

**Bowl Basin Restoration Site
Monitoring Report MY08
DMS Project # 95721
DMS Contract # 005012**

**Onslow County, NC
CU# 03020106
DWR# 2013-0864
SAW# 2013-00393**



Submitted to:

[NCDMS, 1652 Mail Service Center, Raleigh, NC 27699-1652](#)

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Monitoring and Design Firm



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MONITORING RESULTS

This report represents the eighth year of monitoring at the Bowl Basin Wetland Mitigation Site (BBWMS). The eighth year of monitoring was prompted by less than ideal hydrology success in previous monitoring years, especially since MY05 (2019). This was an exceptionally dry year and allowed loblolly pine trees to become established at the site. As the pines began to thrive, they had a negative effect on site hydrology. Pines were removed from the site in November 2021. Monitoring of the site was extended for an additional year to evaluate the effect of the removal of the pines on the hydrology and vegetation of the site.

VEGETATION MONITORING

The vegetation monitoring plots were not sampled in MY08. In MY07, all ten of the vegetation monitoring plots achieved the success criteria of greater than 210 planted stems/acre. Overall the site averaged 749 planted stems/acre and the average height of the planted stems was 11.0 feet after MY07. At the 2022 credit release meeting the IRT requested that KCI sample several transects in the area in which the pines were treated to characterize the vegetation in this area and to ensure that a healthy and diverse overstory was still present. KCI sampled two transects in the area that was treated for pines. These transects were 100 feet in length and were sampled using the point intercept method, with sampling points located at 5 foot intervals. Both transects had greater than 85% cover and at least 6 different species. Across both transects, 43 individual stems and 10 different species were recorded. The average height across both transects was 13.9 feet. Overall these transects showed a robust overstory in the areas of pine treatment.

HYDROLOGY MONITORING

During the site's first seven years of monitoring, 9 of the 10 gauges achieved the success criteria of 9% continuous saturation (22 days) during the growing season in at least 50% of the years that they were installed.

The daily rainfall data was obtained from a local weather station in Jacksonville, NC; provided by the NC State Climate Office. In 2022, the months of March, August, and September experienced average rainfall. January, February, April, May, June, October, and November experienced below average rainfall while only July recorded above average rainfall. Overall the site experienced below average rainfall in 2022. The Palmer Drought Severity Index (PDSI), as compiled by the USACE's Antecedent Precipitation Tool (APT) further backs up this analysis. According to the PDSI, the site spent 10% of the year in mild drought, 50% of the year in moderate drought, and 40% of the year in severe drought.

During the site's eighth growing season, 4 of the 10 gauges achieved the success criteria. The low rate of success that these gauges achieved is a result of the abnormally low rainfall that the site received in 2022 and does not reflect a "typical year".

SOIL MONITORING

Gauge 3 has only achieved the success criteria in 2 of the 8 years that it was installed. In 2020 Gauge 9 was installed approximately 170 feet northwest of Gauge 3, and Gauge 10 was installed approximately 130 feet southeast of Gauge 3, with the intention of better identifying the low performing hydrology area. These two gauges have met the success criteria in all three years since their installation. On December 1, 2022, KCI performed a detailed soil analysis of the area around Gauge 3 to further delineate the low performing hydrology area. This analysis identified the soils on site as having a thick, dark surface underlain by a lighter Bt horizon, consistent with the Pantego Series that was identified on-site during the initial phase of the project. In the area of low performing hydrology, this Bt horizon lacked redoximorphic features and was generally located at a deeper depth than in the wetter areas of the site. A11 – Depleted Below Dark Surface was the predominant hydric soil indicator used during this delineation. There were also some areas of A12 – Thick Dark Surface, but in general, areas with thick dark surfaces failed to meet the chroma or redox requirements for the underlying layer that this indicator requires. A representative description of both soil types is presented in Appendix A – Visual Assessment Data. After identifying the main difference

between the “wet” and “dry” soils, a detailed delineation of the extent of each was completed in the area around Gauge 3. Based on this analysis, 0.668 acres have been designated as low performing hydrology area. KCI is proposing to remove the credits from this area.

CONCLUSION

While the site hydrology has been below the success criteria in the area described, this restoration site brings significant wetland functions back to this system and this part of the river basin. The variable hydrology wetlands create a complex habitat with varied niches throughout the site in an area that is mainly dominated by agricultural land. While Gauge 3 only met the success criteria of 9% continuous saturation in 2 years, it achieved greater than 5% continuous saturation in 6 of the 8 years that it was installed and all of the other gauge have achieved greater than 9% continuous saturation in at least 50% of the time that they were installed. KCI proposes to close out the site and discontinue monitoring.

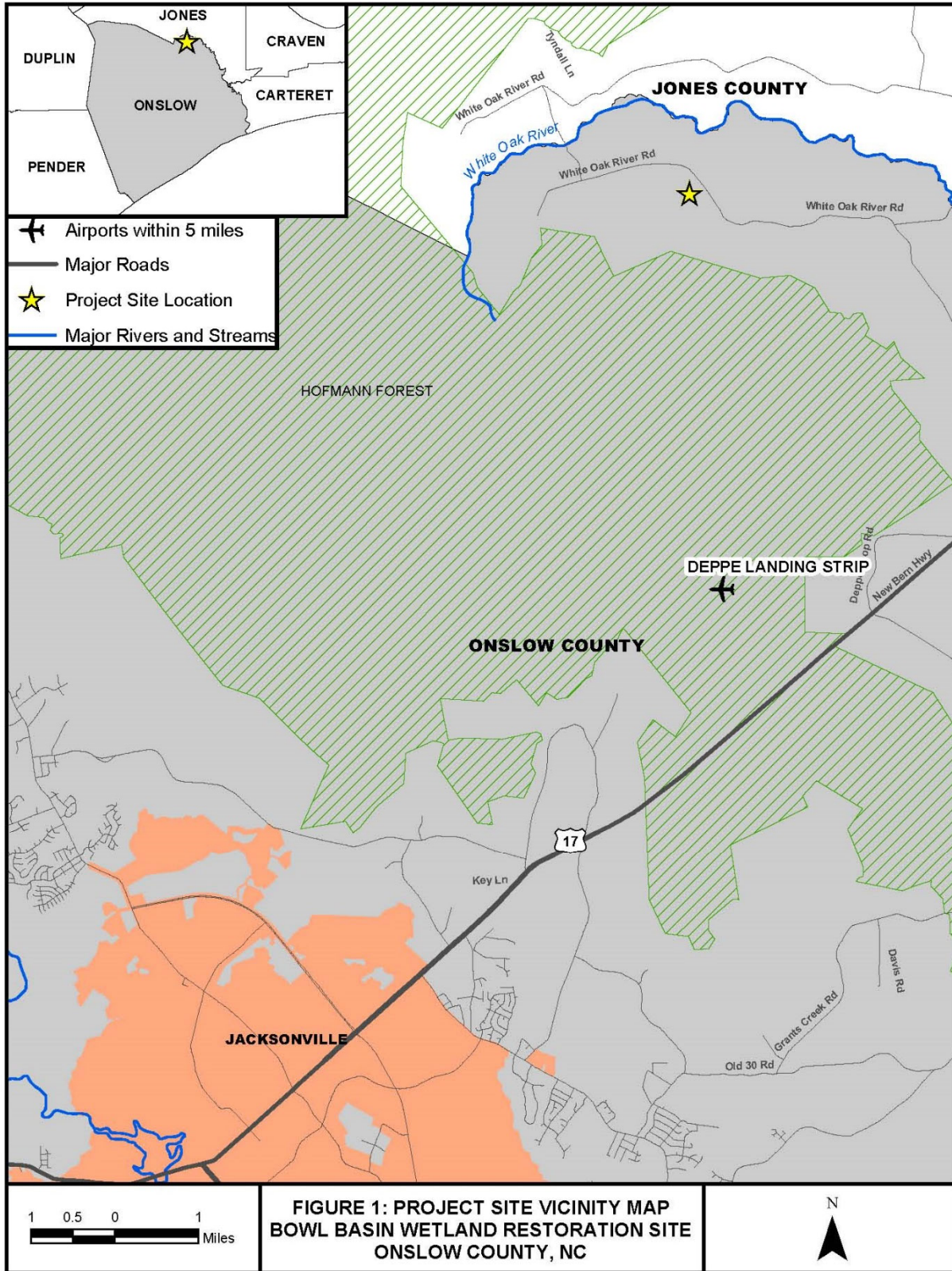


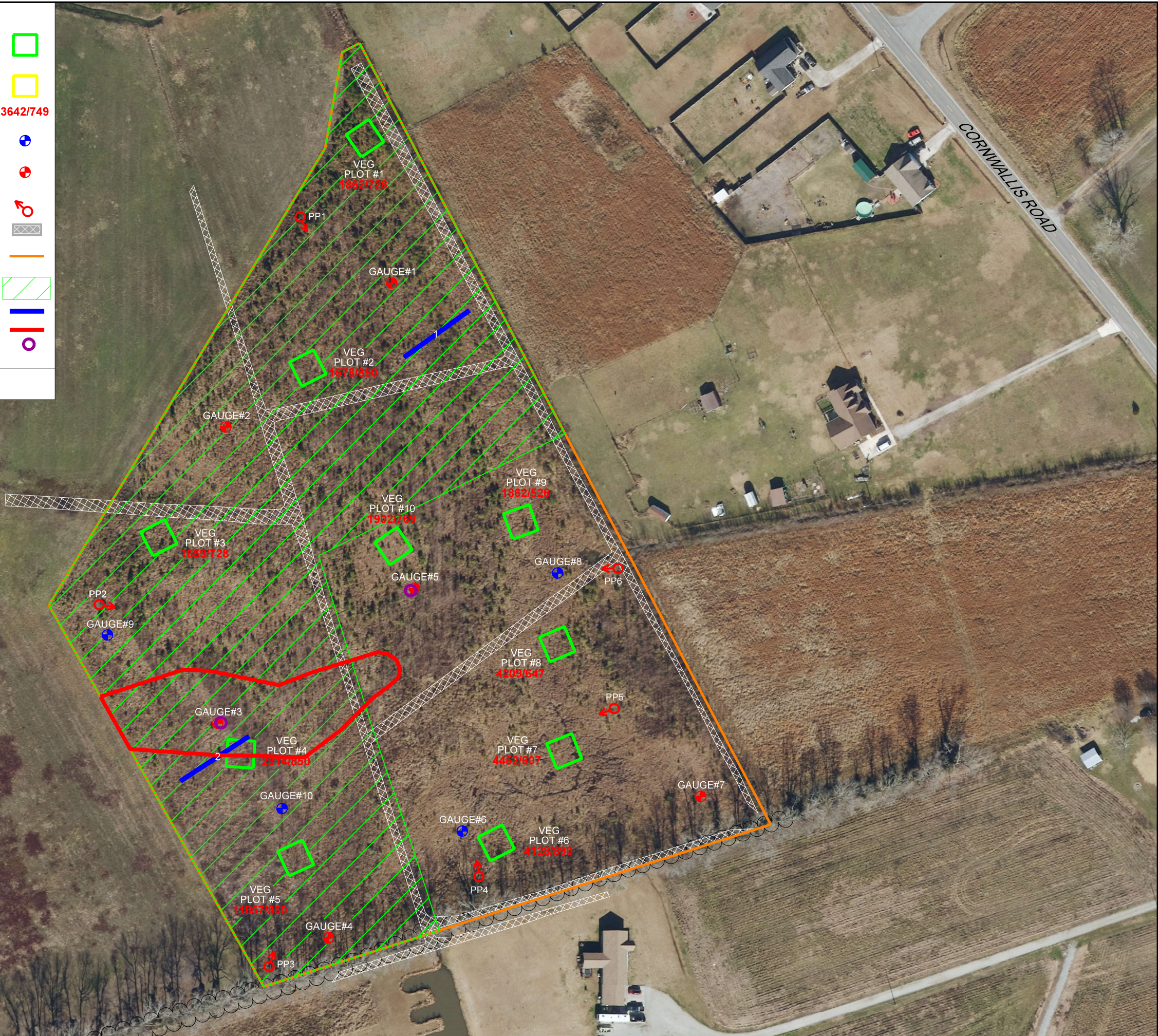
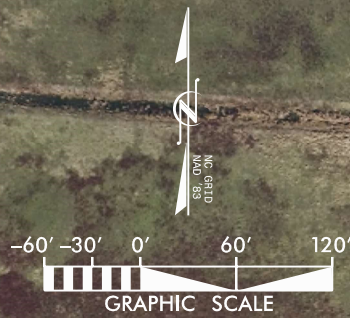
Table 1. Project Assets									
Project Number and Name: 95721 – Bowl Basin Restoration Site									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Acres	-	-	-	-	11.700	-	-	-	-
Credits	-	-	-	-	11.032	-	-	-	-
TOTAL CREDITS	-		-		11.032		-	-	-
Project Components									
Project Component -or- Reach ID	Stationing/ Location		Restoration Footage or Acreage		Approach (PI, PII etc.)		Restoration -or- Restoration Equivalent	Credits	Mitigation Ratio
Wetland Area	-		11.032 acres		-		Restoration	11.032	1:1
Low Performing Hydrology Area	-		0.668 acres		-		Restoration	N/A	N/A
Component Summation									
Restoration Level	Stream (linear feet)		Riparian Wetland (acres)		Non-riparian Wetland (acres)		Buffer (square feet)	Upland (acres)	
			Riverine	Non-Riverine					
Restoration	-		-	-	11.7 acres		-	-	
Enhancement			-	-	-		-	-	
Enhancement I	-								
Enhancement II	-								
Creation			-	-	-			-	
Preservation	-		-	-	-			-	
High Quality Preservation	-		-	-	-			-	
TOTAL	-		-	-	11.7 acres			-	

Appendix A

Visual Assessment Data

- LEGEND:**
- VEG PLOT ACHIEVING DENSITY CRITERION □
 - VEG PLOT BELOW DENSITY CRITERION □
 - *VEG PLOT TOTAL / PLANTED STEM DENSITY- 3642/749
 - WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION ●
 - WETLAND GAUGE BELOW HYDROLOGIC CRITERION ●
 - PHOTO POINT (PP) ♂
 - FILLED DITCHES
 - CONSERVATION EASEMENT = NONRIPARIAN WETLAND RESTORATION = 11.7 ACRES
 - PINE TREATMENT (2021)
 - VEGETATION TRANSECTS
 - LOW PERFORMING HYDROLOGY AREA
 - SOIL BORINGS ○

*VEG DATA FROM MY07 (2021)
 IMAGE SOURCE: NC 2020 ORTHOIMAGERY



SYL	DESCRIPTION	DATE

NCDEQ DIVISION OF
 MITIGATION SERVICES

KCI
 ASSOCIATES OF NC
 ENGINEERS • PLANNERS • SCIENTISTS
 4505 FALLS OF NEUSE ROAD
 RALEIGH, NORTH CAROLINA 27609

BOWL BASIN
 RESTORATION SITE
 DMS PROJECT #95721
 ONSLOW COUNTY, NORTH CAROLINA
 MONITORING YEAR 08

DATE: DEC 2022
 SCALE: GRAPHIC
 CURRENT
 CONDITION
 PLAN VIEW
 SHEET 1 OF 1
 FIGURE 3

Photo Reference Points



PP1 – MY-07 – 9/10/21



PP1 – MY-08 – 12/1/22



PP2 – MY-07 – 9/10/21



PP2 – MY-08 – 12/1/22



PP3 – MY-07 – 9/10/21



PP3 – MY-08 – 12/1/22



PP4 – MY-07 – 9/10/21



PP4 – MY-08 – 12/1/22



PP5 – MY-07 – 9/10/21



PP5 – MY-08 – 12/1/22



PP6 – MY-07 – 9/10/21



PP6 – MY-08 – 12/1/22



SOIL PROFILE DESCRIPTION

Client: KCI Associates of North Carolina, P.A. **Date:** December 1, 2022
Project: Bowl Basin **Project #:** 95721
County: Onslow **State:** NC
Location: Representative Dry Soil **Site/Lot:** GW-3
Soil Series: Rains fine sandy loam
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Typic Paleaquults
AWT: >30" **SHWT:** 0" **Slope:** 0-2% **Aspect:** Concave
Elevation: ~40' **Drainage:** Poorly drained **Permeability:** Moderate
Vegetation: Planted non-raiparian wetland vegetation

Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
A1	0-13	10YR 2/1				scL	1msbk	
A2	13-22	10YR 3/1				Ls	1msbk	
Btg	22-30+	10YR 5/1	10YR4/1	40	M	sc	3msbk	
			10YR 6/8	5	M			

COMMENTS:

DESCRIBED BY: Tommy Seelinger

DATE: 12/1/2022



SOIL PROFILE DESCRIPTION

Client: KCI Associates of North Carolina, P.A. **Date:** December 1, 2022
Project: Bowl Basin **Project #:** 95721
County: Onslow **State:** NC
Location: Representative Wet Soil **Site/Lot:** GW-5
Soil Series: Rains fine sandy loam
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Typic Paleaquults
AWT: >18" **SHWT:** 0" **Slope:** 0-2% **Aspect:** Concave
Elevation: ~40' **Drainage:** Poorly drained **Permeability:** Moderate
Vegetation: Planted non-raiparian wetland vegetation

Borings terminated at 18 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
A	0-10	10YR 3/1				sL	1msbk	
Btg1	10-14	10YR6/1	7.5YR4/6	2	PL	sc	3msbk	oxidized rhizospheres
			10YR 6/8	5	M			
Btg2	14-18+	10YR 6/1	10YR 6/8	20	M	sc	3msbk	

COMMENTS:

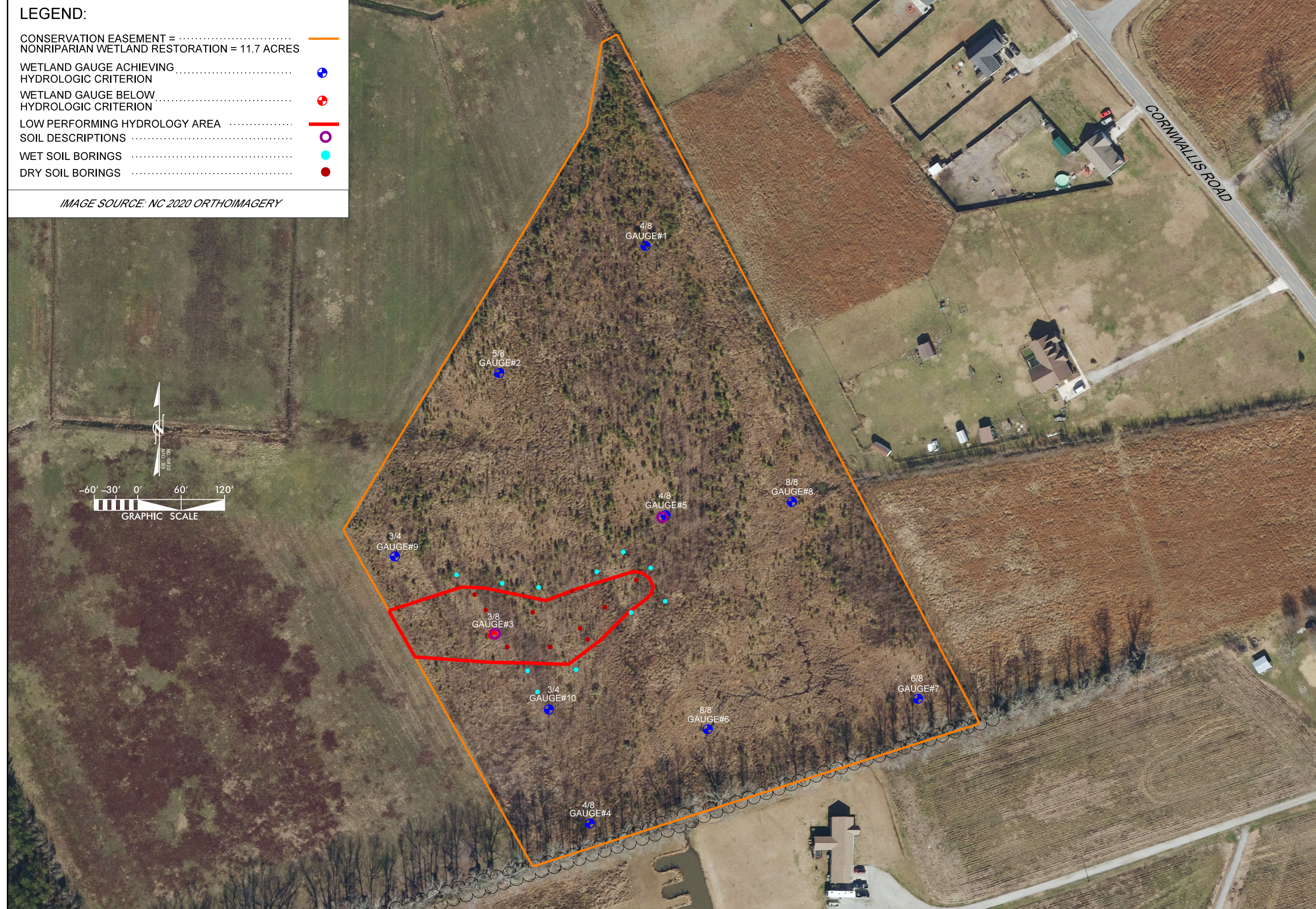
DESCRIBED BY: Tommy Seelinger

DATE: 12/1/2022

LEGEND:

- CONSERVATION EASEMENT =
- NONRIPARIAN WETLAND RESTORATION = 11.7 ACRES
- WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION ●
- WETLAND GAUGE BELOW HYDROLOGIC CRITERION ●
- LOW PERFORMING HYDROLOGY AREA
- SOIL DESCRIPTIONS
- WET SOIL BORINGS ●
- DRY SOIL BORINGS ●

IMAGE SOURCE: NC 2020 ORTHOIMAGERY



NO.	DATE	DESCRIPTION	REVISIONS

**NCDEQ DIVISION OF
MITIGATION SERVICES**

KCI
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4505 FALLS OF NEUSE ROAD
RALEIGH, NORTH CAROLINA 27609

**BOWL BASIN
RESTORATION SITE**
DMS PROJECT #95721
ONSLOW COUNTY, NORTH CAROLINA
MONITORING YEAR 08

DATE: DEC 2022
SCALE: GRAPHIC

**SOIL
BORINGS
MAP**

SHEET 1 OF 1
FIGURE 3

Appendix B

Vegetation Data

Table 2. CVS Stem Count Total and Planted by Plot and Species
DMS Project Code 95721. Project Name: Bowl Basin

Scientific Name	Common Name	Species Type	Annual Means																	
			MY7 (2021)			MY5 (2019)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2015)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	boxelder	Tree																		
<i>Acer rubrum</i>	red maple	Tree			8			5			2			2					1	
<i>Baccharis halimifolia</i>	eastern baccharis	Shrub			19			28			12			7						
<i>Betula nigra</i>	river birch	Tree	25	25	25	25	25	25	26	26	26	27	27	27	27	27	27	22	22	22
<i>Celtis occidentalis</i>	common hackberry	Tree												1						
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub	10	10	11	10	10	14	10	10	10	10	10	10	12	12	12	11	11	11
<i>Diospyros virginiana</i>	common persimmon	Tree			1			1			1			1						
<i>Fraxinus pennsylvanica</i>	green ash	Tree	55	55	57	56	56	57	55	55	56	57	57	57	55	55	59	51	51	51
<i>Juglans nigra</i>	black walnut	Tree			1			6			4			5			2			
<i>Liquidambar styraciflua</i>	sweetgum	Tree			554			578			437			417			280			
<i>Magnolia virginiana</i>	sweetbay	Tree	6	6	6	6	6	6	6	6	6	5	5	5	4	4	4	4	4	4
<i>Morella cerifera</i>	wax myrtle	shrub			7			4			3			2						
<i>Nyssa aquatica</i>	water tupelo	Tree	6	6	6	7	7	9	8	8	8	8	8	8	7	7	7	7	7	7
<i>Nyssa biflora</i>	swamp tupelo	Tree	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3
<i>Pinus taeda</i>	loblolly pine	Tree			93			152			100			25						
<i>Quercus lyrata</i>	overcup oak	Tree			1															
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	11	11	11	12	12	12	12	12	12	13	13	13	12	12	12	15	15	15
<i>Quercus nigra</i>	water oak	Tree						1												
<i>Quercus pagoda</i>	cherrybark oak	Tree	8	8	9	8	8	8	8	8	8	7	7	7	7	7	7	7	7	7
<i>Quercus phellos</i>	willow oak	Tree	11	11	11	11	11	11	12	12	12	11	11	11	9	9	11	9	9	9
<i>Quercus shumardii</i>	Shumard's oak	Tree										1	1	1	1	1	1	2	2	2
<i>Salix nigra</i>	black willow	Tree			22			22			8			3	1	1	2			
<i>Sambucus canadensis</i>	American elderberry	Shrub			5															
<i>Taxodium distichum</i>	bald cypress	Tree	49	49	49	49	49	49	49	49	49	47	47	48	48	48	48	45	45	45
Stem count			185	185	900	189	189	993	191	191	759	191	191	656	188	188	478	176	176	176
size (ares)			10			10			10			10			10			10		
size (ACRES)			0.25			0.25			0.25			0.25			0.25			0.25		
Species count			10	10	20	10	10	19	10	10	18	11	11	21	12	12	15	11	11	11
Stems per ACRE			749	749	3642	765	765	4019	773	773	3072	773	773	2655	761	761	1934	712	712	712

Site: Bowl Basin Date: 10/31/2022 Crew: TS

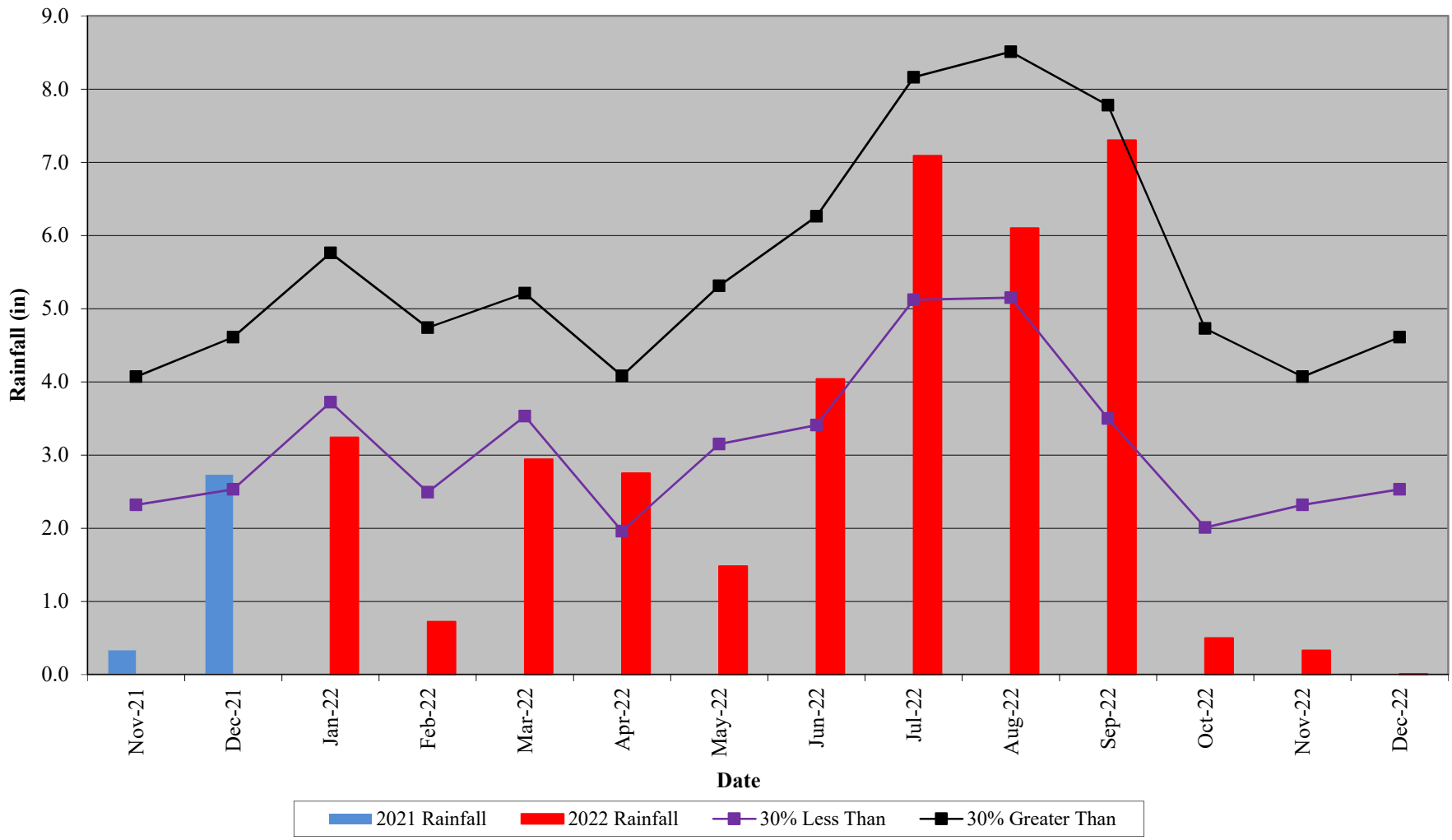
Transect Spacing:

	Point	Species	Height (ft)	Species	Height (ft)		
Transect # 1	5	Bachharis hamilifolia	9	Betula nigra	18		
	10	Betula nigra	20	Betula nigra	18		
	15	Betula nigra	15	Betula nigra	20		
	Start Cord.	20	Betula nigra	15			
		25	Bachharis hamilifolia	12			
		30	Bachharis hamilifolia	12			
	Heading	35	Liquidambar styraciflua	4			
		40	Taxodium distichum	7			
		45	Juglans nigra	7			
	Pt. Spacing	50	Quercus michauxii	9	Quercus michauxii	11	
		55	Liquidambar styraciflua	9			
	5'	60	Liquidambar styraciflua	7	Taxodium distichum	12	
		Notes	65	N/A			
			70	N/A			
		75	Bachharis hamilifolia	15			
		80	Bachharis hamilifolia	15	Quercus phellos	20	
		85	Quercus phellos	20			
		90	N/A				
		95	Liquidambar styraciflua	3	Taxodium distichum	25	
		100	Taxodium distichum	25			
Transect # 2		5	Liquidambar styraciflua	9	Quercus phellos	30	
	10	Liquidambar styraciflua	5	Quercus phellos	30		
	15	N/A					
	Start Cord.	20	Taxodium distichum	12	Fraxinus pennsylvanica	9	
		25	Liquidambar styraciflua	5			
		30	Liquidambar styraciflua	3	Fraxinus pennsylvanica	20, 25	
	Heading	35	Quercus phellos	40			
		40	Liquidambar styraciflua	5	Quercus phellos	40	
		45	Quercus phellos	40	Fraxinus pennsylvanica	25	
	Pt. Spacing	50	Liquidambar styraciflua	4	Fraxinus pennsylvanica	25	
		55	N/A				
	5'	60	Liquidambar styraciflua	3			
		Notes	65	Liquidambar styraciflua	4	Morella cerifera, Quercus pagoda	7, 4
			70	Liquidambar styraciflua	2	Fraxinus pennsylvanica	30
		75	Fraxinus pennsylvanica	25	Fraxinus pennsylvanica	30	
		80	Liquidambar styraciflua	4	Betula nigra, Fraxinus pennsylvanica	40, 15	
		85	Betula nigra	40	Quercus phellos	20	
		90	Betula nigra	40			
		95	Betula nigra	15	Betula nigra	35	
	100	Betula nigra	15				

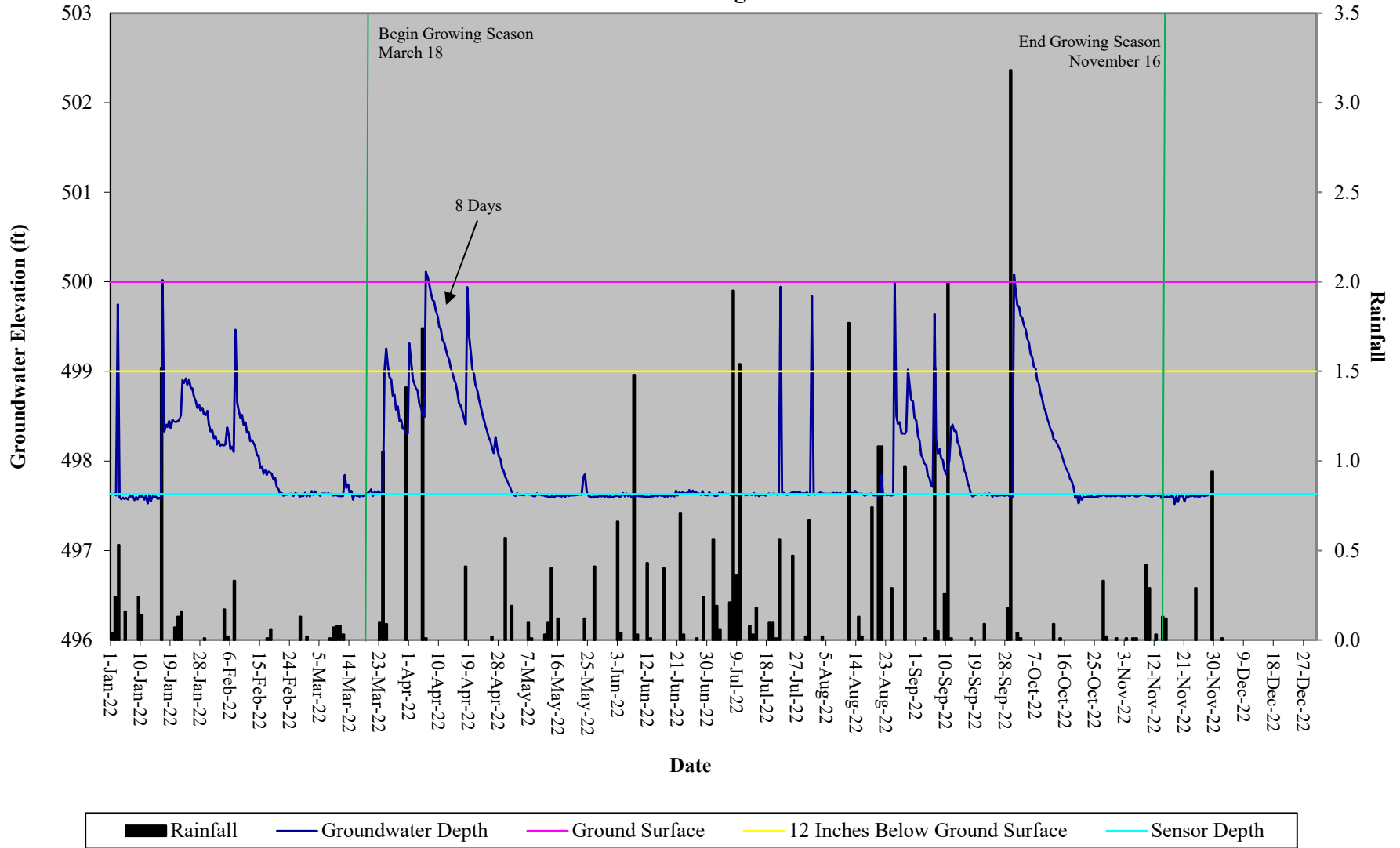
Appendix C

Hydrologic Data

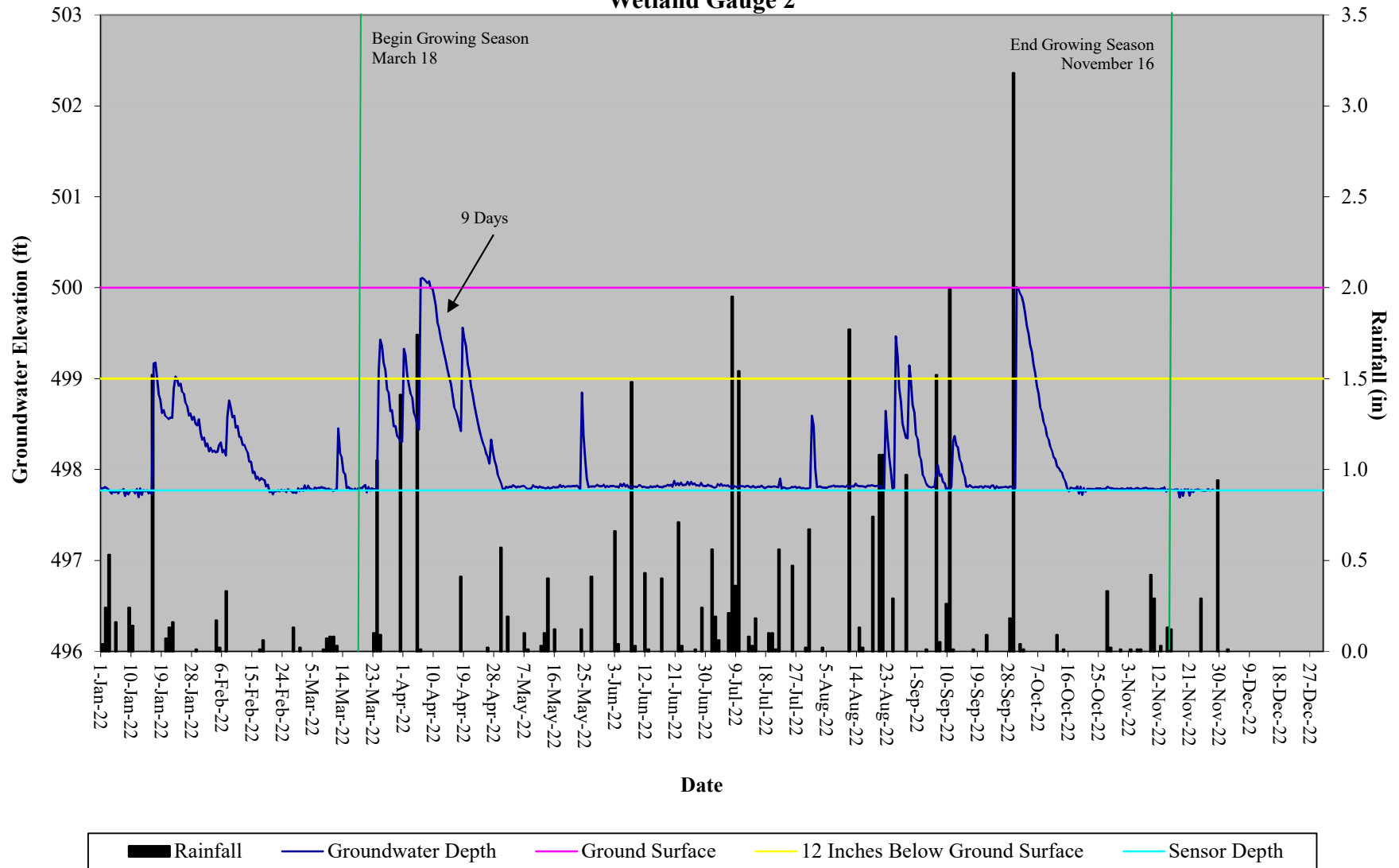
**Bowl Basin Wetland Restoration Site
30-70 Percentile Graph
WETS Station Name: NHOF, Hoffman Forest**



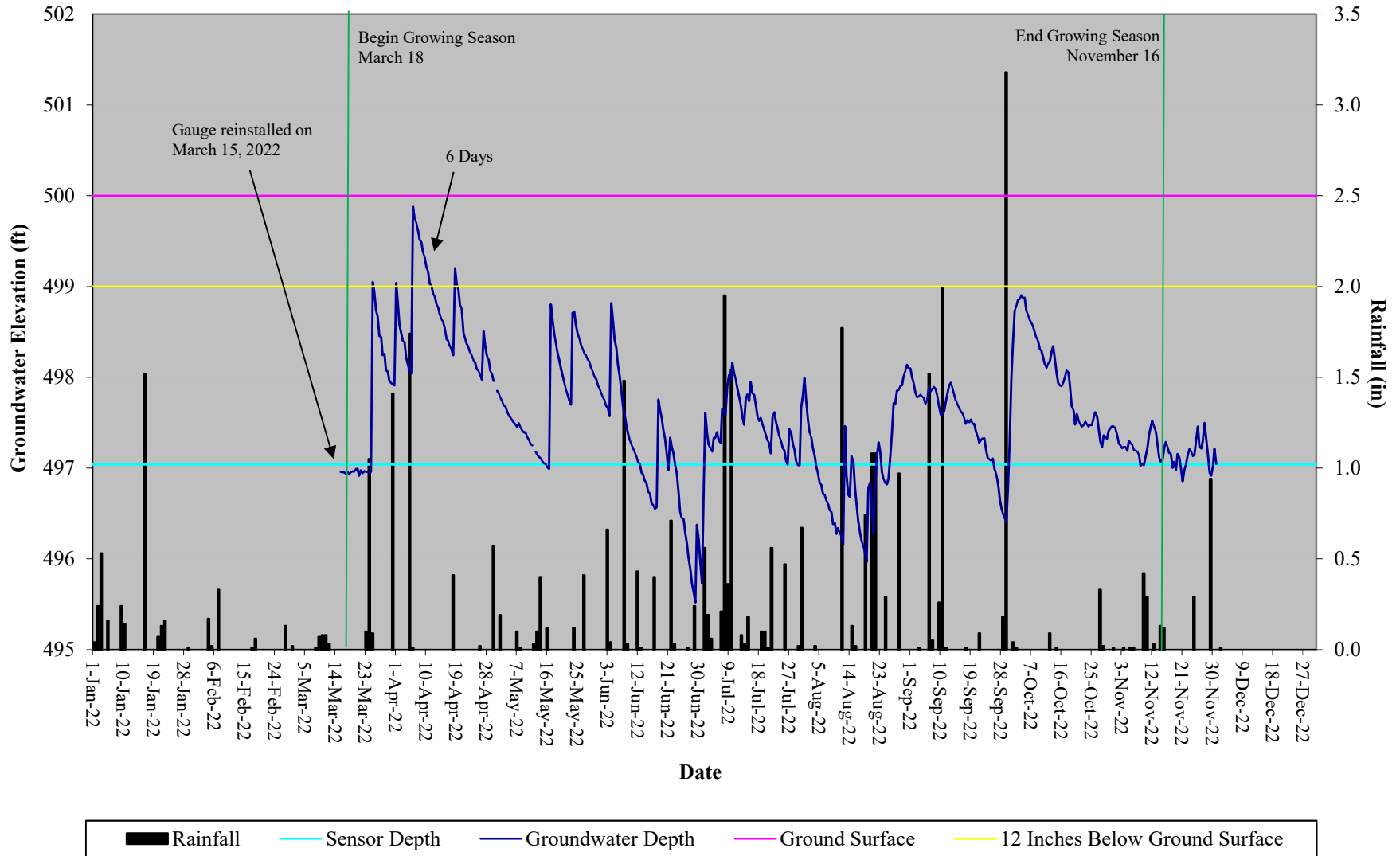
Bowl Basin Restoration Site Hydrograph Wetland Gauge 1



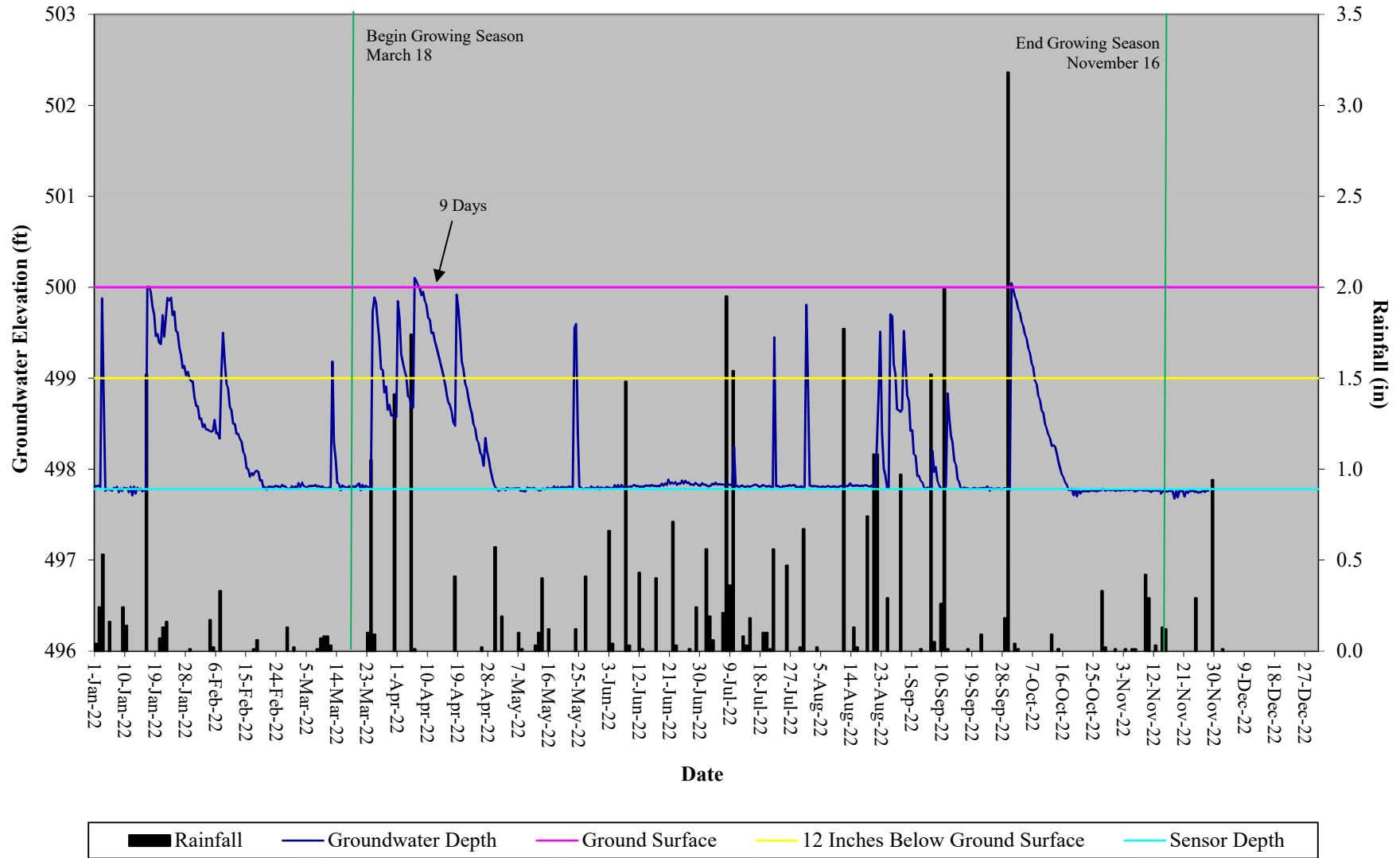
Bowl Basin Restoration Site Hydrograph Wetland Gauge 2



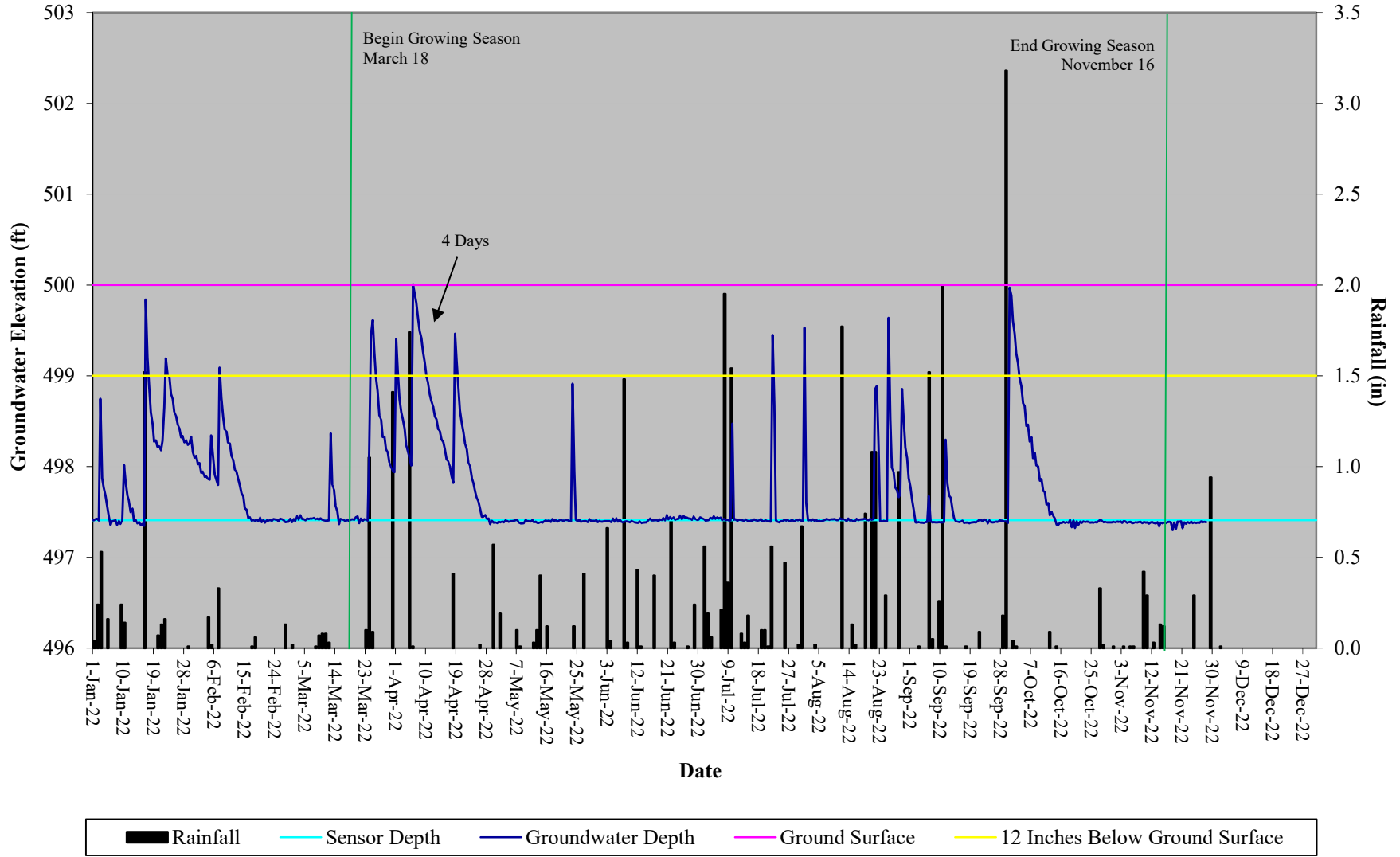
Bowl Basin Restoration Site Hydrograph Wetland Gauge 3



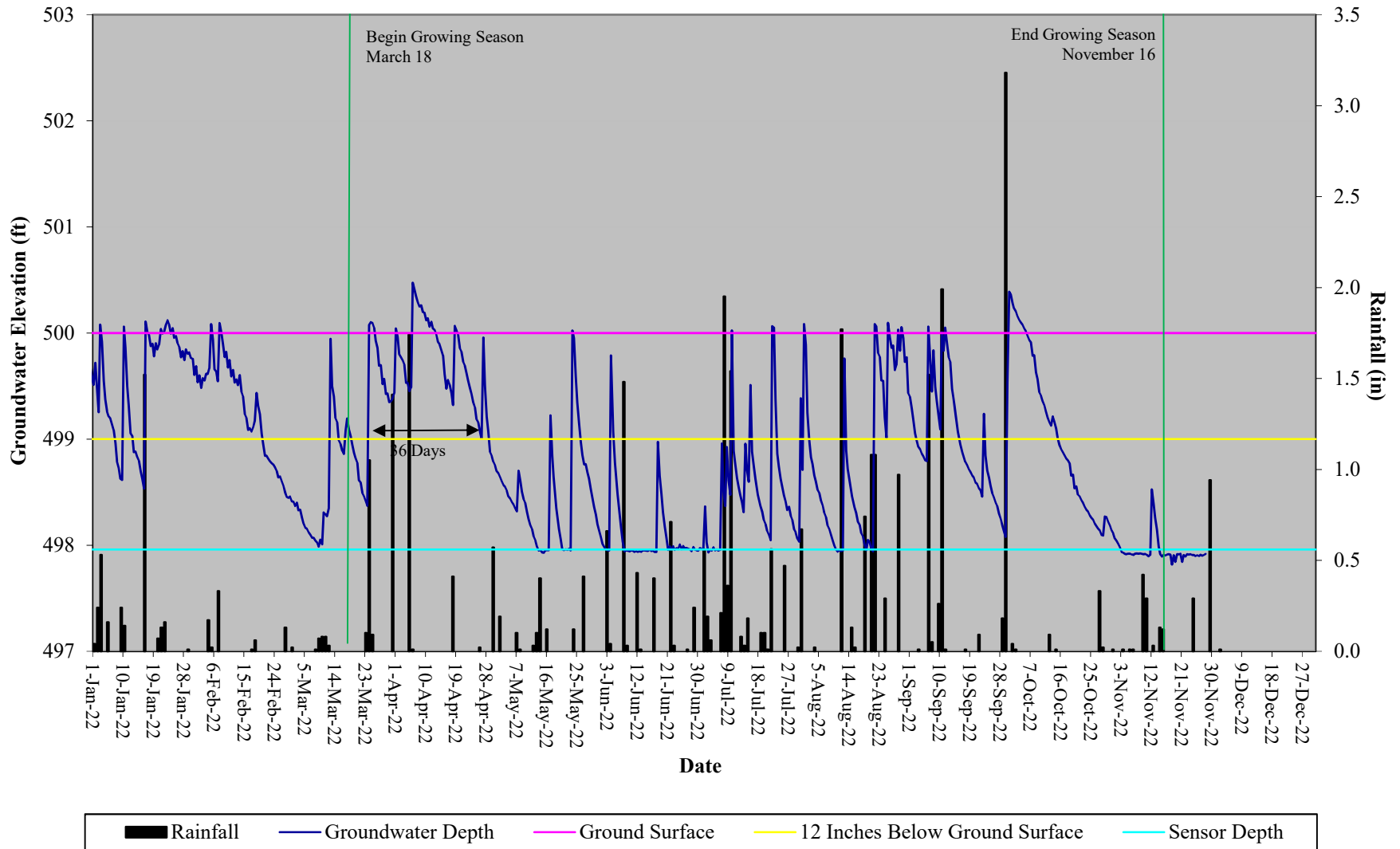
Bowl Basin Restoration Site Hydrograph Wetland Gauge 4



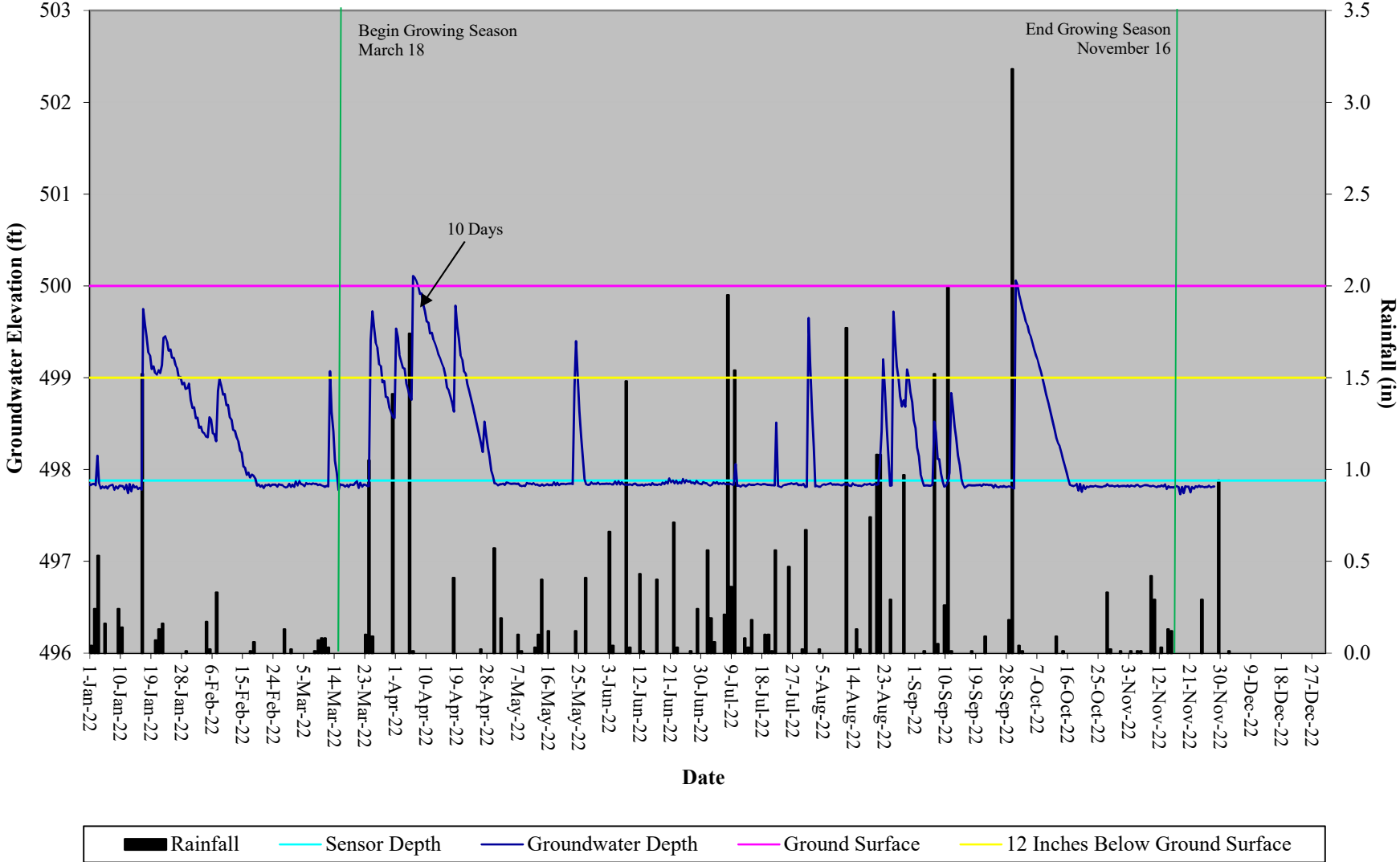
Bowl Basin Restoration Site Hydrograph Wetland Gauge 5



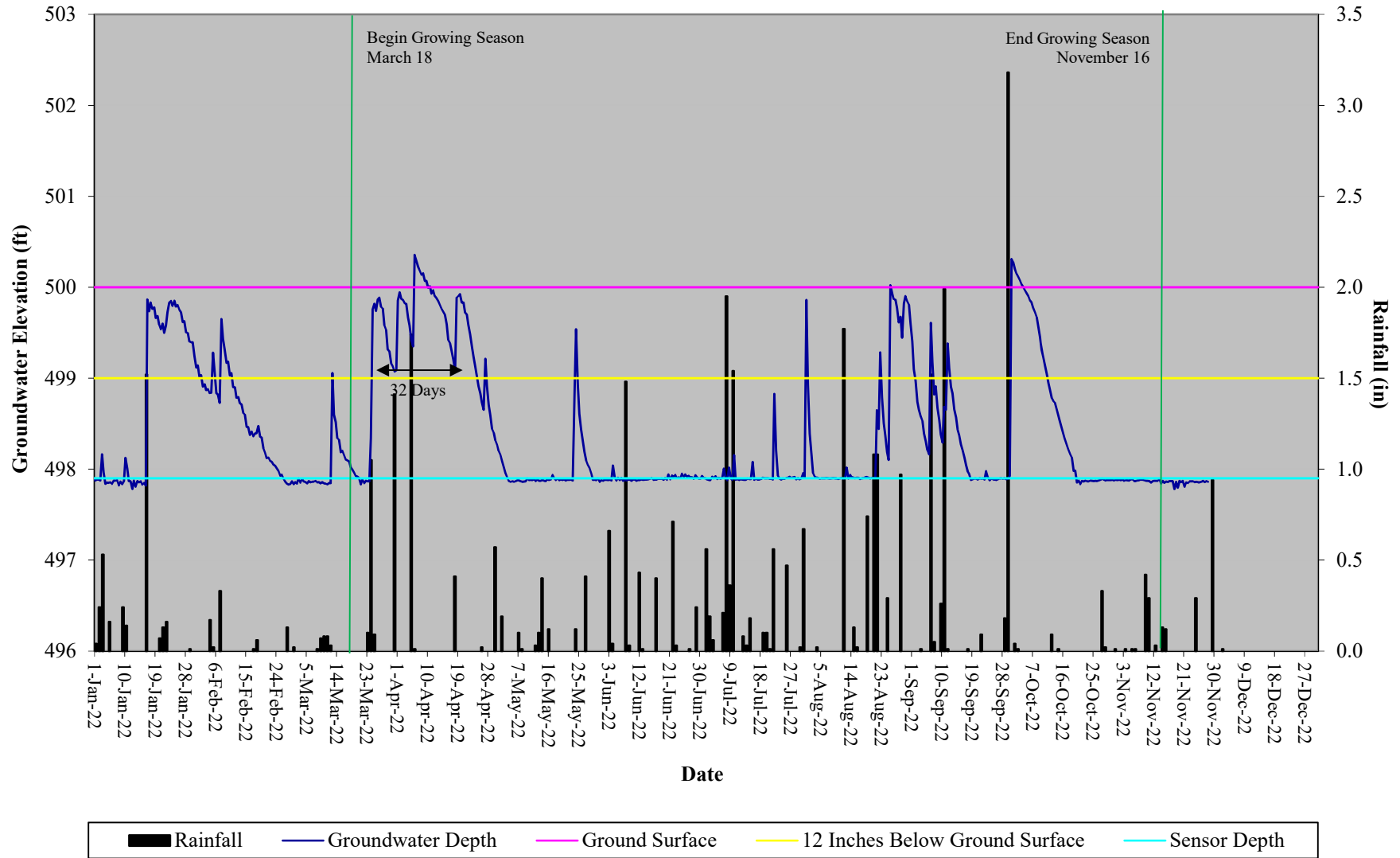
Bowl Basin Restoration Site Hydrograph Wetland Gauge 6



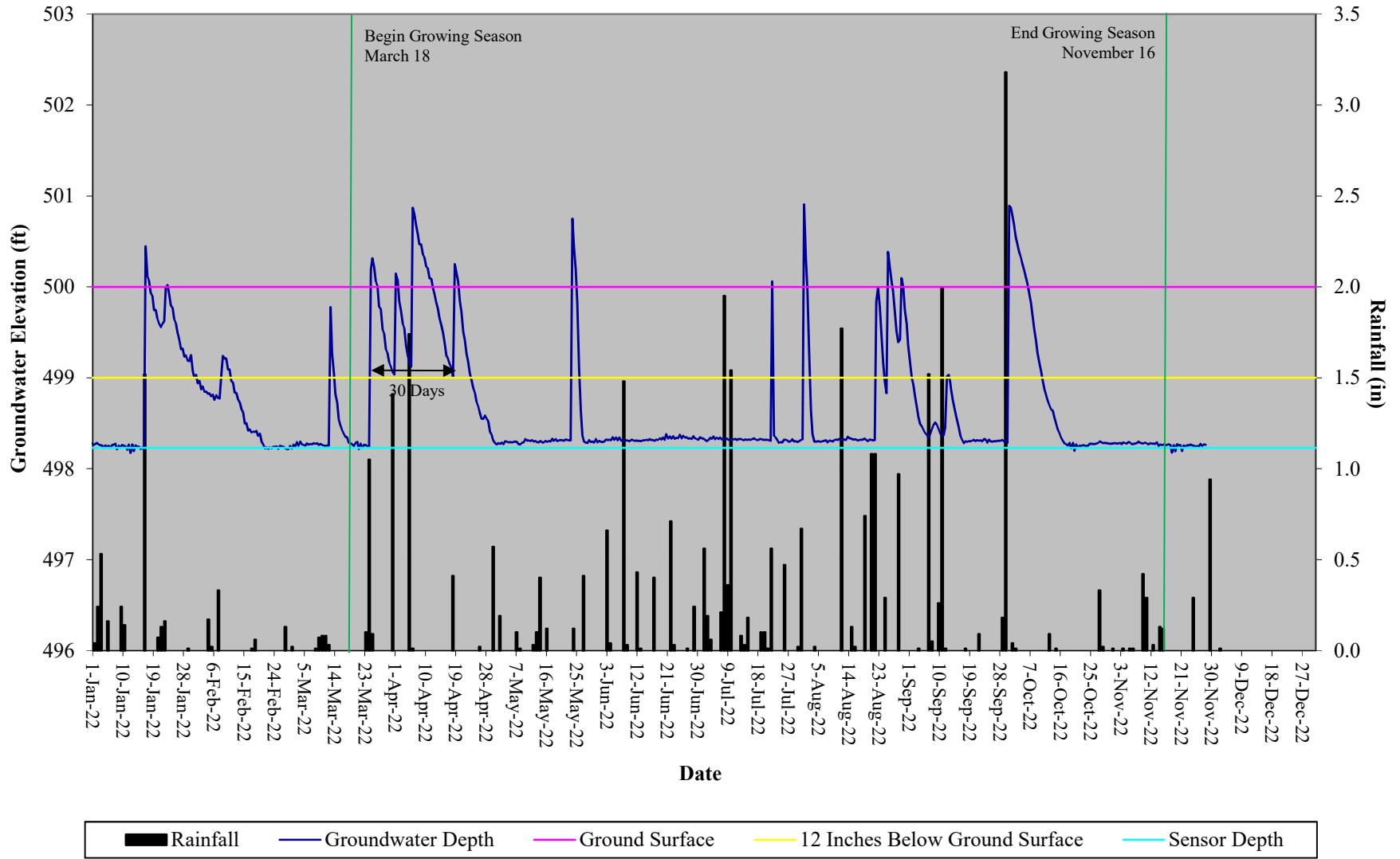
Bowl Basin Restoration Site Hydrograph Wetland Gauge 7



Bowl Basin Restoration Site Hydrograph Wetland Gauge 8



Bowl Basin Restoration Site Hydrograph Wetland Gauge 9



Bowl Basin Restoration Site Hydrograph Wetland Gauge 10

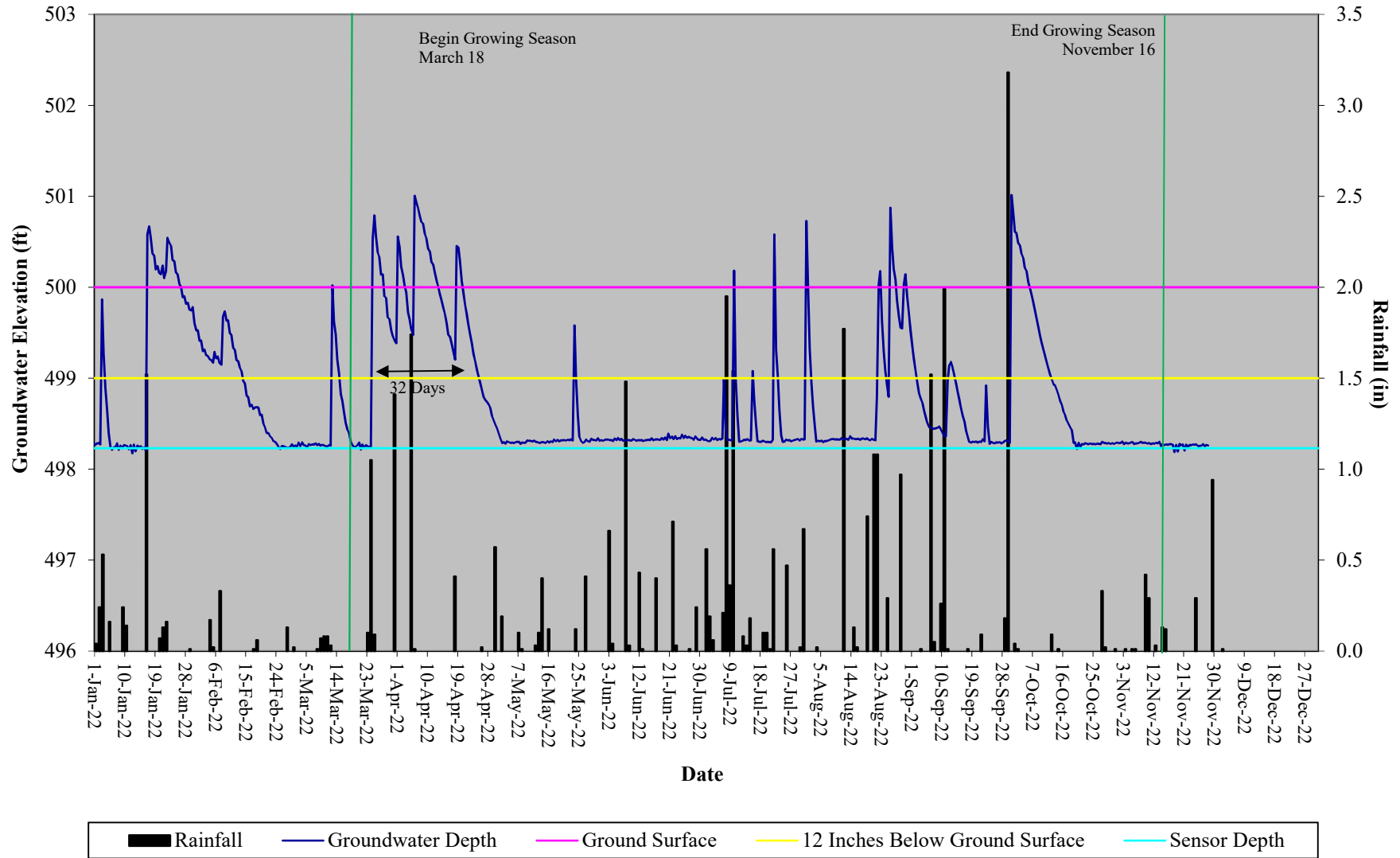


Table 3. Wetland Hydrology Criteria Attainment Table								
Project Number and Name: 95721 - Bowl Basin Restoration Site								
	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)							
Success Criteria (22 Days) (9%)	MY-01 2015	MY-02 2016	MY-03 2017	MY-04 2018	MY-05 2019	MY-06 2020	MY-07 2021	MY-08 2022
Rainfall Conditions	Normal	Normal	Drier than Normal	Normal	Drier than Normal	Normal	Normal	Drier than Normal
Gauge 1	Yes/37 (15.2%)	Yes/29 (11.9%)	Yes/24 (9.8%)	Yes/35 (14.3%)	No/12 (4.9%)	No/18 (7.4%)	No/11 (4.5%)	No/8 (3.3%)
Gauge 2	Yes/69 (28.3%)	Yes/49 (20.1%)	Yes/32 (13.1%)	Yes/37 (15.2%)	No/17 (7.0%)	Yes/22 (9.1%)	No/13 (5.3%)	No/9 (3.7%)
Gauge 3	No/20 (8.2%)	Yes/27 (11.1%)	No/13 (5.3%)	Yes/27 (11.1%)	No/13 (5.3%)	No/14 (5.8%)	No/4 (1.6%)	No/6 (2.5%)
Gauge 4	Yes/29 (11.9%)	Yes/41 (16.8%)	Yes/26 (10.7%)	Yes/32 (13.1%)	No/14 (5.7%)	No/18 (7.4%)	No/11 (4.5%)	No/13 (5.3%)
Gauge 5	Yes/24 (9.8%)	Yes/52 (21.3%)	Yes/50 (20.5%)	Yes/36 (14.8%)	No/12 (4.9%)	No/5 (2.1%)	No/8 (3.3%)	No/4 (1.6%)
Gauge 6	Yes/79 (32.4%)	Yes/60 (24.6%)	Yes/62 (25.4%)	Yes/58 (23.8%)	Yes/40 (16.4%)	Yes/41 (16.9%)	Yes/38 (15.6%)	Yes/36 (14.8%)
Gauge 7	Yes/25 (10.2%)	Yes/38 (15.6%)	No/12 (4.9%)	Yes/31 (12.7%)	Yes/22 (9.0%)	Yes/24 (9.9%)	Yes/27 (11.1%)	No/10 (4.1%)
Gauge 8	Yes/37 (15.2%)	Yes/51 (20.9%)	Yes/49 (20.1%)	Yes/40 (16.4%)	Yes/22 (9.0%)	Yes/61 (25.1%)	Yes/26 (10.7%)	Yes/32 (13.2%)
Gauge 9						Yes/61 (25.1%)	Yes/28 (11.5%)	Yes/30 (12.3%)
Gauge 10						Yes/61 (25.1%)	Yes/28 (11.5%)	Yes/32 (13.2%)