



# MONITORING YEAR 4 ANNUAL REPORT

Final

## OWL'S DEN MITIGATION SITE

Lincoln County, NC  
DEQ Contract 005150  
DMS Project Number 95808  
DWR No. 14-0153  
USACE Action ID No. SAW-2010-00717  
Catawba River Basin  
HUC 03050102

Data Collection Period: March - November 2019  
Final Submission Date: January 16, 2020

---

### PREPARED FOR:



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

**PREPARED BY:**

---



1430 South Mint Street, Suite 104  
Charlotte, NC 28203

Phone: 704.332.7754  
Fax: 704.332.3306

Mitigation Project Name      Ows Den  
DMS ID                              95808  
River Basin                        Catawba  
Cataloging Unit                 03050102

County                              Lincoln  
Date Project Instituted        3/1/2013  
Date Prepared                    6/21/2019

USACE Action ID                2013-00717  
NCDWR Permit No               2014-0153

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riparian	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)		2,453.000					9.468							
Potential Credits (As-Built Survey)		2,468.000					8.939							
Potential Credits (IRT Approved)*		2,453.000					9.468							
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A		N/A	N/A
2 (Year 0 / As-Built)	30%	740.400			2016	3/4/2016	30%	2.682			N/A		2016	3/4/2016
3 (Year 1 Monitoring)	10%	246.800			2017	4/3/2017	10%	0.894			N/A		2017	4/3/2017
IRT Adjustment*		-6.000				4/25/2018								
4 (Year 2 Monitoring)	10%	245.300			2018	4/25/2018	10%	0.894			N/A		2018	4/25/2018
5 (Year 3 Monitoring)	10%	245.300			2019	4/26/2019	15%	1.341			N/A		2019	4/26/2019
6 (Year 4 Monitoring)	5%				2020		5%				N/A		2020	
7 (Year 5 Monitoring)	10%				2021		15%				N/A		2021	
8 (Year 6 Monitoring)	5%				2022		5%				N/A		2022	
9 (Year 7 Monitoring)	10%				2023		10%				N/A		2023	
Stream Bankfull Standard	10%	245.300			2018	4/25/2018	N/A				N/A			
Total Credits Released to Date		1,717.100						5.810						
Total Credits Unrealized (Permanent Reduction)		0.000						0.529						

NOTES:  
4/25/2018: Adjustment required due to IRT concerns on how the as-built credits were calculated

CONTINGENCIES:

  
Signature of Wilmington District Official Approving Credit Release

27 Sept 2019  
Date

- 1 - For NCDMS, no credits are released during the first milestone
- 2 - For NCDMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCDMS Portal, provided the following criteria have been met:
  - 1) Approval of the final Mitigation Plan
  - 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
  - 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
  - 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required
- 3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met





January 16, 2020

Mr. Paul Wiesner  
NC Department of Environmental Quality  
Division of Mitigation Services  
5 Ravenscroft Dr., Suite 102  
Asheville, NC 28801

RE: Owl's Den Mitigation Site-Year 4 Monitoring Report  
Final Submittal for DMS  
Contract Number 004673, RFP Number 16-004110, DMS# 95360  
Yadkin River Basin – CU# 03040105; Union County, NC

Dear Mr. Wiesner:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments and observations from the Owl's Den Mitigation Site Draft Year 4 Monitoring Report. Wildlands walked the site on 1/7/2019 to evaluate the site condition after the beaver dam was removed. Wildlands confirmed that the streams are stable and that monitoring features have not impacted by the beaver dam. The report text has been revised for the final draft to reflect the most current condition of the site. The following are Wildlands responses to your comments and observations from the report noted in italics lettering.

**DMS Comment; General: Please QA/QC the report text and update as necessary prior to final submittal.**

*Wildlands Response; The report text has undergone QA/QC and has been updated in the final submittal.*

**DMS Comment; Cover page: The cover notes HUC 03050103. This should be updated to the project location HUC 03050102. The executive summary explains that the site is in the Catawba 03 ESA.**

*Wildlands Response; The report cover has been updated to location HUC 03050102.*

**DMS Comment; Section 1.2.1 and Section 1.2.5: In the revised report, please indicate when the beaver lodge and associated dam were initially identified by WEI and removed from the site. At a minimum, a scheduled removal date should be included in the revised report. The MY4 report notes that approximately 979 feet of channel were inundated by the referenced beaver dam. DMS recommends removing beaver dams as soon as possible to avoid potential irregular monitoring data, project damage and additional maintenance.**

*Wildlands Response; The beaver dam was removed from the site in December 2019 by USDA/APHIS. The report text was updated to reflect this change in both Section 1.2.1 and Section 1.2.5.*



**DMS Comment; Section 1.2.3; Please show and identify the March 2019 replant area on the revised CCPV maps. In the report verbiage, please also identify the approximate number of plants installed. Please QA/QC this section for grammar errors/ run-on sentences.**

*Wildlands Response; The CCPV maps have been updated to include the supplemental planting area. The approximate number of plants installed have been added to the report text. The report text was reviewed for grammar errors/ run-on sentences.*

**DMS Comment; Section 1.2.4: If possible, please update the revised report with data from groundwater gage 4 if received from the manufacturer in a reasonable timeframe. Please also QA/QC this section for grammar errors/ run-on sentences.**

*Wildlands Response; The manufacturer was unable to provide any additional data for groundwater gage 4. The report text has been updated to reflect this change. The section was reviewed for grammar errors/ run-on sentences.*

**DMS Comment; Table 5: The table reports 100% of all project reaches visually assessed are stable and performing as intended. Please confirm that this is an accurate reflection of the MY4 project conditions.**

*Wildlands Response; Table 5 is an accurate reflection of the MY4 project conditions, the streams on the site are stable based on the visual assessment.*

**DMS Comment; Table 14: GW gage 4 (MY3) shows 143 consecutive days for 64% and GW gage 4 (MY4) shows 143 consecutive days for 22%. Is this correct due to the equipment malfunction reported in MY4? Please review and confirm the data presented in the table and update as necessary.**

*Wildlands Response; Table 14 has been updated to show that in MY4 GW gage 4 met for 49 consecutive days for 22% of the growing season.*

**DMS Comment; Groundwater gage plots: For clarity, consider adding the consecutive day number for each gage on the groundwater gage plots instead of using the currently shown 18-day bar. The 18-day bar adds some confusion to the plots without a description of what it corresponds to (8.1% of the growing season).**

*Wildlands Response; The consecutive number of days meeting criteria was added to each groundwater gage plot and the 18-day bar was removed.*



**Digital Support File Comments:**

**DMS Comment: The Wetland Re-Establishment and HC1 Reach 2 geodatabase features do not match reported assets. DMS needs geospatial features that accurately characterize creditable assets. Please update the report and digital support files accordingly.**

*Wildlands Response; The Wetland Re-Establishment and HC1 Reach 2 geodatabase features and the corresponding figures have been updated. The report and the digital support files have been updated accordingly.*

Enclosed please find three (3) hard copies of the Year 4 Final Monitoring Report and one (1) CD with the final corrected electronic files for DMS distribution. Please contact me at 704-332-7754 x101 if you have any questions.

Sincerely,

A handwritten signature in black ink that reads "Andrea S. Eckardt". The signature is written in a cursive, flowing style.

Andrea S. Eckardt  
aeckardt@wildlandseng.com

## EXECUTIVE SUMMARY

Wildlands Engineering Inc. (Wildlands) implemented a full delivery project at the Owl's Den Mitigation Site (Site) for the North Carolina Division of Mitigation Services (DMS) to restore 2,453 linear feet (LF) of perennial streams, rehabilitate 2.82 acres of existing wetlands, and re-establish 6.77 acres of wetlands in Lincoln County, NC. The Site is expected to generate 2,453,000 stream mitigation units (SMUs) and 8,939 riparian wetland mitigation units (WMUs) (Table 1).

The Site is located near the City of Lincolnton in Lincoln County, NC within the DMS targeted watershed for the Catawba River Basin Hydrologic Unit Code (HUC) 03050102040040 and NCDWR Subbasin 03-08-35 (Figure 1) and is being submitted for mitigation credit in the Catawba River Basin HUC 03050103 within the expanded service area of this HUC. The project streams consist of two unnamed tributaries to Howards Creek, HC1 and HC2 (Figure 2). Howards Creek eventually flows into the South Fork Catawba River near the City of Lincolnton in Lincoln County. The adjacent land to the streams and wetlands is maintained for agricultural purposes.

The Site is located in the Howards Creek watershed and is within a Targeted Local Watershed (TLW) identified in NCDMS 2007 Catawba River Basin Restoration Priority Plan (RBRP). The Site is also identified in the Indian Creek and Howards Creek Local Watershed Plan (LWP) Project Atlas (DMS, 2010). The Indian and Howards Creek LWP identified stream channelization and dredging, incised channels and unstable stream banks, deforested riparian buffers, drained and cleared wetlands, and nutrient inputs to streams and wetlands as major stressors within this watershed. The LWP Project Atlas identified the Owl's Den Mitigation Site as a restoration opportunity with the potential to improve water quality, habitat, and hydrology within the Howards Creek watershed.

The project goals established in the mitigation plan (Wildlands, 2014) were completed with careful consideration of goals and objectives that were described in the RBRP and to address stressors identified in the LWP. The following project goals established include:

- Correct hydrologic modifications to streams including stream incision and dredging, bank erosion, lowering of the local water table, sedimentation, and loss of riparian buffer and floodplain functions;
- Improve hydrology and function of previously drained and cleared wetlands;
- Re-establish riparian buffer and wetland vegetation communities;
- Reduce excess sediment to downstream waters by stabilizing streams and revegetating site; and
- Reduce nutrient loads to downstream waters by improving wetlands and buffers to treat runoff.

Secondary project goals include:

- Improve instream habitat by diversifying the stream bedform and introducing habitat structures and wood debris.
- Reduce agricultural pollution from pesticides and herbicides used on adjacent fields by improving wetland and buffers to treat runoff.

The Site construction and as-built surveys were completed between May 2015 and August 2015. A conservation easement is in place on 12.87 acres of the riparian corridors to protect them in perpetuity.

Monitoring Year (MY) four (4) assessments and Site visits were completed between March and November 2019 to assess the conditions of the project. Per IRT guidelines, detailed monitoring and analysis of vegetation and channel cross-sectional dimensions were omitted during MY4. Visual observations, hydrology data, and management practices are included in this report. To preserve clarity and continuity of reporting structure, this report maintains section and appendix numbering from previous monitoring reports. Omitted sections are denoted in the table of contents.





Overall, the Site has met the required stream, vegetation, and wetland hydrology success criteria for MY4. Vegetation appears to be performing adequately to attain the interim success criteria of 260 stems per acre at the end of monitoring year five. Visual observation indicated that stream channels have remained geomorphically stable during MY4. Persistent flow and multiple bankfull events were recorded on all streams during MY4. All wetland groundwater monitoring gages met the wetland hydrology success criteria.



**OWL'S DEN MITIGATION SITE**  
Monitoring Year 4 Annual Report

**TABLE OF CONTENTS**

<b>Section 1:</b>	<b>PROJECT OVERVIEW .....</b>	<b>1-1</b>
1.1	Project Goals and Objectives .....	1-1
1.2	Monitoring Year 4 Data Assessment.....	1-2
1.2.1	Stream Assessment.....	1-2
1.2.2	Stream Hydrology Assessment .....	1-3
1.2.3	Vegetative Assessment .....	1-3
1.2.4	Wetland Assessment.....	1-3
1.2.5	Areas of Concern/Adaptive Management Plan .....	1-4
1.3	Monitoring Year 4 Summary .....	1-5
<b>Section 2:</b>	<b>METHODOLOGY.....</b>	<b>2-1</b>
<b>Section 3:</b>	<b>REFERENCES .....</b>	<b>3-1</b>
<b>Appendix 1</b>	<b>General Figures and Tables</b>	
Figure 1	Project Vicinity Map	
Figure 2	Project Component/Asset Map	
Table 1	Project Components and Mitigation Credits	
Table 2	Project Activity and Reporting History	
Table 3	Project Contact Table	
Table 4	Project Information and Attributes	
<b>Appendix 2</b>	<b>Visual Assessment Data</b>	
Figure 3.0-3.3	Integrated Current Condition Plan View	
Table 5a-c	Visual Stream Morphology Stability Assessment Table	
Table 6	Vegetation Condition Assessment Table	
	Stream Photographs	
	Vegetation Photographs*	
	Wetland Photographs	
	Area of Concern Photographs	
<b>Appendix 3*</b>	<b>Vegetation Plot Data</b>	
Table 7	Vegetation Plot Criteria Attainment Table	
Table 8	CVS Vegetation Plot Metadata	
Table 9	Planted and Total Stems (Species by Plot with Annual Means)	
<b>Appendix 4*</b>	<b>Morphological Summary Data and Plots</b>	
Table 10a-b	Baseline Stream Data Summary	
Table 11a-b	Morphology and Hydraulic Summary (Dimensional Parameters – Cross-Section)	
Table 12a-c	Monitoring Data – Stream Reach Data Summary	
	Cross-Section Plots	
<b>Appendix 5</b>	<b>Hydrology Summary Data and Plots</b>	
Table 13	Verification of Bankfull Events	
	Stream Gage Plots	
Table 14	Wetland Gage Attainment Summary	
	Groundwater Gage Plots	
	Monthly Rainfall Data	

\* Content omitted from Monitoring Year 4 Report

## Section 1: PROJECT OVERVIEW

---

The Site is located in central Lincoln County within the Catawba River Basin (USGS Hydrologic Unit 03050102) and is located off of Owl's Den Road northwest of Lincolnton, North Carolina. The Site is located in the Inner Piedmont Belt of the Piedmont Physiographic Province (USGS, 1998). The project watershed is dominated by agricultural and forested land. The drainage area for the Site is 152 acres (0.24 square miles).

The project streams consist of unnamed tributaries to Howards Creek (HC1 and HC2). Stream restoration reaches included HC1 (Reach 1 and 2) and HC2 comprising 2,453 linear feet (LF) of perennial stream channel. The riparian areas were planted with native vegetation to improve habitat and protect water quality. Wetland components included rehabilitating 2.82 acres of existing wetlands and re-establishing 6.77 acres of wetlands.

Construction activities were completed by Land Mechanic Designs, Inc. in July 2015. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in January 2016. A conservation easement has been recorded and is in place on 12.87 acres (Deed Book 2455, Page Number 864) within a tract owned by Owl's Den Farm, LLC. The project is expected to generate 2,453,000 stream mitigation units (SMU's) and 8,939 wetland mitigation units (WMUs). Annual monitoring will be conducted for seven years with the close-out anticipated to commence in 2023 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

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

### 1.1 Project Goals and Objectives

Prior to construction activities, the streams on the Site had been straightened, widened, and deepened to provide drainage for surrounding cropland. The adjacent floodplain areas had been cleared and maintained to support agricultural activities. Table 10a and b in Appendix 4 present the pre-restoration conditions in detail.

The Site will help address stressors identified in the LWP and provide numerous ecological benefits within the Catawba River Basin. While many of these benefits are limited to the Owl's Den project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat, have farther-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals established were completed with careful consideration of goals and objectives that were described in the RBRP and address stressors identified in the LWP while also meeting the DMS mitigation needs.

The primary objectives of the Owl's Den Mitigation Site address stressors identified in the LWP and included the following:

- *Correct hydrologic modifications to streams including stream incision and dredging, bank erosion, lowering of the local water table, sedimentation, and loss of riparian buffer and floodplain functions.* The project re-connected streams with a stable floodplain using Priority 1 restoration techniques. The Priority 1 restoration eliminated vertically incised channels on site. Stream banks were stabilized with grading, in-stream structures, and planting. By stabilizing stream banks on site, sediment loading should be reduced in the receiving watershed.
- *Improve hydrology and function of previously drained and cleared wetlands.* The project restored hydrologic connections to existing wetlands using Priority 1 stream restoration to raise



the local water table and increase overbank flooding. The project extended existing wetland zones into adjacent areas and established wetland vegetation throughout the site.

- *Re-establish wetland hydrology and function in relic wetland areas.* Removal of historic overburden uncovered relic hydric soils and should bring local water table elevations closer to the ground surface. Disking and roughening of wetland re-establishment areas should increase retention times and improve natural infiltrative processes.
- *Re-establish riparian buffer and wetland vegetation communities.* A native vegetation community was planted on the site to revegetate the riparian buffers and wetlands and return the functions associated with these wooded areas.
- *Reduce excess sediment to downstream waters by stabilizing streams and revegetating site.* Stream banks were stabilized on all project reaches. The site was also revegetated with a native forest community to prevent erosion and sedimentation from overland runoff of agricultural lands and filter runoff from adjacent fields.
- *Reduce nutrient and agricultural pollutant inputs to streams and wetlands.* Increased retention times along with reestablished vegetation in restored wetland areas will reduce fertilizers used in blackberry and soybean agricultural production before runoff enters the streams.

Secondary project goal includes:

- *Improve instream habitat by diversifying the stream bedform and introducing habitat structures and woody debris.* Large woody debris, brush toe meander bends, other woody structures, and native stream bank vegetation were installed to improve both instream and terrestrial habitat value throughout the riparian corridor.
- *Reduce agricultural pollution from pesticides and herbicides used on adjacent fields by improving wetlands and buffers to treat runoff.* Restored wetland areas will provide treatment for agricultural runoff from blackberry and soy bean fields that are sprayed with pesticides and herbicides.

## 1.2 Monitoring Year 4 Data Assessment

Annual monitoring and quarterly site visits were conducted during MY4 to assess the condition of the project. The stream, vegetation, and hydrologic success criteria for the Site follows the approved success criteria presented in the Owl's Den Mitigation Plan (Wildlands, 2014).

### 1.2.1 Stream Assessment

Detailed morphological survey and analysis is not required in MY4. Based on field observations, the majority of the project reaches within the Site appear stable and functioning as designed, refer to Tables 5a-5c for Site walk data. HC1-R2 had one noted issue during Site visits is high flow events and subsequent floodplain deposition on the downstream end of the project has continued in MY4, however the bed of the channel has maintained a defined riffle pool sequence. The bankfull elevations associated with cross-sections 7 and 8 may need adjustments in MY5 to accommodate this natural depositional component within the larger Howards Creek floodplain.

HC1-R2 was not accessible during the Q4 Site walk due to floodplain flooding and channel backwater from a beaver dam on the most downstream end of the Site, above the confluence to Howard's Creek. HC1-R2 was cleared of the beaver dam on 12/11/19. HC1-R2 was observed on January 7, 2020 and the channel was found to be stable after the beaver dam was removed. Additional information about the beaver activity is located in section 1.2.5.



Refer to Appendix 2 for the visual stability assessment tables, Integrated Current Condition Plan View (CCPV) maps, and reference photographs. Area of Concern Photographs including photographs of the beaver dam can also be found in Appendix 2.

### **1.2.2 Stream Hydrology Assessment**

In MY4 HC1 and HC2 each experienced four bankfull events, although two bankfull events have already occurred in the first two years of monitoring thereby meeting the stream hydrology monitoring criteria. Refer to Appendix 5 for hydrologic summary data and plots.

### **1.2.3 Vegetative Assessment**

Detailed vegetation inventory and analysis is not required during MY4. Visual assessment during MY4 indicated that vegetation on the Site overall is performing adequately to attain interim success criteria of 260 stems per acre. From visual observations the planted stems appear to be on track to meet the criteria of an average height of 10 feet in the planted riparian and wetland corridor in MY7.

A supplemental containerized planting occurred in March 2019. Approximately 30 container plants were planted in vegetation plot 11 and the surrounding low stem density area noted in MY3. Vegetation plot 11 was quantitatively assessed in MY4 to account for added stems. The supplemental stems raised the planted stem density in the plot in MY4 to 485 stems/acre. Refer to the Integrated Current Condition Plan View (CCPV) maps and the Area of Concern Photographs in Appendix 2 for documentation of the supplemental stems.

### **1.2.4 Wetland Assessment**

An on-site reference gage is used to compare the hydrologic response of the restored wetland areas on the Site. Precipitation data is referenced from a local USGS gage station. Pressure transducers in each groundwater gage (GWG) are linked to a barotroll logger on the site that records barometric pressure data used in the calculations of the groundwater level within each gage. All groundwater gages were downloaded on a quarterly basis.

In MY4 all groundwater gages (1-15) met success criteria of a free groundwater surface within 12 inches of the ground surface for eighteen (18) consecutive days (8.1 percent) of the defined two-hundred and twenty-two (222) day growing season for Lincoln County (March 28 through November 5). The measured cumulative hydroperiod for the monitoring gages on the Site ranged from 8.5% to 100% of the growing season. GWG1 met in MY4 with nineteen days (8.5%) meeting criteria compared to sixteen days meeting in MY3 (7%). In general, rainfall was greater than average in the winter and early spring and less than average during the summer based on the 30-70 percentile graph for rainfall in 2019 in Lincoln, NC. The rainfall in MY4 (15.79 inches) in the months prior to the start of growing season (January- March) had an increase of 24% compared to MY3 (11.94 inches). The wet winter months contributed to the groundwater surface remaining above criteria levels for a longer amount of time in the early growing season, allowing all the gages on Site to meet in MY4.

Both GWG1 and GWG9 met hydrologic success criteria prior to malfunctioning in the spring. GWG4 malfunctioned and was unable to be downloaded for dates after 5/15/19. The gage was returned to the manufacturer to retrieve the data in November but was too damaged to retrieve any additional data for MY4. GWG4 was replaced with a new gage in November 2019.

In December 2018 a soil probe and an additional groundwater gage were installed at the Site. The soil probe was installed at least twelve (12) inches below the ground next to GWG1. The soil temperature gage data will continue to be analyzed in conjunction with the timing of the first leaf buds to determine the growing season at the Site. An additional gage (GWG15) was installed in the wetland re-

establishment portion of the Site near GWG1, to provide additional data for the hydrological response of the restoration and rehabilitation efforts surrounding wetland H. GWG1 showed consecutive water level readings at or above criteria levels for 8.5% of the growing season while groundwater gage 15 consecutive criteria level readings for 24.2% of the growing season. This data indicates that overall, the water table is higher in the middle portion of the site (groundwater gage 15) for wetland re-establishment and rehabilitation. The water table on the edge of the site (groundwater gage 1) has taken longer to recharge but is continuing to rise post construction. Refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

### 1.2.5 Areas of Concern/Adaptive Management Plan

Stream areas of concern are minimal. Floodplain deposition has continued at the downstream extent of HC1 Reach 2. Stream stability and conveyance in this reach will be assessed during the MY5 survey, but the channel has maintained a stable pool-riffle sequence. A beaver dam was identified on October 15, 2019, at approximately station 117+79 and caused inundation of the stream and floodplain upstream to station 108+00. There was standing water spanning almost the entire width of the easement on both sides of the stream with a beaver lodge on the Site above the crossing located around station 115+00. The dam was removed by USDA/APHIS on December 11, 2019. Wildlands walked the Site on January 7, 2020, after the beaver dam was removed and found that despite inundation during the Q4 site walk, the channel had maintained bedform and stability. No monitoring features or data were affected by the beaver dam except for the inundation which was recorded for HC1 R2 and is apparent on the stream gage plot in Appendix 5.

During the 2019 IRT Credit Release Meeting, it was discussed that vegetation plot (VP) 5 did not meet criteria in MY3 nor would the plot be likely to meet in subsequent monitoring years. During baseline monitoring VP5 was inadvertently established in an area of low elevation within the floodplain that consistently receives preferential flow from the drainage area; thereby holding approximately 0.5-1 foot of water throughout most of the year, inhibiting the establishment of woody vegetation. Upon direction from the IRT and DMS, Wildlands will continue collecting plot data within VP5 but will also set up a mobile vegetation plot in random areas adjacent to VP5 in MY5 through MY7 to provide an additional quantitative and qualitative assessment of planted woody stems. The additional mobile plot was determined to be a better management strategy than supplemental planting for VP5 because the supplemental stems would have been unlikely to survive due to the standing water that continues to inundate a majority of the plot. Refer to Appendix 2, Area of Concern photographs for images of the standing water in VP 5.

The vegetation areas of concern within the Site include invasive species such as morning glory species (family *Convolvulaceae*), Japanese honeysuckle (*Lonicera japonica*) and Chinese and Japanese privet (*Ligustrum sinsense and japonicum*). The areas of privet have been treated in MY4 but will continue to be closely monitored. The morning glory and honeysuckle vines are affecting approximately 1.9% of the site and are choking out trees and herbaceous vegetation. As needed, herbicide applications will be applied in accordance with state regulations to control these invasive species in future monitoring years.

Low stem density and bare herbaceous areas previously noted in MY3 underwent supplemental planting in March of 2019. Low density areas were planted with one- to three-gallon container trees from the baseline planting list and areas of poor herbaceous growth were over seeded and supplemented with lime and 10-10-10 fertilizer. These planting areas have been visually monitored throughout the MY4 growing season, have responded well, and were removed from the list of areas of concern after the MY4 site walk in early November 2019.



In MY4, a different area of approximately 0.1 acre was document with low stem density. This area will be visually assessed in subsequent monitoring years to see if volunteer species become established or if additional planting is needed. Refer to Appendix 2 for the vegetation condition assessment table and Current Condition Plan View (CCPV) maps.

### **1.3 Monitoring Year 4 Summary**

Visual assessments indicate that all streams above the HC1-HC2 confluence are geomorphically stable and functioning as designed. A beaver dam was identified and removed from the Site during Q4 below the HC1-HC2 confluence. HC2-R2 was walked after the beaver dam removal and maintained stability and channel bedform. Multiple bankfull events have been documented within the restored stream reaches and the Site met the final (MY7) stream hydrology success criteria during MY2 monitoring. Based on visual assessment, the vegetation on the Site is on track to meet the MY7 success criteria. The low stem density area recorded in MY3 underwent supplemental planting in MY4. All groundwater monitoring gages met the success criteria for MY4. Invasive vegetation will continue to be monitored and treated as necessary to support the establishment of native vegetation.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan documents available on DMS's website.



## Section 2: METHODOLOGY

---

All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gages were installed in surveyed riffle cross-sections and monitored quarterly. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers (USACE, 2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).





## Section 3: REFERENCES

---

- Lee, M.T., Peet, R.K., S.D., Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from <http://cvs.bio.unc.edu/protocol/cvs-EEP-protocol-v4.2-lev1-5.pdf>.
- North Carolina Division of Mitigation Services (DMS), 2007. Catawba River Basin Restoration Priorities. <http://nceep.net/services/restplans/RBRPCatawba2007.pdf>
- North Carolina Division of Mitigation Services (DMS), 2010. Indian and Howards Creek Local Watershed Plan. [www.nceep.net/ervices/lwps/Indian\\_Howards\\_Creek/INDIAN\\_HOWARD\\_CREEKS.html](http://www.nceep.net/ervices/lwps/Indian_Howards_Creek/INDIAN_HOWARD_CREEKS.html)
- North Carolina Division of Mitigation Services (DMS) and Interagency Review Team (IRT) Technical Workgroup, 2018. Standard Measurement of the BHR Monitoring Parameter. Raleigh, NC.
- Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.
- Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.
- United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.
- United States Army Corps of Engineers. Email 2018. Standard Measurement of the BHR Monitoring Parameter.
- United States Department of Agriculture. Lincolnton, NC Weather Station NC4996. [http://www.wcc.nrcs.usda.gov/climate/navigate\\_wets.html](http://www.wcc.nrcs.usda.gov/climate/navigate_wets.html)
- United States Geological Survey. 1998. North Carolina Geology. <http://www.geology.enr.state.nc.us/usgs/carolina.htm>
- Wildlands Engineering, Inc (2014). Owl's Den Mitigation Site Mitigation Plan. NCEEP, Raleigh, NC.

## **APPENDIX 1. General Figures and Tables**

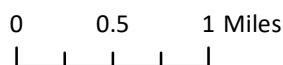
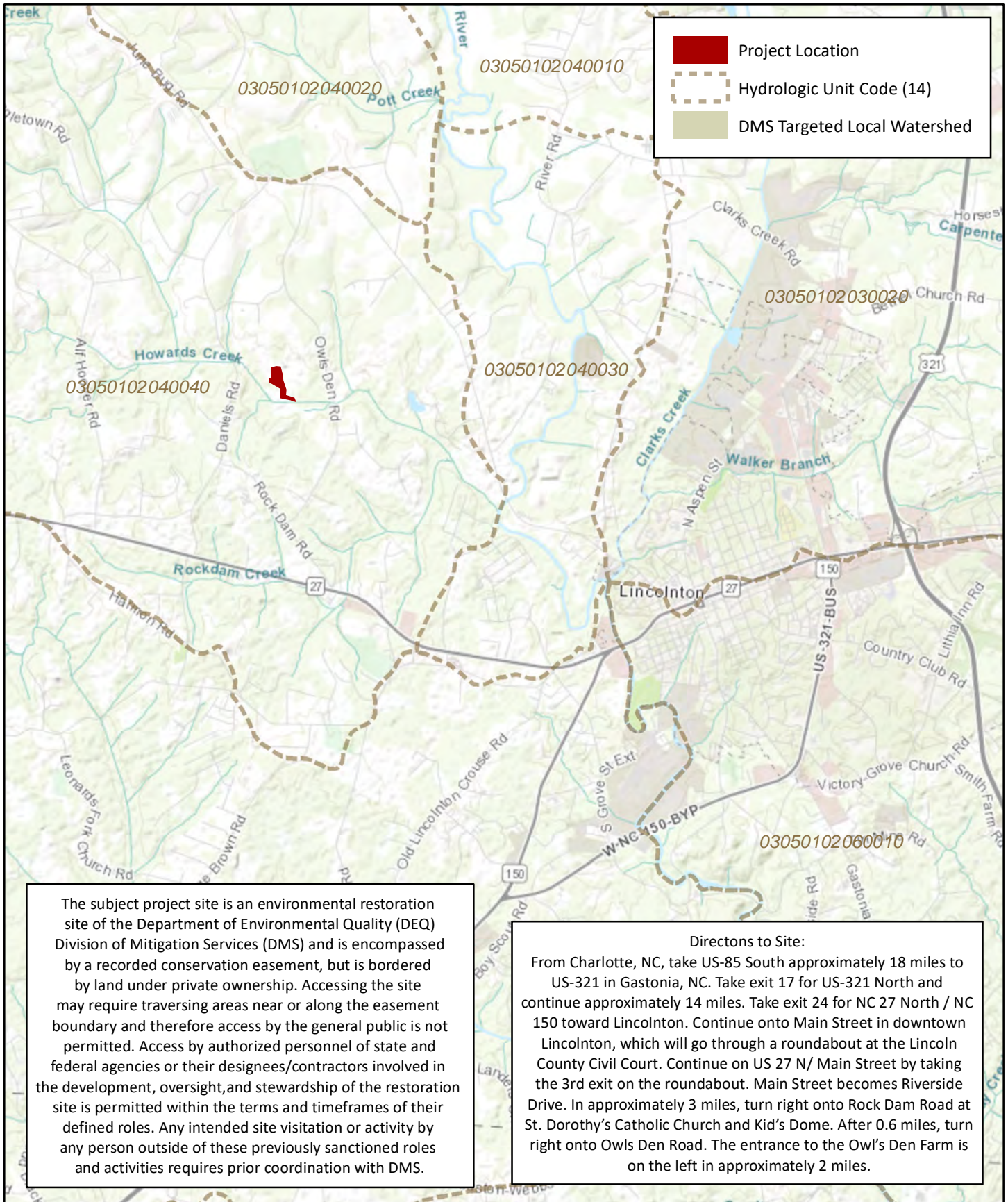
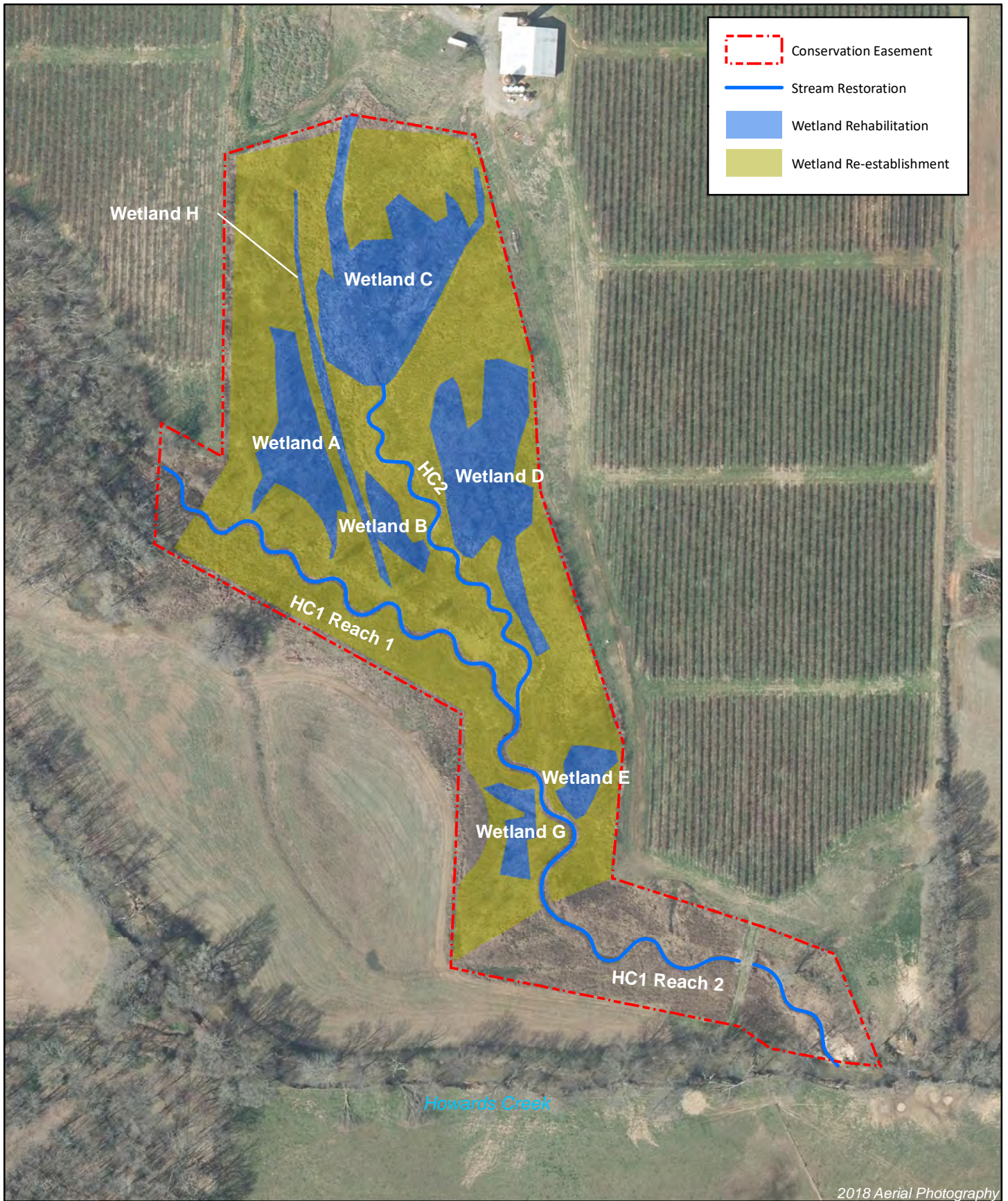





Figure 1 Project Vicinity Map  
Owl's Den Mitigation Site  
DMS Project No. 95808  
Monitoring Year 4 - 2019



	Conservation Easement
	Stream Restoration
	Wetland Rehabilitation
	Wetland Re-establishment

2018 Aerial Photography

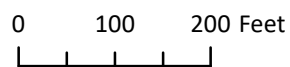


Figure 2 Project Component/Asset Map  
 Owl's Den Mitigation Site  
 DMS Project No. 95808  
 Monitoring Year 4 - 2019  
 Lincoln County, NC

**Table 1. Project Components and Mitigation Credits**

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2,453.000	N/A	8.939	N/A	N/A	N/A	N/A	N/A	N/A
Project Components									
Reach ID	As-Built Stationing / Location <sup>1</sup>	Existing Footage / Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage / Acreage <sup>1</sup>	Mitigation Ratio	Credits <sup>1</sup> (SMU / WMU)		
<b>STREAMS</b>									
HC1 Reach 1	99+94 - 108+09	609	P1	Restoration	815	1:1	815.000		
HC1 Reach 2	108+09 - 115+35	994	P1	Restoration	726	1:1	726.000		
	115+65 - 117+79		P1	Restoration	214	1:1	214.000		
HC2	200+00 - 206+98	444	P1	Restoration	698	1:1	698.000		
<b>WETLANDS</b>									
Wetland A	N/A	0.44	Significant improvement to wetland functions	Rehabilitation	0.44	1.3:1	0.339		
Wetland B	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.100		
Wetland C	N/A	1.03	Significant improvement to wetland functions	Rehabilitation	1.03	1.3:1	0.792		
Wetland D	N/A	0.81	Significant improvement to wetland functions	Rehabilitation	0.81	1.3:1	0.623		
Wetland E	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.100		
Wetland G	N/A	0.13	Significant improvement to wetland functions	Rehabilitation	0.13	1.3:1	0.100		
Wetland H	N/A	0.15	Significant improvement to wetland functions	Rehabilitation	0.15	1.3:1	0.115		
Wetland Re-Establishment Area <sup>2</sup>	N/A	n/a	Planting, hydrologic improvement	Re-Establishment	6.77	1:1	6.770		

Component Summation						
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,453	-	-	-	-	-
Enhancement	-	-	-	-	-	-
Enhancement I	-	-	-	-	-	-
Enhancement II	-	-	-	-	-	-
Wetland Re-Establishment	-	6.77	-	-	-	-
Wetland Rehabilitation	-	2.82	-	-	-	-

The 30 linear feet associated with the stream crossing on HC1 Reach 2 were excluded from the computations.

<sup>1</sup>Stream Mitigation Credits were adjusted in MY2 to reflect credits proposed in the mitigation plan using centerline alignment.

<sup>2</sup>Wetland Re-Establishment credits were revised during the as-built as a result of an easement adjustment after mitigation plan was approved.

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

Owl's Den Mitigation Site  
 DMS Project No. 95808  
**Monitoring Year 4 - 2019**

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	July 2013	April 2014
Final Design - Construction Plans	March 2015	April 2015
Construction	May 2015 - July 2015	July 2015
Temporary S&E mix applied to entire project area <sup>1</sup>	May 2015 - July 2015	July 2015
Permanent seed mix applied to reach/segments	June 2015	July 2015
Bare root and live stake plantings for reach/segments	January 2016	January 2016
Baseline Monitoring Document (Year 0)	Stream Survey	June 2015
	Vegetation Survey	January 2016
Year 1 Monitoring	Stream Survey	April 2016
	Vegetation Survey	September 2016
Year 2 Monitoring	Stream Survey	March 2017
	Vegetation Survey	July 2017
Year 3 Monitoring	Stream Survey	April 2018
	Vegetation Survey	September 2018
Year 4 Monitoring	Supplemental Planting	March 2019
	Stream Survey	N/A
	Vegetation Survey	N/A
	Beaver Removal	N/A
Year 5 Monitoring	Stream Survey	2020
	Vegetation Survey	2020
Year 6 Monitoring	Stream Survey	2021
	Vegetation Survey	2021
Year 7 Monitoring	Stream Survey	2022
	Vegetation Survey	2022

<sup>1</sup>Seed and mulch is added as each section of construction is completed.

**Table 3. Project Contact Table**

Owl's Den Mitigation Site  
 DMS Project No. 95808  
**Monitoring Year 4 - 2019**

<b>Designer</b> Emily Reinicker, PE	<b>Wildlands Engineering, Inc.</b> 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
<b>Construction Contractor</b>	<b>Land Mechanic Designs, Inc.</b> 126 Circle G Lane Willow Spring, NC 27592
<b>Planting Contractor</b>	<b>Bruton Natural Systems, Inc</b> P.O. Box 1197 Fremont, NC 27830
<b>Seeding Contractor</b>	<b>Land Mechanic Designs, Inc.</b> 126 Circle G Lane Willow Spring, NC 27592
<b>Seed Mix Sources</b>	<b>Green Resource, LLC</b>
<b>Nursery Stock Suppliers</b> <b>Bare Roots</b> <b>Live Stakes</b>	<b>Bruton Natural Systems, Inc</b>
<b>Monitoring Performers</b> Monitoring, POC	<b>Wildlands Engineering, Inc.</b> Kristi Suggs 704.332.7754, ext. 110

**Table 4. Project Information and Attributes**

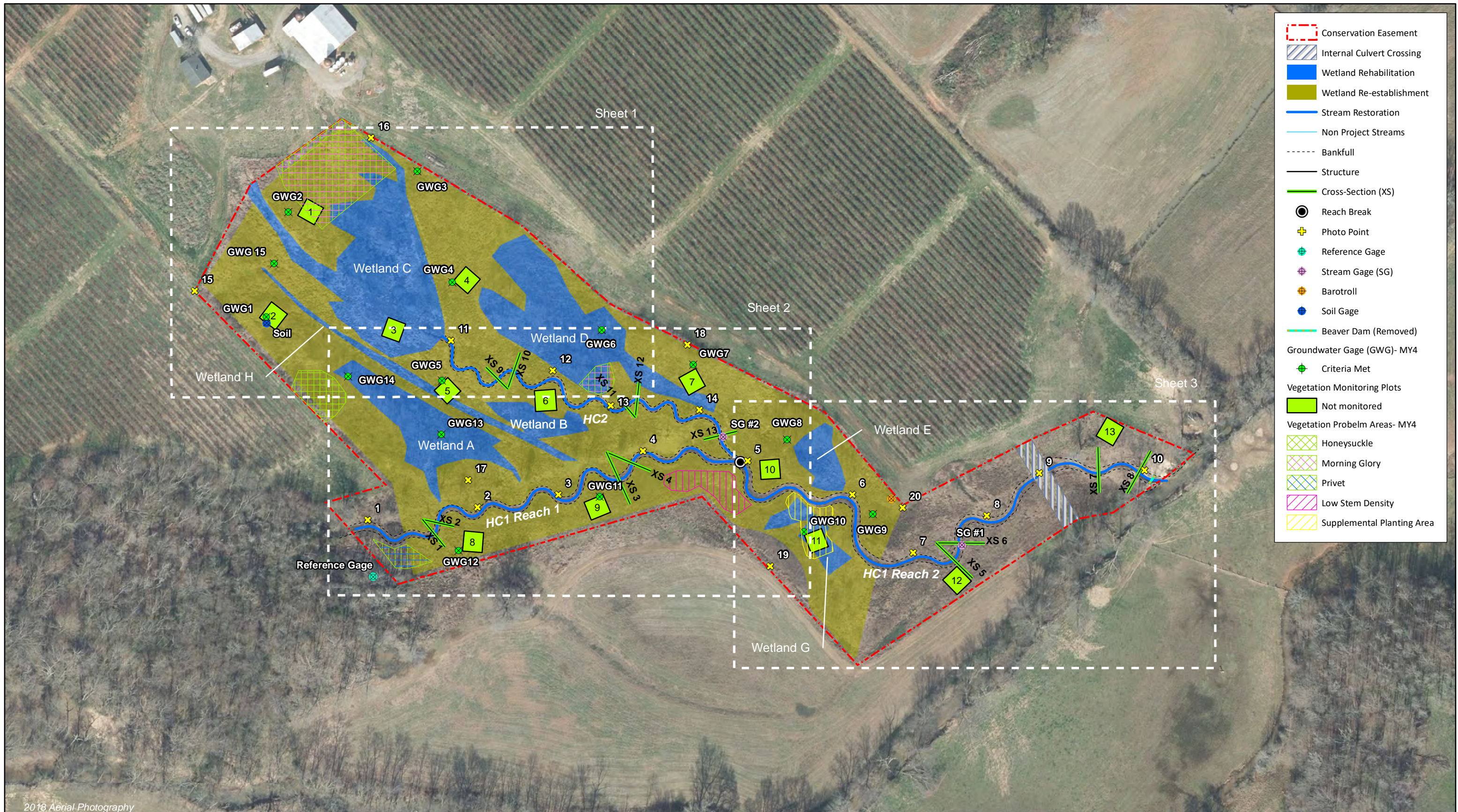
Owl's Den Mitigation Site  
 DMS Project No. 95808  
 Monitoring Year 4 - 2019

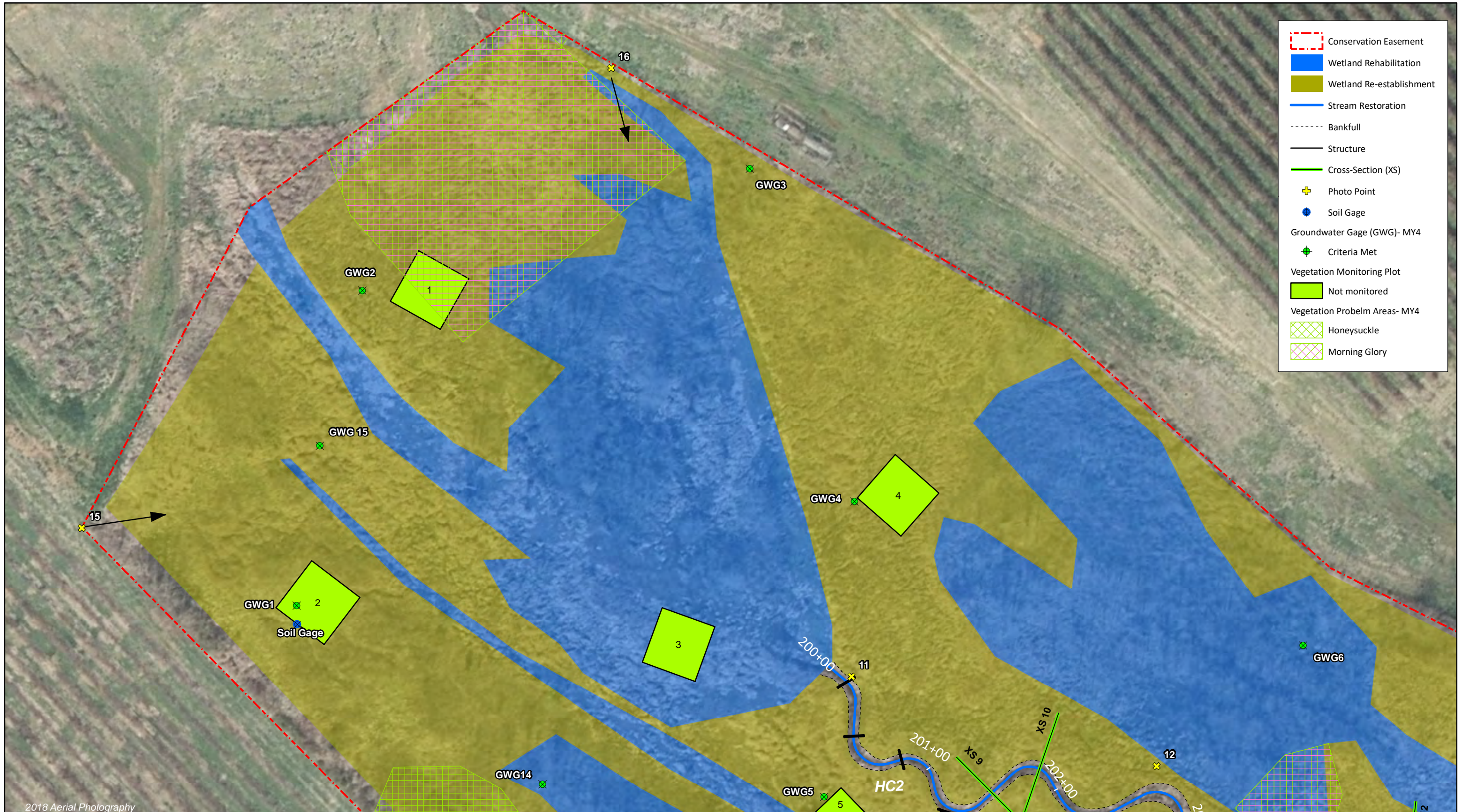
Project Information			
Project Name	Owl's Den Mitigation Site		
County	Lincoln County		
Project Area (acres)	12.87		
Project Coordinates (latitude and longitude)	35°29'33.22" N, 81° 18'45.95" W		
Project Watershed Summary Information			
Physiographic Province	Inner Piedmont Belt of the Piedmont Physiographic Province		
River Basin	Catawba		
USGS Hydrologic Unit 8-digit	03050102		
USGS Hydrologic Unit 14-digit	03050102040040		
DWR Sub-basin	03-08-35		
Project Drainage Area (acres)	152		
Project Drainage Area Percentage of Impervious Area	<1%		
CGIA Land Use Classification	93% – Agriculture/Managed Herbaceous; 7% – Forested/Scrubland		
Reach Summary Information			
Parameters	HC1 Reach 1	HC1 Reach 2	HC2
Length of reach (linear feet) - Post-Restoration	815	940	698
Drainage area (acres)	62	152	27
NCDWR stream identification score	31.5	37.5	31.5
NCDWR Water Quality Classification	C		
Morphological Description (stream type)	P	P	P
Evolutionary trend (Simon's Model) - Pre- Restoration	IV	IV	IV
Underlying mapped soils	Chewacla Loam, Helena sandy loam, Riverview loam, Worsham fine sandy loam		
Drainage class	---	---	---
Soil hydric status	---	---	---
Slope	0.0061	0.0075	0.0059
FEMA classification	AE*		
Native vegetation community	Piedmont Bottomland Forest		
Percent composition exotic invasive vegetation -Post-Restoration	0%		
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	X	X	USACE Nationwide Permit No.27 (Action ID# SAW-2013-00717) and DWQ 401 Water Quality Certification No. 3885.
Waters of the United States - Section 401	X	X	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	X	X	Owl's Den Mitigation Plan; Wildlands determined "no effect" on Lincoln County listed endangered species. May 18, 2015 email correspondence from USFWS indicating no effect on the northern long-eared bat.
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO dated 4/30/2013).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	X	X	Floodplain development permit issued by Lincoln County.
Essential Fisheries Habitat	No	N/A	N/A

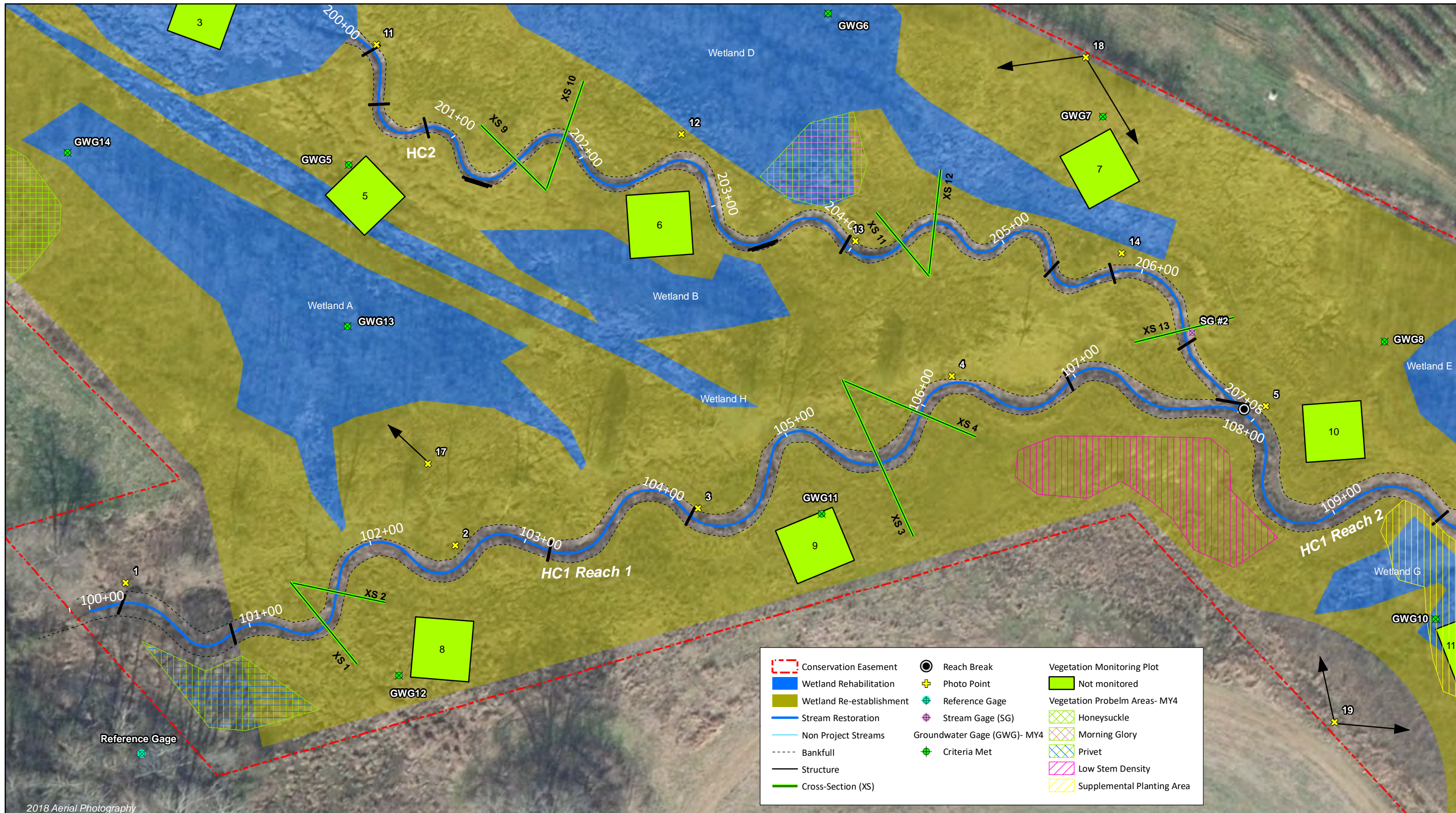
\*The project site reaches do not have regulated floodplain mapping, but are located within the Howards Creek floodplain.

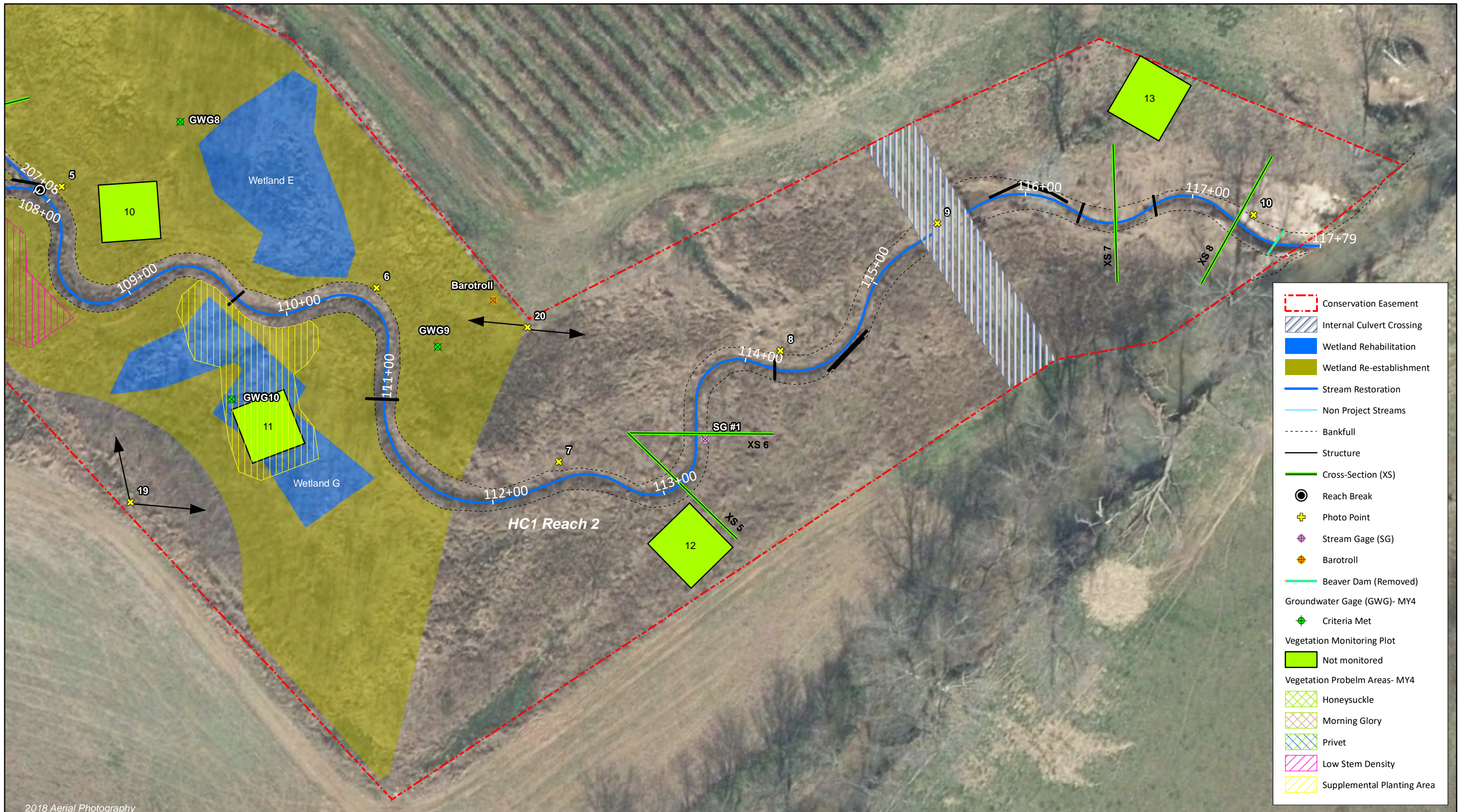
## **APPENDIX 2. Visual Assessment Data**











**Table 5a. Visual Stream Morphology Stability Assessment Table**

Owl's Den Mitigation Site  
 DMS Project No. 95808  
 Monitoring Year 4 - 2019

**HC1 Reach 1 (820 LF)**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Shallow Condition	Texture/Substrate	17	17		100%				
	3. Meander Pool Condition	Depth Sufficient	16	16		100%				
		Length Appropriate	16	16		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	16	16		100%				
		Thalweg centering at downstream of meander bend (Glide)	16	16		100%				
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
3. Engineered Structures <sup>1</sup>	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	9	9			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

<sup>1</sup>Excludes constructed shallows since they are evaluated in channel category.

**Table 5b. Visual Stream Morphology Stability Assessment Table**

Owl's Den Mitigation Site  
 DMS Project No. 95808  
 Monitoring Year 4 - 2019

**HC1 Reach 2 (940 LF)**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Shallow Condition	Texture/Substrate	14	14		100%				
	3. Meander Pool Condition	Depth Sufficient	15	15		100%				
		Length Appropriate	15	15		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15		100%				
Thalweg centering at downstream of meander bend (Glide)		15	15	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
3. Engineered Structures <sup>1</sup>	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	11	11			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	6	6			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

<sup>1</sup>Excludes constructed shallows since they are evaluated in channel category.

**Table 5c. Visual Stream Morphology Stability Assessment Table**

Owl's Den Mitigation Site  
 DMS Project No. 95808  
 Monitoring Year 4 - 2019

**HC2 (708 LF)**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Shallow Condition	Texture/Substrate	17	17		100%				
	3. Meander Pool Condition	Depth Sufficient	16	16		100%				
		Length Appropriate	16	16		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	16	16		100%				
		Thalweg centering at downstream of meander bend (Glide)	16	16		100%				
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
3. Engineered Structures <sup>1</sup>	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	13	13			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

<sup>1</sup>Excludes constructed shallows since they are evaluated in channel category.

**Table 6. Vegetation Condition Assessment Table**

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

**Planted Acreage 13**

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.1	0	0.0	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	1	0.1	0.8%
<b>Total</b>			<b>1</b>	<b>0.1</b>	<b>0.8%</b>
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 Ac	0	0	0%
<b>Cumulative Total</b>			<b>1</b>	<b>0.1</b>	<b>0.8%</b>

**Easement Acreage 35**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	4	0.69	2.0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%



## **Stream Photographs**



Photo Point 1 – HC1 Reach 1 view upstream (05/24/2019)



Photo Point 1 – HC1 Reach 1 view downstream (05/24/2019)



Photo Point 2 – HC1 Reach 1 view upstream (05/24/2019)



Photo Point 2 – HC1 Reach 1 view downstream (05/24/2019)



Photo Point 3 – HC1 Reach 1 view upstream (05/24/2019)



Photo Point 3 – HC1 Reach 1 view downstream (05/24/2019)



Photo Point 4 – HC1 Reach 1 view upstream (05/24/2019)



Photo Point 4 – HC1 Reach 1 view downstream (05/24/2019)



Photo Point 5 – HC1 Reach 1 & HC2 view upstream (05/24/2019)



Photo Point 5 – HC2 view upstream (05/24/2019)



Photo Point 5 – HC1 Reach 1 view downstream (05/24/2019)



Photo Point 6 – HC1 Reach 2 view upstream (05/24/2019)



Photo Point 6 – HC1 Reach 2 view downstream (05/24/2019)

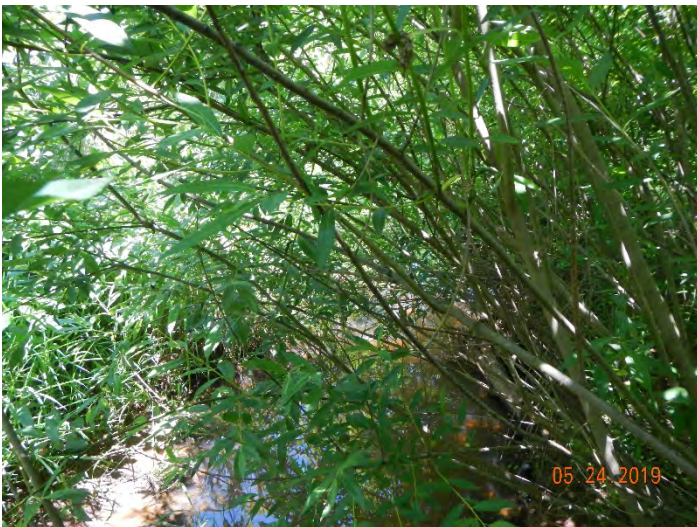


Photo Point 7 – HC1 Reach 2 view upstream (05/24/2019)

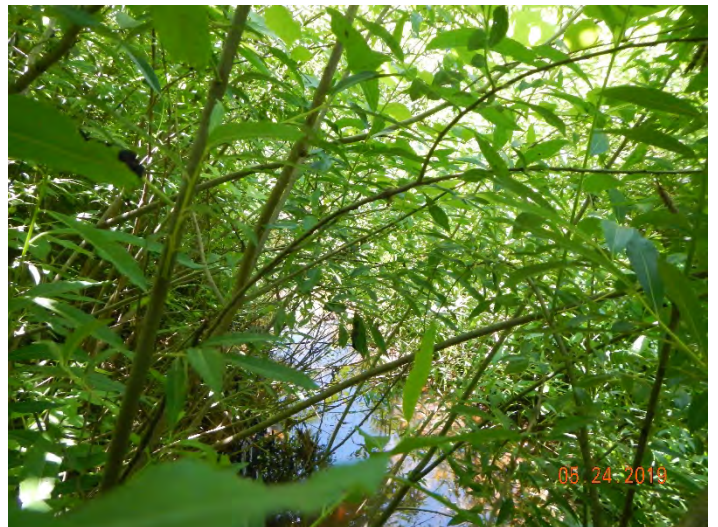


Photo Point 7 – HC1 Reach 2 view downstream (05/24/2019)



Photo Point 8 – HC1 Reach 2 view upstream (05/24/2019)



Photo Point 8 – HC1 Reach 2 view downstream (05/24/2019)



Photo Point 9 – HC1 Reach 2 view upstream (05/24/2019)



Photo Point 9 – HC1 Reach 2 view downstream (05/24/2019)



Photo Point 10 – HC1 Reach 2 view upstream (05/24/2019)



Photo Point 10 – HC1 Reach 2 view downstream (05/24/2019)



Photo Point 11 – HC2 view upstream (05/24/2019)



Photo Point 11 – HC2 view downstream (05/24/2019)



Photo Point 12 – HC2 view upstream (05/24/2019)



Photo Point 12 – HC2 view downstream (05/24/2019)



Photo Point 13 – HC2 view upstream (05/24/2019)



Photo Point 13 – HC2 view downstream (05/24/2019)



Photo Point 14 – HC2 view upstream (05/24/2019)



Photo Point 14 – HC2 view downstream (05/24/2019)

## **Wetland Photographs**



Photo Point 15 – looking southeast (05/24/2019)



Photo Point 16 – looking southeast (05/24/2019)



Photo Point 17 – looking north (05/24/2019)



Photo Point 18 – looking northwest (05/24/2019)



Photo Point 18 – looking southwest (05/24/2019)





Photo Point 19 – looking northeast (05/24/2019)



Photo Point 19 – looking southeast (05/24/2019)



Photo Point 20 – looking northwest (05/24/2019)



Photo Point 20 – looking southeast (05/24/2019)

## **Area of Concern Photographs**



Beaver Dam Removal (12/11/2019)



Standing water in Vegetation Plot 5 (3/1/2019)



Supplemental Planting (3/2019)

### **APPENDIX 3. Vegetation Plot Data**

## **APPENDIX 4. Morphological Summary Data and Plots**

## **APPENDIX 5. Hydrology Summary Data and Plots**

**Table 13. Verification of Bankfull Events**

Owl's Den Mitigation Site

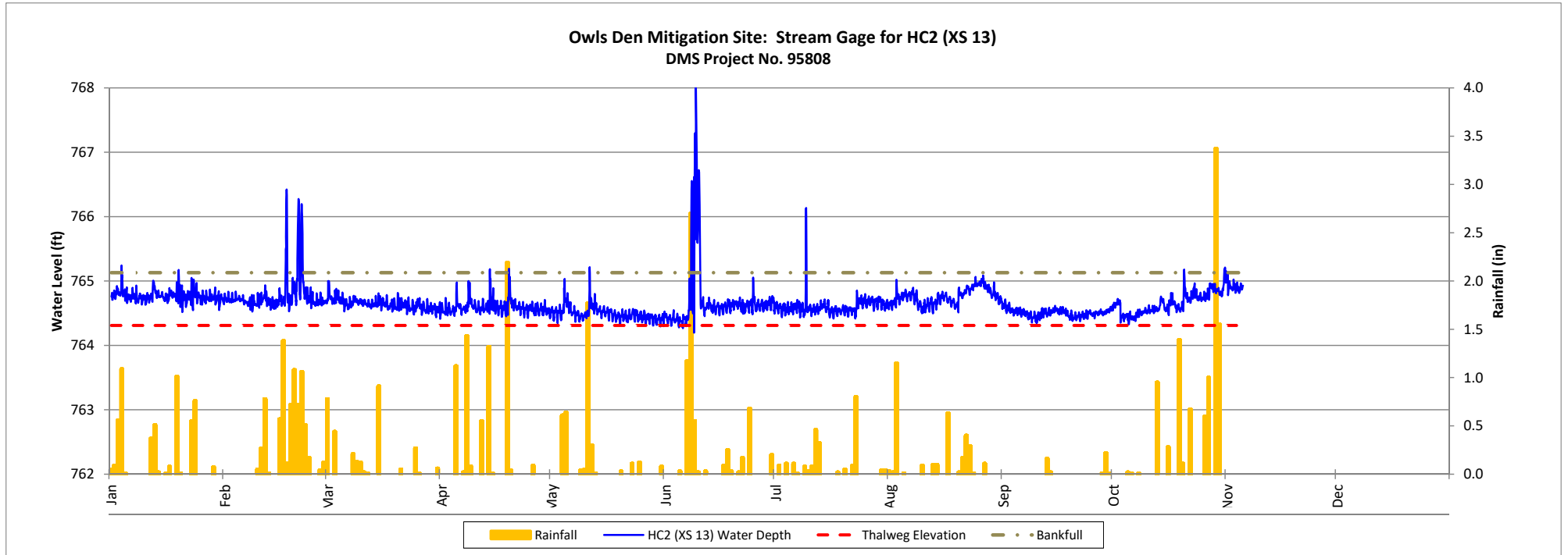
DMS Project No. 95808

**Monitoring Year 4 - 2019**

Reach	Monitoring Year	Date of Occurrence	Method
HC1	MY1	1/16/2016	Stream Gage
		2/3/2016	
		5/1/2016	
		5/3/2016	
		5/20/2016	
		7/4/2016	
HC2	MY1	1/16/2016	Stream Gage
		5/3/2016	
		7/4/2016	
HC1	MY2	5/21/2017	Stream Gage
		7/1/2017	
		9/5/2017	
		10/9/2017	
		10/23/2017	
HC2	MY2	1/23/2017	Stream Gage
		2/9/2017	
		2/26/2017	
		4/24/2017	
		5/21/2017	
		7/1/2017	
		9/5/2017	
		10/9/2017	
		10/23/2017	
		10/29/2017	
HC1	MY3	2/3/2018	Stream Gage
		2/7/2018	
		4/24/2018	
		5/18/2018	
		5/30/2018	
		10/11/2018	
HC2	MY3	10/26/2018	Stream Gage
		2/7/2018	
		4/24/2018	
		5/18/2018	
		10/11/2018	
HC1	MY4	10/26/2018	Stream Gage
		2/18/2019	
		4/14/2019	
		6/8/2019	
HC2	MY4	7/9/2019	Stream Gage
		2/18/2019	
		4/14/2019	
		6/8/2019	
		7/9/2019	

### Recorded Stream Flow Events

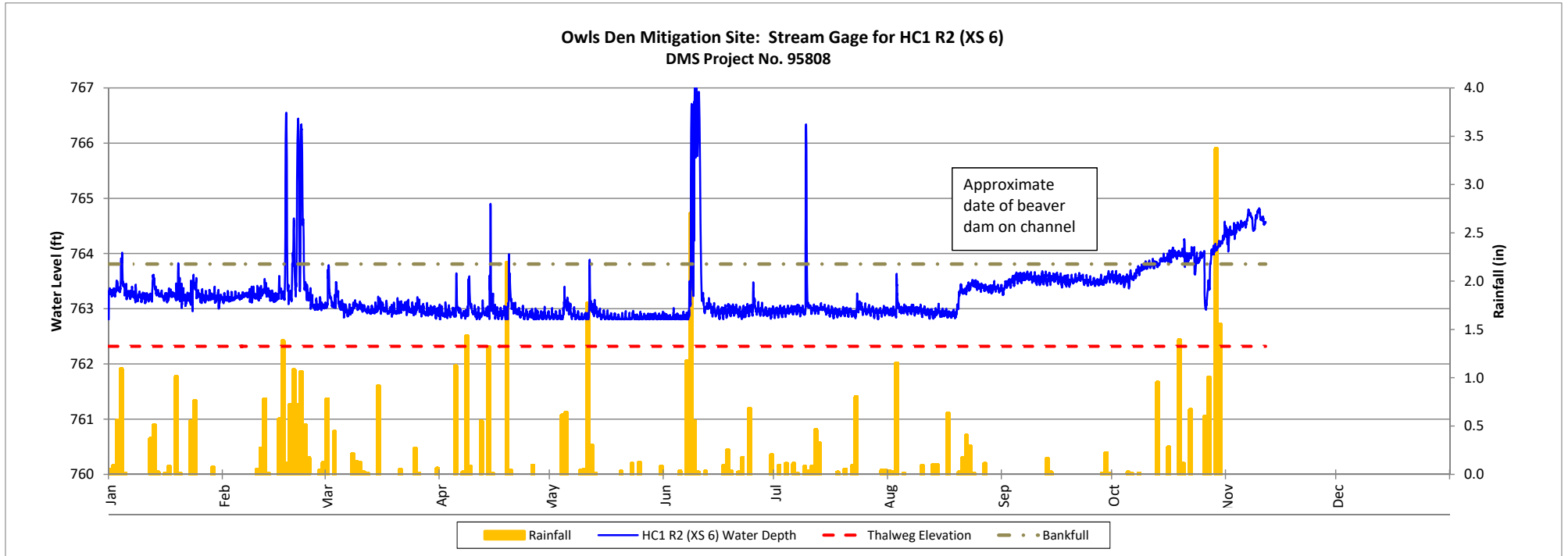
Owls Den Mitigation Site  
DMS Project No. 95808  
Monitoring Year 4 - 2019





### Recorded Stream Flow Events

Owls Den Mitigation Site  
DMS Project No. 95808  
Monitoring Year 4 - 2019



**Table 14. Wetland Gage Attainment Summary**

Owl's Den Mitigation Site

DMS Project No. 95808

**Monitoring Year 4 - 2019**

Summary of Groundwater Gage Results for Monitoring Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage) <sup>1</sup>						
	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)	Year 4 (2019)	Year 5 (2020)	Year 6 (2021)	Year 7 (2022)
1	No/4 Days (2%)	No/14 Days (6%)	No/16 Days (7%)	Yes/19 Days (9%)*			
2	Yes/223 Days (100%)	Yes/223 Days (100%)	Yes/142 Days (64%)	Yes/113 Days (51%)			
3	Yes/223 Days (100%)	Yes/223 Days (100%)	Yes/218 Days (98%)	Yes/222 Days (100%)			
4	Yes/75 Days (34%)	Yes/94 Days (42%)	Yes/143 Days (64%)	Yes/49 Days (22%)**			
5	Yes/223 Days (100%)	Yes/223 Days (100%)	Yes/176 Days (80%)	Yes/222 Days (100%)			
6	Yes/20 Days (9%)	Yes/53 Days (24%)	Yes/87 Days (39%)	Yes/61 Days (27%)			
7	Yes/39 Days (18%)	Yes/68 Days (31%)	Yes/96 Days (43%)	Yes/63 Days (28%)			
8	No/10 Days (5%)	Yes/49 Days (22%)	Yes/47 Days (21%)	Yes/34 Days (15%)			
9	Yes/30 Days (14%)	Yes/51 Days (23%)	Yes/83 Days (37%)	Yes/36 Days (16%)*			
10	Yes/223 Days (100%)	Yes/223 Days (100%)	Yes/217 Days (98%)	Yes/223 Days (100%)			
11	Yes/89 Days (40%)	Yes/52 Days (23%)	Yes/96 Days (43%)	Yes/113 Days (51%)			
12	Yes/39 Days (40%)	Yes/53 Days (24%)	Yes/82 Days (37%)	Yes/58 Days (26%)			
13	Yes/223 Days (100%)	Yes/223 Days (100%)	Yes/217 Days (98%)	Yes/223 Days (100%)			
14	---	Yes/192 Days (87%)	Yes/218 Days (98%)	Yes/222 Days (100%)			
15	---	---	---	Yes/54Days (24%) <sup>2</sup>			
Reference Gage	Yes/83 Days (37%)	Yes/124 Days (56%)	Yes/157 Days (71%)	Yes/223 Days (100%)			

<sup>1</sup>Success Criteria: Water table within 12 inches of ground surface for 8.1% of growing season (3/28 - 11/4)

<sup>2</sup> GWG 15 installed December 2018

\*MY4 GWG 1 and 9 Late April- May data not available due to probe malfunctioning.

\*\* MY4 GWG4 Data from mid-may to Novmeber, data not available due to probe malfunctioning.

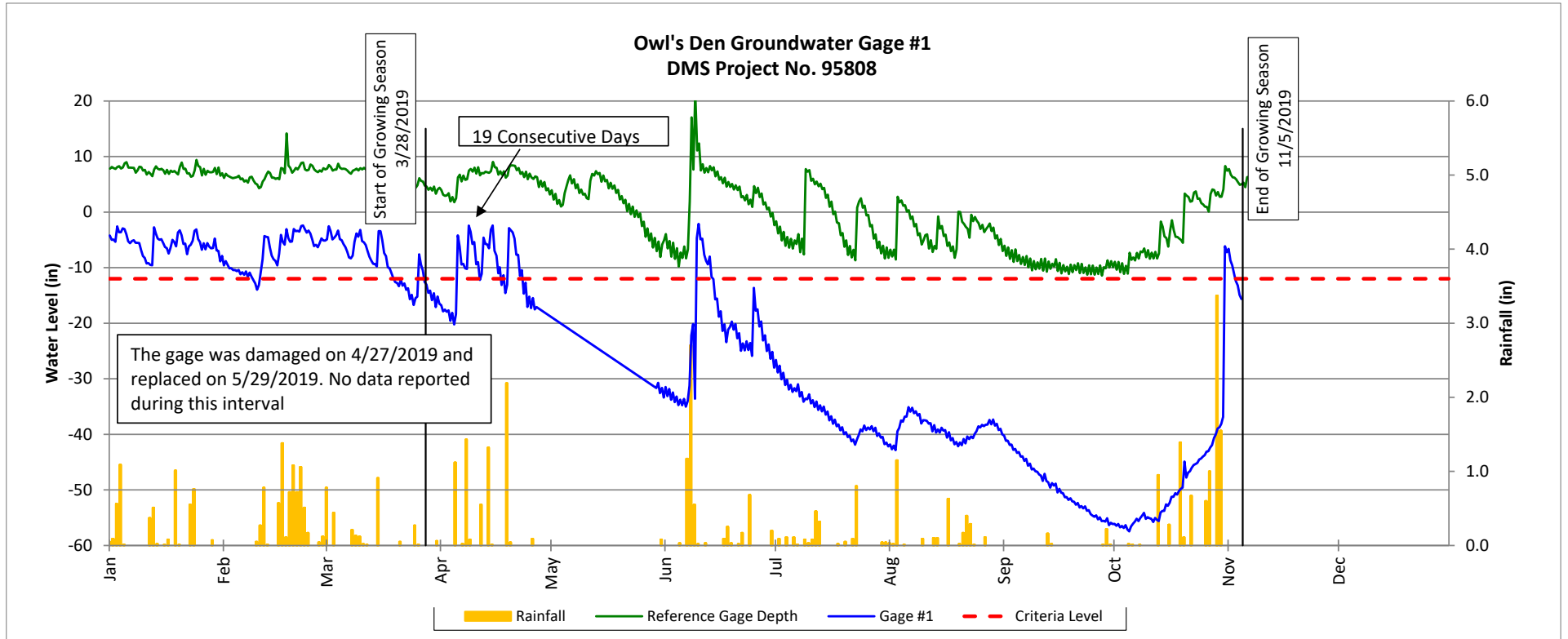
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



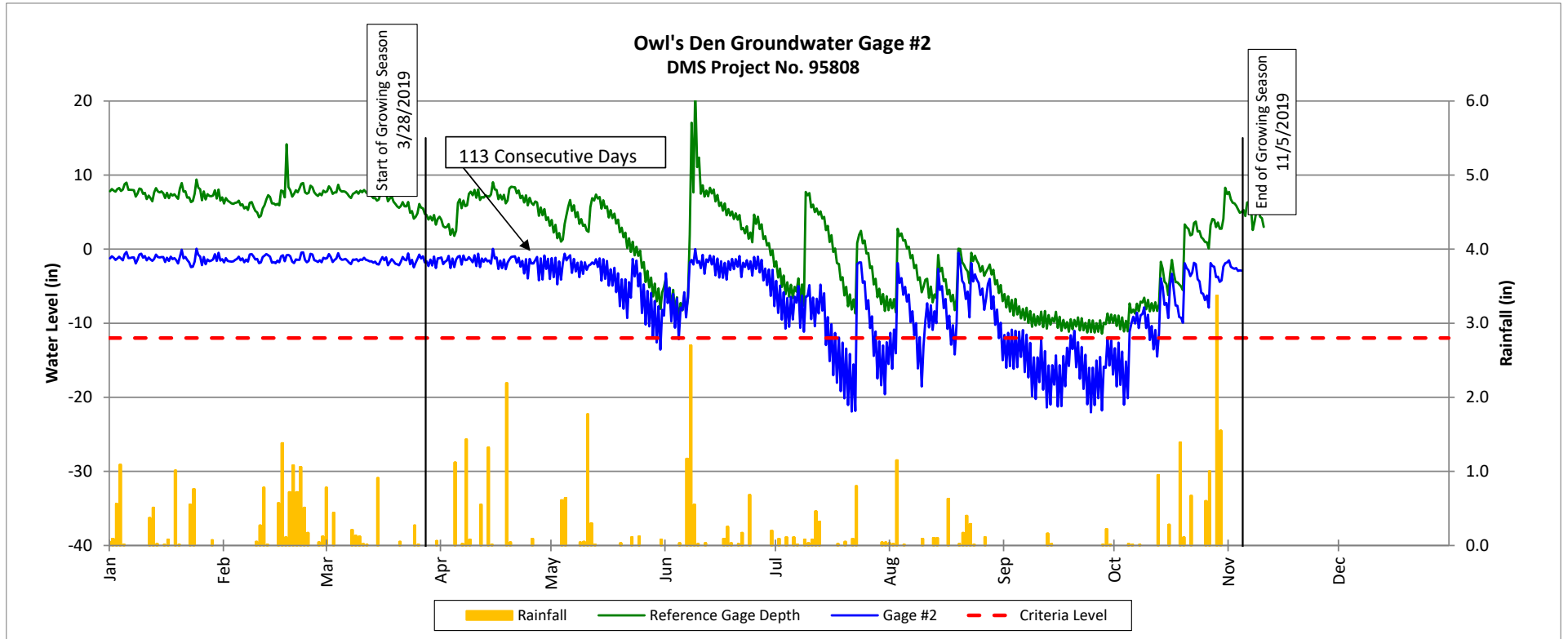
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



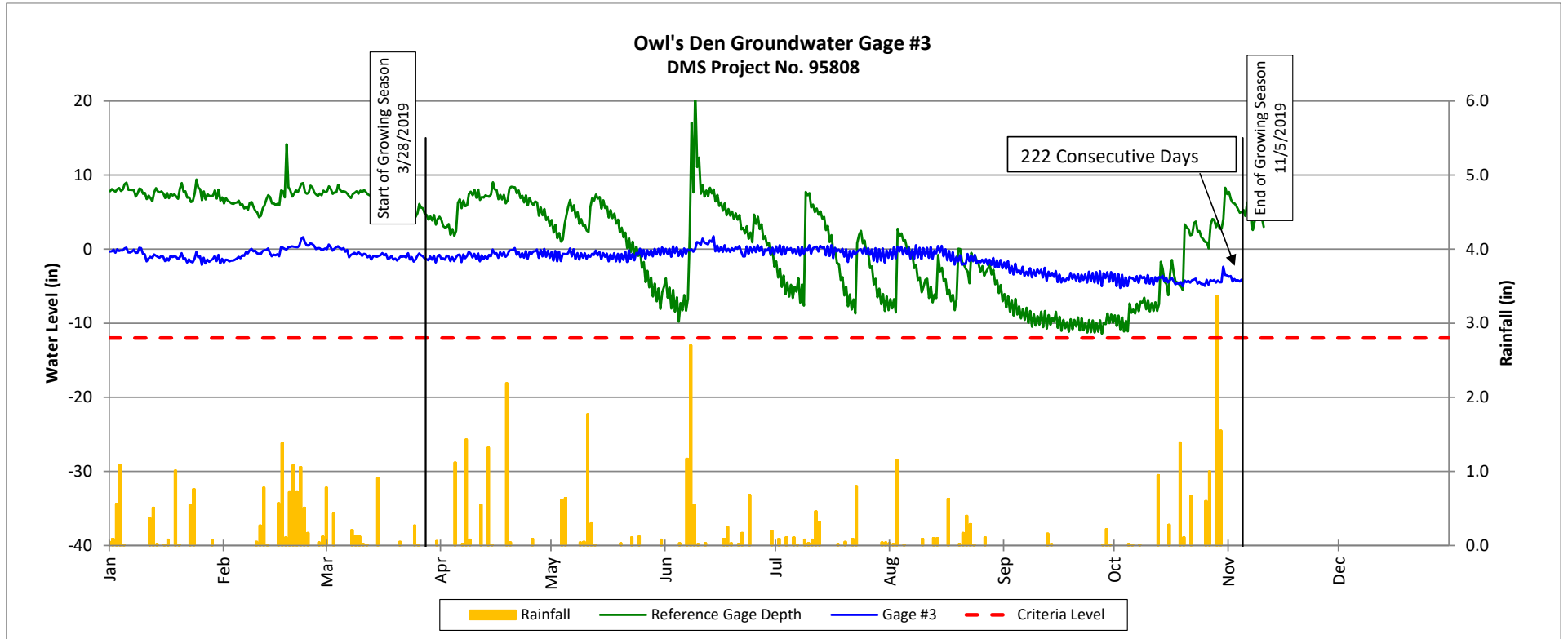
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



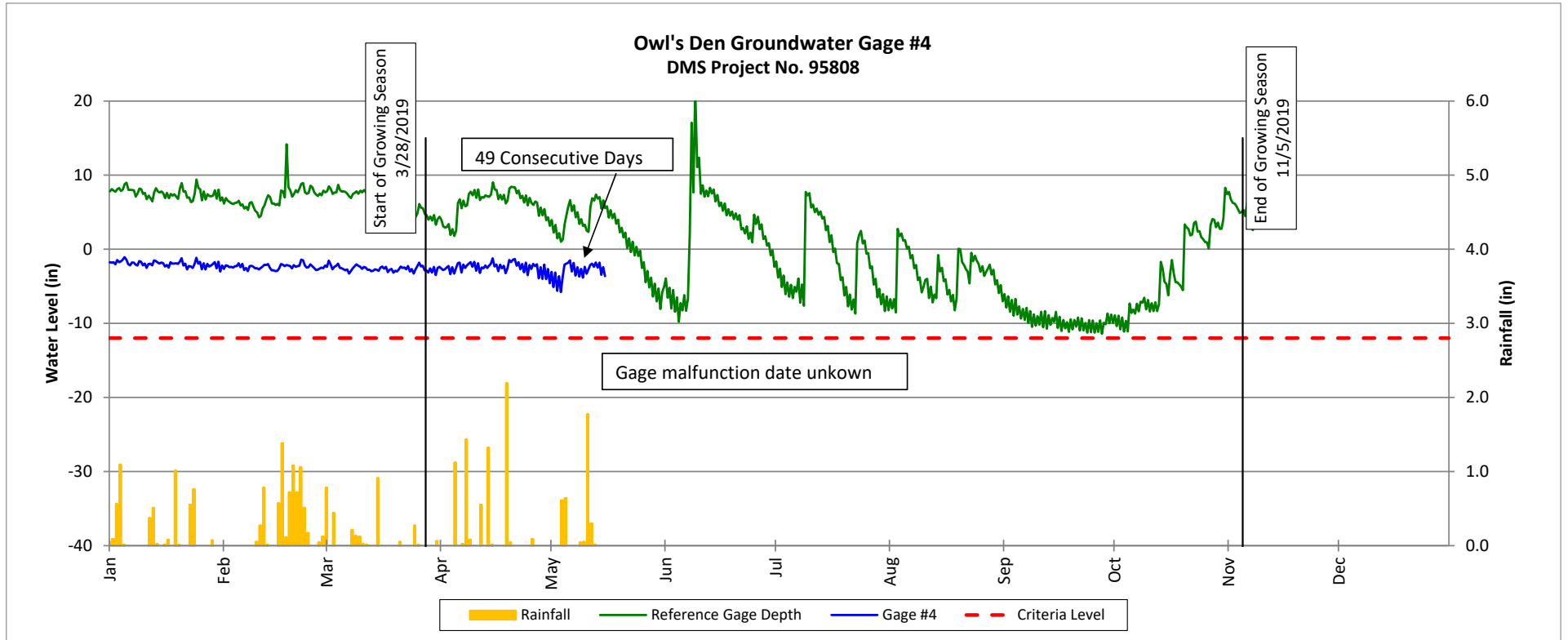
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



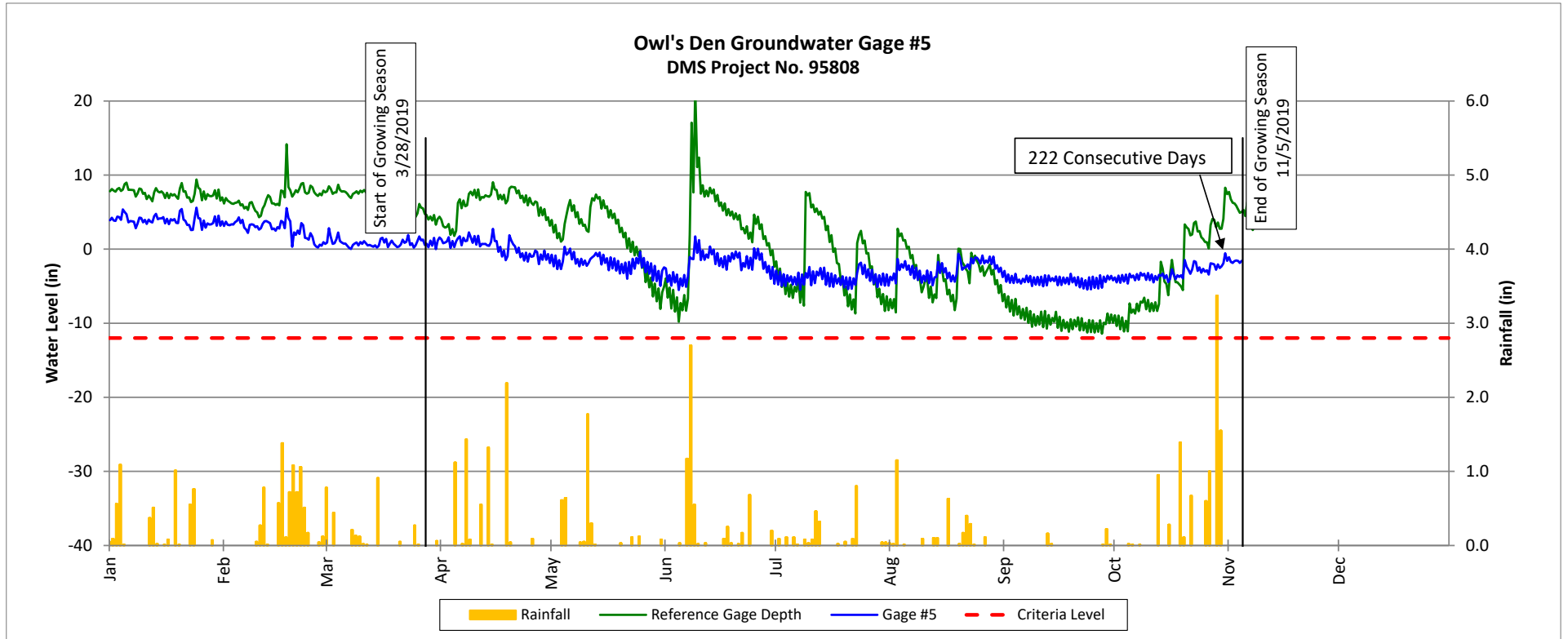
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



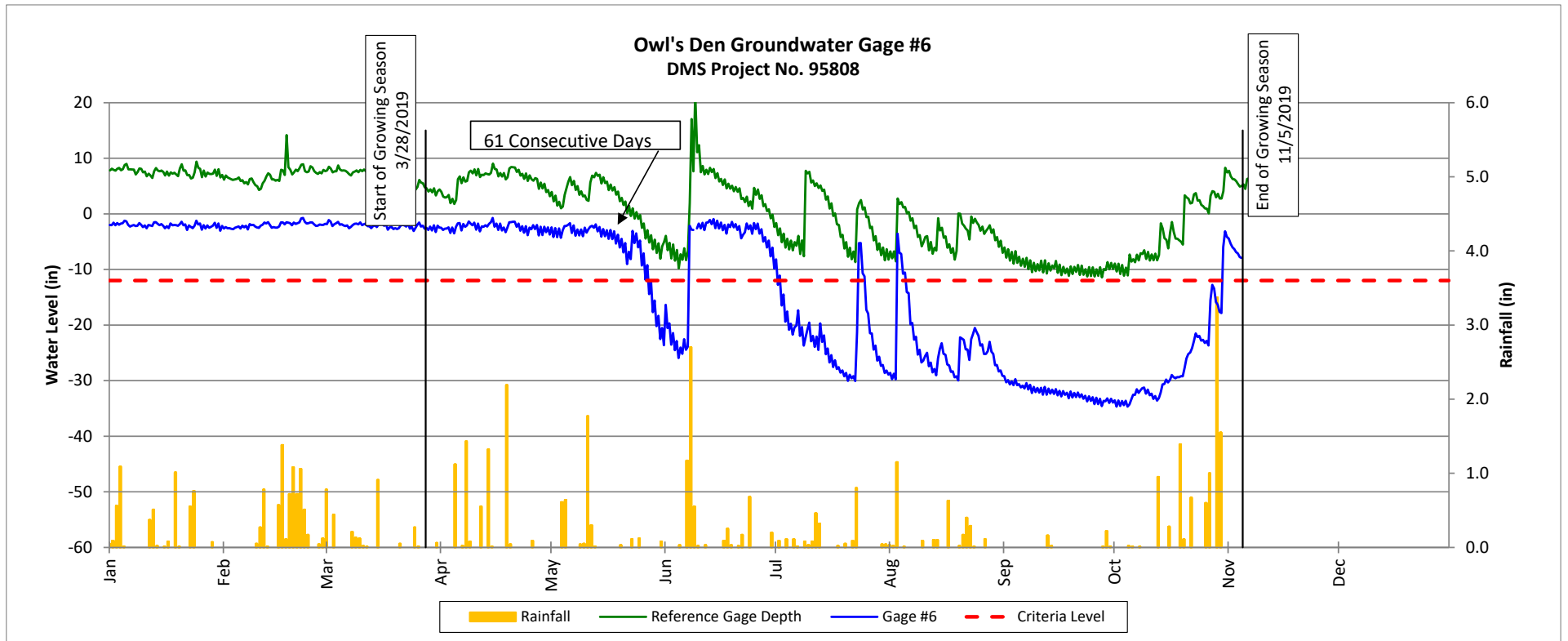
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Rehabilitation





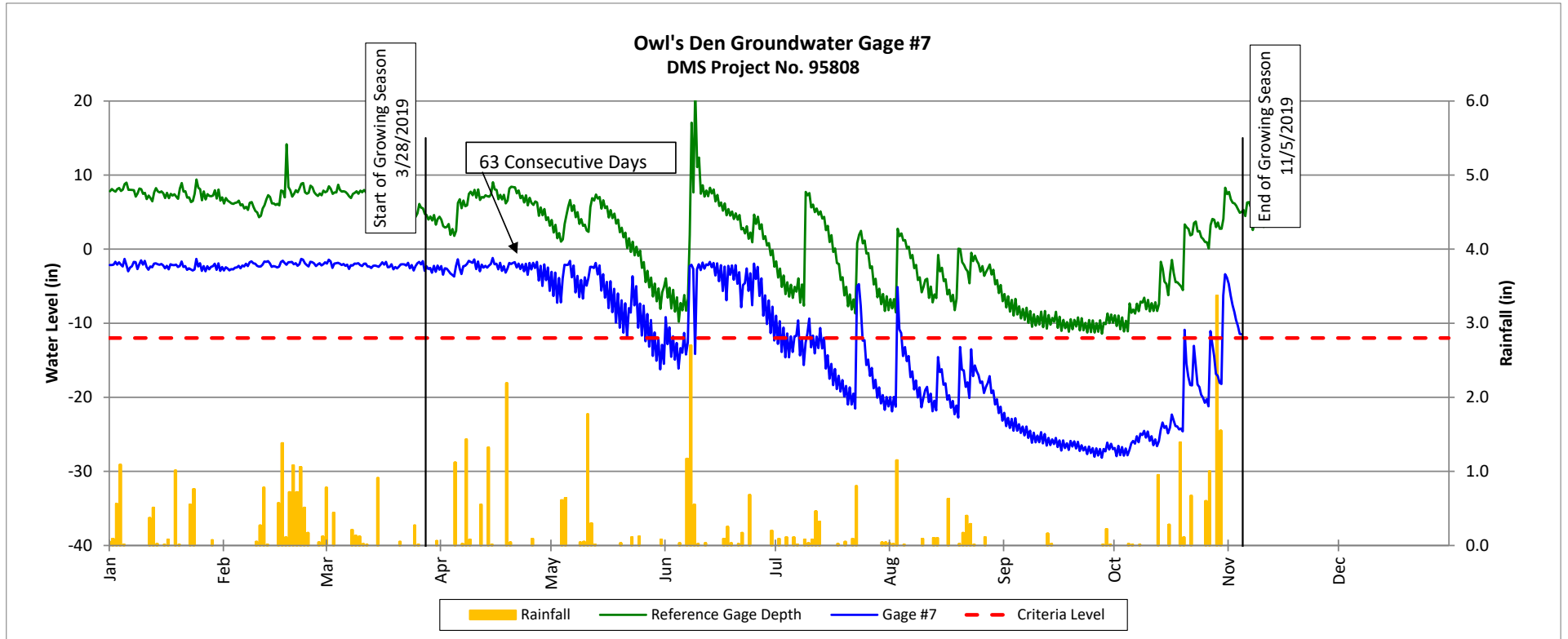
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



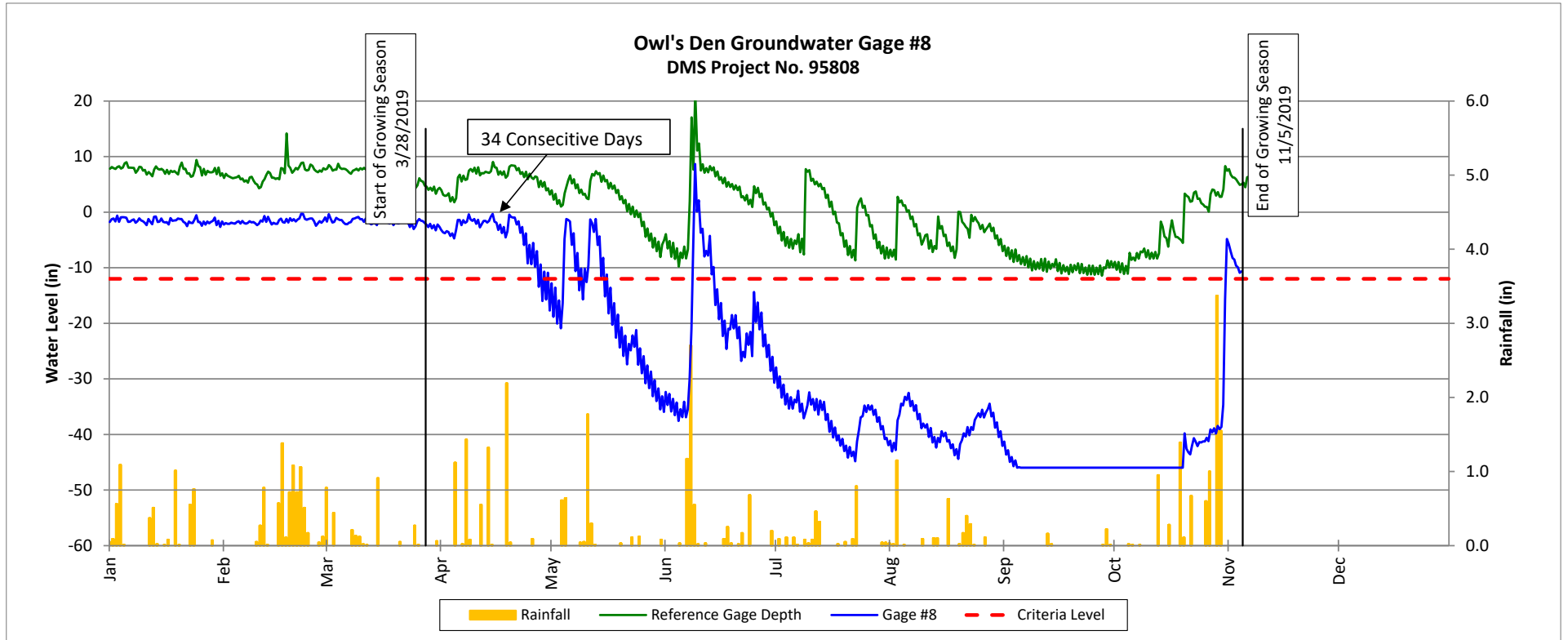
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



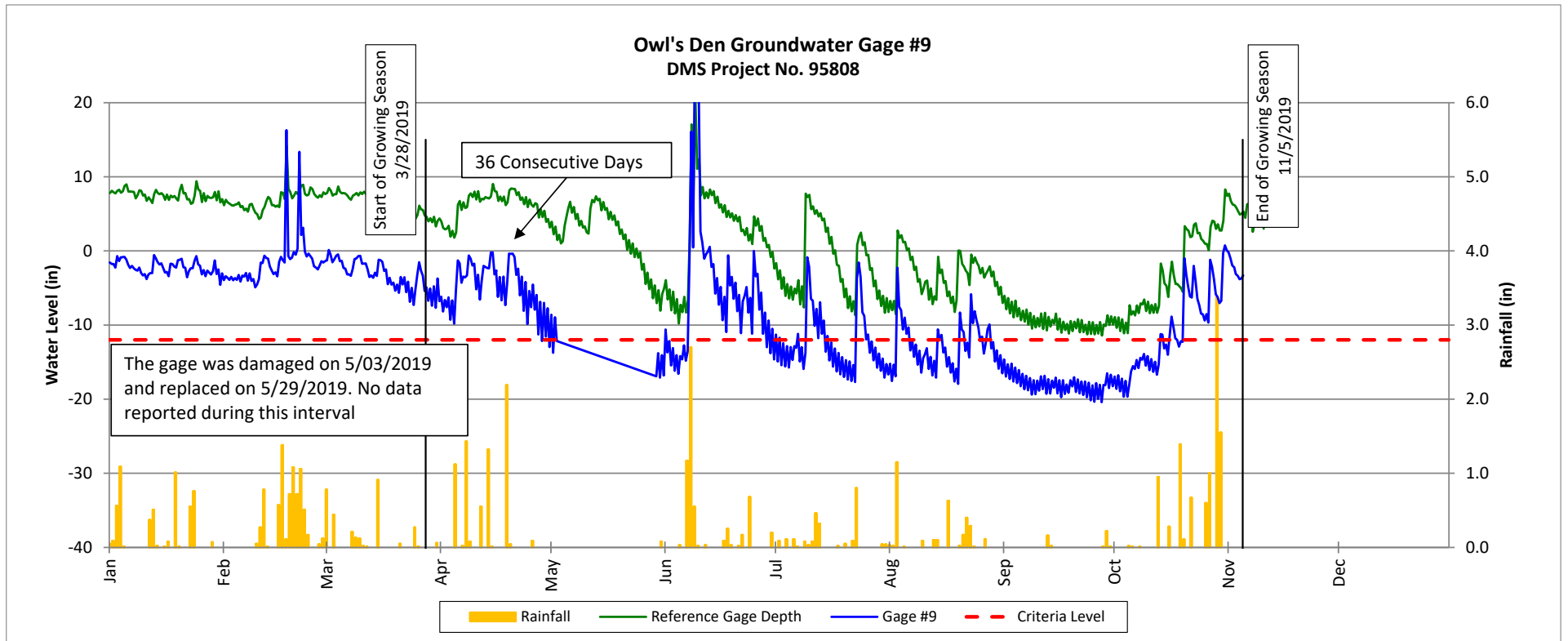
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



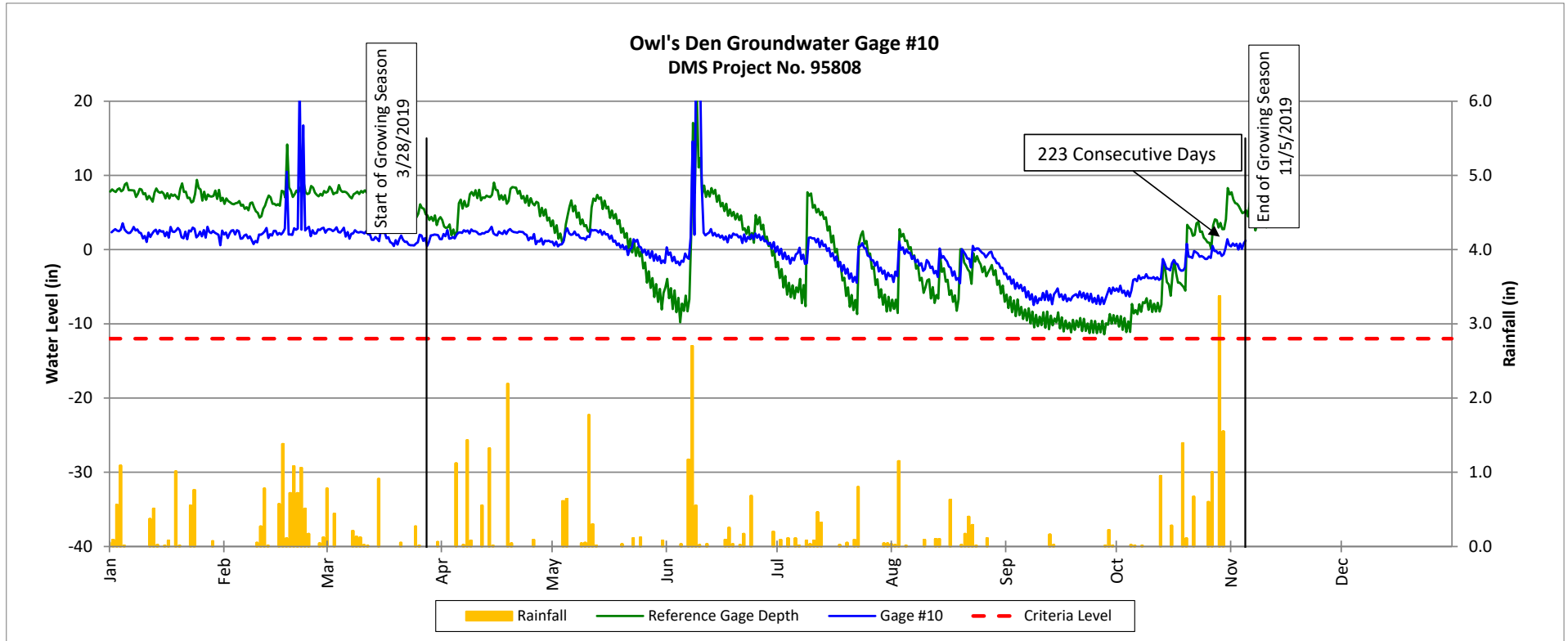
### Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Rehabilitation



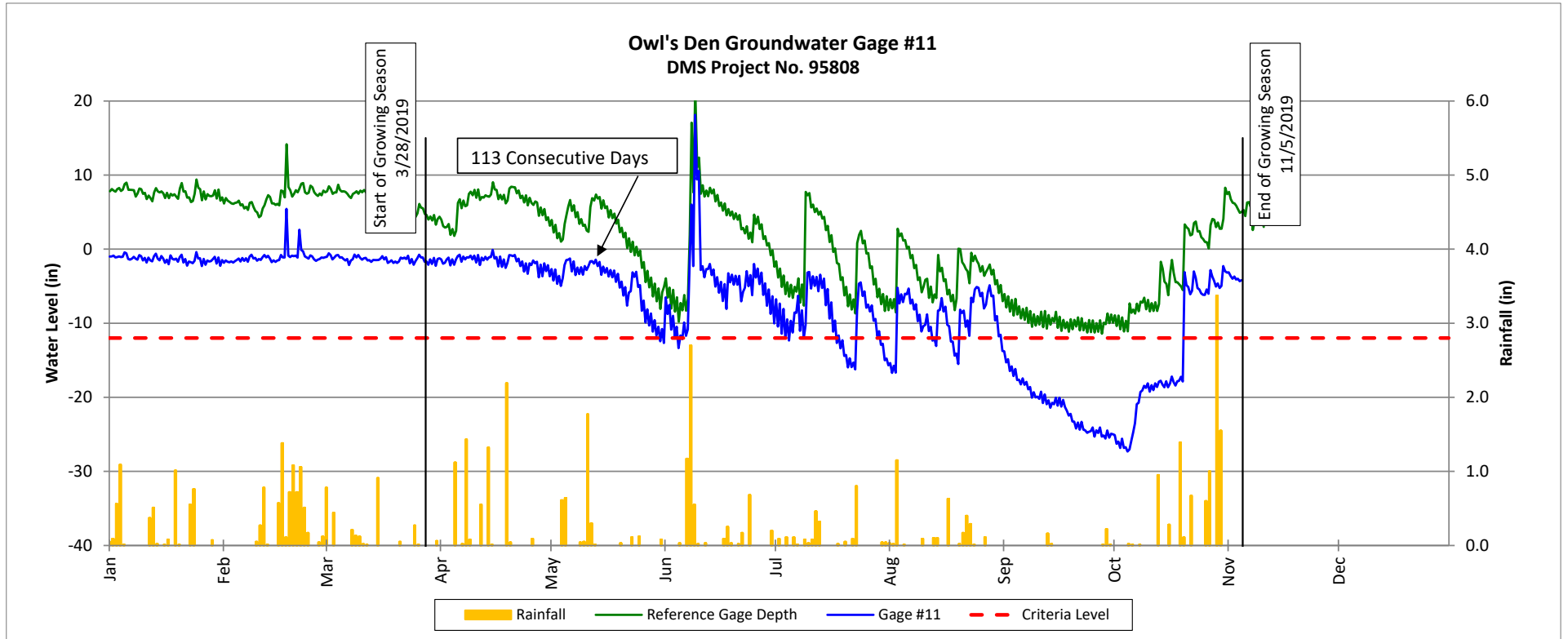
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



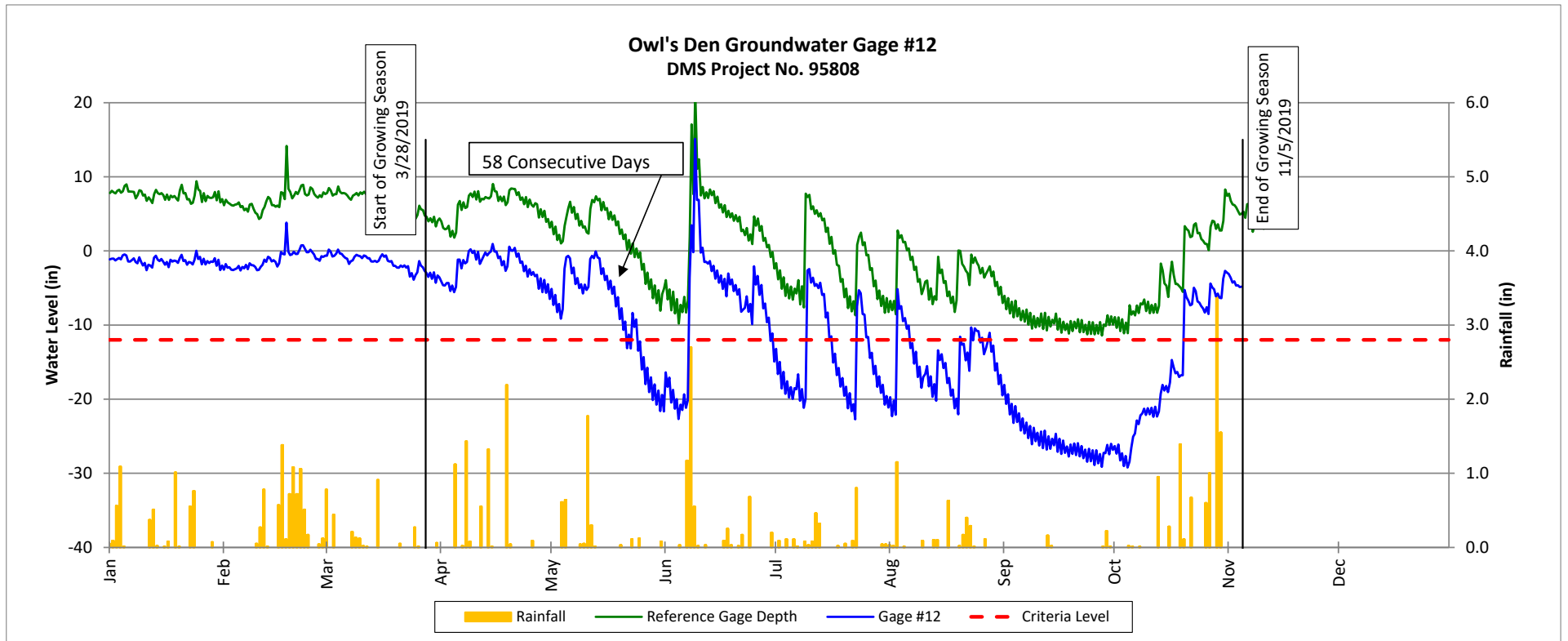
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Re-establishment



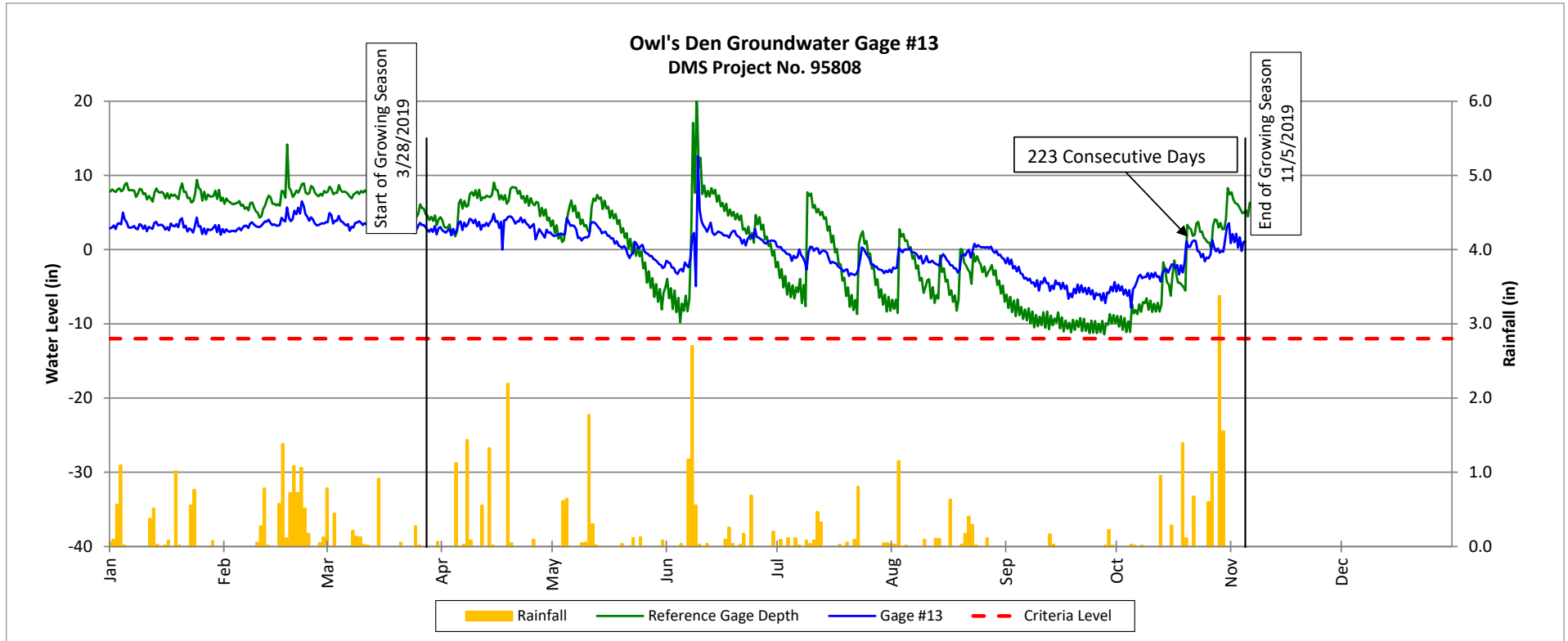
### Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Rehabilitation



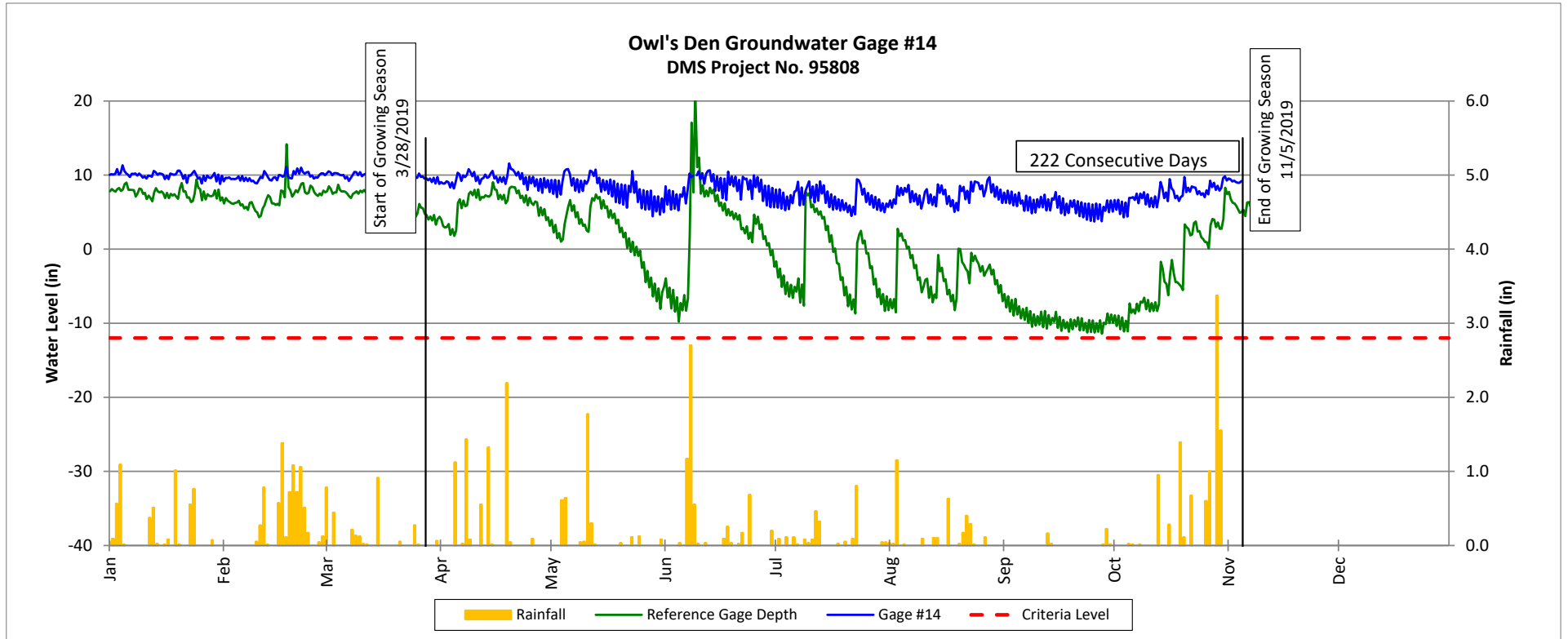
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Rehabilitation





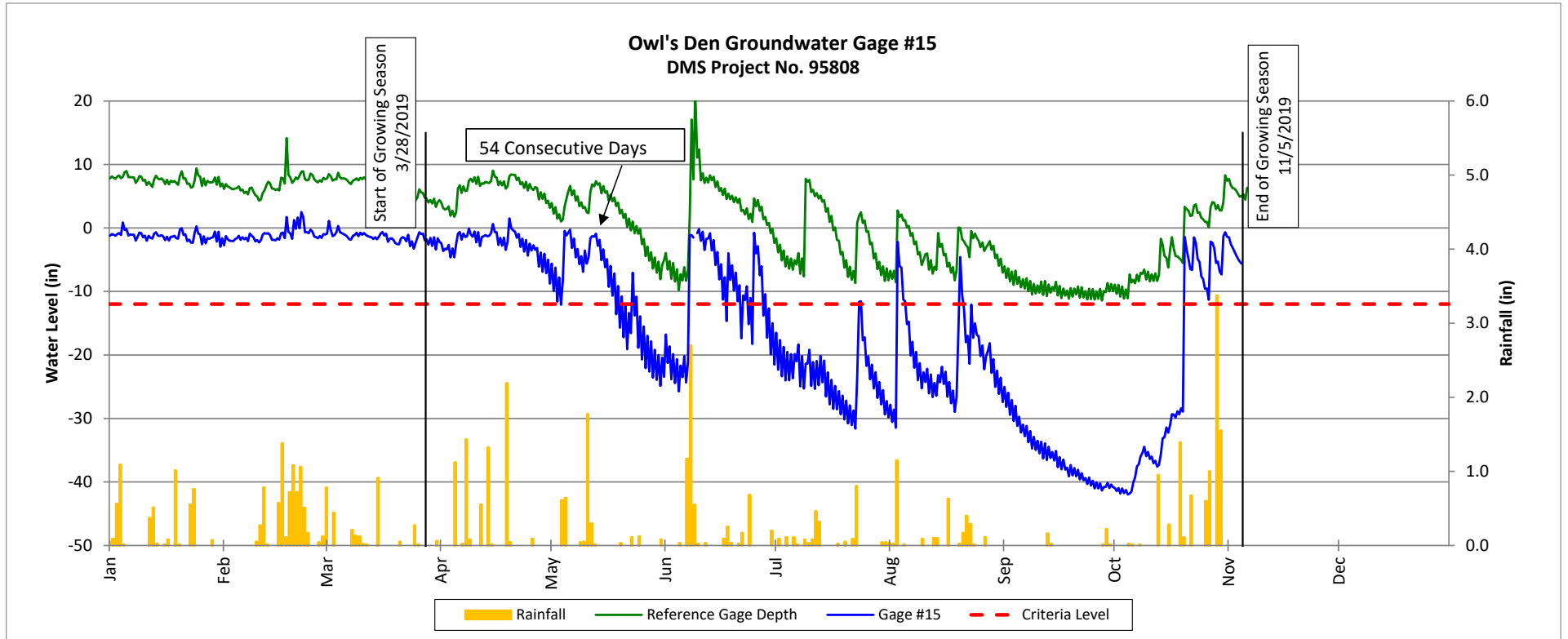
## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

Wetland Rehabilitation

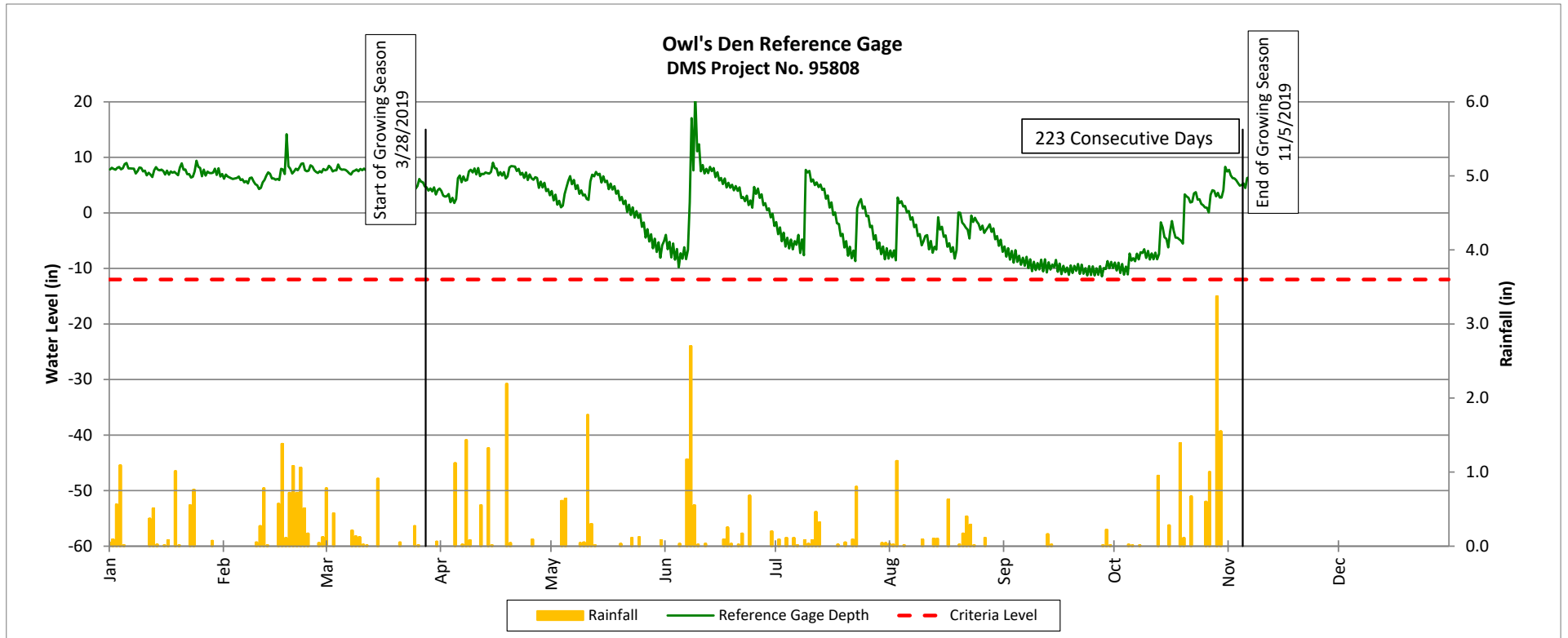


## Groundwater Gage Plots

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019

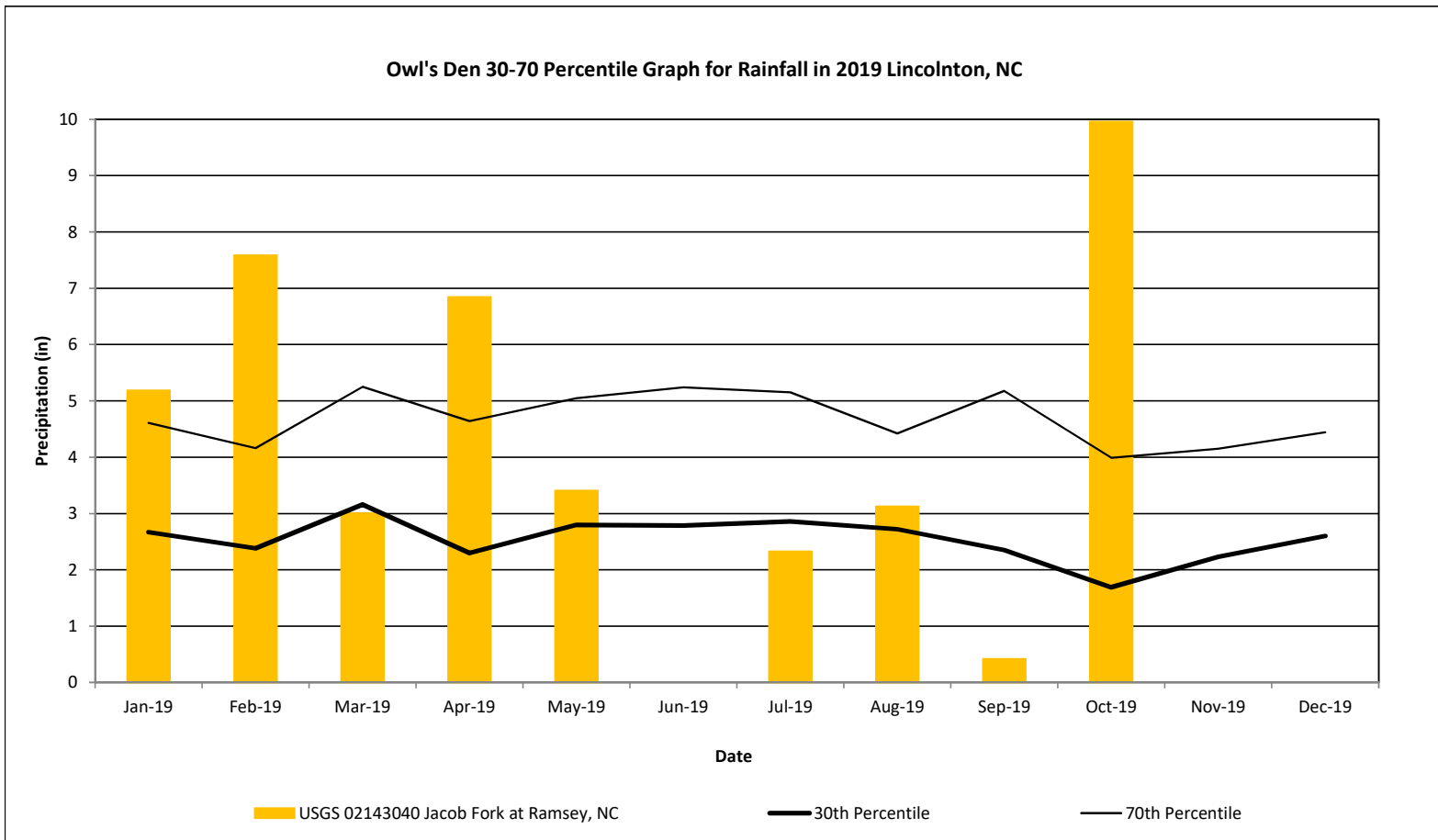


### Monthly Rainfall Plot

Owl's Den Mitigation Site

DMS Project No. 95808

Monitoring Year 4 - 2019



30th and 70th percentile rainfall data collected from weather station NC4996, in Lincolnton, NC (USDA, 2000).