Year 2 Monitoring Report

FINAL

MATTHEW SITE

NCDMS Project #100043 (Contract #7419)
USACE Action ID: SAW-2017-00055
DWR Project #2017-0624

Johnston County, North Carolina
Neuse River Basin
HUC 03020201

Provided by:

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

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

January 2023

ROY COOPER
Governor

ELIZABETH BISER
Secretary

Mitigation Services
ENVIRONMENTAL QUALITY

January 12, 2023

Via email: rmedric@res.us

Ryan Medric
RES / EBX

Subject: Matthew MY2 Comments, Project ID #100043, DMS Contract #0007419

Ryan,

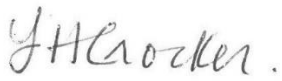
After receiving the Draft MY1 report, DMS offers the following comments:

1. Section 1.6. states success is 320 planted stems. Update to remove the term 'planted' to be consistent with 2016 guidance and success written in MP.
2. Please explain some of the increases in planted stems between MY1 and MY2.
3. VP10 has a high number of loblolly volunteers. Please check if this is isolated to that VP and reminder that those should not be counted for success. As a note, in some later-stage wetland projects, IRT has indicated that pines may be dewatering wetlands. Consider this when evaluating treatment of young pines.
4. Many sites in Eastern NC struggled with wetlands and flow in 2021-22 dormant season. Suggest adding rain data to table 12 for Oct/Nov/Dec 2021 to provide context for antecedent conditions for regulatory (in addition to full 2022). Another tool would be drought status maps, or Corps antecedent precipitation tool.

Digital comments:

1. Please QA/QC cross section data for accuracy. For example, XS 2 shows a greater than 25% reduction in cross sectional area between AB and MY1, then an increase in cross sectional area (6.1 to 8.0) between MY! And MY2. Are these estimates in error or do they reflect a large change in cross sectional area?
2. DMS recommends that RES use the June 2020 monitoring report and table guidance for displaying and reporting data. It is no longer necessary to report flood prone width and entrenchment for stream data. Additionally, the values required in the morphology table has been streamlined to demonstrate stream morphology conditions from year to year.

Thanks for your work,



Lindsay Crocker, DMS

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January 26, 2023

Lindsay Crocker
NC DEQ Division of Mitigation Services
217 West Jones Street
Raleigh, NC 27604

RE: Matthew MY2 Comments, Project ID #100043, DMS Contract #0007419

Listed below are comments provided by DMS on January 12, 2023 regarding the Matthew Stream and Wetland Mitigation Project Year 2 Monitoring Report and RES' responses.

Comments:

1. Section 1.6. states success is 320 planted stems. Update to remove the term 'planted' to be consistent with 2016 guidance and success written in MP

The term "planted" has been removed. Please note that this comment should reference **Section 1.3**.

2. Please explain some of the increases in planted stems between MY1 and MY2.

The increase is due to stems determined as "Missing" in MY1 but were found or had resprouted in MY2. Especially in plots where pioneer vegetation is very thick and planted bare roots are still very small, it can sometimes be challenging to locate all stems in MY1.

3. VP10 has a high number of loblolly volunteers. Please check if this is isolated to that VP and reminder that those should not be counted for success. As a note, in some later-stage wetland projects, IRT has indicated that pines may be dewatering wetlands. Consider this when evaluating treatment of young pines.

For now, the pines are localized to the immediate area around VP10. RES also recorded that all those volunteer pines within that plot were still between 50-100cm tall. Therefore, it is not an immediate concern considering the success of the planted trees and the overall vegetative diversity in that area. However, RES plans to assess the pine situation again during MY3 monitoring and will determine if treatment is necessary.

4. Many sites in Eastern NC struggled with wetlands and flow in 2021-22 dormant season. Suggest adding rain data to table 12 for Oct/Nov/Dec 2021 to provide context for antecedent conditions for regulatory (in addition to full 2022). Another tool would be drought status maps, or Corps antecedent precipitation tool.

Rainfall Summary Table (Now **Table 12a**) has been revised to include antecedent rain data (Oct/Nov/Dec 2021). In addition, a new table (**Table 12b**) has been included to summarize

drought conditions for Johnston County for the applicable period. **Section 1.7**, Wetland Hydrology Section has also been revised to summarize some of the additional drought data.

Digital Comments:

1. Please QA/QC cross section data for accuracy. For example, XS 2 shows a greater than 25% reduction in cross sectional area between AB and MY1, then an increase in cross sectional area (6.1 to 8.0) between MY1 And MY2. Are these estimates in error or do they reflect a large change in cross sectional area?

The reduction in cross sectional area between MY0 and MY1 was legitimate and was due to some aggradation of sediment coming into the top of the Project. However, the actual channel dimension remained stable and almost identical between MY1 and MY2, but the "top-of-bank calls" (which is where we set Low TOB and BF Stage elevations for the sake of calculating cross sectional area) appears somewhat subjective and not perfectly consistent between MY1 and MY2 even though the channel was virtually unchanged. Sometimes there is discrepancy in such calls simply due to surveyor subjectivity and/or a physical "obstacle" in the field while surveying, such as a thick clump of juncus on the TOB or even minor bank sluffing due to the surveyor's boot walking up the bank. In reality, these are not substantial changes in the channel dimension but can appear to skew the calculated cross sectional area and is especially exaggerated for smaller channels.

2. DMS recommends that RES use the June 2020 monitoring report and table guidance for displaying and reporting data. It is no longer necessary to report flood prone width and entrenchment for stream data. Additionally, the values required in the morphology table has been streamlined to demonstrate stream morphology conditions from year to year.

Comment noted. RES is utilizing the new templates and tables for newer DMS projects; however, we would like to continue using the current format for this Project since all our data processing and report templates are already established for this Project.

Table of Contents

1.0 Project Summary

1.1 Project Location and Description

The Matthew Site ("Project") is located within a rural watershed in Johnston County, North Carolina approximately two miles south of Four Oaks. The Project lies within the Neuse River Basin, North Carolina United States Geological Survey (USGS) 8-digit Cataloguing Unit 03020201 and 14-digit hydrologic unit code (HUC) 03020201150020, a Targeted Local Watershed (TLW) and the Division of Water Resources (NCDWR) sub-basin 03-04-04 (Figure 1). The Project restores 3,230 linear feet (LF) and preserves 234 LF of streams as well as restores 12.102 acres and preserves 2.063 acres of wetland that provide water quality benefit for 1,460 acres of drainage area.

The Project area is comprised of a 19.19-acre easement involving two unnamed tributaries within the footprint of a breached pond that drain directly to Juniper Swamp, which eventually drains to Hannah Creek. The Project area also included riparian wetlands that were impounded and filled. The stream and wetland mitigation components are summarized in Table 1. The Project is accessible from state route NC-96. Coordinates for the Project areas are approximately 35.42503, -78.40849 at the NC Department of Transportation (DOT) culvert located just above the Project easement.

1.2 Project Goals and Objectives

Through the comprehensive analysis of the Project's maximum functional uplift using the Stream Functions Pyramid Framework and conclusions based on a Site Hydric Soils Detailed Study, specific, attainable goals and objectives were realized by the Project. These goals clearly address the degraded water quality and nutrient input from agricultural practices that were identified as major watershed stressors in the 2010 Neuse RBRP (amended August 2018). The Project addresses outlined RBRP Goal 2 list in the Mitigation Plan.

The Project goals are:

- Re-establish hydrology to a historical stream/wetland complex that has been impacted by agricultural impoundments for over 113 years.
- To transport water in a stable, non-erosive manner and maintain a stable water table in riparian floodplain wetlands that will also contribute to stream baseflow;
- Improve flood flow attenuation on site and downstream by allowing for overbank flows and connection to the floodplain;
- Create diverse bedforms and stable channels that achieve healthy dynamic equilibrium and provide suitable habitat for life
- Improve in-stream habitat;
- Limit sediment and nutrient inputs into the stream system;
- Re-establish, rehabilitate, and preserve wetlands;
- Restore, enhance, and preserve native wetland and riparian vegetation;
- Indirectly support the goals of the 2010 Neuse RBRP (amended August 2018) to improve water quality and to reduce sediment and nutrient loads; and
- To support the life histories of aquatic and riparian plants and animals through stream restoration activities

The Project objectives carried out to address the goals are:

- Designed and reconstructed stream channels sized to convey bankfull flows that maintain a stable dimension, profile, and planform;
- Added in-stream structures and bank stabilization measures to improve bedform diversity and protect restored streams;

- Installed habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored streams;
- Removed dams, berms, fill material, spoil piles, and debris to restore wetland hydrology and maintain appropriate hydroperiod for Bibb soil series;
- 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 937 linear feet of livestock exclusion fencing along the western easement boundary to ensure livestock will not have stream or wetland access;
- Treated exotic invasive species; and
- Established a permanent conservation easement on the Project that perpetually protects streams, wetlands, and their associated buffers.

1.3 Project Success Criteria

The success criteria for the Project follows the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update, the Matthew Site Final Mitigation Plan, and subsequent agency guidance. Cross section and vegetation plot monitoring takes place in Years 0, 1, 2, 3, 5, and 7. 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. Stage recorders were installed on RL1-A and RL2 to document bankfull events.

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 2.2 within restored riffle cross sections (for C and E streams).

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.

Wetland Hydrology Success Criteria

The Natural Resources Conservation Service (NRCS) has a current WETs table (1989-2018) for Johnston County upon which to base a normal rainfall amount and average growing season. The closest comparable data station was determined to be the WETS station for Smithfield, NC. The growing season for Johnston County is 242 days long, extending from March 18 to November 15, and is based on a daily minimum temperature greater than 28 degrees Fahrenheit occurring in five of ten years.

Based upon field observation across the site, the NRCS mapping units show a good correlation to actual site conditions in areas of the site. Mitigation guidance for soils in the Coastal Plain suggests a hydroperiod

for the Bibb soil of 12-16 percent of the growing season. The hydrology success criterion for the Site is to restore the water table so that it remains continuously within 12 inches of the soil surface for at least 12 percent of the growing season (approximately 29 days) at each groundwater gauge location.

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 are the survival of at least 320 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 10 feet at the end of Year 7. Volunteer trees that are listed on the approved planting list will be counted, identified to species, and included in the yearly monitoring reports, and may be counted towards the success criteria of total planted stems after presence in the plot for two or more growing seasons. Moreover, any single species can only account for up to 50 percent of the required number of stems within any vegetation plot. Any stems in excess of 50 percent will be shown in the monitoring table but will not be used to demonstrate success.

1.4 Project Components

Prior to restoration, the project streams and wetlands were significantly impacted by a large impoundment constructed over a hundred years ago. Improvements to the Project help meet the river basin needs expressed in the 2010 Neuse River Basin Restoration Priorities (RBRP).

Through stream and wetland restoration and preservation, the Project presents 3,253.400 Warm Stream Mitigation Units (SMU) and 7.207 Wetland Mitigation Units (WMU).

Matthew Project Components Summary (Mitigation Plan)

Stream Mitigation			
Mitigation Approach	**Linear Feet**	**Ratio**	**Warm SMU**
Restoration	3,230	1:1	3,230.000
Preservation	234	10:1	23.400
Preservation (No Credit)	108	N/A	0.000
Total	**3,572**		**3,253.400**
Wetland Mitigation			
Mitigation Approach	**Area (acres)**	**Ratio**	**WMU**
Rehabilitation (Pond Conversion)	10.202	2:1	5.101
Re-establishment (Fill Removal)	1.900	1:1	1.900
Preservation	2.063	10:1	0.206
Total	**14.165**		**7.207**

1.5 Design and Approach

Streams

The Project includes Restoration and Preservation. Stream restoration incorporates the design of a single-thread meandering channel, with parameters based on data taken from reference site, 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.

The Project has been broken into the following design reaches:

Reach RL1-A – Priority I Restoration was performed along this reach for 2,438 linear feet both upstream and downstream of the dam. The upstream end is fed from three perched 54-inch crossline culverts under NC HWY 96, and construction activities included installing a plunge pool to stabilize the existing outfall. The conservation easement begins approximately 125 feet downstream of the culverts. This allows for DOT and public utilities to maintain the crossing and a buried water line, respectively. Additionally, the easement is setback from the road such that the adjacent landowner to the north may access and maintain the existing barn located approximately 25 to 40 feet from the channel.

Restoration activities included constructing a channel sized to provide frequent out of bank flows to allow improved floodplain and wetland connectivity. In-stream structures such as log vanes, log sills, brush toes and constructed riffles were installed for vertical and lateral stability and to improve bedform diversity. Additional work included removing the dam, existing pipes, a bridge, and riprap piles.

The restoration activities on the lower extent of Reach RL1-A impacted existing wetlands WE and WD before transitioning to reach RL1-B as preservation. However, the stream restoration results in net positive wetland area as surrounding riparian areas were restored as wetlands by raising the channel bed elevation, thus raising groundwater elevation, and allowing for more frequent overbank events. Also, the surrounding wetland re-establishment involved with this Project, including removal of the upstream dam, spoil piles, and debris, as well as replanting a bottomland hardwood community, further improves existing wetlands.

Reach RL1-B – Preservation was performed for this reach downstream of RL1-A. This section begins where the channel has stabilized from the hurricane breach and continues flowing to the southwest beyond the Project. Preservation activities consisted of supplemental planting throughout the riparian buffer.

Reach RL2 – Priority I Restoration was performed for this reach. Flowing out of a pond just north of the Project, the channel was constructed beginning at the existing pond outfall (24" CMP) and confluences with RL1-A near stationing 16+50. Restoration activities involved constructing a meandering channel sized to improve floodplain connectivity. In-stream structures such as log vanes, log sills, brush toes and constructed riffles were installed for stability and to improve bedform diversity.

Wetlands

The Matthew Project offers a total ecosystem restoration opportunity. As such, the wetland restoration is closely tied to the stream restoration and pond dam removal. The Project provides 7.207 WMUs through a combination of wetland re-establishment, rehabilitation, and preservation.

Wetland rehabilitation via "pond conversion" was performed within the pond footprint, including wetland, WA, with a credit ratio of 2:1. The construction of the farm pond had altered surface drainage and even since the breach, was partially impounded and flow is constricted. The primary restoration activity was the removal of the pond dam and its associated large berm along the eastern edge. Additionally, stream restoration within this pond footprint re-established stable stream channels that maintain a constant surface-groundwater connection that provides retention and storage within the floodplain, and thus healthy wetland hydroperiods.

Wetland re-establishment via "fill removal," with a credit ratio of 1:1, was performed in the area below the dam that consists of hydric soils surrounding Wetlands WC, WD, and WE that lacked sufficient wetland hydrology. This re-established wetland area is referred to as "WF" (Wetland F). This area lacked hydrology due to the construction of the farm pond that had altered surface drainage and had created constricted flow, inhibiting normal flow volumes parallel to the stream both at the surface and within the subsurface. In addition, fill material from the construction of the pond had filled these pre-existing wetlands and buried hydric soils. Furthermore, a ditch from the old pond outlet along the western edge of the floodplain drained upland overland flow and seepage away from the natural floodplain. This wetland area was re-established by removing the dam, removing fill material below the dam, and aligning a stable stream channel via stream restoration efforts. Additional activities included the removal of dam material debris that was littered throughout the floodplain during the breach of Hurricane Matthew, followed by surface roughening and creation of shallow depressions throughout the area in order to mimic natural conditions and provide an appropriate landscape for diverse habitat.

Preservation with a 10:1 credit ratio was used for jurisdictional wetlands WB, WC, WD, and WE. Some of these areas that were impacted by stream restoration efforts were planted with supplemental, native hardwood trees.

The wetland restoration areas directly connect to the existing high-quality bottomland hardwood wetland preservation area. The resulting wetland functions as a large, contiguous bottomland hardwood wetland community.

1.6 Construction and As-Built Conditions

Site construction was completed on January 4, 2021, and planting was completed on March 2, 2021. The Matthew Site was overall built to design plans and guidelines. Fencing was installed as proposed along the western edge of the easement. A rock swale was added to the left bank of the downstream end of RL1 to address runoff from the wetland and old channel area. There are no constructed depressions greater than 12 inches deep; however, there are some segments of abandoned channel that have settled and are more than 12 inches deep. The as-built wetlands were 0.03 acres smaller than design due to minor survey differences of the top of bank during as-built. The record drawings were included in the As-built Report.

A few planting plan changes occurred based on bare root availability at time of planting. Changes included replacing swamp tupelo (*Nyssa biflora*), Atlantic white cedar (*Chamaecyparis thyoides*), overcup oak (*Quercus lyrata*), and water tupelo (*Nyssa aquatica*) with water oak (*Quercus nigra*) and green ash (*Fraxinus pennsylvanica*). Minor monitoring device location changes were made during as-built installation, however, the quantities remained as proposed in the Mitigation Plan.

1.7 Year 2 Monitoring Performance (MY2)

The Matthew Year 2 Monitoring activities were performed in June and October 2022. All MY2 data is present below and in the appendices. The Site is on track to meeting vegetation, wetland, and stream interim success criteria.

Vegetation

Monitoring of the ten permanent vegetation plots and four random vegetation plots was completed on October 20th, 2022. Vegetation data are in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**. MY2 monitoring data indicates that all plots are exceeding the interim success

criteria of 320 planted stems per acre. Planted stem densities ranged from 728 to 1,052 planted stems per acre with a mean of 861 planted stems per acre across all plots. A total of 9 species were documented within the plots. Volunteer species, including swamp tupelo (*Nyssa biflora*), were noted in one plot and are expected to establish further in upcoming years. The average stem height in the vegetation plots was 3.1 feet.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project. The previously identified area of Chinese privet was treated in 2022 and appears to have been an effective kill. Therefore, there are no notable areas of invasive vegetation. The bare area associated with the dam footprint, noted in the previous year, looks much improved with established herbaceous vegetation along with continued tree survival and growth.

Stream Geomorphology

Geomorphology data collection for MY2 was collected in June 2022. Summary tables and cross section plots are in **Appendix D**. Overall the current years cross sections closely match the baseline cross sections. The current conditions show that shear stress and velocities are equilibrated for all restoration reaches. 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. The channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation.

Stream Hydrology

Two stage recorders are currently recording bankfull events on reaches RL1-A and RL2. The stage recorder on RL1-A recorded 6 bankfull events in MY2 with the highest reading being 1.28 feet above the top of bank. The stage recorder on RL2 recorded 11 bankfull events in MY2 with the highest reading being 2.64 feet above the top of bank. Stage recorder locations can be found on **Figure 2**, photos are in **Appendix B**, and hydrology data are in **Appendix E**.

Wetland Hydrology

There are 10 groundwater wells with automatic recording pressure transducers monitoring groundwater hydrology. Six wells are located within wetland rehabilitation areas, two are located within wetland re-establishment areas, and two are located within preservation areas serving as references. These are recording water table depths at a frequency of twice per day. Data recorded in MY1 demonstrates consecutive hydroperiods ranging from zero to 25 percent across all wells onsite. GW2, GW3, GW4, GW5, and GW7 fell short of the 12 percent success criteria with hydroperiods ranging from zero to elevn percent. These lower hydroperiods for the year may be due to multiple factors:

- The majority of the growing season for Johnston County was significantly lower than average, with the beginning two-thirds of the growing season falling with a moderate drought period. More specifically, Johnston County experienced the following droughts during the applicable monitoring period according to U.S. Drought Monitor:
    - D0 – Abnormally Dry for 86% of growing season and 76% of antecedent dormant season
    - D1 – Moderate Drought for 63% of growing season and 36% of antecedent dormant season
    - D2 – Sever Drought for 40% of growing season and 20% of antecedent dormant season

  In addition, see **Appendix E** for all rain data.

- As mentioned in the approved mitigation plan, due to extensive construction, including stream channel construction and dam removal and the associated soil compaction, "there may be a reduced hydroperiod for the first two years after construction."

However, considering these factors, RES identified prevalent hydrophytic wetland vegetation around each of the groundwater wells, including rushes (*Juncus* spp.), sedges (*Carex* spp.) and tearthumb (*Persicaria sagittata*). Evidence of this vegetation can be seen in photos in **Appendix B**. Being less than two years post-construction, and it being a significant drought year, RES anticipates that the restored wetlands will continue to equilibrate, and under normal climate conditions, hydroperiods will increase. All wetland hydrology data can be found in **Appendix E**.

2.0 Methods

Stream 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 16 cross-sections. Survey data were imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. The stage recorders include an automatic pressure transducer placed in PVC casing in a pool. The elevation of the bed and top of bank at each stage recorder are used to detect bankfull events.

Vegetation success is being monitored at 10 permanent vegetation plots and four random vegetation plots. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data are processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with PVC at the origin and metal conduit at the other corners. Photos of each plot are taken from the origin each monitoring year. The random plots are collected in locations where there are no permanent vegetation plots. Random plots are typically collected in the form of 100 square meter belt transects with variable dimensions. Tree species and height are recorded for each planted stem and the transects are mapped, and new locations will be monitored in subsequent years.

Wetland hydrology is monitored to document success in wetland restoration areas where hydrology was affected. This is accomplished with eight automatic pressure transducer gauges (located in groundwater wells) that record daily groundwater levels. Eight have been installed within the wetland restoration crediting area and two within preservation areas to serve as reference wetlands. One automatic pressure transducer is installed above ground for use as a barometric reference. Gauges are downloaded quarterly and wetland hydroperiods are calculated during the growing season. Gauge installation followed current regulatory guidance. Visual observations of primary and secondary wetland hydrology indicators are also recorded during quarterly site visits. As mentioned earlier, soil was characterized at each groundwater well. In December 2021, soil borings were taken within three feet of each existing groundwater well and characterized in accordance with the Soil Characterization Data Forms provided in the USACE's *Technical Standard for Water-Table Monitoring of Potential Wetland Sites*, and includes parameters of soil horizon depths, texture, colors, redoximorphic features, induration, and roots, as well as a photo of each soil profile (**Year 1 Monitoring Report, Appendix E)**.

3.0 References

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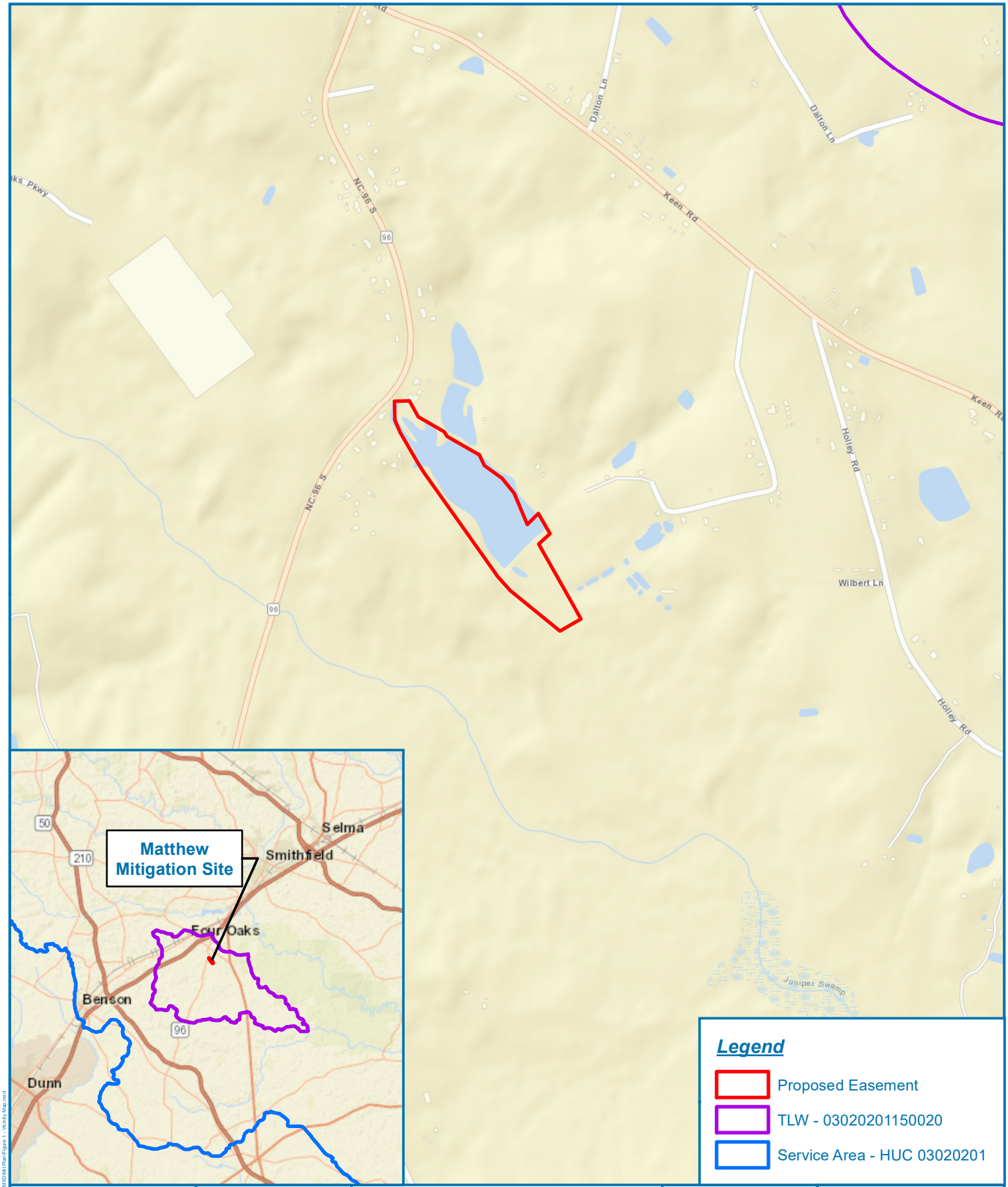
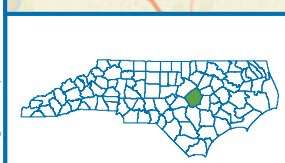
Appendix A

Background Tables





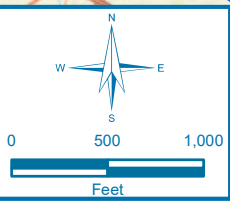


Figure 1 - Site Location Map

Matthew Mitigation Site

Johnston County, North Carolina

Date:	4/3/2019
Drawn by:	MDD
Checked by:	BPB
	1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Matthew\MXD\M1 Plan\Figure 1 - Vicinity Map.mxd

Appendix B

Visual Assessment Data

Table 1. Matthew (100043) - 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
RL1-A	1767	2438	Warm	R	1	1.00000	2438.000		2438	Channel restoration, riparian planting, livestock exclusion
RL1-B	234	234	Warm	P	NA	10.00000	23.400		234	Supplemental planting, livestock exclusion
RL1-B	108	108	Warm	P	NA	NA	0.000		108	Channel within easement; however, no credit
RL2	949	792	Warm	R	1	1.00000	792.000		792	Channel restoration, riparian planting, livestock exclusion
WA	10.199	10.202	RR	RH		2.00000	5.101		10.204	Dam and berm removal, stream restoration, native planting
WB	0.429	0.429	RR	P		10.00000	0.043		0.429	Permanent conservation easement
WC	0.102	0.102	RR	P		10.00000	0.010		0.102	Permanent conservation easement
WD	0.808	0.807	RR	P		10.00000	0.081		0.786	Permanent conservation easement
WE	0.758	0.725	RR	P		10.00000	0.073		0.705	Permanent conservation easement
WF	0.000	1.900	RR	RE		1.00000	1.900		1.903	Dam, fill, spoil, and debris removal; stream restoration, native planting

Project Credits

Restoration Level	Stream			Riparian Wetland	Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration	**3230.000**			**7.001**		
Re-establishment						
Rehabilitation						
Enhancement						
Enhancement I						
Enhancement II						
Creation						
Preservation	**23.400**			**0.206**		
Total	**3253.400**			**7.207**		

Table 2. Project Activity and Reporting History
Matthew Mitigation Site

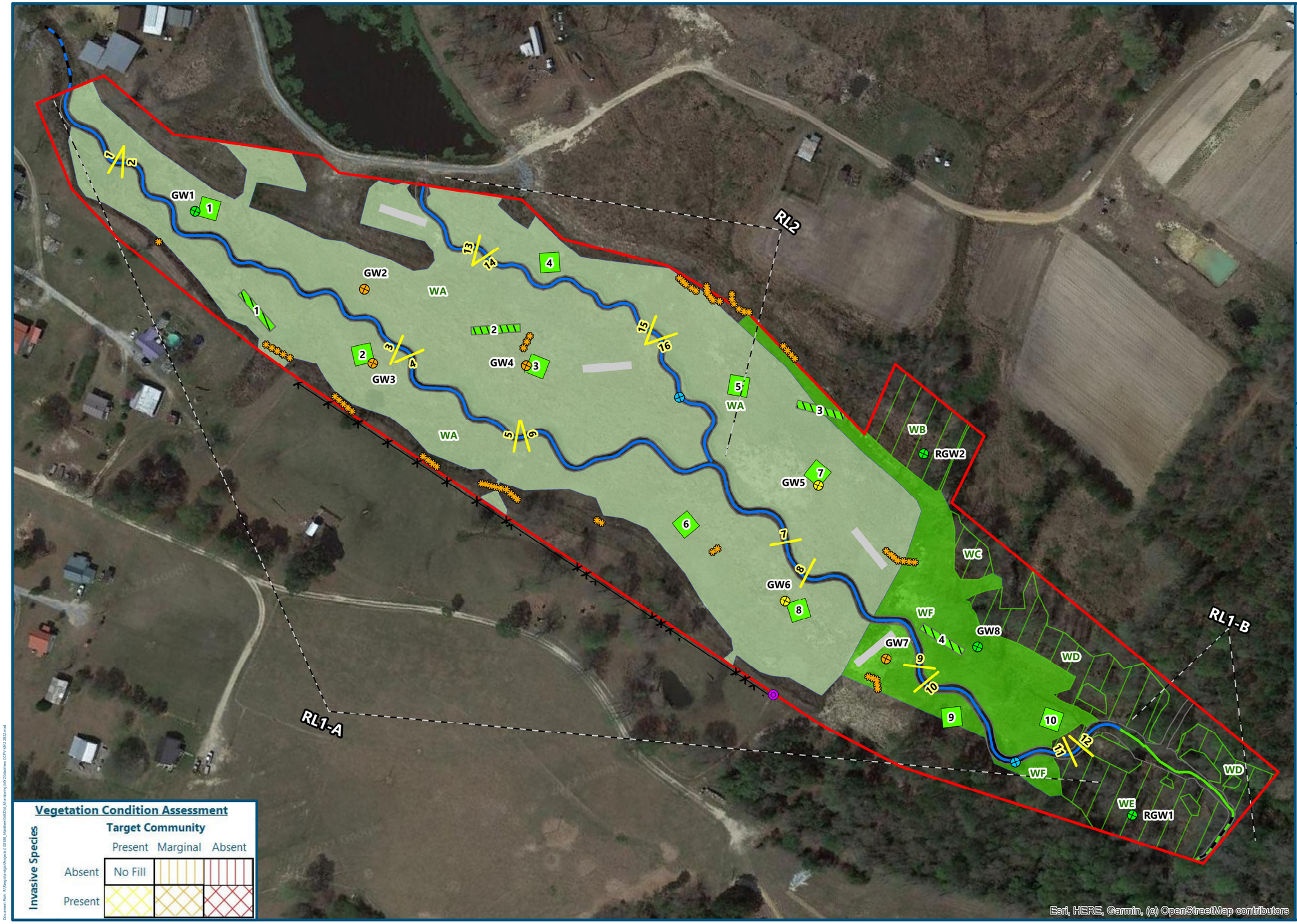
Elapsed Time Since grading complete: **23 months**
Elapsed Time Since planting complete: **21 months**
Number of reporting Years[1]: **2**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	NA	Sep-19
Final Design – Construction Plans	NA	Aug-20
Stream Construction	NA	04-Jan-21
Site Planting	NA	02-Mar-21
As-built (Year 0 Monitoring – baseline)	Mar-21	Jun-21
Year 1 Monitoring	Dec-21	Dec-21
Year 2 Monitoring	XS Survey: Jun-22 Veg. Plots: Oct-22	Dec-22
Year 3 Monitoring		
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 Matthew Mitigation Site	
Designer Primary project design POC	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612 Frasier Mullen, PE
Construction Contractor Construction contractor POC	KBS Earthwork Inc. / 5616 Coble Church Rd., Julian, NC 27283 Kory Strader
Survey Contractor Survey contractor POC	Matrix East, PLLC / 906 N. Queen St., Suite A, Kinston, NC 28501 Chris Paderick, PLS
Planting Contractor Planting contractor POC	Shenandoah Habitats David Coleman
Monitoring Performers	RES / 3600 Glenwood Ave, Suite 100, Raleigh, NC 27612
Monitoring POC	Ryan Medric (919) 741-6268

Table 4. Project Background Information						
Project Name		Matthew				
County		Johnston				
Project Area (acres)		19.19				
Project Coordinates (latitude and longitude)		Latitude: 35.42503 Longitude: -78.40849				
Planted Acreage (Acres of Woody Stems Planted)		16.4				
Project Watershed Summary Information						
Level IV Ecoregion		65m - Rolling Coastal Plain				
River Basin		Neuse				
USGS Hydrologic Unit 8-digit	03020201	USGS Hydrologic Unit 14-digit	03020201150020			
DWR Sub-basin		03-04-04				
Project Drainage Area (Acres and Square Miles)		1,460 ac (2.28 sqmi)				
Project Drainage Area Percentage of Impervious Area		7%				
Reach Summary Information						
Parameters		**RL1-A**	**RL1-B**	**RL2**		
Length of reach (linear feet)		1767	342	949		
Valley confinement (Confined, moderately confined, unconfined)		Unconfined	Unconfined	Unconfined		
Drainage area (Acres and Square Miles)		853 (1.33)	1460 (2.28)	490 (0.77)		
Perennial, Intermittent, Ephemeral		Perennial	Perennial	Perennial		
NCDWR Water Quality Classification		C; NSW	C; NSW	C; NSW		
Stream Classification (existing)		E5	E4	NA		
Stream Classification (proposed)		E4/E5	E4/E5	E4/E5		
Evolutionary trend (Simon)		III	IV/V	III		
FEMA classification		Zone AE	Zone Ae	Zone AE		
Wetland Summary Information						
Parameters		**WA**	**WB**	**WC**	**WD**	**WE**
Size of Wetland (acres)		10.2	0.429	0.100	0.808	0.758
Wetland Type		RR	RR	RR	RR	RR
Mapped Soil Series		Water	Bibb	Bibb	Bibb	Bibb
Drainage Class		NA	PD	PD	PD	PD
Soil Hydric Status		NA	PH	PH	PH	PH
Source of Hydrology		GW, OL	GW, OL	GW, OL	GW, OL	GW, OL
Restoration or enhancement method		H, V	V	V	V	V



Vegetation Condition Assessment

Invasive Species	Target Community: Present	Target Community: Marginal	Target Community: Absent
Absent	No Fill		
Present			

res

Restoring a resilient earth for a modern world

N E S W

0 75 150

Feet

Figure 2 - CCPV MY2

Matthew Mitigation Project

Johnston County, North Carolina

Date: 12/12/2022	Drawn by: GDS
1 in = 150 feet	Checked by: MDD

Legend

- Proposed Easement

Fixed Vegetation Plot

- >320 stems/acre

MY2 Random Vegetation Plot

- >320 stems/acre
- Previous Random Vegetation Plot

Wetland Mitigation Approach

- Rehabilitation (2:1)
- Re-establishment (1:1)
- Preservation
- Top of Bank
- Fence Installation
- Engineered Sediment Pack
- Cross Section

Stream Mitigation Approach

- Restoration
- Preservation
- Restoration (No credit)
- Preservation (No credit)
- Stage Recorder
- Ambient

Groundwater Wells

- >12% Hydroperiod
- 5-11% Hydroperiod
- <5% Hydroperiod

Document Path: R:\Respo\maps\Projects\100300_Matthew\MXD\6_Monitoring\MY2\Matthew CCPV MY2 2022.mxd

Visual Stream Stability Assessment

Reach RL1-A

Assessed Stream Length 2438

Assessed Bank Length 4876

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.	46	46		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)	36	36		100%

Visual Stream Stability Assessment

Reach RL2

Assessed Stream Length 792

Assessed Bank Length 1584

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.	19	19		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)	17	17		100%

Table 6 Vegetation Condition Assessment

Planted Acreage[1] 16.4

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%
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%

Easement Acreage[2] 19.19

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	0	0.00	0.0%
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.

Matthew MY2 Vegetation Monitoring Plot Photos

Vegetation Plot 1 (10/20/2022)

Vegetation Plot 2 (10/20/2022)

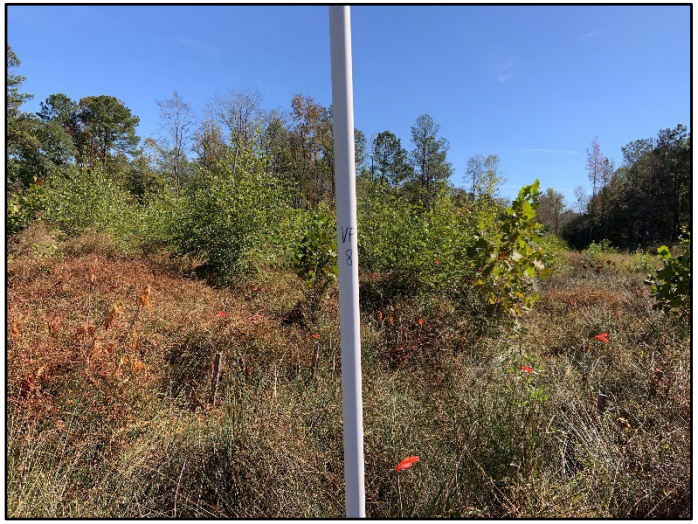
Vegetation Plot 3 (10/20/2022)

Vegetation Plot 4 (10/20/2022)

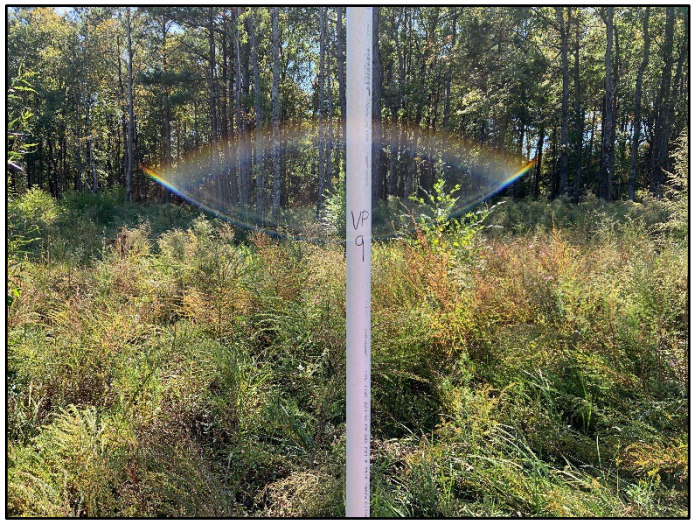
Vegetation Plot 5 (10/20/2022)

Vegetation Plot 6 (10/20/2022)

Vegetation Plot 7 (10/20/2022)



Vegetation Plot 8 (10/20/2022)



Vegetation Plot 9 (10/20/2022)


Vegetation Plot 10 (10/20/2022)

Matthew MY2 Random Vegetation Monitoring Plot Photo

Random Vegetation Plot 1 (10/20/2022)

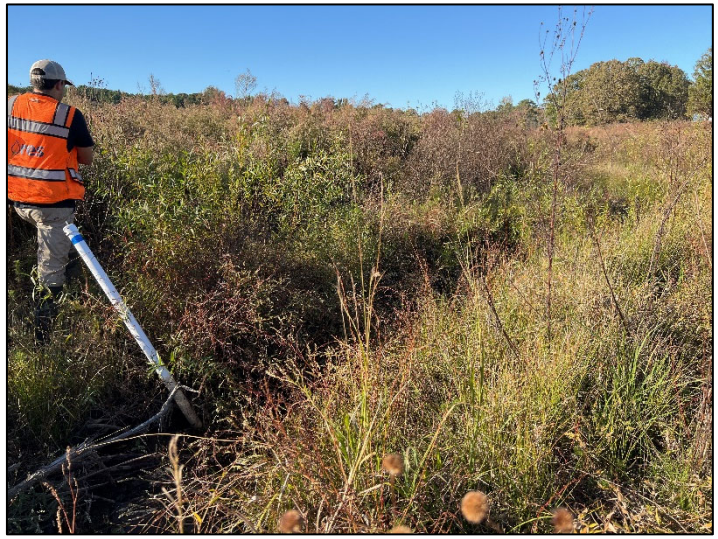
Random Vegetation Plot 2 (10/20/2022)

Random Vegetation Plot 3 (10/20/2022)

Random Vegetation Plot 4 (10/20/2022)

MY2 Matthew Monitoring Device Photos (*All taken on 06/28/2022*)

Stage Recorder RL1-A



Stage Recorder RL2

Groundwater Well 1

Groundwater Well 2

Groundwater Well 3

Groundwater Well 4

Groundwater Well 5

Groundwater Well 6

Groundwater Well 7

Groundwater Well 8

Groundwater Well Ref 1

Groundwater Well Ref 2

MY2 Matthew General Site Photos

Plunge pool and boulder toe protection below NC-96 culvert on RL1-A (06/28/2022)

Preservation area dry (06/28/2022)

Plunge Pool at the top of RL2 (6/28/2022)

Looking upstream from GW5 (10/20/2022)

Appendix C

Vegetation Plot Data

Table 7. Planted Species Summary

Common Name	Scientific Name	Mit Plan %	As-Built %	Total Stems Planted
River Birch	*Betula nigra*	10	20	3,500
Swamp Chestnut Oak	*Quercus michauxii*	5	16	2,700
Buttonbush	*Cephalanthus occidentalis*	10	15	2,500
Sycamore	*Platanus occidentalis*	10	14	2,300
Willow Oak	*Quercus phellos*	10	12	2,200
Bald Cypress	*Taxodium distichum*	15	9	1,500
Water Oak	*Quercus nigra*	0	8	1,400
Green Ash	*Fraxinus pennsylvanica*	0	5	800
Swamp Tupelo	*Nyssa biflora*	10	0	0
Atlantic White Cedar	*Chamaecyparis thyoides*	10	0	0
Overcup Oak	*Quercus lyrata*	10	0	0
Laurel Oak	*Quercus laurifolia*	5	1	100
Water Tupelo	*Nyssa aquatica*	5	0	0
			Total	17,000
			Planted Area	16.4
			As-built Planted Stems/Acre	1,037

Table 8. Vegetation Plot Mitigation Success Summary

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Planted Stem Height (ft)
1	931	0	931	Yes	2.0
2	728	0	728	Yes	2.4
3	931	0	931	Yes	2.3
4	1012	0	1012	Yes	2.7
5	1052	0	1052	Yes	3.0
6	1012	0	1012	Yes	3.8
7	850	0	850	Yes	2.6
8	809	0	809	Yes	2.6
9	931	0	931	Yes	2.0
10	769	1133	1902	Yes	1.8
R1	688	0	688	Yes	6.7
R2	850	0	850	Yes	7.0
R3	688	0	688	Yes	3.4
R4	809	0	809	Yes	2.0
Project Avg	**861**	**113**	**942**	**Yes**	**3.1**

Table 9. Stem Count Total and Planted by Plot Species

			Current Plot Data (MY2 2022)																												
			100043-01-0001			100043-01-0002			100043-01-0003			100043-01-0004			100043-01-0005			100043-01-0006			100043-01-0007			100043-01-0008			100043-01-0009			100043-01-0010		
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	PnoLS	P-all	T
Alnus serrulata	hazel alder	Shrub																													
Betula nigra	river birch	Tree	2	2	2				3	3	3	16	16	16	4	4	4	4	4	4	6	6	6	3	3	3	10	10	10	9	9	9
Cephalanthus occidentalis	common buttonbush	Shrub	6	6	6	6	6	6				3	3	3	2	2	2	3	3	3	3	3	3	10	10	10				1	1	1
Fraxinus pennsylvanica	green ash	Tree													1	1	1	1	1	1											
Liquidambar styraciflua	sweetgum	Tree																													
Liriodendron tulipifera	tuliptree	Tree																													
Nyssa biflora	swamp tupelo	Tree																													8
Pinus taeda	loblolly pine	Tree																													20
Platanus occidentalis	American sycamore	Tree										2	2	2	3	3	3	3	3	3	7	7	7	3	3	3	5	5	5			
Quercus lyrata	overcup oak	Tree																													
Quercus michauxii	swamp chestnut oak	Tree	9	9	9	6	6	6	9	9	9	2	2	2	5	5	5	2	2	2	2	2	2	2	2	2	4	4	4			
Quercus nigra	water oak	Tree							3	3	3										1	1	1								
Quercus phellos	willow oak	Tree	4	4	4	4	4	4	7	7	7	2	2	2	2	2	2	7	7	7	1	1	1	2	2	2	2	2	2	9	9	9
Salix nigra	black willow	Tree																													
Taxodium distichum	bald cypress	Tree	2	2	2	2	2	2	1	1	1				9	9	9	5	5	5	1	1	1				2	2	2			
		Stem count	23	23	23	18	18	18	23	23	23	25	25	25	26	26	26	25	25	25	21	21	21	20	20	20	23	23	23	19	19	47
		size (ares)	1			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			0.02		
		Species count	5	5	5	4	4	4	5	5	5	5	5	5	7	7	7	7	7	7	7	7	7	5	5	5	5	5	5	3	3	5
		Stems per ACRE	931	931	931	728	728	728	931	931	931	1012	1012	1012	1052	1052	1052	1012	1012	1012	850	850	850	809	809	809	931	931	931	769	769	1902

			Current Plot Data (MY2 2022)												Annual Means								
			R1			R2			R3			R4			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
Alnus serrulata	hazel alder	Shrub																		7			
Betula nigra	river birch	Tree	11	11	11	4	4	4	1	1	1	1	1	1	74	74	74	82	82	82	81	81	81
Cephalanthus occidentalis	common buttonbush	Shrub				3	3	3				1	1	1	38	38	38	31	31	31	13	13	13
Fraxinus pennsylvanica	green ash	Tree										1	1	1	3	3	3	4	4	4	42	42	42
Liquidambar styraciflua	sweetgum	Tree																		1			
Liriodendron tulipifera	tuliptree	Tree																		1			
Nyssa biflora	swamp tupelo	Tree															8						
Pinus taeda	loblolly pine	Tree															20						
Platanus occidentalis	American sycamore	Tree	2	2	2	2	2	2	9	9	9	9	9	9	45	45	45	36	36	36	49	49	49
Quercus lyrata	overcup oak					1	1	1							1	1	1						
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	1	1	1	5	5	5	4	4	4	54	54	54	46	46	46	49	49	49
Quercus nigra	water oak	Tree										1	1	1	5	5	5	6	6	6	13	13	13
Quercus phellos	willow oak	Tree				2	2	2				3	3	3	45	45	45	39	39	39	89	89	89
Salix nigra	black willow	Tree																		9			
Taxodium distichum	bald cypress	Tree	1	1	1	8	8	8	2	2	2				33	33	33	29	29	29	43	43	43
		Stem count	17	17	17	21	21	21	17	17	17	20	20	20	298	298	326	273	273	291	379	379	379
		size (ares)	1			1			1			1			14			14			14		
		size (ACRES)	0.02			0.02			0.02			0.02			0.35			0.35			0.35		
		Species count	4	4	4	7	7	7	4	4	4	7	7	7	9	9	11	8	8	12	8	8	8
		Stems per ACRE	688	688	688	850	850	850	688	688	688	809	809	809	861	861	942	789	789	841	1096	1096	1096

Appendix D

Stream Measurement and

Geomorphology Data

Table 10. Baseline Stream Data Summary
Matthew Mitigation Site - Reach RL1-A

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)		---	---	---	8.0	8.2	8.2	8.4	--	2	11.5	---	---	---	---	1	11.0	12.2	13.3	8.8	10.8	11.0	12.1	1.3	6
Floodprone Width (ft)					0.0	>15	15.0	>30	--	2	>30	---	---	---	---	1	>30	>30	>30	>49.8	>49.9	>49.9	>50	0.1	6
Bankfull Mean Depth (ft)		---	---	---	1.1	1.4	1.4	1.6	--	2	1.3	---	---	---	---	1	1.2	1.3	1.3	-	-	-	-	-	-
[1]Bankfull Max Depth (ft)					1.4	2.2	2.2	2.9	--	2	1.9	---	---	---	---	1	1.5	1.6	1.7	1.3	1.7	1.7	2.0	0.3	6
Bankfull Cross Sectional Area (ft^2)		---	---	---	8.5	10.9	10.9	13.2	--	2	15.2	---	---	---	---	1	13.1	15.5	17.9	8.6	12.5	12.2	16.6	3.4	6
Width/Depth Ratio					5.4	6.5	6.5	7.6	--	2	8.7	---	---	---	---	1	9.2	9.5	9.8	-	-		-	-	-
Entrenchment Ratio					2.2	2.2	2.2	2.2	--	2	2.2	---	---	---	---	1	2.2	2.2	2.2	1.3	1.7	1.7	2.0	0.3	6
[1]Bank Height Ratio					--	--	--	1.1	--	2	1.1	---	---	---	---	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	5	---	---	35	---	---	5.5	---	23	10	24	23	44	10	45
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.01	1.04044	0.73	4.04	0.88273	45
Pool Length (ft)					---	---	---	---	---	---	3	---	---	12	---	---	11	---	18	14	33	32	60	10	44
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	11	---	---	35	---	---	39	---	59.5	26	57	56	91	16	44
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	20	---	---	59	---	---	5.5	---	23	5.5	---	---	23	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	11	---	---	26	---	---	---	---	---	---	---	---	---	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	0.9	---	---	2.1	---	---	11	---	18	11	---	---	18	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	155	---	---	177	---	---	---	---	---	---	---	---	---	---	---
Meander Width Ratio					---	---	---	---	---	---	13	---	---	14.8	---	---	39	---	59.5	39	---	---	59.5	---	---
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						E4/5			E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---								
Valley length (ft)					294						842						1013			---					
Channel Thalweg length (ft)					362						995						1219			1219					
Sinuosity (ft)					1.25						1.18						1.21			---					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.002						0.0027						0.0025			---					
[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)
Matthew Mitigation Site - Reach RL2

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)		---	---	---	---	---	---	---	---	---	11.5	---	---	---	---	1	---	9.2	--	8.3	8.8	8.8	9.3	0.5	2
Floodprone Width (ft)					---	---	---	---	---	---	>30	---	---	---	---	1	---	>30	--	>49.8	>49.9	49.9	>50	0.1	2
Bankfull Mean Depth (ft)		---	---	---	---	---	---	---	---	---	1.3	---	---	---	---	1	---	1.0	--	-	-	-	-	-	-
[1]Bankfull Max Depth (ft)					---	---	---	---	---	---	1.9	---	---	---	---	1	---	1.3	--	1.3	1.4	1.4	1.4	0.1	2
Bankfull Cross Sectional Area (ft^2)		---	---	---	---	---	---	---	---	---	15.2	---	---	---	---	1	---	9.0	---	7.7	8.4	8.4	9.0	0.7	2
Width/Depth Ratio					---	---	---	---	---	---	8.7	---	---	---	---	1	---	9.4	---	-	-	-	-	-	-
Entrenchment Ratio					---	---	---	---	---	---	2.2	---	---	---	---	1	---	2.2	---	1.3	1.4	1.4	1.4	0.1	2
[1]Bank Height Ratio					---	---	---	---	---	---	1.1	---	---	---	---	1	---	1.0	---	1.0	1.0	1.0	1.0	0.0	2
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	5	---	---	35	---	---	4	---	18	9	15	14	37	7	16
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.01	1.98875	1.575	5.38	1.68443	16
Pool Length (ft)					---	---	---	---	---	---	3	---	---	12	---	---	4	---	14	17	30	26	82	15	15
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	11	---	---	35	---	---	13	---	45	33	46	40	119	22	14
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	20	---	---	59	---	---	15	---	46	15	---	---	46	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	11	---	---	26	---	---	8	---	20	8	---	---	20	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	0.9	---	---	2.1	---	---	0.9	---	2.1	0.9	---	---	2.1	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	155	---	---	177	---	---	120	---	137	120	---	---	137	---	---
Meander Width Ratio					---	---	---	---	---	---	13	---	---	14.8	---	---	13	---	14.8	13	---	---	14.8	---	---
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					---						E4/5						E4/5			E4/E5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---												---								
Valley length (ft)					---						842						655			---					
Channel Thalweg length (ft)					---						995						792			792					
Sinuosity (ft)					---						1.18						1.21			---					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					---						0.0027						0.004			---					
[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: Matthew #100043

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (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]	127.2	127.6	127.6					127.1	127.7	127.6					126.2	126.3	126.3					126.0	126.0	126.0					125.5	125.6	125.5				
Bankfull Width (ft)[1]	10.1	9.1	11.9					10.0	9.9	11.5					8.8	10.5	9.3					9.8	10.1	10.1					9.7	11.4	9.8				
Floodprone Width (ft)[1]	-	-	-					>49.9	>49.9	>49.9					>50.0	>50	>49.8					-	-	-					-	-	-				
Bankfull Max Depth (ft)[2]	1.5	1.2	1.2					1.3	1.2	1.4					1.6	1.6	1.6					2.0	2.2	2.2					2.9	2.8	3.0				
Low Bank Elevation (ft)	-	-	-					127.1	127.4	127.6					126.2	126.2	126.2					-	-	-					-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	9.0	7.4	7.8					8.6	6.1	8.0					9.9	9.3	9.3					12.1	12.3	12.8					15.3	14.7	16.5				
Bankfull Entrenchment Ratio[1]	-	-	-					>5.0	>5.0	>4.4					>5.7	>4.8	>5.4					-	-	-					-	-	-				
Bankfull Bank Height Ratio[1]	-	-	-					1.0	0.8	1.0					1.0	1.0	1.0					-	-	-					-	-	-				

	Cross Section 6 (Riffle)							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]	125.4	125.6	125.4					124.0	124.1	124.0					123.4	123.2	123.2					123.5	123.5	123.6					122.9	122.9	123.0				
Bankfull Width (ft)[1]	8.9	8.8	9.5					11.9	12.8	13.1					11.2	11.3	11.0					12.0	13.1	13.0					13.4	13.5	14.1				
Floodprone Width (ft)[1]	>49.9	>50	>50					>49.9	>49.9	>49.9					-	-	-					>50	>49.9	>49.9					-	-	-				
Bankfull Max Depth (ft)[2]	1.4	1.2	1.4					2.0	1.9	1.9					2.8	3.0	2.8					2.0	1.9	2.0					2.7	2.9	3.2				
Low Bank Elevation (ft)	125.4	125.2	125.1					124.0	124.0	124.0					-	-	-					123.5	123.4	123.6					-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	8.8	6.1	5.9					16.6	15.0	16.1					19.9	22.0	21.4					16.5	15.9	16.6					21.6	23.9	23.6				
Bankfull Entrenchment Ratio[1]	>5.6	>5.7	>5.2					>4.2	>3.9	>3.8					-	-	-					>4.2	>3.8	>3.8					-	-	-				
Bankfull Bank Height Ratio[1]	1.0	0.8	0.8					1.0	0.9	1.0					-	-	-					1.0	1.0	1.0					-	-	-				

	Cross Section 11 (Pool)							Cross Section 12 (Riffle)							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]	122.3	122.2	122.1					122.2	122.2	122.1					126.4	126.3	126.3					126.7	126.8	126.8					125.4	125.4	125.4				
Bankfull Width (ft)[1]	11.5	11.1	11.0					12.1	13.3	13.6					9.4	10.0	9.9					9.3	10.1	10.6					8.3	8.5	8.3				
Floodprone Width (ft)[1]	-	-	-					>49.8	>49.9	>49.9					-	-	-					>49.8	>50	>49.9					>50	>50	>49.9				
Bankfull Max Depth (ft)[2]	3.2	3.2	3.1					1.7	1.8	1.7					2.3	2.5	2.1					1.4	1.3	1.2					1.3	1.4	1.3				
Low Bank Elevation (ft)	-	-	-					122.2	122.2	122.2					-	-	-					126.7	126.8	126.6					125.4	125.4	125.4				
Bankfull Cross Sectional Area (ft^2)[2]	19.8	21.8	21.6					14.4	14.6	14.7					13.9	16.1	14.1					9.0	9.0	8.0					7.7	8.5	8.1				
Bankfull Entrenchment Ratio[1]	-	-	-					>4.1	>3.7	>3.7					-	-	-					>5.4	>4.9	>4.7					>6.0	>5.9	>6.0				
Bankfull Bank Height Ratio[1]	-	-	-					1.0	1.0	1.0					-	-	-					1.0	1.0	0.9					1.0	1.1	1.0				

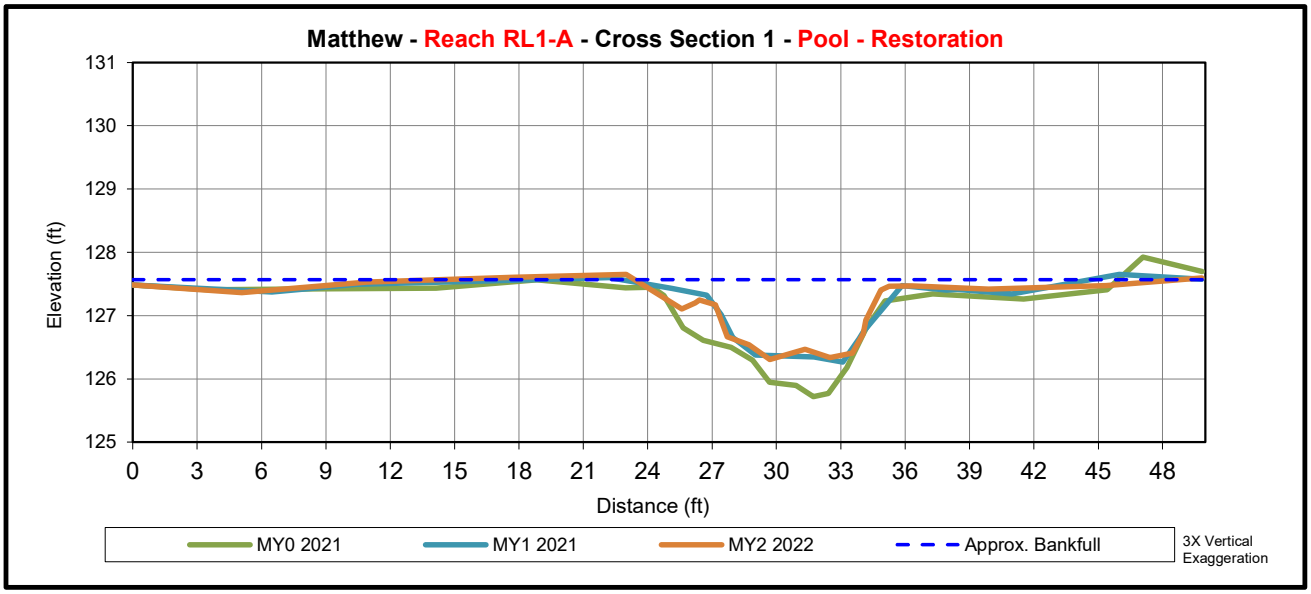
	Cross Section 16 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	125.2	125.3	125.3				
Bankfull Width (ft)[1]	9.2	9.6	9.2				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.4	2.1	2.0				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	12.6	11.3	11.1				
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

Downstream

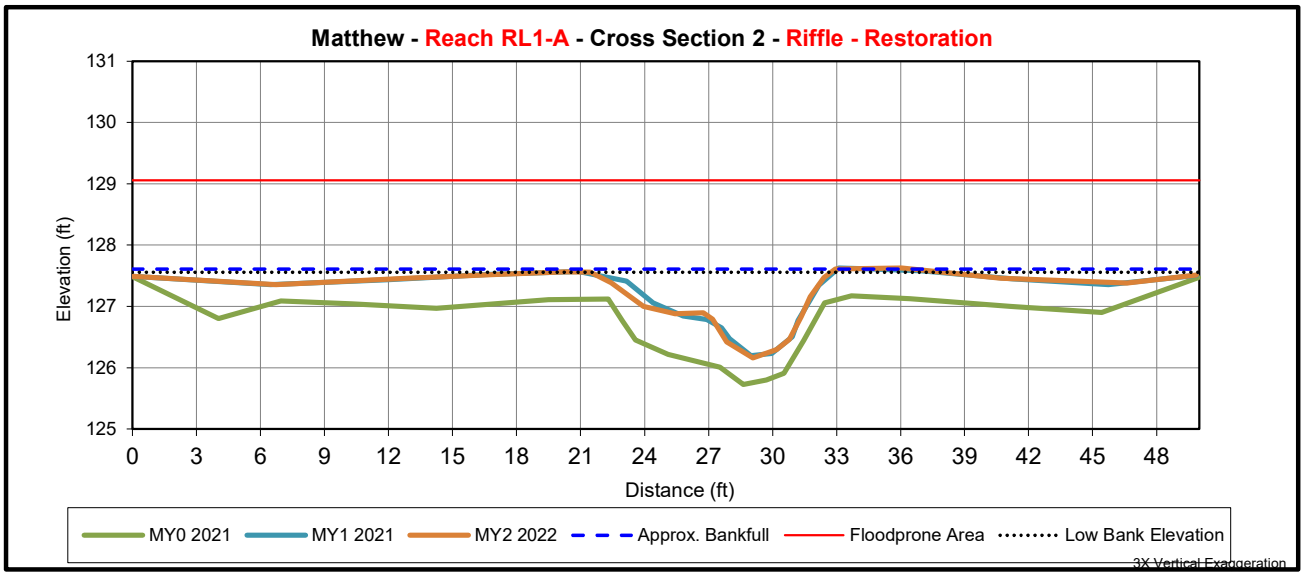


	Cross Section 1 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	127.2	127.6	127.6				
Bankfull Width (ft)[1]	10.1	9.1	11.9				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	1.5	1.2	1.2				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	9.0	7.4	7.8				
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

Downstream

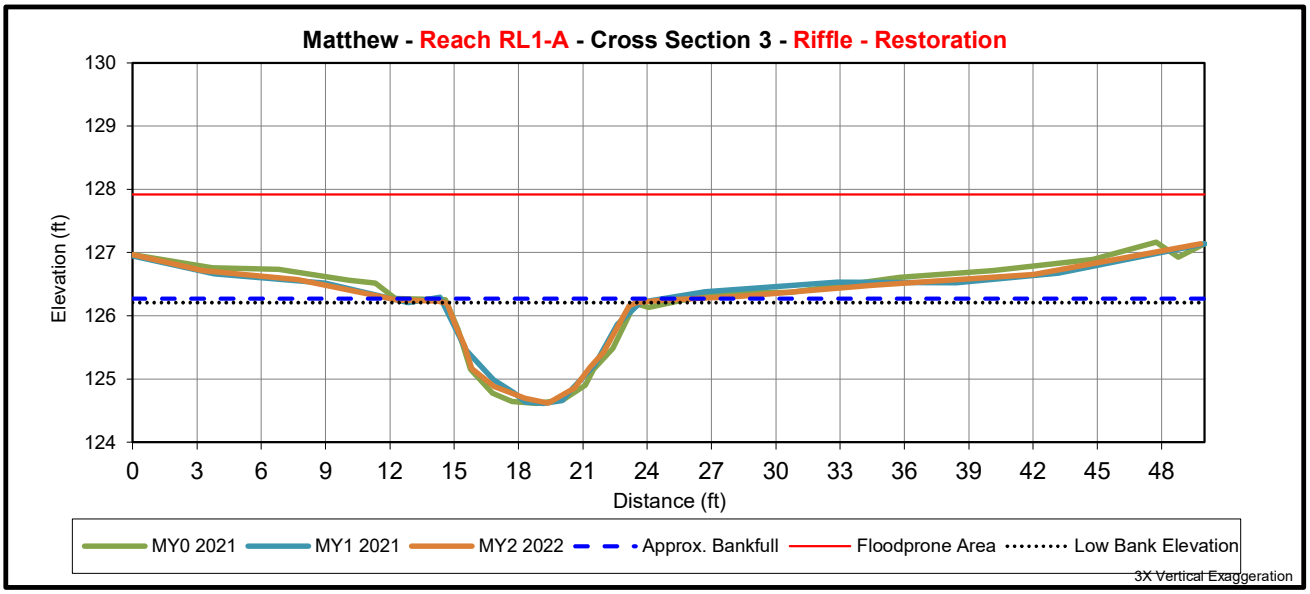


	Cross Section 2 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	127.1	127.7	127.6				
Bankfull Width (ft)[1]	10.0	9.9	11.5				
Floodprone Width (ft)[1]	>49.9	>49.9	>49.9				
Bankfull Max Depth (ft)[2]	1.3	1.2	1.4				
Low Bank Elevation (ft)	127.1	127.4	127.6				
Bankfull Cross Sectional Area (ft^2)[2]	8.6	6.1	8.0				
Bankfull Entrenchment Ratio[1]	>5.0	>5.0	>4.4				
Bankfull Bank Height Ratio[1]	1.0	0.8	1.0				

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

Upstream

Downstream

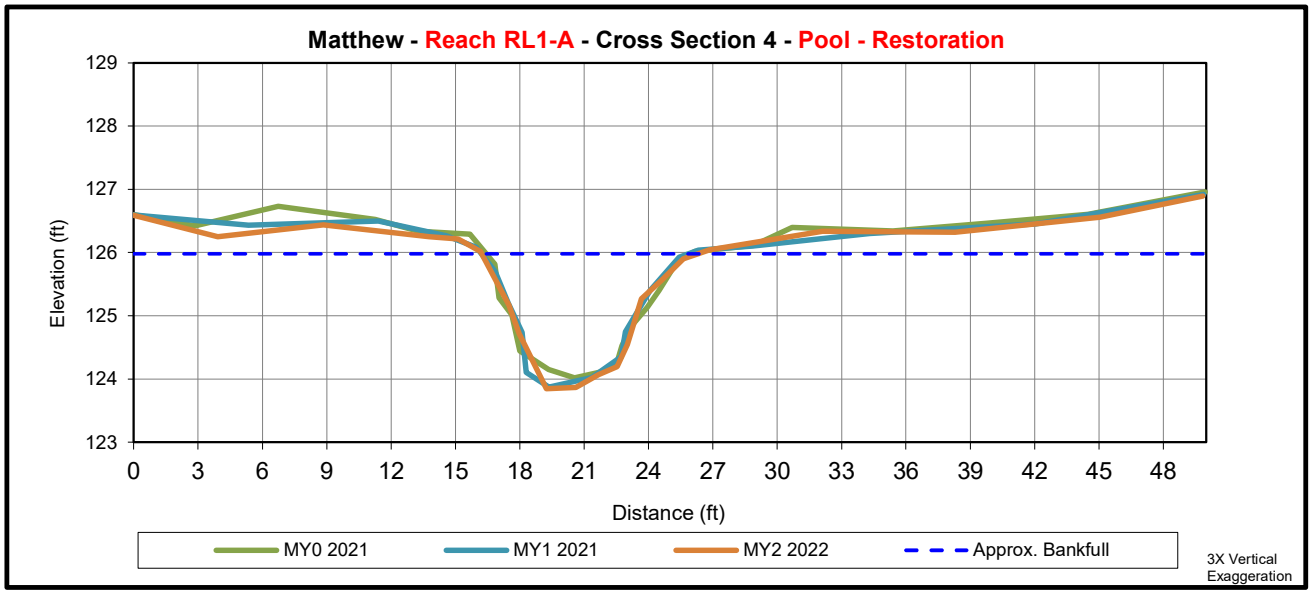


	Cross Section 3 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	126.2	126.3	126.3				
Bankfull Width (ft)[1]	8.8	10.5	9.3				
Floodprone Width (ft)[1]	>50.0	>50	>49.8				
Bankfull Max Depth (ft)[2]	1.6	1.6	1.6				
Low Bank Elevation (ft)	126.2	126.2	126.2				
Bankfull Cross Sectional Area (ft^2)[2]	9.9	9.3	9.3				
Bankfull Entrenchment Ratio[1]	>5.7	>4.8	>5.4				
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0				

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

Upstream

Downstream

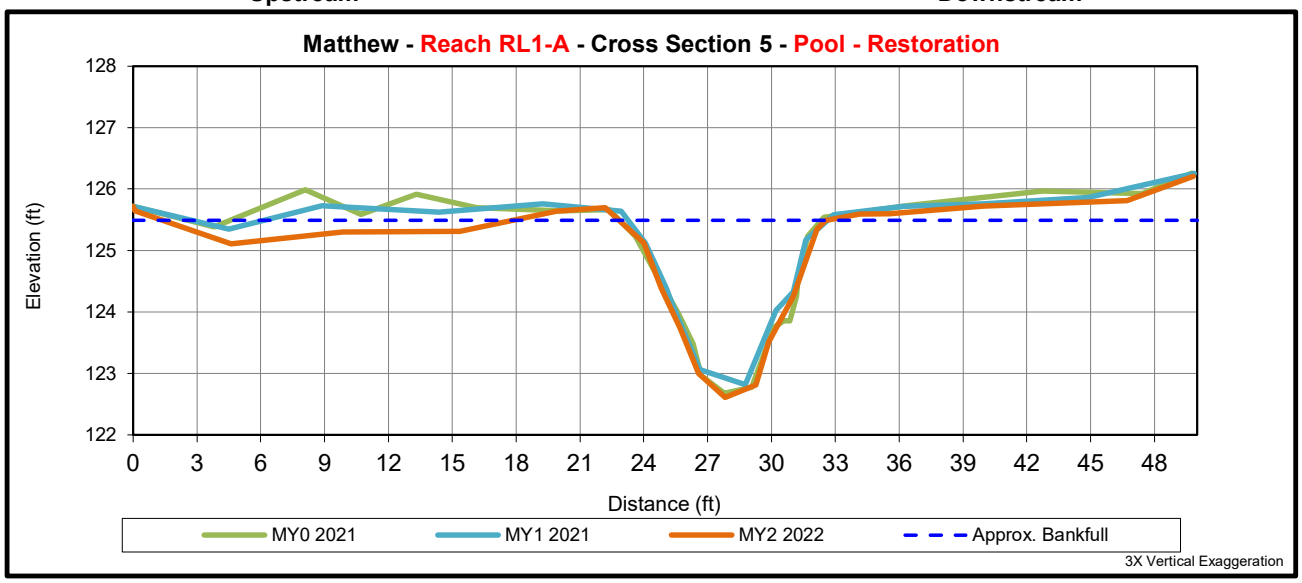


	Cross Section 4 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	126.0	126.0	126.0				
Bankfull Width (ft)[1]	9.8	10.1	10.1				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.0	2.2	2.2				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	12.1	12.3	12.8				
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

Downstream

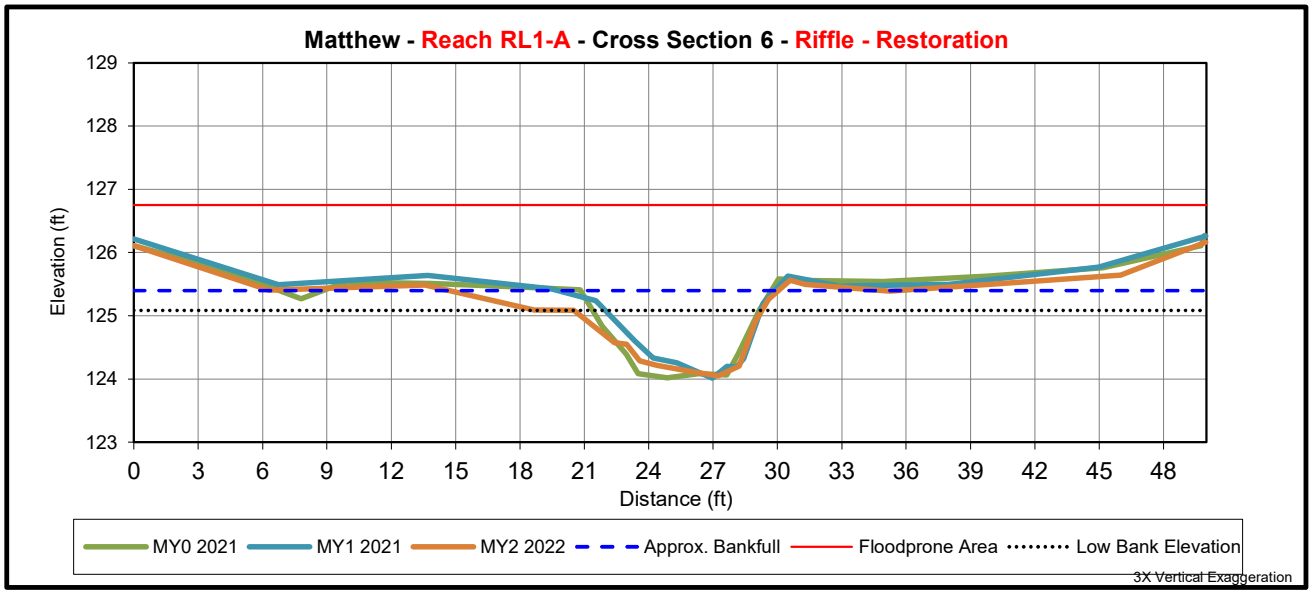


	Cross Section 5 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	125.5	125.6	125.5				
Bankfull Width (ft)[1]	9.7	11.4	9.8				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.9	2.8	3.0				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	15.3	14.7	16.5				
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

Downstream

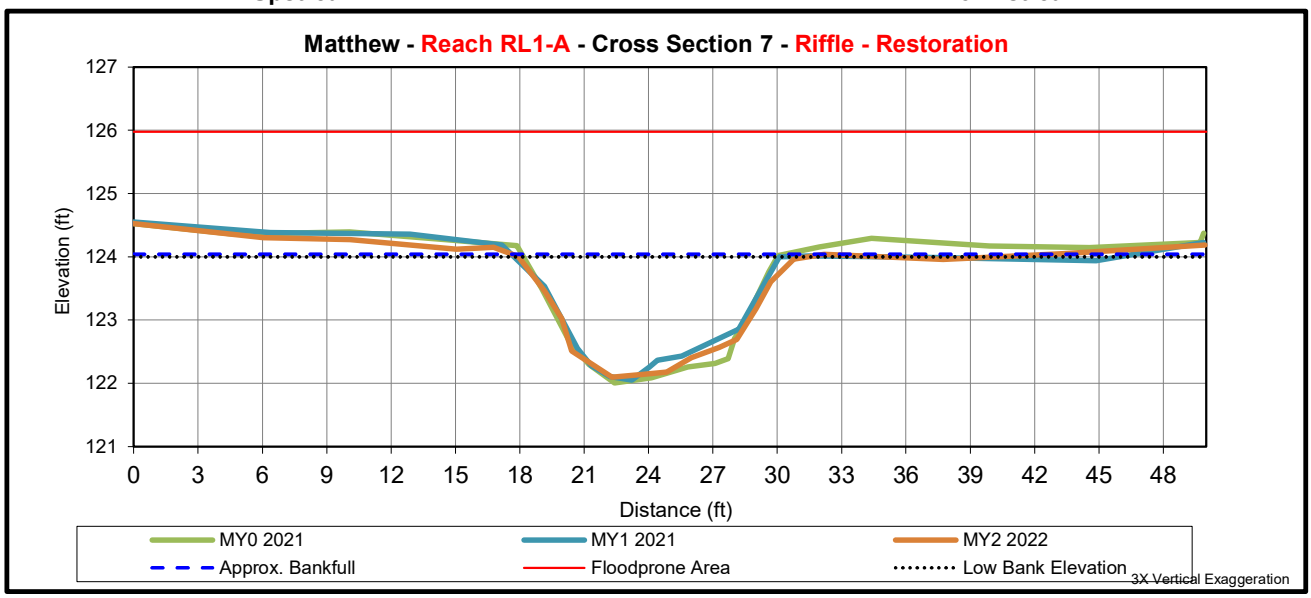


	Cross Section 6 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	125.4	125.6	125.4				
Bankfull Width (ft)[1]	8.9	8.8	9.5				
Floodprone Width (ft)[1]	>49.9	>50	>50				
Bankfull Max Depth (ft)[2]	1.4	1.2	1.4				
Low Bank Elevation (ft)	125.4	125.2	125.1				
Bankfull Cross Sectional Area (ft^2)[2]	8.8	6.1	5.9				
Bankfull Entrenchment Ratio[1]	>5.6	>5.7	>5.2				
Bankfull Bank Height Ratio[1]	1.0	0.8	0.8				

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

Upstream

Downstream

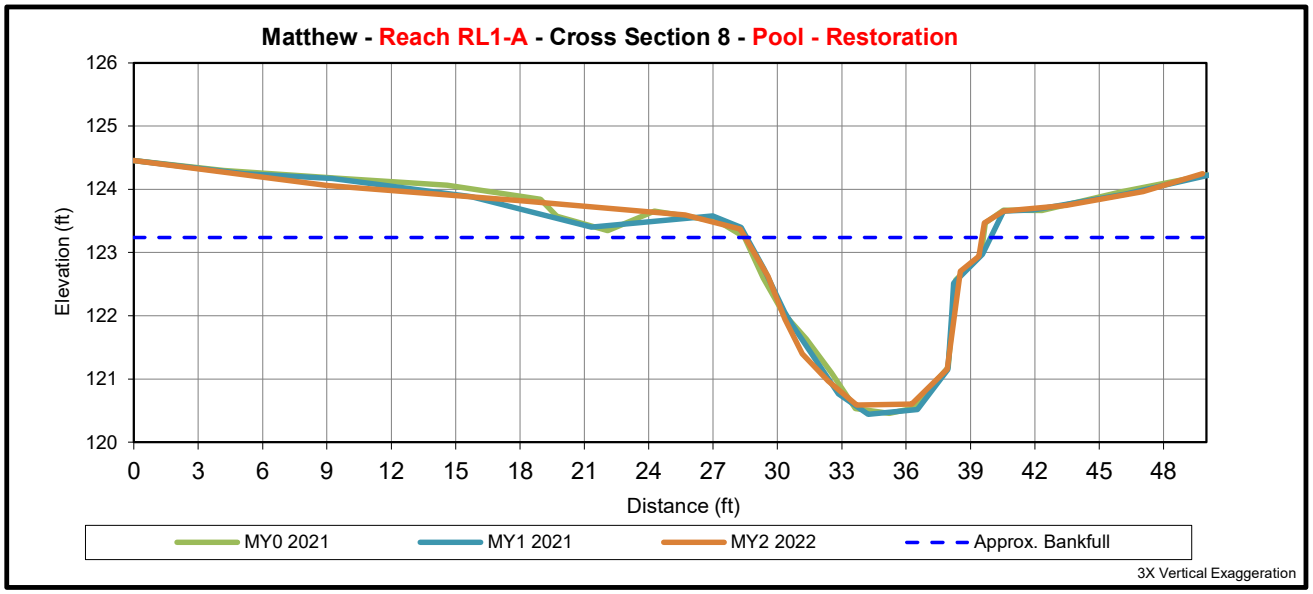


	Cross Section 7 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	124.0	124.1	124.0				
Bankfull Width (ft)[1]	11.9	12.8	13.1				
Floodprone Width (ft)[1]	>49.9	>49.9	>49.9				
Bankfull Max Depth (ft)[2]	2.0	1.9	1.9				
Low Bank Elevation (ft)	124.0	124.0	124.0				
Bankfull Cross Sectional Area (ft^2)[2]	16.6	15.0	16.1				
Bankfull Entrenchment Ratio[1]	>4.2	>3.9	>3.8				
Bankfull Bank Height Ratio[1]	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

Downstream

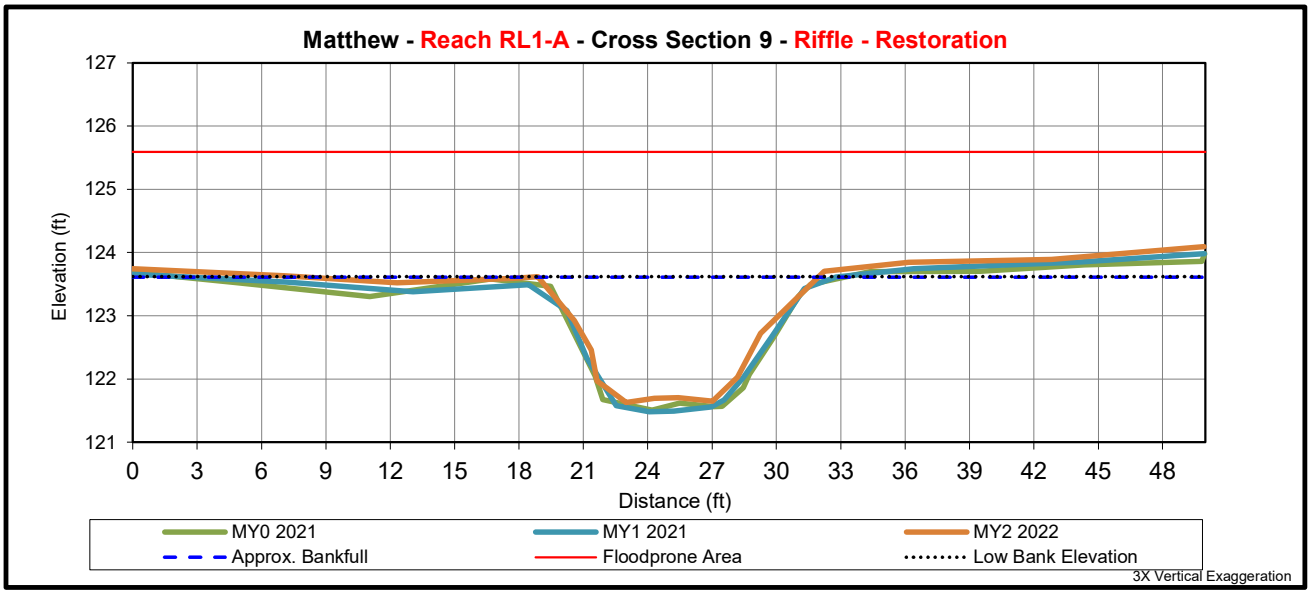


	Cross Section 8 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	123.4	123.2	123.2				
Bankfull Width (ft)[1]	11.2	11.3	11.0				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.8	3.0	2.8				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	19.9	22.0	21.4				
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

Downstream

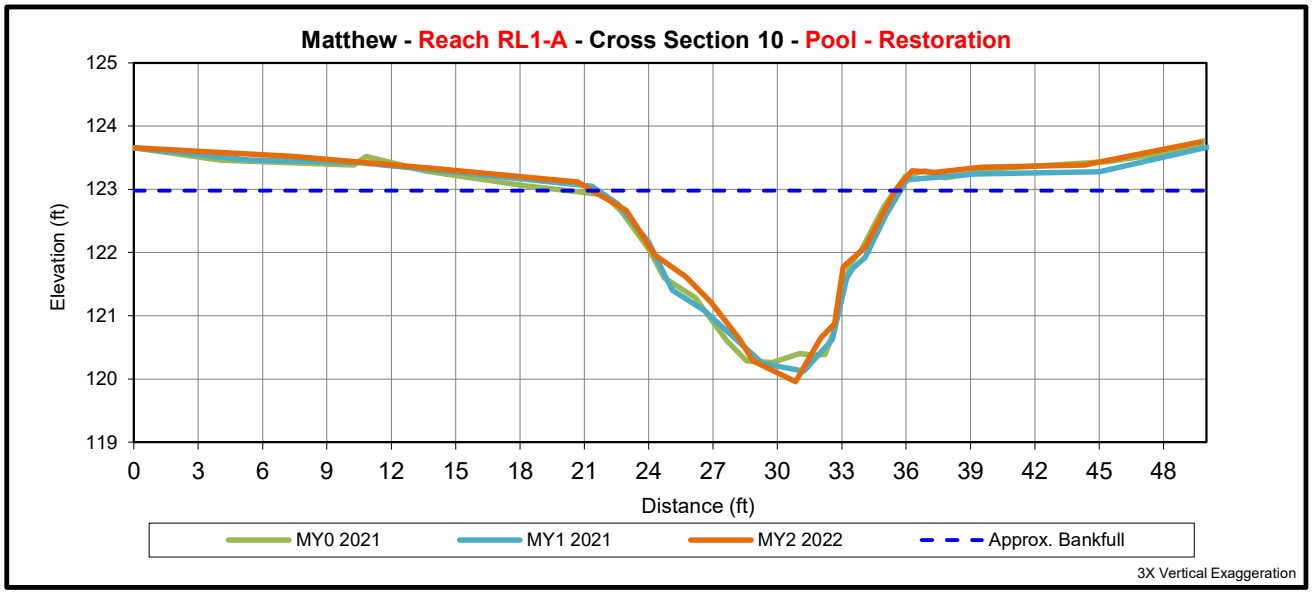


	Cross Section 9 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	123.5	123.5	123.6				
Bankfull Width (ft)[1]	12.0	13.1	13.0				
Floodprone Width (ft)[1]	>50	>49.9	>49.9				
Bankfull Max Depth (ft)[2]	2.0	1.9	2.0				
Low Bank Elevation (ft)	123.5	123.4	123.6				
Bankfull Cross Sectional Area (ft^2)[2]	16.5	15.9	16.6				
Bankfull Entrenchment Ratio[1]	>4.2	>3.8	>3.8				
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0				

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

Upstream

Downstream

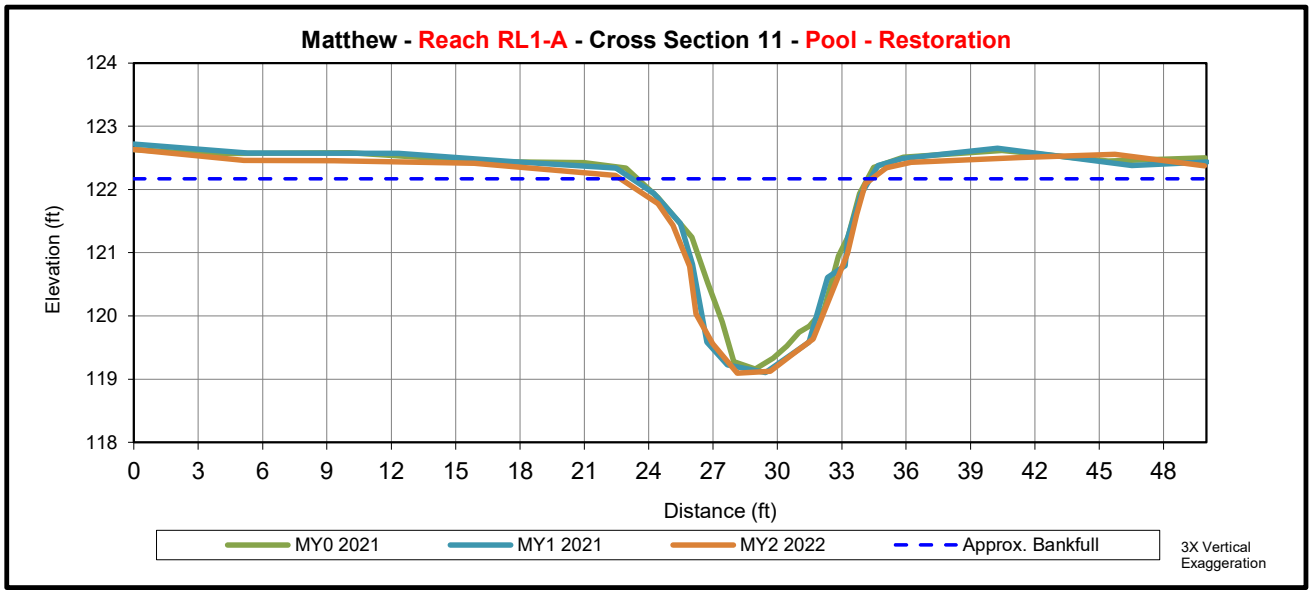


	Cross Section 10 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	122.9	122.9	123.0				
Bankfull Width (ft)[1]	13.4	13.5	14.1				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.7	2.9	3.2				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	21.6	23.9	23.6				
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

Downstream

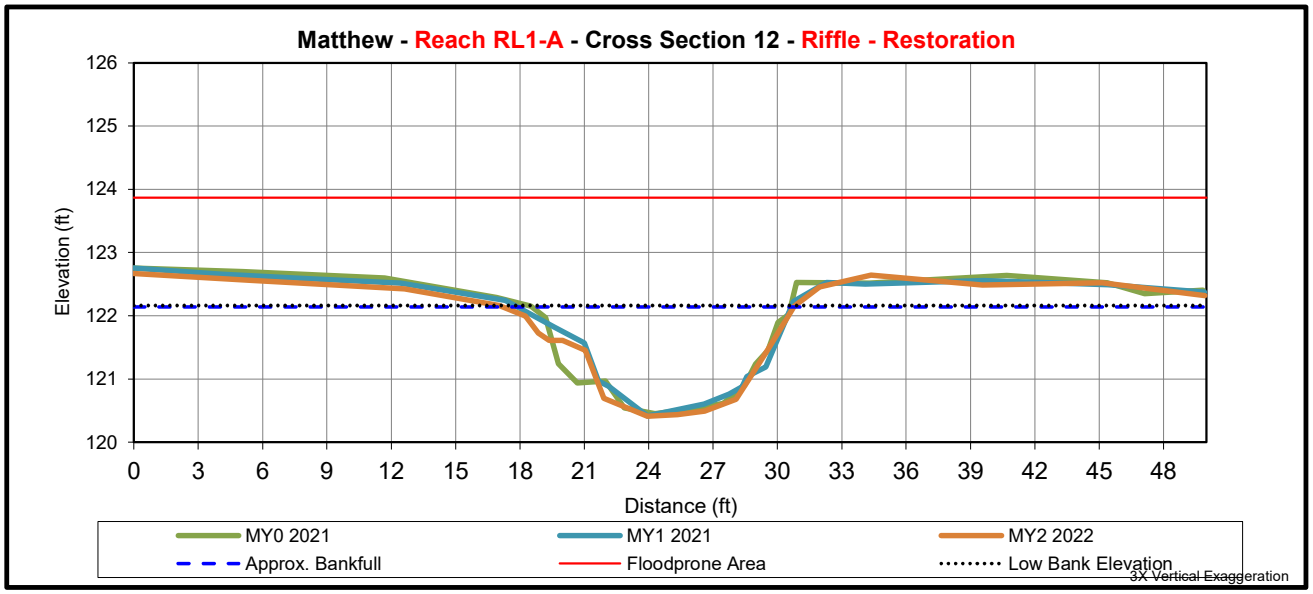


	Cross Section 11 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	122.3	122.2	122.1				
Bankfull Width (ft)[1]	11.5	11.1	11.0				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	3.2	3.2	3.1				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	19.8	21.8	21.6				
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

Downstream

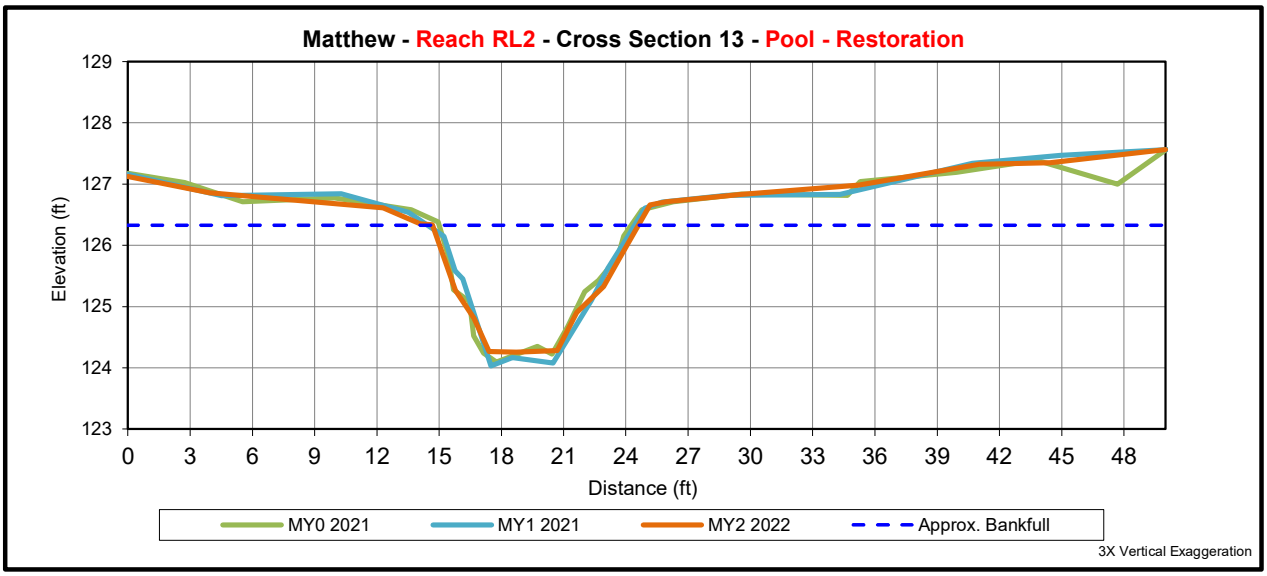


	Cross Section 12 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	122.2	122.2	122.1				
Bankfull Width (ft)[1]	12.1	13.3	13.6				
Floodprone Width (ft)[1]	>49.8	>49.9	>49.9				
Bankfull Max Depth (ft)[2]	1.7	1.8	1.7				
Low Bank Elevation (ft)	122.2	122.2	122.2				
Bankfull Cross Sectional Area (ft^2)[2]	14.4	14.6	14.7				
Bankfull Entrenchment Ratio[1]	>4.1	>3.7	>3.7				
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0				

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

Upstream

Downstream

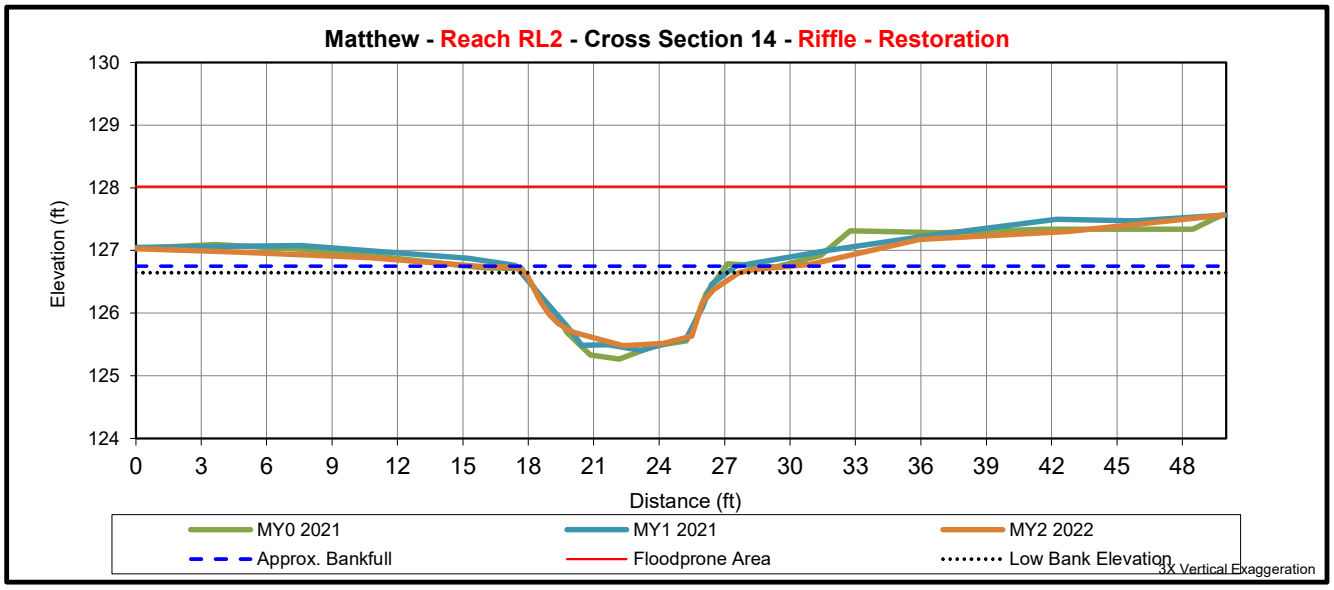


	Cross Section 13 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	126.4	126.3	126.3				
Bankfull Width (ft)[1]	9.4	10.0	9.9				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.3	2.5	2.1				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	13.9	16.1	14.1				
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

Downstream

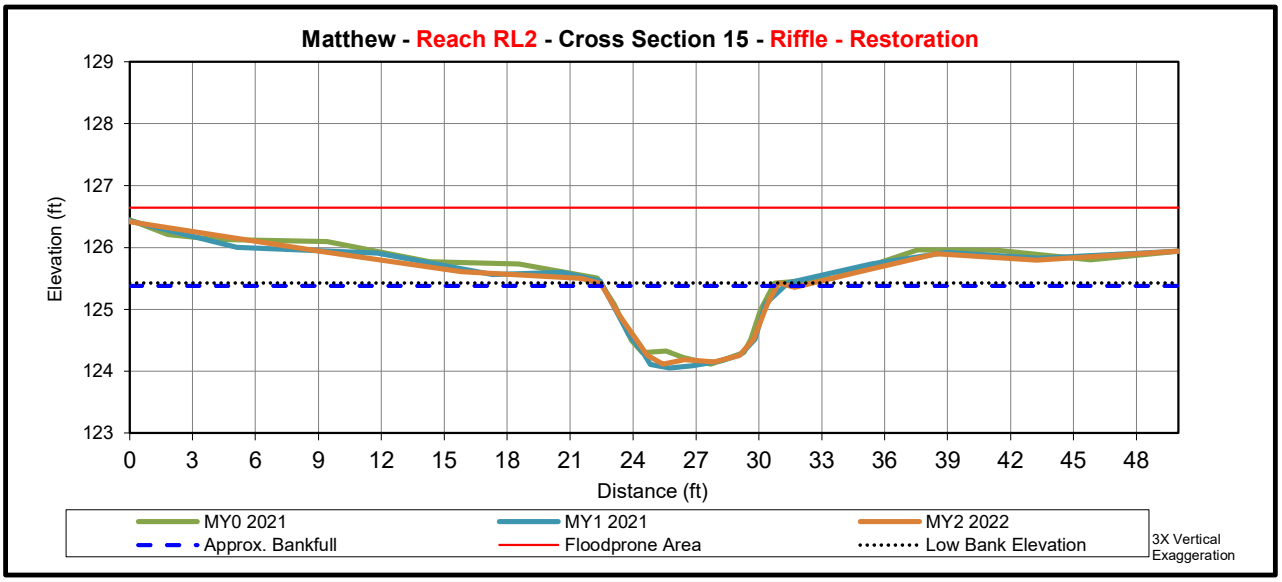


	Cross Section 14 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	126.7	126.8	126.8				
Bankfull Width (ft)[1]	9.3	10.1	10.6				
Floodprone Width (ft)[1]	>49.8	>50	>49.9				
Bankfull Max Depth (ft)[2]	1.4	1.3	1.2				
Low Bank Elevation (ft)	126.7	126.8	126.6				
Bankfull Cross Sectional Area (ft^2)[2]	9.0	9.0	8.0				
Bankfull Entrenchment Ratio[1]	>5.4	>4.9	>4.7				
Bankfull Bank Height Ratio[1]	1.0	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

Downstream

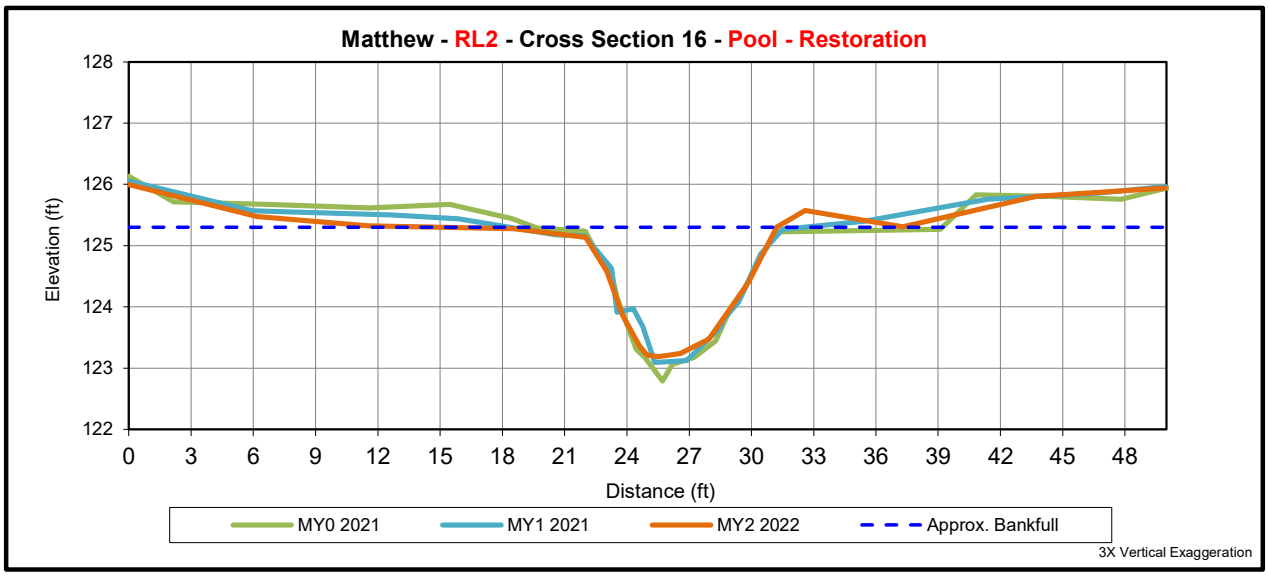


	Cross Section 15 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	125.4	125.4	125.4				
Bankfull Width (ft)[1]	8.3	8.5	8.3				
Floodprone Width (ft)[1]	>50	>50	>49.9				
Bankfull Max Depth (ft)[2]	1.3	1.4	1.3				
Low Bank Elevation (ft)	125.4	125.4	125.4				
Bankfull Cross Sectional Area (ft^2)[2]	7.7	8.5	8.1				
Bankfull Entrenchment Ratio[1]	>6.0	>5.9	>6.0				
Bankfull Bank Height Ratio[1]	1.0	1.1	1.0				

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

Upstream

Downstream



	Cross Section 16 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	125.2	125.3	125.3				
Bankfull Width (ft)[1]	9.2	9.6	9.2				
Floodprone Width (ft)[1]	-	-	-				
Bankfull Max Depth (ft)[2]	2.4	2.1	2.0				
Low Bank Elevation (ft)	-	-	-				
Bankfull Cross Sectional Area (ft^2)[2]	12.6	11.3	11.1				
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

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Soil Characterization

Table 12a. 2022 Rainfall Summary

Month	Average	Normal Limits		Project Location Precipitation*	
		30 Percent	70 Percent		
October	3.32	2.21	3.98	4.08	2021
November	3.24	1.87	3.94	0.99	
December	3.28	2.24	3.91	4.11	
January	3.37	2.39	3.99	4.28	2022
February	3.25	2.10	3.92	1.88	
March	4.23	3.10	4.98	2.50	
April	3.71	2.38	4.47	2.80	
May	4.25	2.93	5.06	4.04	
June	4.60	2.99	5.54	0.87	
July	5.56	4.24	6.47	6.54	
August	5.10	3.61	6.04	6.38	
September	5.02	2.98	6.09	6.03	
October	3.32	2.21	3.98	3.30	
November	3.24	1.87	3.94	2.85	
December	3.28	2.24	3.91	-	
Total Annual **	48.93	44.37	52.62	41.48	

Above Normal Limits	Below Normal Limits

WETS Station: Smithfield, NC. Approximately 7.44 miles from the site.
*Project Location Precipitation is a location-weighted average of surrounding gauged data retrieved by the USACE Antecedent Precipitation Tool. Gauges used include Benson 7.5 ESE, Clayton 5.5 S, Clayton 5.7 SSE, Clayton 6.8 ESE, Clayton WTP, Four Oaks 5.7 NW, Selma 2.3 N, Smithfield 2.8 SE, and Smithfield
**Total Annual represents the average total precipitation, annually, as calculated by the 30-year period.

Table 12b. Drought Summary

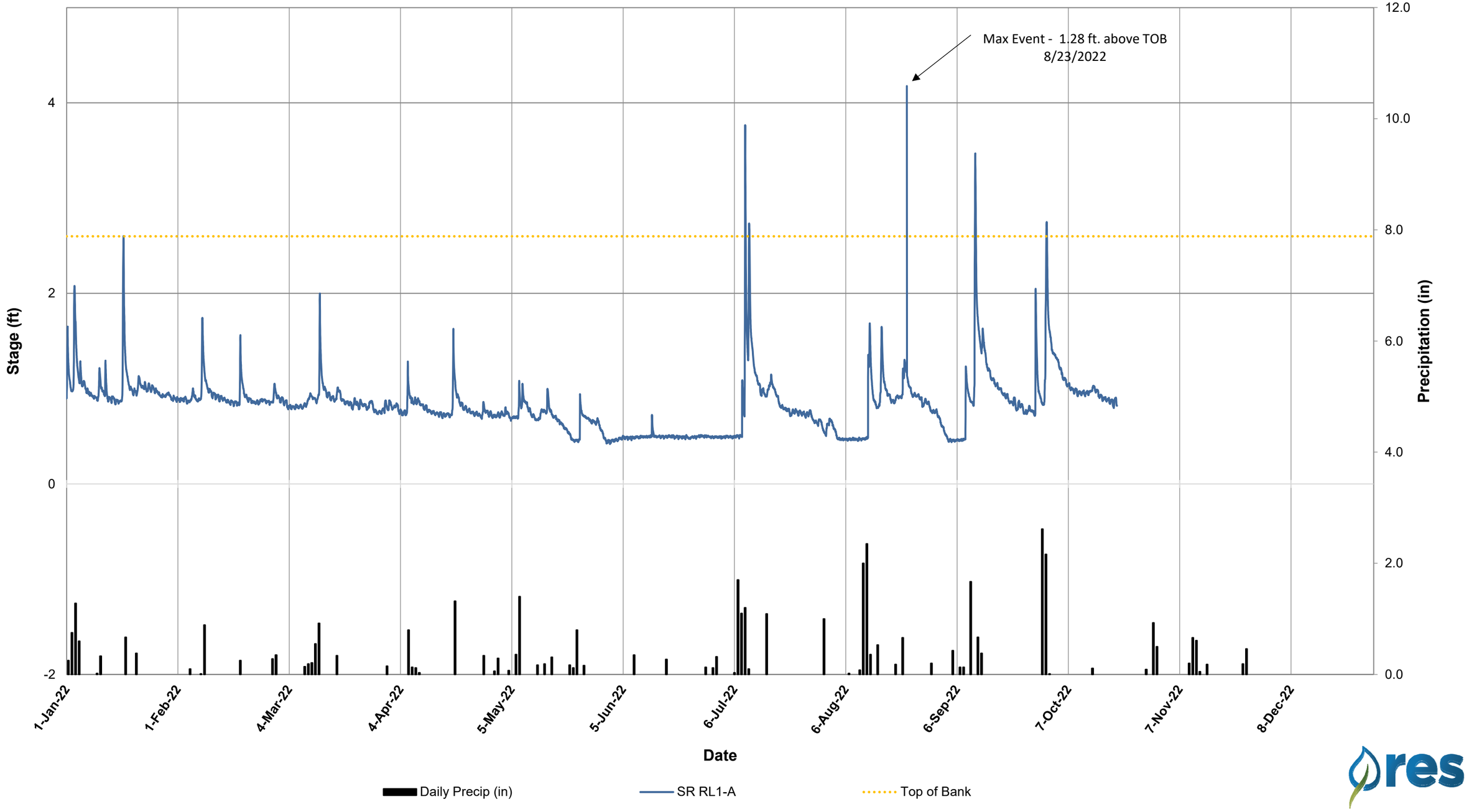
	D0 - Abnormally Dry	D1 - Moderate Drought	D2 - Severe Drought
(Antecedent) Dormant Season (9/28/2021 - 3/17/2022)			
Total weeks	25	25	25
Drought weeks*	19	9	5
Percent	76%	36%	20%
Growing Season (3/18/2022 - 11/15/2022)			
Total weeks	35	35	35
Drought weeks*	30	22	14
Percent	86%	63%	40%
Total Period (9/28/2021 - 11/15/2022)			
Total weeks	60	60	60
Drought weeks*	49	31	19
Percent	82%	52%	32%

* Indicates number of weeks that some or all of Johnston County was in a drought according to USDM

Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Maximum Bankfull Height (ft)	Date of Maximum Bankfull Event
Stage Recorder RL1-A			
MY1 2021	15	2.11	7/20/2021
MY2 2022	6	1.28	8/23/2022
Stage Recorder RL2			
MY1 2021	11	2.78	7/20/2021
MY2 2022	11	2.64	7/8/2022

MY2 Matthew RL1-A Stage Recorder Graph



MY2 Matthew RL2 Stage Recorder Graph

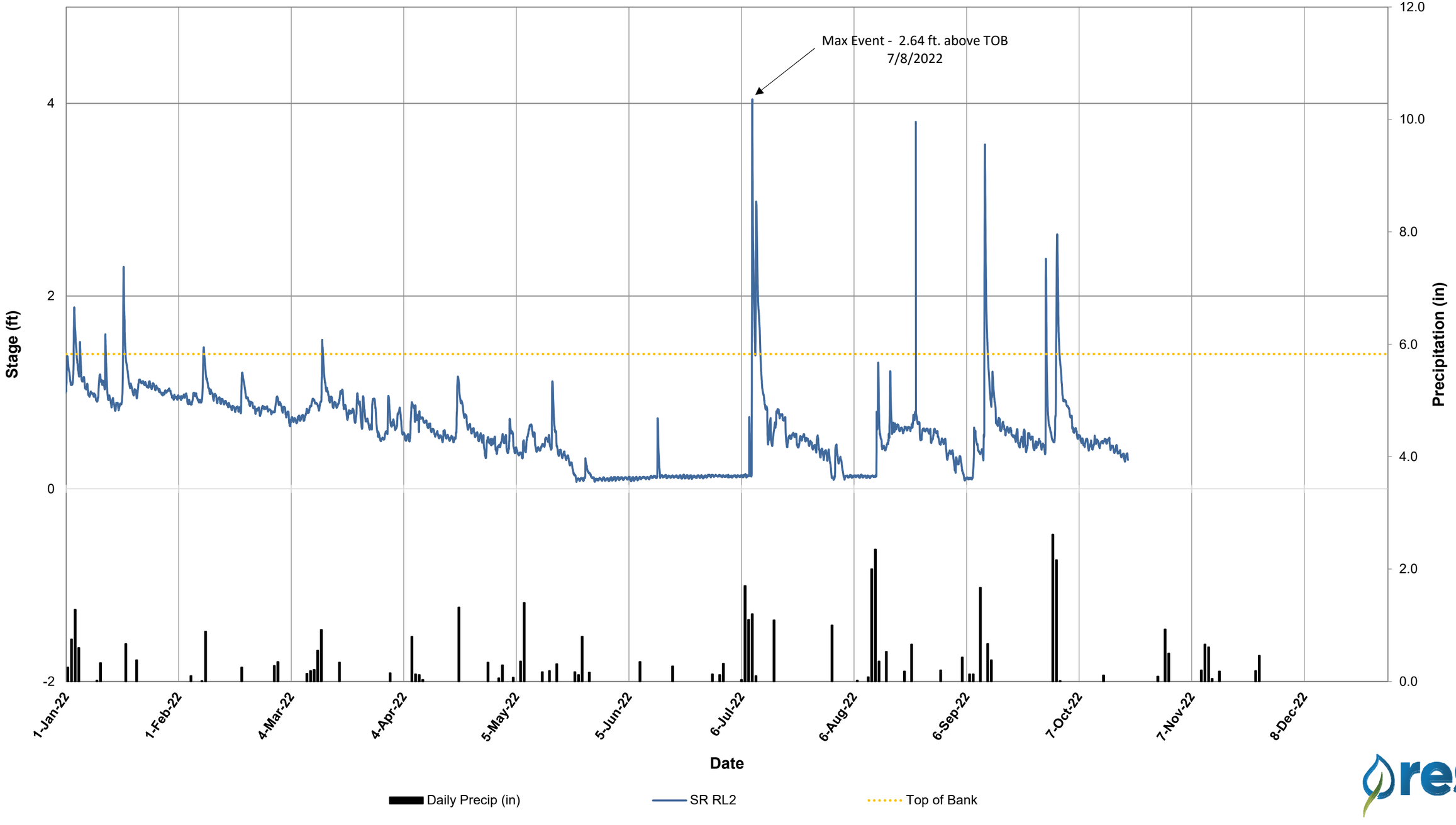


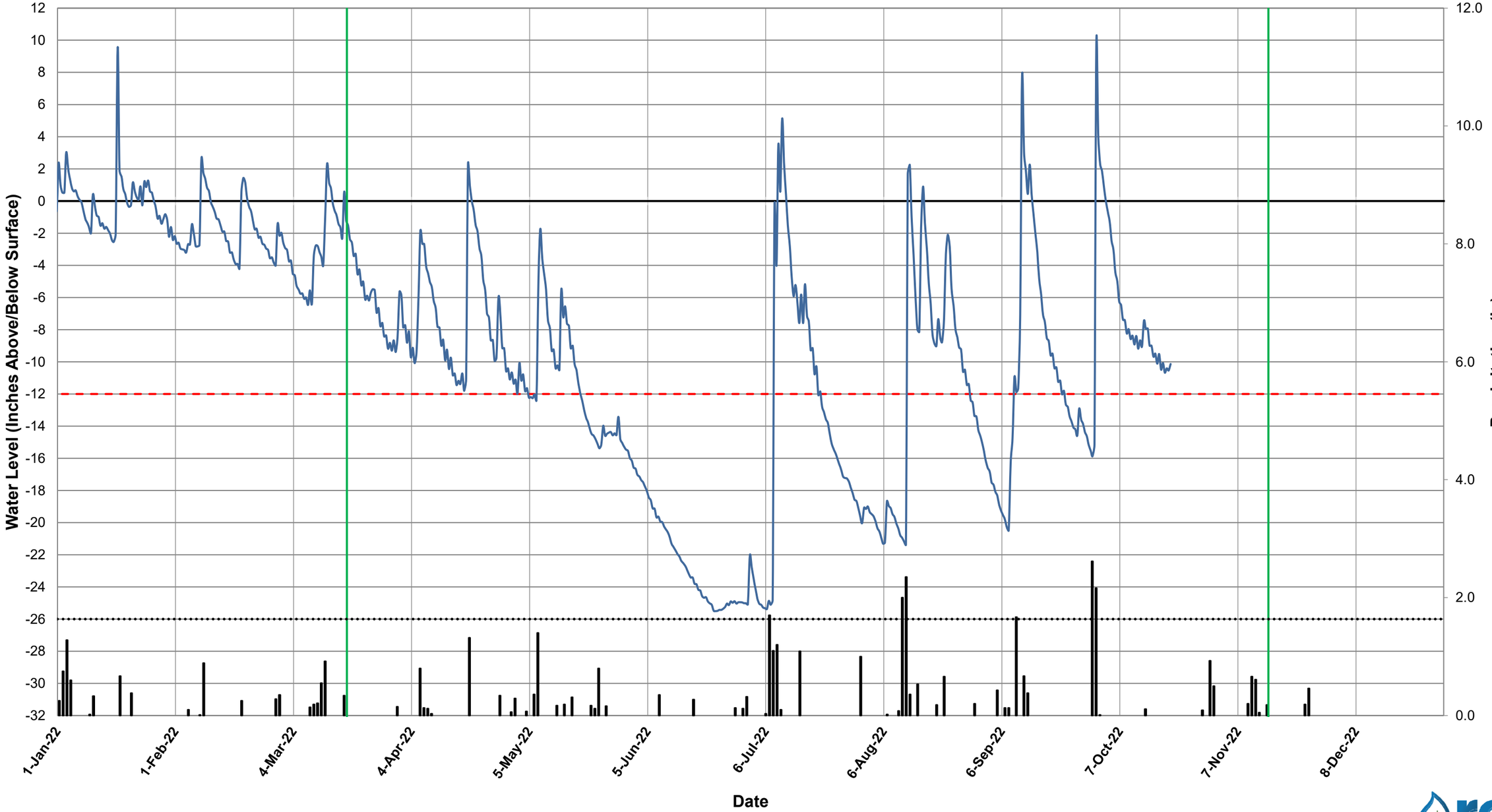
Table 14. 2022 Max Hydroperiod

2022 Max Hydroperiod (Growing Season 18-Mar through 15-Nov, 242 days)					
Well ID	Consecutive		Cumulative		Occurrences
	Days	Hydroperiod (%)	Days	Hydroperiod (%)	
GW1	47	19	119	49	6
GW2	0	0	0	0	0
GW3	2	1	6	2	4
GW4	3	1	7	3	4
GW5	27	11	40	17	5
GW6	17	7	47	19	8
GW7	2	1	6	2	3
GW8	28	12	66	27	9
REF GW1	47	19	120	50	7
REF GW2	60	25	95	39	4

Table 15. Summary of Groundwater Monitoring Results

Summary of Groundwater Monitoring Results Matthew									
Well ID	Wetland ID	Ground Elevation (ft)	Hydroperiod (%)						
			Year 1 (2021)	Year 2 (2022)	Year 3 (2023)	Year 4 (2024)	Year 5 (2025)	Year 6 (2026)	Year 7 (2027)
GW1	WA	126.92	39	19					
GW2	WA	127.43	2	0					
GW3	WA	126.70	2	1					
GW4	WA	126.31	2	1					
GW5	WA	124.95	35	11					
GW6	WA	123.89	22	7					
GW7	WF	123.88	7	1					
GW8	WF	123.58	23	12					
REF GW1	WE	N/A	69	19					
REF GW2	WB	N/A	38	25					

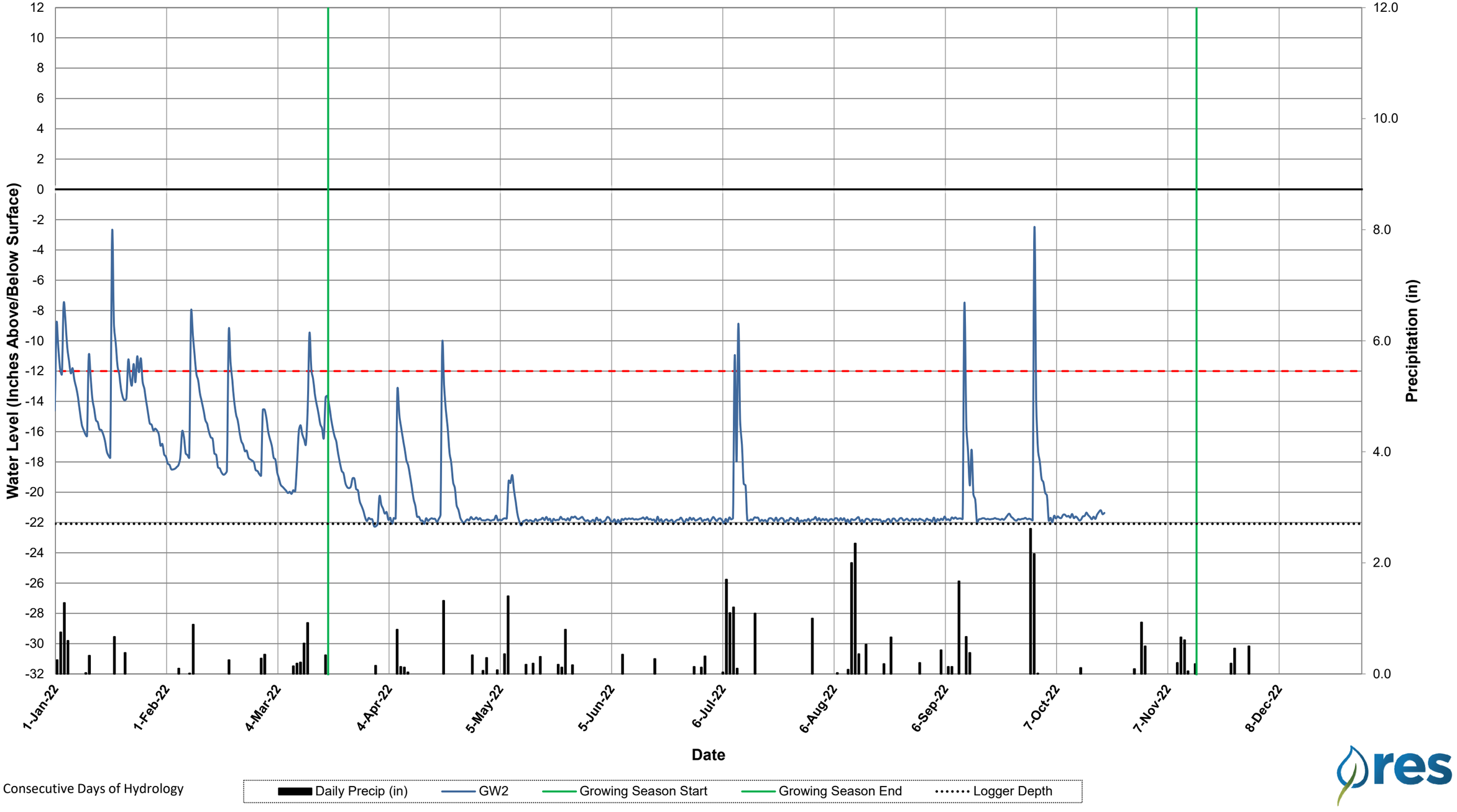
2022 Matthew GW1



47 Consecutive Days of Hydrology
03/18/2022 - 05/03/2022

Daily Precip (in) | GW1 | Growing Season Start | Growing Season End | Logger Depth

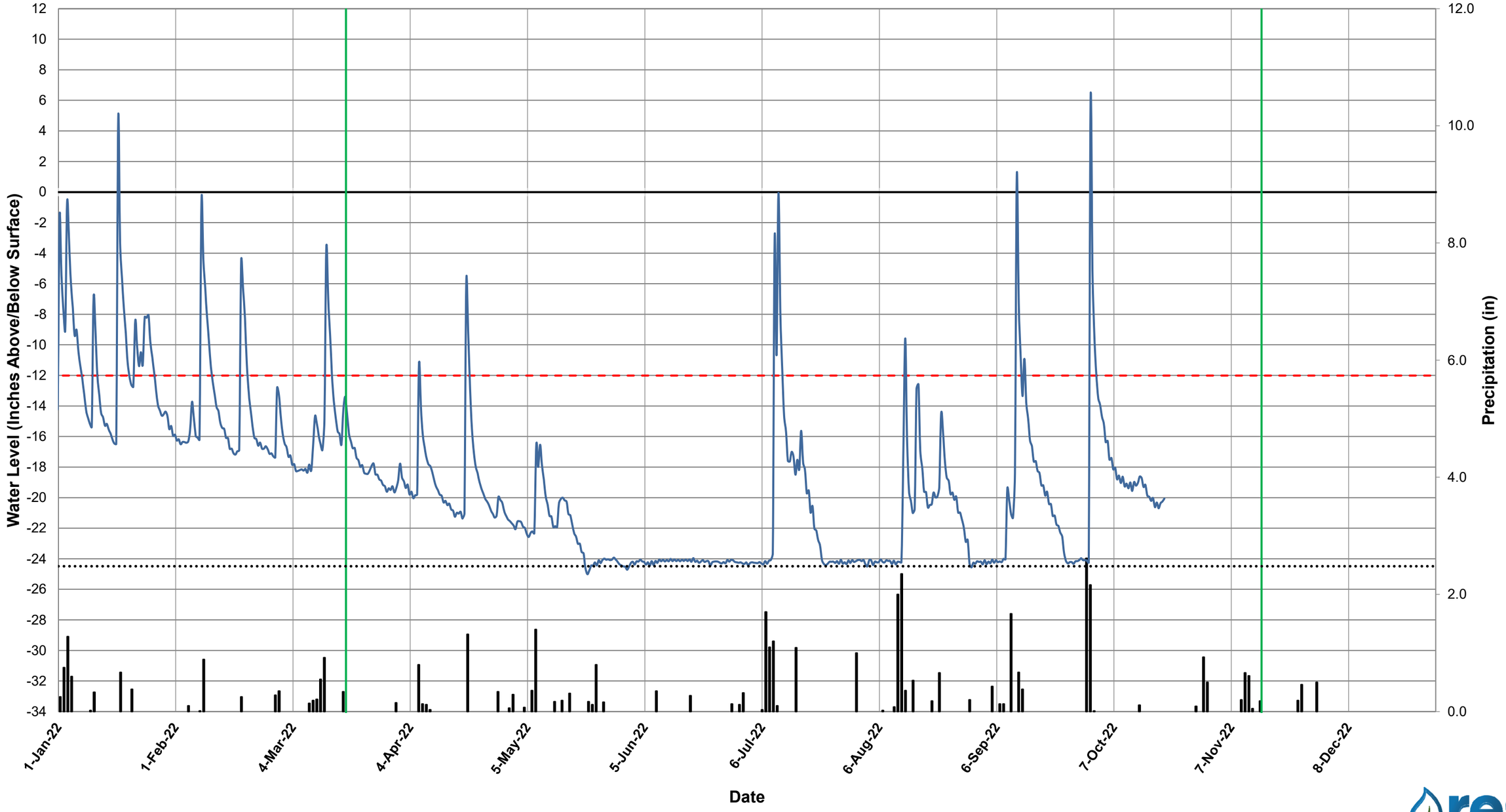
2022 Matthew GW2



0 Consecutive Days of Hydrology

Daily Precip (in) | GW2 | Growing Season Start | Growing Season End | Logger Depth

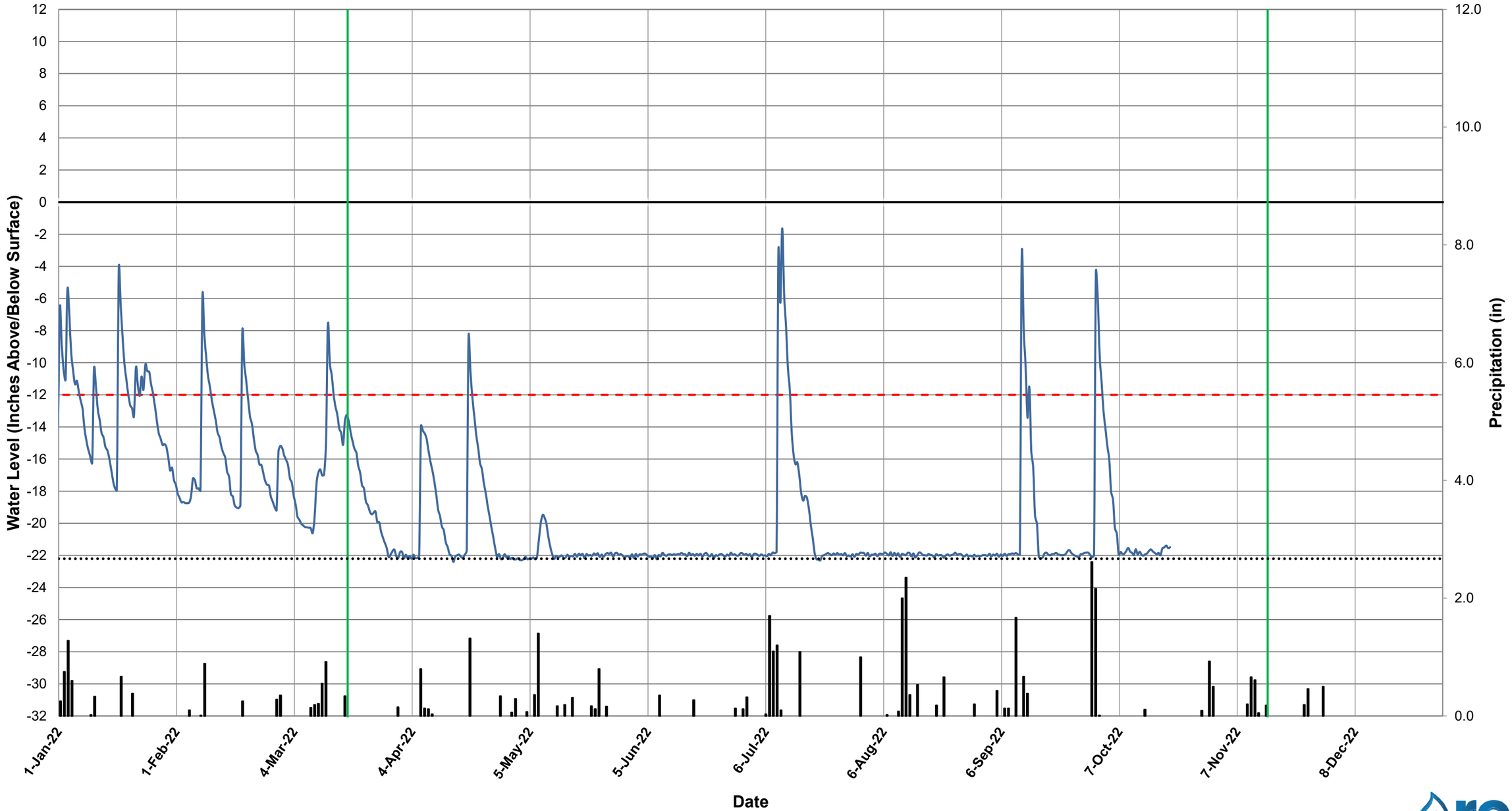
2022 Matthew GW3



2 Consecutive Days of Hydrology
07/09/2022 - 07/10/2022

Daily Precip (in) | GW3 | Growing Season Start | Growing Season End | Logger Depth

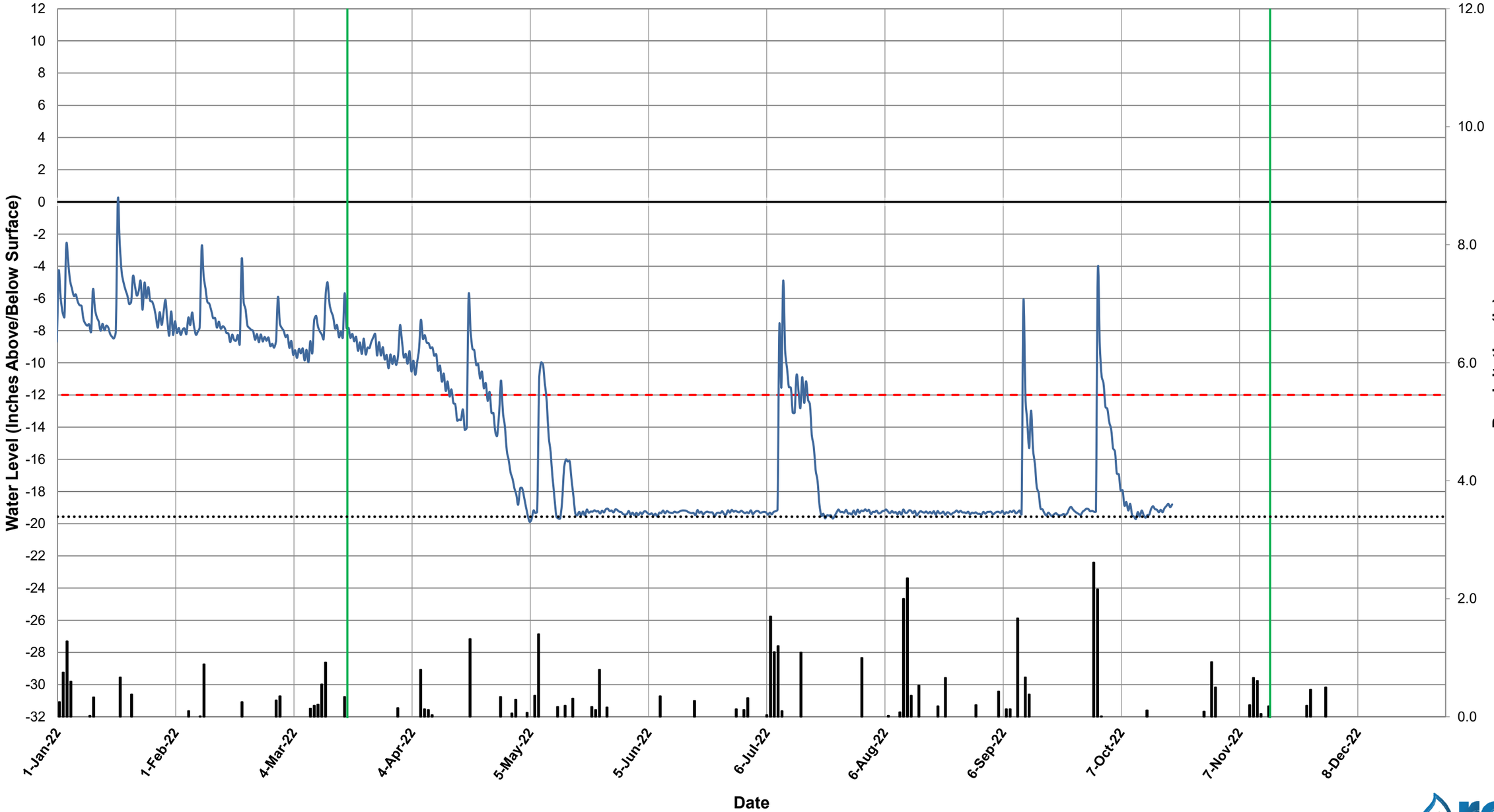
2022 Matthew GW4



3 Consecutive Days of Hydrology
07/09/2022 - 07/11/2022

Daily Precip (in) | GW4 | Growing Season Start | Growing Season End | Logger Depth

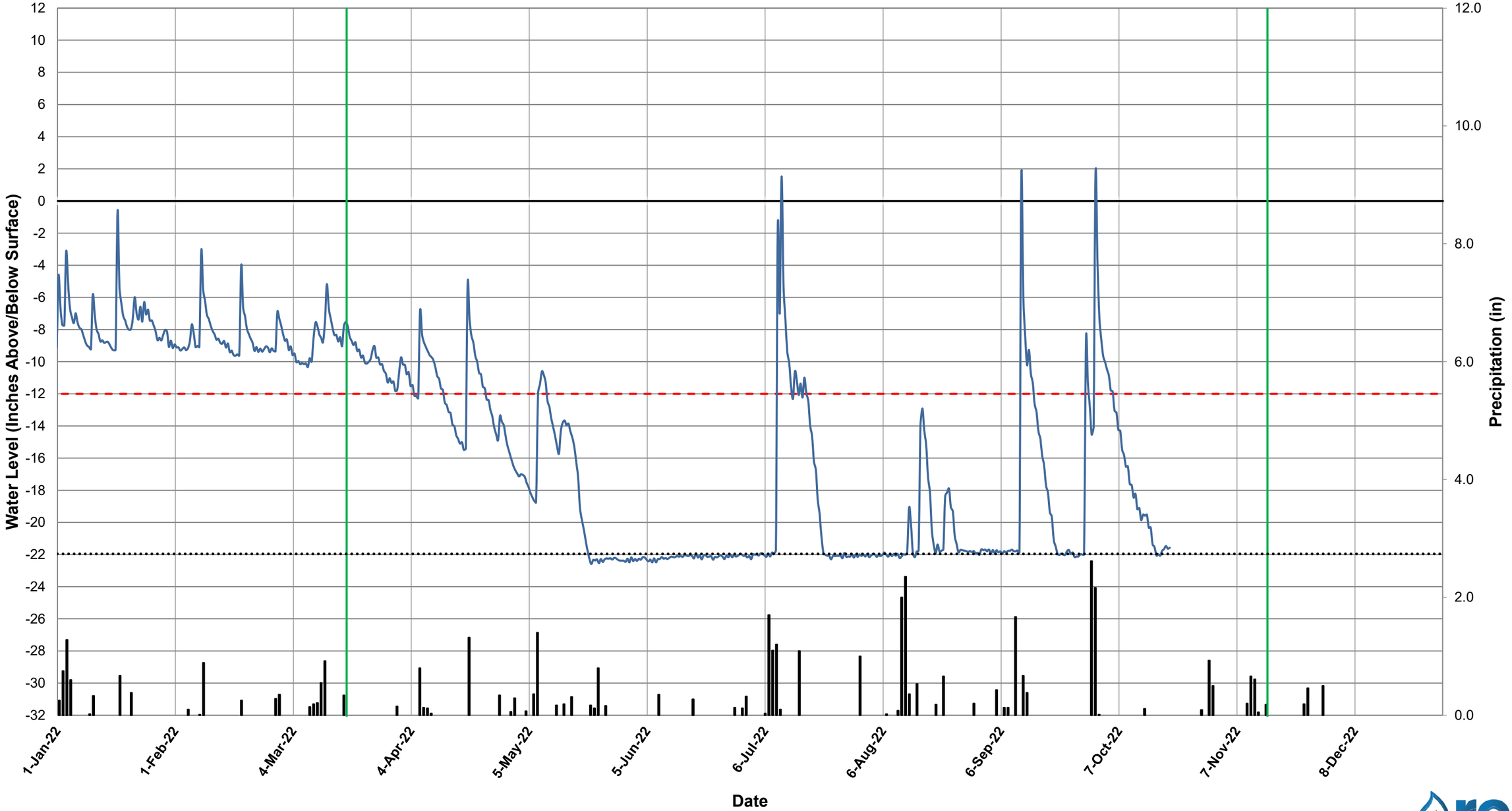
2022 Matthew GW5



27 Consecutive Days of Hydrology
03/18/2022 - 04/13/2022

Daily Precip (in) | GW5 | Growing Season Start | Growing Season End | Logger Depth

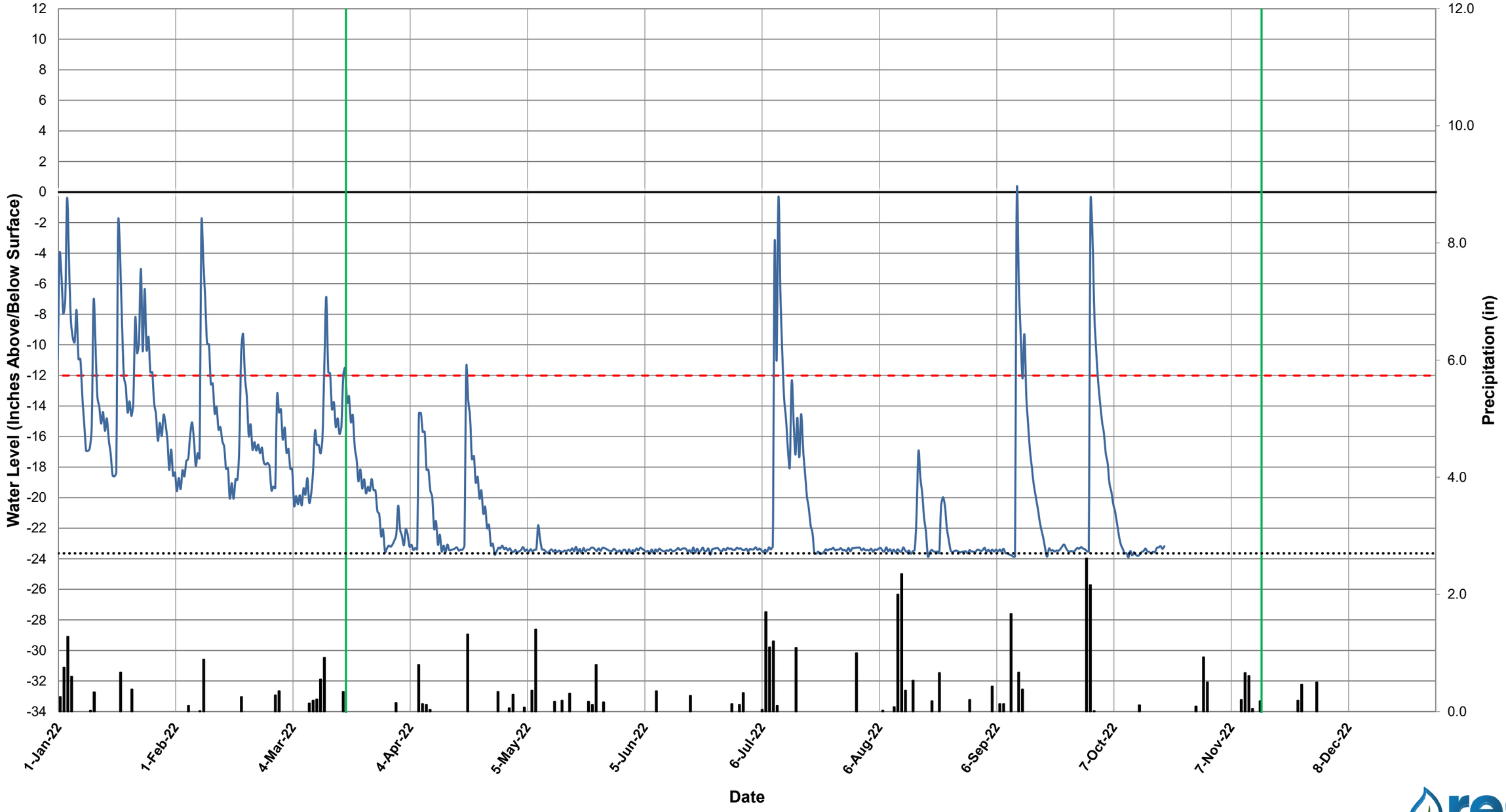
2022 Matthew GW6



17 Consecutive Days of Hydrology
03/18/2022 - 04/03/2022

Daily Precip (in) | GW6 | Growing Season Start | Growing Season End | Logger Depth

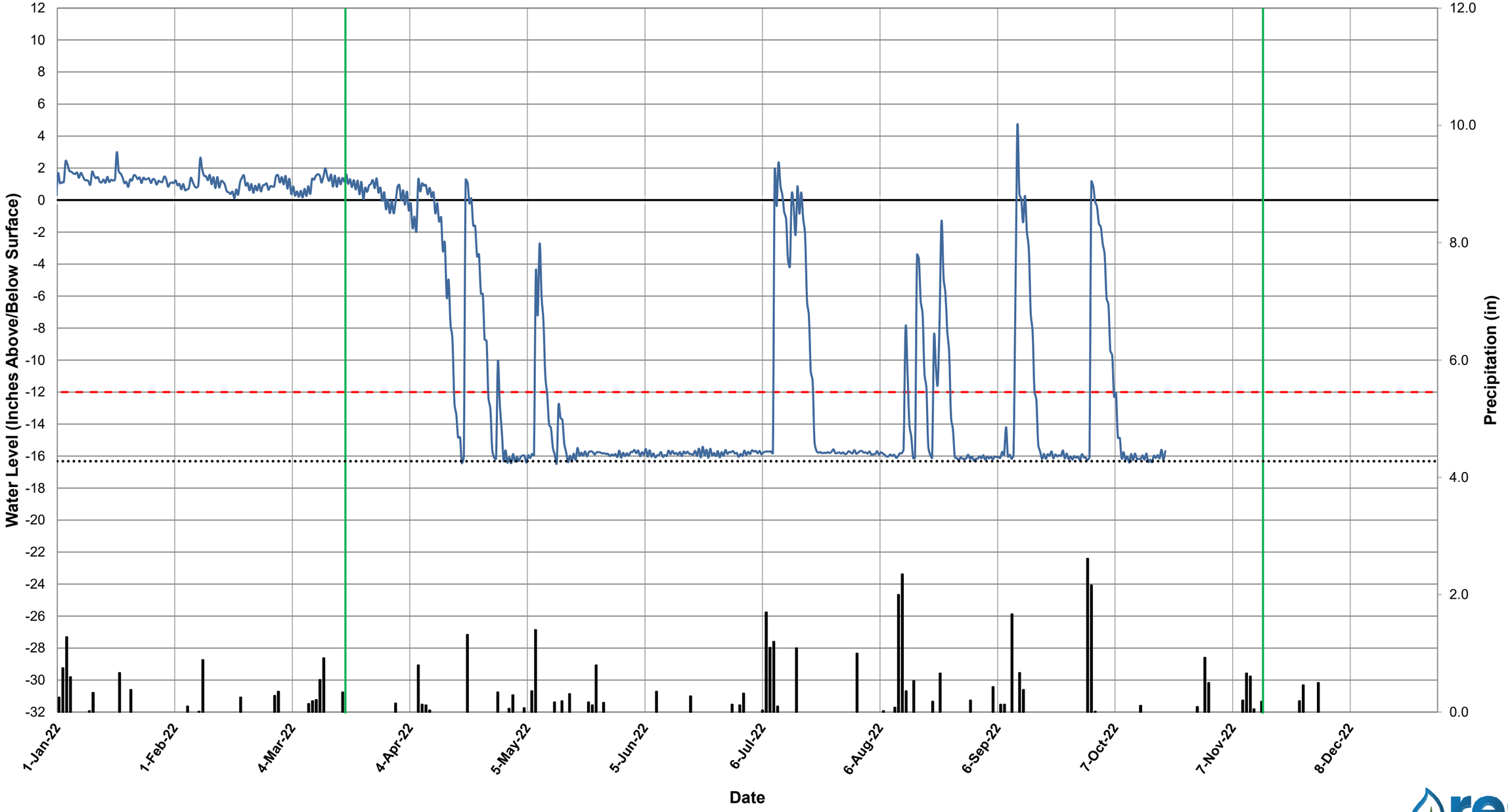
2022 Matthew GW7



2 Consecutive Days of Hydrology
07/09/2022 - 07/10/2022

Daily Precip (in) | GW7 | Growing Season Start | Growing Season End | Logger Depth

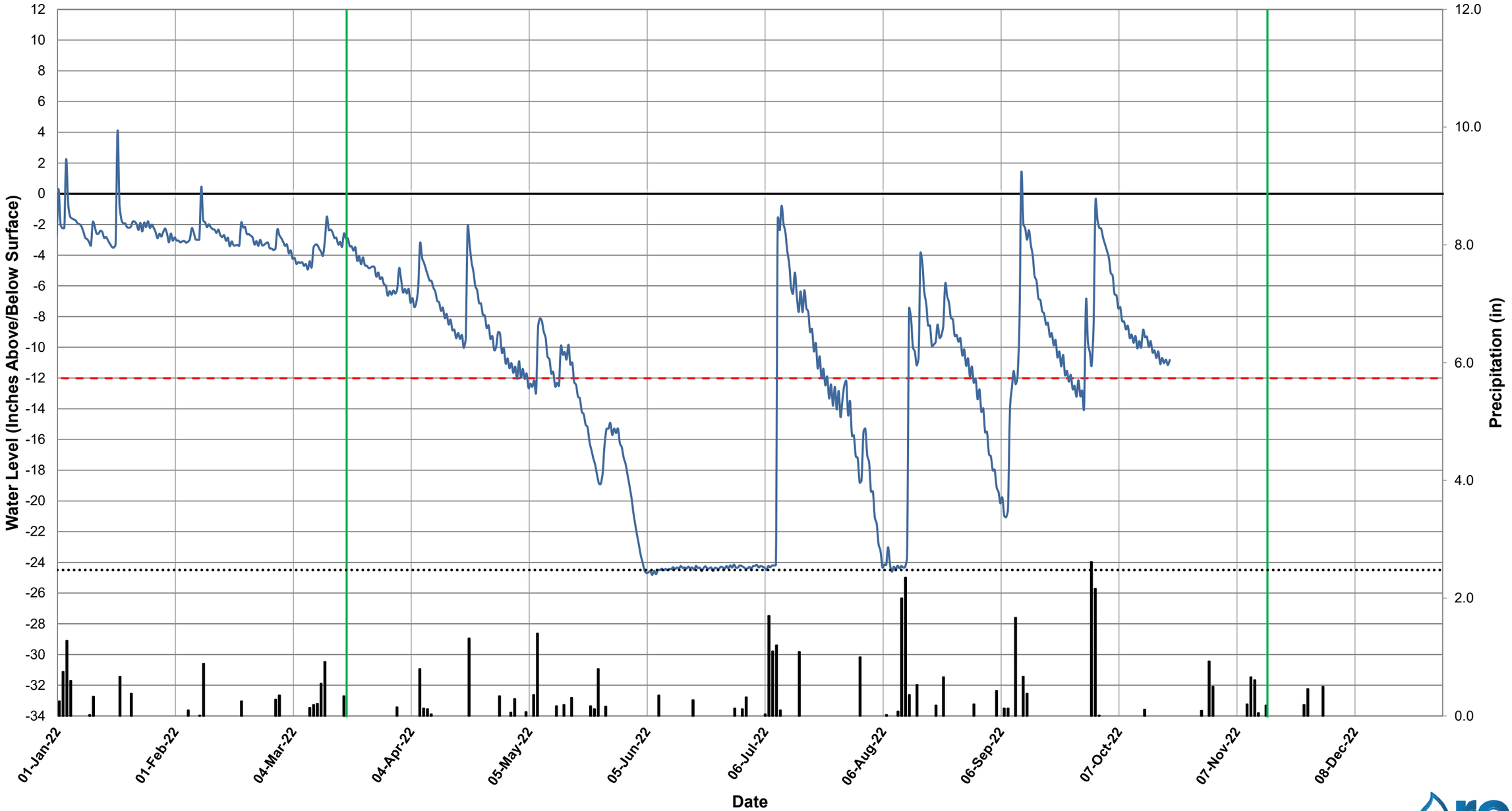
2022 Matthew GW8



28 Consecutive Days of Hydrology
03/18/2022 - 04/14/2022

Daily Precip (in) | GW8 | Growing Season Start | Growing Season End | Logger Depth

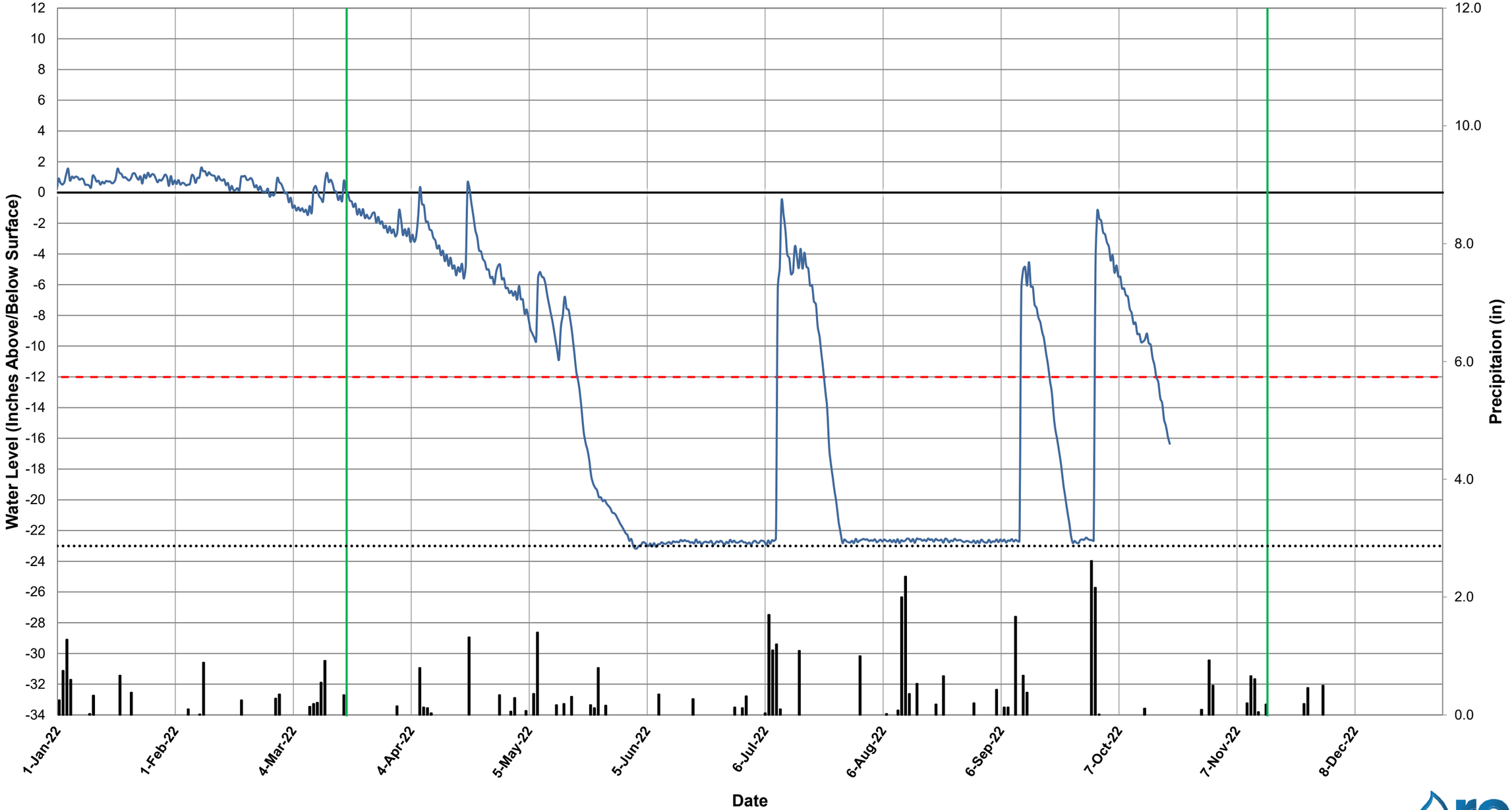
2022 Matthew REF GW1



47 Consecutive Days of Hydrology
03/18/2022 - 05/04/2022

Daily Precip (in) | REFGW1 | Growing Season Start | Growing Season End | Logger Depth

2022 Matthew REF GW2



60 Consecutive Days of Hydrology
03/18/2022 - 05/16/2022

Daily Precip (in) | REFGW2 | Growing Season Start | Growing Season End | Logger Depth