08/10/2021)
	
Photo Point 2 – looking upstream (08/10/2021)	**Photo Point 2** – looking downstream (08/10/2021)
	
Photo Point 3 – looking upstream (08/10/2021)	**Photo Point 3** – looking downstream (08/10/2021)

	
Photo Point 4 – looking upstream (08/10/2021)	**Photo Point 4** – looking downstream (08/10/2021)
	
Photo Point 4A – looking upstream (08/10/2021)	**Photo Point 4A** – looking downstream (08/10/2021)
	
Photo Point 4B – looking north (08/10/2021)	**Photo Point 4C** – looking west (08/10/2021)

	
Photo Point 4D – looking upstream (08/10/2021)	**Photo Point 4D** – looking downstream (08/10/2021)
	
Photo Point 5 – looking upstream (08/10/2021)	**Photo Point 5** – looking downstream (08/10/2021)
	
Photo Point 6 – looking upstream (08/10/2021)	**Photo Point 6** – looking downstream (08/10/2021)

	
Photo Point 7 – looking upstream (08/10/2021)	**Photo Point 7** – looking downstream (08/10/2021)
	
Photo Point 8 – looking upstream (08/10/2021)	**Photo Point 8** – looking downstream (08/10/2021)
	
Photo Point 9 – looking upstream (08/10/2021)	**Photo Point 9** – looking downstream (08/10/2021)

	
Photo Point 10 – looking upstream (08/10/2021)	**Photo Point 10** – looking downstream (08/10/2021)
	
Photo Point 11 – looking upstream (08/10/2021)	**Photo Point 11** – looking downstream (08/10/2021)

STREAM PHOTOGRAPHS

UT1A – UT1C

Monitoring Year 2

	
Photo Point 12 – looking upstream (08/10/2021)	**Photo Point 12** – looking downstream (08/10/2021)
	
Photo Point 12A – looking upstream (08/10/2021)	**Photo Point 12A** – looking downstream (08/10/2021)
	
Photo Point 13 – looking upstream (08/10/2021)	**Photo Point 13** – looking downstream (08/10/2021)

	
Photo Point 14 – looking upstream (08/10/2021)	**Photo Point 14** – looking downstream (08/10/2021)
	
Photo Point 14A – looking upstream (08/10/2021)	**Photo Point 14A** – looking downstream (08/10/2021)
	
Photo Point 14B – looking upstream (08/10/2021)	**Photo Point 14B** – looking downstream (08/10/2021)

	
Photo Point 15 – looking upstream (08/10/2021)	**Photo Point 15** – looking downstream (08/10/2021)

STREAM PHOTOGRAPHS

UT2A – UT2C

Monitoring Year 2

Photo Point 16 – looking upstream (08/10/2021)

Photo Point 16 – looking downstream (08/10/2021)

Photo Point 17 – looking upstream (08/10/2021)

Photo Point 17 – looking downstream (08/10/2021)

Photo Point 18 – looking upstream (08/10/2021)

Photo Point 18 – looking downstream (08/10/2021)

	
Photo Point 19 – looking upstream (08/10/2021)	**Photo Point 19** – looking downstream (08/10/2021)
	
Photo Point 20 – looking upstream (08/10/2021)	**Photo Point 20** – looking downstream (08/10/2021)

STREAM PHOTOGRAPHS

UT3A – UT3C

Monitoring Year 2

Photo Point 21 – looking upstream (08/10/2021)

Photo Point 21 – looking downstream (08/10/2021)

Photo Point 22 – looking upstream (08/10/2021)

Photo Point 22 – looking downstream (08/10/2021)

Photo Point 22A – looking upstream (08/10/2021)

Photo Point 22A – looking downstream (08/10/2021)

	
Photo Point 23 – Wetland looking North (08/10/2021)	**Photo Point 23** – Wetland looking East (08/10/2021)
	
Photo Point 23 – Wetland looking South (08/10/2021)	**Photo Point 23** – Wetland looking West (08/10/2021)
	
Photo Point 24 – looking upstream (08/10/2021)	**Photo Point 24** – looking downstream (08/10/2021)

	
Photo Point 25 – looking upstream (08/10/2021)	**Photo Point 25** – looking downstream (08/10/2021)

VEGETATION PHOTOGRAPHS

Monitoring Year 2

	
Permanent Vegetation Plot 1 (08/12/2021)	**Permanent Vegetation Plot 2** (08/12/2021)
	
Permanent Vegetation Plot 3 (08/26/2021)	**Permanent Vegetation Plot 4** (08/16/2021)
	
Permanent Vegetation Plot 5 (08/12/2021)	**Permanent Vegetation Plot 6** (08/12/2021)

	
Permanent Vegetation Plot 7 (08/11/2021)	**Permanent Vegetation Plot 8** (08/10/2021)

Mobile Vegetation Plot 1 (North) (08/16/2021)

Mobile Vegetation Plot 2 (North) (08/16/2021)

Mobile Vegetation Plot 3 (North) (08/26/2021)

Mobile Vegetation Plot 4 (North) (08/16/2021)

Mobile Vegetation Plot 5 (North) (08/12/2021)

AREA OF CONCERN PHOTOGRAPHS

Monitoring Year 2

Bull Creek Reach 1A: Aggradation at Station 104+00 – looking upstream (08/26/2021)

Bull Creek Reach 3: Piping at Station 164+00– looking upstream (08/26/2021)

Bull Creek Reach 3: Header Dislocated from Footer at Station 164+07 – looking upstream (08/26/2021)

UTC3: Aggradation at Station 408+52 – looking upstream (08/26/2021)

APPENDIX 3. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Permanent Vegetation Plot	MY3 Success Criteria Met (Y/N)	Tract Mean (MY2 - 2021)	
1	Y	100%	100%
2	Y		
3	Y		
4	Y		
5	Y		
6	Y		
7	Y		
8	Y		
Mobile Vegetation Plot	**MY3 Success Criteria Met (Y/N)**		
1	Y	100%	
2	Y		
3	Y		
4	Y		
5	Y		

Table 9. CVS Permanent Vegetation Plot Metadata

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 2 - 2021

Report Prepared By	Brandon Romeo
Date Prepared	11/2/2021 11:24
Database Name	cvs-eep-entrytool-v2.5.0 Key Mill MY2.mdb
Database Location	\\192.168.3.7\projects\ActiveProjects\005-02165 Key Mill\Monitoring\Monitoring Year 2; 2021\Vegetation Assessment
Computer Name	BRANDON
File Size	74149888
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	100025
Project Name	Key Mill Mitigation Site
Description	Full delivery mitigation project in Surry County, NC.
Sampled Plots	13

Table 10a. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Current Permanent Vegetation Plot Data (MY2 2021)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 1**			**Permanent Plot 2**			**Permanent Plot 3**			**Permanent Plot 4**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Boxelder	Tree	2	2	2							3	3	3
Acer rubrum	Red Maple	Tree									2			
Acer saccharinum	Silver Maple, Soft Maple	Tree												
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree												
Asimina triloba [1]	Common Pawpaw, Indian-banana	Shrub Tree												
Betula nigra	River Birch, Red Birch	Tree	3	3	3	3	3	3	6	6	6	2	2	2
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	1									
Diospyros virginiana	American Persimmon	Tree												
Fagus grandifolia	American Beech	Tree												
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1	2	2	2						
Hamamelis virginiana	Witch-hazel	Shrub Tree	2	2	2									
Ilex opaca	American Holly, Christmas Holly	Shrub Tree												
Liriodendron tulipifera	Tulip Poplar	Tree			3			1						
Morus rubra	Red Mulberry	Tree	1	1	1							1	1	1
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree							4	4	4			
Platanus occidentalis [1]	Sycamore, Plane-tree	Tree	1	1	101	1	1	11	3	3	6	2	2	2
Quercus falcata	Spanish Oak, Southern Red Oak	Tree												
Quercus rubra	Northern Red Oak	Tree	3	3	3	1	1	1						
Salix nigra	Black Willow	Tree												
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	1	1	1	1				2	2	2
	Stem count		15	15	118	8	8	19	13	13	18	10	10	10
	size (ares)		1			1			1			1		
	size (ACRES)		0.0247			0.0247			0.0247			0.0247		
	Species count		9	9	10	5	5	6	3	3	4	5	5	5
	Stems per ACRE		607	607	4,775	324	324	769	526	526	728	405	405	405

[1] One planted stem was mislabeled as *Asimina triloba* in the as-built monitoring and was identified as *Platanus occidentalis* in Year 2.

Current Permanent Vegetation Plot Data (MY2 2021)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 5**			**Permanent Plot 6**			**Permanent Plot 7**			**Permanent Plot 8**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Boxelder	Tree												
Acer rubrum	Red Maple	Tree						3			6	2	2	2
Acer saccharinum	Silver Maple, Soft Maple	Tree							2	2	2			
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree			2									
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree												
Betula nigra	River Birch, Red Birch	Tree	3	3	3	2	2	2				3	3	3
Carpinus caroliniana	Ironwood	Shrub Tree												
Diospyros virginiana	American Persimmon	Tree										1	1	1
Fagus grandifolia	American Beech	Tree										1	1	1
Fraxinus pennsylvanica [2]	Green Ash, Red Ash	Tree				2	2	2	2	2	2	2	2	2
Hamamelis virginiana	Witch-hazel	Shrub Tree										1	1	1
Ilex opaca	American Holly, Christmas Holly	Shrub Tree												
Liriodendron tulipifera	Tulip Poplar	Tree												
Morus rubra	Red Mulberry	Tree												
Nyssa sylvatica [1]	Sour Gum, Black Gum, Pepperidge	Tree							1	1	1			
Platanus occidentalis	Sycamore, Plane-tree	Tree	4	4	5	4	4	4	1	1	7	1	1	1
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	1	1	1	1	1	1	1	1	1			
Quercus rubra [2]	Northern Red Oak	Tree				2	2	2	1	1	1	1	1	1
Salix nigra	Black Willow	Tree												
Viburnum dentatum [1]	Arrow-wood	Shrub Tree	1	1	1	1	1	1						
	Stem count		9	9	12	12	12	15	8	8	20	12	12	12
	size (ares)		1			1			1			1		
	size (ACRES)		0.0247			0.0247			0.0247			0.0247		
	Species count		4	4	5	6	6	7	6	6	7	8	8	8
	Stems per ACRE		364	364	486	486	486	607	324	324	809	486	486	486

[1] One planted stem was mislabeled as *Viburnum dentatum* in the as-built monitoring and was identified as *Nyssa sylvatica* in Year 2.
[2] One planted stem was mislabeled as *Fraxinus pennsylvanica* in the as-built monitoring and was identified as *Quercus rubra* in Year 2.

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

Table 10b. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Permanent Vegetation Plot Annual Mean											
Scientific Name	**Common Name**	**Species Type**	**MY2 (08/2021)**			**MY1 (10/2020)**			**MY0 (4/2020)**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Boxelder	Tree	5	5	5						
Acer rubrum	Red Maple	Tree	2	2	13			30			
Acer saccharinum	Silver Maple, Soft Maple	Tree	2	2	2	2	2	2	2	2	2
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree			2						
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree				1	1	1	5	5	5
Betula nigra	River Birch, Red Birch	Tree	22	22	22	19	19	23	16	16	16
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	1	1	1	1	4	4	4
Diospyros virginiana	American Persimmon	Tree	1	1	1						
Fagus grandifolia	American Beech	Tree	1	1	1	2	2	2	4	4	4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	9	9	9	9	9	9	12	12	12
Hamamelis virginiana	Witch-hazel	Shrub Tree	3	3	3						
Ilex opaca	American Holly, Christmas Holly	Shrub Tree				1	1	1	6	6	6
Liriodendron tulipifera	Tulip Poplar	Tree			4			9			
Morus rubra	Red Mulberry	Tree	2	2	2						
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	5	5	5	8	8	8	6	6	6
Platanus occidentalis	Sycamore, Plane-tree	Tree	17	17	137	13	13	120	16	16	16
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	3	3	3	5	5	5	7	7	7
Quercus rubra	Northern Red Oak	Tree	8	8	8	11	11	11	16	16	16
Salix nigra	Black Willow	Tree						1			
Viburnum dentatum	Arrow-wood	Shrub Tree	6	6	6	6	6	6	15	15	15
		Stem count	87	87	224	78	78	229	109	109	109
		size (ares)		8			8			8	
		size (ACRES)		0.1977			0.1977			0.1977	
		Species count	15	15	17	12	12	15	12	12	12
		Stems per ACRE	440	440	1,133	395	395	1,158	551	551	551

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

Table 10c. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Current Mobile Vegetation Plot (MP) Data (MY2 2021)								Annual Means		
Scientific Name	Common Name	Species Type	MP1	MP2	MP3	MP4	MVP5	MY2 (08/2021)	MY1 (10/2020)	MY0 (4/2020)
			PnoLS	PnoLS	PnoLS	PnoLS	PnoLS	PnoLS	PnoLS	PnoLS
Acer negundo	Boxelder	Tree			4			4		
Acer rubrum	Red Maple	Tree	3	1				4		
Acer saccharinum	Silver Maple, Soft Maple	Tree							3	1
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree								
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree				3		3	1	4
Betula nigra	River Birch, Red Birch	Tree	1	3	2	3	2	11	14	15
Carpinus caroliniana	Ironwood	Shrub Tree								5
Diospyros virginiana	American Persimmon	Tree			2	1		3		
Fagus grandifolia	American Beech	Tree								4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree			1	1	3	5	6	7
Hamamelis virginiana	Witch-hazel	Shrub Tree								
Ilex opaca	American Holly, Christmas Holly	Shrub Tree								4
Liriodendron tulipifera	Tulip Poplar	Tree								
Morus rubra	Red Mulberry	Tree				1		1		
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree							6	4
Platanus occidentalis	Sycamore, Plane-tree	Tree	3	4	3	3	5	18	19	4
Quercus falcata	Spanish Oak, Southern Red Oak	Tree							5	1
Quercus rubra	Northern Red Oak	Tree	1	3		3		7	9	16
Salix nigra	Black Willow	Tree				3	1	4		
Viburnum dentatum	Arrow-wood	Shrub Tree					1	1		5
		Stem count	8	11	12	18	12	61	63	70
		size (ares)	1	1	1	1	1	5	5	5
		size (ACRES)	0.0247	0.0247	0.0247	0.0247	0.0247	0.1236	0.1236	0.1236
		Species count	4	4	5	8	5	11	8	12
		Stems per ACRE	324	445	486	728	486	494	510	567

Overall Site Annual Mean					
Scientific Name	Common Name	Species Type	MY2 (08/2021)	MY1 (10/2020)	MY0 (4/2020)
			PnoLS	PnoLS	PnoLS
Acer negundo	Boxelder	Tree	9		
Acer rubrum	Red Maple	Tree	6		
Acer saccharinum	Silver Maple, Soft Maple	Tree	2	5	3
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree			
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	3	2	9
Betula nigra	River Birch, Red Birch	Tree	33	33	31
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	9
Diospyros virginiana	American Persimmon	Tree	4		
Fagus grandifolia	American Beech	Tree	1	2	8
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	14	15	19
Hamamelis virginiana	Witch-hazel	Shrub Tree	3		
Ilex opaca	American Holly, Christmas Holly	Shrub Tree		1	10
Liriodendron tulipifera	Tulip Poplar	Tree			
Morus rubra	Red Mulberry	Tree	3		
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	5	14	10
Platanus occidentalis	Sycamore, Plane-tree	Tree	35	32	20
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	3	10	8
Quercus rubra	Northern Red Oak	Tree	15	20	32
Salix nigra	Black Willow	Tree	4		
Viburnum dentatum	Arrow-wood	Shrub Tree	7	6	20
		Stem count	148	141	179
		size (ares)	13	13	13
		size (ACRES)	0.3212	0.3212	0.3212
		Species count	17	12	12
		Stems per ACRE	461	439	557

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

APPENDIX 4. Morphological Summary Data and Plots

Table 11a. Baseline Stream Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

		Pre-Restoration Condition												Design												As-Built/Baseline											
Parameter	Gage	Bull Creek R1A		Bull Creek R1B		Bull Creek R2		Bull Creek R3		UT1B		UT1C		Bull Creek R1A		Bull Creek R1B		Bull Creek R2		Bull Creek R3		UT1B		UT1C		Bull Creek R1A		Bull Creek R1B		Bull Creek R2		Bull Creek R3		UT1B		UT1C	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																																					
Bankfull Width (ft)		16.2	19.1	16.2	19.1	16.2	19.1	18.0	25.4	5.6	7.0	5.6	7.0	19.5		17.5		16.0		21.0		8.5		8.3		19.4		17.3		16.4		19.6	21.2	6.8		6.9	
Floodprone Width[2] (ft)		21	25	21	25	21	25	27	53	14	17	14	17	42.9	97.5	38.5	87.5	35.2	80.0	46.2	105.0	12.0	19.0	12.0	18.0	70.1		67.6		55.7		94.0	99.0	23.6		34.0	
Bankfull Mean Depth (ft)		1.1		1.1		1.1		1.1	2.1	0.7	1.0	0.7	1.0	1.6		1.3		1.2		1.5		0.6		0.6		1.5		1.7		1.4		1.6	1.8	0.6		0.8	
Bankfull Max Depth (ft)		1.8	2.1	1.8	2.1	1.8	2.1	1.6	2.7	1.0	1.5	1.0	1.5	2.0	2.8	1.7	2.4	1.4	1.9	1.8	2.4	0.7	1.0	0.7	1.1	2.8		2.9		2.5		2.7	3.0	0.9		1.3	
Bankfull Cross-sectional Area (ft[2])	N/A	18.7	21.6	18.7	21.6	18.7	21.6	26.2	39.5	3.9	6.8	3.9	6.8	30.2		23.2		19.3		31.1		5.3		4.8		28.2		29.7		22.9		33.5	36.0	3.9		5.7	
Width/Depth Ratio		14.1	16.8	14.1	16.8	14.1	16.2	8.5	22.5	7.3	8.1	7.3	8.1	12.6		13.2		13.3		14.2		13.8		14.5		13.4		10.1		11.8		10.7	13.4	11.7		8.3	
Entrenchment Ratio[2]		1.3		1.3		1.3		1.3	2.9	2.4	2.5	2.4	2.5	2.2	4.6	>2.2		6.3	7.8	>2.2		2.8	3.3	2.7	2.9	3.6		3.9		3.4		4.3	4.7	3.5		4.9	
Bank Height Ratio		3.7	4.1	3.7	4.1	3.7	4.1	1.9	2.8	5.0	7.9	5.0	7.9	1.0												1.0		1.0		1.0		1.0	1.0	1.0		1.0	
D_{50} (mm)		91.6	96.6	91.6	96.6	25.8	37.2	64.0		17.7	24.2	17.7	24.2													107.3		82.2		135.9		56.4	56.9	33.9		56.2	
Profile																																					
Riffle Length (ft)																																					
Riffle Slope (ft/ft)														0.0100	0.0148	0.0162	0.0203	0.0172	0.0318	0.0103	0.0171	0.0314	0.0801	0.0080	0.0526	0.0050	0.0140	0.0133	0.0258	0.0274	0.0377	0.0037	0.0197	0.0285	0.0604	0.0108	0.0527
Pool Length (ft)																																					
Pool Max Depth (ft)		4.9		4.9		4.9		1.5	2.3	2.6		2.6		4.0	5.6	3.5	4.8	3.2		3.9	6.5	1.3	1.8	1.7		4.3	5.0	3.1	4.6	3.3	4.2	3.0	5.4	0.9	2.0	1.2	2.4
Pool Spacing (ft)		52.0		52.0		52.0		N/A		48.0	262.0	48.0	262.0	96.0	111.0	80.0	101.0	74.6	76.7	55.8	149.0	20.0	54.0	20.0	27.0	230.4		76.6	110.1	59.3	99.2	60.8	187.8	19.9	63.0	18.2	51.5
Pool Volume (ft[3])																																					
Pattern																																					
Channel Beltwidth (ft)		---		---		---		---		---		---		68.8	89.4	53.4	81.3	45.0	69.2	39.0	108.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]	68.8	89.4	53.4	81.3	45.0	69.2	39.0	108.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Radius of Curvature (ft)		---		---		---		---		---		---		35.0	50.0	32.0	50.0	30.0	50.5	36.0	85.6	N/A[1]	N/A[1]	N/A[1]	N/A[1]	35.0	50.0	32.0	50.0	30.0	50.5	36.0	85.6	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Rc/Bankfull Width	N/A	---		---		---		---		---		---		1.8	2.6	1.8	2.9	1.9	3.2	1.7	4.1	N/A[1]	N/A[1]	N/A[1]	N/A[1]	1.8	2.6	1.8	2.9	1.9	3.2	1.7	4.1	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Meander Length (ft)		---		---		---		---		---		---		192.2	207.2	179.2	199.8	149.3	171.4	177.0	312.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]	192.2	207.2	179.2	199.8	149.3	171.4	177.0	312.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Meander Width Ratio		---		---		---		---		---		---		3.5	4.6	3.1	4.6	2.8	4.3	1.9	5.2	N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.5	4.6	3.1	4.6	2.8	4.3	1.9	5.2	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Substrate, Bed and Transport Parameters																																					
Ri%/Ru%/P%/G%/S%																																					
SC%/Sa%/G%/C%/B%/Be%																																					
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	N/A	0.3/2.8/34.3/167.3/287.3/ >2048				0.5/9.2/13.7/ 100.0/180.0/ 362.0		0.5/3.4/13.3/ 109.5/166.9/ 256.0		0.3/8.0/13.5/33.6/75.9/ 180.0																		0.1/5.6/20.7/ 113.8/171.4/ 362.0		0.1/5.6/28.5/ 151.8/256.0/ 362.0		SC/0.3/11.0/ 222.4/346.7/ 512.0		0.2/0.5/19.0/ 96.0/146.7/ 362.0		0.3/6.4/12.8/45.0 /101.2/ 256.0		0.3/1.8/8.9/ 87.3/137.0/ 1024.0	
Reach Shear Stress (Competency) lb/ft[2]														0.64		0.98		1.76		1.02		1.19		1.50		0.66		1.32		2.17		0.92		1.31		2.03	
Max part size (mm) mobilized at bankfull														49		77		140		80		94		119		29.0		60.0		89.0		42.0	47.0	53.0		94.0	
Stream Power (Capacity) W/m[2]																																					
Additional Reach Parameters																																					
Drainage Area (SM)		1.63		1.68		1.79		2.02		0.16		0.16		1.63		1.68		1.79		2.02		0.16		0.16		1.63		1.68		1.79		2.02		0.16		0.16	
Watershed Impervious Cover Estimate (%)		1%								<1%				1%								<1%				1%								<1%			
Rosgen Classification		F3		F3		F3		F3/G3c		G4c		G4		C3		C3		C3b		C3		B4		B4a		C3		C3		C3b		C3		B4		B4a	
Bankfull Velocity (fps)		4.8	4.9	4.8	4.9	4.8	4.9	4.2	4.3	3.5	5.0	3.5	5.0	3.2		3.9		5.2		3.9		3.8		4.1		3.8		5.6		6.6		4.7	5.1	4.4		6.2	
Bankfull Discharge (cfs)		90.0		90.0		99.0		116.0		19.0		19.0		90.0		90.0		99.0		116.0		19.0		19.00		107		166		151		157	184	17		35	
Q-NFF regression (2-yr)	N/A																																				
Q-USGS extrapolation (1.2-yr)														111				119		130		20		20													
Max Q-Mannings														1,484				N/A		922		1,159															
Valley Slope (ft/ft)		0.0100		0.0120		0.0270		0.0080		0.0240		0.0370		0.0086		0.0150		0.0295		0.0118		0.0335		0.0458		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		435		876		403		2,291		188		332		444		722		418		1,674		212		257		421		722		418		1,676		212		257	
Sinuosity		1.2		1.2		1.2		1.2		1.1		1.3		1.3		1.2		1.2		1.3		1.1		1.1		1.2		1.2		1.2		1.3		1.1		1.1	
Bankfull/Channel Slope (ft/ft)		0.0130		0.0090		0.0160		0.0190		0.0140		0.0440		0.0069		0.0123		0.0242		0.0076	0.0114	0.0316		0.0425		0.0071		0.0124		0.0249		0.0092		0.0349		0.0407	

1. Pattern data is not applicable for A-type and B-type channels
2. ER for the baseline/monitoring parameters are based on the width of the cross-section, in lieu of assuming the width across the floodplain.
SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11b. Baseline Stream Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

		Pre-Restoration Condition												Design												As-Built/Baseline											
Parameter	**Gage**	**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**		**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**		**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																																					
Bankfull Width (ft)		5.3		5.3		5.3		5.3		3.9	5.7	3.9	5.7	3.5		6.0		6.0		6.8		7.0		7.5		N/A		6.8		8.1		7.8		6.9		8.8	
Floodprone Width[2] (ft)		84	112	84	112	84	112	84	112	9	14	9	14	5.0	8.0	8.0	13.0	13.0	30.0	15.0	34.0	10.0	15.0	16.5	37.5	N/A		30.3		32.0		48.2		21.4		55.8	
Bankfull Mean Depth (ft)		1.1	1.4	1.1	1.4	1.1	1.4	1.1	1.4	0.7		0.7		0.2		0.5		0.5		0.5		0.5		0.6		N/A		0.5		0.6		0.7		0.5		0.8	
Bankfull Max Depth (ft)		1.9	2.0	1.9	2.0	1.9	2.0	1.9	2.0	0.8	1.2	0.8	1.2	0.3	0.4	0.5	0.7	0.5	0.7	0.6	0.8	0.6	0.8	0.8	1.0	N/A		0.8		1.1		1.1		0.8		1.3	
Bankfull Cross-sectional Area (ft^2)	N/A	5.7	7.4	5.7	7.4	5.7	7.4	5.7	7.4	2.8	4.1	2.8	4.1	0.9		2.7		2.6		3.2		3.6		4.7		N/A		3.4		4.8		5.8		3.5		6.8	
Width/Depth Ratio		3.7	4.8	3.7	4.8	3.7	4.8	3.7	4.8	5.4	7.8	5.4	7.8	14.2		13.3		13.3		12.9		13.7		12.0		N/A		13.9		11.7		10.5		13.4		11.3	
Entrenchment Ratio[2]		16.0	21.2	16.0	21.2	16.0	21.2	16.0	21.2	1.6	3.5	1.6	3.5	1.4	2.2	2.8	5.7	5.0	7.5	5.1	6.6	3.1	6.0	>2.2		N/A		4.4		3.5		6.2		3.1		6.3	
Bank Height Ratio		1.4	1.9	1.4	1.9	1.4	1.9	1.4	1.9	2.7	3.8	2.7	3.8	1.0												N/A		1.0		1.0		1.0		1.0		1.0	
D_{50} (mm)		SC	0.1	SC	1.1	SC	2.1	SC	3.1	3.6	6.4	3.6	6.4													N/A		58.6		69.3		49.0		21.1		28.2	
Profile																																					
Riffle Length (ft)																																					
Riffle Slope (ft/ft)														0.0457	0.0681	0.0287	0.0414	0.0135	0.0409	0.0135	0.0449	0.0385	0.0488	0.0198	0.0266	N/A		0.0046	0.0347	0.0054	0.0371	0.0132	0.0510	0.0113	0.0530	0.0081	0.0249
Pool Length (ft)	N/A																																				
Pool Max Depth (ft)		---		---		---		---		---		---		1.6		1.3		1.4		1.5		1.6		1.9		N/A		1.4	2.2	1.6	2.2	1.4	2.1	0.9	2.6	1.8	2.5
Pool Spacing (ft)		---		---		---		---		---		---		21.0		22.0	33.0	23.0	44.0	30.0	47.0	24.0	29.0	31.0	58.0	N/A		18.6	39.9	20.5	44.1	26.1	55.9	19.5	30.4	17.4	79.9
Pool Volume (ft^3)																																					
Pattern																																					
Channel Beltwidth (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	19.0	26.0	23.0	34.0	N/A[1]	N/A[1]	17.2	44.8	N/A[1]	N/A[1]	N/A[1]	N/A[1]	19.0	26	23.0	34.0	N/A[1]	N/A[1]	17.2	44.8
Radius of Curvature (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	12.0	15.0	13.0	17.0	N/A[1]	N/A[1]	12.0	22.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	12.0	15.0	13.0	17.0	N/A[1]	N/A[1]	12.0	22.0
Rc/Bankfull Width	N/A	---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	2.0	2.5	1.9	2.5	N/A[1]	N/A[1]	1.6	2.9	N/A[1]	N/A[1]	N/A[1]	N/A[1]	2.0	2.5	1.9	2.5	N/A[1]	N/A[1]	1.6	2.9
Meander Length (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	56.0	76.0	73.0	90.0	N/A[1]	N/A[1]	65.2	118.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	56.0	76.0	73.0	90.0	N/A[1]	N/A[1]	65.2	118.0
Meander Width Ratio		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.2	4.3	3.3	4.9	N/A[1]	N/A[1]	2.2	6.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.2	4.3	3.3	4.9	N/A[1]	N/A[1]	2.2	6.0
Substrate, Bed and Transport Parameters																																					
Ri%/Ru%/P%/G%/S%																																					
SC%/Sa%/G%/C%/B%/Be%																																					
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	N/A	N/A		SC/0.1/0.2/8.4/12.5/32.0						SC/0.5/5.9/21.0/100.0/256.0																N/A		SC/0.1/0.8/ 64.0/ 85.4/128.0		SC/0.1/1.3/ 85.4/137.0/256.0		SC/0.1/8.9/92.5/ 124.6/256.0		0.8/4.2/9.4/ 64.0/165.3/362.0		0.1/0.3/4.0/73.4/ 148.1/256.0	
Reach Shear Stress (Competency) lb/ft^2														1.06		1.05		0.52		0.38		1.13		0.55		N/A		0.74		0.69		0.59		0.99		0.66	
Max part size (mm) mobilized at bankfull														84		83		40		29		89		42		N/A		36.0		35.0		28.0		50.0		28.0	
Stream Power (Capacity) W/m^2																																					
Additional Reach Parameters																																					
Drainage Area (SM)		0.01		0.05		0.05		0.05		0.07		0.07		0.01		0.04		0.05		0.05		0.07		0.07		0.01		0.04		0.05		0.05		0.07		0.07	
Watershed Impervious Cover Estimate (%)		<1%												<1%												<1%											
Rosgen Classification		G4		G5		G5c		G5		G5		G5c		B4		B4		C4b		C4		B4		C4		B4		B4		C4b		C4		B4		C4	
Bankfull Velocity (fps)		1.9	2.2	1.9	2.2	1.9	2.2	1.9	2.2	4.0	4.2	4.0	4.2	3.0		2.7		2.4		2.2		3.3		2.4		N/A		3.6		3.7		3.3		4.2		3.4	
Bankfull Discharge (cfs)		3.0		7.0		7.0		7.0		12.0		12.0		3.0		7.0		7.0		7.0		12.0		12.0		N/A		12		18		19		15		23	
Q-NFF regression (2-yr)																																					
Q-USGS extrapolation (1.2-yr)	N/A													3		9						11															
Max Q-Mannings														N/A		62						102															
Valley Slope (ft/ft)		0.0640		0.0290		0.0310		0.0190		0.0360		0.0160		0.0731		0.0272		0.0234		0.0179		0.0329		0.0153		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		61		349		299		223		414		296		42		315		263		469		307		412		42		315		263		469		307		412	
Sinuosity		1.1		1.1		1.2		1.1		1.5		1.2		N/A		1.1		1.2		1.3		1.1		1.2		N/A		1.1		1.2		1.3		1.1		1.2	
Bankfull/Channel Slope (ft/ft)		0.0470		0.0220		0.0170		0.0200		0.0230		0.0170		0.0580		0.0229	0.0387	0.0200		0.0135		0.0304	0.0363	0.0121	0.0146	N/A		0.0237		0.0184		0.0134		0.0317		0.0132	

1. Pattern data is not applicable for A-type and B-type channels
2. ER for the baseline/monitoring parameters are based on the width of the cross-section, in lieu of assuming the width across the floodplain.
SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11c. Reference Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Reference Reach Data																			
Parameter	**Gage**	**UT to Catawba R1**		**UT to Catawba R2**		**UT to Sandy Run**		**Box Creek**		**UT to Kelly Branch**		**UT to Gap Branch**		**UT to South Fork Catawba**		**Timber Tributary**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	N/A	9.7	12.4	12.3		7.3	7.8	23.5		7.9		6.2		8.2	11.2	8.9	
Floodprone Width (ft)		52.0	79.0	53.0		12.2	15.6	76.3		9.1		20.9		14.7	18.5	13.6	
Bankfull Mean Depth		1.2	1.4	1.1		0.7	0.8	1.2		0.7		0.6		1.0	1.4	0.5	
Bankfull Max Depth		1.7		1.7		1.1	1.4	1.9		1.1		1.0		1.5	1.6	0.7	
Bankfull Cross-sectional Area (ft^2)		11.4	17.5	13.2		5.7	6.2	28.9		5.7		3.8		10.7	11.1	4.6	
Width/Depth Ratio		8.1	8.9	11.5		6.6	9.8	19.1		10.9		10.1		6.0	11.7	17.0	17.5
Entrenchment Ratio		5.4	6.4	4.3		1.6	2.1	3.3		1.2		3.4		1.5	1.9	1.5	
Bank Height Ratio		0.9	1.4	0.8	1.3	1.7	2.6	1.5		2.5		1.0		1.8	2.1	1.0	2.4
D50 (mm)		1.8		75.9		19.0		22		N/A		19.0		38.0		6.5	
Profile																	
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		---	
Riffle Slope (ft/ft)		0.0114	0.0605	0.0142	0.3451	0.0036	0.0420	0.0063	0.0770	N/A		0.0110	0.1400	0.0120	0.0320	0.0230	0.1700
Pool Length (ft)		---		---		---		---		---		---		---		---	
Pool Max Depth (ft)		2.5		N/A		1.3	1.5	4.4		N/A		1.5		2.4		N/A	
Pool Spacing (ft)		31	60	19	46	9	55	29	88	N/A		18	27	36	149	13	49
Pool Volume (ft^3)		---		---		---		---		---		---		---		---	
Pattern																	
Channel Beltwidth (ft)	N/A	55		23		24	60	62	88	18	34	N/A		25	56	N/A	
Radius of Curvature (ft)		31	56	29	52	14	29	7	38	8	26	N/A		9	28	N/A	
Rc/Bankfull Width		2.8	5.1	2.4	4.2	1.9	3.8	0.3	1.6	N/A		N/A		0.9	2.9	N/A	
Meander Length (ft)		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Meander Width Ratio		4.4	5.7	1.8		3.3	7.6	2.6	3.7	2.3	4.3	N/A		2.6	5.8	N/A	
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	N/A																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		0.3/0.4/1.8/12.8/25.2/90.0		0.5/29.8/75.9/170.8/332.0/2048.0		0.062/1/19/76/150		4.1/11/22/50/78		N/A		0.37/8/19.02/102.3/256/>2048		8.9/27/38/71/150		0.49/3.5/6.5/48.0/83.0/128.0	
Reach Shear Stress (Competency) lb/ft^2																	
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	N/A	1.6		1.6		0.2		2.1		0.1		0.0		0.2		0.1	
Watershed Impervious Cover Estimate (%)		---		---		---		---		---		---		---		---	
Rosgen Classification		E5		E3b/ C3b		E4		C4		B4/ B4a		B4a or A4		B4c		B4	
Bankfull Velocity (fps)		5.5		6.1		3.4		3.4		5.9		5.0		2.7		3.7	
Bankfull Discharge (cfs)		80		80		20		99		23		19		26	32	17	
Q-NFF regression (2-yr)																	
Q-USGS extrapolation (1.2-yr)																	
Q-Mannings																	
Valley Length (ft)		---		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		---		---		---		---		---		---		---		---	
Sinuosity		1.1		1.1		1.6		1.3		1.2		---		1.3		N/A	
Water Surface Slope (ft/ft)		---		---		---		---		---		---		---		---	
Bankfull/Channel Slope (ft/ft)		0.0046		0.0270		0.0150		0.0084		0.0300	0.0650	0.0680		0.0067		---	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided N/A: Not Applicable

Table 12. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

	Bull Creek Reach 1A Cross-Section 1, Riffle								Bull Creek Reach 1B Cross-Section 2, Riffle[4]								Bull Creek Reach 1B Cross-Section 3, Pool								Bull Creek Reach 2 Cross-Section 4, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1106.41	1106.62	1106.65						1099.36	1099.30	1099.26						1098.70	1098.92	1098.83						1088.01	1087.72	1087.70					
Low Bank Elevation	1106.41	1106.54	1106.31						1099.36	1099.16	1099.24						1098.70	1098.92	1098.83						1088.01	1088.08	1087.60					
Bankfull Width (ft)	19.4	20.6	16.1						17.3	17.2	18.4						24.4	30.4	30.1						16.4	17.9	15.6					
Floodprone Width (ft)[2]	70.1	70.0	69.5						67.6	67.6	66.2						-	-	-						55.7	55.6	55.6					
Bankfull Mean Depth (ft)	1.5	1.3	1.4						1.7	1.6	1.6						2.3	2.8	2.7						1.4	1.6	1.4					
Bankfull Max Depth (ft)	2.8	2.8	2.5						2.9	2.7	3.0						5.3	6.0	5.9						2.5	2.9	2.3					
Bankfull Cross-Sectional Area (ft^2)	28.2	26.7	22.6						29.7	27.3	29.3						56.8	84.5	79.9						22.9	29.0	21.3					
Bankfull Width/Depth Ratio	13.4	16.0	11.5						10.1	10.8	11.6						10.5	10.9	11.3						11.8	11.0	11.4					
Bankfull Entrenchment Ratio[3]	3.6	3.4	4.3						3.9	3.9	3.6						-	-	-						3.4	3.1	3.6					
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9						1.0	1.0	1.0						-	-	-						1.0	1.1	1.0					

	Bull Creek Reach 3 Cross-Section 5, Pool								Bull Creek Reach 3 Cross-Section 6, Riffle								Bull Creek Reach 3 Cross-Section 7, Riffle								Bull Creek Reach 3 Cross-Section 8, Pool							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1079.64	1079.57	1079.48						1079.35	1079.51	1079.46						1073.27	1072.90	1072.76						1068.53	1068.20	1067.99					
Low Bank Elevation	1079.64	1079.57	1079.48						1079.35	1079.42	1079.33						1073.27	1072.62	1072.37						1068.53	1068.20	1067.99					
Bankfull Width (ft)	27.0	26.2	26.7						21.2	21.4	20.9						19.6	23.5	21.3						29.3	32.2	22.2					
Floodprone Width (ft)[2]	-	-	-						99.0	99.0	98.9						84.0	84.0	84.0						-	-	-					
Bankfull Mean Depth (ft)	1.8	1.9	1.8						1.6	1.5	1.5						1.8	1.2	1.3						1.9	1.4	1.9					
Bankfull Max Depth (ft)	3.7	4.8	4.8						2.7	2.4	2.3						3.0	2.5	2.5						4.3	3.8	3.9					
Bankfull Cross-Sectional Area (ft^2)	49.0	50.3	48.8						33.5	31.7	30.7						36.0	29.2	27.7						55.1	45.7	42.3					
Bankfull Width/Depth Ratio	14.9	13.6	14.6						13.4	14.5	14.3						10.7	18.9	16.5						15.6	22.7	11.6					
Bankfull Entrenchment Ratio[3]	-	-	-						4.7	4.6	4.7						4.3	3.6	3.9						-	-	-					
Bankfull Bank Height Ratio[1]	-	-	-						1.0	1.0	0.9						1.0	0.9	0.9						-	-	-					

	UT1B Cross-Section 9, Riffle								UT1C Cross-Section 10, Riffle								UT2A Cross-Section 11, Riffle								UT2B Cross-Section 12, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1101.94	1102.09	1102.13						1089.27	1088.91	1088.90						1096.25	1096.44	1096.48						1088.43	1088.53	1088.49					
Low Bank Elevation	1101.94	1102.05	1101.93						1089.27	1089.29	1089.21						1096.25	1096.40	1096.43						1088.43	1088.57	1088.45					
Bankfull Width (ft)	6.8	6.3	5.8						6.9	6.4	7.3						6.8	7.3	8.2						8.1	8.8	8.5					
Floodprone Width (ft)[2]	23.6	26.9	18.8						34.0	35.4	34.9						30.3	31.4	30.0						32.0	30.9	28.0					
Bankfull Mean Depth (ft)	0.6	0.6	0.5						0.8	1.2	1.1						0.5	0.4	0.4						0.6	0.5	0.5					
Bankfull Max Depth (ft)	0.9	1.2	0.9						1.3	1.9	1.9						0.8	0.7	0.6						1.1	1.0	0.9					
Bankfull Cross-Sectional Area (ft^2)	3.9	3.7	2.6						5.7	8.0	7.7						3.4	3.1	3.0						4.8	4.5	3.9					
Bankfull Width/Depth Ratio	11.7	10.8	12.8						8.3	5.2	6.9						13.9	17.3	22.5						13.4	17.1	18.6					
Bankfull Entrenchment Ratio[3]	3.5	4.3	3.2						4.9	5.5	4.8						4.4	4.3	3.6						4.0	3.5	3.3					
Bankfull Bank Height Ratio[1]	1.0	1.0	0.8						1.0	1.3	1.2						1.0	0.9	0.9						1.0	1.0	1.0					

	UT2C Cross-Section 13, Riffle								UT3B Cross-Section 14, Riffle								UT3C Cross-Section 15, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1081.59	1081.67	1081.59						1084.57	1084.34	1084.52						1081.13	1081.26	1081.24					
Low Bank Elevation	1081.59	1081.68	1081.48						1084.57	1084.80	1084.74						1081.13	1081.21	1081.07					
Bankfull Width (ft)	7.8	8.2	7.7						6.9	7.4	6.9						8.8	8.4	7.9					
Floodprone Width (ft)[2]	48.2	50.0	46.1						21.4	61.3	43.6						55.8	55.8	55.4					
Bankfull Mean Depth (ft)	0.7	0.7	0.6						0.5	0.8	0.7						0.8	0.8	0.7					
Bankfull Max Depth (ft)	1.1	1.2	1.1						0.8	1.7	1.3						1.3	1.4	1.3					
Bankfull Cross-Sectional Area (ft^2)	5.8	5.8	5.0						3.5	6.1	4.8						6.8	6.4	5.4					
Bankfull Width/Depth Ratio	10.5	11.6	12.0						13.4	8.9	9.9						11.3	11.1	11.5					
Bankfull Entrenchment Ratio[3]	6.2	6.1	6.0						3.1	8.3	6.3						6.3	6.6	7.0					
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9						1.0	1.4	1.2						1.0	1.0	0.9					

[1]Bankfull elevation for riffles are based on the MY0 cross-sectional area. MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

[2]Floodprone width is calculated from the width of cross-section but valley width may extend further.

[3]ER for the baseline/monitoring parameters is based on the width of the cross-section, in lieu of assuming the width across the floodplain.

[4]Repairs conducted during MY1 resulted in a slight shift in the cross-section alignment between the MY0 and MY1 cross-section pin locations; therefore the plot was adjusted so that cross-sections lined up for easier comparison.

Table 13a. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 1A

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	19.4		20.6		16.1											
Floodprone Width (ft)	70		70		70											
Bankfull Mean Depth (ft)	1.5		1.3		1.4											
Bankfull Max Depth (ft)	2.8		2.8		2.5											
Bankfull Cross-sectional Area (ft^2)	28.2		26.7		22.6											
Width/Depth Ratio	13.4		16.0		11.5											
Entrenchment Ratio	3.6		3.4		4.3											
Bank Height Ratio	1.0		1.0		0.9											
D_{50} (mm)	107.3															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.005	0.014														
Pool Length (ft)																
Pool Max Depth (ft)	4.3	5.0														
Pool Spacing (ft)	230.4															
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	68.8	89.4														
Radius of Curvature (ft)	35.0	50.0														
Rc/Bankfull Width (ft/ft)	1.8	2.6														
Meander Length (ft)	192.2	207.2														
Meander Width Ratio	3.5	4.6														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.1/5.6/20.7/113.8/171.4/362.0		0.1/0.2/11.0/120.1/174.0/512.0		SC/0.2/1.0/114.7/171.4/362.0											
Reach Shear Stress (Competency) lb/ft^2	0.66															
Max part size (mm) mobilized at bankfull	29.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	1.63															
Watershed Impervious Cover Estimate (%)	1%															
Rosgen Classification	C3															
Bankfull Velocity (fps)	3.8															
Bankfull Discharge (cfs)	107.0															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	421															
Sinuosity	1.20															
Bankfull/Channel Slope (ft/ft)	0.0071															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13b. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 1B

Parameter	As-Built/Baseline		MY1[2]		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	17.3		17.2		18.4											
Floodprone Width (ft)	68		68		66											
Bankfull Mean Depth (ft)	1.7		1.6		1.6											
Bankfull Max Depth (ft)	2.9		2.7		3.0											
Bankfull Cross-sectional Area (ft^2)	29.7		27.3		29.3											
Width/Depth Ratio	10.1		10.8		11.6											
Entrenchment Ratio	3.9		3.9		3.6											
Bank Height Ratio	1.0		1.0		1.0											
D_{50} (mm)	82.2															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.013	0.026														
Pool Length (ft)																
Pool Max Depth (ft)	3.1	4.6														
Pool Spacing (ft)	76.6	110.1														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	53.4	81.3														
Radius of Curvature (ft)	32.0	50.0														
Rc/Bankfull Width (ft/ft)	1.8	2.9														
Meander Length (ft)	179.2	199.8														
Meander Width Ratio	3.1	4.6														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.1/5.6/28.5/ 151.8/256.0/ 362.0		0.1/0.3/37.9/168.1/304.4 /512.0		0.1/0.4/2.0/148.1/234.4/ 512.0											
Reach Shear Stress (Competency) lb/ft^2	1.32															
Max part size (mm) mobilized at bankfull	60.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	1.68															
Watershed Impervious Cover Estimate (%)	1%															
Rosgen Classification	C3															
Bankfull Velocity (fps)	5.6															
Bankfull Discharge (cfs)	166															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	722															
Sinuosity	1.22															
Bankfull/Channel Slope (ft/ft)	0.0124															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

[2]Repairs conducted during MY1 resulted in a slight shift in the cross-section alignment between the cross-section pins; therefore the plot was adjusted so that cross-sectional areas lined up for easier comparison.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13c. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	16.4		17.9		15.6											
Floodprone Width (ft)	56		56		56											
Bankfull Mean Depth (ft)	1.4		1.6		1.4											
Bankfull Max Depth (ft)	2.5		2.9		2.3											
Bankfull Cross-sectional Area (ft^2)	22.9		29.0		21.3											
Width/Depth Ratio	11.8		11.0		11.4											
Entrenchment Ratio	3.4		3.1		3.6											
Bank Height Ratio	1.0		1.1		1.0											
D_{50} (mm)	135.9															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.027	0.038														
Pool Length (ft)																
Pool Max Depth (ft)	3.3	4.2														
Pool Spacing (ft)	59.3	99.2														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	45.0	69.2														
Radius of Curvature (ft)	30.0	50.5														
Rc/Bankfull Width (ft/ft)	1.9	3.2														
Meander Length (ft)	149.3	171.4														
Meander Width Ratio	2.8	4.3														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	SC/0.3/11.0/ 222.4/346.7/ 512.0		SC/0.4/32.0/118.0/256.0 /1024.0		0.1/0.5/1.8/222.4/326.3 /1024.0											
Reach Shear Stress (Competency) lb/ft^2	2.17															
Max part size (mm) mobilized at bankfull	89.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	1.79															
Watershed Impervious Cover Estimate (%)	1%															
Rosgen Classification	C3b															
Bankfull Velocity (fps)	6.6															
Bankfull Discharge (cfs)	151															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	418															
Sinuosity	1.22															
Bankfull/Channel Slope (ft/ft)	0.0249															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13d. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 3

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	19.6	21.2	21.4	23.5	20.9	21.3										
Floodprone Width (ft)	94	99	84	99	84	98.9										
Bankfull Mean Depth (ft)	1.6	1.8	1.2	1.5	1.3	1.5										
Bankfull Max Depth (ft)	2.7	3.0	2.4	2.5	2.3	2.5										
Bankfull Cross-sectional Area (ft^2)	33.5	36.0	29.2	31.7	27.7	30.7										
Width/Depth Ratio	10.7	13.4	14.5	18.9	14.3	16.5										
Entrenchment Ratio	4.3	4.7	3.6	4.6	3.9	4.7										
Bank Height Ratio	1.0	1.0	0.9	1.0	0.9	0.9										
D_{50} (mm)	56.4	56.9														
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.004	0.020														
Pool Length (ft)																
Pool Max Depth (ft)	3.0	5.4														
Pool Spacing (ft)	60.8	187.8														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	39.0	108.4														
Radius of Curvature (ft)	36.0	85.6														
Rc/Bankfull Width (ft/ft)	1.7	4.1														
Meander Length (ft)	177.0	312.4														
Meander Width Ratio	1.9	5.2														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.2/0.5/19.0/ 96.0/146.7/ 362.0		0.1/0.2/22.6/143.4/ 256.0/512.0		0.2/0.5/26.9/125.2/180.0 /362.0											
Reach Shear Stress (Competency) lb/ft^2	0.92															
Max part size (mm) mobilized at bankfull	42.0	47.0														
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	2.02															
Watershed Impervious Cover Estimate (%)	1%															
Rosgen Classification	C3															
Bankfull Velocity (fps)	4.7	5.1														
Bankfull Discharge (cfs)	157	184														
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	1,676															
Sinuosity	1.28															
Bankfull/Channel Slope (ft/ft)	0.0092															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13e. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT1B

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[2]																
Bankfull Width (ft)	6.8		6.3		5.8											
Floodprone Width (ft)	24		27		19											
Bankfull Mean Depth (ft)	0.6		0.6		0.5											
Bankfull Max Depth (ft)	0.9		1.2		0.9											
Bankfull Cross-sectional Area (ft^2)	3.9		3.7		2.6											
Width/Depth Ratio	11.7		10.8		12.8											
Entrenchment Ratio	3.5		4.3		3.2											
Bank Height Ratio	1.0		1.0		0.8											
D_{50} (mm)	33.9															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.029	0.060														
Pool Length (ft)																
Pool Max Depth (ft)	0.9	2.0														
Pool Spacing (ft)	19.9	63.0														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	N/A[1]	N/A[1]														
Radius of Curvature (ft)	N/A[1]	N/A[1]														
Rc/Bankfull Width (ft/ft)	N/A[1]	N/A[1]														
Meander Length (ft)	N/A[1]	N/A[1]														
Meander Width Ratio	N/A[1]	N/A[1]														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.3/6.4/12.8/45.0/101.2 / 256.0		0.3/8.0/22.6/69.0/113.8 /180.0		0.4/1.7/16.7/65.7/87.7/ 256.0											
Reach Shear Stress (Competency) lb/ft^2	1.31															
Max part size (mm) mobilized at bankfull	53.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.16															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	B4															
Bankfull Velocity (fps)	4.4															
Bankfull Discharge (cfs)	17															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	212															
Sinuosity	1.10															
Bankfull/Channel Slope (ft/ft)	0.0349															

[1]Pattern data is not applicable for A-type and B-type channels

[2]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13f. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT1C

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[2]																
Bankfull Width (ft)	6.9		6.4		7.3											
Floodprone Width (ft)	34		35		35											
Bankfull Mean Depth (ft)	0.8		1.2		1.1											
Bankfull Max Depth (ft)	1.3		1.9		1.9											
Bankfull Cross-sectional Area (ft^2)	5.7		8.0		7.7											
Width/Depth Ratio	8.3		5.2		6.9											
Entrenchment Ratio	4.9		5.5		4.8											
Bank Height Ratio	1.0		1.3		1.2											
D_{50} (mm)	56.2															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.011	0.053														
Pool Length (ft)																
Pool Max Depth (ft)	1.2	2.4														
Pool Spacing (ft)	18.2	51.5														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	N/A[1]	N/A[1]														
Radius of Curvature (ft)	N/A[1]	N/A[1]														
Rc/Bankfull Width (ft/ft)	N/A[1]	N/A[1]														
Meander Length (ft)	N/A[1]	N/A[1]														
Meander Width Ratio	N/A[1]	N/A[1]														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.3/1.8/8.9/ 87.3/137.0/ 1024.0		0.3/2.0/17.7/83.2/128.0 /180.0		0.1/1.8/14.4/84.1/137.0/ 362.0											
Reach Shear Stress (Competency) lb/ft^2	2.03															
Max part size (mm) mobilized at bankfull	94.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.16															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	B4a															
Bankfull Velocity (fps)	6.2															
Bankfull Discharge (cfs)	35															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	257															
Sinuosity	1.10															
Bankfull/Channel Slope (ft/ft)	0.0407															

[1]Pattern data is not applicable for A-type and B-type channels

[2]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13g. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2A

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[2]																
Bankfull Width (ft)	6.8		7.3		8.2											
Floodprone Width (ft)	30		31		30											
Bankfull Mean Depth (ft)	0.5		0.4		0.4											
Bankfull Max Depth (ft)	0.8		0.7		0.6											
Bankfull Cross-sectional Area (ft^2)	3.4		3.1		3.0											
Width/Depth Ratio	13.9		17.3		22.5											
Entrenchment Ratio	4.4		4.3		3.6											
Bank Height Ratio	1.0		0.9		0.9											
D_{50} (mm)	58.6															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.005	0.035														
Pool Length (ft)																
Pool Max Depth (ft)	1.4	2.2														
Pool Spacing (ft)	18.6	39.9														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	N/A[1]	N/A[1]														
Radius of Curvature (ft)	N/A[1]	N/A[1]														
Rc/Bankfull Width (ft/ft)	N/A[1]	N/A[1]														
Meander Length (ft)	N/A[1]	N/A[1]														
Meander Width Ratio	N/A[1]	N/A[1]														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	SC/0.1/0.8/ 64.0/ 85.4/128.0		0.2/0.4/11.0/62.0/111.2 /180.0		SC/0.2/8.0/94.6/124.8/ 180.0											
Reach Shear Stress (Competency) lb/ft^2	0.74															
Max part size (mm) mobilized at bankfull	36.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.04															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	B4															
Bankfull Velocity (fps)	3.6															
Bankfull Discharge (cfs)	12															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	315															
Sinuosity	1.10															
Bankfull/Channel Slope (ft/ft)	0.0237															

[1]Pattern data is not applicable for A-type and B-type channels

[2]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13h. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2B

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	8.1		8.8		8.5											
Floodprone Width (ft)	32		31		28											
Bankfull Mean Depth (ft)	0.6		0.5		0.5											
Bankfull Max Depth (ft)	1.1		1.0		0.9											
Bankfull Cross-sectional Area (ft^2)	4.8		4.5		3.9											
Width/Depth Ratio	11.7		17.1		18.6											
Entrenchment Ratio	3.5		3.5		3.3											
Bank Height Ratio	1.0		1.0		1.0											
D_{50} (mm)	69.3															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.005	0.037														
Pool Length (ft)																
Pool Max Depth (ft)	1.6	2.2														
Pool Spacing (ft)	20.5	44.1														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	19.0	26.0														
Radius of Curvature (ft)	12.0	15.0														
Rc/Bankfull Width (ft/ft)	2.0	2.5														
Meander Length (ft)	56.0	76.0														
Meander Width Ratio	3.2	4.3														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	SC/0.1/1.3/ 85.4/137.0/256.0		SC/0.1/0.4/77.1/121.7/ 180.0		SC/1.1/4.7/59.6/137.0/ 256.0											
Reach Shear Stress (Competency) lb/ft^2	0.69															
Max part size (mm) mobilized at bankfull	35.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.05															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	C4b															
Bankfull Velocity (fps)	3.7															
Bankfull Discharge (cfs)	18															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	263															
Sinuosity	1.20															
Bankfull/Channel Slope (ft/ft)	0.0184															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13i. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2C

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	7.8		8.2		7.7											
Floodprone Width (ft)	48		50		46											
Bankfull Mean Depth (ft)	0.7		0.7		0.6											
Bankfull Max Depth (ft)	1.1		1.2		1.1											
Bankfull Cross-sectional Area (ft^2)	5.8		5.8		5.0											
Width/Depth Ratio	10.5		11.6		12.0											
Entrenchment Ratio	6.2		6.1		6.0											
Bank Height Ratio	1.0		1.0		0.9											
D_{50} (mm)	49.0															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.013	0.051														
Pool Length (ft)																
Pool Max Depth (ft)	1.4	2.1														
Pool Spacing (ft)	26.1	55.9														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	23.0	34.0														
Radius of Curvature (ft)	13.0	17.0														
Rc/Bankfull Width (ft/ft)	1.9	2.5														
Meander Length (ft)	73.0	90.0														
Meander Width Ratio	3.3	4.9														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	SC/0.1/8.9/92.5/124.6/256.0		SC/11.0/24.2/79.2/119.3/256.0		SC/0.2/12.1/75.9/115.2/180.0											
Reach Shear Stress (Competency) lb/ft^2	0.59															
Max part size (mm) mobilized at bankfull	28.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.05															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	C4															
Bankfull Velocity (fps)	3.3															
Bankfull Discharge (cfs)	19															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	469															
Sinuosity	1.30															
Bankfull/Channel Slope (ft/ft)	0.0134															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13j. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT3B

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[2]																
Bankfull Width (ft)	6.9		7.4		6.9											
Floodprone Width (ft)	21		61		44											
Bankfull Mean Depth (ft)	0.5		0.8		0.7											
Bankfull Max Depth (ft)	0.8		1.7		1.3											
Bankfull Cross-sectional Area (ft^2)	3.5		6.1		4.8											
Width/Depth Ratio	13.4		8.9		9.9											
Entrenchment Ratio	3.1		8.3		6.3											
Bank Height Ratio	1.0		1.4		1.2											
D_{50} (mm)	21.1															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.011	0.053														
Pool Length (ft)																
Pool Max Depth (ft)	0.9	2.6														
Pool Spacing (ft)	19.5	30.4														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	N/A[1]	N/A[1]														
Radius of Curvature (ft)	N/A[1]	N/A[1]														
Rc/Bankfull Width (ft/ft)	N/A[1]	N/A[1]														
Meander Length (ft)	N/A[1]	N/A[1]														
Meander Width Ratio	N/A[1]	N/A[1]														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.8/4.2/9.4/ 64.0/165.3/362.0		0.7/13.3/27.3/81.3/ 146.7/256.0		SC/1.8/22.6/124.3/202.4 /362.0											
Reach Shear Stress (Competency) lb/ft^2	0.99															
Max part size (mm) mobilized at bankfull	50.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.07															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	B4															
Bankfull Velocity (fps)	4.2															
Bankfull Discharge (cfs)	15															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	307															
Sinuosity	1.10															
Bankfull/Channel Slope (ft/ft)	0.0317															

[1]Pattern data is not applicable for A-type and B-type channels

[2]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

(---): Data was not provided

N/A: Not Applicable

Table 13k. Monitoring Data - Stream Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT3C

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle[1]																
Bankfull Width (ft)	8.8		8.4		7.9											
Floodprone Width (ft)	56		56		55											
Bankfull Mean Depth (ft)	0.8		0.8		0.7											
Bankfull Max Depth (ft)	1.3		1.4		1.3											
Bankfull Cross-sectional Area (ft^2)	6.8		6.4		5.4											
Width/Depth Ratio	11.3		11.1		11.5											
Entrenchment Ratio	6.3		6.6		7.0											
Bank Height Ratio	1.0		1.0		0.9											
D_{50} (mm)	28.2															
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.008	0.025														
Pool Length (ft)																
Pool Max Depth (ft)	1.8	2.5														
Pool Spacing (ft)	17.4	79.9														
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	17.2	44.8														
Radius of Curvature (ft)	12.0	22.0														
Rc/Bankfull Width (ft/ft)	1.6	2.9														
Meander Length (ft)	65.2	118.0														
Meander Width Ratio	2.2	6.0														
Substrate, Bed and Transport Parameters																
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.1/0.3/4.0/73.4/148.1/256.0		0.1/0.5/19.5/84.6/151.8/1024.0		SC/0.3/0.5/72.7/128.0/180.0											
Reach Shear Stress (Competency) lb/ft^2	0.66															
Max part size (mm) mobilized at bankfull	28.0															
Stream Power (Capacity) W/m^2																
Additional Reach Parameters																
Drainage Area (SM)	0.07															
Watershed Impervious Cover Estimate (%)	<1%															
Rosgen Classification	C4															
Bankfull Velocity (fps)	3.4															
Bankfull Discharge (cfs)	23															
Valley Slope (ft/ft)	---															
Channel Thalweg Length (ft)	412															
Sinuosity	1.20															
Bankfull/Channel Slope (ft/ft)	0.0132															

[1]MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.

SC: Silt/Clay <0.062 mm diameter particles

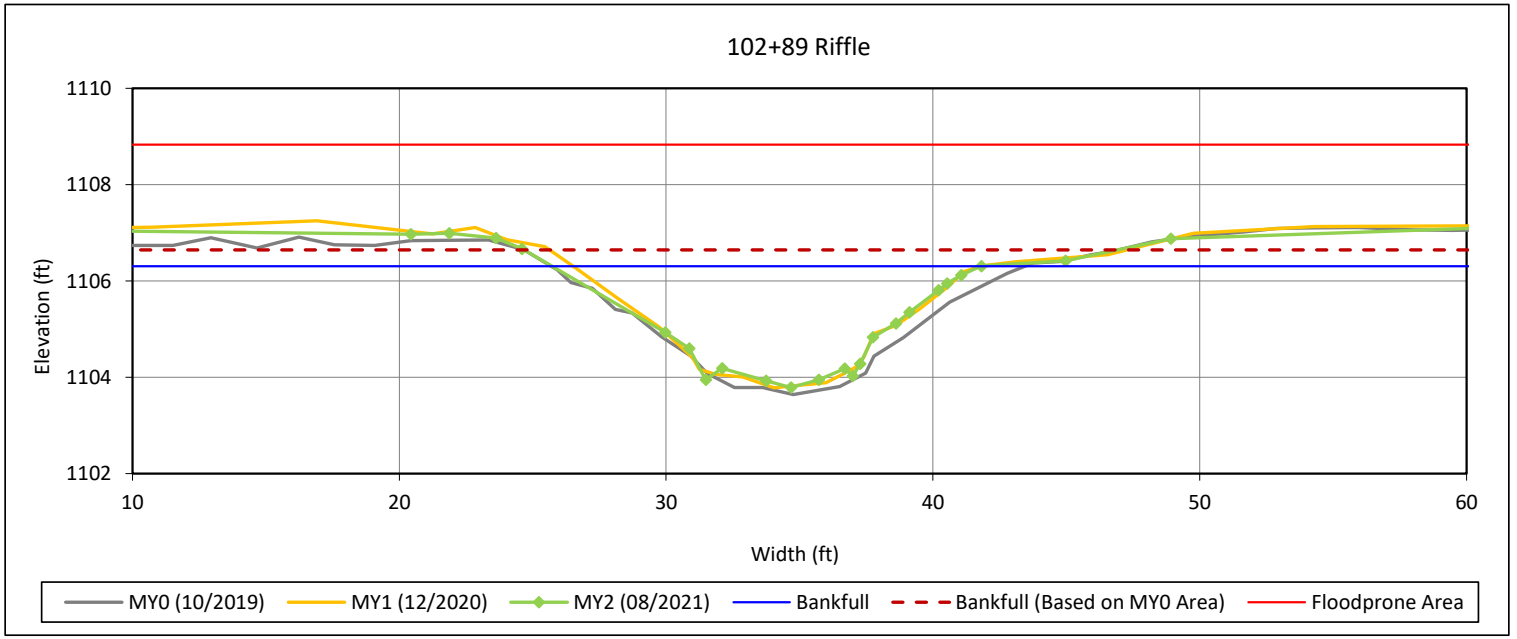
(---): Data was not provided

N/A: Not Applicable

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 1-Bull Creek Reach 1A



Bankfull Dimensions	
22.6	x-section area (ft.sq.)
16.1	width (ft)
1.4	mean depth (ft)
2.5	max depth (ft)
17.4	wetted perimeter (ft)
1.3	hydraulic radius (ft)
11.5	width-depth ratio
69.5	W flood prone area (ft)
4.3	entrenchment ratio
0.9	low bank height ratio

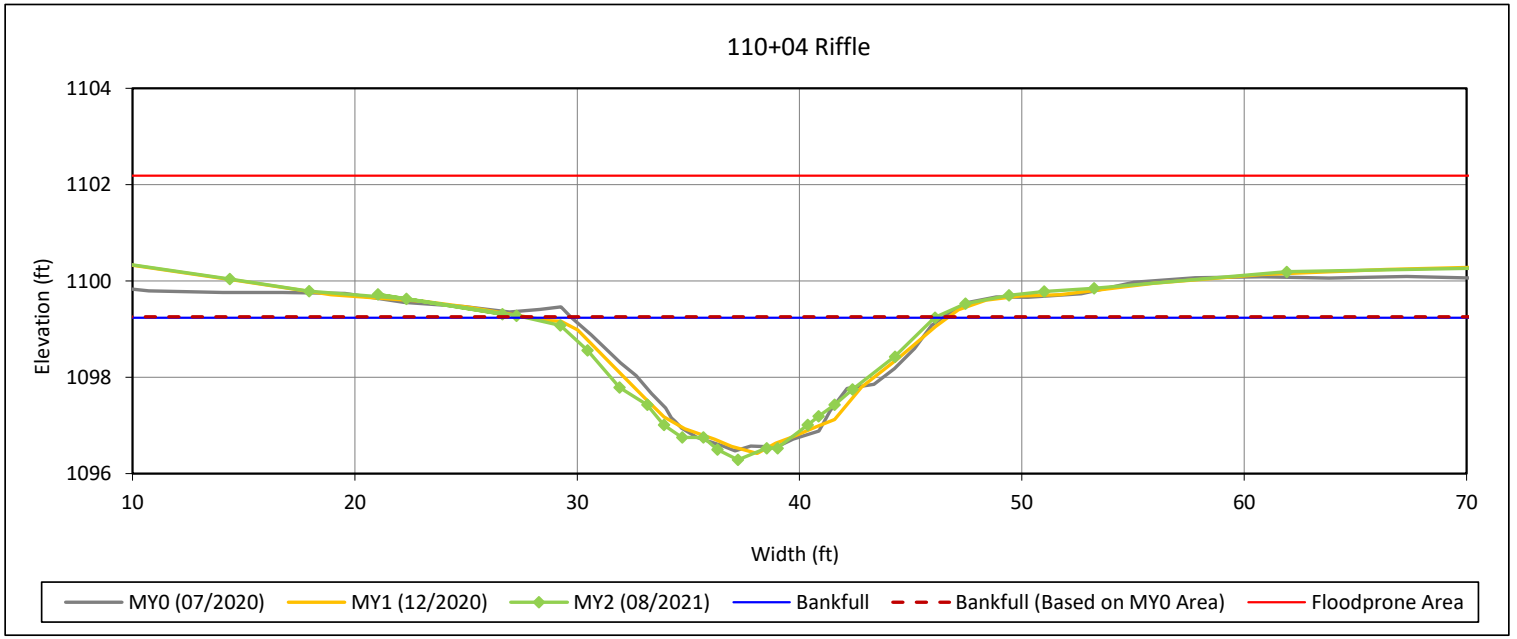
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 2-Bull Creek Reach 1B



Bankfull Dimensions	
29.3	x-section area (ft.sq.)
18.4	width (ft)
1.6	mean depth (ft)
3.0	max depth (ft)
19.5	wetted perimeter (ft)
1.5	hydraulic radius (ft)
11.6	width-depth ratio
66.2	W flood prone area (ft)
3.6	entrenchment ratio
1.0	low bank height ratio

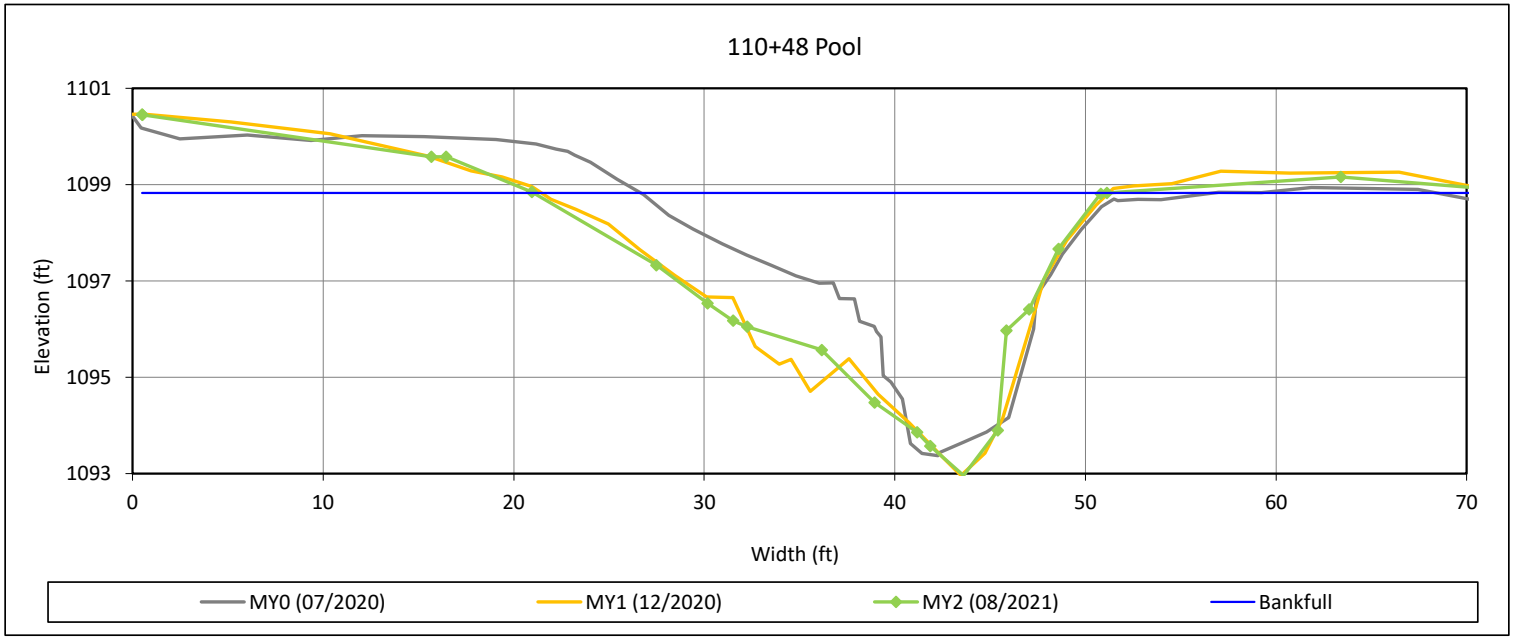
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 3-Bull Creek Reach 1B



Bankfull Dimensions	
79.9	x-section area (ft.sq.)
30.1	width (ft)
2.7	mean depth (ft)
5.9	max depth (ft)
33.6	wetted perimeter (ft)
2.4	hydraulic radius (ft)
11.3	width-depth ratio

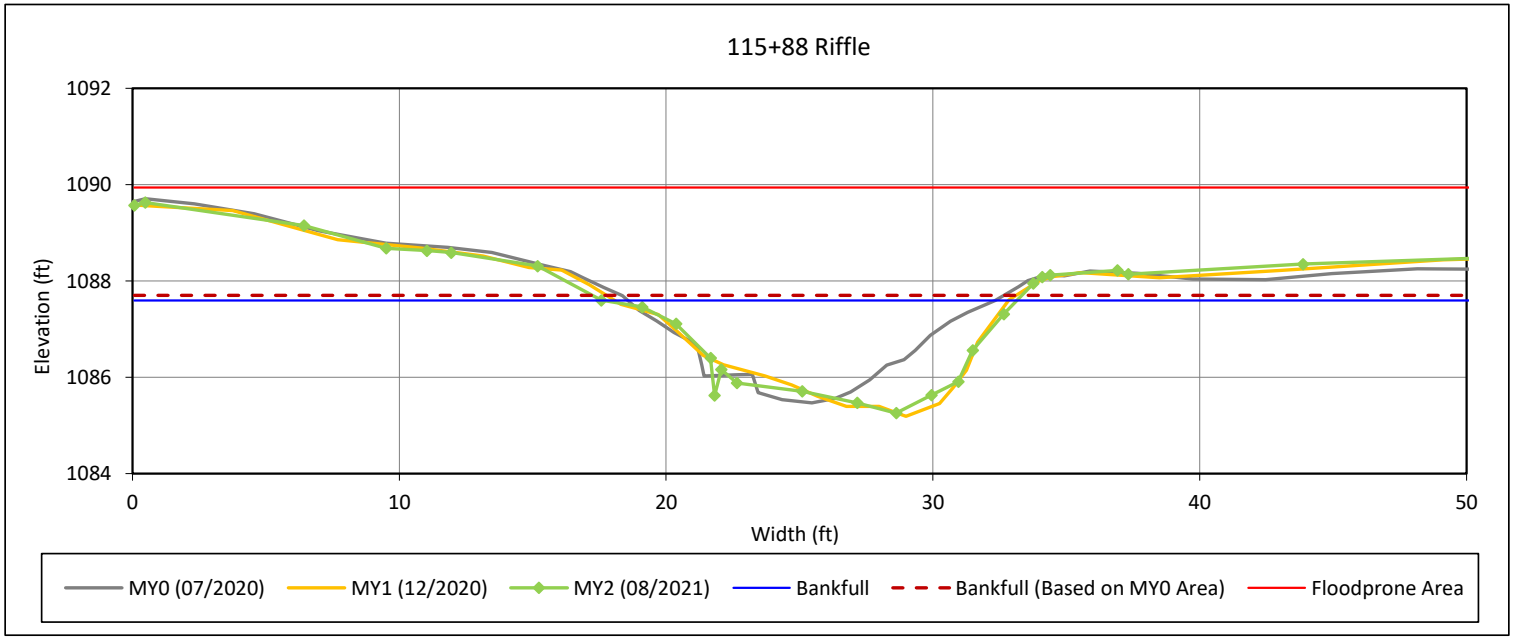
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 4-Bull Creek Reach 2



Bankfull Dimensions	
21.3	x-section area (ft.sq.)
15.6	width (ft)
1.4	mean depth (ft)
2.3	max depth (ft)
17.6	wetted perimeter (ft)
1.2	hydraulic radius (ft)
11.4	width-depth ratio
55.6	W flood prone area (ft)
3.6	entrenchment ratio
1.0	low bank height ratio

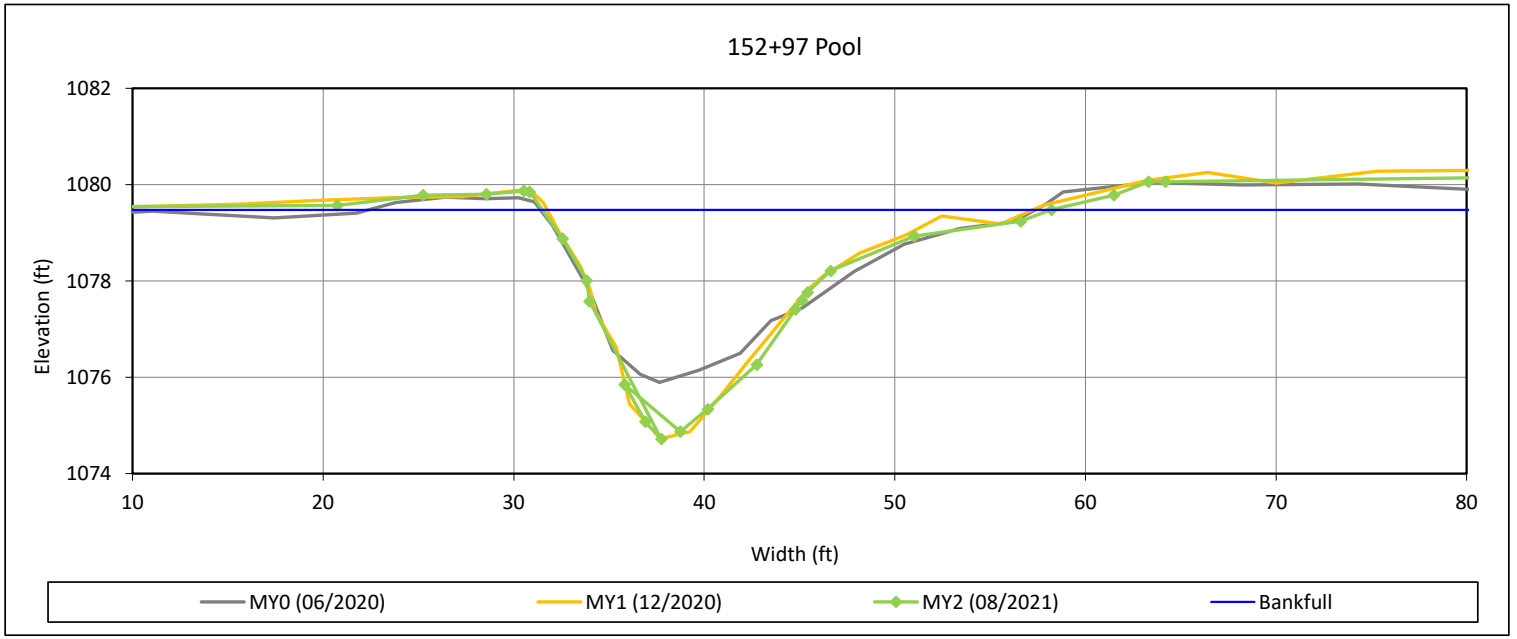
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 5-Bull Creek Reach 3



Bankfull Dimensions	
48.8	x-section area (ft.sq.)
26.7	width (ft)
1.8	mean depth (ft)
4.8	max depth (ft)
33.5	wetted perimeter (ft)
1.5	hydraulic radius (ft)
14.6	width-depth ratio

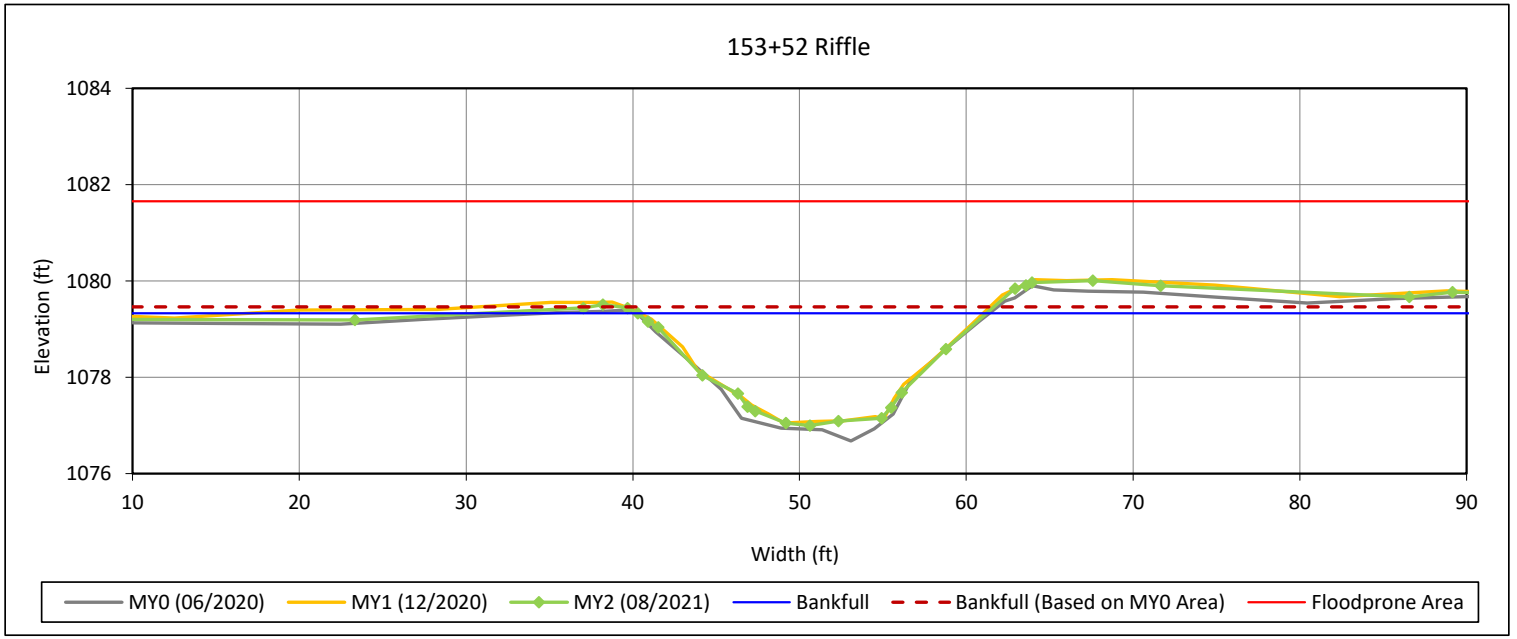
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 6-Bull Creek Reach 3



Bankfull Dimensions	
30.7	x-section area (ft.sq.)
20.9	width (ft)
1.5	mean depth (ft)
2.3	max depth (ft)
21.6	wetted perimeter (ft)
1.4	hydraulic radius (ft)
14.3	width-depth ratio
98.9	W flood prone area (ft)
4.7	entrenchment ratio
0.9	low bank height ratio

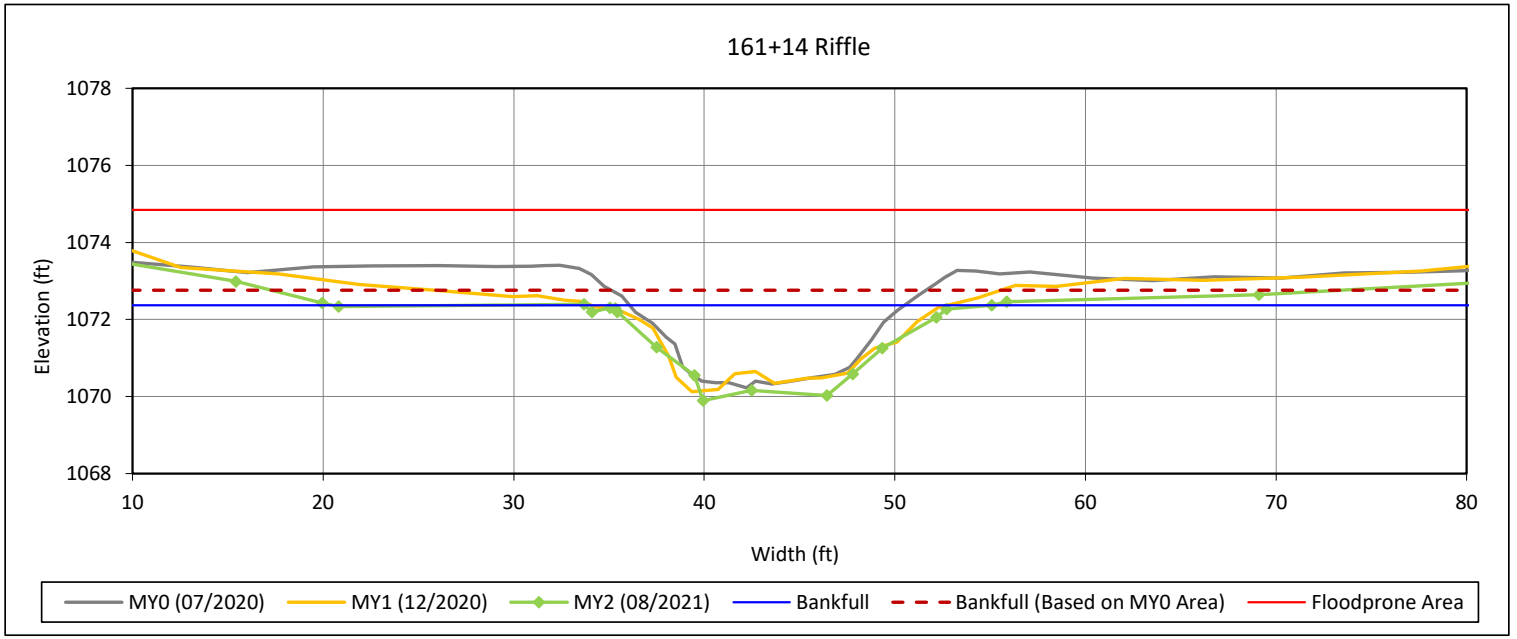
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 7-Bull Creek Reach 3



Bankfull Dimensions	
27.7	x-section area (ft.sq.)
21.3	width (ft)
1.3	mean depth (ft)
2.5	max depth (ft)
22.5	wetted perimeter (ft)
1.2	hydraulic radius (ft)
16.5	width-depth ratio
84.0	W flood prone area (ft)
3.9	entrenchment ratio
0.9	low bank height ratio

Survey Date: 08/2021
Field Crew: Wildlands Engineering

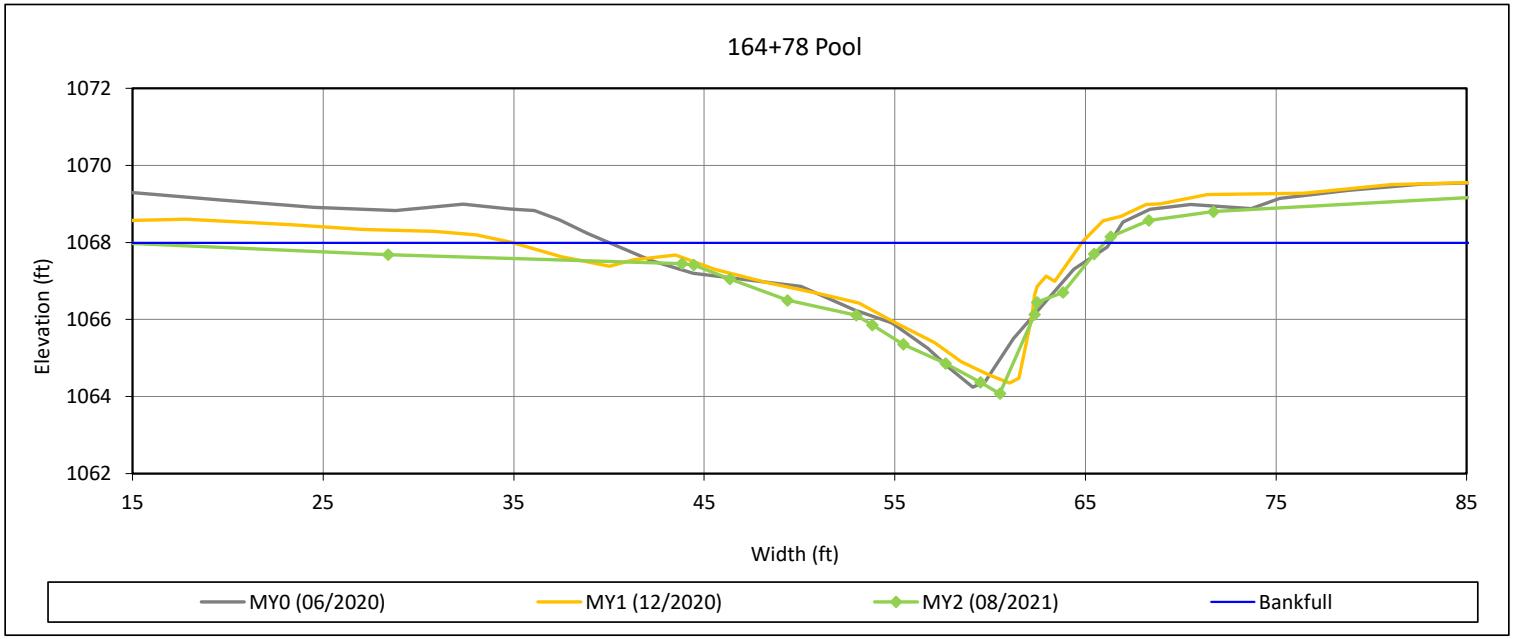
*Cross Section affected by repairs conducted during July 2021.

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 8-Bull Creek Reach 3



Bankfull Dimensions	
42.3	x-section area (ft.sq.)
22.2	width (ft)
1.9	mean depth (ft)
3.9	max depth (ft)
24.1	wetted perimeter (ft)
1.8	hydraulic radius (ft)
11.6	width-depth ratio

Survey Date: 08/2021
Field Crew: Wildlands Engineering

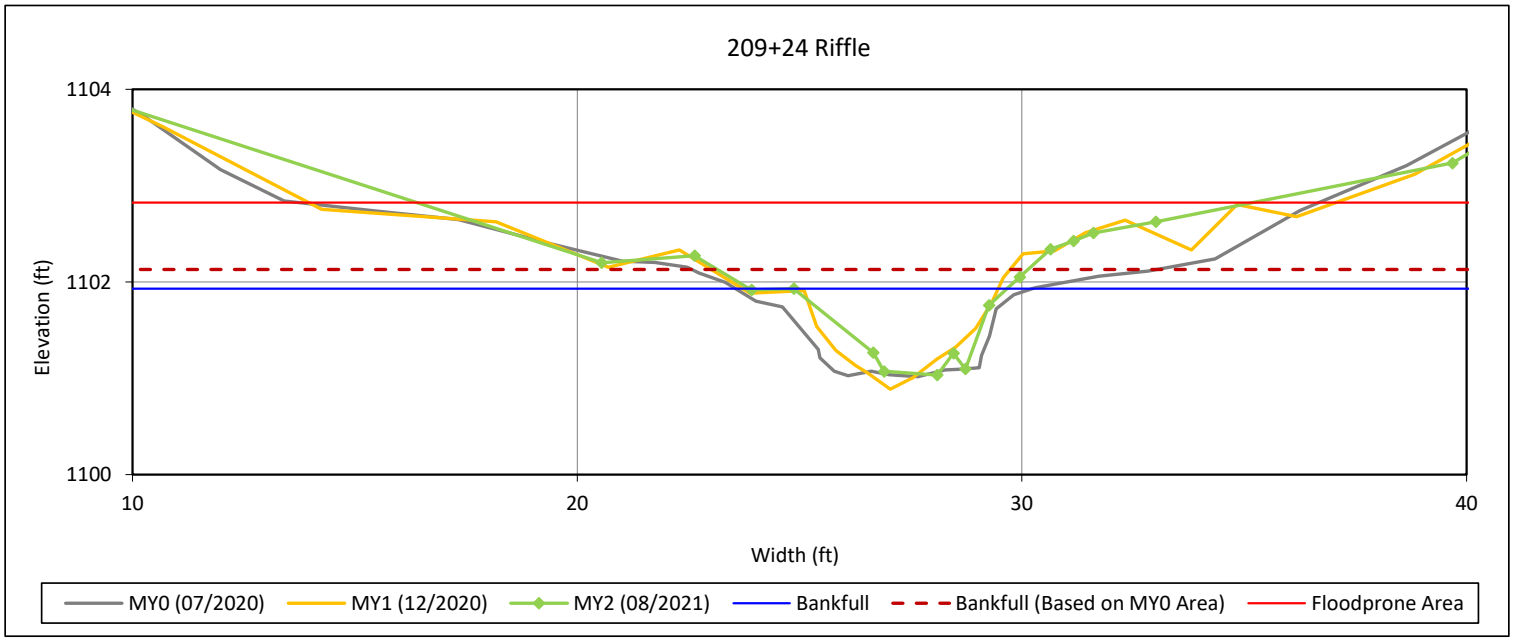
*Cross Section affected by repairs conducted during July 2021.

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 9-UT1B



Bankfull Dimensions	
2.6	x-section area (ft.sq.)
5.8	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
6.4	wetted perimeter (ft)
0.4	hydraulic radius (ft)
12.8	width-depth ratio
18.8	W flood prone area (ft)
3.2	entrenchment ratio
0.8	low bank height ratio

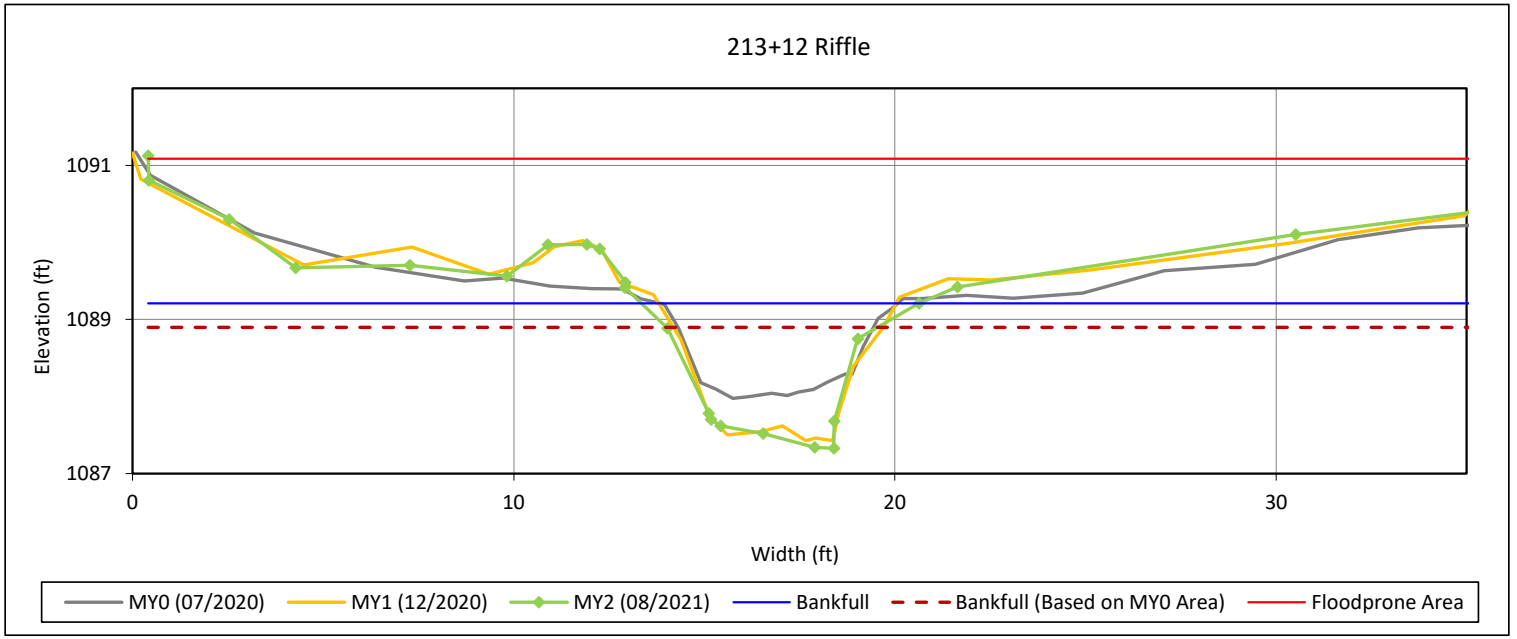
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 10-UT1C



Bankfull Dimensions	
7.7	x-section area (ft.sq.)
7.3	width (ft)
1.1	mean depth (ft)
1.9	max depth (ft)
8.9	wetted perimeter (ft)
0.9	hydraulic radius (ft)
6.9	width-depth ratio
34.9	W flood prone area (ft)
4.8	entrenchment ratio
1.2	low bank height ratio

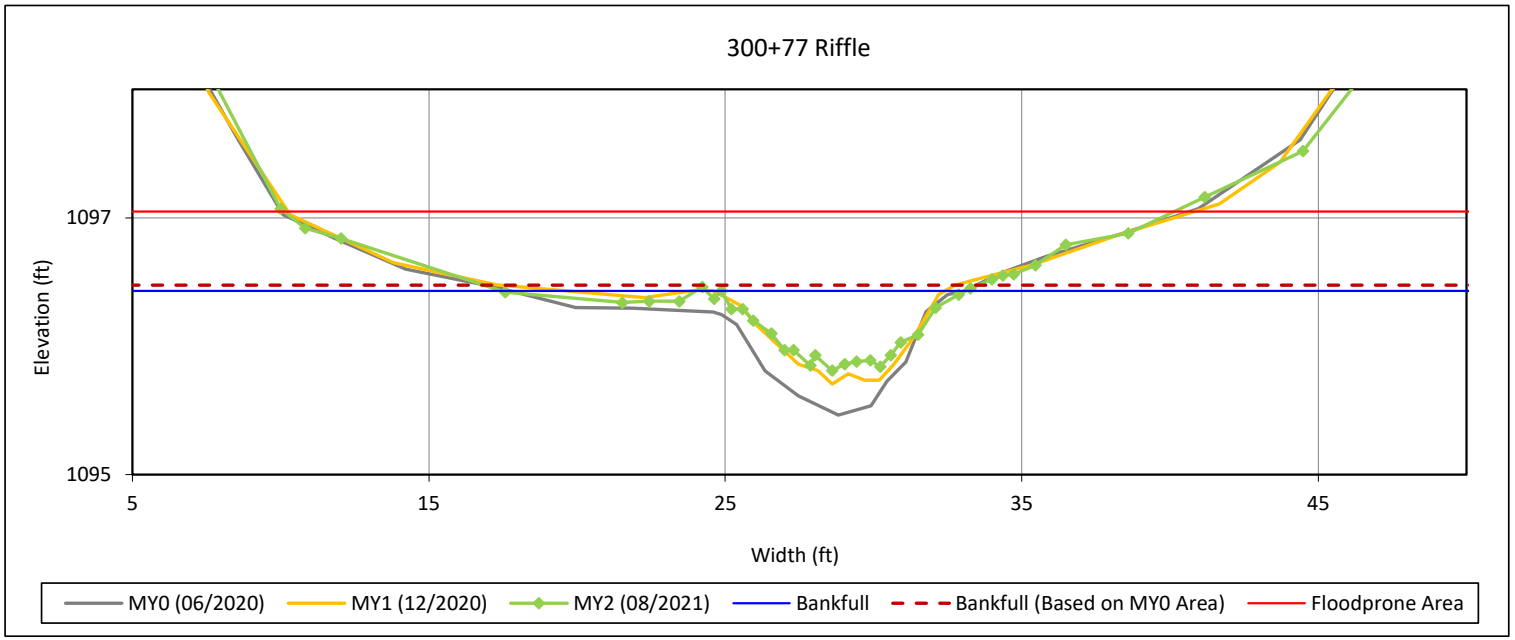
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 11-UT2A



Bankfull Dimensions	
3.0	x-section area (ft.sq.)
8.2	width (ft)
0.4	mean depth (ft)
0.6	max depth (ft)
8.4	wetted perimeter (ft)
0.4	hydraulic radius (ft)
22.5	width-depth ratio
30.0	W flood prone area (ft)
3.6	entrenchment ratio
0.9	low bank height ratio

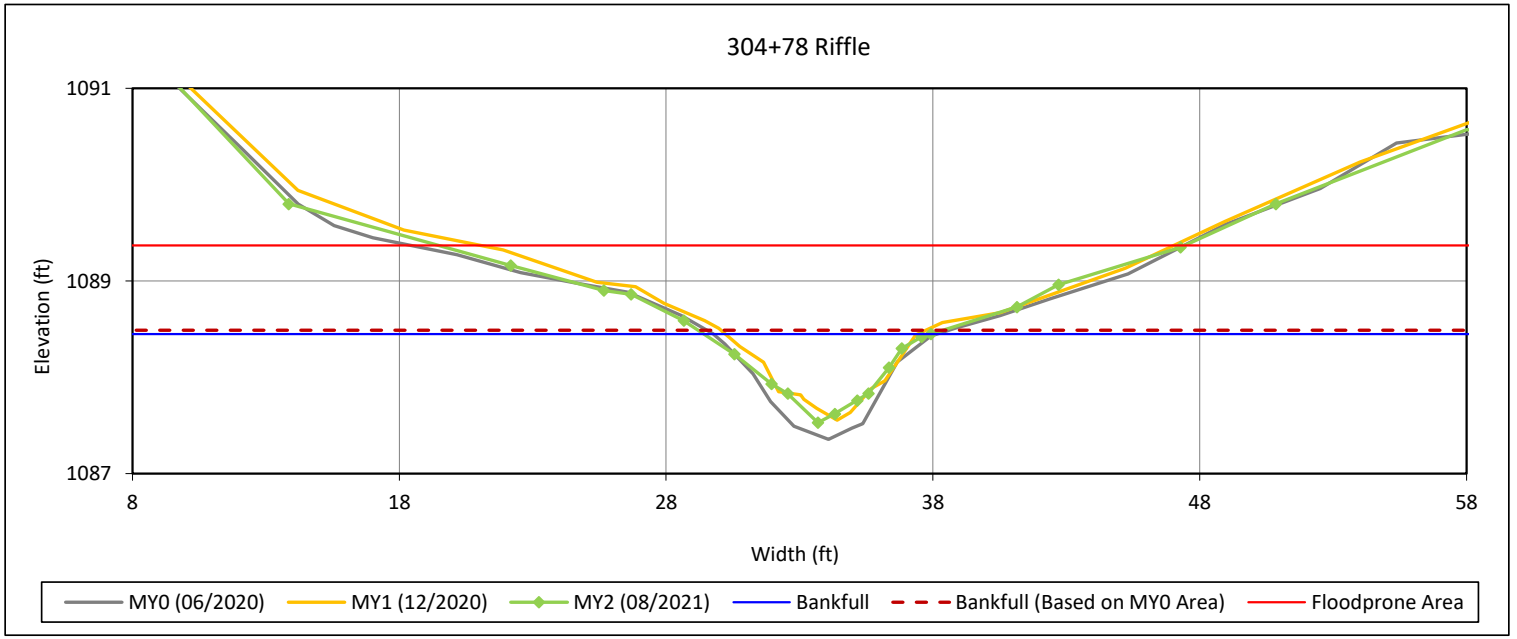
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 12-UT2B



Bankfull Dimensions	
3.9	x-section area (ft.sq.)
8.5	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
8.7	wetted perimeter (ft)
0.4	hydraulic radius (ft)
18.6	width-depth ratio
28.0	W flood prone area (ft)
3.3	entrenchment ratio
1.0	low bank height ratio

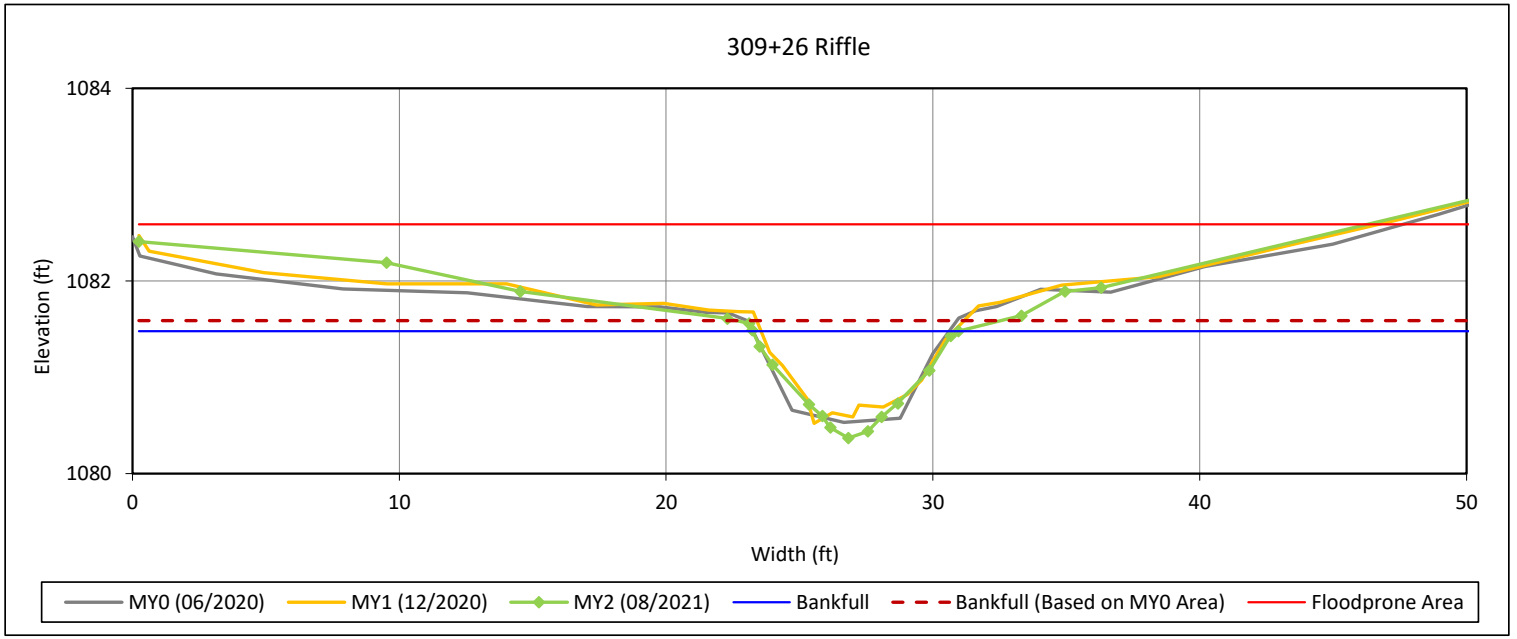
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 13-UT2C



Bankfull Dimensions	
5.0	x-section area (ft.sq.)
7.7	width (ft)
0.6	mean depth (ft)
1.1	max depth (ft)
8.1	wetted perimeter (ft)
0.6	hydraulic radius (ft)
12.0	width-depth ratio
46.1	W flood prone area (ft)
6.0	entrenchment ratio
0.9	low bank height ratio

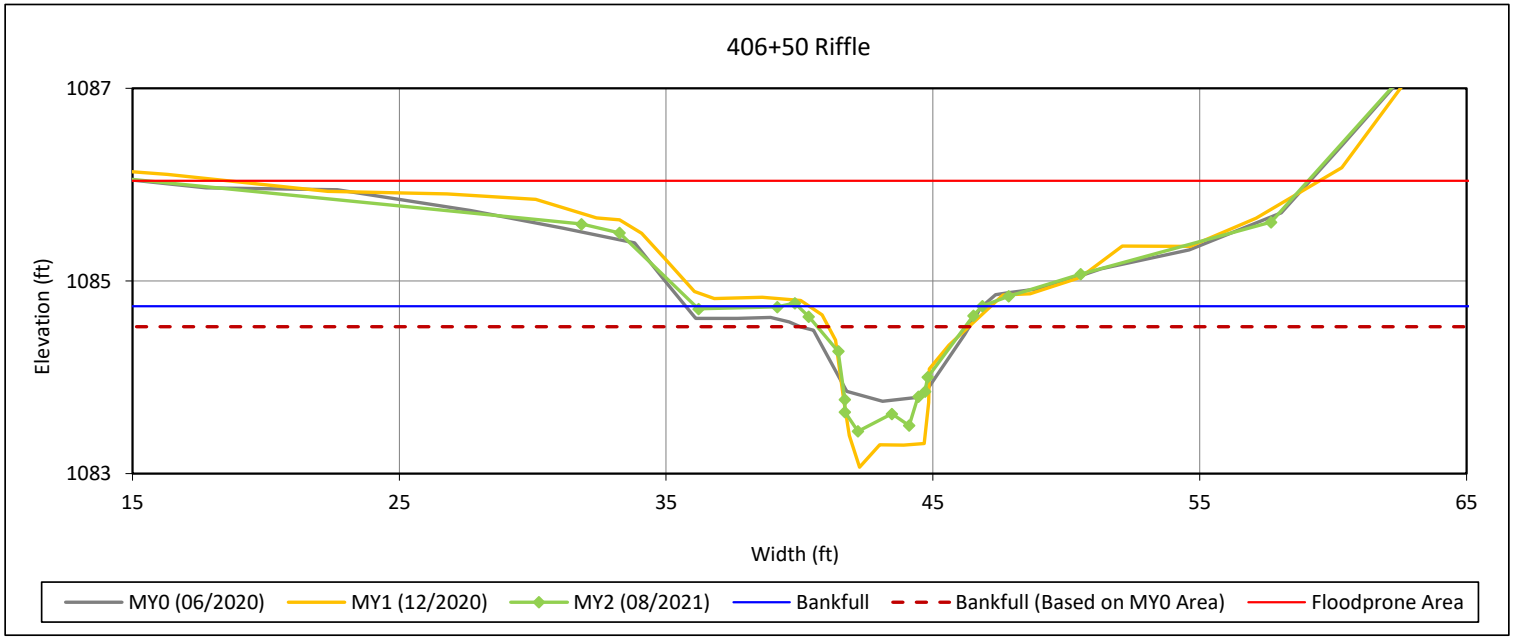
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 14-UT3B



Bankfull Dimensions	
4.8	x-section area (ft.sq.)
6.9	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
7.8	wetted perimeter (ft)
0.6	hydraulic radius (ft)
9.9	width-depth ratio
43.6	W flood prone area (ft)
6.3	entrenchment ratio
1.2	low bank height ratio

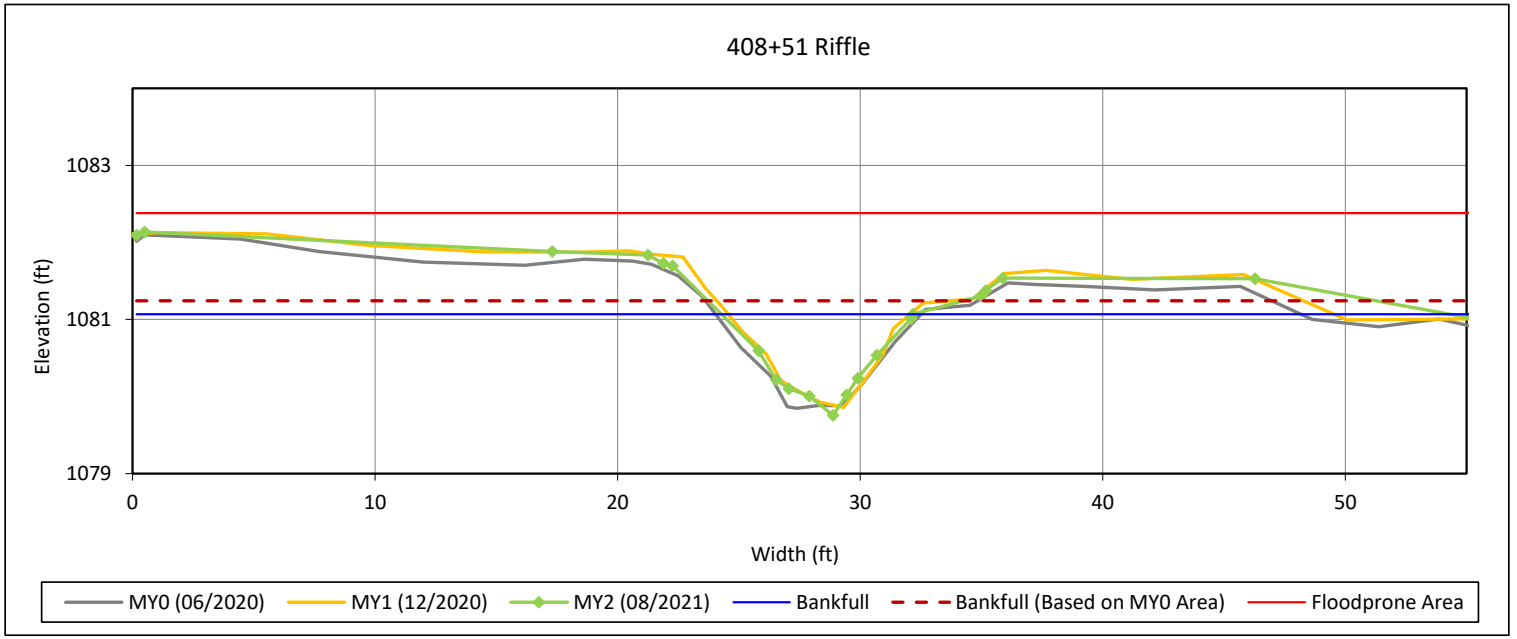
Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Cross-Section 15-UT3C



Bankfull Dimensions	
5.4	x-section area (ft.sq.)
7.9	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
8.4	wetted perimeter (ft)
0.6	hydraulic radius (ft)
11.5	width-depth ratio
55.4	W flood prone area (ft)
7.0	entrenchment ratio
0.9	low bank height ratio

Survey Date: 08/2021
Field Crew: Wildlands Engineering

View Downstream

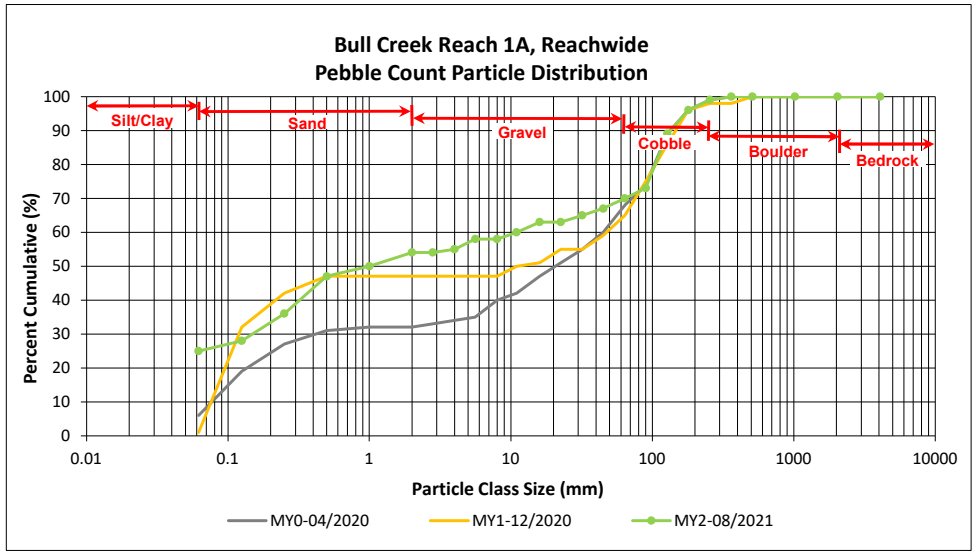
Reachwide Pebble Count Plots

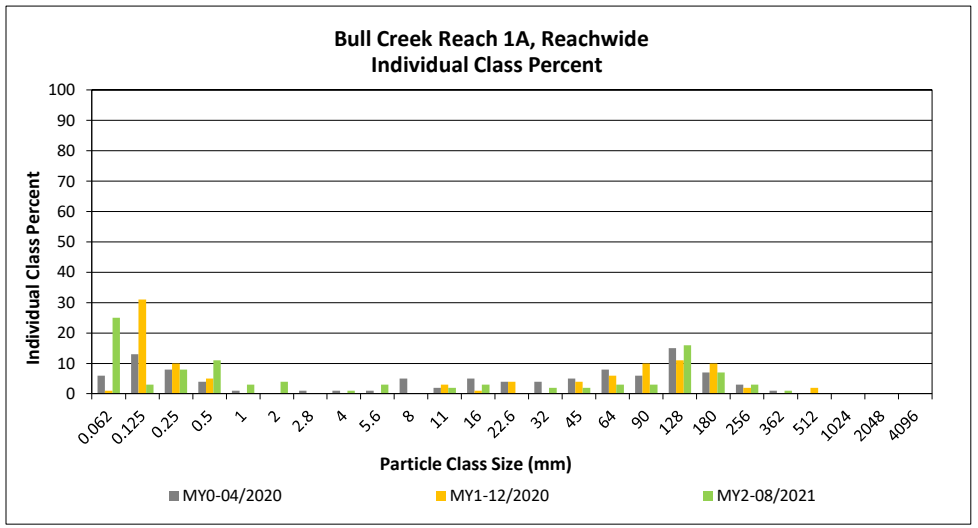
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 1A, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		25	25	25	25
SAND	Very fine	0.062	0.125		3	3	3	28
	Fine	0.125	0.250		8	8	8	36
	Medium	0.25	0.50	1	10	11	11	47
	Coarse	0.5	1.0	1	2	3	3	50
	Very Coarse	1.0	2.0	4		4	4	54
GRAVEL	Very Fine	2.0	2.8					54
	Very Fine	2.8	4.0		1	1	1	55
	Fine	4.0	5.6	3		3	3	58
	Fine	5.6	8.0					58
	Medium	8.0	11.0	1	1	2	2	60
	Medium	11.0	16.0	3		3	3	63
	Coarse	16.0	22.6					63
	Coarse	22.6	32	2		2	2	65
	Very Coarse	32	45	2		2	2	67
	Very Coarse	45	64	3		3	3	70
COBBLE	Small	64	90	3		3	3	73
	Small	90	128	16		16	16	89
	Large	128	180	7		7	7	96
	Large	180	256	3		3	3	99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.2
D_{50} =	1.0
D_{84} =	114.7
D_{95} =	171.4
D_{100} =	362.0





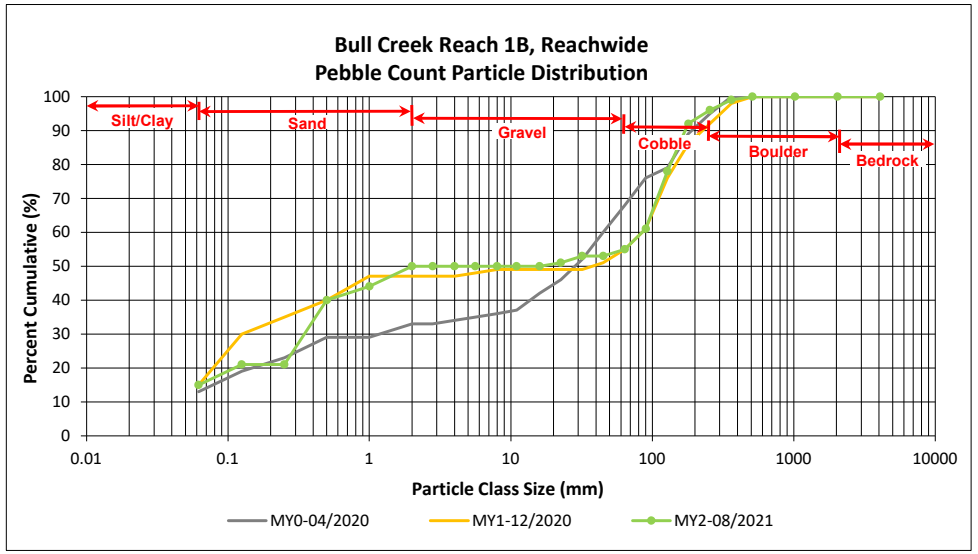
Reachwide Pebble Count Plots

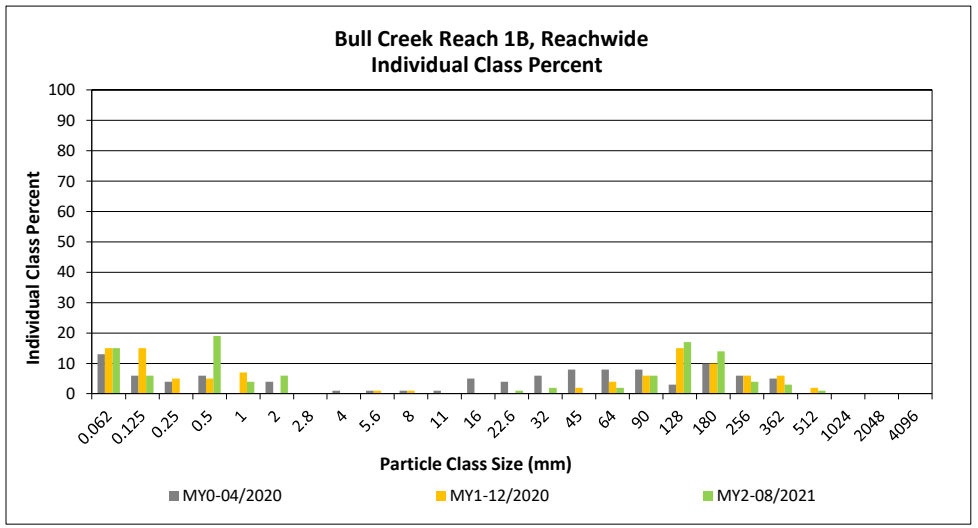
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 1B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		15	15	15	15
SAND	Very fine	0.062	0.125		6	6	6	21
	Fine	0.125	0.250					21
	Medium	0.25	0.50		19	19	19	40
	Coarse	0.5	1.0		4	4	4	44
	Very Coarse	1.0	2.0	1	5	6	6	50
GRAVEL	Very Fine	2.0	2.8					50
	Very Fine	2.8	4.0					50
	Fine	4.0	5.6					50
	Fine	5.6	8.0					50
	Medium	8.0	11.0					50
	Medium	11.0	16.0					50
	Coarse	16.0	22.6	1		1	1	51
	Coarse	22.6	32	1	1	2	2	53
	Very Coarse	32	45					53
	Very Coarse	45	64	2		2	2	55
COBBLE	Small	64	90	6		6	6	61
	Small	90	128	17		17	17	78
	Large	128	180	14		14	14	92
	Large	180	256	4		4	4	96
BOULDER	Small	256	362	3		3	3	99
	Small	362	512	1		1	1	100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.1
D_{35} =	0.4
D_{50} =	2.0
D_{84} =	148.1
D_{95} =	234.4
D_{100} =	512.0





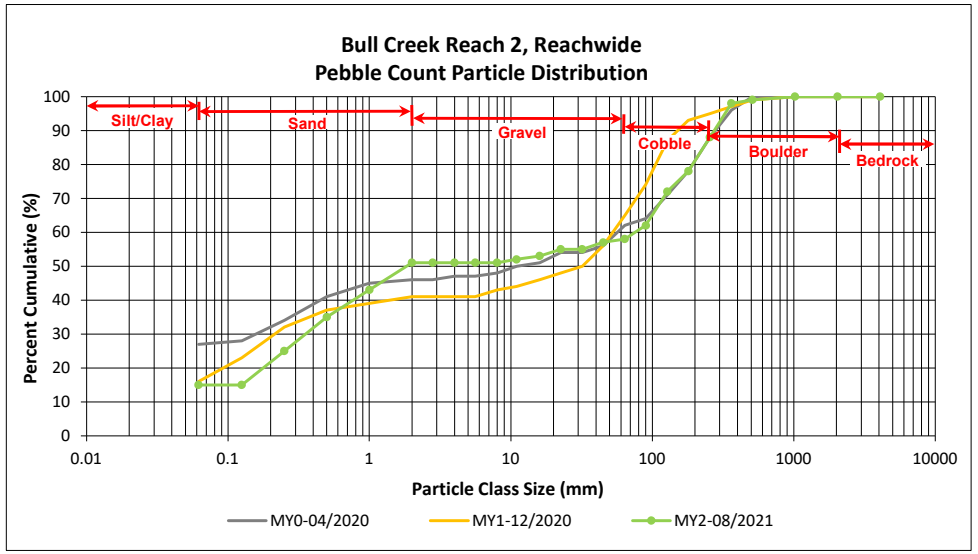
Reachwide Pebble Count Plots

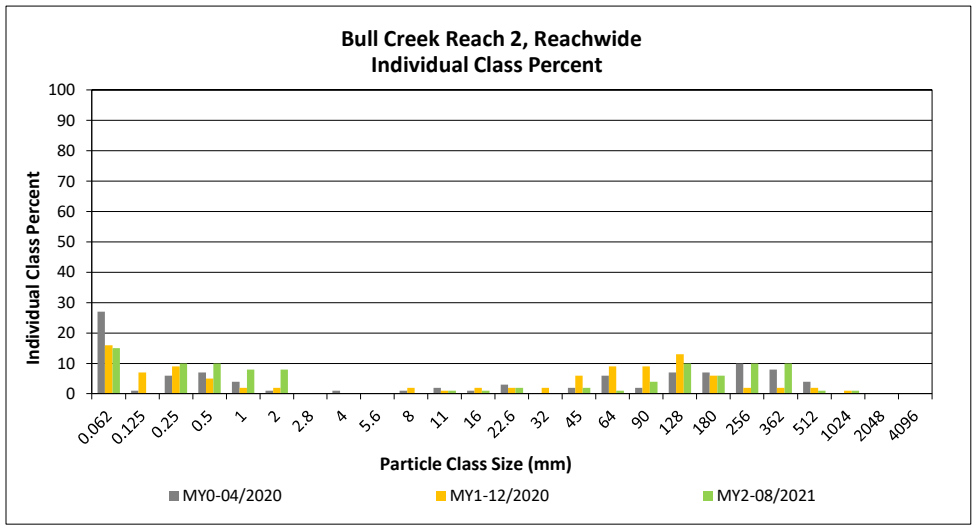
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		15	15	15	15
SAND	Very fine	0.062	0.125					15
	Fine	0.125	0.250		10	10	10	25
	Medium	0.25	0.50		10	10	10	35
	Coarse	0.5	1.0		8	8	8	43
	Very Coarse	1.0	2.0	1	7	8	8	51
GRAVEL	Very Fine	2.0	2.8					51
	Very Fine	2.8	4.0					51
	Fine	4.0	5.6					51
	Fine	5.6	8.0					51
	Medium	8.0	11.0	1		1	1	52
	Medium	11.0	16.0	1		1	1	53
	Coarse	16.0	22.6	2		2	2	55
	Coarse	22.6	32					55
	Very Coarse	32	45	2		2	2	57
	Very Coarse	45	64	1		1	1	58
COBBLE	Small	64	90	4		4	4	62
	Small	90	128	10		10	10	72
	Large	128	180	6		6	6	78
	Large	180	256	10		10	10	88
BOULDER	Small	256	362	10		10	10	98
	Small	362	512	1		1	1	99
	Medium	512	1024	1		1	1	100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.1
D_{35} =	0.5
D_{50} =	1.8
D_{84} =	222.4
D_{95} =	326.3
D_{100} =	1024.0





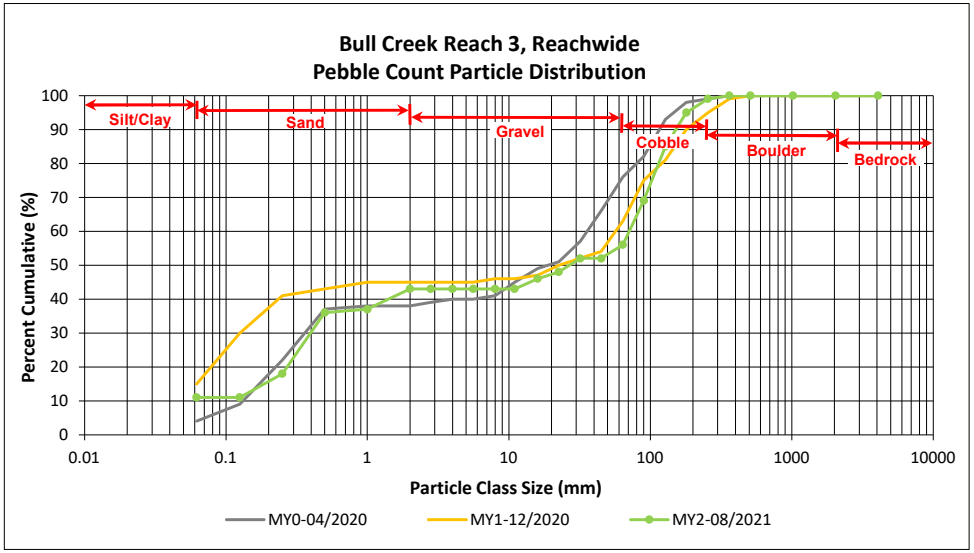
Reachwide Pebble Count Plots

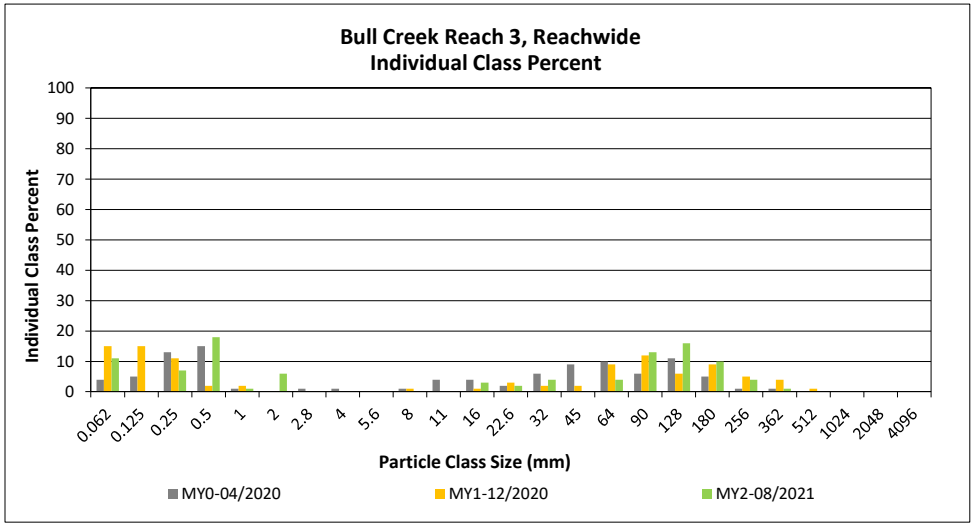
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Bull Creek Reach 3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		11	11	11	11
SAND	Very fine	0.062	0.125					11
	Fine	0.125	0.250		7	7	7	18
	Medium	0.25	0.50		18	18	18	36
	Coarse	0.5	1.0		1	1	1	37
	Very Coarse	1.0	2.0		6	6	6	43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.6					43
	Fine	5.6	8.0					43
	Medium	8.0	11.0					43
	Medium	11.0	16.0	1	2	3	3	46
	Coarse	16.0	22.6	2		2	2	48
	Coarse	22.6	32	3	1	4	4	52
	Very Coarse	32	45					52
	Very Coarse	45	64	4		4	4	56
COBBLE	Small	64	90	11	2	13	13	69
	Small	90	128	15	1	16	16	85
	Large	128	180	10		10	10	95
	Large	180	256	3	1	4	4	99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.2
D_{35} =	0.5
D_{50} =	26.9
D_{84} =	125.2
D_{95} =	180.0
D_{100} =	362.0





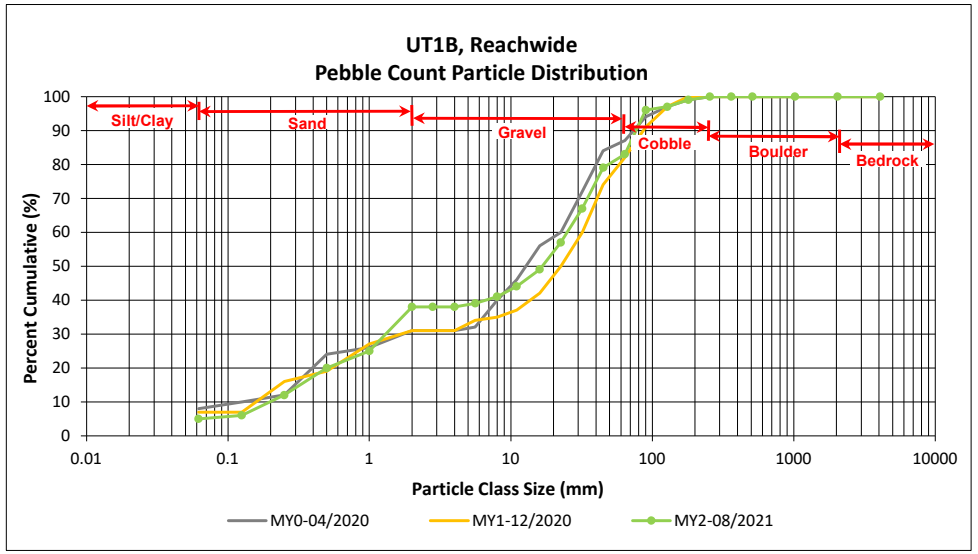
Reachwide Pebble Count Plots

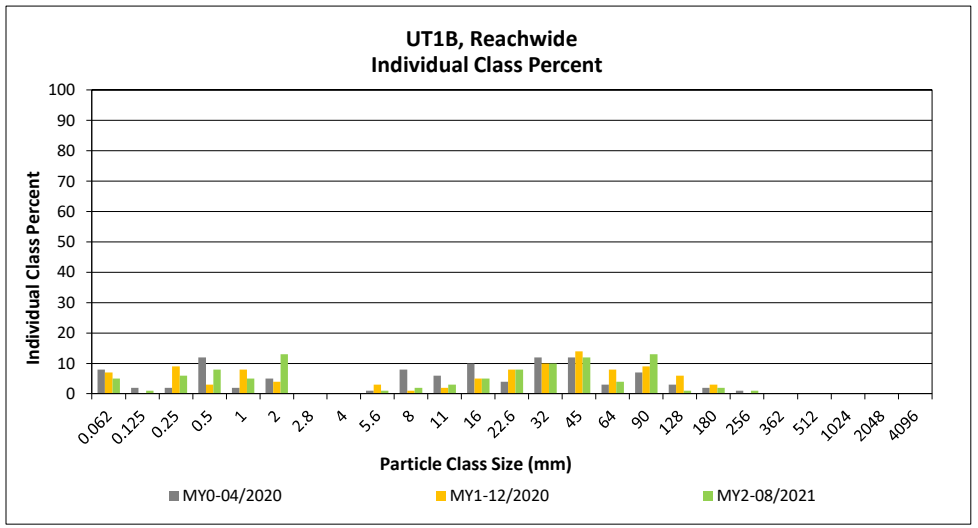
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT1B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		5	5	5	5
SAND	Very fine	0.062	0.125		1	1	1	6
	Fine	0.125	0.250		6	6	6	12
	Medium	0.25	0.50		8	8	8	20
	Coarse	0.5	1.0		5	5	5	25
	Very Coarse	1.0	2.0	4	9	13	13	38
GRAVEL	Very Fine	2.0	2.8					38
	Very Fine	2.8	4.0					38
	Fine	4.0	5.6	1		1	1	39
	Fine	5.6	8.0	2		2	2	41
	Medium	8.0	11.0	2	1	3	3	44
	Medium	11.0	16.0	3	2	5	5	49
	Coarse	16.0	22.6	7	1	8	8	57
	Coarse	22.6	32	5	5	10	10	67
	Very Coarse	32	45	11	1	12	12	79
	Very Coarse	45	64	1	3	4	4	83
COBBLE	Small	64	90	11	2	13	13	96
	Small	90	128	1		1	1	97
	Large	128	180	1	1	2	2	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.4
D_{35} =	1.7
D_{50} =	16.7
D_{84} =	65.7
D_{95} =	87.7
D_{100} =	256.0





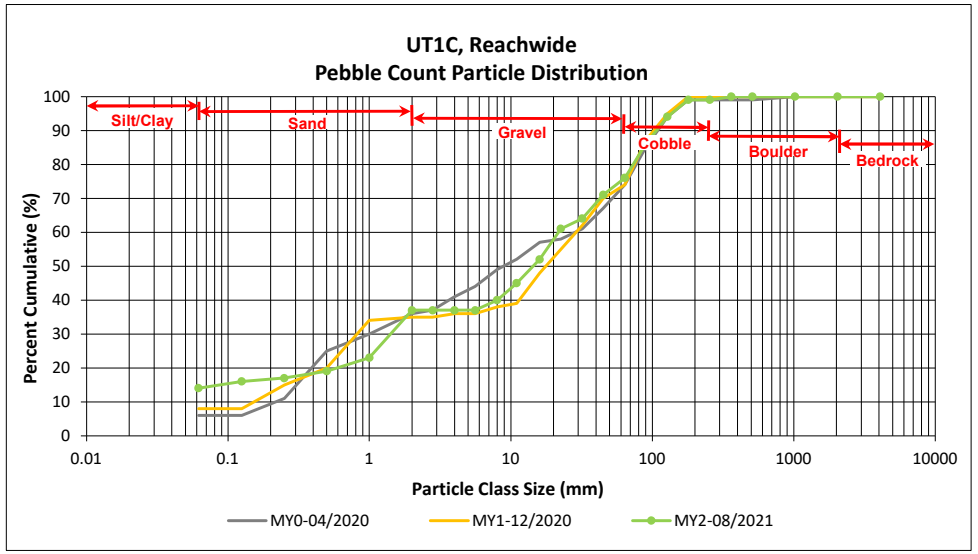
Reachwide Pebble Count Plots

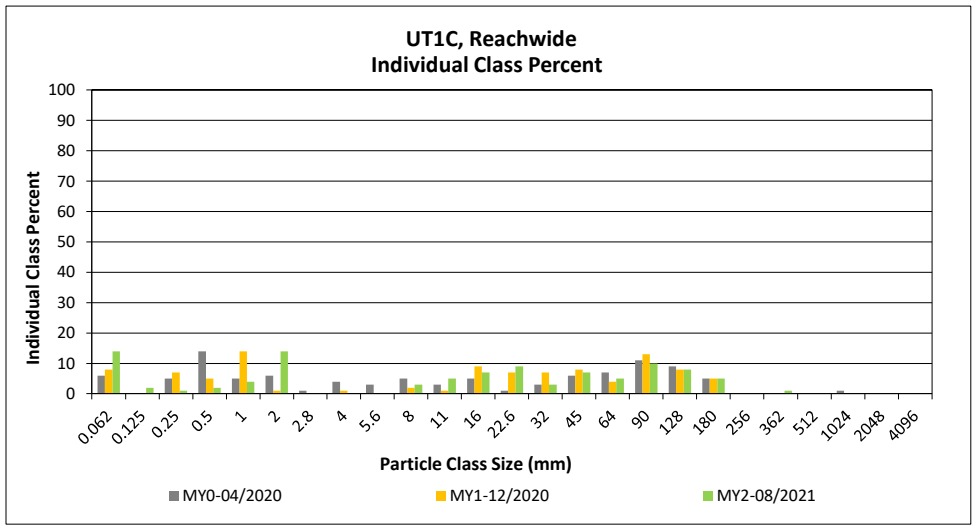
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT1C, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		14	14	14	14
SAND	Very fine	0.062	0.125		2	2	2	16
	Fine	0.125	0.250		1	1	1	17
	Medium	0.25	0.50		2	2	2	19
	Coarse	0.5	1.0		4	4	4	23
	Very Coarse	1.0	2.0	6	8	14	14	37
GRAVEL	Very Fine	2.0	2.8					37
	Very Fine	2.8	4.0					37
	Fine	4.0	5.6					37
	Fine	5.6	8.0	2	1	3	3	40
	Medium	8.0	11.0		5	5	5	45
	Medium	11.0	16.0	3	4	7	7	52
	Coarse	16.0	22.6	4	5	9	9	61
	Coarse	22.6	32	1	2	3	3	64
	Very Coarse	32	45	5	2	7	7	71
	Very Coarse	45	64	5		5	5	76
COBBLE	Small	64	90	10		10	10	86
	Small	90	128	8		8	8	94
	Large	128	180	5		5	5	99
	Large	180	256					99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.1
D_{35} =	1.8
D_{50} =	14.4
D_{84} =	84.1
D_{95} =	137.0
D_{100} =	362.0





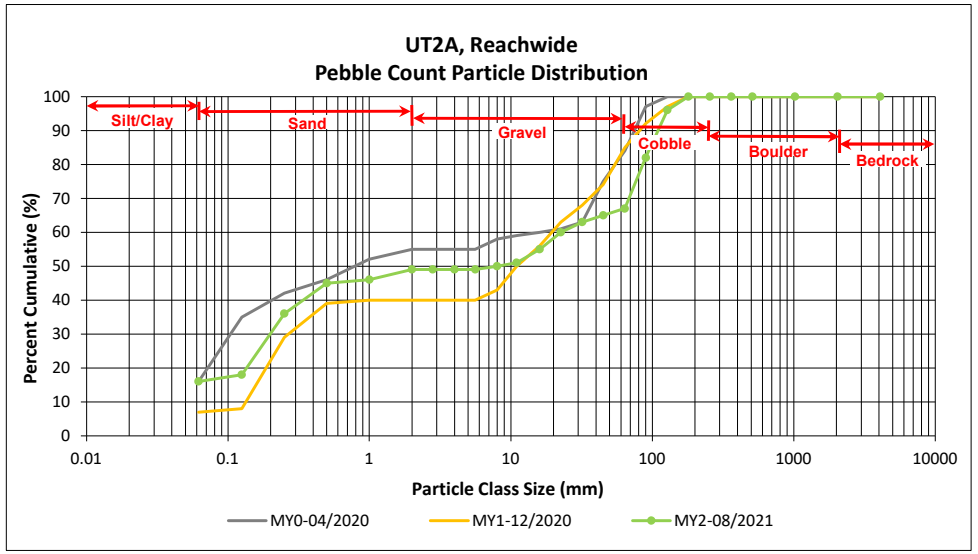
Reachwide Pebble Count Plots

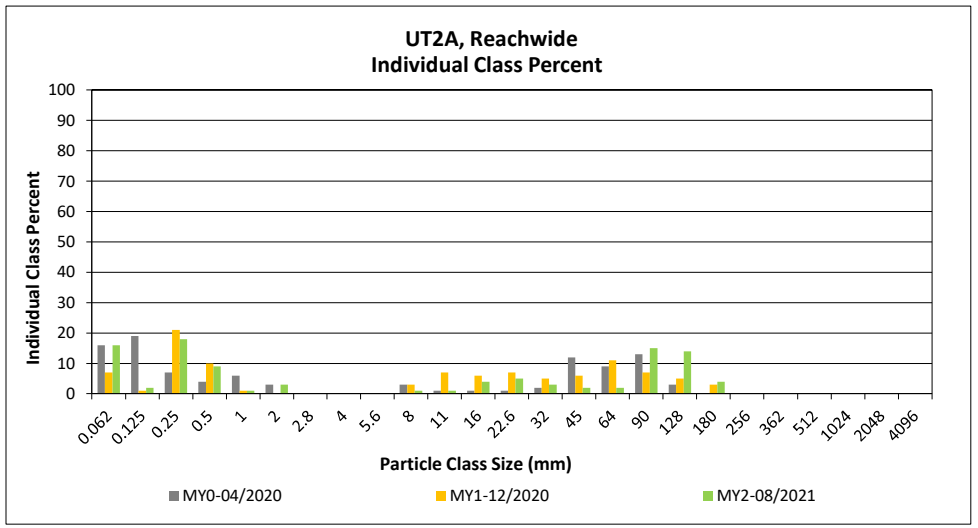
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2A, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	15	16	16	16
SAND	Very fine	0.062	0.125		2	2	2	18
	Fine	0.125	0.250	3	15	18	18	36
	Medium	0.25	0.50	5	4	9	9	45
	Coarse	0.5	1.0	1		1	1	46
	Very Coarse	1.0	2.0	1	2	3	3	49
GRAVEL	Very Fine	2.0	2.8					49
	Very Fine	2.8	4.0					49
	Fine	4.0	5.6					49
	Fine	5.6	8.0	1		1	1	50
	Medium	8.0	11.0	1		1	1	51
	Medium	11.0	16.0	3	1	4	4	55
	Coarse	16.0	22.6	1	4	5	5	60
	Coarse	22.6	32	1	2	3	3	63
	Very Coarse	32	45	1	1	2	2	65
	Very Coarse	45	64	1	1	2	2	67
COBBLE	Small	64	90	14	1	15	15	82
	Small	90	128	13	1	14	14	96
	Large	128	180	3	1	4	4	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.2
D_{50} =	8.0
D_{84} =	94.6
D_{95} =	124.8
D_{100} =	180.0





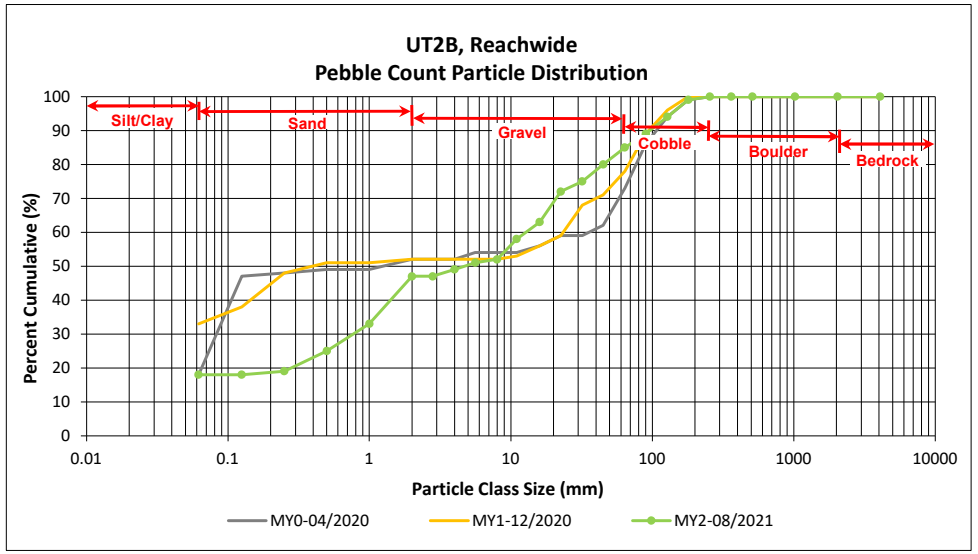
Reachwide Pebble Count Plots

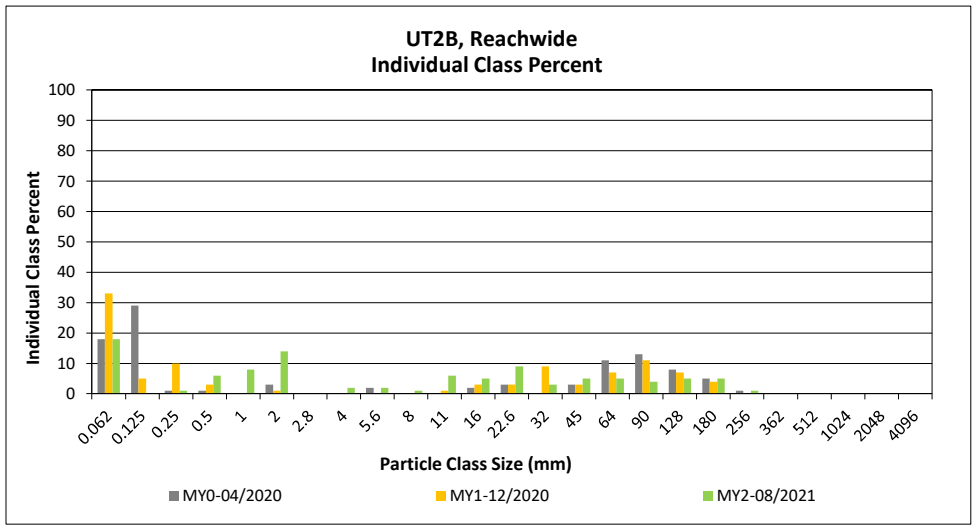
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	15	18	18	18
SAND	Very fine	0.062	0.125					18
	Fine	0.125	0.250		1	1	1	19
	Medium	0.25	0.50	2	4	6	6	25
	Coarse	0.5	1.0	1	7	8	8	33
	Very Coarse	1.0	2.0	7	7	14	14	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0		2	2	2	49
	Fine	4.0	5.6		2	2	2	51
	Fine	5.6	8.0	1		1	1	52
	Medium	8.0	11.0	4	2	6	6	58
	Medium	11.0	16.0	5		5	5	63
	Coarse	16.0	22.6	5	4	9	9	72
	Coarse	22.6	32		3	3	3	75
	Very Coarse	32	45	4	1	5	5	80
	Very Coarse	45	64	3	2	5	5	85
COBBLE	Small	64	90	4		4	4	89
	Small	90	128	5		5	5	94
	Large	128	180	5		5	5	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	1.1
D_{50} =	4.7
D_{84} =	59.6
D_{95} =	137.0
D_{100} =	256.0





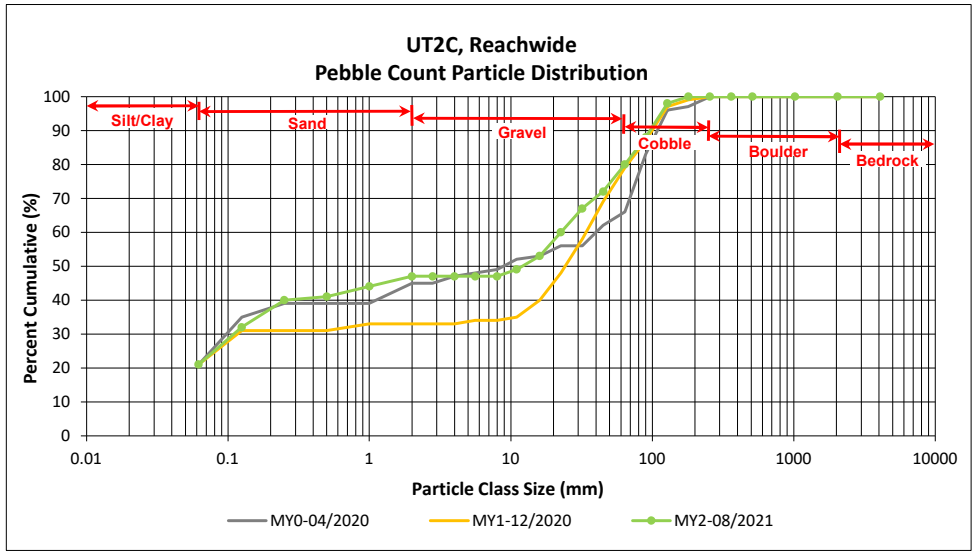
Reachwide Pebble Count Plots

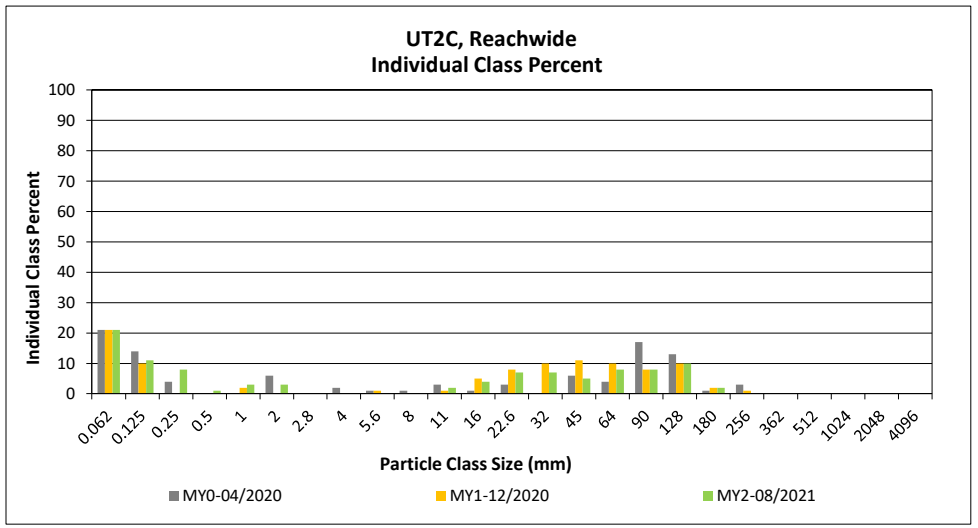
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT2C, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	17	21	21	21
SAND	Very fine	0.062	0.125	3	8	11	11	32
	Fine	0.125	0.250		8	8	8	40
	Medium	0.25	0.50	1		1	1	41
	Coarse	0.5	1.0	2	1	3	3	44
	Very Coarse	1.0	2.0		3	3	3	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0					47
	Fine	4.0	5.6					47
	Fine	5.6	8.0					47
	Medium	8.0	11.0		2	2	2	49
	Medium	11.0	16.0	2	2	4	4	53
	Coarse	16.0	22.6	3	4	7	7	60
	Coarse	22.6	32	5	2	7	7	67
	Very Coarse	32	45	3	2	5	5	72
	Very Coarse	45	64	7	1	8	8	80
COBBLE	Small	64	90	8		8	8	88
	Small	90	128	10		10	10	98
	Large	128	180	2		2	2	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.2
D_{50} =	12.1
D_{84} =	75.9
D_{95} =	115.2
D_{100} =	180.0





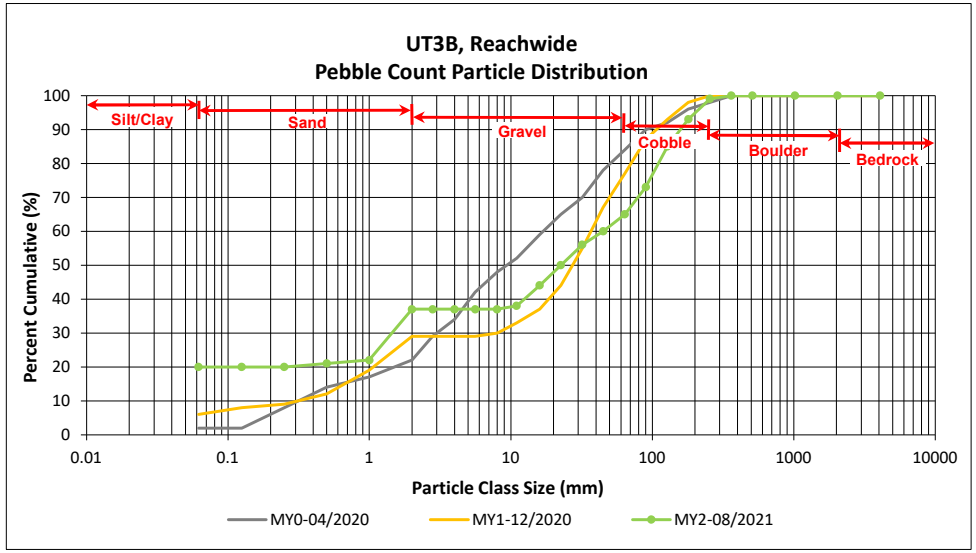
Reachwide Pebble Count Plots

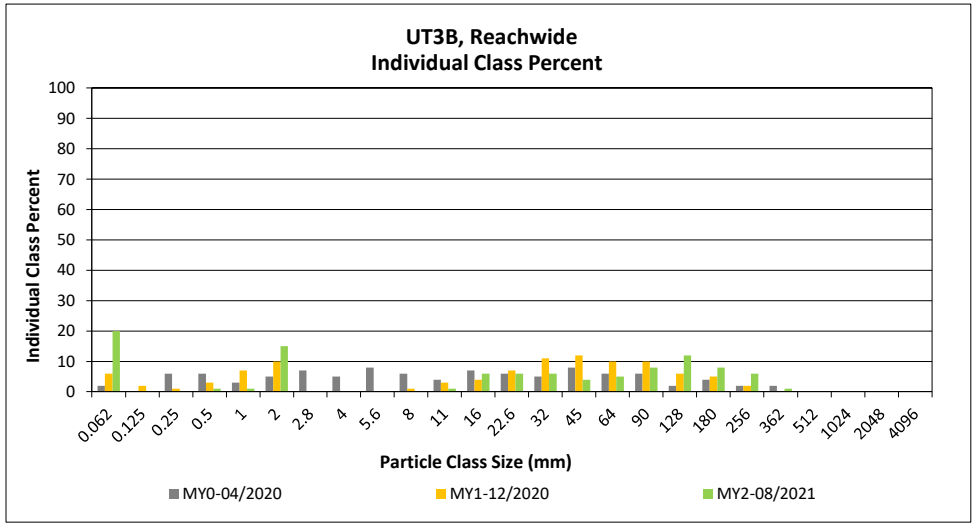
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT3B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	19	20	20	20
SAND	Very fine	0.062	0.125					20
	Fine	0.125	0.250					20
	Medium	0.25	0.50		1	1	1	21
	Coarse	0.5	1.0		1	1	1	22
	Very Coarse	1.0	2.0	5	10	15	15	37
GRAVEL	Very Fine	2.0	2.8					37
	Very Fine	2.8	4.0					37
	Fine	4.0	5.6					37
	Fine	5.6	8.0					37
	Medium	8.0	11.0	1		1	1	38
	Medium	11.0	16.0	2	4	6	6	44
	Coarse	16.0	22.6	4	2	6	6	50
	Coarse	22.6	32	4	2	6	6	56
	Very Coarse	32	45	1	3	4	4	60
	Very Coarse	45	64		5	5	5	65
COBBLE	Small	64	90	6	2	8	8	73
	Small	90	128	12		12	12	85
	Large	128	180	7	1	8	8	93
	Large	180	256	6		6	6	99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	1.8
D_{50} =	22.6
D_{84} =	124.3
D_{95} =	202.4
D_{100} =	362.0





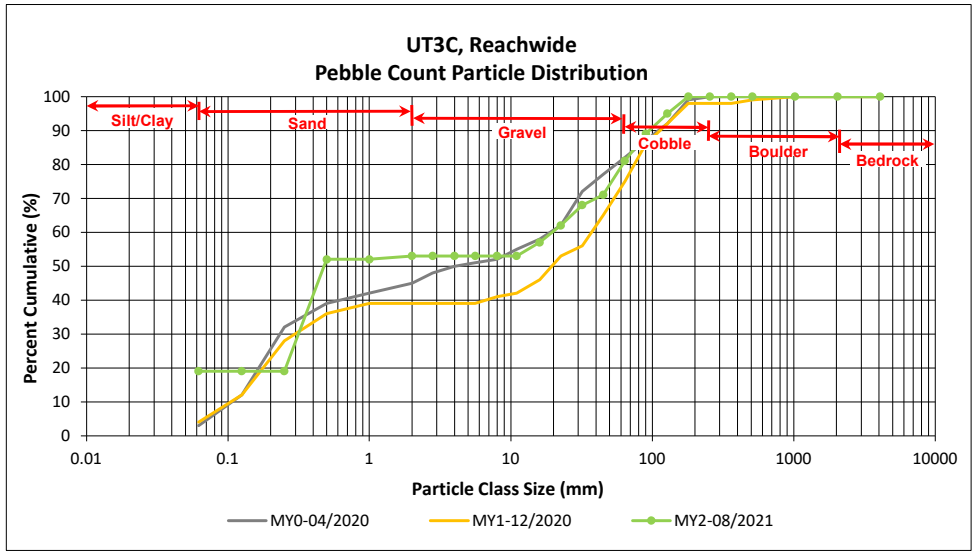
Reachwide Pebble Count Plots

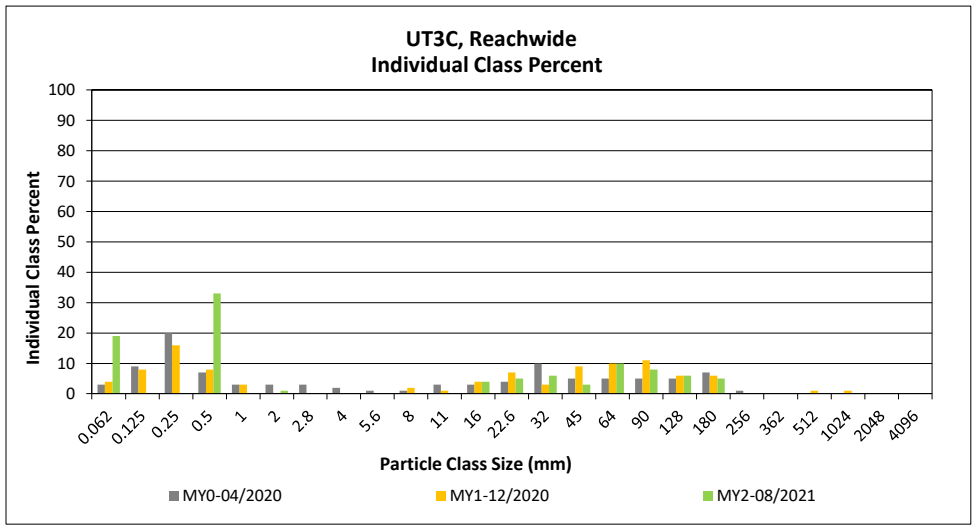
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

UT3C, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		19	19	19	19
SAND	Very fine	0.062	0.125					19
	Fine	0.125	0.250					19
	Medium	0.25	0.50	5	28	33	33	52
	Coarse	0.5	1.0					52
	Very Coarse	1.0	2.0	1		1	1	53
GRAVEL	Very Fine	2.0	2.8					53
	Very Fine	2.8	4.0					53
	Fine	4.0	5.6					53
	Fine	5.6	8.0					53
	Medium	8.0	11.0					53
	Medium	11.0	16.0	3	1	4	4	57
	Coarse	16.0	22.6	5		5	5	62
	Coarse	22.6	32	5	1	6	6	68
	Very Coarse	32	45	2	1	3	3	71
	Very Coarse	45	64	10		10	10	81
COBBLE	Small	64	90	8		8	8	89
	Small	90	128	6		6	6	95
	Large	128	180	5		5	5	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.3
D_{50} =	0.5
D_{84} =	72.7
D_{95} =	128.0
D_{100} =	180.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 14. Verification of Bankfull Events

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Reach	Monitoring Year	Date of Occurrence	Method
Bull Creek Reach 2 (Crest Gage #1)	MY1	5/28/2020	Automated Crest Gage
		8/5/2020	
		11/12/2020	
		12/26-27/2020	
	MY2	---	---
UT1C (Crest Gage #2)	MY1	8/5/2020	Automated Crest Gage
		8/15/2020	
		10/29/2020	
		11/11-12/2020	
		12/3/2020	
		12/19/2020	
		12/25-27/2020	
	MY2	9/21-22/2021	Automated Crest Gage
UT2C (Crest Gage #3)	MY1	8/15/2020	Automated Crest Gage
		10/29/2020	
		11/12/2020	
		12/30/2020	
	MY2	9/21-22/2021	Automated
UT3C (Crest Gage #4)	MY1	8/5/2020	Automated Crest Gage
		8/15/2020	
		8/21/2020	
		10/29/2020	
		12/25-26/2020	
	MY2	9/21-22/2021	Automated Crest Gage
Bull Creek Reach 3 (Crest Gage #5)	MY1	5/28/2020	Automated Crest Gage
		8/5/2020	
		8/15/2020	
		11/12/2020	
	MY2	---	---

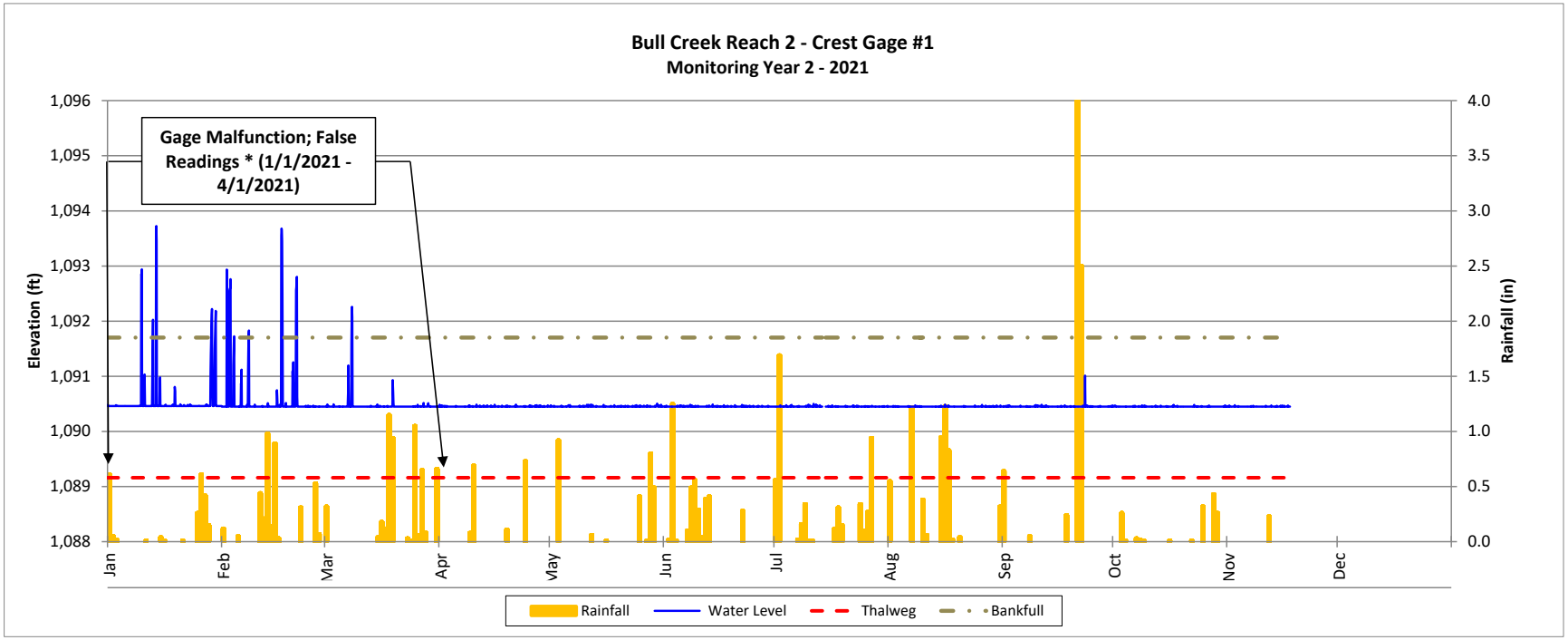
Table 15. Verification of 30 Days Consecutive Flow

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

Summary of In-Stream Gage Results for Monitoring Years 1 through 7							
Gage	**Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)**						
	MY1	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
UT2 Stream Gage	Yes/256 days (100%)	Yes/351 days (100%)					

Recorded Bankfull Events

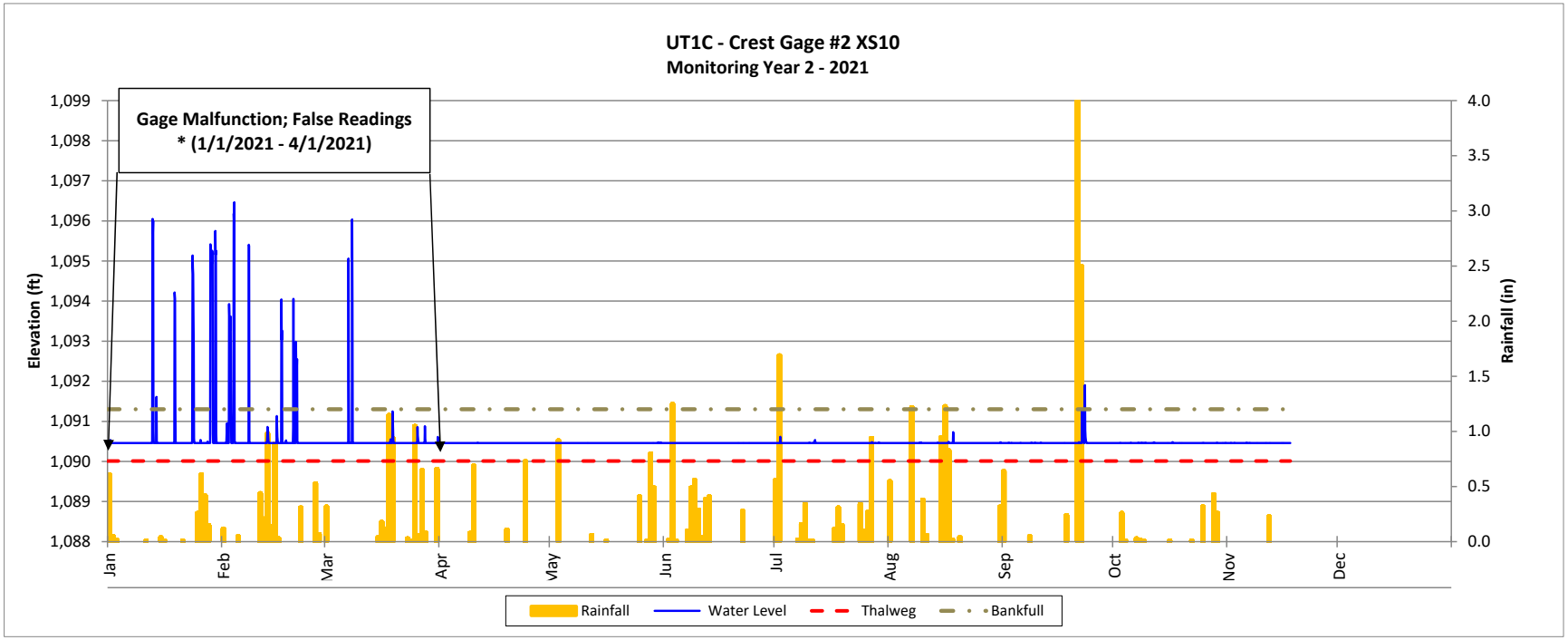
Key Mill Mitigation Bank
DMS Project No. 100025
Monitoring Year 2 - 2021



*Due to the large spikes that do not seem to correlate with rainfall amounts, but occurred only during the winter months, Wildlands pulled air temperature data for the surrounding area and noticed a correlation between the spikes and when the air temperatures dropped below freezing. Therefore, Wildlands contacted In-situ on 11.18.21 to gain some technical insight on these findings. A Technical Support Specialist, Kaylie Haynes, at In-situ confirmed that these spikes are likely false readings due to freezing water around the pressure diaphragm in the gage. She referred us to specification sheet for the pressure transducers, Rugged TROLL(R) 100 Data Loggers, that Wildlands commonly uses in the field (2021). Therefore, Wildlands ignored the bankfull event spikes recorded from 01.01.21 - 04.01.21, when air temperature is more likely to fall below freezing, and only includef bankfull events recorded between 04.01.21 - 10.31.21 when air temperature is more likely to remain above freezing and that positively correlated with rainfall amounts from the nearest rainfall gage. Moving forward, Wildlands will check the calibration on the gages using a known depths of water. If the gage is recording correctly, it will be reinstalled for use in 2022. If the gage is not recording correctly, Wildlands will refrain from using the gage unless it can be refurbished by In-situ, upon which Wildlands will check the calibration before reinstalling it for use during 2022.

Recorded Bankfull Events

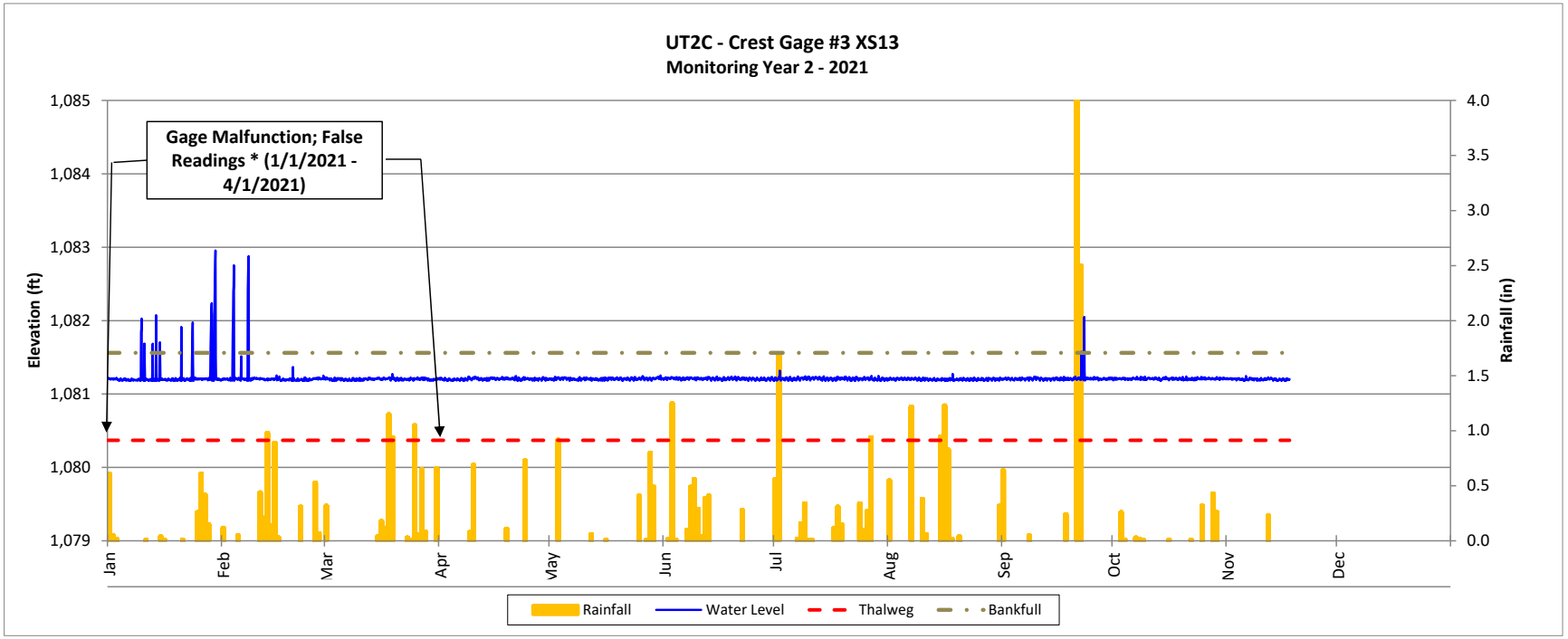
Key Mill Mitigation Bank
DMS Project No. 100025
Monitoring Year 2 - 2021



*Due to the large spikes that do not seem to correlate with rainfall amounts, but occurred only during the winter months, Wildlands pulled air temperature data for the surrounding area and noticed a correlation between the spikes and when the air temperatures dropped below freezing. Therefore, Wildlands contacted In-situ on 11.18.21 to gain some technical insight on these findings. A Technical Support Specialist, Kaylie Haynes, at In-situ confirmed that these spikes are likely false readings due to freezing water around the pressure diaphragm in the gage. She referred us to specification sheet for the pressure transducers, Rugged TROLL(R) 100 Data Loggers, that Wildlands commonly uses in the field (2021). Therefore, Wildlands ignored the bankfull event spikes recorded from 01.01.21 - 04.01.21, when air temperature is more likely to fall below freezing, and only includef bankfull events recorded between 04.01.21 - 10.31.21 when air temperature is more likely to remain above freezing and that positively correlated with rainfall amounts from the nearest rainfall gage. Moving forward, Wildlands will check the calibration on the gages using a known depths of water. If the gage is recording correctly, it will be reinstalled for use in 2022. If the gage is not recording correctly, Wildlands will refrain from using the gage unless it can be refurbished by In-situ, upon which Wildlands will check the calibration before reinstalling it for use during 2022.

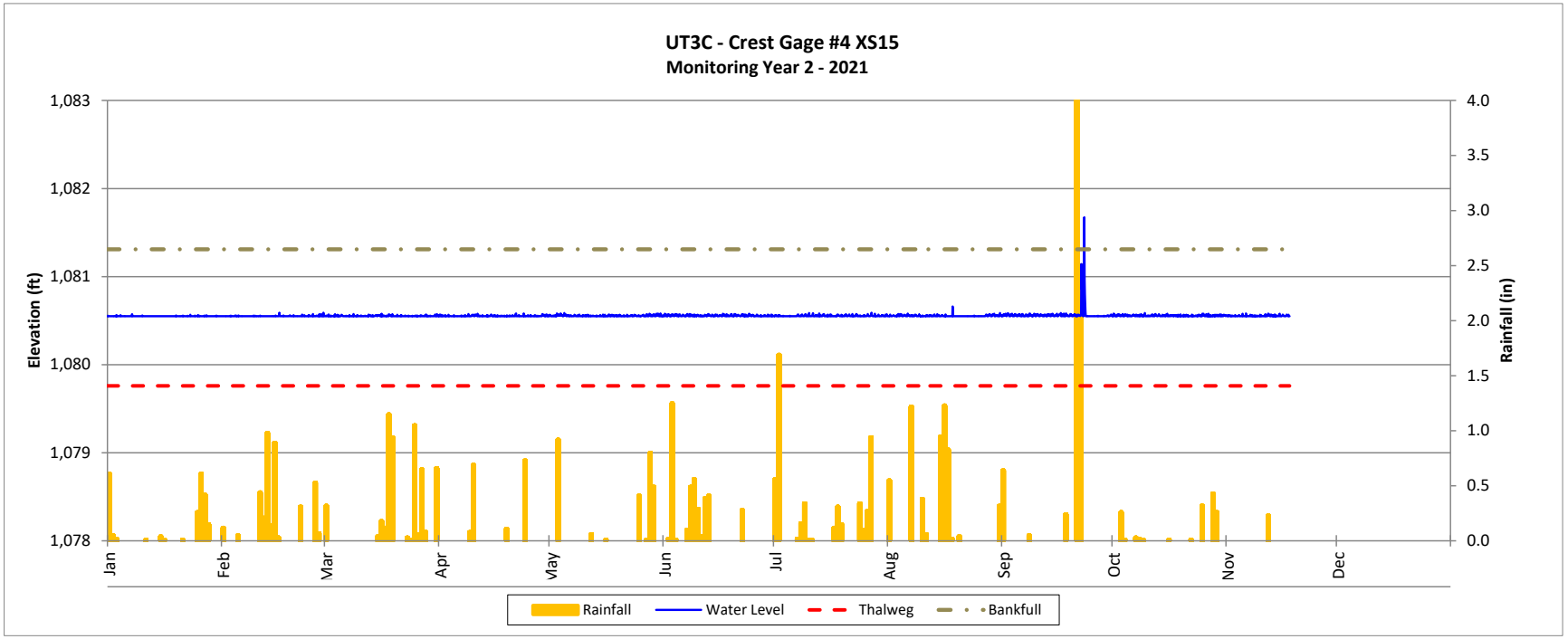
Recorded Bankfull Events

Key Mill Mitigation Bank
DMS Project No. 100025
Monitoring Year 2 - 2021

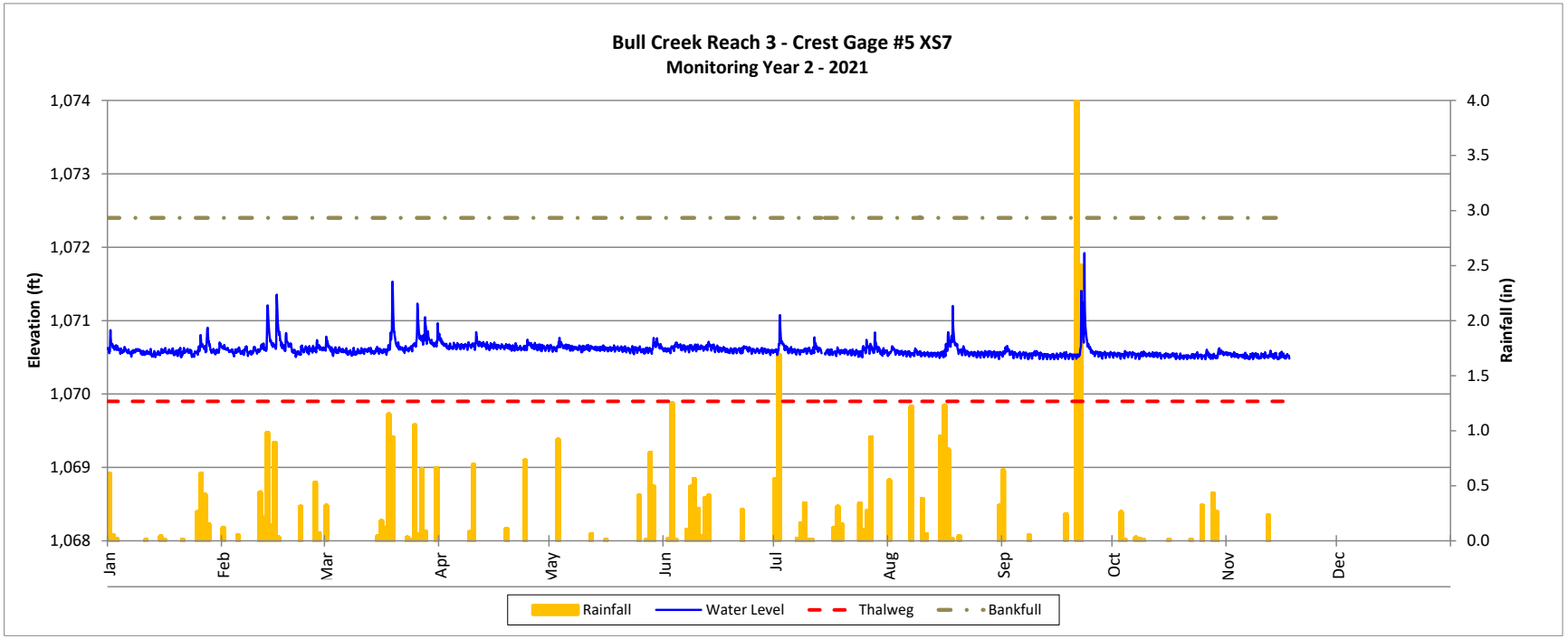


*Due to the large spikes that do not seem to correlate with rainfall amounts, but occurred only during the winter months, Wildlands pulled air temperature data for the surrounding area and noticed a correlation between the spikes and when the air temperatures dropped below freezing. Therefore, Wildlands contacted In-situ on 11.18.21 to gain some technical insight on these findings. A Technical Support Specialist, Kaylie Haynes, at In-situ confirmed that these spikes are likely false readings due to freezing water around the pressure diaphragm in the gage. She referred us to specification sheet for the pressure transducers, Rugged TROLL(R) 100 Data Loggers, that Wildlands commonly uses in the field (2021). Therefore, Wildlands ignored the bankfull event spikes recorded from 01.01.21 - 04.01.21, when air temperature is more likely to fall below freezing, and only includef bankfull events recorded between 04.01.21 - 10.31.21 when air temperature is more likely to remain above freezing and that positively correlated with rainfall amounts from the nearest rainfall gage. Moving forward, Wildlands will check the calibration on the gages using a known depths of water. If the gage is recording correctly, it will be reinstalled for use in 2022. If the gage is not recording correctly, Wildlands will refrain from using the gage unless it can be refurbished by In-situ, upon which Wildlands will check the calibration before reinstalling it for use during 2022.

Recorded Bankfull Events
Key Mill Mitigation Bank
DMS Project No. 100025
Monitoring Year 2 - 2021

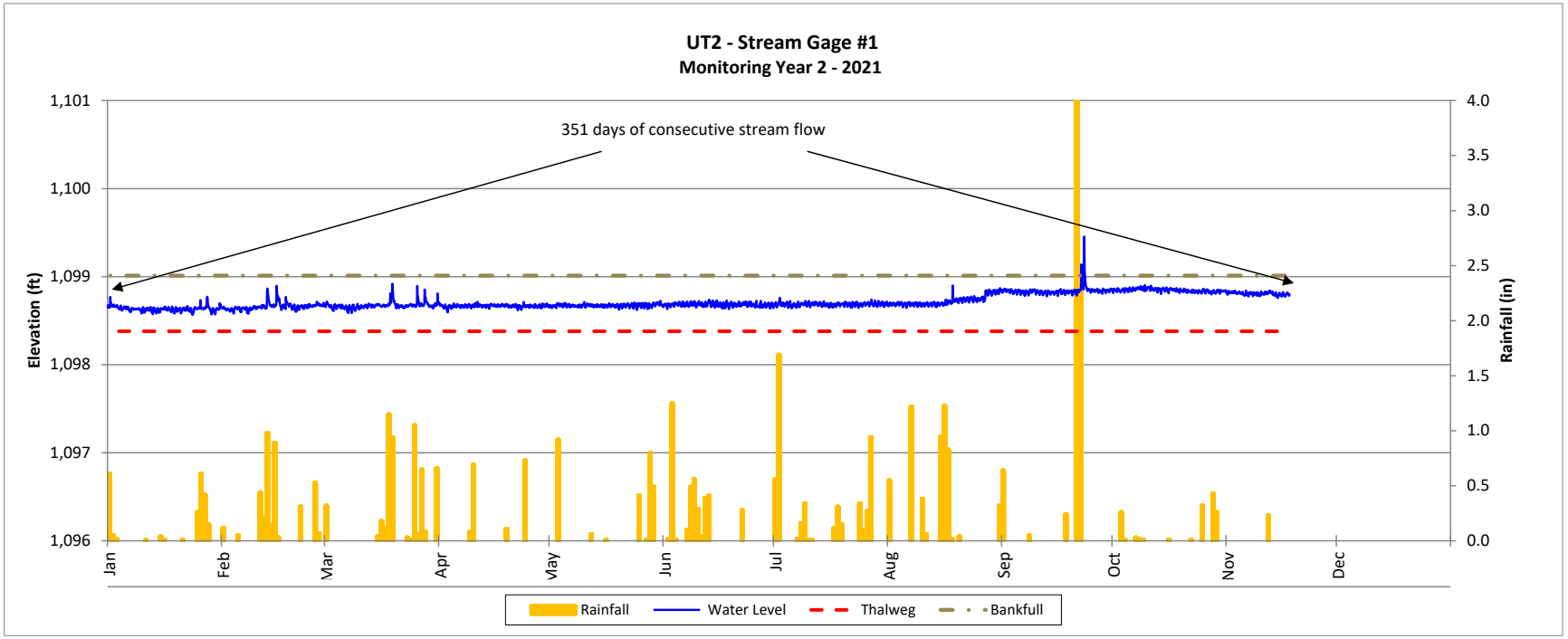


Recorded Bankfull Events
Key Mill Mitigation Bank
DMS Project No. 100025
Monitoring Year 2 - 2021



Recorded In-stream Flow Events

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 2 - 2021

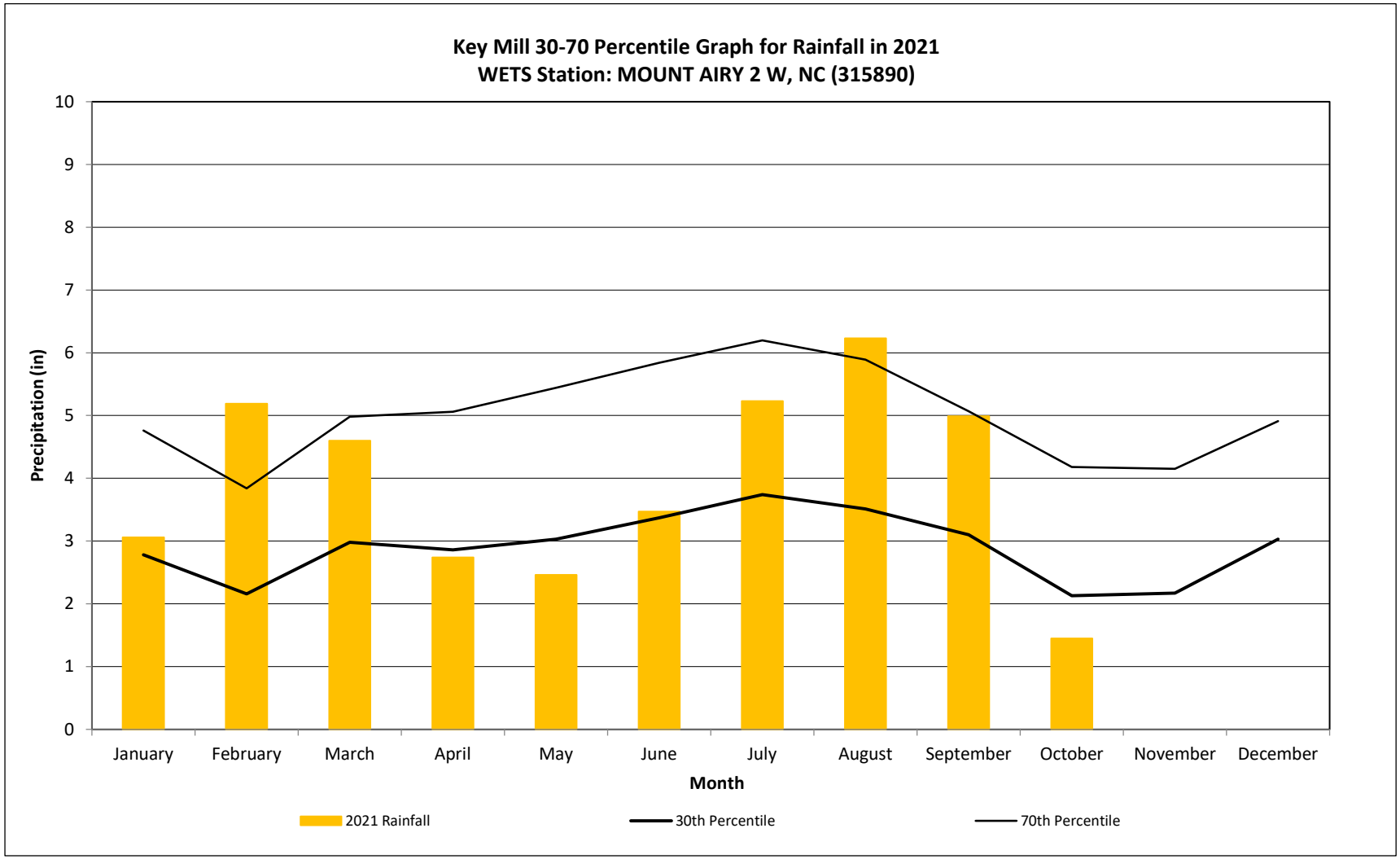


Monthly Rainfall Data

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 2 - 2021



Annual Rainfall collected by USGS 362416080334345 RAINGAGE AT ARARAT RIVER AT ARARAT, NC

30th and 70th percentile rainfall data collected from WETS Station: MOUNT AIRY 2 W, NC (315890); percentiles based on 30-yr climate normal (1991-2021)

APPENDIX 6. Adaptive Management Plan

ADAPTIVE MANAGEMENT PLAN – AS-BUILT/RECORD DRAWINGS

KEY MILL MITIGATION SITE
Surry County, NC
NCDEQ Contract No. 7180
DMS Project No. 100025
USACE Action ID No. SAW-2017-01504
NCDEQ DWR Certification No. 17-1045
RFP #: 16-006993

Yadkin River Basin
HUC 03040101

Data Collection Period: October 2020 – April 2021
Draft Submission Date: April 20, 2021

PREPARED FOR:

NC Department of Environment Quality
Division of Mitigation Services
217 West Jones Street; 3rd Floor
Raleigh, NC 27603

May 17, 2021

Mr. Matthew Reid
Project Manager
NCDEQ – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Review of Draft AMP - As-built/Record Drawings
Key Mill Mitigation Site, Surry County
Yadkin River Basin – HUC 03040101
DMS Project ID No. 100025 / DEQ Contract #7180

Dear Mr. Reid:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft As-built and Record Drawings for Repairs at the Key Mill Mitigation Site. The report has been updated to reflect those comments where requested. The Final As-built Report and Record Drawings are included. DMS' comments are noted below in **bold.** Wildlands' responses to DMS' comments are noted below in *italics*.

DMS comment: The approved Key Mill Mitigation Plan states in section 11.0 Adaptive Management Plan that WEI will notify and work with members of the IRT to develop contingency plans and remedial actions when Site performance standards are jeopardized. Unfortunately, the IRT did not have an opportunity to review the Key Mill Adaptive Management Plan and provide comments prior to implementation. Since repair work has already been completed, the Draft Adaptive Management Plan submitted to DMS for review serves as the As-built/Record Drawing of the corrective actions. In the future, please notify the USACE when repairs are needed as required by the Nationwide Permit 27 general conditions. If necessary, NCDWR may also need to be notified for 401 conditions.

Wildlands' response: Wildlands acknowledges DMS' concerns about proper regulatory notification and will do better in the future.

DMS comment: Did WEI confirm that the repairs and additional work on the site would be acceptable to complete under the existing permits from a regulatory standpoint? Consider adding a short discussion regarding permitting as it pertains to the repair, additional work and existing permits.

Wildlands' response: Since the impacts within the project had already been permitted under a NW-27, Wildlands did not think that it was necessary to confirm the repairs with the regulatory agencies, since the repair areas would be covered by and not subject to regulatory notification under a NW-3, paragraph (a) for Maintenance and the corresponding GC4132. Wildlands has added text to the report in Section 3.0 discussing permit requirements.

DMS comment: Recommend adding a short discussion/justification for not notifying the IRT of needed repairs. DMS and WEI discussed the need for an AMP in February, and WEI identified the need for repairs as early as November 2020.

Wildlands' response: Since the draft AMP was a relatively new guidance, Wildlands had to evaluate how it applied to this site. In the meantime, a contractor became available, so it was decided to move forward

with repairs in order to finish within planting season. Wildlands understands that the IRT must be contacted for significant repairs and will do so on future projects.

DMS comment: Please revise title to: Adaptive Management Plan – As-built/Record Drawings.

Wildlands' response: Wildlands has revised the title as requested.

DMS comment: The AMP states that 5 acres were replanted. It should be noted that 5 acres is approximately 51% of the total planted acreage of 9.8 acres.

Wildlands' response: The AMP does state that 5 acres were replanted; however, the supplemental planting was conducted at lower density rates that varied among the areas of low stem density throughout the site. Therefore, a more accurate determination of the approximate percentage that was replanted would be based on the number of bare roots installed as part of the supplemental planting effort (2,078 stems) versus the original number of bare roots installed after the completion of construction (8,049 stems). This would result in approximately 26% of the site being supplementally planted. Text has been added to Section 4.2.1 to provide this additional information.

DMS comment: Recommend quantifying the total length of bank repair, bed repair, and geo-lift/boulder toe.

Wildlands' response: As requested approximate lengths of bank repair, bed repair, and geo-lifts with boulder toe are 1,587 LF or 12%, 453 LF or 0.07%, and 149 LF or 0.02%, respectively. The percentage of these repairs does not include the length of Reach 4, the preservation reach, since no work was conducted in the area. Text has been added to Section 4.1 to provide this additional information.

DMS comment: Recommend discussing the design change from the originally designed brush toe to geo-lift/boulder toe. The photos of the post repair work show a heavily armored channel that deviates from the original design.

Wildlands' response: There were three locations where brush toe was replaced with boulder toe during repairs. The reason a more robust bank structure was installed was due to a combination of poor in-situ soils and groundwater seeps that formed after the original construction effort. Wildlands determined that a rock toe was needed to stabilize the banks.

As requested, Wildlands is digitally submitting a copy of the final Adaptive Management Plan – As-built/Record Drawings with copy of our comment response letter inserted after the report's cover page.

Sincerely,

Kristi Suggs
Senior Environmental Scientist
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Key Mill MITIGATION SITE

Adaptive Management Plan – As-built/Record Drawings

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APPENDICES

Section 1: Introduction

Wildlands Engineering, Inc. (Wildlands) implemented a full-delivery stream mitigation project at the Key Mill Mitigation Site (Site) for the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS). The project restored, enhanced, and preserved a total of 7,437 linear feet (LF) of perennial and intermittent stream in Surry County, NC. The Site is located at 36.3993° N, -80.6033° W and within the DMS targeted watershed for the Yadkin River Basin Hydrologic Unit Code (HUC) 03040101110040 and the NC Division of Water Resources (NCDWR) Sub-basin 03-07-03. The project is providing 6,107.300 cool stream mitigation units (SMUs) for the Yadkin River Basin HUC 03040101 (Yadkin 01). The final Mitigation Plan was submitted and accepted by DMS in October of 2018 and the IRT in January of 2019. The final Baseline Conditions and As-built Monitoring Report was submitted in early Oct 2020. The project is currently in Monitoring Year 2 (MY2).

In early 2021, Wildlands Engineering submitted a MY1 report summarizing stream and vegetative areas of concern on the Site that were caused by late season planting, poor soils, and multiple occurrences of high stream and floodplain flows, which were due to multiple incidents from the end of construction through the first year of monitoring. Initially construction was scheduled for completion in February 2020. Toward the end of January through early February 2020, the contractor was conducting repairs. On the night of February 5, 2020, the site received approximately 4-inches of rain within a 24-hour period. This event caused some significant damage on the newly constructed and repair areas across the Site, especially along the main channel, Bull Creek. Repairs pushed the completion of construction to early April 2020, which pushed planting to mid-April. Planting was completed by 4/17/2020.

According to data collected by USGS at the Ararat rain gage (2020), monthly rainfall was above average for five out of six months between April and September. During this time, only a few repairs were needed and consisted mostly of the addition of rock lined outlets to Bull Creek to drain floodplain discharge. However, in addition to an already unseasonably wet year, during the month of October the Site incurred three large 24-hour rain events on 10/10 – 10/11, 10/24 – 10/25, and 10/28 – 10/29 of which it received 3.4-inches, 2.0-inches, and 3.7-inches, respectively. It was the last event in October when most of the damage occurred. Bull Creek, with a drainage area between 1.8 and 2.0 square miles, received the brunt of the damage. In addition, there were a few areas of either bed scour or bank erosion on UT1C and UT3B and some erosion around the culvert on the crossings at UT1C, UT2B, and UT3B.

Though much of the site remained stable, the damage to stream channels and to portions of open and newly planted areas of the floodplain warranted a repair and supplemental planting to keep the Site on track to meet the MY3, MY5, and MY7 requirements. Based on previous comments and discussions on other similar projects between DMS and the NC Interagency Review Team (IRT) and subsequently Wildlands, it was determined by Wildlands that an Adaptive Management Plan – As-built/Record Drawings (AMP) report was needed to document areas where repairs and supplemental planting were conducted. This effort is outlined in the following sections.

Section 2: Monitoring Year 1 Assessment

Annual monitoring for MY1 was conducted between October and December 2020 to assess the condition of the project. The stream and vegetative performance criteria for the Site follows the approved success criteria presented in the Key Mill Mitigation Plan (Wildlands, 2019). Stream and vegetative monitoring features and locations are shown in Figures 1.1 – 1.3 in Appendix 1.

2.1 Performance Criteria

2.1.1 Vegetative

The final vegetative success criteria will be the survival of 210 planted stems per acre in the open planted riparian corridor at the end of the required seventh monitoring period. The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of MY3 and at least 260 stems per acre at the end of MY5. Planted vegetation in each plot must average 7 feet in height by MY5 and 10 feet in height at the end of the MY7.

2.1.2 Stream

Stream channels should maintain a stable pattern and profile considering the hydrologic and sediment inputs to the system, the landscape setting, and the watershed conditions. Bank height ratios should stay below 1.2. Visual assessments should indicate a progression towards stability. Entrenchment ratios should be >1.4 for restored B channels and ≥2.2 for C/E channels. Cross-sections should show little change in bankfull area and width-to-depth ratio.

2.2 MY1 Results

2.2.1 Vegetative

The MY1 vegetation survey that was completed in October 2020, resulting in an average planted stem density of 439 stems per acre for all monitored permanent and mobile vegetation plots (VPs). Ten of the thirteen vegetation plots (Permanent and mobile), with densities ranging from 324 to 809, are on track to meet the interim MY3 requirement of 320 planted stems per acre. Of those three plots not meeting the MY3 success criteria, one plot (VP4) is not on track to meet the final success criteria of 210 planted stems per acre.

Though much of the Site is on track to meet the vegetative success criteria for MY3, some areas of low stem density and one area of low herbaceous cover were noted during the Site's field assessment in December 2020. The low stem density areas total approximately five acres of the Site and were predominantly located along Bull Creek Reach 1B, the southern portion of Bull Creek Reach 3, UT3A, and the upper portion of UT3B. The area of poor herbaceous cover totaled approximately 1.5 acres and was noted along Bull Creek Reach 3 within an area of low stem density.

See Appendix 1 for the location of areas of poor vegetative performance (Figures 1.1 – 1.3) and Appendix 2 (Tables 1 and 2a-c) for the MY1 vegetation plot monitoring results.

2.2.2 Stream

Morphological surveys for MY1 were conducted in December 2020 after repairs were completed on Bull Creek Reach 1A, 1B, and 2 and UT1B and C. Overall, cross-section (XS) survey results indicate that most of the channels' dimensions are stable and functioning as designed with minimal adjustments. Changes occurring within some cross-sections include slight variations in cross-sectional areas and widths, as well as mean depths; however, most of the width to depth ratios have remained consistent. Additionally,

bank height ratios (BHR) at surveyed cross-sections were at or near 1.0 for all reaches, except for XS10 on UT1C and XS14 on UT3B. Minor changes in cross-sectional profiles are normal for newly restored streams and are examples of how a channel adjusts to maintain stability from natural processes like rain events, a lack of mature woody vegetation along the stream bank, herbaceous growth along the banks, and/or sediment transport processes or to grading of repair areas. However, damage from storm events in MY1 were the likely cause for the variations in cross-section dimensions noted at XS2, XS3, XS7, XS10, and XS14. This included riffle displacement, bank erosion, floodplain scour, and repairs conducted in November 2020 before MY1 survey was collected. See Appendix 3 for cross-section plots and Table 3 for cross-sectional parameter comparisons.

Though many of the surveyed cross-sections represent stable conditions, stream areas of concern were noted during the Site's field assessment in December 2020 and include areas of bank scour and/or erosion along outer meander bends, riffle scour and/or the displacement of riffle material, localized areas of aggradation and three areas of structure piping.

See Section 4.1 for the discussion of repair areas, if needed, within surveyed cross-sections and areas of concern noted in Site assessment from MY1 report.

Section 3: Site Assessment

After the storm event on October 28th and 29th, Wildlands surveyed the Site to assess the extent of the damage incurred, to explore the factors contributing to their occurrence, to determine what measures were needed to stabilize the site, and to identify potential areas of concern. After assessing the Site, it was determined that approximately 5.0 acres of the site would need supplemental planting and approximately 12% of the restored and/or enhanced areas needed repair. This was likely due to a combination of factors including but not limited to:

- Delays in construction, previously discussed in Section 1.0, pushed post-construction planting to April 17th after the on-set of the growing season,
- Topsoil that was harvested and reapplied during construction to promote woody growth was washed downstream during large post-construction storm events leaving exposed poor-quality subsoils with low organic matter content and limited biology in graded areas,
- The occurrence of high discharge rates and flow velocities from numerous rain events throughout the first year of monitoring before vegetation could become established.

Since these areas in need of repair had already been permitted, the work should be covered and not subject to regulatory notification under a NW-3 paragraph (a) for Maintenance and the corresponding GC4132.

Between November 26 – 28, 2020, repairs conducted on Site were limited to the western side of Key Mill Road due to limited availability of the contractor. These repairs included Bull Creek R1A – R2 and UT1C. Therefore, the site was temporarily stabilized, and the remainder of the repairs and supplemental planting were put on hold until a contractor became available.

In March 2021, a contractor became available to complete the remainder of the Site repairs. Since it had been approximately 4.5 months since the Site was evaluated, Wildlands reassessed the Site to determine if any additional measures would be needed and to verify the stability of the repairs conducted in November 2020. The repairs along Bull Creek R1A – R2 and UT1C had remained stable; however, construction access and bank grading further damaged the planted vegetation and compacted floodplain soils in these areas. On the eastern side of Key Mill Road, areas of concern were still in need of repair; however, it was determined that a few additional repairs and proactive measures were needed throughout both the repaired and non-repaired areas to ensure long-term stability. These repairs, as well as those completed in November 2020, are further discussed in Section 4.0.

Section 4: Corrective Measures for Implementation

4.1 Construction Repairs

Wildlands conducted repairs along the western side of Key Mill Road from November 26-28, 2020 and included Bull Creek R1A, R1B, and R2 and UT1C. However, as previously discussed, the remainder of the Site repairs were delayed until March 18 – 23, 2021 due to limited availability of a contractor. Locations and types of repairs conducted, as well as preventative measures installed are briefly discussed below and outlined in a marked-up pdf of the Record Drawings from Baseline Conditions (Wildlands, 2020) for the Site in Appendix 3. Bank repairs consisted of 1,587 LF or 12%; bed repairs consisted of 453 LF or 7%; and structure changes from brush toe to geo-lift with boulder toe consisted of 149 LF or 2% of the project. The length of the preservation reach, Reach 4 of Bull Creek, was not included in the percent of the project calculation for the repair areas.

November 26-28, 2020:

Bull Creek Reach 1A

- Brush toe repaired at Station 102+00.

Bull Creek Reach 1B

- Banks were regraded and matted on:
    - Left bank at Station 105+85,
    - Left and right bank at Station 107+00 and 107+90,
    - Right bank at Station 108+70 and 111+25.
- Riffles rebuilt and log sills reset when needed at Station 105+85, 108+70, 109+70, and 110+60.
- Near Station 150+00:
    - Point bar regraded on left bank at XS3,
    - Brush toe extended up to head of riffle on right bank, and
    - Floodplain outlet moved upstream to Station 110+10.
- Repaired brush toe and added a geo-lift at Station 112+00.

Bull Creek Reach 2

- Banks were regraded or scraped and matted at:
    - Left bank at Station 112+55,
    - Right bank at Station 115+00, and
    - Left and right bank at Station 113+50.
- Brush toe repaired on left bank at Station 113+00, and right bank at Station 113+80.
- Riffle repaired at Station 113+50 and 114+20.

UT1C

- At Station 211+35:
    - Repaired crossing around downstream side of culvert,
    - Added rip rap on downstream face of crossing, and
    - Installed a log sill at the toe of the culvert outlet.
- Regraded and matted bank on right bank at Station 211+35 and left bank at Station 212+25.

As briefly mentioned in Section 2.2.2, cross-sections 2 and 3 are located in an area of repair work conducted on Bull Creek R1B. Work conducted in this area was completed prior to the MY1 survey and consisted of rebuilding the riffle, resetting the log sill, moving a flood plain outlet upstream, and

regrading on the left bank. These repairs resulted in a slight lateral shift in the channel alignment at XS2 and an enlargement of the cross-sectional area, bankfull width, and mean depth of XS3.

March 18 - 23, 2021:

Bull Creek Reach 1B

- Replaced brush toe with geo-lift and boulder toe on right bank at Station 106+35 and right bank at Station 108+20.

Bull Creek Reach 2

- Replaced brush toe with geo-lift and boulder toe on left bank at Station 113+00 and 114+60.
- Added a floodplain outlet on left bank at Station 113+00.
- Point bar regraded and brush toe installed at Station 115+35.

Bull Creek Reach 3

- Banks regraded and matted on:
    - Left and right bank at Station 150+30,
    - Right bank at Station 152+10 and 156+40,
    - Left bank at Station 160+70 and XS7,
    - Right bank at Station 162+75,
    - Left bank at Station 163+80, and
    - Right bank at Station 164+00 and 165+00.
- From Station 161+00 – 166+00:
    - Installed a vegetation berm along the left floodplain, just inside the conservation easement, to divert overland runoff into stabilized rock lined swales and outlets,
- At Station 163+00:
    - Repaired a brush toe and added a geo-lift, and
    - Installed a rock line swale and floodplain outlet.

UT1C

- Installed a boulder toe at Station 211+36 and 212+75.

UT3B

- Riffle material added as needed from Station 404+40 – 404+70, and
- Rip rap added to the left side of the upstream face of the culvert crossing at Station 407+77.

Cross-sections 7 and 14 are also located in areas where repairs were needed. However, repairs in these areas were conducted after the completion of the MY1 survey, so repair work did not affect variations in cross-sectional dimensions reported in MY1. Instead, these variations were likely due to storm damage in the form of bank erosion along the riffle and the displacement of bed material within the riffle and resulted in an increase in bankfull width and width to depth ratio on XS7 and an increase in the BHR for XS10 and XS14.

Pre- and post-construction repair photos are included, when available, and are located in Appendix 1. One area that still needs to be addressed is the culvert crossing on Bull Creek R3. Currently, Wildlands is evaluating the feasibility of adding floodplain relief culverts to pass high flow event. Modifications have not been scheduled yet but should take place within 2021. It is anticipated that any other areas of localized bank or bed scour and aggradation not included in these repairs, will repair themselves as vegetation becomes established and natural channel processes move sediment through the system.

However, Wildlands will continue to monitor these areas and adaptive measures will be implemented if needed.

4.2 Supplemental Vegetation Planting

4.2.1 Bare Root Plantings

Supplemental planting occurred between March 24 – 25, 2021 after repair work was finished. A mixture of ten species were planted at varying densities across 5.0 acres of the site within the areas designated for low stem density during MY1. This consisted of a total of 2,078 bare roots stems, or 26% of the site, as opposed to the original 8,049 bare root stems installed after the completion of construction. See Figures 1.1, 1.2, and 1.3 for supplemental planting locations and specific planting densities. All planted trees consisted of bare root stock. Species and quantities of trees planted are located in on Table 4. Seven of the species were not included in the Final Mitigation Plan for the Key Mill Site (Wildlands, 2019). They are northern red oak (*Quercus rubra*), white oak (*Quercus alba*), boxelder (*Acer negundo*), persimmon (*Diospyros virginiana*), witch hazel (*Hamamelis virginiana*), red mulberry (*Morus rubra*), and black gum (*Nyssa sylvatica*). However, two of the seven species, northern red oak and black gum were previously approved by the IRT for addition to the planting list as part of the As-built Baseline Monitoring Report for the Site (Wildlands, 2020). Though the remaining five species (boxelder, persimmon, red mulberry, white oak, and witch hazel) were not included as part of the project's previously approved planting plans these new species were picked based on observations of similar systems in the same area. These additional species should establish well in the growing conditions found on-site (poor soils with variable moisture regimes) and will provide a good mix of canopy, early successional, and shrub-type species to the buffer, as well as increase species diversity (LeGrand, et. al., 2021). Supplementally planted trees added to a vegetation plot will be flagged with a color different from what was used to flag the originally planted trees. The additional trees will not be counted towards success criteria until two growing seasons have passed.

The approved planting lists and plans from the Site's Mitigation Plan and As Built report are included in Appendix 4.

4.2.2 Live Stakes

Live stake plantings were also conducted between March 24th and 25th 2021. Approximately 1,250 live stakes were installed throughout the project in areas that received repair work and were also added, as needed, to the stream banks of UT3 and Bull Creek Reach 3 where repair work was not done but live stake mortality was present. Live stakes consisted of a mix of black willow (*Salix nigra*), silky willow (*Salix sericea*), and silky dogwood (*Cornus amomum*). Both silky willow and silky dogwood were included in the approved Final Mitigation Plan (Wildlands 2019); however, black willow was not. Wildlands believes that adding black willow as an additional species to the live stake planting list will aid stream bank stabilization with their ability to become quickly established and will further increase species diversity.

4.2.3 Herbaceous Seed Mix

A temporary seed mix of rye grain and clover were broadcasted in multiple areas throughout the Site as specified below:

- To all disturbed areas after the completion of the repairs conducted in November 2020,
- Any remaining bare areas across the site. These were predominately on Bull Creek Reach 3, and
- To all disturbed areas after the completion of repairs in March 2021.

In late April or May 2021, a spring and summer cover crop of millet, clover, and a riparian mix will be broadcast across the Site in repair areas as well as in the 1.5 acres of poor herbaceous

performance. Amendments of peat moss and biochar will be added to the spring/summer mix to add some extra organic matter and biology to the soil and to assist in germination by soaking up rainwater after seeding. A tacking agent may also be added to the mix for areas on steeper slopes. The seeding rate varies depending on the percent of existing herbaceous cover in the application area. See Table 5 for the species included in the cover crop mix and the application rates.

4.2.4 Soil Amendments

Topsoil that was harvested and reapplied during construction was washed downstream during large post-construction storm events leaving exposed poor-quality subsoils. These remaining soils contain low organic matter content and presumably limited biology in graded areas. Therefore, soil amendments will be added at a rate of approximately 3 ounces to the base of each planted tree in all areas across the Site that were slated for supplemental planting. Soil amendments will include humic acid, biochar, dried molasses, slow-release fertilizer (2-4-3), rock phosphate, and azomite (a trace mineral supplement). Beyond boosting macro- and micronutrients in the soil, the addition of these amendments will improve other soil properties including cation exchange capacity, pH, and microbial communities. Expected improvements include greater moisture-holding capacity, organic matter, and nutrient availability for plants.

Section 5: Proposed Monitoring

5.1 Vegetative

Wildlands will continue to monitor Site vegetation as previously planned. If the monitoring requirements are not met during MY7 in any of the planted areas, including ones with supplemental planting, Wildlands proposes to add another year of vegetation monitoring for those areas. Vegetation monitoring will continue until success criteria are met.

5.2 Stream

Wildlands will continue to monitor the stream as previously planned. If areas of concern begin to threaten the stability of the project, then remedial actions will be implemented and documented for all future reports.

Section 6: Conclusion

In summary, Wildlands conducted stream repairs in November 2020 and March 2021 to address damage incurred by multiple storm events in 2020, in particular the event that occurred from October 28-29. After the repairs were completed, the disturbed areas and the area noted for low herbaceous performance in MY1 were temporarily stabilized and subsequently supplemented with an amended mix of cover crop seed and riparian seed. In addition, approximately 5.0 acres of riparian buffer were supplementally planted with a mix of 10 native species of bare root stock at varying densities in March 2021. Soil amendments will be placed around each supplementally planted bare root to aid in growth and establishment. Stability of repair areas and growth and health of supplementally planted areas will be reevaluated in the Monitoring Year 2 report along with pictures of the addressed areas.

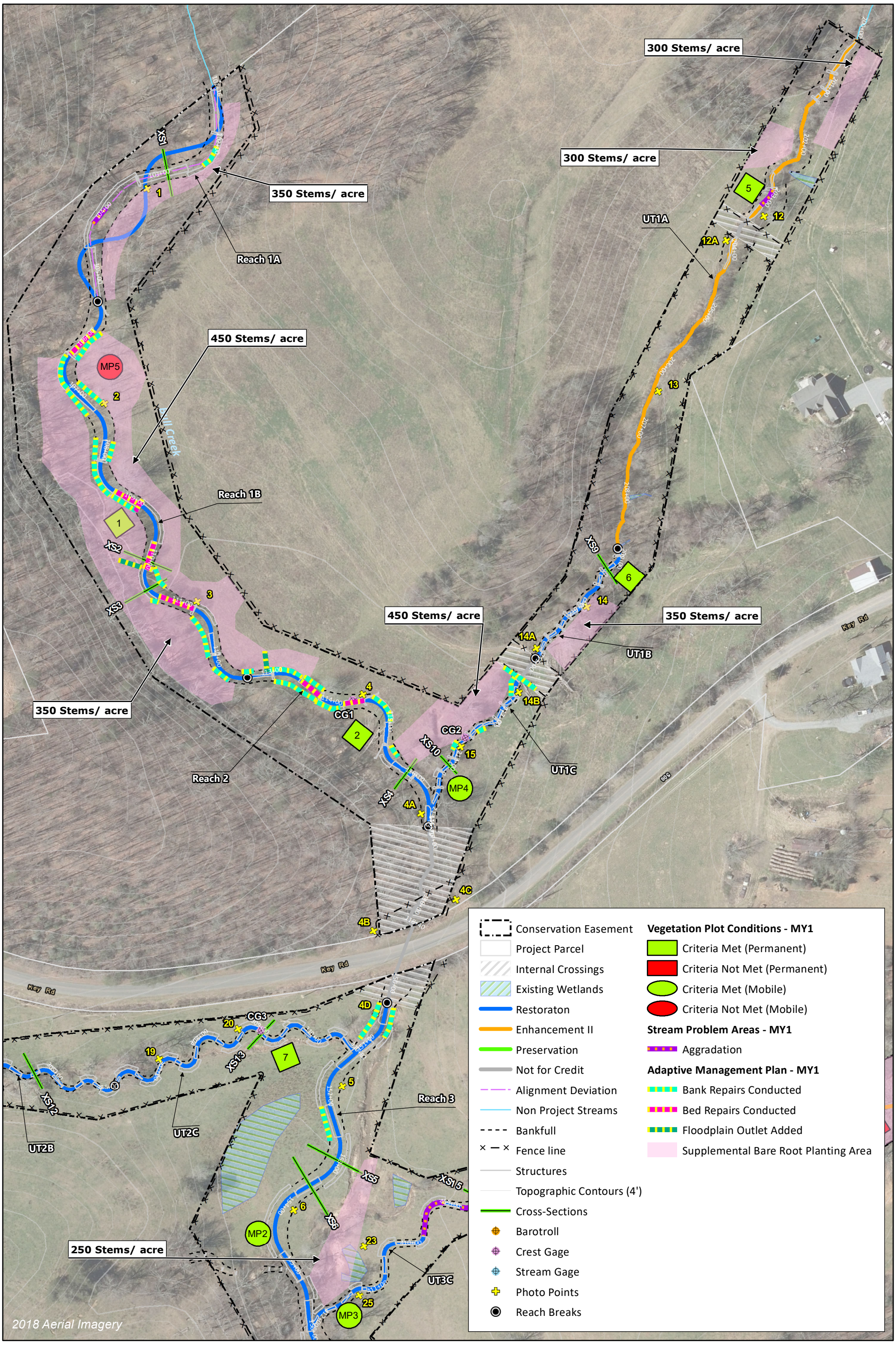
Section 7: REFERENCES

LeGrand, H., B., Sorrie, and T. Howard. 2021. Vascular Plants of North Carolina [Internet]. Raleigh, NC. North Carolina Biodiversity Project and North Carolina State Parks. https://auth1.dpr.ncparks.gov/flora/index.php.

Wildlands Engineering, Inc (Wildlands), 2020. Key Mill Mitigation Site As-built Baseline Monitoring Report. DMS, Raleigh, NC.

Wildlands, 2019. Key Mill Mitigation Site Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. Visual Assessment Data

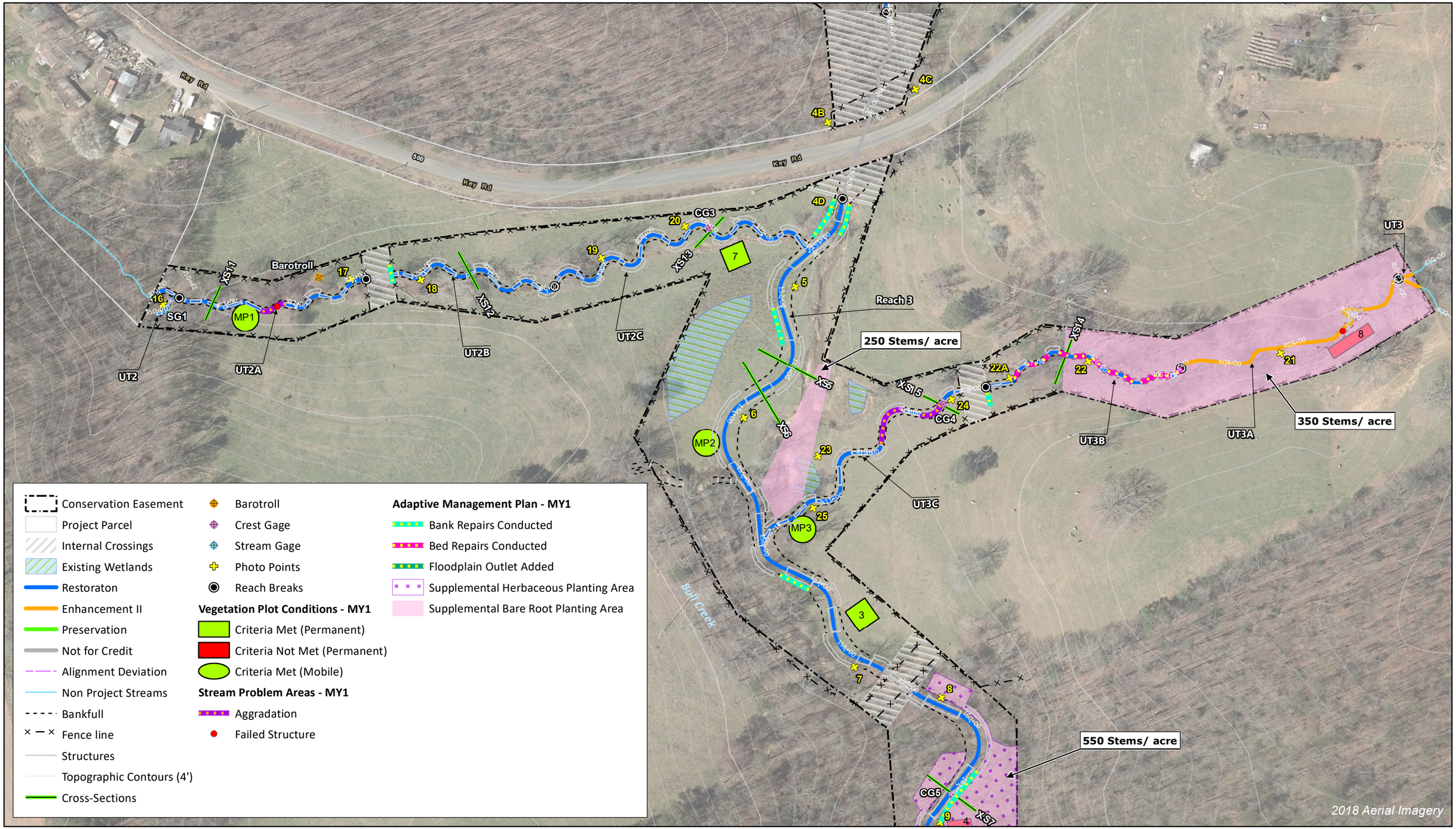


WILDLANDS ENGINEERING

0 130 260 Feet

Figure 1.1 Stream Repairs & Supplemental Planting Map
Key Mill Mitigation Site DMS Project No. 100025
Adaptive Management Plan - As-built Record Drawings

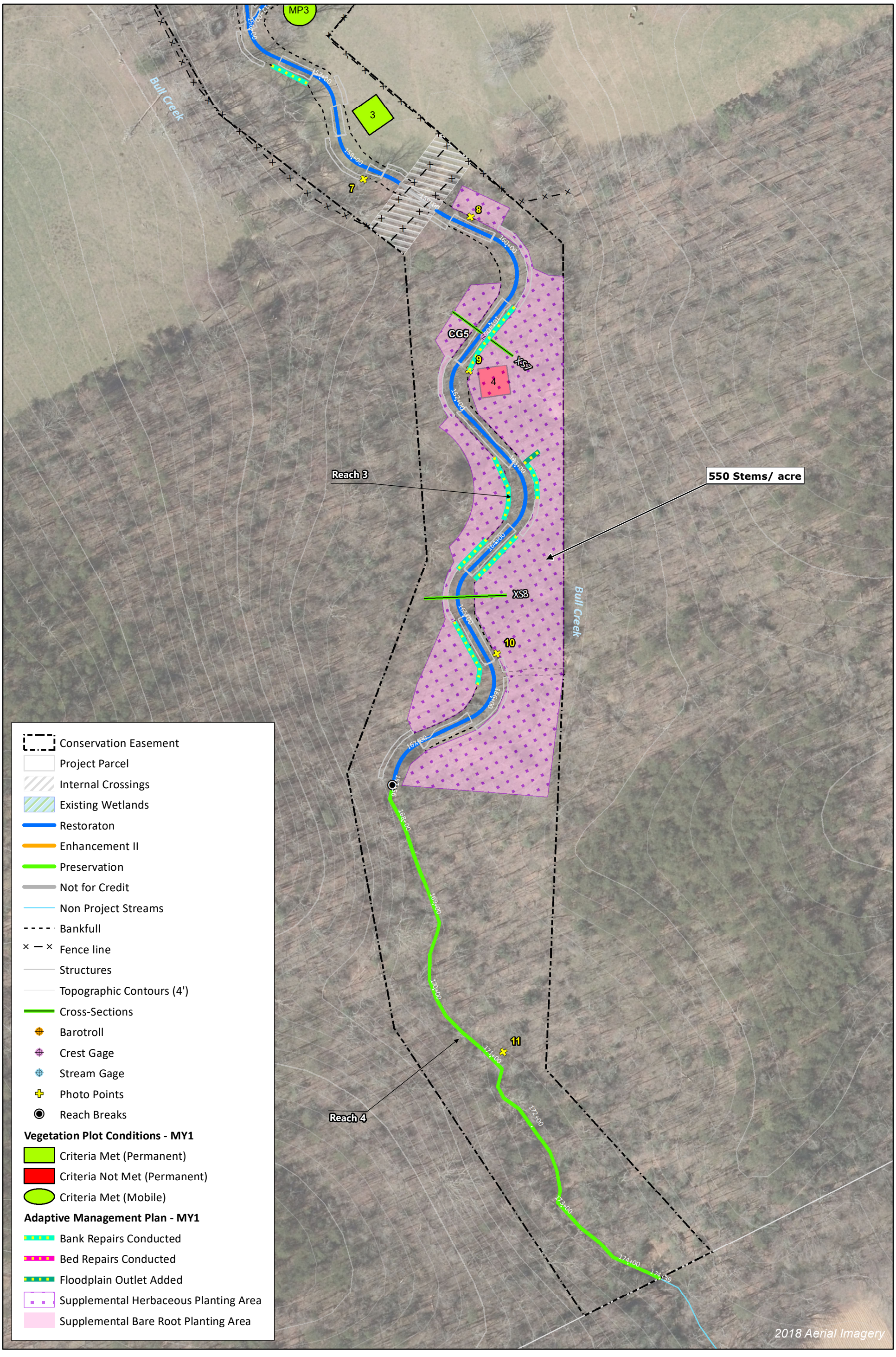
Surry County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

Figure 1.2 Stream Repairs & Supplemental Planting Map
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan - As-built / Record Drawings
Surry County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

Figure 1.3 Stream Repairs & Supplemental Planting Map
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan - As-built / Record Drawings
Surry County, NC

PRE & POST REPAIR PHOTOGRAPHS

Bull Creek Reach 1A
Adaptive Management Plan - As-built /
Record Drawings

	
Pre-Repair – STA 102+00 Downstream; Erosion Along Left Bank and Brush Toe (11/02/2020)	**Post-Repair** – STA 102+00 Upstream; Left Bank Brush Toe Repaired (04/07/2021)

PRE & POST REPAIR PHOTOGRAPHS

Bull Creek Reach 1B
Adaptive Management Plan - As-built /
Record Drawings

	
Pre-Repair – STA 105+85 Downstream; Erosion Along Left Bank at Structure Tie-ins and Loss of Riffle Material (11/02/2020)	**Post-Repair** – STA 105+85 Downstream; Rebuilt Riffle and Regraded and Matted Left Bank (04/07/2021)
	
Pre-Repair – STA 106+35 Downstream; Erosion Along Right Bank Underneath Matting Possible Brush Toe Failure (11/02/2020)	**Post-Repair** – STA 106+35 Downstream; Replaced Brush Toe on Right Bank with Geolift and Boulder Toe (04/07/2021)
	
Pre-Repair – STA 107+00 Downstream; Erosion Along Right and Left Banks (11/02/2020)	**Post-Repair** – STA 107+00 Downstream; Right and Left Banks Regraded and Matted (04/07/2021)

Pre-Repair – STA 107+90 Downstream; Erosion Along Right and Left Banks
STA 108+20 Downstream; Erosion Along Right Bank and Brush Toe (11/02/2020)

Post-Repair – STA 107+90 Downstream; Right and Left Banks Regraded and Matted (04/07/2021)

Post-Repair – STA 108+20 Downstream; Right Bank Replaced Brush Toe with Geolift and Boulder Toe (04/07/2021)

Pre-Repair – STA 108+70 Downstream; Loss of Riffle Material and Dislodged Log Sill (11/02/2020)

Post-Repair – STA 108+70 Downstream; Rebuilt Riffle, Reset Log Sill, and Regraded and Matted Right Bank (04/07/2021)

	
Pre-Repair – STA 109+80 Downstream; Riffle Failure, Dislodged Log Sill, and Erosion Along Point Bar (11/02/2020)	**Post-Repair** – STA 109+80 Downstream; Rebuilt Riffle, Reset Log Sill, and Moved Floodplain Outlet Upstream (04/07/2021)
	
Pre-Repair – STA 110+65 Downstream; Scour Pocket Along Right Bank and Displacement of Riffle Material (11/02/2020)	**Post-Repair** – STA 110+65 Downstream; Extended Brush Toe Along Right Bank and Rebuilt Riffle (04/07/2021)
	
Pre-Repair – STA 111+25 Downstream; Scour on Right Bank from Point Bar into Riffle (11/03/2020)	**Post-Repair** – STA 111+70 Downstream; Right Bank Regraded and Matted (04/07/2021)

	
Pre-Repair – STA 112+00 Downstream; Erosion Along Right Bank Above and Within Brush Toe (11/02/2020)	**Post-Repair -** STA 112+00 Downstream; Repaired Brush Toe and Added Geo-Lift (04/07/2021)

PRE & POST REPAIR PHOTOGRAPHS

Bull Creek Reach 2
Adaptive Management Plan - As-built /
Record Drawings

Pre-Repair – STA 113+00 Downstream; After the November Repair a Floodplain Seep Created Erosion Behind Brush Toe and Outlet (12/30/2020)

Post-Repair – STA 113+00 Downstream; Repaired Brush Toe Along Left Bank; Added a Geolift, Boulder Toe and Floodplain Outlet (04/07/2021)

Pre-Repair – STA 113+40 – 113+80 Downstream; Riffle Scour and Erosion Along Left Bank at Riffle and Along Right Bank from Riffle Through the Brush Toe (11/02/2020)

Post-Repair – STA 113+40 Downstream; Repaired Riffle and Scraped and Re-Matted Banks (04/07/2021)

Post-Repair – STA 113+80 Downstream; Right Bank Brush Toe Repaired (04/07/2021)

	
Pre-Repair – STA 114+20 Downstream; Riffle Scour (11/02/2020)	**Post-Repair** – STA 114+20 Downstream; Repaired Riffle (04/07/2021)
	
Pre-Repair – STA 114+65 Downstream; Erosion Along Left Bank and Brush Toe (11/02/2020)	**Post-Repair** – STA 114+50 Downstream; Replaced Brush Toe with Geo-Lift and Boulder Toe (04/07/2021)
	
Pre-Repair – STA 115+35 Downstream; Erosion Along Right Bank (11/02/2020)	**Post-Repair** – STA 115+35 Downstream; Regraded and Installed Brush Toe along Right Bank (04/07/2021)

PRE & POST REPAIR PHOTOGRAPHS

Bull Creek Reach 3

Adaptive Management Plan

	
Pre-Repair – STA 150+30 Downstream; Erosion along Right and Left Banks (11/02/2020)	**Post-Repair** – STA 150+30 Downstream; Right and Left Banks Regraded and Matted (04/07/2021)
	
Pre-Repair – STA 152+10 Downstream; Erosion along Right Bank (12/30/2020)	**Post-Repair** – STA 152+10 Downstream; Right Bank Regraded and Matted (04/07/2021)
	
Pre-Repair – STA 156+35 Downstream; Erosion Along Right Bank (10/30/2020)	**Post-Repair** – STA 156+35 Downstream; Right Bank Regraded and Matted (04/07/2021)

	
Pre-Repair – STA 160+65 Downstream; Erosion Along Left Bank (12.30.20)	**Post-Repair** – STA 160+65 Downstream; Left Bank Regraded and Matted (04/07/2021)
	
Pre-Repair – STA 163+00 Downstream; Left Bank Erosion from Floodplain Discharge and Erosion Along Right Bank (11/02/2020)	**Post-Repair** – STA 163+00 Downstream; Installed Rock-Lined Swale and Outlet; Repaired Brush Toe & Added Geolift Along Left Bank (04/07/2021); Regraded and Matted Right Bank (Not Shown)
	
Pre-Repair – STA 163+70 Downstream; Erosion Along Right and Left Banks (11/02/2020)	**Post-Repair** – STA 163+70 Downstream; Right and Left Banks Regraded and Matted (04/07/2021)

	
Pre-Repair – STA 165+30 Downstream; Erosion Along Right Bank (11/02/2020)	**Post-Repair** – STA 165+30 Downstream; Right Bank Regraded and Matted; Left Bank Seeded and Matted due to Construction Access (04/07/2021)

PRE & POST REPAIR PHOTOGRAPHS

UT1C

Adaptive Management Plan

Pre-Repair – STA 211+50 From Left Bank; Erosion along Downstream Side of Crossing and Around Culvert (11/02/2020)

Pre-Repair – STA 211+50 Downstream; Erosion Along Right Bank (11/02/2020)

Post-Repair – STA 211+50 Upstream; Repaired Crossing Around Downstream Side of Culvert and Added Rip Rap on Downstream Face of Crossing; Right Bank Repaired and Boulder Toe Installed (04/07/2021)

Pre-Repair – STA 212+30 Downstream; Erosion Along Left Bank Causing Channel Migration (11/02/2020)

Post-Repair – STA 212+30 Upstream; Left Bank Regraded and Matted (04/07/2021)

	
Pre-Repair – STA 212+80 Downstream; Erosion Along Right Bank (11/02/2020)	**Post-Repair** – STA 212+80 Upstream; Installed Brush Toe Along Right Bank (04/07/2021)

PRE & POST REPAIR PHOTOGRAPHS

UT3B

Adaptive Management Plan

	
Pre-Repair – STA 404+90 – 405+30 Downstream; Riffle Scour (11/02/2020)	**Post-Repair** – STA 404+90 – 405+30 Downstream; Added Riffle Material (04/07/2021)
	
Pre-Repair – STA 405+40 – 405+65 Downstream; Riffle Scour (11/02/2020)	**Post-Repair** – STA 405+40 – 405+65 Downstream; Added Riffle Material (04/07/2021)

APPENDIX 2. Monitoring Year 1 Data

Table 1. Vegetation Plot Criteria Attainment

Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Permanent Vegetation Plot	MY3 Success Criteria Met (Y/N)	Tract Mean (MY1 - 2020)	
1	Y	75%	77%
2	Y		
3	Y		
4	N		
5	Y		
6	Y		
7	Y		
8	N		
Mobile Vegetation Plot	**MY3 Success Criteria Met (Y/N)**		
1	Y	80%	
2	Y		
3	Y		
4	Y		
5	N		

Table 2a. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Current Permanent Vegetation Plot Data (MY1 2020)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 1**			**Permanent Plot 2**			**Permanent Plot 3**			**Permanent Plot 4**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	Red Maple	Tree			1			1						
Acer saccharinum	Silver Maple, Soft Maple	Tree												
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree				1	1	1						
Betula nigra	River Birch, Red Birch	Tree	3	3	6	3	3	3	6	6	6			
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	1									
Fagus grandifolia	American Beech	Tree	2	2	2									
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1	2	2	2						
Ilex opaca	American Holly, Christmas Holly	Shrub Tree												
Liriodendron tulipifera	Tulip Poplar	Tree			3			2						
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree							5	5	5			
Platanus occidentalis	Sycamore, Plane-tree	Tree			50			50	3	3	3	1	1	1
Quercus falcata	Spanish Oak, Southern Red Oak	Tree							1	1	1			
Quercus rubra	Northern Red Oak	Tree	3	3	3	2	2	2	1	1	1			
Salix nigra	Black Willow	Tree						1						
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	1	1	1	1						
	Stem count		11	11	68	9	9	63	16	16	16	1	1	1
	size (ares)		1			1			1			1		
	size (ACRES)		0.0247			0.0247			0.0247			0.0247		
	Species count		6	6	9	5	5	9	5	5	5	1	1	1
	Stems per ACRE		445	445	2,753	364	364	2,551	648	648	648	41	41	41

Current Permanent Vegetation Plot Data (MY1 2020)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 5**			**Permanent Plot 6**			**Permanent Plot 7**			**Permanent Plot 8**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	Red Maple	Tree			10			12			5			1
Acer saccharinum	Silver Maple, Soft Maple	Tree							2	2	2			
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree												
Betula nigra	River Birch, Red Birch	Tree	3	3	4	2	2	2				2	2	2
Carpinus caroliniana	Ironwood	Shrub Tree												
Fagus grandifolia	American Beech	Tree												
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree				2	2	2	2	2	2	2	2	2
Ilex opaca	American Holly, Christmas Holly	Shrub Tree										1	1	1
Liriodendron tulipifera	Tulip Poplar	Tree						1			3			
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	2	2	2				1	1	1			
Platanus occidentalis	Sycamore, Plane-tree	Tree	4	4	5	4	4	5	1	1	6			
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	1	1	1	2	2	2	1	1	1			
Quercus rubra	Northern Red Oak	Tree				2	2	2	1	1	1	2	2	2
Salix nigra	Black Willow	Tree												
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	1	3	3	3						
	Stem count		11	11	23	15	15	29	8	8	21	7	7	8
	size (ares)		1			1			1			1		
	size (ACRES)		0.0247			0.0247			0.0247			0.0247		
	Species count		5	5	6	6	6	8	6	6	8	4	4	5
	Stems per ACRE		445	445	931	607	607	1,174	324	324	850	283	283	324

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

Table 2b. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Permanent Vegetation Plot Annual Mean								
Scientific Name	**Common Name**	**Species Type**	**MY1 (10/2020)**			**MY0 (4/2020)**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	Red Maple	Tree			30			
Acer saccharinum	Silver Maple, Soft Maple	Tree	2	2	2	2	2	2
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	1	1	1	5	5	5
Betula nigra	River Birch, Red Birch	Tree	19	19	23	16	16	16
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	1	4	4	4
Fagus grandifolia	American Beech	Tree	2	2	2	4	4	4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	9	9	9	12	12	12
Ilex opaca	American Holly, Christmas Holly	Shrub Tree	1	1	1	6	6	6
Liriodendron tulipifera	Tulip Poplar	Tree			9			
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	8	8	8	6	6	6
Platanus occidentalis	Sycamore, Plane-tree	Tree	13	13	120	16	16	16
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	5	5	5	7	7	7
Quercus rubra	Northern Red Oak	Tree	11	11	11	16	16	16
Salix nigra	Black Willow	Tree			1			
Viburnum dentatum	Arrow-wood	Shrub Tree	6	6	6	15	15	15
		Stem count	78	78	229	109	109	109
		size (ares)		8			8	
		size (ACRES)		0.1977			0.1977	
		Species count	12	12	15	12	12	12
		Stems per ACRE	395	395	1,158	551	551	551

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

Table 2c. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Current Mobile Vegetation Plot (MP) Data (MY1 2020)								Annual Means	
Scientific Name	**Common Name**	**Species Type**	**MP1**	**MP2**	**MP3**	**MP4**	**MVP5**	**MY1 (10/2020)**	**MY0 (4/2020)**
			PnoLS	**PnoLS**	**PnoLS**	**PnoLS**	**PnoLS**	**PnoLS**	**PnoLS**
Acer saccharinum	Silver Maple, Soft Maple	Tree				3		3	1
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree				1		1	4
Betula nigra	River Birch, Red Birch	Tree	3	2	6	3		14	15
Carpinus caroliniana	Ironwood	Shrub Tree							5
Fagus grandifolia	American Beech	Tree							4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	3		2		1	6	7
Ilex opaca	American Holly, Christmas Holly	Shrub Tree							4
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree		3	3			6	4
Platanus occidentalis	Sycamore, Plane-tree	Tree	5	4	8		2	19	4
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	1	1	1	1	1	5	1
Quercus rubra	Northern Red Oak	Tree	2	3		2	2	9	16
Viburnum dentatum	Arrow-wood	Shrub Tree							5
		Stem count	14	13	20	10	6	63	70
		size (ares)	1	1	1	1	1	5	5
		size (ACRES)	0.0247	0.0247	0.0247	0.0247	0.0247	0.1236	0.1236
		Species count	5	5	5	5	4	8	12
		Stems per ACRE	567	526	809	405	243	510	567

Overall Site Annual Mean				
Scientific Name	**Common Name**	**Species Type**	**MY1 (10/2020)**	**MY0 (4/2020)**
			PnoLS	**PnoLS**
Acer saccharinum	Silver Maple, Soft Maple	Tree	5	3
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	2	9
Betula nigra	River Birch, Red Birch	Tree	33	31
Carpinus caroliniana	Ironwood	Shrub Tree	1	9
Fagus grandifolia	American Beech	Tree	2	8
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	15	19
Ilex opaca	American Holly, Christmas Holly	Shrub Tree	1	10
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	14	10
Platanus occidentalis	Sycamore, Plane-tree	Tree	32	20
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	10	8
Quercus rubra	Northern Red Oak	Tree	20	32
Viburnum dentatum	Arrow-wood	Shrub Tree	6	20
		Stem count	141	179
		size (ares)	13	13
		size (ACRES)	0.3212	0.3212
		Species count	12	12
		Stems per ACRE	439	557

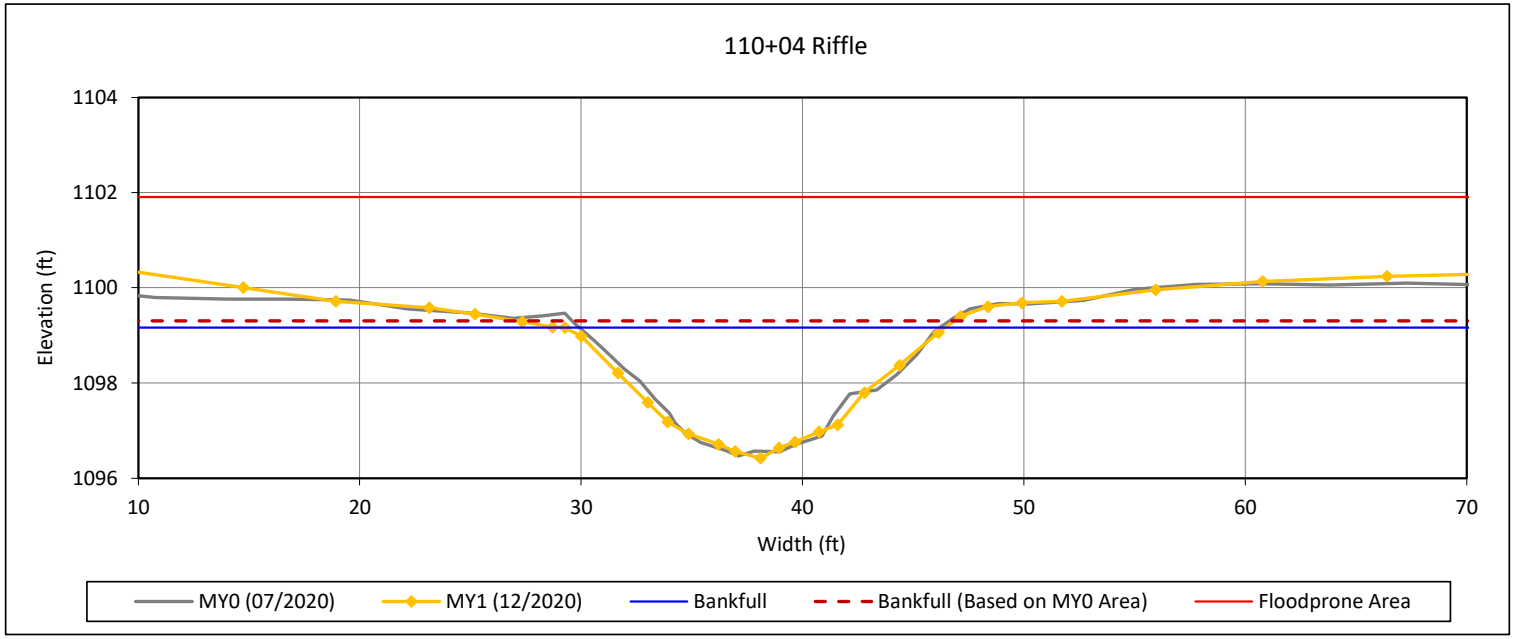
Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020

Cross-Section 2-Bull Creek Reach 1B



Bankfull Dimensions	
27.3	x-section area (ft.sq.)
17.2	width (ft)
1.6	mean depth (ft)
2.7	max depth (ft)
18.2	wetted perimeter (ft)
1.5	hydraulic radius (ft)
10.8	width-depth ratio
67.6	W flood prone area (ft)
3.9	entrenchment ratio
1.0	low bank height ratio

Survey Date: 12/2020
Field Crew: Wildlands Engineering

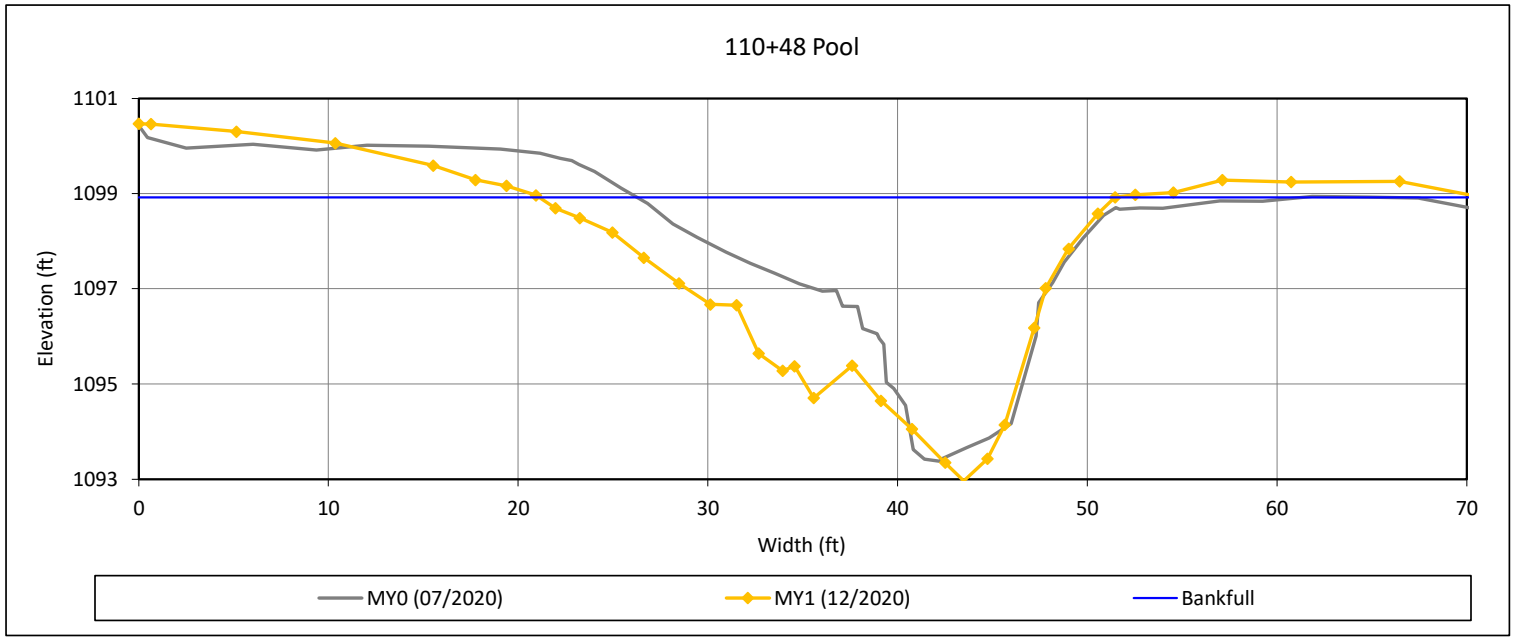
*Repairs conducted during MY1 resulted in a slight shift in the cross-section alignment between the MY0 and MY1 cross-section pin locations; therefore the plot was adjusted so that the cross-sections lined up for easier comparison.

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020

Cross-Section 3-Bull Creek Reach 1B



Bankfull Dimensions	
84.5	x-section area (ft.sq.)
30.4	width (ft)
2.8	mean depth (ft)
6.0	max depth (ft)
34.1	wetted perimeter (ft)
2.5	hydraulic radius (ft)
10.9	width-depth ratio

Survey Date: 12/2020
Field Crew: Wildlands Engineering

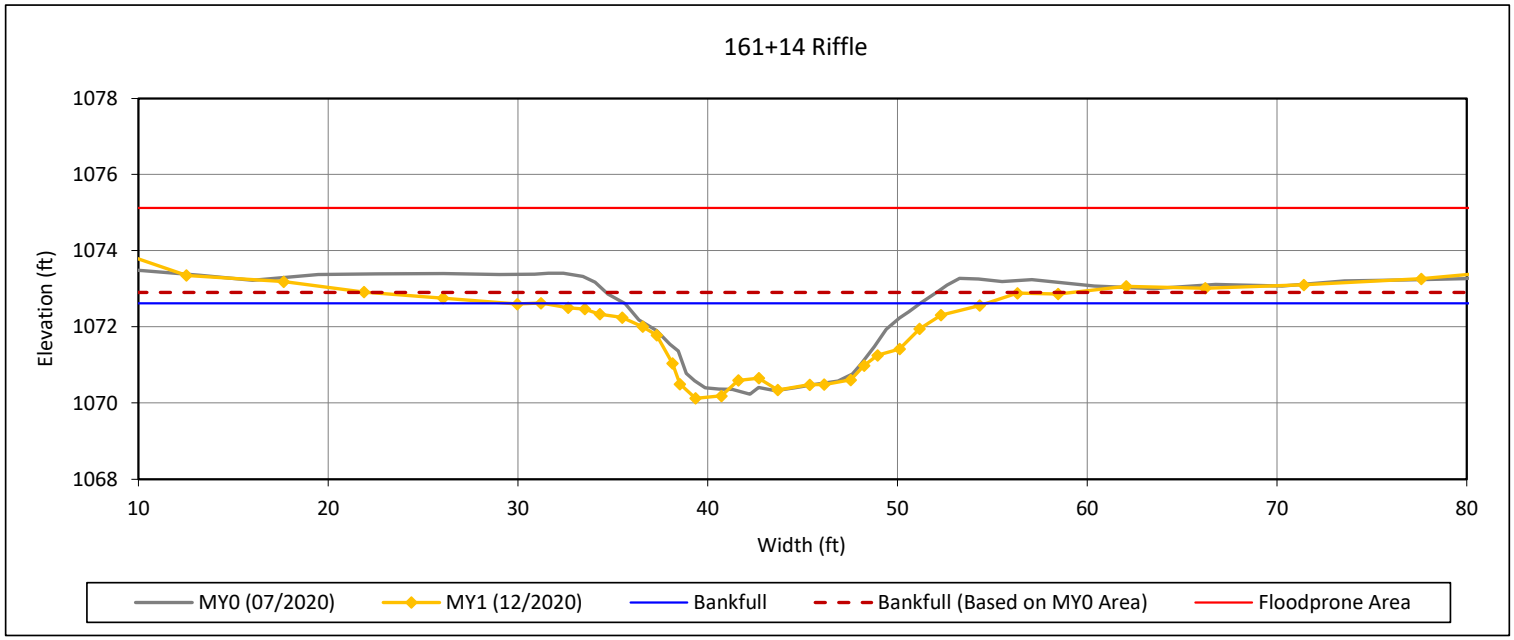
*Repairs were conducted on the left bank of XS3 during MY1 prior to the collection of the MY1 cross-section data and photos. The MY1 plot line shows the repaired cross -sectional profile. Also the station number for XS3 was incorrectly reported on the MY0 cross-section plot, it should have been reported as Station 110+48 as shown in the above plot.

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020

Cross-Section 7-Bull Creek Reach 3



Bankfull Dimensions	
29.2	x-section area (ft.sq.)
23.5	width (ft)
1.2	mean depth (ft)
2.5	max depth (ft)
24.7	wetted perimeter (ft)
1.2	hydraulic radius (ft)
18.9	width-depth ratio
84.0	W flood prone area (ft)
3.6	entrenchment ratio
0.9	low bank height ratio

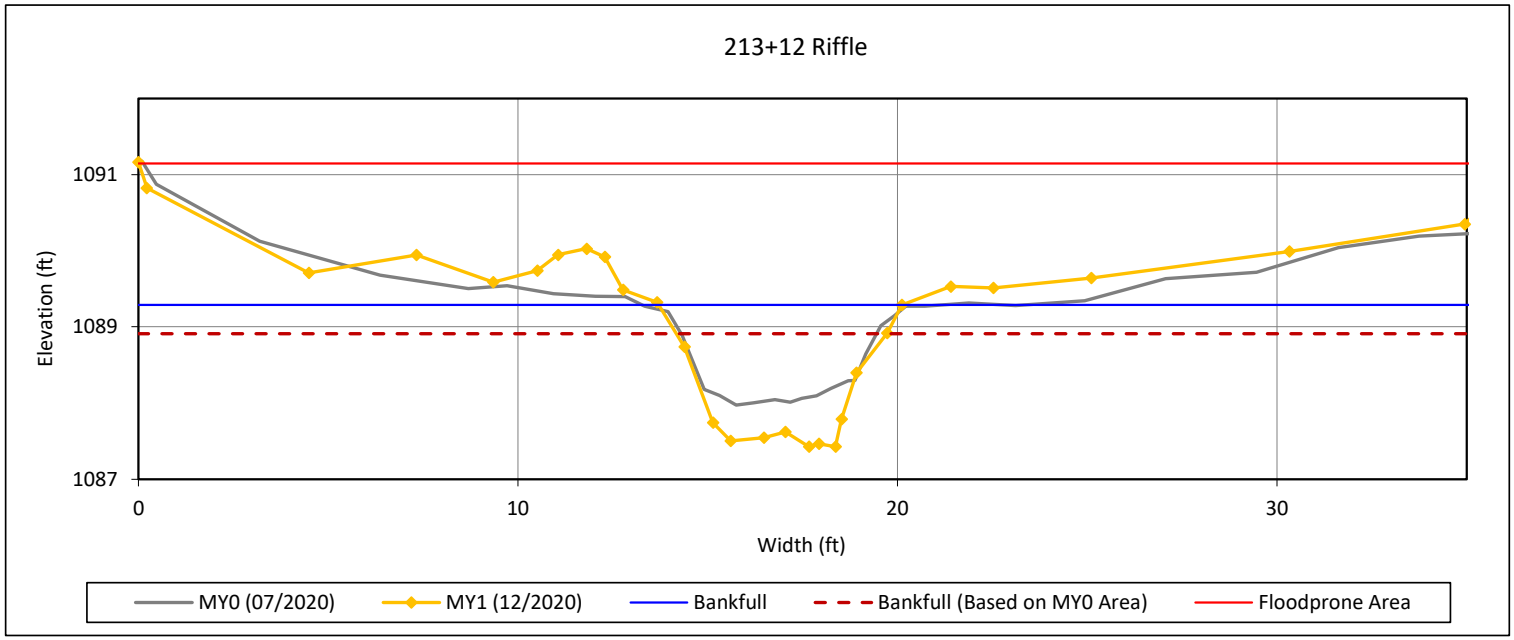
Survey Date: 12/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020

Cross-Section 10-UT1C



Bankfull Dimensions	
8.0	x-section area (ft.sq.)
6.4	width (ft)
1.2	mean depth (ft)
1.9	max depth (ft)
8.1	wetted perimeter (ft)
1.0	hydraulic radius (ft)
5.2	width-depth ratio
35.4	W flood prone area (ft)
5.5	entrenchment ratio
1.3	low bank height ratio

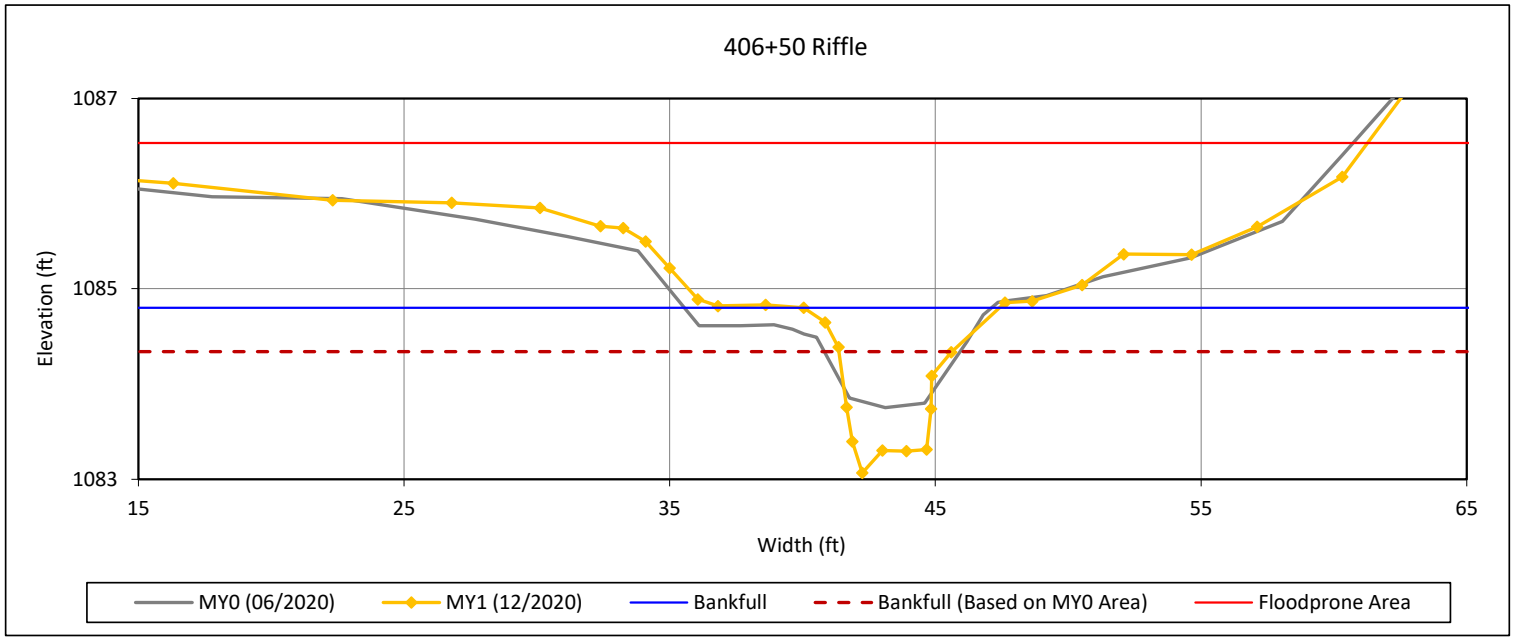
Survey Date: 12/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020

Cross-Section 14-UT3B



Bankfull Dimensions	
6.1	x-section area (ft.sq.)
7.4	width (ft)
0.8	mean depth (ft)
1.7	max depth (ft)
8.9	wetted perimeter (ft)
0.7	hydraulic radius (ft)
8.9	width-depth ratio
61.3	W flood prone area (ft)
8.3	entrenchment ratio
1.4	low bank height ratio

Survey Date: 12/2020
Field Crew: Wildlands Engineering

View Downstream

Table 3. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

	Bull Creek Reach 1A Cross-Section 1, Riffle								Bull Creek Reach 1B Cross-Section 2, Riffle[4]								Bull Creek Reach 1B Cross-Section 3, Pool								Bull Creek Reach 2 Cross-Section 4, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1106.41	1106.62							1099.36	1099.30							1098.70	1098.92							1088.01	1087.72						
Low Bank Elevation	1106.41	1106.54							1099.36	1099.16							1098.70	1098.92							1088.01	1088.08						
Bankfull Width (ft)	19.4	20.6							17.3	17.2							24.4	30.4							16.4	17.9						
Floodprone Width (ft)[2]	70.1	70.0							67.6	67.6							-	-							55.7	55.6						
Bankfull Mean Depth (ft)	1.5	1.3							1.7	1.6							2.3	2.8							1.4	1.6						
Bankfull Max Depth (ft)	2.8	2.8							2.9	2.7							5.3	6.0							2.5	2.9						
Bankfull Cross-Sectional Area (ft^2)	28.2	26.7							29.7	27.3							56.8	84.5							22.9	29.0						
Bankfull Width/Depth Ratio	13.4	16.0							10.1	10.8							10.5	10.9							11.8	11.0						
Bankfull Entrenchment Ratio[3]	3.6	3.4							3.9	3.9							-	-							3.4	3.1						
Bankfull Bank Height Ratio[1]	1.0	1.0							1.0	1.0							-	-							1.0	1.1						

	Bull Creek Reach 3 Cross-Section 5, Pool								Bull Creek Reach 3 Cross-Section 6, Riffle								Bull Creek Reach 3 Cross-Section 7, Riffle								Bull Creek Reach 3 Cross-Section 8, Pool							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1079.64	1079.57							1079.35	1079.51							1073.27	1072.90							1068.53	1068.20						
Low Bank Elevation	1079.64	1079.57							1079.35	1079.42							1073.27	1072.62							1068.53	1068.20						
Bankfull Width (ft)	27.0	26.2							21.2	21.4							19.6	23.5							29.3	32.2						
Floodprone Width (ft)[2]	-	-							99.0	99.0							84.0	84.0							-	-						
Bankfull Mean Depth (ft)	1.8	1.9							1.6	1.5							1.8	1.2							1.9	1.4						
Bankfull Max Depth (ft)	3.7	4.8							2.7	2.4							3.0	2.5							4.3	3.8						
Bankfull Cross-Sectional Area (ft^2)	49.0	50.3							33.5	31.7							36.0	29.2							55.1	45.7						
Bankfull Width/Depth Ratio	14.9	13.6							13.4	14.5							10.7	18.9							15.6	22.7						
Bankfull Entrenchment Ratio[3]	-	-							4.7	4.6							4.3	3.6							-	-						
Bankfull Bank Height Ratio[1]	-	-							1.0	1.0							1.0	0.9							-	-						

	UT1B Cross-Section 9, Riffle								UT1C Cross-Section 10, Riffle								UT2A Cross-Section 11, Riffle								UT2B Cross-Section 12, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1101.94	1102.09							1089.27	1088.91							1096.25	1096.44							1088.43	1088.53						
Low Bank Elevation	1101.94	1102.05							1089.27	1089.29							1096.25	1096.40							1088.43	1088.57						
Bankfull Width (ft)	6.8	6.3							6.9	6.4							6.8	7.3							8.1	8.8						
Floodprone Width (ft)[2]	23.6	26.9							34.0	35.4							30.3	31.4							32.0	30.9						
Bankfull Mean Depth (ft)	0.6	0.6							0.8	1.2							0.5	0.4							0.6	0.5						
Bankfull Max Depth (ft)	0.9	1.2							1.3	1.9							0.8	0.7							1.1	1.0						
Bankfull Cross-Sectional Area (ft^2)	3.9	3.7							5.7	8.0							3.4	3.1							4.8	4.5						
Bankfull Width/Depth Ratio	11.7	10.8							8.3	5.2							13.9	17.3							13.4	17.1						
Bankfull Entrenchment Ratio[3]	3.5	4.3							4.9	5.5							4.4	4.3							4.0	3.5						
Bankfull Bank Height Ratio[1]	1.0	1.0							1.0	1.3							1.0	0.9							1.0	1.0						

	UT2C Cross-Section 13, Riffle								UT3B Cross-Section 14, Riffle								UT3C Cross-Section 15, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull Elevation[1]	1081.59	1081.67							1084.57	1084.34							1081.13	1081.26						
Low Bank Elevation	1081.59	1081.68							1084.57	1084.80							1081.13	1081.21						
Bankfull Width (ft)	7.8	8.2							6.9	7.4							8.8	8.4						
Floodprone Width (ft)[2]	48.2	50.0							21.4	61.3							55.8	55.8						
Bankfull Mean Depth (ft)	0.7	0.7							0.5	0.8							0.8	0.8						
Bankfull Max Depth (ft)	1.1	1.2							0.8	1.7							1.3	1.4						
Bankfull Cross-Sectional Area (ft^2)	5.8	5.8							3.5	6.1							6.8	6.4						
Bankfull Width/Depth Ratio	10.5	11.6							13.4	8.9							11.3	11.1						
Bankfull Entrenchment Ratio[3]	6.2	6.1							3.1	8.3							6.3	6.6						
Bankfull Bank Height Ratio[1]	1.0	1.0							1.0	1.4							1.0	1.0						

[1]Bankfull elevation for riffles are based on the MY0 cross-sectional area. MY1-MY7 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by the NCIRT and NCDMS (9/2018). The remainder of the cross-section dimension parameters were calculated based on the current low bank height.
[2]Floodprone width is calculated from the width of cross-section but valley width may extend further.
[3]ER for the baseline/monitoring parameters is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
[4]Repairs conducted during MY1 resulted in a slight shift in the cross-section alignment between the MY0 and MY1 cross-section pin locations; therefore the plot was adjusted so that cross-sections lined up for easier comparison.

APPENDIX 3. Adaptive Management Plan – As-built /Record Drawings

Table 4. Supplemental Vegetation Planting

Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Streambank Planting Zone						
Live Stakes						
Common Name	**Scientific Name**	**Approved for Mitigation Plan**	**Approved for As-Built Plan**	**Wetland Status**	**Bare Root Planting Rates**	**Total**
Black Willow	*Salix nigra*	No	No	OBL	50%	800
Silky Willow	*Salix sericea*	Yes	Yes	OBL	25%	250
Silky Dogwood	*Cornus amomum*	Yes	Yes	FACW	25%	200
	Total	---	---	---	**100%**	**1,250**

Buffer Planting Zone						
Bare Root (See Figures 1.1 - 1.3 for planting densities)						
Common Name	**Scientific Name**	**Approved for Mitigation Plan**	**Approved for As-Built Plan**	**Wetland Status**	**Bare Root Planting Rates**	**Total**
Boxelder	*Acer negundo*	No	No	FAC	10%	208
Sycamore	*Platanus occidentalis*	Yes	Yes	FACW	15%	311
River Birch	*Betula nigra*	Yes	Yes	FACW	15%	311
White Oak	*Quercus alba*	No	No	FACU	10%	208
Northern Red Oak	*Quercus rubra*	No	Yes	FACU	10%	208
Persimmon	*Diospyros virginiana*	No	No	FAC	10%	208
Witch Hazel	*Hamamelis virginiana*	No	No	FACU	5%	104
Red Mulberry	*Morus rubra*	No	No	FACU	10%	208
Black Gum	*Nyssa sylvatica*	No	Yes	FAC	10%	208
Arrowwood	*Viburnum dentatum*	Yes	Yes	FAC	5%	104
	Total	---	---	---	**100%**	**2,078**

Table 5. Spring/Summer Cover Crop Mix and Application Rates

Key Mill Mitigation Site
DMS Project No. 100025
Adaptive Management Plan

Permanent Riparian Seeding					
Pure Live Seed					
Common Name	**Scientific Name**	**Approved for Mitigation Plan**	**Approved for As-Built Plan**	**Wetland Status**	**Percentage of Seed Mix**
German Millet	*Setaria italica*	Yes	Yes	FACU	20%
Pearl Millet	*Pennisetum glaucum*	No	No	FACU	10%
Buckwheat	*Fagopyrum esculentum*	No	No	-	20%
Crimson Clover	*Trifolium incarnatum*	No	No	-	20%
Ladino Clover	*Trifolium repens*	No	No	FACU	10%
Deertongue	*Panicum clandestinum*	Yes	Yes	FAC	5%
Little Bluestem	*Schizachyrium scoparium*	Yes	Yes	FACU	5%
Black-eyed Susan	*Rudbeckia hirta*	Yes	Yes	FACU	5%
Partridge Pea	*Chamaecrista nictitans*	No	No	FACU	5%
Total		---	---	---	**100%**

Seeding Rate Guide		
Severity	**Current % Cover**	**Seeding Rate**
High	< 20%	40 lbs/acre
Medium - High	> 20% - < 40%	30 lbs/acre
Medium	> 40% - < 70%	20-25 lbs/acre
Low	> 70%	10-15 lbs/acre

October 6, 2020

Key Mill Mitigation Site - Record Drawings

Surry County, North Carolina
Yadkin River Basin HUC 03040101
for
NCDEQ
Division of Mitigation Services

Adaptive Management Plan -
As-built/Record Drawings - 2021

Surry County, NC

Vicinity Map
Not to Scale

Environmental Quality

Record Drawings
August 27, 2020

CERTIFICATE OF SURVEY AND ACCURACY

I, PHILLIP B. KEE, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION; THAT THE RECORD DRAWINGS WERE PREPARED BY WILDLANDS ENGINEERING, INC. FROM DIGITAL FILES PROVIDED BY KEE MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "KEY MILL MITIGATION SITE AREA A-WEST & AREA B-EAST", JOB #190870-AB, DATED 01/31/20 (AREA A-WEST) & 07/23/20 (AREA B-EAST); THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS AND TO MEET THE REQUIREMENTS OF A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAINED BETWEEN THE DATES OF 09/30/19-10/18/19 (AREA A-WEST) & 04/28/20-06/04/20 (AREA B-EAST); THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD AND ALL COORDINATES ARE BASED ON NAD 83 (NSRS 2011) AND ALL ELEVATIONS ARE BASED ON NAVD 88; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS AS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, LICENSE NUMBER, AND SEAL THIS 6TH DAY OF OCTOBER, 2020, A.D.

NORTH CAROLINA PROFESSIONAL SEAL L-4647 LAND SURVEYOR PHILLIP B. KEE

DocuSigned by:
Phillip B. Kee
D985004A7692407...

PHILLIP B. KEE, PLS L-4647

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
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Aaron Earley, PE, CFM
704-332-7754

Surveying:
Kee Mapping & Surveying
Box P.O. 2566
Asheville, NC 28802
Phillip B. Kee, PLS
828-575-9021

Owner:
NCDEQ
Division of Mitigation Services
5 Ravenscroft Drive, Ste 102
Asheville, NC 28801
Matthew Reid
919-707-8976

DMS Project no. 100025

Yadkin River Basin HUC 03040101

USACE Action ID: SAW-2017-01504

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NORTH CAROLINA PROFESSIONAL SEAL 023419 ENGINEER AARON S. EARLEY 10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Title Sheet

Revisions: 10/06/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.1

J:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Cad\As-Built\02165-AB-Cover and Notes.dwg

October 6, 2020

Existing Features

- Pre-Construction Property Line
- Pre-Construction Overhead Electric (OHE)
- Pre-Construction Power Pole
- Pre-Construction Tree
- Pre-Construction Pond

Design Features

- Design Thalweg Alignment (10+00)
- Design Major Contour (100)
- Design Minor Contour
- Design Terracell 140 Cattle Crossing
- Design Road over Culvert
- Design Various Constructed Riffles Per Plans
- Design Brush Toe
- Design Sod Mat
- Design Brush Mattress
- Design Boulder Toe
- Design Log Sill
- Design Log J-Hook
- Design Boulder J-Hook
- Design Log Vane
- Design Rock Sill
- Design Cover Log
- Design Rock Vane
- Design Lunker Log

As-Built Features

- As-Built Thalweg Alignment
- As-Built Bankfull
- As-Built Major Contour (100)
- As-Built Minor Contour
- As-Built Limits of Disturbance (LOD)
- As-Built Culvert
- As-Built Fencing (x)
- Recorded Conservation Easement (CE)
- Recorded Internal Crossing at Conservation Easement (CS-XS)
- As-Built Various Constructed Riffles Per Plans
- As-Built Brush Toe
- As-Built Boulder Toe / Riprap
- As-Built Log Sill
- As-Built Log Vane
- As-Built Rock Sill
- As-Built Log J-Hook

Monitoring Features

- Permanent Cross Section
- Vegetation Plot (VEG / VP#)
- PP# Photo Point
- CG# Crest Gage
- SG# Stream Gauge
- BT Barotroll

Repair Features

Repair areas/items are outlined with a red polygon and the type of repair and when it was conducted is denoted in a call out box.

Repair issue

Notes:

1. Deviations from Design will be shown in Red.
2. Both the As-Built surveyed thalweg alignment and Design Centerline are depicted in this plan set.
3. The Design Centerline stationing is used for the profiles as well as project credit stationing.
4. Pre-construction topography by Kee Mapping and Surveying March 16, 2018.
5. Boundary survey by Kee Mapping and Surveying June 1, 2018.
6. As-built survey west of Key Road November 1, 2019.
7. As-built survey east of Key Road June 9, 2020.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 12-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
General Notes and Legend

Revisions:

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.2

T:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Cad\1 As-Built\02165-AB-Cover and Notes.dwg

October 6, 2020

Reach	Reach Start			End Station	Type of Mitigation
	Northing	Easting	Station		
Bull Creek R1A	967255.23	1526843.10	100+95	105+39	Restoration
Bull Creek R1B	966953.15	1527027.89	105+39	112+61	Restoration
Bull Creek R2	966864.77	1527613.64	112+61	116+79	Restoration
Bull Creek R3	966807.00	1528127.22	150+30	167+56	Restoration
Bull Creek R4	966185.55	1529301.19	167+56	174+39	Preservation
UT1A	968069.36	1527267.64	200+21	208+85	Enhancement II
UT1B	967430.25	1527721.40	208+85	210+97	Restoration
UT1C	967245.93	1527800.36	211+36	213+93	Restoration
UT2	965906.42	1527791.97	350+00	350+42	Restoration
UT2A	965925.08	1527767.27	300+00	303+15	Restoration
UT2B	966181.96	1527894.24	303+50	306+13	Restoration
UT2C	966402.88	1528032.86	306+13	310+82	Restoration
UT3	967436.62	1528615.63	450+38	450+56	Enhancement II
UT3A	967430.52	1528625.75	400+57	404+70	Enhancement II
UT3B	967094.08	1528563.75	404+70	407+77	Restoration
UT3C	966848.62	1528451.56	408+12	412+24	Restoration

STA. 200+21
START REACH UT1A

STA. 208+85
END UT1A
BEGIN UT1B

STA. 210+97
END REACH UT1B

STA. 211+36
START REACH UT1C

STA. 213+93
END UT1C

STA. 310+82
END UT2C

STA. 306+13
END REACH UT2B
BEGIN REACH UT2C

STA. 303+15
END REACH UT2A

STA. 303+50
START REACH UT2B

STA. 350+42
END REACH UT2

STA. 300+00
START REACH UT2A

STA. 350+00
START REACH UT2

STA. 100+95
START BULL CREEK REACH 1A

STA. 105+39
END BULL CREEK REACH 1A
START BULL CREEK REACH 1B

STA. 112+61
END REACH 1B
START REACH 2

STA. 116+79
END BULL CREEK REACH 2

STA. 150+30
BEGIN BULL CREEK REACH 3

STA. 412+24
END UT3C

STA. 450+38
START UT3

STA. 450+56
END UT3

STA. 400+57
START UT3A

STA. 404+70
END REACH UT3A
START REACH UT3B

STA. 407+77
END REACH UT3B

STA. 408+12
START UT3C

STA. 167+56
END REACH 3
START REACH 4

STA. 174+39
END REACH 4

UT1 UT2 UT2A UT3 UT3A BULL CREEK KEY ROAD

SHEET 1.1 SHEET 1.2 SHEET 1.3 SHEET 1.4 SHEET 1.5 SHEET 1.6 SHEET 1.7 SHEET 1.8 SHEET 1.9 SHEET 1.10 SHEET 1.11 SHEET 1.12 SHEET 1.13 SHEET 1.14 SHEET 1.15 SHEET 1.16 SHEET 1.17 SHEET 1.18 SHEET 1.19 SHEET 1.20 SHEET 1.21 SHEET 1.22 SHEET 1.23

JASON ELLIOT SMITH AND MARCIA LYNN SMITH
PIN: 5926-77-7725
DB: 907 PG: 890
PB: 19 PG: 146, TRACT 1

LINDA S. KEY
PIN: 5926-00-77-7192
DB: 302 PG: 610, DB: 385 PG: 465 & DB: 325 PG: 180
REFERENCES FOR DB: 302 PG: 610 & DB: 385 PG: 465
TRACT 1 - DB: 124 PAGE 426
TRACT 2 - DB: 149 PG: 69
TRACT 3 - DB: 117 PG: 278
TRACT 4 - DB: 124 PG: 375, SECOND TRACT

ZACHARY NEIL HARDY AND SARAH SMITH HARDY
PIN: 5926-66-6552
DB: 1169 PG: 387

MARY L. HOLYFIELD HEIRS
PIN: 5926-00-75-4818
DB: 204 PG: 127
REF.: DB: 167 PG: 581

DELANA SHINAULT
PIN: 5936-00-07-5126
DB: 1625 PG: 282
REF.: PORTION OF DB: 239 PG: 676

HOMEPLACE RECREATIONAL PARK, INC.
PIN: 5936-00-05-7889
DB: 1025 PG: 756 TRACTS 1 & 2
& DB: 1201 PG: 1206
PB: 19 PG: 29 & PB: 24 PG: 160

N

0' 150' 300' 450'
(HORIZONTAL)

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ENG
6-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Project Overview

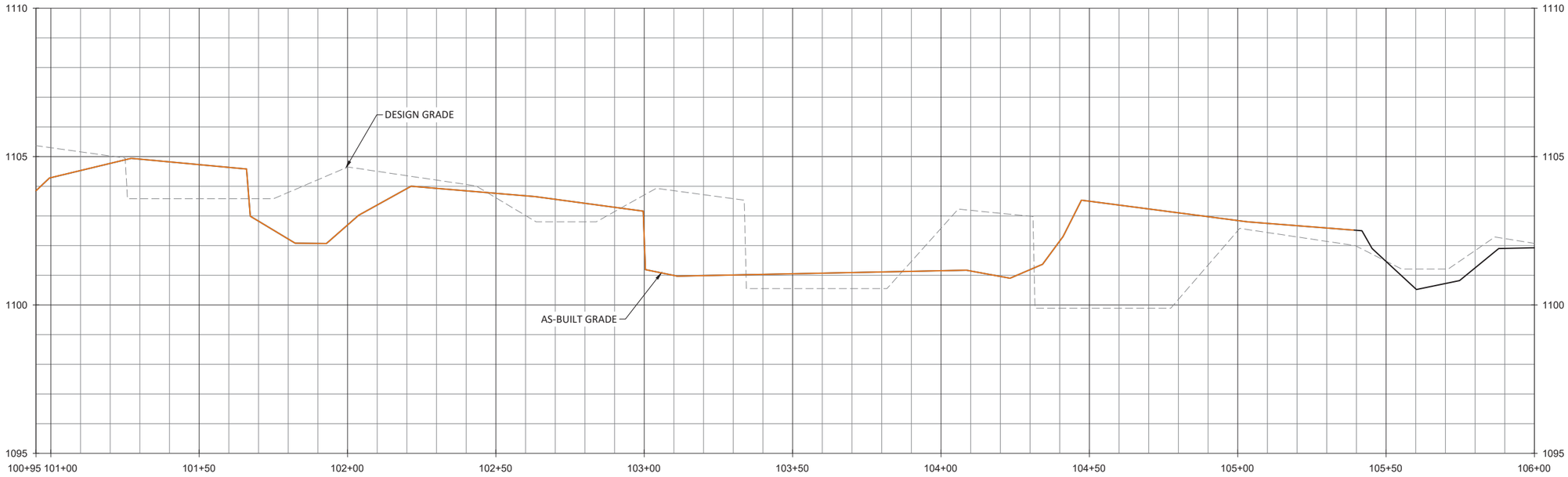
Revisions: 09/29/2020

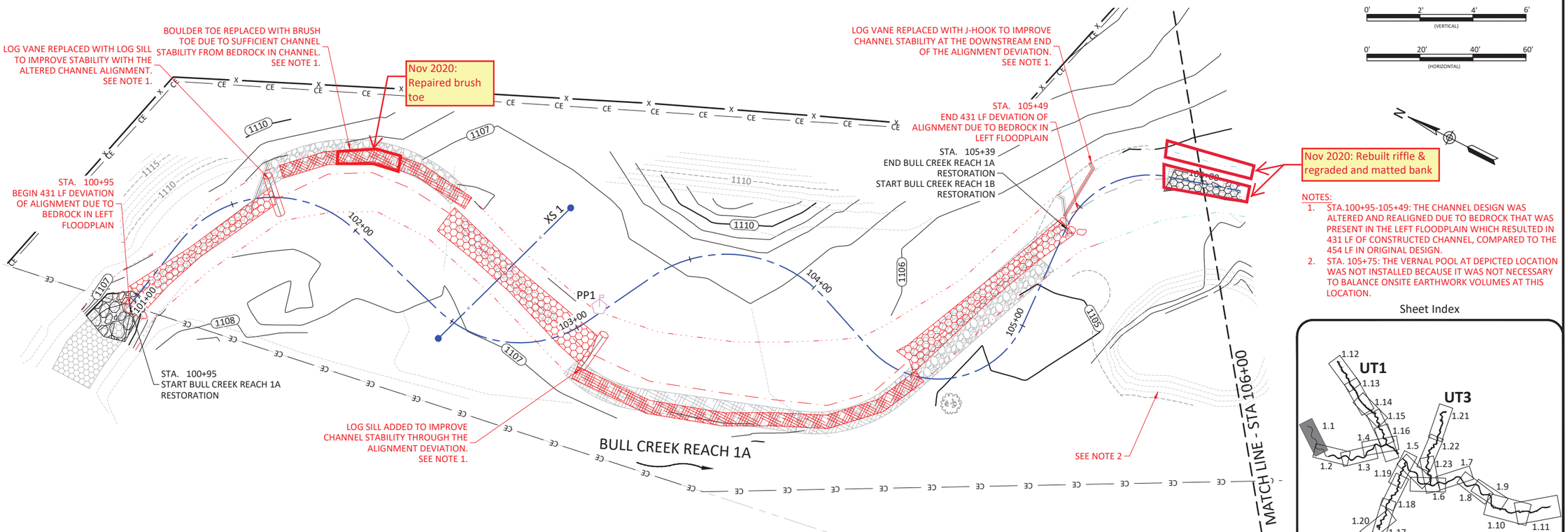
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.3

T:\ACTIVE PROJECTS (NO)\005-02165 Key Mill\Grading\As-Built\02165-AsBuilt-West.dwg

October 6 2020

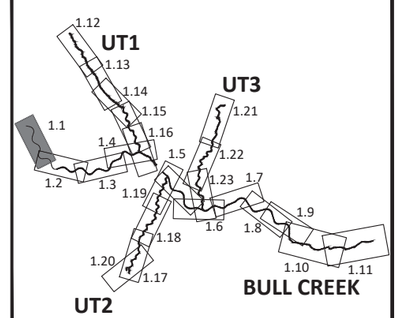




NOTES:

1. STA.100+95-105+49: THE CHANNEL DESIGN WAS ALTERED AND REALIGNED DUE TO BEDROCK THAT WAS PRESENT IN THE LEFT FLOODPLAIN WHICH RESULTED IN 431 LF OF CONSTRUCTED CHANNEL, COMPARED TO THE 454 LF IN ORIGINAL DESIGN.
2. STA. 105+75: THE VERNAL POOL AT DEPICTED LOCATION WAS NOT INSTALLED BECAUSE IT WAS NOT NECESSARY TO BALANCE ONSITE EARTHWORK VOLUMES AT THIS LOCATION.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 028349 ENGINEER AARON S. ERVIN 12-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1A
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.1

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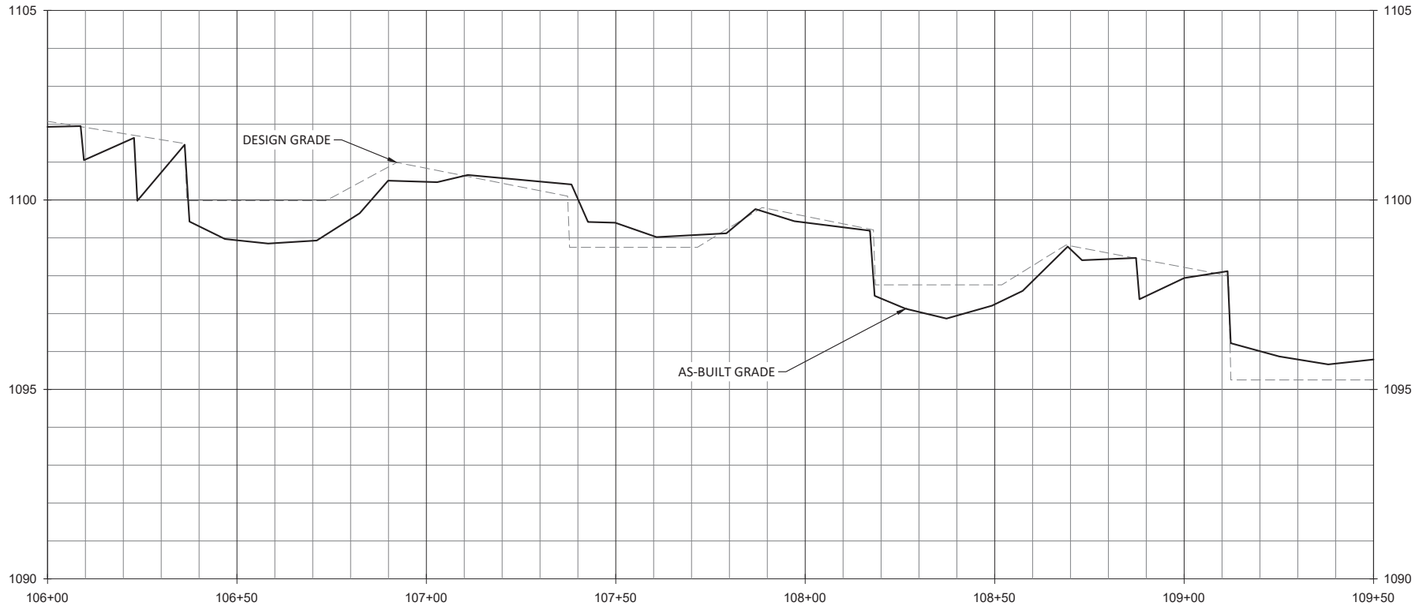
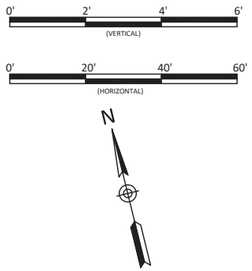
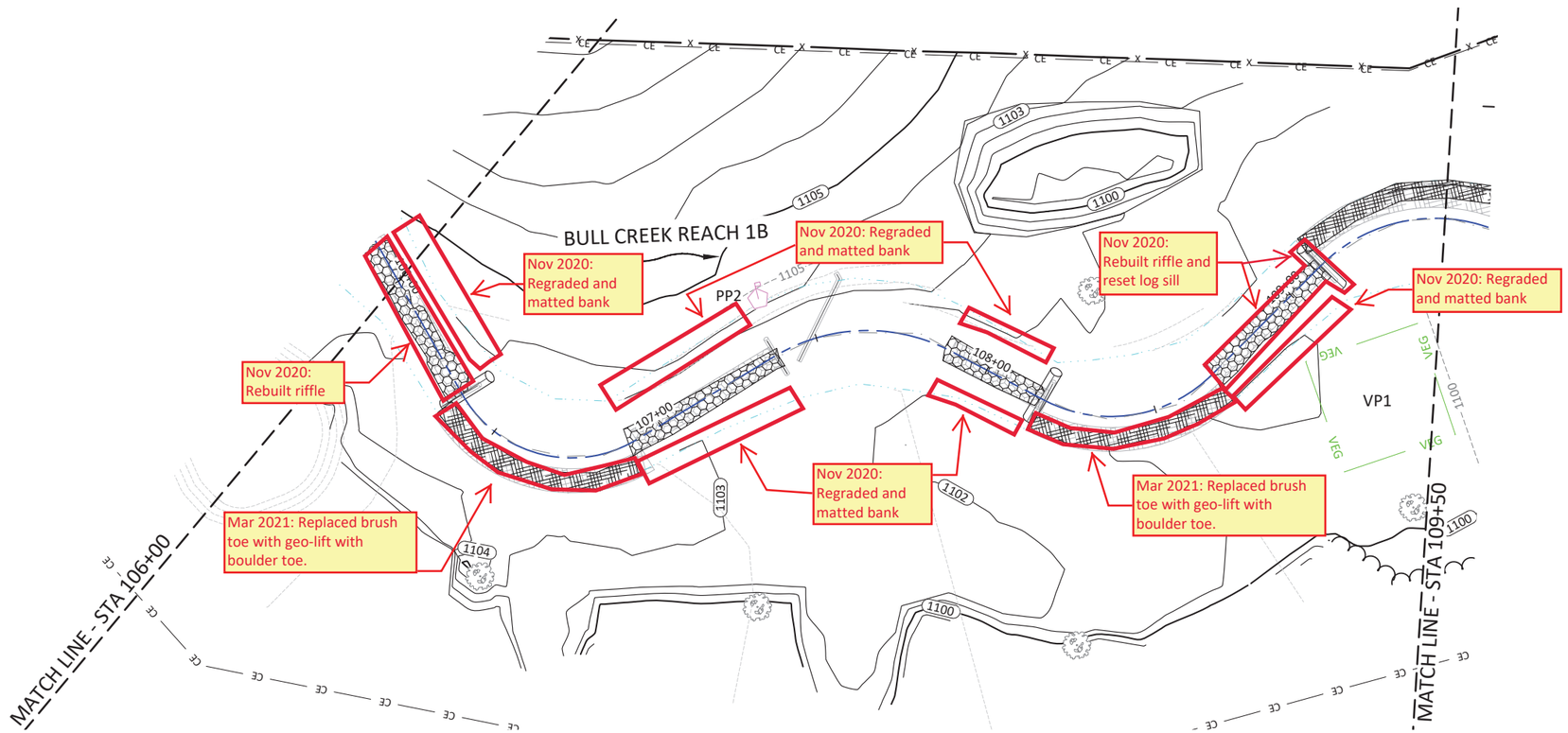
October 6 2020

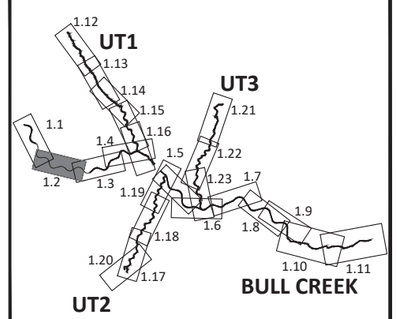




NOTE:
1. STA. 107+40: THE LOG SILL AND LOG VANE WERE OMITTED DUE TO PRESENCE OF BEDROCK.



Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 ENGINEER AARON S. ERVIN 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1B
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.2

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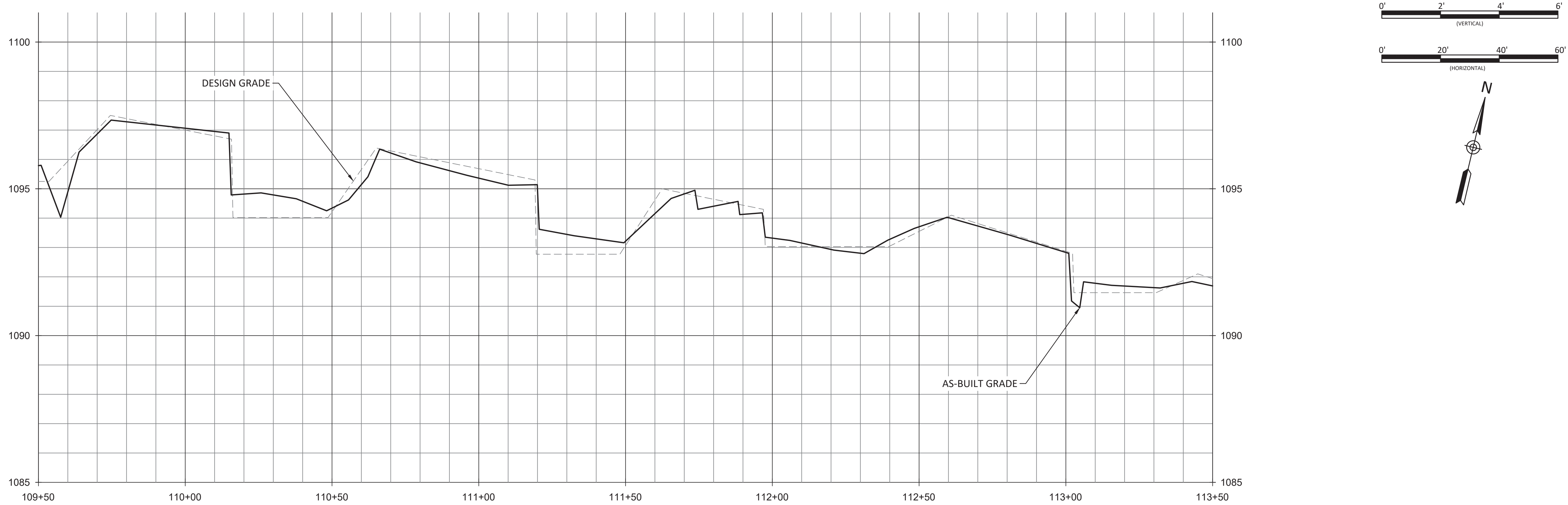
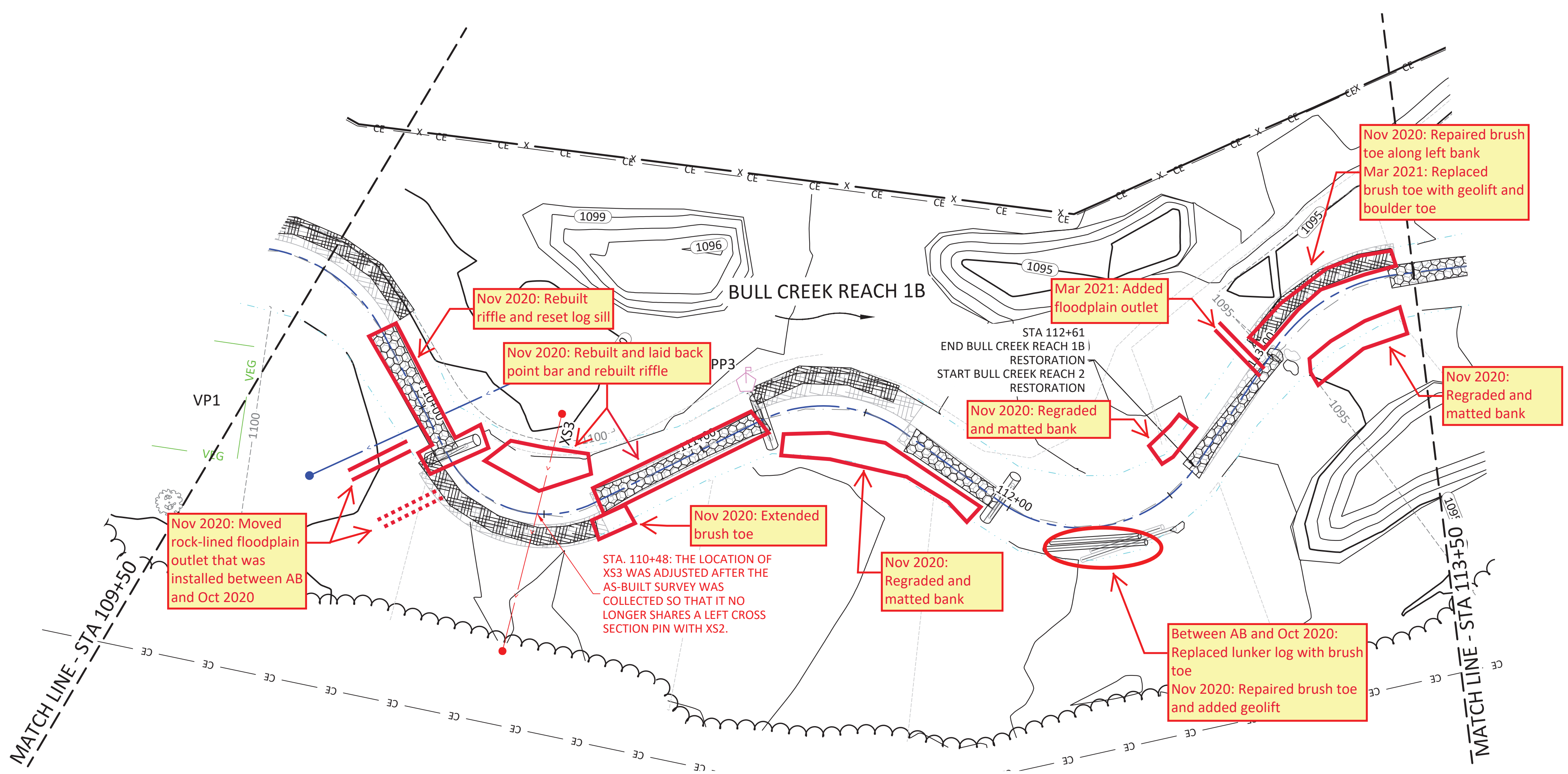
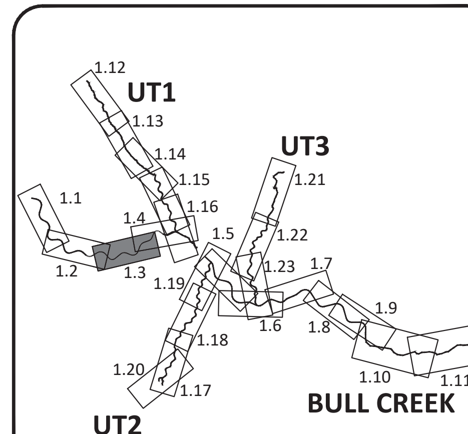
October 6, 2020





Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028346 AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1B
Stream Plan and Profile

Revisions:
09/29/2020

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

Sheet 1.3

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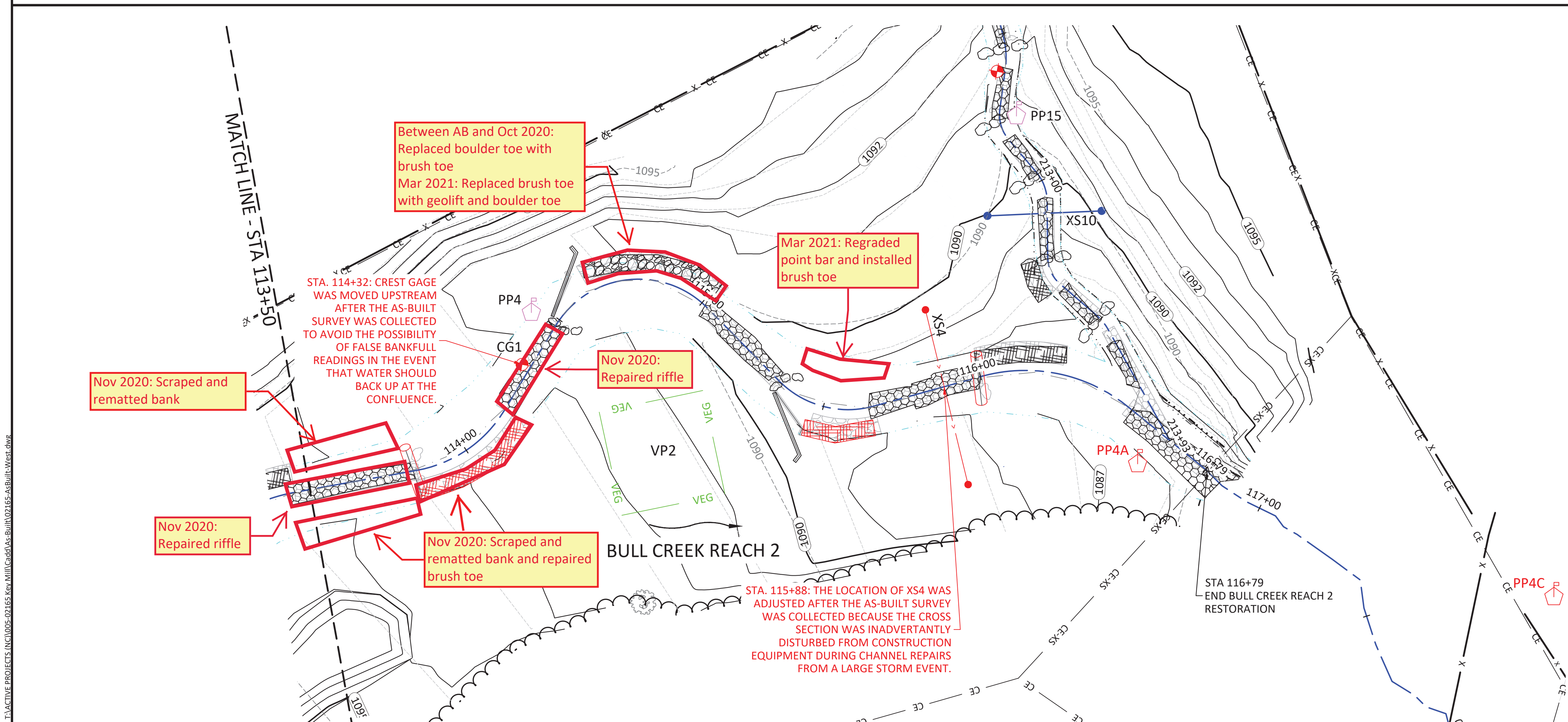
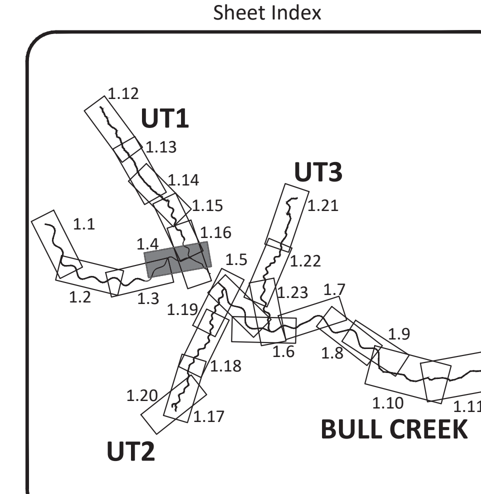


NOTES:

1. STA. 113+80: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
2. STA. 113+85: BRUSH TOE WAS SUBSTITUTED FOR BRUSH MATTRESS DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
3. STA. 115+45: BRUSH TOE WAS SUBSTITUTED FOR BOULDER TOE DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
4. STA. 116+00: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
5. STA. 116+62: PHOTO POINT 4A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE THE CONSERVATION EASEMENT BREAK.

Sheet Index



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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

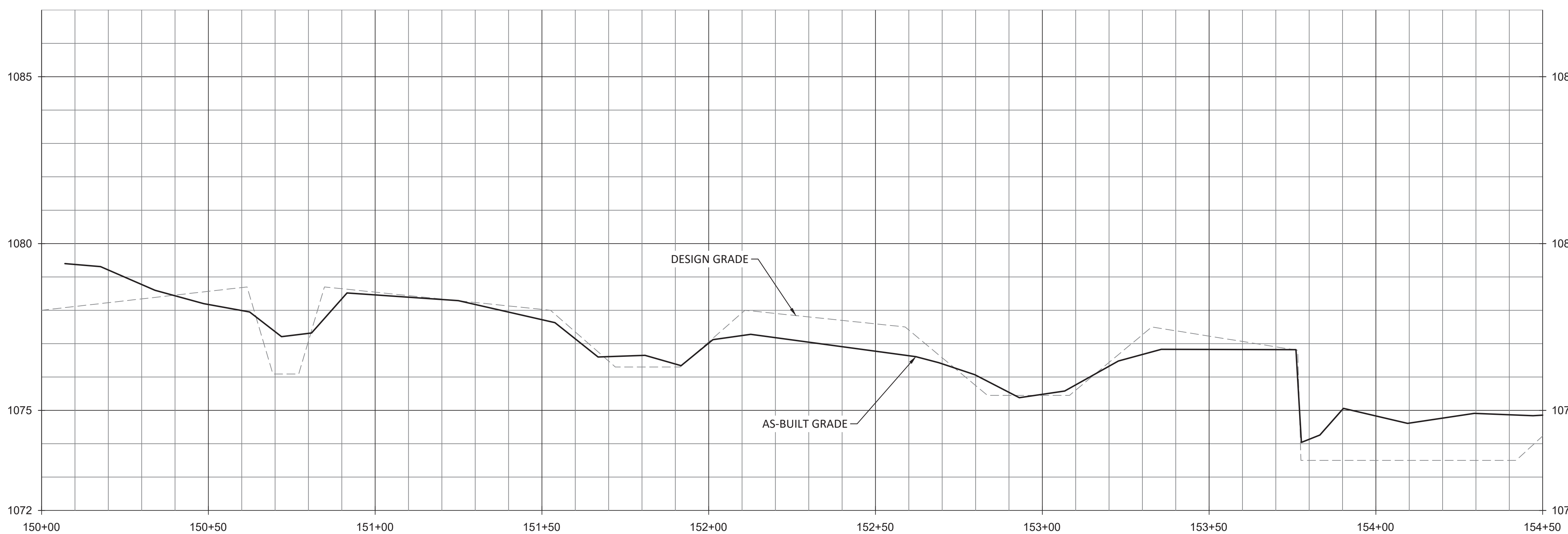
Bull Creek Reach 2
Stream Plan and Profile

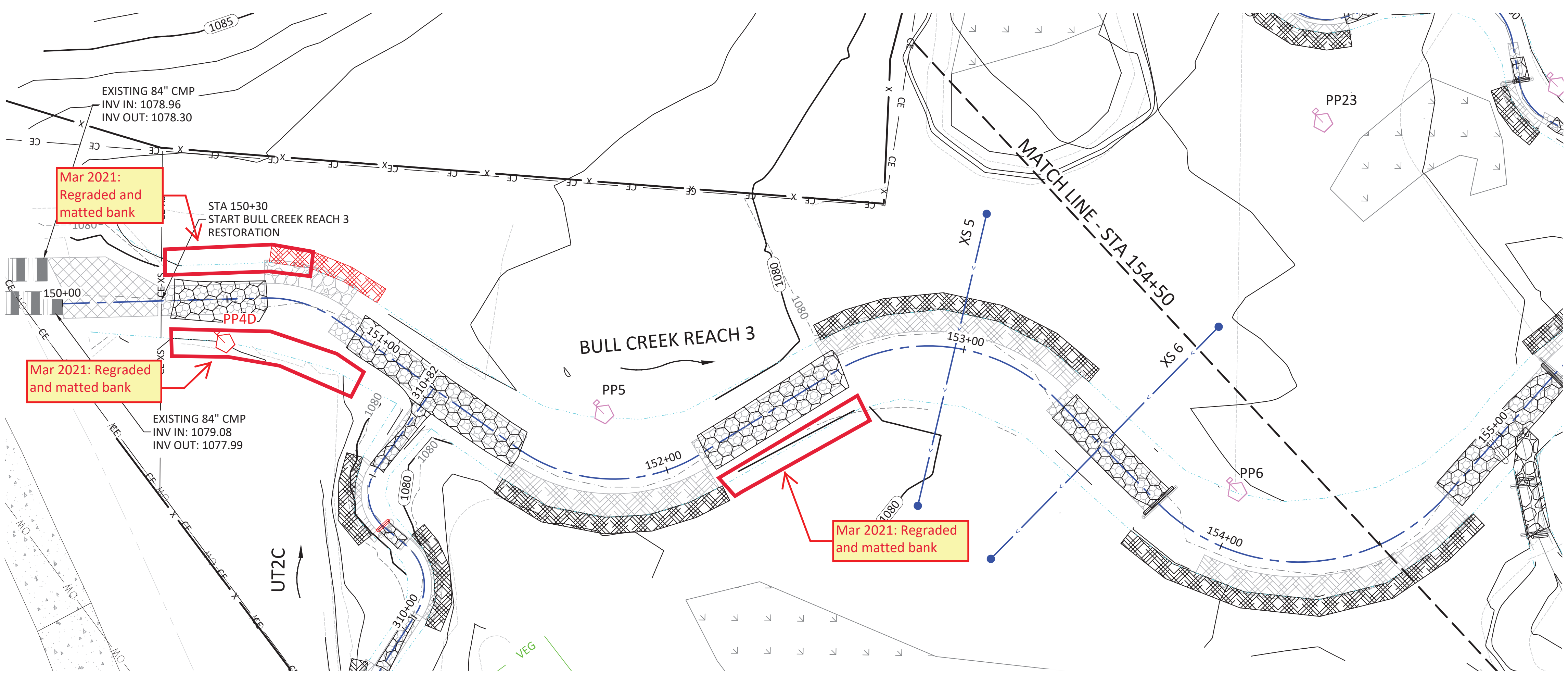
Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK
Revisions:	09/29/2020

Sheet 1.4

October 6, 2020

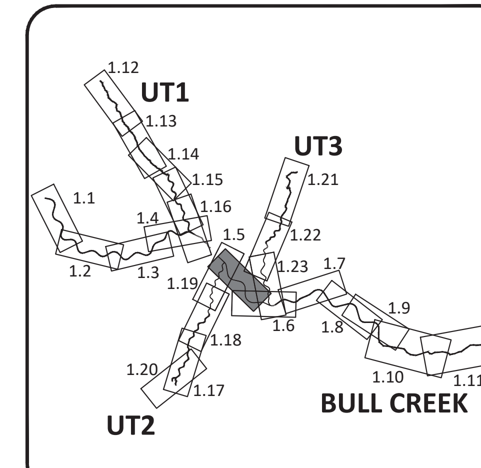
T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cadd\As-Built\02165-AsBuilt-West.dwg





NOTE:
1. STA. 150+50: PHOTO POINT 4D WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE THE CONSERVATION EASEMENT BREAK.
2. STA. 150+62: BOULDER TOE REPLACED WITH BRUSH TOE DUE TO LOCAL MATERIAL AVAILABILITY AND TO IMPROVE IN-STREAM HABITAT.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. EARLEY 8-27-20

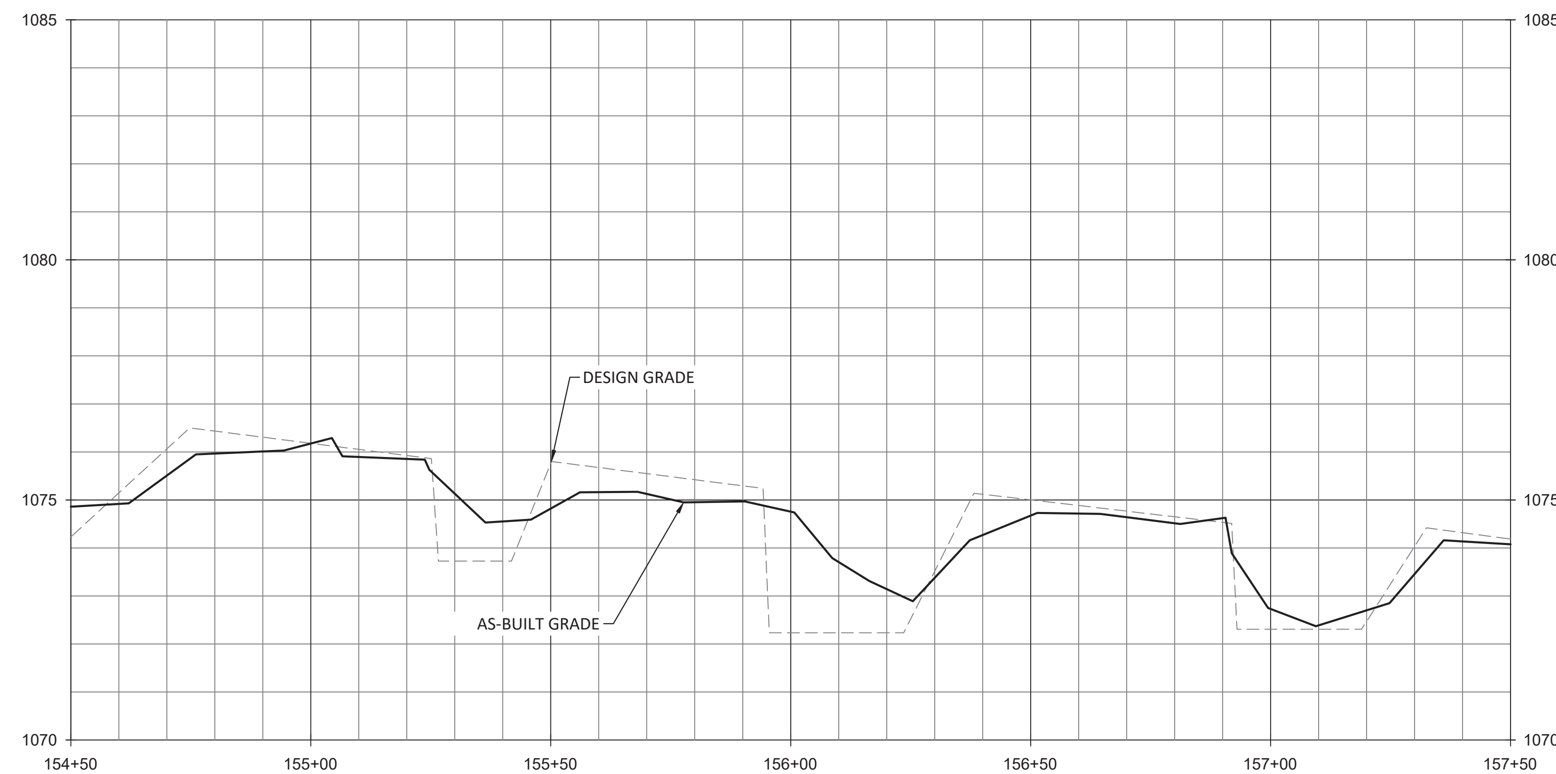
Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

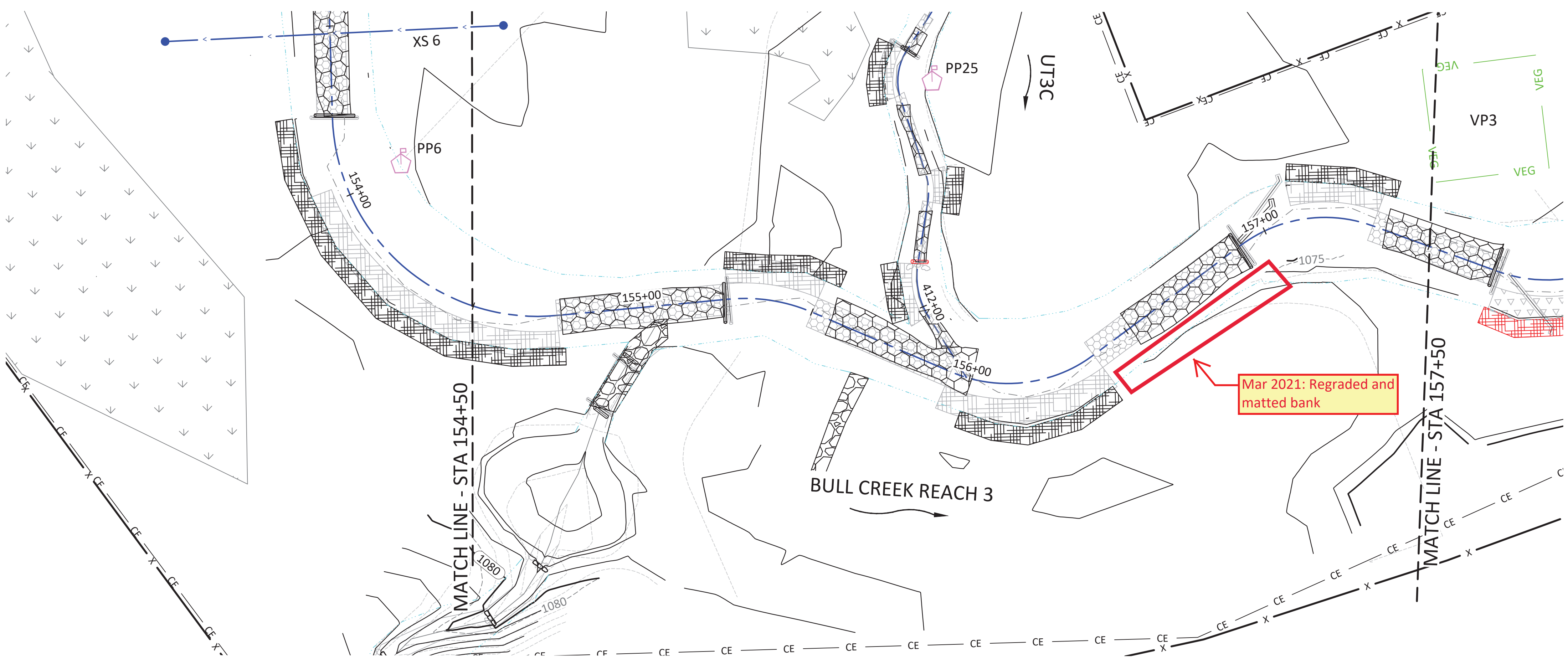
Bull Creek Reach 3
Stream Plan and Profile

Revisions: 09/29/2020

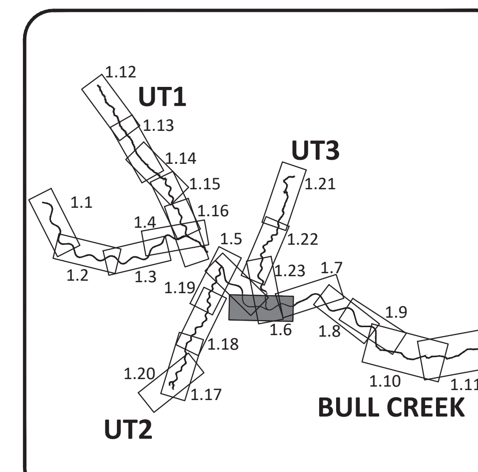
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.5





Sheet Index



0' 2' 4' 6' (VERTICAL)

0' 20' 40' 60' (HORIZONTAL)

N

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NORTH CAROLINA PROFESSIONAL SEAL 023447 ENGINEER AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

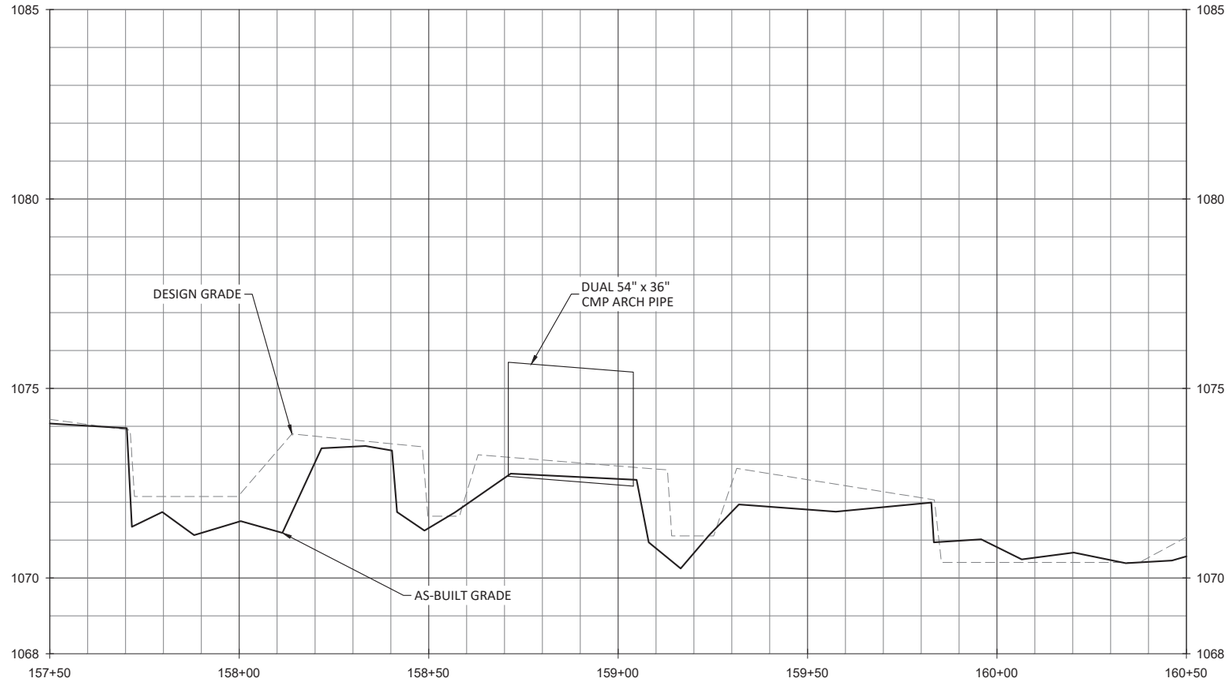
Bull Creek Reach 3
Stream Plan and Profile

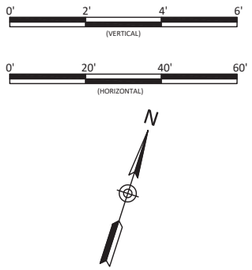
Revisions: 09/29/2020

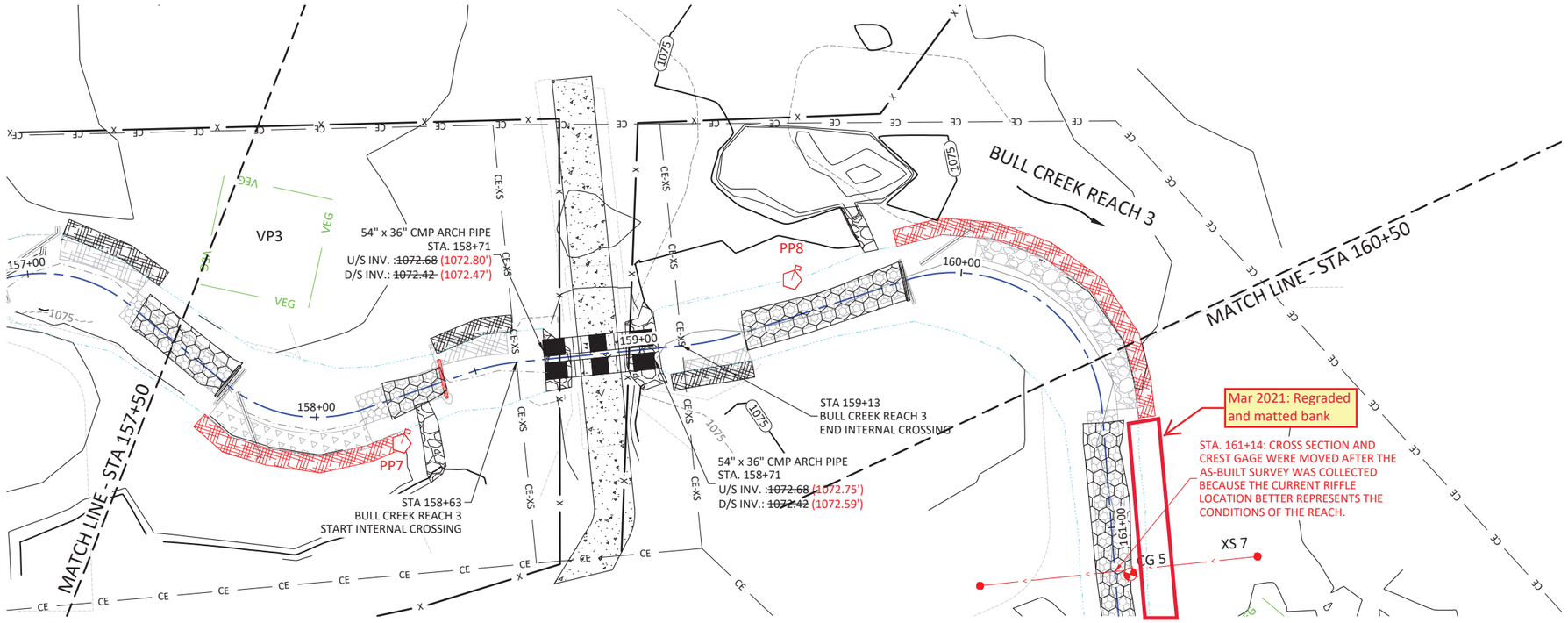
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.6

October 6, 2020







NOTE:

1. STA. 157+72: BRUSH MATTRESS REPLACED WITH BRUSH TOE DUE TO TIME OF YEAR OF INSTALLATION. LOG VANE REMOVED DUE TO BANK STABILITY AND HABITAT ENHANCEMENT PROVIDED BY BRUSH TOE.
2. STA. 158+22: PHOTO POINT 7 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 158+40: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
4. STA. 159+50: PHOTO POINT 8 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
5. STA. 159+84: BRUSH TOE WAS SUBSTITUTED FOR BOULDER TOE AND LOG VANE REMOVED DUE TO LOCAL MATERIAL AVAILABILITY AND THE BANK STABILITY AND HABITAT ENHANCEMENT PROVIDED BY BRUSH TOE.

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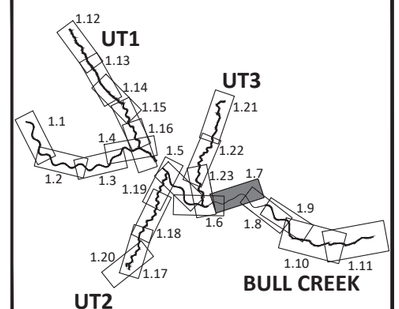

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Bull Creek Reach 3
Stream Plan and Profile

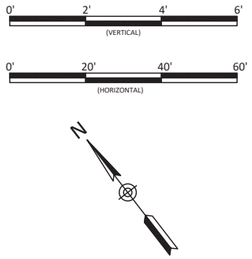
Revisions: 09/29/2020

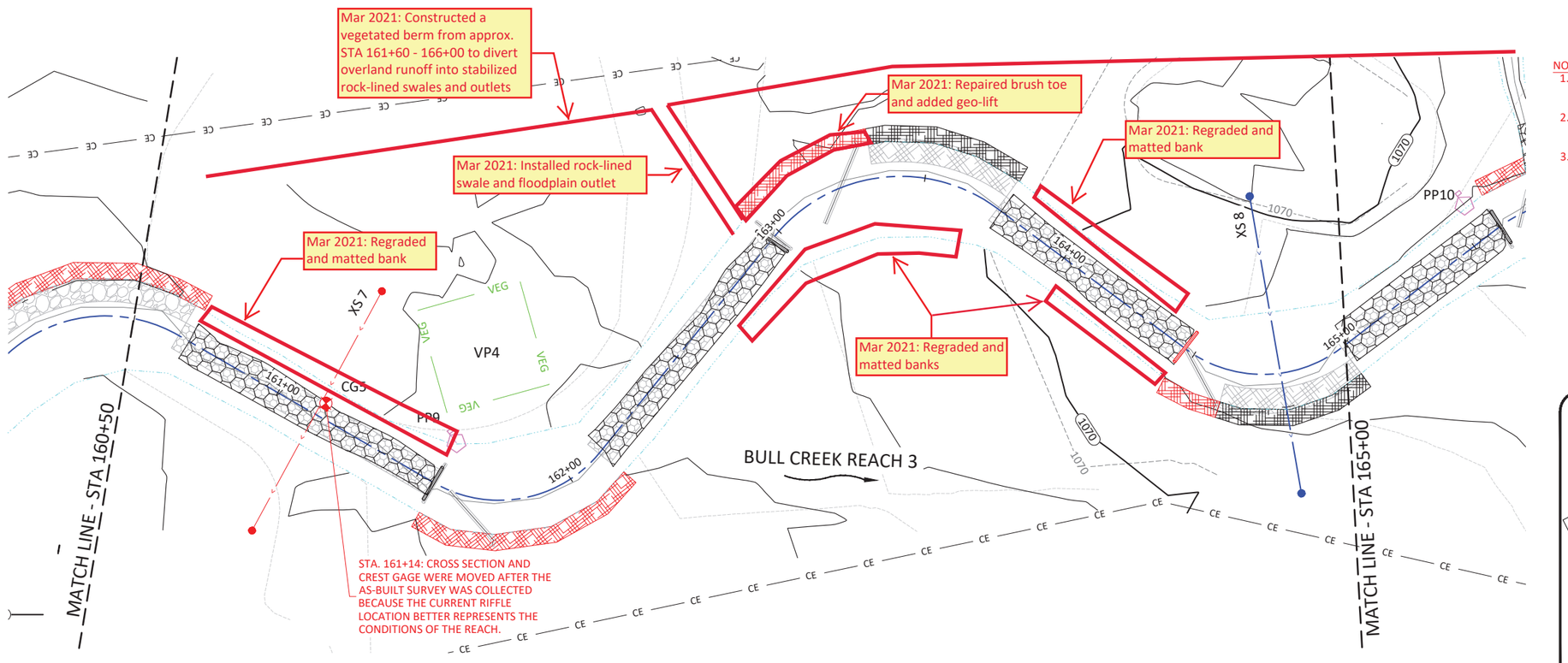
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.7

T:\ACTIVE PROJECTS\NCDMS\005-02165\Key Mill\Cad\As-Built\02165-AsBuilt-Final.dgn

October 6, 2020





NOTE:
1. STA. 161+56: LOG VANE REMOVED AND BRUSH TOE ADDED TO OUTSIDE BANK TO IMPROVE STABILITY FOR THE ENTIRE OUTSIDE BANK.
2. STA. 163+30: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND TO IMPROVE STREAM BANK STABILITY AND HABITAT.
3. STA. 164+47: LOG VANE REMOVED, LOG SILL ADDED AND BRUSH TOE EXTENDED DUE TO LOCAL AVAILABILITY OF MATERIALS AND TO IMPROVE CHANNEL STABILITY AND HABITAT.

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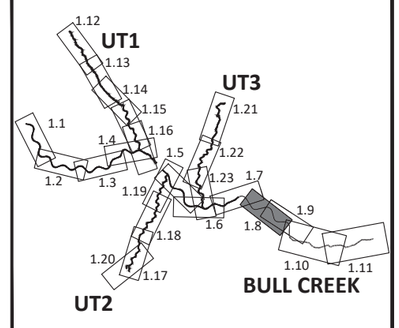

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Bull Creek Reach 3
Stream Plan and Profile

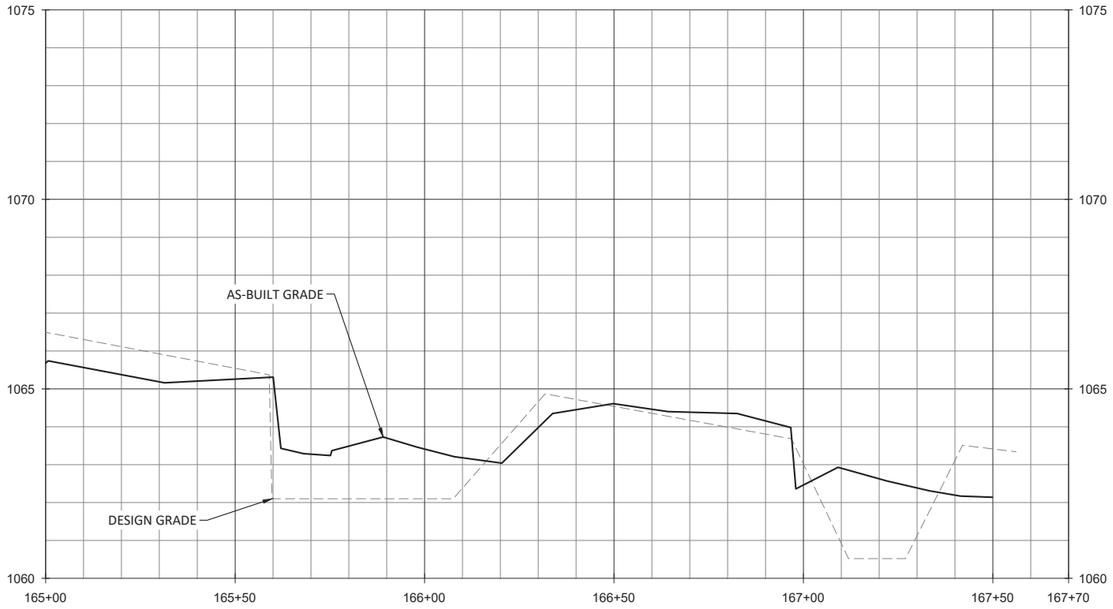
Revisions: 09/29/2020

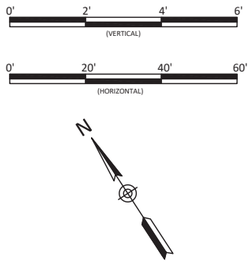
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

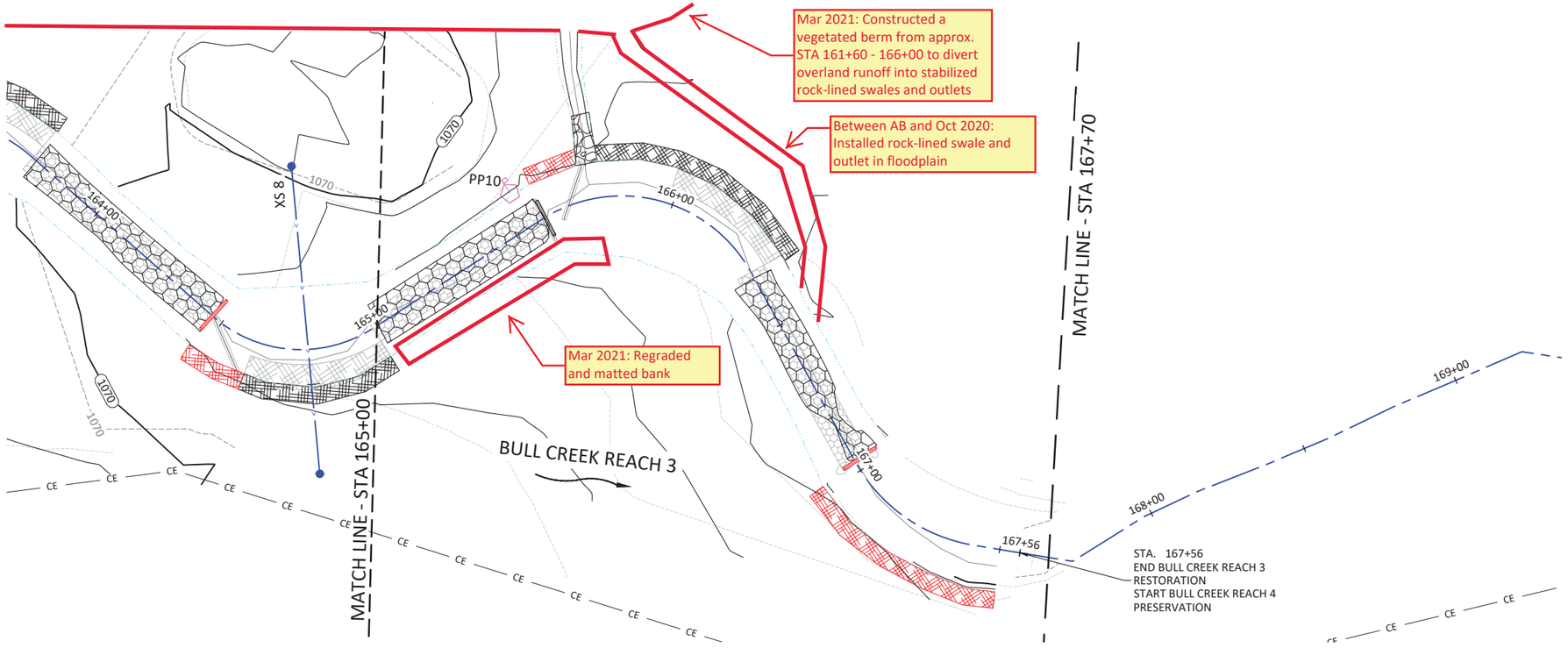
Sheet 1.8

T:\ACTIVE PROJECTS\NC\005-02165\Key Mill\Grafx\As-Built\02165-As-Built-Fig1.dgn

October 6, 2020







NOTE:
1. STA. 165+75: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND THE IMPROVED HABITAT PROVIDED BY BRUSH TOE.
2. STA. 166+97: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
3. STA. 167+00: BRUSH TOE WAS ADDED TO IMPROVE BANK STABILITY.

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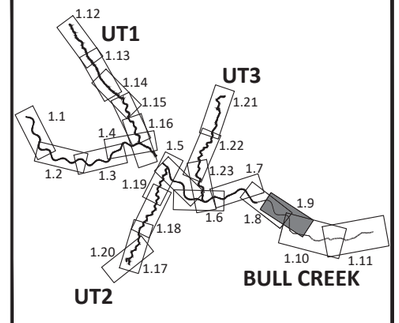

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

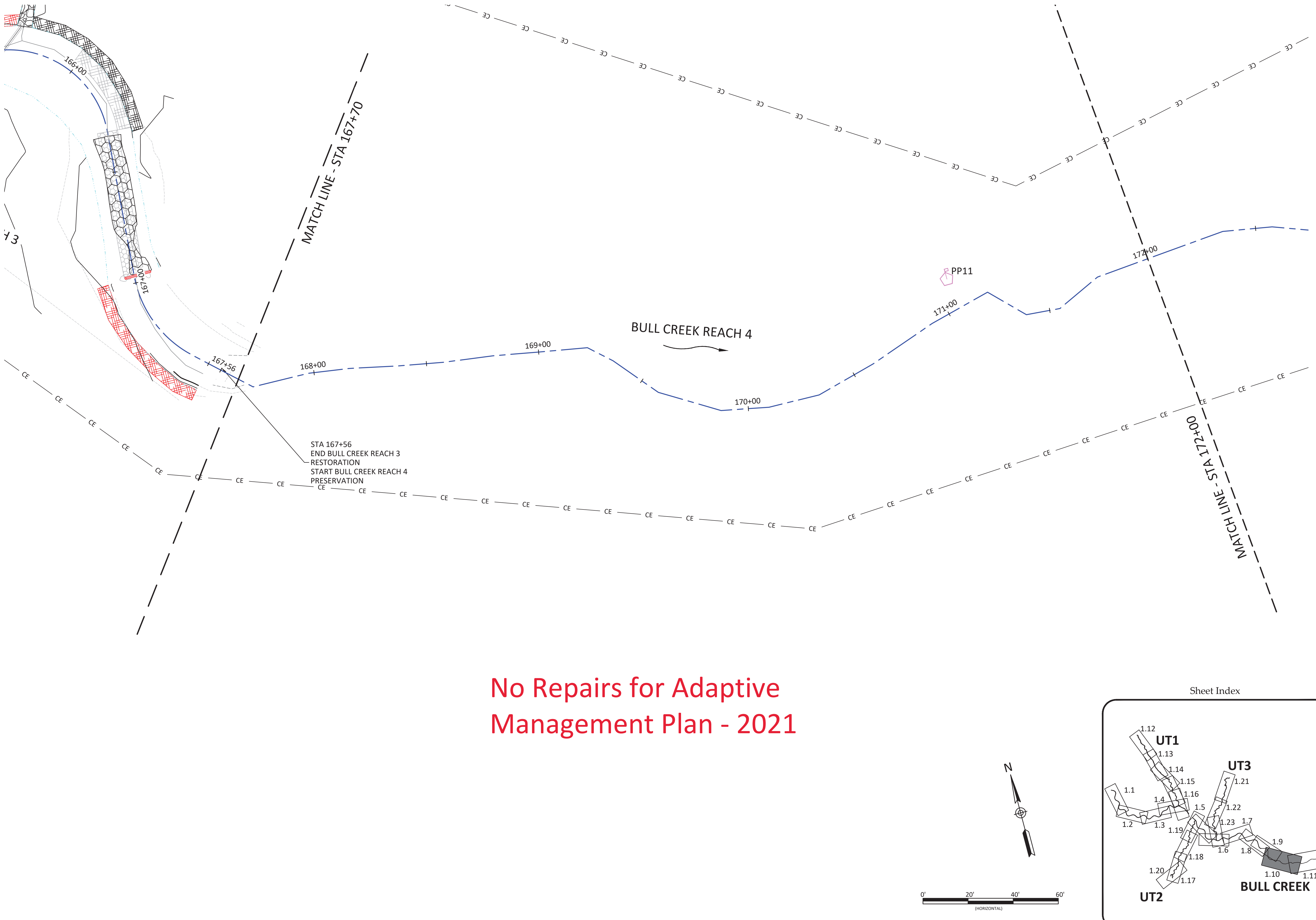
Bull Creek Reach 3
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.9

T:\ACTIVE PROJECTS\SURRY\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt-Feet.dwg



No Repairs for Adaptive Management Plan - 2021

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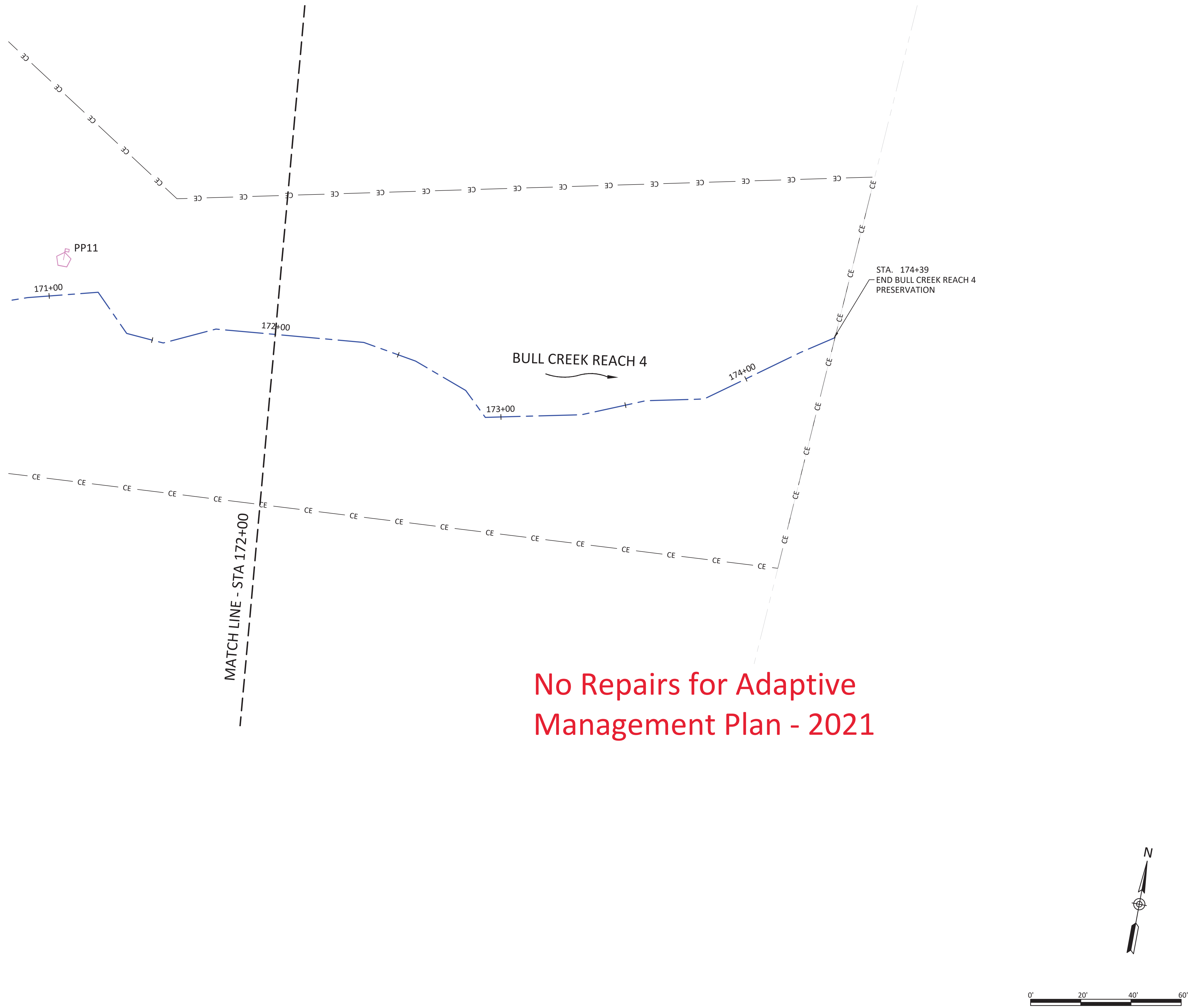
Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 4
Stream Plan

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.10



No Repairs for Adaptive Management Plan - 2021

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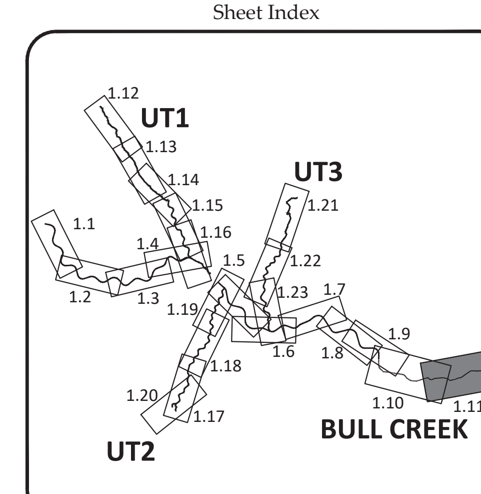

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

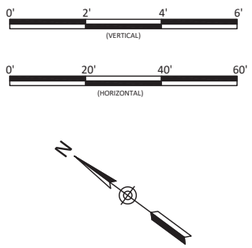
Bull Creek Reach 4
Stream Plan

Revisions: 09/29/2020

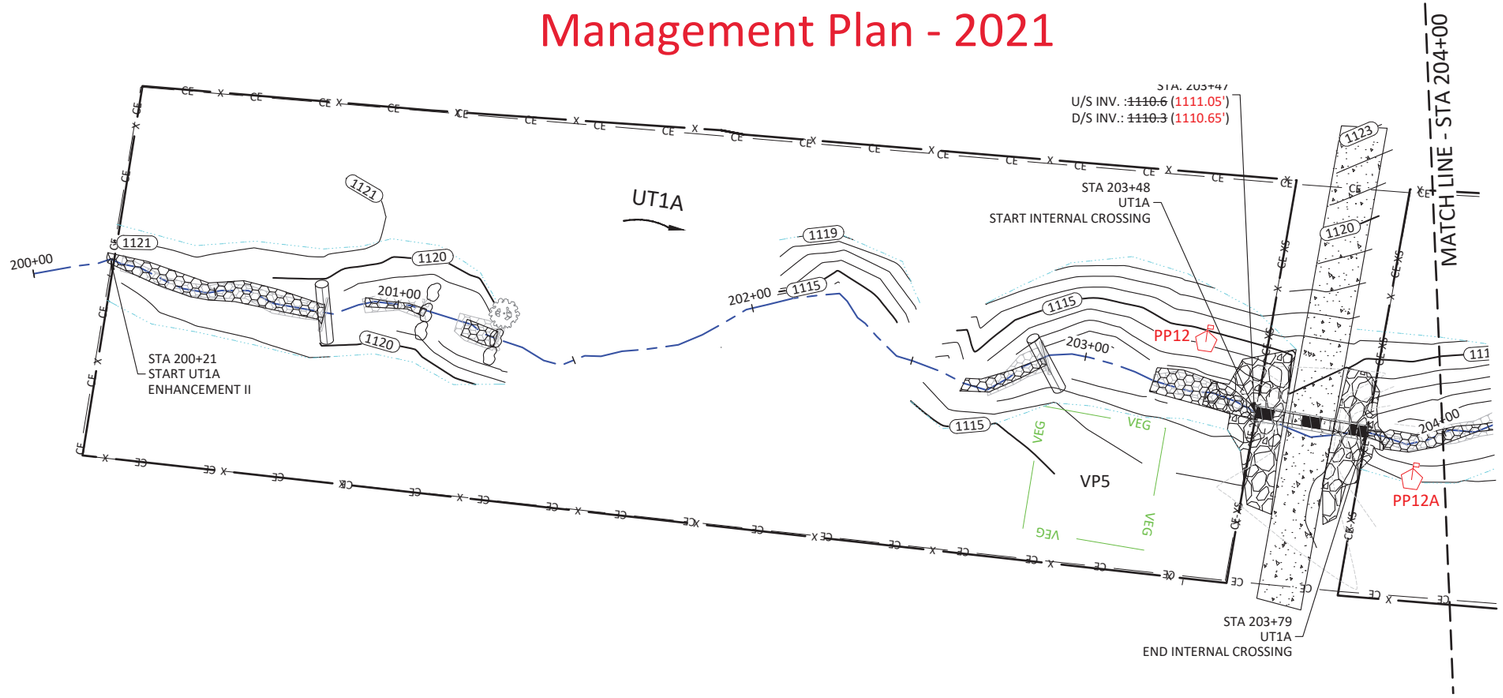
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.11

October 6 2020



No Repairs for Adaptive Management Plan - 2021



NOTES:
1. STA. 202+26: POOL WAS NOT EXCAVATED DUE TO EXISTING PROFILE STABILITY.
2. STA. 203+32: PHOTO POINT 12 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 203+90: PHOTO POINT 12A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.

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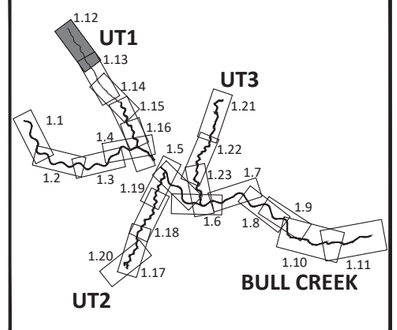

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

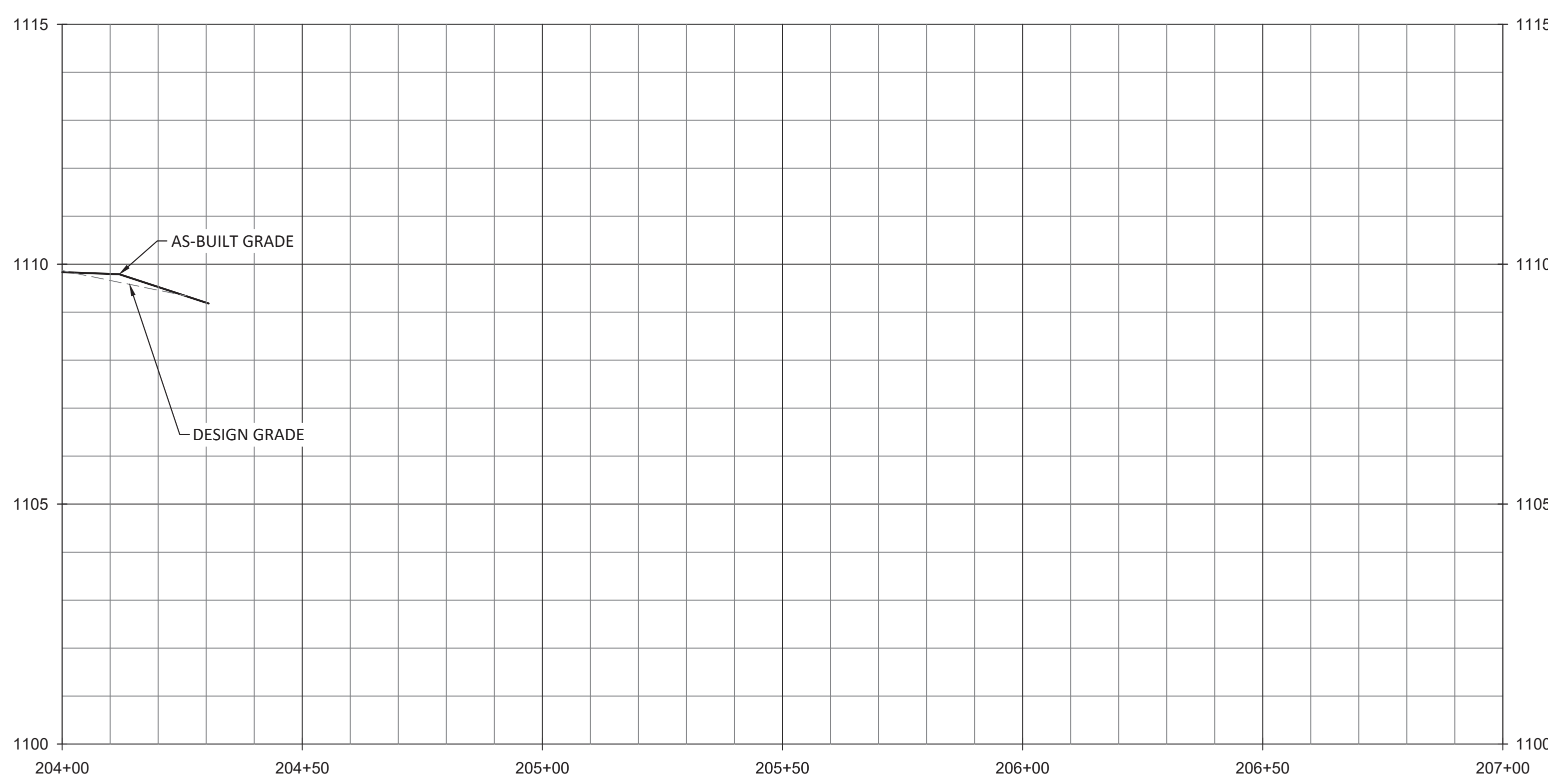
UT1A
Stream Plan and Profile

Revisions: 09/29/2020

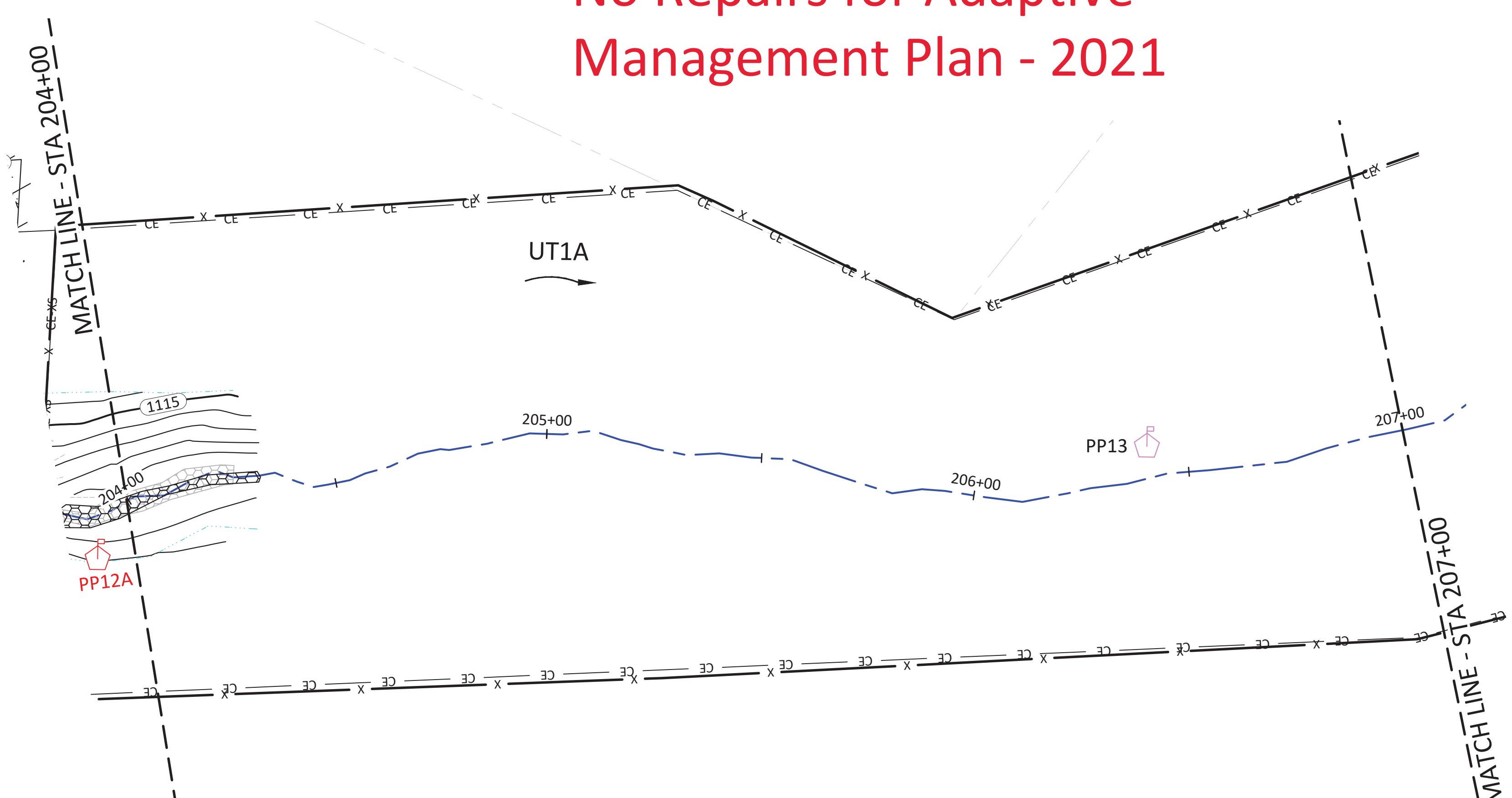
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.12

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt-West.dwg



No Repairs for Adaptive Management Plan - 2021



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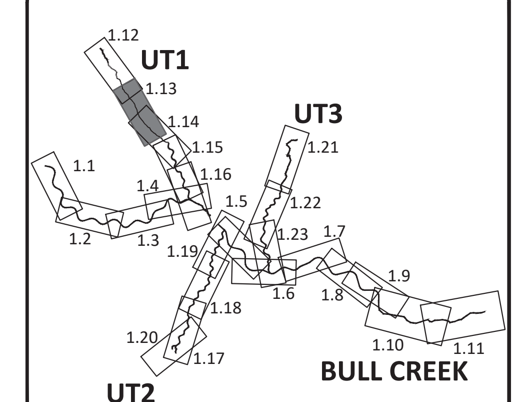

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

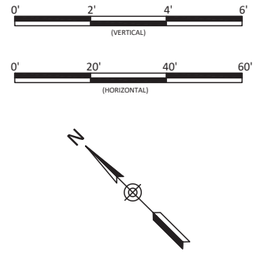
UT1A
Stream Plan and Profile

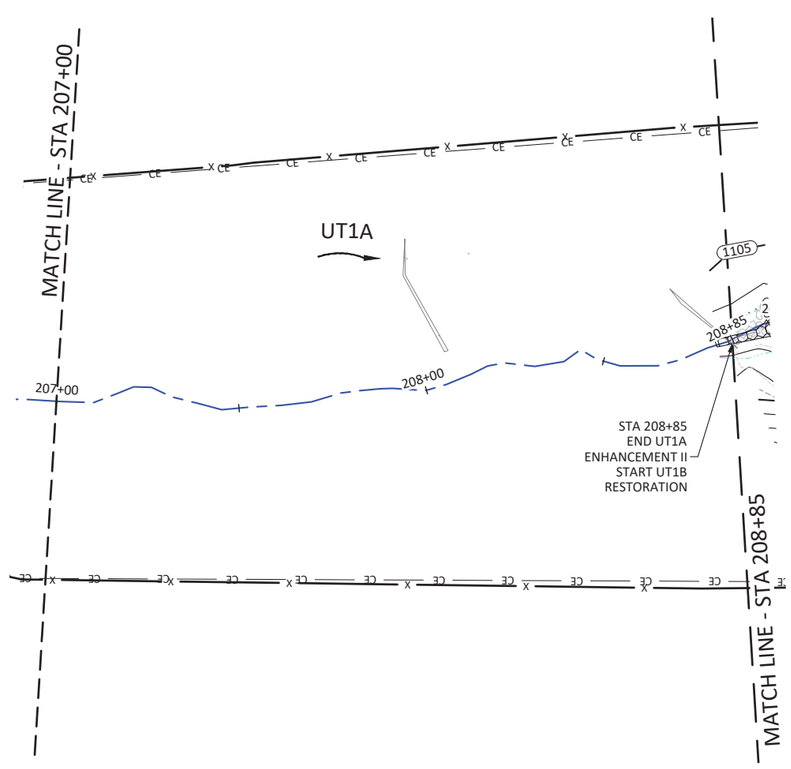
Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.13

October 6 2020





No Repairs for Adaptive Management Plan - 2021

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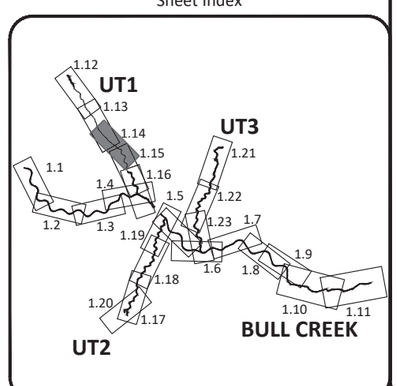

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 AARON S. ERVIN 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

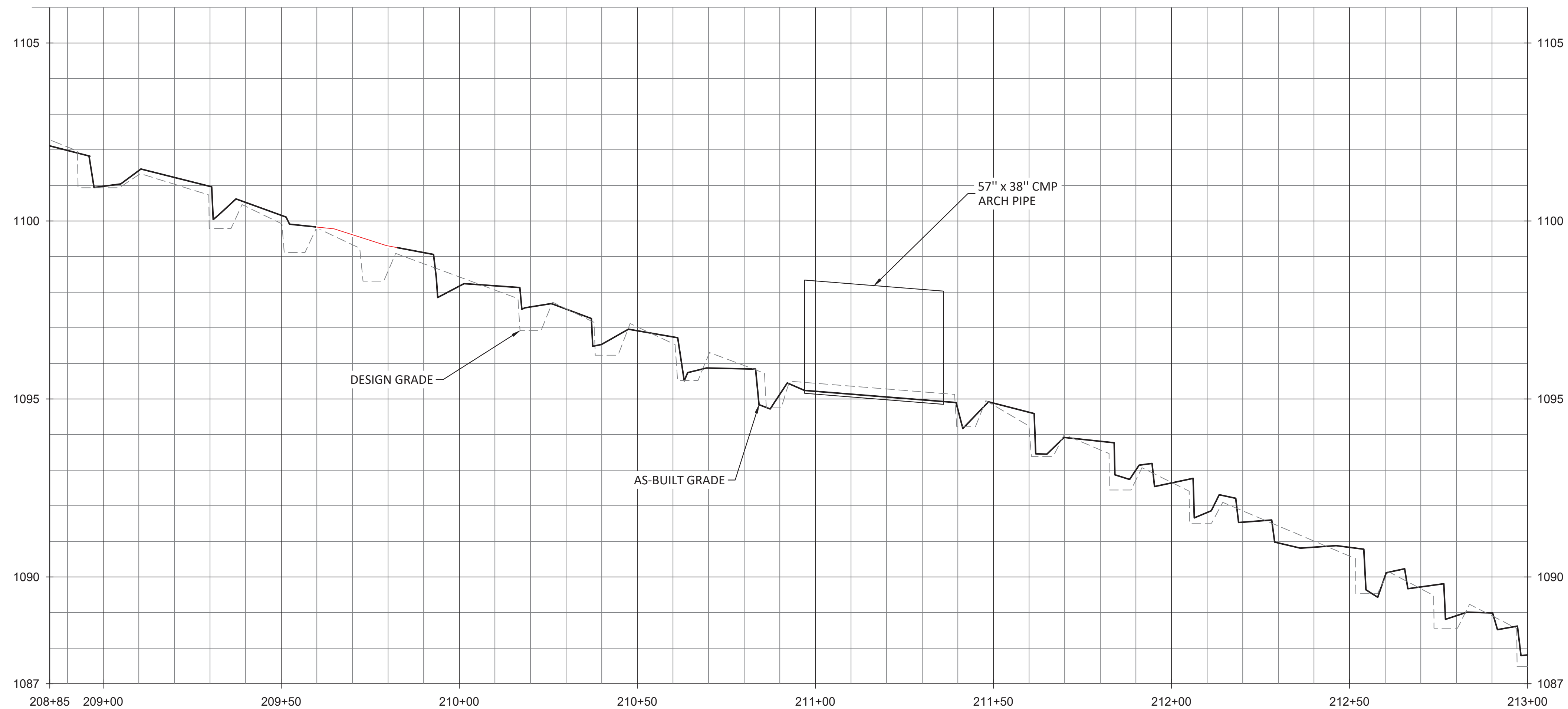
UT1A
Stream Plan and Profile

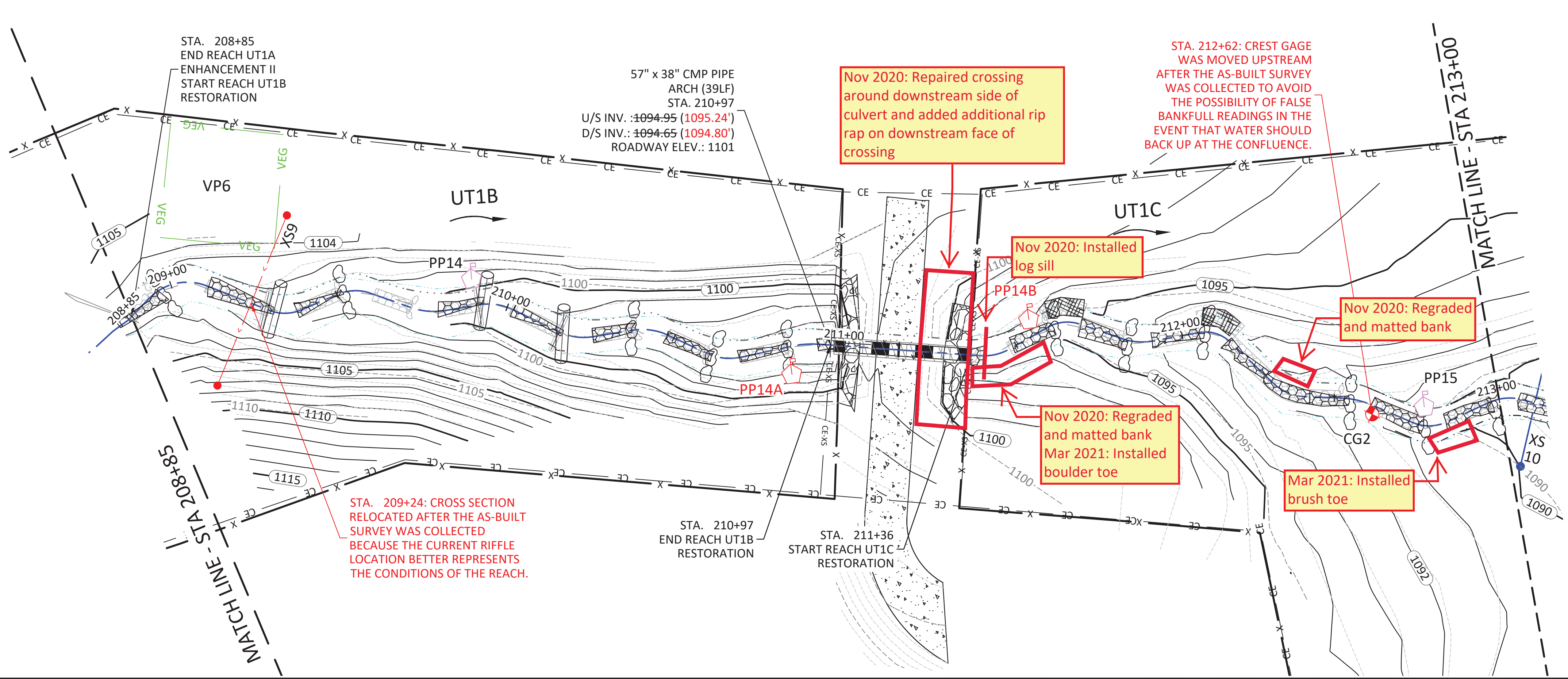
Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.14

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt-UT1a1.dwg





NOTE:
1. STA. 209+65: RIFFLE, ROCK SILL AND POOL WERE OMITTED DUE TO SUFFICIENT STABILITY AND SLOPE ON THE REACH.
2. STA. 210+83: PHOTO POINT 14A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 211+57: PHOTO POINT 14B WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
4. STA. 212+35: UPSTREAM ROCK AND ROLL RIFFLE BOULDER SILL WAS OMITTED AND RIFFLE WAS EXTENDED TO CONNECT TO DOWNSTREAM ROCK AND ROLL RIFFLE.

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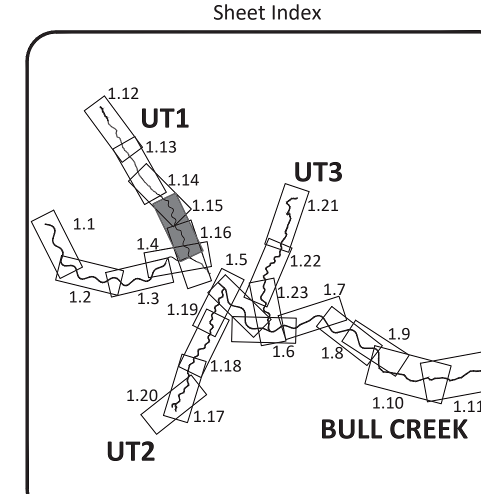

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

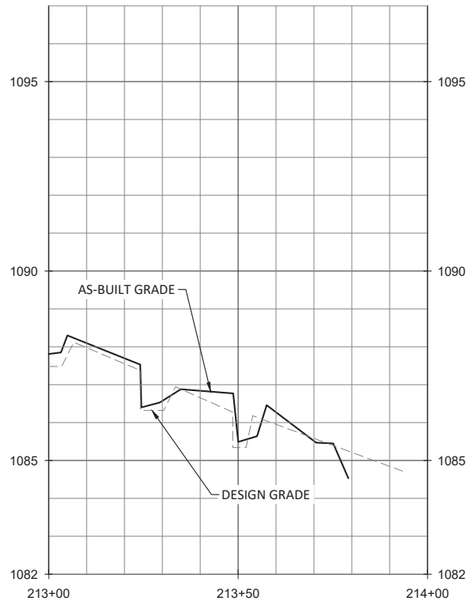
UT1B
Stream Plan and Profile

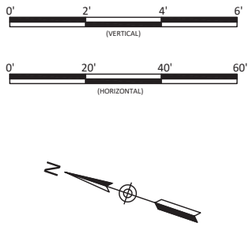
Revisions: 09/29/2020

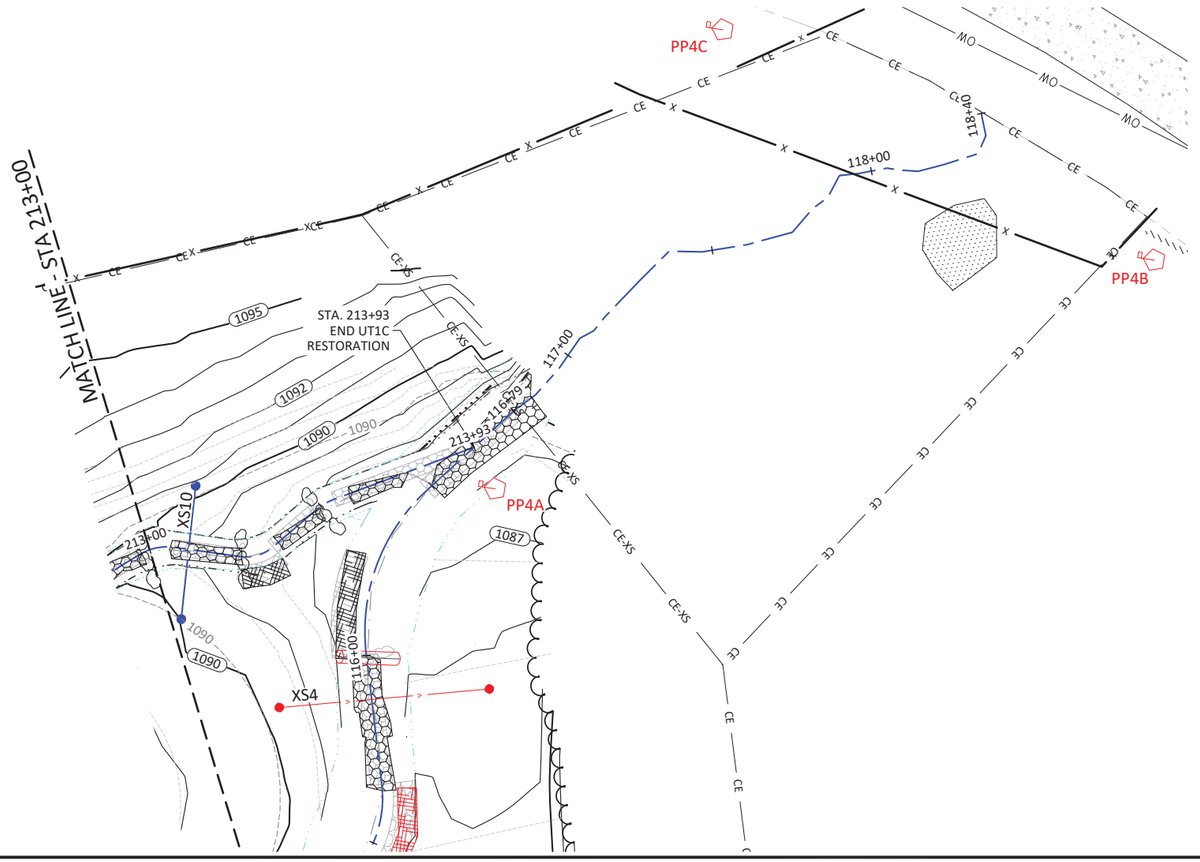
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.15

October 6 2020







NOTE:
1. STA. 118+30: PHOTO POINT 4B AND 4C WERE ADDED AFTER THE SURVEY WAS COMPLETE AT THE REQUEST OF DMS TO CAPTURE VIEWS ACROSS THE CATTLE CROSSING.

No Repairs for Adaptive Management Plan - 2021

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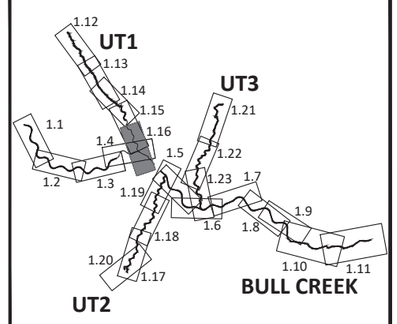

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 8-27-20

Key Mill Mitigation Site
Surry County, North Carolina

UT1C
As-Built Plan & Profile

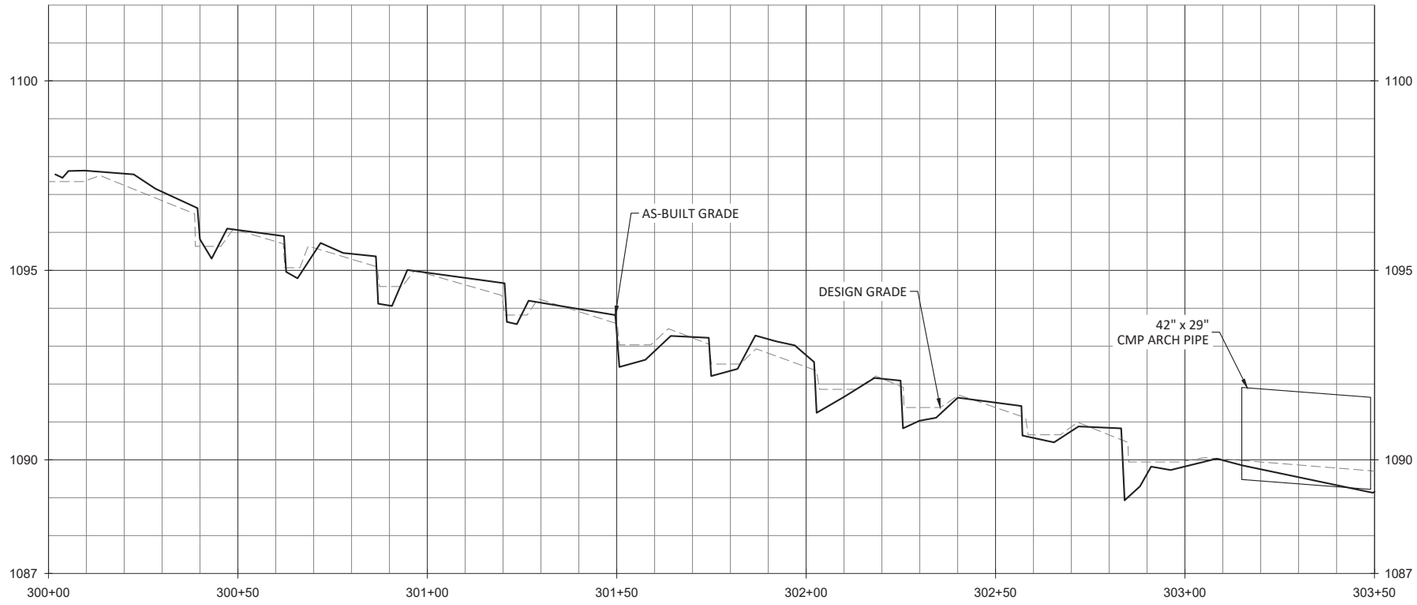
Revisions: 09/29/2020

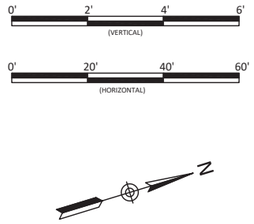
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

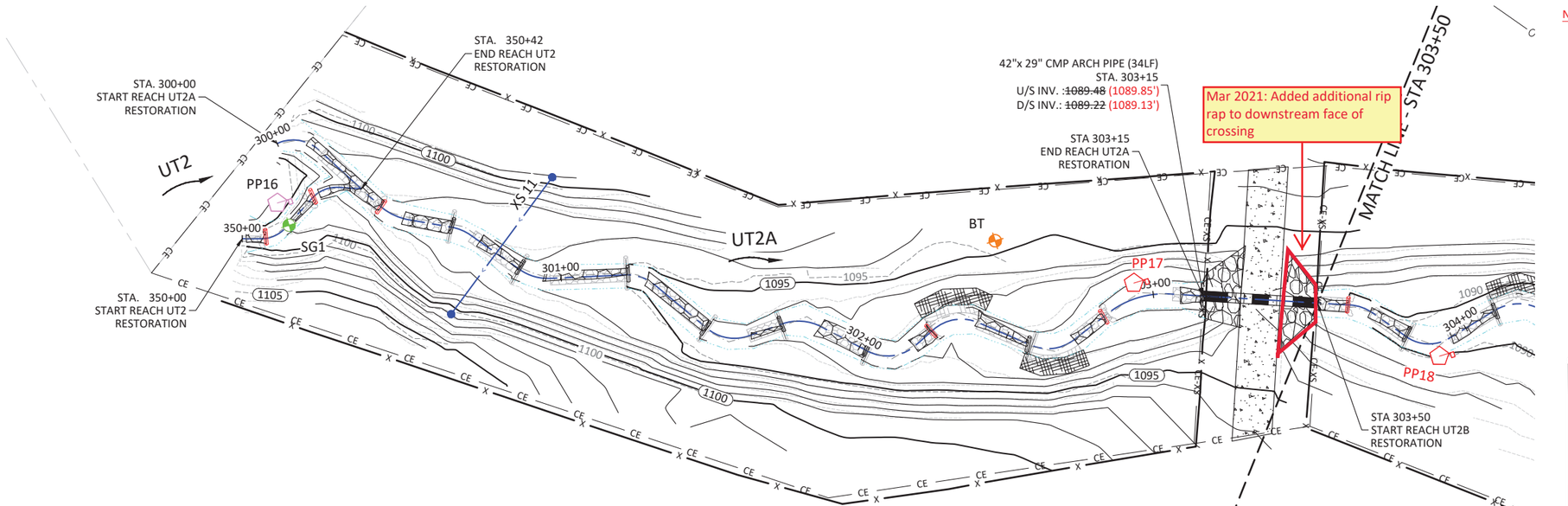
Sheet 1.16

T:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Grading-Built\02165-AsBuilt Workflow

October 6, 2020







NOTE:
1. STA. 300+40, 302+25, & 302+83: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 302+95: PHOTO POINT 17 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.

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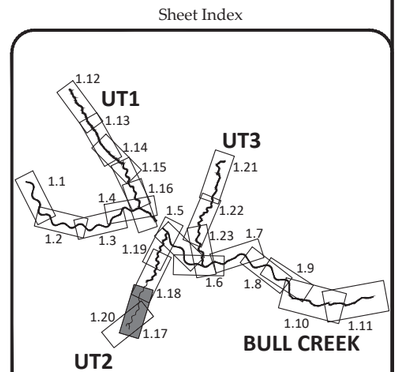

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023419 AARON S. ERVIN 10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

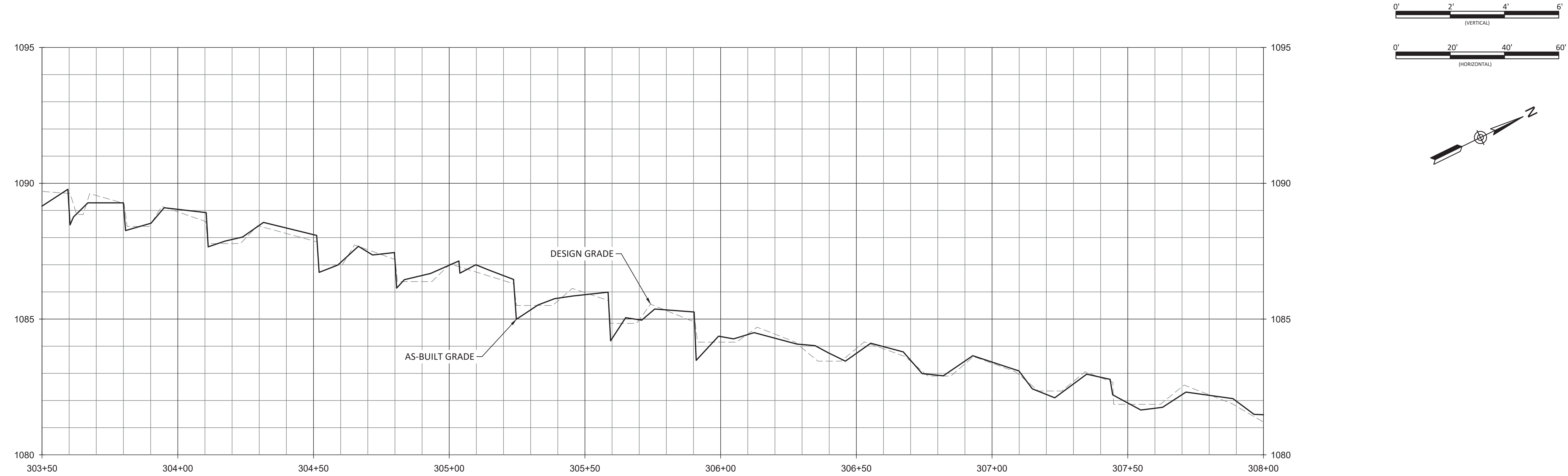
UT2A
Stream Plan and Profile

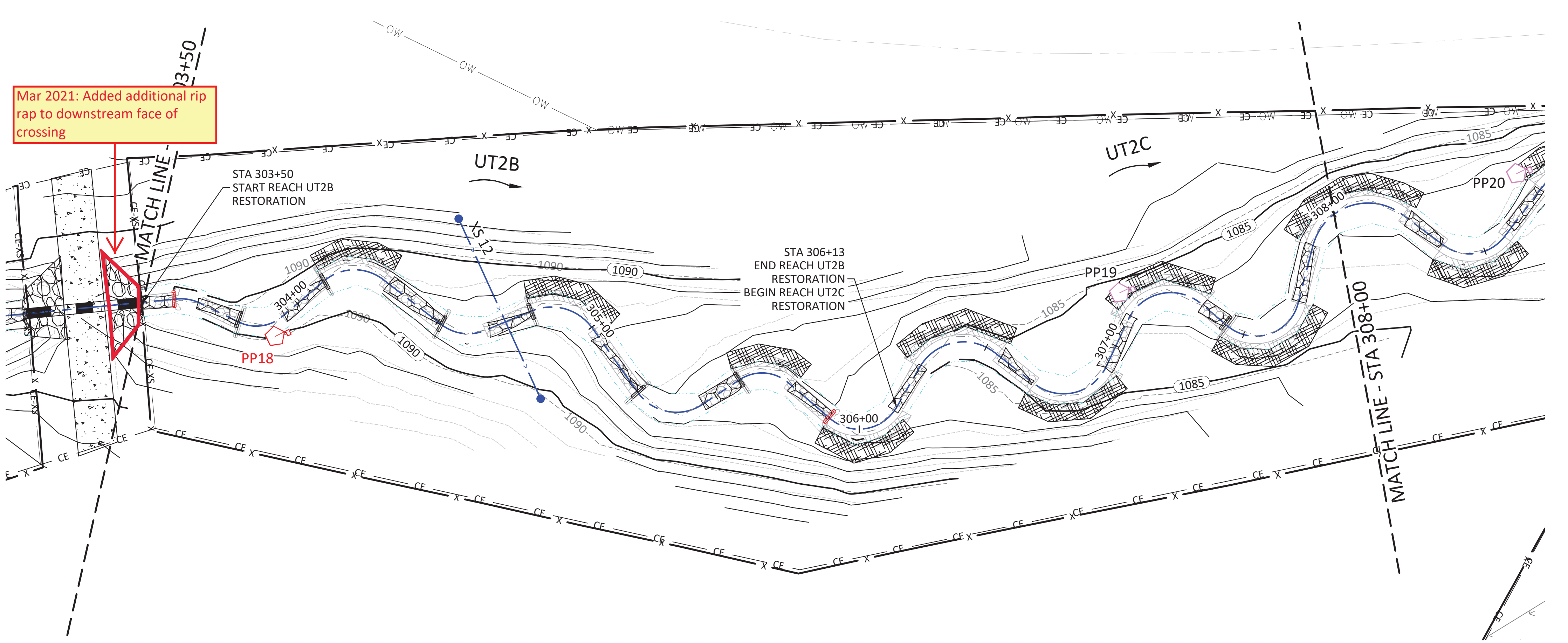
Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.17

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt.dwg

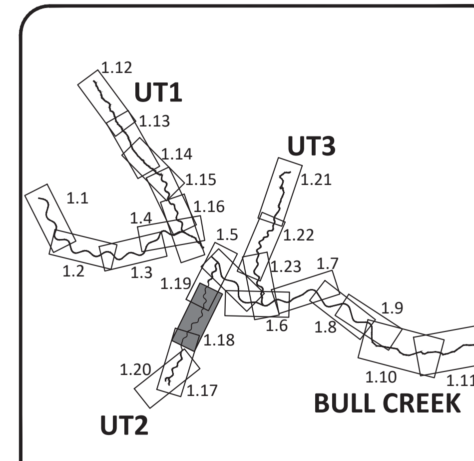




NOTE:

1. STA. 303+59 & 305+90: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 303+90: PHOTO POINT 18 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023467 AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings

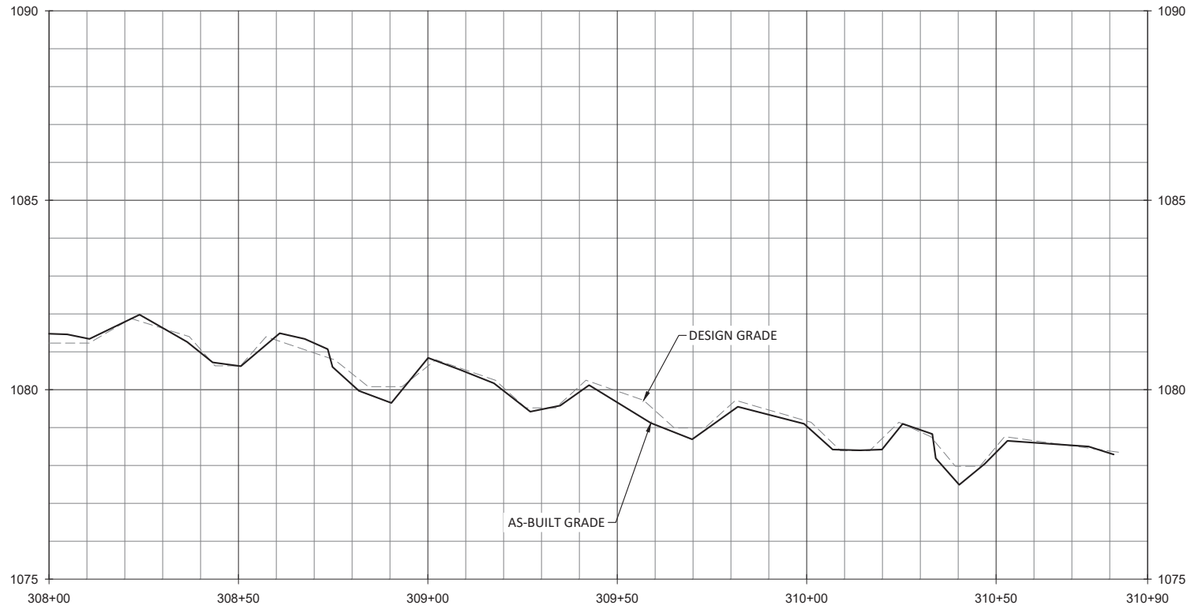
Surry County, North Carolina

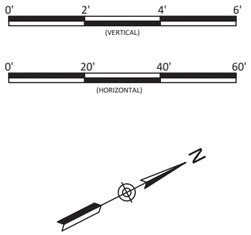
UT2B
Stream Plan and Profile

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK
Revisions:	09/29/2020

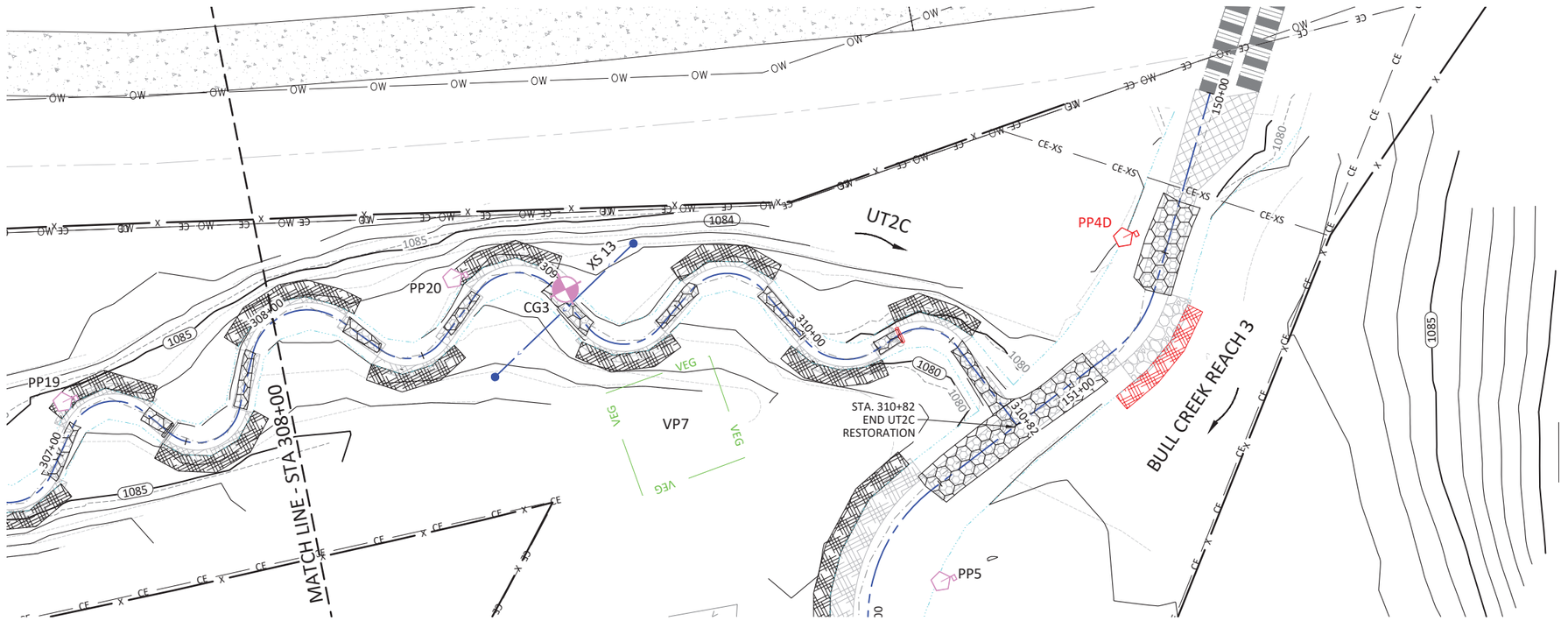
Sheet 1.18

October 6, 2020



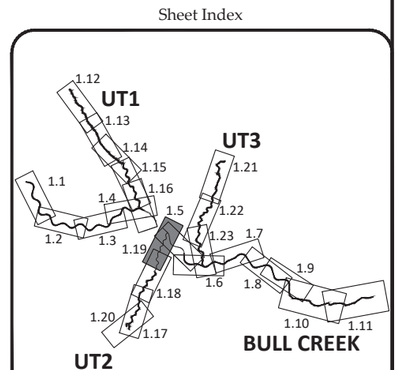


No Repairs for Adaptive Management Plan - 2021



NOTE:
1. STA. 310+33: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ENG
12-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT2C
Stream Plan and Profile

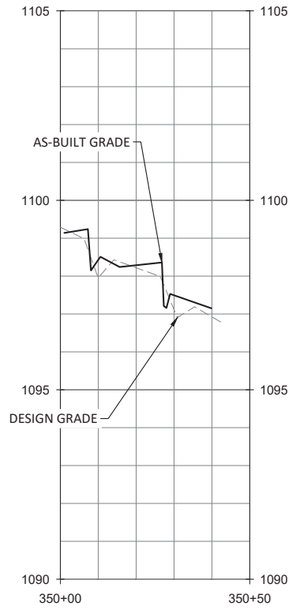
Revisions: 09/29/2020

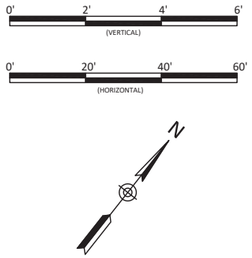
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.19

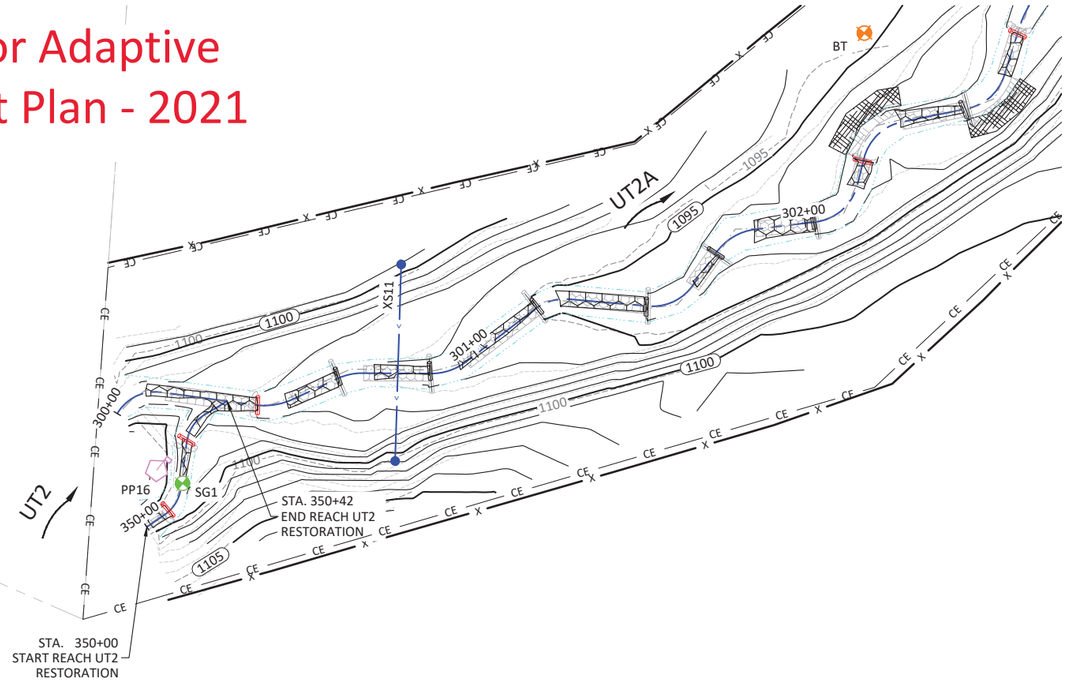
T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuiltPlan.dgn

October 6, 2020



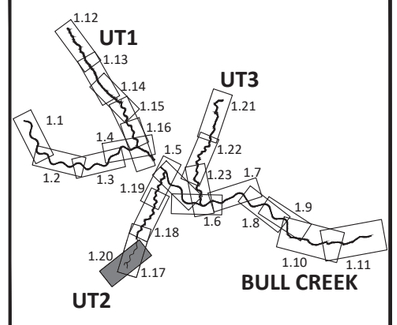


No Repairs for Adaptive Management Plan - 2021



NOTE:
1. STA. 350+08 & 350+27: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 AARON S. ERVIN 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

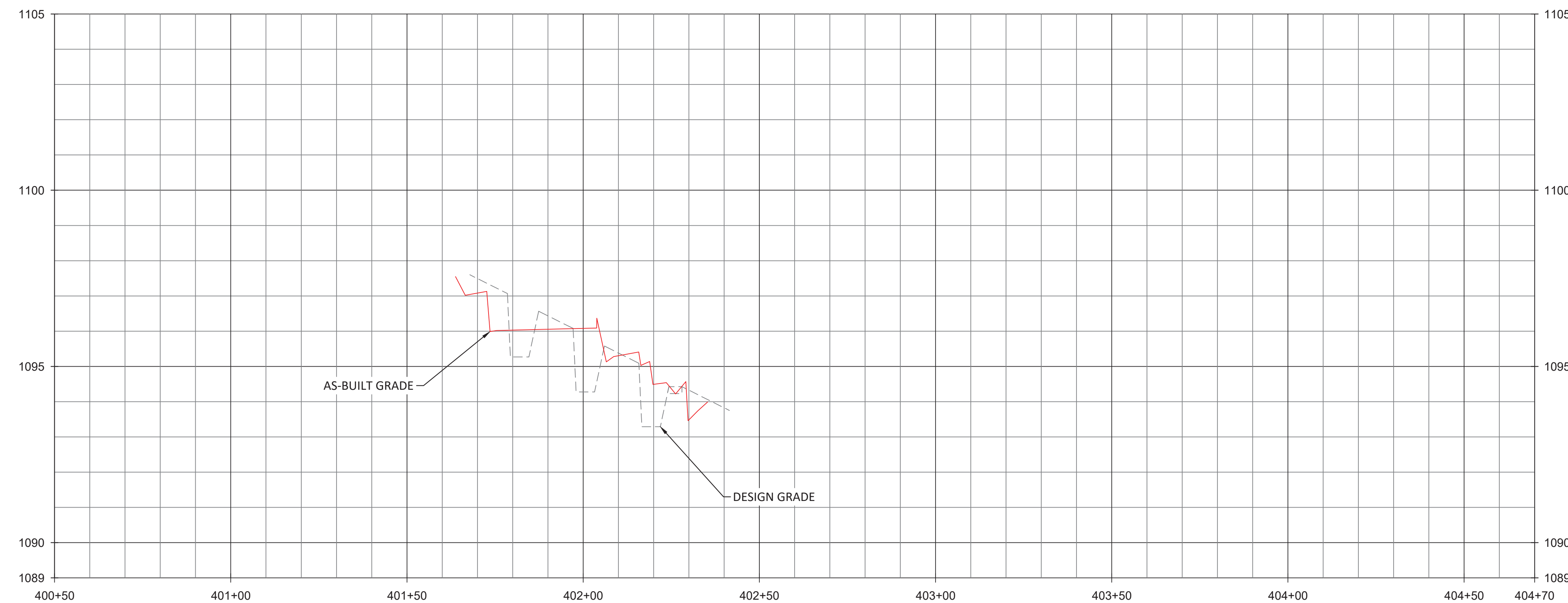
UT2
Stream Plan and Profile

Revisions:
09/29/2020

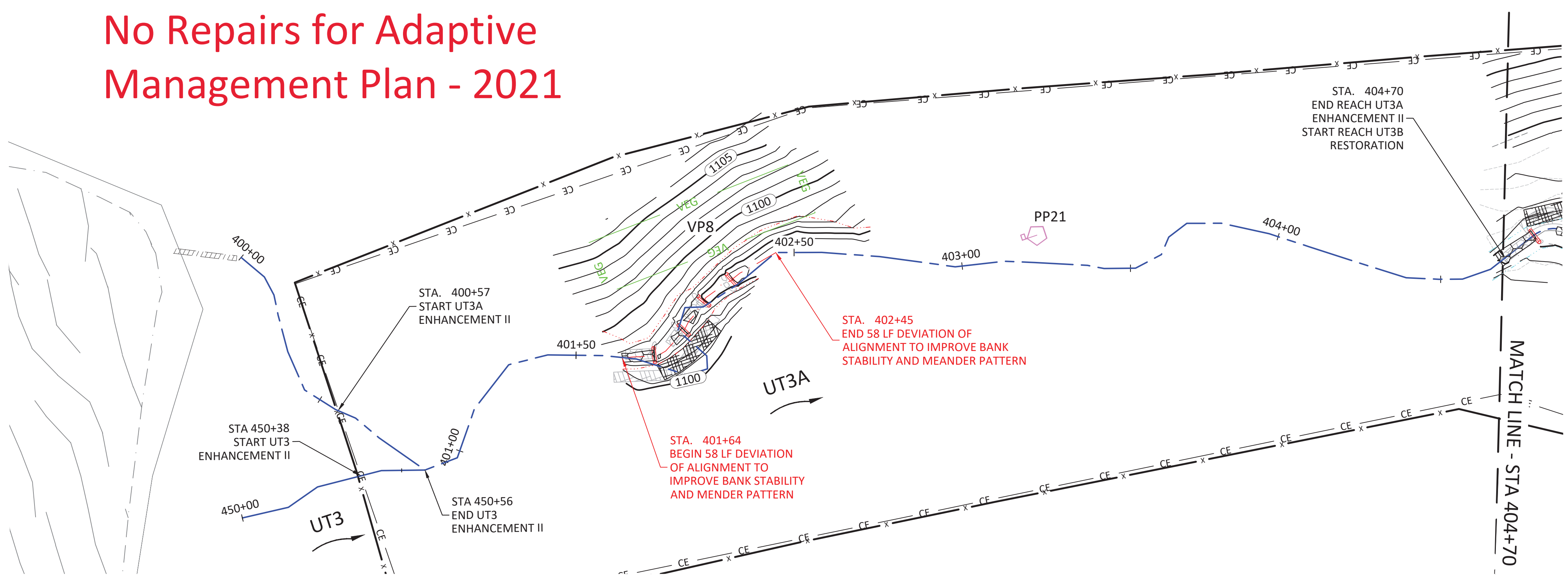
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.20

T:\ACTIVE PROJECTS\NC\005-02165\Key Mill\Cad\As-Built\02165-AsBuiltFinal.dgn



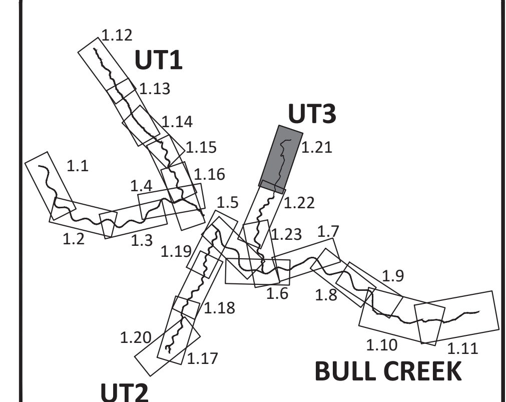
No Repairs for Adaptive Management Plan - 2021



NOTE:

1. STA. 401+64 - 402+45: THE CHANNEL DESIGN WAS ALTERED AND REALIGNED TO IMPROVE BANK STABILITY AND MEANDER PATTERN WHICH RESULTED IN 58 LF OF CONSTRUCTED CHANNEL, COMPARED TO 81 LF IN THE ORIGINAL DESIGN.
2. STA. 401+71 - 402+29: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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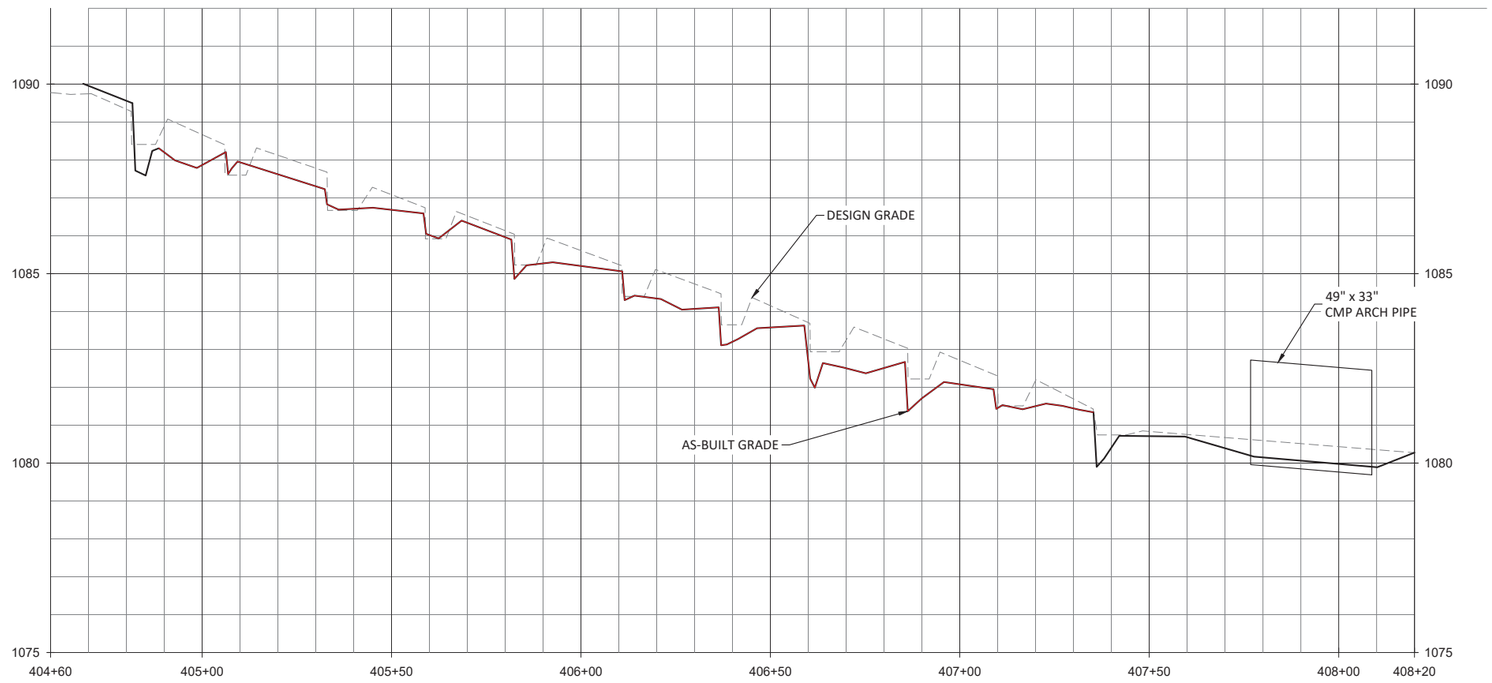
Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

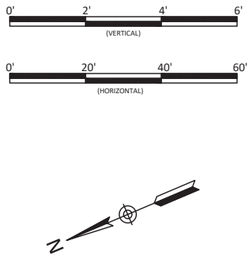
UT3 and UT3A
Stream Plan and Profile

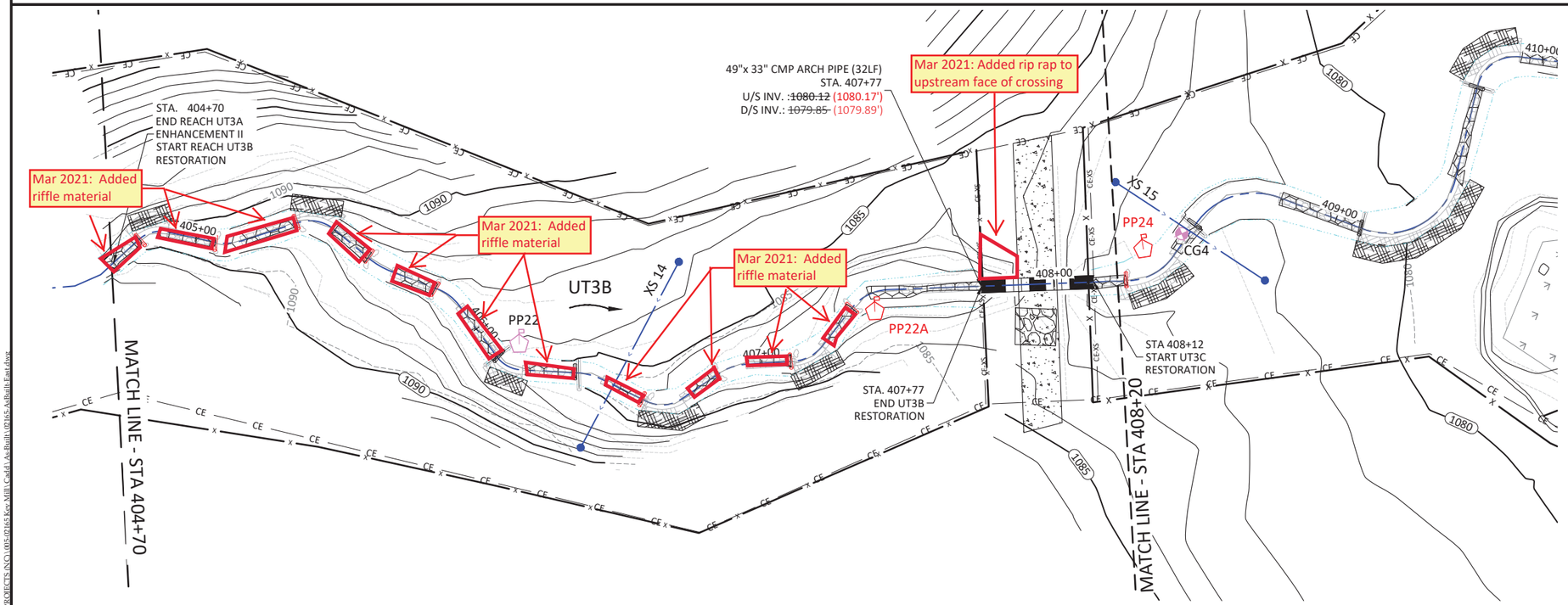
Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK
Revisions:	09/29/2020

Sheet 1.21

October 6, 2020

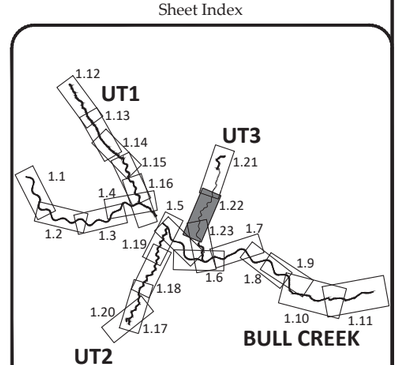






NOTE:
1. STA. 404+82, 405+06, 405+32, 405+58, 405+82, 406+59, 406+85, 407+09 AND 407+35: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 404+89 - 407+35: RIFFLE ELEVATIONS ADJUSTED DUE TO THE UPSTREAM TIE IN ELEVATION BEING CHANGED DUE TO FIELD CONDITIONS.
3. STA. 407+41: PHOTO POINT 22A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

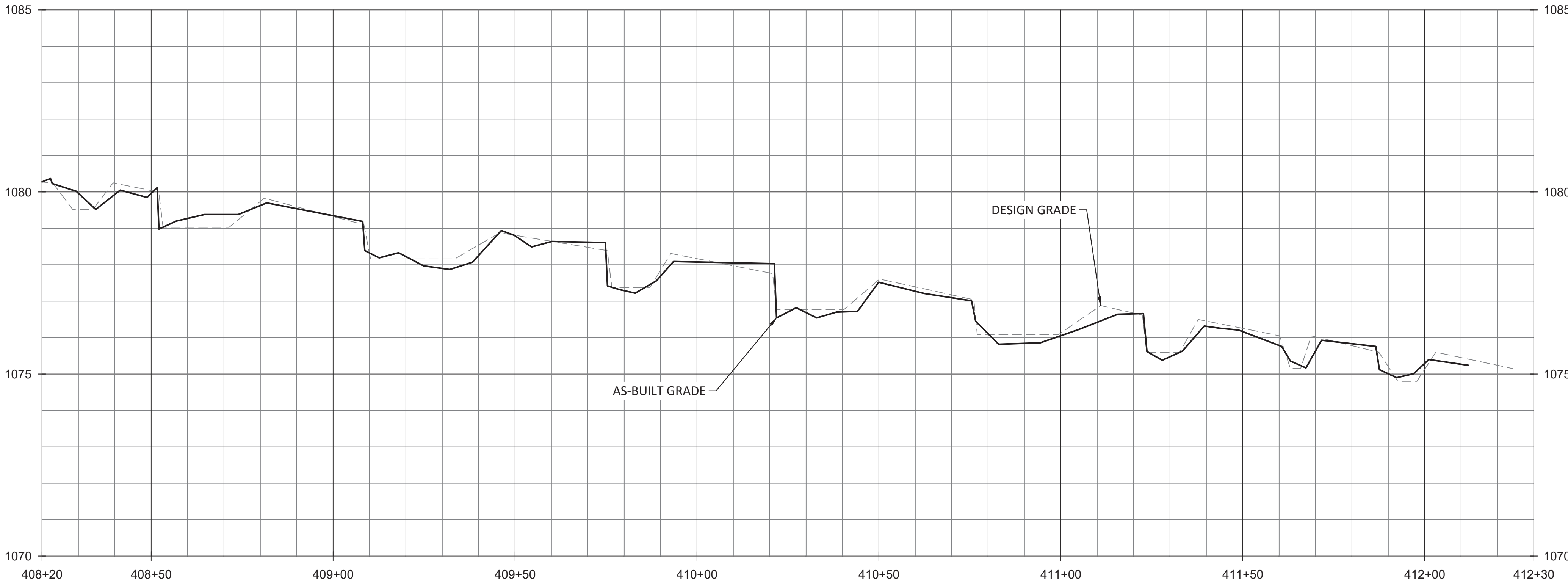
Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT3B and UT3C
Stream Plan and Profile

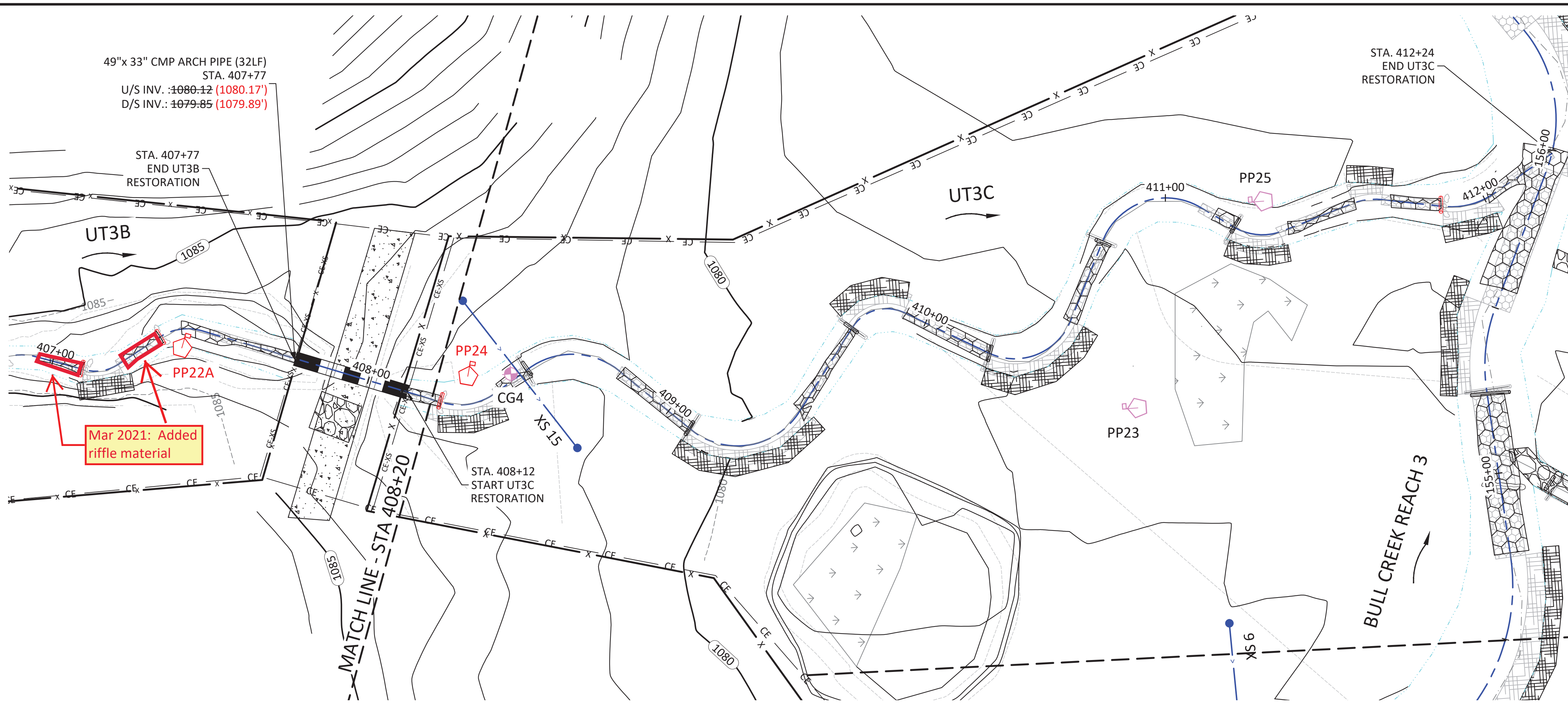
Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.22

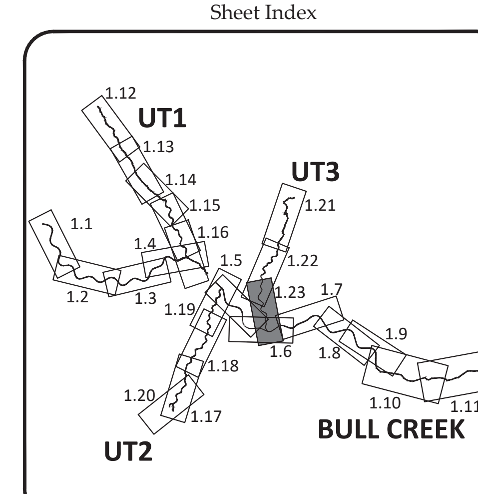
T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165 As-Built Fea.dgn





NOTE:
1. STA. 408+22: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 408+33: PHOTO POINT 24 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 411+86: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023340 AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT3C
Stream Plan and Profile

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK
Revisions:	09/29/2020

Sheet 1.23

October 6, 2020
T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cadd\As-Built\02165-AsBuilt-East.dwg

APPENDIX 4. Approved Planting Plans

January 21, 2019

Streambank Planting Zone

Species	Common Name	Max Spacing	Indiv. Spacing	Min. Size	Stratum	# of Stems
			Live Stakes and Herbaceous Plugs			
Physocarpus opulifolius	Ninebark	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	20%
Cornus ammomum	Silky Dogwood	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	40%
Salix sericea	Silky Willow	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	40%
Juncus effusus	Common Rush	5 ft.	4-6 ft.	1.0"- 2.0" plug	Herb	N\A
Carex alata	Broadwing Sedge	5 ft.	4-6 ft.	1.0"- 2.0" plug	Herb	N\A
						100%

Streambank planting between bottom of bank and top of bank is not shown on plan. See Detail 4, Sheet 6.5 for planting specifics.

Buffer Planting Zone

Bare Root

Species	Common Name	Max Spacing	Indiv. Spacing	Min. Caliper Size	Stratum	# of Stems
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
						100%

Buffer Planting Zone - Shaded

Bare Root

Species	Common Name	Max Spacing	Indiv. Spacing	Min. Caliper Size	Stratum	# of Stems
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	25%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Carpinus caroliniana	Ironwood	18 ft.	6-18 ft.	0.25"-1.0"	Shrub	5%
Viburnum dentatum	Arrowwood Viburnum	18 ft.	6-18 ft.	0.25"-1.0"	Shrub	5%
Magnolia macrophylla	Bigleaf Magnolia	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
						100%

Vernal Pool and Wetland Planting Zone

Herbaceous Plugs

Species	Common Name	Max Spacing	Indiv. Spacing	Min. Size	Stratum	# of Stems
Calamagrostis canadensis	Bluejoint Grass	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	30%
Carex alata	Broadwing Sedge	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	35%
Juncus effusus	Common Rush	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	35%
						100%

Permanent Riparian Seeding

Pure Live Seed (20 lbs/ acre)

Approved Date	Species Name	Common Name	Stratum	Density (lbs/acre)
All Year	*Panicum rigidulum*	Redtop Panicgrass	Herb	1.5
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	1.5
All Year	*Chasmanthium latifolium*	Indian Woodoats	Herb	1.5
All Year	*Rudbeckia hirta*	Blackeyed Susan	Herb	1.0
All Year	*Coreopsis lanceolata*	Lanceleaf Coreopsis	Herb	0.2
All Year	*Carex vulpinoidea*	Fox Sedge	Herb	1.5
All Year	*Panicum clandestinum*	Deertongue	Herb	3.0
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	2.5
All Year	*Panicum virgatum*	Switchgrass	Herb	3.5
All Year	*Schizachyrium scoparium*	Little Bluestem	Herb	2.5
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.5
All Year	*Lobelia cardinalis L.*	Cardinal Flower	Herb	0.4
All Year	*Eupatorium perfoliatum*	Boneset	Herb	0.2
All Year	*Liatris spicata*	Dense Blazing Star	Herb	0.2

All disturbed areas.

Temporary Seeding

Pure Live Seed

Approved Date	Species Name	Common Name	Stratum	Density (lbs/acre)
Aug 15 - May 1	*Secale cereale*	Rye Grain	Herb	140
May 1 - Aug 15	*Setaria italica*	German Millet	Herb	50

Pasture areas outside easement.

Pasture Seeding

Approved Date	Species Name	Stratum	Common Name	Density (lbs/acre)
All Year	*Festuca arundinacea*	Herb	Tall Fescue	80

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Key Mill Mitigation Site
Surry County, North Carolina

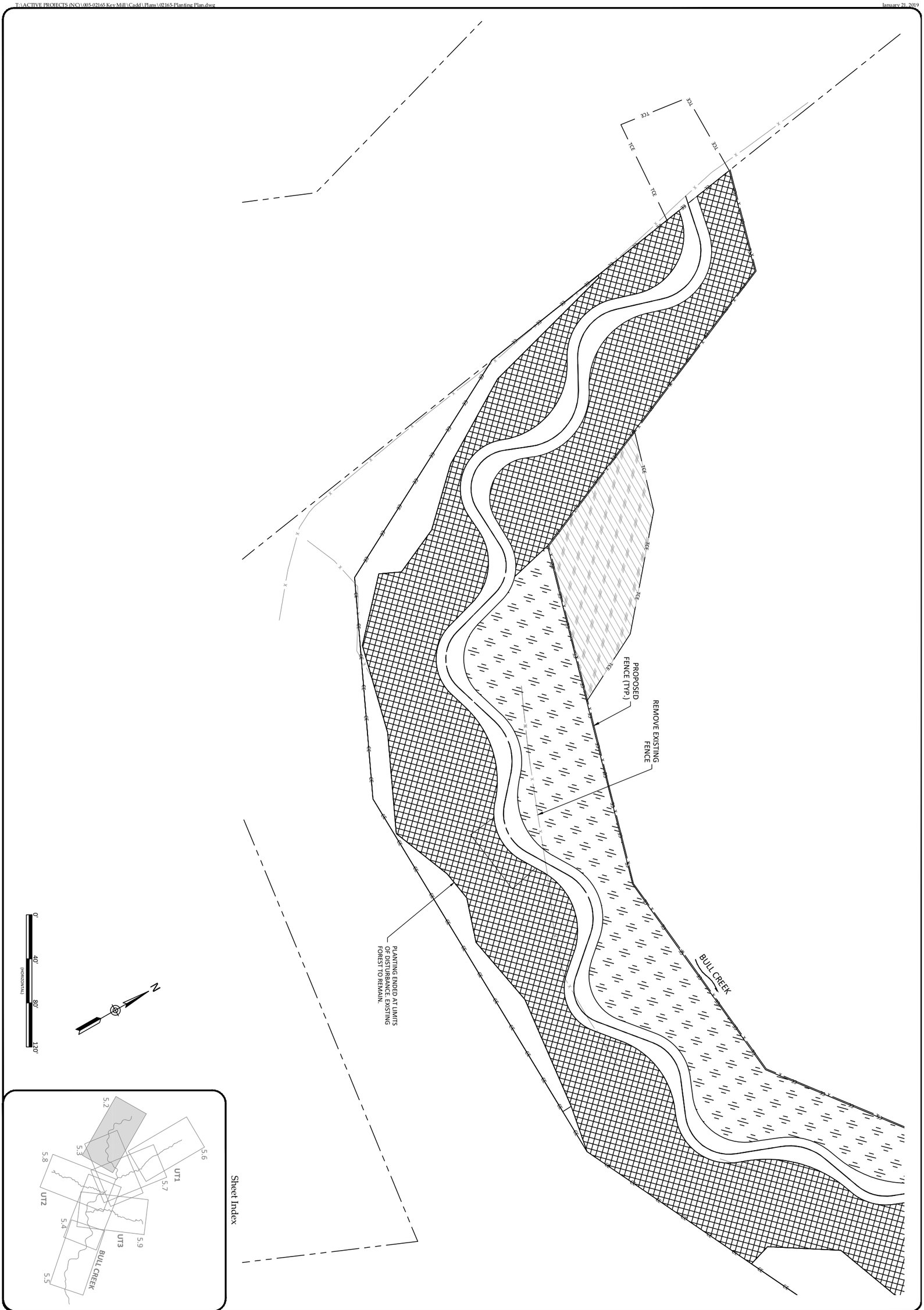
Plant List
Planting and Fencing Plan

Revisions:

Date: January 15, 2018
Job Number: 005-02165
Project Engineer: AE
Drawn By: MJC/BJB
Checked By: DJ

Sheet 5.1

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cadd\Plans\02165-Planting Plan.dwg



Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

Revisions:

5.2

Sheet

Key Mill Mitigation Site
Surry County, North Carolina

Bull Creek West
Planting and Fencing Plan

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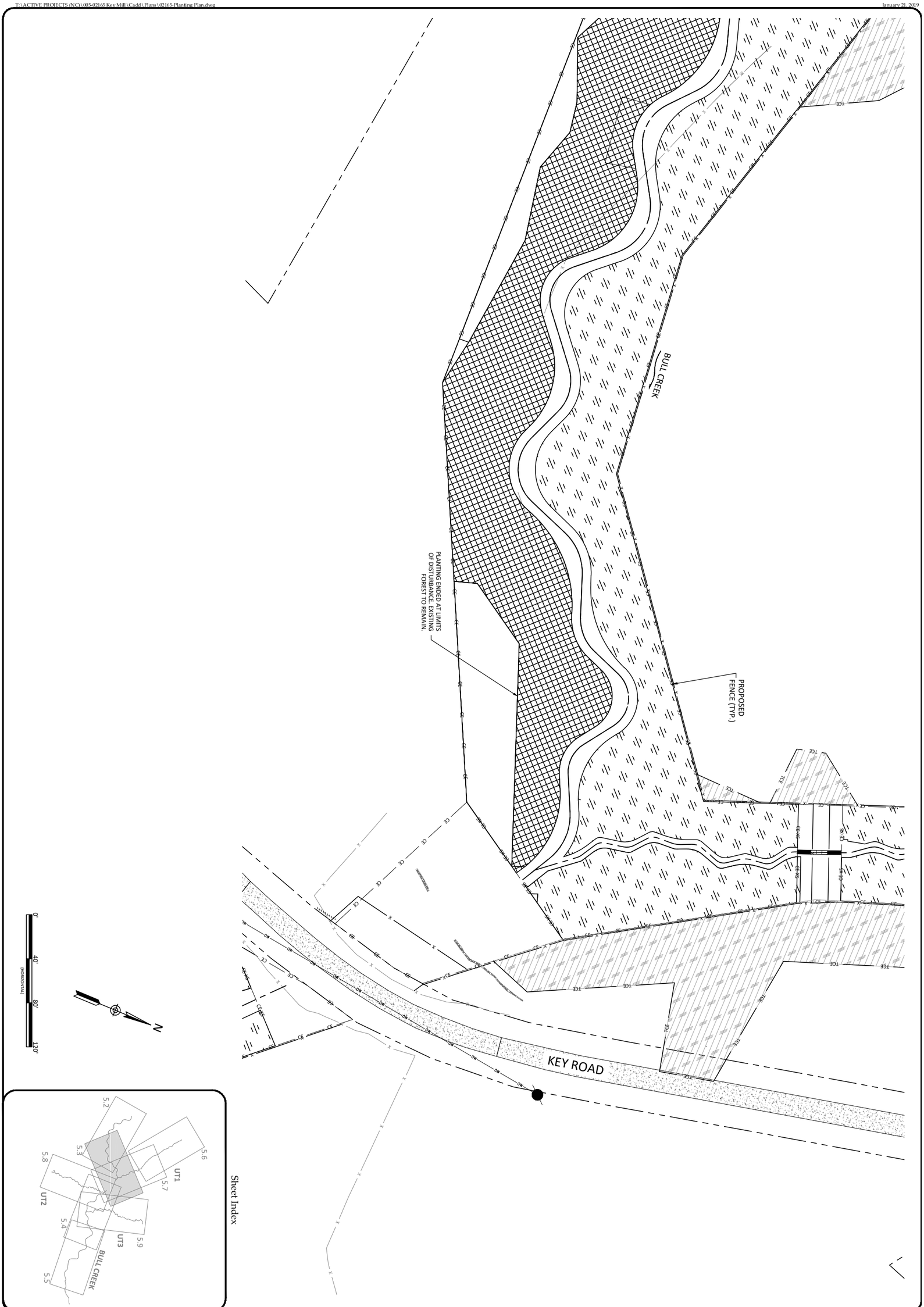

Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

5.3
Sheet

Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

Bull Creek West
Planting and Fencing Plan

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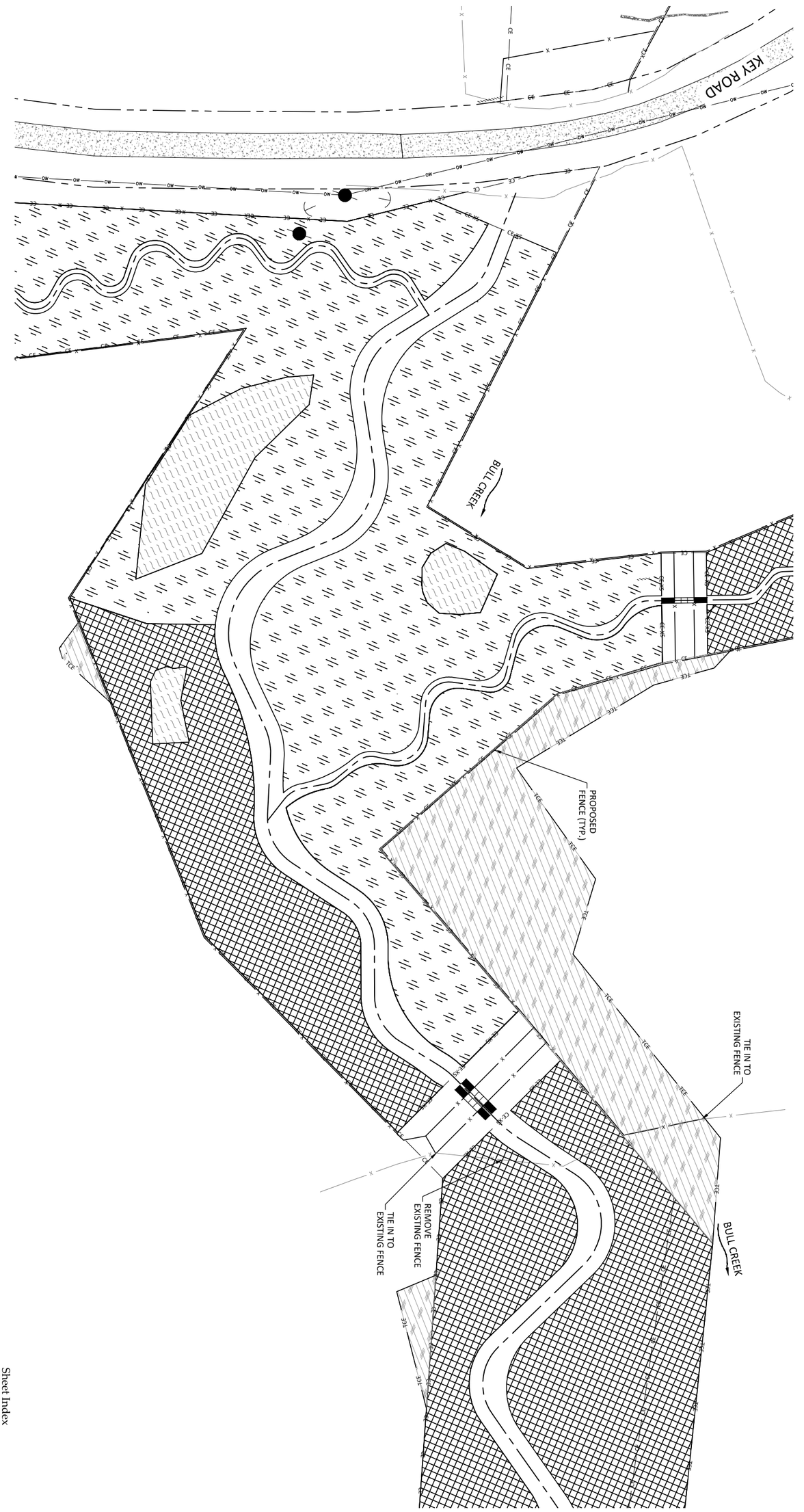

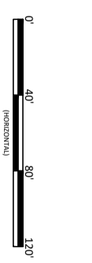

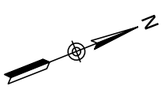

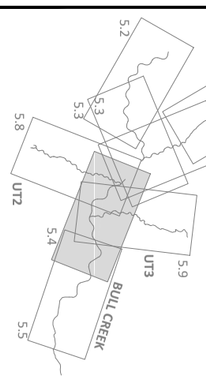

Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

Revisions:

5.4
Sheet

Key Mill Mitigation Site
Surry County, North Carolina

Bull Creek East
Planting and Fencing Plan

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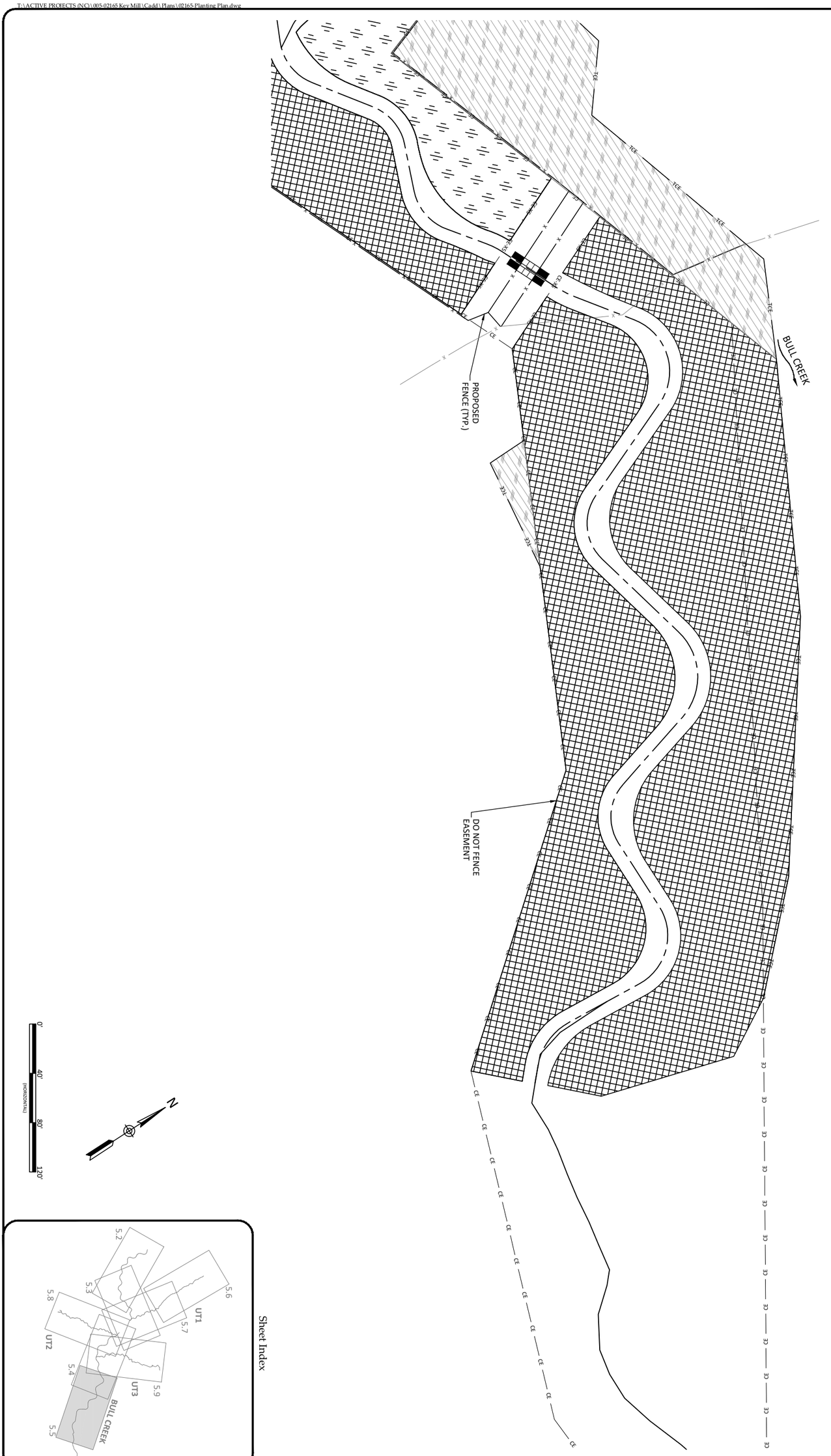

Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

5.5
Sheet

Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

Bull Creek East
Planting and Fencing Plan

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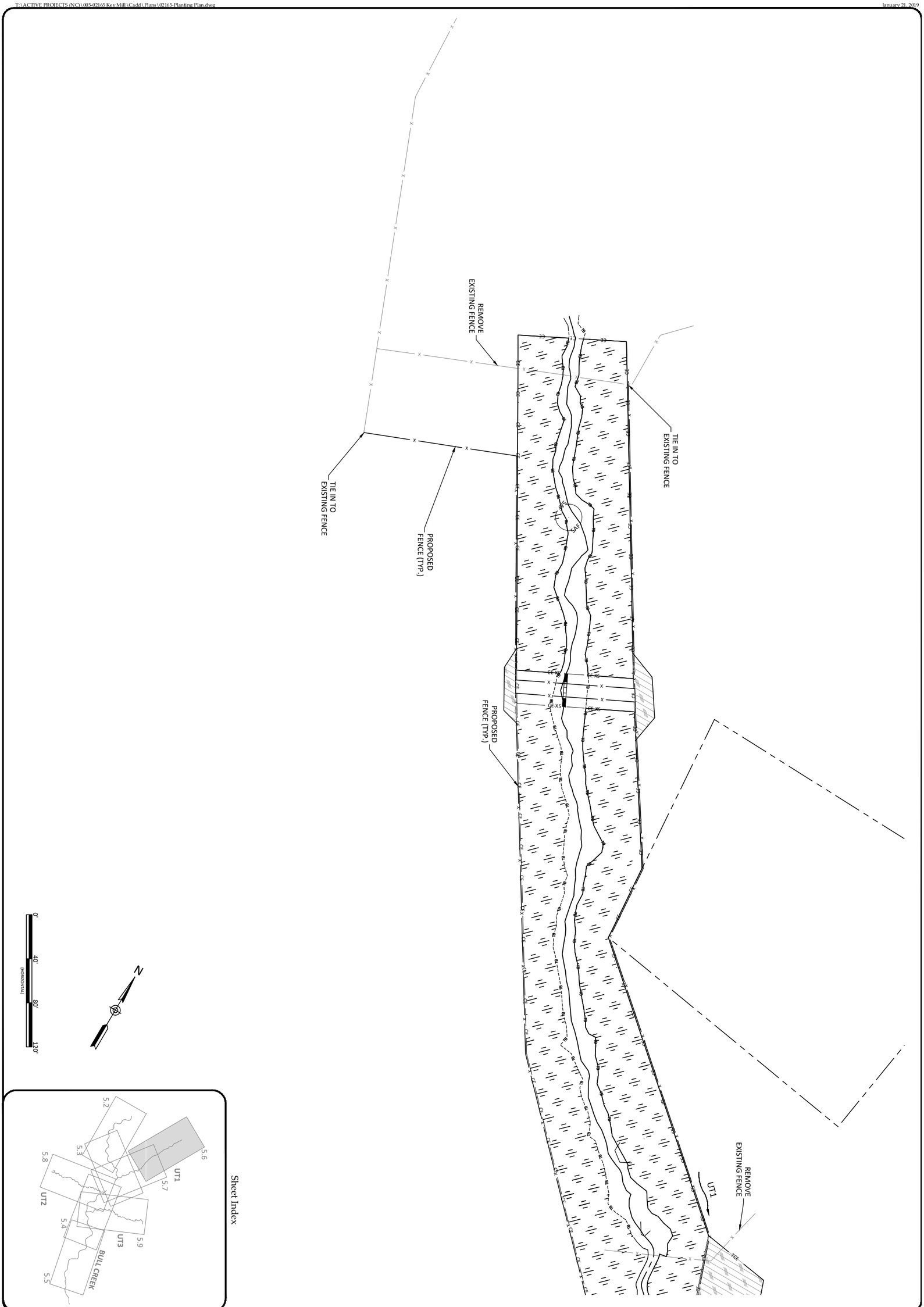

Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

5.6
Sheet

Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

UT1
Planting and Fencing Plan

PRELIMINARY DO NOT USE FOR CONSTRUCTION

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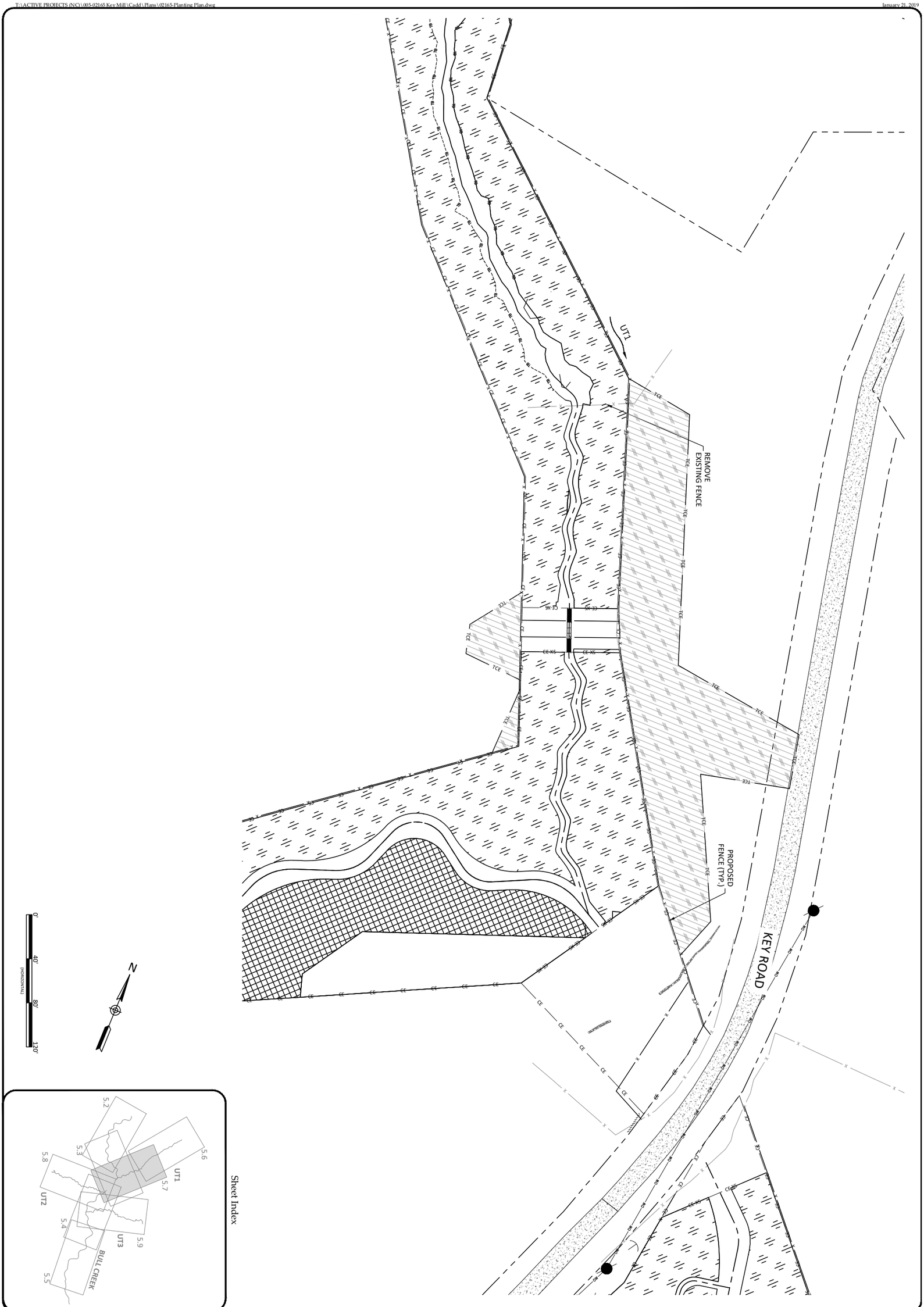

Sheet Index

Date:	January 15, 2018
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

5.7
Sheet

Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

UT1
Planting and Fencing Plan

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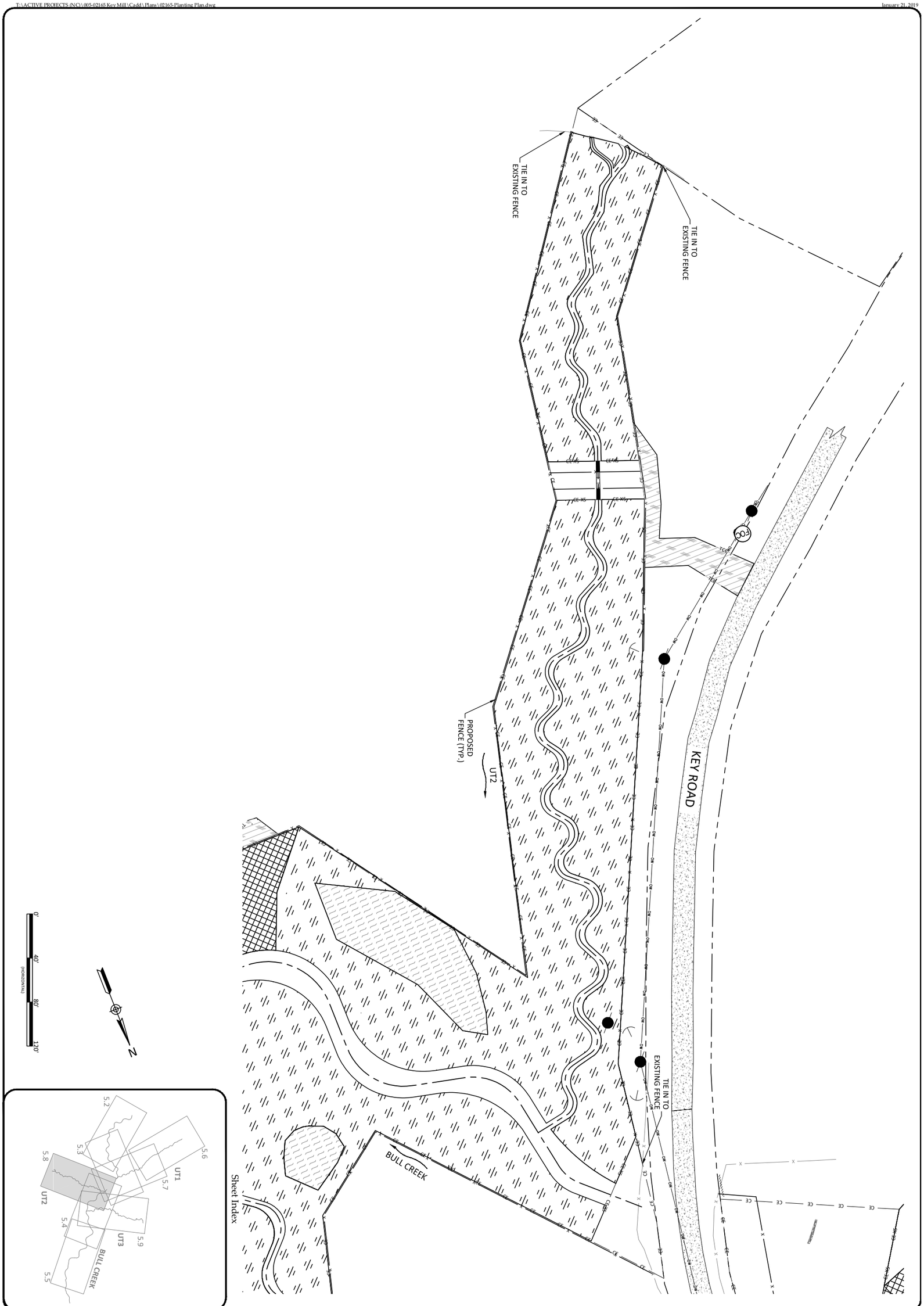

Date:	January 15, 2018
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Project Engineer:	AE
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Checked By:	DJ

5.8
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Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

UT2
Planting and Fencing Plan

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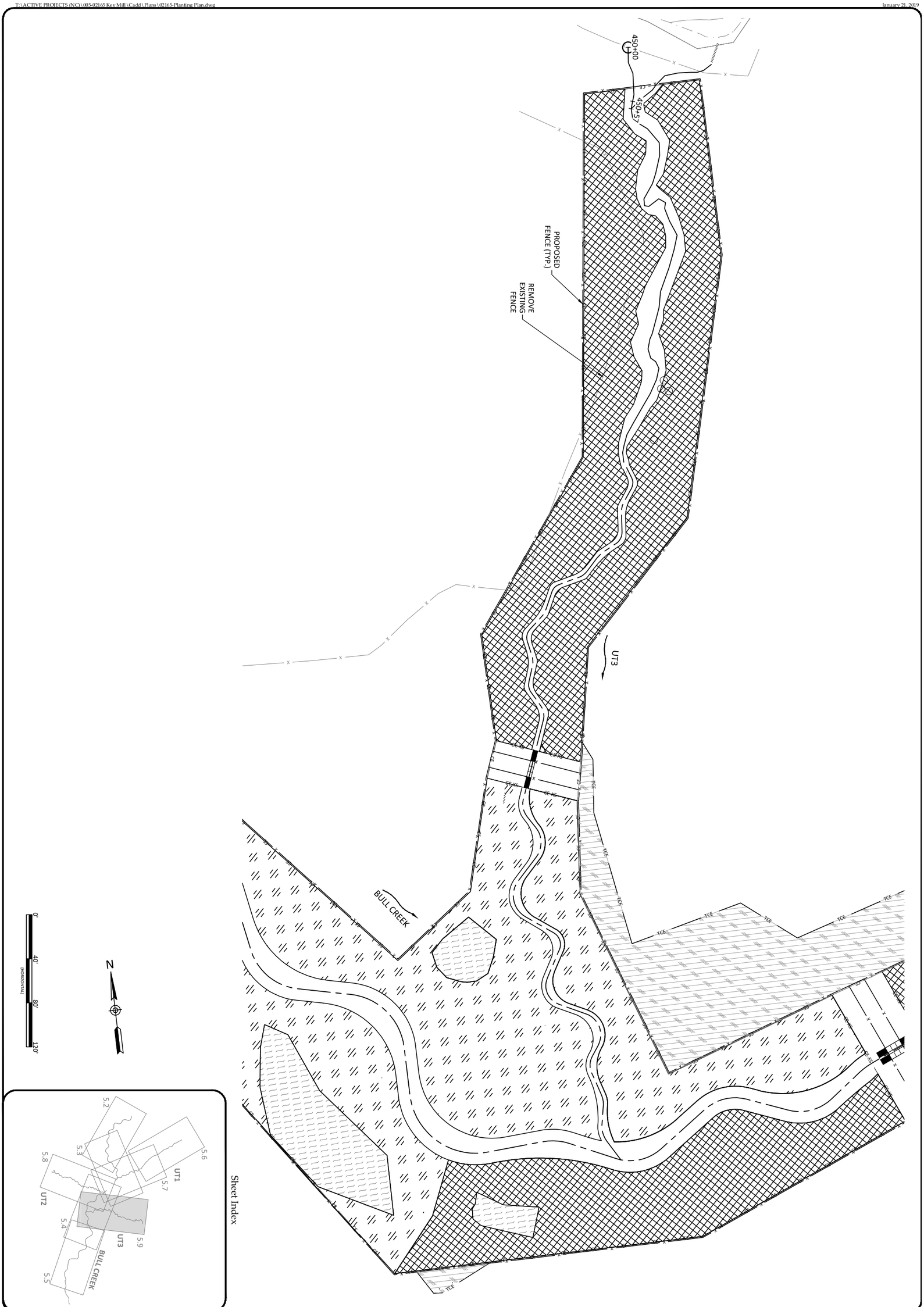

Sheet Index

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Job Number:	005-02165
Project Engineer:	AE
Drawn By:	MJC/BJB
Checked By:	DJ

5.9
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Revisions:

Key Mill Mitigation Site
Surry County, North Carolina

UT3
Planting and Fencing Plan

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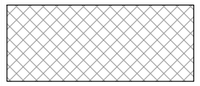
October 6, 2020

Streambank Planting Zone						
Live Stakes						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**# of Stems**
Physocarpus opulifolius	Ninebark	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	~~20%~~ 10%
Cornus ammomum	Silky Dogwood	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	~~40%~~ 30%
Salix sericea	Silky Willow	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	40%
Cephalanthus occidentalis	Button Bush	8 ft.	2-8ft.	0.5" 1.5" cal.	Shrub	10%
Sambucus canadensis	Elderberry	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	10%
						100%

Buffer Planting Zone						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~20%~~ 0%
Quercus rubra	Nothern Red Oak	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	12.5%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~20%~~ 18%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~25%~~ 18%
Quercus falcata	Southern Red Oak	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	8%
Asimina triloba	Paw Paw	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	3%
Nyssa sylvatica	Black Gum	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	6%
Acer saccharinum	Silver Maple	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	3%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	12.5%
Carpinus caroliniana	Ironwood	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~5%~~ 4%
Viburnum dentatum	Arrowwood	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~5%~~ 4%
Ilex opaca	American Holly	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	4%
Fagus gradifolia	American Beech	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	7%
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	~~20%~~ 0%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	~~20%~~ 0%
Magnolia macrophylla	Bigleaf Magnolia	12 ft.	6-12 ft.	0.25-1.0"	Canopy	~~5%~~ 0%
						100%

Note:
- Planting contractor provided plant quantities for entire site. Total plant quantities were not broken up between shaded and unshaded areas.

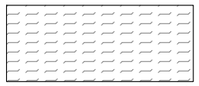
Buffer Planting Zone



Buffer Planting Zone - Shaded

Streambank, Vernal Pool and Wetland Planting Zone						
Herbaceous Plugs						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**# of Stems**
Scirpus altrovirens	Green Bulrush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	8%
Juncus effusus	Common Rush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~35%~~ 40%
Calamagrostis canadensis	Bluejoint Grass	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~30%~~ 0%
Carex crinita	Fringed Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	13%
Andropogon glomeratus	Bushy Beardgrass	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	4%
Caryx stricta	Upright Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	18%
Schoenoplectus tabernaemontani	Softstem Bulrush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	17%
Carex alata	Broadwing Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~35%~~ 0%
						100%

Note:
- Planting Contractor provided plant quantities for entire site. Total plant quantities were not broken up between streambank, vernal pool and wetland area planting zones.
- Herbaceous plugs shifted to similar species due to quality of materials available at nursery.



Vernal Pool and Wetland Planting Zone

Permanent Riparian Seeding				
Pure Live Seed (20 lbs/ acre)				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
All Year	*Panicum rigidulum*	Redtop Panicgrass	Herb	1.0
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	3.0
All Year	*Chasmanthium latifolium*	Indian Woodoats	Herb	0.4
All Year	*Rudbeckia hirta*	Blackeyed Susan	Herb	1.0
All Year	*Coreopsis lanceolata*	Lanceleaf Coreopsis	Herb	1.0
All Year	*Carex vulpinoidea*	Fox Sedge	Herb	1.5
All Year	*Panicum clandestinum*	Deertongue	Herb	3.0
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	3.5
All Year	*Panicum virgatum*	Switchgrass	Herb	2.0
All Year	*Schizachyrium scoparium*	Little Bluestem	Herb	2.0
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.4
All Year	*Bidens aristosa*	Bearded Beggartick	Herb	1.0
All Year	*Eupatorium perfoliatum*	Boneset	Herb	0.2
All Year	*Lobelia cardinalis L.*	Cardinal Flower	Herb	~~0.4~~ 0.0
All Year	*Liatris spicata*	Dense Blazing Star	Herb	~~0.4~~ 0.0

Temporary Seeding				
Pure Live Seed				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
Aug 15 - May 1	*Secale cereale*	Rye Grain	Herb	140
May 1 - Aug 15	*Setaria italica*	German Millet	Herb	50

*All disturbed areas.

Pasture Areas Outside Easement

Pasture Seeding				
Approved Date	**Species Name**	**Stratum**	**Common Name**	**Density (lbs/acre)**
All Year	*Festuca arundinacea*	Herb	Tall Fescue	80

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Plant List
Planting Plan

Revisions:
09-25-2020

Date: August 27, 2020
Job Number: 065-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 2.1

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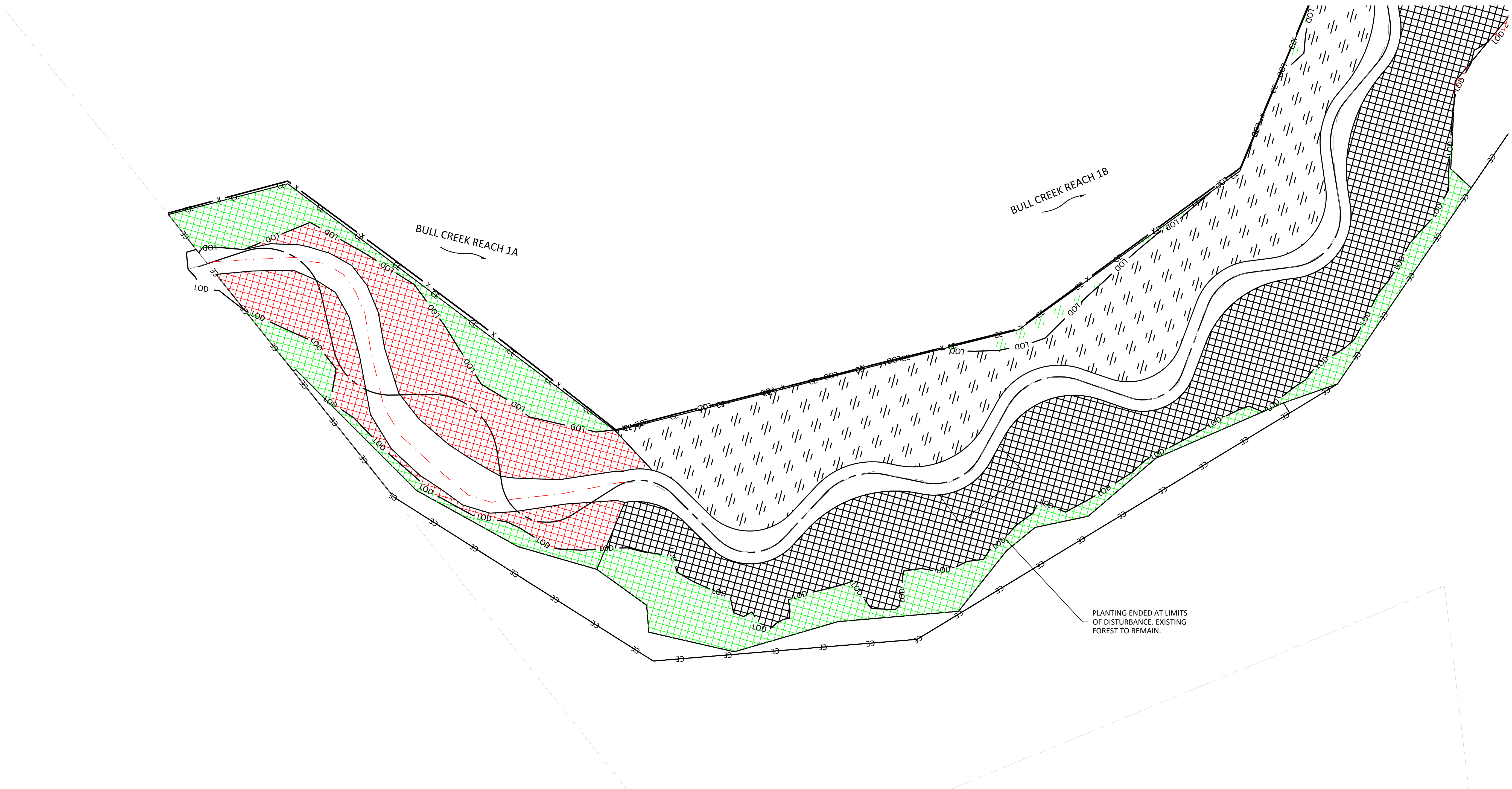

NOTES:

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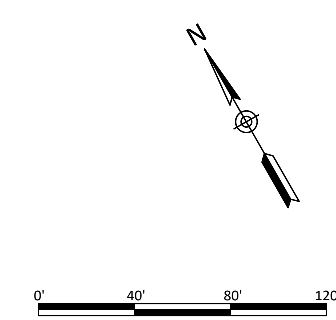
2. DEVIATIONS TO THE DESIGN PLANTING PLAN THAT WERE OUTSIDE THE AS-BUILT LIMIT OF DISTURBANCE AND WERE NOT PLANTED ARE SHOWN IN GREEN.
3. STA.100+95-105+39: PLANTING AREA ALTERED DUE TO BEDROCK THAT WAS PRESENT IN THE LEFT FLOODPLAIN.



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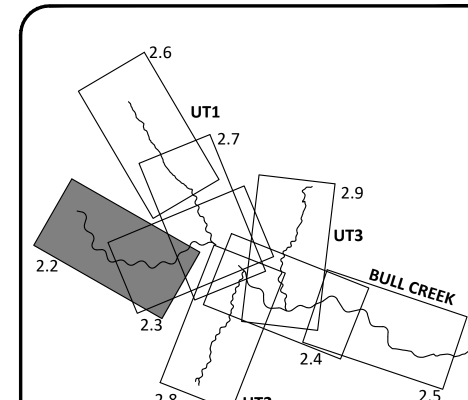

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NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek West
Planting Plan

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

Revisions:
10-01-2020

Sheet 2.2

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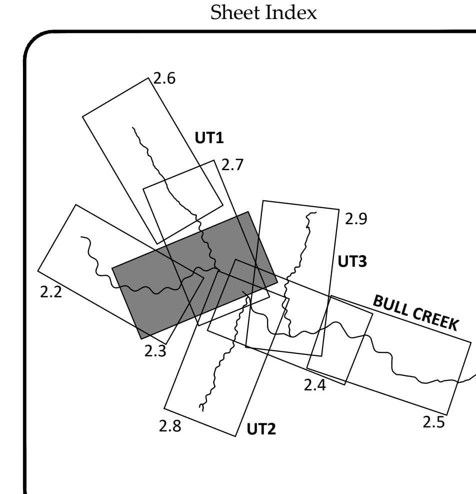

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Key Mill Mitigation Site - Record Drawings

Surry County, North Carolina

Bull Creek West Planting Plan

Revisions: 10-01-2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 2.3

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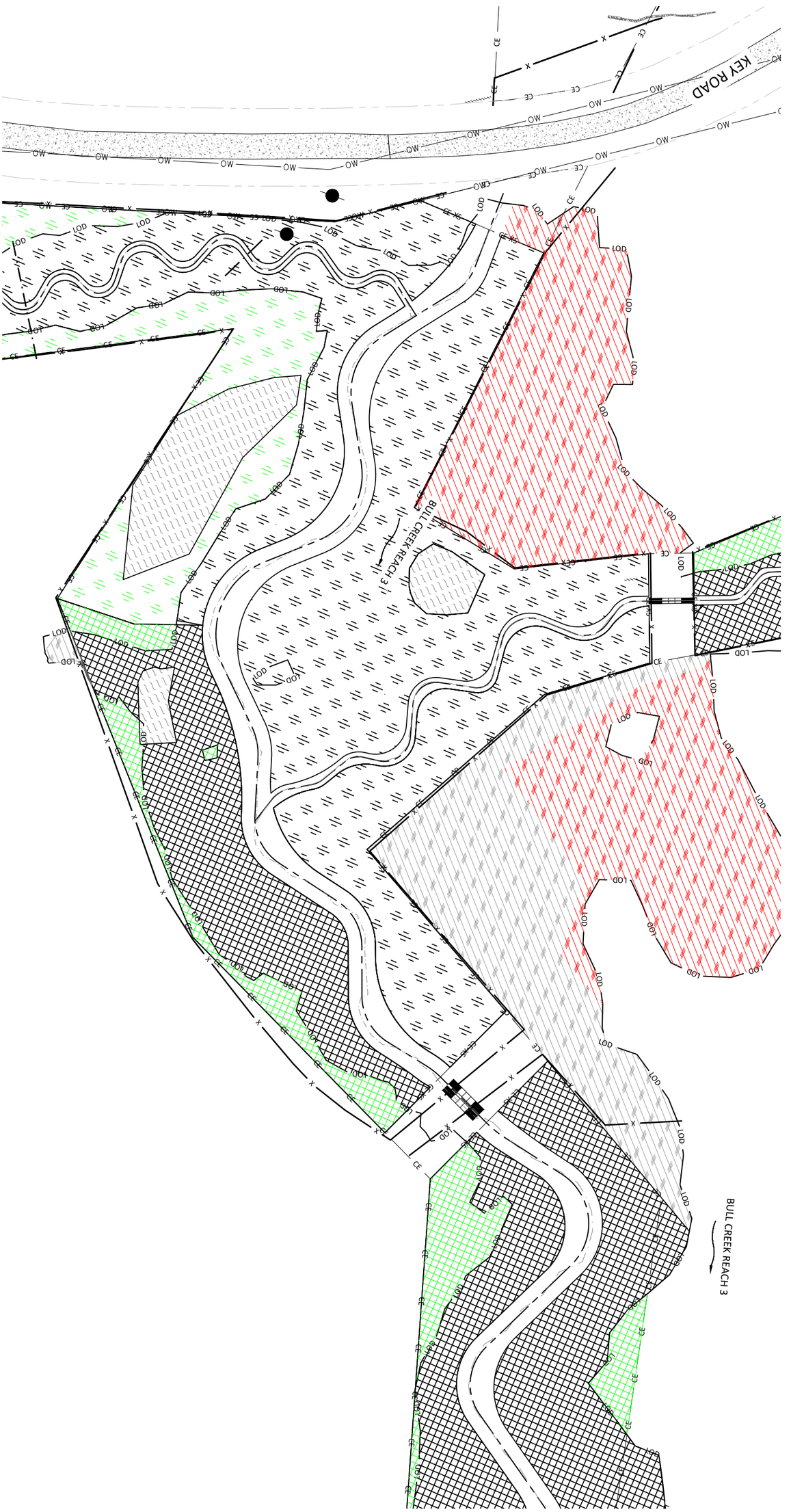

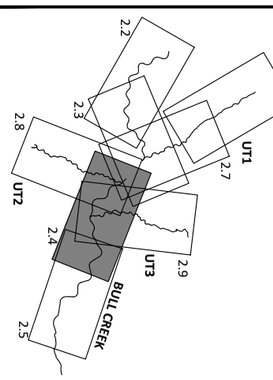

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Date:	August 27, 2020
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Drawn By:	ABP/JTC
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Revisions:
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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek East
Planting Plan

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023340 AARON S. EARLEY
8-27-20

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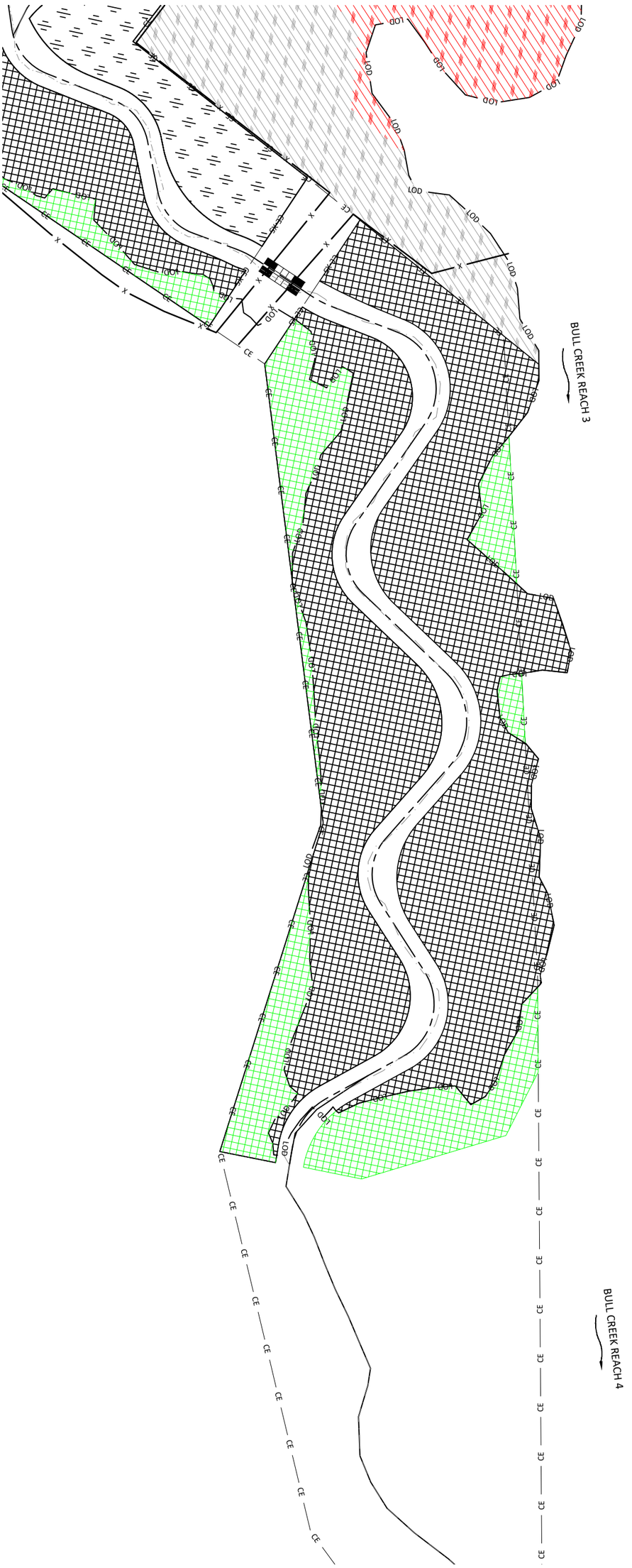

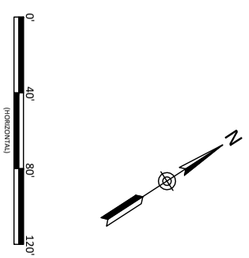

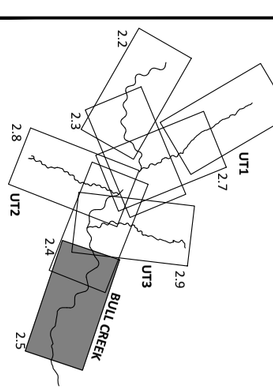

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek East
Planting Plan

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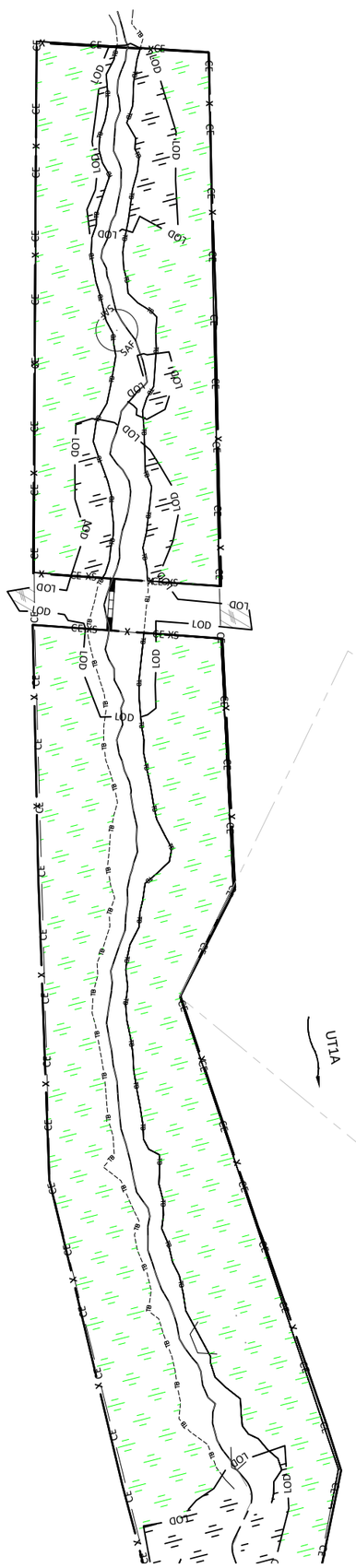

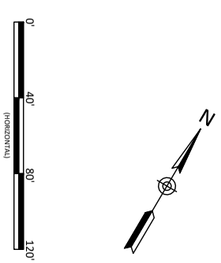

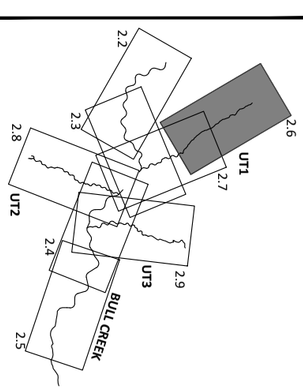

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Revisions:
10-01-2020

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1
Planting Plan

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8-27-20

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1
Planting Plan

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8-27-20

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10-01-2020

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT2
Planting Plan

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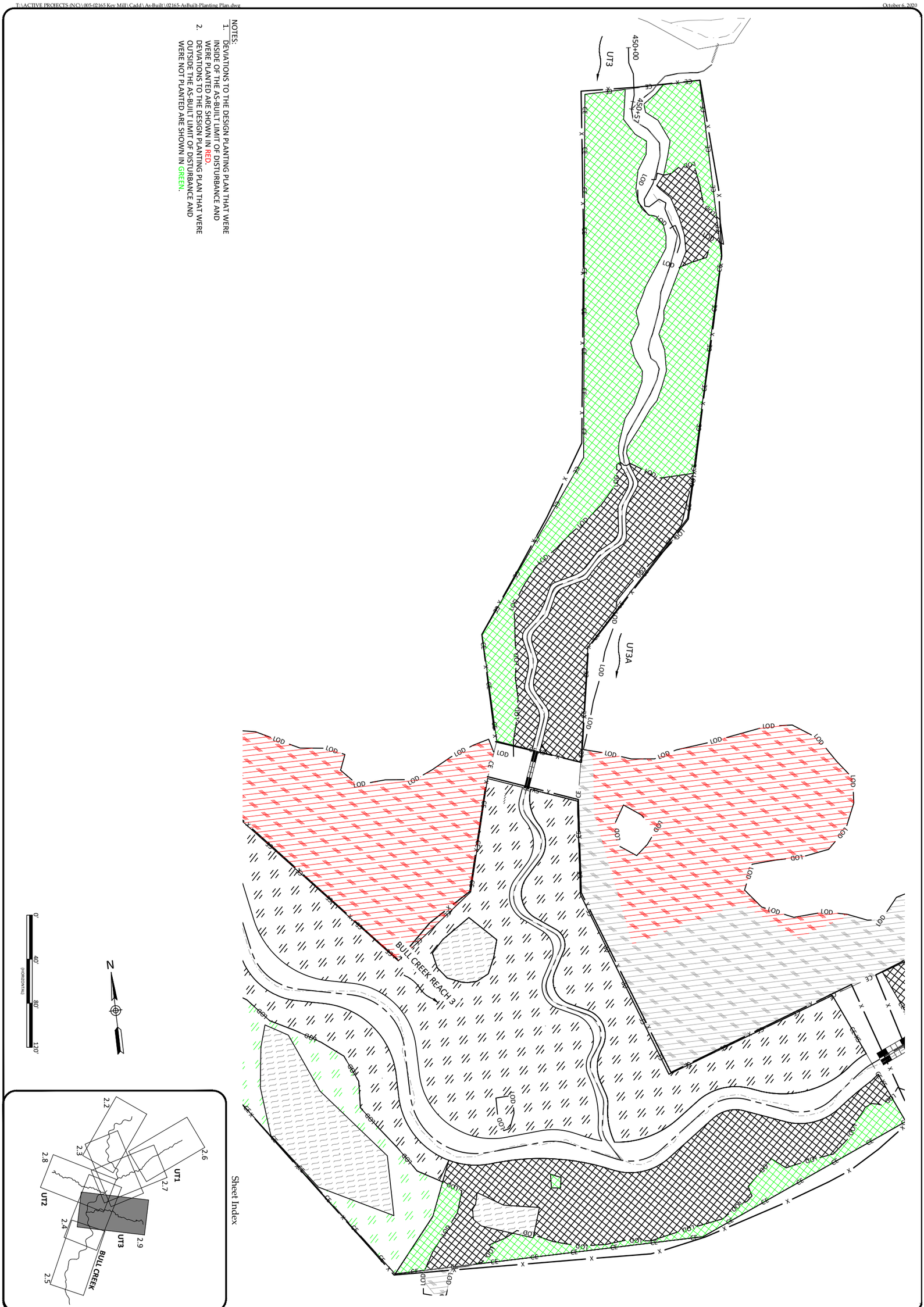

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10-01-2020

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT3
Planting Plan

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Kristi Suggs

From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Monday, June 7, 2021 3:25 PM
To: Wiesner, Paul
Cc: Reid, Matthew; Allen, Melonie; Aaron Earley; Kristi Suggs; Haywood, Casey M CIV (USA); Tugwell, Todd J CIV USARMY CESAW (USA); Davis, Erin B; Bowers, Todd; Wilson, Travis W.; Andrea Leslie (Andrea.Leslie@ncwildlife.org); Smith, Ronnie D CIV USARMY CESAW (USA); McLendon, C S CIV USARMY CESAW (USA)
Subject: RE: Notice of Adaptive Management Plan Review/ NCDMS Key Mill Mitigation Site/ Surry County/ SAW-2017-01504

Follow Up Flag: Follow up
Flag Status: Flagged

Good afternoon
The 15-day comment review period for the NCDMS Key Mill Mitigation Site Adaptive Management Plan (SAW-2017-01504) closed on June 1, 2021. Per Section 332.8(o)(9) of the 2008 Mitigation Rule, this review followed the streamlined review process. All comments received during the review process are below. DWR has some concerns with the completed AMP, particularly the construction of berms and riprap channel in the conservation easement. Although we originally discussed a site visit in fall, we would like to schedule one sooner and hold off on the credit release until after our visit. We currently have July 8, 13, 27 and 29 open.

EPA Comments, Todd Bowers:
I have reviewed the Adaptive Management Plan for the Key Mill mitigation site sponsored by Wildlands Engineering dated April 20, 2021. Following the MY1 Report it was determined that much of the site (5 acres or approximately 51%) would need supplemental planting in order to meet interim vegetation performance as much of the project was experiencing high mortality rates due to poor soil conditions, late season planting and multiple flooding events. Wildlands has proposed a reasonable approach to correct this deficiency and has recommended additional monitoring and soil amendments to ensure vegetation success. I am curious about the proposed soil amendments going only to the new bare root plantings (3 ounces to the base of each planted tree in all areas across the Site that were slated for supplemental planting). If there is a possible sitewide deficiency in soil nutrients, carbon or low cation exchange capability, what is the contingency to ensure the rest of the site remains in a trajectory towards success? Are only the areas of concern focused on the storm damage where topsoil was removed exposing poor-quality subsoils? Should we be expecting continued or excessive mortality in the areas that will not receive the soil amendments? I am all for improving the soil conditions of the areas of low stem density but will the rest of the site be able to perform as expected? I suppose this a question that can only be answered as MY2 data is collected.

I have some issues with the planting plan in Section 4.2 and the revised Sheet 2.1. Both the bare root and live stake lists do not match each other between the narrative and the revised list on Sheet 2.1. For example, the narrative in includes witch hazel, red mulberry, white oak, boxelder and are missing from this list. Southern red oak (Quercus falcata), paw paw (Asimina triloba), silver maple (Acer saccharinum), green ash (Fraxinus pennsylvanica), American holly (Ilex opaca) and American beech (Fagus granfolia (sic)) are not mentioned in the narrative for bare root plantings in Section 4.2.1. Elderberry (Sambucus canadensis) and

button bush (Cephalanthus occidentalis) are not in the narrative for live stakes in Section 4.2.2.. All the species are appropriate for the site and I don't have any issues with those chosen.

Excellent pre and post-repair photos. Only item to mention is that for consistency sake the photos should be taken from the same location. Most of the follow-up post-repair photos I saw, while generally clear, were taken from the opposite bank as the pre-repair.

Please let us know if any of the dates listed work for a site visit.
Thanks
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>
Sent: Monday, May 17, 2021 2:13 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>; Bowers, Todd <bowers.todd@epa.gov>; Youngman, Holland J <holland_youngman@fws.gov>; Twyla Cheatwood <twyla.cheatwood@noaa.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; gabriela.garrison@ncwildlife.org; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>
Cc: Wiesner, Paul <paul.wiesner@ncdenr.gov>; Reid, Matthew <matthew.reid@ncdenr.gov>; Allen, Melonie <melonie.allen@ncdenr.gov>; Aaron Earley <aearley@wildlandseng.com>; Shawn Wilkerson <swilkerson@wildlandseng.com>; Kristi Suggs <ksuggs@wildlandseng.com>; Brandon Romeo <bromeo@wildlandseng.com>; Joe Lovenshimer <jlovenshimer@wildlandseng.com>
Subject: Notice of Adaptive Management Plan Review/ NCDMS Key Mill Mitigation Site/ Surry County/ SAW-2017-01504

Good morning IRT,

The below referenced Adaptive Management Plan review has been requested by NCDMS. A copy of this AMP is attached. Per Section 332.8(o)(9) of the 2008 Mitigation Rule, this review follows the streamlined review process, which requires an IRT review period of 15 calendar days from this email notification. Please provide any comments by 5 PM on March 11, 2021. Comments provided after the 15-day comment deadline may not be considered.

At the conclusion of this comment period, a copy of all comments will be provided to NCDMS and the NCIRT along with District Engineer's intent to approve or disapprove this AMP.

Please note that the repair work has already been completed. At the Monday May 10, 2021 IRT credit release meeting, the IRT indicated that project credits proposed for release should be put on HOLD until the IRT reviews the project's AMP. The IRT additionally noted that they would like to complete a site visit in the fall of 2021 but they do not anticipate holding credits until the site visit is conducted.

*Note to IRT members: Please send comments to the USACE Mitigation Team only.

15 Day Comment Start: May 17, 2021

15-Day Comment Deadline: June 01, 2021

45-DE Decision: July 01, 2021

Project Information:

Key Mill Site

DMS Project # 100025

USACE # SAW-2017-01504

DWR # 20171045

RFP: 16-006993 – Issued 09/16/2016

Institution Date: 05/25/2017 – Full Delivery

Yadkin River Basin

Cataloging Unit 03040101

Surry County, North Carolina

Project Assets:

6,107.300 SMUs (cool)

FD Provider: Wildlands Engineering, Inc. – Contact: Aaron Earley, PE, CFM, aearley@wildlandseng.com <mailto:aearley@wildlandseng.com> Office: 704-332-7754 (x109) & Mobile: (704) 819-0848

NCDEQ - DMS PM: Matthew Reid; matthew.reid@ncdenr.gov <mailto:matthew.reid@ncdenr.gov> , (828)-231-7912

The Adaptive Management Plan - As-Built/ Record Drawings can be accessed directly on the DMS SharePoint site here:

IRT-DMS SharePoint Page:

https://ncconnect.sharepoint.com/sites/IRT-DMS/SitePages/Home.aspx <Blockedhttps://ncconnect.sharepoint.com/sites/IRT-DMS/SitePages/Home.aspx>

KeyMill_100025_AMP_May 17, 2021

KeyMill_100025_AMP_May 17, 2021.pdf <Blockedhttps://ncconnect.sharepoint.com/sites/IRT-DMS/Misc%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FIRT%2DDMS%2FMisc%20Documents%2FKeyMill%5F100025%5FAMP%5FMay%2017%2C%202021%2Epdf&parent=%2Fsites%2FIRT%2DDMS%2FMisc%20Documents>

Please contact the mitigation team if you have questions.

Thank you,

Casey

Casey Haywood

Mitigation Specialist, Regulatory Division I U.S. Army Corps of Engineers

BUILDING STRONG ®

November 23, 2021

Kim Browning
Mitigation Project Manager
Regulatory Division, U.S. Army Corp of Engineers
Kimberly.D.Browing@usace.army.mil

Subject: Adaptive Management Plan: 15-Day Record Drawing Review
Key Mill Mitigation Site, Surry County
Yadkin River Basin – HUC 03040101
DMS Project ID No. 100025 / DEQ Contract #7180

Dear Ms. Browning:

Wildlands Engineering, Inc. (Wildlands) has reviewed the 15-Day Record Drawing review comments from the NC Interagency Review Team (IRT) regarding the Key Mill Mitigation Site. All of the IRT's comments are noted below in **bold**, while Wildlands' responses to those comments are noted in *italics*.

Email received from NCIRT on 6/7/2021

EPA, Todd Bowers

EPA Comment: Following the MY1 Report it was determined that much of the site (5 acres or approximately 51%) would need supplemental planting in order to meet interim vegetation performance as much of the project was experiencing high mortality rates due to poor soil conditions, late season planting and multiple flooding events. Wildlands has proposed a reasonable approach to correct this deficiency and has recommended additional monitoring and soil amendments to ensure vegetation success. I am curious about the proposed soil amendments going only to the new bare root plantings (3 ounces to the base of each planted tree in all areas across the Site that were slated for supplemental planting). If there is a possible sitewide deficiency in soil nutrients, carbon or low cation exchange capability, what is the contingency to ensure the rest of the site remains in a trajectory towards success? Are only the areas of concern focused on the storm damage where topsoil was removed exposing poor-quality subsoils? Should we be expecting continued or excessive mortality in the areas that will not receive the soil amendments? I am all for improving the soil conditions of the areas of low stem density but will the rest of the site be able to perform as expected? I suppose this a question that can only be answered as MY2 data is collected.

Wildlands' response: In the past, Wildlands has found that broadcasting soil amendments throughout a large area over fertilizes the weeds and dilutes their effectiveness where the nutrients are needed, whereas, focusing those amendments on the targeted areas allows for better woody growth and success. Additionally, broadcasted amendments are more susceptible to washing away during storm events; thereby, creating conditions similar to those being corrected.

EPA Comment: I have some issues with the planting plan in Section 4.2 and the revised Sheet 2.1. Both the bare root and live stake lists do not match each other between the narrative and the revised list on Sheet 2.1. For example, the narrative in includes witch hazel, red mulberry, white oak, boxelder and are missing from this list. Southern red oak (Quercus falcata), paw paw (Asimina triloba), silver maple (Acer saccharinum), green ash (Fraxinus pennsylvanica), American holly (Ilex opaca) and American beech (Fagus granfolia (sic)) are not mentioned in the narrative for bare root plantings in Section 4.2.1. Elderberry (Sambucus canadensis) and button bush (Cephalanthus occidentalis) are not in the narrative for live stakes in Section 4.2.2. All the species are appropriate for the site and I don't have any issues with those chosen.

Wildlands' response: The species listed in Section 4.2.1 Bare Root Plantings and Section 4.2.2 are the species that were planted as part of the Site's Adaptive Management Plan (AMP) and correlate with Tables 4 and 5 in Appendix 3. Species listed on the Planting Sheet 2.1 in Appendix 4 are the approved planted species and revisions from the Site's Baseline Conditions Record Drawings established at Monitoring Year (MY) 0.

EPA Comment: Excellent pre and post-repair photos. Only item to mention is that for consistency sake the photos should be taken from the same location. Most of the follow-up post-repair photos I saw, while generally clear, were taken from the opposite bank as the pre-repair.

Wildlands' response: Thank you for that comment and in the future Wildlands will make sure to provide photos taken from the same locations whenever possible for consistency.

Please contact me at 704-332-7754 if you have any questions.

Sincerely,

Aaron Earley, PE, CFM
Project Manager
aearley@wildlandseng.com

APPENDIX 7. IRT Credit Release Site Walk (MY1)

WILDLANDS ENGINEERING

MEETING MINUTES

MEETING:	IRT Credit Release Site Walk (MY1) Key Mill Mitigation Site DMS Project No. 100025 USACE Action ID No. SAW-2017-01504 NCDEQ DWR Certification No. 17-1045
MEETING DATE:	July 13, 2021
LOCATION:	Key Road Ararat, NC

Attendees:

- Aaron Earley, Wildlands Project Manager
- Casey Haywood, USACE Mitigation Specialist
- Erin Davis, NC IRT for DWR
- Matthew Reid, NC DMS Project Manager
- Paul Wiesner, NC DMS Western Regional Supervisor
- Sam Kirk, Wildlands Stewardship Lead
- Shawn Wilkerson, Wildlands Principal
- Todd Tugwell, USACE Mitigation Project Manager
- Travis Wilson, NC WRC Eastern NCDOT Permit Coordinator

Attendees met at Key Road.

1. Aaron gave an introduction to the site and explained history of flooding and repairs during and after construction. Multiple large storm events (5-year to 25-year return interval) between February 2020 and October 2020 resulted in damages to the channel and washed away topsoil and seed.
2. Todd asked why repairs were made prior to AMP submittal. Aaron said that the draft guidance was relatively new at the time and Wildlands did the best they could based on contractor availability and timing planting season. Wildlands understands the reason for AMP and will adhere to protocol for future sites.
3. Erin asked about the reasons for low stem density. Aaron responded that it was a combination of planting later in the season and poor soil conditions due to the topsoil being washed away by the numerous floods.

4. Todd asked what other measures were considered instead of rock lined toe. Aaron responded that brush toe was previously installed multiple times and kept getting washed away during the multiple out-of-bank storm events. Due to the lack of good soil, Wildlands decided to use rock toe to help hold the banks in place.

Attendees walked upstream to look at Bull Creek Reaches 1 & 2 and UT1.

5. It was noted that baseflow was piping under the log sill downstream of the culvert crossing on UT1 (STA 211+40). The log appeared to be installed at the right elevation to back water into the culvert.
6. On Bull Creek (STA 106+35 – 115+10), rock was added along the toe of multiple riffles and pools. This was not part of the mitigation plan. The size (Class 1) of the rock is too large and it was placed on the banks instead of being incorporated into the bank.
7. Erin noted that the live stakes on some banks had low survival rates.
8. The berm along the downstream side of the floodplain outlet at STA 113+00 is too high. It would intercept and direct floodplain flows back into the channel at a discreet location.
9. The brush toe logs in the meander bend at STA 112+25 seemed to be too large, set too high, and lacked smaller brush material.
10. The right floodplain elevation on Bull Creek between STA 109+50 and 112+60 was constructed 0.5' – 1.0' too high while the left floodplain is at grade. This section of channel appears to be stable.

Attendees walked downstream to look at Bull Creek Reaches 3 & 4.

11. Travis noted the cattails in the wetland pocket near Bull Creek STA 155+50 left floodplain.
12. On Bull Creek (STA 160+70 – 165+60), rock was added along the toe of multiple riffles. Similar to item 6, this was not in the mitigation plan and size and placement were concerning.
13. The berm and multiple rock-lined floodplain outlets installed in the left floodplain of Bull Creek (STA 160+60 – 166+00) is preventing diffuse flow across the vegetated buffer. The length of rock placement in the floodplain outlets was considered too extensive. Travis noted the size of the rock in the floodplain outlet at STA 163+00 was too large for turtles.
14. Erin noted the presence of privet along the Bull Creek woodline (STA 160+50 – 167+56).

Action Items

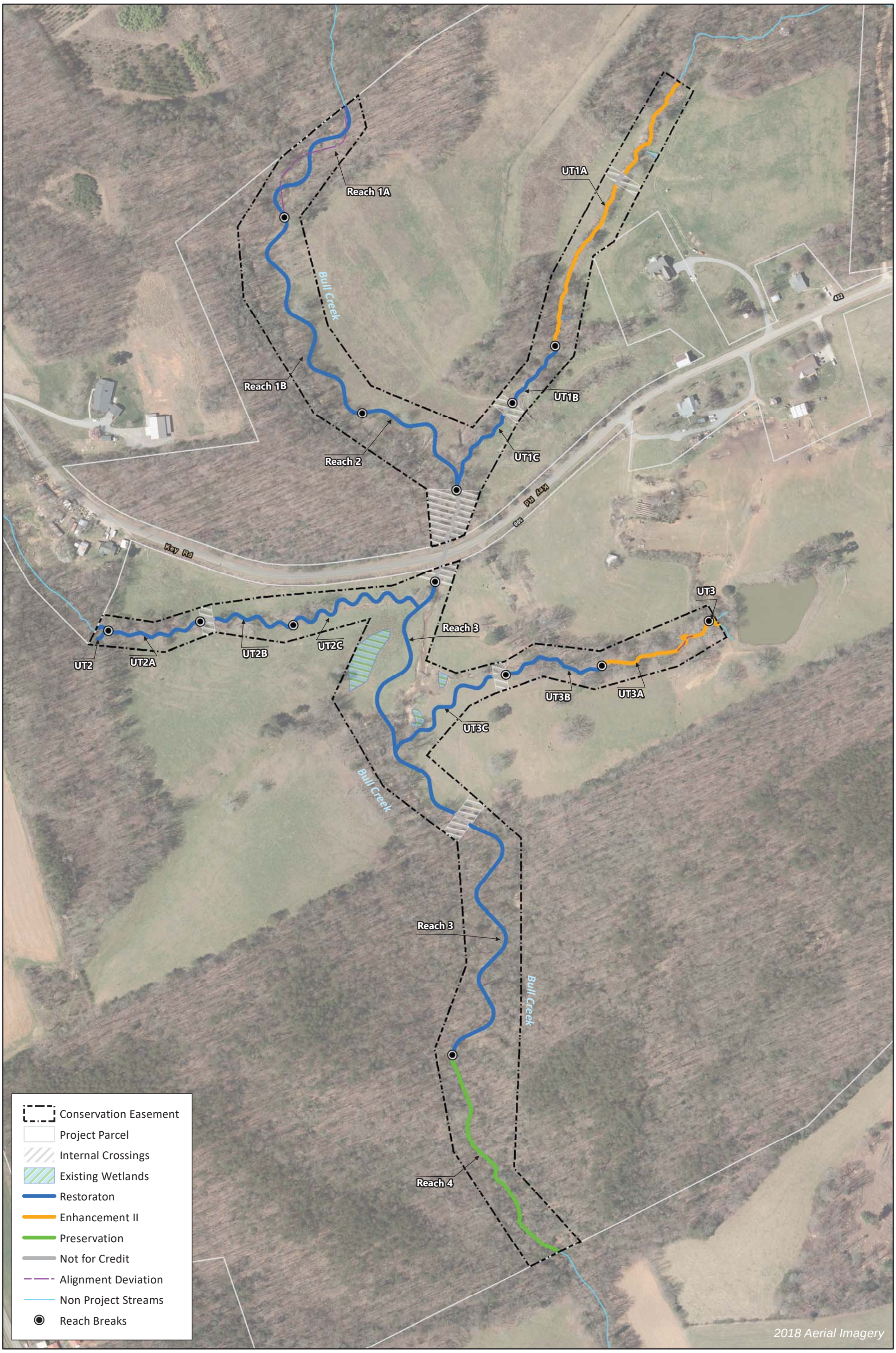
Attendees agreed that the items in Table 1 need to be completed by MY2 to bring the site back into compliance and release credits. If the items are satisfactorily addressed by MY2, then no additional monitoring years will be required. Please refer to the attached plans for locations and stations.

Table 1: Action Items

Item	Description	Action
A1	UT1 STA 211+40 Piping under log sill.	Reset log sill to prevent piping.
A2	Rock-lined outer meander bends on Bull Creek STA 106+35 – 115+10.	Remove rock placed on outer meander bends and replace with brush toe or proper rock toe with geolift.

A3	Sections of low live stake survival rate.	Ongoing live stake planting where survival rate is low.
A4	Raised berm along floodplain outlet at Bull Creek STA 113+00.	Remove berm to allow floodplain flow to flow down-valley unimpeded.
A5	Cattails present in wetland pocket at Bull Creek STA 115+50.	Treat cattails throughout the site to prevent spread and colonization.
A6	Parallel berm along Bull Creek STA 106+60 – 166+00.	Remove parallel berm to allow diffuse sheet flow across vegetated buffer.
A7	Extensive length of rock in floodplain outlets along Bull Creek 106+60 – 166+00.	Remove rock from upper section of floodplain outlet. Stabilize with juncus transplants and/or matting.
A8	Privet along Bull Creek woodline STA 160+50 – 167+56.0.	Ongoing invasive treatments to include privet.
A9	Multiple rock-lined riffles banks on Bull Creek STA 106+35 – 165+60.	The rock toe added to the riffles will be left in place and jointed planted with juncus and willows. Riffles will be reevaluated in MY3. If the rock does not incorporate into the banks (soil & veg within voids, sink into banks), then Wildlands will address at that time or a discussion will be held regarding a credit adjustment.

Attachments
Project Component/Asset Map
IRT Credit Release Site Walk Action Plan Set



WILDLANDS ENGINEERING

0 250 500 Feet

Figure 2 Project Component/ Asset Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 1 - 2020
Surry County, NC

Key Mill Mitigation Site - Record Drawings

Surry County, North Carolina
Yadkin River Basin HUC 03040101
for
NCDEQ
Division of Mitigation Services

IRT Credit Release Site Walk
Action Plan
July 13, 2021

Adaptive Management Plan - As-built/Record Drawings - 2021

Surry County, NC

Vicinity Map
Not to Scale

Record Drawings
August 27, 2020

CERTIFICATE OF SURVEY AND ACCURACY

I, PHILLIP B. KEE, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION; THAT THE RECORD DRAWINGS WERE PREPARED BY WILDLANDS ENGINEERING, INC. FROM DIGITAL FILES PROVIDED BY KEE MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "KEY MILL MITIGATION SITE AREA A-WEST & AREA B-EAST", JOB #190870-AB, DATED 01/31/20 (AREA A-WEST) & 07/23/20 (AREA B-EAST); THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS AND TO MEET THE REQUIREMENTS OF A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAINED BETWEEN THE DATES OF 09/30/19-10/18/19 (AREA A-WEST) & 04/28/20-06/04/20 (AREA B-EAST); THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD AND ALL COORDINATES ARE BASED ON NAD 83 (NSRS 2011) AND ALL ELEVATIONS ARE BASED ON NAVD 88; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS AS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, LICENSE NUMBER, AND SEAL THIS 6TH DAY OF OCTOBER, 2020, A.D.

NORTH CAROLINA PROFESSIONAL SEAL L-4647 LAND SURVEYOR PHILLIP B. KEE

DocuSigned by:
Phillip B. Kee
D0650044A7007437

PHILLIP B. KEE, PLS L-4647

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
1430 S. Mint St., Ste. 104
Charlotte, NC 28203
Aaron Earley, PE, CFM
704-332-7754

Surveying:
Kee Mapping & Surveying
Box P.O. 2566
Asheville, NC 28802
Phillip B. Kee, PLS
828-575-9021

Owner:
NCDEQ
Division of Mitigation Services
5 Ravenscroft Drive, Ste 102
Asheville, NC 28801
Matthew Reid
919-707-8976

DMS Project no. 100025

Yadkin River Basin HUB 03040101

USACE Action ID: SAW-2017-01504

WILDLANDS ENGINEERING
1430 S. Mint Street, Ste 104
Charlotte, NC 28203
Tel: 704.332.7754
Fax: 704.332.3306
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 023434 ENGINEER AARON S. EARLEY 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Title Sheet

Revisions: 10/06/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.1

Existing Features

- Pre-Construction Property Line
- Pre-Construction Overhead Electric (OHE)
- Pre-Construction Power Pole
- Pre-Construction Tree
- Pre-Construction Pond

Design Features

- Design Thalweg Alignment (10+00)
- Design Major Contour (100)
- Design Minor Contour
- Design Terracell 140 Cattle Crossing
- Design Road over Culvert
- Design Various Constructed Riffles Per Plans
- Design Brush Toe
- Design Sod Mat
- Design Brush Mattress
- Design Boulder Toe
- Design Log Sill
- Design Log J-Hook
- Design Boulder J-Hook
- Design Log Vane
- Design Rock Sill
- Design Cover Log
- Design Rock Vane
- Design Lunker Log

As-Built Features

- As-Built Thalweg Alignment
- As-Built Bankfull
- As-Built Major Contour (100)
- As-Built Minor Contour
- As-Built Limits of Disturbance (LOD)
- As-Built Culvert
- As-Built Fencing (x)
- Recorded Conservation Easement (CE)
- Recorded Internal Crossing at Conservation Easement (CS-XS)
- As-Built Various Constructed Riffles Per Plans
- As-Built Brush Toe
- As-Built Boulder Toe / Riprap
- As-Built Log Sill
- As-Built Log Vane
- As-Built Rock Sill
- As-Built Log J-Hook

Monitoring Features

- Permanent Cross Section
- Vegetation Plot (VEG / VP#)
- PP# Photo Point
- CG# Crest Gage
- SG# Stream Gauge
- BT Barotroll

Repair Features

Repair areas/items are outlined with a red polygon and the type of repair and when it was conducted is denoted in a call out box.

Repair issue

Notes:

1. Deviations from Design will be shown in Red.
2. Both the As-Built surveyed thalweg alignment and Design Centerline are depicted in this plan set.
3. The Design Centerline stationing is used for the profiles as well as project credit stationing.
4. Pre-construction topography by Kee Mapping and Surveying March 16, 2018.
5. Boundary survey by Kee Mapping and Surveying June 1, 2018.
6. As-built survey west of Key Road November 1, 2019.
7. As-built survey east of Key Road June 9, 2020.

WILDLANDS ENGINEERING
1430 S. Mint Street, Ste 104
Charlotte, NC 28203
Tel: 704.332.7754
Fax: 704.332.3306
Firm License No. P-0831

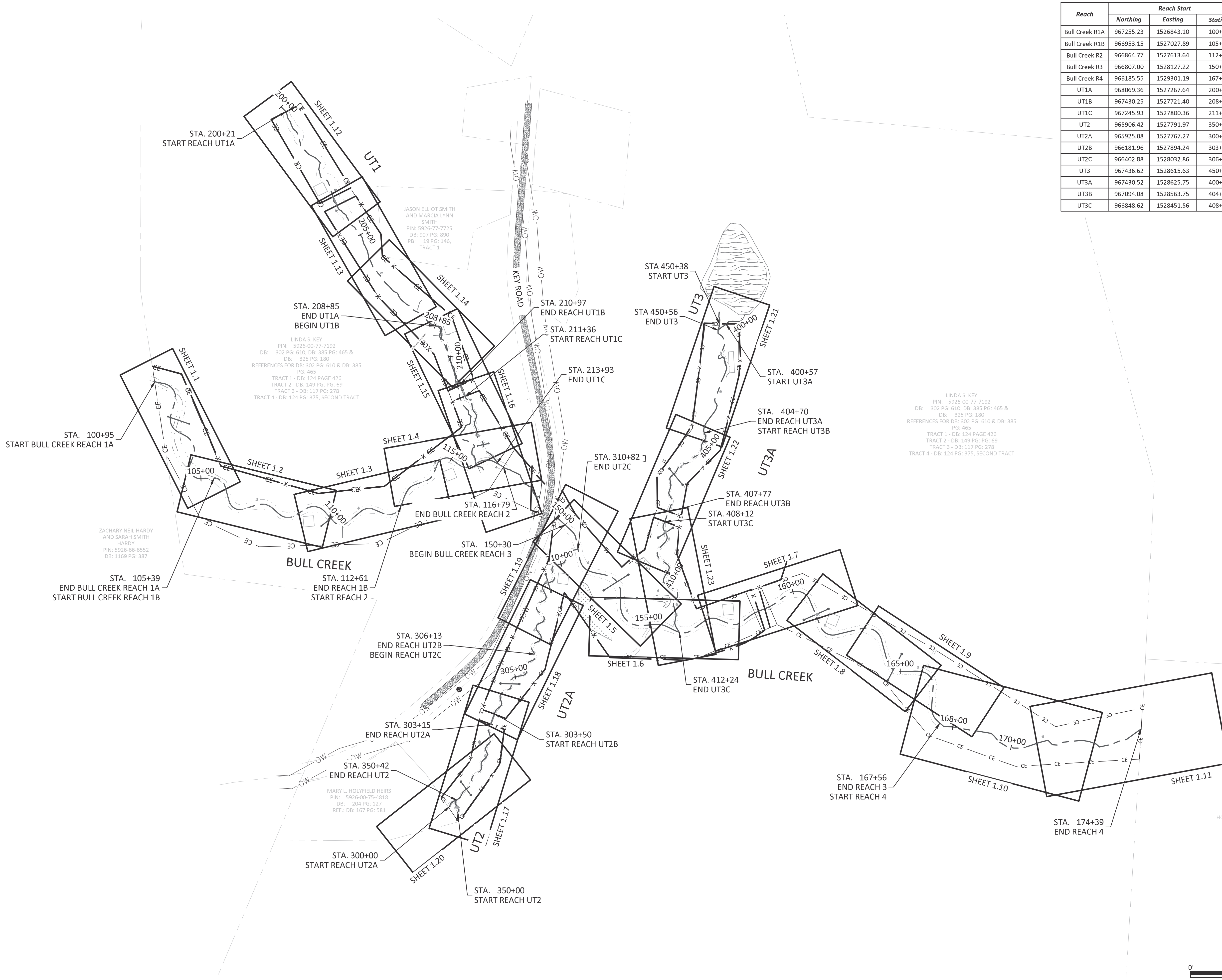
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 029349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
General Notes and Legend

Revisions:

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.2



Reach	Reach Start			End Station	Type of Mitigation
	Northing	Easting	Station		
Bull Creek R1A	967255.23	1526843.10	100+95	105+39	Restoration
Bull Creek R1B	966953.15	1527027.89	105+39	112+61	Restoration
Bull Creek R2	966864.77	1527613.64	112+61	116+79	Restoration
Bull Creek R3	966807.00	1528127.22	150+30	167+56	Restoration
Bull Creek R4	966185.55	1529301.19	167+56	174+39	Preservation
UT1A	968069.36	1527267.64	200+21	208+85	Enhancement II
UT1B	967430.25	1527721.40	208+85	210+97	Restoration
UT1C	967245.93	1527800.36	211+36	213+93	Restoration
UT2	965906.42	1527791.97	350+00	350+42	Restoration
UT2A	965925.08	1527767.27	300+00	303+15	Restoration
UT2B	966181.96	1527894.24	303+50	306+13	Restoration
UT2C	966402.88	1528032.86	306+13	310+82	Restoration
UT3	967436.62	1528615.63	450+38	450+56	Enhancement II
UT3A	967430.52	1528625.75	400+57	404+70	Enhancement II
UT3B	967094.08	1528563.75	404+70	407+77	Restoration
UT3C	966848.62	1528451.56	408+12	412+24	Restoration

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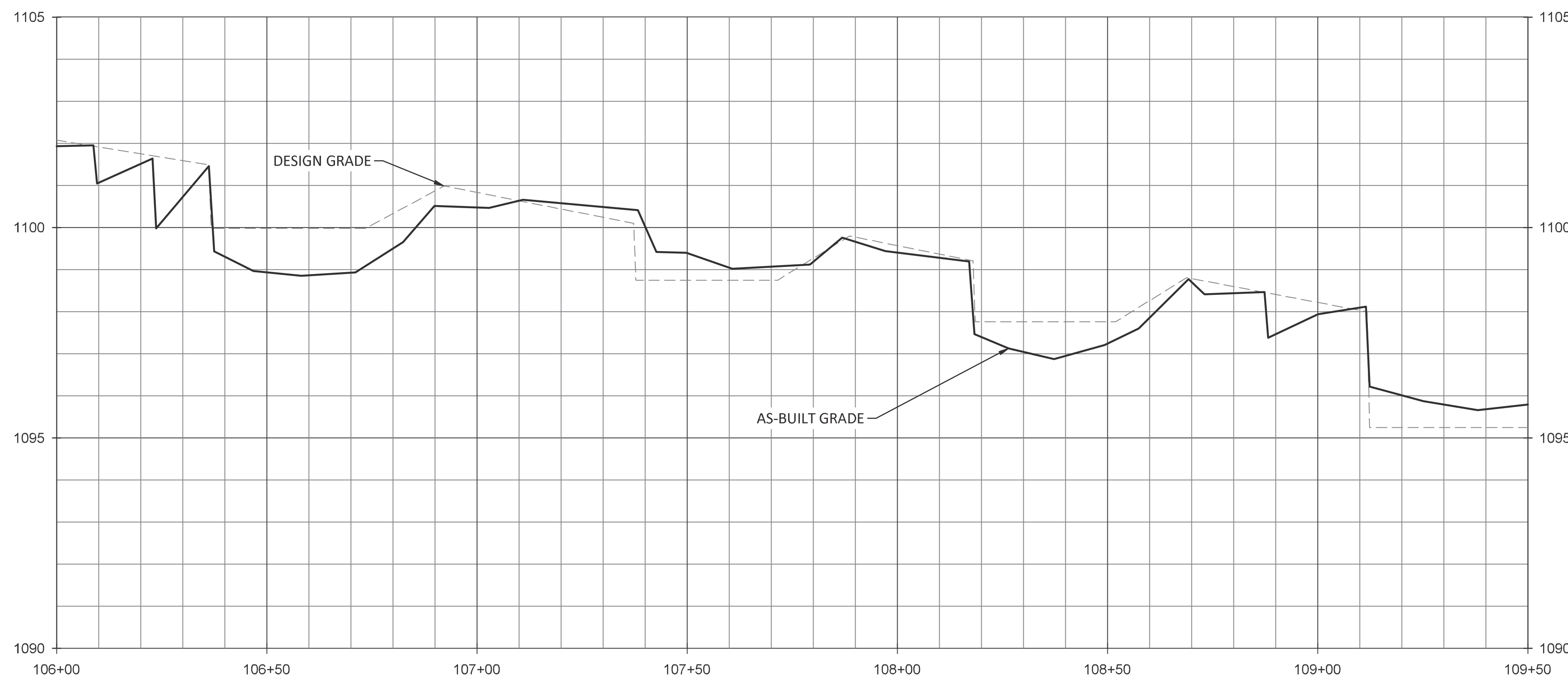
Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Project Overview

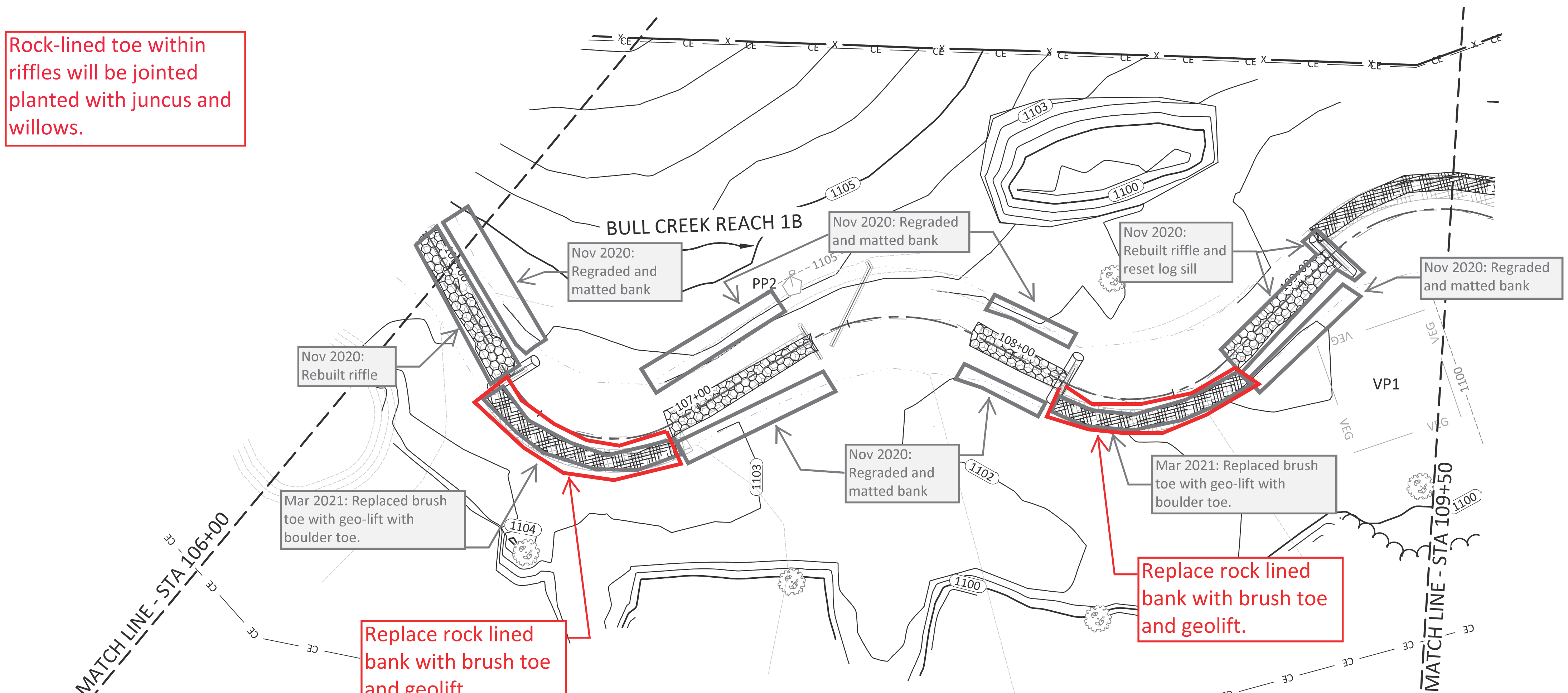
Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

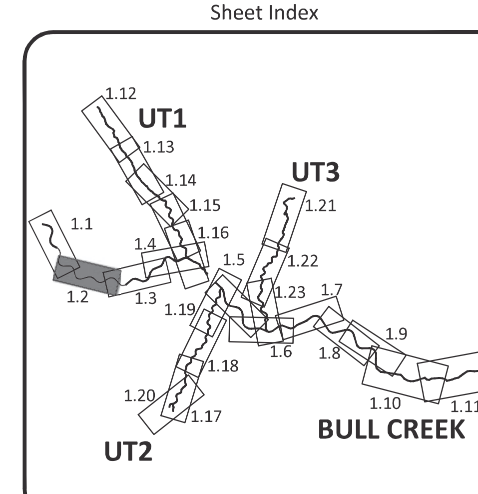
Sheet 0.3



NOTE:
1. STA. 107+40: THE LOG SILL AND LOG VANE WERE OMITTED DUE TO PRESENCE OF BEDROCK.



Sheet Index



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Fax: 704.332.3306
Firm License No. F-0831

Key Mill Mitigation Site - Record Drawings

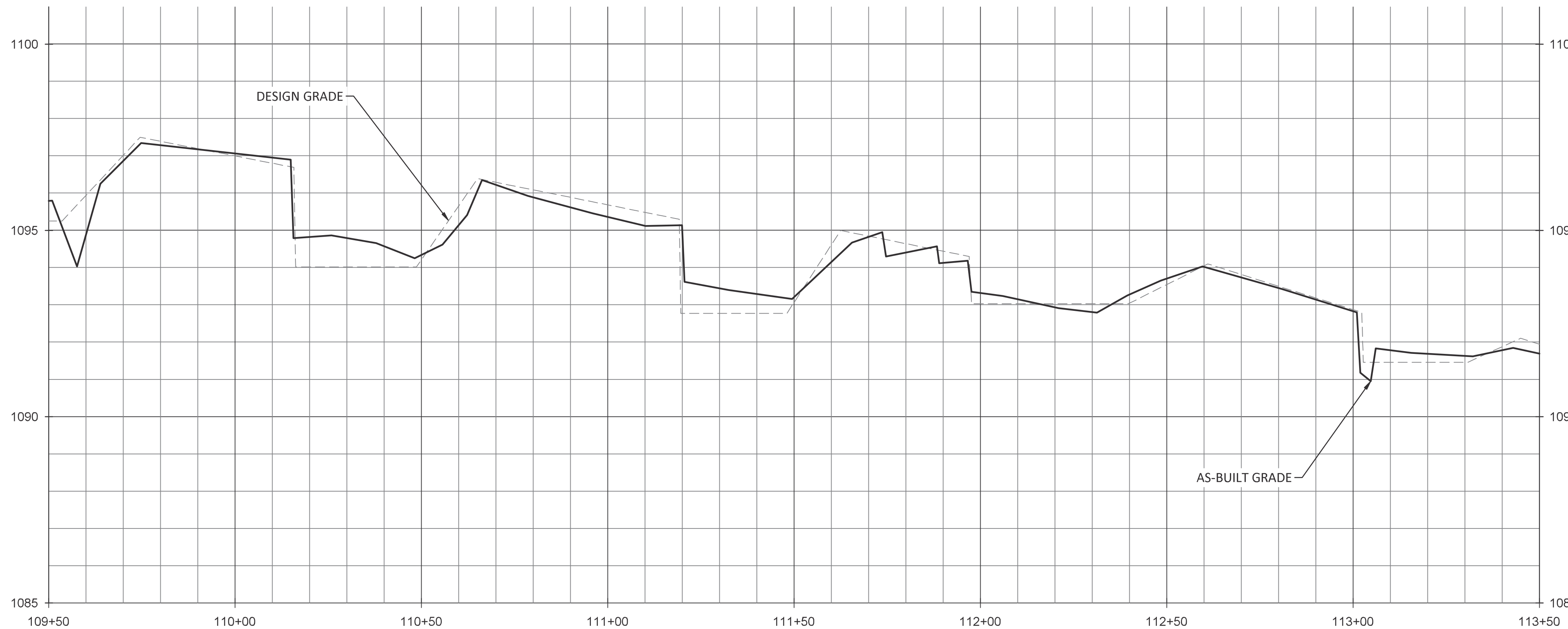
Surry County, North Carolina

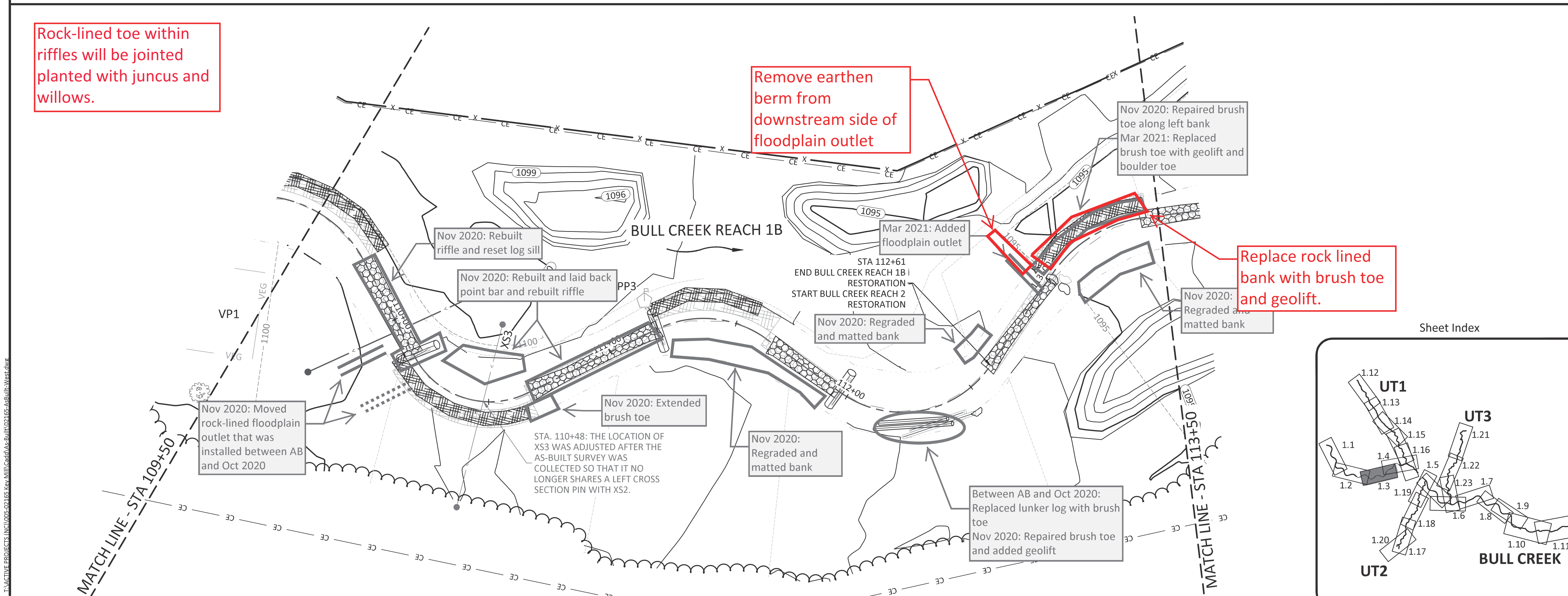
Bull Creek Reach 1B
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.2





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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1B
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
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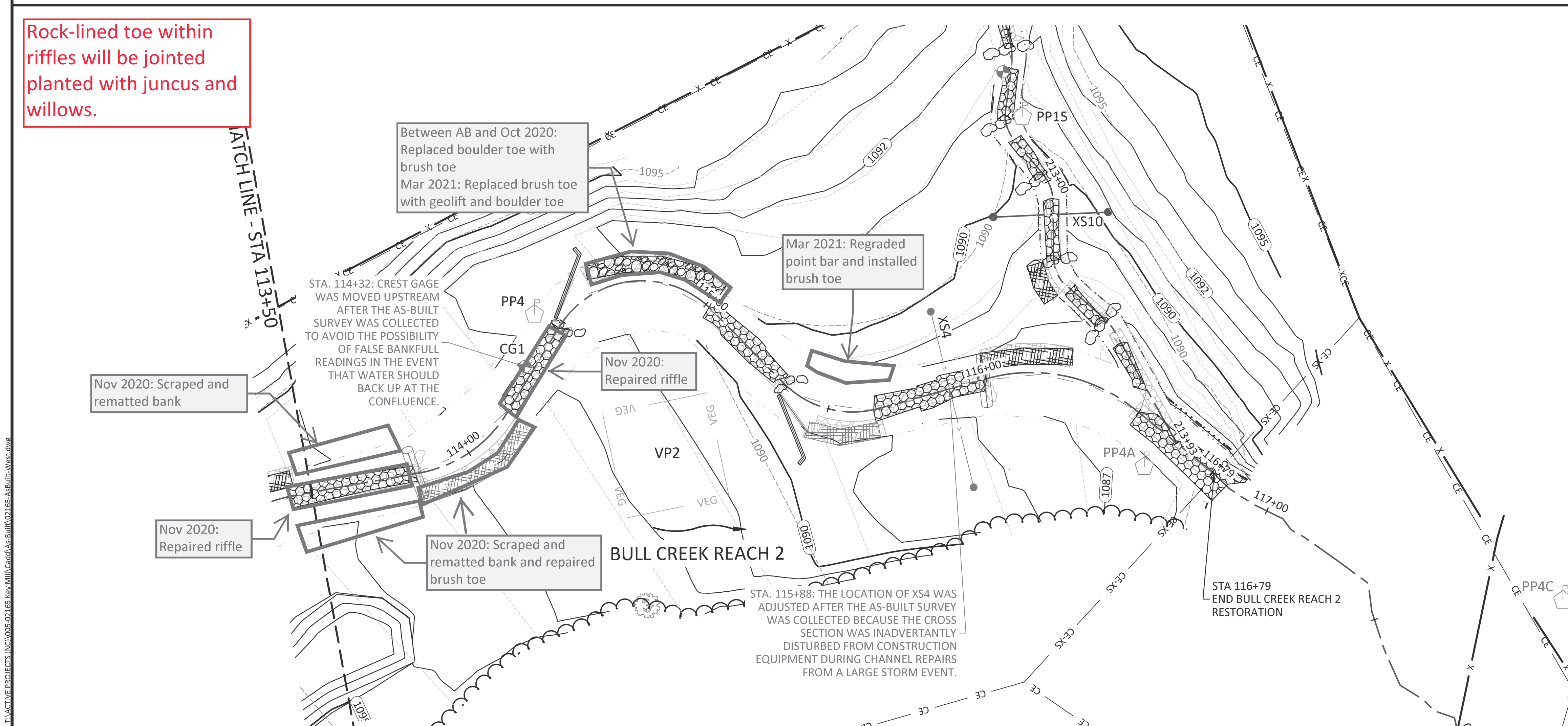
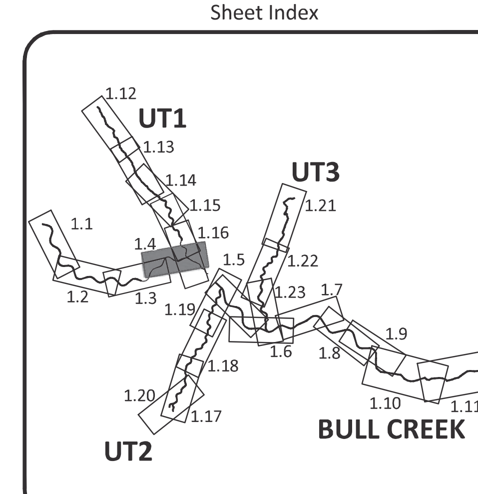
Sheet 1.3



NOTES:

1. STA. 113+80: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
2. STA. 113+85: BRUSH TOE WAS SUBSTITUTED FOR BRUSH MATTRESS DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
3. STA. 115+45: BRUSH TOE WAS SUBSTITUTED FOR BOULDER TOE DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
4. STA. 116+00: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
5. STA. 116+62: PHOTO POINT 4A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE THE CONSERVATION EASEMENT BREAK.

Sheet Index



0' 2' 4' 6' (VERTICAL)

0' 20' 40' 60' (HORIZONTAL)

N

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Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028347 AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

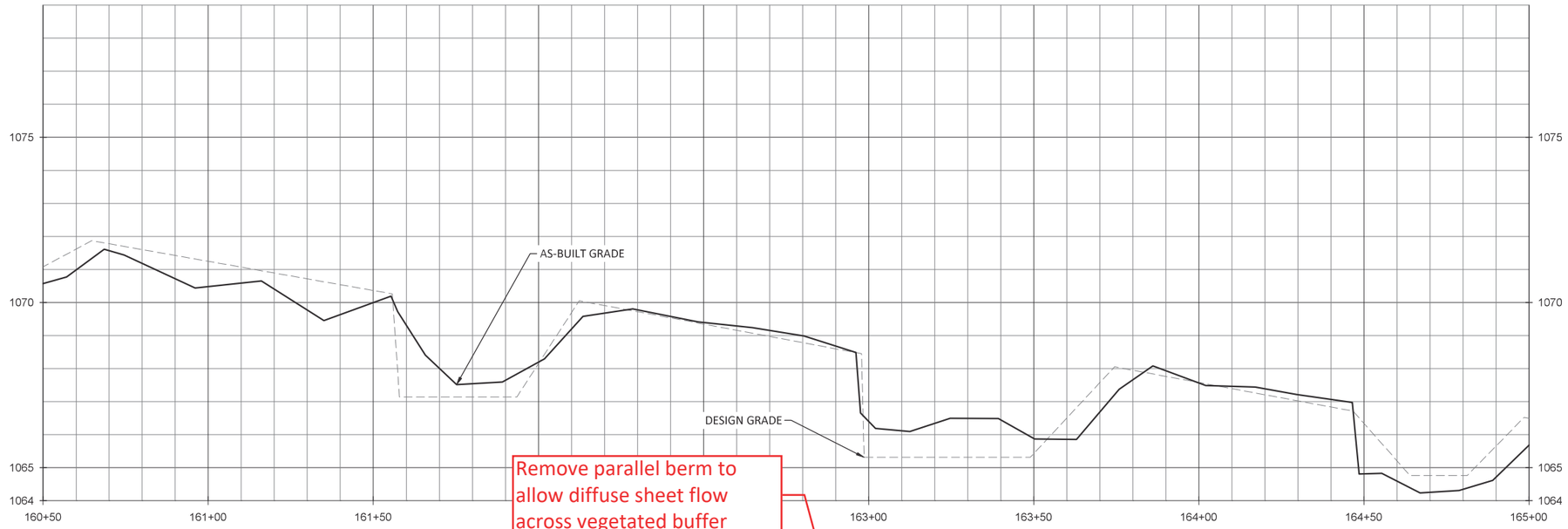
Bull Creek Reach 2
Stream Plan and Profile

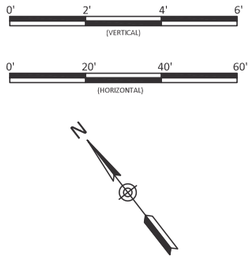
Revisions: 09/29/2020

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

Sheet 1.4

October 6, 2020





Remove parallel berm to allow diffuse sheet flow across vegetated buffer

Rock-lined toe within riffles will be jointed planted with juncus and willows.

Mar 2021: Constructed a vegetated berm from approx. STA 161+60 - 166+00 to divert overland runoff into stabilized rock-lined swales and outlets

Mar 2021: Repaired brush toe and added geo-lift

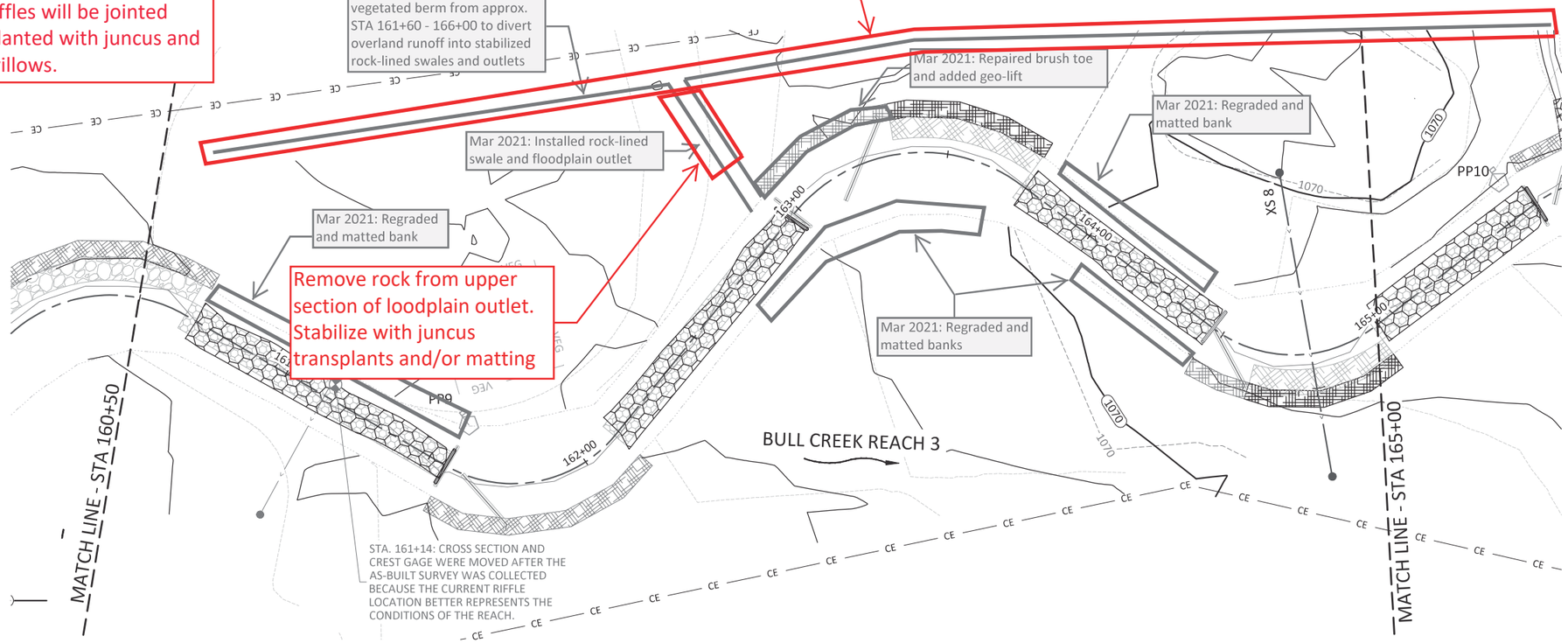
Mar 2021: Regraded and matted bank

Mar 2021: Installed rock-lined swale and floodplain outlet

Mar 2021: Regraded and matted bank

Remove rock from upper section of loodplain outlet. Stabilize with juncus transplants and/or matting

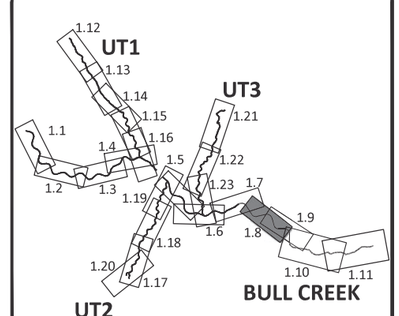
Mar 2021: Regraded and matted banks



STA. 161+14: CROSS SECTION AND CREST GAGE WERE MOVED AFTER THE AS-BUILT SURVEY WAS COLLECTED BECAUSE THE CURRENT RIFFLE LOCATION BETTER REPRESENTS THE CONDITIONS OF THE REACH.

NOTE:
1. STA. 161+56: LOG VANE REMOVED AND BRUSH TOE ADDED TO OUTSIDE BANK TO IMPROVE STABILITY FOR THE ENTIRE OUTSIDE BANK.
2. STA. 163+30: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND TO IMPROVE STREAM BANK STABILITY AND HABITAT.
3. STA. 164+47: LOG VANE REMOVED, LOG SILL ADDED AND BRUSH TOE EXTENDED DUE TO LOCAL AVAILABILITY OF MATERIALS AND TO IMPROVE CHANNEL STABILITY AND HABITAT.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

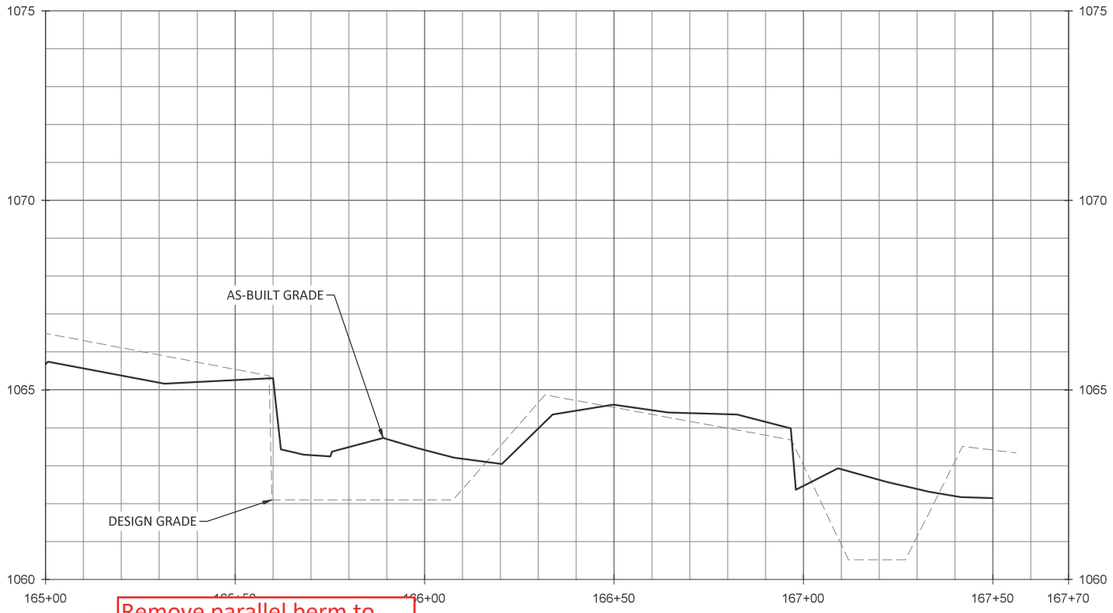
Bull Creek Reach 3
Stream Plan and Profile

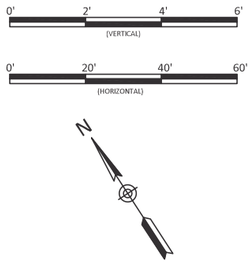
Revisions:	09/29/2020
Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

Sheet 1.8

T:\ACTIVE PROJECTS\NCY\005-02165\Key Mill\CadAA-Built\02165-AsBuiltFeatures

October 6, 2020





Rock-lined toe within riffles will be jointed planted with juncus and willows.

Remove parallel berm to allow diffuse sheet flow across vegetated buffer

Mar 2021: Constructed a vegetated berm from approx. STA 161+60 - 166+00 to divert overland runoff into stabilized rock-lined swales and outlets

Between AB and Oct 2020: Installed rock-lined swale and outlet in floodplain

Remove rock from upper section of floodplain outlet. Stabilize with juncus transplants and/or matting

Mar 2021: Regraded and matted bank

Remove rock from upper section of floodplain outlet. Stabilize with juncus transplants and/or matting

XS 8

PP10

MATCH LINE - STA 165+00

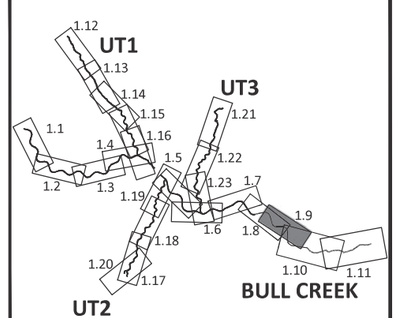
MATCH LINE - STA 167+70

BULL CREEK REACH 3

STA. 167+56
END BULL CREEK REACH 3 RESTORATION
START BULL CREEK REACH 4 PRESERVATION

NOTE:
1. STA. 165+75: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND THE IMPROVED HABITAT PROVIDED BY BRUSH TOE.
2. STA. 166+97: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
3. STA. 167+00: BRUSH TOE WAS ADDED TO IMPROVE BANK STABILITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 029349 ENGINEER AARON S. ERVIN
10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 3
Stream Plan and Profile

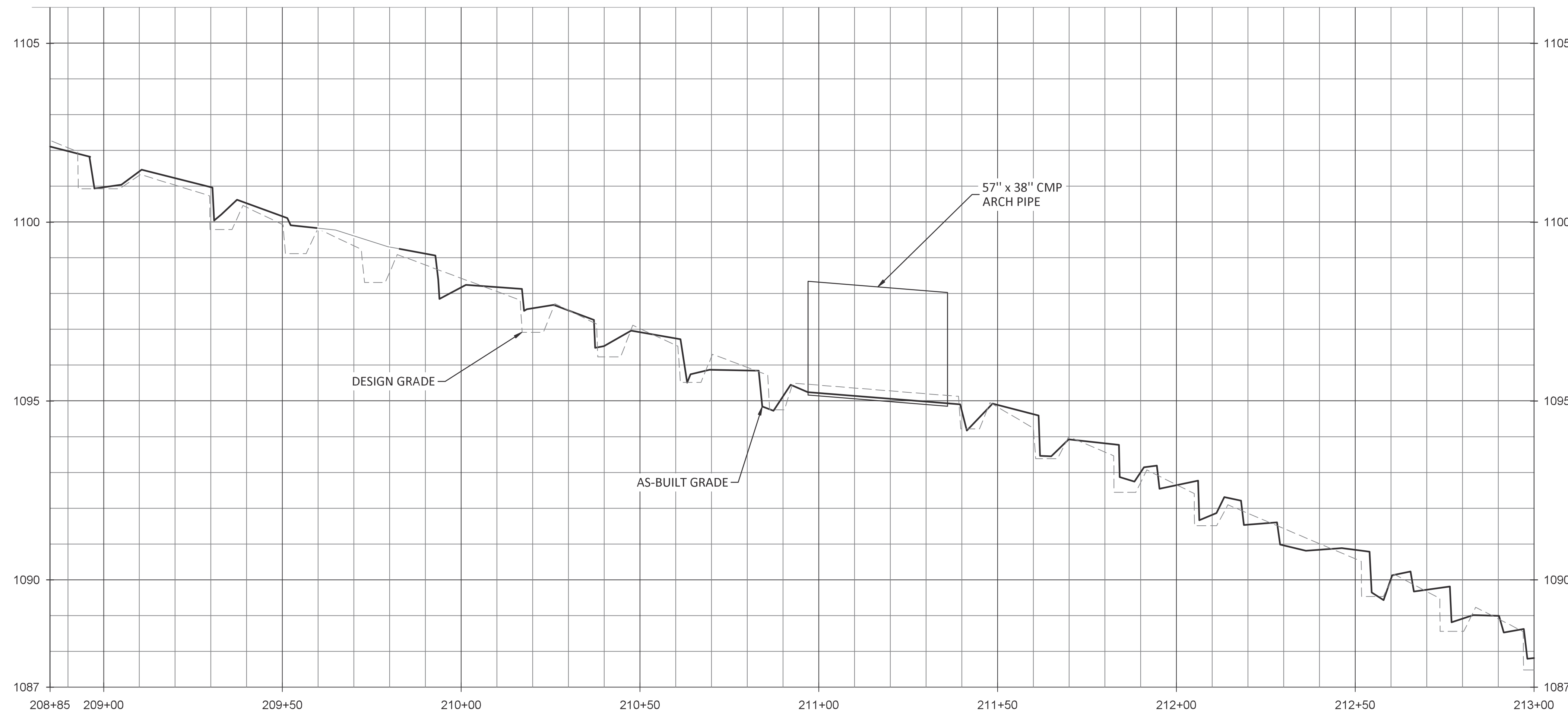
Revisions:
09/29/2020

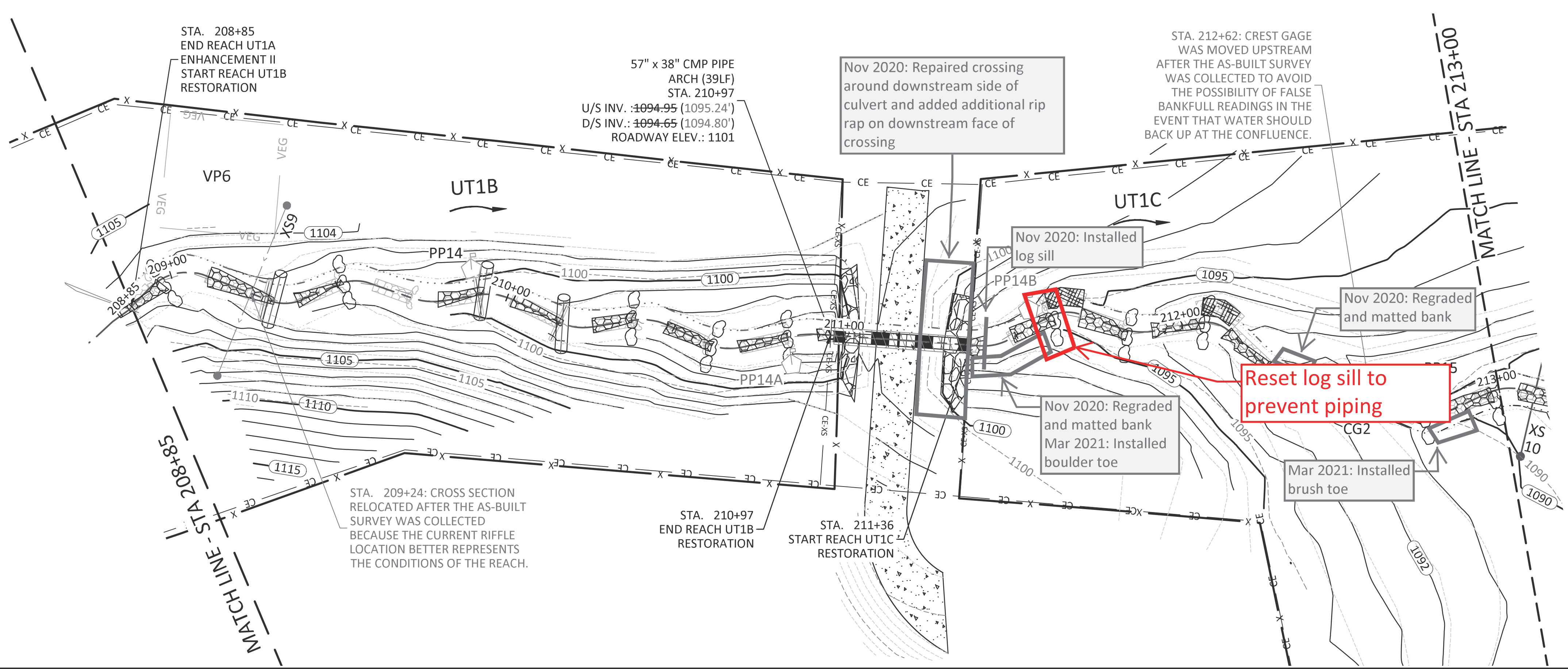
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.9

T:\ACTIVE PROJECTS\005\02165\Key Mill\Credit\As-Built\02165-AsBuilt.dwg

October 6, 2020

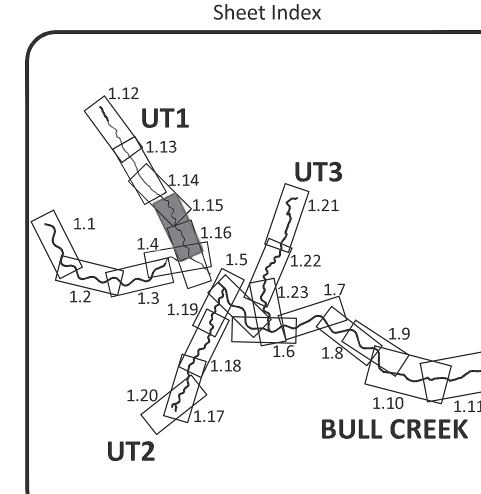




NOTE:

1. STA. 209+65: RIFFLE, ROCK SILL AND POOL WERE OMITTED DUE TO SUFFICIENT STABILITY AND SLOPE ON THE REACH.
2. STA. 210+83: PHOTO POINT 14A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 211+57: PHOTO POINT 14B WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
4. STA. 212+35: UPSTREAM ROCK AND ROLL RIFFLE BOULDER SILL WAS OMITTED AND RIFFLE WAS EXTENDED TO CONNECT TO DOWNSTREAM ROCK AND ROLL RIFFLE.

Sheet Index



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Key Mill Mitigation Site - Record Drawings

Surry County, North Carolina

UT1B

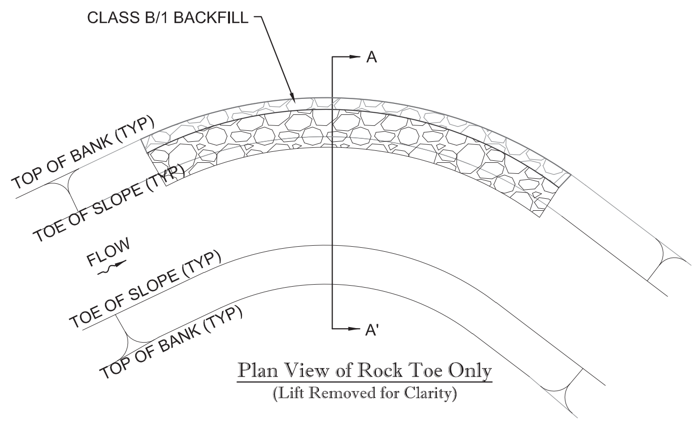
Stream Plan and Profile

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

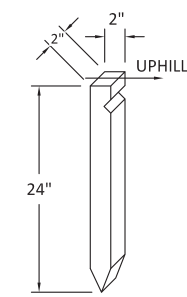
Revisions: 09/29/2020

Sheet 1.15

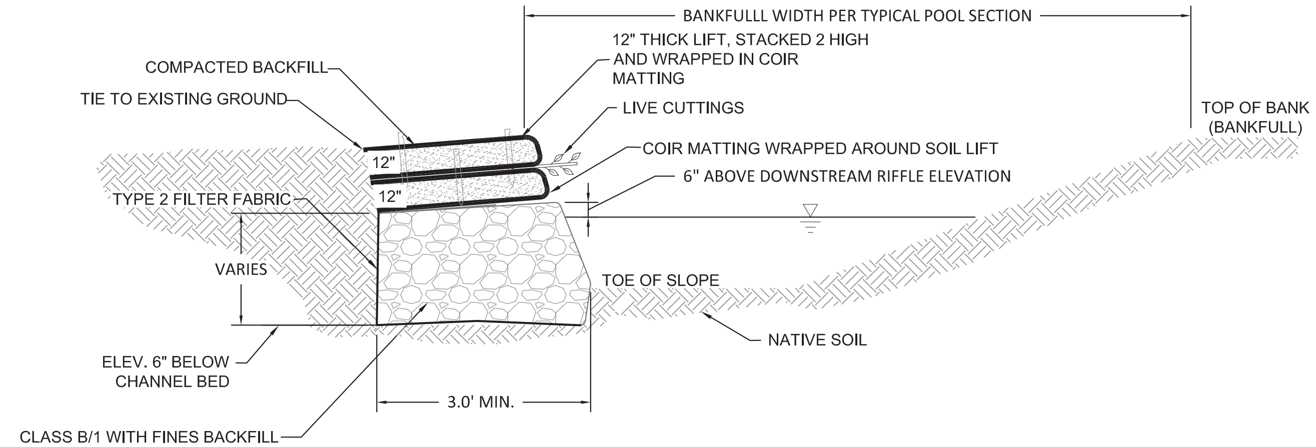
T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\CadD\As-Built\02165_AsBuilt-West.dwg



Plan View of Rock Toe Only
(Lift Removed for Clarity)



Typical Stakes

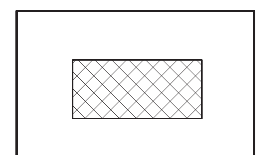


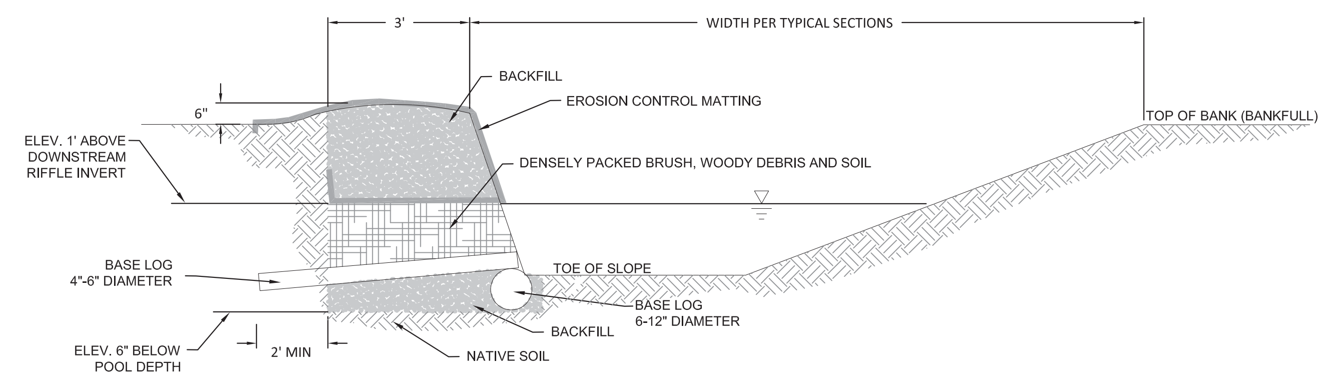
Section View

Rock Toe with Geolift

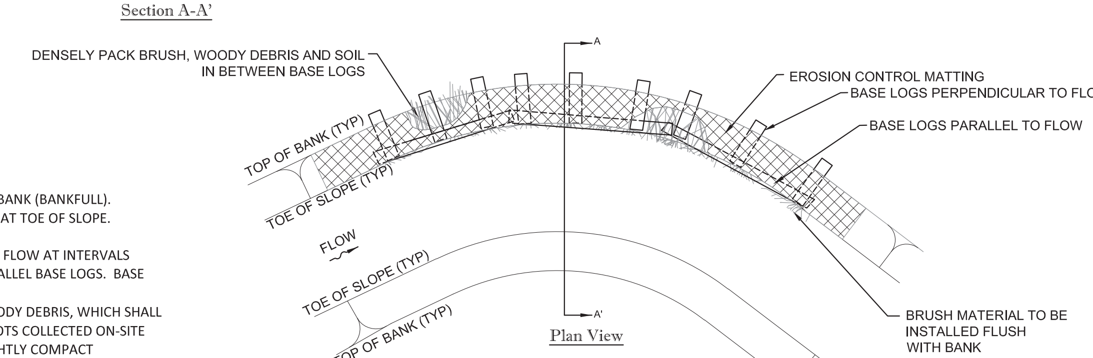
1 / 6.4 Not to Scale
Bull Creek

NOTES:
1. INSTALL CLASS B/1 RIPRAP MIXTURE IN 1.0' LIFTS. COMPACT EACH LIFT.
2. SET MATTING FOR FIRST LIFT.
3. INSTALL SOIL AND COMPACT WITH PLATE COMPACTER.
4. SEED, MULCH AND INSTALL EROSION CONTROL MATTING AND BANK STABILIZATION PER PLANS.
5. REPEAT FOR SUBSEQUENT LIFTS.
6. LIVE CUTTINGS SHALL CONSIST OF BLACK WILLOW, SILKY WILLOW, OR SILKY DOGWOOD.





Section A-A'



Plan View

NOTES:
1. OVEREXCAVATE 3' OUTSIDE OF TOP OF BANK (BANKFULL).
2. INSTALL BASE LOGS PARALLEL TO FLOW AT TOE OF SLOPE. DIAMETER 6"-12".
3. INSTALL BASE LOGS PERPENDICULAR TO FLOW AT INTERVALS ALONG BANK, RESTING ON TOP OF PARALLEL BASE LOGS. BASE LOGS SHALL BE 6"-12" DIAMETER.
4. INSTALL A DENSE LAYER OF BRUSH/WOODY DEBRIS, WHICH SHALL CONSIST OF SMALL BRANCHES AND ROOTS COLLECTED ON-SITE AND SOIL TO FILL ANY VOID SPACE. LIGHTLY COMPACT BRUSH/WOODY DEBRIS LAYER.
5. BRUSH SHOULD BE ALIGNED SO STEMS ARE ROUGHLY PARALLEL AND IS INSTALLED POINTING SLIGHTLY UPSTREAM.
6. INSTALL MATTING OVER BRUSH/WOODY DEBRIS.
7. INSTALL EARTH BACKFILL OVER BRUSH/WOODY LAYER ACCORDING TO TYPICAL SECTION DIMENSIONS.
8. SEED, MULCH AND INSTALL EROSION CONTROL MATTING AND BANK STABILIZATION PER PLANS.

Brush Toe - Large Streams

2 / 6.4 Not to Scale
Bull Creek

Key Mill Mitigation Site
Surry County, North Carolina
Details

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Charlotte, NC 28203
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Firm License No. F-0831

Revisions:

Date: July 19, 2021
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP
Checked By: DJ

Sheet 6.4

POST REPAIR PHOTOGRAPHS

Key Mill Monitoring Year 2

	
Post-Repair – A1 (08/16/2021)	**Post-Repair** – A2 106+50 (08/16/2021)
	
Post-Repair – A2 108+50 (08/16/2021)	**Post-Repair** – A2 113+25 A4 (08/16/2021)

	
Post-Repair – A6 160+50 – 163+00 (08/16/2021)	**Post-Repair** – A6 163+00 – 165+00 (08/16/2021)
	
Post-Repair – A6 165+00 – 166+00 (08/16/2021)	**Post-Repair** – A7 163+00 (08/16/2021)

	
Post-Repair – A7 165+60 (08/16/2021)	**Post-Repair** – A7 166+40 (08/16/2021)