Monitoring Report
Year 4
FINAL
Little Buffalo Creek Stream Mitigation Project

NCDEQ-DMS Project Number: 94147
Contract Number: 2029
USACE Permit Action ID: 2014-00386
DWR Permit: 14-0129
Cabarrus County

Data collection: September/October/November 2018
Draft Submitted: January 2019
Final Submitted: March 2019

Reach 1 Restoration Area Pre-Construction

Reach 1 Restoration Area MY4

Prepared for:

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

Prepared by:

Louis Berger

Louis Berger
1001 Wade Avenue, Suite 400
Raleigh, North Carolina 27605
Tel (919) 866-4400
Fax (919) 755-3502

Project Manager:
Robin Maycock Perez
Tel (919) 866-4428
Fax (919) 755-3502
RMaycockperez@louisberger.com

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
TIM BAUMGARTNER
Director

NORTH CAROLINA
Environmental Quality

February 15, 2019

Robin Maycock
Project Manager
Louis Berger
1001 Wade Avenue
Suite 400
Raleigh, NC 27605

Subject: DRAFT Monitoring Year 4 report for the
Little Buffalo Creek Stream Mitigation Project
Yadkin River Basin – CU# 03040105– Cabarrus County
DMS Project ID No. 94147
Contract # 002029

Dear Mrs. Maycock:

On January 15, 2019, the Division of Mitigation Services (DMS) received the DRAFT Monitoring Year 4 report for the Little Buffalo Creek Stream Mitigation Project site from Louis Berger. The report establishes the year 4 monitoring conditions at the site. Anticipated mitigation on the site includes 2,017 linear feet of stream restoration; 1,244 linear feet of stream Enhancement (Level I); 7,723 linear feet of stream Enhancement (Level II); and 2,378 linear feet of stream Preservation for a total of 6,411 Stream Mitigation Units (SMUs).

DMS, DEQ Stewardship and Louis Berger conducted a site visit on February 7, 2019 to review conditions on the site. Comments from the site visit are captured in this letter as well as comments from the DRAFT MY4 report.

General – DMS Property and DEQ Stewardship Comments: In general, the boundary marking looked to be in pretty good shape. We noted below a few areas in need of upgrades. The other ongoing area of concern for this project continues to be the issue with neighboring livestock. As we noted on-site, the best use of our time in the next few months will be to help promote a positive landowner relationship and transfer to the DEQ Stewardship Program. To help accomplish this task, DMS property (Jeff Horton) and DEQ Stewardship (Ed Hajnos) are willing to go back out to meet with the landowners and have a face to face conversation. Louis Berger should coordinate this when they believe there is a window of opportunity.

1. Just below the bridge at Old Mine Rd. the barbed wire fence was cut to extend field ditching into the CE. This fence needs to be repaired and the ditch filled in up to the CE boundary.

2. We noted some minor evidence of livestock near the bridge. Please keep working to exclude livestock.
3. The ford crossing looked to need some repair to prevent cattle from entering the CE. Please maintain the crossing as necessary to exclude cattle from CE. The project landowners should be informed and understand that all fence and crossing maintenance will be the landowner's responsibility when Louis Berger closes the project with DMS and the IRT.
4. The CE boundary near the pond incorporated lightweight chicken wire posts. These have already shown signs of being knocked over. Please update to a heavier gauge steel, like the many others observed on the site or use 6" wooden rounds like are used for the fence posts. All zip ties used to hang signs should be changed to something more permanent. Photo examples are provided below. Make sure signage is located at all corners near the pond area to clearly delineate this area of the CE boundary. There appears to have been some mowing and possibly loss of tree cover during and after the pond construction.
5. We did not get to the forested side of the stream below the crossing where the property release is needed. How was this area marked?
6. Please provide an up to date list for all contacts associated with this project to include landowners and farm managers.

Examples of marking for reference https://photos.app.goo.gl/fdk9jotFWW10xXAy1

General: In MY4, BHR should have been calculated based on DMS guidance provided to consultants in 2018 (attached). Please confirm the guidance was utilized and update if necessary. Please note that BHR is not required for pools. A dash can be utilized for pools (BHR). This method is not required for previous years; just MY4 (2018) and MY5 (2019).

General: DMS has concerns about the stream mitigation assets on UT 2, UT 3 and UT 5 and believes that portions these assets could be "at risk" at project closeout due to lack of flow and/ or silting. Please continue to monitor and report any issues through project closeout. In regards to silting reaches (i.e. linear wetlands), lengths should be reported for applicable reaches.

Section 1.5.1.3 – Random Vegetation Plots: The report text indicates that the random vegetation plots are shown in Figure 2. The plots are shown in the CCPV sheets but they do not appear to be in a standalone figure 2. Please update the report text accordingly. DMS recommends including a simple map or set of simple maps showing the random plots to go along with Table 14 in the report appendices.

Section 1.5.2 - Stream Assessment: In the paragraph discussing the UT5 hydrology, please indicate the pre-construction regulatory determination of the channel status. Was a jurisdictional determination conducted and approved by the USACE on UT5 as part of the mitigation plan?

Section 1.5.3.2 - Encroachments: Please add discussion of the newly planted pines along the easement boundary which may reduce the future mowing potential. Please inform the landowner that trees planted within the conservation easement cannot be cut or harvested.

General – Proposed Conclusions Section: There is a wealth of information in the report text. DMS recommends a brief Conclusion section before Section 2.0 that summarizes and indicates that the project site is meeting the Success Criteria as established in the mitigation plan and reported in Section 1.3.

Section 2 – Methodology: Please add a brief methodology for the random vegetation plot data collection conducted. Table 14 shows data for both planted stems and total stems. How were planted and volunteer stems differentiated? Random vegetation plot data is typically just the total woody stems in the random plot.

Project Components Map: Please thicken the stream lines so it is easier to see which mitigation activities are associated with each stream/ reach. The project components map should be a simple 1-page map that shows the mitigation approach for each reach. An example from another project is provided. Please edit/ update as deemed necessary.

Table 3 – Project Contact Table: Please add the invasive contractor to the table.

Table 4 - Project Information – Please add the thermal regime (warm) to the table.

CCPV Figures – The magenta hatch for encroachment/cow prints should be removed from the reach figures. The information would be less obstructive and better summarized in Figure 1 using the hatch or leaders with text. Please review the CCPV figures and Tables 5a-g for completeness regarding aggradation in UT 2 and UT 3. Please consider changing the light blue text color for the call outs as it is difficult to see in the figures.

CCPV Figures (Figure 6) - What is the yellow hatched area that covers the crossing? The call out is covered by the legend and there is no reference in the legend. Please revise accordingly.

Please provide an electronic comment response letter addressing the DMS comments received. This comment response letter should also be included in the FINAL MY4 revised report after the report cover. Please send three (3) final hard copies and the final electronic deliverables and support files (on a CD) directly to my attention at the address below (Western DMS field office). The final electronic monitoring report with all attachments should be named:
Little Buffalo Creek_94147_MY4_2018.pdf

If you have any questions, please contact me at any time at (828) 273-1673 or email me at paul.wiesner@ncdenr.gov .

Sincerely,

Paul Wiesner

Paul Wiesner
Western Regional Supervisor
NCDENR – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801
(828)273-1673 Mobile

cc: file

March 7, 2019

Mr. Paul Wiesner
Western Project Management Supervisor
NCDEQ – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: DRAFT Monitoring Year 4 report for the
Little Buffalo Creek Stream Mitigation Project
Yadkin River Basin – CU# 03040105 – Cabarrus County
DMS Project ID No. 94147
Contract # 002029

Dear Mr. Wiesner:

Louis Berger has reviewed your comments, received on February 15, 2019, for the DRAFT Monitoring Year 4 report for the Little Buffalo Creek Stream Mitigation Project site. We offer the following responses.

- **General – DMS Property and DEQ Stewardship Comments:** In general, the boundary marking looked to be in pretty good shape. We noted below a few areas in need of upgrades. The other ongoing area of concern for this project continues to be the issue with neighboring livestock. As we noted on-site, the best use of our time in the next few months will be to help promote a positive landowner relationship and transfer to the DEQ Stewardship Program. To help accomplish this task, DMS property (Jeff Horton) and DEQ Stewardship (Ed Hajnos) are willing to go back out to meet with the landowners and have a face to face conversation. Louis Berger should coordinate this when they believe there is a window of opportunity.

1. Just below the bridge at Old Mine Rd. the barbed wire fence was cut to extend field ditching into the CE. This fence needs to be repaired and the ditch filled in up to the CE boundary.
    - *Louis Berger is coordinating the repair of the fence to occur in the coming months with our fencing contractor. The area within the CE boundary will be properly seeded and stabilized.*

2. We noted some minor evidence of livestock near the bridge. Please keep working to exclude livestock.
    - *Minor evidence of livestock near the bridge is the result of an isolated event occurring from Hurricane Florence in MY4. This event is discussed in detail in the MY4 report.*

3. The ford crossing looked to need some repair to prevent cattle from entering the CE. Please maintain the crossing as necessary to exclude cattle from CE. The project landowners should be

informed and understand that all fence and crossing maintenance will be the landowner's responsibility when Louis Berger closes the project with DMS and the IRT.

- *Louis Berger is coordinating the repair of the cattle crossing with the repair of the fence in the coming months. Louis Berger is looking to include through the removal in order for the landowners to maintain the crossing more easily after project transfer to the DEQ stewardship.*

4. The CE boundary near the pond incorporated lightweight chicken wire posts. These have already shown signs of being knocked over. Please update to a heavier gauge steel, like the many others observed on the site or use 6" wooden rounds like are used for the fence posts. All zip ties used to hang signs should be changed to something more permanent. Photo examples are provided below. Make sure signage is located at all corners near the pond area to clearly delineate this area of the CE boundary. There appears to have been some mowing and possibly loss of tree cover during and after the pond construction.
    - *Locations where lighter weight chicken wire posts were used will be replaced with the heavy-duty steel gauge posts as used in other locations of the project site. Zip ties will be replaced with bolt anchors. Signs will be added to the corners of the easement property around the constructed pond if not already there. Mowing was observed during the construction of the pond before easement signs were installed in this area. Mowing only occurred to the formerly maintained grass area. Tree coverage does not extend to the edge of the CE boundary in all portions of this area.*

5. We did not get to the forested side of the stream below the crossing where the property release is needed. How was this area marked?
    - *Per conversations with Jeff Horton, the area of the easement property on the forested side this comment pertains too currently does not have easement signs installed. Louis Berger will provide Jeff the total quantity of additional signs required for this segment within the forested area to attach to trees at approximate corners and around every 100 feet to indicate in a line of site where the easement property is approximately located. Per Jeff's direction, this does not need to be the exact location of the easement and is just a warning that the easement is in this area. At locations of 90-degree turns in the property due to Berger not obtaining the conservation easement on both sides of the stream, two signs will be placed at a single tree to indicate which direction the easement property goes.*

6. Please provide an up to date list for all contacts associated with this project to include landowners and farm managers.
    - *Louis Berger has updated Table 3 to include all contact information for new landowners and farm managers.*

- **General:** In MY4, BHR should have been calculated based on DMS guidance provided to consultants in 2018 (attached). Please confirm the guidance was utilized and update if necessary. Please note that BHR is not required for pools. A dash can be utilized for pools (BHR). This method is not required for previous years; just MY4 (2018) and MY5 (2019).
    - *As requested, the DMS guidance provided was utilized to calculate the BHR for MY4. MY4 appendices have been updated to have a dash for BHR values for pools.*

- **General:** DMS has concerns about the stream mitigation assets on UT 2, UT 3 and UT 5 and believes that portions these assets could be "at risk" at project closeout due to lack of flow and/ or silting. Please continue to monitor and report any issues through project closeout. In regards to silting reaches (i.e. linear wetlands), lengths should be reported for applicable reaches.
    - *As discussed with DMS, ongoing monitoring for continuous flow is being conducted for these tributaries. UT 5 is being recognized by Louis Berger as being at risk for lack of flow. UT2 and UT3 have recorded periods of continuous flow during each monitoring year thus far. Silting in UT2 and UT3 has also subsided since major occurrence in MY2. Where silting has occurred in past, defined channels are beginning to form with evidence of flow. These areas are being monitored with photo documentation during the four seasons through project closeout, as requested by the IRT during the site visit with them and DMS in MY4.*

- **Section 1.5.1.3 – Random Vegetation Plots:** The report text indicates that the random vegetation plots are shown in Figure 2. The plots are shown in the CCPV sheets but they do not appear to be in a standalone figure 2. Please update the report text accordingly. DMS recommends including a simple map or set of simple maps showing the random plots to go along with Table 14 in the report appendices.
    - *Figure 2 is referring to Figure 2a- 2j for the MY4 CCPV. The report text has been updated accordingly to refer to the CCPV. Figure 7a-d has been created and placed with Table 14 to show closer views of each random transect in relation to the vegetation plot.*

- **Section 1.5.2 - Stream Assessment:** In the paragraph discussing the UT5 hydrology, please indicate the pre-construction regulatory determination of the channel status. Was a jurisdictional determination conducted and approved by the USACE on UT5 as part of the mitigation plan?
    - *The following information has been added to the discussion of UT5: "Louis Berger personnel completed the proper jurisdictional determination forms for UT5 in the site selection study. These forms were submitted as part of the proposal to DMS, as well as included in the final design reports to DMS. At the time of the assessment, UT5 was scored as an intermittent stream. The USACE provided a complimentary site walk and assessment with Louis Berger during the design as part of the mitigation plan, however, only the site walk occurred and there is no final documentation approving the jurisdictional determination of UT5 as an intermittent stream."*

- **Section 1.5.3.2 - Encroachments:** Please add discussion of the newly planted pines along the easement boundary which may reduce the future mowing potential. Please inform the landowner that trees planted within the conservation easement cannot be cut or harvested
    - *Discussion added as requested. The landowner will be notified that the trees planted inside the CE boundary are now restricted by the CE.*

- **General - Proposed Conclusions Section:** There is a wealth of information in the report text. DMS recommends a brief Conclusion section before Section 2.0 that summarizes and indicates that the project site is meeting the Success Criteria as established in the mitigation plan and reported in Section 1.3.
    - *Louis Berger has added Section 1.5.4 to the report to provide a summary that the site is meeting the requirements, as detailed in Section 1.3 for requirements, as requested.*

- **Section 2 – Methodology:** Please add a brief methodology for the random vegetation plot data collection conducted. Table 14 shows data for both planted stems and total stems. How were planted and volunteer stems differentiated? Random vegetation plot data is typically just the total woody stems in the random plot.
    - *The methodology has been added as requested to Section 2.4. Louis Berger assumed that the trees identified in the random transects that were of the same species and in similar size to that planted were planted trees versus recruits. Table 14 has been revised to show just the total woody stems for each random transect and removed the designations for planted or recruit.*

- **Project Components Map:** Please thicken the stream lines so it is easier to see which mitigation activities are associated with each stream/ reach. The project components map should be a simple 1-page map that shows the mitigation approach for each reach. An example from another project is provided. Please edit/ update as deemed necessary.
    - *Stream lines have been thickened and the map has been simplified to show the mitigation approach for each reach more clearly.*

- **Table 3 – Project Contact Table:** Please add the invasive contractor to the table.
    - *The planting contractor has served as the invasive contractor for this project. Table 3 has been updated to detail this.*

- **Table 4 - Project Information –** Please add the thermal regime (warm) to the table.
    - *Thermal regime (warm) has been added to Table 4.*

- **CCPV Figures –** The magenta hatch for encroachment/cow prints should be removed from the reach figures. The information would be less obstructive and better summarized in Figure 1 using the hatch or leaders with text. Please review the CCPV figures and Tables 5a-g for completeness regarding aggradation in UT 2 and UT 3. Please consider changing the light blue text color for the call outs as it is difficult to see in the figures.
    - *The magenta hatch for encroachment has been removed and leaders added. Text color for the callouts has been changed to a darker color. UT2 and UT3 have been revised for aggradation along the areas of linear wetlands. As no additional aggradation in MY4 was observed in the portion of UT3 impacted by the MY2 encroachment incident, this area is not shown for aggradation on the CCPV for MY4 or within Table 5a-g. This information has been updated in Tables 5a-g also. UT2 in Table 5a-g in past has been focused on the*

portion of E1 where work was performed, which does not include the portion of aggradation/linear wetland that is within an area of E2. This has been revised to include this segment of UT2.

- **CCPV Figures (Figure 6) -** What is the yellow hatched area that covers the crossing? The call out is covered by the legend and there is no reference in the legend. Please revise accordingly.
    - *The yellow hatch is for the area being removed from the easement as part of the proposed easement modification, pending state finalization. The plan has been revised to show the call out.*

If you have any further questions or comments please contact Robin Maycock Perez at RMaycockPerez@louisberger.com or 919-866-4428.

Sincerely,

Matthew Holthaus
Civil/Environmental Engineer

CC: Robin Maycock Perez, Louis Berger
Douglas Parker, Louis Berger

Table of Contents

Appendices

Appendix A. Project Vicinity Map & Background Tables
Figure 1 – Project Vicinity Map
Figure A1 – Project Components Map
Table 1 – Project Mitigation Components
Table 2 – Project Activity and Reporting History
Table 3 – Project Contacts Table
Table 4 – Project Baseline Information and Attributes

Appendix B. Visual Assessment Data
Figure 2a-2j – Integrated Current Condition Plan View-MY4
Table 5a-g – Visual Stream Morphology Stability Assessment Table
Table 6a-e – Vegetation Condition Assessment Table
Photo Appendices A-E: Vegetation Monitoring Photographs, Cross Section Photographs, Photo Station Photographs, Problem Area Photographs, Significant Flow Events

Appendix C. Vegetation Plot Data
Table 7 – Vegetation Plot Criteria Attainment
Table 8 – Total Planted Stems
Table 9 – CVS Vegetation Plot Metadata and Planted and Total Stem Counts (Species by Plot with Annual Means)

Appendix D. Stream Measurement & Geomorphology Data
Table 10aa-af – Baseline Stream Data Summary
Table 10ba-bg – Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Table 11aa-ag – Monitoring Data: Dimensional Morphology Summary (Dimensional Parameters – Cross Section)
Table 11ba-bf – Monitoring Data: Stream Reach Data Summary
Figure 3a-k – Longitudinal Profile Plots
Figure 4a-q – Cross-section Plots
Figure 5a-q – Pebble Count Plots

Appendix E. Hydrologic Data
Table 12 – Documentation of Geomorphologically Significant Flow Events
Figure 6a-g – Water Level and Rainfall Plots
Table 13 – Continuous Stream Flow Record

Appendix F. Year 4 Supplemental Information
June 2018 IRT Site Walk Meeting Minutes
Table 14 – Random Vegetation Plot Transects Stem Counts
Figure 7a-7d – Random Vegetation Plot Transects Location Maps
CDROM Copy of Electronic Files

1.0 Executive Summary

1.1 Project Setting and Background

The Little Buffalo Creek Stream Mitigation site is located in Cabarrus County, North Carolina, two miles southwest of the Town of Gold Hill, and 12 miles east of Kannapolis. The site encompasses approximately 47 acres of former cattle pasture, cropland and riparian forest along Little Buffalo Creek and portions of seven unnamed tributaries (Figures 1 and 2). Little Buffalo Creek is located within the Yadkin River Basin (03040105; 03040105020060). Historic land use at the site had consisted primarily of ranching activities that had allowed cattle access to the stream and riparian zone. Several reaches of the stream have bedrock in their streambed and vertical migration of the stream has been confined to a small percentage of the project site.

1.2 Project Goals and Objectives

The goals of the Little Buffalo Creek Stream Restoration project include, but are not limited to, the enhancement of water quality and aquatic/terrestrial habitat, stream stability improvement, and erosion reduction. The uplift of these stream functions specifically requires:

- Protecting and improving water quality through the removal or minimization of the biological, chemical, and physical stressors:
  - Reducing sediment input into the stream from erosion;
  - Reducing non-point pollutant impacts by removing livestock access (including restoring forested buffer);
  - Protecting headwater springs.
- Improving aquatic and terrestrial wildlife habitat:
  - Moderating stream water temperatures by improving canopy coverage over the channel;
  - Restoring, enhancing, reconnecting, and protecting valuable wildlife habitat.
- Restore floodplain connectivity:
  - Reestablishing floodplain connection thereby dissipating energy associated with flood flows.

In addition to the ecological uplift that the project will provide to the Site through the improvement of the stream functions, this project establishes the following environmentally advantageous goals:

- Providing a water source for livestock removed from the stream and riparian corridor;
- Reducing the number of locations that livestock are able to cross the stream;
- Providing a safe and environmentally appropriate stream crossing point for livestock.

In order to achieve the project goals, Berger proposes to accomplish the following objectives:

- Fence the cattle out of the stream and riparian corridor;
- Remove invasive vegetative species from the riparian corridor;
- Restore and enhance unstable portions of the stream;
- Preserve the stream channel and banks through a conservation easement;
- Plant the riparian corridor with native tree and shrub vegetation.

The expected ecological benefits and goals associated with the Little Buffalo Creek site mitigation plan serve to meet objectives consistent with the resource protection objectives detailed in the Yadkin-Pee Dee River Basinwide Water Quality Plan, 2008.

1.3 Project Success Criteria

Streams
For stream hydrology, a minimum of two bankfull events must be documented within the standard 5-year monitoring period. In order for the monitoring to be considered complete, the two verification events must occur in separate monitoring years. All of the morphologic and channel stability parameters will be evaluated in the context of hydrologic events to which the system is exposed.

- Dimension – General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. For stream dimension, cross-sectional overlays and key parameters such as cross-sectional area, and the channel's width to depth ratios should demonstrate relative stability in order to be deemed successful.
- Pattern – Pattern features should show little adjustment over the standard 5-year monitoring period. Rates of lateral migration need to be moderate.
- Profile – For the channels' profile, the reach under assessment should not demonstrate any trends in thalweg aggradation or degradation over any significant continuous portion of its length. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes.
- Substrate and Sediment Transport – Substrate measurements should indicate progression towards, or maintenance of the known distributions from the design phase. Sediment Transport should be deemed successful by the absence of any significant trend in the aggradation or depositional potential of the channel.

Vegetation
Survival of woody species planted at mitigation sites should be at least 288 stems/acre through Year 4. A 10 percent mortality rate will be accepted in Year 5 resulting in a required survival rate of 260 trees/acre through Year 5. This is consistent with Wilmington District (1993) guidance for wetland mitigation (USACE 2003).

1.4 Mitigation Components and Design
The Little Buffalo Creek Site consists of six reaches along the main stem and seven unnamed tributaries (UTs). The main stem of Little Buffalo Creek as well as UT 4 and UT 7 are perennial streams. The remainders of the UTs are intermittent streams associated with groundwater seeps. This stream mitigation project includes reaches of restoration, enhancement, and preservation along the main stem and the associated UTs. In total, the Site will provide 13,362 linear feet of restoration, enhancement, and preservation (Tables 1 & 4). A summary of restoration and enhancement activity and reporting history can be found in Table 2.

Restoration activities have established a new, stable stream channel with the appropriate dimension, pattern and profile to transport perennial flow and sediment and have re-connected the stream to its floodplain. Reestablishment of native riparian forest vegetation and installation of cattle exclusion fencing were also performed as part of the restoration activities. Enhancement activities included reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. In the case of enhancement level I the activities included reshaping or relocating the bed and banks and riparian forest planting. Preservation was conducted within portions of the stream corridors that have

intact riparian forests and stable stream reaches and included excluding cattle with fencing. At a 1:1 ratio for restoration, 1.5:1 for enhancement level I, 2.5:1 for enhancement level II, and a 5:1 ratio for preservation, the DMS will receive, as of December 2017, approximately 6,411 stream mitigation units from the Site (Table 1). In addition, approximately 47 acres of riparian buffer have been protected within a conservation easement. This stream credit generation has the potential to increase to 6,450 stream mitigation units as a result of additional enhancement level I work conducted in the fall of 2016 within a portion of UT3. This area, previously assessed as enhancement level II, had additional entrenched portions of the tributary graded to re-connect the channel with its floodplain and the riparian zone replanted.

1.5 Monitoring Year 4 Conditions Assessment

1.5.1 Vegetation Assessment

Five plots (3, 5, 7, 8, and 9) have coverage of goldenrod, dog fennel, and blackberry. In Year 4, to facilitate a more accurate count, the goldenrod, dog fennel, and blackberry were carefully hand trimmed prior to counting stems. Rainfall for Year 4 is higher than in prior years. In addition, there was more rainfall during the growing season (April – September). The additional rainfall would have contributed to more vigorous growth.

	Rainfall in inches*				
	Year 0 (2014)	**Year 1 (2015)**	**Year 2 (2016)**	**Year 3 (2017)**	**Year 4 (2018)**
January - March	8.97	5.75	7.86	8.56	14.14
April – June	8.33	6.29	9.37	17.67	12.47
July – September	14.57	7.9	9.23	8.92	26.78
October - December	6.9	25.3	11.43	6.09	20.28
Total	**38.77**	**45.24**	**37.89**	**41.24**	**73.67**

*Gauge NC-SN-6, Richfield, https://www.cocorahs.org/ViewData/StationPrecipSummary.aspx

1.5.1.1 Planted Stems

Planted stem density requirements for Year 4 is 288 stems per acre. When examining planted stems only, in Year 4 of monitoring, ten vegetation monitoring plots (1-4, 6-9, 11, and 12) are exceeding requirements by 10% (339 to 920 stems/acre), one vegetation monitoring plot (5) is exceeding requirements by less than 10% (290 stems/acre), no vegetation monitoring plots fail to meet requirements by less than 10% (260 stems/acre), and one vegetation monitoring plot (10) is failing to meet requirements by over 10% (242 stems/acre). Recruitment of native plant seedlings was recorded in seven (1, 3, 8, 9, 10, 11, and 12) of the twelve vegetation monitoring plots (Tables 6, 7, 8, and 9). The current average estimate of 540 planted stems per acre for the site is exceeding the required success criteria of 288 stems per acre.

The reasons for the uplift in previous Year 3 poor performing areas (2, 3, 6, and 11) are varied. The stem count (339) in vegetation monitoring plot 2 has remained stable and the uplift is due to the change in success criteria. The uplift in vegetation monitoring plot 3 is most likely from a combination of a more accurate counting due to hand clearing and the additional rainfall. The uplifts in vegetation monitoring plots 6 and 11 are most likely due to the additional rainfall.

Increased stems/acre counts were noted in vegetation monitoring plots 1, 10, and 12 most likely due to the additional rainfall. Though, underperforming, vegetation monitoring plot 10 has shown steady improvement year over year. Increased stems/acre counts were noted for vegetation monitoring plots 7, 8, and 9 most likely due to a combination of more accurate counting due to hand clearing and the additional rainfall. Two

vegetation monitoring plots (4 and 5) showed decreases in stems/acre counts. The decrease in stems/acre count in vegetation monitoring plot 4 is most likely due to natural seedling mortality after planting in March 2017. The decrease in stems/acre count in vegetation monitoring plot 5 is directly attributable to blackberry choking out the other vegetation in the plot.

1.5.1.2 Combined Planted/Volunteer Stems

When examining combined planted/volunteer stems, in Year 4 of monitoring, eleven vegetation monitoring plots (1, 2, 3, 4, 5, 6, 7, 8, 9, 11, and 12) are exceeding requirements by 10% (387 to 1,694 stems/acre), no vegetation monitoring plots are exceeding requirements by less than 10% (288 stems/acre), no vegetation monitoring plots are failing to meet requirements by less than 10% (260 stems/acre), and one vegetation monitoring plot (10) is failing to meet requirements by over 10% (242 stems/acre). Recruitment of native plant seedlings was recorded in 7 of 12 vegetation monitoring plots (Tables 6, 7, 8, and 9). The current average estimate of 863 combined planted/volunteer stems per acre for the site is exceeding the planted stem success criteria of 288 stems per acre.

1.5.1.3 Random Vegetation Plots

During the June 19, 2018 IRT site visit (meeting minutes included in Appendix F), it was requested that random vegetation transects be conducted along UT 3 (vegetation monitoring plot 3), Reach 4 (vegetation monitoring plot 4), UT 2 (vegetation monitoring plot 8), and Reach 1 (vegetation monitoring plot 11). During the September 2018 vegetation survey, two randomly placed 10 x 10 meter vegetation plots were surveyed in those four areas. For the eight random vegetation plots (Table 14), seven are exceeding requirements for planted stems by 10% (387 to 4695 stems/acre) and one is exceeding requirements by less than 10% (290 stems per acre). Locations of each transect are provided in the MY4 CCPV Plan (Figure 2a-2j). Additionally, locations are shown in Figure 7a-7d as part of Table 14.

The two random vegetation plots along UT 3 were 290 stems per acre (downstream, opposite bank from vegetation monitoring plot 3) and 435 stems/acre (upstream from vegetation monitoring plot 3). These planted stem counts are in line vegetation monitoring plot 3's planted stem count of 387 stems/acre.

The two random vegetation plots along Reach 4 were 387 stems/acre (downstream from vegetation monitoring plot 4) and 532 stems/acre (upstream from vegetation monitoring plot 4). These planted stem counts are in line with vegetation monitoring plot 4's planted stem count of 532 stems/acre.

The two random vegetation plots along UT 2 were 436 stems/acre (downstream, opposite bank from vegetation monitoring plot 8) and 581 stems/acre (downstream, same bank as vegetation monitoring plot 8). These planted stem counts are lower than vegetation monitoring plot 8's Year 4 planted stem count of 920 stems/acre but are in line with vegetation monitoring plot 8's Year 3 planted stem count of 581 stems/acre. The difference is most likely due to the hand clearing in vegetation monitoring plot 8 generating a more accurate count.

The two random vegetation plots along Reach 1 were 2,613 stems/acre (downstream plot 11) and 4,695 stems/acre (upstream of plot 11). These planted stem counts were higher than vegetation monitoring plot 11's planted stem count of 339 stems/acre. The difference is most likely due to deeper and nutrient rich soils found outside of vegetation monitoring plot 11. The soils in vegetation monitoring plot 11 are known to be nutrient poor and shallow to bedrock.

1.5.1.4 Volunteer Species/Volunteer Diversity

Species diversity has steadily increased from Year 0 (14 planted), to Year 1 (18 combined planted/volunteer), to Year 2 (18 combined planted/volunteer), to Year 3 (22 combined planted/volunteer), to current Year 4 (23 combined planted/volunteer). The increase in two species was due to direct plantings of slippery elm (*Ulmus rubra*) and blackgum (*Nyssa sylvatica*) in March 2017.

The remaining increase of ten species would be volunteers. In Year 1, three new volunteer species were noted: red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and eastern red cedar (*Juniperus virginiana*). In Year 2, two new volunteer species were noted: boxelder (*Acer negundo*) and common elderberry (*Sambucus canadensis*). In the Year 3, five new volunteer species were noted: eastern baccharis (*Baccharis halimifolia*), common persimmon (*Diospyros virginiana*), loblolly pine (*Pinus taeda*), smooth sumac (*Rhus glabra*), and sassafras (*Sassafras albidum*). In the current Year 4, one new volunteer species was noted: inkberry (*Ilex glabra*).

When comparing planted stems only between Year 3 and Year 4, five vegetation monitoring plots (3, 6, 7, 8, and 10) have seen an increase in species diversity, five vegetation monitoring plots (1, 2, 9, 11, and 12), have maintained species diversity, and two vegetation monitoring plots (4 and 5) lost species diversity. The increased planted stem species diversity in vegetation monitoring plots 3, 7, and 8 are most likely due to a more accurate count resulting from hand clearing. The increased planted stem species diversity in vegetation monitoring plot 6 is for an unknown reason. The increased planted stem species diversity in vegetation monitoring plot 10 is probably due to floodwaters flattening herbaceous growth on the lower portion of the plot, allowing stems to be located during the survey. The decreased planted stem species diversity in vegetation monitoring plot 4 is most likely due to natural mortality from the planting in March 2017. The decreased planted species diversity in vegetation monitoring plot 5 is directly related to the blackberry competition.

When comparing combined planted/volunteer stems between Year 3 and Year 4, three vegetation monitoring plots (7, 10, and 12) saw an increase in species diversity, three vegetation monitoring plots (1, 3, and 4) maintained species diversity, and six vegetation monitoring plots (2, 5, 6, 8, 9, and 11) lost species diversity. The increased combined planted/volunteer stem count in vegetation monitoring plots 7 and 10 are as above. The increased combined planted/volunteer stem count in vegetation monitoring plot 12 is most likely due to the additional rainfall. The decreased combined planted/volunteer stem count in vegetation monitoring plot 5 is as above and for the remaining vegetation monitoring plots is most likely due to site-specific variables such as shading, competition, soil depth or fertility.

1.5.1.5 Non-plot Assessment

Significant growth was observed in planted American sycamore (*Platanus occidentalis*) and black willow (*Salix nigra*) trees, likely due to the additional rainfall in 2018. Other planted species were observed to be healthy and exhibiting significant growth due to the additional rainfall. Tree establishment and survival will continue to be monitored.

Black willow and silky dogwood (*Cornus amomum*) live stakes throughout the restoration areas are doing well and very few have been observed to be dead. Surviving stakes are continuing to grow quickly and contribute to bank stability. Soft rush (*Juncus effusus*) has become established on parts of the stream bank and is adding additional stability to sections of UT7 and UT3. Additional stability is being provided by grasses and sedges that have become established on banks throughout the site. Volunteer crop cover is no longer present and has been outcompeted by other species such as goldenrods (*Solidago*), asters (*Aster*), dogfennel (*Eupatorium capillifolium*), and native grasses.

Previously there were areas within the riparian buffer that were having low success in establishing herbaceous vegetation cover due to drought and sections of bank scour. These areas included approximately 300 feet along the main stem of Reach 1, approximately 130 feet along the main stem of Reach 4, and approximately 530 feet of UT 3. These problem areas were reseeded with annual ryegrass and native forbs in February 2016. Reseeded areas total approximately 1.8 acres and make up 53% of E1 areas and 20% of restoration areas. Based on observations during an initial site visit in the early spring of 2018, no additional seeding was performed in these specific areas in 2018 as coverage has significantly increased to meet requirements.

Reach 1 has improved greatly through the previous reseedings; however, there is a small bare patch, approximately 0.02 acres, with no herbaceous cover on the left bank flood plain. This is due to an exceedance in copper within the soils that is preventing establishment, determined by sediment sampling during Year 4. Overall herbaceous cover throughout the site has greatly increased.

1.5.1.6 Invasive Species

Past treatment and removal of privet (*Ligustrum*) and multiflora rose (*Rosa multiflora*) from riparian areas has been mostly successful for Reaches 1-5. On April 13, 2018, Louis Berger personnel surveyed all Reaches for Princess tree (*Paulownia tomentosa*) and tree-of-heaven (*Ailanthus altissima*). Thirty-eight mature trees and numerous saplings for both species were noted. The mature trees and saplings were banded with orange paint. On May 4, 2018, Carolina Silvics conducted an Early Growing Season invasive treatment during which the identified smaller trees and saplings were cut and treated with herbicides. During June 5-7, 2018, Strader Fencing cut down the remaining larger mature trees and treated the stumps with herbicides. Between September 4 through 6, 2018, Carolina Silvics conducted a Late Growing Season invasive treatment. On November 29, 2018, Carolina Silvics basal bark treated privet on Reach 6, below the cattle crossing. During site visits by Louis Berger personnel in April, June, September, October, and November, any noted invasive saplings were removed by hand. Herbicide applications for invasive species will continue during MY5 as necessary.

1.5.1.7 Additional Tree Planting

During the June 19, 2018 IRT site visit, Kim Browning, USACE, stated that the trees on the left bank of Reach 4, in entire UT-2, and in entire UT-3 did not exhibit the expected level of vigor (tree height) and recommended planting those areas with more mature trees of at least four different species. In an August 8, 2018 email, DMS verified that there is no success criteria standard for tree height on Little Buffalo Creek but recommended planting the areas the IRT noted with at least 4-foot-high trees as the IRT team will want to see successful vegetation (tree height) onsite at closeout. As such, between November 27-29, 2018, Carolina Silvics planted 300 trees (60 trees along Reach 4, 70 trees along UT 2, 120 trees along UT 3, and 50 trees in Reach 1) that were at least 4-foot-tall and selected for habitat from among twelve recommended species: silver maple, pin oak, white oak, willow oak, black gum, green ash, box elder, pignut hickory, shagbark hickory, mockernut hickory, hackberry, and tulip popular.

1.5.2 Stream Assessment

Overall, the site is functioning as anticipated geomorphically. Issues identified in Year 3 monitoring have almost all been resolved. Additionally, multiple bankfull events occurred in Year 4 with no significant changes of concern experienced due to the storms. One change in profile alignment was observed in UT 4 because of the extreme events experienced at the site, approximately 26-feet, in which a downed tree has created a log sill near the top of the enhancement level 1 reach. This sill has caused the channel to divert into

the right flood plain around established willows and re-enter the as-built alignment just downstream. A riffle is forming in the diversion. This segment is indicated on Figure 4 and is called out as an area of degradation in Table 5.

The following lists the key/potential problems identified through the project during Year 3 monitoring and how the issues have been resolved in Year 4:

- **Beaver dams within Reach 1** - Between March 10-13, 2018, three beavers were trapped and removed from Reach 1 and the dam breached. The beaver dam area was monitored during subsequent site visits for return of beavers and any stream impacts. It was subsequently determined that no beavers were remaining and that the channel was not self-restoring. It was further determined that restoration of the area would coincide with scheduled fall tree planting. As such, on November 1, 2018, a bobcat excavator was mobilized to the dam site and the dam was carefully removed to minimize impacts to established vegetation. The stream profile and section was restored to the as-built characteristics for approximately 20-feet of channel length upstream from the beaver dam under the direction of the engineer who conducted the original work. The dam debris was scattered along the upper floodplain of the stream and seeded with an appropriate vegetation seed mix. Willow live stakes were installed along the re-established channel banks. During a November 16, 2018 site visit, the dam restoration area was noted to be stable.

- **No defined channel for 30 feet portion of UT 2 (wetlands)** – During the June 19, 2018 IRT Site Visit, this stretch of channel in UT 2 was visited and observed to have a functioning and defined channel at the time. It was noted that photo documentation should be provided year round to show a defined channel structure during each season. Louis Berger field verified the portion of UT 2 that was in question in years past during the October/November field visit and determined that the length of channel in question is approximately 230 feet. A defined channel with flow was still observed for this section in question during the October/November field visit, however, due to the nature of the shallow valley slope in this area, additional water is observed in the interior floodplain as has been observed in years past. The consensus during the IRT Site Visit is that as trees mature in the area, additional water observed may begin to be taken up by evapotranspiration and the tree roots will help maintain the defined channel. Water monitoring observations indicated continuous flow of a period longer than 30-days during Year 4. Ongoing photo observations and water monitoring will continue for this area through project closeout.

- **48 feet of undercutting banks, 4-15 inches deep, along the interior left bank in Reach 3** – This area was discussed with the IRT during the June 19, 2018 site visit and deemed not a major concern with the established vegetation and Reach 3's connection to the floodplain. The undercutting has subsided some in Year 4 due to the multiple bankfull events that have occurred. This is no longer considered as an area of concern as the trees and vegetation have furthered reinforced the area in Year 4, and as observed in the October/November site visit, shown resiliency to major flooding events with no significant alterations.

- **Scoured banks along the portion of E1 in Reach 4** – This area was discussed with the IRT during the June 19, 2018 site visit and deemed not a major concern. Additionally, during the October/November site visit, it was observed that much of this area of scoured banks was actually within the general wet-season base flow channel. In monitoring years past, the channels were dry or with next to no water flow as stream assessments were conducted during the dry season of September. This was changed in Year 4 to observe the channels when they typically have water and flow within them.

- **Lateral point bars within UT 7 forming sinuous low flow channel** – As noted last year, the formation of these lateral point bars within UT 7 provided for a sinuous low flow within the restoration section and in-stream habitat. No changes were observed in UT 7 from Year 3 to Year 4 monitoring and the tributary is functioning as anticipated.

- **Piping of rock vane in step pool feature of UT 7** - The potential piping of the step pool features was monitored in Year 4 and it was determined that the piping is not occurring. The lower three step pool features were observed to be a riffle now in Year 4 following in-filling that occurred in earlier monitoring years, however, the upper three step pool features are still providing pool functionalities and habitat potential. No change has occurred with the step pool features in Year 4; these observations were made due to monitoring during periods of water flow. No change to the in-filled step pool features are proposed as the reach is stable and providing transport functionality for the water and sediment through the head drop.

The following lists the key/potential problems identified through the project during Year 4 monitoring:

- **Aggradation in Reach 1 Restoration section upstream of the Beaver Dam removal** - Due to the beaver dam, very fine material (gravel and sand) has settled out within the channel and interior flood bench upstream of the beaver dam. This was caused due to the backflow condition upstream of the beaver dam during flood events. This is evident in the Year 4 profile survey, MS-1P cross section, and with field observations. The material is very loose and it is evident that it has just recently settled out within the area. This aggradation was not removed during the beaver dam removal in Year 4 as it would cause significant damage to the very well established vegetation within the channel. Due the visual gradation of this material, it is believed that additional storm events will remove the majority of this material and allow the channel to rebound to its condition prior to the beaver establishing the dam. During a November 16, 2018 site visit, the dam restoration area was noted to be stable. On-going monitoring will be made for this area to observe any changes and determine if any field maintenance is required. Due to the timing in the monitoring period, it is likely no earthwork will be performed as the channel is still functioning.

Similar to Year 2 and 3 of monitoring, pebble count surveys were not conducted in the following cross sections during the 2018 monitoring event: UT2-1R, UT3-1R, UT3-1P, and UT3-2R. This was due to the channel being consistently lined with vegetation and silt/clay. This is expected to remain consistent for this intermittent stream as it does not have a large sediment supply of coarser material.

No future channel maintenance is required at this time for Year 5. Any maintenance work identified going forward will be limited to hand work to the maximum extent possible as heavy equipment can likely cause more damage than anticipated maintenance needs.

The stream restoration and enhancement areas are relatively stable and will continue to adjust somewhat in response to storm events. Gauge data throughout the site supports seven different bankfull events during the Year 4 monitoring period, including Hurricane Florence, which are supported by water monitoring gauges, observations of wrack debris outside of the top of bank and in the floodplain throughout the site, as well as photo documentation during the storm events. The in-stream structures are remaining stable and functioning as designed and have had no change in functionality since Year 3.

As commented by DMS in Year 2 and Year 3 and discussed with the IRT during the June 19, 2018 Site Visit, UT 2, UT 3, and UT 5 are being monitored to confirm continuous flow for 30 consecutive days within the intermittent streams. Table 13 provides documentation of the continuous flow periods for all areas, by gauge monitoring, for each monitoring year. All gauges but Gauge 11, including those in UT 2 and UT 3,

indicated a period of continuous flow for 30 days or more during Year 4 of monitoring, as observed in the water level plots of Figure 6a-6e, and summarized in Table 13. An additional stream gauge has been installed in UT 3 and an additional groundwater gauge has been installed in UT 2, as recommended by the IRT and DMS. These will be monitored through Year 5 for continuous flow. It should be noted, during the field personnel change, some gauges were missed in field downloads in trying to find the gauges during Year 4. This has resulted in short periods of data missing between July 2018 and September 2018 for Gauges 1, 2, 4, 6, and the site barologger. Additionally, the redeployment of Gauge 3 due to not finding the gauge (vegetation overgrowth) occurred in September 2018. Multiple efforts to find Gauge 3 with the use of a metal detector were made, but all were unsuccessful. As a result, the data was lost for this gauge during the Year 4 monitoring period. Manual compensation for all gauges for the period of July 2018 to November 2018 occurred using data provided by the Concord Regional Airport due to the missing data in the site barologger. Field personnel managing the site are now fully acclimated to the locations of all gauges and no additional data gaps should occur through project closeout.

An additional stream gauge was installed within UT 5 in September 2018, however has not shown continuous flow for 30 days since deployed. The tributary at the gauge was dry and showed no sign of flow during the October/November site visit, during a season of significant rainfall and flow. It is anticipated that UT 5 will not be considered at close out for credit generation, however, will continued to be monitored for flow at this time. It is believed that the stream credit requirements of the project will still be met without UT 5 due to additional work performed throughout the site. Louis Berger personnel completed the proper jurisdictional determination forms for UT5 in the site selection study. These forms were submitted as part of the proposal to DMS, as well as included in the final design reports to DMS. At the time of the assessment, UT5 was scored as an intermittent stream. The USACE provided a complimentary site walk and assessment with Louis Berger during the design as part of the mitigation plan, however, only the site walk occurred and there is no final documentation approving the jurisdictional determination of UT5 as an intermittent stream.

Due to the change in monitoring procedures required by DMS this year, UT 3 cross sections indicate unstable bank height ratios and channel. This, however, is caused by the use of the baseline cross sectional area as the consistent factor for determining bankfull elevations and channel parameters. The baseline values for most of UT 3 were determined in dry conditions, immediately following construction in which channel banks were cut back to leave a small 6-inch-deep by 1-foot wide channel throughout UT 3. This small channel was not sufficient for most of UT 3, specifically where the valley slopes increased to form a B6 type channel. Through Year 1, most of this constructed channel began to dissipate, and higher bankfull elevations were evident due to the presence of vegetation. Additionally, with the cattle encroachment in Year 2, this 6-inch deep channel was eradicated and a true B6 channel formed with the accretion of sediments. Since this event in Year 2, however, vegetation vigor within the channel and its banks has increased dramatically, providing a stable reach with consistent water flow during most of the year. Additionally, no additional accretion has been observed through Year 4 since the vegetation has established. This segment was discussed with the IRT at the June 19, 2018 meeting, in which they did not voice concerns with the stability of the channel, but more so the vegetation vigor and height of trees and the need for monitoring to document consistent flow. As such, the additional gauge was deployed. No corrective actions for UT 3 are required and on-going monitoring for consistent flow and photo documentation will be made as requested by the IRT.

1.5.3 Site Boundary Assessment

1.5.3.1 Easement Modification

In February 2018, DMS requested that the easement boundary at the cattle crossing be modified to remove a portion of the crossing from the easement due to changes in the installation of the crossing that occurred during construction. Subsequently, Louis Berger contracted Turner Land Surveying to conduct the modification. On April 13, 2018, Turner surveyed the area in question. On May 31, 2018, DMS was presented with three options for modifying the easement: Option 1: five new corners, Option 2: three new

corners, and Option 3: one new corner. On August 15, 2018, DMS selected Option 3. On September 24, 2018, DMS was presented the draft easement modification paperwork. On October 17, 2018, DMS returned the reviewed paperwork with edits. On October 24, 2018, the final easement modification paperwork was submitted to Blane Rice, State Property Office. On November 20, 2018, Mr. Rice responded that the paperwork was complete and that the State Property Office would handle the remaining steps. Mr. Rice reported the State Property Office's work queue had a two-month backlog. When the State Property Office has finalized the easement modification, Turner will erect the new corner monument. The area being removed from the conservation easement at the cattle crossing is depicted in the MY4 CCPV Plan (Figure 2a-2j). There is still no update on the approval from the State Property Office.

1.5.3.2 Encroachments

On April 12, 2018, a meeting was held with Allen Hammill, Marcus Howard, and Kenneth Strader to evaluate fencing alternatives for the cattle crossing. Subsequently, during June 5-7, 2018, Kenneth Strader re-enforced the cattle crossing fencing.

During Hurricane Florence (September 14-17, 2018), the cattle crossing fence was damaged by storm debris. The crossing was temporarily repaired with hog fencing while repair options were evaluated. During the September 17-21, 2018, vegetation survey, it was noted that five cows had gotten into the easement while the cattle crossing fence was damaged. On September 20, 2018, Marcus Howard was notified that cows were in the easement. Mr. Howard was not aware that cows had gotten into the easement and promised to have them removed immediately. On October 30, 2018, during the engineering survey, the cows were noted to be still within the fencing and DMS was immediately notified. Mr. Howard was again notified that the cows had not been removed as promised. As of November 5, 2018, Mr. Howard removed all five cows from the easement. On November 16, 2018, Louis Berger personnel verified that the cows had been removed from the easement.

Overall management of encroachment has significantly increased in Year 4; however, this single event resulted in cows within the easement in all reaches (with the exception of UT 5 and UT 6) upstream of the cattle crossing. No significant damage was observed due to this event, however, fresh cow pies and trails in the outer extents of the easement corridor were observed during the engineering monitoring event. Louis Berger intends to modify the crossing to incorporate a more manageable and cost effective fence with breakaway barbed wire across the stream. This has been discussed with the landowners and DMS as possible solution to allow for easier maintenance of the fence for the landowners after significant storm events. This will be implemented in the first Quarter of Year 5.

In addition to this event, DMS noted during the October/November field-monitoring event that the pond installed by Larry Hammill may be encroaching into the easement but they were not certain if grade manipulation had occurred or to what extent it had impacted the easement. Louis Berger evaluated this area while at the site in during the October/November monitoring event and determined that grading within the easement for the pond had not occurred, but that mowing may have resulted along a portion of the forested edge within the easement. In addition to the mowing, it was observed that the landowner has been using a point along the edge of the easement boundary off Kluttz Road for access. No trees have been planted in this portion of E2 by Louis Berger, and as such, the encroachment has been limited to the mowing of grasses in the historically maintained field. Louis Berger has maintained ongoing communications with all landowners and leaseholders for the property in attempts to stop ongoing encroachment issues and has informed Larry Hammill of these issues. The mowing event occurred during construction of the pond, prior to Louis Berger installing easement posts and signs along Larry Hammill's property in June 2018. Areas within the easement along Larry Hammill's property were visually untouched during the October/November site visit and assessments, indicating that mowing is no longer occurring within the easement not that the signs have been installed clearly indicating the easement boundary. Louis Berger will install metal wire along the installed posts going forward, as well as insure a post is installed along the corner of Kluttz Road to indicated where

access roads should not be used by Mr. Hammill to prevent future encroachment in this area. In addition, Mr. Hammill has installed pine trees along the edge of the conservation easement in the winter of 2018. This will prevent future mowing encroachment within the conservation easement property by providing a new forested boundary along the edge of the property. Mr. Hammill will be informed that all pines that were placed within the conservation easement boundary itself are now protected by the restrictions of the conservation easement and should not be cut and/or removed.

1.5.4 Monitoring Year 4 Conditions Assessment Summary

Streams

In summary, the site is performing as intended through MY4 and is meeting the required success criteria going into MY5 and project closeout. The site has experienced more than two bankfull events through MY4, as well as experienced bankfull events in each monitoring year. Cross sections, with the exception of isolated problem areas (such as the beaver dam in Reach 1 during MY4), show stability in channel dimensions through MY4. Small deviations have occurred since construction of the channel geometry; however, this is to be expected and is within reason of a stable and successful restoration project. Pattern features have remained consistent, with only minor changes occurring in short sections of channel reaches. Pattern feature changes observed have been directly identified as the result of natural occurrences within channels and are not related to failures in design. Channel profiles, following the events of MY2 with major cattle encroachment, remain consistent. Areas affected by the MY2 encroachment show increased signs of stability and improved vegetation coverage despite the encroachment incident. Areas within UT2 and UT3 that have formed linear wetland features due to aggradation have reformed channel form and profiles to provide water flow during MY4 and are being monitored through project closeout to show stabilization of channels. Lastly, bedform diversity and substrate/sediment transport measurements are as designed and indicated overall stability in the project through MY4.

Vegetation

Through MY4, planted woody species are meeting the density requirements of 288 stems/acre through 92 percent of the site. Additional plantings of larger species have been installed in the winter of 2018 in isolated areas showing lack of tree height or other deficiencies. A significant rebound in planted woody vigor has occurred between MY3 and MY4 thanks to the very wet season in MY4. Lastly, the site is continuously being monitored and treated for invasive species. As of the end of the MY4 monitoring period, the site is now 100% in compliance with vegetation monitoring requirements.

2.0 Methodology

Monitoring for stream stability, stream hydrology, and vegetation will be monitored annually for five years following the initial Baseline and As-Built Report. Annual monitoring requirements are based on the U.S. Army Corps of Engineers *Stream Mitigation Guidelines* document (USACE 2003) and supplemental requirements listed in the DMS *Stream and Wetland Mitigation Monitoring Guidelines* dated February 2014 (NCEEP 2014). Establishment, collection, and summarization of data collected was in accordance with the NCDEQ guidance document *EEP Annual Monitoring Report Format, Data Requirements, and Content Guidance* (April 2015). Additionally, DMS provided new bank height ratio calculation procedures (un-published) in 2018 to be implemented in MY4 and MY5, which modifies observations to maintain as-built bankfull area in determining bank height ratios versus as-built bankfull elevations.

2.1 Geomorphology

Surveys for Year 4 monitoring were conducted by Louis Berger in October/November 2018 using a Trimble M3 Total Station, geo referenced to North Carolina State Plane (NAD83-State Plane Feet-FIPS3200) with vertical datum North American Vertical Datum of 1988 (Feet NAVD88).

2.2 Longitudinal Profiles

A total of approximately 2950 feet of channel along 8 longitudinal profiles is being surveyed annually. This includes 335 feet on LBC Reach 1; 225 feet on LBC Reach 3; 112 feet on LBC Reach 4; 51 feet on UT 2; 771 feet on UT 3; 411 feet on UT 4; 977 feet on UT 7; and 62 feet on UT 8. Data collected from annual monitoring is being compared with the as-built conditions to document the current state of the channel and any trends in the stream profile occurring throughout the monitoring period. The start and finish locations of each cross-section and longitudinal profile are collected using a Total Station.

2.3 Cross Sections & Particle Size Distribution

A total of 15 cross-sections, including 9 riffles and 6 pools were installed upon completion of construction and are being monitored annually. Two additional cross-sections were added within the step-pool portion of UT 7 in monitoring Year 2. The total number of cross-sections includes five on the main stem of Little Buffalo Creek, one on UT 2, four on UT 3, two on UT 4, and five on UT 7.

Pebble count surveys were conducted at each cross section, unless noted otherwise in this report. Moving from bank to bank, particles were picked up blindly and at random and measured in millimeters. Enough samples were taken to get a representative sample of particle size distribution for each cross section. Sample size ranged from 50 in pool areas dominated by fines to 100 in flowing riffle areas with a diversity of particle sizes.

2.4 Vegetation Monitoring

The Carolina Vegetation Survey (CVS)-DMS entry tool database was used to calculate the number of monitoring plots needed based on project acreage. Louis Berger established twelve vegetation monitoring plots across all reaches and tributaries of the project area based on guidance given in the *CVS-DMS Protocol for Recording Vegetation Version 4.2* (Lee et al. 2008). Each plot measures approximately 0.025 acres individually and is staked out with bright orange painted rebar and marked with two upright sections of PVC pipe. Photos were taken of each plot and Year 3 monitoring data was entered into the CVS-DMS database under the Little Buffalo Creek Stream Mitigation Project (Project ID 94147). Additional PVC markers were added to plot corners during Year 2 in order to make corner stakes easier to find among the increasing herbaceous cover.

For a monitoring event, yellow rope is tied around the four corner stakes to mark out the plot. In Year 0, a GPS was used to collect coordinates of each stem and their position was measured in relation to the X and Y axis of the plot. Additionally, each stem was marked with pink flagging to make them easy to locate and identify during the next monitoring event. Flagging is re-applied each year. Planted stems were identified, measured, and given a vigor score ranging from 0 to 4 based on the CVS-DMS database. Naturally recruited stems were identified and tallied only if alive. These stems were not measured or given a vigor score. In 5 plots (3, 5, 7, 8, and 9), goldenrod, dog fennel, and blackberry were hand cleared from the plot to facilitate a more accurate count.

The 10 x 10 meter random transect plots were randomly placed in the vicinity of the anchoring vegetation plot. The random plot was established by running a measuring tape 10 meters in a random direction. With the first measuring tape laid down, a second measure tap was run out 10 meters, intersecting at a right angle with the first measuring tape at the 5 meter mark. All living stems over 1 foot in height were counted in the four 5 x 5 meter quadrants and aggregated for the 10 x 10 meter random plot. The locations of the random plots were noted but no permanent markings were placed on the ground. The random plot data was manually entered into a CVS-DMS database excel spreadsheet (retaining all formulas) to obtain stems/acre data comparable to the established vegetation monitoring plots.

2.5 Hydrological Monitoring

A total of 13 water level gauges are installed on site, including three groundwater monitoring gauges. The gauges are being monitored biannually to document the highest stage for the monitoring interval and verify occurrences of bankfull and geomorphically significant flow events. In addition, observations of wrack and depositional features in the floodplain, if present, are being documented with photos. In February 2016, two groundwater monitoring wells were installed at the top and bottom of UT 3 to provide additional hydrological data to demonstrate groundwater connectivity to the stream channel. In September 2018, an additional groundwater gauge was installed in UT 2 and an additional surface water gauge was installed in the mid-section of UT 3.

In addition to the event stage monitoring, the gauges are being utilized to monitor base flow for verification of water flow for a continuous 30-day period. Gauges are secured in place through PVC structures in channel pools (Reach 1, Reach 4, UT 4 and UT 7), or in the channel bed (UT 2, UT 3). Elevations are tied to the gauge structures, in which the thalweg invert elevation immediately downstream of the gauge is also monitored. Base flow is recorded when the elevation of water recorded by the gauge rises above the downstream thalweg control elevation.

A surface water gauge was installed in UT 5 during the Year 4 monitoring to monitoring for continuous flow, but was subsequently removed due to the data not showing continuous flow and the channel appearing dry during a wet year and season.

2.6 Photo Points & Visual Assessment

Permanent photo stations were established at each cross-section to digitally document annual conditions of the left and right banks. Each vegetation monitoring plot includes a photo station taken diagonally from a plot corner towards the opposite plot corner. Additional permanent photo locations have been established throughout the project area and can be found on the Current Conditions Plan View (CCPV) maps in Appendix A. Visual stream assessments are conducted during annual monitoring to summarize performance percentages of morphological and structural features. Visual vegetation assessments are also occurring to catalog the extent and type of vegetation issue as compared to the total planted acreage within the project site.

3.0 References

NCDEQ: DMS 2018. Bank Height Ratio Guidance – Unpublished

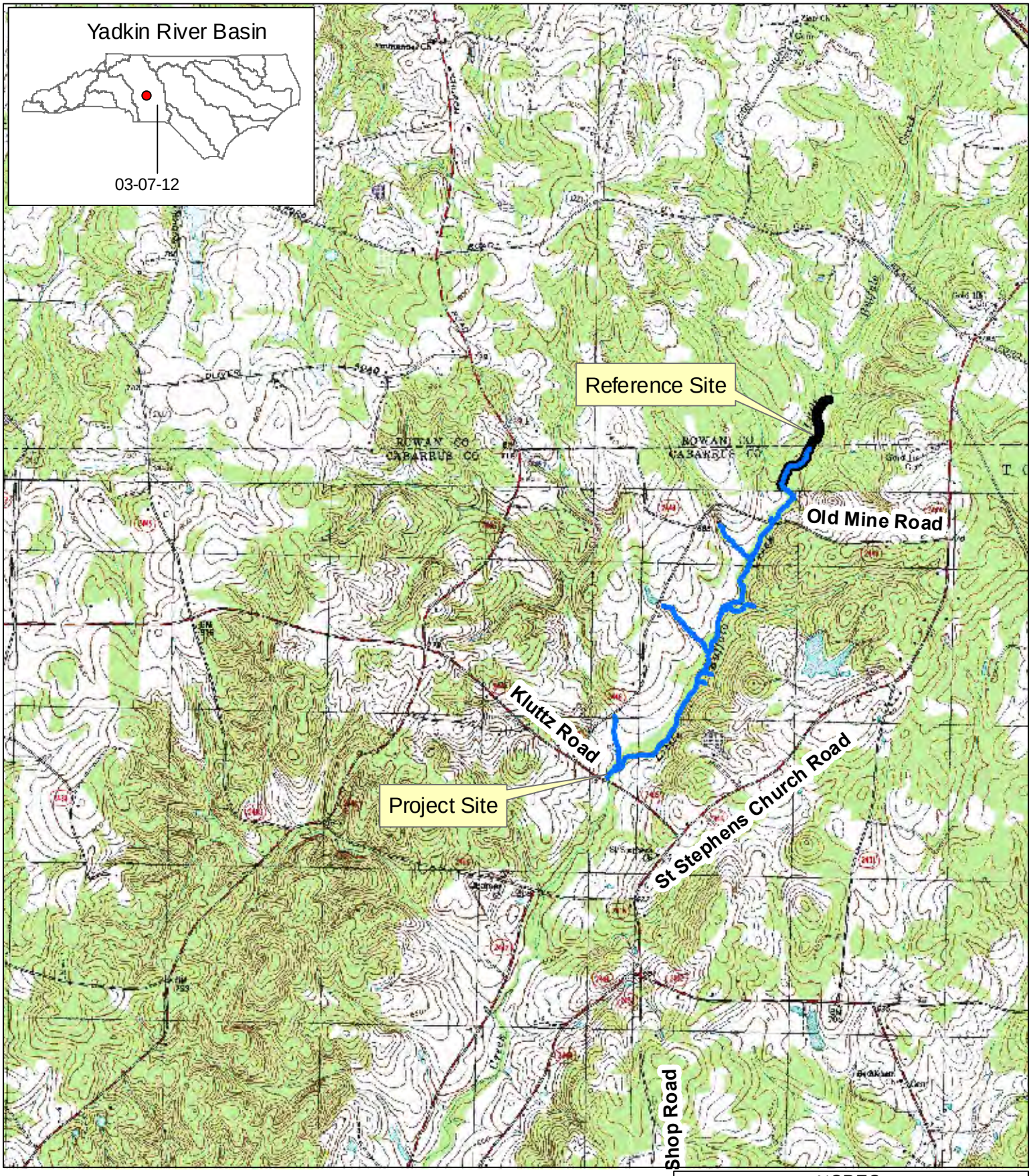
Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-DMS Protocol for Recording Vegetation, Version 4.2 (http://cvs.bio.unc.edu/methods.htm).

National Oceanic and Atmospheric Administration. Historical Palmer Drought Indices. December 2014 through November 2015. http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201412-201511/. Accessed October 2016.

North Carolina Ecosystem Enhancement Program 2014. *Stream and Wetland Mitigation Monitoring Guidelines*. February 2014. 7pp.

USACE 2003. Stream Mitigation Guidelines. Prepared by: USACE, NCDWQ, USEPA, NCWRC.

Appendix A – Project Vicinity Map & Background Tables



Legend

- Project Stream Segments
- Reference Reach

N

0 0.5 1 Miles

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

NCDEQ
Division of Mitigation Services

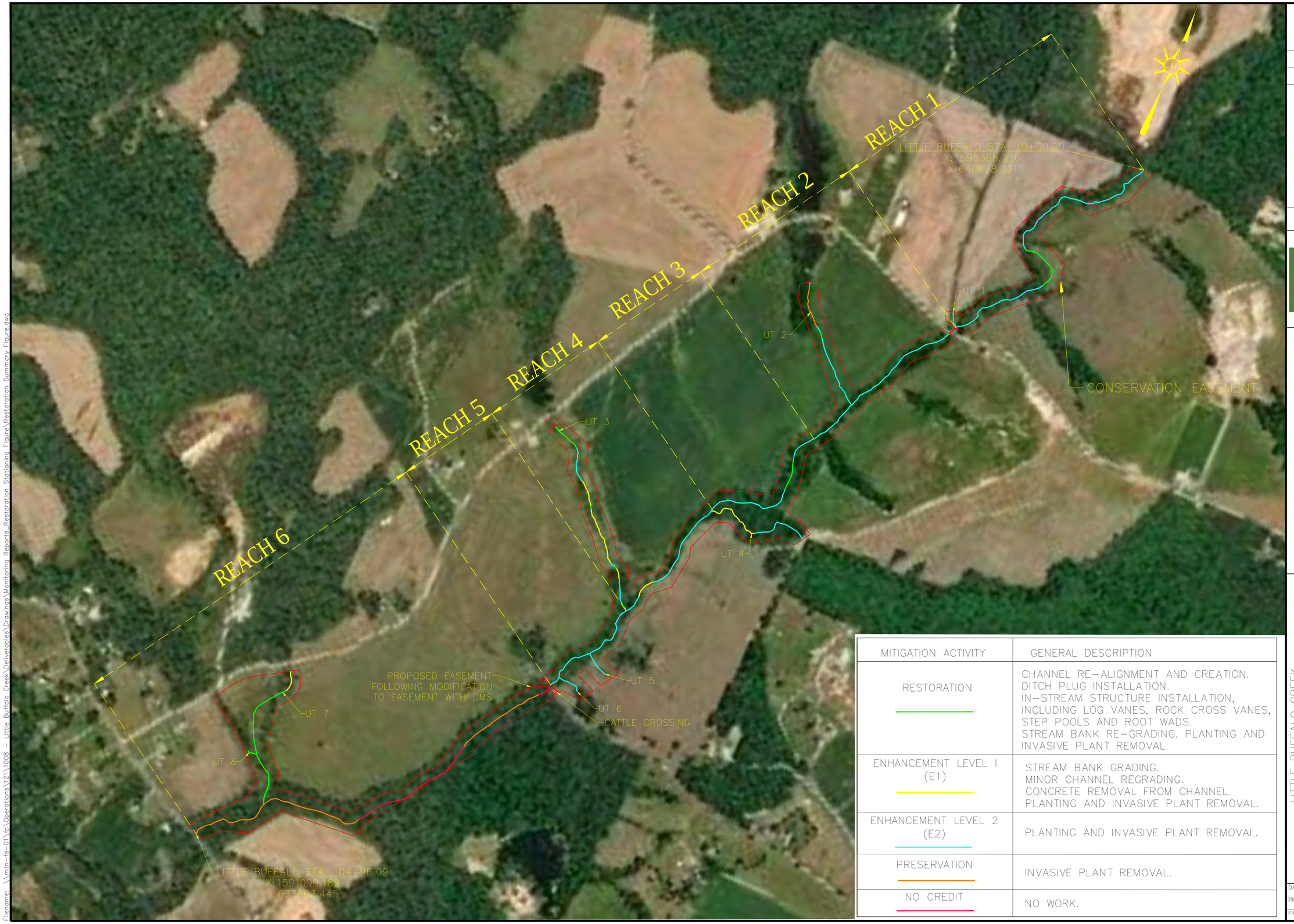
Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
DMS Project # 94147

Project Location Map

THE LOUIS BERGER GROUP
1001 Wade Avenue, Suite 400
Raleigh, NC 27605

Figure 1

November 2016



MITIGATION ACTIVITY	GENERAL DESCRIPTION
RESTORATION	CHANNEL RE-ALIGNMENT AND CREATION. DITCH PLUG INSTALLATION. IN-STREAM STRUCTURE INSTALLATION, INCLUDING LOG VANES, ROCK CROSS VANES, STEP POOLS AND ROOT WADS. STREAM BANK RE-GRADING. PLANTING AND INVASIVE PLANT REMOVAL.
ENHANCEMENT LEVEL I (E1)	STREAM BANK GRADING. MINOR CHANNEL REGRADING. CONCRETE REMOVAL FROM CHANNEL. PLANTING AND INVASIVE PLANT REMOVAL.
ENHANCEMENT LEVEL 2 (E2)	PLANTING AND INVASIVE PLANT REMOVAL.
PRESERVATION	INVASIVE PLANT REMOVAL.
NO CREDIT	NO WORK.

NO.	REVISIONS	DRN. CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

PROJECT COMPONENTS MAP

DATE MARCH 2019
PROJECT NO. 94147
FIGURE A1

Filename: \\rdu-fs-01\lp\Operations\121\1008 - Little Buffalo Creek\Deliverables\Drawings\Monitoring Reports_Restoration Stationing Figure\Restoration Summary Figure.dwg

Table 1. Project Components and Mitigation Credits
Little Buffalo Creek Stream Mitigation Project
DMS Project No. 94147

Mitigation Credit Summations

	Stream	Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset			
Overall Mitigation Units	6,411	0	0						

Project Components

Reach ID	Stationing	Existing Feet (linear feet)	Restoration Footage or Acreage	Restoration Level	Restoration or Rest Equiv.	Mitigation Ratio	Stream Mitigation Units	Notes
Reach 1	10+00 to 33+05	2,305	377 R 1928 EII	Restoration Enhancement Level II	N/A	Restoration 1:1 Enhancement Level II 2.5:1	1148	
Reach 2	33+66 to 46+10	1,244	1244 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	498	
Reach 3	46+10 to 56+93	1,083	244 R 839 EII	Restoration Enhancement Level II	N/A	Restoration 1:1 Enhancement Level II 2.5:1	580	
Reach 4	56+93 to 66+62	969	151 EI 818 EII	Enhancement Level I Enhancement Level II	N/A	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	428	
Reach 5	66+62 to 74+88	826	826 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	330	
Reach 6	75+19 to 82+55; 91+89 to 104+96	2,043	2,043 P	Preservation	N/A	Preservation 5:1	409	
UT 1	10+00 to 11+11	111	111 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	44	
UT 2	10+00 to 19+51	951	49 R 567 EII 335 P	Restoration Enhancement Level II Preservation	N/A	Restoration 1:1 Enhancement Level II 2.5:1 Preservation 5:1	343	
UT 3	10+00 to 24+75	1,475	305 R; 536 EI 634 EII	Restoration Enhancement Level I Enhancement Level II	N/A	Restoration 1:1 Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	916	There is the potential to increase stream mitigation units after
UT 4	100+00 to 18+31	831	410 EI 421 EII	Enhancement Level I Enhancement Level II	N/A	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	442	
UT 5	10+00 to 11+84	184	184 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	74	At risk to not get credit due to lack of continous flow.
UT 6	10+00 to 11+51	151	151 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	60	
UT 7	10+00 to 21+27	1,127	980 R 147 EI	Restoration Enhancement Level I	N/A	Restoration 1:1 Enhancement Level I 1.5:1	1078	
UT 8	10+19 to 10+81	62	62 R	Restoration	N/A	Restoration 1:1	62	

Note: Due to rounding some of the values when added may appear to be 1' short of total, this is purely a product of values being rounded to nearest linear foot

Length and Area Summations

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-riverine			
Restoration	2,017	N/A	N/A	N/A	201,700	N/A
Enhancement	N/A	N/A	N/A	N/A	N/A	N/A
Enhancement I	1,244	N/A	N/A	N/A	124,400	N/A
Enhancement II	7,723	N/A	N/A	N/A	772,300	N/A
Creation	N/A	N/A	N/A	N/A	N/A	N/A
Preservation	2,378	N/A	N/A	N/A	237,800	N/A
High Quality Preservation	N/A	N/A	N/A	N/A	N/A	N/A

BMP Elements

Element	Location	Purpose/Function	Notes

Table 2: Project Activity and Reporting History		
Little Buffalo Creek Stream Mitigation Project		
DMS Project No. 94147		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Technical Proposal	June 2009	August 2008
Categorical Exclusion	February 2010	March 2010
Secure Conservation Easement	March 2010	July 2012
Mitigation Plan	August 2010	April 2014
Final Design – Construction Plans	N/A	May 2014
Construction	June 2014	December 2014
Fencing Installation	June 2014	December 2014
Native Species Planting	December 2014	December 2014
Mitigation Plan / As-built (Year 0 Monitoring – Baseline)	March 2015	June 2015
Year 1 Monitoring	September 2015	December 2015
Replanting & Reseeding	N/A	February 2016
Year 2 Monitoring	September 2016	January 2017
Replanting & Reseeding	N/A	March 2017
Invasive Treatment	N/A	March 2017
Fence Repairs	N/A	December 2016
Construction Repairs	N/A	September 2016
Year 3 Monitoring	September 2017	February 2018
Beaver Trapped and Dam Breached	N/A	March 2018
Land Owner Coordination Meeting/Invasive Vegetation Walk Through/Soil Sample Collection	N/A	April 2018
Invasive Treatment - Spring	N/A	May 2018
Cattle Crossing and Fence Repairs	N/A	June 2018
IRT Site Visit and Additional Easement Sign Installation	N/A	June 2018
Invasive Treatment - Fall	N/A	September 2018
Beaver Dam Removal and Repair	N/A	November 2018
Replanting & Reseeding	N/A	November 2018
Year 4 Monitoring	Setpember - November 2018	Draft January 2019
Cattle Crossing Fence Repair and Ammendment	N/A	*February 2019
Year 5 Monitoring		

*:Estimated dates for maintenace activities.

Table 3: Project Contact Table Little Buffalo Creek Stream Mitigation Project DMS Project No. 94147	
Designer Primary Project Design POC	The Louis Berger Group, Inc. 1001 Wade Avenue, Suite 400 Raleigh, NC 27605 Edward Samanns (973) 407-1468
Construction Contractor **Construction contractor POC**	Backwater Environmental, Doug Smith P.O. Box 1107 Eden, NC 27289
Fencing Contractor	Strader Fencing Inc 5434 Amick Road Julian, NC 27283
Planting and Invasive Treatment Contractor	Carolina Sylvics 908 Indian Trail Edenton, NC 27932
Nursery Stock Suppliers	Mellow Marsh
	1312 Woody Store Rd.
	Siler City, NC 27344
	919-742-1200
	ArborGen Inc.
	2011 Broadbank Court
	Ridgeville, SC 29472
	843-851-4129
	Superior Trees Inc.
	12493 US-90
	Lee, FL 32059
	850-971-5159
Monitoring Performers	The Louis Berger Group, Inc. 1001 Wade Avenue, Suite 400 Raleigh, NC 27605
Stream Monitoring POC	Louis Berger Group, Inc., Robin Perez (919-866-4428)
Vegetation Monitoring POC	
Landowner Contact Information	Allen Hammill - landowner(704) 433-4656
	Larry Hammill - landowner (704) 202-3905
	Phil Cline - landowner (704) 791-6819
Farmhand Contact Information	Marcus Howard - farm operator (704)-322-0840
	Garrett – Marcus' cow handler (704) 785-6487

Table 4 Project Information			
Project Name	Little Buffalo Creek Stream Mitigation Project		
County	Cabarrus County		
Project Area (acres)	12		
Project Coordinates (latitude and longitude)	35.491041°N, . -80.366698° W.		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin-Pee Dee River		
USGS Hydrologic Unit 8-digit	3040105	USGS Hydrologic Unit 14-digit	3040105020060
DWQ Sub-basin	03-07-12		
Project Drainage Area (acres)	4,039		
Project Drainage Area Percentage of Impervious Area	5%		
CGIA Land Use Classification	Rural		
Thermal Regime	Warm		

Reach Summary Information (Mainstem)

Parameters	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Length of reach (linear feet)	2,305	1,244	1,083	969	826	2,043
Valley classification	Type 8	Type 8	Type 8	Type 8	Type 8	Type 8
Drainage area (acres)	1914	2146	2446	2568	2632	4039
NCDWQ stream identification score	37.5	37.5	37.5	37.5	37.5	37.5
NCDWQ Water Quality Classification	C	C	C	C	C	C
Morphological Description (stream type)	C4/F4	C4/E4	C4/F4	C4	C4/D4b	C4
Design Rosgen Stream Type	C4	C4	C4	C4	C4	C4
Evolutionary Trend						
Design Approach (P1, P2, P3, E, etc)	R; EII	EII	R; EII	EI; EII	EII	P
Underlying mapped soils	Chewacla/ Goldston	Chewacla	Chewacla	Chewacla	Chewacla	Chewacla
Drainage class	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained
Soil Hydric status	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric
Slope	0.48%	0.38%	0.51%	0.39%	0.47%	0.43%
FEMA classification	N/A	N/A	N/A	N/A	N/A	N/A
Native vegetation community	Pasture	Pasture	Pasture	Pasture	Pasture	Pasture
Percent composition of exotic invasive vegetation						

Reach Summary Information (Unnamed Tributaries

Parameters	UT 1	UT 2	UT 3	UT 4	UT 5	UT 6	UT 7/UT 8
Length of reach (linear feet)	111	951	1,475	831	184	151	1,127
Valley classification	N/A	Type 2	Type 2	Type 2	N/A	N/A	Type 8
Drainage area (acres)	293	193	62	254	8	16	1222
NCDWQ stream identification score	21	20	26.5	36.5	27.5	24.8	36.5
NCDWQ Water Quality Classification	C	C	C	C	C	C	C
Morphological Description (stream type)	N/A	B6	B6/G6	B4c	N/A	N/A	F4
Design Rosgen Stream Type	No Restoration	B6	B6	B4c	No Restoration	No Restoration	C4
Evolutionary Trend							
Design Approach (P1, P2, P3, E, etc)	EII	R; EII, P	R; EI; EII	EI; EII	EII	EII	R; EI
Underlying mapped soils	Chewacla	Chewacla	Badin/Georgeville	Goldston	Goldston	Goldston	Chewacla
Drainage class	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained
Soil Hydric status	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric
Slope	N/A	2.45%	2.35%	2.17%	N/A	N/A	0.96%
FEMA classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Native vegetation community	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Percent composition of exaotic invasive vegetation	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Wetland Summary Information

Parameters	Wetland 1	Wetland 2	Wetland 3
Size of Wetland (acres)	N/A	N/A	N/A
Wetland Type (non-riparian, riparian riverine or riparian	N/A	N/A	N/A
Mapped Soil Series	N/A	N/A	N/A
Drainage class	N/A	N/A	N/A
Soil Hydric Status	N/A	N/A	N/A
Source of Hydrology	N/A	N/A	N/A
Hydrologic Impairment	N/A	N/A	N/A
Native vegetation community	N/A	N/A	N/A
Percent composition of exotic invasive vegetation	N/A	N/A	N/A

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States – Section 404	Y	Y	Permit 2014-00386
Waters of the United States – Section 401	Y	Y	Letter from NCDENR dated February 24, 2015 Nationwide Permit Number 27
Endangered Species Act	Y	Y	Letter to USFWS dated November 16, 2009
Historic Preservation Act	Y	Y	Letter from NC SHPO dated February 2, 2010
Coastal Zone Management Act (CZMA)/ Coastal Area Management	N	N/A	N/A
FEMA Floodplain Compliance	Y	Y	FEMA Floodplain Checklist Restoration Plan Appendix 9
Essential Fisheries Habitat	N	N/A	N/A

Appendix B – Visual Assessment Data

Figures 2a-j – Integrated Current Condition Plan View – Monitoring Year 4

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

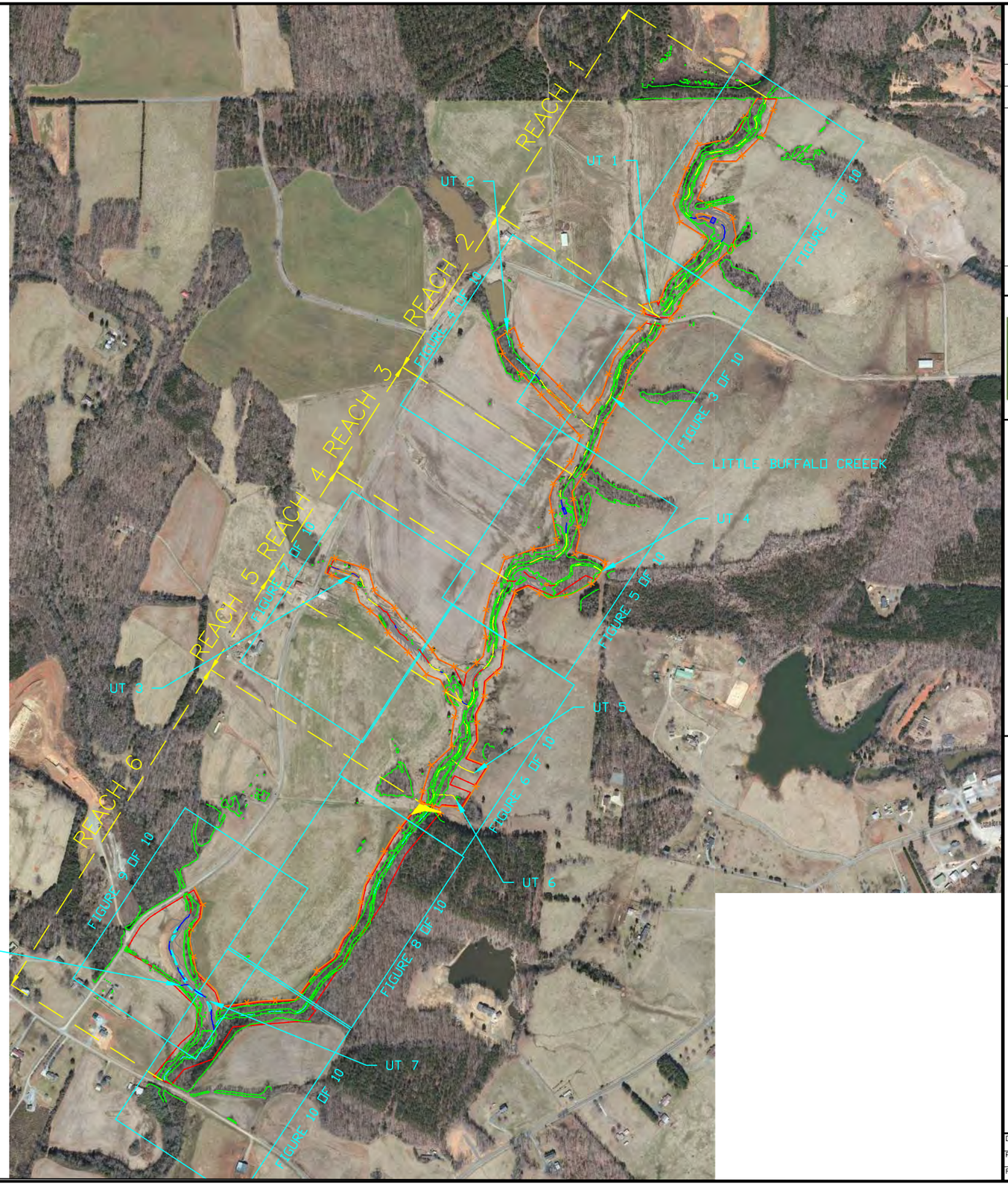
VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

0' 800' 1600'

SCALE: 1"= 800'



NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW -MY4-

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 1 OF 10

Filename: V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

BEGIN UPSTREAM
MAINSTEM RESTORATION
STA. 22+00
END E2

GAGE 1

BEGIN BEDROCK
EL: 638.68

END BEDROCK
EL: 638.56

VEGPLOT 12

PL 13

GATE

LITTLE BUFFALO STA. 10+00.00
BEGIN E2
X:1595368.236
Y:1640628.321

RANDOM VEGPLOT UPSTREAM

CROSS SECTION MS-1P

LITTLE BUFFALO CREEK

BEGIN BEDROCK
EL: 638.03

MY4 BEAVER DAM REMOVED
AND CHANNEL REPAIR

VEGPLOT 11

END BEDROCK
EL: 637.97

RANDOM VEGPLOT DOWNSTREAM

PL 12

CROSS SECTION MS-1R

ISOLATED EVENT OF
EASEMENT ENCROACHMENT
THROUGHOUT REACH 1 DURING
MY4, 5 COWS OBSERVED IN
CONSERVATION EASEMENT
AFTER HURRICANE FLORENCE.
COWS WERE REMOVED
APPROXIMATELY 6 WEEKS
LATER. NO DAMAGE OBSERVED.

END UPSTREAM
MAINSTEM RESTORATION
STA. 25+77.37
BEGIN E2

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT

- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\BC_CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

NO.	REVISIONS	DRN	CHK	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 2 OF 10

0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS–BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

UT-2 STA. 13+78.56
END E2
BEGIN RESTORATION

UT-2 STA. 13+34.67
END PRESERVATION
BEGIN E2

UT-2 STA. 14+27.35
END RESTORATION
BEGIN E2

CROSS SECTION UT2-1R

VEGPLOT 8

RANDOM VEGPLOT
DOWNSTREAM, OPPOSITE BANK

RANDOM VEGPLOT
DOWNSTREAM, SAME BANK

UT 2

LINEAR WETLAND LIKE FEATURE.
CHANNEL FORMATION IS
CONTINUING TO OCCUR.

GAGE 13

GAGE 3

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 2 AND UT2 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

PL 10

VEGPLOT 9

LITTLE BUFFALO CREEK

UT-1 STA. 11+10.63
LITTLE BUFFALO STA. 32+99
END UT-1 E2

OLD MINE RD

BOULDERS

UT-2 STA. 19+50.70
LITTLE BUFFALO STA. 42+43
END UT-2 E2

LITTLE BUFFALO STA. 33+66.34
BEGIN E2
BEGIN REACH 2

BEGIN UT-1 STA. 10+00.00
BEGIN E2

UT 1

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 1 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

VEGPLOT 10

PL 11

GATE

LITTLE BUFFALO STA. 33+04.88
END E2

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

NO.	REVISIONS	DRN	CHK	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE	MARCH 2019
PROJECT NO.	94147
FIGURE	3 OF 10

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

GAGE 2

UT-2 STA. 10+00.00
BEGIN PRESERVATION

PL 9

UT-2 STA. 13+78.56
END E2
BEGIN RESTORATION

UT-2 STA. 13+34.67
END PRESERVATION
BEGIN E2

UT-2 STA. 14+27.35
END RESTORATION
BEGIN E2

CROSS SECTION UT2-1R

VEGPLOT 8

RANDOM VEGPLOT
DOWNSTREAM, OPPOSITE BANK

RANDOM VEGPLOT
DOWNSTREAM, SAME BANK

UT 2
LINEAR WETLAND LIKE FEATURE.
CHANNEL FORMATION IS
CONTINUING TO OCCUR.

GAGE 3

GAGE 13

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 2 AND UT2 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

0' 100' 200'

SCALE: 1"= 100'

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 4 OF 10

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC_CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 4 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

UT-4 STA. 18+30.57
LITTLE BUFFALO STA. 56+93
END UT-4 E1

CROSS SECTION UT4-1R

BEGIN BEDROCK
EL: 624.94

END BEDROCK
EL: 624.30

VEGPLOT 4

PL 7

GATE

VEGPLOT 5

RANDOM VEGPLOT UPSTREAM

RANDOM VEGPLOT DOWNSTREAM

GAGE 4

CROSS SECTION UT4-1P

BAROLOGGER

UT 4

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT UT4 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

UT-4 STA. 14+21.25
END E2
BEGIN E1

UT-4 STA. 10+00.00
BEGIN E2

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 3 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

LITTLE BUFFALO CREEK

MY2 CHANNEL REPAIR

VEGPLOT 6

MY2 CHANNEL REPAIR

PL 8

LITTLE BUFFALO STA. 46+10
END REACH 2
BEGIN REACH 3

VEGPLOT 7

BEGIN DOWNSTREAM MAINSTEM RESTORATION
STA. 48+12.45
END E2

CROSS SECTION MS-2R

CROSS SECTION MS-2P

END DOWNSTREAM MAINSTEM RESTORATION
STA. 50+56.51
BEGIN E2

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

0' 100' 200'

SCALE: 1"= 100'

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%-40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 5 OF 10

Filename: V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT UT3 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

UT-3 STA. 20+21.97
END E1
BEGIN E2

UT 3

UT-3 STA. 21+29
END E2
BEGIN RESTORATION

UT-3 STA. 21+55
END RESTORATION
BEGIN E2

MY2 CHANNEL REPAIR

CONCRETE REMOVAL SECTION
STA.65+21.37
END E1 AREA

CONCRETE REMOVAL SECTION
STA. 63+70.48
BEGIN E1 AREA

UT-3 STA. 24+05
END E2
BEGIN RESTORATION

GAGE 7

CROSS SECTION MS-3P

PL 6

GAGE 10

LITTLE BUFFALO CREEK

CROSS SECTION UT3-3R

LITTLE BUFFALO STA.74+87.83
END E2

UT-6 STA. 11+51.33
LITTLE BUFFALO STA.74+06
END E2

UT-3 STA. 24+50
END RESTORATION
BEGIN E2

VEGPLOT 2

BEGIN BEDROCK
EL: 621.83

END BEDROCK
EL: 621.84

BEGIN BEDROCK
EL: 620.91

END BEDROCK
EL: 621.45

GAGE 5

PROPOSED EASEMENT MODIFICATION – PROPERTY REMOVAL PENDING STATE FINALIZATION

GATE

CATTLE GUARD

GATE

GATE

END BEDROCK
EL: 621.18

BEGIN BEDROCK
EL: 621.38

PL 4

GAGE 11

UT-3 STA.24+74.90
LITTLE BUFFALO STA.66+62
END UT-3 E2

UT-5 STA. 11+84.46
LITTLE BUFFALO STA.71+04
END UT-5 E2

ISOLATED EVENT OF EASEMENT ENCROACHMENT THROUGHOUT REACH 4 AND REACH 5 DURING MY4. 5 COWS OBSERVED IN CONSERVATION EASEMENT AFTER HURRICANE FLORENCE. COWS WERE REMOVED APPROXIMATELY 6 WEEKS LATER. NO DAMAGE OBSERVED.

UT-5 STA. 10+00.00
BEGIN E2

UT 6

UT 5

UT-6 STA. 10+00.00
BEGIN E2

LITTLE BUFFALO STA.75+19.23
BEGIN PRESERVATION

0' 100' 200'

SCALE: 1"= 100'

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 6 OF 10

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

0’ 100’ 200’

SCALE: 1”= 100’

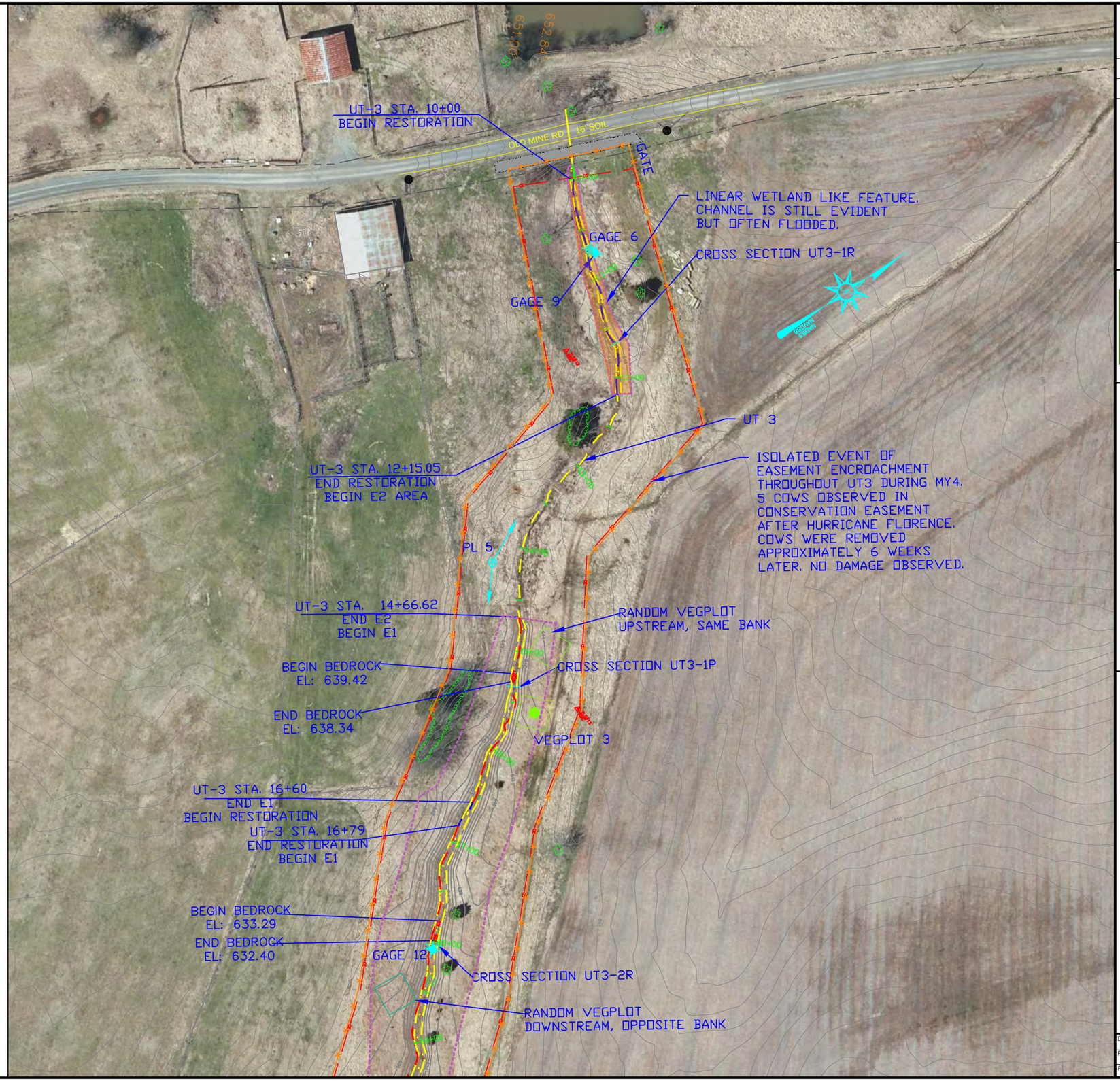
AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%-40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			



NO.	REVISIONS	DRN. CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW -MY4-

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 7 OF 10

Filename: V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Drawings\LBC_CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

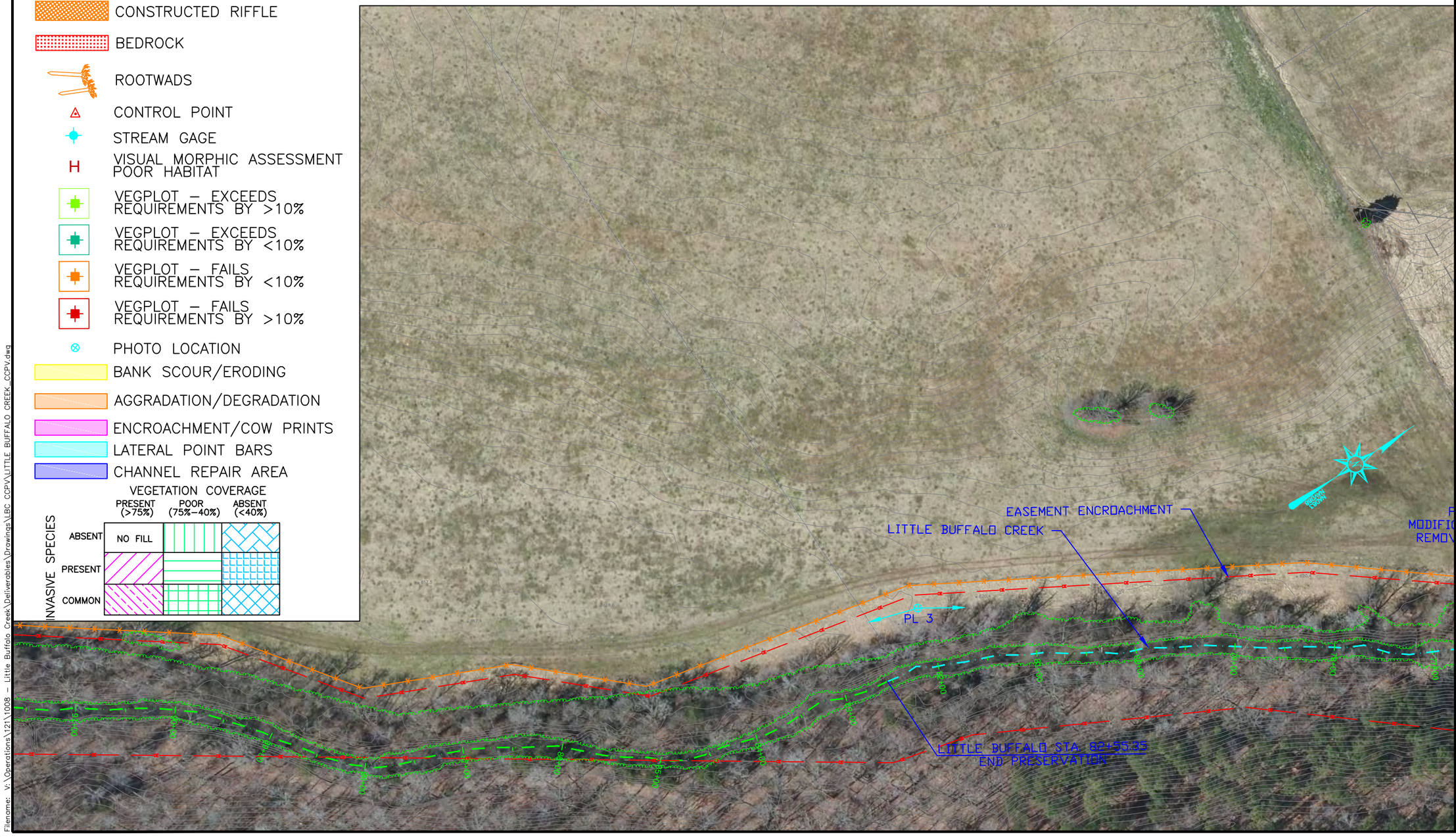
VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015



NO.	REVISIONS	DRN	CHK	DATE

NCDEQ-DMS

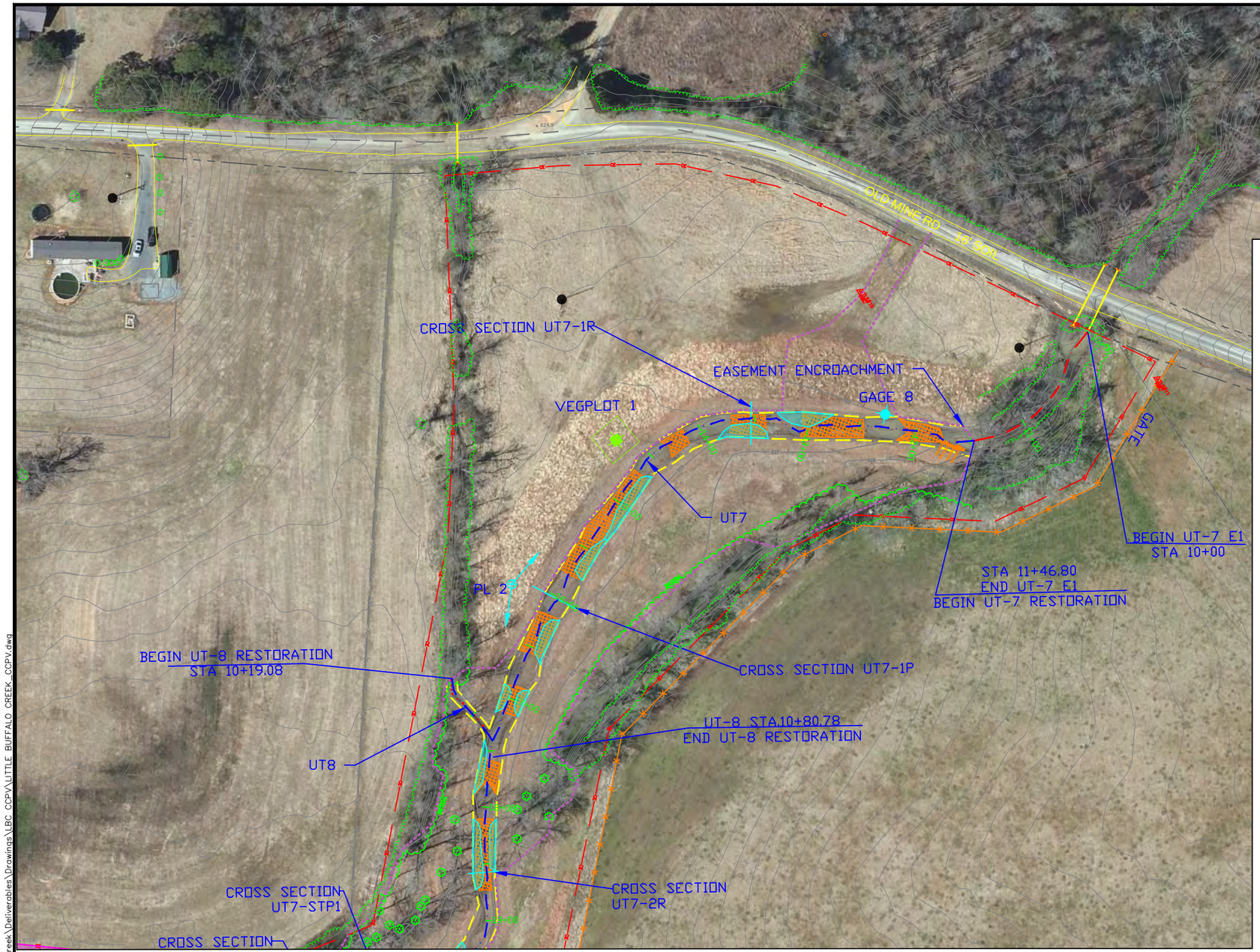
THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 8 OF 10

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC_CCPV\LITTLE BUFFALO CREEK_CCPV.dwg



AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

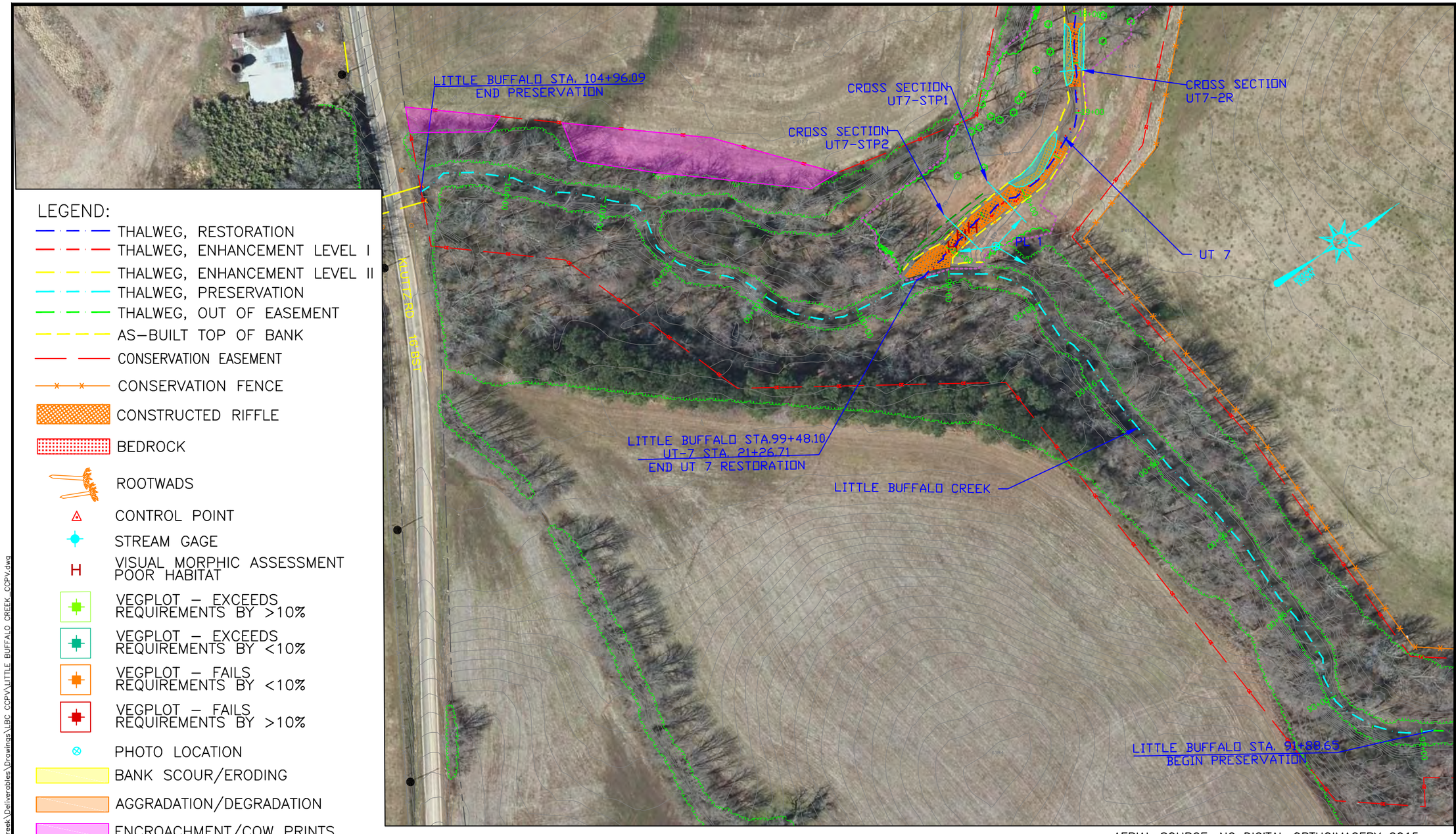
THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 9 OF 10

Filename: V:\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\BC_CCPV\LITTLE BUFFALO CREEK_CCPV.dwg



LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

0' 100' 200'

SCALE: 1"= 100'

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY4–

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 10 OF 10

Filename: V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

Tables 5a-g – Visual Stream Morphology Assessment

Reach ID Reach 1
Assessed Length 381

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation			1	114	70%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	5	6			83%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	3			100%			
		2. Length appropriate?	3	3			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	3	3			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	3	3			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	Log Vane structures installed incorrectly during construction, final as-built developed inner berm material overtop structures to bury the log vanes and have no structures within this reach.									

Reach ID Reach 3
Assessed Length 261

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	3	3			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	2	2			100%			
	2. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	2	2			100%			
	3. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	2	2			100%			

Reach ID Reach 4
Assessed Length 200

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	3	3			100%			
2. Bank	1. Scoured/Eroding	Visual point scour along small portion of bank within bankfull			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%

Reach ID UT 2

Assessed Length 279

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed[1]	1. Vertical Stability	1. Aggradation - No visual aggradation[1]			1	230	18%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	1	1			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
		Totals			0	0	100%	0	0	100%

1: The assessed length of UT2 for visual morphology has been limited to the portion of Enhancement Level I in the reach in past years. Assessed length has been increased to monitor a section of Enhancement Level II along the lower ends of UT2, measured in field at approximately 230 feet of stream, for a defined stream with flow. As of Year 4, a defined channel is present with flow. Seasonal photos and monitoring will be made through closeout.

Reach ID UT 3
Assessed Length 898

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation[1]			1	218	76%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	8	8			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%

1: Linear wetland feature accounted in aggradation reach segment at the top of UT3. A defined channel is clear and has been evident since construction, but is often flooded due to wetland like structure.

Reach ID UT 4
Assessed Length 410

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			1	26	94%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	8	8			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	3			100%			
		2. Length appropriate?	3	3			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	3	3			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	3	3			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth			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%

Reach ID UT 7/8
Assessed Length 1189

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - Lateral Point Bars have formed, but as expected due to the overwide channel design. Reach is in stable condition, so point bars were omitted from this section.			0	0	100%			
		2. Degradation - degradation in last curve pool before step pool system - occurred in MY 2, not included on MY4 CCPV and table, segement has stabilized			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	11	11			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	4			75%			
		2. Length appropriate?	4	4			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	4	4			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	4	4			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	9	9			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	9	9			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms. -DMS Identified piping in one rock vane in step pool feature	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	9	9			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.- step pools filled with large boulders from upstream of site, maintains small pools at low flow, but <1.6 Max to Mean Deptj	4	9			44%			

Tables 6a-i – Vegetation Condition Assessment Table

Table 6 Vegetation Condition Assessment

Reach 1

Planted Acreage **5.47**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	1	0.42	7.7%
			Total	0	0.42	7.7%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	1	0.42	7.7%

Easement Acreage **7.29**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in reach.	none	Pattern and Color	1	7.29	100.0%

Reach 2

Planted Acreage **2.85**

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

Easement Acreage **3.73**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in reach.	none	Pattern and Color	1	3.73	100.0%

Reach 3

Planted Acreage **2.65**

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

Easement Acreage **3.83**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in reach.	none	Pattern and Color	1	3.83	100.0%

Reach 4

Planted Acreage **2.26**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **3.1**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in reach.	none	Pattern and Color	1	3.10	100.0%

Reach 5

Planted Acreage **2.05**

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

Easement Acreage **2.74**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in reach. Crossing fence blown out during hurricane, temporarially repaired.	none	Pattern and Color	3	2.74	100.0%

UT 2

Planted Acreage **1.25**

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

Easement Acreage **2.65**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in trib.	none	Pattern and Color	1	2.65	100.0%

UT 3

Planted Acreage **3.21**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material. - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	3.21	100.0%

Easement Acreage **4.11**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in trib.	none	Pattern and Color	1	4.11	100.0%

UT 4

Planted Acreage **1.43**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Top of bank area bare where sheet flow washed seeding into channel	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **2.01**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Isolated event following hurricane with 5 cattle in easement and observed in trib.	none	Pattern and Color	1	2.01	100.0%

UT 7

Planted Acreage **2.63**

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

Easement Acreage **6.07**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas		none	Pattern and Color	0	0.00	0.0%

Photo Appendix A: Vegetation Monitoring Plots

Veg Plot 1

Veg Plot 2

Veg Plot 3

Veg Plot 4

Veg Plot 5

Veg Plot 6

Veg Plot 7

Veg Plot 8

Veg Plot 9

Veg Plot 10

Veg Plot 11

Veg Plot 12

Photo Appendix B: Cross Sections

Cross Section MS-1P Downstream

Cross Section MS-1P Upstream

Cross Section MS-1R Downstream

Cross Section MS-1R Upstream

Cross Section MS-2P Downstream

Cross Section MS-2P Upstream

Cross Section MS-2R Downstream

Cross Section MS-2R Upstream

Cross Section MS-3P Downstream

Cross Section MS-3P Upstream

Cross Section UT2-1R Downstream

Cross Section UT2-1R Upstream

Cross Section UT3-1P Downstream

Cross Section UT3-1P Upstream

Cross Section UT3-1R Downstream

Cross Section UT3-1R Upstream

Cross Section UT3-2R Downstream

Cross Section UT3-2R Upstream

Cross Section UT3-3R Downstream

Cross Section UT3-3R Upstream

Cross Section UT4-1P Downstream

Cross Section UT4-1P Upstream

Cross Section UT4-1R Downstream

Cross Section UT4-1R Upstream

Cross Section UT7-1P Downstream

Cross Section UT7-1P Upstream

Cross Section UT7-1R Downstream

Cross Section UT7-1R Upstream

Cross Section UT7-2R Downstream

Cross Section UT7-2R Upstream

Cross Section UT7-STP1 Downstream

Cross Section UT7-STP1 Upstream

Cross Section UT7-STP2 Downstream

Cross Section UT7-STP2 Upstream

Photo Appendix C: Photo Stations

Photo Location 1-A – Mainstem Upstream

Photo Location 1-B – Mainstem Downstream

Photo Location 1-C – UT7 Upstream

Photo Location 2-A – UT7 Upstream

Photo Location 2-B – UT7 Downstream

Photo Location 3-A - Upstream

Photo Location 3-B - Downstream

Photo Location 4-A – Upstream

Photo Location 4-B - Downstream

Photo Location 5-A - Downstream

Photo Location 5-B – Upstream

Photo Location 6-A – Mainstem Downstream

Photo Location 6-B – Mainstem Upstream

Photo Location 6-C – UT3 Upstream

Photo Location 7-A – Mainstem Downstream

Photo Location 7-B – UT4 Downstream

Photo Location 7-C – Mainstem Upstream

Photo Location 7-D – UT4 Upstream

Photo Location 8-A - Downstream

Photo Location 8-B - Upstream

Photo Location 9-A - Downstream

Photo Location 9-B – Upstream

Photo Location 10-A – Mainstem Downstream

Photo Location 10-B – Mainstem Upstream

Photo Location 10-C – UT2 Upstream

Photo Location 11-A –Downstream

Photo Location 11-B - Upstream

Photo Location 12-A - Downstream

Photo Location 12-B – Upstream

Photo Location 13-A – Downstream

Photo Location 13-B – Upstream

Photo Appendix D: Problem Areas

Bare spot (Copper Toxicity) in floodplain in Reach 1

Reach 1 before beaver dam clearing work taken in June 2018

Beaver dam in restoration area of Reach 1

Beaver dam removal from Reach 1 (beginning)

Beaver dam removal from Reach 1 (during project)

Beaver dam removal from Reach 1 (after removal)

Cows in UT3

Cow Trampling in Reach 2

Cow tracks in Reach 3

Cow tracks in Reach 5

Cow Pie in Reach 5

Cattle trail in Reach 5

Cow tracks in Reach 5

Cow tracks in Reach 5

Blown out cattle crossing (Reach 5)

Blown out cattle crossing (Reach 5)

Blown out cattle crossing (Reach 5)

Photo Appendix E: Significant Flow Events

Significant Flow in Reach 1, herbaceous vegetation bent over in floodplain
Photo taken in September 2018

Significant Flow in outskirts of Reach 1, vegetation bent over in floodplain
Photo taken in September 2018

Wrack line indicating high water levels
Photo take in September 2018

Dropped Debris from Hurricane in Reach 2

More Debris from Hurricane event in Reach 2

Flattened vegetation from hurricane flow event (Reach 2)

Evidence of Significant flow event on Reach 2 bank

Over flowing in Reach 3

Significant flow evidence in Reach 4

Hurricane flow damage in Reach 4

Debris in floodplain of UT 4


Flow debris in floodplain in Reach 5

Significant flow evidence in Reach 5

Debris settled in floodplain of UT2

Bent vegetation in floodplain of UT7

Bent vegetation in floodplain of UT7

Bent vegetation in floodplain of UT7

Bent vegetation in floodplain of UT7

Bent vegetation into easement fence from hurricane

Flooding over old mine road at UT7

Flooding at UT7 during Hurricane

Wrack line at cattle crossing from Hurricane

Appendix C – Vegetation Plot Data

Table 7 – Vegetation Plot Criteria Attainment

Plot	MY4 Success Criteria Met (Y/N)	Tract Mean
1	Y	92%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	N	
11	Y	
12	Y	

Table 8 - CVS Vegetation Plot Metadata

Report Prepared By	Gregory A. Russo
Date Prepared	12/26/2018 9:32
database name	cvs-eep-entrytool-v2.3.1.mdb
database location	C:\Users\grrusso\Desktop
computer name	MTN-GRUSSO7
file size	62984192

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 ste
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
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 e
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for e

PROJECT SUMMARY----------

Project Code	94147
project Name	Little Buffalo Creek Stream Mitigation Project
Description	Louis Berger is restoring the Little Buffalo Creek Stream Mitigation Site in Cabarrus County, North Carolina
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	48265.23781
Required Plots (calculated)	12
Sampled Plots	12

Table 9 - Planted and Total Stem Counts

EEP Project Code 94147. Project Name: Little Buffalo Creek Stream Mitigation Project

Current Plot Data (MY4 2018)

Scientific Name	Common Name	Species Type	94147-01-0001			94147-01-0002			94147-01-0003			94147-01-0004			94147-01-0005			94147-01-0006		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																		
Acer rubrum	red maple	Tree												2						
Alnus serrulata	hazel alder	Shrub																		
Baccharis halimifolia	eastern baccharis	Shrub																		
Carpinus caroliniana	American hornbeam	Tree																		
Celtis laevigata	sugarberry	Tree	2	2	2	1	1	1	3	3	3							3	3	3
Cercis canadensis	eastern redbud	Tree	1	1	1	1	1	1							1	1	1			
Diospyros virginiana	common persimmon	Tree																		
Fraxinus pennsylvanica	green ash	Tree				3	3	3							2	2	2	1	1	1
Ilex glabra	inkberry	Shrub																		
Juglans nigra	black walnut	Tree																		
Juniperus virginiana	eastern redcedar	Tree						3												
Liquidambar styraciflua	sweetgum	Tree			3									1			8	1	1	1
Liriodendron tulipifera	tuliptree	Tree										4	4	4						
Nyssa sylvatica	blackgum	Tree				1	1	1	1	1	1	1	1	1						
Pinus rigida	pitch pine	Tree																		
Pinus taeda	loblolly pine	Tree																		
Pinus virginiana	Virginia pine	Tree																		
Platanus occidentalis	American sycamore	Tree													3	3	3	7	7	7
Prunus serotina	black cherry	Tree															1			
Quercus falcata	southern red oak	Tree	2	2	2				1	1	1	1	1	1						
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	1	1	1	2	2	2	5	5	5				1	1	1
Rhus glabra	smooth sumac	shrub			4															
Sambucus	elderberry	Shrub																		
Sambucus canadensis	Common Elderberry	Shrub																		
Sassafras albidum	sassafras	Tree																		
Ulmus	elm	Tree												10						
Ulmus rubra	slippery elm	Tree																		
Viburnum dentatum	southern arrowwood	Shrub	2	2	2				1	1	1									
		Stem count	10	10	17	7	7	10	8	8	8	11	11	24	6	6	15	13	13	13
		size (ares)	0.83613			0.83613			0.83613			0.83613			0.83613			0.83613		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	7	5	5	6	5	5	5	4	4	7	3	3	5	5	5	5
		Stems per ACRE	484	484	822.8	338.8	338.8	484	387.2	387.2	387.2	532.4	532.4	1162	290.4	290.4	726	629.2	629.2	629.2

Scientific Name	94147-01-0007			94147-01-0008			94147-01-0009			94147-01-0010			94147-01-0011			94147-01-0012		
	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	3	3	3															
Acer rubrum			1															7
Alnus serrulata													2	2	2			
Baccharis halimifolia																		
Carpinus caroliniana																1	1	1
Celtis laevigata	3	3	3	4	4	4	7	7	7	1	1	1	2	2	2	6	6	6
Cercis canadensis				3	3	3	1	1	1									
Diospyros virginiana																		1
Fraxinus pennsylvanica	1	1	1															
Ilex glabra																		1
Juglans nigra																		
Juniperus virginiana			1			1												2
Liquidambar styraciflua						7									1			5
Liriodendron tulipifera							1	1	1									
Nyssa sylvatica	4	4	4	2	2	2	2	2	2	1	1	1				1	1	1
Pinus rigida																		
Pinus taeda															16			1
Pinus virginiana																		1
Platanus occidentalis							2	2	2	2	2	2	1	1	1	1	1	1
Prunus serotina	1	1	1															
Quercus falcata	1	1	1	3	3	3	1	1	1									
Quercus michauxii	3	3	3	7	7	7	4	4	4	1	1	1	2	2	2	5	5	5
Rhus glabra																		1
Sambucus																		2
Sambucus canadensis																		
Sassafras albidum																		
Ulmus																		
Ulmus rubra																		
Viburnum dentatum																		
Stem count	16	16	18	19	19	27	18	18	18	5	5	5	7	7	24	14	14	35
size (ares)	0.83613			0.83613			0.83613			0.83613			0.83613			0.83613		
size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
Species count	7	7	9	5	5	7	7	7	7	4	4	4	4	4	6	5	5	14
Stems per ACRE	774.4	774.4	871.2	919.6	919.6	1307	871.2	871.2	871.2	242	242	242	338.8	338.8	1162	677.6	677.6	1693.9947

Annual Means

Scientific Name	MY4 (2018)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2014)		
	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	3	3	3			5			2						
Acer rubrum			10			5			3			4			
Alnus serrulata	2	2	2	2	2	2	5	5	5	5	5	5	13	13	13
Baccharis halimifolia						1									
Carpinus caroliniana	1	1	1	1	1	1	8	8	8	14	14	14	11	11	11
Celtis laevigata	32	32	32	14	14	14	13	13	13	4	4	4	29	29	29
Cercis canadensis	7	7	7	7	7	7	7	7	7	4	4	4	13	13	13
Diospyros virginiana			1			1									
Fraxinus pennsylvanica	7	7	7	8	8	9	14	14	14	7	7	7	14	14	14
Ilex glabra			1												
Juglans nigra									6						
Juniperus virginiana			7			4			3			1			
Liquidambar styraciflua	1	1	26			47			108			254			
Liriodendron tulipifera	5	5	5	6	6	7	5	5	7	10	10	13	19	19	19
Nyssa sylvatica	13	13	13	12	12	12									
Pinus rigida									3						
Pinus taeda			17			12									
Pinus virginiana			1									1			
Platanus occidentalis	16	16	16	10	10	28	12	12	27	10	10	52	16	16	16
Prunus serotina	1	1	2												
Quercus falcata	9	9	9	8	8	8	20	20	24	4	4	6	7	7	7
Quercus michauxii	34	34	34	26	26	26	8	8	8	6	6	6	10	10	10
Rhus glabra			5			3									
Sambucus			2						8						
Sambucus canadensis						3									
Sassafras albidum						1									
Ulmus			10												
Ulmus rubra						16			1						
Viburnum dentatum	3	3	3	5	5	5	6	6	6	6	6	6	11	11	11
Stem count	134	134	214	99	99	217	98	98	253	70	70	377	143	143	143
size (ares)	10.03356			10.03356			10.03356			10.03356			10.03356		
size (ACRES)	0.25			0.25			0.25			0.25			0.25		
Species count	14	14	23	11	11	22	10	10	18	10	10	14	10	10	10
Stems per ACRE	540.5	540.5	863.1	399.3	399.3	875.2	395.3	395.3	1020	282.3324	282.3324	1520.562	576.7648	576.7648	576.7648

Type = Tree, Shrub, Livestake
P = Planted
T = Total

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%

Appendix D – Stream Measurement & Geomorphology Data

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					45.55	56.61	52.02	82.98	14.98	5	43.1	52.2	50.6	64.4	8.8	4	36	36	36	35.21	35.21	35.21	35.21		1
Floodprone Width (ft)					67.73	106.5	96.36	177.3	43.15	5	54.9	75.3	74.3	98	15.4	4	>88	>88	>88	>80	>80	>80	>80		1
Bankfull Mean Depth (ft)					0.65	1.18	1.24	1.6	0.35	5	0.98	1.16	1.1	1.38	0.18	4	0.96	0.96	0.96	1.23	1.23	1.23	1.23		1
[1]Bankfull Max Depth (ft)					2.54	3.04	2.8	3.83	0.58	5	2.17	2.41	2.5	2.5	0.14	4	1.5	1.5	1.5	1.79	1.79	1.79	1.79		1
Bankfull Cross Sectional Area (ft^2)					53.58	63.29	59.12	83.09	11.52	5	55.4	59.3	58.7	64.5	3.36	4	34.38	34.38	34.38	43.15	43.15	43.15	43.15		1
Width/Depth Ratio					32.51	56.56	40.56	127.7	40.14	5	31.3	47	46.2	64.4	14.35	4	37.5	37.5	37.5	28.73	28.73	28.73	28.73		1
Entrenchment Ratio					1.49	1.84	1.92	2.17	0.33	5	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio					**0.91**	**1.09**		**1.37**								**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		**1**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	35	40	50	7.73	23.71	22.04	38.44		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.003	0.014	0.028	0	0.026	0.022	0.076		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	20	20	4.21	25.43	17.55	83.2		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	1.5	1.81	1.81	1.96	2.71	2.48	3.76		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	80	125	170	29.95	48.64	39.06	91.87		
Pattern																									
Channel Beltwidth (ft)																	84	84	84	59.64	105.8	92.68	165.2		
Radius of Curvature (ft)																	57.62	79.3	101	72.97	83.15	79.01	97.49		
Rc:Bankfull width (ft/ft)																	**35.24**	**36**	**69.62**	**27.95**	**35.6**	**36.13**	**46.36**		
Meander Wavelength (ft)																									
Meander Width Ratio																	1.21	2.33	2.38	1.29	3.04	2.57	5.91		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.334											0.32				0.322			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							C4						C4					C4				C4			
Bankfull Velocity (fps)							1.82											4.36				3.48			
Bankfull Discharge (cfs)							115																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					2293.33				2299.79			
Sinuosity (ft)							1.05						1.25					1.05				1.05			
Water Surface Slope (Channel) (ft/ft)													0.38												
BF slope (ft/ft)													**0.38**												
[3]Bankfull Floodplain Area (acres)																		**0.45**				**0.3959**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

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

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

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

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					34.42	41.48	41.54	48.48	7.03	3	43.1	52.2	50.6	64.4	8.8	4	40	40	40	38.31	38.31	38.31	38.31		1
Floodprone Width (ft)					258.2	265.4	265.4	272.6	7.21	3	54.9	75.3	74.3	98	15.4	4	>88	>88	>88	>90	>90	>90	>90		1
Bankfull Mean Depth (ft)					1.2	1.47	1.42	1.8	0.3	3	0.98	1.16	1.1	1.38	0.18	4	1.58	1.58	1.58	1.26	1.26	1.26	1.26		1
[1]Bankfull Max Depth (ft)					2.47	2.78	2.79	3.09	0.31	3	2.17	2.41	2.5	2.5	0.14	4	2	2	2	1.9	1.9	1.9	1.9		1
Bankfull Cross Sectional Area (ft^2)					58.33	59.79	58.96	62.09	2.01	3	55.4	59.3	58.7	64.5	3.36	4	63	63	63	48.23	48.23	48.23	48.23		1
Width/Depth Ratio					19.12	29.59	29.25	40.4	10.64	3	31.3	47	46.2	64.4	14.35	4	39.87	39.87	39.87	30.43	30.43	30.43	30.43		1
Entrenchment Ratio					5.33	6.53	6.56	7.71	1.19	3	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio					**1.94**	**2.19**		**2.43**								**4**	**1**	**1**	**1**	**0.94**	**0.94**	**0.94**	**0.94**		**1**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	15	30	65	11.3	18.65	20.99	21.31		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.017	0.027	0.033	0.018	0.05	0.024	0.134		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	15	20	6.32	12.33	10.63	21.53		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	2	2.25	2.5	0.5	1.13	1.26	1.69		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	70	70	70	36.04	45.42	46.77	53.33		
Pattern																									
Channel Beltwidth (ft)																				58.77	58.77	58.77	58.77		
Radius of Curvature (ft)																				83.8	83.8	83.8	83.8		
Rc:Bankfull width (ft/ft)																				**4.58**	**15.65**	**16.52**	**23.05**		
Meander Wavelength (ft)																									
Meander Width Ratio																				2.55	5.2	3.56	12.83		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.619											0.516				0.199			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							C4						C4					C4				C4			
Bankfull Velocity (fps)							2.73											3.03				3.96			
Bankfull Discharge (cfs)							163																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					1030.85				1079.45			
Sinuosity (ft)							1.13						1.25					1.05				1.01			
Water Surface Slope (Channel) (ft/ft)													0.38												
BF slope (ft/ft)													**0.38**												
[3]Bankfull Floodplain Area (acres)																		**0.49**				**0.074**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

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

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

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

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 2 (951 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																	4	4	4	3.52	3.52	3.52	3.52		1
Floodprone Width (ft)																	7	7	7	8.34	8.34	8.34	8.34		1
Bankfull Mean Depth (ft)																	0.47	0.47	0.47	0.52	0.52	0.52	0.52		1
[1]Bankfull Max Depth (ft)																	0.75	0.75	0.75	0.72	0.72	0.72	0.72		1
Bankfull Cross Sectional Area (ft^2)																	1.88	1.88	1.88	1.82	1.82	1.82	1.82		1
Width/Depth Ratio																	8.51	8.51	8.51	6.82	6.82	6.82	6.82		1
Entrenchment Ratio																	1.75	1.75	1.75	2.37	2.37	2.37	2.37		1
[1]Bank Height Ratio																	**1**	**1**	**1**	**1.01**	**1.01**	**1.01**	**1.01**		**1**
Profile																									
Riffle Length (ft)																	51.74	51.74	51.74	6.98	13.52	13.52	20.07		
Riffle Slope (ft/ft)																	0.024	0.024	0.024	0.01	0.013	0.013	0.016		
Pool Length (ft)																				12.76	12.76	12.76	12.76		
Pool Max depth (ft)																				0.89	0.89	0.89	0.89		
Pool Spacing (ft)																				30.63	30.63	30.63	30.63		
Pattern																									
Channel Beltwidth (ft)																									
Radius of Curvature (ft)																									
Rc:Bankfull width (ft/ft)																									
Meander Wavelength (ft)																									
Meander Width Ratio																									
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																	0.571			0.249					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																	B6			B6					
Bankfull Velocity (fps)																				1.66					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																	951			951.37					
Sinuosity (ft)																				0.96					
Water Surface Slope (Channel) (ft/ft)																									
BF slope (ft/ft)																									
[3]Bankfull Floodplain Area (acres)																									
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

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

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

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

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 3 (1,475 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																	4	4	4	3.5	4.38	3.73	5.91		3
Floodprone Width (ft)																	7	7	7	6.35	14.65	13.14	24.45		3
Bankfull Mean Depth (ft)																	0.47	0.47	0.47	0.2	0.34	0.29	0.53		3
[1]Bankfull Max Depth (ft)																	0.75	0.75	0.75	0.31	0.58	0.61	0.82		3
Bankfull Cross Sectional Area (ft^2)																	1.88	1.88	1.88	0.75	1.43	1.69	1.84		3
Width/Depth Ratio																	8.51	8.51	8.51	6.66	15.31	18.61	20.67		3
Entrenchment Ratio																	1.75	1.75	1.75	1.7	3.64	2.22	6.99		3
[1]Bank Height Ratio																	**1**	**1**	**1**	**0.54**	**0.64**	**0.64**	**0.74**		**3**
Profile																									
Riffle Length (ft)																	197.1	355.9	514.7	57.25	107.8	89.01	215.1		
Riffle Slope (ft/ft)																	0.006	0.012	0.044	0.011	0.017	0.014	0.029		
Pool Length (ft)																				1.5	12.97	6.04	31.37		
Pool Max depth (ft)																				4.14	4.46	4.61	4.62		
Pool Spacing (ft)																				114.3	133.6	143.3	143.3		
Pattern																									
Channel Beltwidth (ft)																	50.42	59.15	61.2	13.4	34.2	42.73	46.46		
Radius of Curvature (ft)																				21.64	35.62	35.15	50.55		
Rc:Bankfull width (ft/ft)																				**2.38**	**15.62**	**14.63**	**30.84**		
Meander Wavelength (ft)																									
Meander Width Ratio																				0.43	5.37	2.44	19.52		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																	0.285			0.29					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																	B6			B6					
Bankfull Velocity (fps)																				1.47					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																	1475			1469.07					
Sinuosity (ft)																				0.95					
Water Surface Slope (Channel) (ft/ft)																				0.019					
BF slope (ft/ft)																				**0.019**					
[3]Bankfull Floodplain Area (acres)																				**0.84**					
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

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

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

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

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 4 (831 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																				13.32	13.32	13.32	13.32		1
Floodprone Width (ft)																				>50	>50	>50	>50		1
Bankfull Mean Depth (ft)																				0.91	0.91	0.91	0.91		1
[1]Bankfull Max Depth (ft)																				1.71	1.71	1.71	1.71		1
Bankfull Cross Sectional Area (ft^2)																				12.13	12.13	12.13	12.13		1
Width/Depth Ratio																				14.63	14.63	14.63	14.63		1
Entrenchment Ratio																				>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio																				**0.6**	**0.6**	**0.6**	**0.6**		**1**
Profile																									
Riffle Length (ft)																				4.74	19.81	21.81	30.73		
Riffle Slope (ft/ft)																				0.012	0.027	0.018	0.074		
Pool Length (ft)																				6.99	12.56	9.1	26.02		
Pool Max depth (ft)																				1.89	2.28	2.32	2.7		
Pool Spacing (ft)																				50.06	56.72	55.31	68.08		
Pattern																									
Channel Beltwidth (ft)																				80.13	98.47	98.47	116.8		
Radius of Curvature (ft)																				36.7	47.23	49.01	56.95		
Rc:Bankfull width (ft/ft)																				**16.34**	**19.23**	**18.89**	**23.76**		
Meander Wavelength (ft)																				221.95	221.95	221.95	221.95		
Meander Width Ratio																				3.37	5.19	4.91	7.15		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																				1.35					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																				C4b					
Bankfull Velocity (fps)																				4.23					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																				830.01					
Sinuosity (ft)																				0.806					
Water Surface Slope (Channel) (ft/ft)																									
BF slope (ft/ft)																									
[3]Bankfull Floodplain Area (acres)																				**0.03**					
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 7 (1,127 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					20.47	26.07	26.81	30.18	4.06	4	43.1	52.2	50.6	64.4	8.8	4	25	25	25	18.58	19.65	19.65	20.71		2
Floodprone Width (ft)					39.2	54.4	43.82	90.77	24.57	4	54.9	75.3	74.3	98	15.4	4	>55	>55	>55	>80			>100		2
Bankfull Mean Depth (ft)					0.85	1	1	1.17	0.13	4	0.98	1.16	1.1	1.38	0.18	4	0.98	0.98	0.98	0.96	1.07	1.07	1.17		2
[1]Bankfull Max Depth (ft)					1.79	2.16	1.94	2.95	0.54	4	2.17	2.41	2.5	2.5	0.14	4	1.13	1.13	1.13	1.17	1.43	1.43	1.69		2
Bankfull Cross Sectional Area (ft^2)					19.96	26.07	26.67	31	5.47	4	55.4	59.3	58.7	64.5	3.36	4	24.44	24.44	24.44	19.93	20.81	20.81	21.68		2
Width/Depth Ratio					20.89	26.33	26.3	31.81	5.33	4	31.3	47	46.2	64.4	14.35	4	25.51	25.51	25.51	15.92	18.72	18.72	21.52		2
Entrenchment Ratio					1.45	2.07	1.92	3.01	0.75	4	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		2
[1]Bank Height Ratio																**4**	**1**	**1**	**1**	**0.78**	**0.85**	**0.85**	**0.92**		**2**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	10	35	60	9.79	36.53	37.12	54.31		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.008	0.01	0.01	0.001	0.014	0.013	0.039		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	10	20	8.16	15.87	13.77	28.95		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	1.5	2	2	1	2.05	2.04	2.85		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	15	55	100	13.27	54.36	56.47	130.7		
Pattern																									
Channel Beltwidth (ft)																	201	201	201	154.6	209.3	209.3	264		
Radius of Curvature (ft)																	50	137.5	686	90.88	194.3	125.7	434.9		
Rc:Bankfull width (ft/ft)																	**28**	**31.5**	**31**	**15.71**	**20.53**	**21.99**	**22.62**		
Meander Wavelength (ft)																	720	720	720	687.9	687.9	687.9	687.9		
Meander Width Ratio																	6.48	6.38	7.18	9.838	10.19	9.514	11.67		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.479											0.407				0.358			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							F4/C4						C4					C4				C4			
Bankfull Velocity (fps)							3.7											3.93				4.61			
Bankfull Discharge (cfs)							96																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					1110.53				1126.71			
Sinuosity (ft)													1.25					1.21				1.23			
Water Surface Slope (Channel) (ft/ft)													0.38					0.006				0.006			
BF slope (ft/ft)													**0.38**					**0.006**				**0.005**			
[3]Bankfull Floodplain Area (acres)																		**0.459**				**5.35**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															41.8	25.4	19.4	13.4	0			30.5	14.7	36.8	18	0		
[1]SC% / Sa% / G% / C% / B% / Be%	26	22.1	51.9	0	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.69	2.33	10.3	21.3			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															41.3	13	13	32.7	0			25.8	20.2	26	28	0		
[1]SC% / Sa% / G% / C% / B% / Be%	17	20	41	22	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.06	0.9	12.5	94.2	159			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	5	95	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						98	2	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 4 (969 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%	40.9	28.8	11.7	18.6	0																	40.9	28.8	11.7	18.6	0		
[1]SC% / Sa% / G% / C% / B% / Be%	24.8	21	28.6	2.9	1	21.9		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.74	2.75	bedroc	bedrock			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtuion distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT2 (951 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															100	0	0	0	0			90	2	6	2	0		
[1]SC% / Sa% / G% / C% / B% / Be%								10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)								0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	90	10	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						90	10	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtuion distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT3 (1,475 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															100	0	0	0	0			83.7	3.2	5.5	7.6	0		
[1]SC% / Sa% / G% / C% / B% / Be%								10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)								0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	50	30	20	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						80	18	2	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT4 (831 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																						43.1	21.2	19.7	16	0		
[1]SC% / Sa% / G% / C% / B% / Be%	10.2	20.4	59.2	0	0	10.2		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.24	2.96	6.85	26.8	bedrock			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT7 (1,127 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															40.7	18.9	15.6	15.1	9.7			34.9	26.1	12.1	18.2	8.7		
[1]SC% / Sa% / G% / C% / B% / Be%	24.3	19.4	50.5	5.8	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.78	3.3	14.3	75.1			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	0	15	85		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						95	5	0	0			

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

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

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

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

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-constrution distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 1 (2,305 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	640.21	640.21	640.21	640.21	641.24			640.24	640.24	640.24	640.24	640.730		
Bankfull Width (ft)	35.21	36.55	37.70	38.49	35.95			35.77	36.90	36.53	37.81	48.400		
Floodprone Width (ft)	>80	125.20	135.20	>100	>100			>80	127.00	158.50	>100	>100		
Bankfull Mean Depth (ft)	1.23	1.16	1.15	1.23	1.20			1.11	0.97	1.15	1.14	0.820		
Bankfull Max Depth (ft)	1.79	1.78	1.96	2.26	2.36			2.48	2.03	2.52	2.25	2.270		
Bankfull Cross Sectional Area (ft^2)	43.15	42.32	43.25	47.22	43.15			39.80	35.60	42.08	43.05	39.800		
Bankfull Width/Depth Ratio	28.73	31.56	32.87	31.37	29.95			32.15	38.17	31.71	33.21	58.860		
Bankfull Entrenchment Ratio	>2.2	3.43	3.59	>2.2	>2.2			>2.2	3.44	4.34	>2.2	>2.2		
Bankfull Bank Height Ratio[2]	1.00	0.97	1.09	0.42	0.45			0.73	0.88	0.94	0.76	-		
Cross Sectional Area between end pins (ft^2)	77.79	86.15	88.38	92.57	85.02			85.42	81.10	88.9	93.80	61.430		
d50 (mm)	15.90	21.00	22.00	81.73	17.35			5.00	16.00	11.00	32.00	4.61		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 3 (1,083 feet)

	Cross Section 1 (Riffle)-2R							Cross Section 2 (Pool)-2P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	630.92	630.92	630.92	630.92	631.08	630.92		629.80	629.80	629.80	629.80	630.14	629.80	
Bankfull Width (ft)	38.31	41.03	38.35	37.41	40.07			39.59	26.70	33.35	37.91	43.99		
Floodprone Width (ft)	>90	419.00	488.00	>100	>100			>90	350.00	368.00	99.57	>100		
Bankfull Mean Depth (ft)	1.26	1.25	1.37	1.38	1.20			1.11	1.59	1.00	0.92	1.00		
Bankfull Max Depth (ft)	1.90	2.18	2.97	2.94	3.02			2.44	2.20	2.26	2.26	2.50		
Bankfull Cross Sectional Area (ft^2)	48.23	51.15	52.43	51.64	48.23			43.79	42.50	33.19	34.92	43.79		
Bankfull Width/Depth Ratio	30.43	32.91	28.05	27.10	33.29			35.79	16.77	33.52	41.16	44.19		
Bankfull Entrenchment Ratio	>2.2	10.21	12.73	>2.2	>2.2			>2.2	13.11	11.03	2.63	>2.2		
Bankfull Bank Height Ratio[2]	0.94	1.06	1.38	1.44	0.42			0.69	0.72	0.84	0.82	-		
Cross Sectional Area between end pins (ft^2)	116.34	104.46	103.94	106.00	92.88			89.91	77.86	68.32	69.90	64.3		
d50 (mm)	31.00	29.00	13.5	49.22	49.54			6.70	9.00	14.50	42.83	33.50		

NOTE: XS 2R and 2P reshaped as part of MY2 to remove backwater and overflow conditions upstream.

As observed in the method of determining bank height ratio, modifications to the channel in year 2 at XS 2R has created high bank height ratios. This is not a valid characterization of stability at this section with holding by holding the as-built baseline bankfull elevation in determining cross-section characterizations. The channel in this section of restoration is a tiered system and is providing proper floodplain connection to allow waters out of the channel. The work was performed due to backwater conditions caused by this riffle, which was a greater sign of instability.

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 4 (969 feet)

	Cross Section 1 (Pool)-3P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	624.26	624.26	624.26	624.26	624.66		
Bankfull Width (ft)	29.35	25.94	24.64	22.88	31.28		
Floodprone Width (ft)	>65	438.00	435.00	>100	>100		
Bankfull Mean Depth (ft)	1.87	2.38	2.36	2.22	1.76		
Bankfull Max Depth (ft)	3.12	3.38	3.32	3.24	3.32		
Bankfull Cross Sectional Area (ft^2)	54.90	61.79	58.25	50.77	54.90		
Bankfull Width/Depth Ratio	15.69	10.89	10.42	10.32	17.82		
Bankfull Entrenchment Ratio	>2.2	16.89	17.65	>2.2	>2.2		
Bankfull Bank Height Ratio[2]	0.70	0.66	0.73	0.72	-		
Cross Sectional Area between end pins (ft^2)	106.25	112.61	110.74	99.73	92.04		
d50 (mm)	3.40	13.00	19.50	41.75	30.68		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 2 (951 feet)

	Cross Section 1 (Riffle)-1R						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	639.34	639.34	639.34	639.34	639.07		
Bankfull Width (ft)	3.52	6.23	4.31	3.59	3.04		
Floodprone Width (ft)	8.34	31.10	40.80	10.96	6.79		
Bankfull Mean Depth (ft)	0.52	0.42	0.80	0.90	0.60		
Bankfull Max Depth (ft)	0.72	0.96	1.03	1.2	0.85		
Bankfull Cross Sectional Area (ft^2)	1.82	2.65	3.43	3.22	1.82		
Bankfull Width/Depth Ratio	6.82	14.65	5.42	4.00	5.08		
Bankfull Entrenchment Ratio	2.37	5.00	9.46	>2.2	2.20		
Bankfull Bank Height Ratio[2]	1.01	0.86	1.20	1.18	1.39		
Cross Sectional Area between end pins (ft^2)	20.73	21.69	20.37	20.83	18.02		
d50 (mm)	5.00	silt/clay	silt/clay	5.36	silt/clay		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT3 (1,475 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Riffle)-2R							Cross Section 3 (Riffle)-3R							Cross Section 4 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	647.14	647.14	647.14	647.14	647.16			632.79	633.69	633.69	633.69	633.21			622.92	623.77	623.77	623.77	623.14			638.72	639.22	639.22	639.22	639.19		
Bankfull Width (ft)	3.50	5.20	5.42	4.66	4.79			5.91	11.93	8.65	13.46	7.40			3.73	7.17	8.16	7.29	3.58			4.06	8.51	6.87	9.21	5.55		
Floodprone Width (ft)	24.45	29.60	27.50	11.22	11.03			13.14	31.20	30.20	15.96	13.67			6.35	>100	>100	90.60	5.62			8.28	20.40	15.30	9.41	11.67		
Bankfull Mean Depth (ft)	0.53	0.30	5.42	0.29	0.38			0.29	0.99	1.19	0.54	0.23			0.20	0.48	0.58	0.55	0.21			0.25	0.58	0.46	0.22	0.18		
Bankfull Max Depth (ft)	0.82	0.78	0.60	0.64	0.67			0.61	1.62	1.56	1.05	0.48			0.31	1.05	1.08	1.05	0.34			0.46	1.19	0.79	0.51	0.46		
Bankfull Cross Sectional Area (ft^2)	1.84	1.55	1.80	1.36	1.84			1.69	11.79	10.31	7.29	1.69			0.75	3.41	4.75	4.02	0.75			1.01	4.90	3.14	2.03	1.01		
Bankfull Width/Depth Ratio	6.66	17.47	16.31	16.01	12.47			20.67	12.06	7.25	24.84	32.40			18.61	15.08	14.02	13.21	17.09			16.32	8.51	15.06	41.78	30.50		
Bankfull Entrenchment Ratio	6.99	5.70	5.07	>2.2	2.30			2.22	2.62	3.49	1.19	1.85			1.70	>2.2	>2.2	>2.2	1.57			2.04	2.40	2.23	1.02	2.10		
Bankfull Bank Height Ratio[2]	0.74	1.04	0.69	0.90	1.33			0.57	0.35	0.54	0.82	2.29			0.71	0.99	1.03	1.17	2.56			0.54	0.46	0.64	0.53	-		
Cross Sectional Area between end pins (ft^2)	13.50	13.86	15.62	14.11	13.77			26.63	32.12	30.79	26.15	24.96			15.64	14.90	15.72	13.13	13.96			27.61	28.88	24.81	23.54	22.36		
d50 (mm)	silt/clay	silt/clay	silt/clay	silt/clay	silt/clay			4.50	0.19	silt/clay	silt/clay	silt/clay			0.11	silt/clay	silt/clay	silt/clay	0.50			silt/clay	silt/clay	silt/clay	silt/clay	silt/clay		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

NOTE: MY1 Data modified to use same bankfull elevation as baseline data for 1R. MY1 Bankfull for 2R, 3R and 1P established as baseline bankfull as the original bankfull only had slope indications to identify, where MY1 provided more thorough evidence of bankfull.

MY3 field survey bankfull indicates a change in bankfull from baseline elevation. This is expected due to the cattle damage in the channel during MY2. The stream appears more stable in MY3 than in past. Baseline bankful for previous years still used as per North Carolina DMS protocols, but MY3 bankfull elevations are shown on the Cross Section plot exhibits.

MY4 monitoring protocols by DMS requires baseline cross section area remain constant for determining other ratios. This leads to misleading results for UT3, as baseline values were calculated immediately after construction, and based on a small 6-inch deep channel that only slope indications were available to determine bankfull after cutting entrenched banks back. MY1 cross-sectional area is more realistic for baseline data. The reach is stable, which is not indicated based on MY4 cross sectional values.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 4 (831 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	627.41	627.41	627.41	627.41	627.88			629.84	629.84	629.84	629.84	630.43		
Bankfull Width (ft)	13.32	13.94	14.33	11.55	13.07			20.38	17.20	19.45	18.10	21.08		
Floodprone Width (ft)	>50	>100	>100	35.53	>100			>100	>100	>100	77.83	>100		
Bankfull Mean Depth (ft)	0.91	0.89	0.73	0.84	0.93			1.34	1.35	1.22	1.32	1.30		
Bankfull Max Depth (ft)	1.71	1.65	1.74	1.76	1.93			2.71	2.53	2.94	2.64	3.18		
Bankfull Cross Sectional Area (ft^2)	12.13	12.35	10.42	9.70	12.13			27.37	23.29	23.75	23.94	27.37		
Bankfull Width/Depth Ratio	14.63	15.73	19.70	13.75	14.08			15.18	12.71	15.93	18.10	16.24		
Bankfull Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[2]	0.60	0.99	1.16	0.80	0.47			0.63	0.85	1.07	0.95	-		
Cross Sectional Area between end pins (ft^2)	29.20	32.81	31.19	29.13	25.00			54.73	53.60	54.93	53.03	43.31		
d50 (mm)	8.90	6.90	10.00	11.30	20.55			7.00	0.18	10.00	41.10	3.43		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 7 (1,127 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Riffle)-2R							Cross Section 3 (Pool)-1P							Cross Section 4 (Step Pool)-STP1							Cross Section 5 (Step Pool)-STP2						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	615.87	615.87	615.87	615.87	616.44			613.60	613.60	613.60	613.60	613.43			614.93	614.93	614.93	614.93	615.03					612.87	612.87	613.07					610.22	610.22	610.25		
Bankfull Width (ft)	20.71	21.76	21.47	21.15	21.45			18.58	21.20	21.61	18.23	17.61			27.10	29.90	23.14	22.65	22.46					28.17	26.53	30.22					20.56	22.82	21.98		
Floodprone Width (ft)	>100	>100	>100	>100	>100			>80	>100	>100	>100	>100			>80	>100	>100	>100	>100					>100	>100	>100					>100	38.67	55.00		
Bankfull Mean Depth (ft)	0.96	0.75	0.98	0.86	0.93			1.17	1.02	1.21	1.15	1.23			0.96	0.81	1.24	1.11	1.16					1.86	1.70	1.74					1.66	1.37	1.56		
Bankfull Max Depth (ft)	1.17	0.92	1.29	1.31	1.74			1.69	1.82	2.04	1.78	1.67			1.29	1.25	1.53	1.61	1.73					2.55	2.32	2.68					2.32	2.04	2.62		
Bankfull Cross Sectional Area (ft^2)	19.93	16.42	21.15	18.21	19.93			21.68	21.71	26.11	21.00	21.68			25.98	24.19	28.70	25.11	25.98					52.44	44.98	52.44					34.22	31.17	34.22		
Bankfull Width/Depth Ratio	21.52	28.86	21.80	24.56	23.09			15.92	20.70	17.89	15.83	14.30			28.27	36.96	18.65	20.43	19.42					15.13	15.65	17.42					12.35	16.71	14.12		
Bankfull Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2					>2.2	>2.2	>2.2					>2.2	1.69	2.50		
Bankfull Bank Height Ratio[2]	0.78	0.84	0.96	1.24	1.02			0.92	1.25	1.12	0.97	1.13			0.67	1.23	0.80	1.03	-					0.92	0.92	-					0.78	0.50	-		
Cross Sectional Area between end pins (ft^2)	66.61	65.98	73.43	67.07	50.19			52.17	56.85	61.51	55.95	58.95			76.83	80.07	90.25	81.55	76.23					149.86	133.36	139.31					200.48	197.13	197.08		
d50 (mm)	23.00	11.00	18.00	36.00	12.87			0.50	0.50	20.00	27.84	30.29			silt/clay	silt/clay	silt/clay	silt/clay	silt/clay					49.00	39.22	45.00					30.00	41.10	36.33		

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	35.21	35.21	35.21	35.21		1	36.55	36.55	36.55	36.55		1	37.7	37.7	37.7	37.7		1	38.49	38.49	38.49	38.49		1	35.95	35.95	35.95	35.95		1						
Floodprone Width (ft)	>80	>80	>80	>80		1	125.20	125.20	125.20	125.20		1	135.2	135.2	135.2	135.2		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1						
Bankfull Mean Depth (ft)	1.23	1.23	1.23	1.23		1	1.16	1.16	1.16	1.16		1	1.15	1.15	1.15	1.15		1	1.23	1.23	1.23	1.23		1	1.2	1.2	1.2	1.2		1						
[1]Bankfull Max Depth (ft)	1.79	1.79	1.79	1.79		1	1.78	1.78	1.78	1.78		1	1.96	1.96	1.96	1.96		1	2.26	2.26	2.26	2.26		1	2.36	2.36	2.36	2.36		1						
Bankfull Cross Sectional Area (ft²)	43.15	43.15	43.15	43.15		1	42.32	42.32	42.32	42.32		1	43.25	43.25	43.25	43.25		1	47.22	47.22	47.22	47.22		1	43.15	43.15	43.15	43.15		1						
Width/Depth Ratio	28.73	28.73	28.73	28.73		1	31.56	31.56	31.56	31.56		1	32.87	32.87	32.87	32.87		1	31.37	31.37	31.37	31.37		1	29.95	29.95	29.95	29.95		1						
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	3.43	3.43	3.43	3.43		1	3.59	3.59	3.59	3.59		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1						
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**1**	**0.97**	**0.97**	**0.97**	**0.97**		**1**	**1.09**	**1.09**	**1.09**	**1.09**		**1**	**0.42**	**0.42**	**0.42**	**0.42**		1	**0.45**	**0.45**	**0.45**	**0.45**		1						
Profile																																				
Riffle Length (ft)	7.73	23.71	22.04	38.44			5.02	14.18	9.18	31.54			8.88	15.73	16.57	20.64			12.59	16.66	14.88	21.37			6.19	13.48	12.60	22.78								
Riffle Slope (ft/ft)	0.00	0.026	0.022	0.076			0.001	0.015	0.007	0.044			0.004	0.016	0.006	0.062			0.004	0.022	0.021	0.044			0.016	0.032	0.029	0.058								
Pool Length (ft)	4.21	25.43	17.55	83.2			2.96	7.07	6.1	14.54			6.82	22.35	21.04	39.29			9.78	27.54	24.39	48.90			1.51	12.13	12.39	20.64								
Pool Max depth (ft)	1.96	2.71	2.48	3.76			1.96	2.63	2.43	3.42			2.10	2.53	2.37	3.75			1.33	1.65	1.48	2.55			0.90	1.74	1.72	2.42								
Pool Spacing (ft)	29.95	48.64	39.06	91.87			14.66	32.47	23.01	54.64			21.81	33.95	34.70	46.54			28.90	40.23	40.13	51.92			9.85	27.04	27.19	45.08								
Pattern																																				
Channel Beltwidth (ft)	59.64	105.83	92.68	165.18																																
Radius of Curvature (ft)	72.965	83.153	79.01	97.485																																
Rc:Bankfull width (ft/ft)	**27.95**	**35.603**	**36.13**	**46.36**																																
Meander Wavelength (ft)																																				
Meander Width Ratio	1.2865	3.037	2.5652	5.9098																																

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

Additional Reach Parameters																																				
Rosgen Classification	C4						C4c-						C4						C4						C4											
Channel Thalweg length (ft)	2299.79						2318.86						2306.75						2305.11						2304.87											
Sinuosity (ft)	1.05						1.05						1.05						1.05						1.05											
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						NA (DRY/STAGNET WATER)						0.0015 (BACKWATER-BEAVER DAM)						0.0061											
BF slope (ft/ft)							**0.0007**						**0.0014**						**0.0027**						**0.006**											
[3]Ri% / Ru% / P% / G% / S%	**30.5**	**14.7**	**36.8**	**18**	**0**		**35.2**	**19.6**	**19.5**	**25.6**	**0**		**25.7**	**12.3**	**36.5**	**25.5**	**0**		**22.6**	**15.4**	**37.4**	**24.6**	**0**		**25.8**	**16.9**	**31.0**	**26.3**	**0**							
[3]SC% / Sa% / G% / C% / B% / Be%													**0**	**0**	**76.6**	**0**	**0**	**23.4**	**7**	**0**	**82.7**	**0**	**0**	**10.3**	**0**	**0**	**73.0**	**0**	**27.0**	**0.0**						
[3]d16 / d35 / d50 / d84 / d95 /													**0.78**	**10**	**17.5**	**45**	**Bed**		**14.72**	**27.09**	**41.24**	**Bed**	**Bed**		**4.31**	**7.43**	**10.32**	**39.22**	**Bed**							
[2]% of Reach with Eroding Banks							**0**																													
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	38.31	38.31	38.31	38.31		1	41.03	41.03	41.03	41.03		1	38.35	38.35	38.35	38.35		1	23.08	23.08	23.08	23.08		1	40.07	40.07	40.07	40.07		1						
Floodprone Width (ft)	>90	>90	>90	>90		1	419.00	419.00	419.00	419.00		1	488	488	488	488		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1						
Bankfull Mean Depth (ft	1.26	1.26	1.26	1.26		1	1.25	1.25	1.25	1.25		1	1.37	1.37	1.37	1.37		1	2.24	2.24	2.24	2.24		1	1.2	1.2	1.2	1.2		1						
[1]Bankfull Max Depth (ft	1.9	1.9	1.9	1.9		1	2.18	2.18	2.18	2.18		1	2.97	2.97	2.97	2.97		1	2.94	2.94	2.94	2.94		1	3.02	3.02	3.02	3.02		1						
Bankfull Cross Sectional Area (ft	48.23	48.23	48.23	48.23		1	51.15	51.15	51.15	51.15		1	52.43	52.43	52.43	52.43		1	51.64	51.64	51.64	51.64		1	48.23	48.23	48.23	48.23		1						
Width/Depth Ratio	30.43	30.43	30.43	30.43		1	32.91	32.91	32.91	32.91		1	28.05	28.05	28.05	28.05		1	10.31	10.31	10.31	10.31		1	33.29	33.29	33.29	33.29		1						
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	10.21	10.21	10.21	10.21		1	12.73	12.73	12.73	12.73		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1						
[1]Bank Height Ratio	**0.94**	**0.94**	**0.94**	**0.94**		**1**	**1.06**	**1.06**	**1.06**	**1.06**		**1**	**1.38**	**1.38**	**1.38**	**1.38**		**1**	**1.44**	**1.44**	**1.44**	**1.44**		**1**	**0.42**	**0.42**	**0.42**	**0.42**		**1**						
Profile																																				
Riffle Length (ft)	11.3	18.65	20.99	21.31			10.65	25.52	26.64	38.18			6.30	20.06	16.55	40.86		1	11.81	23.48	23.48	35.15			4.18	19.91	12.75	42.80								
Riffle Slope (ft/ft)	0.0182	0.0502	0.0241	0.1345			0.007	0.013	0.008	0.027			0.008	0.022	0.022	0.037		1	0.008	0.011	0.011	0.015			0.002	0.155	0.009	0.454								
Pool Length (ft)	6.32	12.33	10.63	21.53			7.42	17.75	21.33	24.51			2.19	20.09	4.60	68.96		1	8.91	19.63	24.99	64.83			7.60	34.17	34.91	59.24								
Pool Max depth (ft)	0.5	1.13	1.26	1.69			1.75	2.81	1.87	4.81			2.70	2.88	2.79	3.23		1	2.68	4.12	2.98	6.69			1.67	1.99	2.02	2.24								
Pool Spacing (ft)	36.04	45.42	46.77	53.33			48.94	61.06	51.44	82.8			16.88	40.66	30.84	84.05		1	2.21	39.18	30.57	93.38			21.62	37.50	24.74	66.13								
Pattern																																				
Channel Beltwidth (ft)	58.77	58.77	58.77	58.77																																
Radius of Curvature (ft)	83.8	83.8	83.8	83.8																																
Rc:Bankfull width (ft/ft)	**4.58**	**15.654**	**16.52**	**23.05**																																
Meander Wavelength (ft)																																				
Meander Width Ratio	2.5497	5.1978	3.5575	12.832																																
Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4						C4											
Channel Thalweg length (ft)	1079.45						1069.58						1074.38						1075.39						1073.51											
Sinuosity (ft)	1.01						1.01						1.01						1.01						1.01											
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						0.002						0.0013						0.005											
BF slope (ft/ft)							**0.0138**						**0.0084**						**0.007**						**0.0021**											
[3]Ri% / Ru% / P% / G% / S%	**25.8**	**20.2**	**26**	**28**	**0**		**42**	**14.4**	**21.9**	**21.7**	**0**		**33**	**9.9**	**33.1**	**24**	**0**		**20.8**	**13.3**	**54.8**	**11.1**	**0**		**22.3**	**5.8**	**50.9**	**21**	**0**							
[3]SC% / Sa% / G% / C% / B% / Be%													**13.7**	**0**	**78.7**	**0**	**0**	**7.6**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**83.8**	**16.2**	**0**	**0**						
[3]d16 / d35 / d50 / d84 / d95 /													**2.5**	**9**	**14**	**25**	**38**		**23.69**	**36.14**	**45**	**77.57**	**90**		**11.3**	**29.92**	**42.4**	**84.97**	**172.57**							
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

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

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 2 (951 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	3.52	3.52	3.52	3.52		1	6.23	6.23	6.23	6.23		1	4.31	4.31	4.31	4.31		1	3.59	3.59	3.59	3.59		1	3.04	3.04	3.04	3.04		1						
Floodprone Width (ft)	8.34	8.34	8.34	8.34		1	31.10	31.10	31.10	31.10		1	40.8	40.8	40.8	40.8		1	10.96	10.96	10.96	10.96		1	6.79	6.79	6.79	6.79		1						
Bankfull Mean Depth (ft	0.52	0.52	0.52	0.52		1	0.42	0.42	0.42	0.42		1	0.8	0.8	0.8	0.8		1	0.90	0.90	0.90	0.90		1	0.60	0.60	0.60	0.60		1						
[1]Bankfull Max Depth (ft	0.72	0.72	0.72	0.72		1	0.96	0.96	0.96	0.96		1	1.03	1.03	1.03	1.03		1	1.20	1.20	1.20	1.20		1	0.85	0.85	0.85	0.85		1						
Bankfull Cross Sectional Area (ft	1.82	1.82	1.82	1.82		1	2.65	2.65	2.65	2.65		1	3.43	3.43	3.43	3.43		1	3.22	3.22	3.22	3.22		1	1.82	1.82	1.82	1.82		1						
Width/Depth Ratio	6.82	6.82	6.82	6.82		1	14.65	14.65	14.65	14.65		1	5.42	5.42	5.42	5.42		1	4.00	4.00	4.00	4.00		1	5.08	5.08	5.08	5.08		1						
Entrenchment Ratio	2.37	2.37	2.37	2.37		1	5.00	5.00	5.00	5.00		1	9.46	9.46	9.46	9.46		1	>2.2	>2.2	>2.2	>2.2		1	2.20	2.20	2.20	2.20		1						
[1]Bank Height Ratio	**1.01**	**1.01**	**1.01**	**1.01**		**1**	**0.86**	**0.86**	**0.86**	**0.86**		**1**	**1.2**	**1.2**	**1.2**	**1.2**		**1**	**1.18**	**1.18**	**1.18**	**1.18**		**1**	**1.39**	**1.39**	**1.39**	**1.39**		**1**						
Profile																																				
Riffle Length (ft)	6.98	13.52	13.52	20.07			35.95	35.95	35.95	35.95			18.87	20.43	20.43	21.99			9.18	11.88	11.88	14.58			7.65	7.65	7.65	7.65								
Riffle Slope (ft/ft)	0.01	0.013	0.013	0.016			0.008	0.008	0.008	0.008			0.019	0.022	0.022	0.026			0.004	0.019	0.019	0.034			0.011	0.011	0.011	0.011								
Pool Length (ft)	12.76	12.76	12.76	12.76			NA	NA	NA	NA			7.71	11.145	11.145	14.58			8.52	8.52	8.52	8.52			6.48	16.30	13.72	28.71								
Pool Max depth (ft)	0.89	0.89	0.89	0.89			NA	NA	NA	NA			0.725	1.0875	1.0875	1.45			1.38	1.38	1.38	1.38			1.23	1.43	1.46	1.59								
Pool Spacing (ft)	30.63	30.63	30.63	30.63			NA	NA	NA	NA			36.22	36.22	36.22	36.22			NA	NA	NA	NA			6.94	13.9	13.9	20.86								
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				

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

Additional Reach Parameters																																				
Rosgen Classification	B6						B6						B6						B4c						B6c											
Channel Thalweg length (ft)	951.37						951.54						952.31						952.33						952.54											
Sinuosity (ft)	0.96						0.96						0.96						0.96						0.96											
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						NA (DRY)						0.0104						0.0041											
BF slope (ft/ft)							**0.0482**						**0.0209**						**0.0113**						**0.0045**											
[3]Ri% / Ru% / P% / G% / S%	**90**	**2**	**6**	**2**	**0**		**100**	**0**	**0**	**0**	**0**		**47.1**	**22.5**	**25.7**	**4.7**	**0**		**46.8**	**24.8**	**16.8**	**11.6**	**0**		**9.5**	**22.2**	**61**	**7.2**	**0**							
[3]SC% / Sa% / G% / C% / B% / Be%													**14.7**	**53.9**	**0**	**0**	**0**	**31.4**	**21.8**	**11.6**	**66.6**	**0**	**0**	**0**	**35.4**	**0**	**6.3**	**0**	**58.3**	**0**						
[3]d16 / d35 / d50 / d84 / d95 /													**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**0.83**	**5.36**	**Bed**	**Bed**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**							
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 3 (1,475 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	3.5	4.38	3.73	5.91		3	5.20	8.10	7.17	11.93		3	5.42	7.41	8.16	8.65		3	4.66	8.47	7.29	13.46		3	3.58	5.26	4.79	7.40		3						
Floodprone Width (ft)	6.35	14.65	13.14	24.45		3	29.60	30.40	30.40	>100		3	27.5	28.85	28.85	>100		3	11.22	39.26	15.96	90.60		3	5.62	10.11	11.03	13.67		3						
Bankfull Mean Depth (ft	0.2	0.34	0.29	0.53		3	0.30	0.59	0.48	0.99		3	0.58	2.40	1.19	5.42		3	0.29	0.46	0.54	0.55		3	0.21	0.27	0.23	0.38		3						
[1]Bankfull Max Depth (ft	0.31	0.58	0.61	0.82		3	0.78	1.15	1.05	1.62		3	0.6	1.08	1.08	1.56		3	0.64	0.91	1.05	1.05		3	0.34	0.50	0.48	0.67		3						
Bankfull Cross Sectional Area (ft	0.75	1.43	1.69	1.84		3	1.55	5.58	3.41	11.79		3	1.8	5.62	4.75	10.31		3	1.36	4.22	4.02	7.29		3	0.75	1.43	1.69	1.84		3						
Width/Depth Ratio	6.66	15.31	18.61	20.67		3	12.06	14.87	15.08	17.47		3	7.25	12.53	14.02	16.31		3	13.21	18.02	16.01	24.84		3	12.47	20.65	17.09	32.40		3						
Entrenchment Ratio	1.7	3.64	2.22	6.99		3	2.62	4.16	4.16	5.70		3	3.49	4.28	4.28	5.07		3	1.19	1.19	1.19	1.19		3	1.57	1.91	1.85	2.30		3						
[1]Bank Height Ratio	**0.57**	**0.67**	**0.71**	**0.74**		**3**	**0.35**	**0.79**	**0.99**	**1.04**		**3**	**0.54**	**0.75**	**0.69**	**1.03**		**3**	**0.82**	**0.96**	**0.90**	**1.17**		**3**	**1.33**	**2.06**	**2.29**	**2.56**		**3**						
Profile																																				
Riffle Length (ft)	57.25	107.81	89.01	215.05			31.91	81.09	72.62	143.24			Not Identifiable due to cattle damage						10.98	57.75	51.85	109.87			3.38	16.17	10.55	70.02								
Riffle Slope (ft/ft)	0.011	0.017	0.014	0.029			0.001	0.016	0.016	0.03									0.006	0.019	0.019	0.033			0.003	0.043	0.032	0.108								
Pool Length (ft)	1.5	12.97	6.04	31.37			6.73	16.17	12.09	33.76									2.00	9.44	9.13	21.10			0.91	8.70	5.15	31.75								
Pool Max depth (ft)	4.14	4.46	4.61	4.62			0.63	1.48	1.48	2.31									0.31	1.26	1.40	2.06			0.32	1.37	1.35	2.32								
Pool Spacing (ft)	114.27	133.63	143.31	143.31			125.06	186.72	186.72	248.38									26.92	80.80	77.14	123.04			3.93	24.64	20.79	49.80								
Pattern																																				
Channel Beltwidth (ft)	13.4	34.2	42.73	46.46																																
Radius of Curvature (ft)	21.64	35.62	35.15	50.55																																
Rc:Bankfull width (ft/ft)	**2.38**	**15.62**	**14.63**	**30.84**																																
Meander Wavelength (ft)																																				
Meander Width Ratio	0.43	5.37	2.44	19.52																																
Additional Reach Parameters																																				
Rosgen Classification	B6						B6c						B6						B6						B6											
Channel Thalweg length (ft)	1469.07						1467.05						1471.15						1484.42						1489.27											
Sinuosity (ft)	0.95						0.95						0.95						0.95						0.95											
Water Surface Slope (Channel) (ft/ft)	0.019						NA (DRY)						NA (DRY)						NA (NO VISUAL FLOW BUT SATURATED)						0.018											
BF slope (ft/ft)	**0.019**						**0.0198**						**0.0249**						**0.0167**						**0.018**											
[3]Ri% / Ru% / P% / G% / S%	**83.7**	**3.2**	**5.5**	**7.6**	**0**		**83.2**	**4.2**	**7.4**	**4.9**	**0.3**		**Not Identifiable due to cattle damage**						**69.7**	**10.7**	**9.5**	**10.1**	**0**		**45.0**	**14.2**	**25.1**	**15.8**	**0**							
[3]SC% / Sa% / G% / C% / B% / Be%													**92.3**	**4.7**	**1.6**	**0**	**0**	**1.4**	**94.3**	**3.5**	**0**	**0**	**0**	**2.2**	**83.4**	**0**	**6.8**	**3.7**	**6.6**	**0**						
[3]d16 / d35 / d50 / d84 / d95 /													**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**0.63**	**5.97**							
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

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

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

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

4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 4 (831 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	13.32	13.32	13.32	13.32		1	13.94	13.94	13.94	13.94		1	14.326914	14.326914	14.326914	14.326914		1	11.55	11.55	11.55	11.55		1	13.07	13.07	13.07	13.07		1						
Floodprone Width (ft)	>50	>50	>50	>50		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1	35.53	35.53	35.53	35.53		1	>100	>100	>100	>100		1						
Bankfull Mean Depth (ft	0.91	0.91	0.91	0.91		1	0.89	0.89	0.89	0.89		1	0.73	0.73	0.73	0.73		1	0.84	0.84	0.84	0.84		1	0.93	0.93	0.93	0.93		1						
[1]Bankfull Max Depth (ft	1.71	1.71	1.71	1.71		1	1.65	1.65	1.65	1.65		1	1.738	1.738	1.738	1.738		1	1.76	1.76	1.76	1.76		1	1.93	1.93	1.93	1.93		1						
Bankfull Cross Sectional Area (ft	12.13	12.13	12.13	12.13		1	12.35	12.35	12.35	12.35		1	10.42	10.42	10.42	10.42		1	9.70	9.70	9.70	9.70		1	12.13	12.13	12.13	12.13		1						
Width/Depth Ratio	14.63	14.63	14.63	14.63		1	15.73	15.73	15.73	15.73		1	19.7	19.7	19.7	19.7		1	13.75	13.75	13.75	13.75		1	14.08	14.08	14.08	14.08		1						
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1						
[1]Bank Height Ratio	**0.60**	**0.60**	**0.60**	**0.60**		**1**	**0.99**	**0.99**	**0.99**	**0.99**		**1**	**1.16**	**1.16**	**1.16**	**1.16**		**1**	**0.80**	**0.80**	**0.80**	**0.80**		**1**	**0.47**	**0.47**	**0.47**	**0.47**		**1**						
Profile																																				
Riffle Length (ft)	4.74	19.81	21.81	30.73			11.72	23.29	21.67	36.64			4.04	13.83	11.615	30.23			3.55	15.06	10.92	37.19			5.16	13.42	13.08	28.88								
Riffle Slope (ft/ft)	0.012	0.027	0.018	0.074			0.013	0.025	0.024	0.037			0.005	0.036	0.035	0.070			0.005	0.034	0.025	0.072			0.018	0.034	0.035	0.055								
Pool Length (ft)	6.99	12.56	9.1	26.02			6.8	9.62	8.54	15.58			3.41	6.15	5.915	10.44			1.93	5.72	4.41	12.47			3.73	11.34	11.05	23.33								
Pool Max depth (ft)	1.89	2.28	2.32	2.7			1.71	2.42	2.52	2.88			1.835	2.6798333	2.731	3.385			1.74	2.20	2.15	2.74			0.63	1.31	1.30	2.17								
Pool Spacing (ft)	50.06	56.72	55.31	68.08			22.59	37.51	42.3	46.92			7.58	27.928182	26.45	52			14.21	32.41	31.88	48.40			13.33	26.70	26.09	42.89								
Pattern																																				
Channel Beltwidth (ft)	80.13	98.47	98.47	116.81																																
Radius of Curvature (ft)	36.7	47.23	49.01	56.95																																
Rc:Bankfull width (ft/ft)	**16.34**	**19.23**	**18.89**	**23.76**																																
Meander Wavelength (ft)	221.95	221.95	221.95	221.95																																
Meander Width Ratio	3.37	5.19	4.91	7.15																																

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

Additional Reach Parameters																																				
Rosgen Classification	C4b						C4						C4						C4						C4											
Channel Thalweg length (ft)	830.01						837.13						838.29						838.81						846.12											
Sinuosity (ft)	0.81						0.81						0.81						0.81						0.81											
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						0.0138						0.014						0.015											
BF slope (ft/ft)							**0.0123**						**0.0123**						**0.0132**						**0.013**											
[3]Ri% / Ru% / P% / G% / S%	**43.1**	**21.2**	**19.7**	**16**	**0**		**52.2**	**9.8**	**19.2**	**18.8**	**0**		**34**	**17.9**	**18.1**	**30**	**0**		**41.2**	**23.9**	**14.2**	**20.6**	**0**		**30.6**	**15.8**	**28.7**	**24.8**	**0**							
[3]SC% / Sa% / G% / C% / B% / Be%													**0**	**1.7**	**98.3**	**0**	**0**	**0**	**0**	**2.1**	**97.9**	**0**	**0**	**0**	**0**	**31.9**	**65.1**	**0**	**3**	**0**						
[3]d16 / d35 / d50 / d84 / d95 /													**0.38**	**5**	**10**	**30**	**64**		**0.96**	**12.95**	**25.21**	**66.50**	**140.13**		**0.76**	**5.57**	**10.53**	**40.49**	**74.73**							
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 7 (1,127 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	18.58	19.65	19.65	20.71		2	21.20	21.48	21.48	21.76		2	21.47	21.54	21.54	21.61		2	18.23	19.69	19.69	21.15		2	17.61	19.53	19.53	21.45		2						
Floodprone Width (ft)	>80			>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2						
Bankfull Mean Depth (ft	0.96	1.07	1.07	1.17		2	0.75	0.89	0.89	1.02		2	0.98	1.10	1.10	1.21		2	0.86	1.01	1.01	1.15		2	0.93	1.08	1.08	1.23		2						
[1]Bankfull Max Depth (ft	1.17	1.43	1.43	1.69		2	0.92	1.37	1.37	1.82		2	1.29	1.67	1.67	2.04		2	1.31	1.55	1.55	1.78		2	1.67	1.705	1.705	1.74		2						
Bankfull Cross Sectional Area (ft	19.93	20.81	20.81	21.68		2	16.42	19.07	19.07	21.71		2	21.15	23.63	23.63	26.11		2	18.21	19.61	19.61	21.00		2	19.93	20.805	20.805	21.68		2						
Width/Depth Ratio	15.92	18.72	18.72	21.52		2	20.70	24.78	24.78	28.86		2	17.89	19.85	19.85	21.80		2	15.83	20.20	20.20	24.56		2	14.3	18.695	18.695	23.09		2						
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2						
[1]Bank Height Ratio	**0.78**	**0.85**	**0.85**	**0.92**		**2**	**0.84**	**1.05**	**1.05**	**1.25**		**2**	**0.96**	**1.04**	**1.04**	**1.12**		**2**	**0.97**	**1.11**	**1.11**	**1.24**		**2**	**1.02**	**1.075**	**1.075**	**1.13**		**2**						
Profile																																				
Riffle Length (ft)	9.79	36.53	37.12	54.31			9.14	29.70	30.63	67.19			8.10	26.04	26.01	42.49			10.09	24.33	24.79	48.87			3.09	20.29	17.36	45.06								
Riffle Slope (ft/ft)	0.001	0.014	0.013	0.039			0.001	0.013	0.010	0.051			0.0005	0.012	0.010	0.022			0.002	0.019	0.014	0.064			0.002	0.092	0.018	0.720								
Pool Length (ft)	8.16	15.87	13.77	28.95			4.08	13.77	14.49	22.02			5.80	16.74	14.35	34.69			6.43	19.08	16.76	46.09			3.41	20.00	14.16	78.77								
Pool Max depth (ft)	1	2.05	2.04	2.85			1.19	1.94	2.00	2.62			1.61	2.25	2.15	3.11			6.43	1.95	1.91	3.96			1.25	2.47	2.50	4.01								
Pool Spacing (ft)	13.27	54.36	56.47	130.67			13.50	54.60	58.53	94.06			32.29	56.33	54.12	82.92			6.63	43.62	40.83	80.17			3.56	27.89	28.07	69.19								
Pattern																																				
Channel Beltwidth (ft)	154.56	209.27	209.27	263.98																																
Radius of Curvature (ft)	90.88	194.28	125.65	434.94																																
Rc:Bankfull width (ft/ft)	**15.71**	**20.53**	**21.99**	**22.62**																																
Meander Wavelength (ft)	687.9	687.9	687.9	687.9																																
Meander Width Ratio	9.8383	10.191	9.5145	11.67																																

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

Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4						C4											
Channel Thalweg length (ft)	1126.71						1140.94						1154.67						1143.65						1140.69											
Sinuosity (ft)	1.23						1.23						1.23						1.23						1.23											
Water Surface Slope (Channel) (ft/ft)	0.006						NA (DRY)						NA (DRY)						NA (DRY)						0.0087											
BF slope (ft/ft)	**0.005**						**0.0053**						**0.0068**						**0.0064**						**0.0079**											
[3]Ri% / Ru% / P% / G% / S%	**34.9**	**26.1**	**12.1**	**18.2**	**8.7**		**41.1**	**13.7**	**17.6**	**17.4**	**10.2**		**30.1**	**14.3**	**24.7**	**25.1**	**5.8**		**25.0**	**17.4**	**28.4**	**22.8**	**6.3**		**20.9**	**13**	**39.2**	**19.5**	**7.4**							
[3]SC% / Sa% / G% / C% / B% / Be%													**21.8**	**17.9**	**45.5**	**12.5**	**1.7**	**0.6**	**29.9**	**0**	**68.9**	**0**	**1.2**	**0**	**13.2**	**0**	**85.6**	**0**	**1.2**	**0**						
[3]d16 / d35 / d50 / d84 / d95 /													**N/A**	**8**	**17.5**	**50**	**100**		**N/A**	**18.82**	**32.67**	**61.10**	**98.87**		**6.28**	**18.35**	**28.34**	**65.33**	**119.69**							
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

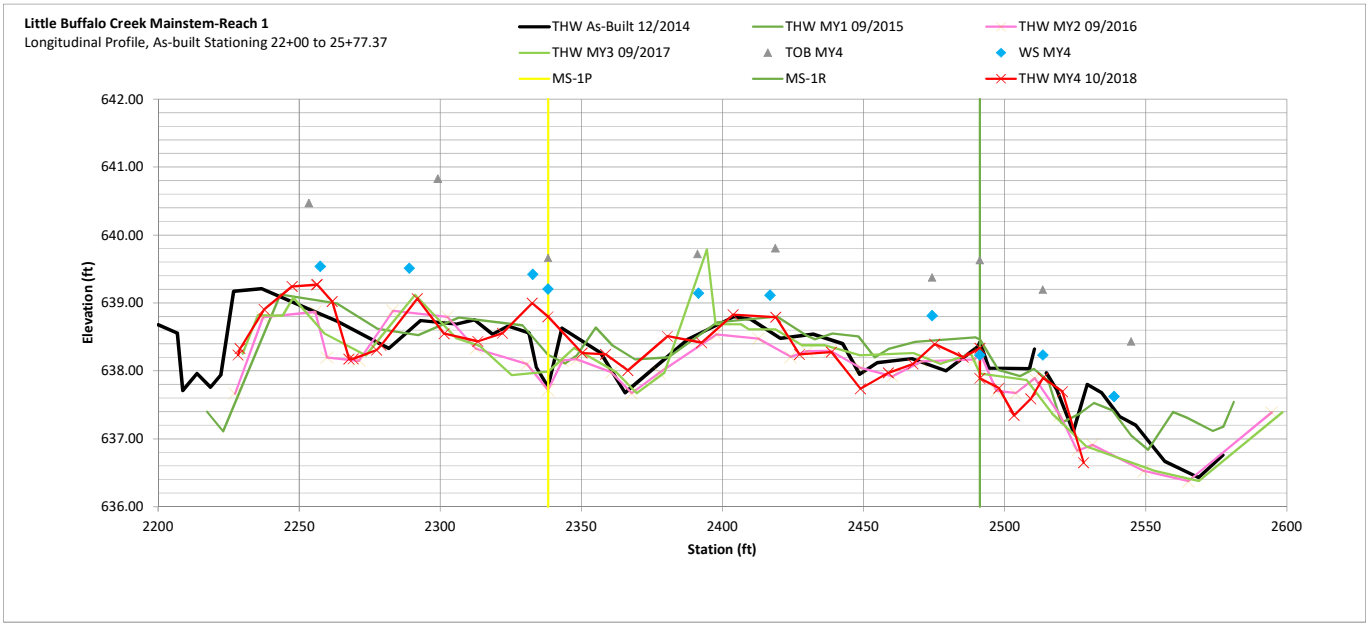
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.

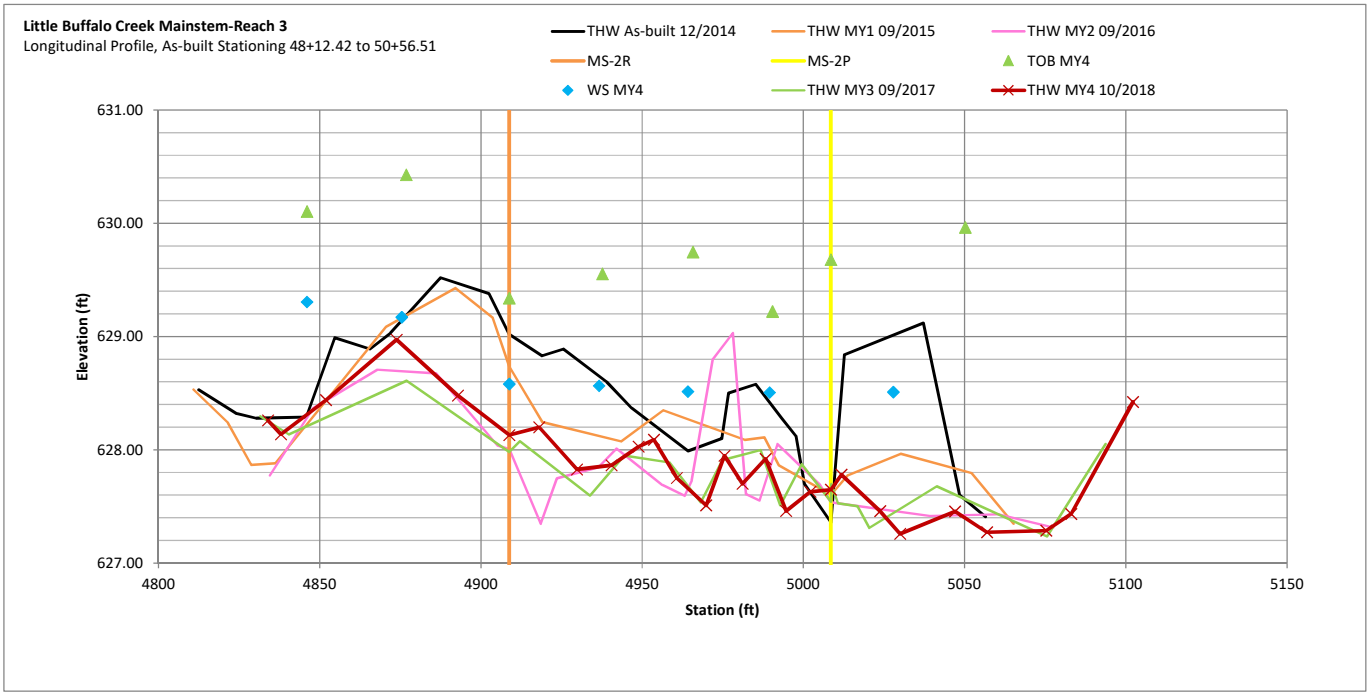
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

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

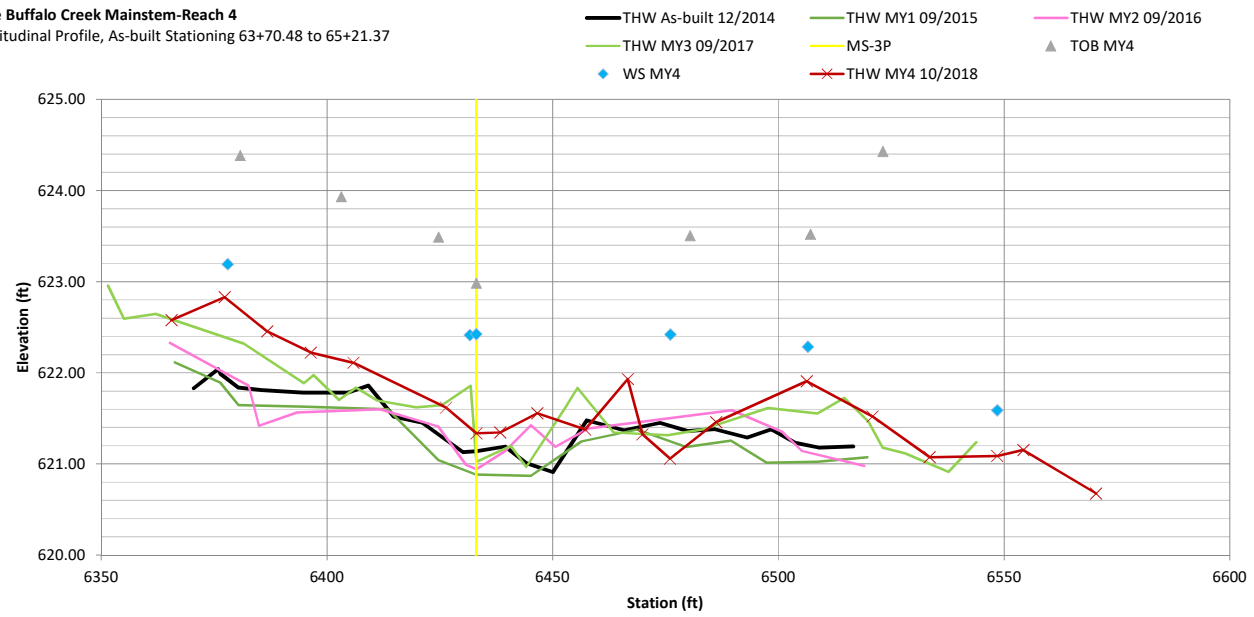
4. = Of value/needed only if the n exceeds 3

Figures 3a-k – Longitudinal Profile Plots

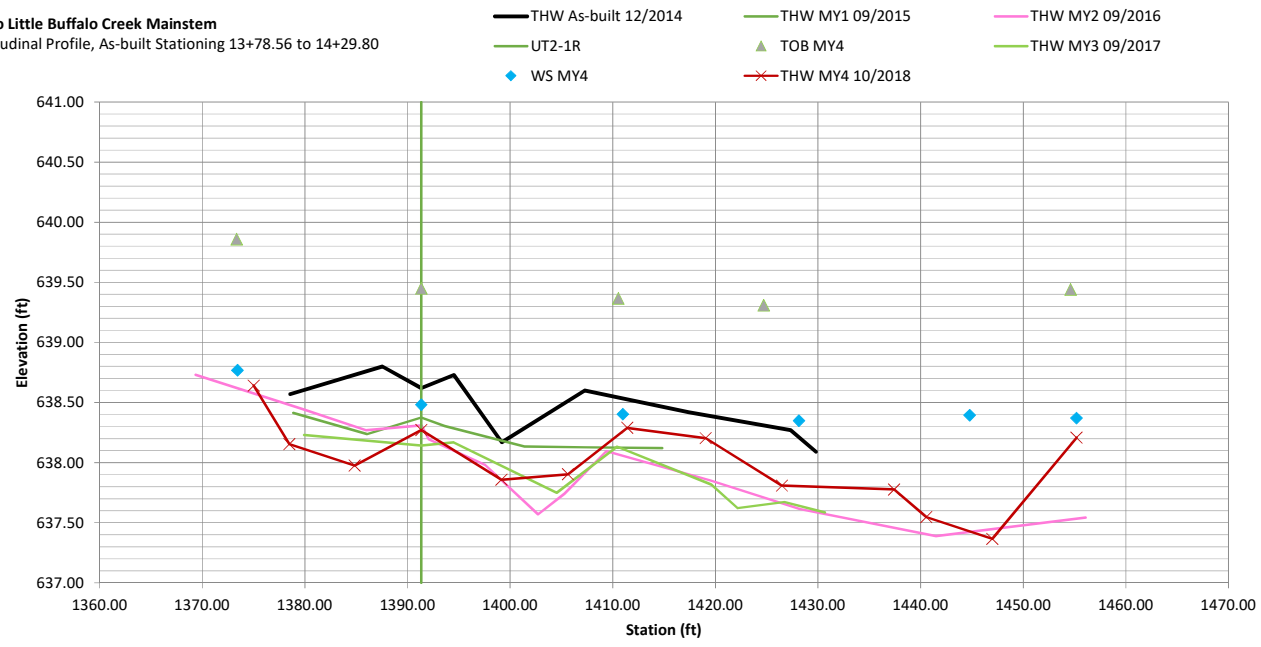

Little Buffalo Creek Mainstem-Reach 1
Longitudinal Profile, As-built Stationing 22+00 to 25+77.37
THW As-Built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
TOB MY4
WS MY4
MS-1P
MS-1R
THW MY4 10/2018
642.00
641.00
640.00
639.00
638.00
637.00
636.00
Elevation (ft)
2200
2250
2300
2350
2400
2450
2500
2550
2600
Station (ft)


Little Buffalo Creek Mainstem-Reach 3
Longitudinal Profile, As-built Stationing 48+12.42 to 50+56.51
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
MS-2R
MS-2P
TOB MY4
WS MY4
THW MY3 09/2017
THW MY4 10/2018
631.00
630.00
629.00
628.00
627.00
Elevation (ft)
4800
4850
4900
4950
5000
5050
5100
5150
Station (ft)

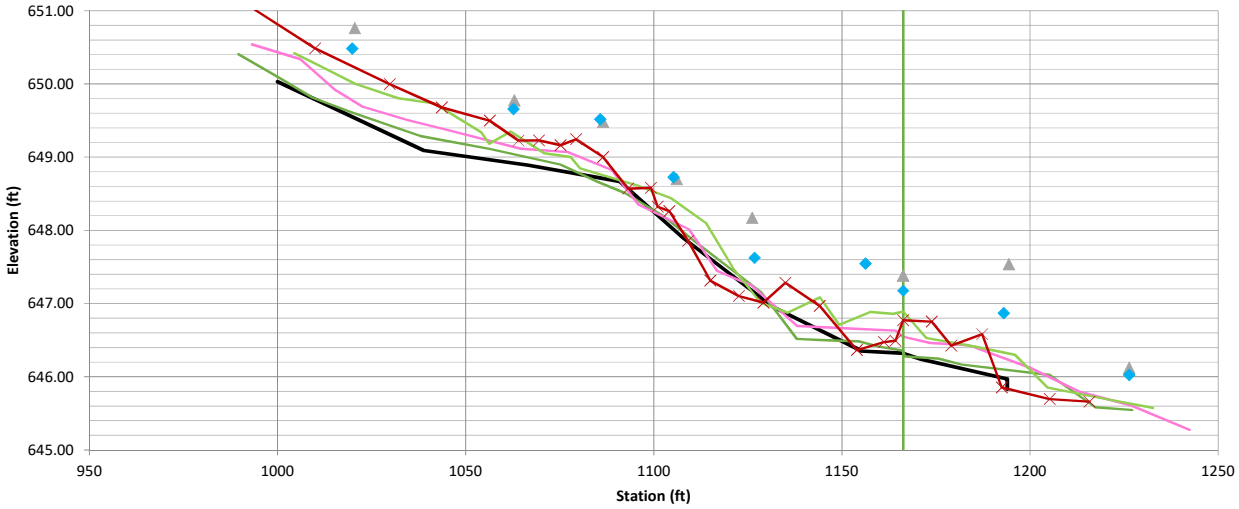
Little Buffalo Creek Mainstem-Reach 4
Longitudinal Profile, As-built Stationing 63+70.48 to 65+21.37



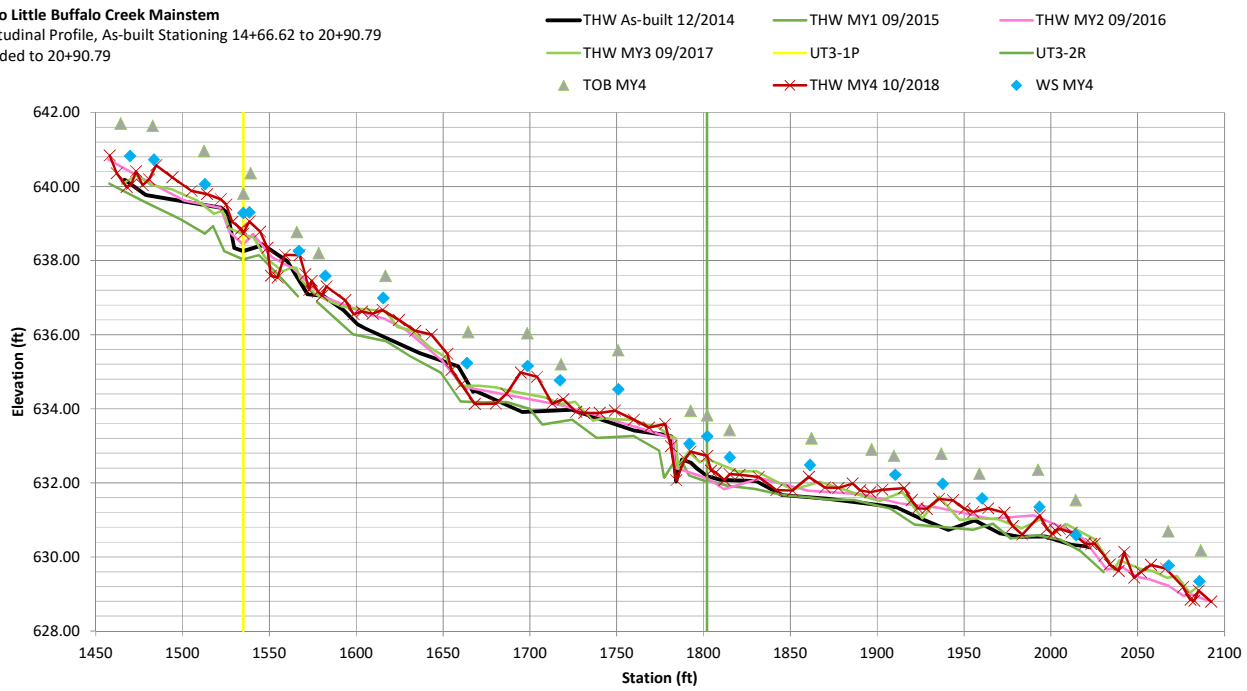
UT2 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 13+78.56 to 14+29.80



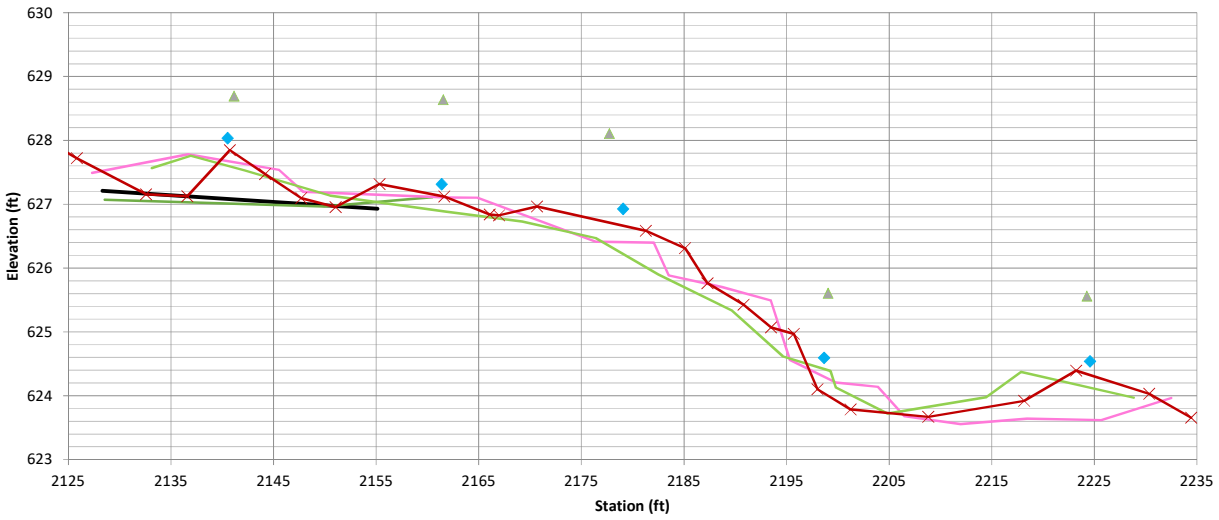
UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 10+00 to 12+15.05



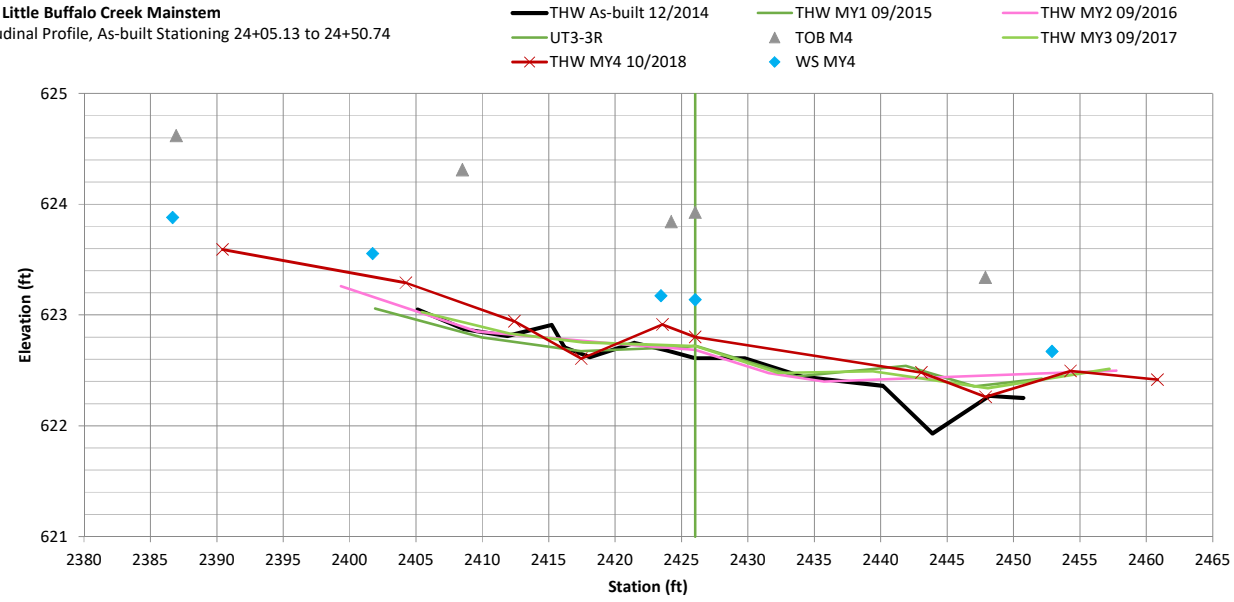
UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 14+66.62 to 20+90.79
Extended to 20+90.79



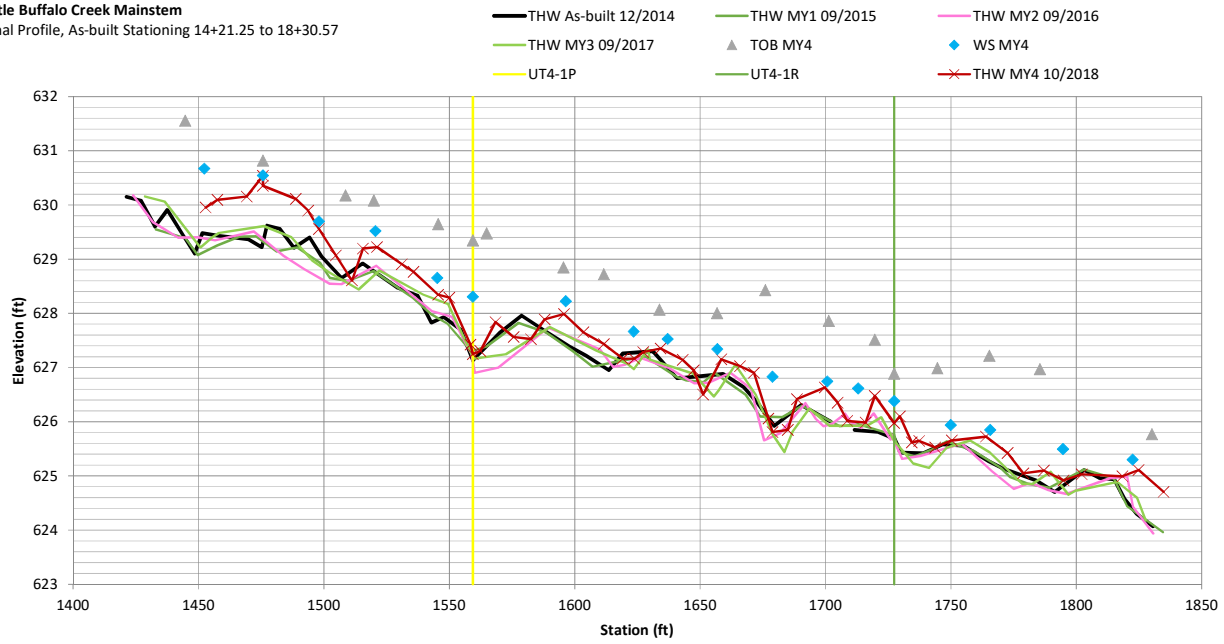
UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 21+29 to 22+32.49;
Extended to Station 22+32.49



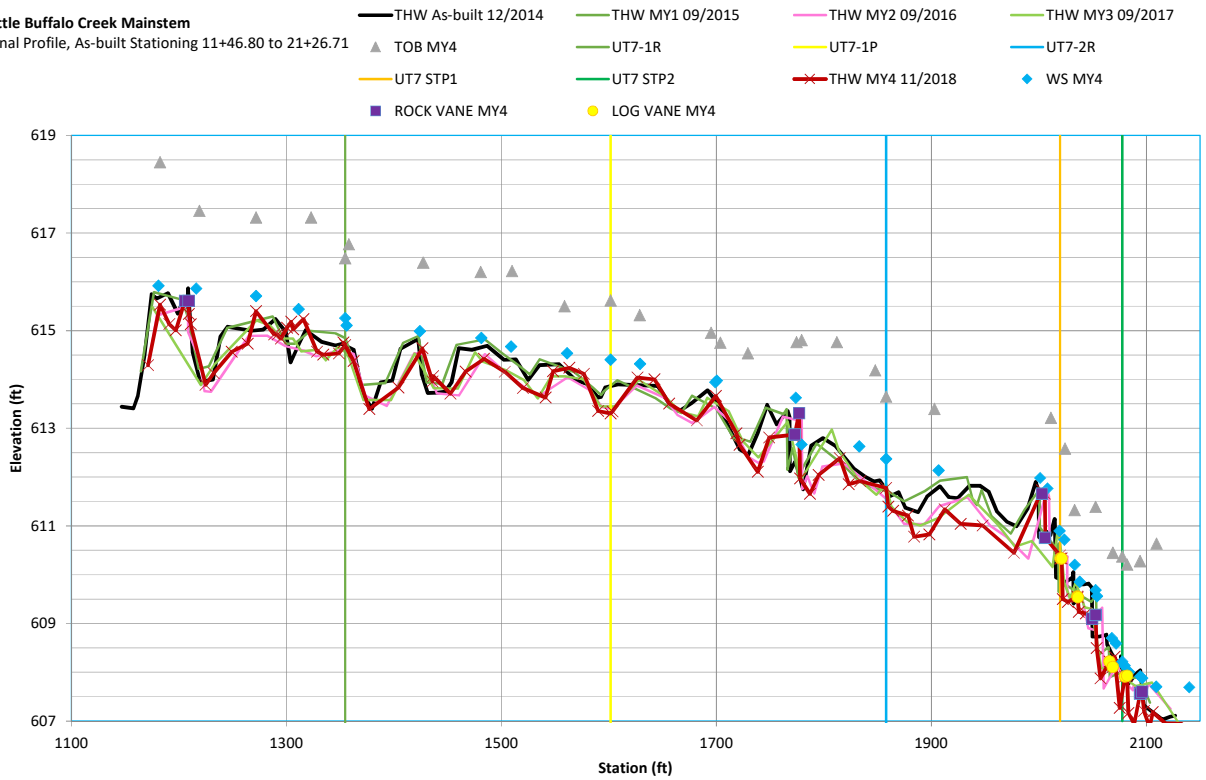
UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 24+05.13 to 24+50.74



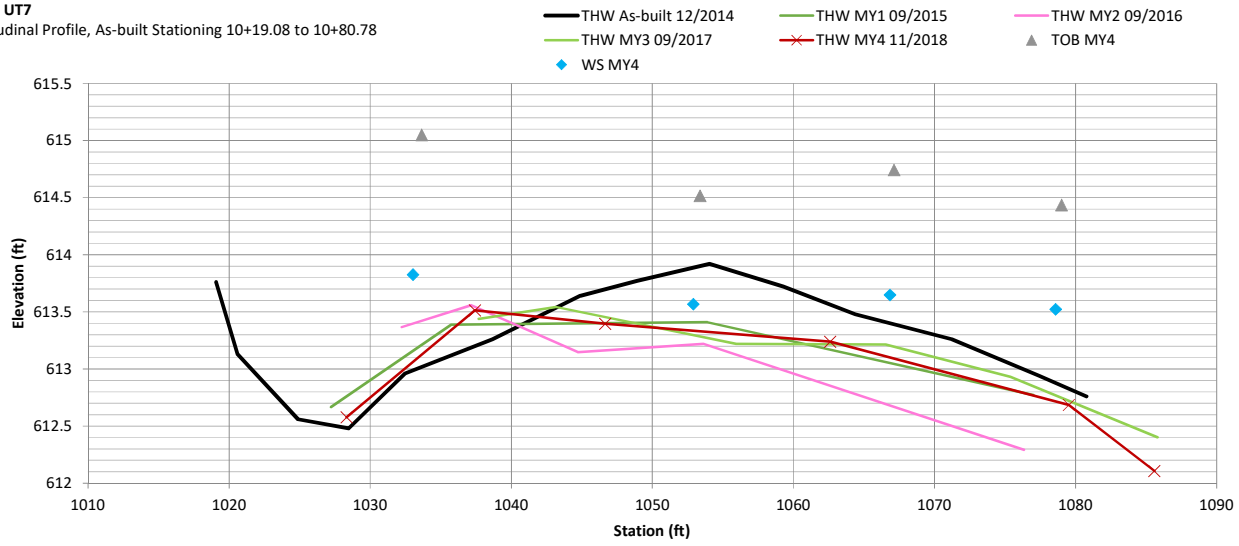
UT4 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 14+21.25 to 18+30.57



UT7 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 11+46.80 to 21+26.71



UT8 to UT7
Longitudinal Profile, As-built Stationing 10+19.08 to 10+80.78



Figures 4a-q – Cross-section Plot Exhibits

Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-1P
Drainage Area (sq mi):	2.99
Date:	11/1/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

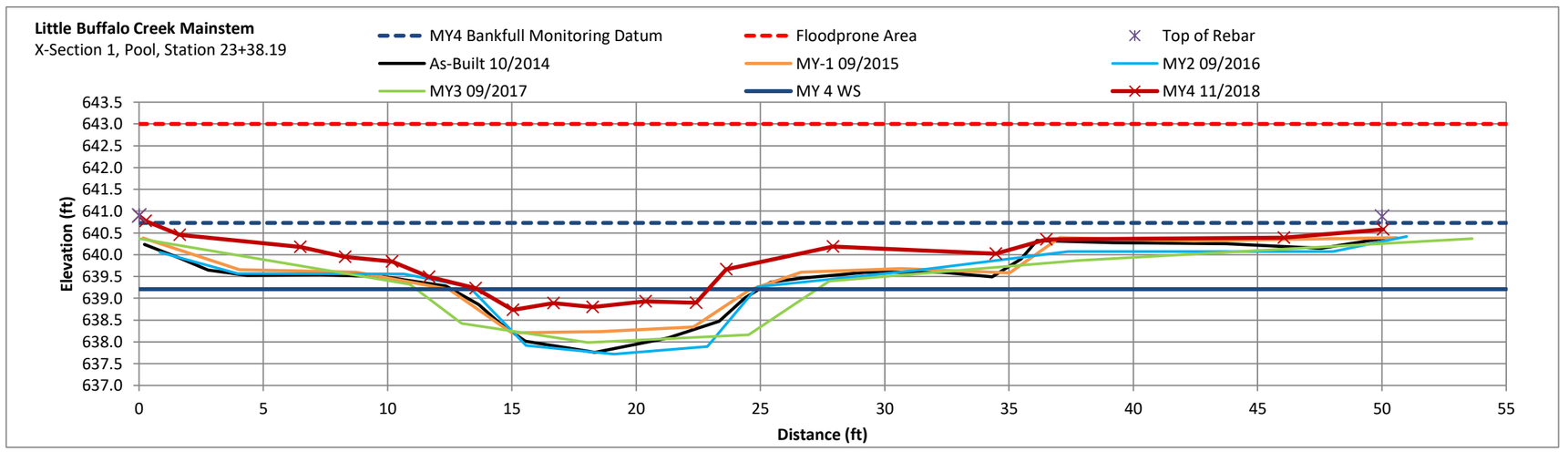
Station	Elevation
0.00	640.89
0.26	640.77
1.64	640.46
6.48	640.18
8.28	639.95
10.18	639.84
11.66	639.50
13.53	639.24
15.04	638.73
16.67	638.89
18.24	638.80
20.37	638.93
22.40	638.90
23.62	639.66
27.92	640.19
34.47	640.03
36.50	640.35
46.06	640.39
50.00	640.87
50.05	640.58

SUMMARY DATA	
Bankfull Elevation:	640.73
Bankfull Cross-Sectional Area:	39.80
Bankfull Width:	48.40
Flood Prone Area Elevation:	643.00
Flood Prone Width:	>100
Max Depth at Bankfull:	2.27
Mean Depth at Bankful:	0.82
W/D Ratio:	58.86
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4

Station and description	23+38.19 MS-1P Looking Upstream

23+38.19 MS-1P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-1R
Drainage Area (sq mi):	2.99
Date:	11/1/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

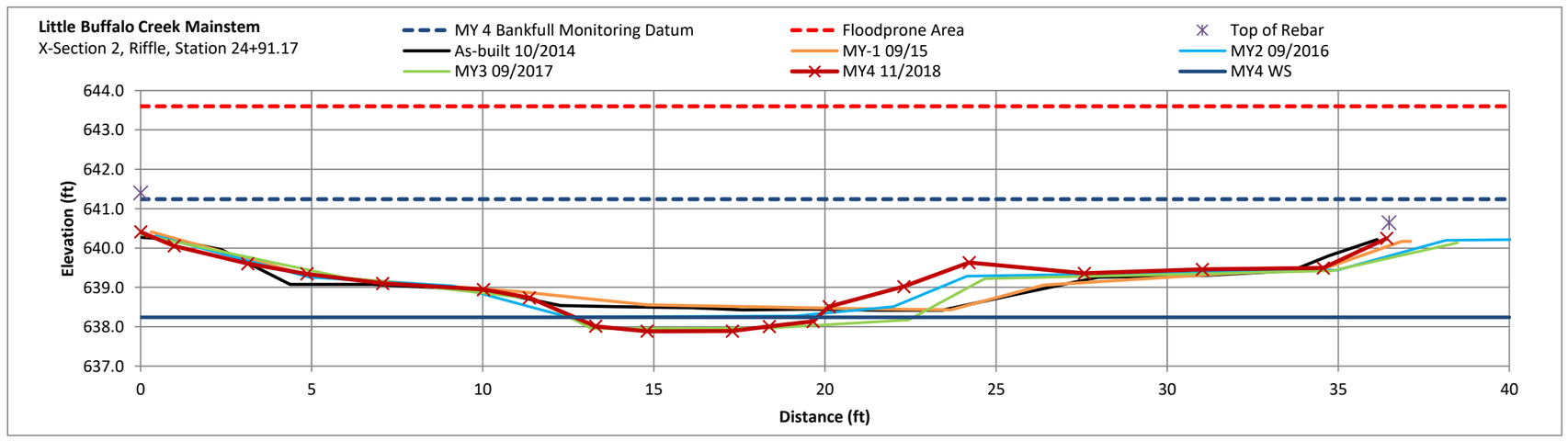
Station	Elevation
0.00	640.41
0.98	640.05
3.13	639.60
4.86	639.34
7.07	639.10
10.01	638.95
11.36	638.74
13.30	638.01
14.80	637.88
17.29	637.89
18.37	638.01
19.65	638.13
20.12	638.51
22.30	639.02
24.21	639.63
27.57	639.36
31.02	639.45
34.56	639.49
36.41	640.24
36.48	640.65

SUMMARY DATA	
Bankfull Elevation:	641.24
Bankfull Cross-Sectional Area:	43.15
Bankfull Width:	35.95
Flood Prone Area Elevation:	643.60
Flood Prone Width:	>100
Max Depth at Bankfull:	2.36
Mean Depth at Bankful:	1.20
W/D Ratio:	29.95
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.45

Stream Type	C4

Station and description	24+91.17 MS-1R Looking Upstream

24+91.17 MS-1R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-2R
Drainage Area (sq mi):	2.82
Date:	10/31/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

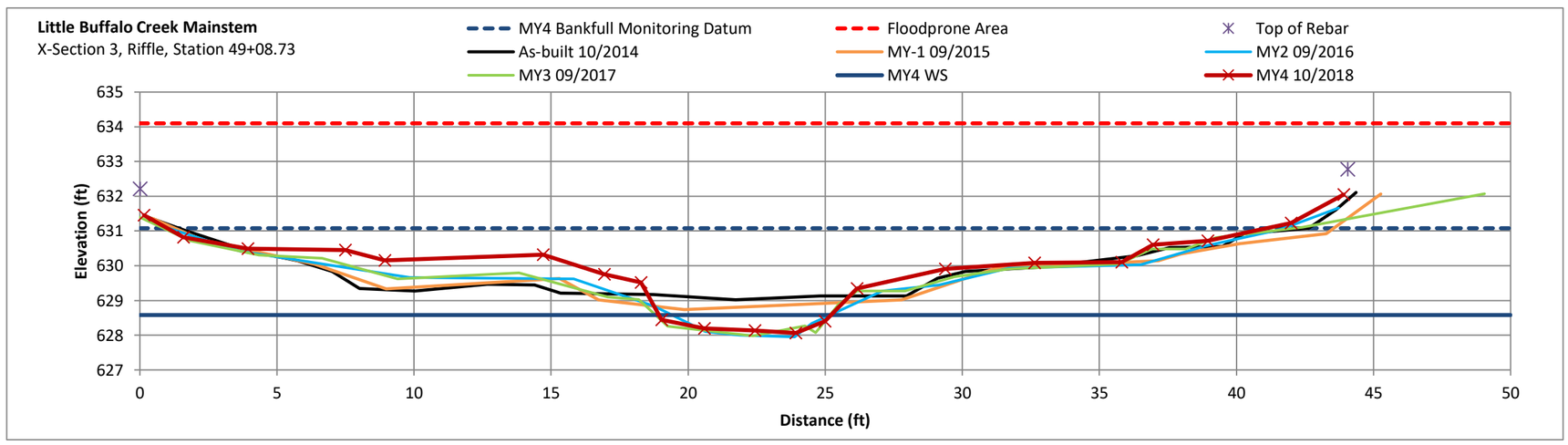
Station	Elevation
0.00	632.21
0.15	631.46
1.59	630.82
3.94	630.50
7.49	630.45
8.93	630.16
14.71	630.32
16.94	629.76
18.28	629.51
19.03	628.45
20.59	628.19
22.43	628.13
23.92	628.06
24.99	628.40
26.15	629.34
29.38	629.91
32.63	630.09
35.81	630.10
36.96	630.60
38.95	630.72
41.99	631.23
43.91	632.05
44.05	632.78

SUMMARY DATA	
Bankfull Elevation:	631.08
Bankfull Cross-Sectional Area:	48.23
Bankfull Width:	40.07
Flood Prone Area Elevation:	634.10
Flood Prone Width:	>100
Max Depth at Bankfull:	3.02
Mean Depth at Bankful:	1.20
W/D Ratio:	33.29
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.42

Stream Type	C4

Station and description	4908.73 MS-2R Looking Upstream

4908.73 MS-2R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-2P
Drainage Area (sq mi):	2.82
Date:	10/31/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

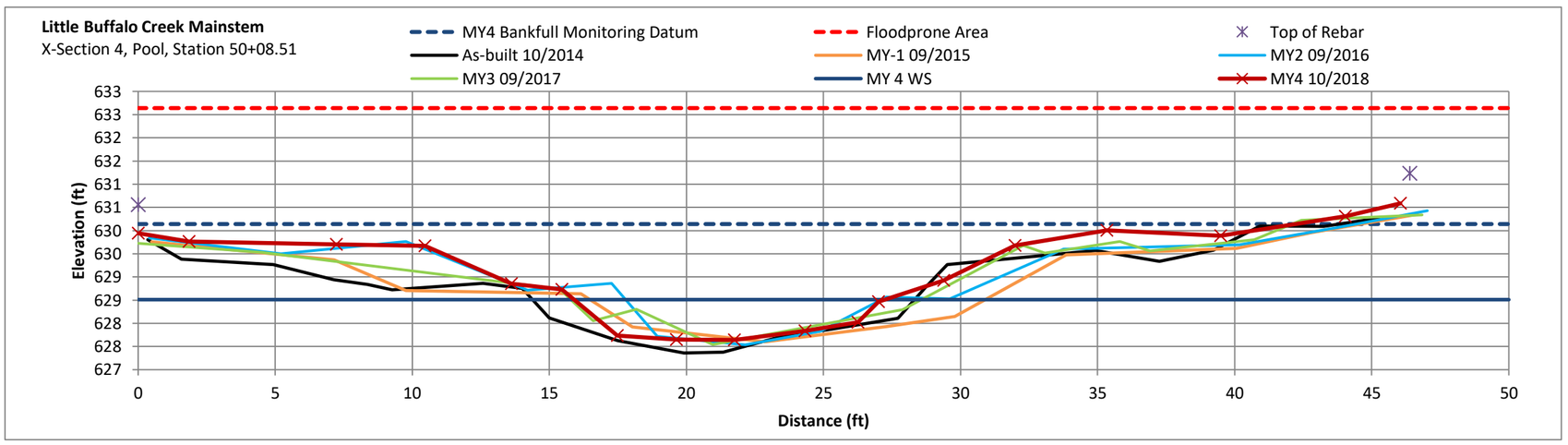
Station	Elevation
0.00	630.56
0.00	629.95
1.86	629.76
7.23	629.70
10.46	629.67
13.61	628.85
15.45	628.73
17.48	627.74
19.63	627.65
21.75	627.64
24.33	627.84
26.25	628.03
27.01	628.47
29.38	628.93
31.98	629.68
35.33	630.00
39.49	629.89
44.04	630.31
46.04	630.59
46.38	631.23

SUMMARY DATA	
Bankfull Elevation:	630.14
Bankfull Cross-Sectional Area:	43.79
Bankfull Width:	43.99
Flood Prone Area Elevation:	632.64
Flood Prone Width:	>100
Max Depth at Bankfull:	2.50
Mean Depth at Bankful:	1.00
W/D Ratio:	44.19
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4

Station and description	5008.51 MS-2P Looking Upstream

5008.51 MS-2P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-3P
Drainage Area (sq mi):	4.01
Date:	10/30/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

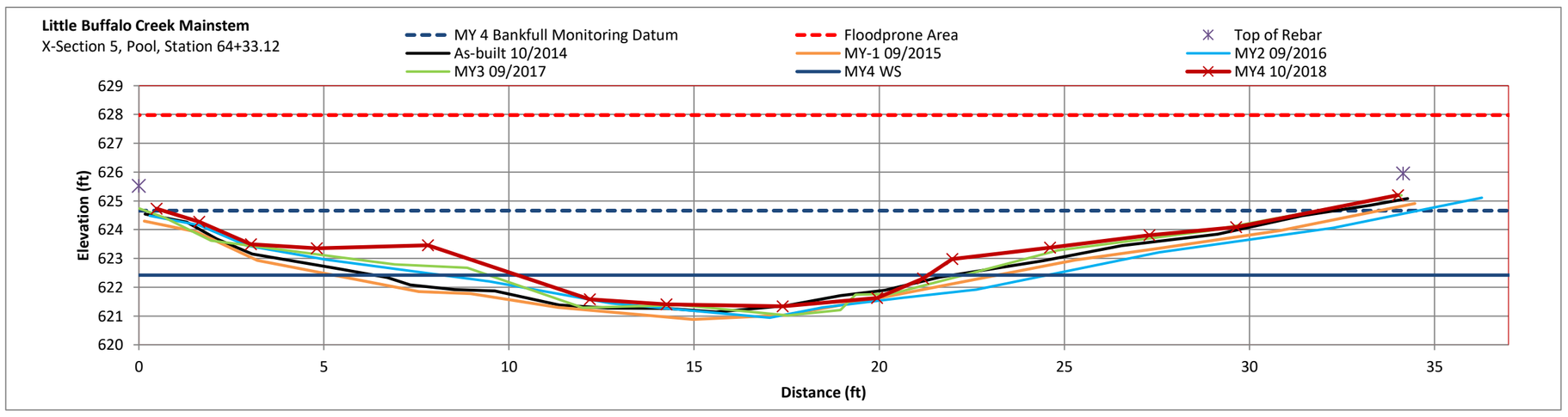
Station	Elevation
0.00	625.53
0.48	624.72
1.63	624.28
3.03	623.49
4.81	623.35
7.81	623.46
12.18	621.58
14.25	621.40
17.39	621.34
19.94	621.63
21.18	622.30
21.97	622.98
24.61	623.37
27.30	623.80
29.64	624.08
34.01	625.20
34.15	625.96

SUMMARY DATA	
Bankfull Elevation:	624.66
Bankfull Cross-Sectional Area:	54.90
Bankfull Width:	31.28
Flood Prone Area Elevation:	627.98
Flood Prone Width:	>100
Max Depth at Bankfull:	3.32
Mean Depth at Bankful:	1.76
W/D Ratio:	17.82
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4

Station and description	6433.12 MS-3P Looking Upstream

6433.12 MS-3P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT2-1R
Drainage Area (sq mi):	0.3
Date:	10/29/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

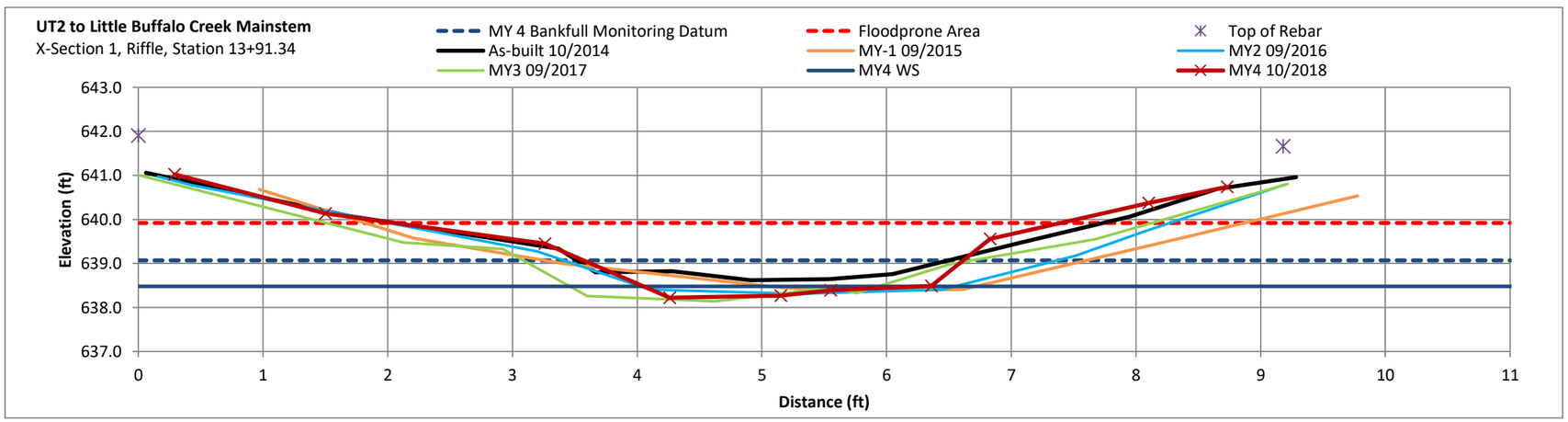
Station	Elevation
0.00	641.90
0.29	641.03
1.50	640.14
3.26	639.45
4.26	638.22
5.15	638.27
5.55	638.39
6.36	638.49
6.83	639.56
8.10	640.38
8.73	640.74
9.18	641.66

SUMMARY DATA	
Bankfull Elevation:	639.07
Bankfull Cross-Sectional Area:	1.82
Bankfull Width:	3.04
Flood Prone Area Elevation:	639.92
Flood Prone Width:	6.79
Max Depth at Bankfull:	0.85
Mean Depth at Bankful:	0.60
W/D Ratio:	5.08
Entrenchment Ratio:	2.20
Bank Height Ratio:	1.39

Stream Type	B6c

Station and description	1391.34 UT2-1R Looking Upstream

1391.34 UT2-1R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-1R
Drainage Area (sq mi):	0.097
Date:	10/31/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

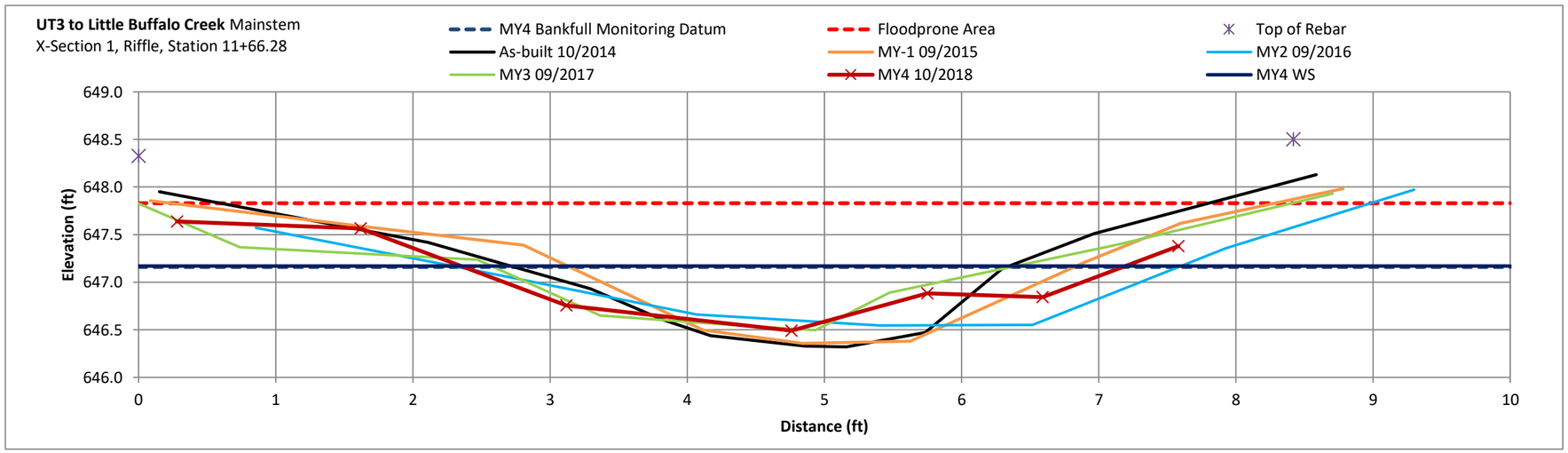
Station	Elevation
0.00	648.33
0.28	647.64
1.62	647.57
3.12	646.76
4.76	646.49
5.75	646.88
6.59	646.84
7.58	647.38
8.42	648.50

SUMMARY DATA	
Bankfull Elevation:	647.16
Bankfull Cross-Sectional Area:	1.84
Bankfull Width:	4.79
Flood Prone Area Elevation:	647.83
Flood Prone Width:	11.03
Max Depth at Bankfull:	0.67
Mean Depth at Bankful:	0.38
W/D Ratio:	12.47
Entrenchment Ratio:	2.30
Bank Height Ratio:	1.33

Stream Type	B6

Station and description	1166.28 UT3-1R Looking Upstream

1166.28 UT3-1R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-1P
Drainage Area (sq mi):	0.097
Date:	10/30/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

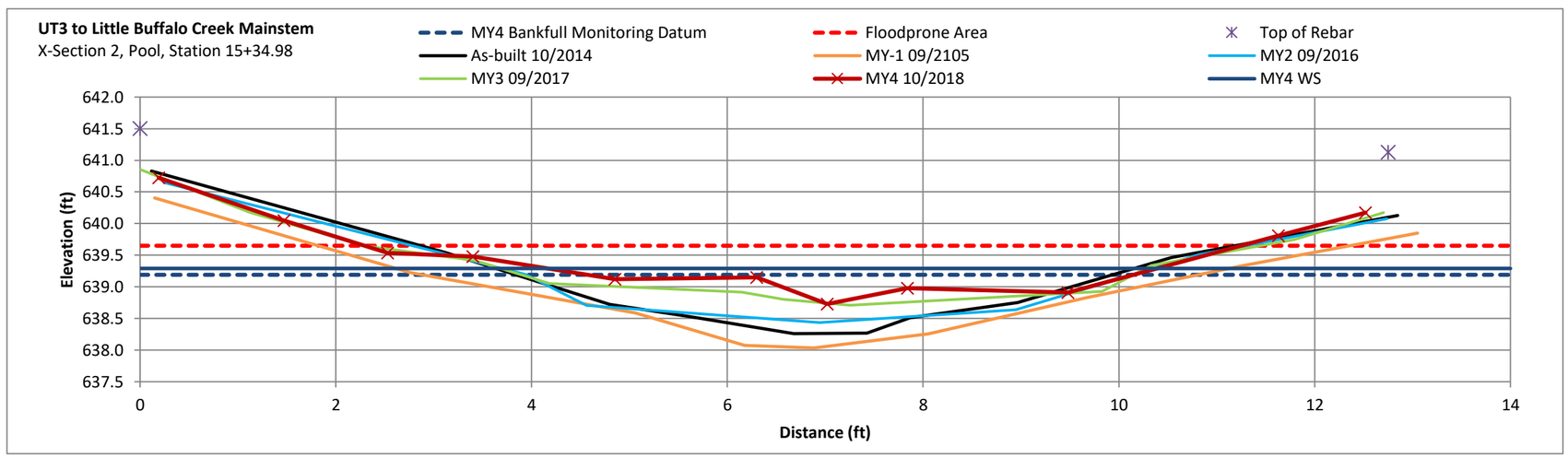
Station	Elevation
0.00	641.50
0.19	640.72
1.47	640.05
2.53	639.54
3.40	639.48
4.85	639.12
6.30	639.15
7.02	638.73
7.84	638.98
9.48	638.91
11.63	639.81
12.52	640.17
12.75	641.126

SUMMARY DATA	
Bankfull Elevation:	639.19
Bankfull Cross-Sectional Area:	1.01
Bankfull Width:	5.55
Flood Prone Area Elevation:	639.65
Flood Prone Width:	11.67
Max Depth at Bankfull:	0.46
Mean Depth at Bankful:	0.18
W/D Ratio:	30.50
Entrenchment Ratio:	2.10
Bank Height Ratio:	-

Stream Type	B6

Station and description	1534.98 UT3-1P Looking Upstream

1534.98 UT3-1P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-2R
Drainage Area (sq mi):	0.097
Date:	10/31/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

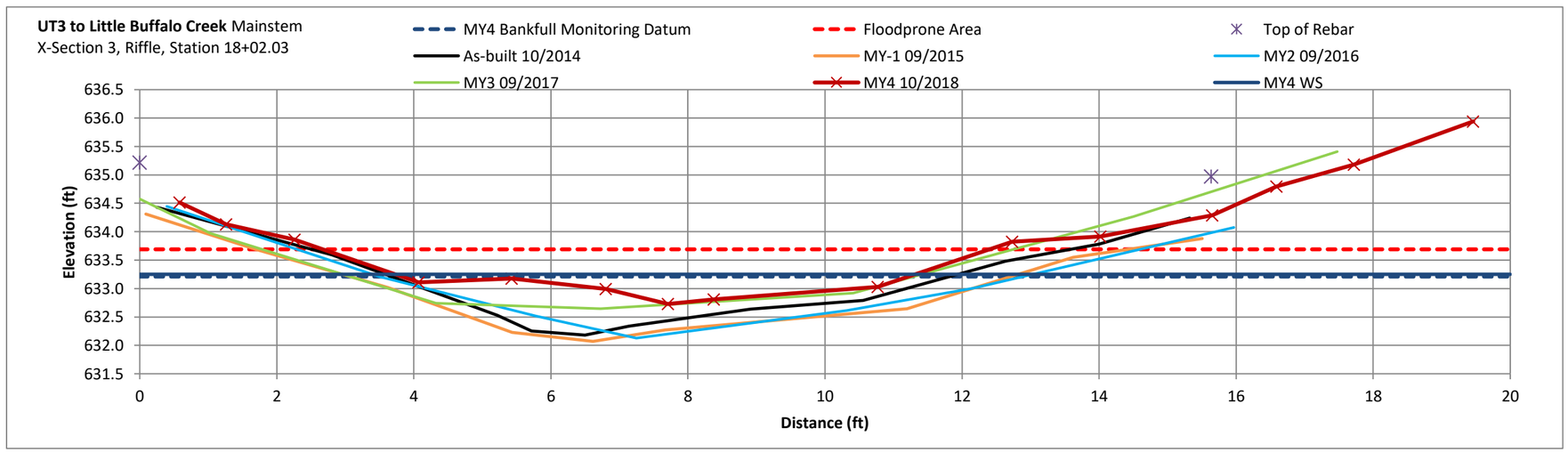
Station	Elevation
0.00	635.22
0.58	634.51
1.26	634.13
2.26	633.86
4.07	633.11
5.43	633.17
6.80	632.99
7.71	632.73
8.38	632.81
10.77	633.028
12.73	633.823
14.02	633.916
15.65	634.288
16.59	634.799
17.72	635.181
19.46	635.942
22.16	637.017

SUMMARY DATA	
Bankfull Elevation:	633.21
Bankfull Cross-Sectional Area:	1.69
Bankfull Width:	7.40
Flood Prone Area Elevation:	633.69
Flood Prone Width:	13.67
Max Depth at Bankfull:	0.48
Mean Depth at Bankful:	0.23
W/D Ratio:	32.40
Entrenchment Ratio:	1.85
Bank Height Ratio:	2.29

Stream Type	B6

Station and description	1802.03 UT3-2R Looking Upstream

1802.03 UT3-2R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-3R
Drainage Area (sq mi):	0.097
Date:	10/30/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

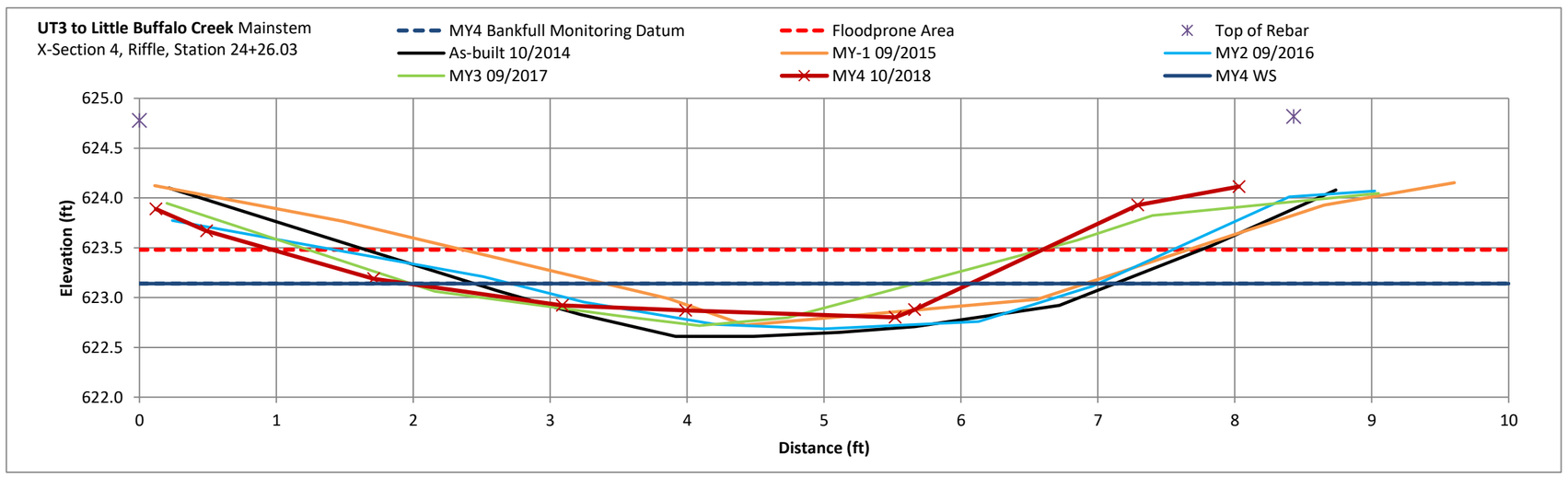
Station	Elevation
0.00	624.78
0.12	623.89
0.49	623.67
1.71	623.19
3.09	622.92
3.99	622.87
5.52	622.80
5.66	622.88
7.29	623.93
8.03	624.11
8.43	624.82

SUMMARY DATA	
Bankfull Elevation:	623.14
Bankfull Cross-Sectional Area:	0.75
Bankfull Width:	3.58
Flood Prone Area Elevation:	623.48
Flood Prone Width:	5.62
Max Depth at Bankfull:	0.34
Mean Depth at Bankful:	0.21
W/D Ratio:	17.09
Entrenchment Ratio:	1.57
Bank Height Ratio:	2.56

Stream Type	B6

Station and description	2426.03 UT3-3R Looking Upstream

2426.03 UT3-3R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT4-1P
Drainage Area (sq mi):	0.4
Date:	10/30/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

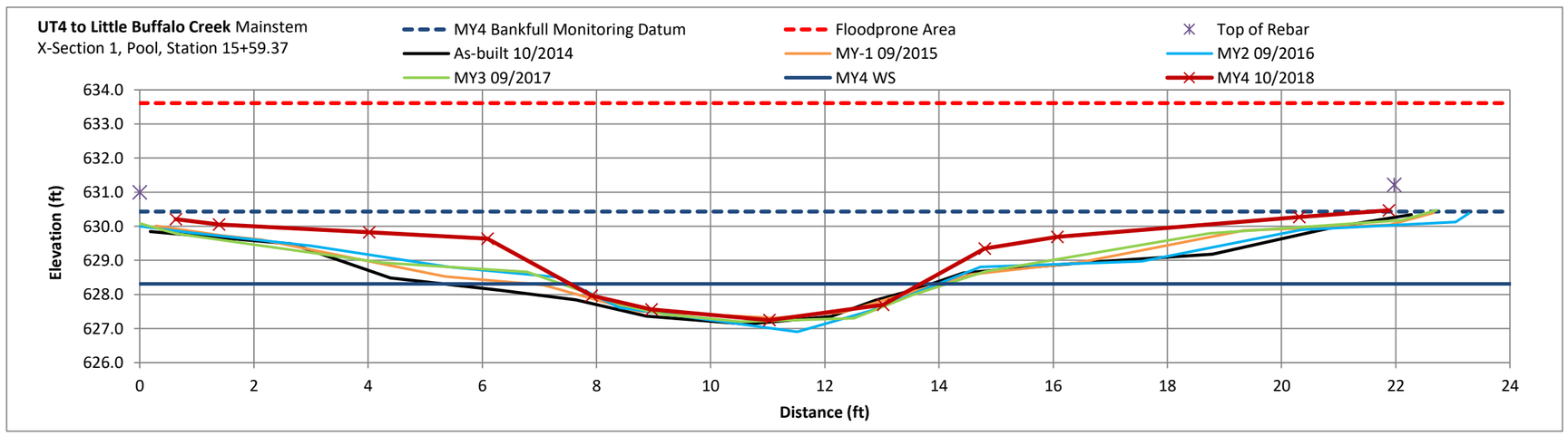
Station	Elevation
0.00	630.99
0.63	630.21
1.39	630.05
4.02	629.82
6.09	629.64
7.91	627.97
8.96	627.56
11.03	627.25
13.02	627.70
14.80	629.35
16.07	629.68
20.31	630.27
21.88	630.47
21.97	631.21

SUMMARY DATA	
Bankfull Elevation:	630.43
Bankfull Cross-Sectional Area:	27.37
Bankfull Width:	21.08
Flood Prone Area Elevation:	633.61
Flood Prone Width:	>100
Max Depth at Bankfull:	3.18
Mean Depth at Bankful:	1.30
W/D Ratio:	16.24
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4

Station and description	1559.37 UT4-1P Looking Upstream

1559.37 UT4-1P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT4-1R
Drainage Area (sq mi):	0.4
Date:	10/30/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

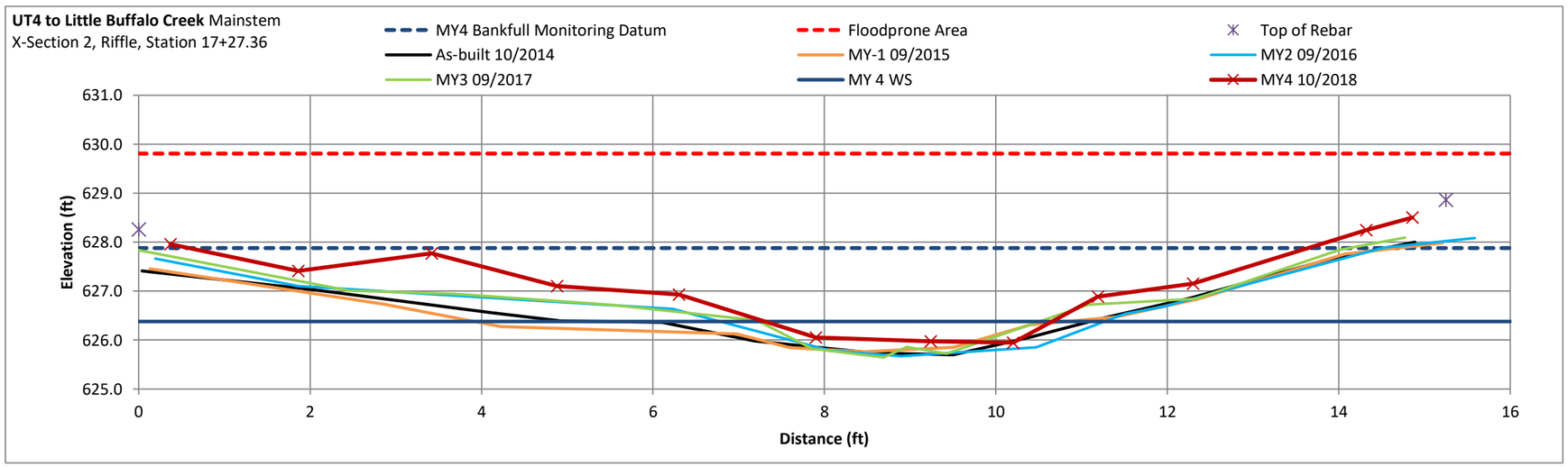
Station	Elevation
0.00	628.26
0.37	627.96
1.86	627.41
3.42	627.77
4.88	627.10
6.30	626.93
7.90	626.06
9.24	625.98
10.20	625.95
11.19	626.89
12.30	627.15
14.32	628.25
14.86	628.50
15.25	628.86

SUMMARY DATA	
Bankfull Elevation:	627.88
Bankfull Cross-Sectional Area:	12.13
Bankfull Width:	13.07
Flood Prone Area Elevation:	629.81
Flood Prone Width:	>100
Max Depth at Bankfull:	1.93
Mean Depth at Bankful:	0.93
W/D Ratio:	14.08
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.47

Stream Type	C4

Station and description	1727.36 UT4-1R Looking Upstream

1727.36 UT4-1R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-1R
Drainage Area (sq mi):	1.91
Date:	11/2/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

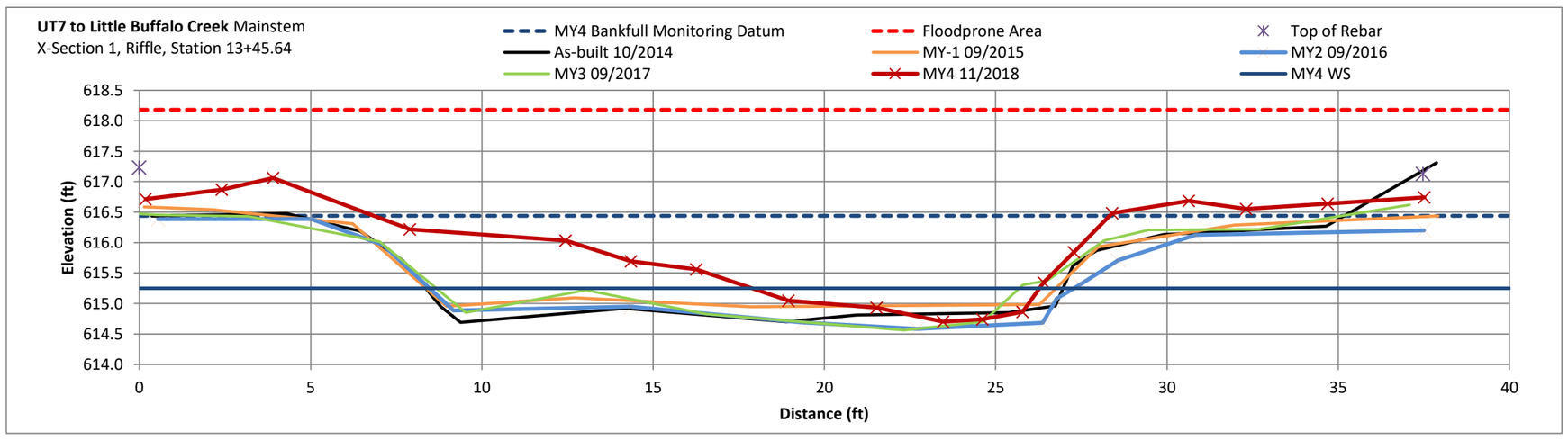
Station	Elevation
0.00	617.23
0.18	616.71
2.41	616.87
3.91	617.06
7.90	616.22
12.44	616.03
14.35	615.69
16.26	615.56
18.95	615.05
21.53	614.93
23.47	614.70
24.62	614.74
25.79	614.86
26.40	615.35
27.29	615.85
28.40	616.48
30.64	616.68
32.31	616.55
34.7	616.64
37.48	617.13
37.52	616.75

SUMMARY DATA	
Bankfull Elevation:	616.44
Bankfull Cross-Sectional Area:	19.93
Bankfull Width:	21.45
Flood Prone Area Elevation:	618.18
Flood Prone Width:	>100
Max Depth at Bankfull:	1.74
Mean Depth at Bankful:	0.93
W/D Ratio:	23.09
Entrenchment Ratio:	>2.2
Bank Height Ratio:	1.02

Stream Type	C4

Station and description	1345.64 UT7-1R Looking Upstream

1345.64 UT7-1R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-1P
Drainage Area (sq mi):	1.91
Date:	11/2/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

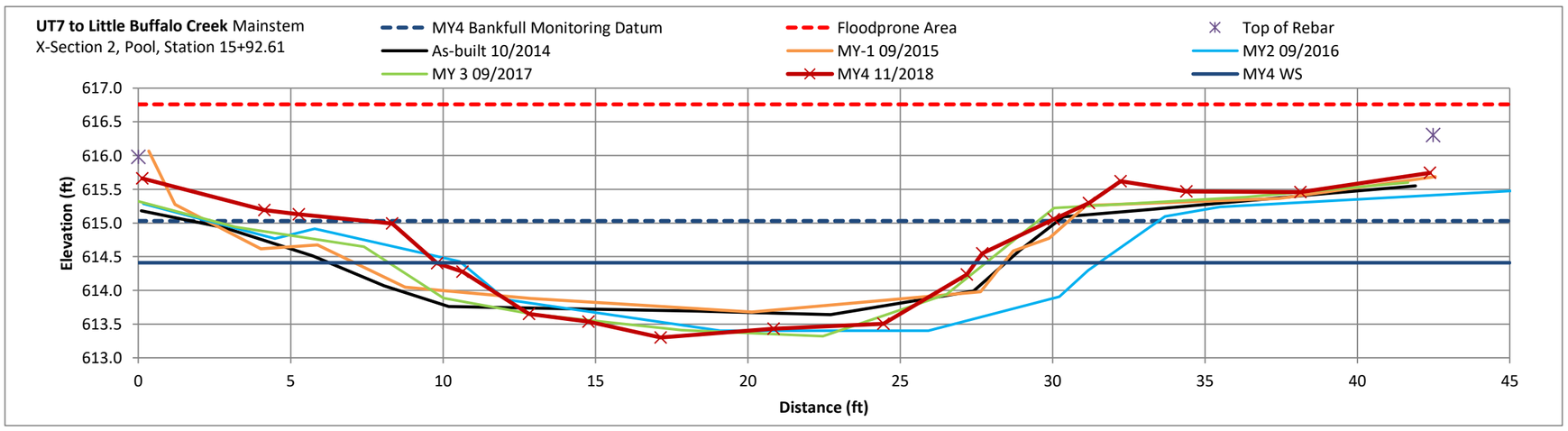
Station	Elevation
0.00	615.98
0.13	615.66
4.14	615.19
5.27	615.13
8.33	614.99
9.81	614.40
10.64	614.28
12.82	613.65
14.77	613.53
17.14	613.30
20.85	613.43
24.45	613.50
27.19	614.23
27.70	614.55
30.04	615.06
31.19	615.30
32.23	615.62
34.39	615.47
38.13	615.46
42.38	615.74
42.49	616.30

SUMMARY DATA	
Bankfull Elevation:	615.03
Bankfull Cross-Sectional Area:	25.98
Bankfull Width:	22.46
Flood Prone Area Elevation:	616.76
Flood Prone Width:	>100
Max Depth at Bankfull:	1.73
Mean Depth at Bankful:	1.16
W/D Ratio:	19.42
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4

Station and description	1592.61 UT7-1P Looking Upstream

1592.61 UT7-1P Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-2R
Drainage Area (sq mi):	1.91
Date:	11/2/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

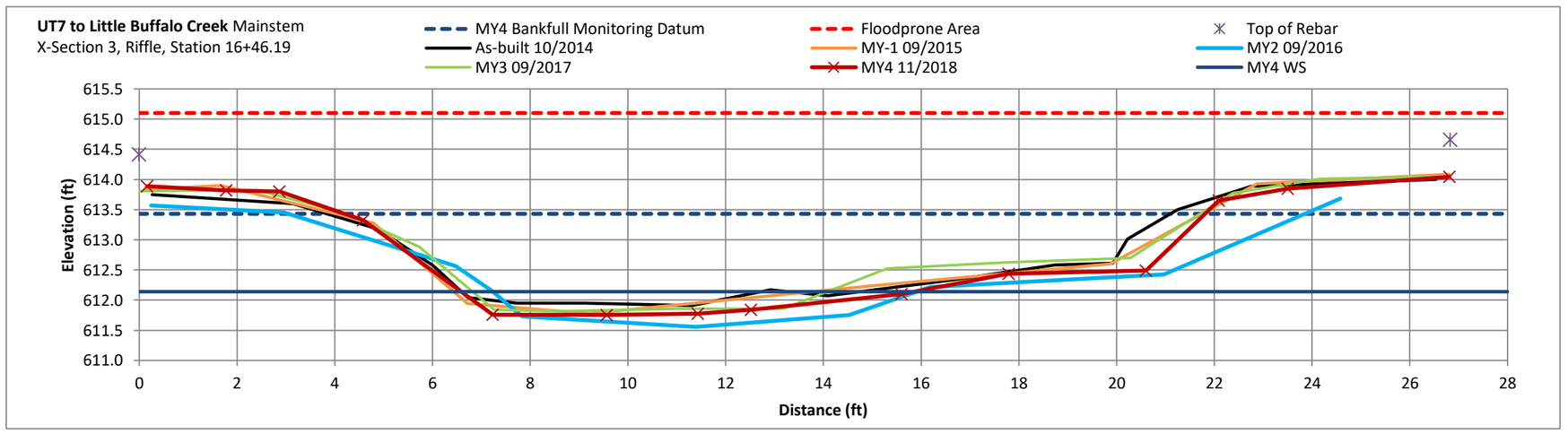
Station	Elevation
0.00	614.42
0.16	613.89
1.78	613.82
2.87	613.80
4.58	613.33
7.23	611.76
9.57	611.76
11.43	611.78
12.52	611.84
15.60	612.10
17.79	612.44
20.60	612.49
22.09	613.65
23.50	613.84
26.81	614.04
26.83	614.66

SUMMARY DATA	
Bankfull Elevation:	613.43
Bankfull Cross-Sectional Area:	21.68
Bankfull Width:	17.61
Flood Prone Area Elevation:	615.10
Flood Prone Width:	>100
Max Depth at Bankfull:	1.67
Mean Depth at Bankful:	1.23
W/D Ratio:	14.30
Entrenchment Ratio:	>2.2
Bank Height Ratio:	1.13

Stream Type	C4

Station and description	1846.19 UT7-2R Looking Upstream

1846.19 UT7-2R Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-STP1
Drainage Area (sq mi):	1.91
Date:	11/2/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

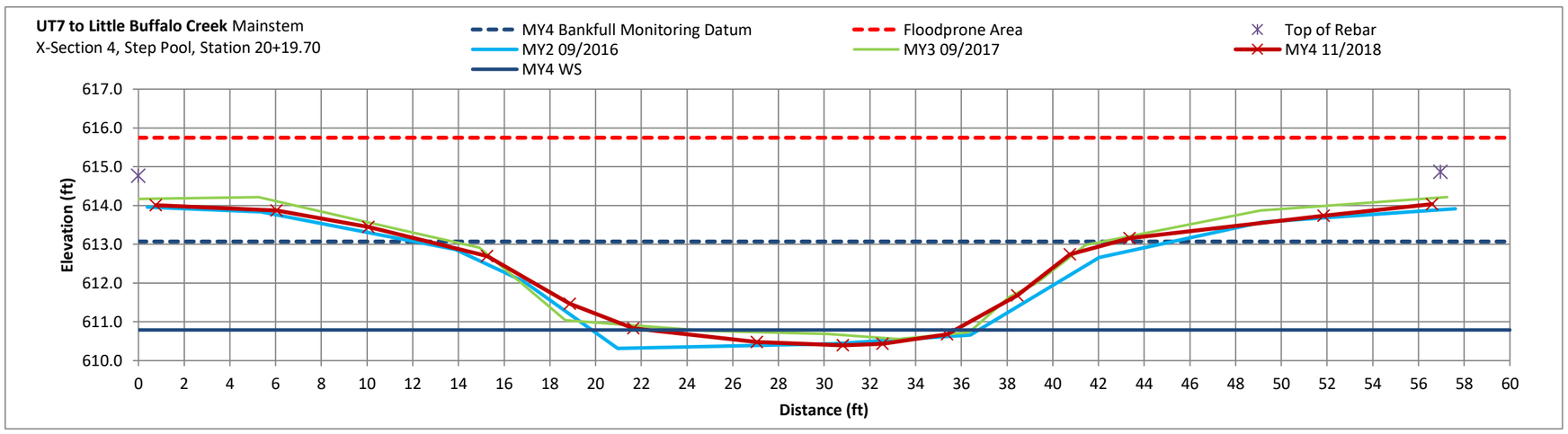
Station	Elevation
0.00	614.77
0.76	614.01
6.05	613.87
10.07	613.45
15.25	612.69
18.88	611.47
21.65	610.83
27.06	610.48
30.83	610.39
32.55	610.43
35.38	610.67
38.45	611.68
40.76	612.74
43.36	613.16
51.85	613.73
56.60	614.04
56.97	614.87

SUMMARY DATA	
Bankfull Elevation:	613.07
Bankfull Cross-Sectional Area:	52.44
Bankfull Width:	30.22
Flood Prone Area Elevation:	615.75
Flood Prone Width:	>100
Max Depth at Bankfull:	2.68
Mean Depth at Bankful:	1.74
W/D Ratio:	17.42
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-

Stream Type	C4b

Station and description	2019.70 UT7-STP1 Looking Upstream

2019.70 UT7-STP1 Looking Downstream



Cross Section Plot Exhibit

River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-STP2
Drainage Area (sq mi):	1.91
Date:	11/2/2018
Field Crew:	Matthew Holthaus, Alston Willard: Louis Berger

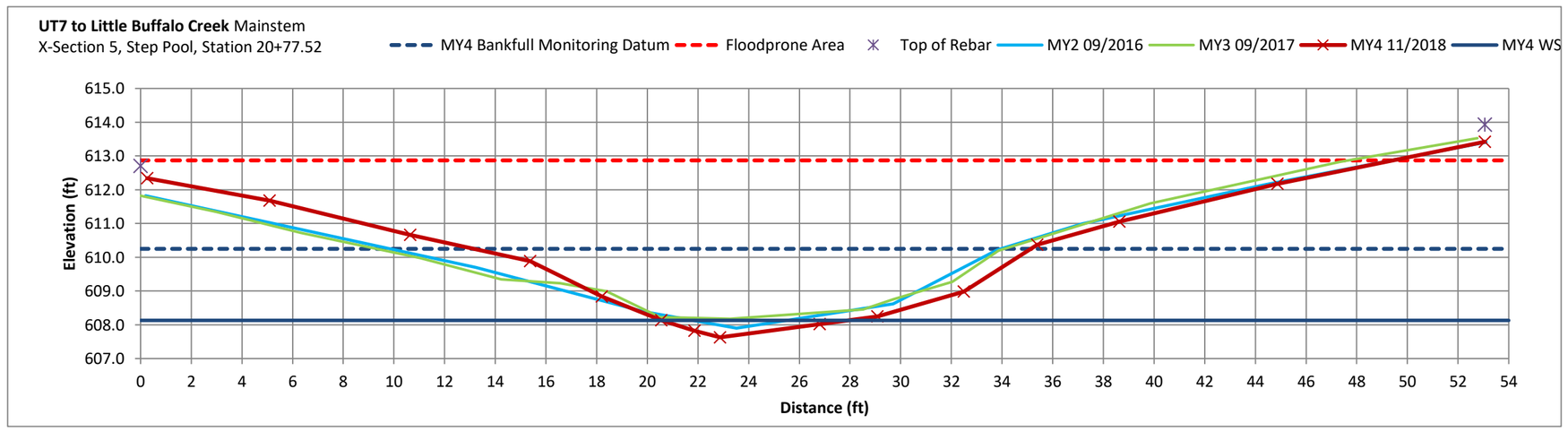
Station	Elevation
0.00	612.70
0.26	612.35
5.10	611.68
10.65	610.66
15.38	609.89
18.21	608.84
20.56	608.14
21.87	607.82
22.87	607.63
26.80	608.02
29.08	608.24
32.49	608.99
35.39	610.37
38.64	611.06
44.88	612.17
53.06	613.42
53.06	613.93

SUMMARY DATA	
Bankfull Elevation:	610.25
Bankfull Cross-Sectional Area:	34.22
Bankfull Width:	21.98
Flood Prone Area Elevation:	612.87
Flood Prone Width:	55.00
Max Depth at Bankfull:	2.62
Mean Depth at Bankful:	1.56
W/D Ratio:	14.12
Entrenchment Ratio:	2.50
Bank Height Ratio:	-

Stream Type	B4

Station and description	2077.52 UT7-STP2 Looking Upstream

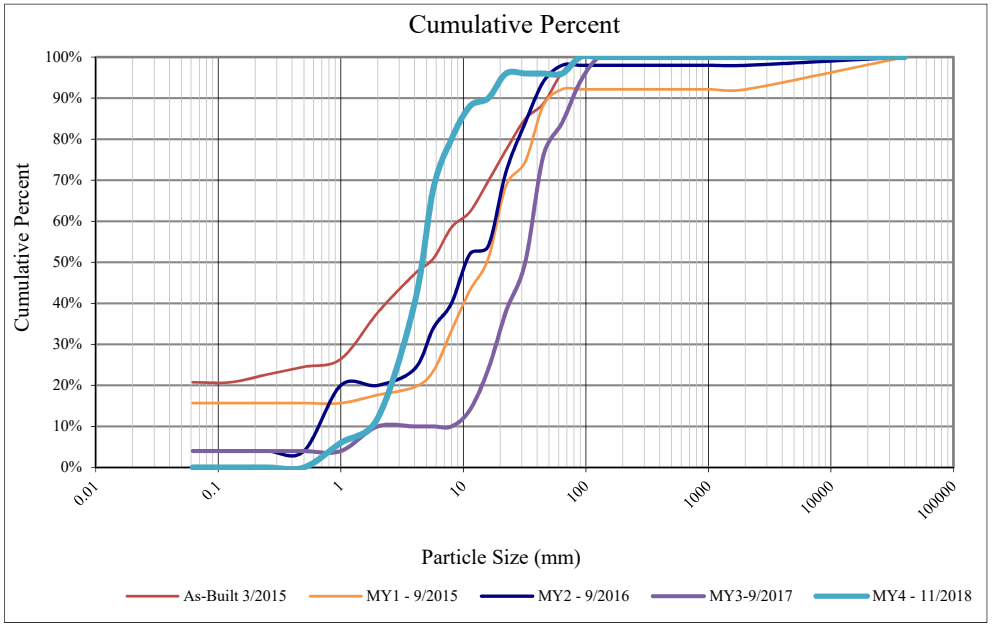
2077.52 UT7-STP2 Looking Downstream

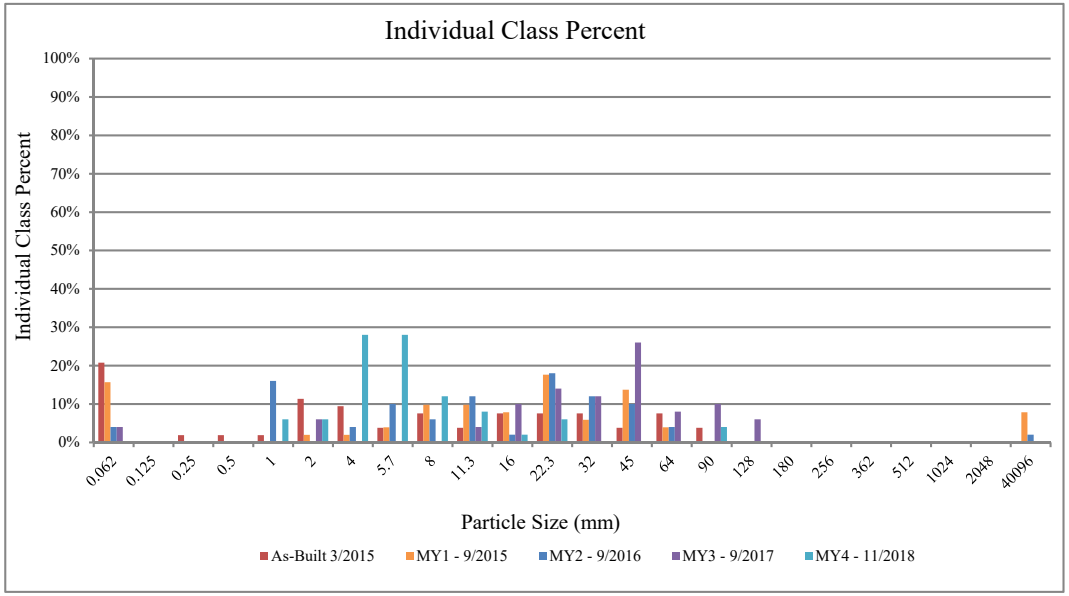


Figures 5a-q – Pebble Count Plots

Project Name: Little Buffalo Creek					
Cross-Section: MS-1P					
Feature: Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	3	6%	6%
	very coarse sand	2.0	3	6%	12%
Gravel	very fine gravel	4.0	14	28%	40%
	fine gravel	5.7	14	28%	68%
	fine gravel	8.0	6	12%	80%
	medium gravel	11.3	4	8%	88%
	medium gravel	16.0	1	2%	90%
	coarse gravel	22.3	3	6%	96%
	coarse gravel	32.0	0	0%	96%
	very coarse gravel	45	0	0%	96%
	very coarse gravel	64	0	0%	96%
Cobble	small cobble	90	2	4%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

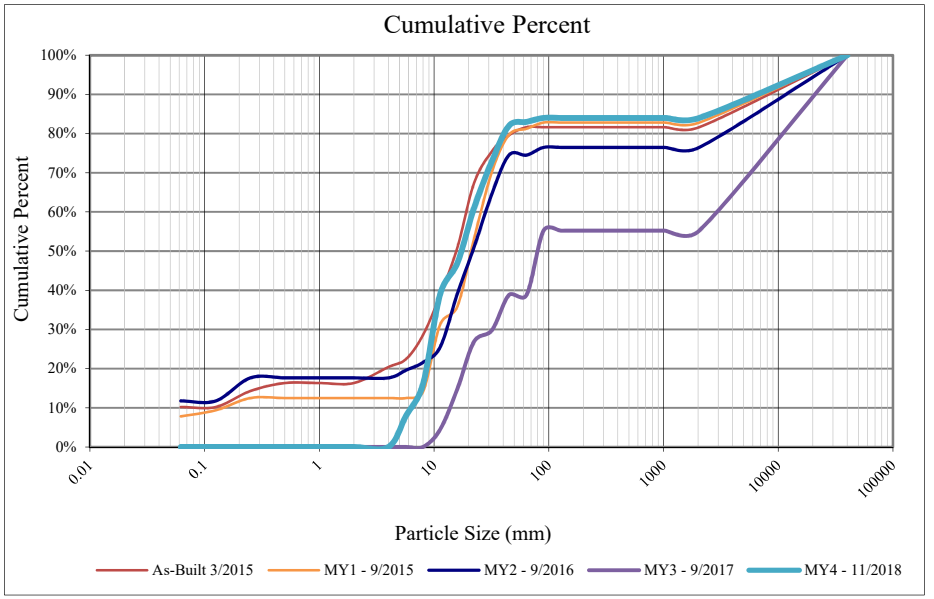
Summary Data	
D16	2.29
D35	3.64
D50	4.61
D84	9.65
D95	21.25
D100	90.00

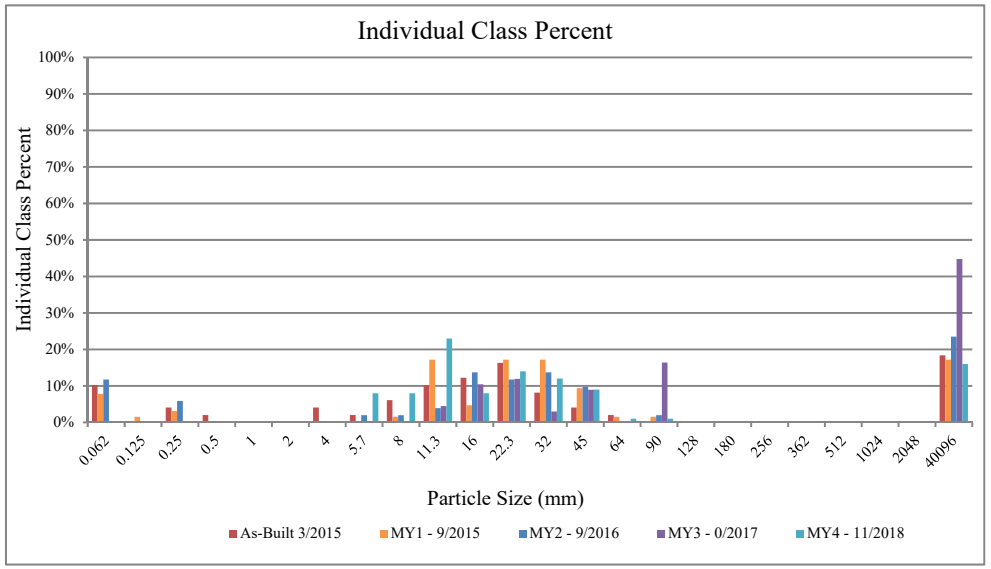




Project Name: Little Buffalo Creek					
Cross-Section: MS-1R					
Feature: Riffle					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	0	0%	0%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	0	0%	0%
	fine gravel	5.7	8	8%	8%
	fine gravel	8.0	8	8%	16%
	medium gravel	11.3	23	23%	39%
	medium gravel	16.0	8	8%	47%
	coarse gravel	22.3	14	14%	61%
	coarse gravel	32.0	12	12%	73%
	very coarse gravel	45	9	9%	82%
	very coarse gravel	64	1	1%	83%
Cobble	small cobble	90	1	1%	84%
	medium cobble	128	0	0%	84%
	large cobble	180	0	0%	84%
	very large cobble	256	0	0%	84%
Boulder	small boulder	362	0	0%	84%
	small boulder	512	0	0%	84%
	medium boulder	1024	0	0%	84%
	large boulder	2048	0	0%	84%
Bedrock	bedrock	40096	16	16%	100%
TOTAL % of whole count			100	100%	100%

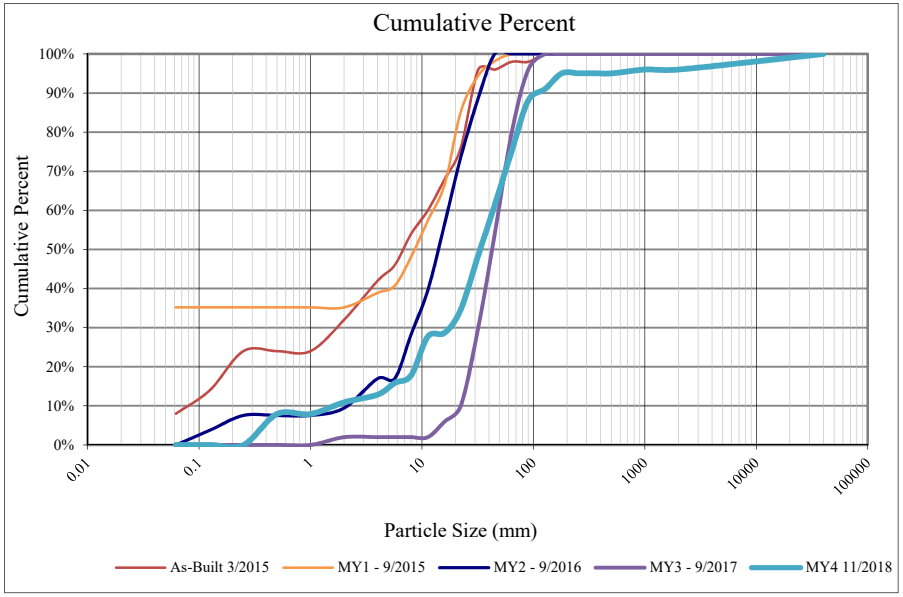
Summary Data	
D16	8.00
D35	10.73
D50	17.35
D84	90.00
D95	Bedrock
D100	Bedrock

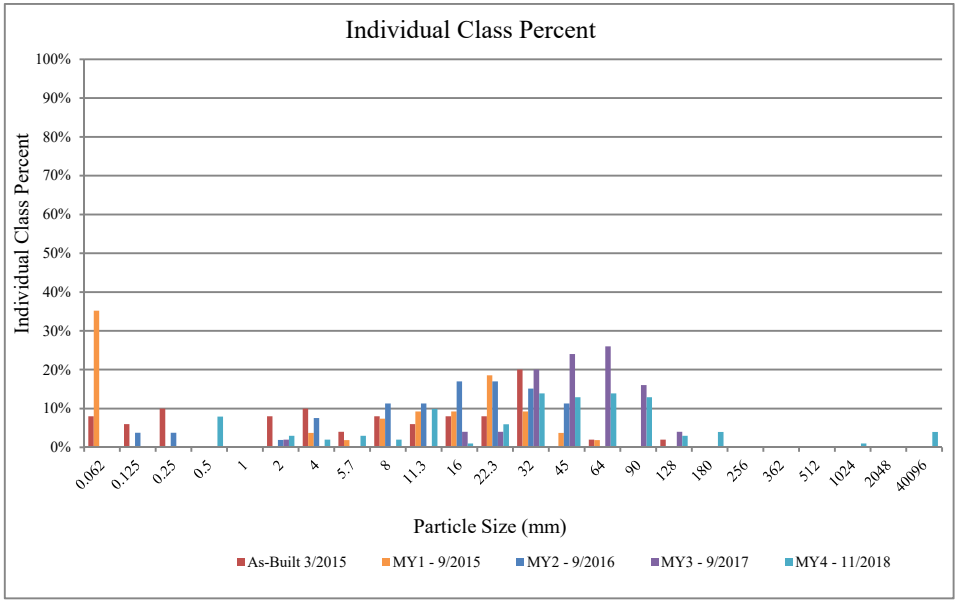




Project Name: Little Buffalo Creek					
Cross-Section: MS-2P					
Feature: Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	8	8%	8%
	coarse sand	1.00	0	0%	8%
	very coarse sand	2.0	3	3%	11%
Gravel	very fine gravel	4.0	2	2%	13%
	fine gravel	5.7	3	3%	16%
	fine gravel	8.0	2	2%	18%
	medium gravel	11.3	10	10%	28%
	medium gravel	16.0	1	1%	29%
	coarse gravel	22.3	6	6%	35%
	coarse gravel	32.0	14	14%	49%
	very coarse gravel	45	13	13%	61%
	very coarse gravel	64	14	14%	75%
Cobble	small cobble	90	13	13%	88%
	medium cobble	128	3	3%	91%
	large cobble	180	4	4%	95%
	very large cobble	256	0	0%	95%
Boulder	small boulder	362	0	0%	95%
	small boulder	512	0	0%	95%
	medium boulder	1024	1	1%	96%
	large boulder	2048	0	0%	96%
Bedrock	bedrock	40096	4	4%	100%
TOTAL % of whole count			101	100%	100%

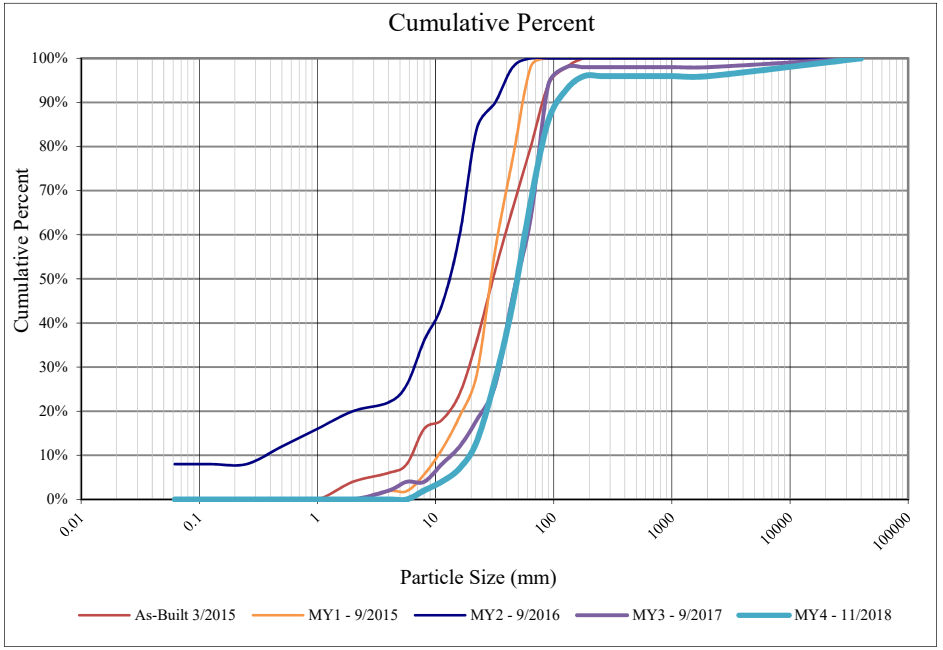
Summary Data	
D16	5.88
D35	22.54
D50	33.50
D84	81.68
D95	179.35
D100	Bedrock

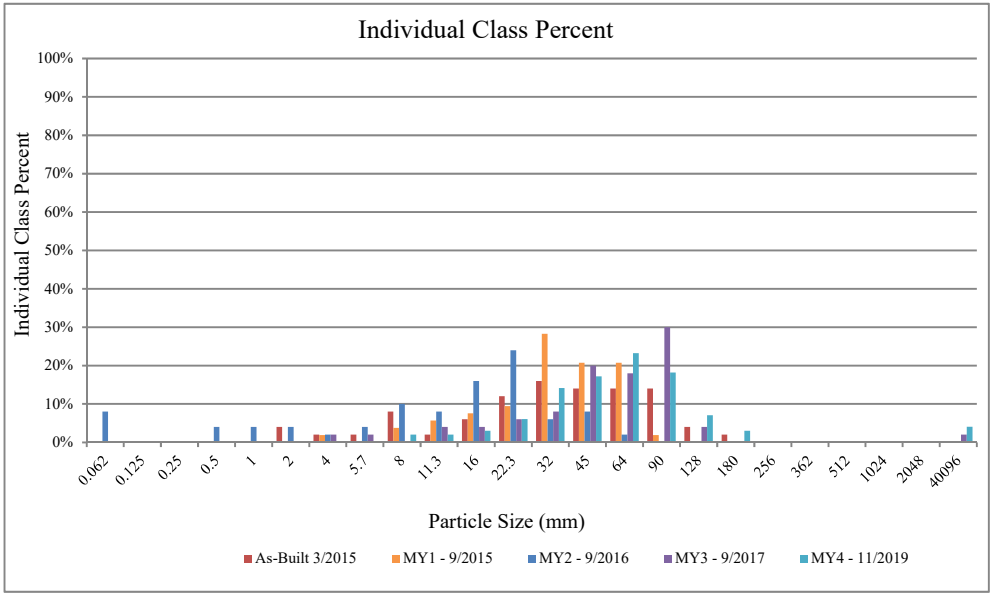




Project Name: Little Buffalo Creek					
Cross-Section: MS-2R					
Feature: Riffle					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	0	0%	0%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	0	0%	0%
	fine gravel	5.7	0	0%	0%
	fine gravel	8.0	2	2%	2%
	medium gravel	11.3	2	2%	4%
	medium gravel	16.0	3	3%	7%
	coarse gravel	22.3	6	6%	13%
	coarse gravel	32.0	14	14%	27%
	very coarse gravel	45	17	17%	44%
	very coarse gravel	64	23	23%	68%
Cobble	small cobble	90	18	18%	86%
	medium cobble	128	7	7%	93%
	large cobble	180	3	3%	96%
	very large cobble	256	0	0%	96%
Boulder	small boulder	362	0	0%	96%
	small boulder	512	0	0%	96%
	medium boulder	1024	0	0%	96%
	large boulder	2048	0	0%	96%
Bedrock	bedrock	40096	4	4%	100%
TOTAL % of whole count			99	100%	100%

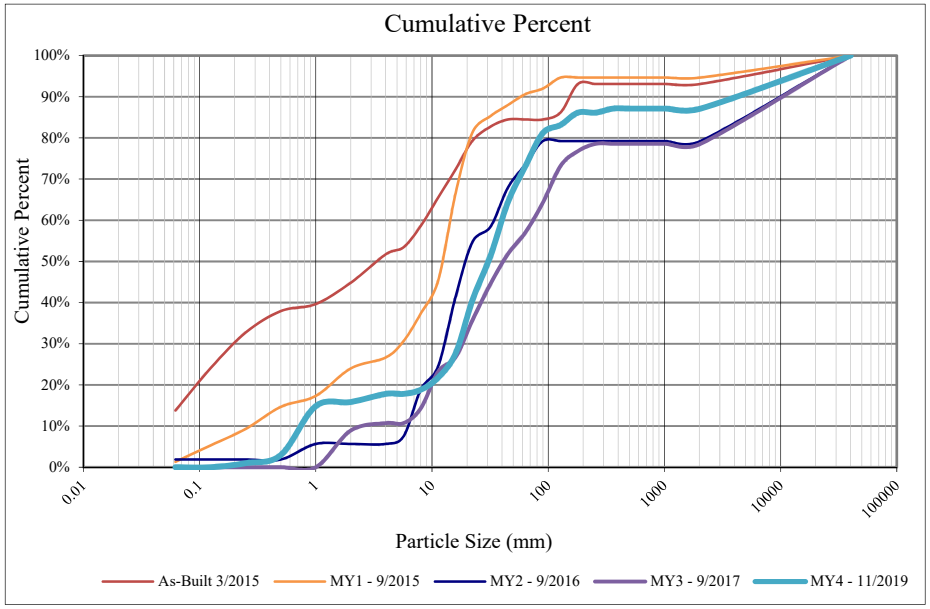
Summary Data	
D16	24.27
D35	37.85
D50	49.54
D84	87.34
D95	163.53
D100	Bedrock

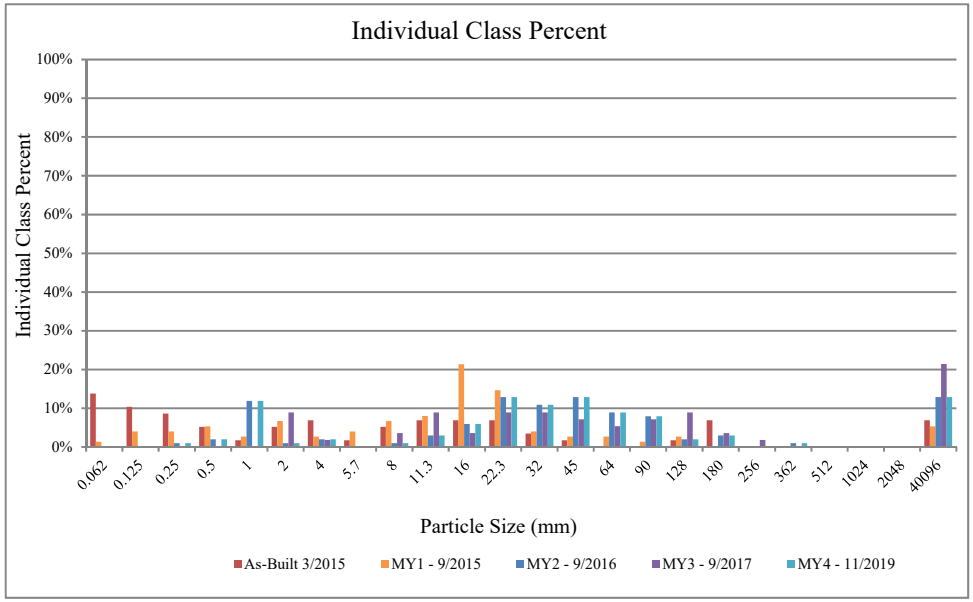




Project Name: Little Buffalo Creek					
Cross-Section: MS-3P					
Feature: Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	1	1%	1%
	medium sand	0.50	2	2%	3%
	coarse sand	1.00	12	12%	15%
	very coarse sand	2.0	1	1%	16%
Gravel	very fine gravel	4.0	2	2%	18%
	fine gravel	5.7	0	0%	18%
	fine gravel	8.0	1	1%	19%
	medium gravel	11.3	3	3%	22%
	medium gravel	16.0	6	6%	28%
	coarse gravel	22.3	13	13%	41%
	coarse gravel	32.0	11	11%	51%
	very coarse gravel	45	13	13%	64%
	very coarse gravel	64	9	9%	73%
Cobble	small cobble	90	8	8%	81%
	medium cobble	128	2	2%	83%
	large cobble	180	3	3%	86%
	very large cobble	256	0	0%	86%
Boulder	small boulder	362	1	1%	87%
	small boulder	512	0	0%	87%
	medium boulder	1024	0	0%	87%
	large boulder	2048	0	0%	87%
Bedrock	bedrock	40096	13	13%	100%
TOTAL % of whole count			101	100%	100%

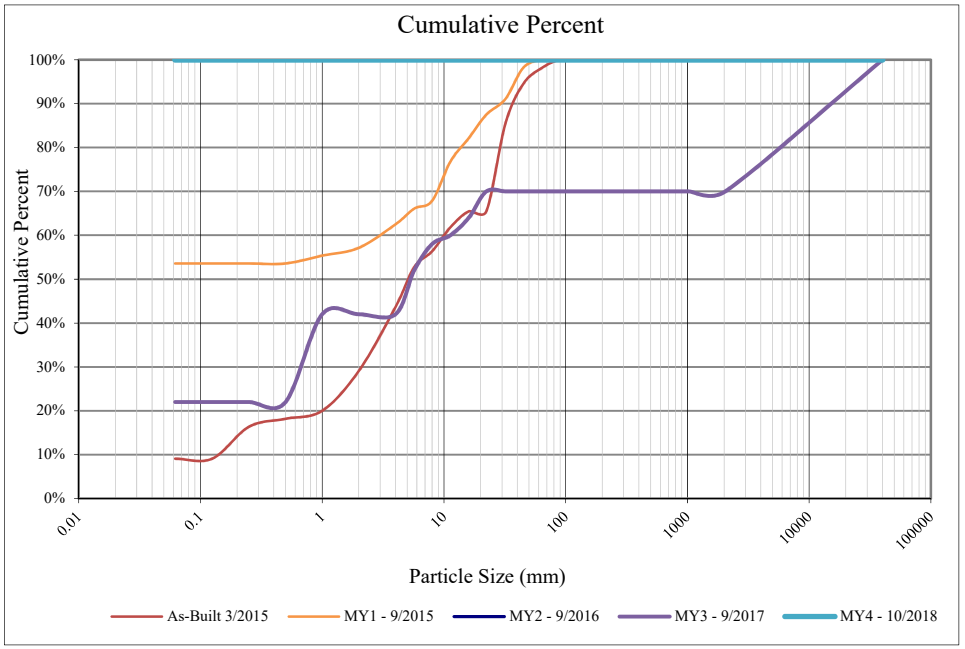
Summary Data	
D16	2.16
D35	19.56
D50	30.68
D84	142.56
D95	Bedrock
D100	Bedrock

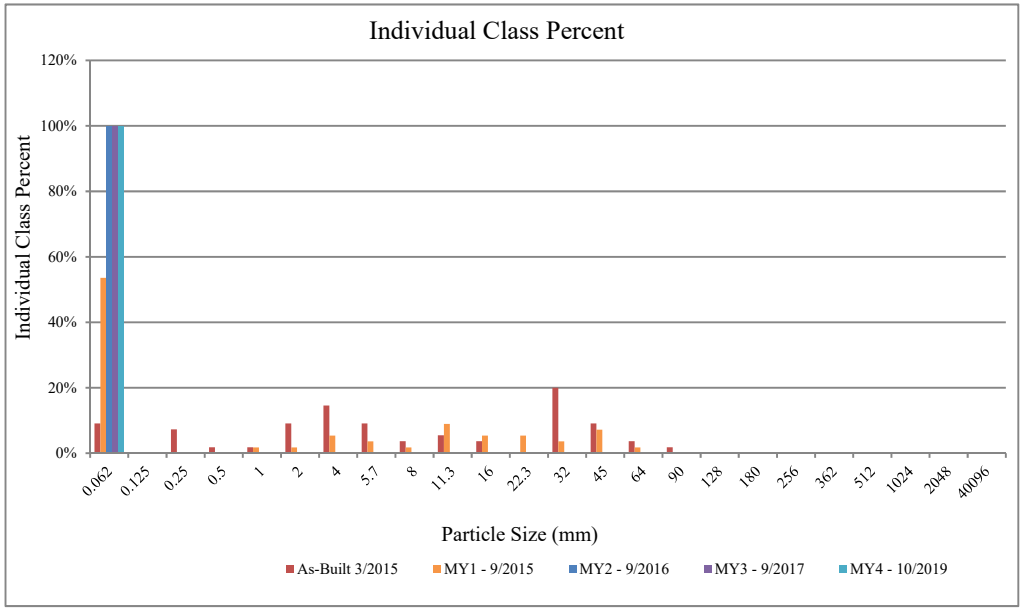




Project Name: Little Buffalo Creek					
Cross-Section: UT2-1R					
Feature: Riffle					
silt/clay/organic			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	50	100%	100%
Sand	very fine sand	0.125	0	0%	100%
	fine sand	0.250	0	0%	100%
	medium sand	0.50	0	0%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

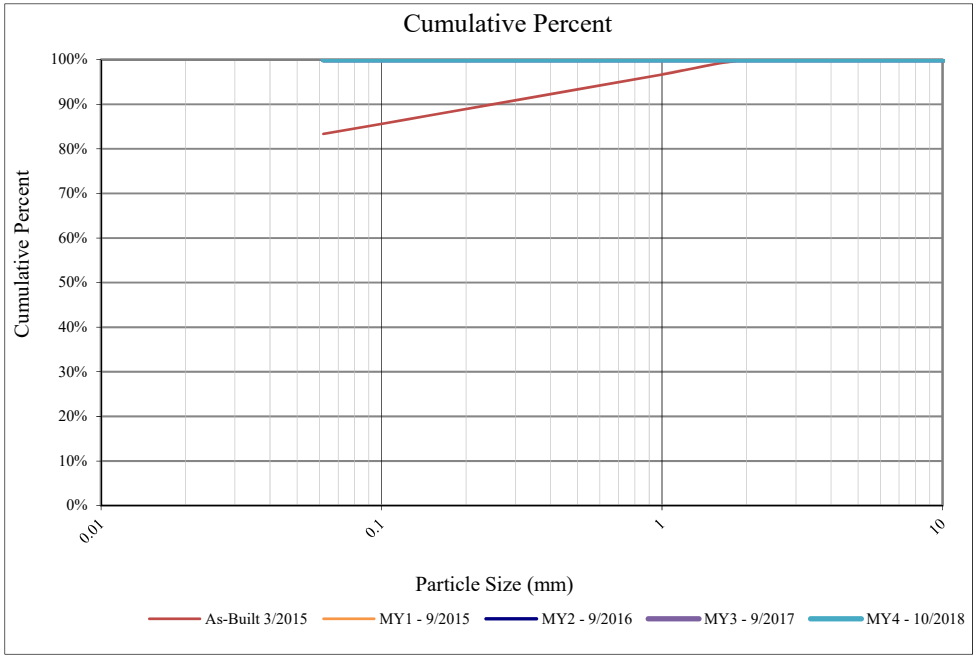
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	Silt/Clay
D95	Silt/Clay
D100	Silt/Clay

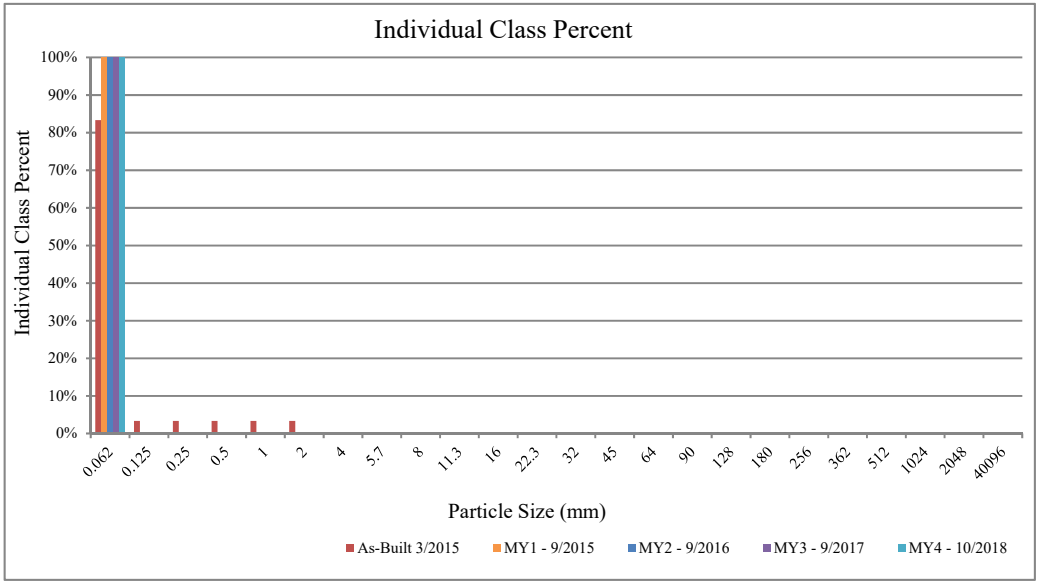




Project Name: Little Buffalo Creek					
Cross-Section: UT3-1R					
Feature: Riffle					
silt/clay/organic			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	50	100%	100%
Sand	very fine sand	0.125	0	0%	100%
	fine sand	0.250	0	0%	100%
	medium sand	0.50	0	0%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

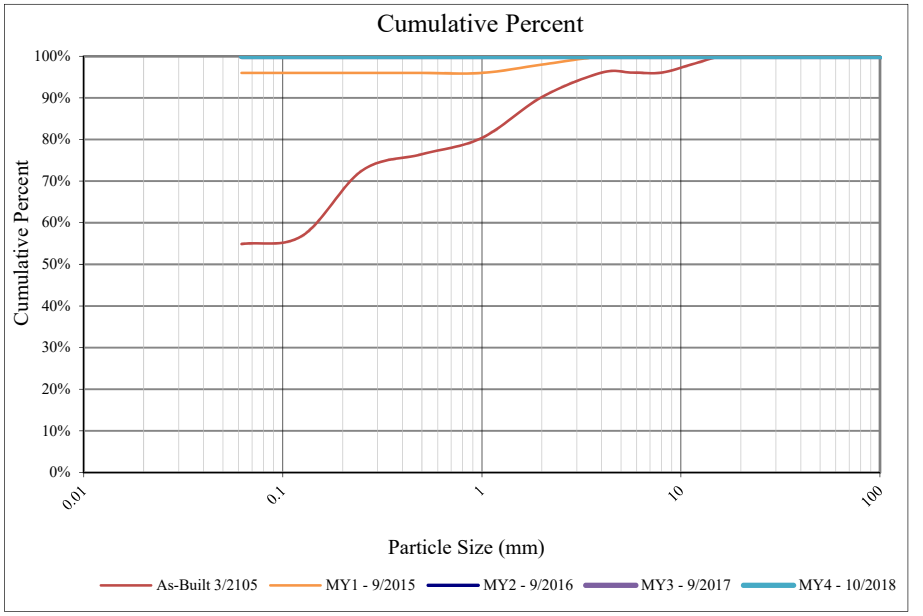
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	Silt/Clay
D95	Silt/Clay
D100	Silt/Clay

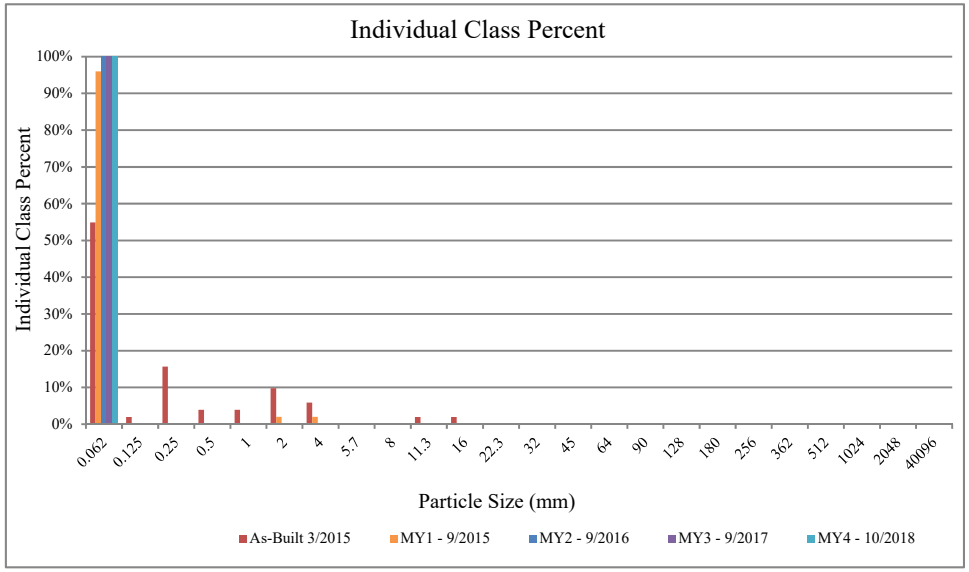




Project Name: Little Buffalo Creek					
Cross-Section: UT3-1P					
Feature: Pool					
silt/clay/organic			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	50	100%	100%
Sand	very fine sand	0.125	0	0%	100%
	fine sand	0.250	0	0%	100%
	medium sand	0.50	0	0%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

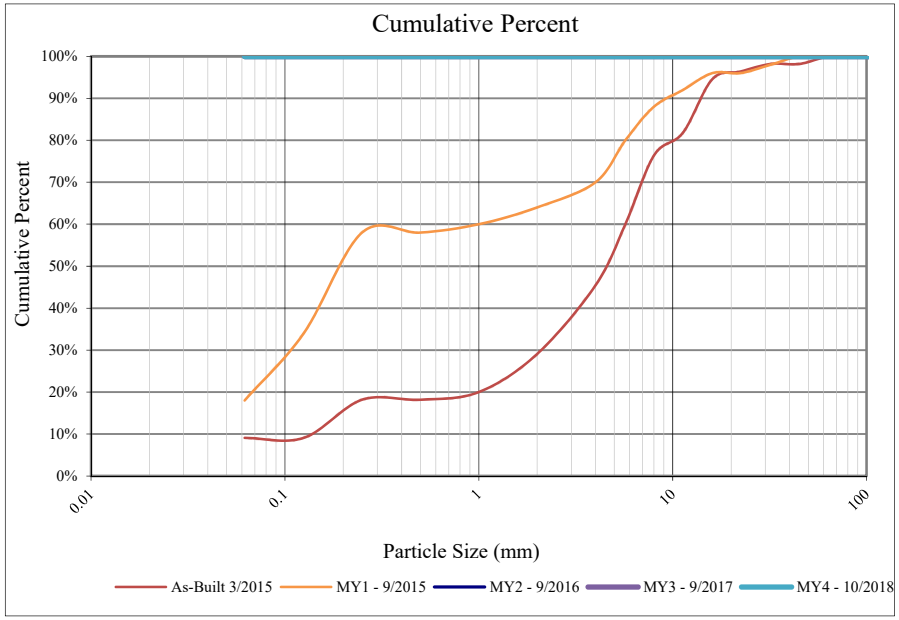
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	Silt/Clay
D95	Silt/Clay
D100	Silt/Clay

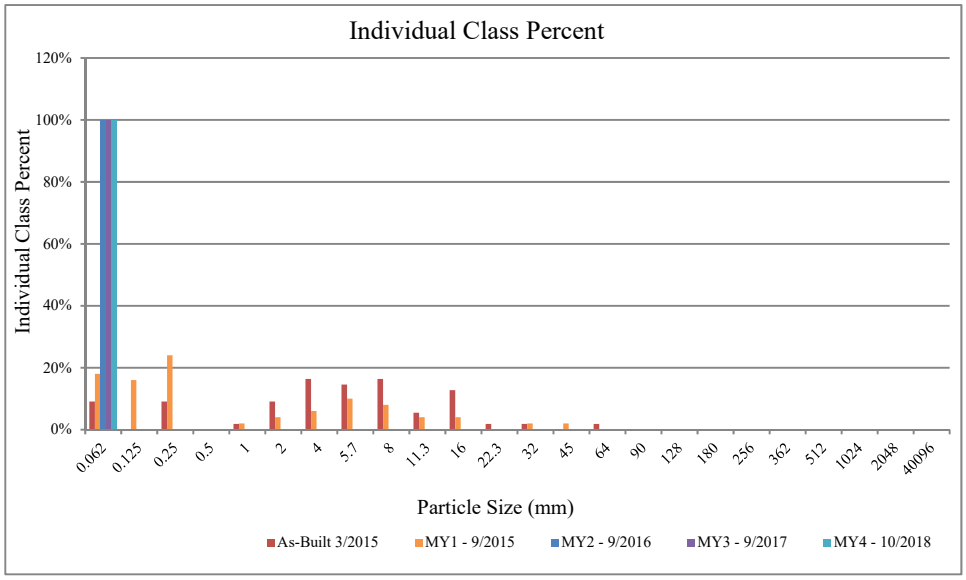




Project Name: Little Buffalo Creek					
Cross-Section: UT3-2R					
Feature: Riffle					
silt/clay/organic			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	50	100%	100%
Sand	very fine sand	0.125	0	0%	100%
	fine sand	0.250	0	0%	100%
	medium sand	0.50	0	0%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

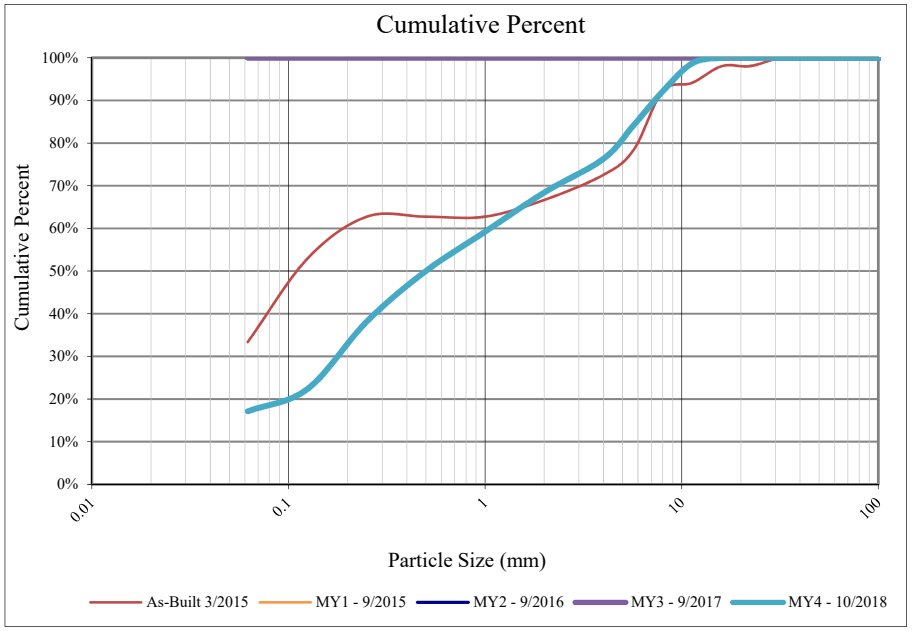
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	Silt/Clay
D95	Silt/Clay
D100	Silt/Clay

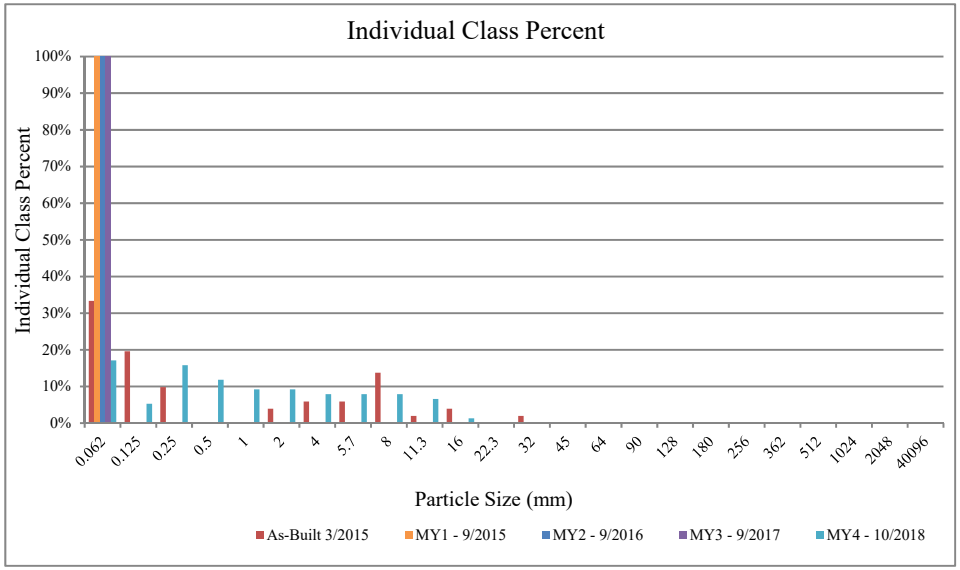




Project Name: Little Buffalo Creek					
Cross-Section: UT3-3R					
Feature: Riffle					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	13	17%	17%
Sand	very fine sand	0.125	4	5%	22%
	fine sand	0.250	12	16%	38%
	medium sand	0.50	9	12%	50%
	coarse sand	1.00	7	9%	59%
	very coarse sand	2.0	7	9%	68%
Gravel	very fine gravel	4.0	6	8%	76%
	fine gravel	5.7	6	8%	84%
	fine gravel	8.0	6	8%	92%
	medium gravel	11.3	5	7%	99%
	medium gravel	16.0	1	1%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			76	100%	100%

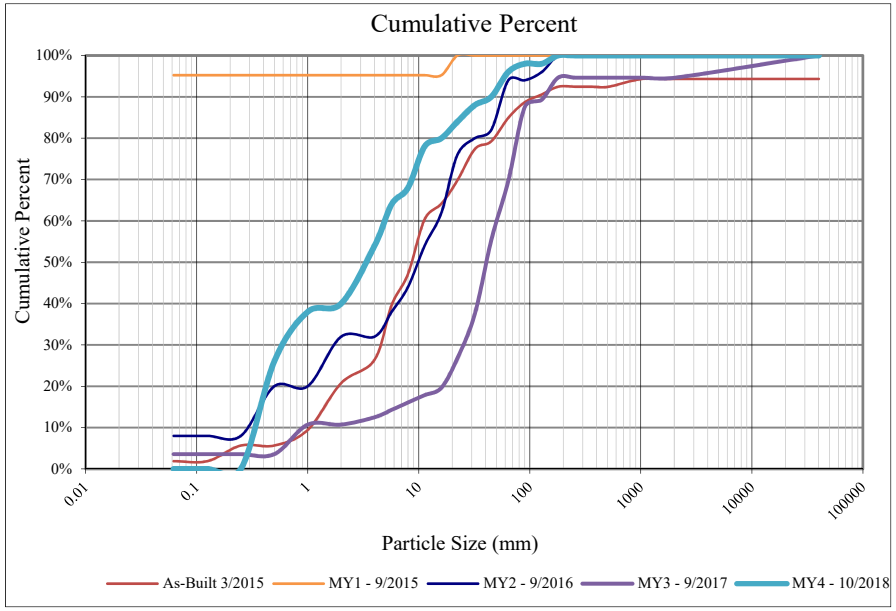
Summary Data	
D16	Silt/Clay
D35	0.23
D50	0.50
D84	5.65
D95	9.45
D100	16.00

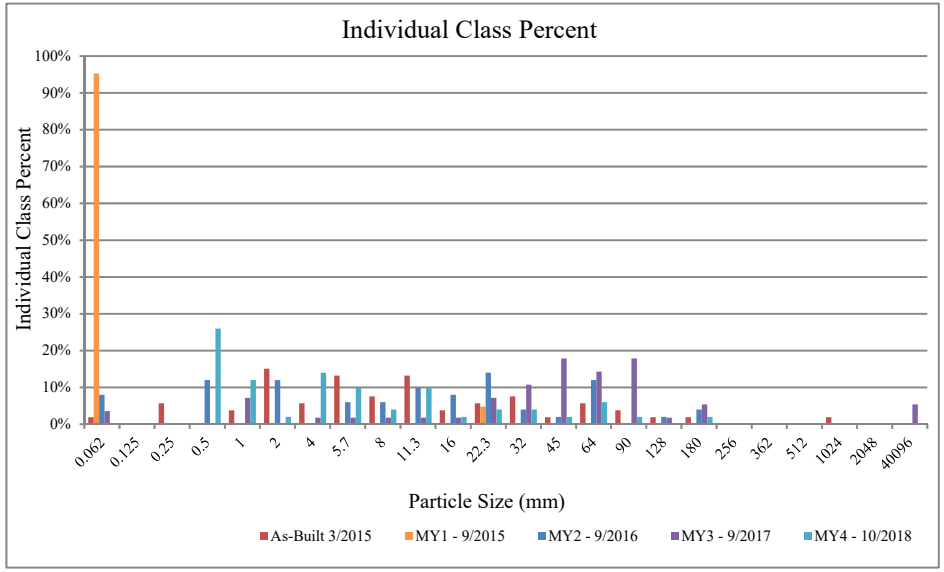




Project Name: Little Buffalo Creek					
Cross-Section: UT4-1P					
Feature: Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	13	26%	26%
	coarse sand	1.00	6	12%	38%
	very coarse sand	2.0	1	2%	40%
Gravel	very fine gravel	4.0	7	14%	54%
	fine gravel	5.7	5	10%	64%
	fine gravel	8.0	2	4%	68%
	medium gravel	11.3	5	10%	78%
	medium gravel	16.0	1	2%	80%
	coarse gravel	22.3	2	4%	84%
	coarse gravel	32.0	2	4%	88%
	very coarse gravel	45	1	2%	90%
	very coarse gravel	64	3	6%	96%
Cobble	small cobble	90	1	2%	98%
	medium cobble	128	0	0%	98%
	large cobble	180	1	2%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

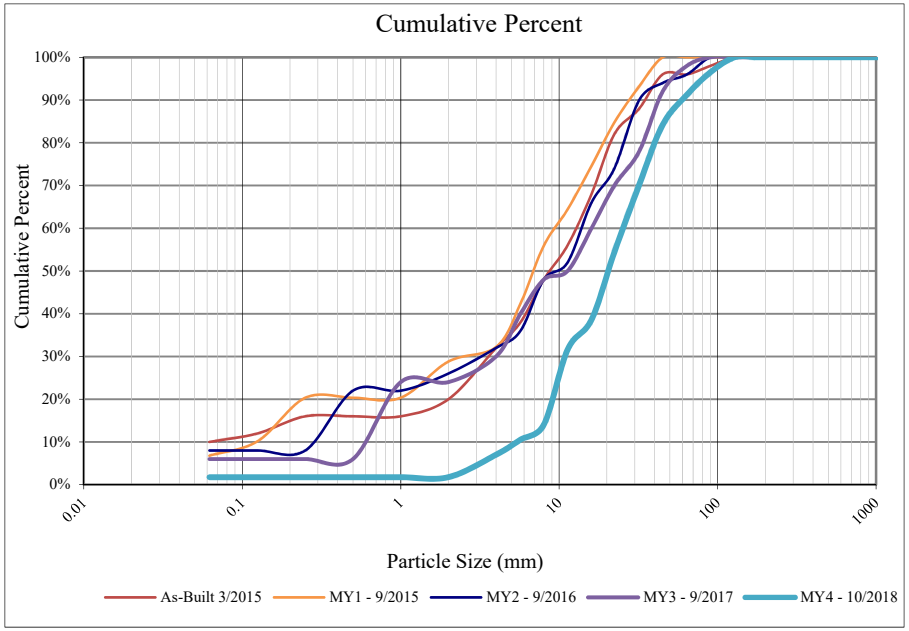
Summary Data	
D16	0.40
D35	0.88
D50	3.43
D84	22.30
D95	60.83
D100	180.00

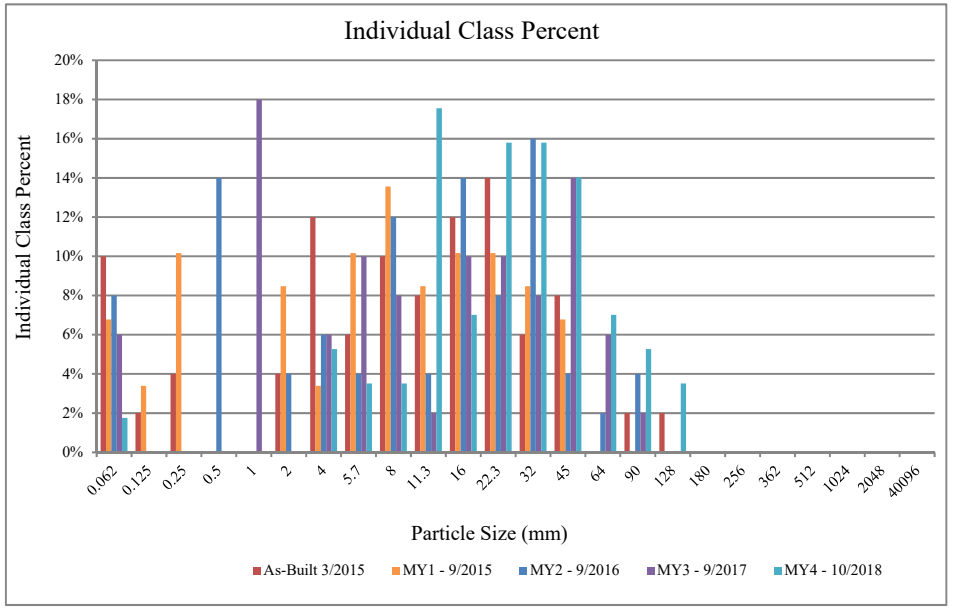




Project Name: Little Buffalo Creek					
Cross-Section: UT4-1R					
Feature: Riffle					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	1	2%	2%
Sand	very fine sand	0.125	0	0%	2%
	fine sand	0.250	0	0%	2%
	medium sand	0.50	0	0%	2%
	coarse sand	1.00	0	0%	2%
	very coarse sand	2.0	0	0%	2%
Gravel	very fine gravel	4.0	3	5%	7%
	fine gravel	5.7	2	4%	11%
	fine gravel	8.0	2	4%	14%
	medium gravel	11.3	10	18%	32%
	medium gravel	16.0	4	7%	39%
	coarse gravel	22.3	9	16%	54%
	coarse gravel	32.0	9	16%	70%
	very coarse gravel	45	8	14%	84%
	very coarse gravel	64	4	7%	91%
Cobble	small cobble	90	3	5%	96%
	medium cobble	128	2	4%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			57	100%	100%

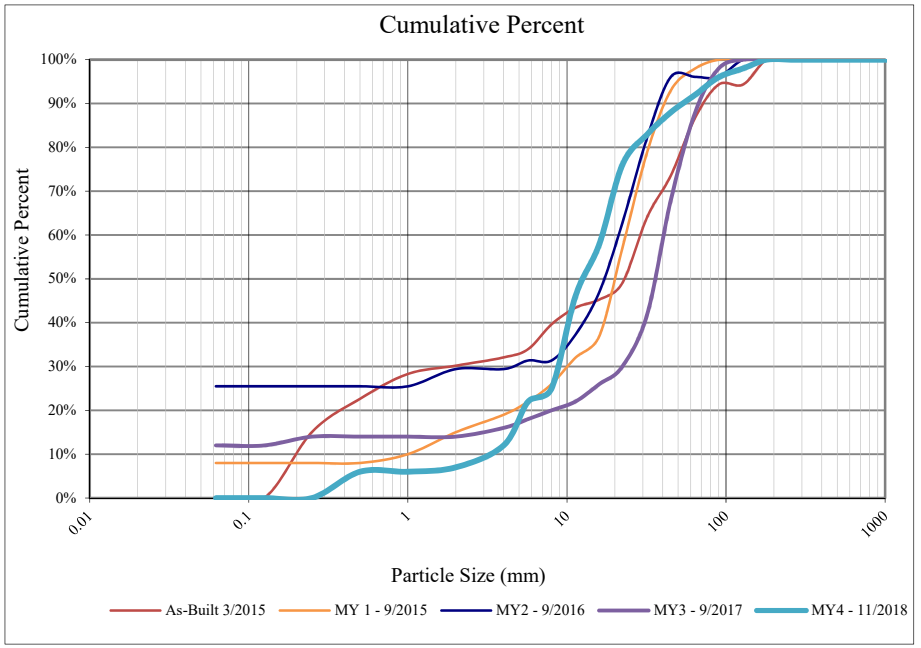
Summary Data	
D16	8.37
D35	13.59
D50	20.55
D84	44.81
D95	82.60
D100	128.00

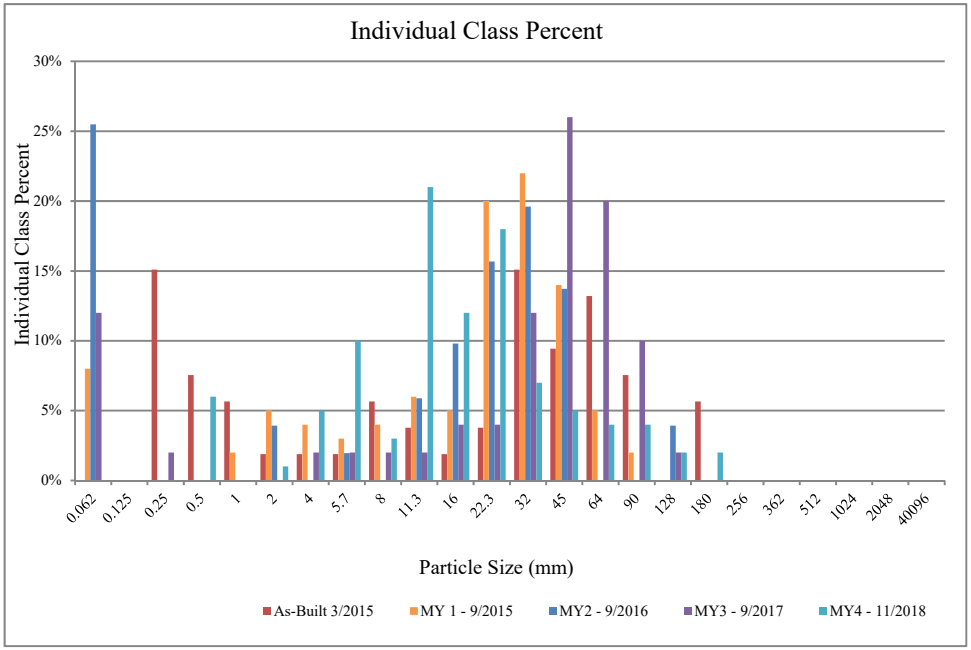




Project Name: Little Buffalo Creek					
Cross-Section: UT7-1R					
Feature: Riffle					
			2017		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	6	6%	6%
	coarse sand	1.00	0	0%	6%
	very coarse sand	2.0	1	1%	7%
Gravel	very fine gravel	4.0	5	5%	12%
	fine gravel	5.7	10	10%	22%
	fine gravel	8.0	3	3%	25%
	medium gravel	11.3	21	21%	46%
	medium gravel	16.0	12	12%	58%
	coarse gravel	22.3	18	18%	76%
	coarse gravel	32.0	7	7%	83%
	very coarse gravel	45	5	5%	88%
	very coarse gravel	64	4	4%	92%
Cobble	small cobble	90	4	4%	96%
	medium cobble	128	2	2%	98%
	large cobble	180	2	2%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

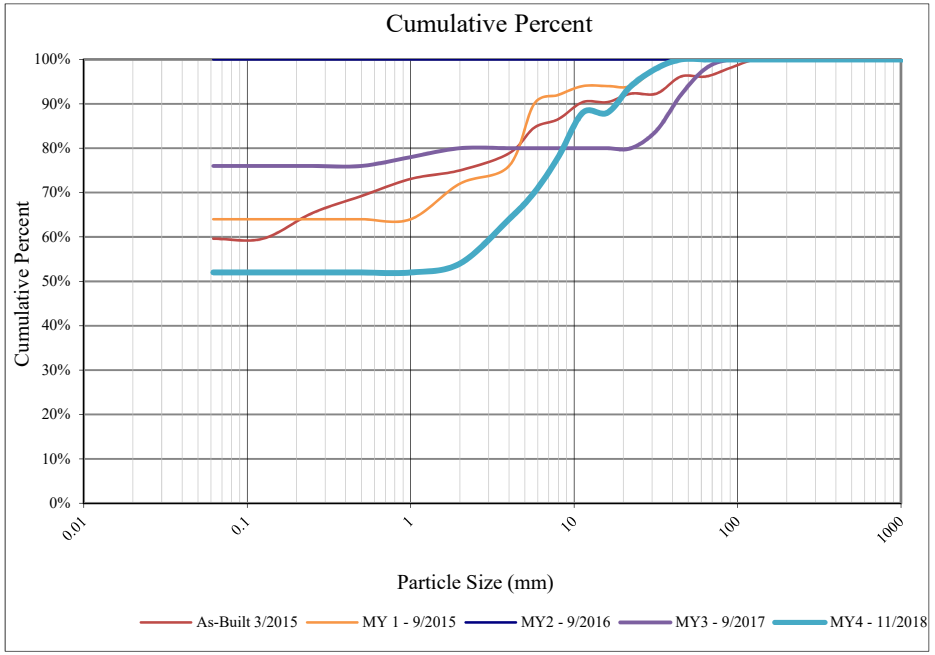
Summary Data	
D16	4.68
D35	9.57
D50	12.87
D84	34.60
D95	83.50
D100	180.00

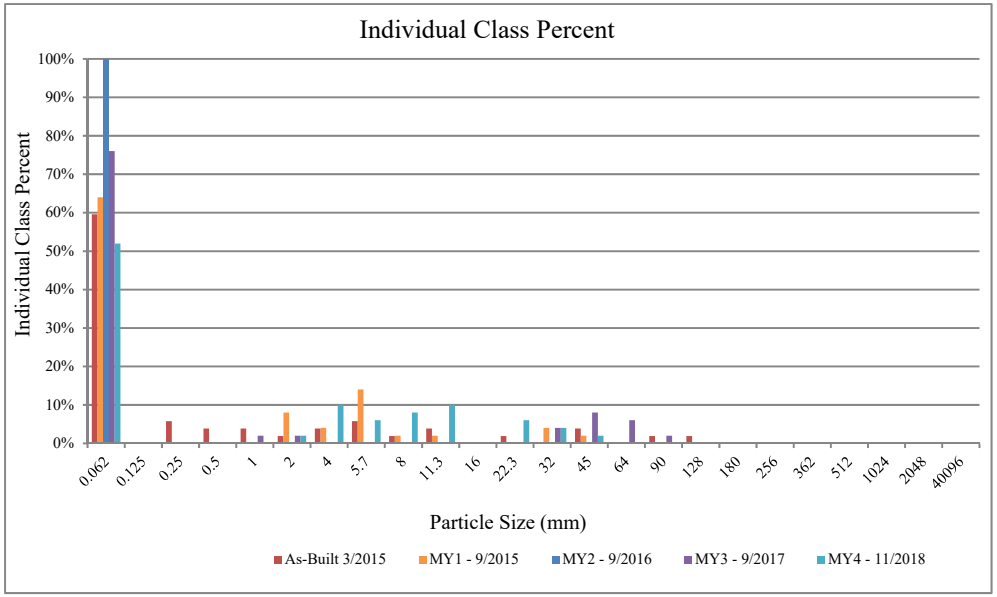




Project Name: Little Buffalo Creek					
Cross-Section: UT7-1P					
Feature: Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	26	52%	52%
Sand	very fine sand	0.125	0	0%	52%
	fine sand	0.250	0	0%	52%
	medium sand	0.50	0	0%	52%
	coarse sand	1.00	0	0%	52%
	very coarse sand	2.0	1	2%	54%
Gravel	very fine gravel	4.0	5	10%	64%
	fine gravel	5.7	3	6%	70%
	fine gravel	8.0	4	8%	78%
	medium gravel	11.3	5	10%	88%
	medium gravel	16.0	0	0%	88%
	coarse gravel	22.3	3	6%	94%
	coarse gravel	32.0	2	4%	98%
	very coarse gravel	45	1	2%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

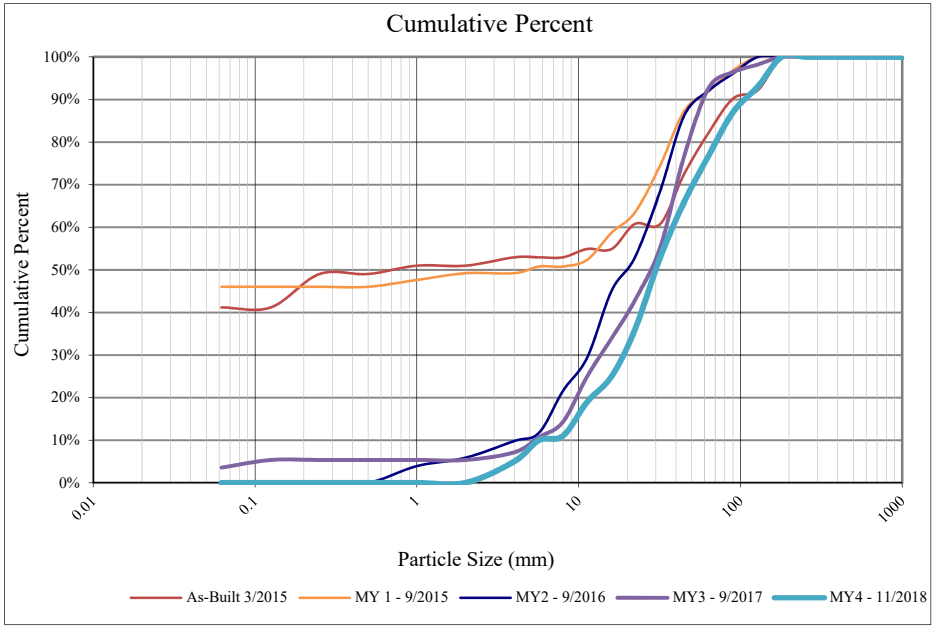
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	9.98
D95	24.73
D100	45.00

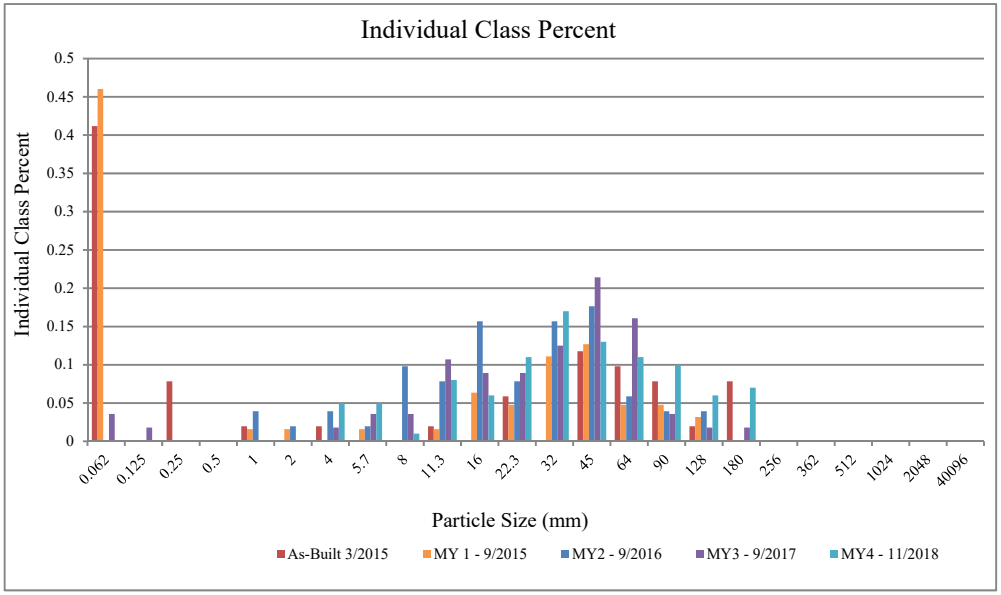




Project Name: Little Buffalo Creek					
Cross-Section: UT7-2R					
Feature: Riffle					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	0	0%	0%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	5	5%	5%
	fine gravel	5.7	5	5%	10%
	fine gravel	8.0	1	1%	11%
	medium gravel	11.3	8	8%	19%
	medium gravel	16.0	6	6%	25%
	coarse gravel	22.3	11	11%	36%
	coarse gravel	32.0	17	17%	53%
	very coarse gravel	45	13	13%	66%
	very coarse gravel	64	11	11%	77%
Cobble	small cobble	90	10	10%	87%
	medium cobble	128	6	6%	93%
	large cobble	180	7	7%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

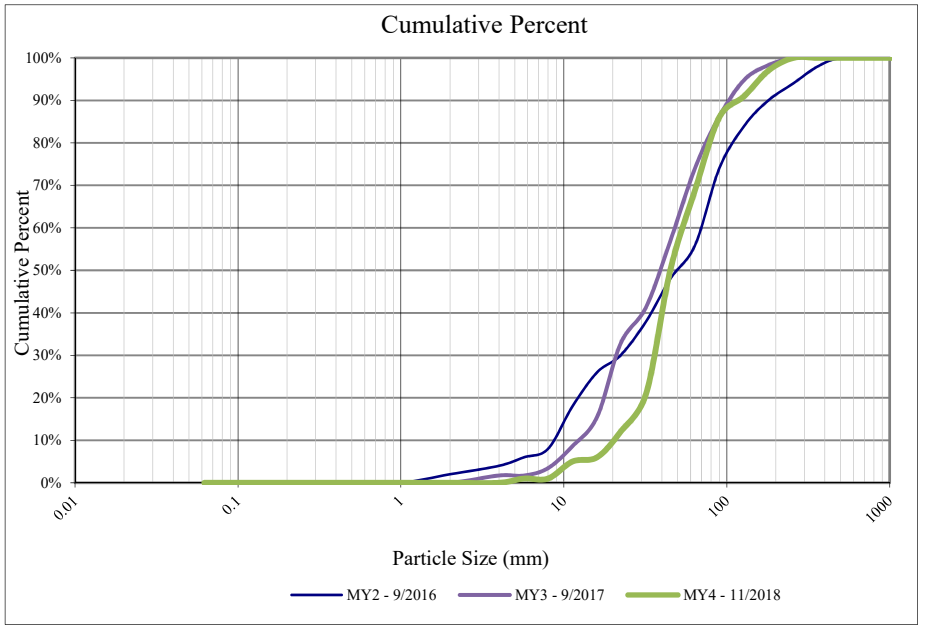
Summary Data	
D16	10.06
D35	21.72
D50	30.29
D84	82.20
D95	142.86
D100	180.00

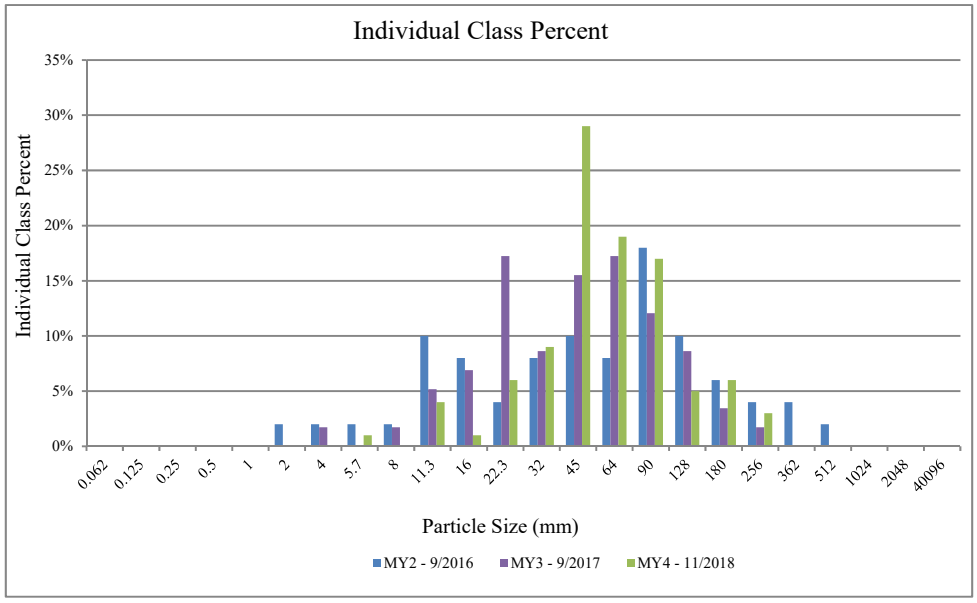




Project Name: Little Buffalo Creek					
Cross-Section: UT7-STP1					
Feature: Step Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	0	0%	0%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	0	0%	0%
	fine gravel	5.7	1	1%	1%
	fine gravel	8.0	0	0%	1%
	medium gravel	11.3	4	4%	5%
	medium gravel	16.0	1	1%	6%
	coarse gravel	22.3	6	6%	12%
	coarse gravel	32.0	9	9%	21%
	very coarse gravel	45	29	29%	50%
	very coarse gravel	64	19	19%	69%
Cobble	small cobble	90	17	17%	86%
	medium cobble	128	5	5%	91%
	large cobble	180	6	6%	97%
	very large cobble	256	3	3%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

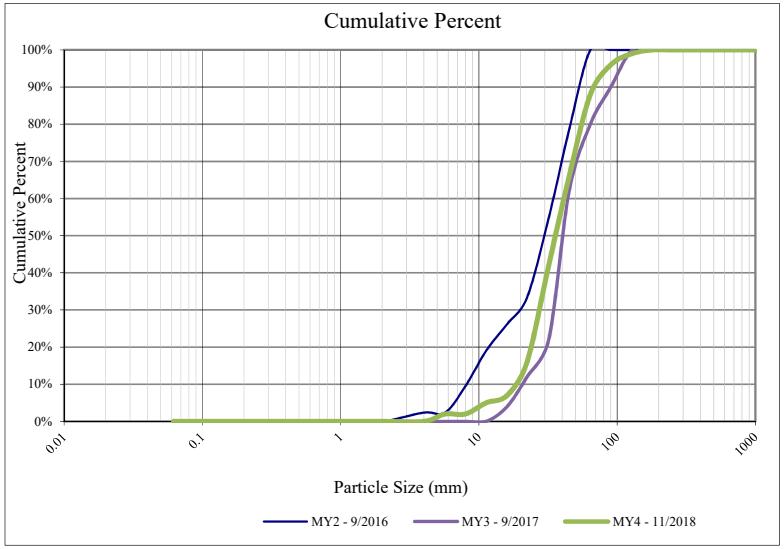
Summary Data	
D16	26.61
D35	38.28
D50	45.00
D84	86.94
D95	162.67
D100	256.00

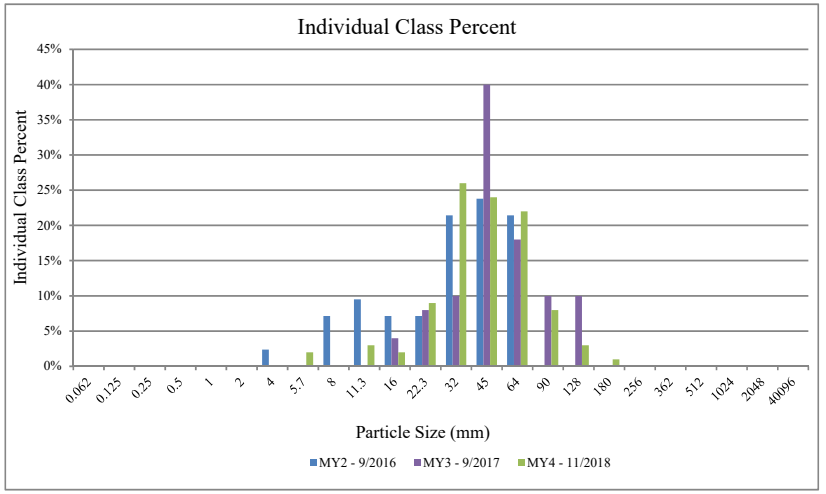




Project Name: Little Buffalo Creek					
Cross-Section: UT7-STP2					
Feature: Step Pool					
			2018		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	0	0%	0%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	0	0%	0%
	fine gravel	5.7	2	2%	2%
	fine gravel	8.0	0	0%	2%
	medium gravel	11.3	3	3%	5%
	medium gravel	16.0	2	2%	7%
	coarse gravel	22.3	9	9%	16%
	coarse gravel	32.0	26	26%	42%
	very coarse gravel	45	24	24%	66%
	very coarse gravel	64	22	22%	88%
Cobble	small cobble	90	8	8%	96%
	medium cobble	128	3	3%	99%
	large cobble	180	1	1%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D16	22.30
D35	29.39
D50	36.33
D84	60.55
D95	86.75
D100	180.00



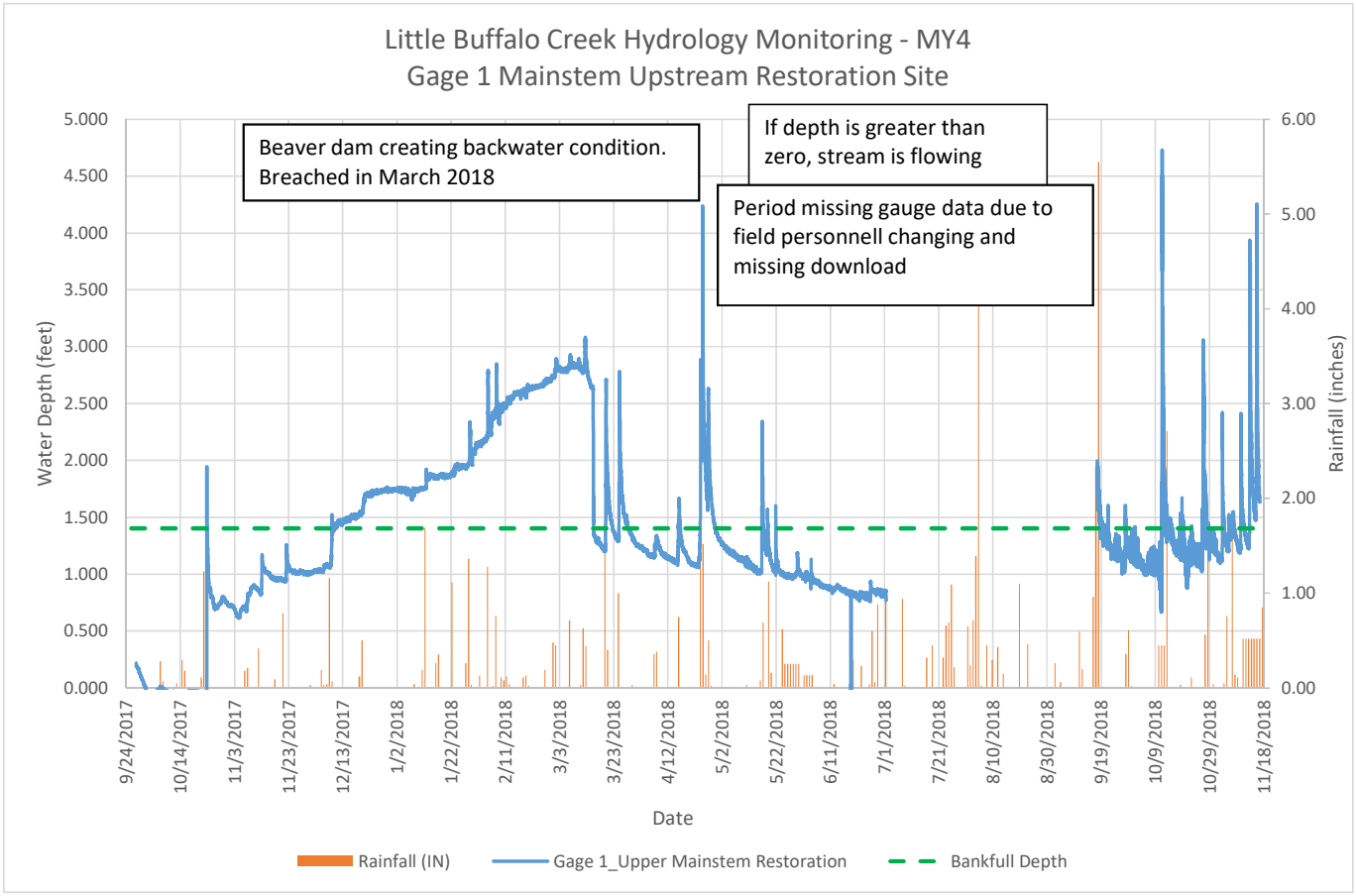


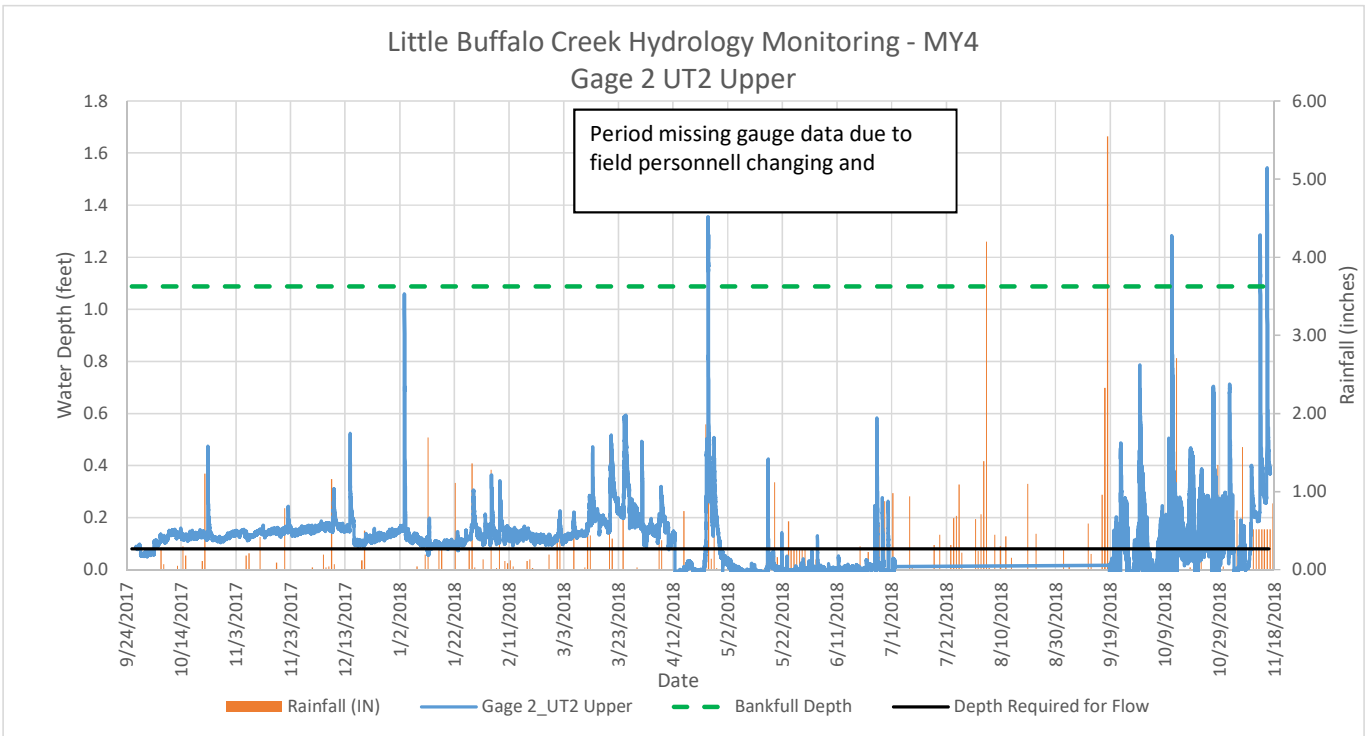
Appendix E – Hydrologic Data

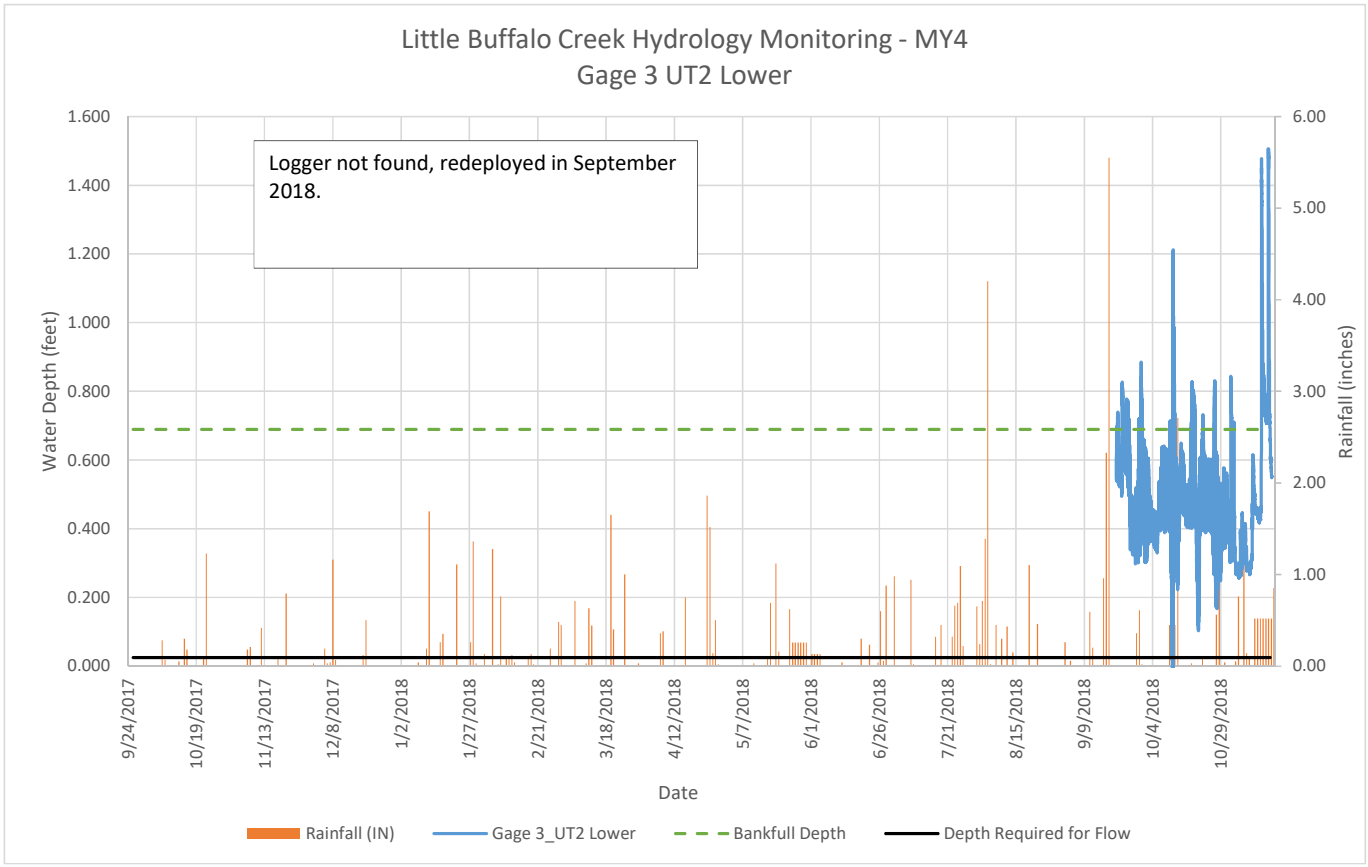
Table 12. Documentation of Geomorphologically Significant Flow Events					
Date of Observation	Date of Occurrence	Method	Greater than Qgs = Q2*0.66 stage?[1]	Greater than Qbkf Stage?	Notes
2/27/2016	11/9/2015	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
2/27/2016	12/22/2015	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
2/27/2016	12/30/2015	Surface Water Transducer Rack Lines	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations. See Photo Appendix.
9/19/2016	5/20/2016	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
3/2/2017	1/23/2017	Surface Water Transducer Rack Lines	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	5/5/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	5/25/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	6/5/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	4/24/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	8/5/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/6/2018	9/16/2018	Photos/Surface Water Transducer	Yes	Yes	Hurricane Florence, photos taken during the storm by land owners
12/15/2018	10/11/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	10/26/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	11/13/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	11/15/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations

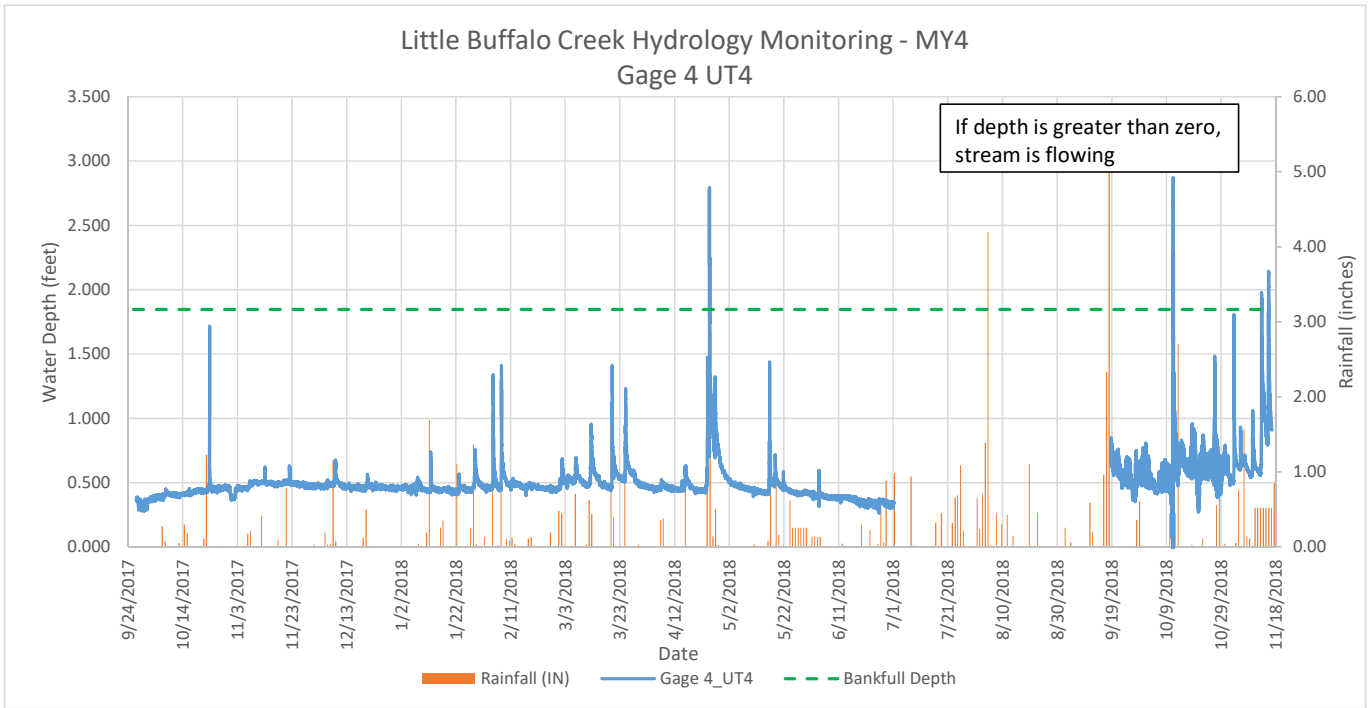
1) As stage relationships have not been calculated for the Qgs event, it is assumed that an event that has surpassed the identified bankfull stage on site also passed the Qgs event

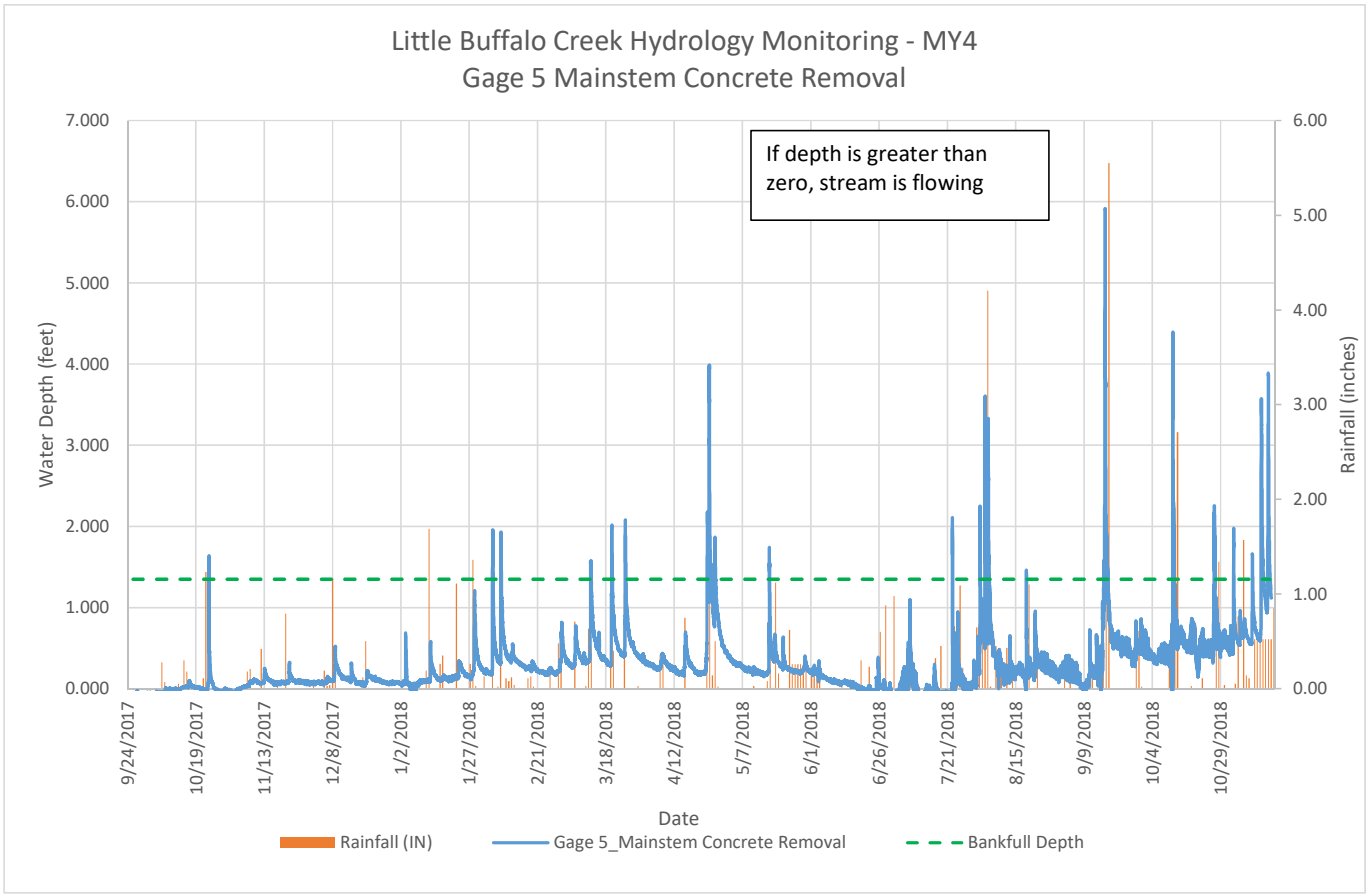
Figures 6a-g – Water Level and Rainfall Plots

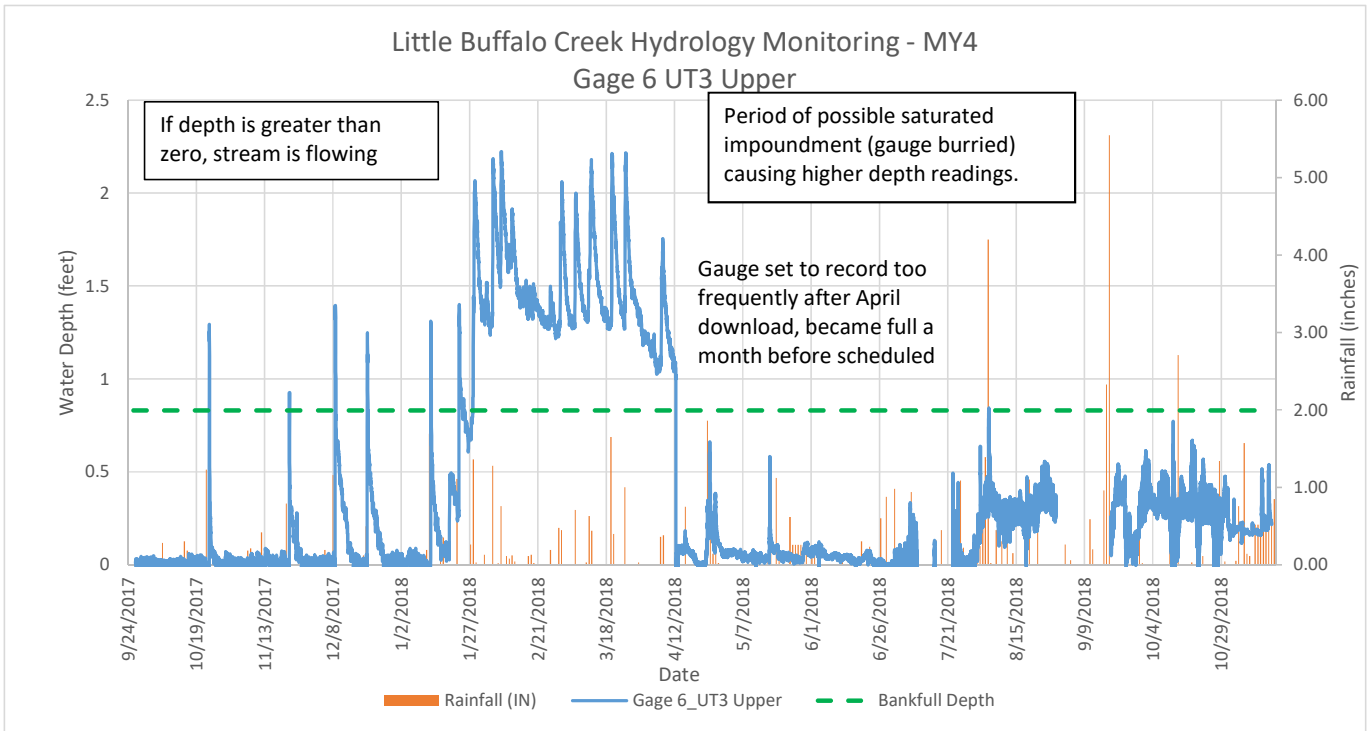

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 1 Mainstem Upstream Restoration Site
Beaver dam creating backwater condition. Breached in March 2018
If depth is greater than zero, stream is flowing
Period missing gauge data due to field personnell changing and missing download
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 1_Upper Mainstem Restoration
Bankfull Depth

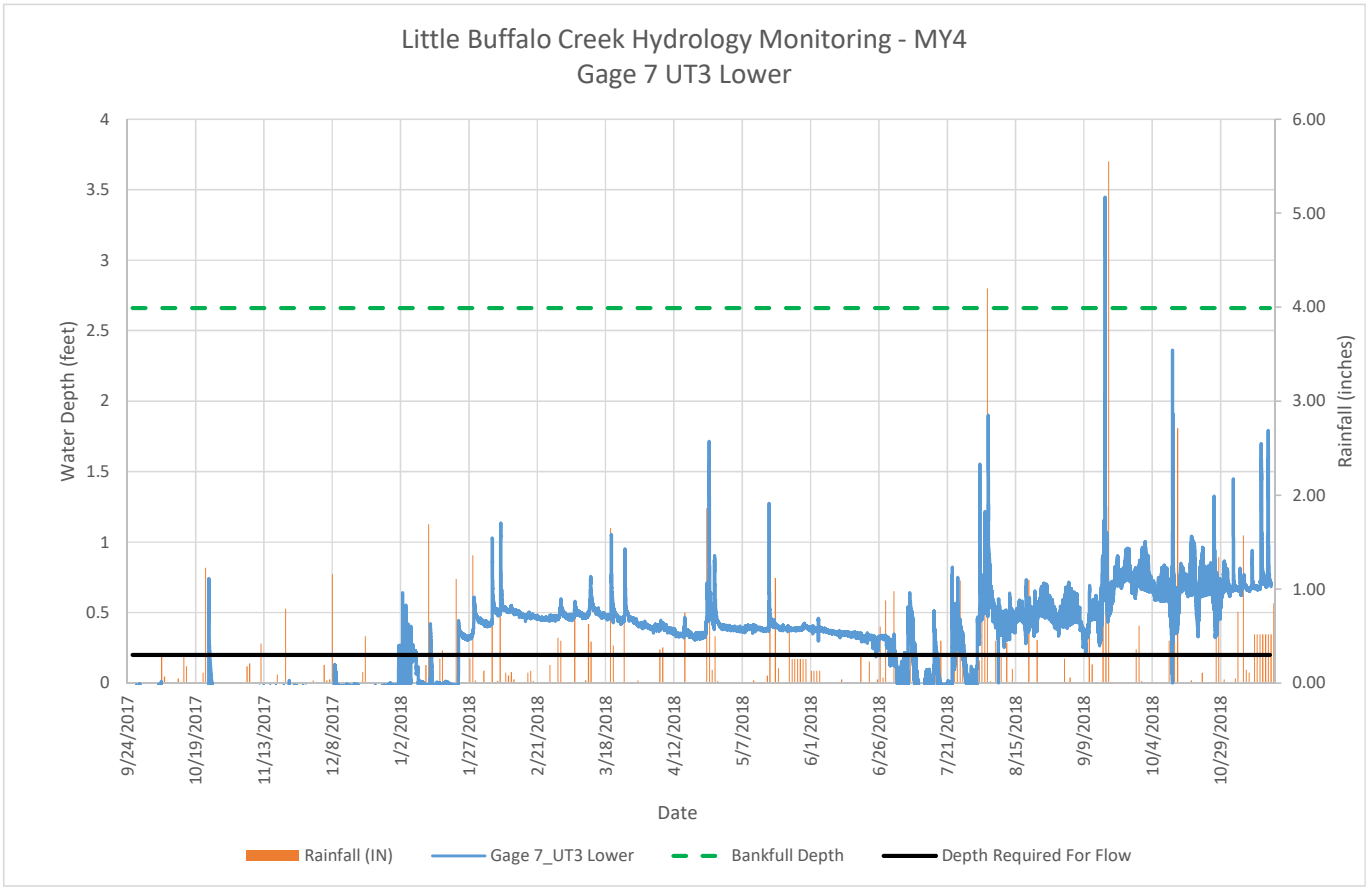

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 2 UT2 Upper
Period missing gauge data due to field personnell changing and
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 2_UT2 Upper
Bankfull Depth
Depth Required for Flow

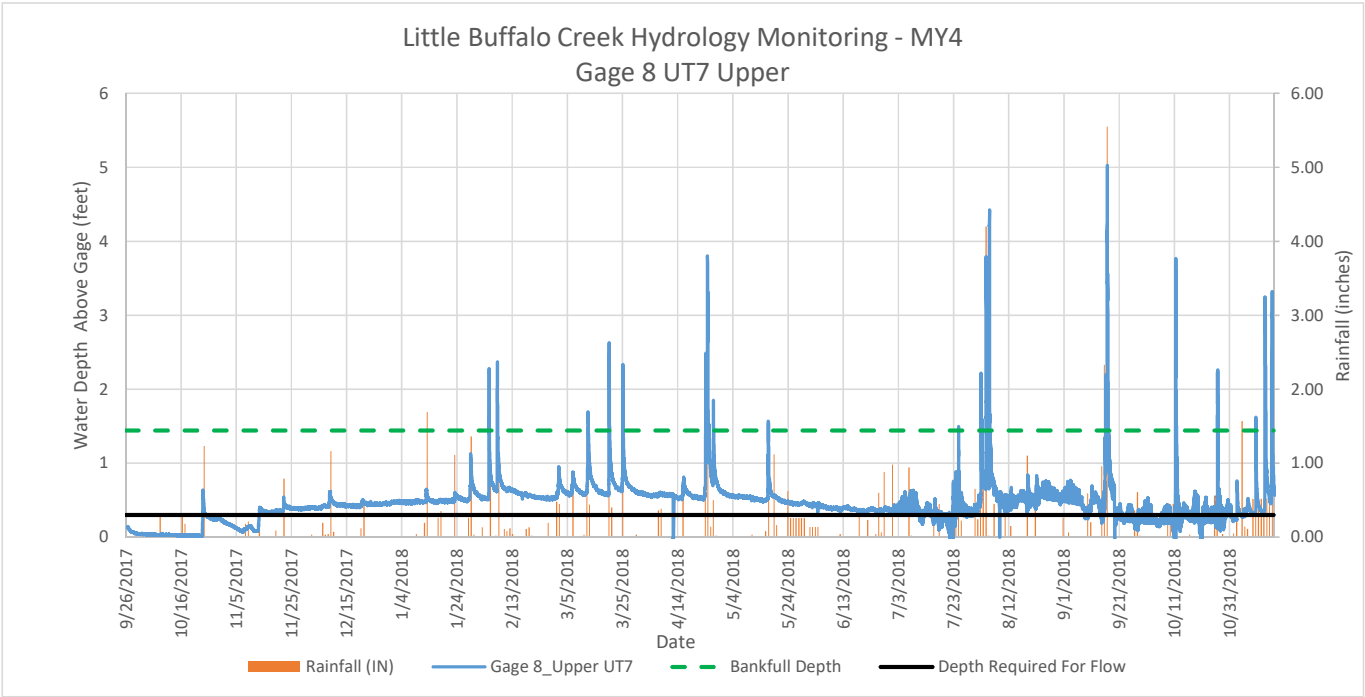

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 3 UT2 Lower
Logger not found, redeployed in September 2018.
Water Depth (feet)
Rainfall (inches)
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 3_UT2 Lower
Bankfull Depth
Depth Required for Flow

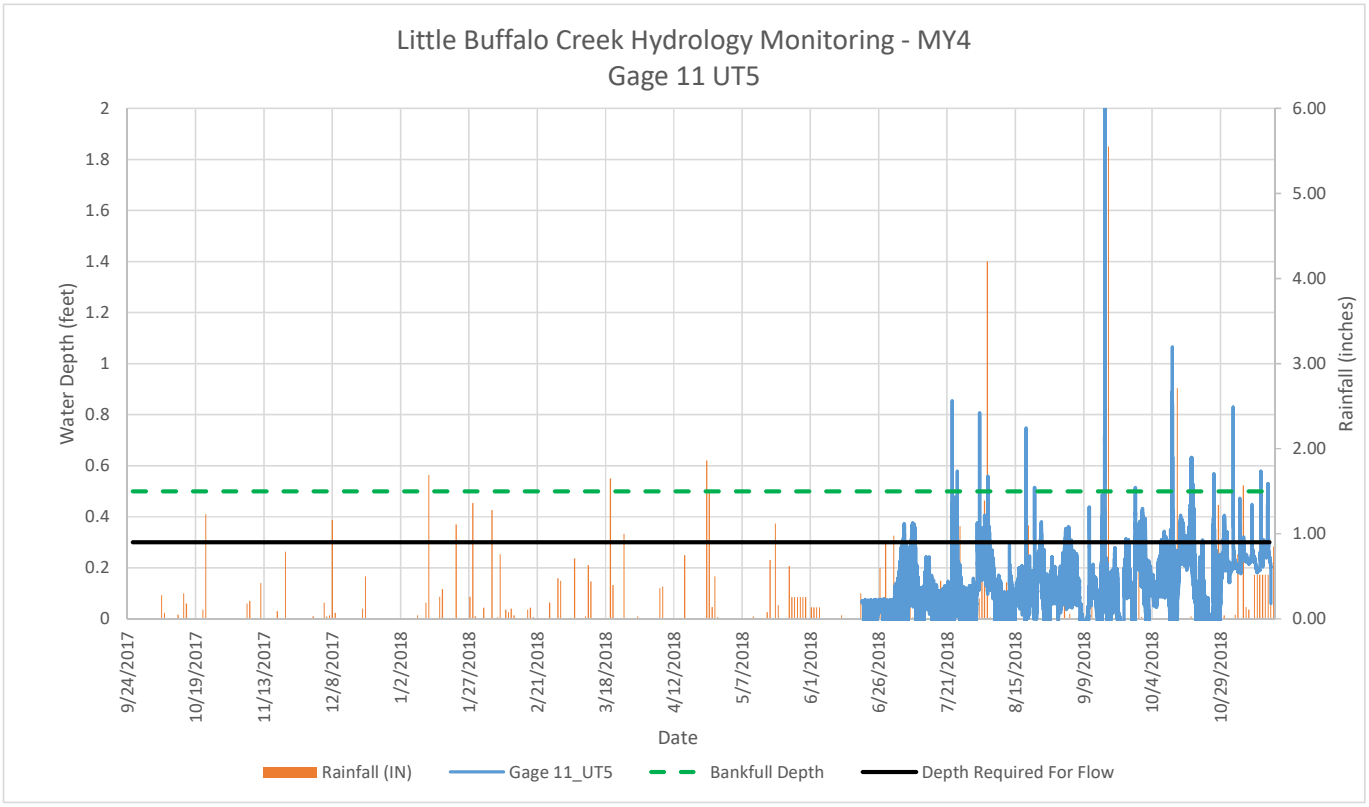

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 4 UT4
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/14/2017
11/3/2017
11/23/2017
12/13/2017
1/2/2018
1/22/2018
2/11/2018
3/3/2018
3/23/2018
4/12/2018
5/2/2018
5/22/2018
6/11/2018
7/1/2018
7/21/2018
8/10/2018
8/30/2018
9/19/2018
10/9/2018
10/29/2018
11/18/2018
Date
Rainfall (IN)
Gage 4_UT4
Bankfull Depth

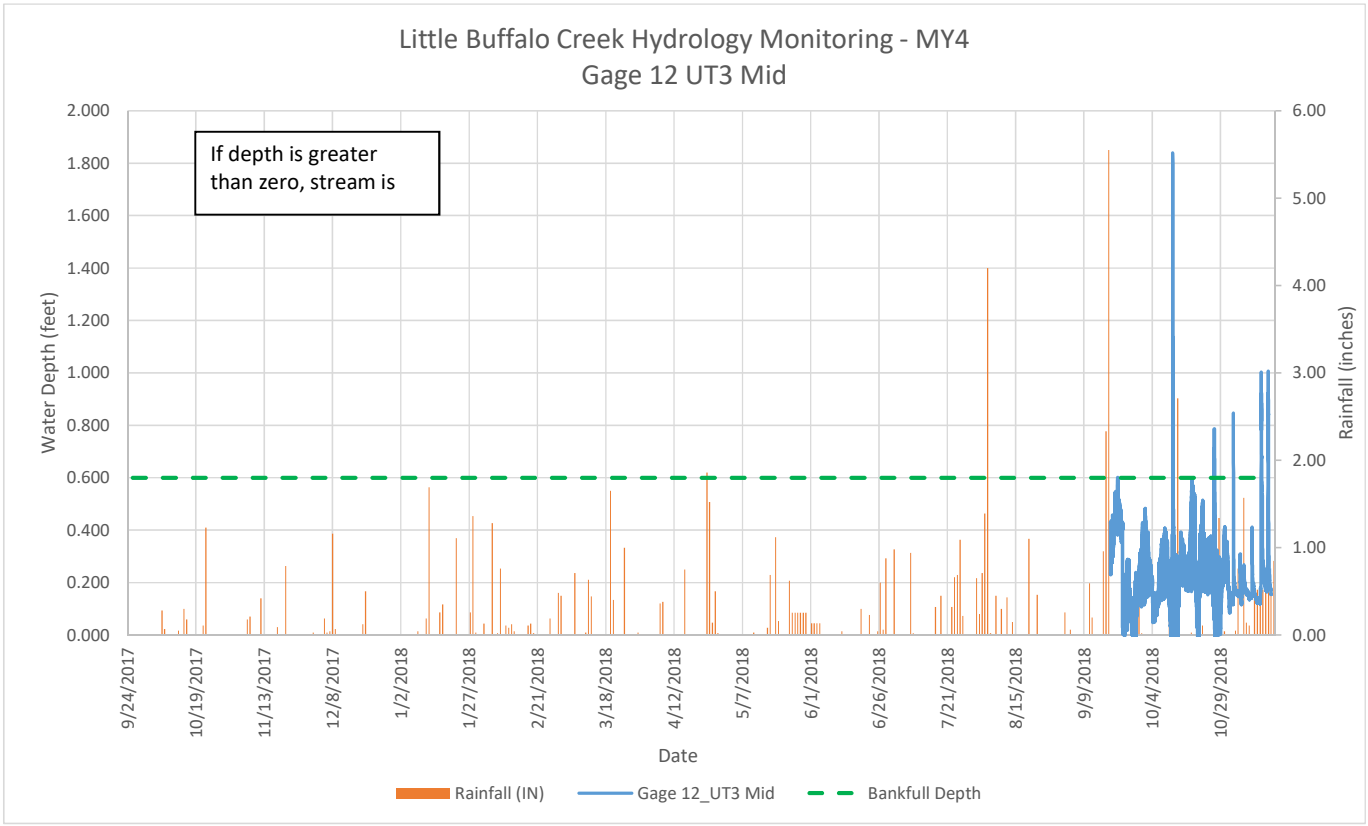

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 5 Mainstem Concrete Removal
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 5_Mainstem Concrete Removal
Bankfull Depth

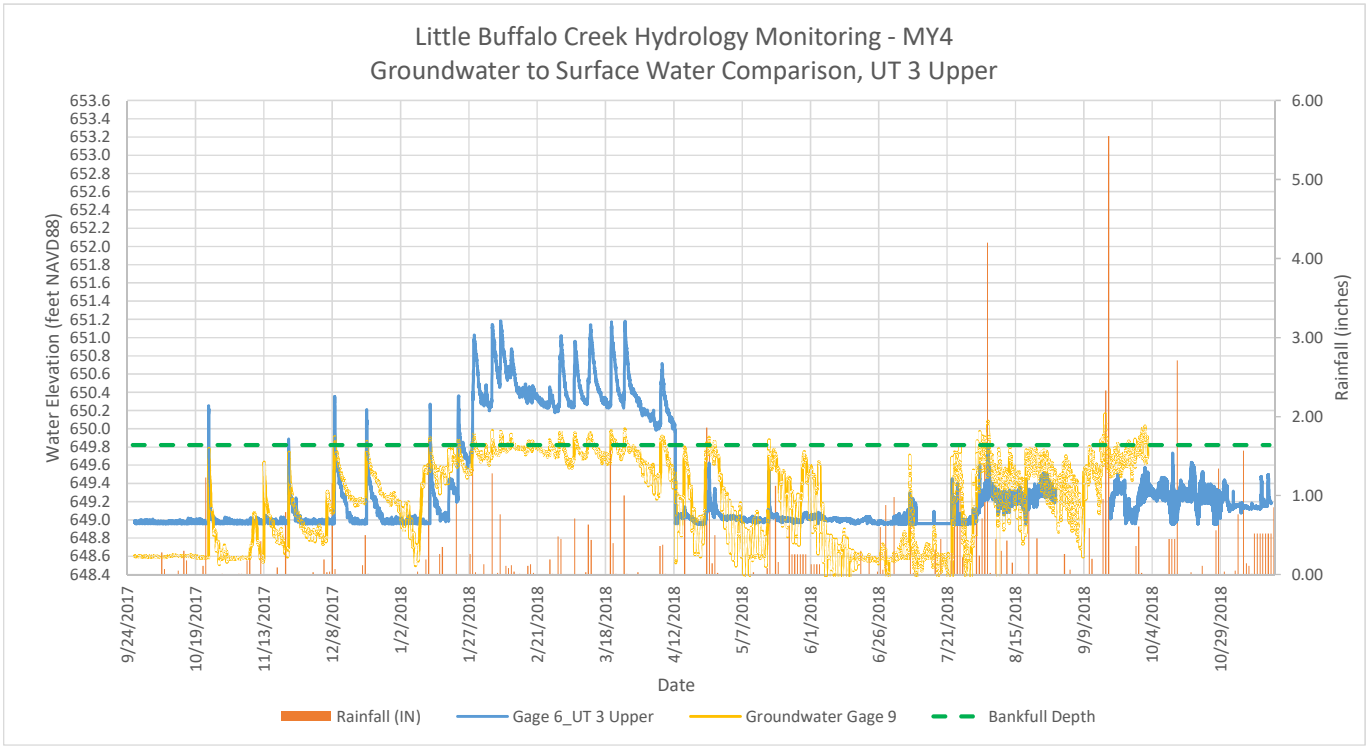

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 6 UT3 Upper
If depth is greater than zero, stream is flowing
Period of possible saturated impoundment (gauge burried) causing higher depth readings.
Gauge set to record too frequently after April download, became full a month before scheduled
Water Depth (feet)
Rainfall (inches)
2.5
2
1.5
1
0.5
0
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 6_UT3 Upper
Bankfull Depth

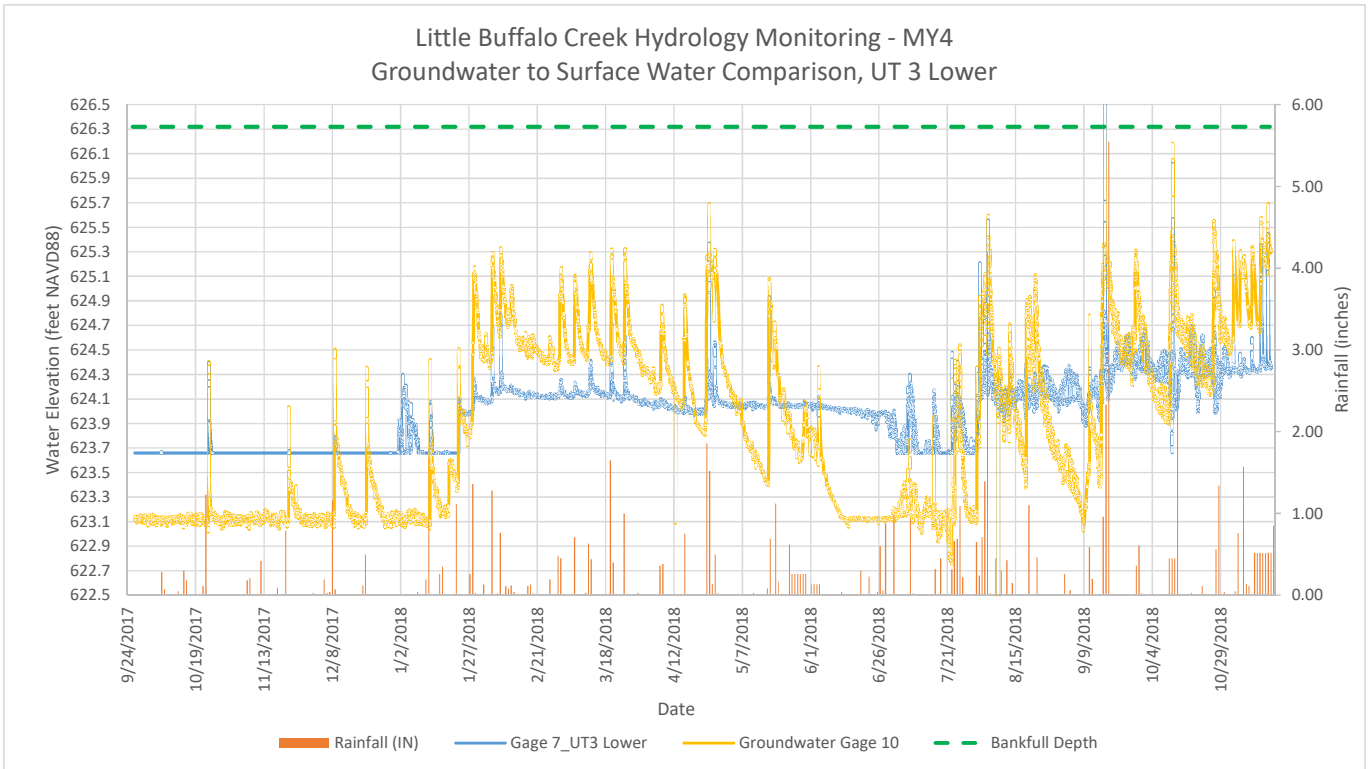

Little Buffalo Creek Hydrology Monitoring - MY4
Gage 7 UT3 Lower
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 7_UT3 Lower
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY4
Gage 8 UT7 Upper
Water Depth Above Gage (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 8_Upper UT7
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY4
Gage 11 UT5
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 11_UT5
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY4
Gage 12 UT3 Mid
If depth is greater than zero, stream is
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 12_UT3 Mid
Bankfull Depth


Little Buffalo Creek Hydrology Monitoring - MY4
Groundwater to Surface Water Comparison, UT 3 Upper
Water Elevation (feet NAVD88)
653.6
653.4
653.2
653.0
652.8
652.6
652.4
652.2
652.0
651.8
651.6
651.4
651.2
651.0
650.8
650.6
650.4
650.2
650.0
649.8
649.6
649.4
649.2
649.0
648.8
648.6
648.4
Rainfall (inches)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 6_UT 3 Upper
Groundwater Gage 9
Bankfull Depth


Little Buffalo Creek Hydrology Monitoring - MY4
Groundwater to Surface Water Comparison, UT 3 Lower
Water Elevation (feet NAVD88)
626.5
626.3
626.1
625.9
625.7
625.5
625.3
625.1
624.9
624.7
624.5
624.3
624.1
623.9
623.7
623.5
623.3
623.1
622.9
622.7
622.5
Rainfall (inches)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 7_UT3 Lower
Groundwater Gage 10
Bankfull Depth

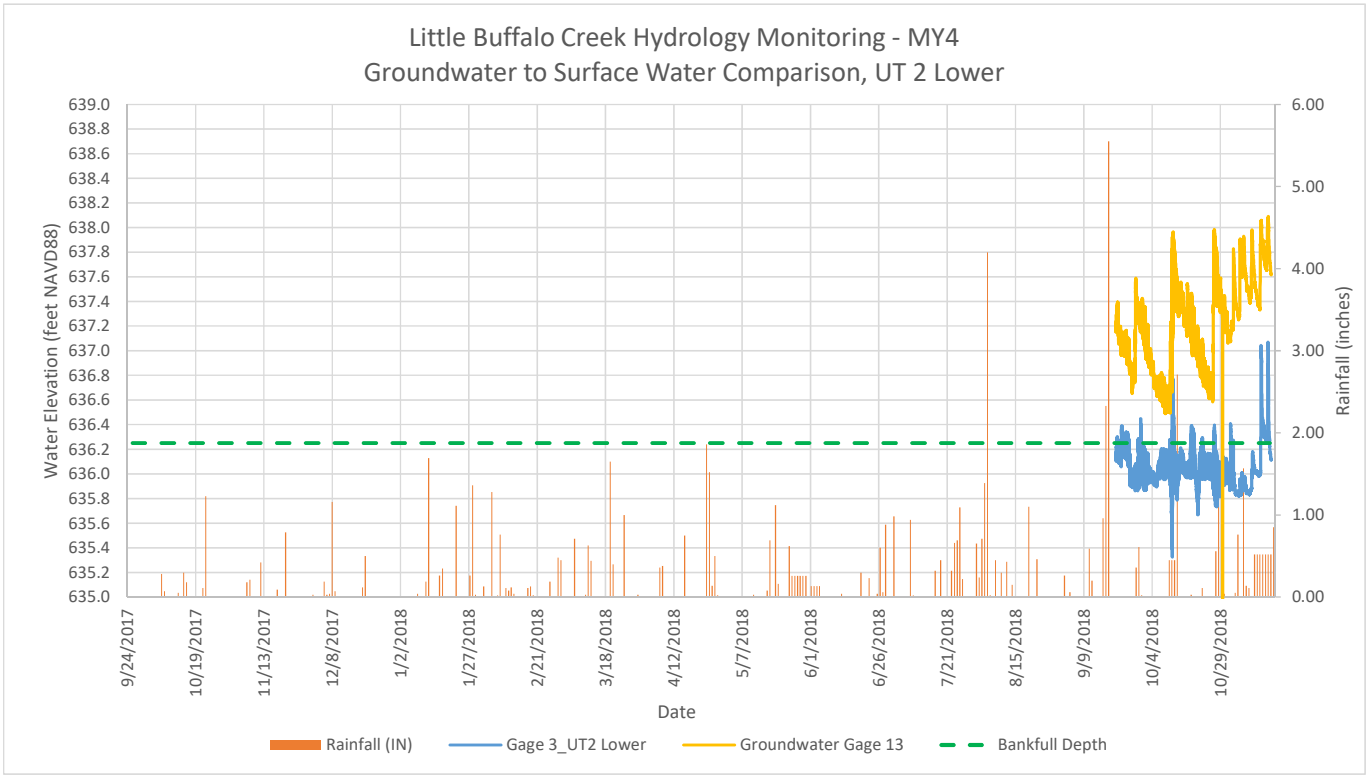

Little Buffalo Creek Hydrology Monitoring - MY4
Groundwater to Surface Water Comparison, UT 2 Lower
Water Elevation (feet NAVD88)
639.0
638.8
638.6
638.4
638.2
638.0
637.8
637.6
637.4
637.2
637.0
636.8
636.6
636.4
636.2
636.0
635.8
635.6
635.4
635.2
635.0
Rainfall (inches)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
9/24/2017
10/19/2017
11/13/2017
12/8/2017
1/2/2018
1/27/2018
2/21/2018
3/18/2018
4/12/2018
5/7/2018
6/1/2018
6/26/2018
7/21/2018
8/15/2018
9/9/2018
10/4/2018
10/29/2018
Date
Rainfall (IN)
Gage 3_UT2 Lower
Groundwater Gage 13
Bankfull Depth

Table 13 - Continuous Stream Flow Record						
Gauge	Tributary	30-Day Continous Flow Met in Current Monitoring Period	MY 1 Period	MY 2 Period	MY 3 Period	MY 4 Period
1	LBC Reach 1	Y	12/18/14-5/25/15	2/27/15 - 7/14/16	9/22/16-9/26/17	3/12/18 - 6/25/18
2	UT 2 Upper	Y	12/18/14-9/1/15	-	7/19/17-9/26/17	1/23/18 - 4/12/18
3	UT 2 Lower	Y	12/18/14 - 8/2/15	2/26/16 - 7/14/16	1/1/17-2/1/17	9/18/18 - 11/16/18
4	UT 4	Y	3/21/15 - 9/3/15	2/26/16 - 7/13/16	9/19/16-9/26/17	9/27/17 - 7/1/18
5	LBC Reach 4	Y	12/18/14 - 3/13/15	2/26/16 - 6/12/16	11/17/16-7/27/17	11/7/17 - 6/17/18
6	UT 3 Upper	Y	12/18/14 - 6/22/15	-	5/30/17-8/26/17	8/18/18 - 911/16/18
7	UT 3 Lower	Y	12/18/14 - 3/14/15	2/26/16 - 7/2/16	12/30/16-8/18/17	1/24/18 - 7/1/18
8	UT 7	Y	12/18/14 - 5/20/15	2/28/16 - 7/13/16	10/7/16-7/30/17	11/15/17 - 7/1/18
11	UT 5	N	NA	NA	NA	-
12	UT 7	Y	12/18/14 - 5/20/15	2/28/16 - 7/13/16	10/7/16-7/30/17	9/18/18 - 11/16/18

Note: Period listed for observed continuous flow is for the longest period of observed continuous flow based on hydrologic gauges at the project site. Additional periods of 30-day continuous flow are observed at individual gauges besides what is shown in the table.

Note: loggers ran out of memory in MY2 (7/14/16) after changing the frequency recording to a shorter interval than being downloaded.

Note: Barometric pressure gauge was lost/damage in MY2 and replaced. Regional airport barometric pressure was used for compensation from 9/20/15 - 2/26/16 and is likely to cause periods showing no flow when flow occurred.

Gauge 2 only gauge during monitoring with consistant data and no continous flow for 30 days observed

Appendix F – Supplemental Information

IRT Site Visit Minutes

Little Buffalo Creek – Old Mine Road, Gold Hill, Cabarrus County
June 19, 2018 – IRT Site Visit Meeting Summary

Attendees: Paul Wiesner & Kelly Phillips, DMS; Mac Haupt, NCDEQ/DWR; Kim Browning, USACE
Louis Berger: Robin Maycock (Project Manager); Matt Holthaus (Engineer); Douglas Parker (Botanist); Alston Willard (Field Tech/Intern)

Purpose: To provide IRT an opportunity to visit the site and make comments prior to closeout.

Coverage: The main channel from Reach 1, just north of vegetation plot 11, to the cattle crossing in Reach 5, as well as the lower portions of UT-2, UT-3, UT-4, UT-5, and UT-6.

Reach 1
The group walked in the pasture, north along the east fence line of Reach 1.

The small tributary, outside of the easement area

- The IRT recommended an additional 20 feet of fencing in this area to create a filter/buffer for the tributary to protect water quality in Little Buffalo Creek. Any increased filtering capacity is better than the existing conditions.
- Source of maggots is assumed to be a dead cow. It was pointed out that Marcus (tenant) owns several stock yards and tends to buy poorer cows with the thought of improving them.
- Consider speaking with Marcus about keeping such cows elsewhere and/or to Phil Cline about potentially adding fenced area. (DMS Note: We can't add conservation easement to the project at this point for numerous reasons. Any additional BMP type measures would be acceptable.)

Invasive species

- Upon crossing the fence, an area where mature Tree of Heavens were removed, to prevent seeding of the disturbed area to the north, was pointed out. Kelly stated that this had been a good idea.
- Invasive species maintenance is ongoing with another treatment occurring in the fall.

The bare area around Vegetation Plot 11 was examined.

- The small area where soil sampling results showed copper toxicity was pointed out and the anecdotal history of copper mining in the area was mentioned.
- The lack of trees in a narrow band encompassing vegetation plot 11 was examined. The soil sample report was shared, showing low nutrient soil, as well as that the area being shallow to rock, and wet.
    - It was noted that on the stream side of this area, there were healthy willow saplings, and on the upland side, healthy loblolly pines.
    - Robin suggested spreading the beaver dam soil and debris on the bare areas and the IRT agreed that it would be a good area to add depth and organic matter by adding the beaver dam debris and accumulated sediment.
    - Paul recommended random transects (100 meters square) to be more representative of the vegetation in the area.

The beaver dam area was examined.

- The IRT asked how long the dam had been there (since approximately November) and when it was removed. Robin stated that the beaver were trapped and the dam was breached in March).
- As beaver dam had been breached prior to the growing season, the trees survived, with the exception of small area behind the dam.

- The IRT team asked why Berger was waiting until the fall to reshape the dam area and Robin replied that they would prefer that it coincided with replanting and surveying trips.

General rule of thumb for performance tolerances at closeout were discussed:

- 5% of entire restoration length for streams.
- 10% of entire restoration area for vegetation (DMS Note: Site specific factors such as the area of copper toxicity are considered on a case-by-case basis.)

Buffer width:

- IRT stated that the buffer width appeared to be narrow just north of the bend.
- They explained that buffer width should be 50 feet or greater and too much length without that buffer width would be a concern.
- Thus, prior to closeout, Berger should measure and verify buffer widths.

Reach 2

The group then turned south, following the main branch. A turkey on her nest was encountered near vegetation plot 10. The group crossed under the bridge into Reach 2. The group primarily walked down the channel.

UT-2 was thoroughly examined:

- Flowing water was observed in the channel.
- The area was impacted by cattle following construction and has a shallow slope and as such, water is backing up, forming a linear wetland type system.
- The area was pointed out to be in a landscape position that is known to have seeps and UT-2 is fed by a pond.
- The consensus of the group was that as the trees matured they would transpire the accumulated water and help the stream maintain a channel.
- IRT recommended getting good photos year round to show the channel structure during each season.
- IRT requested that Gauge 3 not be replaced where it originally was but moved to the mid-point of the stream length of UT-2 where the channel is clearly evident.
- Installation of the gauge at an increased depth sufficient to record water levels beneath the channel was also requested. Correlation of the gauge water level reading to continuous channel flow is required for this type of installation. An accompanying groundwater monitoring well was also requested.
- DMS suggested random vegetation transects for this area.
- IRT noted that the tree density was sufficient but was concerned that their vigor (i.e., size) was not where it should be.
- IRT recommended additional plantings in this area with larger (5-gallon) trees of at least 4 different species.
- IRT stated that they would be looking for a defined channel with a history of flow and a lack of these two features would be an issue.
- Matt stated that if the gauge was in a pool, it was correlated to elevation to show continuous flow.
- DMS suggests continued monitoring and documentation of the “linear wetland areas”. Measured lengths should be discussed and documented in MY4 and MY5 reports. Detailed observations of any channel adjustments within these areas should be made and presented in the reports.

Reach 3

A small area of undercutting on the main branch was examined:

- The area appears to be stabilizing with tree growth, with no mass wasting, nice substrate, and connected to the floodplain.
- IRT stated the area looks good.

UT-4 was examined near Gauge 5

- IRT stated the area looks good.

Reach 4

The left bank riparian corridor was examined (where the cattle had gotten in and grazed):

- IRT expressed concern about the size of the tree saplings.
- IRT recommend replanting with more mature trees (5-gallon) of at least 4 different species.
- At closeout, IRT is looking for trees to be at or near 10 feet tall.
- IRT believes if the area is left alone (not replanted) this area could be a concern at closeout.

Enhancement level 1 area on main channel (concrete removal area):

- A small area with scour was examined.
- IRT stated it was not significant and had no issues with this area.

The lower portions of UT-3 (ash grove):

- It was pointed out that Berger did additional work in this area that was beyond the initial scope.
- Berger asked about incorporating the extra section of work that had been done into the credits (this would require a mitigation plan modification).
    - IRT highly recommended against trying to modify the existing mitigation plan to incorporate the extra section of work Berger completed as it could potentially open the project to additional monitoring.
    - IRT suggested that Berger note that extra repairs were made in the final report and to also mention it at close out.

UT-3 was thoroughly examined:

- The tributary was found to be flowing.
- Bare banks along UT-3 were pointed out as well as the fact that the willow live stakes had leafed out this year (had not the prior year).
- IRT recommended deploying a gauge at the mid-point of the stream length.
- IRT was concerned with the size of the tree saplings in this area and recommended planting with more mature trees (5-gallon) of at least 4 different species.
- IRT recommended getting good photos year around to show the channel structure during each season.

Reach 5

UT-5 was thoroughly examined:

- The tributary was found to have no flow but contained some wet areas.
- Gauge was moved to mid-point of the stream length
- Kim stated that she considered UT-5 to be a grass water-way.
- Mac stated it was likely not a stream.
- The soil was examined and found to vary between hydric and non-hydric.

- UT-5 was considered by the IRT to potentially not be a stream and is considered a clear credit risk.

UT-6 was examined:

- The tributary was found to have flow and has historically had flow.
- IRT no comments.
- IRT no need for a gauge.

Cattle Crossing

- IRT – cattle crossing looks good and the re-enforcement looks sufficient. There was no evidence of recent cattle access within the conservation easement.
- Asked about a hot wire for when cattle cross (had one, but the solar pack was removed by the landowners).
- Asked about why the gates weren't kept closed continuously (maintain cattle access to water).
- Asked about alternative water (had gotten a cost proposal for a well but was too expensive, researching other alternatives).
- IRT stated that they were not familiar with the blue pickle barrels but were good with whatever we wanted to try.
    - Verified that the blue barrels would be in addition to the existing fencing.
    - IRT recommended waiting to see how the new re-enforcement was working before installing the blue pickle barrels.
- IRT stated the biggest concern with the cattle crossing was continued maintenance by the landowners.
- The easement modification was brought up (at state property office for review) and the IRT expressed no concerns and made no comments regarding the easement modification.

Miscellaneous

- Paul would proceed with getting Berger paid for MY3.
- IRT requested that MY4 and MY5 reports include discussion on initial planted acreage versus replanted acreage (as percentages).
- IRT recommended providing before and after photos of the site in MY5 report for their closeout review to understand the uplift that has occurred.
- IRT was complimentary of Berger's efforts to keep the cows out and appreciated that Berger staff visited the site frequently enough to be familiar with it and its issues.
- The possibility of an additional year's monitoring was brought up
    - IRT stated this was a possibility due to low vigor on the tree sapling growth
    - If an additional year of monitoring was requested, it could be tailored to just vegetation
    - Paul stated that the IRT, in the past, has been very reasonable in requesting additional monitoring years

Action Items:

1. Color code stream centerlines on CCPV maps for MY4 and MY5 reports to distinguish levels of restoration effort.
2. Remove beaver dam and spread debris on the copper area and the bare area around vegetation plot 11.
3. Deploy new gauge mid-point of stream length UT-2. Installation of the gauge at an increased depth sufficient to record water levels beneath the channel.
4. Install groundwater well on UT-2 in conjunction with new gauge.
5. Replant around UT-2 with more mature trees of at least 4 different species.

6. Measure linear stream length that may be considered a linear wetland at closeout for more accurate number in the winter. (DMS Note: This should be measured in both MY4 & MY5 to track any changes. Measurements will be much easier in the dormant season).
7. Replant the left bank riparian corridor of Reach 4 (cattle grazed area) with more mature trees of at least 4 different species.
8. Deploy new gauge mid- point of stream length UT-3.
9. Replant around UT-3 with more mature trees of at least 4 different species.
10. Conduct more vegetation transects around Vegetation Plot #11, UT-2, Reach 4, and UT-3.
11. Take lots of photographs of the tributary's in flow, at different times of the year, to show the channels.
12. Include this meeting summary in the Appendix of MY4's report.

Random Vegetation Plot Transects Stem Counts

			Plot 3 - UT3		Plot 4 - Reach 4		Plot 8 - UT2		Plot 11 - Reach 1	
Scientific Name	Common Name	Species Type	Upstream - Same bank	Downstream - opposite bank	Upstream	Downstream	Downstream - Same bank	Downstream - Opposite Bank	Upstream	Downstream
			T	T	T	T	T	T	T	T
Acer	maple	Tree								
Acer negundo	boxelder	Tree								
Acer rubrum	red maple	Tree								
Alnus serrulata	hazel alder	Shrub						2		
Baccharis halimifolia	eastern baccharis	Shrub					1			
Carpinus caroliniana	American hornbeam	Tree								
Celtis laevigata	sugarberry	Tree	1			2	2	1	71	15
Cercis canadensis	eastern redbud	Tree				1	2			
Diospyros virginiana	common persimmon	Tree								
Fraxinus pennsylvanica	green ash	Tree		4	1	1		3		
Ilex glabra	inkberry	Shrub								
Juglans nigra	black walnut	Tree								
Juniperus virginiana	eastern redcedar	Tree			1					
Liquidambar styraciflua	sweetgum	Tree								
Liriodendron tulipifera	tuliptree	Tree			6	1	2			
Nyssa sylvatica	blackgum	Tree	1				2			
Pinus rigida	pitch pine	Tree								
Pinus taeda	loblolly pine	Tree							12	2
Pinus virginiana	Virginia pine	Tree								
Platanus occidentalis	American sycamore	Tree	1					3	8	15
Prunus serotina	black cherry	Tree								
Quercus falcata	southern red oak	Tree	1				2			
Quercus michauxii	swamp chestnut oak	Tree	4	2	2	2	2			
Rhus glabra	smooth sumac	shrub								
Salix nigra	black willow	Tree							18	24
Sambucus	elderberry	Shrub								
Sambucus canadensis	Common Elderberry	Shrub								
Sassafras albidum	sassafras	Tree								
Ulmus	elm	Tree			2	1				
Ulmus rubra	slippery elm	Tree								
Viburnum dentatum	southern arrowwood	Shrub	1							
		Stem count	9	6	12	8	13	9	109	56
		size (ares)	0.83613	0.83613	0.83613	0.83613	0.83613	0.83613	0.83613	0.83613
		size (ACRES)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
		Species count	6	2	5	6	7	4	4	4
		Stems per ACRE	435.5986244	290.3990829	580.7981658	387.1987772	629.198013	435.5986244	5275.58334	2710.391441

Type = Tree, Shrub, Livestake
T = Total

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%

Figure 7a-7d – Random Vegetation Plot Transects Location Maps

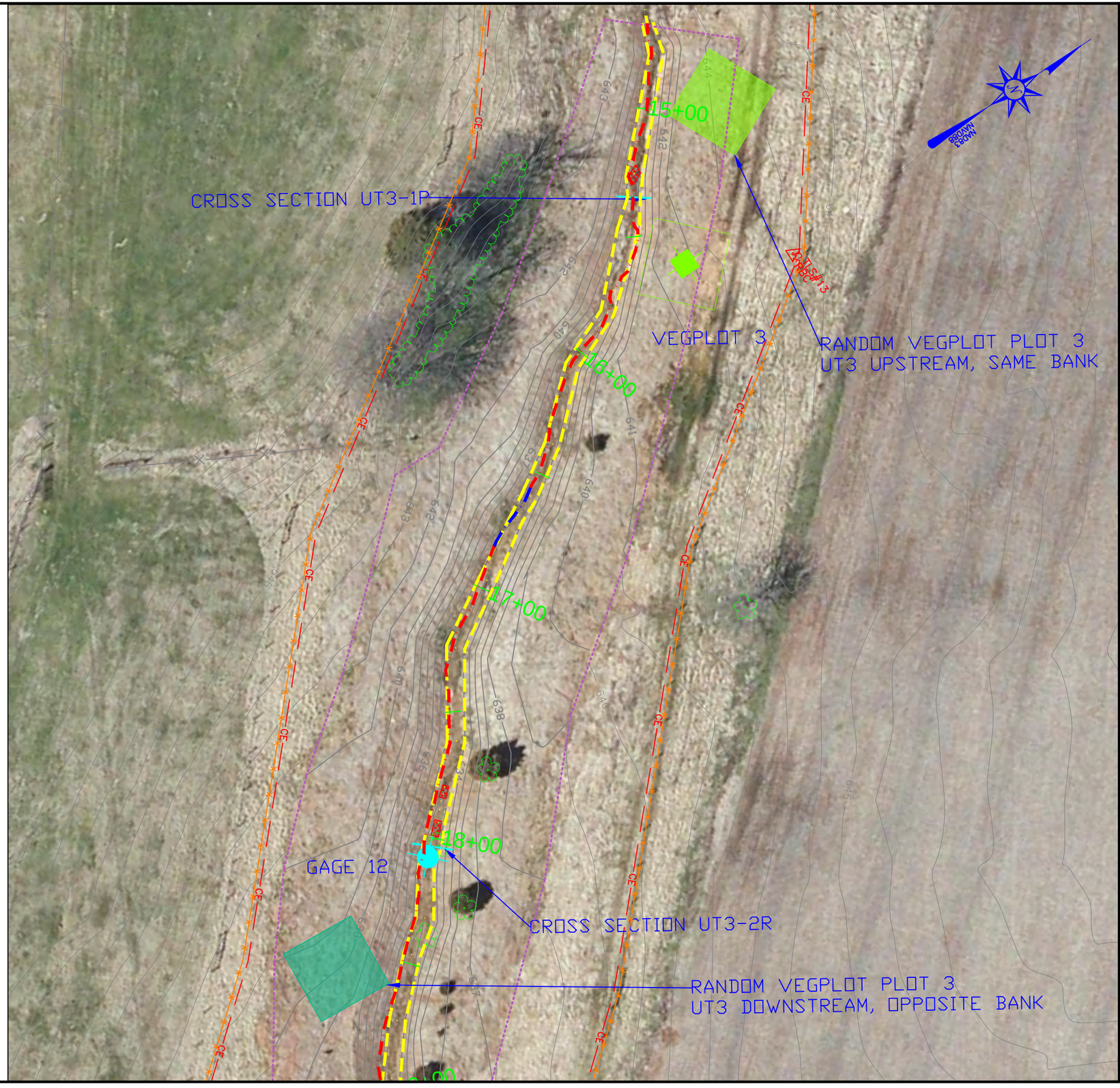
0’ 40’ 80’

SCALE: 1”= 40’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS–BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONTROL POINT
- STREAM GAGE
- PHOTO LOCATION
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY <10%



NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

RANDOM VEGETATION PLOTS – PLOT 3 UT3

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 7A

Filename: \\mtn-fs-01\lp\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\Random Transect Figure.dwg

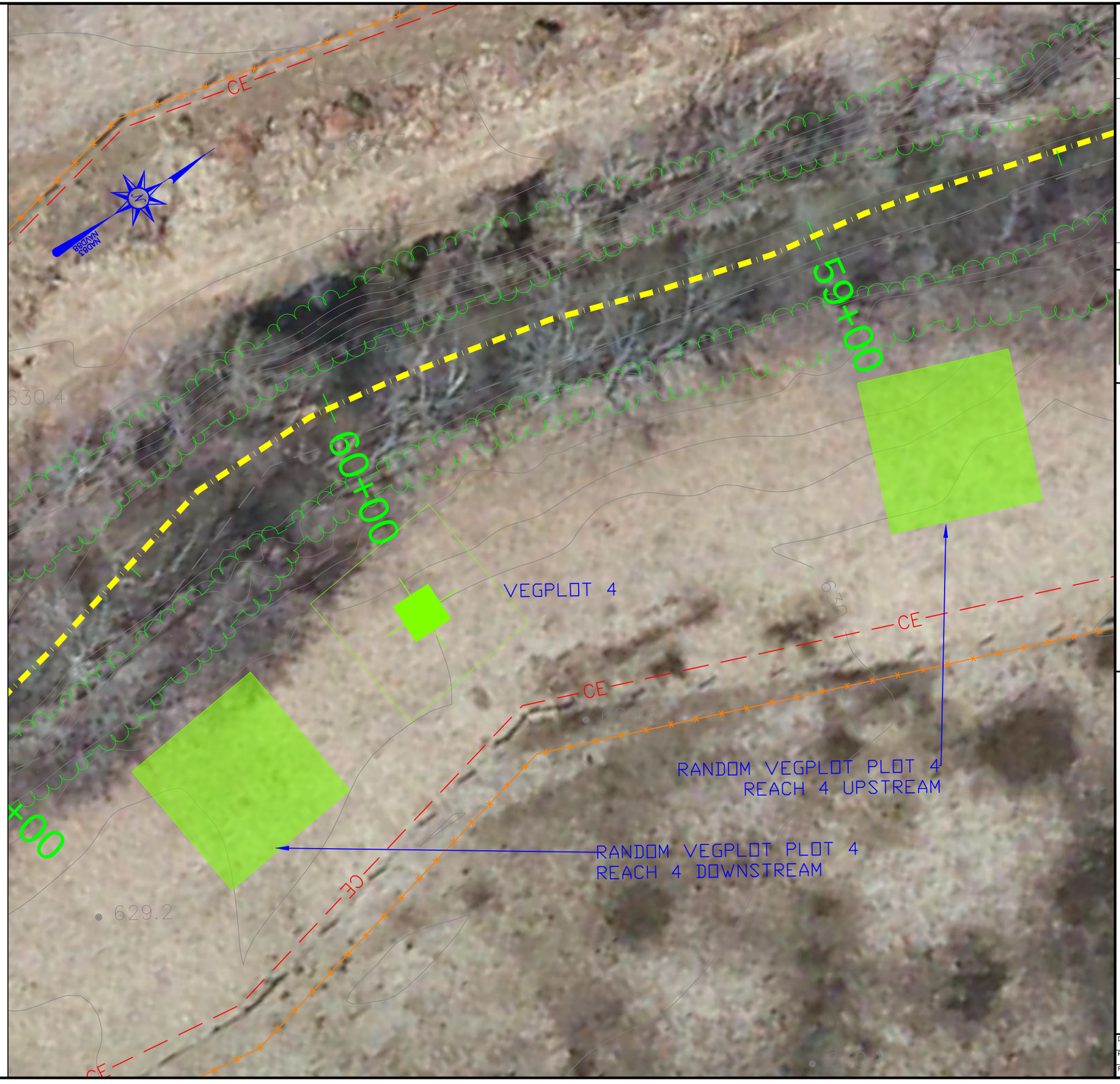
0’ 20’ 40’

SCALE: 1”= 20’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS–BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONTROL POINT
- STREAM GAGE
- PHOTO LOCATION
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY <10%



NO.	REVISIONS	DRN	CHK	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

RANDOM VEGETATION PLOTS – PLOT 4 REACH 4

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 7B

Filename: \\nth-fs-01\lg\Operations\121\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\Random Transect Figure.dwg

0’ 20’ 40’

SCALE: 1”= 20’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS–BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONTROL POINT
- STREAM GAGE
- PHOTO LOCATION
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY <10%

NO.	REVISIONS	DRN	CHK	DATE

NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

RANDOM VEGETATION PLOTS – PLOT 8 UT2

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 7C

Filename: \\vntn-fs-01\fp\Operations\121\0008 - Little Buffalo Creek\Deliverables\Drawings\LBC CCPVA\Random Transect Figure.dwg

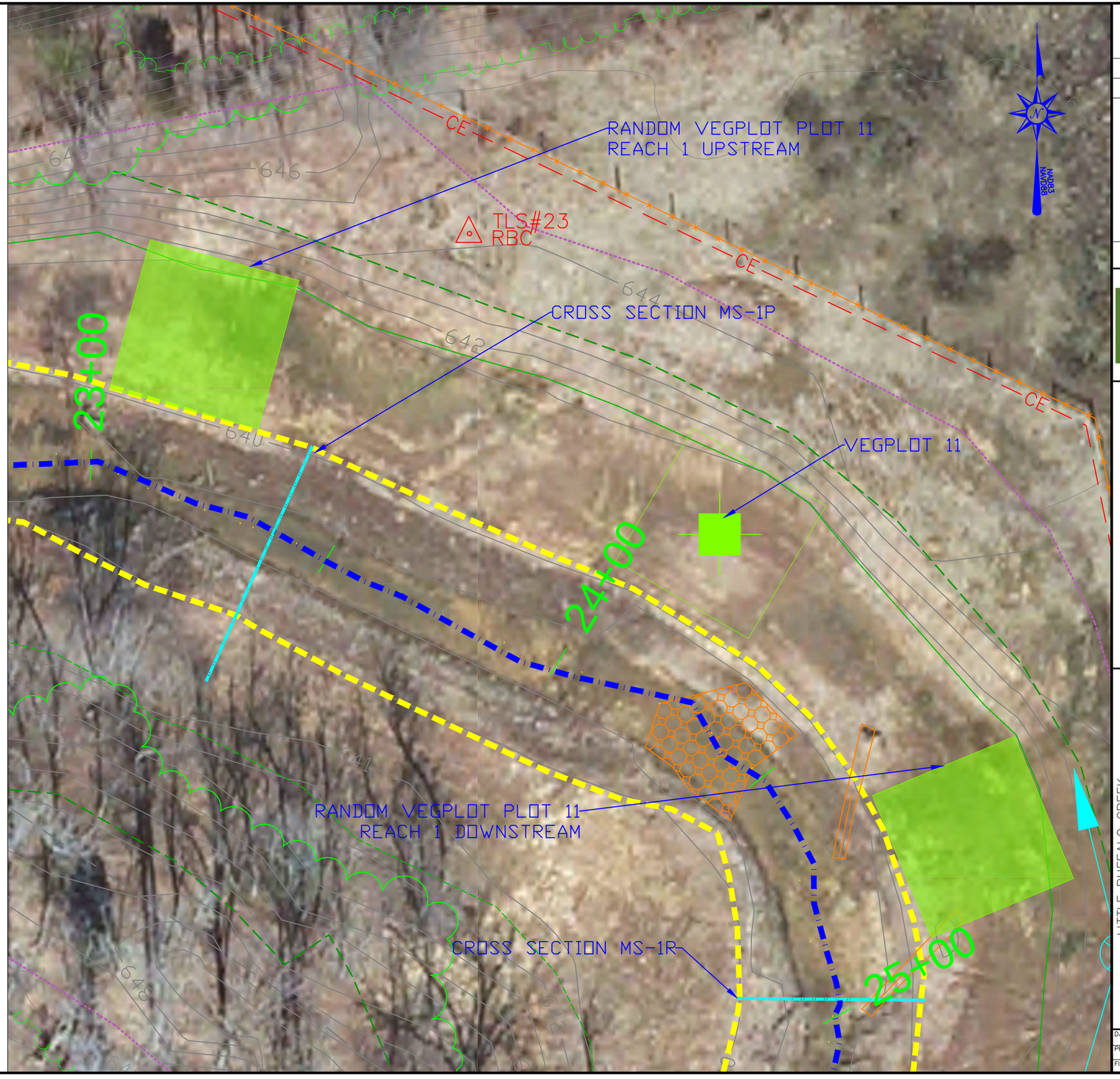
0’ 20’ 40’

SCALE: 1”= 20’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2015

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS–BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONTROL POINT
- STREAM GAGE
- PHOTO LOCATION
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- RANDOM VEGPLOT – EXCEEDS REQUIREMENTS BY <10%



NCDEQ-DMS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

RANDOM VEGETATION PLOTS – PLOT 11 REACH 1

DATE MARCH 2019
PROJECT NO. 94147
FIGURE 7D

NO. | REVISIONS | DRN | CHK | DATE

Filename: \\mtn-fs-01\lp\Operations\V2\1008 – Little Buffalo Creek\Deliverables\Drawings\LBC CCPV\Random Transect Figure.dwg