Year Three Monitoring Report

GROUNDHOG HOLLOW PROJECT

NCDMS Project #100049 (Contract #7417) | RFP 16-007277 (Issued 6/21/2017)

USACE Action ID: SAW-2018-00450 | DWR Project #20180666

Alexander County, North Carolina
Catawba River Basin
HUC 03050101

Provided by:

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

Provided for:
NC Department of Environmental Quality
Division of Mitigation Services

February 2024

3600 Glenwood Avenue, Suite 100
Raleigh, NC 27612

Corporate Headquarters
6575 W Loop S #300
Bellaire, TX 77401
Main: 713.520.5400

February 23, 2024

Paul Wiesner
Western Regional Supervisor NCDEQ – Division of Mitigation Services 5
Asheville Regional Office
2090 U.S. 70 Highway
Swannanoa, NC 28778-8211 (828)273-1673 Mobile

RE: Groundhog: Year 3 Monitoring Report (NCDMS ID 100049)

Listed below are comments provided by DMS on February 9th, 2024 regarding the Groundhog Mitigation Site: Year 3 Report and RES' responses highlighted in blue.

- Section 1.2 Project Goals and Objectives/ Section 1.3 Project Success Criteria – DMS recommends updating the report to include the "Table 2: Summary: Goals, Performance and Results" from the current monitoring table guidance (October 2020); this table is very helpful in showing how project performance is tying into the goals and summarizing cumulative monitoring results. This is available on the DMS website at: https://www.deq.nc.gov/about/divisions/mitigation-services/vendors/templates-guidelines-tools- projects.
    - The table in section 1.3 of the MY3 report has been updated to include cumulative monitoring results.
- Section 1.6 Construction and As-Built Conditions: "However, in May 2021, approximately 200 linear feet of channel (three percent of the total stream length) and 10 structures underwent repairs." Please discuss the reach/ reaches repaired in the revised report.
    - Section 1.6 has been expanded to include details on the May 2021 repairs.
- Section 1.7 Monitoring Performance (MY3): This section reports that there are no known encroachments on the easement; however, a bull was found in the easement during the 11/14/23 DMS site visit, please update the report and describe any follow up communication with the landowner to prevent future livestock encroachment. Letter or email correspondence should be included in an Appendix of the revised MY3(2023) report. Was this due to a gate being left open or a break in the fencing somewhere? Please provide more information in the revised report text.
    - RES will work with the landowner to ensure future encroachments don't happen and will include any correspondence in the MY4 report.
- Section 1.7 Monitoring Performance (MY3) _Vegetation: During the November 14, 2023, DMS site visit, Fescue was observed at the outer extent of numerous portions of the conservation easement. Is existing Fescue considered a project vegetation concern within the conservation easement? Are any ring sprays around planted vegetation proposed in MY4(2024) or future monitoring years? Please address in the comment responses and update the report text accordingly.

    - RES will continue to monitor vegetative succession along the outer portion of the easement, random vegetation monitoring plots have been done in these areas

showing tree survivorship however options to promote tree height are being considered in MY4 such as ring sprays.

- Section 1.7 Monitoring Performance (MY3) _Vegetation: Easement integrity, fencing and boundary marking are discussed in the Vegetation Section of 1.7 Monitoring Performance. DMS recommends breaking out this discussion into a new sub-section entitled “Conservation Easement Boundary” or similar. RES should also mention the recent DMS boundary inspection conducted with RES on 11/14/2023 and briefly summarize:
    - A) What actions have been taken since that inspection and MS Teams meetings,
        - RES has contacted the original surveyor regarding rebar size used for easement marking and we have investigated rebar sizes in the field. Several virtual meetings have taken place between RES representatives and NCDMS. The most recent meeting concluded that RES will investigate the makeup of #4s vs #5s on site while DMS will talk to SPO/stewardship about putting the proper fitting caps on to rebar or explore other options available.
    - B) The approximate timeline to rectify the rest of the action items moving forward,
        - RES will work towards rectifying all known boundary issues before the end of 2024. We are currently working to determine the appropriate option to forwards with NCDMS.
    - C) The survey plat and monument issues currently being reviewed and resolved with RES’s surveyor and DEQ/DMS/State Property. During a 1/19/2024 meeting, RES survey staff committed to inspecting and determining the length and diameter of survey monumentation rebar installed on the site.
        - After field investigations on we have determined the common rebar size on site to be 18” #4 rebar. We are currently working between our in-house surveyor and NCDMS/SPO to determine the next steps to take.

- Section 1.7 Monitoring Performance (MY3) _Stream Geomorphology: The report indicates that geomorphology data collection for MY2 was conducted on July 5th, 2022. RES should be providing the data collection date for MY3(2023). Please review and revise this section accordingly. Based on Table 2, morphological surveys were completed in June 2023. Please consider collecting morphological data later in the growing season so it represents the full monitoring year. If collected earlier, data collection dates should be consistent each year to allow a full year between surveys.

    - This section has been revised. MY2 cross sections were shot in July 2022 while MY3 cross sections were surveyed in June 2023. Table 2 was updated to reflect this for MY2. Cross section data has been consistently collected during the early summer months since MY1.
- Section 1.7 Monitoring Performance (MY3) _Stream Geomorphology: During the 11/14/2023 site visit, the upper portion of GF2-A showed evidence of high banks that are potentially actively eroding. Please discuss this reach and any anticipated/ proposed maintenance and continue to monitor the reach/ area in MY4(2024). If photos of the

reach/ eroding high banks are available, please include them in the final MY3(2023) report.
    - Photos of GF2-A have been added to Appendix B. RES is planning to live stake and reseed actively eroding this reach during MY4. Debris is also scheduled to be removed. We will continue to monitor this section and report on it.

- General/ Section 1.7 Monitoring Performance (MY3) _Stream Hydrology: Please ensure that project monitoring equipment is checked prior to the start of the MY4(2024) growing season and at least quarterly thereafter to confirm that it is functioning properly and collecting data through the full growing season/ monitoring year.
    - RES has since replaced this gage and downloaded gage data from the site. We will continue to download gages quarterly throughout the monitoring phase.
- Table 2. Project Activity and Reporting History: Morphological surveys and vegetation surveys appear to have been completed at separate times/ dates in MY3(2023); please update the table to identify the separate survey dates (Morphological – June 2023 & Vegetation – October 2023). This was also an IRT request at the 2023 IRT Credit Release meeting. Please include all MY3(2023) maintenance activities in the table including any beaver dam removals, project invasive treatments, repairs (GF4-A structure), etc.
    - Table 2 has been updated as requested.
- Please review and add dates to the header/s as necessary; one header date is missing from several crossing photos. The GF4-A structure repair header notes “crossing photos”; please QA/QC and update as applicable. For the crossing GF-3 (downstream), both double barrels culverts look filled in approximately 50%. Is RES concerned with sediment transport through and below any of the installed project culvert crossings? Please review in detail.
    - Crossing photo headers have been updated as well as maintenance photos. RES will investigate the GF3 culverts and determine the appropriate action to take once we determine the severity of sedimentation and potential causes.

- MY3(2023) Cross Sections: At the 2023 IRT Credit Release meeting, the IRT requested that accurate dates or date stamps be included with all project photos including Cross Sections photos. Please review the report and include dates for all Cross Sections/ Cross Section photos provided.
    - Cross Section photos have been updated to include the dates photos were taken.

- General: During the 11/14/2023 site visit, DMS observed some areas of farm trash within the easement that likely blew in from off-site. Please continue to inspect and remove any trash from the conservation easement through the monitoring term. DMS noted a conservation easement gate on reach GF4-A that may have been recently hit by farm equipment. The next time RES is on- site, please review and confirm that the gate is functional and excluding livestock as required.
    - The easement gate has been investigated and determined to be functional. Debris on GF4-A is scheduled to be removed in early 2024 and RES will continue to monitor/remove debris if it appears in the easement.

- Report Text/ Table 6/ CCPV Map: Significant amounts of invasive species were noted during the 11/14/2023 DMS site visit. The MY2 (2022) report text indicated that approximately 0.21 acres of Chinese Privet was “flush cut” in MY1(2021) and will require further invasive treatment in 2023. Chinese privet was also noted along GF1-A, GF1-B, GF2-B, and GF4-A during MY2(2022) and was proposed for treated in 2023. Was any invasive treatment completed in MY3(2023); if not, please explain why invasive treatment was not completed in the monitoring year as previously proposed by RES.
    - Invasives were treated via foliar spray in March 2023, Table 2 now details this. RES will continue to work to find the best methods for handling invasives on site.

- November 14, 2023: DMS Property Boundary Inspection Observations & Required Action Items:
    - **DMS 11/14/23 Property Field Inspection Observations:**
    - The easement corners were monumented with stamped aluminum caps. The rebar used for the corner pins was #4 (1/2”) of unknown length. The caps had pink bushings designed for #5 (5/8”) rebar and were attached with a putty like adhesive resembling caulk.
    - Many caps could not be found in their expected location despite extensive digging. Some of the caps were deeply buried, possibly during fence post installation. Excessive effort is required to field locate these caps or the caps may be absent. Examples of corners where the caps could not be found are: 1/6/11/12/14/28/38/39/70/71/72/73. There were missing T-posts and caps between corners 69-73 where the fence deviated from the easement line where the fence runs with the easement, then diverges.
    - Easement boundaries were generally not apparent at crossings. The location of the easement boundary is obscured because the fence is offset from the unmarked easement line. Examples are shown on the provided .kmz file.
    - Numerous easement signs were not securely fastened to the wooden fence posts. Many
    - One bull was observed within the easement near corner 70. DMS opened the gate to allow the bull to exit the easement. The gate was subsequently closed. A photo is available in the provided .kmz file.
    - There is apparent fencing within easement at GF1-A reach terminus between 11 and 19; 19 was found but 11 was not. The section of fencing along this line is failing and is a potential risk for cattle access/ encroachment. There is fencing on the plat that may not have been removed/replaced/relocated. Please evaluate this section and address accordingly.
    - There is a powerline support cable anchored in the conservation easement at #18. This is considered infrastructure.
- Required Action Items:
    - Determine the length of the #4 rebar installed. Replacement with #5 rebar 30” in length may be required. Once reported, please discuss with DMS and SPO staff for next steps.
        - RES has determined the length of the installed rebar on easement corners and is in talks with NCDMS on how to move forward.

- Verify the monument caps are present and flush with the ground surface. Install any missing witness posts and monuments.
  - RES is working to determine all caps are present on easement corners. RES will install the appropriate caps as needed.
- Verify the in-line marking is installed at a frequency of 200' spacing or less. Shorter segments should have the signs installed equidistant from the corners, but signs must be installed at a spacing no greater than 200'.
  - RES is working to verify in-line marking is installed at a frequency of 200' spacing or less and addressing any areas where signage is insufficient.
- Remove fallen trees from the exclusion fencing.
  - RES is working to remove fallen trees from fencing surrounding the easement.
- Please add a couple posts/signs at each crossing where the easement line is outside the crossing corridor and not readily visible.
  - RES will add additional easement signage at easement crossings.
- Upgrade the fasteners used to attach the signs to the wooden fence posts. Please select a durable fastener that will meet the durability specification as required by the RFP and be representative of a quality installation. Repair/replace all damaged signs and re-install missing signs. Loose fasteners located on the ground surface in pasture areas are hazardous to livestock.
  - RES will upgrade fasteners on easement signage and repair or replace damaged and missing signage.
- Please ensure that any nails removed during the work are recovered and properly disposed of offsite.
  - RES will remove all debris from associated easement work completed on site.
- Notify the landowner that cattle are accessing the conservation easement. Identify all locations where cattle are gaining access to the easement and repair the exclusion fencing.
  - RES will work with the landowner to prevent future incidents of cattle accessing the easement.
- Provide accurate mapping for guy wire installed near corner 18. Determine if there are conflicting easements associated with the line and propose recommendations for resolution and/or any mitigation credit implications.
  - RES will update the CCPV concerning the guy wire encroachment on site and will keep NCDMS up to date on the resolution of this issue.

- Digital Support File Comments:

  - The surface water graphs submitted were mislabeled as MY 2; the data appeared to be MY3 2023. Please review, verify and update accordingly. For future submissions, please check to ensure the data tables and graphs are labeled correctly.
    - The labels for the MY3 2023 hydrographs have been updated and are included in the digital support files.

Table of Contents

Hydro Graphs

1.0 Project Summary

1.1 Project Location and Description

The Groundhog Hollow Project ("Project") is located within a rural watershed in Alexander County, North Carolina approximately three and a half miles northwest of Taylorsville. Water quality stressors affecting the Project included livestock production, agricultural production, and lack of riparian buffer. The Project presents stream restoration and enhancement generating 4,093.95 Warm Stream Mitigation Units (SMU).

The Project's total easement area is 20.58 acres within the overall drainage area of 156 acres. Grazing livestock historically had access to all the 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 stream design approach for the Project was to combine the analog method of natural channel design with analytical methods to evaluate stream flows and hydraulic performance of the channel and floodplain. The analog method involved the use of a reference reach, or "template" stream, adjacent to, nearby, or previously in the same location as the design reach. The template parameters of the analog reach were replicated to create the features of the design reach. The analog approach is useful when watershed and boundary conditions are similar between the design and analog reaches. Hydraulic geometry was developed using analytical methods to identify the design discharge.

The Project has been constructed and planted and 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 will be 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 (amended 2018) Upper Catawba River Basin Restoration Priorities (RBRP). These goals and objectives reflect those stated in the Groundhog Hollow Project Final 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 overbank flows and connection to the floodplain;
- Improve instream habitat;
- Reduce sediment, nutrient, and fecal coliform inputs into stream system;
- Restore and enhance native floodplain vegetation; and
- Indirectly support the goals of the 2009 Upper Catawba RBRP to improve water quality and to reduce sediment and nutrient loads

The Project goals were addressed through the following project objectives:

- Designed and reconstructed stream channels that convey bankfull flows while maintaining stable dimension, profile, and planform;
- Added in-stream structures and bank stabilization measures to protect restored streams;
- Installed habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored streams;
- Increased forested riparian buffers to at least 50 feet on both sides of the channel along the Project reaches with a hardwood riparian plant community;
- Installed approximately 12,000 linear feet of livestock exclusion fencing along the easement boundary to ensure livestock will no longer have stream access;
- Treated exotic invasive species; and
- Established a permanent conservation easement on the Project that will exclude future livestock from stream channels and their associated buffers and prevent future land use changes.

Functional uplift, benefits, and improvements within the Project area, as based on the Function Based Framework, are outlined in the Mitigation Plan**.**

1.3 Project Success Criteria

The success criteria for the Project follows the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update, the Groundhog Hollow Project 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 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.

Specific Project reaches will be monitored to document intermittent or seasonal surface flow. Intermittent reaches must demonstrate a minimum of 30 consecutive days of flow.

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 seven feet at the end of Year 5, and the final vegetative success criteria is 210 trees per acre with an average height of ten 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 present 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.

Level		Treatment	Objective	Monitoring Metric	Performance Standard	Cumulative Monitoring Results
1	*Hydrology*	Convert land-use of Project reaches from pasture to riparian forest	Improve the transport of water from the watershed to the Project reaches in a non-erosive way	NA	NA	**235 flow days - MY1 297 flow days - MY2 164 flow days - MY3**
2	*Hydraulic*	Reduce bank height ratios and increase entrenchment ratios by reconstructing channels to mimic reference reach conditions	Improve flood bank connectivity by reducing bank height ratios and increase entrenchment ratios	Stage recorders:	Four bankfull events occurring in separate years	**29 BF Events - MY1 42 BF Events - MY2 11 BF Events - MY3**
				Inspected quarterly		
				Flow gauge:	At least 30 days of continuous flow each year	
				Inspected quarterly		
				Cross sections: Surveyed in	Entrenchment ratio shall be no less than 1.4 within restored reaches	
				Years 1, 2, 3, 5 and 7	Bank height ratio shall not exceed 1.2	
3	*Geomorphology*	Establish a riparian buffer to reduce erosion and sediment transport into project streams. Establish stable banks with livestakes, erosion control matting, and other in stream structures.	Limit erosion rates and maintain channel stability	As-built stream profile	NA	**19/22 with BHR<1.2 - MY0 19/22 with BHR<1.2 - MY1 19/22 with BHR<1.2 - MY2 19/22 with BHR<1.2 - MY3**
				Cross sections: Surveyed in	Entrenchment ratio shall be no	
			Improve bedform diversity (pool spacing, percent riffles, etc.	Years 1, 2, 3, 5 and 7	less than 1.4 within restored	
					reaches	
			Increase buffer width to 50 feet	Visual monitoring	Bank height ratio shall not exceed	
					1.2	
				Visual monitoring: Performed at least semiannually	Identify and document significant	
					stream problem areas; i.e.	
					erosion, degradation,	
					aggradation, etc.	
				Vegetation plots: Surveyed in	MY 1-3: 320 trees/acre	
				Years 1, 2, 3, 5 and 7	MY 5: 260 trees/acre (7 ft. tall)	
					MY 7: 210 trees/acre (10 ft. tall)	
4	*Physicochemical*	Exclude livestock from riparian areas with exclusion fence, conservation easement, and plant a riparian buffer	*Unmeasurable Objective/Expected Benefit*	Vegetation plots: Surveyed in	MY 1-3: 320 trees/acre	**12/12 passed - MY0 11/12 passed - MY1 12/12 passed - MY2 12/12 passed - MY3**
			Establish native hardwood riparian buffer and exclude livestock.	Years 1, 2, 3, 5 and 7	MY 5: 260 trees/acre (7 ft. tall)	
				(*indirect measurement*)	MY 7: 210 trees/acre (10 ft. tall)	
				Visual assessment of established fencing and conservation signage: Performed at least semiannually	Inspect fencing and signage.	
				(*indirect measurement*)	Identify and document any	
					damaged or missing fencing	
					and/or signs	

1.4 Project Components

The Project area is comprised of a 20.58-acre easement involving four unnamed tributaries which drain directly into the Lower Little River which eventually drains into the Catawba River. These four

Project streams are split into nine reaches based on treatment type and/or changes in flow: GF1-A, GF1-B, GF2-A, GF2-B, GF3-A, GF3-B, GF4-A, GF4-B, and GF5.

Due to landowner and utility requirements, there are five easement breaks within the project. One break is for an existing utility easement; fencing was installed across the utility easement in order to provide contiguous livestock exclusion to the stream. The other three are locations for current agricultural crossings. These easement breaks will allow landowners to continue current land-use and access throughout the property as needed.

Through stream restoration and enhancement, the Project presents 6,129 LF of stream, generating 4,093.95 Warm Stream Mitigation Units (SMU). The stream mitigation components are summarized below. Mitigation credits presented below are based upon the Approved Mitigation Plan. To account for areas of more or less than minimum 50-foot buffer widths, credits were adjusted using the USACE Wilmington District Stream Buffer Credit Calculator.

Mitigation Approach	Linear Feet	Ratio	Warm SMU
Restoration	2,851	1	2,851.00
Enhancement I	306	1.5	204.00
Enhancement II	2,338	2.5	935.20
Enhancement II	253	5	5060
Enhancement II	381	7.5	50.80
Total	**6,129**		**4,091.60**
		Non-standard Buffer Width Adjustment	**+2.35***
		Total Adjusted SMUs	**4,093.95**

* Credit adjustment for Non-standard Buffer Width calculation using the Wilmington District Stream Buffer Credit Calculator issued by the USACE in January 2018.

1.5 Stream Design/Approach

The Project includes Priority I and II Restoration and Enhancement Levels I and II. 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 were also a crucial element of the project and were used to determine the design discharge and to verify the design as a whole. For livestock exclusion, woven wire fencing with one strand of barbed wire at the top was installed.

The following treatments were performed on the Project reaches:

Reach GF1-A
An Enhancement Level II approach was performed for this reach to address areas of bed instability, bank erosion, and buffer impacts. Enhancement activities included:

- Stabilizing a 2-foot knick-point located near station 00+70 by installing two rock sills,
- Removal and regrading of an existing culvert crossing near station 03+50,
- Bank stabilization beginning near station 05+75 by installing a log vane and brush toe,

- Stabilizing a 5-foot headcut located near station 07+10 by installing a rock step-pool,
- Livestock exclusion,
- Riparian planting,
- Invasive vegetation treatment.

Reach GF1-B

An inline restoration approach was used for the upstream portion of the reach to address eroding banks, channel entrenchment, and buffer impacts. Restoration activities included:

- Raising the channel bed with a mix of log sill, log vanes, riffle grade controls, and clay plugs,
- Normalizing the existing channel alignment to reduce channel stress,
- Establishing a riffle pool sequence throughout the reach,
- Installing brush toe protection on meander bends,
- Transitioning existing vertical channel banks to a minimum 5:1 floodplain slope,
- Livestock exclusion,
- Riparian planting,
- Invasive vegetation treatment.

An offline priority I restoration approach was performed for the middle portion of the reach to address, eroding banks, channel entrenchment, and channel braiding. Restoration activities included:

- Regrading a new single thread channel in the existing floodplain,
- Installing log and rock structures to provide grade control and habitat,
- Establishing a riffle pool sequence throughout the reach,
- Installing brush toe protection on meander bends,
- Filling the existing channel,
- Replacing an existing ford crossing with a culvert crossing,
- Livestock exclusion,
- Riparian planting.

An offline priority II restoration approach was performed for the downstream potion of the reach to address, eroding banks, channel entrenchment, and channel braiding. Restoration activities included:

- Regrading a new single thread channel and floodplain,
- Installing log and rock structures to provide grade control and habitat,
- Establishing a riffle pool sequence throughout the reach,
- Installing brush toe protection on meander bends,
- Filling the existing channel,
- Livestock exclusion,
- Riparian planting.

Enhancement Level II was performed along the portion of the reach that ties into the Lower Little River and is within its non-encroachment area. Enhancement activities included:

- Livestock exclusion,
- Riparian planting,

- Invasive vegetation treatment.

Reach GF2-A

An Enhancement Level II approach was performed for this reach to address areas of bed instability, bank erosion, and buffer impacts. Enhancement activities included:

- Stabilizing a 9-foot headcut located near station 01+30 by installing log sills and a log step pool,
- Bed stabilization beginning near station 05+00 by installing a double log drop,
- Bank stabilization beginning near station 07+50 by installing a log vane and brush toe,
- Livestock exclusion,
- Riparian planting,
- Invasive vegetation treatment.

Reach GF2-B

A mix of offline and inline restoration was performed for this portion of the reach to address eroding banks, channel entrenchment, historic impoundment, and buffer impacts. Restoration activities included:

- Regrading a new single thread channel in the existing floodplain,
- Installing log and rock structures to provide grade control and habitat,
- Establishing a riffle pool sequence throughout the reach,
- Installing brush toe protection on meander bends,
- Removing the relic earthen dam and relic pond,
- Filling the existing channel,
- Replacing an existing ford crossing with a culvert crossing,
- Livestock exclusion,
- Riparian planting.

Reach GF3-A

An Enhancement Level I approach was performed for this reach to address areas of bank erosion, and buffer impacts. Enhancement activities included:

- Stabilizing the left bank near station 08+75 by installing a brush toe,
- Stabilizing the left bank near station 10+25 by installing a brush toe,
- Bank stabilization beginning near station 09+40 and 09+80 by installing a log vane,
- Floodplain grading,
- Livestock exclusion,
- Riparian planting,
- Invasive vegetation treatment.

Reach GF3-B

An offline restoration approach was performed for this portion of the reach to address eroding banks, channel entrenchment, and buffer impacts. Restoration activities included:

- Regrading a new single thread channel in the existing floodplain,

- Installing log and rock structures to provide grade control and habitat,
- Establishing a riffle pool sequence throughout the reach,
- Installing brush toe protection on meander bends,
- Filling the existing channel,
- Replacing an existing ford crossing with a culvert crossing,
- Livestock exclusion,
- Riparian planting.

Reach GF4-A

An Enhancement Level II approach was performed for this reach to address areas of bed instability, bank erosion, and buffer impacts. Enhancement activities included:

- Stabilizing head cut near station 00+50 by grading a vegetated swale,
- Stabilizing banks near station 01+50 by grading back channel banks,
- Bed stabilization beginning near station 03+30 by installing a rock step-pool,
- Removing and replacing the two existing 24" Corrugated Metal Pipes,
- Livestock exclusion,
- Riparian planting,
- Invasive vegetation treatment.

Reach GF4-B

A limited Enhancement Level II approach was performed for this reach at a reduced credit ratio. Enhancement activities included:

- Livestock exclusion,
- Riparian planting,
- Trash removal,
- Invasive vegetation treatment.
    - To ensure bank stability, Chinese privet was flush cut and sprayed; therefore, subsoil was not disturbed. Roots will remain intact while plantings establish roots.

Reach GF5

An Enhancement Level II approach was performed for this reach to address buffer impacts and protect multiple spring heads. Enhancement activities included:

- Livestock exclusion,
- Riparian planting,
- Removal of existing concrete tank,
- Invasive vegetation treatment.

1.6 Construction and As-Built Conditions

Stream construction was completed in September 2020 and planting was completed in December 2020. The Groundhog Hollow Project was built to design plans and guidelines. However, in May 2021, approximately 200 linear feet of channel (three percent of the total stream length) and 10 structures underwent repairs, several additional log sills were added to stabilize grade, multiple banks were back filled and matted after large flow events caused channel damage. Generally, the

problem areas were step pools, sills, banks, and old channel erosion that failed during extreme high flows that occurred before vegetation could be established. Banks were regraded and matting was added, sills were replaced, repaired, or added to reestablish proposed bed elevations, and check dams were installed in the old channel to discourage concentrated flow. Repair areas were livestaked in May 2021 and will be livestaked again this upcoming dormant season in 2024 to increase stability. Additionally, bareroot supplemental planting was performed in the areas affected by the repairs.

Planting plan changes included the removal of black gum (*Nyssa sylvatica*) and hackberry (*Celtis occidentalis*). Hackberry was replaced with sugarberry (*Celtis laevigata*) and the quantities of the other planted species were increased to compensate for not planting black gum. These changes were based on bare root availability. Minor monitoring device location changes were made during as-built installation; however, the quantities remained as proposed in the Final Mitigation Plan.

1.7 Monitoring Performance (MY3)

The Groundhog Hollow Monitoring activities were performed in June and October 2023. All monitoring year three data is present below and in the appendices. There was one known encroachments on the easement by a young bull that accessed the easement, there are multiple areas around the easement where will RES will work to bring the boundary markings and project fencing up to standard. The Project is on track to meeting interim success criteria.

Conservation Easement Boundary

The easement boundary was walked last during MY3 on 11/14/2023, this walk also included DMS representatives performing a Boundary Inspection. Results from that boundary inspection concluded: (a) The rebar used for the corner pins was #4 (1/2") of unknown length and many caps could not be found in their expected location despite extensive digging. Some of the caps were deeply buried, possibly during fence post installation. (b) Easement boundaries were generally not apparent at crossings and throughout the easement numerous easement signs were not securely fastened to the wooden fence posts. (c) Treefalls were on the fence in several locations potentially resulting in a young bull being observed within the easement that day, (d)A guy wire support cable was found anchored in the easement and (e) there was debris from the previous fencing still found within the easement. RES will work to rectify all of these issues through 2024 and keep NCDMS up to date as these situations are resolved.

Vegetation

Monitoring of the nine fixed vegetation plots and three random vegetation plots was completed on October 05th, 2023. Vegetation data is in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**. MY3 monitoring data indicates that all plots are exceeding the interim success criteria of 320 planted stems per acre. Planted stem densities ranged from 405 to 688 planted stems per acre with a mean of 506 planted stems per acre across all vegetation plots. The average planted stem height in the vegetation plots was 4.06 feet. A total of 10 species

were documented within the plots. Volunteer species were noted during monitoring year three and are expected to continue establishing in upcoming years.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project. Chinese privet and multiflora rose have been treated on site in the past but will need to be retreated to eliminate potential resprouting. Scattered Chinese privet populations have been noted along GF1-A, GF1-B, GF2-B, and GF4-A during 2023 and is being treated in 2024.

Project fencing has been maintained throughout MY3 and the fencing that had previously encroached into the easement, discussed in the MY1 report, was relocated out of the easement in MY2. There are several known easement boundary insufficiencies due to inadequate signage and insufficient witness posts with one section of fencing being potentially in the easement. One section of project fencing has a downed tree on top of it, it is not yet opening access to the easement for cattle however will soon be repaired. RES will work to identify and rectify these issues throughout 2024.

Stream Geomorphology

A total of 22 cross sections were installed on January 27, 2021 and geomorphology data collection for MY3 was conducted on June 14th, 2023. Summary tables and cross section plots are in **Appendix D**. Overall the cross sections and profile relatively match the proposed design. Slight degradation was observed on pool cross section six but has remained stable since MY1. Pool cross section 13 shows some signs of degradation but has been stable since. This cross section will continue to be monitored to determine if adaptive measures are needed. Monitoring data shows minor changes in both cross sections and riffle cross sections above and below cross sections six and 13. The MY3 conditions show that channel conditions are stable and functioning as intended. All reaches were designed as gravel bed channels and remain classified as gravel 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. A structure on GF4-A was previously deteriorating where the stream was beginning to add stress to the banks around the log sills. This structure was notched to direct flow in the desired location and a rock ramp was installed below to stabilize the area and improve aquatic passage. Repair areas are cataloged in **Appendix B**. The channel over all is transporting sediment as designed and will continue to be monitored for aggradation and degradation.

Stream Hydrology

Three stage recorders and one flow gauge were installed on February 4, 2021: one stage recorder on GF1-B, one stage recorder on GF2-B, one stage recorder on GF3-B, and one flow gauge on GF4-A. The stage recorders are in place to document bankfull events and the flow gauge to document at least intermittent flow. The stage recorder on GF1-B had two bankfull events with

the highest reading being 0.17 feet above the top of bank. The stage recorded on GF2-B recorded four bankfull events with the highest reading being 0.48 feet above top of bank. The stage recorded on GF3-B recorded three bankfull events with the highest reading being 0.39 feet above top of bank. Monitoring Year Three has lower number of out of bank events compared to previous years, we attribute this to irregular precipitation patterns and are not concerned at this time. The flow gauge on GF4-A recorded one flow event lasting 164 consecutive days, the gauge appears to have been tampered with at some point between June and October and we have lost data as a result. Gauge locations can be found on **Figure 2** and photos are in **Appendix B** including photo evidence of the flow gauge on GF4-A and its current condition, this flow gauge will be replaced as soon as possible.

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 22 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. The flow gauge was also installed in a pool and records flow conditions at an hourly interval. Water level data from the flow gauge is corrected using the height of the downstream riffle to detect stream flow events.

Vegetation success is being monitored at nine fixed monitoring plots and three random monitoring plot. 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 plots are to be collected in locations where there are no permanent vegetation plots. Random plots 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.

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 (2019). Groundhog Hollow Project 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. Groundhog Hollow (100049) - 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
GF1-A	1,192	1,206	Warm	EII	N/A	2.50000	482.400		1202	Bed and bank stabilization, riparian planting, livestock exclusion (Powerline easement: STA 12+34 to 12+70)
GF1-A	62	62	Warm	EII	N/A	2.50000	24.800		63	Bed and bank stabilization, riparian planting, livestock exclusion
GF1-B	1034	1,020	Warm	R	P1/P2	1.00000	1020.000		1031	Channel restoration, riparian planting, livestock exclusion (Stream crossing: STA 23+52 to STA 24+12)
GF1-B	936	986	Warm	R	P1/P2	1.00000	986.000		994	Channel restoration, riparian planting, livestock exclusion
GF1-B	130	130	Warm	EII	N/A	2.50000	52.000		133	Riparian planting, livestock exclusion
GF2-A	642	642	Warm	EII	N/A	2.50000	256.800		636	Bed and bank stabilization, riparian planting, livestock exclusion
GF2-B	442	451	Warm	R	P1/P2	1.00000	451.000		459	Channel restoration, riparian planting, livestock exclusion (Stream crossing: STA 12+80 to STA 13+10)
GF2-B	167	83	Warm	R	P1/P2	1.00000	83.000		84	Channel restoration, riparian planting, livestock exclusion
GF3-A	311	306	Warm	EI	N/A	1.50000	204.000		306	Bed and bank stabilization, riparian planting, livestock exclusion (Stream crossing: STA 10+75 to STA 11+07)
GF3-B	270	311	Warm	R	P1	1.00000	311.000		311	Channel restoration, riparian planting, livestock exclusion
GF4-A	283*	298	Warm	EII	N/A	2.50000	119.200		283	Bed and bank stabilization, riparian planting, livestock exclusion (Stream crossing: STA 3+54 to STA 3+88)
GF4-B	381	381	Warm	EII	N/A	7.50000	50.800		383	Riparian planting, livestock exclusion
GF5	253	253	Warm	EII	N/A	5.00000	50.600		249	Riparian planting, livestock exclusion

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	Riverine	Non-Riv		
Restoration	2851.000						
Re-establishment							
Rehabilitation							
Enhancement							
Enhancement I	204.000						
Enhancement II	935.200						
Enhancement II (5:1)	50.600						
Enhancement II (7.5:1)	50.800						
Creation							
Preservation							
NSBW	2.350						
Total	**4093.950**						

Table 2. Project Activity and Reporting History
Groundhog Hollow Mitigation Project

Elapsed Time Since grading complete: 38 months
Elapsed Time Since planting complete: 37 months
Number of reporting Years[1]: 3

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	NA	Dec-19
Final Design – Construction Plans	NA	Jun-20
Stream Construction	NA	Sep-20
Site Planting	NA	Dec-20
As-built (Year 0 Monitoring – baseline)	Feb-21	Jun-21
Stream Channel and Structure Reapirs	NA	May-21
Invasive Plant Treatment	NA	Dec-21
Year 1 Monitoring	Nov-21	Dec-21
Supplemental Planting	NA	Mar-22
Fence Relocation	NA	Aug-22
Year 2 Monitoring	XS -July 2022 VP - October 2022	Dec-22
Invasive Plant Treatment	NA	Mar-23
Stream Structure Repair	NA	Oct-23
Year 3 Monitoring	XS - June 2023 VP - October-2023	Dec-23
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

1 = The number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table Groundhog Hollow Mitigation Project	
Designer	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Primary project design POC	Ben Carroll, PE
Construction Contractor	Carolina Environmental Contracting Inc. / PO Box 1905 Mount Airy, NC 27030
Construction contractor POC	James Poe
Survey Contractor	WSP USA / 434 Fayetteville St, Suite 1500, Raleigh, NC 27601
Survey contractor POC	Barry Creed, PLS
Planting Contractor	Shenandoah Habitats
Planting contractor POC	David Coleman
Monitoring Performers	RES / 401 Charles Avenue, Charlotte NC 28205
Monitoring POC	Daniel Dixon (864) 567-7761

Table 4. Project Background Information										
Project Name	Groundhog Hollow									
County	Alexander									
Project Area (acres)	20.58									
Project Coordinates (latitude and longitude)	35.937201° N, -81.237783° W									
Planted Acreage (Acres of Woody Stems Planted)	14.42									
Project Watershed Summary Information										
Physiographic Province	Northern Inner Piedmont									
River Basin	Catawba									
USGS Hydrologic Unit 8-digit	3050101	USGS Hydrologic Unit 14-digit	3050101120030							
DWR Sub-basin	03-08-32									
Project Drainage Area (Acres and Square Miles)	156 (0.24)									
Project Drainage Area Percentage of Impervious Area	<1%									
CGIA Land Use Classification	Managed Herbaceous Cover, Mixed Upland Hardwoods									
Reach Summary Information										
Parameters	**Reach GF1-A**	**Reach GF1-B**	**Reach GF2-A**	**Reach GF2-B**	**Reach GF3-A**	**Reach GF3-B**	**Reach GF4-A**	**Reach GF4-B**	**Reach GF5**	
Length of reach (linear feet)	1,254	2,100	642	609	311	270	283	381	253	
Valley confinement (Confined, moderately confined, unconfined)	Moderately confined	Moderately confined/Unconfined	Confined	Moderately confined	Moderately confined	Unconfined	Moderately confined/Unconfined	Confined	Moderately confined	
Drainage area (Acres and Square Miles)	42 (0.07)	156 (0.24)	35 (0.05)	45 (0.07)	36 (0.06)	39 (0.06)	16 (0.02)	23 (0.04)	9 (0.01)	
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Intermittent	Intermittent	Perennial	
Thermal Regime	Warm	Warm	Warm	Warm	Warm	Warm	Warm	Warm	Warm	
NCDWR Water Quality Classification	C	C	C	C	C	C	C	C	C	
Stream Classification (existing)	F4b	G4c/C4	F4b	F4b	G4	G5/6	G4	F4b	C4/5a	
Stream Classification (proposed)	F4b	C4/E4	F4b	C4/E4	G4	C4/E4	G4	F4b	C4/5a	
Evolutionary trend (Simon)	III / IV	II / III	IV	III	III / IV	III	IV / V	IV	I	
FEMA classification	Zone X	Zone X and Zone AE	Zone X	Zone X	Zone X	Zone X	Zone X	Zone X	Zone X	

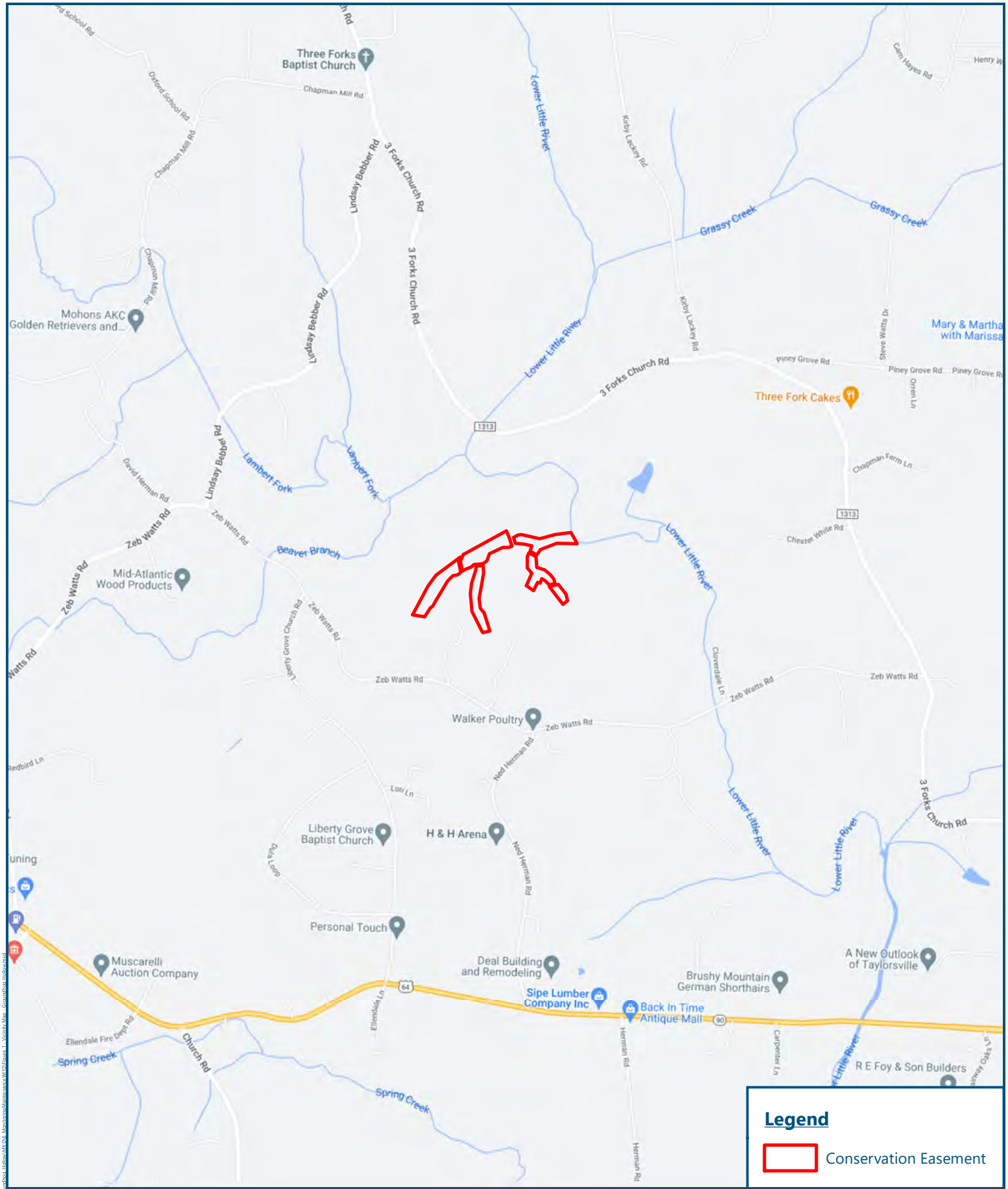


Figure 1 - Site Location Map

Groundhog Hollow Mitigation Project

Alexander County, North Carolina

Date: 10/27/2022

Drawn by: GDS

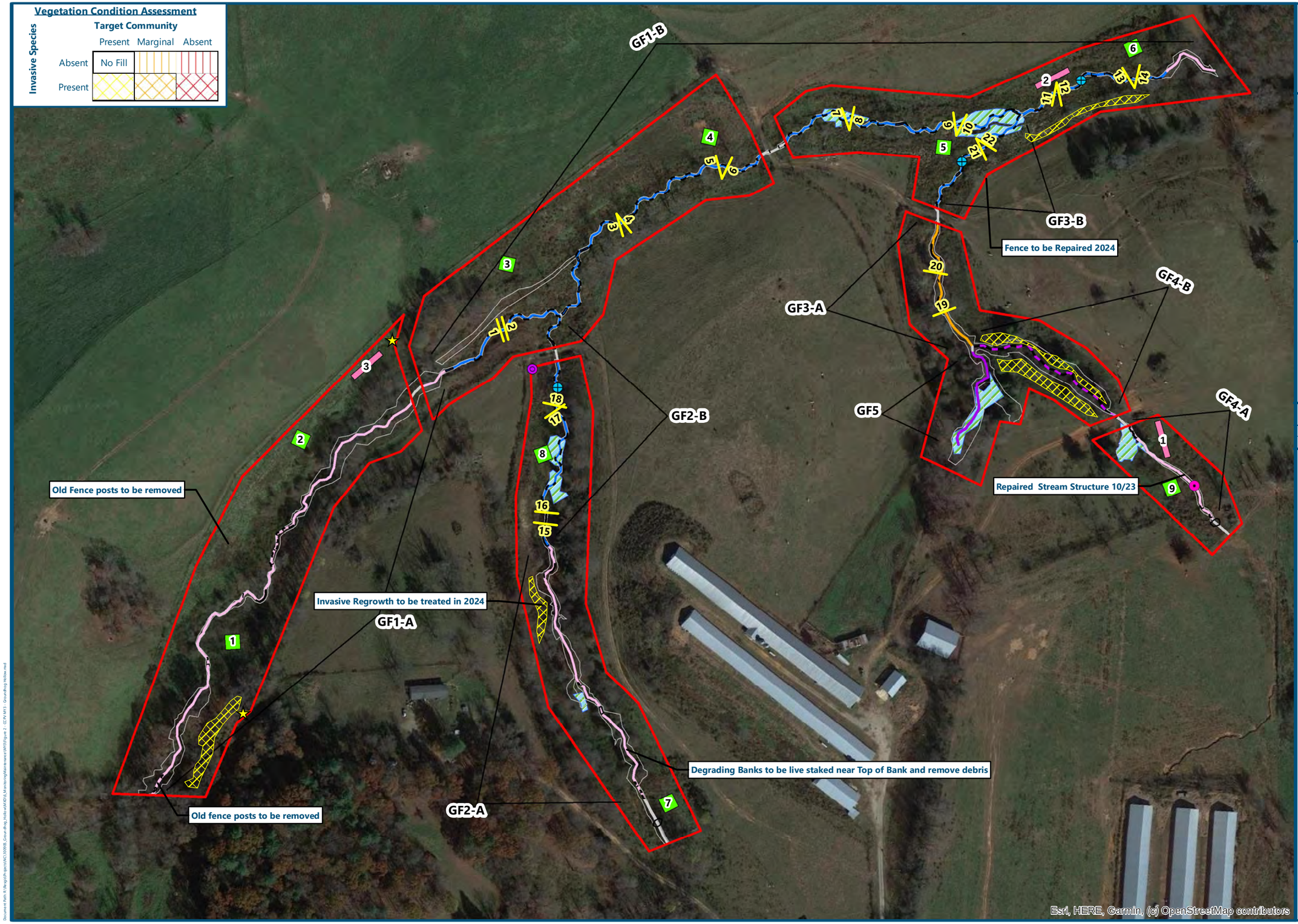
Checked by: RTM

1 inch = 2,000 feet

Restoring a resilient earth for a modern world

Appendix B

Visual Assessment Data



res

Restoring a resilient earth for a modern world

N
W
E
S

0 100 200

Feet

Figure 2 - CCPV MY3
Groundhog Hollow Mitigation Project

Alexander County, North Carolina

Date: 2/21/2024	Drawn by: DGD
1 in = 200 feet	Checked by: RTM

- Guy
- Conservation Easement
- RVP MY3 GroundhogHoll...
- > 320 Stems
- Invasive Vegetation Regrowth
- Existing Fixed Vegetation Plot
- >320 stems/acre
- As-Built Top of Bank
- Existing Top of Bank
- Stream Mitigation Approach
- Enhancement
- Enhancement
- Enhancement II (5:1)
- Enhancement II (7.5:1)
- No Credit
- Stream Structure
- Cross
- Gauge Type
- Ambient
- Flow Gauge
- Stage Recorder

Document Path: K:\Projects\NC\100908_GroundHog_Hollow_MM\MY6_Monitoring\Maintenance\MY6\Figure 2 - CCPV MY3 - GroundHog Hollow.mxd

Visual Stream Stability Assessment Table 5a

Reach GF1-B
Assessed Stream Length 2006
Assessed Bank Length 4012
Last Site Inspection - Oct 05, 2023

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 NOT 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%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	32	32		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	60	60		100%

Visual Stream Stability Assessment Table 5b

Reach GF2-B
Assessed Stream Length 534
Assessed Bank Length 1068
Last Site Inspection - Oct 05, 2023

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 NOT 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%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	15	15		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	18	18		100%

Visual Stream Stability Assessment Table 5c

Reach GF3-B
Assessed Stream Length 311
Assessed Bank Length 622
Last Site Inspection - Oct 05, 2023

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 NOT 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%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	12	12		100%

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **14.42**

Last Site Inspection - Oct 13, 2023

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

Easement Acreage[2] **20.66**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Areas or points (if too small to render as polygons at map scale).	1000 SF	Yellow Crosshatch	5	0.45	2.2%
5. Easement Encroachment Areas[3]	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 spcies 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 likley 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 ealry 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 symbolzing invasives polygons, particulalry for situations where the conditon 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.

Groundhog Hollow MY3 Vegetation Monitoring Plot Photos

Vegetation Plot 1 (10/05/2023)

Vegetation Plot 2 (10/05/2023)

Vegetation Plot 3 (10/05/2023)

Vegetation Plot 4 (10/05/2023)

Vegetation Plot 5 (10/05/2023)

Vegetation Plot 6 (10/05/2023)

Vegetation Plot 7 (10/05/2023)

Vegetation Plot 8 (10/05/2023)

Vegetation Plot 9 (10/05/2023)


Random Vegetation Plot 1 (10/05/2023)


Random Vegetation Plot 2 (10/05/2023)


Random Vegetation Plot 3 (10/05/2023)

Groundhog Hollow Monitoring Device Photos MY3 (10/05/2023)

Stage Recorder GF1-B

Stage Recorder GF2-B

Stage Recorder GF3-A

Flow Gauge GF4-A

Groundhog Hollow Crossing Photos – 10/05/2023

Crossing GF2-B - Upstream

Crossing GF2-B – Downstream

Crossing GF1-B – Downstream

Crossing GF1-B – Upstream

Groundhog Hollow Crossing Photos -10/05/2023

Crossing GF3 – Downstream)

Crossing GF3 – Upstream

Crossing GF4-A – Downstream

Crossing GF4-A - Upstream

Groundhog Hollow Stream Repair Photos – 10/05/2023

GF4 Structure Repair (looking Upstream)

Monitoring Year 3 – 2024 Supplemental Site Condition Photos

Log Sills GF3-A (02/13/2024)

Eroding Slope – GF3A (02/13/2024)

Eroding Slope – GF3A (02/13/2024)

Eroding Slope – GF3A (02/13/2024)

Structure Decline- GF2-A

Appendix C

Vegetation Plot Data

Table 7. Planted Species Summary

Common Name	Scientific Name	Mit Plan %	As-Built %	Wetland Indicator Status	Total Stems Planted
White Oak	*Quercus alba*	15	15	FACU	2,100
River Birch	*Betula nigra*	15	15	FACW	2,100
Sycamore	*Platanus occidentalis*	15	15	FACW	2,100
Willow Oak	*Quercus phellos*	15	15	FAC	2,100
Persimmon	*Diospyros virginiana*	5	10	FAC	1,500
Northern Red Oak	*Quercus rubra*	10	10	FAC	1,500
Yellow Poplar	*Liriodendron tulipifera*	10	10	FACU	1,500
Sugarberry	*Celtis laevigata*	0	10	FACW	1,500
Hackberry	*Celtis occidentalis*	10	0	FACU	0
Blackgum	*Nyssa sylvatica*	5	0	FAC	0
				Total	14,400
				Planted Area	14.42
				As-built Planted Stems/Acre	999

Table 8. Vegetation Plot Mitigation Success Summary

Plot #	Planted Stems/Acres	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Planted Stem Height
1	405	81	486	Yes	2.3
2	405	0	324	Yes	2.9
3	486	0	486	Yes	2.8
4	486	40	526	Yes	4.6
5	526	40	567	Yes	6.0
6	405	162	567	Yes	3.2
7	647	0	647	Yes	5.0
8	688	0	688	Yes	4.2
9	486	81	567	Yes	4.7
R1	486	0	486	Yes	4.3
R2	486	0	486	Yes	4.2
R3	567	0	567	Yes	3.3
Project Avg	**506**	**45**	**533**	**Yes**	**4.1**

Table 9. Stem Count Total and Planted by Plot Species

			Current Plot Data (MY3 2023)																									
			100049-01-0001			100049-01-0002			100049-01-0003			100049-01-0004			100049-01-0005			100049-01-0006			100049-01-0007			100049-01-0008			100049-01-0009		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree																		2								
Betula nigra	river birch	Tree	1	1	1							3	3	3	6	6	6							4	4	4	6	6	7
Celtis laevigata	sugarberry	Tree	2	2	2				1	1	1							3	3	3	9	9	9	1	1	1			
Diospyros virginiana	common persimmon	Tree							1	1	1										1	1	1						
Liquidambar styraciflua	sweetgum	Tree																		2								
Platanus occidentalis	American sycamore	Tree							2	2	2	3	3	4	3	3	3				1	1	1	6	6	6	5	5	6
Prunus serotina	black cherry	Tree			2																								
Quercus alba	white oak	Tree				2	2	2	2	2	2							1	1	1	2	2	2	1	1	1			
Quercus phellos	willow oak	Tree	7	7	7							2	2	2	4	4	4							4	4	4			
Quercus rubra	northern red oak	Tree				6	6	6	6	6	6	4	4	4			1	6	6	6	3	3	3	1	1	1	1	1	1
		Stem count	10	10	12	8	8	8	12	12	12	12	12	13	13	13	14	10	10	14	16	16	16	17	17	17	12	12	14
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	3	3	4	2	2	2	5	5	5	4	4	4	3	3	4	3	3	5	5	5	5	6	6	6	3	3	3
		Stems per ACRE	405	405	486	324	324	324	486	486	486	486	486	526	526	526	567	405	405	567	647	647	647	688	688	688	486	486	567

			Current Plot Data (MY3 2023)									Annual Means											
			R1			R2			R3			MY3 (2023)			MY2 (2022)			MY1 (2021)			MY0 (2021)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree												2									
Betula nigra	river birch	Tree	3	3	3	8	8	8				31	31	32	26	26	26	22	22	22	40	40	40
Celtis laevigata	sugarberry	Tree	3	3	3	2	2	2	8	8	8	29	29	29	19	19	19	17	17	17	21	21	21
Diospyros virginiana	common persimmon	Tree	3	3	3							6	6	6	1	1	1	1	1	1	3	3	3
Liquidambar styraciflua	sweetgum	Tree												2	1	1	1						
Platanus occidentalis	American sycamore	Tree	1	1	1	1	1	1				23	23	23	32	32	32	23	23	23	35	35	35
Prunus serotina	black cherry	Tree												2									
Quercus alba	white oak	Tree							4	4	4	12	12	12	9	9	9	10	10	10	15	15	15
Quercus phellos	willow oak	Tree							1	1	1	18	18	18	21	21	21	21	21	21	29	29	29
Quercus rubra	northern red oak	Tree	2	2	2	1	1	1	1	1	1	31	31	32	47	47	47	44	44	44	55	55	55
		Stem count	12	12	12	12	12	12	14	14	14	150	150	158	156	156	156	138	138	138	198	198	198
		size (ares)	1			1			1			12			12			12			12		
		size (ACRES)	0.02			0.02			0.02			0.30			0.30			0.30			0.30		
		Species count	5	5	5	4	4	4	4	4	4	7	7	10	8	8	8	7	7	7	7	7	7
		Stems per ACRE	486	486	486	486	486	486	567	567	567	506	506	533	520	520	520	460	460	460	660	660	660

Appendix D

Stream Measurement and Geomorphology Data

Table 10. Baseline Stream Data Summary
Groundhog Hollow Mitigation Site - Reach GF1-B

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	4.4	--	6.3	8.3	---	3	4.4	---	---	---	---	1	5.2	5.3	6.8	6.2	6.8	6.4	8.3	0.8	7
Floodprone Width (ft)					6.5	---	8.3	22.5	---	3	12.0	---	---	20.0	---	1	19.2	19.3	20.8	44.8	47.6	47.0	50.6	2.5	7
Bankfull Mean Depth (ft)		---	---	---	0.5	---	0.6	1.1	---	3	0.5	---	---	0.6	---	1	0.5	0.5	0.7	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.9	---	0.9	1.3	---	3	0.8	---	---	0.9	---	1	0.7	0.7	1.0	0.6	1.0	1.0	1.4	0.2	7
Bankfull Cross Sectional Area (ft^2)		---	---	---	2.6	---	4.5	6.8	---	3	2.1	---	---	2.8	---	1	2.5	2.7	5.0	1.9	3.8	3.4	6.2	1.4	7
Width/Depth Ratio					5.9	---	7.6	15.2	---	3	6.9	---	---	9.2	---	1	9.2	10.3	10.7	---	---	---	---	---	---
Entrenchment Ratio					1.3	---	1.5	2.9	---	3	2.7	---	---	4.5	---	1	3.6	3.7	3.9	5.5	7.1	7.3	8.2	1.0	7
[1]Bank Height Ratio					1.3	---	2.3	2.8	---	3	1.0	---	---	2.5	---	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	7
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	4	---	---	18	---	---	3.9	---	19.8	2	8	7	18	3	84
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.0	3.1	2.5	11.4	2.3	84.0
Pool Length (ft)					---	---	---	---	---	---	3	---	---	8	---	---	3.2	---	9	3	16	14	87	10	83
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	12	---	---	35	---	---	13.1	---	38.8	9	24	22	92	11	83
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	15	---	---	35	---	---	16.7	---	39	16.7	---	---	39	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	6	---	---	17	---	---	6.7	---	18.7	6.7	---	---	18.7	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.4	---	---	3.9	---	---	1.2	---	3.3	1.2	---	---	3.3	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	23	---	---	43	---	---	25.3	---	47.7	25.3	---	---	47.7	---	---
Meander Width Ratio					---	---	---	---	---	---	3.4	---	---	8	---	---	4.4	---	8.3	4.4	---	---	8.3	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					F4b						E4/5						C4/E4			C4/E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					1168						842						1535			1535					
Channel Thalweg length (ft)					1350						995						689			689					
Sinuosity (ft)					1.16						1.18						1.17			1.17					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.024						0.0033						0.011			0.011					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary (continued)
Groundhog Hollow Mitigation Site - Reach GF2-B

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	---	---	7.7	---	---	1	---	---	4.4	---	---	1	---	4.9	---	5.5	6.6	6.8	7.5	1.0	3
Floodprone Width (ft)					---	---	8.1	---	---	1	---	---	12.0	20.0	---	1	---	16.9	---	38.6	44.9	45.4	50.8	6.1	3
Bankfull Mean Depth (ft)		---	---	---	---	---	0.5	---	---	1	---	---	0.5	0.6	---	1	---	0.4	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					---	---	0.8	---	---	1	---	---	0.8	0.9	---	1	---	0.6	---	1.0	1.1	1.1	1.2	0.1	3
Bankfull Cross Sectional Area (ft^2)		---	---	---	---	---	4.0	---	---	1	---	---	2.1	2.8	---	1	---	2.2	---	3.0	3.8	3.7	4.8	0.9	3
Width/Depth Ratio					---	---	14.8	---	---	1	---	---	6.9	9.2	---	1	---	11.1	---	---	---	---	---	---	---
Entrenchment Ratio					---	---	1.1	---	---	1	---	---	2.7	4.5	---	1	---	3.4	---	5.7	6.9	6.8	8.3	1.3	3
[1]Bank Height Ratio					---	---	2.1	---	---	1	---	---	1.0	2.5	---	1	---	1.0	---	1.0	1.0	1.0	1.0	0.0	3
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	4	---	---	18	---	---	3.3	---	16.9	3	9	6	48	9	27
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.5	3.4	2.5	16.3	3.2	27.0
Pool Length (ft)					---	---	---	---	---	---	3	---	---	8	---	---	2.7	---	7.6	6	12	11	22	4	26
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	12	---	---	35	---	---	11.1	---	33	12	21	19	65	11	25
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	15	---	---	35	---	---	14	---	33	14	---	---	33	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	6	---	---	17	---	---	6	---	16	6	---	---	16	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.4	---	---	3.9	---	---	1.2	---	3.3	1.2	---	---	3.3	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	23	---	---	43	---	---	30	---	56	30	---	---	56	---	---
Meander Width Ratio					---	---	---	---	---	---	3.4	---	---	8	---	---	6.1	---	11.5	6.1	---	---	11.5	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					F4b						E4/5						C4/E4			C4/E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---			---					
Valley length (ft)					573						842						492			492					
Channel Thalweg length (ft)					680						995						53			53					
Sinuosity (ft)					1.19						1.18						1.14			1.14					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.031						0.0033						0.02			0.02					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary (continued)
Groundhog Hollow Mitigation Site - Reach GF3-B

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	---	---	4.1	---	---	1	---	---	4.4	---	---	1	---	5.3	---	---	---	7.6	---	---	1
Floodprone Width (ft)					---	---	6.2	---	---	1	---	---	12.0	20.0	---	1	---	19.3	---	---	---	25.6	---	---	1
Bankfull Mean Depth (ft)		---	---	---	---	---	0.7	---	---	1	---	---	0.5	0.6	---	1	---	0.5	---	---	---	---	---	---	1
[1]Bankfull Max Depth (ft)					---	---	1.0	---	---	1	---	---	0.8	0.9	---	1	---	0.7	---	---	---	0.9	---	---	1
Bankfull Cross Sectional Area (ft^2)		---	---	---	---	---	2.9	---	---	1	---	---	2.1	2.8	---	1	---	2.7	---	---	---	2.9	---	---	1
Width/Depth Ratio					---	---	5.8	---	---	1	---	---	6.9	9.2	---	1	---	10.3	---	---	---	---	---	---	1
Entrenchment Ratio					---	---	1.5	---	---	1	---	---	2.7	4.5	---	1	---	3.6	---	---	---	3.4	---	---	1
[1]Bank Height Ratio					---	---	1.6	---	---	1	---	---	1.0	2.5	---	1	---	1.0	---	---	---	1.0	---	---	1
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	4	---	---	18	---	---	3.1	---	15.8	3	7	6	12	2	16
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.1	4.6	4.2	11.8	3.2	16.0
Pool Length (ft)					---	---	---	---	---	---	3	---	---	8	---	---	2.6	---	7.2	7	12	11	23	4	15
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	12	---	---	35	---	---	3.8	---	31	10	18	18	27	4	14
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	15	---	---	35	---	---	13	---	31	13	---	---	31	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	6	---	---	17	---	---	5	---	15	5	---	---	15	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	1.4	---	---	3.9	---	---	1	---	2.8	1	---	---	2.8	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	23	---	---	43	---	---	20	---	38	20	---	---	38	---	---
Meander Width Ratio					---	---	---	---	---	---	3.4	---	---	8	---	---	3.8	---	7.2	3.8	---	---	7.2	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5/6						E4/5						C4/E4			C4/E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---			---					
Valley length (ft)					253						842						294			294					
Channel Thalweg length (ft)					272						995						343			343					
Sinuosity (ft)					1.08						1.18						1.17			1.17					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.021						0.0033						0.013			0.013					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

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

Project Name/Number: Groundhog Hollow #100049

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Pool)							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+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1103.8	1103.8	1103.7	1103.9				1103.5	1103.5	1103.5	1103.6				1097.9	1097.9	1098.0	1098.0				1097.5	1097.5	1097.5	1097.6				1092.7	1092.7	1092.8	1092.8			
Bankfull Width (ft)[1]	6.3	5.8	6.7	4.7				6.4	6.8	7.2	6.6				8.5	9.5	7.9	8.1				6.2	6.2	5.7	7.3				6.3	5.5	4.7	4.8			
Floodprone Width (ft)[1]	50.0	42.7	>42.5	>43.6				-	-	-	-				-	-	-	-				>50.6	>50.7	>50.6	>50.9				45	>45	>45.9	>44.7			
Bankfull Max Depth (ft)[2]	0.6	0.6	0.6	0.6				0.7	0.7	0.7	0.7				1.6	1.4	1.2	1.3				1.0	1.1	1.0	1.2				0.9	1.0	1.1	1.1			
Low Bank Elevation (ft)	1103.77	1103.9	1103.7	1103.8				1103.5	1103.5	1103.5	1103.6				1097.9	1097.9	1097.8	1097.9				1097.5	1097.6	1097.5	1097.6				1092.7	1092.7	1092.8	1092.9			
Bankfull Cross Sectional Area (ft^2)[2]	1.9	2.3	1.7	1.6				2.3	2.3	2.5	2.3				6.1	5.8	4.7	5.0				3.3	3.9	3.0	3.3				2.6	2.7	2.7	3.1			
Bankfull Entrenchment Ratio[1]	7.9	7.4	>6.3	>9.2				-	-	-	-				-	-	-	-				8.2	>8.2	>8.9	>7.0				7.1	>8.2	>9.8	>9.3			
Bankfull Bank Height Ratio[1]	1.0	1.1	0.9	0.9				-	-	-	-				-	-	-	-				1.0	1.1	0.9	1.0				1.0	1.0	1.0	1.1			

	Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section 8 (Pool)							Cross Section 9 (Riffle)							Cross Section 10 (Pool)						
	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+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1092.2	1091.9	1091.9	1092.0				1085.5	1085.5	1085.7	1085.9				1085.2	1085.2	1085.4	1085.5				1081.3	1081.4	1081.4	1081.5				1081.0	1080.9	1081.0	1081.0			
Bankfull Width (ft)[1]	7.9	5.5	5.6	5.8				6.4	7.3	7.7	6.0				6.5	8.3	5.9	6.9				7.6	6.6	7.3	6.9				6.6	6.0	6.9	6.7			
Floodprone Width (ft)[1]	-	-	-	-				>49.8	>50	>50.2	>49.9				-	-	-	-				>44.8	>45.4	>44.2	>45.7				-	-	-	-			
Bankfull Max Depth (ft)[2]	1.2	1.6	1.8	1.8				1.0	0.9	0.9	0.8				1.0	1.0	0.9	1.0				1.1	1.0	1.1	1.0				1.2	1.5	1.5	1.6			
Low Bank Elevation (ft)	1092.2	1092.2	1092.3	1092.3				1085.5	1085.5	1085.5	1085.4				1085.2	1085.2	1085.2	1085.4				1081.3	1081.3	1081.4	1081.3				1081.00	1081.0	1081.0	1081.0			
Bankfull Cross Sectional Area (ft^2)[2]	5.0	7.2	7.8	7.4				4.7	4.2	3.7	2.2				4.1	4.1	2.9	3.4				4.5	3.8	4.4	3.6				4.7	5.5	5.0	5.0			
Bankfull Entrenchment Ratio[1]	-	-	-	-				7.8	>6.9	>6.5	>8.4				-	-	-	-				5.9	>6.9	>6.1	>6.7				-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-				1.0	0.9	0.9	0.7				-	-	-	-				1.0	0.9	1.0	0.9				-	-	-	-			

	Cross Section 11 (Riffle)							Cross Section 12 (Pool)							Cross Section 13 (Pool)							Cross Section 14 (Riffle)							Cross Section 15 (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+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1076.2	1076.3	1076.6	1076.4				1076.3	1076.3	1076.3	1076.1				1071.6	1071.5	1071.6	1071.1				1071.0	1071.1	1071.1	1071.1				1119.1	1119.2	1119.3	1119.3			
Bankfull Width (ft)[1]	6.4	6.8	6.8	6.3				5.5	7.1	5.7	5.4				7.8	7.3	7.5	5.3				8.3	8.1	8.1	7.7				6.8	6.7	7.3	6.2			
Floodprone Width (ft)[1]	>47	>49	>50.2	>50.2				-	-	-	-				-	-	-	-				46.1	46.5	46.5	46.5				>38.6	>38.6	>38.9	>39.3			
Bankfull Max Depth (ft)[2]	0.9	0.8	0.9	0.9				1.6	1.5	1.7	1.8				2.5	3.0	3.1	3.4				1.4	1.4	1.4	1.4				1.2	1.1	1.1	1.2			
Low Bank Elevation (ft)	1076.24	1076.2	1076.4	1076.3				1076.3	1076.2	1076.2	1076.2				1071.6	1071.7	1071.7	1071.6				1071.0	1071.1	1071.3	1071.1				1119.1	1119.2	1119.2	1119.2			
Bankfull Cross Sectional Area (ft^2)[2]	3.4	2.9	2.4	3.1				5.4	5.4	5.6	6.2				9.9	9.9	11.3	13.0				6.2	6.2	6.6	6.3				4.8	4.5	4.3	4.2			
Bankfull Entrenchment Ratio[1]	7.3	>7.2	>7.4	>8.0				-	-	-	-				-	-	-	-				5.5	5.7	5.7	6.1				5.7	>5.8	>5.3	>6.3			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9	0.9				-	-	-	-				-	-	-	-				1.0	1.0	0.9	1.0				1.0	1.0	0.9	0.9			

	Cross Section 16 (Pool)							Cross Section 17 (Pool)							Cross Section 18 (Riffle)							Cross Section 19 (Riffle)							Cross Section 20 (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+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1118.6	1119.2	1118.7	1118.6				1111.0	1111.0	1111.0	1111.0				1110.6	1110.5	1110.5	1110.6				1087.0	1087.0	1087.0	1087.1				1084.8	1084.9	1085.0	1085.1			
Bankfull Width (ft)[1]	8.0	7.2	8.5	7.3				7.5	7.0	6.8	6.2				5.5	4.8	5.1	6.2				4.9	4.7	4.6	4.8				6.2	6.4	6.2	5.8			
Floodprone Width (ft)[1]	-	-	-	-				-	-	-	-				>45.4	>45.3	>45.5	>45.9				6.3	6.4	>6	6.5				9.6	8.7	>9.3	10.5			
Bankfull Max Depth (ft)[2]	2.3	2.4	2.3	2.2				1.1	1.3	1.3	1.4				1.0	1.0	1.0	1.1				0.8	1.0	0.8	2.7				0.8	0.7	1.9	1.5			
Low Bank Elevation (ft)	1118.63	1119.2	1118.6	1118.6				1111.0	1111.0	1111.0	1111.0				1110.6	1110.5	1110.5	1110.5				1089.2	1088.9	1088.9	1089.0				1086.2	1086.3	1086.0	1085.7			
Bankfull Cross Sectional Area (ft^2)[2]	8.3	8.8	7.6	8.3				3.7	3.7	3.7	3.5				3.0	3.0	2.8	3.3				3.0	3.0	2.9	14.7				3.0	3.0	11.1	7.7			
Bankfull Entrenchment Ratio[1]	-	-	-	-				-	-	-	-				8.3	>9.4	>8.8	>7.4				1.3	1.4	>1.3	1.4				1.5	1.4	1.5	1.8			
Bankfull Bank Height Ratio[1]	-	-	-	-				-	-	-	-				1.0	1.0	1..0	1.1				3.6	2.9	3.2	3.0				2.9	3.0	>2.2	1.7			

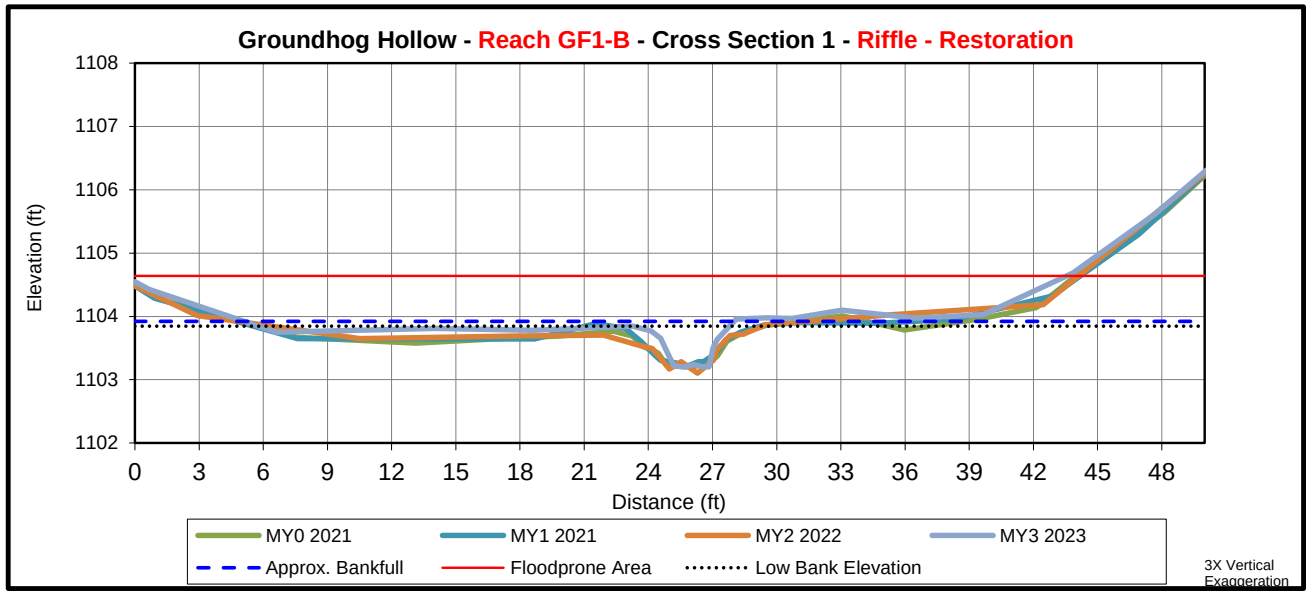
	Cross Section 21 (Riffle)							Cross Section 22 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1079.8	1079.9	1080.0	1080.1				1079.6	1079.8	1079.9	1080.0			
Bankfull Width (ft)[1]	7.6	5.5	7.9	4.6				6.2	5.1	4.7	4.4			
Floodprone Width (ft)[1]	25.6	27.1	>23.8	31.9				-	-	-	-			
Bankfull Max Depth (ft)[2]	0.9	0.8	0.7	0.7				1.0	0.7	1.1	0.9			
Low Bank Elevation (ft)	1079.84	1079.8	1079.9	1079.8				1079.6	1079.5	1079.7	1079.8			
Bankfull Cross Sectional Area (ft^2)[2]	2.9	2.3	2.2	1.7				3.1	1.9	2.5	2.5			
Bankfull Entrenchment Ratio[1]	3.4	4.9	>3.0	6.9				-	-	-	-			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9	0.7				-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

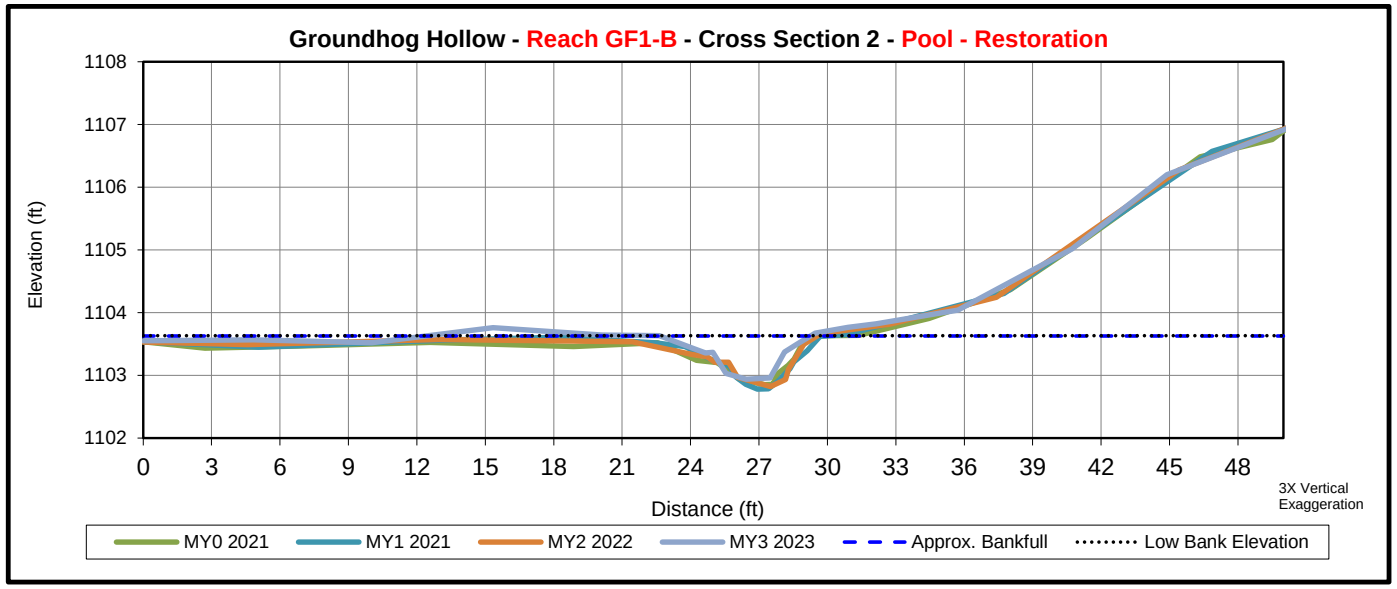


	Cross Section 1 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1103.77	1103.8	1103.7	1103.9			
Bankfull Width (ft)[1]	6.3	5.8	6.7	4.7			
Floodprone Width (ft)[1]	50.0	42.7	>42.5	>43.6			
Bankfull Max Depth (ft)[2]	0.6	0.6	0.6	0.6			
Low Bank Elevation (ft)	1103.77	1103.9	1103.7	1103.8			
Bankfull Cross Sectional Area (ft^2)[2]	1.9	2.3	1.7	1.6			
Bankfull Entrenchment Ratio[1]	7.9	7.4	>6.3	>9.2			
Bankfull Bank Height Ratio[1]	1.0	1.1	0.9	0.9			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

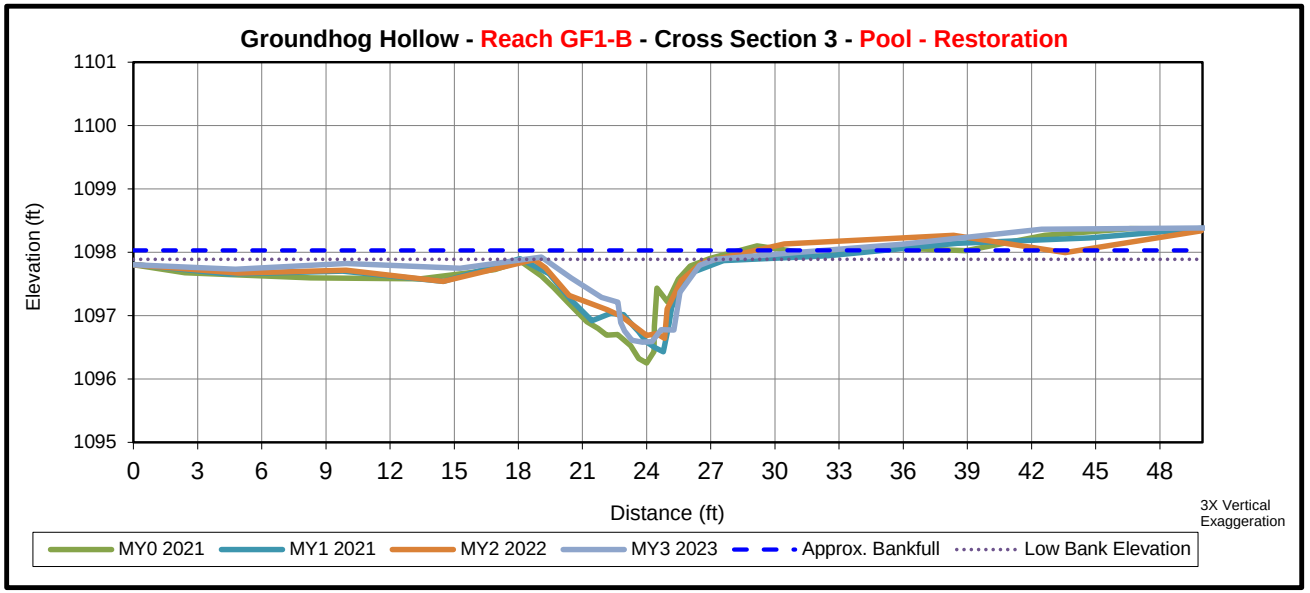


	Cross Section 2 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1103.52	1103.5	1103.5	1103.6			
Bankfull Width (ft)[1]	6.4	6.8	7.2	6.6			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	0.7	0.7	0.7	0.7			
Low Bank Elevation (ft)	1103.52	1103.5	1103.5	1103.6			
Bankfull Cross Sectional Area (ft^2)[2]	2.3	2.3	2.5	2.3			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

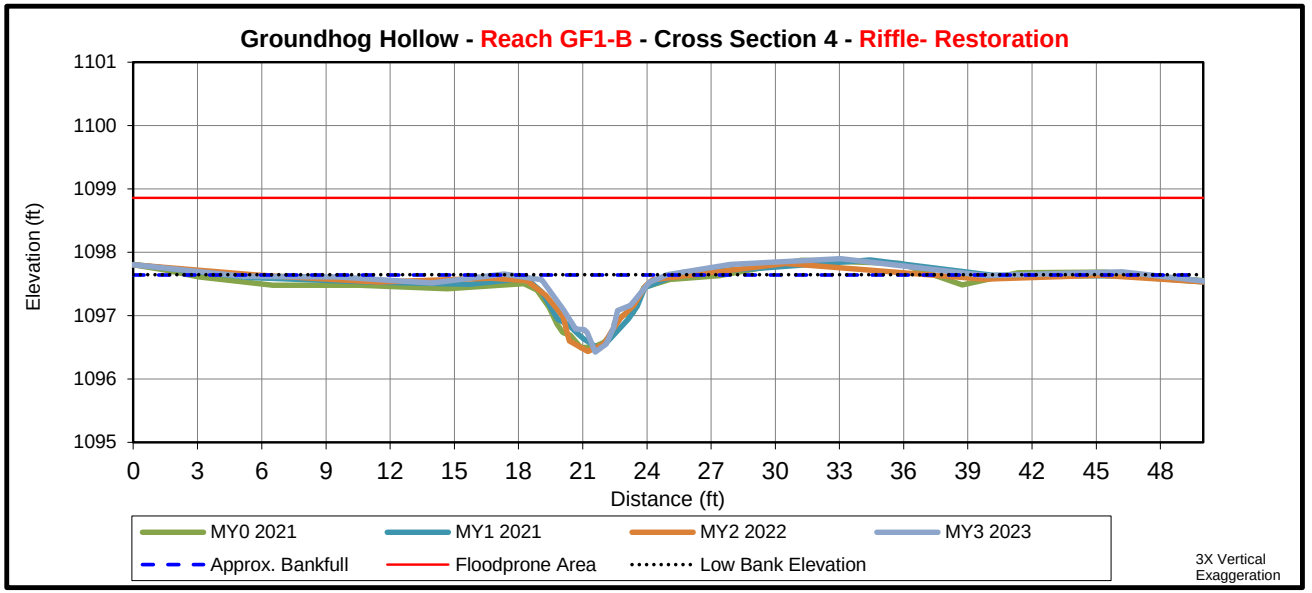


	Cross Section 3 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1097.86	1097.9	1098.0	1098.0			
Bankfull Width (ft)[1]	8.5	9.5	7.9	8.1			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.6	1.4	1.2	1.3			
Low Bank Elevation (ft)	1097.86	1097.9	1097.8	1097.9			
Bankfull Cross Sectional Area (ft^2)[2]	6.1	5.8	4.7	5.0			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

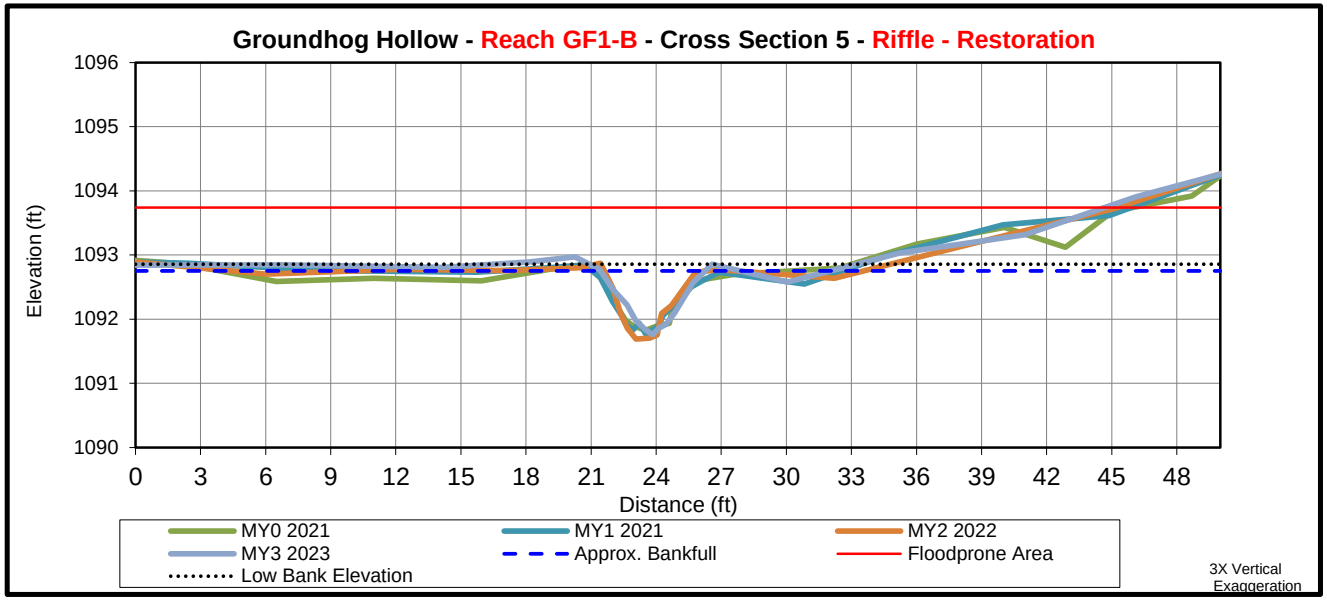


	Cross Section 4 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1097.50	1097.5	1097.5	1097.6			
Bankfull Width (ft)[1]	6.2	6.2	5.7	7.3			
Floodprone Width (ft)[1]	>50.6	>50.7	>50.6	>50.9			
Bankfull Max Depth (ft)[2]	1.0	1.1	1.0	1.2			
Low Bank Elevation (ft)	1097.50	1097.6	1097.5	1097.6			
Bankfull Cross Sectional Area (ft^2)[2]	3.3	3.9	3.0	3.3			
Bankfull Entrenchment Ratio[1]	8.2	>8.2	>8.9	>7.0			
Bankfull Bank Height Ratio[1]	1.0	1.1	0.9	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 (June 14th, 2023)

Downstream (June 14th, 2023)

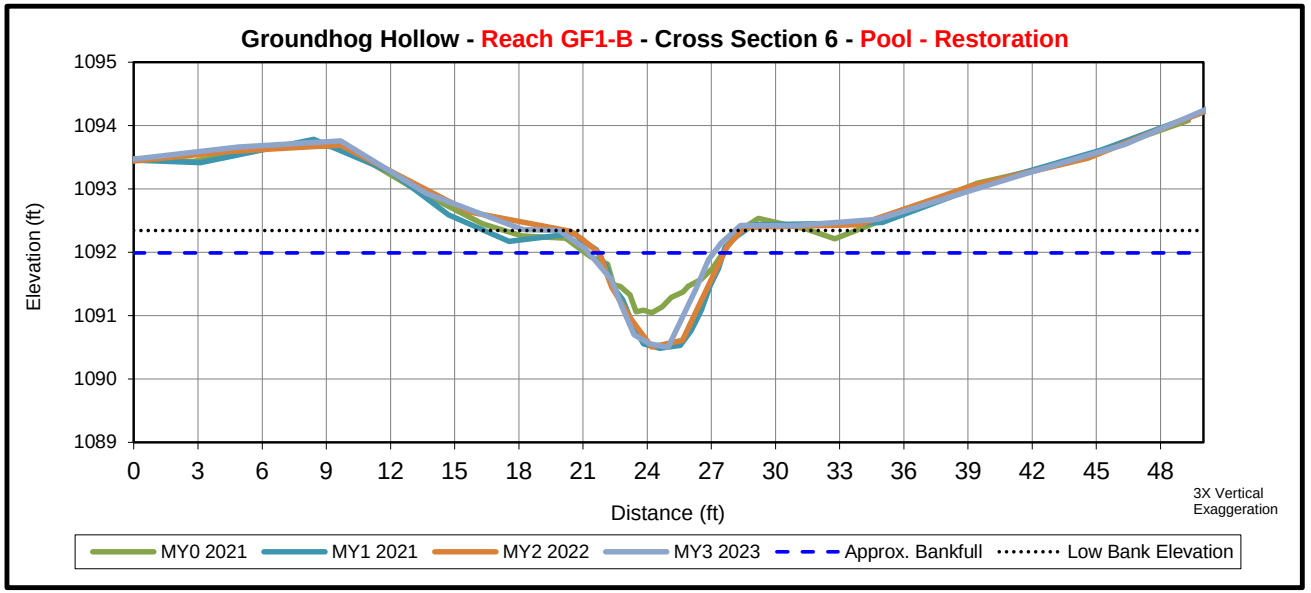


	Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1092.70	1092.7	1092.8	1092.8			
Bankfull Width (ft)[1]	6.3	5.5	4.7	4.8			
Floodprone Width (ft)[1]	45	>45	>45.9	>44.7			
Bankfull Max Depth (ft)[2]	0.9	1.0	1.1	1.1			
Low Bank Elevation (ft)	1092.70	1092.7	1092.8	1092.9			
Bankfull Cross Sectional Area (ft^2)[2]	2.6	2.7	2.7	3.1			
Bankfull Entrenchment Ratio[1]	7.1	>8.2	>9.8	>9.3			
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.1			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

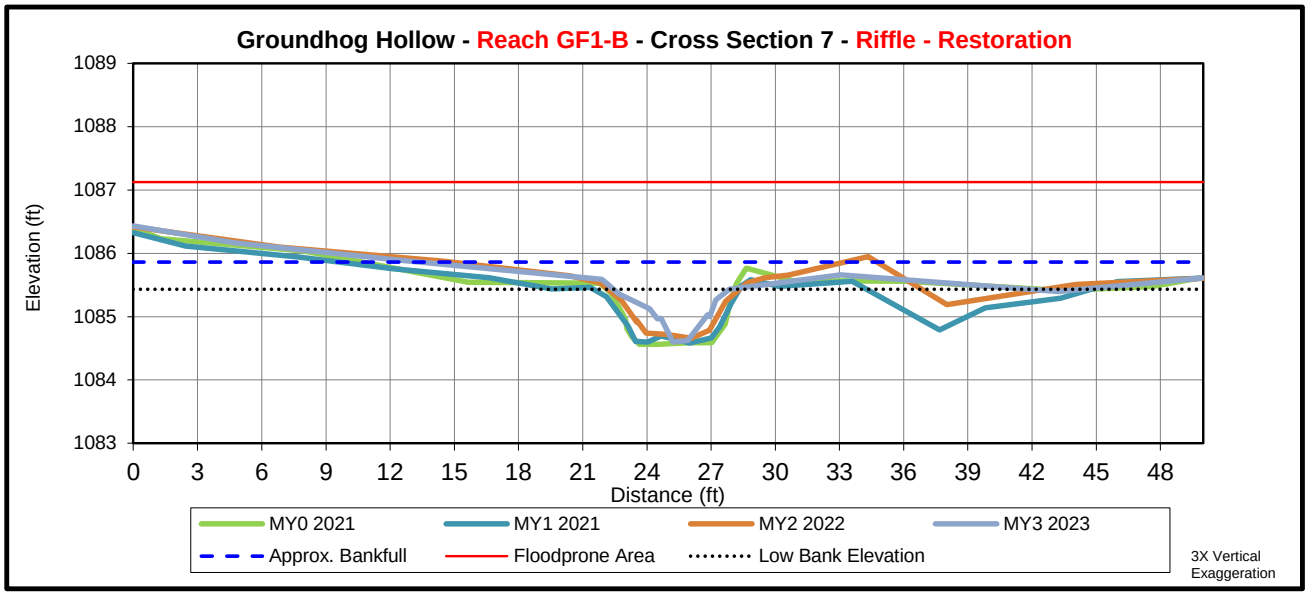


	Cross Section 6 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1092.22	1091.9	1091.9	1092.0			
Bankfull Width (ft)[1]	7.9	5.5	5.6	5.8			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.2	1.6	1.8	1.8			
Low Bank Elevation (ft)	1092.22	1092.2	1092.3	1092.3			
Bankfull Cross Sectional Area (ft^2)[2]	5.0	7.2	7.8	7.4			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

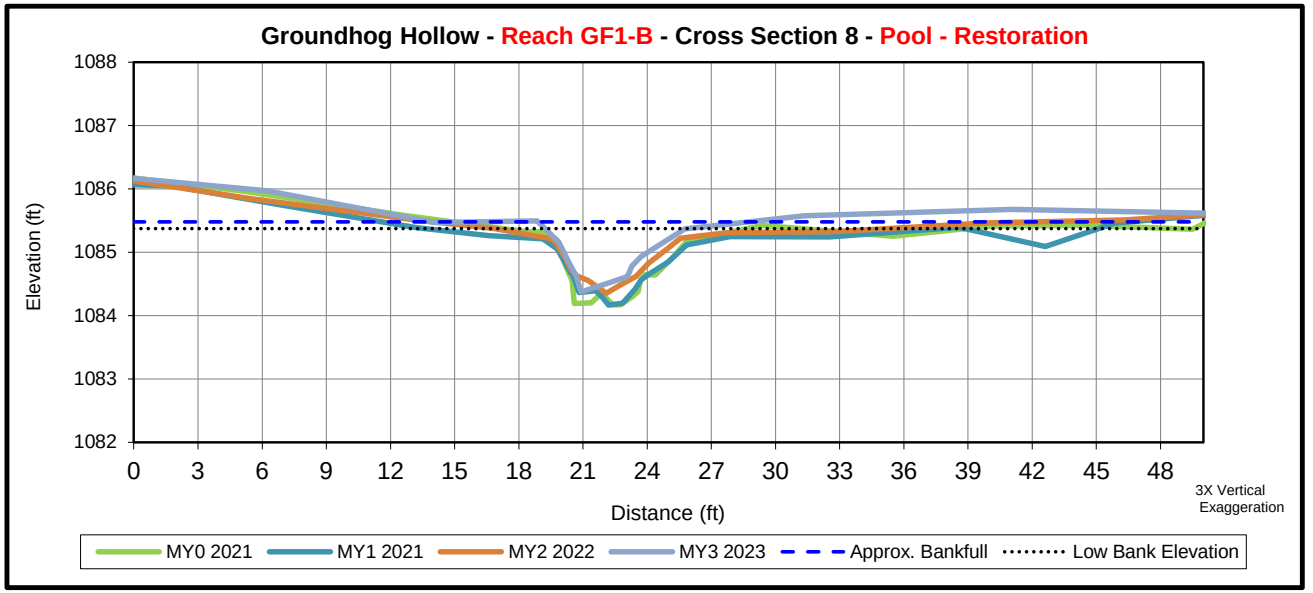


	Cross Section 7 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1085.53	1085.5	1085.7	1085.9			
Bankfull Width (ft)[1]	6.4	7.3	7.7	6.0			
Floodprone Width (ft)[1]	>49.8	>50	>50.2	>49.9			
Bankfull Max Depth (ft)[2]	1.0	0.9	0.9	0.8			
Low Bank Elevation (ft)	1085.53	1085.5	1085.5	1085.4			
Bankfull Cross Sectional Area (ft^2)[2]	4.7	4.2	3.7	2,2			
Bankfull Entrenchment Ratio[1]	7.8	>6.9	>6.5	>8.4			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9	0.7			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

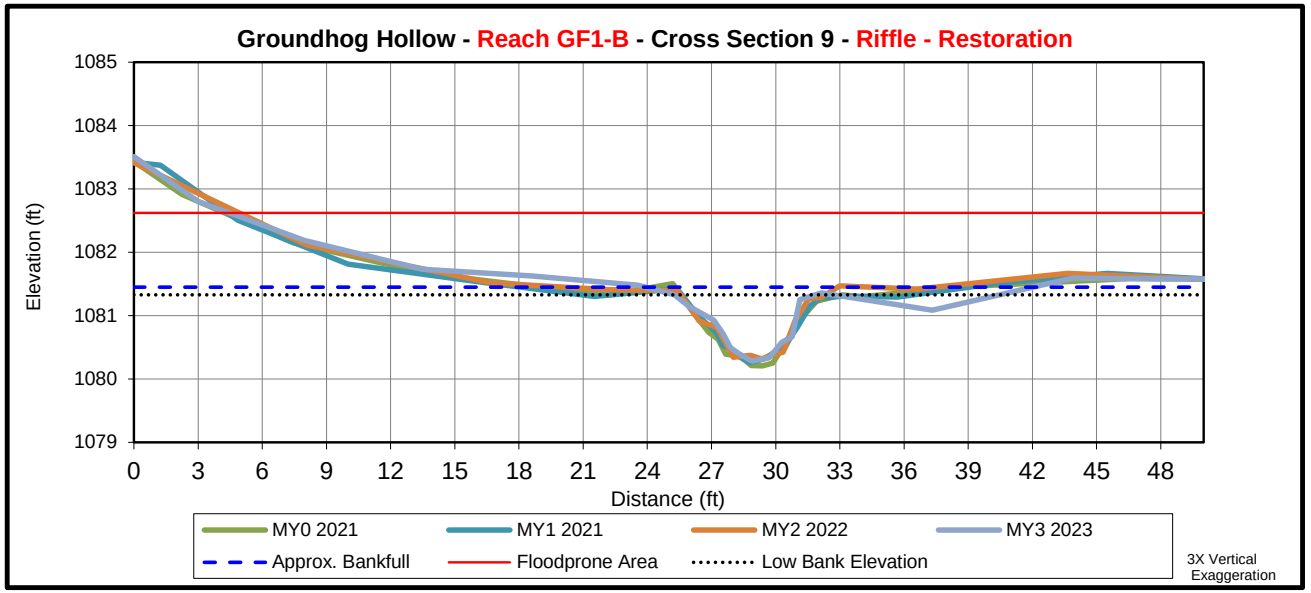


	Cross Section 8 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1085.20	1085.2	1085.4	1085.5			
Bankfull Width (ft)[1]	6.5	8.3	5.9	6.9			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.0	1.0	0.9	1.0			
Low Bank Elevation (ft)	1085.20	1085.2	1085.2	1085.4			
Bankfull Cross Sectional Area (ft^2)[2]	4.1	4.1	2.9	3.4			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

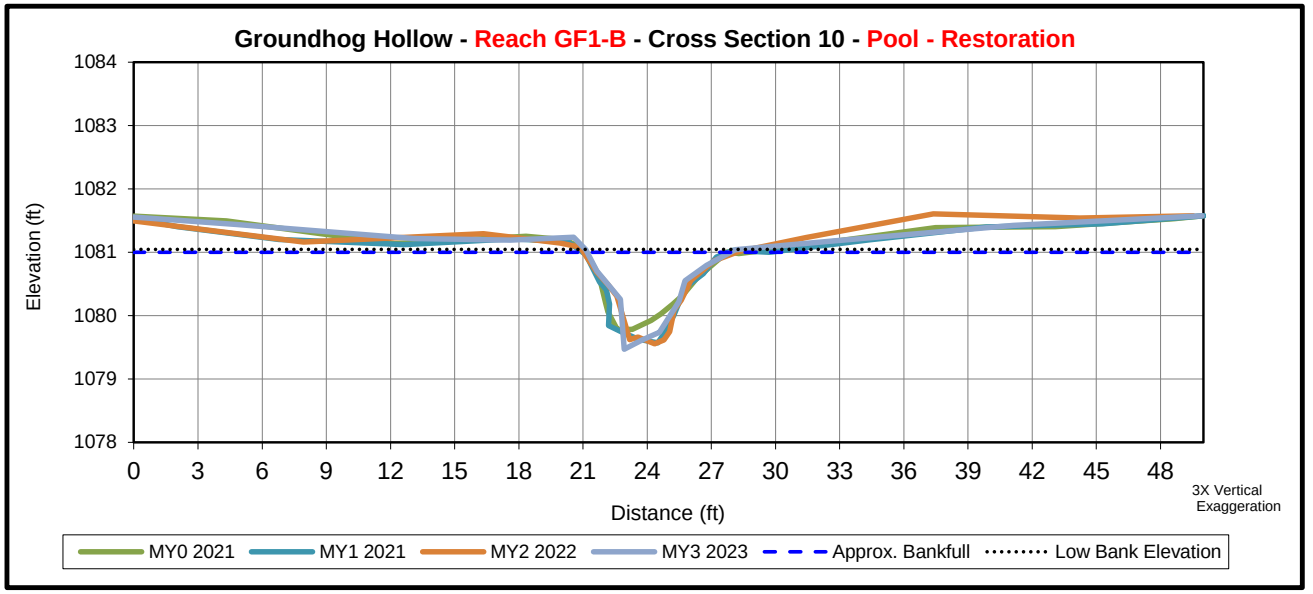


	Cross Section 9 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1081.33	1081.4	1081.4	1081.5			
Bankfull Width (ft)[1]	7.6	6.6	7.3	6.9			
Floodprone Width (ft)[1]	>44.8	>45.4	>44.2	>45.7			
Bankfull Max Depth (ft)[2]	1.1	1.0	1.1	1.0			
Low Bank Elevation (ft)	1081.33	1081.3	1081.4	1081.3			
Bankfull Cross Sectional Area (ft^2)[2]	4.5	3.8	4.4	3.6			
Bankfull Entrenchment Ratio[1]	5.9	>6.9	>6.1	>6.7			
Bankfull Bank Height Ratio[1]	1.0	0.9	1.0	0.9			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

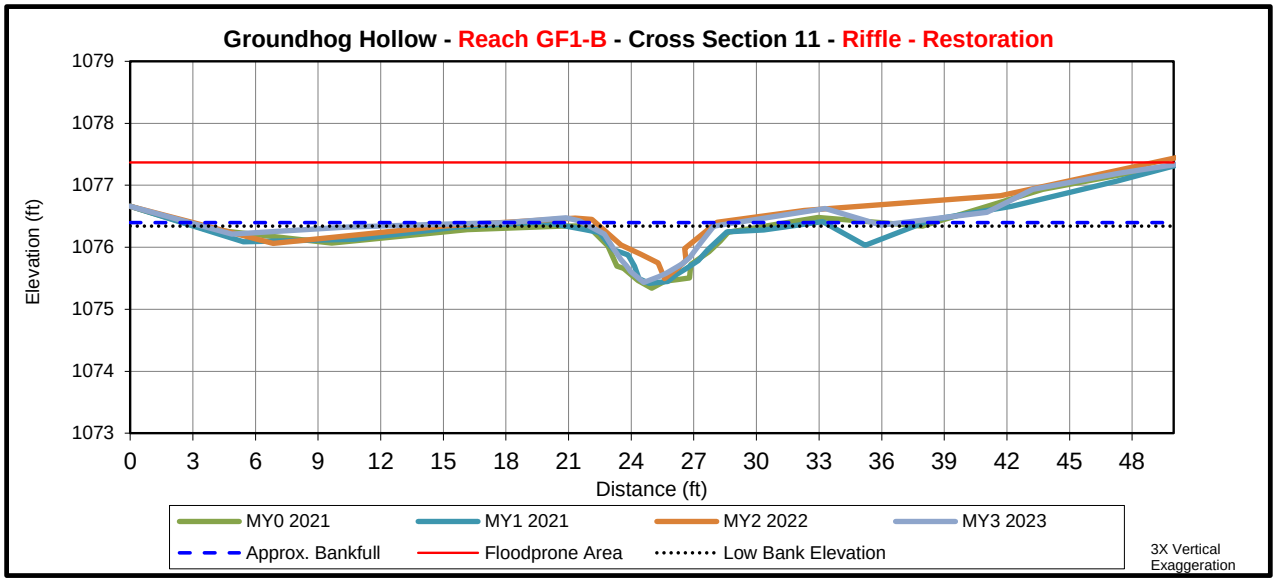


	Cross Section 10 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1081.00	1080.9	1081.0	1081.0			
Bankfull Width (ft)[1]	6.6	6.0	6.9	6.7			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.2	1.5	1.5	1.6			
Low Bank Elevation (ft)	1081.00	1081.0	1081.0	1081.0			
Bankfull Cross Sectional Area (ft^2)[2]	4.7	5.5	5.0	5.0			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

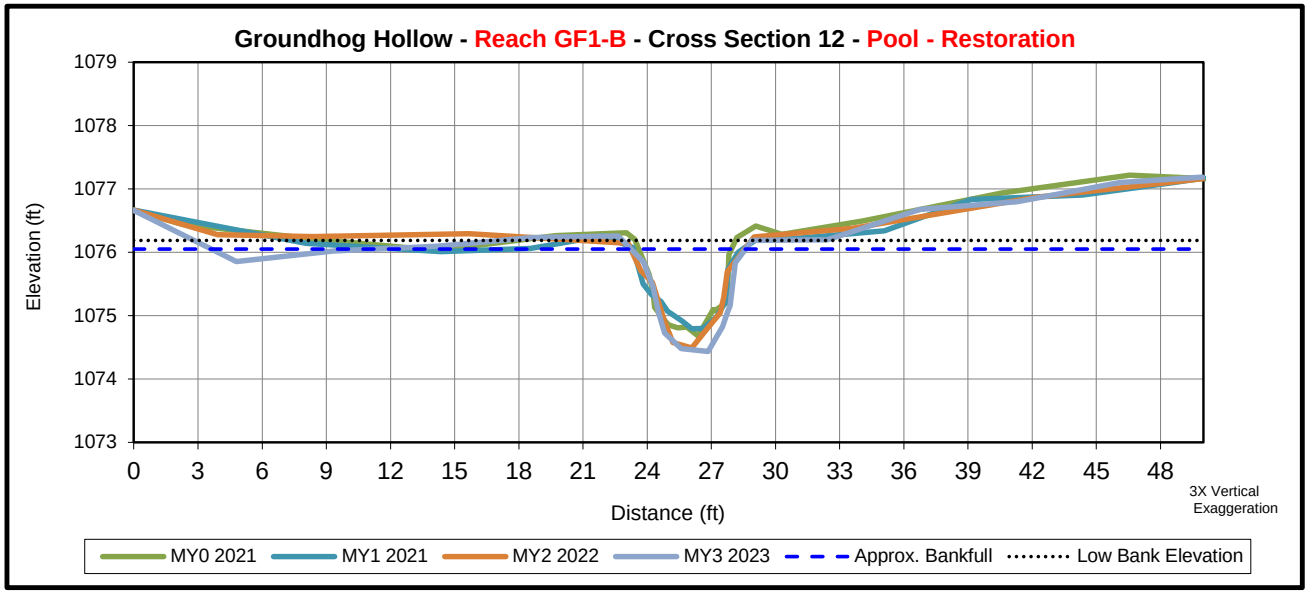


	Cross Section 11 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1076.24	1076.3					
Bankfull Width (ft)[1]	6.4	6.8					
Floodprone Width (ft)[1]	>47	>49					
Bankfull Max Depth (ft)[2]	0.9	0.8					
Low Bank Elevation (ft)	1076.24	1076.2					
Bankfull Cross Sectional Area (ft^2)[2]	3.4	2.9					
Bankfull Entrenchment Ratio[1]	7.3	>7.2					
Bankfull Bank Height Ratio[1]	1.0	0.9					

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 (June 14th, 2023)

Downstream (June 14th, 2023)



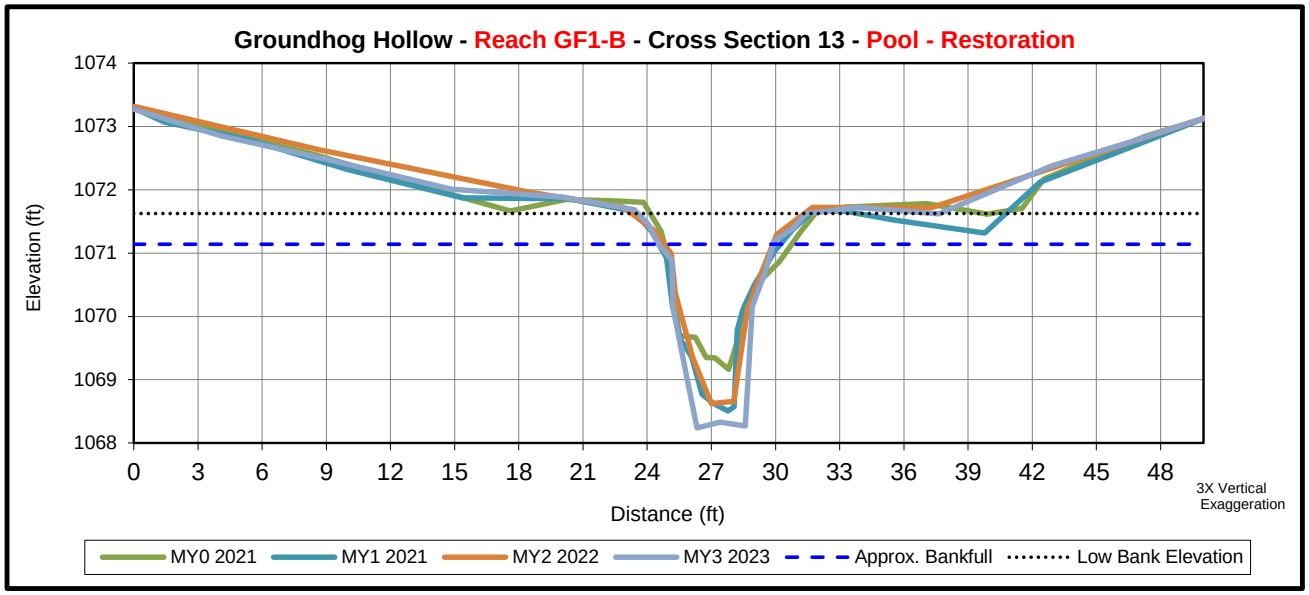
	Cross Section 12 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1076.31	1076.3	1076.3	1076.1			
Bankfull Width (ft)[1]	5.5	7.1	5.7	5.4			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.6	1.5	1.7	1.8			
Low Bank Elevation (ft)	1076.31	1076.2	1076.2	1076.2			
Bankfull Cross Sectional Area (ft^2)[2]	5.4	5.4	5.6	6.2			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

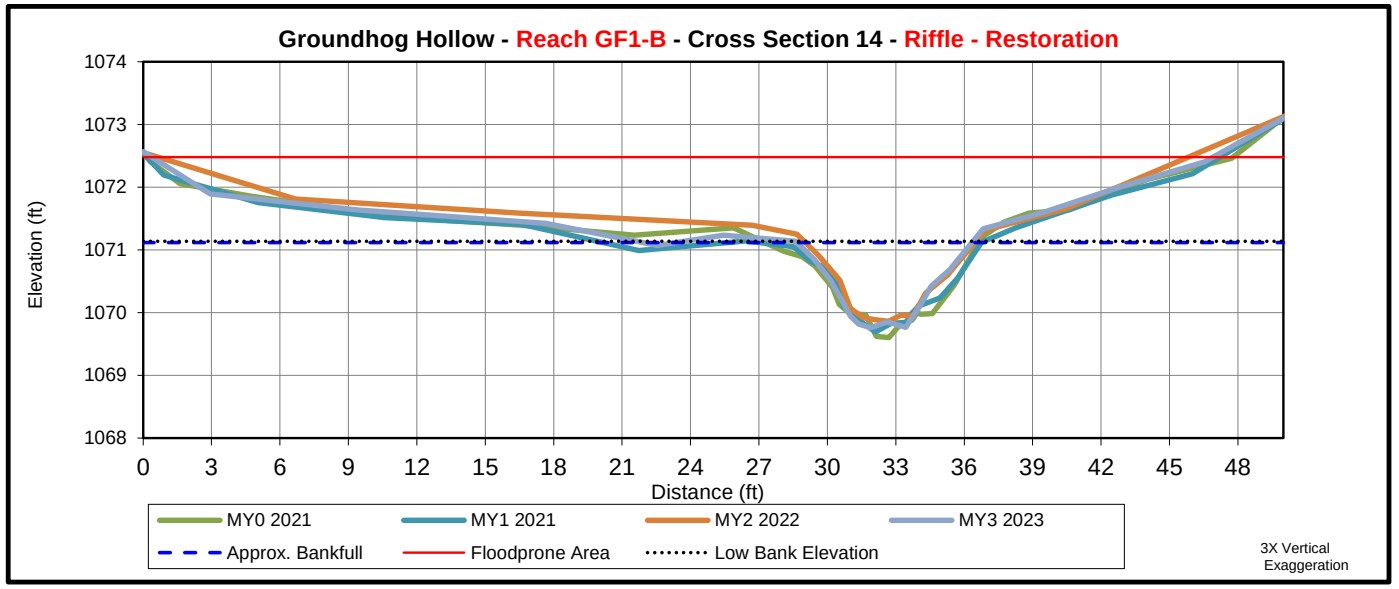


	Cross Section 13 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1071.64	1071.5	1071.6	1071.1			
Bankfull Width (ft)[1]	7.8	7.3	7.5	5.3			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	2.5	3.0	3.1	3.4			
Low Bank Elevation (ft)	1071.64	1071.7	1071.7	1071.6			
Bankfull Cross Sectional Area (ft^2)[2]	9.9	9.9	11.3	13.0			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

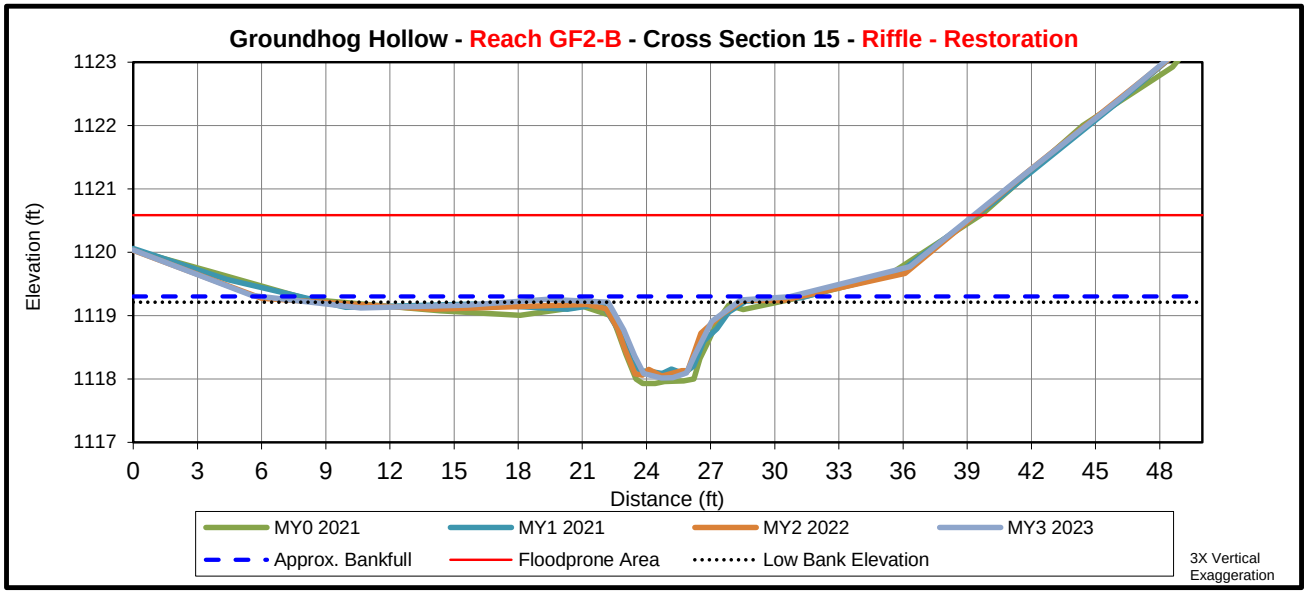


	Cross Section 14 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1070.98	1071.1	1071.1	1071.1			
Bankfull Width (ft)[1]	8.3	8.1	8.1	7.7			
Floodprone Width (ft)[1]	46.1	46.5	46.5	46.5			
Bankfull Max Depth (ft)[2]	1.4	1.4	1.4	1.4			
Low Bank Elevation (ft)	1070.98	1071.1	1071.3	1071.1			
Bankfull Cross Sectional Area (ft^2)[2]	6.2	6.2	6.6	6.3			
Bankfull Entrenchment Ratio[1]	5.5	5.7	5.7	6.1			
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9	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 (June 14th, 2023)

Downstream (June 14th, 2023)

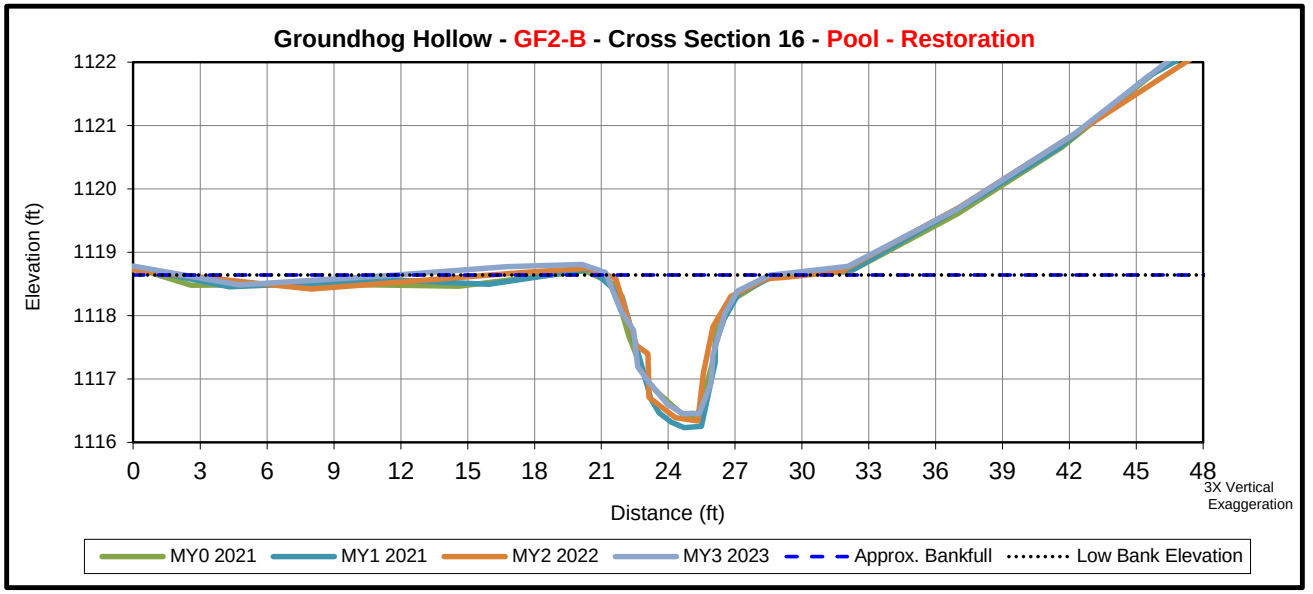


	Cross Section 15 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1119.15	1119.2	1119.3	1119.3			
Bankfull Width (ft)[1]	6.8	6.7	7.3	6.2			
Floodprone Width (ft)[1]	>38.6	>38.6	>38.9	>39.3			
Bankfull Max Depth (ft)[2]	1.2	1.1	1.1	1.2			
Low Bank Elevation (ft)	1119.15	1119.2	1119.2	1119.2			
Bankfull Cross Sectional Area (ft^2)[2]	4.8	4.5	4.3	4.2			
Bankfull Entrenchment Ratio[1]	5.7	>5.8	>5.3	>6.3			
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9	0.9			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

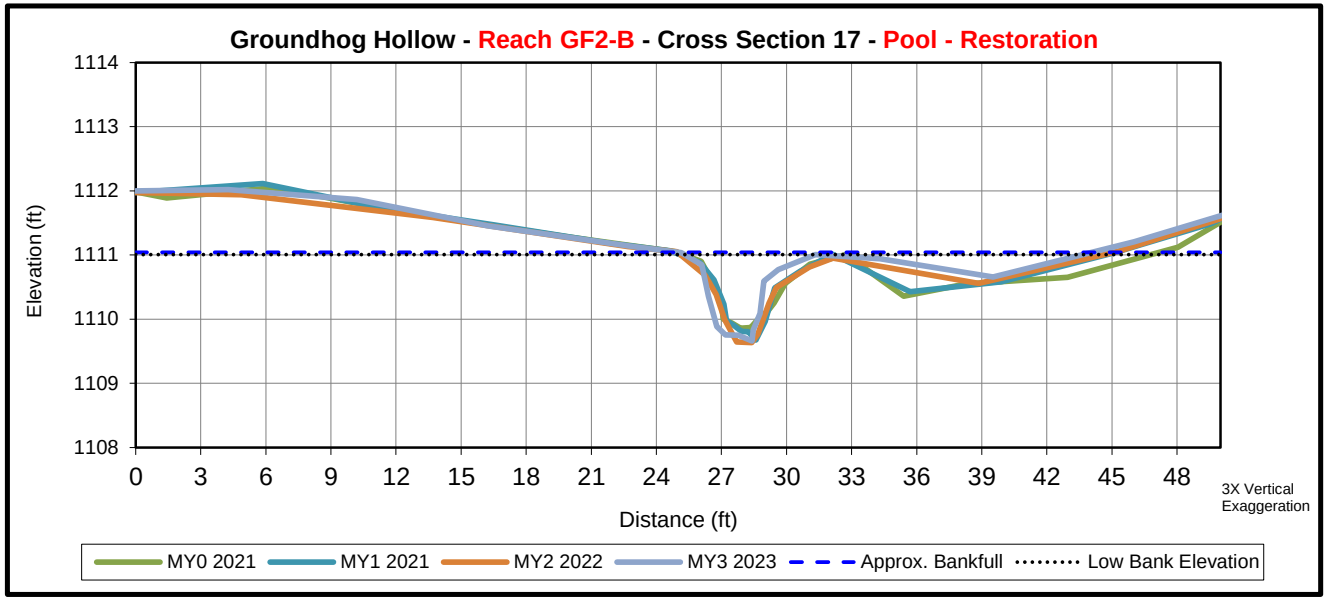


	Cross Section 16 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1118.63	1119.2	1118.7	1118.6			
Bankfull Width (ft)[1]	8.0	7.2	8.5	7.3			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	2.3	2.4	2.3	2.2			
Low Bank Elevation (ft)	1118.63	1119.2	1118.6	1118.6			
Bankfull Cross Sectional Area (ft^2)[2]	8.3	8.8	7.6	8.3			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

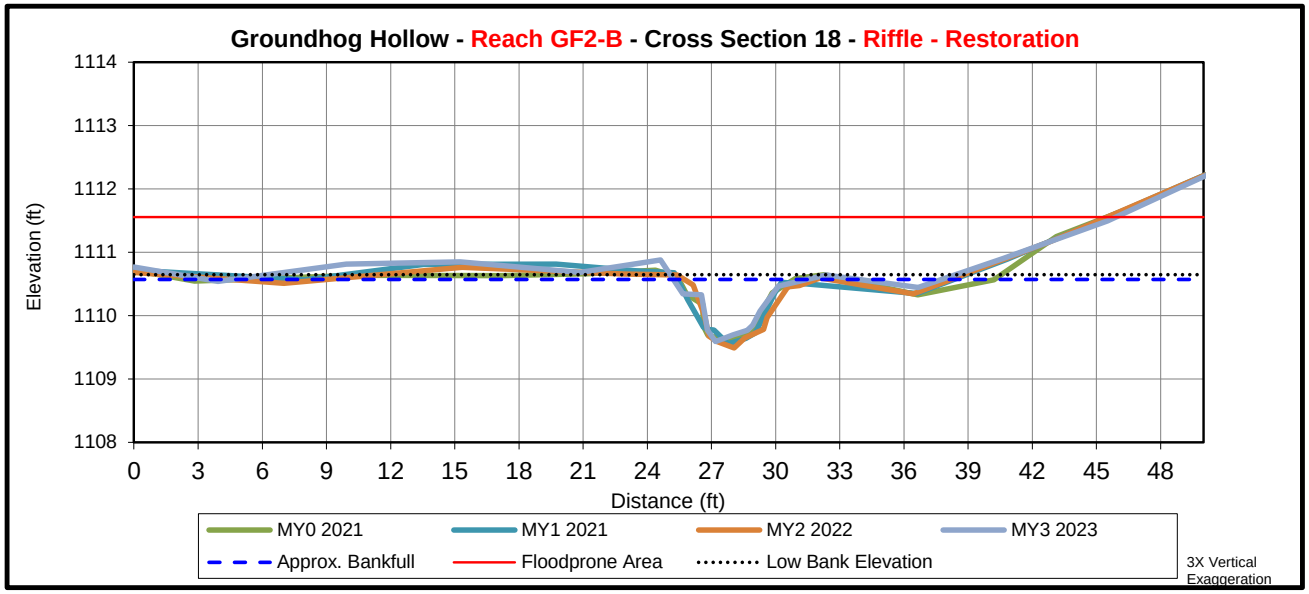


	Cross Section 17 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1111.00	1111.0	1111.0	1111.0			
Bankfull Width (ft)[1]	7.5	7.0	6.8	6.2			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.1	1.3	1.3	1.4			
Low Bank Elevation (ft)	1111.00	1111.0	1111.0	1111.0			
Bankfull Cross Sectional Area (ft^2)[2]	3.7	3.7	3.7	3.5			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

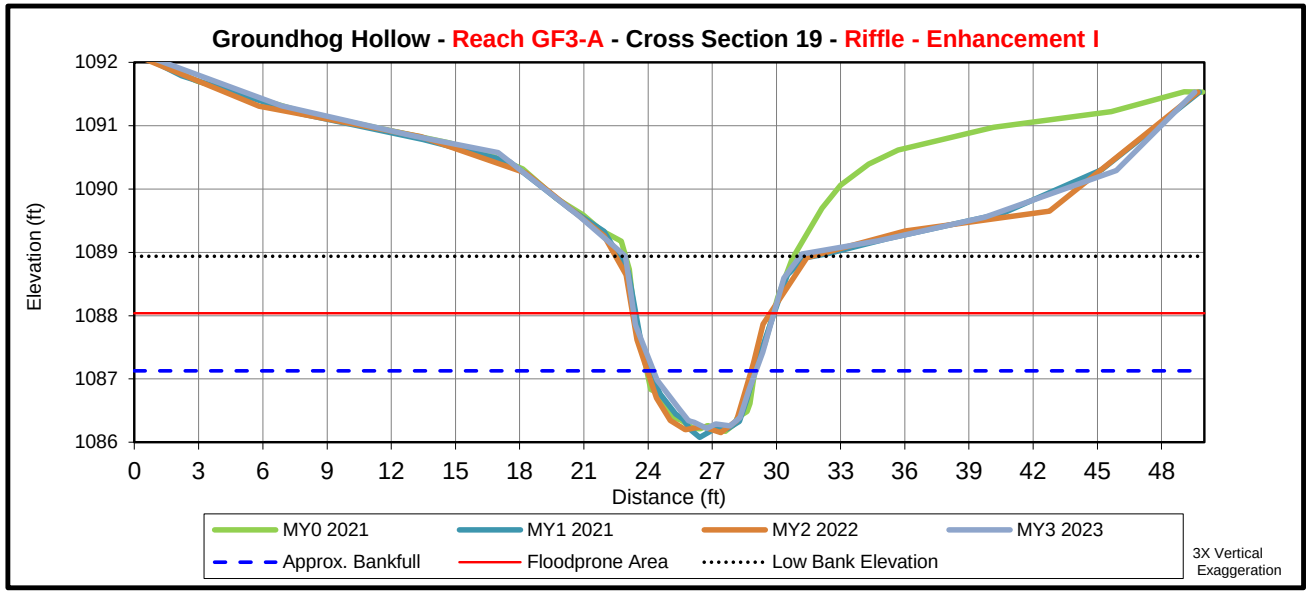


	Cross Section 18 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1110.59	1110.5	1110.5	1110.6			
Bankfull Width (ft)[1]	5.5	4.8	5.1	6.2			
Floodprone Width (ft)[1]	>45.4	>45.3	>45.5	>45.9			
Bankfull Max Depth (ft)[2]	1.0	1.0	1.0	1.1			
Low Bank Elevation (ft)	1110.59	1110.5	1110.5	1110.5			
Bankfull Cross Sectional Area (ft^2)[2]	3.0	3.0	2.8	3.3			
Bankfull Entrenchment Ratio[1]	8.3	>9.4	>8.8	>7.4			
Bankfull Bank Height Ratio[1]	1.0	1.0	1..0	1.1			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

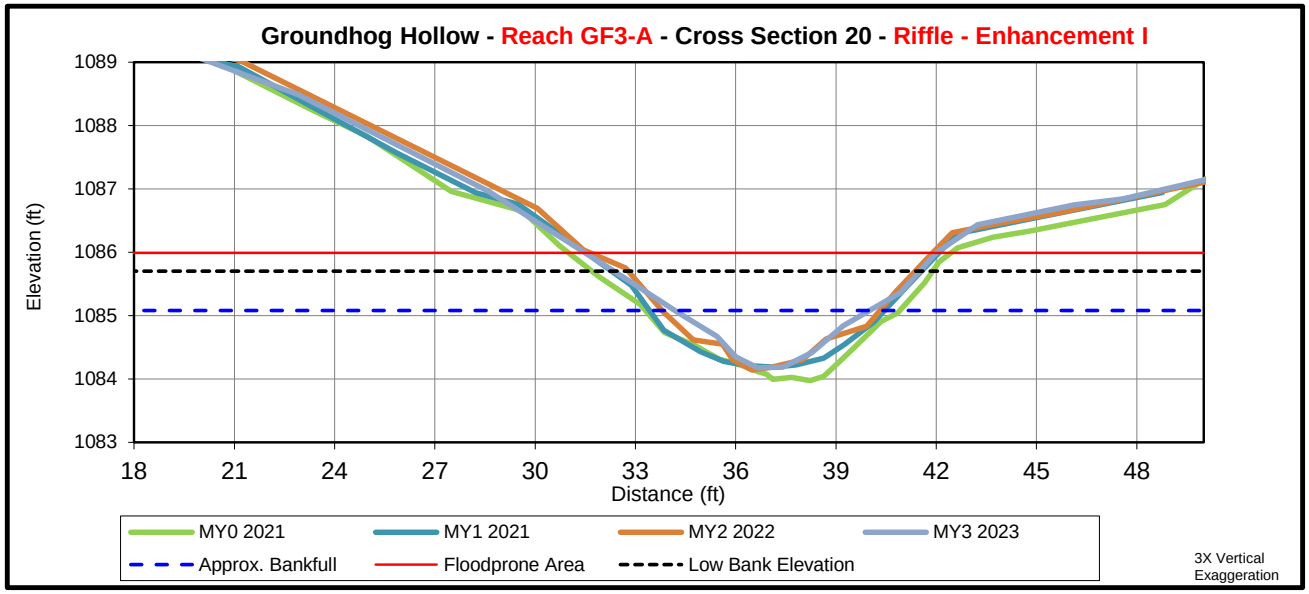


	Cross Section 19 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1087.00	1087.0	1087.0	1087.1			
Bankfull Width (ft)[1]	4.9	4.7	4.6	4.8			
Floodprone Width (ft)[1]	6.3	6.4	>6	6.5			
Bankfull Max Depth (ft)[2]	0.8	1.0	0.8	2.7			
Low Bank Elevation (ft)	1089.20	1088.9	1088.9	1089.0			
Bankfull Cross Sectional Area (ft^2)[2]	3.0	3.0	2.9	14.7			
Bankfull Entrenchment Ratio[1]	1.3	1.4	>1.3	1.4			
Bankfull Bank Height Ratio[1]	3.6	2.9	3.2	3.0			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

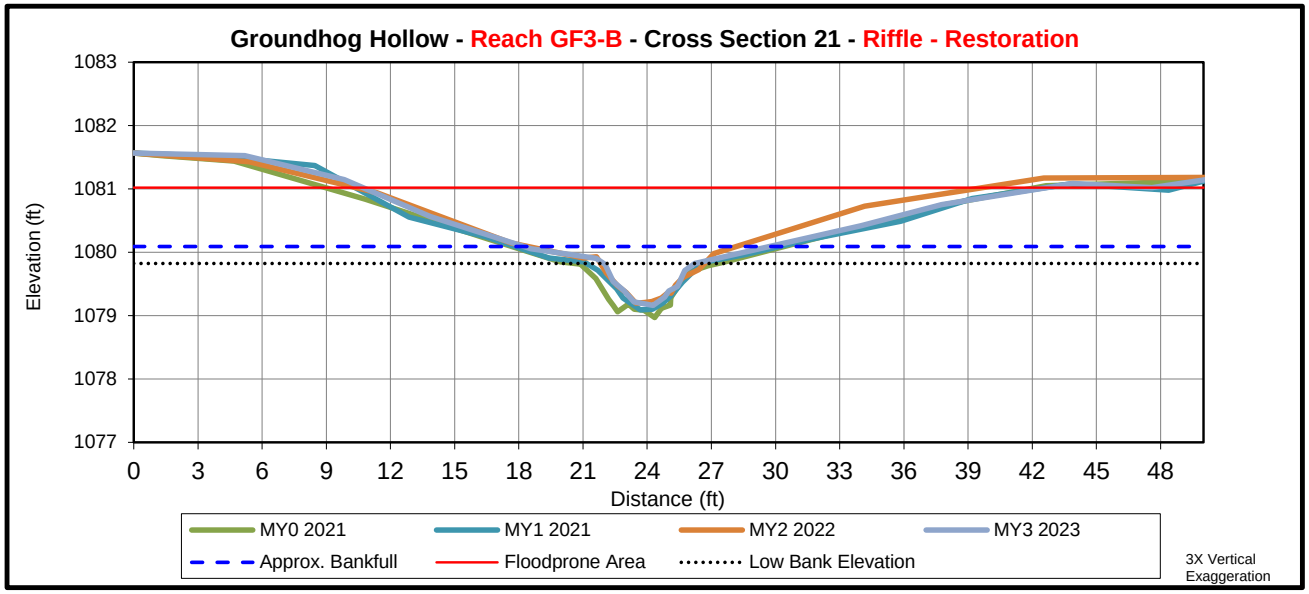


	Cross Section 20 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1084.80	1084.9	1085.0	1085.1			
Bankfull Width (ft)[1]	6.2	6.4	6.2	5.8			
Floodprone Width (ft)[1]	9.6	8.7	>9.3	10.5			
Bankfull Max Depth (ft)[2]	0.8	0.7	1.9	1.5			
Low Bank Elevation (ft)	1086.20	1086.3	1086.0	1085.7			
Bankfull Cross Sectional Area (ft^2)[2]	3.0	3.0	11.1	7.7			
Bankfull Entrenchment Ratio[1]	1.5	1.4	1.5	1.8			
Bankfull Bank Height Ratio[1]	2.9	3.0	>2.2	1.7			

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 (June 14th, 2023)

Downstream (June 14th, 2023)

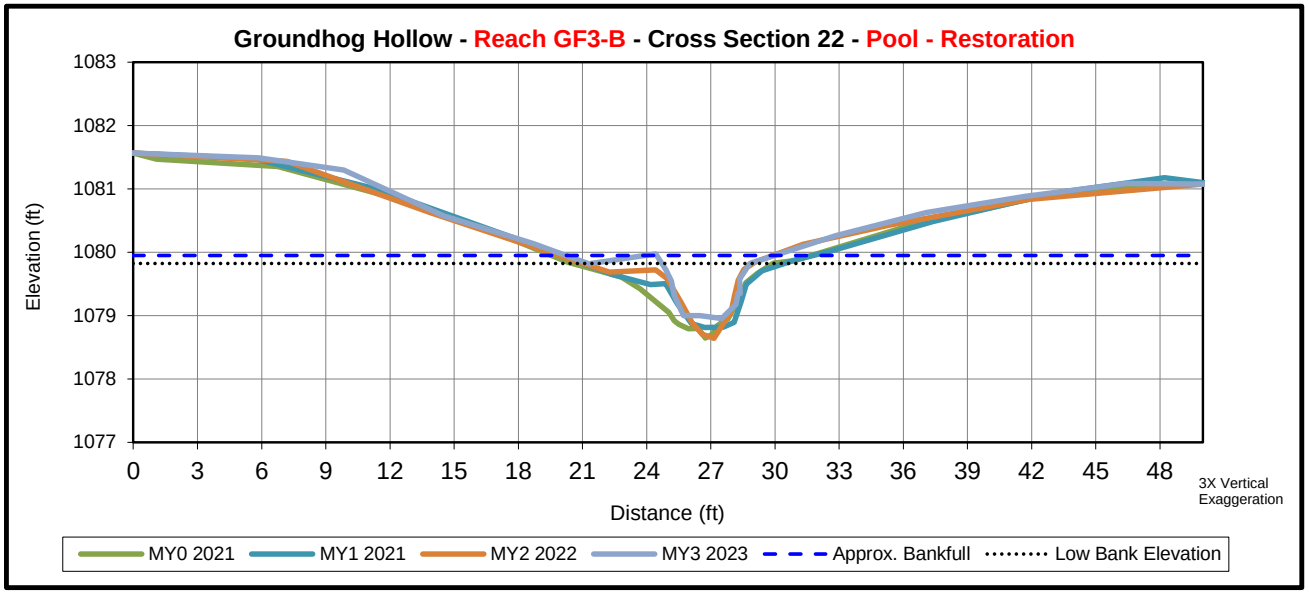


	Cross Section 21 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1079.84	1079.9	1080.0	1080.1			
Bankfull Width (ft)[1]	7.6	5.5	7.9	4.6			
Floodprone Width (ft)[1]	25.6	27.1	>23.8	31.9			
Bankfull Max Depth (ft)[2]	0.9	0.8	0.7	0.7			
Low Bank Elevation (ft)	1079.84	1079.8	1079.9	1079.8			
Bankfull Cross Sectional Area (ft^2)[2]	2.9	2.3	2.2	1.7			
Bankfull Entrenchment Ratio[1]	3.4	4.9	>3.0	6.9			
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9	0.7			

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 (June 14th, 2023)

Downstream (June 14th, 2023)



	Cross Section 22 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	1079.61	1079.8	1079.9	1080.0			
Bankfull Width (ft)[1]	6.2	5.1	4.7	4.4			
Floodprone Width (ft)[1]	-	-	-	-			
Bankfull Max Depth (ft)[2]	1.0	0.7	1.1	0.9			
Low Bank Elevation (ft)	1079.61	1079.5	1079.7	1079.8			
Bankfull Cross Sectional Area (ft^2)[2]	3.1	1.9	2.5	2.5			
Bankfull Entrenchment Ratio[1]	-	-	-	-			
Bankfull Bank Height Ratio[1]	-	-	-	-			

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

Hydrology Data

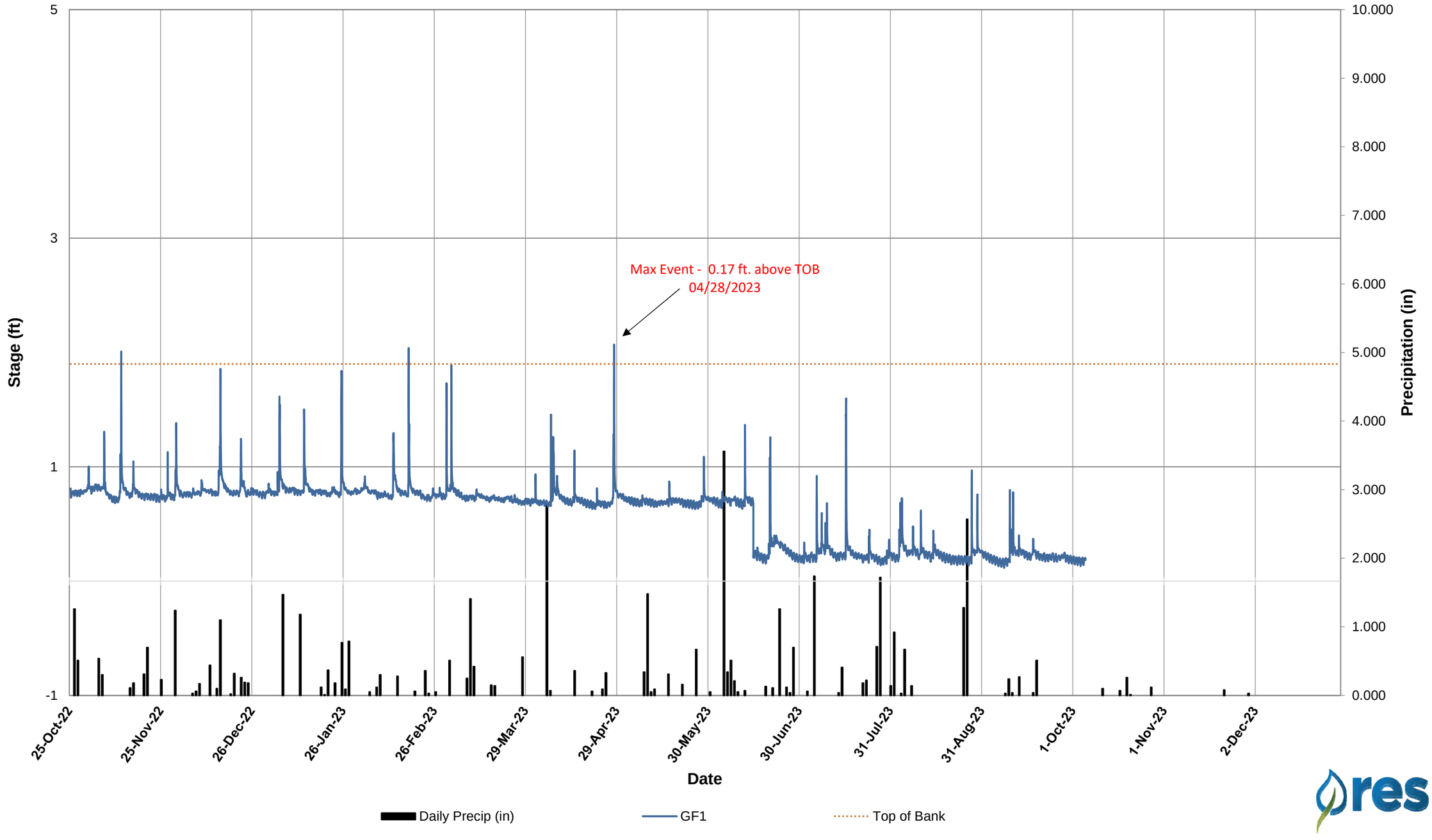
Month	Average	Normal Limits		Project Location Precipitation*
		30 Percent	70 Percent	
January	4.08	2.98	4.80	2.72
February	3.89	2.58	4.66	4.90
March	4.20	3.23	4.88	3.96
April	4.55	2.78	5.51	2.90
May	4.52	2.61	5.49	6.20
June	5.15	3.62	6.11	2.87
July	4.75	3.30	5.65	5.93
August	5.19	3.56	6.19	5.01
September	4.48	2.90	5.38	8.18
October	3.61	2.53	4.31	1.13
November	3.59	1.92	4.39	0.06
December	4.28	3.04	5.07	-
Total Annual **	52.29	35.05	62.44	43.86
Above Normal Limits	Below Normal Limits			

Note: Taylorsville CRONOS Station is approximately 3 miles southeast of the site
**Total Annual represents the average total precipitation, annually, as calculated by the 30-year period.

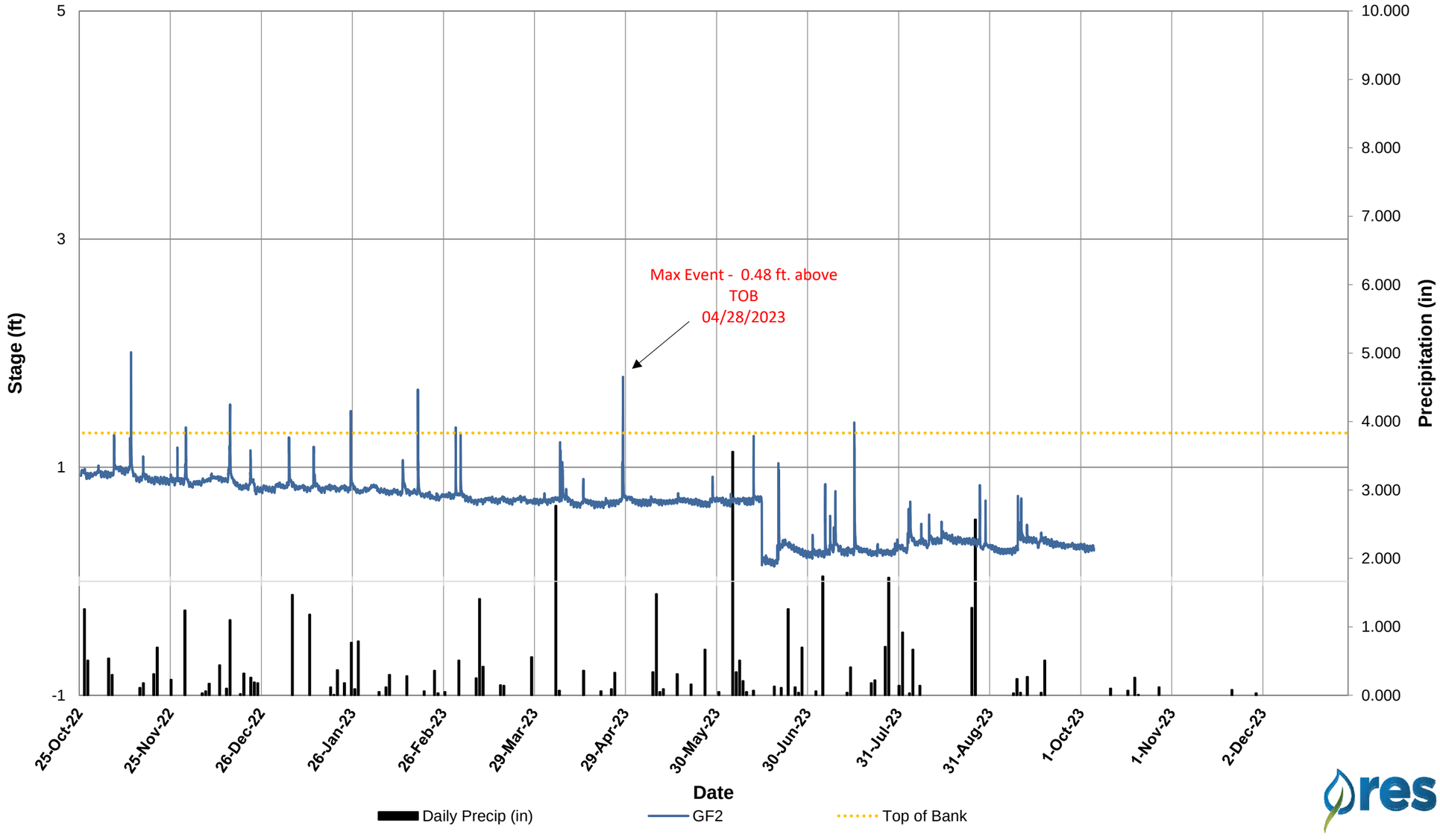
Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Maximum Bankfull Height (ft)	Date of Maximum Bankfull Event	
Stage Recorder GF1-B				
MY1 2021	15	1.90	8/17/2021	
MY2 2022	11	0.78	5/23/2022	
MY3 2023	2	0.17	4/28/2023	
Stage Recorder GF2-B				
MY1 2021	6	1.58	3/25/2021	
MY2 2022	16	0.67	5/23/2022	
MY3 2023	4	0.48	4/28/2023	
Stage Recorder GF3-B				
MY1 2021	8	1.68	8/17/2021	
MY2 2022	15	0.68	5/23/2022	
MY3 2023	3	0.39	4/28/2023	
Year	**Number of Flow Events**	**Maximum Consecutive Flow Days**	**Maximum Cummlative Flow Days**	**Maximum Consecutive Flow Date Range**
Flow Gauge GF4-A				
MY1 2021	1	235	235	5/10/2021-12/31/2021
MY2 2022	1	297	297	1/1/2021-10/25/2022
MY3 2023	1	164	164	1/1/2023-06/13/2023

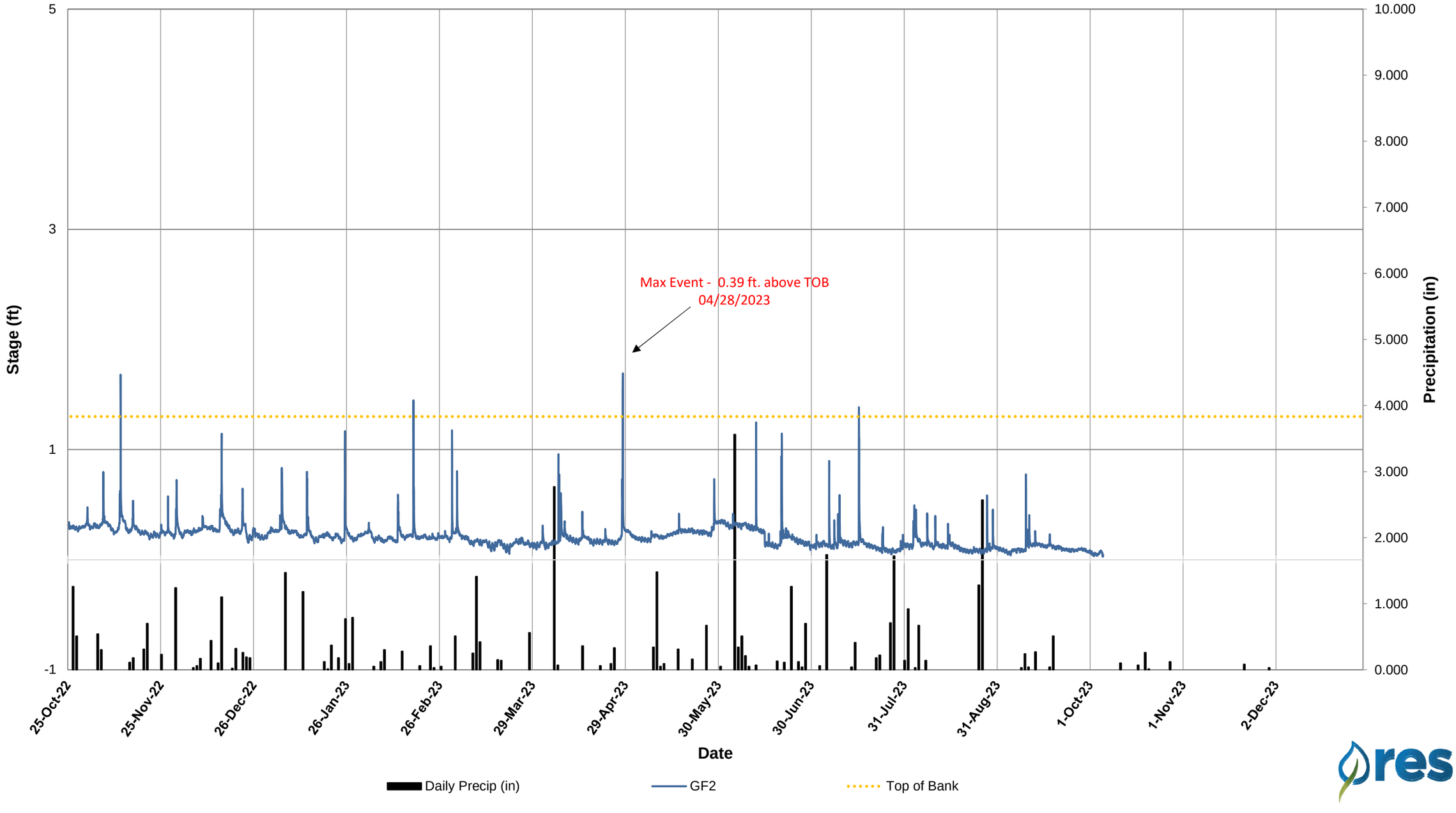
2023 Groundhog Hollow GF1 Stage Recorder Graph



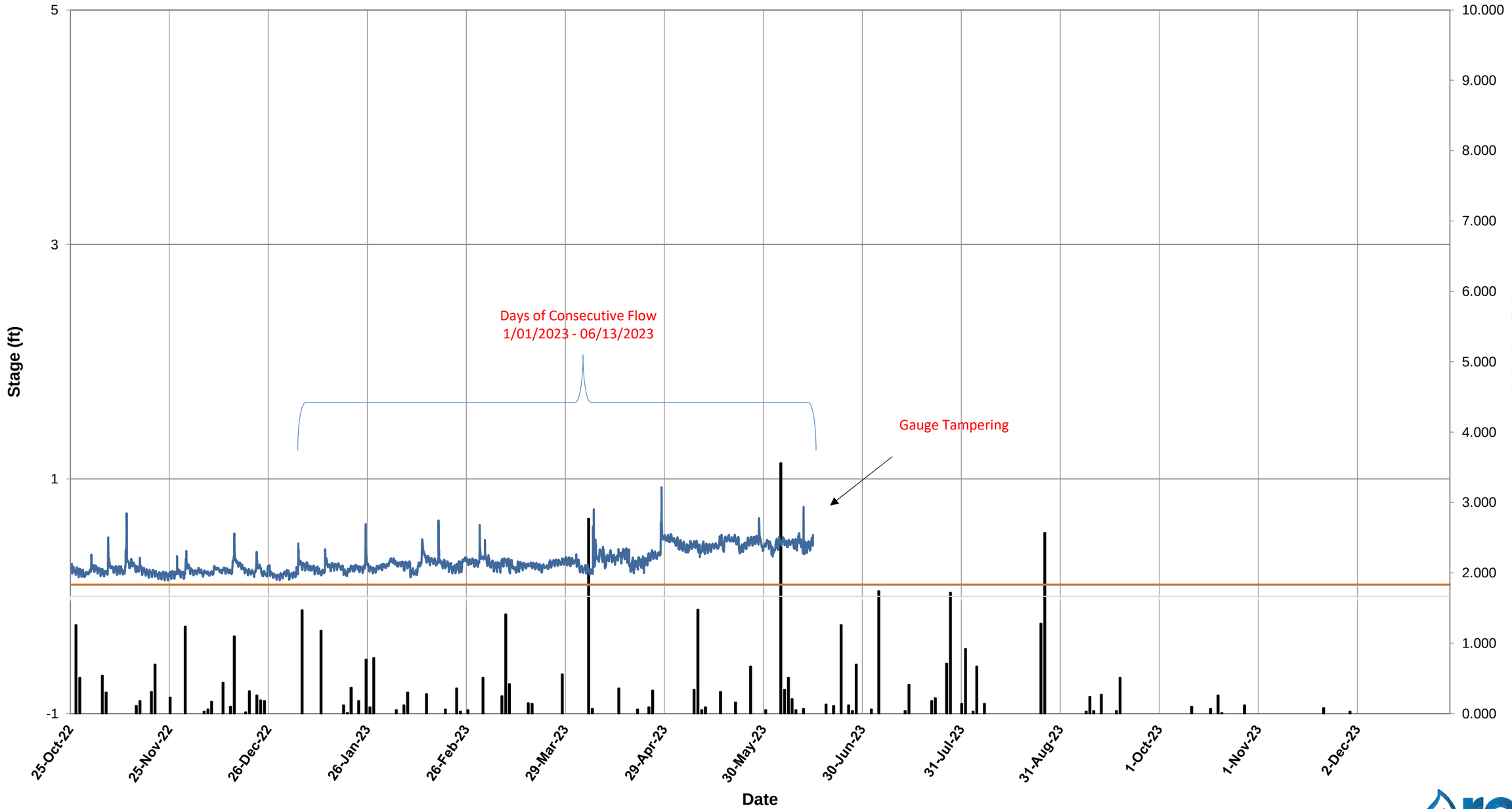
2023 Groundhog Hollow GF2 Stage Recorder Graph



2023 Groundhog Hollow GF3 Stage Recorder Graph



2023 Groundhog Hollow GF4a Flow Gauge Graph



164 Consecutive Days Consecutive Flow
01/01/2023 - 06/13/2023