

**As-Built Baseline Monitoring Report**

**FINAL**

**LITTLE SEBASTIAN SITE**

NCDMS Project # 100027 (Contract # 7187) | RFP 16-006993 (Issued 9/16/2016)  
USACE Action ID: SAW-2017-01507 | DWR Project # 2017-1041

Surry County, North Carolina  
Yadkin River Basin  
HUC 03040101



**Provided by:**



Resource Environmental Solutions, LLC  
For Environmental Banc & Exchange, LLC

**Provided for:**

NC Department of Environmental Quality  
Division of Mitigation Services

**October 2021**



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August 26, 2021

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RE: Little Sebastian Mitigation Site: Baseline Report and As-Built Drawings (NCDMS Project ID #100027)

Listed below are comments provided by DMS on August 11, 2021 regarding the Little Sebastian Mitigation Site: Baseline Report and As-Built Drawings and RES' responses.

**Report Cover:** Please also include the RFP # and issuance date of the RFP on the report cover: RFP 16-006993 (Issued 9/16/2016).

[Done.](#)

**General:** The 2018 IRT approved mitigation plan reported 4,554.300 SMUs on the project site. The draft MY0 report notes 4,573.960 SMUs on the site due to the addition of Reach JN7 (37 linear feet of stream restoration). This represents a 19.66 SMU increase on the project site; please provide a separate mitigation plan addendum request (memo) for IRT review and approval to accompany the revised MY0 report and Record Drawings.

Please confirm that the USACE non-standard buffer width calculation was recalculated on the entire project site after the addition of Reach JN7. Please provide the full set of revised stream buffer credit adjustment maps and supporting documentation in the mitigation plan addendum for IRT review.

[Confirmed, the non-standard buffer width calculation was recalculated for the entire project. The full set of revised maps and supporting documentation are in the mitigation plan addendum.](#)

**Section 1.1 – Project Location and Description:** “Funding will be supplied by the responsible party on a yearly basis until such time an endowment is established.” Please clarify or remove this sentence.

[This sentence has been removed.](#)

**Section 1.3 – Project Success Criteria:** This section references the Apple Valley Mitigation Plan. Please update the text and QA/QC this section to confirm that the success criteria presented is consistent with the IRT approved mitigation plan for the Little Sebastian project.

[This typo has been corrected.](#)

**Section 1.4 - Project Components:** The proposed addition of JN7 represents a 19.66 SMU increase from the IRT approved mitigation plan. Please update the section accordingly.

[This section has been updated.](#)



**Section 1.5 - Stream Mitigation Approach:** In the report text, please also note the type of fencing installed to exclude livestock from the project conservation easement. If multiple fencing types were utilized, please describe in the report text.

The fence is five-strand high tensile electric. This has been added to Section 1.6.

**Section 1.7 - Baseline Monitoring Performance (MY0):** Please indicate how project photo points have been established and will be monitored on the site. Fixed digital image locations appear to have been established at each cross section, vegetation plot, stage recorder, and flow gauge. Per recent IRT discussion, DMS recommends adding photo points in the MY1 (2021) report at each project crossing location to document crossing stability and function during the monitoring term.

RES has added information about fixed digital image locations to Section 2.0 and agrees to include crossings.

**Table 4 and Table 7:** Table 4 notes that the project area is 6.42 acres and the planted acreage is 6.09 acres. Table 7 indicates a planted acreage of 10.7 acres. Please review and update the report as necessary. Based on the CCPV maps and a construction site visit, numerous areas of the project site do not appear to have been planted due to existing vegetation within the conservation easement.

This error has been corrected.

**Appendix A – Table 1:** DMS recommends adding a note to Table 1 indicating that all crossings and utility easements have been removed from the credit calculations.

Done.

**Appendix A – Table 2:** In the table, please update the elapsed time since grading and planting.

Done.

**Appendix B - Visual Stream Stability Assessment & Vegetation Condition Assessment Tables:** On the tables, please include the date/s that the visual assessments were performed. These dates should also be included in future monitoring reports in these tables and Table 2. DMS understands this is a variance from the current template; however, it will help address IRT concerns discussed at the most recent IRT credit release meeting (2021).

Done.

**Appendix D - Cross Section Sheets – Cross Section 4:** The cross section sheet notes that the reach approach associated with the cross section location is EII. The CCPV sheet notes EI. Please review and update as necessary.

The correct approach is EI. This has been updated in the report.

**Appendix E - Cover Page:** Please update the appendix cover sheet to “Record Drawings” to coincide with the table of contents and sheets provided.

Done.



### **Record Drawings:**

- The project conservation easement shown on the draft record drawings is identified as the Limits of Proposed Conservation Easement (LCE). The final recorded conservation easement (approved by the NC SPO) should be utilized for the record drawings. Please update the record drawings and legend accordingly. Once updated, please confirm that no areas of fencing or project crossings are located within the recorded conservation easement.

The record drawings have been updated with the recorded easement. Two areas of fencing within the easement were found on MC1 and will be removed by MY1.

- Thank you for showing the relocated utility line on the record drawings. Please confirm that no other utility lines/ utility easements cross the conservation easement. If others exist, please make sure to show them on the final record drawings.

Confirmed.

### **Digital Support File Comments:**

- A majority of features in the “Streams\_AB\_LittleSebastian” shapefile have lengths that differ from the lengths reported in the asset table by more than 5 ft. Please review these features and ensure that feature lengths reflect asset table lengths. Also, please be sure that there is a feature representing each record in the asset table.

The stream shapefile has been updated to the most recent version which matches the asset table.

- Note that there is a portion of the feature for MC3-B that is outside of the conservation easement. This is no longer an issue with the updated shapefile.

- Please include unique ID’s with the stream gauge features that correspond with the ID’s that will be used for the supporting data.

Done.

- Please submit features that represent the mitigation plan design, ensuring that there is a feature representing each record in the asset table and that feature lengths are within 5 ft of asset table lengths (e.g. Mitigation Plan Footage or Acreage).

Done.

- Please include the as-built .DWG file with the final digital submission.

Done.

- Please associate stem heights and x,y coordinate data with individual stems for the fixed plots, and be prepared to indicate planted vs. volunteer stems in subsequent monitoring years.

CVS datasheets have been included in the digital submission.

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## **1.0 Project Summary**

### ***1.1 Project Location and Description***

The Little Sebastian Mitigation Site (“the Project”) is located in Surry County, approximately 10 miles north of Elkin. The Project presents 4,554.300 Cool Stream Mitigation Units (SMU) along Mill Creek and three unnamed tributaries.

The Project’s total easement area is approximately 25.91 acres within the overall drainage area of 3,261 acres. The Project has two separate portions and in between those portions is the Gideon Mitigation Site. The Gideon Mitigation Site has a total easement area that is approximately 11.23 ac and presents 4,782 linear feet of stream restoration, enhancement, and preservation. Therefore, a total 37.14 ac and 12,887 LF of stream are protected in perpetuity. Grazing livestock historically had access to all stream reaches within the Project. The lack of riparian buffer vegetation, deep-rooted vegetation, and unstable channel characteristics contributed to the degradation of stream banks throughout the Project area.

The Project will be monitored on a regular basis throughout the seven-year post-construction monitoring period, or until performance standards are met. The Project will be transferred to the NCDEQ Stewardship Program. This party shall serve as conservation easement holder and long-term steward for the property and will conduct periodic inspection of the site to ensure that restrictions required in the conservation easement are upheld.

### ***1.2 Project Goals and Objectives***

Through the comprehensive analysis of the Project’s maximum functional uplift using the Stream Functions Pyramid Framework, specific, attainable goals and objectives were realized by the Project. These goals clearly address the degraded water quality and nutrient input from farming that were identified as major watershed stressors in the 2009 Upper Yadkin Pee-Dee River RBRP. The Project will address outlined RBRP Goals 2, 4, and 6 (**Mitigation Plan**).

The Project goals are:

- Improve water transport from watershed to the channel in a non-erosive manner in a stable channel;
- Improve flood flow attenuation on site and downstream by allowing for overbanks flows and connection to the active floodplain;
- Improve instream habitat;
- Restore and enhance native floodplain vegetation; and
- Indirectly support the goals of the 2009 Upper Yadkin Pee-Dee RBRP to improve water quality and to reduce sediment and nutrient loads.

The Project objectives to address the goals are:

- Designed and reconstructed stream channels sized to convey bankfull flows that maintain a stable dimension, profile, and planform based on modeling, watershed conditions, and reference reach conditions;
- Permanently excluded livestock from stream channels and their associated buffers;
- Added in-stream structures and bank stabilization measures to protect restored and enhanced streams;
- Installed habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored and enhanced streams;
- Reduced bank height ratios and increased entrenchment ratios to reference reach conditions;

- Increased forested riparian buffers to at least 30 feet on both sides of the channel along the Project reaches with a hardwood riparian plant community;
- Implemented one agricultural BMP in order to limit inputs of sediment, nutrients, and fecal coliform to streams from surrounding farming operations;
- Treated exotic invasive species; and
- Established a permanent conservation easement on the Project.

### ***1.3 Project Success Criteria***

The success criteria for the Project follows the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update, the Little Sebastian Final Mitigation Plan, and subsequent agency guidance. Cross section and vegetation plot monitoring takes place in Years 0, 1, 2, 3, 5, and 7. Stream hydrology, wetland hydrology, and visual monitoring takes place annually. Specific success criteria components are presented below.

#### **Stream Restoration Success Criteria**

Four bankfull flow events must be documented within the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years.

There should be little change in as-built cross sections. If changes do take place, they should be evaluated to determine if they represent a movement toward a less stable condition (for example down-cutting or erosion) or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross sections shall be classified using the Rosgen stream classification method, and all monitored cross sections should fall within the quantitative parameters defined for channels of the design stream type. Bank height ratio shall not exceed 1.2, and the entrenchment ratio shall be above 1.4 within restored riffle cross sections. Channel stability should be demonstrated through a minimum of four bankfull events documented in the seven-year monitoring period.

Digital images are used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal images should not indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral images should not indicate excessive erosion or continuing degradation of the banks over time. A series of images over time should indicate successional maturation of riparian vegetation.

Stream restoration reaches will be monitored to document intermittent or seasonal surface flow. This will be accomplished through direct observation and the use of hydraulic pressure transducers with data loggers. Reaches must demonstrate a minimum of 30 consecutive days of flow. Flow gauges will be installed on JN2-A and BS1-A. The flow gauge on BS1-A will also be capable of monitoring bankfull events.

#### **Vegetation Success Criteria**

Specific and measurable success criteria for plant density within the riparian buffers on the Project follow IRT Guidance. The interim measures of vegetative success for the Project is the survival of at least 320 planted three-year old trees per acre at the end of Year 3, 260 trees per acre with an average height of six feet at the end of Year 5, and the final vegetative success criteria is 210 trees per acre with an average height of eight feet at the end of Year 7. Volunteer trees are counted, identified to species, and included in the yearly monitoring reports, but are not counted towards the success criteria of total planted stems until they

are present in the plot for greater than two seasons. Moreover, any single species can only account for up to 50 percent of the required number of stems within any vegetation plot. Any stems in excess of 50 percent will be shown in the monitoring table but will not be used to demonstrate success.

### *1.4 Project Components*

The project streams were significantly impacted by livestock production, agricultural practices, and a lack of riparian buffer. Improvements to the Project help meet the river basin needs expressed in the 2009 Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) as well as ecological improvements to riparian corridor within the easement.

Through stream restoration, enhancement, and preservation, the Project presents 4,554.300 Cool Stream Mitigation Units (SMU) (**Table 1**).

<b>Mitigation Approach</b>	<b>Linear Feet</b>	<b>Ratio</b>	<b>Cool Base SMU</b>
Restoration	2,758	1	2,721
Enhancement I	597	1.5	398
Enhancement II	1,898	2.5	759.2
Enhancement II	1,372	5	274.4
Enhancement II	819	7.5	109.2
Enhancement II	243	10	24.3
Preservation	418	10	41.8
<b>Total</b>	<b>8,068</b>		<b>4,327.9</b>
<b>Credit Loss in Required Buffer</b>			<b>-278.7</b>
<b>Credit Gain for Additional Buffer</b>			<b>505.1</b>
<b>Total Adjusted SMUs</b>			<b>4,554.300</b>

### *1.5 Stream Mitigation Approach*

The Project includes priority I stream restoration, enhancement I, enhancement II, and preservation. Priority I stream restoration incorporates the design of a single thread meandering channel, with parameters based on data taken from reference sites, published empirical relationships, regional curves developed from existing project streams, and NC Regional Curves. Analytical design techniques also were a crucial element of the project and were used to determine the design discharge and to verify the design as a whole.

**Reach JN2-A** - Preservation activities included improving the existing livestock exclusion fencing and buffers greater than 30 feet. The easement was extended to provide preservation beyond the origin point of the stream as per the PJD.

**Reach JN2-B** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. Minimal bank grading and buffer re-establishment was done along the downstream end. In-stream structures such as log sills and one log cross vane were installed for stability and to improve habitat. The restoration of the riparian areas at the downstream end filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach JN2-C** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. Minimal bank grading and buffer re-establishment were done along the downstream end. The restoration of the riparian areas at the downstream end filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach JN2-D** - Enhancement activities included some channel relocation, bed, and bank stabilization, removing an existing ford crossing and access road, improving habitat through supplemental buffer plantings, and livestock exclusion fencing. The restoration of the riparian areas at the downstream end filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach JN3-A** –Enhancement II activities at a 7.5:1 ratio included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the right bank filters runoff from adjacent pasture and reduce sediment loads.

**Reach JN3-B** - Restoration activities included constructing a new channel within the natural valley to the north with appropriate dimensions and pattern and backfilling the abandoned channel. In-stream structures such as log sills, brush toes, and log vanes were installed for stability and to improve habitat. Habitat was further improved through buffer plantings and livestock exclusion. Buffer activities improved riparian areas that filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel. Also, the reach was built through two small jurisdictional wetlands that are currently on the right bank floodplain and degraded from cattle access and pasture-use. While this project is not claiming any wetland credit, the raised channel bed enhances the wetlands' hydrology by reconnecting the floodplain wetlands to the stream. Two groundwater wells were installed on the right floodplain to monitor the wetland hydrology and will be reported in the yearly monitoring reports.

**Reach MC1-A** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the right bank filters runoff from adjacent pasture and reduce sediment loads.

**Reach MC1-B** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach MC1-C** - Restoration activities included using log structures to provide vertical stability, assist in maintaining riffle, run and pool features and to provide habitat features. Cut and fill was balanced in an effort to raise the channel bed to provide regular inundation of the adjacent floodplain. Habitat was improved through supplemental buffer plantings and livestock exclusion fencing. The Gideon Mitigation Bank was constructed with the Project.

**Reach MC3-A** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the right bank filters runoff from adjacent pasture and reduce sediment loads.

**Reach MC3-B** - Enhancement activities included reshaping the left bank, install coir matting and livestock, and improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area. A ford crossing was installed on this reach.

**Reach MC3-C** - Enhancement activities included reshaping the left bank, install coir matting and livestock, and improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the project area.

**Reach MC3-D** - Enhancement activities includes improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach BS1-A** - Restoration activities included using log and rock structures to provide vertical stability, assist in maintaining riffle, run and pool features and to provide habitat features. Cut and fill were balanced in an effort to raise the channel bed to provide small floodplain benches where topography allows. Habitat was further improved through supplemental buffer plantings and livestock exclusion fencing. An engineered sediment pack was installed at the top of this reach.

**Reach BS1-B** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the project area.

**Reach BS1-C** - Restoration activities included using log and rock structures to provide vertical stability, assist in maintaining riffle, run and pool features and to provide habitat features. Cut and fill was balanced in an effort to raise the channel bed to provide small floodplain benches where topography allows. Habitat was further improved through supplemental buffer plantings and livestock exclusion fencing.

**Reach BS1-D** - Enhancement activities included improving habitat through supplemental buffer plantings and livestock exclusion fencing. The widening and restoration of the riparian areas along the left bank filters runoff from adjacent pasture, reduce sediment loads, and provide wildlife corridors throughout the Project area.

**Reach BS1-E** - Restoration activities included using log structures to provide vertical stability, assist in maintaining riffle, run and pool features and to provide habitat features. Cut and fill were balanced in an effort to raise the channel bed to provide small floodplain benches where topography allows. Habitat was further improved through supplemental buffer plantings and livestock exclusion fencing.

### ***1.6 Construction and As-Built Conditions***

Stream construction was completed in February 2021 and planting was completed in March 2021. Additionally, five-strand high tensile electric fencing was installed for cattle exclusion. The Little Sebastian Site was built to design plans and guidelines. Two minor changes were made during construction: a log sill was added on JN2-B for extra grade control and log sills were removed from BS1 due to bedrock. Additionally, JN7 was added between Final Mitigation Plan approval and construction. This reach has a 30-acre drainage area and includes a pond located about 150 linear feet upstream of the easement area. Historically, this pond drained through a short ditch into JN3-B but due to the relocation of JN3-B, a channel was constructed in order to connect the pond back to JN3-B. The restored JN7 includes 37 linear feet within the easement. A photo of JN7 is in **Appendix B**. RES proposed the addition of JN7 for credit; however, this request was denied by IRT. RES will monitor the stability and hydrology of this reach and if back-up credits are needed at closeout there is the potential to use the 19.660 SMUs from JN7. The record drawings are included in **Appendix E**.

Planting plan changes included replacing blackgum (*Nyssa sylvatica*) and elderberry (*Sambucus canadensis*) with sugarberry (*Celtis laevigata*) and buttonbush (*Cephalanthus occidentalis*). These changes were based on bare root availability. A planted species summary is included in **Appendix C**. Minor monitoring device location changes were made during as-built installation due to site conditions. The only monitoring devices not installed were the stage recorders proposed for MC1-C and BS1-C due to the reach

being less than 1,000 linear feet and there being two stage recorders proposed for the same reach, respectively.

### ***1.7 Baseline Monitoring Performance (MY0)***

The Little Sebastian baseline monitoring activities were performed in March 2021. All baseline monitoring data is present below and in the appendices. The Project is on track to meeting vegetation and stream interim success criteria.

#### Vegetation

Setup and monitoring of six fixed vegetation plots and three random vegetation plots was completed after planting and stream construction on March 17, 2021. Vegetation data are in **Appendix C**, associated photos are in **Appendix B**, and plot locations are in **Appendix B**. MY0 monitoring data indicates that all plots are exceeding the interim success criteria of 320 planted stems per acre. Planted stem densities ranged from 647 to 1,538 planted stems per acre with a mean of 1,111 planted stems per acre across all plots. A total of 10 species were documented within the plots. Volunteer species were not noted at baseline monitoring but are expected to establish in upcoming years. The average stem height in the plots was 1.5 feet.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project.

#### Stream Geomorphology

A total of 12 cross sections were installed on March 3, 2021, and geomorphology data collection for MY0 was conducted on March 16, 2021. Summary tables and cross section plots are in **Appendix D**. Overall the baseline cross sections and profile relatively match the proposed design. The as-built conditions show that shear stress and velocities have been reduced for the restoration reach. The reaches were designed as gravel/cobble bed channels and remain classified as gravel/cobble bed channels post-construction.

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. The channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation.

#### Stream Hydrology

Two stage recorders and two flow gauges were installed on March 17, 2021 and will document bankfull events and flow days, respectively. Stream hydrology data will be included in the Monitoring Year 1 Report in this section and in the appendices. Gauge locations can be found on **Figure 2** and photos are in **Appendix B**. RES will add a flow gauge on JN7 this winter.

#### Wetland Hydrology

Two groundwater wells with automatic recording pressure transducers were installed in March 2021. The goal of the groundwater wells is to track the hydrology of the jurisdictional wetlands on site post-stream construction. There is no hydroperiod success criteria for these groundwater wells. Wetland hydrology data will be included in the Monitoring Year 1 Report in this section and in the appendices. Gauge locations can be found on **Figure 2** and photos are in **Appendix B**.

## **2.0 Methods**

Stream cross section monitoring was conducted using a Topcon GTS-312 Total Station. Three-dimensional coordinates associated with cross-section data were collected in the field (NAD83 State Plane feet FIPS 3200). Morphological data were collected at 12 cross-sections. Survey data were imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. The stage recorders include an automatic pressure transducer placed in PVC casing in a pool. The elevation of the bed and top of bank at each stage recorder are used to detect bankfull events.

Vegetation success is being monitored at six fixed monitoring plots and three random monitoring plots. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data are processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with PVC at the origin and metal conduit at the other corners. Photos of each plot are to be taken from the origin each monitoring year. The random plot is to be collected in locations where there are no permanent vegetation plots. Random plot will most likely be collected in the form of 100 square meter belt transects with variable dimensions. Tree species and height will be recorded for each planted stem and the transects will be mapped and new locations will be monitored in subsequent years.

Wetland hydrology is monitored to track the hydrology of the jurisdictional wetlands on site post-stream construction. This is accomplished with two automatic pressure transducer gauges (located in groundwater wells) that record daily groundwater levels. One automatic pressure transducer is installed above ground for use as a barometric reference. Gauges are downloaded quarterly and wetland hydroperiods are calculated during the growing season. Gauge installation followed current regulatory guidance. Visual observations of primary and secondary wetland hydrology indicators are also recorded during quarterly site visits.

Fixed digital image locations are established at each cross section, vegetation plot, stage recorder, flow gauge, and the upstream and downstream side of each crossing.

## **3.0 References**

- Griffith, G.E., J.M.Omernik, J.A. Comstock, M.P. Schafale, W.H.McNab, D.R.Lenat, T.F.MacPherson, J.B. Glover, and V.B. Shelburne. (2002). Ecoregions of North Carolina and South Carolina, (color Poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).
- Lee Michael T., Peet Robert K., Roberts Steven D., and Wentworth Thomas R., 2008. *CVS-EEP Protocol for Recording Vegetation Level*. Version 4.2
- Peet, R.K., Wentworth, T.S., and White, P.S. (1998), *A flexible, multipurpose method for recording vegetation composition and structure*. *Castanea* 63:262-274
- Resource Environmental Solutions (2018). Little Sebastian Final Mitigation Plan.
- Schafale, M.P. 2012. Guide to the Natural Communities of North Carolina, Fourth Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, NCDENR, Raleigh, NC.
- USACE. (2016). Wilmington District Stream and Wetland Compensatory Mitigation Update. NC: Interagency Review Team (IRT).

# **Appendix A**

## Background Tables

**Table 1. Little Sebastian (ID-10027) - Mitigation Assets and Components**

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits		As-Built Footage or Acreage	Comments
JN2-A	418	418	Cool	P	NA	10.00000	41.800		418	Livestock exclusion
JN2-B	187	187	Cool	EI	NA	1.50000	124.667		187	Buffer planting and livestock exclusion
JN2-C	307	307	Cool	EII	NA	2.50000	122.800		307	Buffer planting and livestock exclusion; 31-foot crossing
JN2-C	837	837	Cool	EII	NA	2.50000	334.800		837	Buffer planting and livestock exclusion
JN2-D	39	43	Cool	EI	NA	1.50000	28.667		43	Channel relocation, bed and bank stabilization, crossing relocation, buffer plantings, and livestock exclusion; 62-foot crossing
JN2-D	150	153	Cool	EI	NA	1.50000	102.000		153	Channel relocation, bed and bank stabilization, crossing relocation, buffer plantings, and livestock exclusion
JN3-A	350	350	Cool	EII	NA	7.50000	46.667		350	Buffer planting and livestock exclusion
JN3-B	900	781	Cool	R	I	1.00000	781.000		781	Channel relocation in the natural valley, improved stream structures, buffer planting, and livestock exclusion; 43-foot crossing
JN3-B	224	262	Cool	R	I	1.00000	262.000		262	Channel relocation, bed and bank stabilization, crossing relocation, buffer plantings, and livestock exclusion
JN7*	0	0	Cool	R	I	1.00000	0.000		37	Channel construction, bed and bank stabilization, buffer plantings, and livestock exclusion; No Credit
MC1-A	469	469	Cool	EII	NA	7.50000	62.533		469	Buffer planting and livestock exclusion
MC1-B	717	717	Cool	EII	NA	5.00000	143.400		717	Buffer planting and livestock exclusion; 41-foot utility line crossing
MC1-B	260	260	Cool	EII	NA	5.00000	52.000		260	Buffer planting and livestock exclusion
MC1-C	545	555	Cool	R	I	1.00000	555.000		555	Channel bed raised, improved stream structures, buffer planting, and livestock exclusion
MC3-A	243	243	Cool	EII	NA	10.00000	24.300		243	Buffer planting and livestock exclusion
MC3-B	402	402	Cool	EII	NA	2.50000	160.800		402	Buffer planting and livestock exclusion; 41-foot crossing
MC3-C	214	214	Cool	EI	NA	1.50000	142.667		214	Bank stabilization, improved stream structures, buffer planting, and livestock exclusion
MC3-D	395	395	Cool	EII	NA	5.00000	79.000		395	Buffer planting and livestock exclusion
BS1-A	205	214	Cool	R	I	1.00000	214.000		214	Channel bed raised, improved stream structures, buffer planting, and livestock exclusion
BS1-B	190	175	Cool	EII	NA	2.50000	70.000		175	Buffer planting and livestock exclusion
BS1-C	580	541	Cool	R	I	1.00000	541.000		541	Channel bed raised, improved stream structures, buffer planting, and livestock exclusion
BS1-D	185	177	Cool	EII	NA	2.50000	70.800		177	Buffer planting and livestock exclusion
BS1-E	278	274	Cool	R	I	1.00000	274.000		274	Channel bed raised, improved stream structures, buffer planting, and livestock exclusion; 45-foot crossing
BS1-E	94	94	Cool	R	I	1.00000	94.000		94	Channel bed raised, improved stream structures, buffer planting, and livestock exclusion

\*Added between Final Mitigation Plan and Construction; no credit but potential to add credits if reach meets success criteria and back-up credits are needed

Note: all crossings and utility easements have been removed from credit calculations.

**Project Credits**

Restoration Level	Stream			Riparian Wetland	Non-rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration		2721.000				
Re-establishment						
Rehabilitation						
Enhancement						
Enhancement I		398.000				
Enhancement II		1167.100				
Creation						
Preservation		41.800				
NSBW		226.400				
<b>TOTALS</b>		<b>4,554.300</b>				

**Table 2. Project Activity and Reporting History  
Little Sebastian**

**Elapsed Time Since grading complete: 6 months**  
**Elapsed Time Since planting complete: 5 months**  
**Number of reporting Years<sup>1</sup>: 0**

<b>Activity or Deliverable</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Mitigation Plan	NA	Nov-18
Final Design – Construction Plans	NA	Sep-20
Stream Construction	NA	Feb-21
Site Planting	NA	Mar-21
As-built (Year 0 Monitoring – VP, XS, Hydro, Visual)	Mar-21	Oct-21
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

<sup>1</sup> = The number of reports or data points produced excluding the baseline

**Table 3. Project Contacts Table  
Little Sebastian**

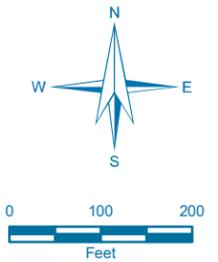
<b>Designer</b>	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Primary project design POC	Frasier Mullen, PE
<b>Construction Contractor</b>	KBS Earthwork Inc. / 5616 Coble Church Rd., Julian, NC 27283
Construction contractor POC	Kory Strader
<b>Survey Contractor</b>	Acension Land Surveying, PC / 116 Williams Road, Mocksville, NC 27028
Survey contractor POC	Chris Cole, PLS
<b>Planting Contractor</b>	Shenandoah Habitats
Planting contractor POC	David Coleman
<b>Monitoring Performers</b>	RES / 3600 Glenwood Ave, Suite 100, Raleigh, NC 27612
Monitoring POC	Ryan Medric (919) 741-6268

Table 4. Project Background Information						
Project Name		Little Sebastian				
County		Surry				
Project Area (acres)		25.91				
Project Coordinates (latitude and longitude)		36.40, -80.86				
Planted Acreage (Acres of Woody Stems Planted)		10.7				
Project Watershed Summary Information						
Physiographic Province		45e - Northern Inner Piedmont				
River Basin		Yadkin				
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	03040101080020			
DWR Sub-basin		03-04-01				
Project Drainage Area (Acres and Square Miles)		3,261 acres (5.1 sq mi)				
Project Drainage Area Percentage of Impervious Area		<1%				
Reach Summary Information						
Parameters		JN2-A	JN2-B	JN2-C	JN2-D	JN3-A
Length of reach (linear feet)		418	187	1114	189	350
Valley confinement (Confined, moderately confined, unconfined)		UC	MC	MC	MC	UC
Drainage area (Acres)		10	17	37	38	956
Perennial, Intermittent, Ephemeral		I	P	P	P	P
Parameters		JN3-B	MC1-A	MC1-B	MC1-C	MC3-A/B/C
Length of reach (linear feet)		1043	469	977	555	859
Valley confinement (Confined, moderately confined, unconfined)		C	UC	UC	UC	UC
Drainage area (Acres)		999	1862	1915	2921	3225
Perennial, Intermittent, Ephemeral		P	P	P	P	P
Parameters		MC3-D	BS1-A/C/E	BS1-B/D	JN7	
Length of reach (linear feet)		395	1029	352	37	
Valley confinement (Confined, moderately confined, unconfined)		UC	C	C	UC	
Drainage area (Acres)		3262	12-29	14-28	30	
Perennial, Intermittent, Ephemeral		P	I/P	P	I	



# **Appendix B**

## Visual Assessment Data



**Figure 2**

Current Conditions  
Plan View

MY0 2021

Little Sebastian  
Mitigation Site

Surry County, NC

Date: 10/7/2021

Drawn by: RTM

Lat: 35.937509

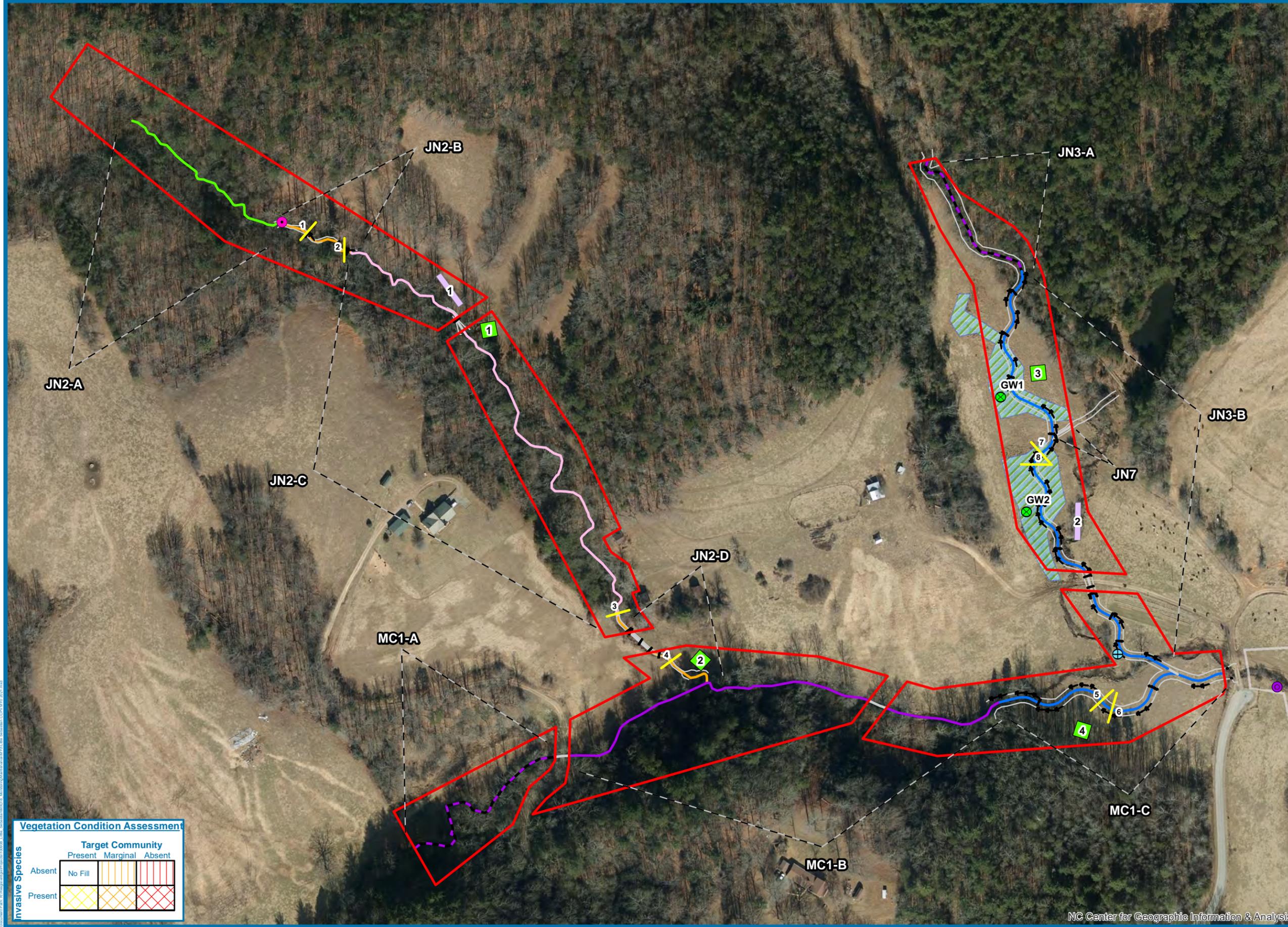
Long: -81.234876

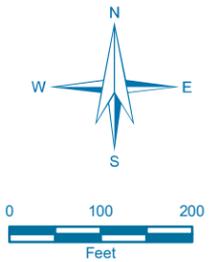
**LEGEND**

- ▬ Conservation Easement
- Gideon Bank Site
- Fixed Veg Plot
- Random Veg Plot
- Existing Wetland
- Structure
- Top of Bank
- Cross Section
- Stream Mitigation**
- Restoration
- Enhancement I
- Enhancement II
- Enhancement II (5:1)
- Enhancement II (7.5:1)
- Enhancement II (10:1)
- Preservation
- No Credit
- ⊗ Groundwater Well
- ⊕ Stage Recorder
- Flow Gauge
- Ambient

**Vegetation Condition Assessment**

Invasive Species	Target Community		
	Present	Marginal	Absent
Absent	No Fill		
Present			





**Figure 2**

Current Conditions  
Plan View

MY0 2021

Little Sebastian  
Mitigation Site

Surry County, NC

Date: 10/7/2021

Drawn by: RTM

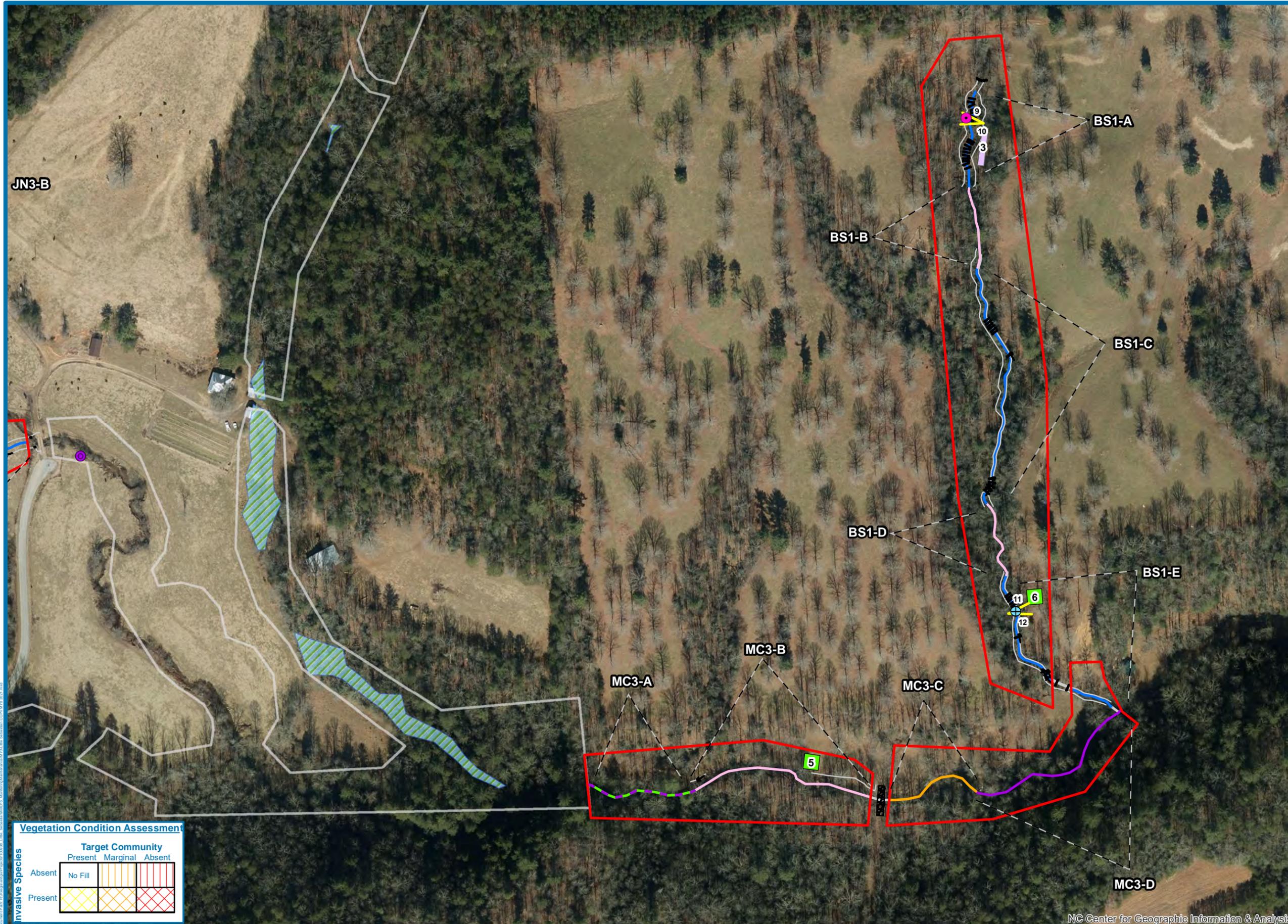
Lat: 35.937509

Long: -81.234876

**LEGEND**

- ▬ Conservation Easement
- Gideon Bank Site
- Fixed Veg Plot
- Random Veg Plot
- Existing Wetland
- Structure
- Top of Bank
- Cross Section
- Restoration
- Enhancement I
- Enhancement II
- Enhancement II (5:1)
- Enhancement II (7.5:1)
- Enhancement II (10:1)
- Preservation
- No Credit
- ⊗ Groundwater Well
- ⊕ Stage Recorder
- Flow Gauge
- Ambient

**Stream Mitigation**



**Vegetation Condition Assessment**

Invasive Species	Target Community		
	Present	Marginal	Absent
Absent	No Fill		
Present			

Visual Stream Stability Assessment

Reach JN3  
 Assessed Stream Length 1043  
 Assessed Bank Length 2086

Date Mar-21

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
<b>Totals</b>					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	10	10		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	18	18		100%

Visual Stream Stability Assessment

Reach MC1-C  
 Assessed Stream Length 555  
 Assessed Bank Length 1110

Date Mar-21

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
<b>Totals</b>					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	2	2		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	7	7		100%

Visual Stream Stability Assessment

Reach BS1  
 Assessed Stream Length 1123  
 Assessed Bank Length 2246

Date Mar-21

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
<b>Totals</b>					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	3	3		100%

**Table 6** **Vegetation Condition Assessment**

**Planted Acreage<sup>1</sup>**

**10.7**

**Date**

**Mar-21**

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

**Easement Acreage<sup>2</sup>**

**25.91**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
<b>4. Invasive Areas of Concern<sup>4</sup></b>	Areas or points (if too small to render as polygons at map scale).	1000 SF	Yellow Crosshatch	0	0.00	0.0%
<b>5. Easement Encroachment Areas<sup>3</sup></b>	Areas or points (if too small to render as polygons at map scale).	none	Red Simple Hatch	0	0.00	0.0%

**1** = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

**2** = The acreage within the easement boundaries.

**3** = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

**4** = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

**Little Sebastian MY0 Vegetation Monitoring Plot Photos**



**Vegetation Plot 1 (3/17/2021)**



**Vegetation Plot 2 (3/17/2021)**



**Vegetation Plot 3 (3/17/2021)**



**Vegetation Plot 4 (3/17/2021)**



Vegetation Plot 5 (3/17/2021)



Vegetation Plot 6 (Photo Unavailable)

**Little Sebastian Monitoring Device Photos**



Flow Gauge JN2-A



Stage Recorder JN3



Flow Gauge BS1-A



Stage Recorder BS1-E



Groundwater Well 1



Groundwater Well 2

**Little Sebastian Reach JN7**



# **Appendix C**

## Vegetation Plot Data

**Table 7. Planted Species Summary**

Common Name	Scientific Name	Mit Plan %	As-Built %	Total Stems Planted
Willow Oak	<i>Quercus phellos</i>	15	15	1,600
River Birch	<i>Betula nigra</i>	15	15	1,600
Sycamore	<i>Platanus occidentalis</i>	10	15	1,600
Water Oak	<i>Quercus nigra</i>	15	14	1,600
Northern Red Oak	<i>Quercus rubra</i>	10	11	1,200
Yellow Poplar	<i>Liriodendron tulipifera</i>	10	10	1,100
Green Ash	<i>Fraxinus pennsylvanica</i>	10	5	600
Persimmon	<i>Diospyros virginiana</i>	5	5	600
Buttonbush	<i>Cephalanthus occidentalis</i>	0	5	600
Sugarberry	<i>Celtis laevigata</i>	0	5	600
Elderberry	<i>Sambucus canadensis</i>	5	0	0
Nyssa sylvatica	<i>Blackgum</i>	5	0	0
<b>Total</b>				11,100
Planted Area				10.7
As-built Planted Stems/Acre				1,037

**Table 8. Vegetation Plot Mitigation Success Summary**

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Averaged Planted Stem Height (ft)
1	931	0	931	Yes	1.5
2	1335	0	1335	Yes	1.3
3	1133	0	1133	Yes	1.8
4	1214	0	1214	Yes	1.8
5	647	0	647	Yes	1.4
6	1052	0	1052	Yes	1.5
R1	1012	0	1012	Yes	1.5
R2	1133	0	1133	Yes	1.6
R3	1538	0	1538	Yes	1.4
<b>Project Avg</b>	<b>1111</b>	<b>0</b>	<b>1111</b>	<b>Yes</b>	<b>1.5</b>

**Table 9. Stem Count Total and Planted by Plot Species**

Little Sebastian			Current Plot Data (MYO 2021)																								Annual Means											
Scientific Name	Common Name	Species Type	100027-01-0001			100027-01-0002			100027-01-0003			100027-01-0004			100027-01-0005			100027-01-0006			100027-01-R1			100027-01-R2			100027-01-R3			MYO (2021)								
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T						
Betula nigra	river birch	Tree	6	6	6				4	4	4				1	1	1	2	2	2	1	1	1							1	1	1	2	2	2	18	18	18
Celtis laevigata	sugarberry	Tree										1	1	1	2	2	2	1	1	1													4	4	4			
Cephalanthus occidentalis	common buttonbush	Shrub	5	5	5	6	6	6				1	1	1	1	1	1				8	8	8	2	2	2	3	3	3	26	26	26	26	26	26			
Diospyros virginiana	common persimmon	Tree				2	2	2							3	3	3							1	1	1	1	1	1	7	7	7	7	7	7			
Fraxinus pennsylvanica	green ash	Tree				1	1	1							1	1	1	2	2	2				2	2	2	3	3	3	9	9	9	9	9	9			
Liriodendron tulipifera	tuliptree	Tree	3	3	3				1	1	1	2	2	2				1	1	1				1	1	1	3	3	3	11	11	11	11	11	11			
Platanus occidentalis	American sycamore	Tree	4	4	4	6	6	6	15	15	15	8	8	8	2	2	2	6	6	6	3	3	3	5	5	5	4	4	4	53	53	53	53	53	53			
Quercus nigra	water oak	Tree				4	4	4	2	2	2	3	3	3	2	2	2	2	2	2	5	5	5	4	4	4	7	7	7	29	29	29	29	29	29			
Quercus phellos	willow oak	Tree	1	1	1	8	8	8	4	4	4	14	14	14	3	3	3	2	2	2	7	7	7	5	5	5	9	9	9	53	53	53	53	53	53			
Quercus rubra	northern red oak	Tree	4	4	4	6	6	6	2	2	2	1	1	1	2	2	2	7	7	7	2	2	2	7	7	7	6	6	6	37	37	37	37	37	37			
<b>Stem count</b>			23	23	23	33	33	33	28	28	28	30	30	30	16	16	16	26	26	26	25	25	25	28	28	28	38	38	38	247	247	247	247	247	247			
<b>size (ares)</b>			1			1			1			1			1			1			1			1			9			9								
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.22			0.22								
<b>Species count</b>			6	6	6	7	7	7	6	6	6	7	7	7	8	8	8	8	8	8	5	5	5	9	9	9	9	9	9	10	10	10	10	10	10			
<b>Stems per ACRE</b>			931	931	931	1335	1335	1335	1133	1133	1133	1214	1214	1214	647	647	647	1052	1052	1052	1012	1012	1012	1133	1133	1133	1538	1538	1538	1111	1111	1111	1111	1111	1111			

# **Appendix D**

## Stream Measurement and Geomorphology Data

**Table 10. Baseline Stream Data Summary  
Little Sebastian Mitigation Site - Reach JN-3**

Parameter	Gauge <sup>2</sup>	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Med	Max	Min	Mean	Med	Max	SD <sup>b</sup>	n
<b>Dimension and Substrate - Riffle Only</b>																									
Bankfull Width (ft)		---	---	---	14.9	16.4	--	17.9	---	2	7.1	12.3	--	17.5	---	2	---	16.0	---	---	---	15.0	---	---	1
Floodprone Width (ft)					37.0	48.5	--	60.0	---	2	>30	51.3	--	72.5	---	2	---	>50	---	---	---	>64.4	---	---	1
Bankfull Mean Depth (ft)		---	---	---	1.6	1.7	--	1.6	---	2	1.0	1.3	--	1.6	---	2	---	2.2	---	---	---	---	---	---	---
<sup>1</sup> Bankfull Max Depth (ft)					2.1	3.0	--	3.9	---	2	1.2	1.9	--	2.6	---	2	---	2.9	---	---	---	2.2	---	---	1
Bankfull Cross Sectional Area (ft <sup>2</sup> )		---	---	---	26.1	27.3	--	28.5	---	2	6.7	17.2	--	27.7	---	2	---	26.9	---	---	---	22.8	---	---	1
Width/Depth Ratio					8.5	9.9	--	11.2	---	2	7.4	9.3	--	11.1	---	2	---	9.5	---	---	---	---	---	---	---
Entrenchment Ratio					2.5	3.0	--	3.4	---	2	>4	4.2	--	4.3	---	2	---	>2.2	---	---	---	>4.3	---	---	1
<sup>1</sup> Bank Height Ratio					1.0	1.2	--	1.3	---	2	1.0	1.2	--	1.3	---	2	---	1.0	---	---	---	1.0	---	---	1
<b>Profile</b>																									
Riffle Length (ft)					---	---	---	---	---	---	5.6	---	---	17	---	---	7	---	29	14	25	22	48	10	18
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.43	2.605	2.735	5.1	1.23176	18
Pool Length (ft)					---	---	---	---	---	---	4	---	---	16	---	---	4	---	18	19	35	34	55	10	17
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	26	---	---	68	---	---	29	---	75	38	59	59	78	11	15
<b>Pattern</b>																									
Channel Beltwidth (ft)					---	---	---	---	---	---	20	---	---	85	---	---	39	---	94	39	---	---	94	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	54	---	---	14	---	60	14	---	---	60	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	0.9	---	---	3.7	---	---	0.9	---	3.7	0.9	---	---	3.7	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	33	---	---	105	---	---	74	---	116	74	---	---	116	---	---
Meander Width Ratio					---	---	---	---	---	---	2.4	---	---	5.9	---	---	2.4	---	5.9	2.4	---	---	5.9	---	---
<b>Transport parameters</b>																									
Reach Shear Stress (competency) lb/ft <sup>2</sup>																									
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m <sup>2</sup>																									
<b>Additional Reach Parameters</b>																									
Rosgen Classification																									
Bankfull Velocity (fps)		---	---	---																					
Bankfull Discharge (cfs)		---	---	---																					
Valley length (ft)																									
Channel Thalweg length (ft)																									
Sinuosity (ft)																									
Water Surface Slope (Channel) (ft/ft)																									
Channel slope (ft/ft)																									
<sup>3</sup> Bankfull Floodplain Area (acres)																									
<sup>4</sup> % 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 10. Baseline Stream Data Summary  
Little Sebastian Mitigation Site - Reach MC1-C**

Parameter	Gauge <sup>2</sup>	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Med	Max	Min	Mean	Med	Max	SD <sup>b</sup>	n
<b>Dimension and Substrate - Riffle Only</b>																									
Bankfull Width (ft)		---	---	---	---	---	17.4	---	---	1	7.1	12.3	--	17.5	---	2	---	23.0	---	---	---	21.3	---	---	1
Floodprone Width (ft)					---	---	50.0	---	---	1	>30	51.3	--	72.5	---	2	---	>50	---	---	---	>64.9	---	---	1
Bankfull Mean Depth (ft)		---	---	---	---	---	1.8	---	---	1	1.0	1.3	--	1.6	---	2	---	2.4	---	---	---	---	---	---	---
<sup>1</sup> Bankfull Max Depth (ft)					---	---	2.9	---	---	1	1.2	1.9	--	2.6	---	2	---	3.2	---	---	---	3.2	---	---	1
Bankfull Cross Sectional Area (ft <sup>2</sup> )		---	---	---	---	---	30.6	---	---	1	6.7	17.2	--	27.7	---	2	---	54.4	---	---	---	49.8	---	---	1
Width/Depth Ratio					---	---	10.0	---	---	1	7.4	9.3	--	11.1	---	2	---	9.7	---	---	---	---	---	---	---
Entrenchment Ratio					---	---	2.9	---	---	1	>4	4.2	--	4.3	---	2	---	>2.2	---	---	---	>3	---	---	1
<sup>1</sup> Bank Height Ratio					---	---	1.0	---	---	1	1.0	1.2	--	1.3	---	2	---	1.0	---	---	---	1.0	---	---	1
<b>Profile</b>																									
Riffle Length (ft)					---	---	---	---	---	---	5.6	---	---	17	---	---	10	---	41	14	25	18	61	17	7
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.19	2.32	1.35	4.8	1.89753	7
Pool Length (ft)					---	---	---	---	---	---	4	---	---	16	---	---	6	---	25	36	51	48	73	12	6
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	26	---	---	68	---	---	41	---	108	65	81	73	109	19	5
<b>Pattern</b>																									
Channel Beltwidth (ft)					---	---	---	---	---	---	20	---	---	85	---	---	56	---	135	56	---	---	135	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	54	---	---	21	---	86	21	---	---	86	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	0.9	---	---	3.7	---	---	1	---	4	1	---	---	4	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	33	---	---	105	---	---	106	---	167	106	---	---	167	---	---
Meander Width Ratio					---	---	---	---	---	---	2.4	---	---	5.9	---	---	2	---	6	2	---	---	6	---	---
<b>Transport parameters</b>																									
Reach Shear Stress (competency) lb/ft <sup>2</sup>							---																		
Max part size (mm) mobilized at bankfull							---																		
Stream Power (transport capacity) W/m <sup>2</sup>							---																		
<b>Additional Reach Parameters</b>																									
Rosgen Classification							E3							E3/E4b					E3						E3
Bankfull Velocity (fps)		---	---	---			---							---					---						---
Bankfull Discharge (cfs)		---	---	---			---							---					---						---
Valley length (ft)							1109							160					478						478
Channel Thalweg length (ft)							1288							189					542						542
Sinuosity (ft)							1.16							1.195					1.13						1.13
Water Surface Slope (Channel) (ft/ft)							---							---					---						---
Channel slope (ft/ft)							0.008							1.85					0.0085						0.0085
<sup>3</sup> Bankfull Floodplain Area (acres)							---							---					---						---
<sup>4</sup> % 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 10. Baseline Stream Data Summary  
Little Sebastian Mitigation Site - Reach BS-1**

Parameter	Gauge <sup>2</sup>	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Mean	Med	Max	SD <sup>b</sup>	n	Min	Med	Max	Min	Mean	Med	Max	SD <sup>b</sup>	n
<b>Dimension and Substrate - Riffle Only</b>																									
Bankfull Width (ft)		---	---	---	---	---	3.2	---	---	1	7.1	12.3	--	17.5	---	2	---	4.5	---	5.7	6.0	---	6.3	---	2
Floodprone Width (ft)					---	---	60.0	---	---	1	>30	51.3	--	72.5	---	2	---	---	---	11.3	17.6	---	23.8	---	2
Bankfull Mean Depth (ft)		---	---	---	---	---	1.6	---	---	1	1.0	1.3	--	1.6	---	2	---	0.6	---	---	---	---	---	---	---
<sup>1</sup> Bankfull Max Depth (ft)					---	---	3.9	---	---	1	1.2	1.9	--	2.6	---	2	---	0.7	---	0.7	0.9	---	1.1	---	2
Bankfull Cross Sectional Area (ft <sup>2</sup> )		---	---	---	---	---	2.4	---	---	1	6.7	17.2	--	27.7	---	2	---	2.7	---	2.6	3.3	---	4.0	---	2
Width/Depth Ratio					---	---	4.2	---	---	1	7.4	9.3	--	11.1	---	2	---	7.4	---	---	---	---	---	---	---
Entrenchment Ratio					---	---	3.4	---	---	1	>4	4.2	--	4.3	---	2	---	>1.4	---	2.0	2.9	---	3.8	---	2
<sup>1</sup> Bank Height Ratio					---	---	1.0	---	---	1	1.0	1.2	--	1.3	---	2	---	1.0	---	1.0	1.0	---	1.0	---	2
<b>Profile</b>																									
Riffle Length (ft)					---	---	---	---	---	---	5.6	---	---	17	---	---	4.0	---	11	4	16	16	32	8	19
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.1	5.9	5.0	14.5	3.7	19
Pool Length (ft)					---	---	---	---	---	---	4	---	---	16	---	---	2.0	---	7	11	18	15	43	8	17
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	26	---	---	68	---	---	5.0	---	20	21	34	33	63	10	17
<b>Pattern</b>																									
Channel Beltwidth (ft)					---	---	---	---	---	---	20	---	---	85	---	---	13.0	---	19.0	13.0	---	---	19.0	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	7	---	---	54	---	---	4.0	---	10.0	4.0	---	---	10.0	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	0.9	---	---	3.7	---	---	1.0	---	2.0	1.0	---	---	2.0	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	33	---	---	105	---	---	21.0	---	32.0	21.0	---	---	32.0	---	---
Meander Width Ratio					---	---	---	---	---	---	2.4	---	---	5.9	---	---	3.0	---	4.0	3.0	---	---	4.0	---	---
<b>Transport parameters</b>																									
Reach Shear Stress (competency) lb/ft <sup>2</sup>							---												---						
Max part size (mm) mobilized at bankfull							---												---						
Stream Power (transport capacity) W/m <sup>2</sup>							---												---						
<b>Additional Reach Parameters</b>																									
Rosgen Classification							B4a												B4/E4						
Bankfull Velocity (fps)		---	---	---			---												---						
Bankfull Discharge (cfs)		---	---	---			---												---						
Valley length (ft)							1508																		
Channel Thalweg length (ft)							1703																		
Sinuosity (ft)							1.13																		
Water Surface Slope (Channel) (ft/ft)							---												---						
Channel slope (ft/ft)							0.049																		
<sup>3</sup> Bankfull Floodplain Area (acres)							---												---						
<sup>4</sup> % 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

**Appendix D. Table 11 - Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)**

**Project Name/Number: Little Sebastian #10027**

	Cross Section 1 (Riffle)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Riffle)							Cross Section 5 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1214.7							1211.2							1170.7							1165.0							1150.6						
Bankfull Width (ft) <sup>1</sup>	5.4							5.4							5.3							9.0							21.3						
Floodprone Width (ft) <sup>1</sup>	13.1							8.7							>34.8							>43.9							>64.9						
Bankfull Max Depth (ft) <sup>2</sup>	0.7							0.5							1.0							0.9							3.2						
Low Bank Elevation (ft)	1214.74							1211.2							1170.7							1165.0							1150.6						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	2.4							2.3							3.5							3.5							49.8						
Bankfull Entrenchment Ratio <sup>1</sup>	2.4							1.6							>6.6							>4.9							>3.0						
Bankfull Bank Height Ratio <sup>1</sup>	1.0							1.0							1.0							1.0							1.0						
	Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section 8 (Pool)							Cross Section 9 (Pool)							Cross Section 10 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1150.5							1157.4							1157.2							1188.3							1187.6						
Bankfull Width (ft) <sup>1</sup>	-							15.0							-							-							6.3						
Floodprone Width (ft) <sup>1</sup>	-							>64.4							-							-							23.8						
Bankfull Max Depth (ft) <sup>2</sup>	4.1							2.2							3.6							1.0							1.1						
Low Bank Elevation (ft)	-							1157.4							-							-							1187.6						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	56.7							22.8							34.8							3.6							4.0						
Bankfull Entrenchment Ratio <sup>1</sup>	-							>4.3							-							-							3.8						
Bankfull Bank Height Ratio <sup>1</sup>	-							1.0							-							-							1.0						
	Cross Section 11 (Riffle)							Cross Section 12 (Pool)																											
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+																					
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1136.4							1136.1																											
Bankfull Width (ft) <sup>1</sup>	5.7							-																											
Floodprone Width (ft) <sup>1</sup>	11.3							-																											
Bankfull Max Depth (ft) <sup>2</sup>	0.7							1.2																											
Low Bank Elevation (ft)	1136.4							-																											
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	2.6							4.6																											
Bankfull Entrenchment Ratio <sup>1</sup>	2.0							-																											
Bankfull Bank Height Ratio <sup>1</sup>	1.0							-																											

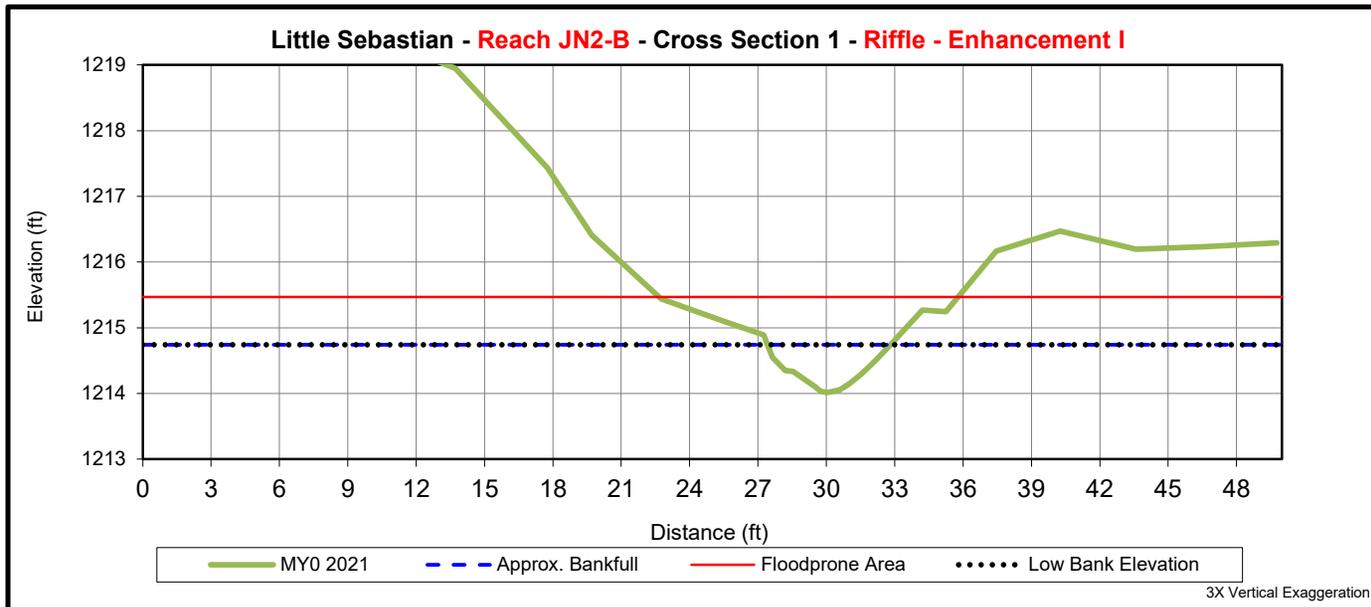
1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation  
 2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 1 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1214.7						
Bankfull Width (ft) <sup>1</sup>	5.4						
Floodprone Width (ft) <sup>1</sup>	13.1						
Bankfull Max Depth (ft) <sup>2</sup>	0.7						
Low Bank Elevation (ft)	1214.74						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	2.4						
Bankfull Entrenchment Ratio <sup>1</sup>	2.4						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

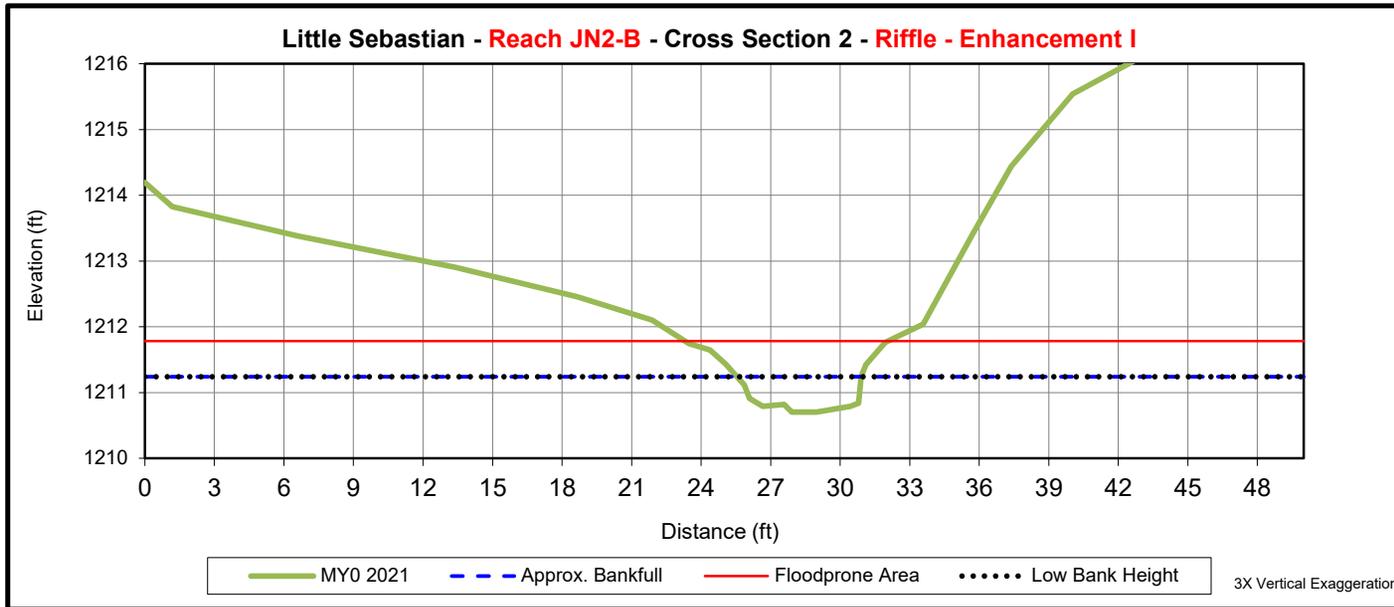
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 2 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1211.2						
Bankfull Width (ft) <sup>1</sup>	5.4						
Floodprone Width (ft) <sup>1</sup>	8.7						
Bankfull Max Depth (ft) <sup>2</sup>	0.5						
Low Bank Elevation (ft)	1211.2						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	2.3						
Bankfull Entrenchment Ratio <sup>1</sup>	1.6						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

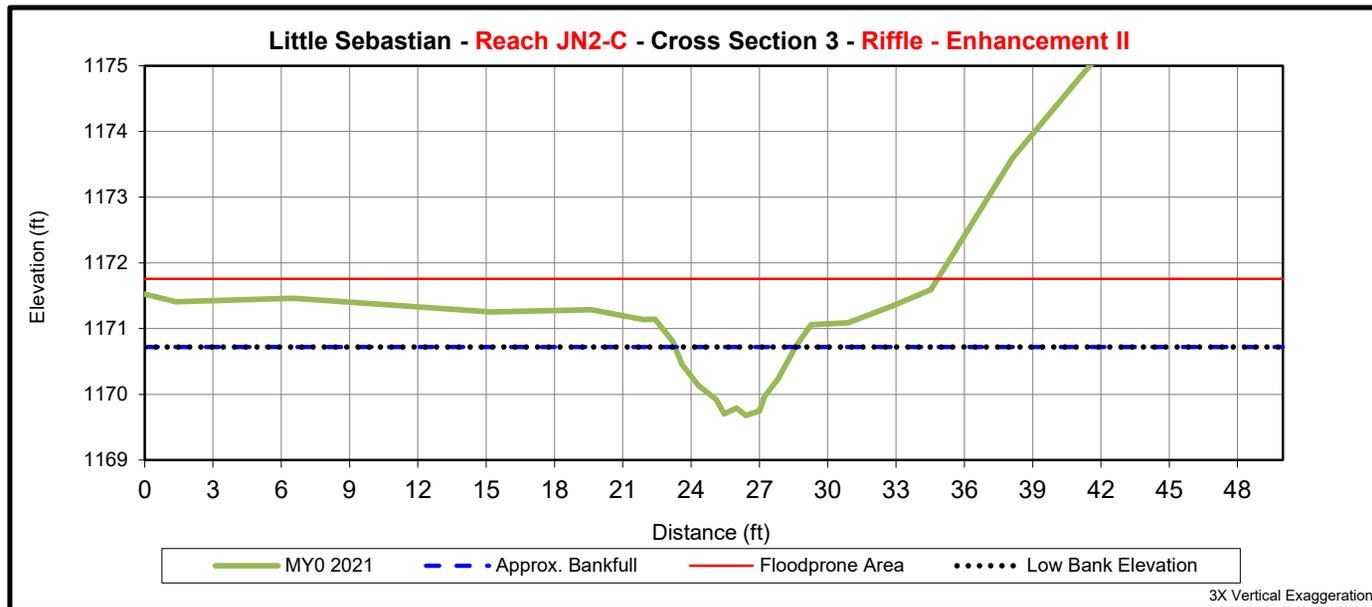
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 3 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1170.7						
Bankfull Width (ft) <sup>1</sup>	5.3						
Floodprone Width (ft) <sup>1</sup>	>34.8						
Bankfull Max Depth (ft) <sup>2</sup>	1.0						
Low Bank Elevation (ft)	1170.7						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	3.5						
Bankfull Entrenchment Ratio <sup>1</sup>	>6.6						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

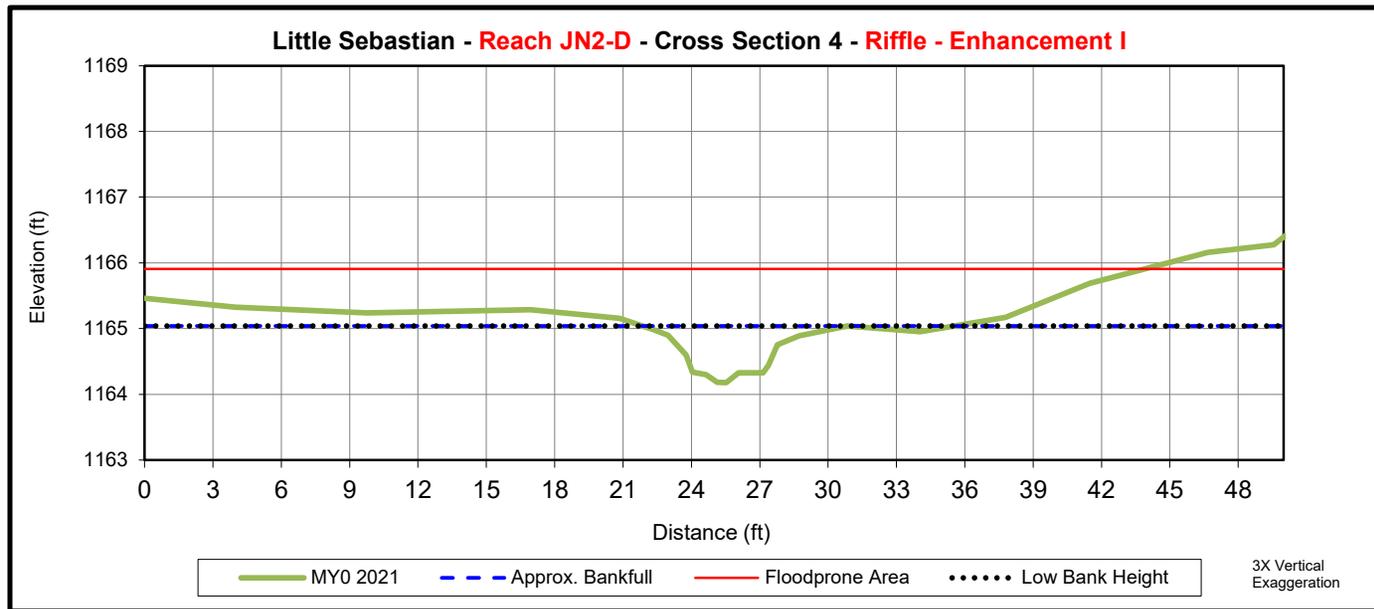
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 4 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1165.0						
Bankfull Width (ft) <sup>1</sup>	9.0						
Floodprone Width (ft) <sup>1</sup>	>43.9						
Bankfull Max Depth (ft) <sup>2</sup>	0.9						
Low Bank Elevation (ft)	1165.0						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	3.5						
Bankfull Entrenchment Ratio <sup>1</sup>	>4.9						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

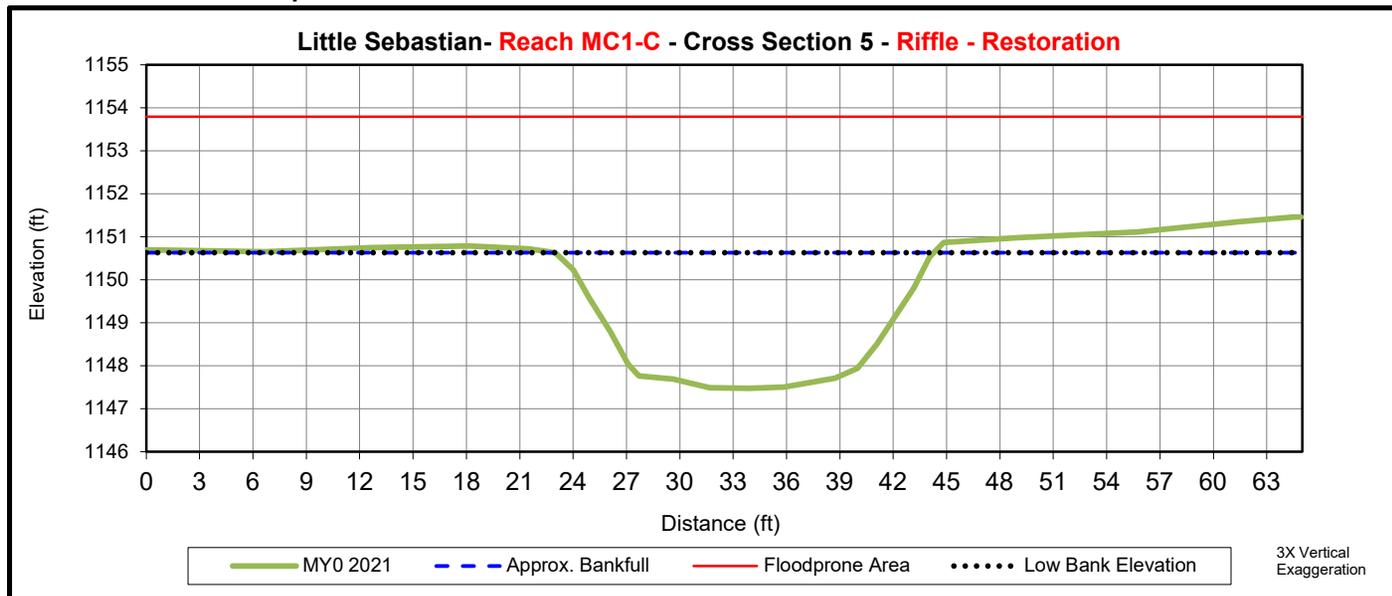
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	<b>Cross Section 5 (Riffle)</b>						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1150.6						
Bankfull Width (ft) <sup>1</sup>	21.3						
Floodprone Width (ft) <sup>1</sup>	>64.9						
Bankfull Max Depth (ft) <sup>2</sup>	3.2						
Low Bank Elevation (ft)	1150.6						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	49.8						
Bankfull Entrenchment Ratio <sup>1</sup>	>3.0						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

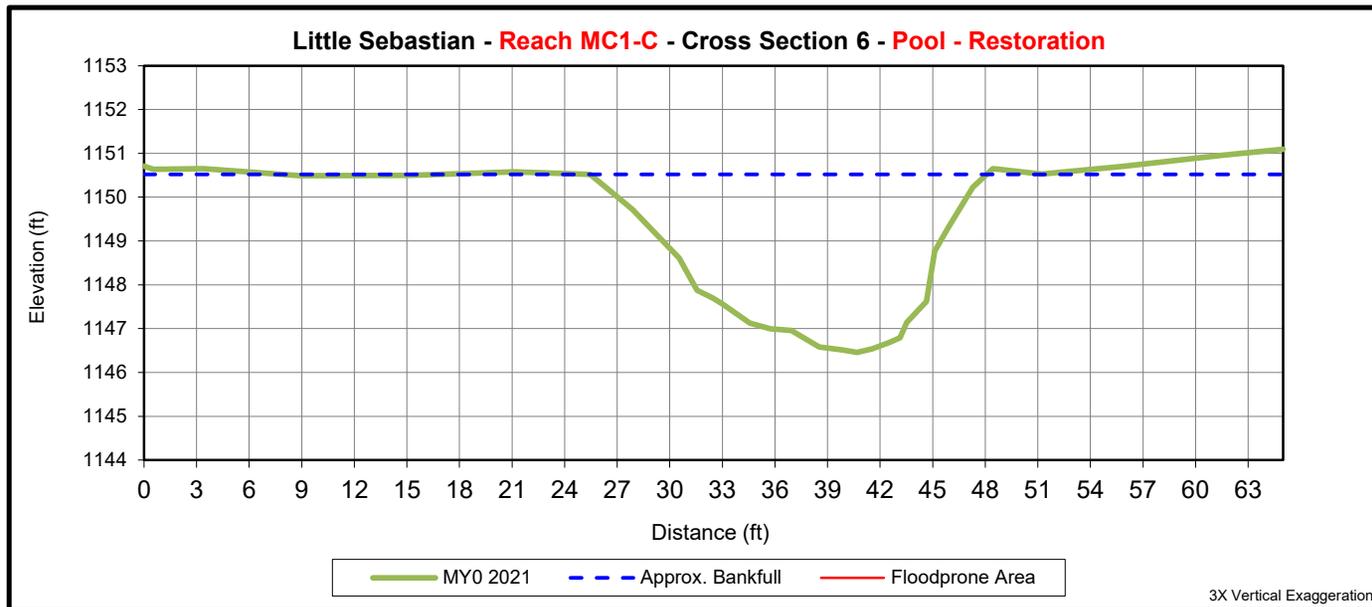
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	<b>Cross Section 6 (Pool)</b>						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1150.5						
Bankfull Width (ft) <sup>1</sup>	-						
Floodprone Width (ft) <sup>1</sup>	-						
Bankfull Max Depth (ft) <sup>2</sup>	4.1						
Low Bank Elevation (ft)	-						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	56.7						
Bankfull Entrenchment Ratio <sup>1</sup>	-						
Bankfull Bank Height Ratio <sup>1</sup>	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

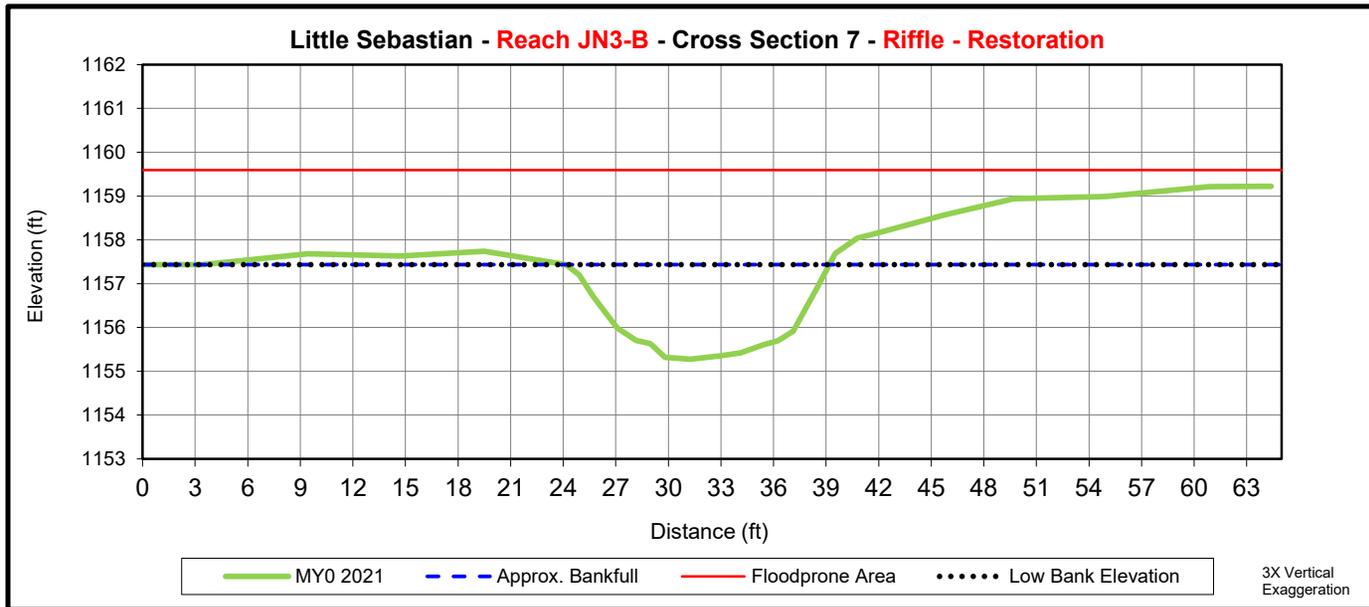
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	<b>Cross Section 7 (Riffle)</b>						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1157.4						
Bankfull Width (ft) <sup>1</sup>	15.0						
Floodprone Width (ft) <sup>1</sup>	>64.4						
Bankfull Max Depth (ft) <sup>2</sup>	2.2						
Low Bank Elevation (ft)	1157.4						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	22.8						
Bankfull Entrenchment Ratio <sup>1</sup>	>4.3						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

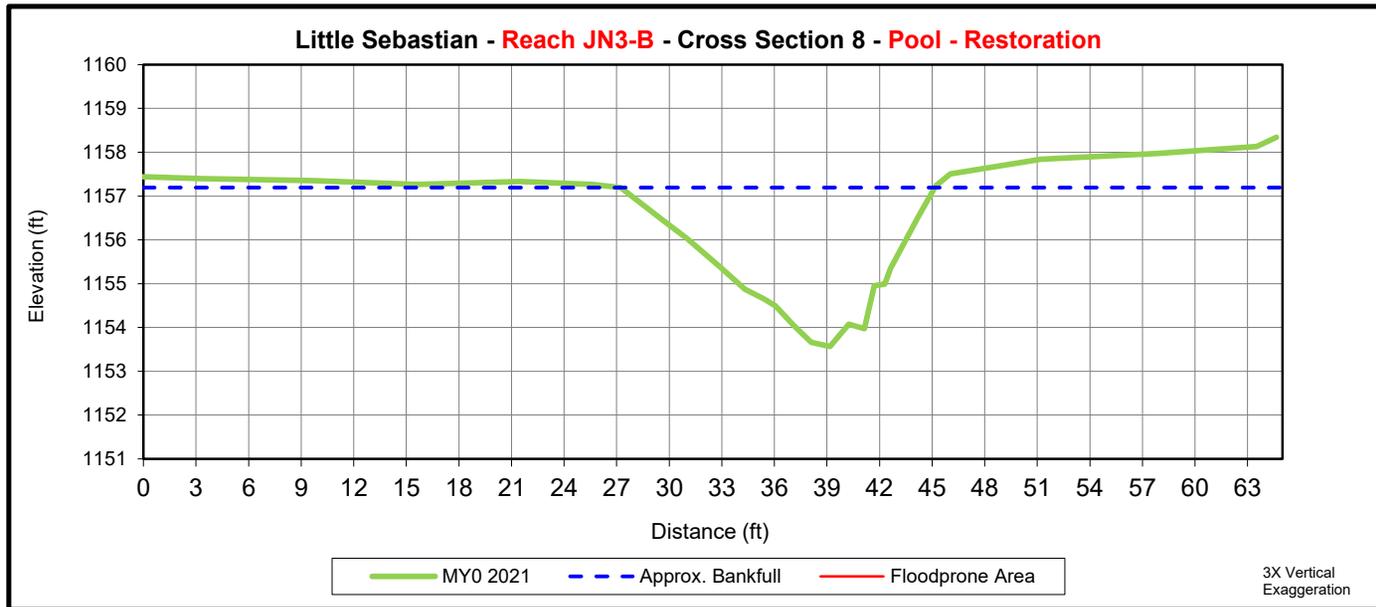
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	<b>Cross Section 8 (Pool)</b>						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1157.2						
Bankfull Width (ft) <sup>1</sup>	-						
Floodprone Width (ft) <sup>1</sup>	-						
Bankfull Max Depth (ft) <sup>2</sup>	3.6						
Low Bank Elevation (ft)	-						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	34.8						
Bankfull Entrenchment Ratio <sup>1</sup>	-						
Bankfull Bank Height Ratio <sup>1</sup>	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

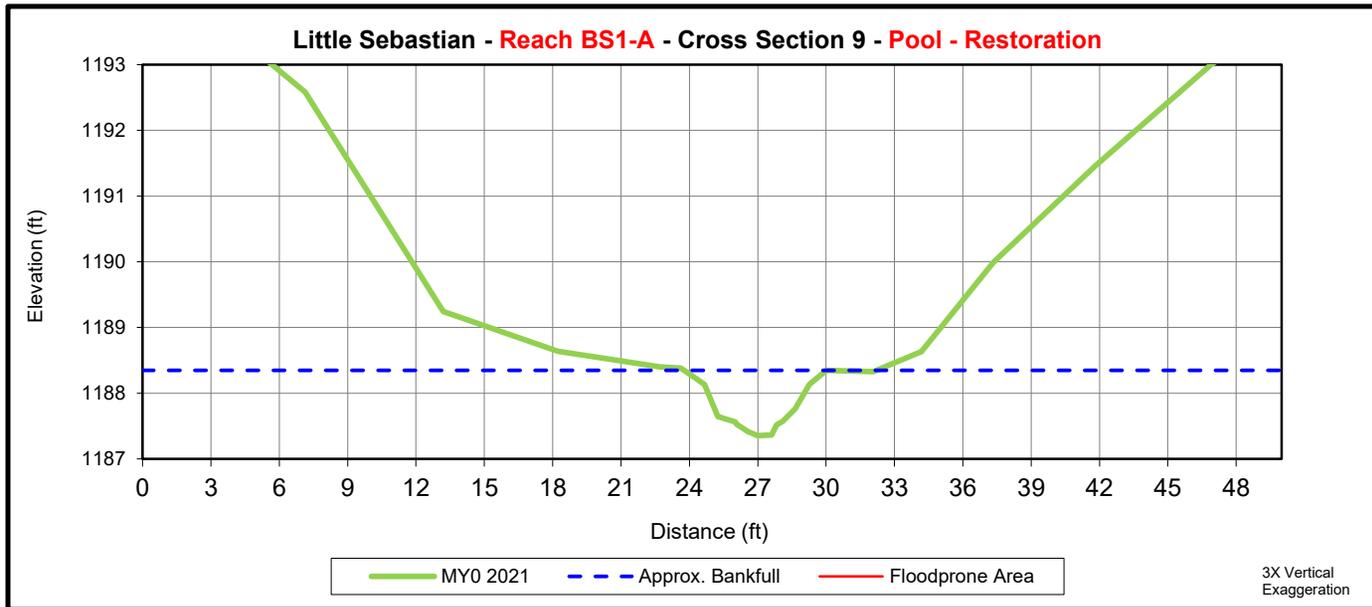
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	<b>Cross Section 9 (Pool)</b>						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1188.3						
Bankfull Width (ft) <sup>1</sup>	-						
Floodprone Width (ft) <sup>1</sup>	-						
Bankfull Max Depth (ft) <sup>2</sup>	1.0						
Low Bank Elevation (ft)	-						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	3.6						
Bankfull Entrenchment Ratio <sup>1</sup>	-						
Bankfull Bank Height Ratio <sup>1</sup>	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

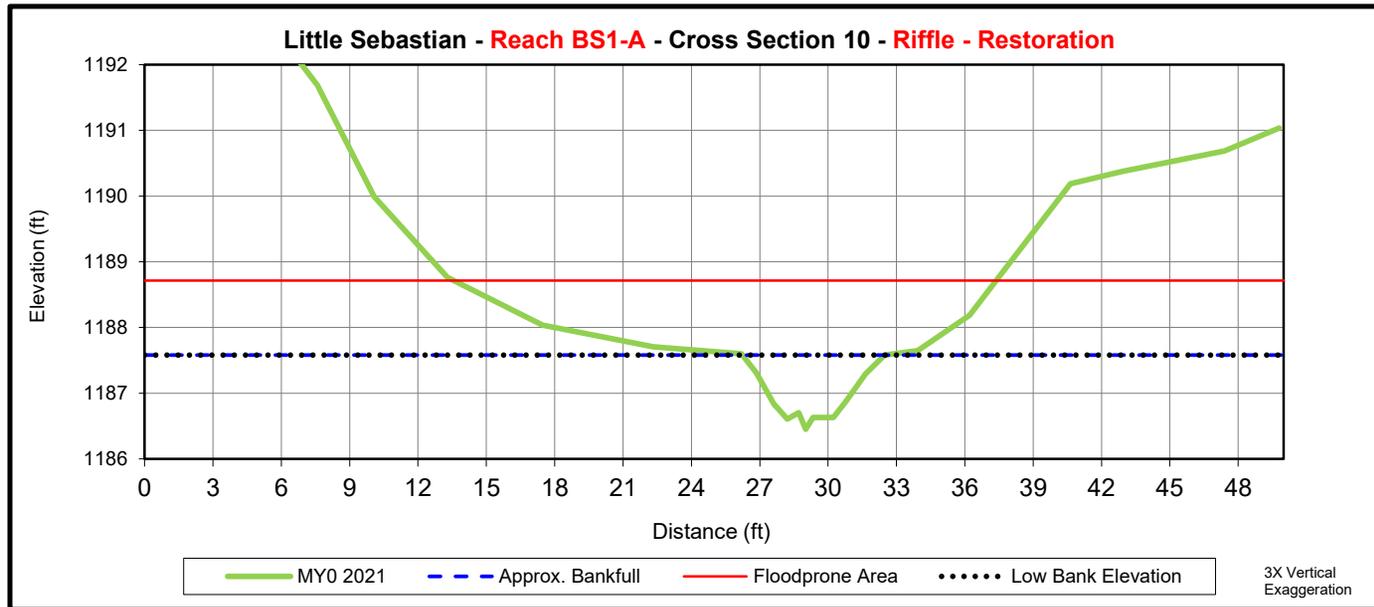
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 10 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1187.6						
Bankfull Width (ft) <sup>1</sup>	6.3						
Floodprone Width (ft) <sup>1</sup>	23.8						
Bankfull Max Depth (ft) <sup>2</sup>	1.1						
Low Bank Elevation (ft)	1187.6						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	4.0						
Bankfull Entrenchment Ratio <sup>1</sup>	3.8						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

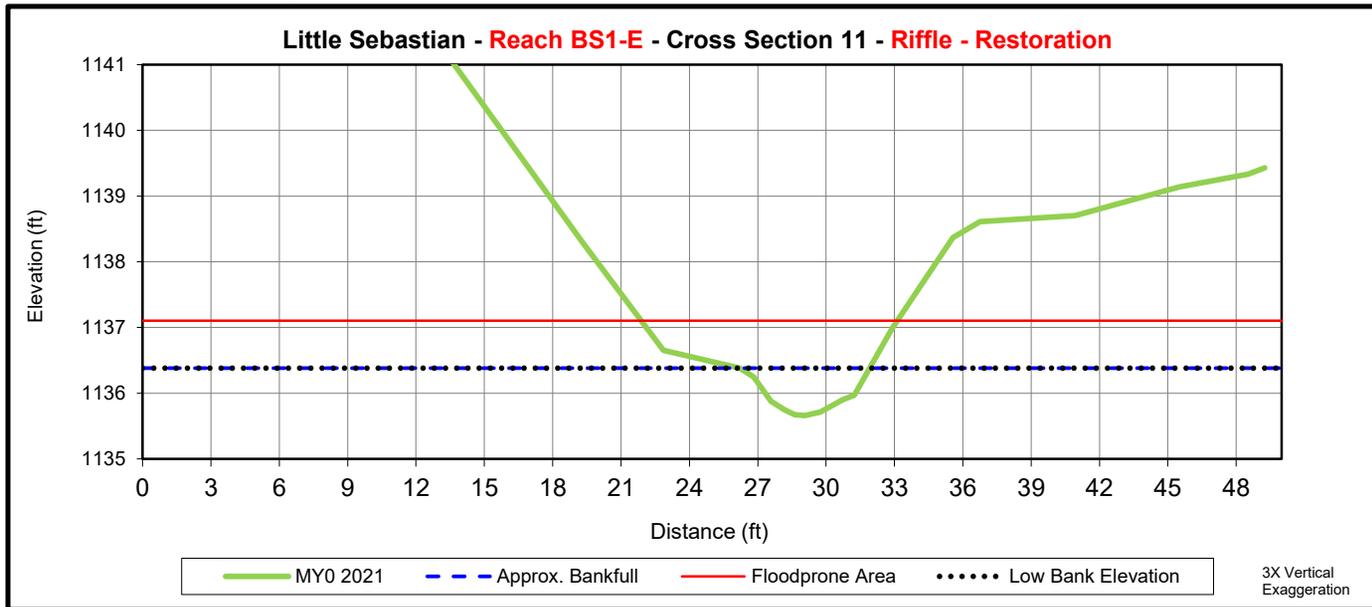
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream



	Cross Section 11 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1136.4						
Bankfull Width (ft) <sup>1</sup>	5.7						
Floodprone Width (ft) <sup>1</sup>	11.3						
Bankfull Max Depth (ft) <sup>2</sup>	0.7						
Low Bank Elevation (ft)	1136.4						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	2.6						
Bankfull Entrenchment Ratio <sup>1</sup>	2.0						
Bankfull Bank Height Ratio <sup>1</sup>	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

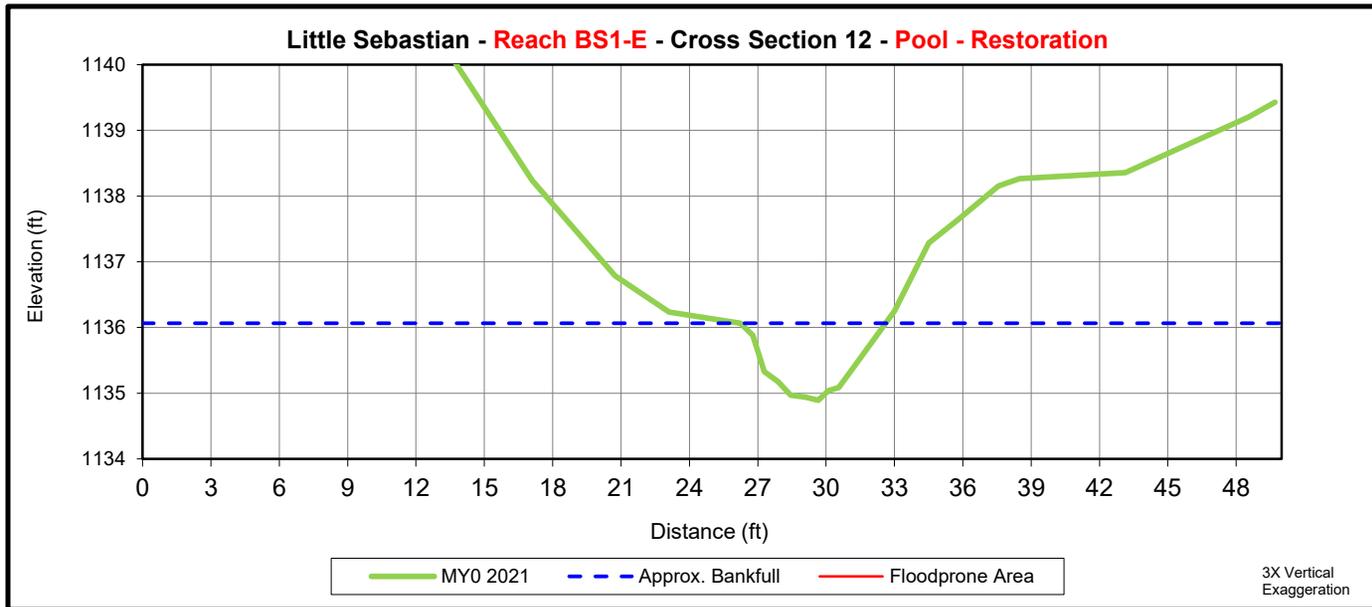
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation



Upstream



Downstream

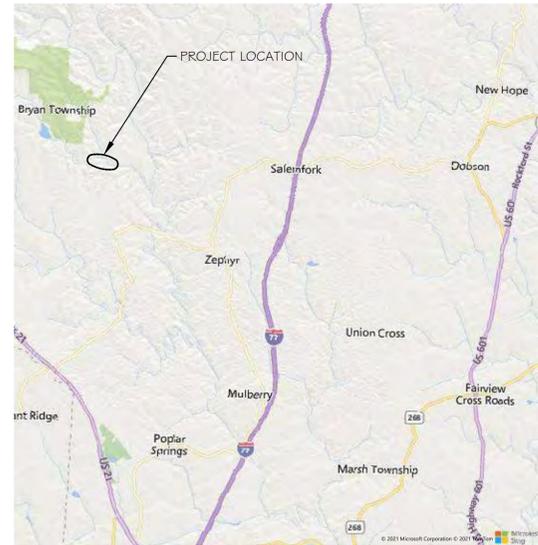


	Cross Section 12 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Bankfull Elevation (ft) - Based on AB-XSA<sup>1</sup></b>	1136.1						
Bankfull Width (ft) <sup>1</sup>	-						
Floodprone Width (ft) <sup>1</sup>	-						
Bankfull Max Depth (ft) <sup>2</sup>	1.2						
Low Bank Elevation (ft)	-						
Bankfull Cross Sectional Area (ft <sup>2</sup> ) <sup>2</sup>	4.6						
Bankfull Entrenchment Ratio <sup>1</sup>	-						
Bankfull Bank Height Ratio <sup>1</sup>	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

**Appendix E**  
Record Drawings



VICINITY MAP  
NTS

# LITTLE SEBASTIAN SITE RECORD DRAWINGS

PROJECT LOCATION: (36.396724, -80.858382)  
SURRY COUNTY, NORTH CAROLINA

YADKIN RIVER BASIN: HUC 03040101080020  
AUGUST 2021

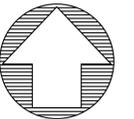
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC  
3600 GLENWOOD AVE, SUITE 100  
RALEIGH, NC 27612



3600 Glenwood Ave, Suite 100  
Raleigh, NC 27612  
Main: 919.829.9909  
www.res.us

Engineering Services Provided By:  
RES Environmental Operating Company, LLC  
License: F-1428

SEAL



PLOT DATE:  
8/16/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS

## PROJECT DIRECTORY

DESIGNED BY:  
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC  
3600 GLENWOOD AVE, STE 100  
RALEIGH, NC 27612

DESIGNED FOR:  
NC DEPARTMENT OF ENVIRONMENTAL QUALITY  
DIVISION OF MITIGATION SERVICES  
5 RAVENSCROFT DR., #102  
ASHEVILLE, NC 28801

SURVEYED BY:  
ASCENSION LAND SURVEYING, PC  
116 WILLIAMS ROAD  
MOCKSVILLE, NC 27028

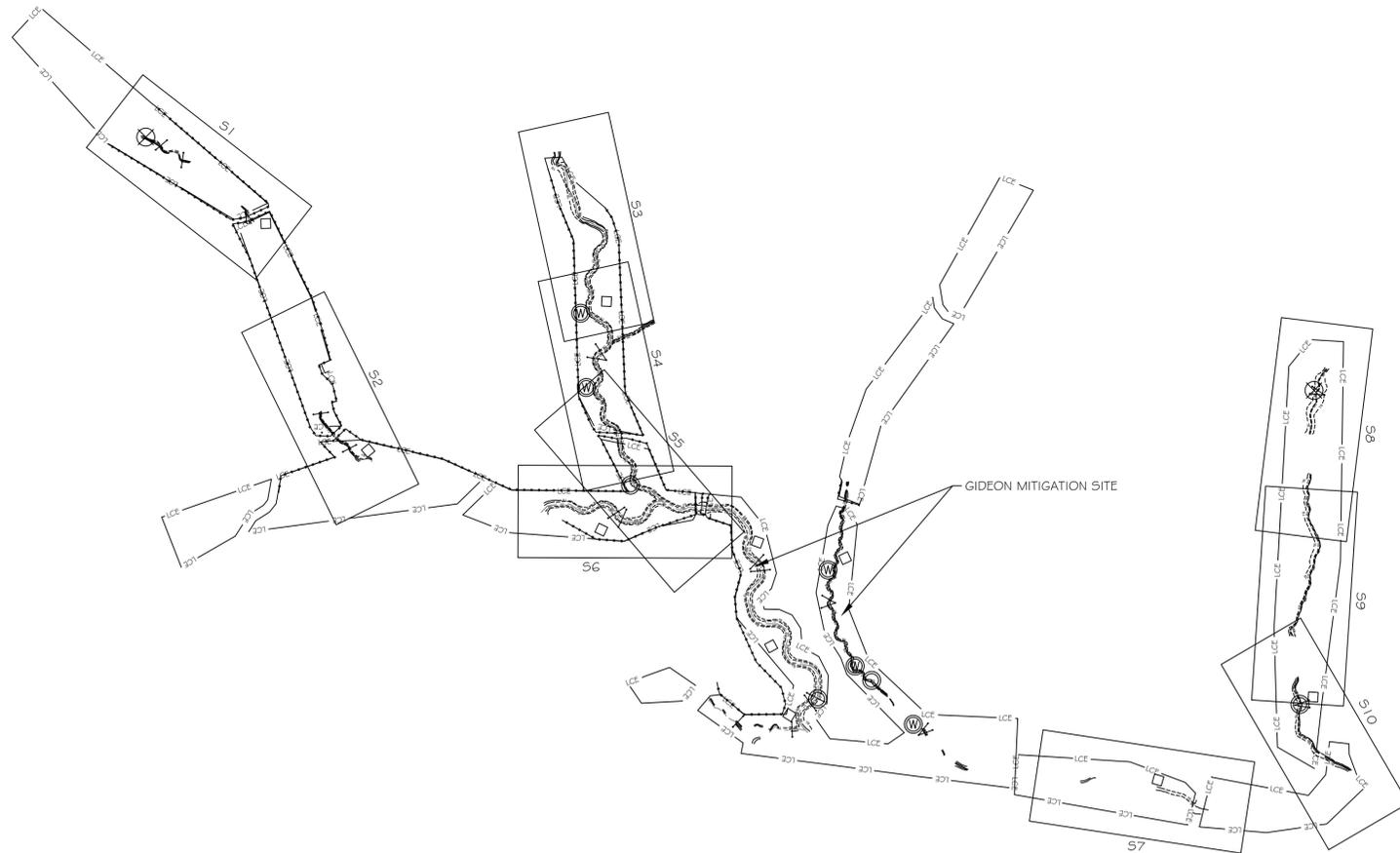
CONSTRUCTION CONTRACTOR:  
KBS EARTHWORKS, INC.  
5616 COBLE CHURCH RD.  
JULIAN, NC 27283

MONITORING:  
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC  
3600 GLENWOOD AVE, STE 100  
RALEIGH, NC 27612

PROJECT TOPOGRAPHY AND AS-BUILT  
CONDITIONS PLANIMETRICS SURVEY WAS  
PROVIDED BY ASCENSION LAND SURVEYING, PC  
(NC FIRM LICENSE NUMBER C-4288,  
CHRISTOPHER L. COLE, NC PLS L-5008)

### LITTLE SEBASTIAN MITIGATION SITE

DMS PROJECT #: 100027  
CONTRACT #: 7187  
USACE ACTION ID #: SAW-2017-01507  
RFP #: 16-006993



SITE MAP  
NTS

## Sheet List Table

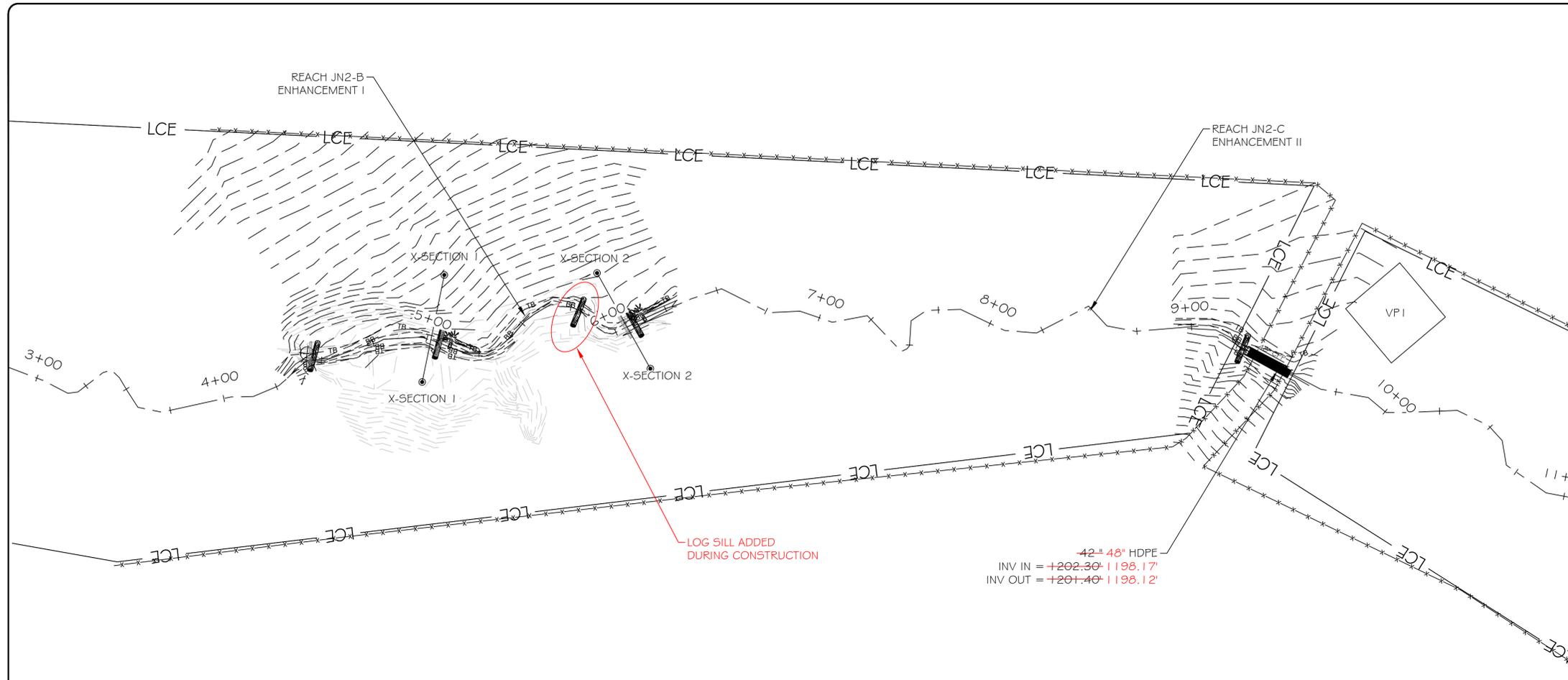
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S2	REACH JN2D
S3	REACH JN3
S4	REACH JN3 & JN7
S5	REACH JN3 & JN7
S6	REACH MC1
S7	REACH MC3
S8	REACH BS1
S9	REACH BS1
S10	REACH BS1

PROJECT NUMBER: ---  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

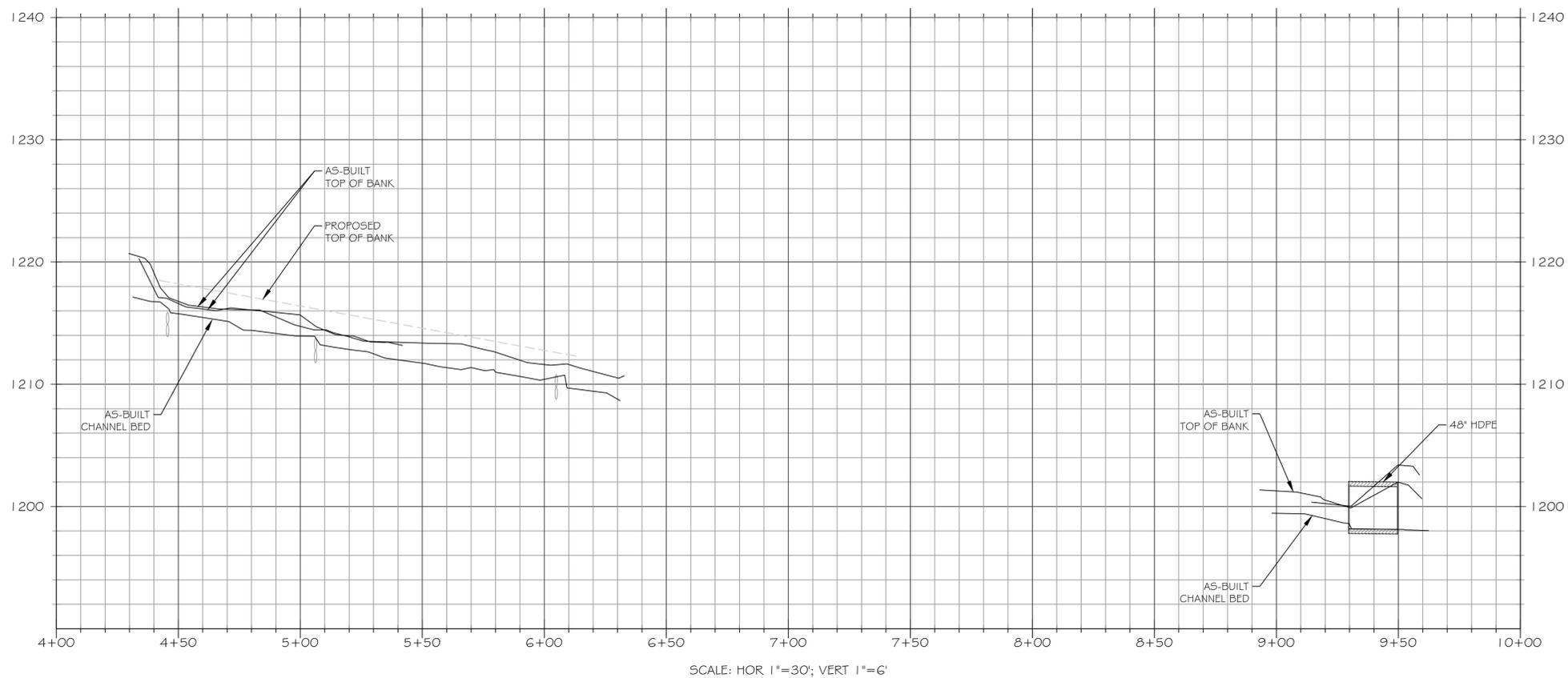
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 INV OUT = +201.40' 1198.12'



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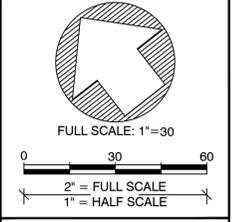
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- AS-BUILT CONTOUR MAJOR ——— 50 ———
- AS-BUILT CONTOUR MINOR ——— 46 ———
- OVERHEAD ELECTRIC UTILITY LINE ——— ⊗ ———
- PROPERTY LINE ——— - - - - -
- FENCELINE ——— x x x x x ———
- AS-BUILT FENCELINE ——— x x x x x ———
- TREELINE ——— ~~~~~
- LIMITS OF RECORDED CONSERVATION EASEMENT ——— LCE ———
- PROPOSED BRUSH TOE PROTECTION
- PROPOSED LOG STRUCTURE
- PROPOSED ROCK STRUCTURE
- PROPOSED CONSTRUCTED RIFFLE
- PROPOSED LOG STRUCTURE (PROFILE)
- PROPOSED ROCK STRUCTURE (PROFILE)
- AS-BUILT BRUSH TOE PROTECTION
- AS-BUILT LOG STRUCTURE
- AS-BUILT ROCK STRUCTURE
- GROUNDWATER MONITORING WELL
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT

NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED



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PLOT DATE:  
8/16/2021

REVISIONS:

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RECORD DRAWINGS

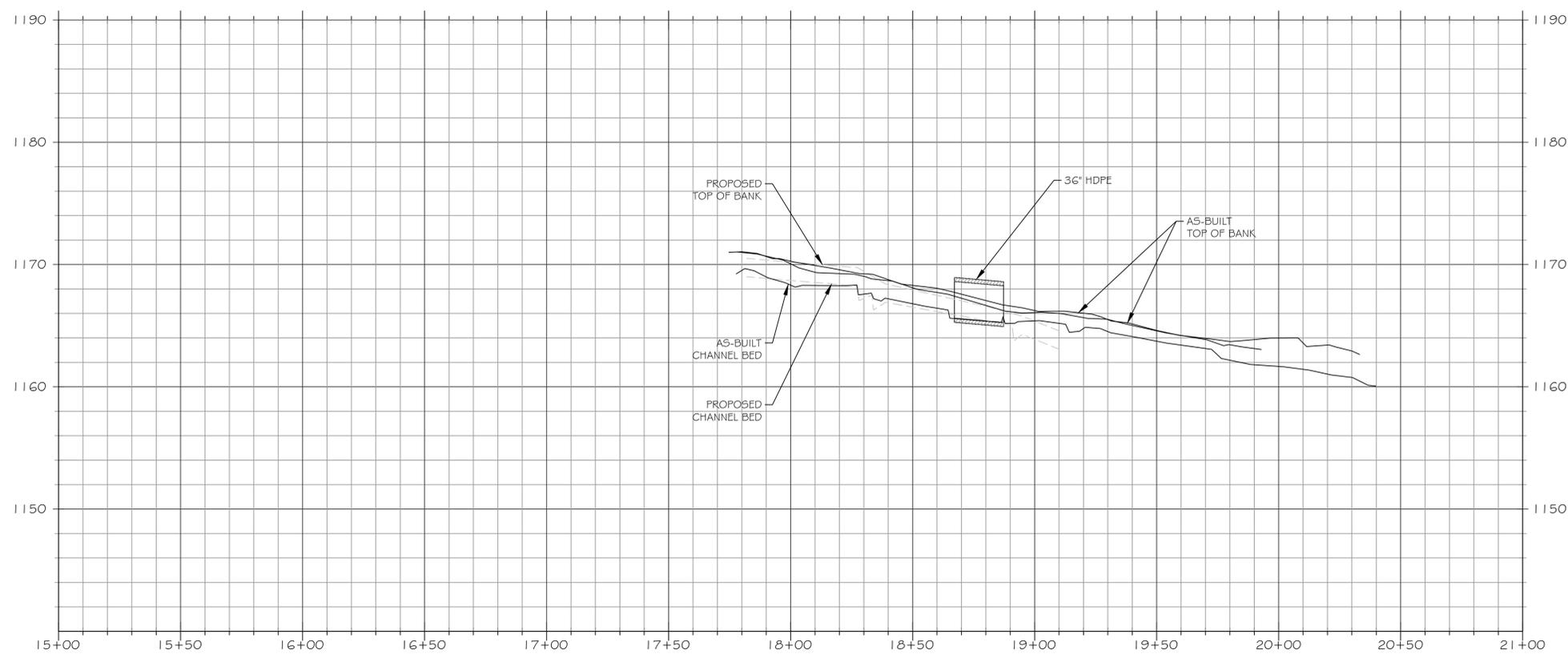
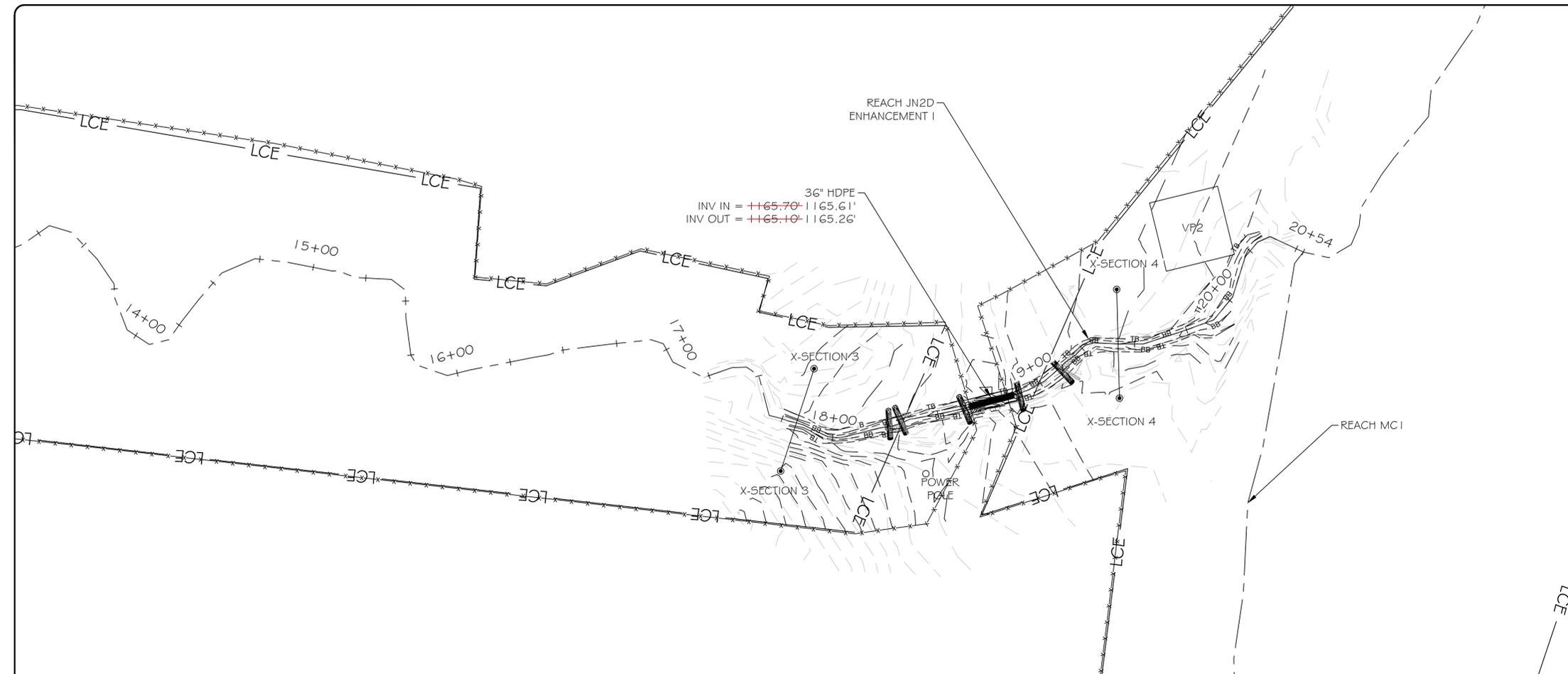
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SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
REACH JN2B

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 PROJECT MANAGER: BPB  
 DESIGNED: AFM  
 DRAWN: TRS  
 CHECKED: RTM

SHEET NUMBER:  
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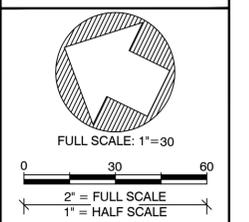
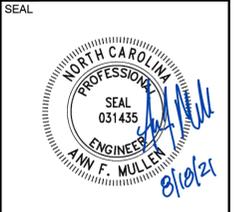
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OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	— x — x — x — x — x —
AS-BUILT FENCELINE	— x — x — x — x — x —
TREELINE	— — — — —
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
GROUNDWATER MONITORING WELL	
STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

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PLOT DATE:  
8/16/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS

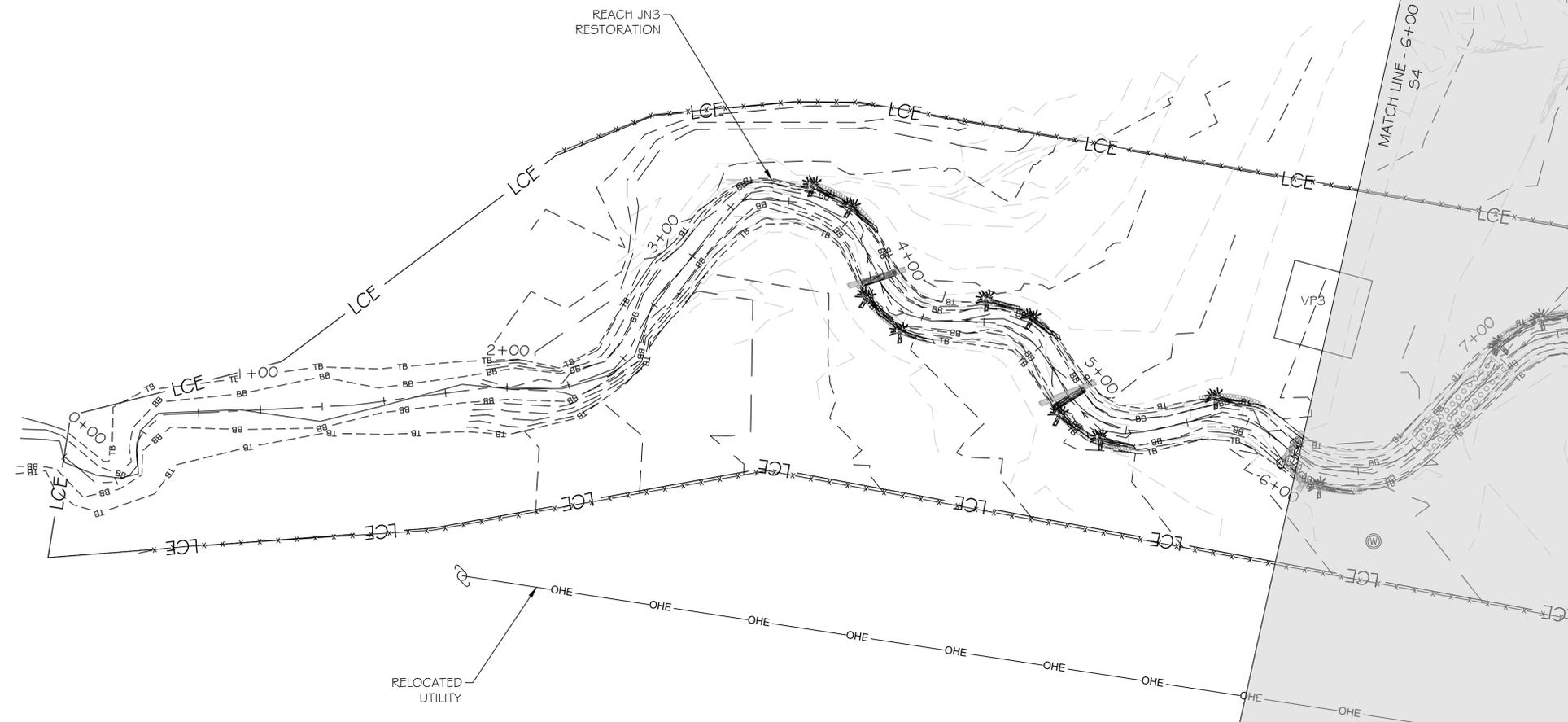
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SURRY COUNTY, NORTH CAROLINA

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PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

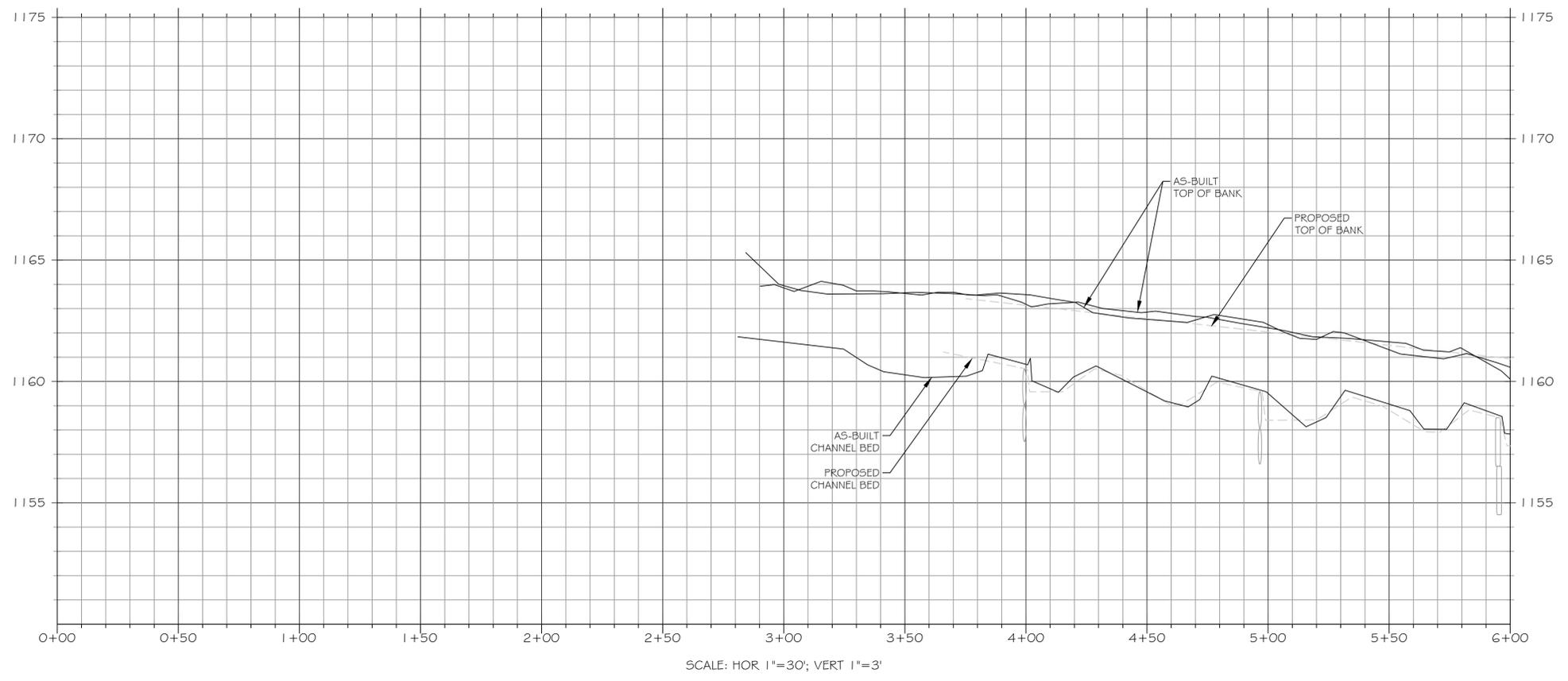
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**LEGEND**

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AS-BUILT CONTOUR MAJOR	— 50 —
AS-BUILT CONTOUR MINOR	- - - 46 - - -
OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	— x — x — x — x —
AS-BUILT FENCELINE	— x — x — x — x —
TREELINE	— — — — —
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
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STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

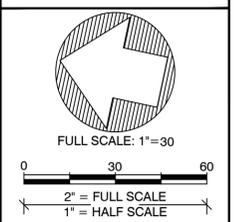
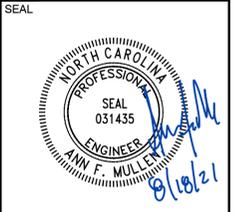


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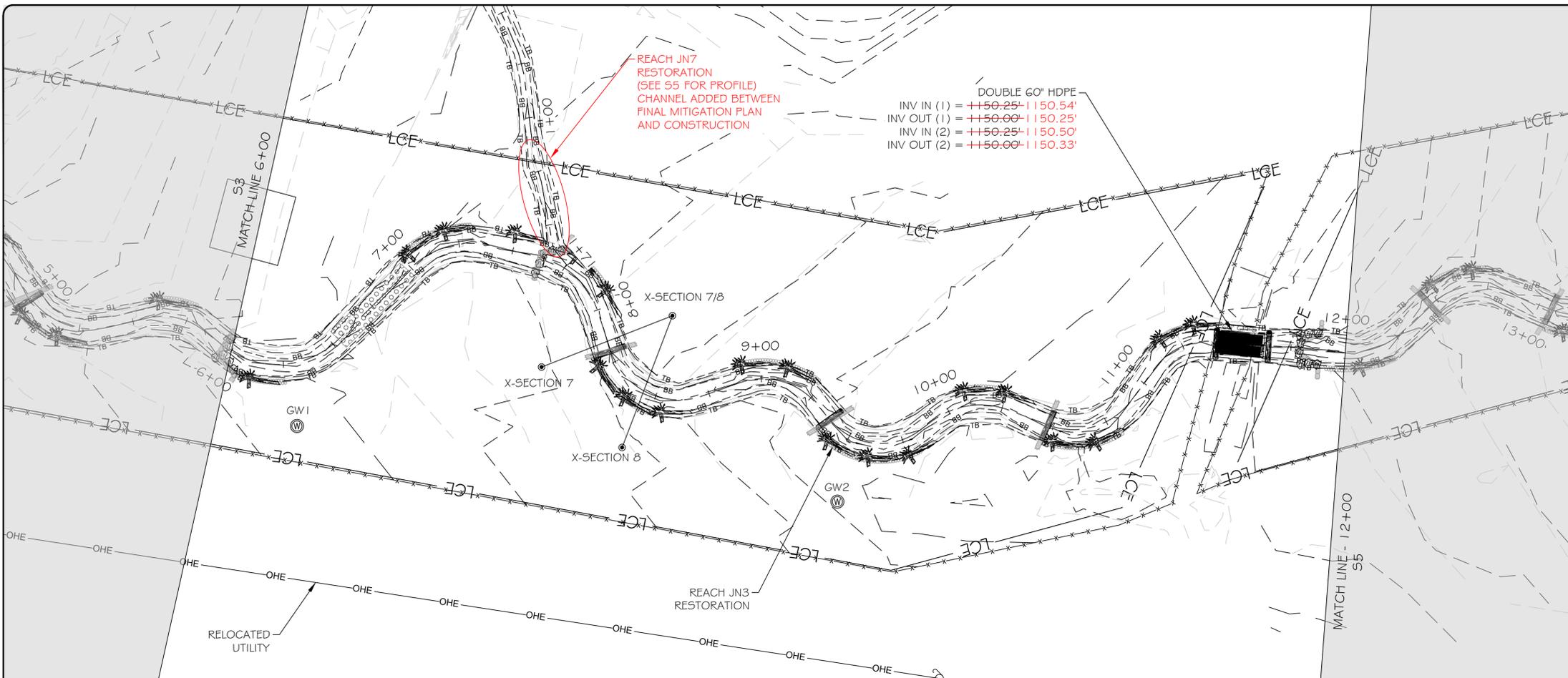
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SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
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PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

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PROPERTY LINE	— — — —
FENCELINE	— X — X — X — X —
AS-BUILT FENCELINE	— X — X — X — X —
TREELINE	— ~ ~ ~ ~
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
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AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
GROUNDWATER MONITORING WELL	
STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

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SEAL

FULL SCALE: 1"=30'  
2" = FULL SCALE  
1" = HALF SCALE

PLOT DATE:  
8/16/2021

REVISIONS:

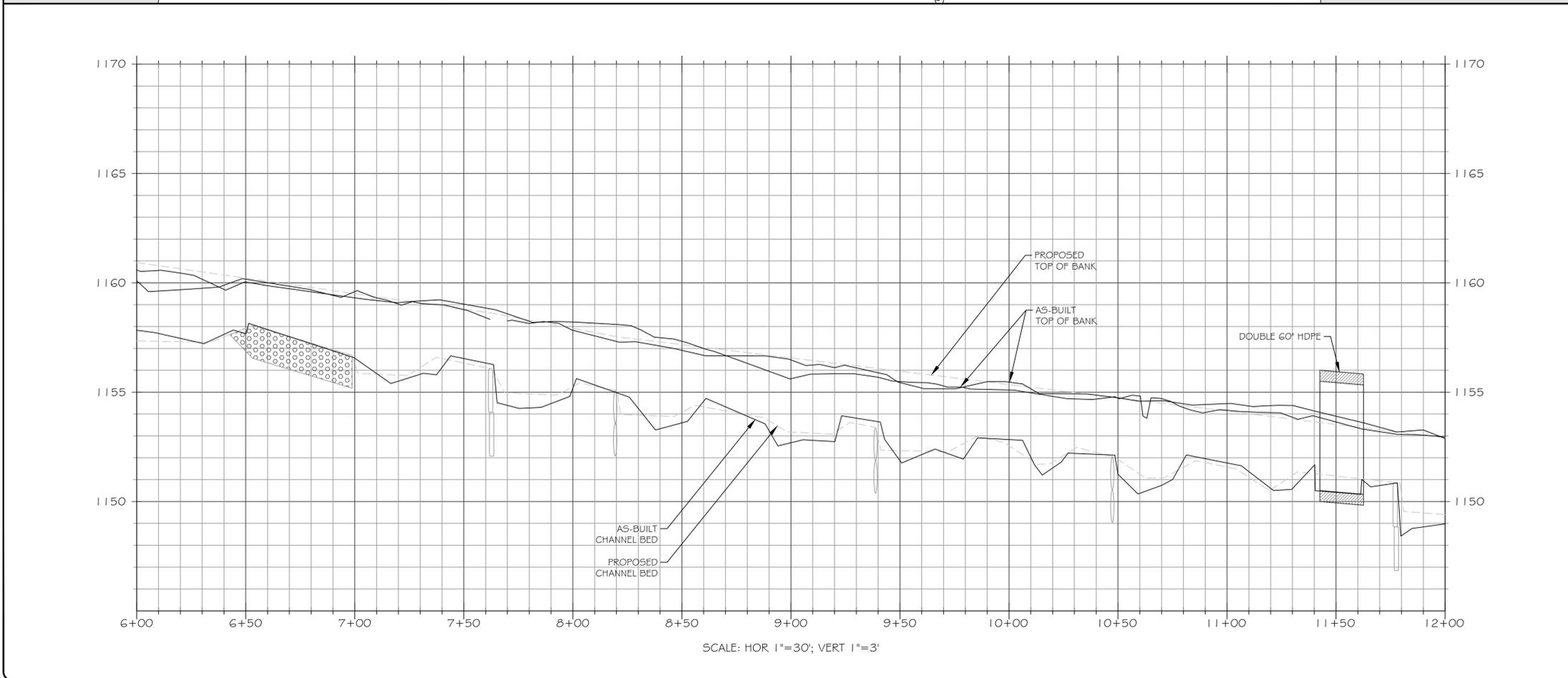
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LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

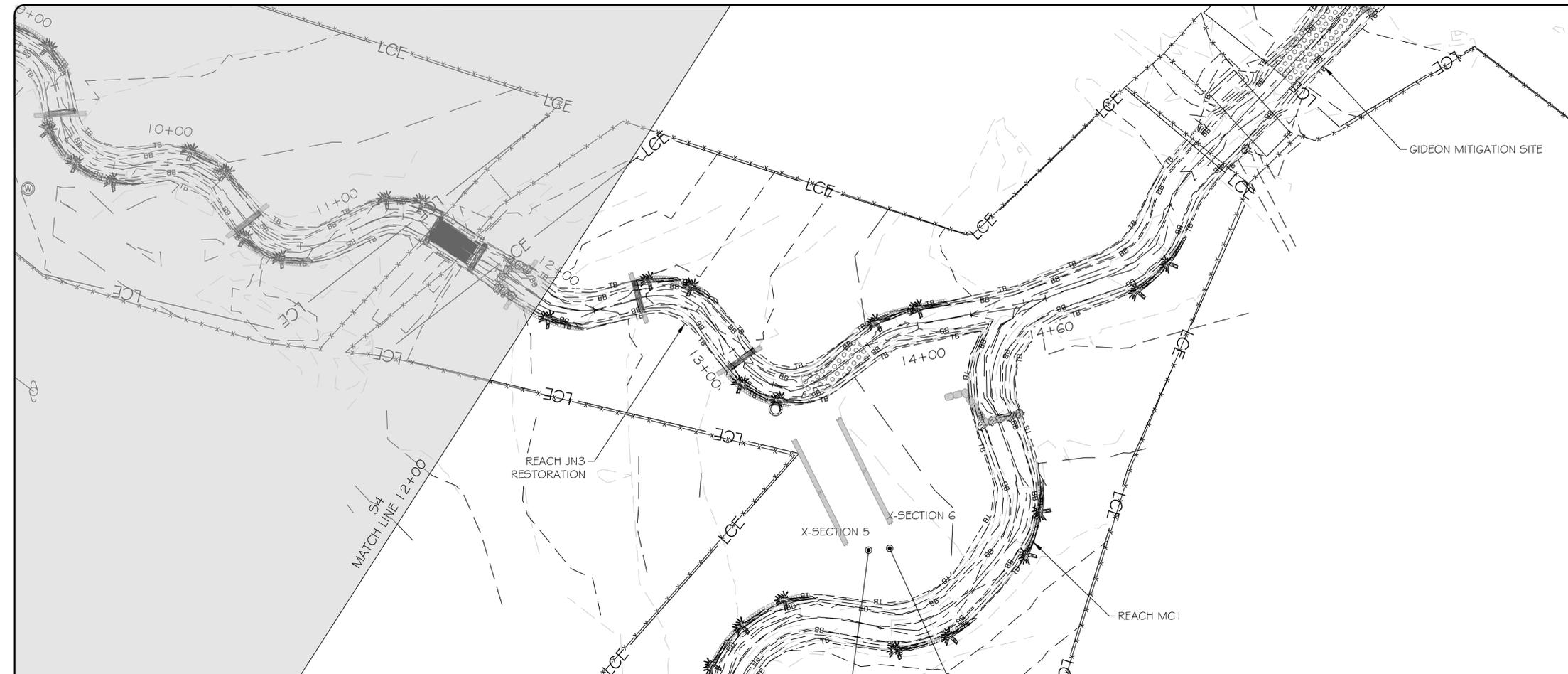
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REACH JN3 & JN7

PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:  
**S4**



NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED



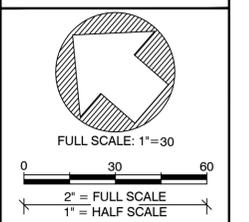
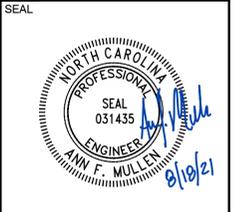
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OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	- x - x - x - x -
AS-BUILT FENCELINE	- x - x - x - x -
TREELINE	~ ~ ~ ~ ~
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
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MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	



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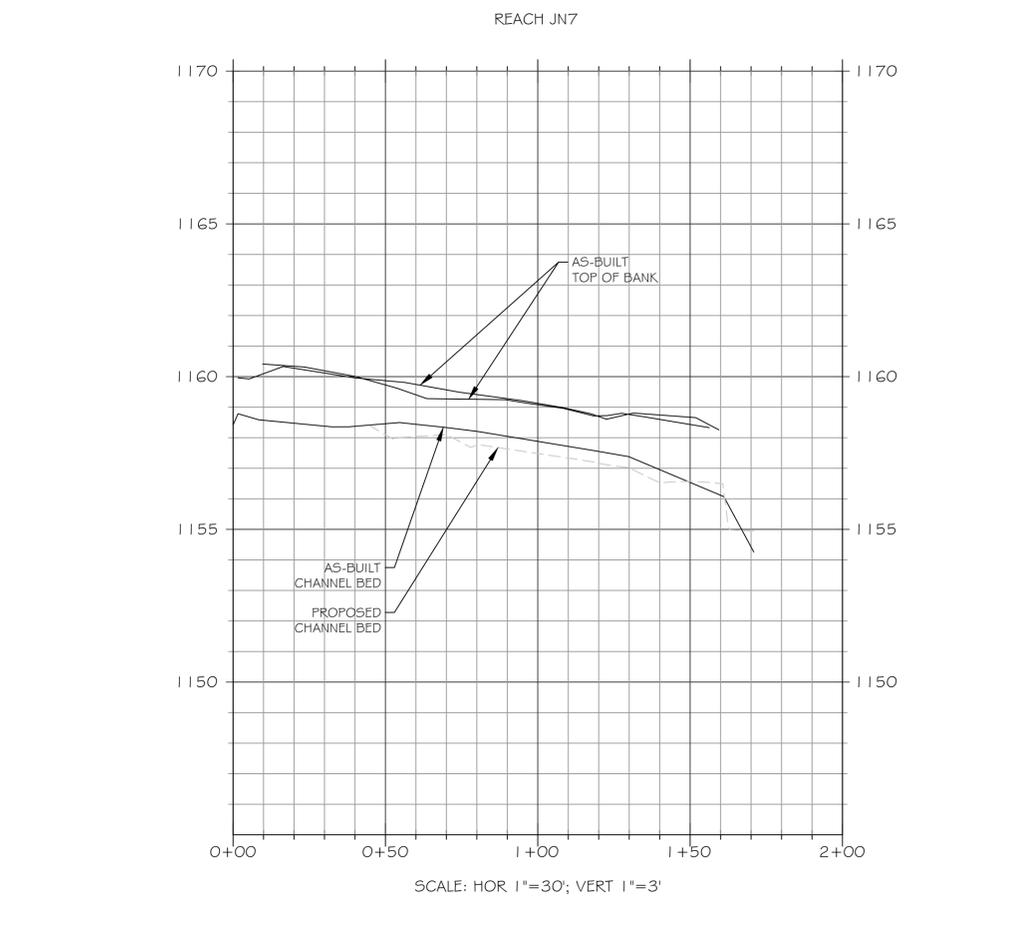
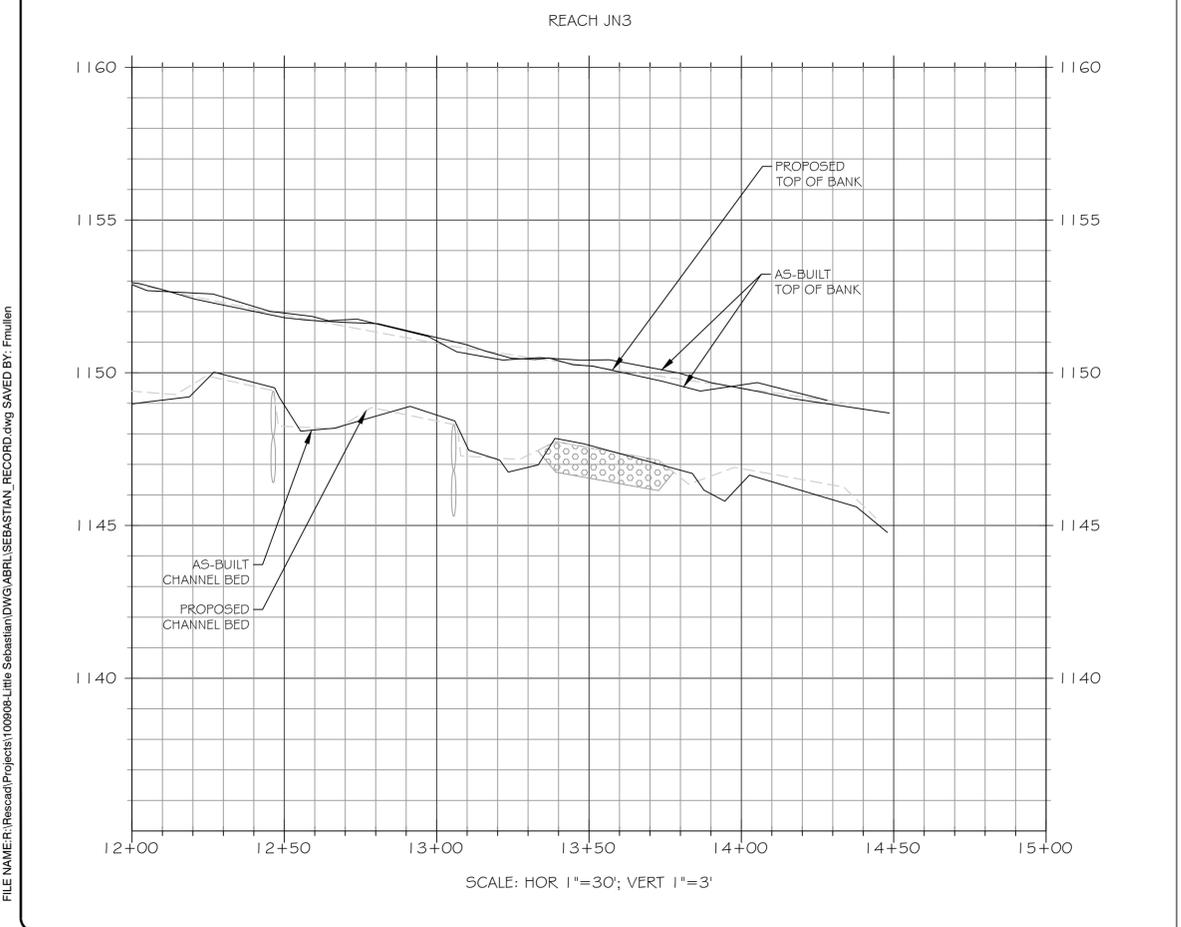
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License: F-1428



PLOT DATE:  
8/16/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS



NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED

PROJECT NAME:  
LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

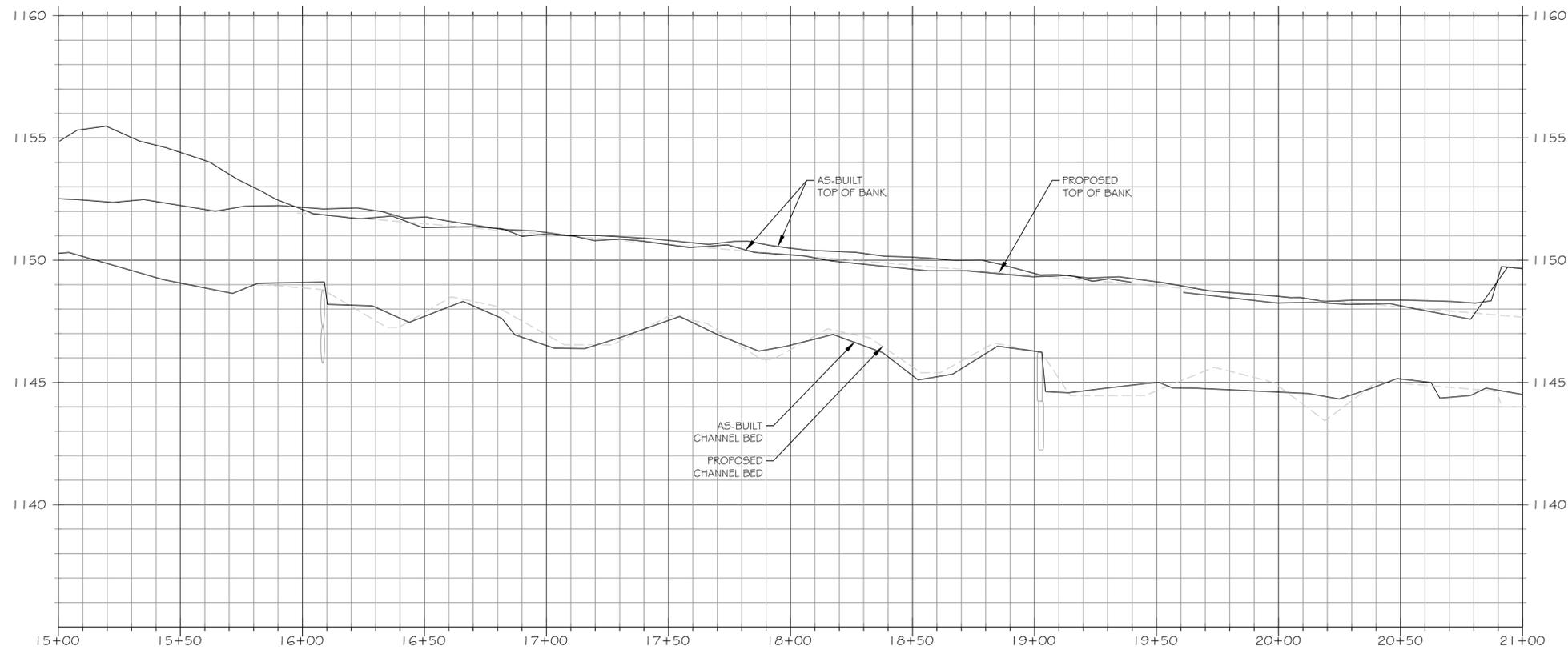
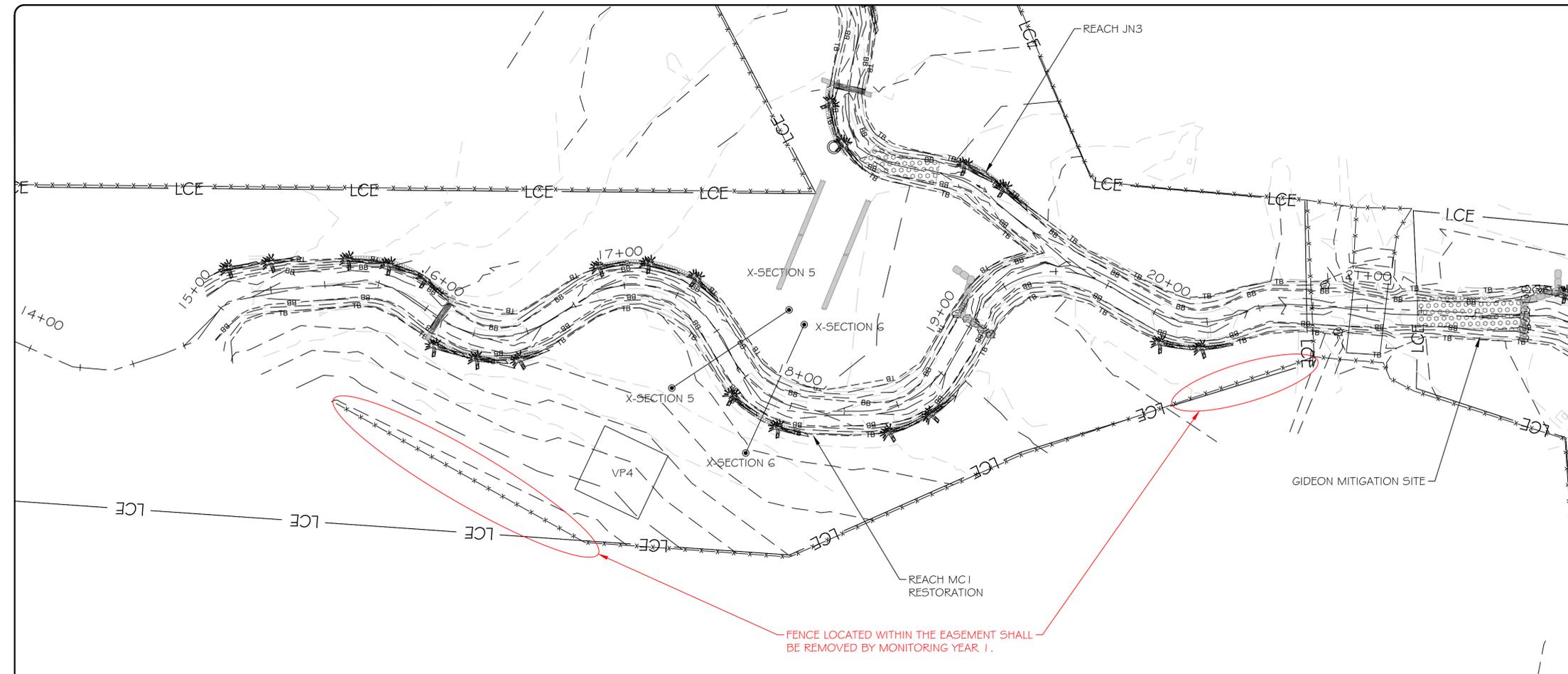
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REACH JN3 & JN7

PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:  
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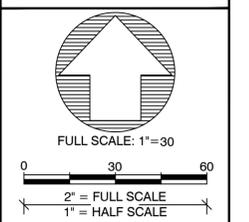
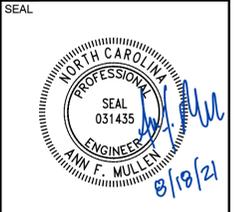
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AS-BUILT CONTOUR MINOR	- - - 46 - - -
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PROPERTY LINE	— — — — —
FENCELINE	— x — x — x — x —
AS-BUILT FENCELINE	— x — x — x — x —
TREELINE	— — — — —
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
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GROUNDWATER MONITORING WELL	
STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED



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PLOT DATE:  
8/18/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS

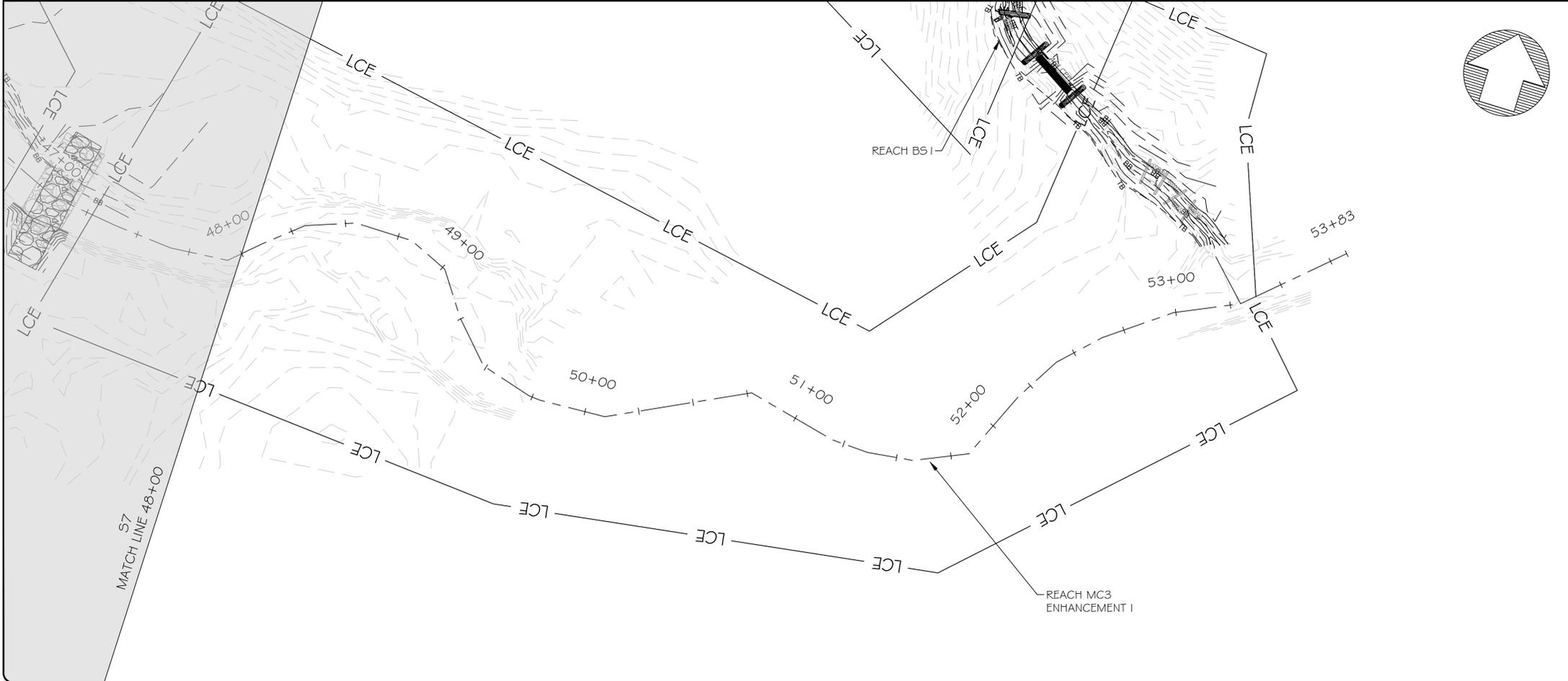
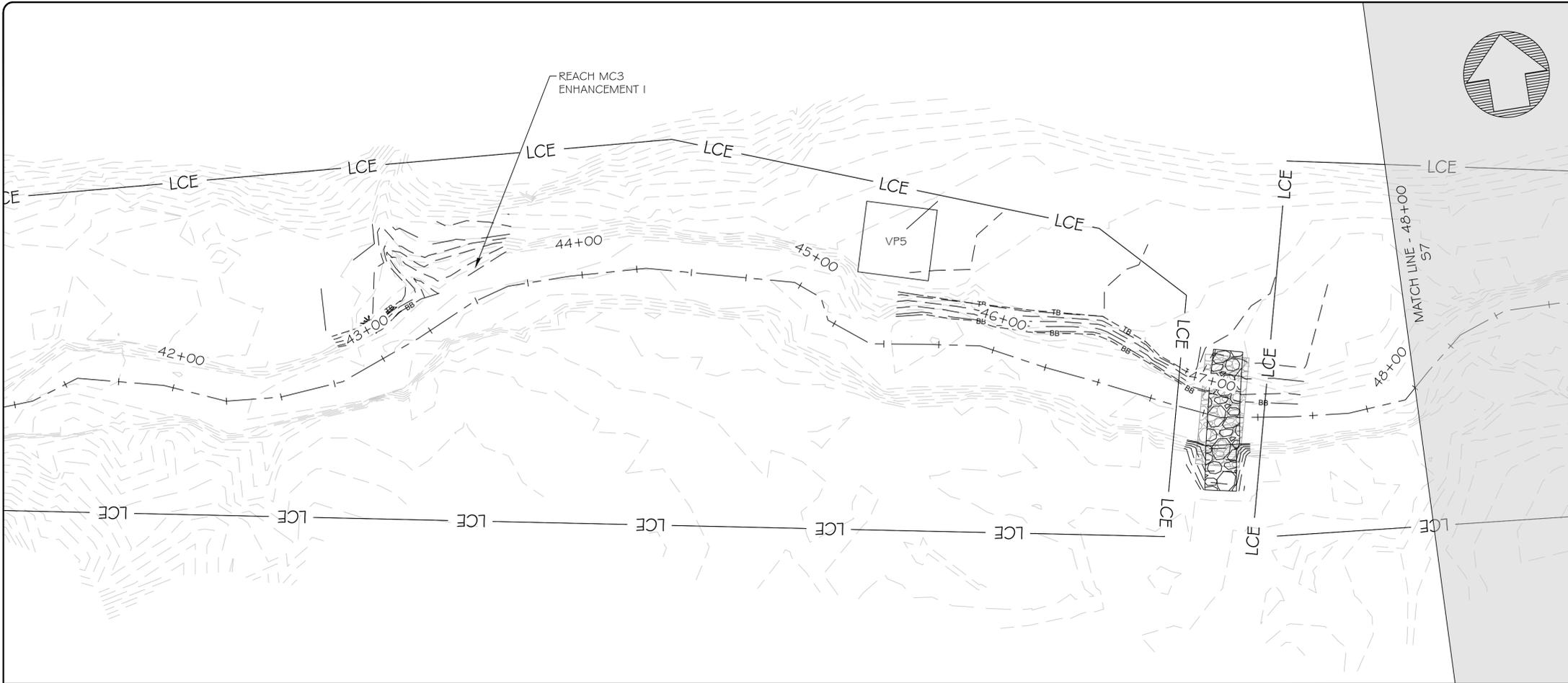
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LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
REACH MC1

PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:  
**S6**

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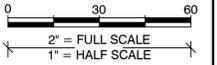
3600 Glenwood Ave, Suite 100  
Raleigh, NC 27612  
Main: 919.829.9909  
www.res.us

Engineering Services Provided By:  
RES Environmental Operating Company, LLC  
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SEAL



FULL SCALE: 1"=30'



PLOT DATE:  
8/16/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS

PROJECT NAME:  
LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

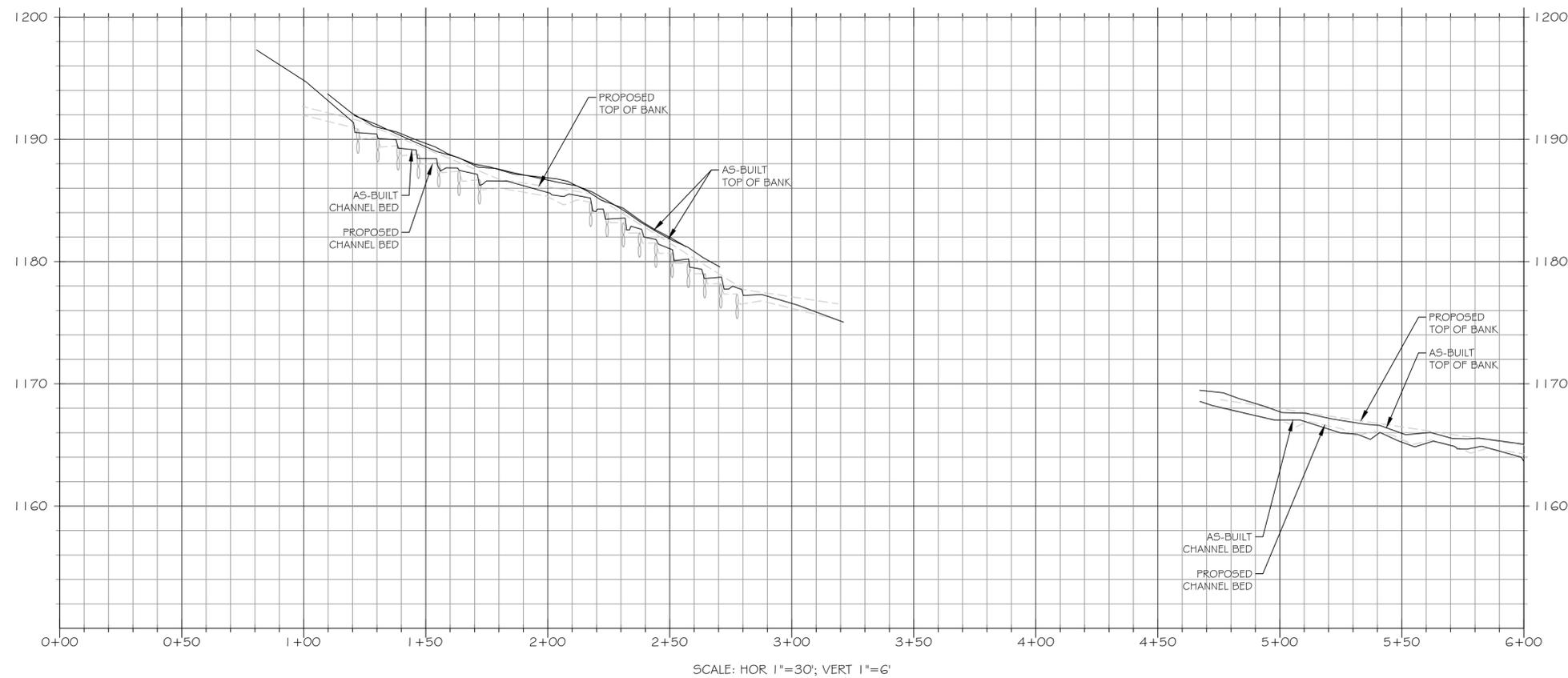
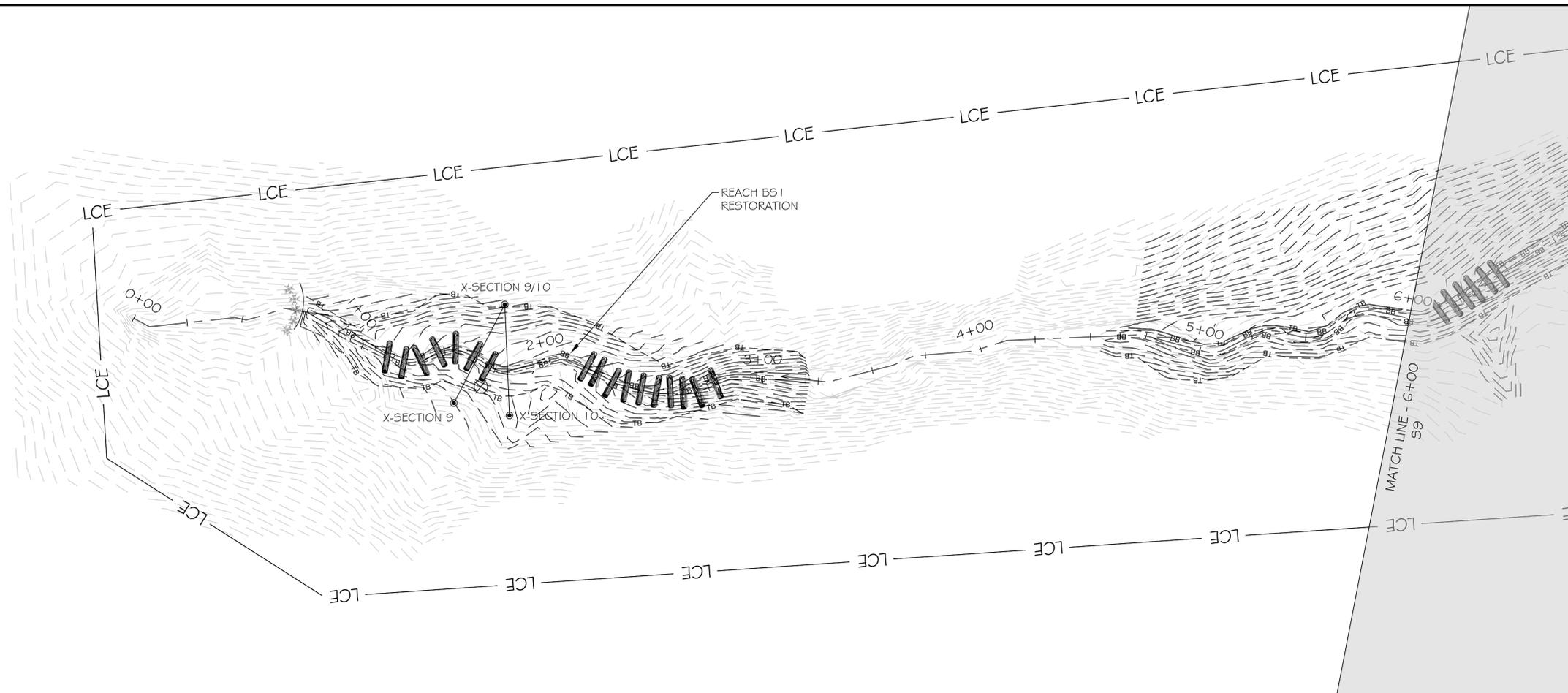
DRAWING TITLE:  
REACH MC3

PROJECT NUMBER: ---  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:

S7

FILE NAME: F:\Rescad\Projects\100909-Little Sebastian\DWG\ABRL\SEBASTIAN\_RECORD.dwg SAVED BY: Fmullen



SCALE: HOR 1"=30'; VERT 1"=6'

**LEGEND**

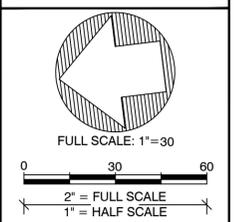
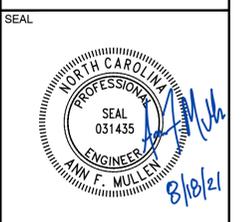
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PROPOSED CONTOUR MINOR	- - - 46 - - -
AS-BUILT CONTOUR MAJOR	— 50 —
AS-BUILT CONTOUR MINOR	- - - 46 - - -
OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	- x - x - x - x -
AS-BUILT FENCELINE	- x - x - x - x -
TREELINE	~~~~~
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
GROUNDWATER MONITORING WELL	
STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED



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8/16/2021

REVISIONS:

RELEASED FOR:  
RECORD DRAWINGS

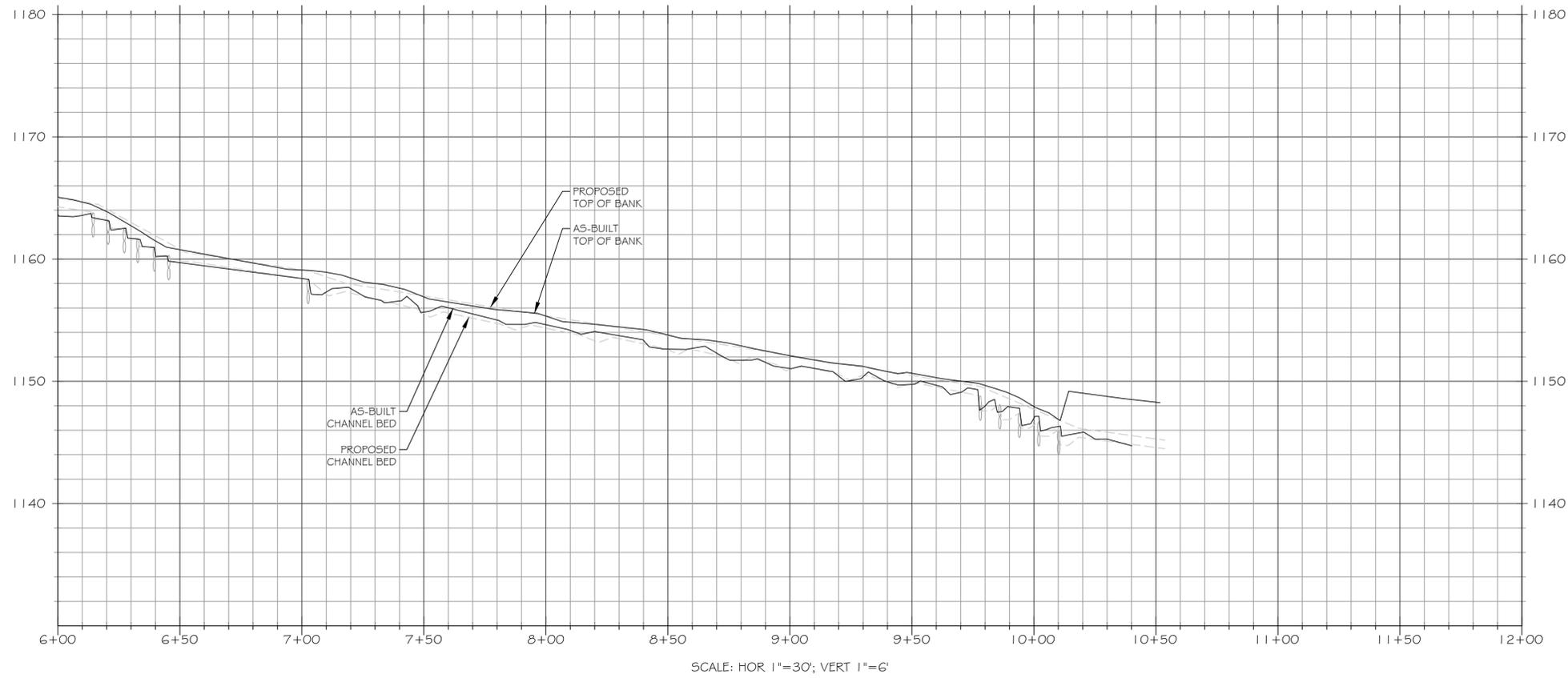
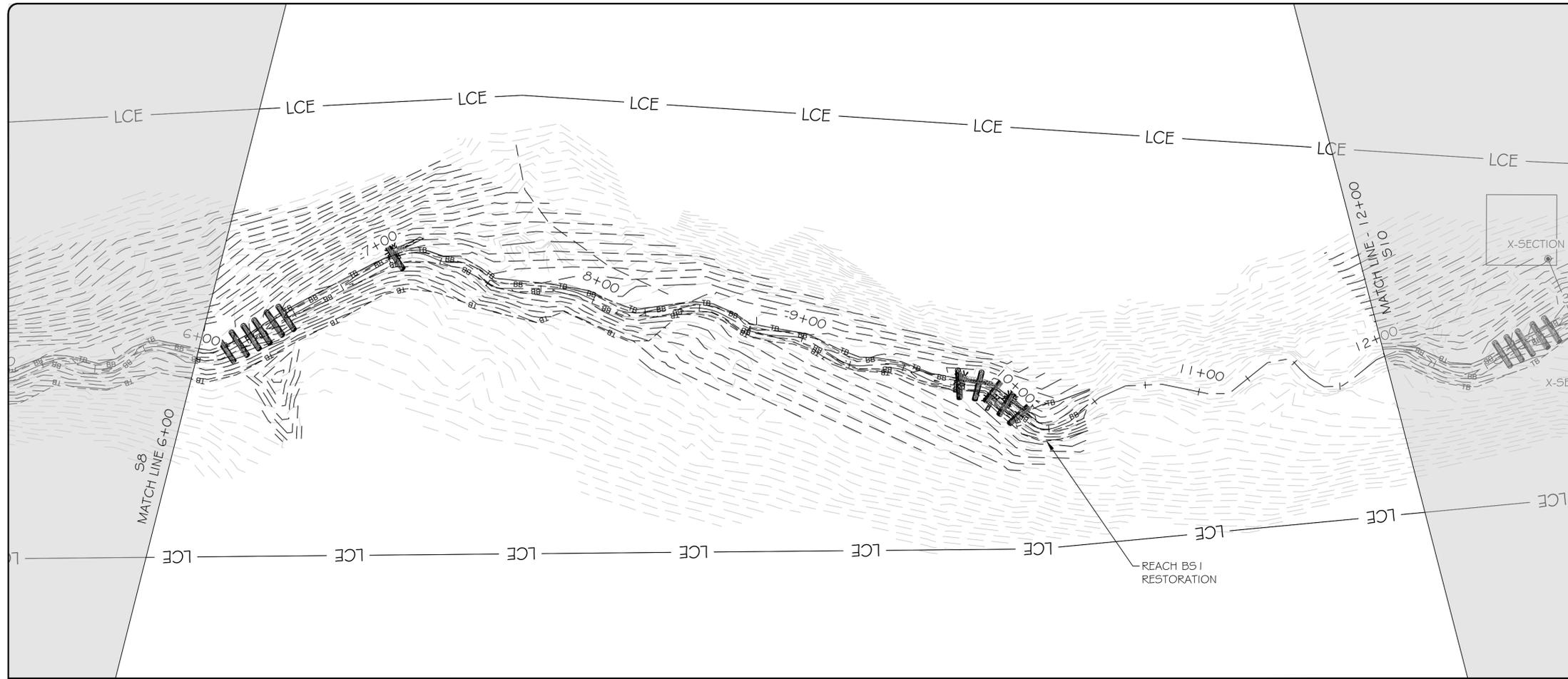
PROJECT NAME:  
LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
REACH BS1

PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:  
**S8**

FILE NAME: F:\Research\Projects\100909-Little Sebastian\DWG\ARL\SEBASTIAN\_RECORD.dwg SAVED BY: Fmullen



SCALE: HOR 1"=30'; VERT 1"=6'

**LEGEND**

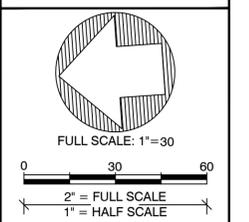
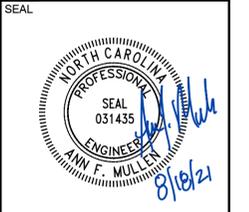
PROPOSED CONTOUR MAJOR	— 50 —
PROPOSED CONTOUR MINOR	— 46 —
AS-BUILT CONTOUR MAJOR	— 50 —
AS-BUILT CONTOUR MINOR	— 46 —
OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	— X — X — X — X —
AS-BUILT FENCELINE	— X — X — X — X —
TREELINE	— — — — —
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
GROUNDWATER MONITORING WELL	
STAGE RECORDER	
FLOW GAUGE	
MONITORING CROSS SECTION	
VEGETATION MONITORING PLOT	

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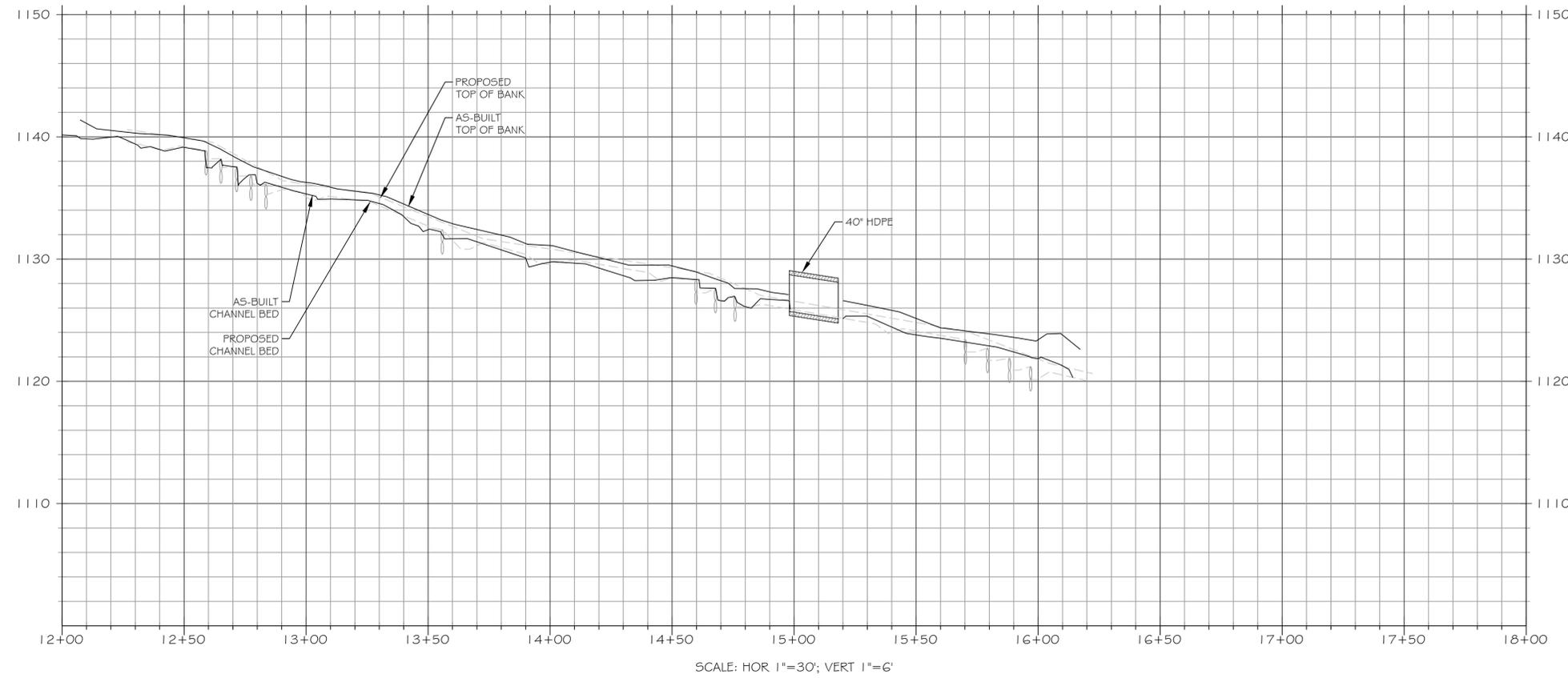
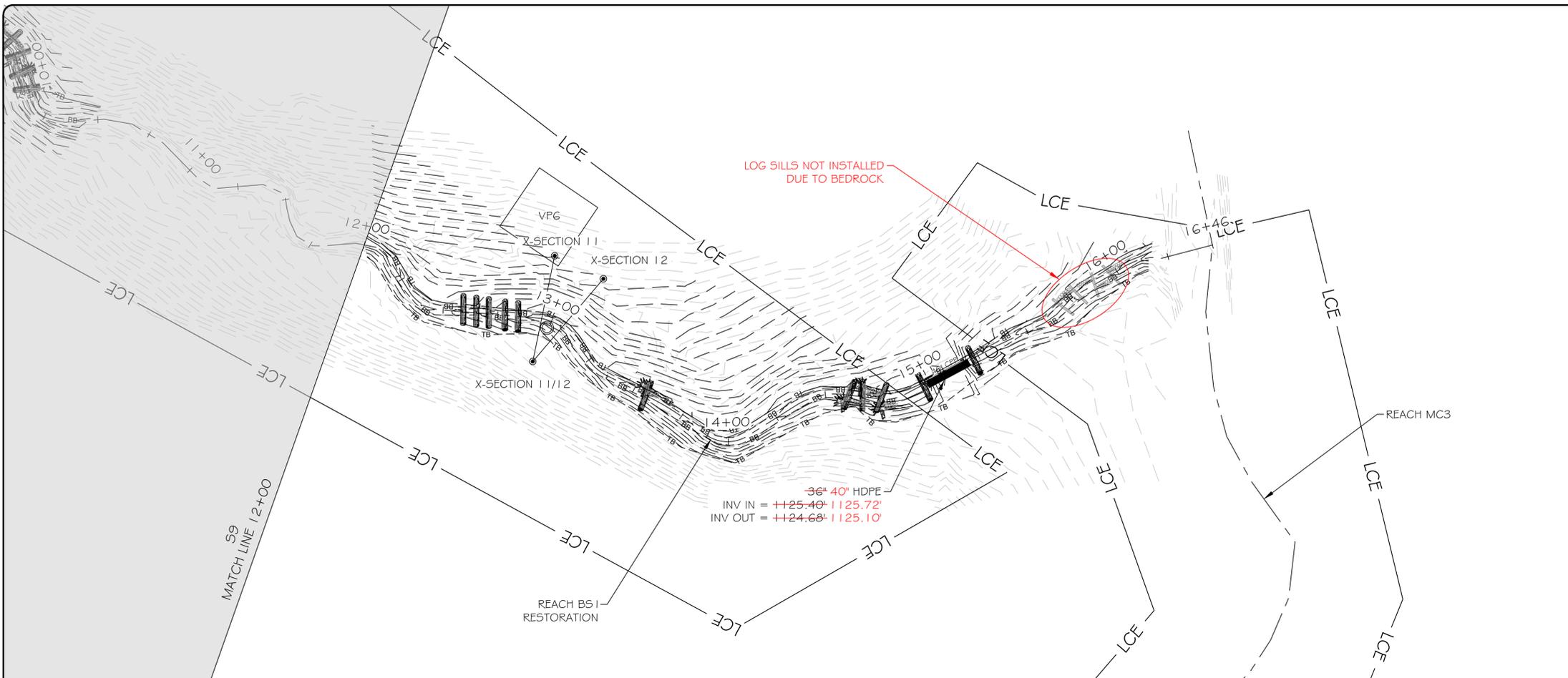
PROJECT NAME:  
LITTLE SEBASTIAN SITE RECORD DRAWINGS  
SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
REACH BS1

PROJECT NUMBER: —  
PROJECT MANAGER: BPB  
DESIGNED: AFM  
DRAWN: TRS  
CHECKED: RTM

SHEET NUMBER:  
**S9**

FILE NAME: F:\Research\Projects\100909-Little Sebastian\DWG\ABRL\SEBASTIAN\_RECORD.dwg SAVED BY: Fmullen



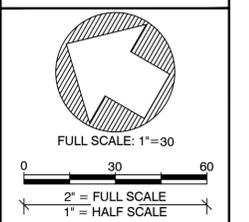
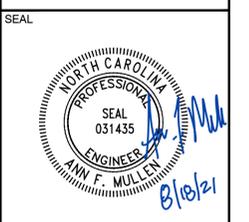
**LEGEND**

PROPOSED CONTOUR MAJOR	— 50 —
PROPOSED CONTOUR MINOR	- - - 46 - - -
AS-BUILT CONTOUR MAJOR	— 50 —
AS-BUILT CONTOUR MINOR	- - - 46 - - -
OVERHEAD ELECTRIC UTILITY LINE	— — — — —
PROPERTY LINE	— — — — —
FENCELINE	- x - x - x - x -
AS-BUILT FENCELINE	- x - x - x - x -
TREELINE	~ ~ ~ ~ ~
LIMITS OF RECORDED CONSERVATION EASEMENT	— LCE —
PROPOSED BRUSH TOE PROTECTION	
PROPOSED LOG STRUCTURE	
PROPOSED ROCK STRUCTURE	
PROPOSED CONSTRUCTED RIFFLE	
PROPOSED LOG STRUCTURE (PROFILE)	
PROPOSED ROCK STRUCTURE (PROFILE)	
AS-BUILT BRUSH TOE PROTECTION	
AS-BUILT LOG STRUCTURE	
AS-BUILT ROCK STRUCTURE	
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PROJECT NAME:  
**LITTLE SEBASTIAN SITE RECORD DRAWINGS**  
SURRY COUNTY, NORTH CAROLINA

DRAWING TITLE:  
**REACH BS1**

PROJECT NUMBER:	---
PROJECT MANAGER:	BPB
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	RTM

SHEET NUMBER:  
**S10**