MONITORING YEAR 3 ANNUAL REPORT
Final

UNDERWOOD MITIGATION SITE
Chatham County, NC
NCDEQ Contract 003268
DMS Project Number 94641

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PREPARED FOR:

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EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) completed a full-delivery project for the North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS) to restore and enhance a total of 9,133 linear feet (LF) of stream and restore, enhance, and create 13.84 acres (ac) of wetlands in Chatham County, North Carolina. The project streams consist of South Fork Cane Creek (South Fork) and three unnamed tributaries (UTs) of the South Fork. The largest of these streams, South Fork, ultimately drains to the Haw River. At the downstream limits of the project, the drainage area is 3,362 acres (5.25 square miles). The Site provides 6,765 Stream Mitigation Units (SMUs) and 9.1 Wetland Mitigation Units (WMUs).

The Underwood Mitigation Site, hereafter referred to as the Site, consists of two separate areas (Harris Site and Lindley Site) located in western Chatham County north of Siler City, North Carolina. The Harris Site is located within the upstream area of the project watershed along Clyde Underwood Road, just west of Plainfield Church Road. The Lindley Site is located downstream from the Harris Site, southwest of Moon Lindley Road between Johnny Lindley Road and Bob Clark Road (Figure 1). The Site is located within the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). It is within the North Carolina Division of Water Resources (NCDWR) subbasin 03-06-04 of the Cape Fear River Basin and the United States Geological Survey (USGS) Hydrologic Unit 03030002050050. Approximately 60% of the land in the project watershed is forested, 39% is classified as managed herbaceous cover or agricultural, and the remaining 1% is split between unmanaged herbaceous and open water (MRLC, 2001).

Prior to construction activities, the streams and wetlands on the Harris Site were impacted by cattle grazing, which led to stream bank erosion and instability. The Lindley Site was used for row crop agriculture and the streams were straightened and deepened and much of the riparian vegetation was removed. Related degradation includes declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, and water quality problems related to increased sediment and nutrient loadings. The design features of this project were developed to achieve multiple project objectives. The stream restoration elements were designed to frequently flood the reconnected floodplain and adjacent riparian wetlands. This design approach provides more frequent dissipation of energy from higher flows (bankfull and above) to improve channel stability; provide water quality treatment through detention, settling, and biological removal of pollutants; and restore a more natural hydrologic regime. These objectives were achieved by restoring and enhancing 9,133 linear feet (LF) of perennial and intermittent stream channel, and restoring, enhancing, and creating 13.84 acres of riparian and non-riparian wetlands. The Stream Site and Wetland Site riparian areas were also planted to stabilize streambanks, improve habitat, and protect water quality. Figure 2 and Table 1 present design applications for the Site.

The following project goals were established to address the effects listed above from watershed and project site stressors:

- Restore and stabilize stream dimensions, pattern, and profile;
- Establish proper substrate distribution throughout restored and enhanced streams;
- Improve aquatic and riparian habitat;
- Reduce nutrient loads within the watershed and to downstream waters;
- Further improve water quality within the watershed through reductions of sediment, bacteria, and other pollutants;
- Decrease water temperature and increase dissolved oxygen concentrations;
- Establish appropriate hydrology for wetland areas;
- Restore native vegetation to wetlands and riparian buffers/improve existing buffers; and

- Create appropriate terrestrial habitat.

Stream and wetland restoration, enhancement, and creation construction efforts were completed in November 2012. A conservation easement is in place on 37.8 acres of riparian corridor and wetland resources to protect them in perpetuity.

Monitoring Year 3 (MY3) monitoring and site visits were completed between June and October 2015 to assess the conditions of the project. Overall, the Site has met the required hydrologic, vegetation, and stream success criteria for MY3. The overall average planted stem density of 459 stems/ acre is greater than the 320 stem/ acre density required for MY3. With the exception of an isolated enhancement reach, all restored and enhanced streams are stable and functioning as designed. The majority of the Site has met the Monitoring Year 5 (MY5) hydrology success criteria. All groundwater wells have met MY3 success criteria.

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APPENDICES

Section 1: PROJECT OVERVIEW

The Underwood Mitigation Site, hereafter referred to as the Site, consists of two separate areas (Harris Site and Lindley Site) located in western Chatham County within the Cape Fear River Basin (USGS Hydrologic Unit 03030002) north of Siler City, North Carolina. The Harris Site is located within the upstream area of the project watershed along Clyde Underwood Road, just west of Plainfield Church Road. The Lindley Site is located downstream from the Harris Site, southwest of Moon Lindley Road between Johnny Lindley Road and Bob Clark Road. The Site is located within the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The project watersheds consist of forested, managed herbaceous, unmanaged herbaceous, and open water areas (MRLC, 2001). The drainage areas for the Harris Site and Lindley Site are 1,051 acres (1.64 square miles) and 3,362 acres (5.25 square miles) respectively. The Site provides 6,765 Stream Mitigation Units (SMUs) and 9.1 Wetland Mitigation Units (WMUs).

The project stream reaches consist of SF1, SF3, SF4, SF4A, UT1, and UT2 (stream restoration and/or enhancement level I approach) and SF2, SF3, UT1, UT1A, and UT1B (enhancement level II approach). Mitigation work within the Site included restoring and enhancing 9,133 linear feet (LF) of perennial and intermittent stream channel and restoring, enhancing, and creating 13.84 acres of riparian and non-riparian wetland. The stream and wetland areas were also planted with native vegetation to improve habitat and protect water quality. Four separate conservation easements have been recorded and are in place along the riparian corridors and stream resources to protect them in perpetuity; 7.68 acres (Deed Book 1578, Page 495) within the tract owned by Mary Jean Harris, 18.44 acres (Deed Book 1578, Page 507) within the tract owned by William Darrel Harris, 5.34 acres (Deed Book 1579, Page 1067) within the tract owned by James Randall Lindley, and 6.29 acres (Deed Book 716, Page 707) within the tract owned by Jonathan Marshall Lindley. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figures 2a, 2b and 2c.

1.1 Project Goals and Objectives

Prior to construction activities, the streams and wetlands on the Harris Site were impacted by cattle grazing, which led to stream bank erosion and instability. The Lindley Site was used for row crop agriculture and the streams were straightened and deepened and much of the riparian vegetation was removed. Related degradation included declining aquatic habitat, degraded riparian buffers, loss of wetlands, and water quality problems related to increased sediment and nutrient loadings. Table 4 in Appendix 1 and Tables 10a, 10b, and 10c in Appendix 4 present the pre-restoration conditions in detail.

The Site was designed to meet the over-arching goals as described in the Mitigation Plan (Wildlands, 2011) to address the effects from watershed and project site stressors. The project addresses multiple watershed stressors that have been documented for both the Cane Creek and Jordan Lake watersheds. While many of these benefits are limited to the Underwood Site project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. The following project specific goals established in the mitigation plan include:

- Restore and stabilize stream dimensions, pattern, and profile;
- Establish proper substrate distribution throughout restored and enhanced streams;
- Improve aquatic and riparian habitat;
- Reduce nutrient loads within the watershed and to downstream waters;
- Further improve water quality within the watershed through reductions of sediment, bacteria, and other pollutants;

- Decrease water temperature and increase dissolved oxygen concentrations;
- Establish appropriate hydrology for wetland areas;
- Restore native vegetation to wetlands and riparian buffers/improve existing buffers; and
- Create appropriate terrestrial habitat.

The project goals were addressed through the following project objectives:

- Construct stream channels that will remain relatively stable over time and adequately transport their sediment loads without significant erosion or aggradation;
- Construct stream channels that maintain riffles with coarse bed material and pools with finer bed material;
- Provide aquatic and benthic habitat diversity in the form of pools, riffles, woody debris, and in-stream structures;
- Add riffle features and structures and riparian vegetation to decrease water temperatures and increase dissolved oxygen to improve water quality;
- Construct stream reaches so that floodplains and wetlands are frequently flooded to provide energy dissipation, detain and treat flood flows, and create a more natural hydrologic regime;
- Install fencing to keep livestock out of the streams;
- Raise local groundwater table through raising stream beds and removing agricultural drainage features;
- Grade wetland creation areas as necessary to promote wetland hydrology; and
- Plant native tree species to establish appropriate wetland and floodplain communities and retain existing, native trees where possible.

The project streams and wetlands were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration to existing watershed conditions and trajectory. The mitigation project corrected incision and lack of pattern caused by channelization, bank instability caused by erosion and livestock access, lack of vegetation in riparian zones, lack of riparian and aquatic habitat, and depletion of hydrology for adjacent wetlands. The final Mitigation Plan was submitted and accepted by the North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS) in September of 2011. Construction activities were completed by Land Mechanics Designs, Inc. in November 2012. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in January 2013. Baseline monitoring (MY0) was conducted between December 2012 and February of 2013. Annual monitoring will be conducted for five years with the close-out anticipated to commence in 2018 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring and quarterly site visits were conducted during Monitoring Year 3 (MY3) to assess the condition of the project. The stream and wetland mitigation success criteria for the Site follow the approved success criteria presented in the Underwood Mitigation Plan (Wildlands, 2011).

1.2.1 Vegetative Assessment

A total of 42 (29 at the Harris Site; 13 at the Lindley Site) vegetation plots were established within the project easement areas using standard 10 meter by 10 meter plots. The final vegetative success criteria will be the survival of 260 planted stems per acre at the end of MY5. The interim measurement of

vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of MY3.

The MY3 vegetative survey was completed in June 2015. The 2015 annual vegetation monitoring resulted in an average stem density of 459 stems per acre, which is greater than the interim requirement of 320 stems per acre and approximately 35% less than the baseline density of 712 stems per acre. There was an average of 12 stems per plot compared to 19 stems per plot during MY0. While the Site as a whole is on track to meet the interim requirement, seven plots are not meeting the success criteria. However, when volunteers are included in the total stem counts, only one plot is not meeting the interim success criteria. This plot will be closely monitored during subsequent monitoring years. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

During MY3 a few isolated areas were observed to have low tree densities. These areas are shown on the CCPV maps (Figures 3.0-3.3). These areas will be supplemented with additional trees during the beginning of MY4. Some of these areas were graded down several feet during construction and are believed to have poor soil conditions due to the removal of the nutrient rich top soil. Soil samples will be taken in these graded areas and appropriate actions, such as lime or fertilizer application, will be taken to help improve soil growing conditions. Also, most of these areas have limited herbaceous cover growing on them. A native grass seed mix will be applied to these areas to create a well-established herbaceous ground cover.

1.2.3 Stream Assessment

Morphological surveys for MY3 were conducted in April 2015. With the exception of SF4A, all streams within the Site are stable with little to no erosion and have met the success criteria for MY3. Refer to Appendix 2 for the visual assessment table, the Integrated Current Condition Plan View, and reference photographs. Refer to Appendix 4 for the morphological data and plots.

In general cross sections show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Surveyed riffle cross sections fell within the parameters defined for channels of the appropriate Rosgen stream type. The surveyed longitudinal profile data for SF1, UT2, SF3, UT1, and SF4 illustrates that the bedform features are maintaining lateral and vertical stability. The riffles are remaining steeper and shallower than the pools, while the pools are remaining deeper than the riffles and maintaining flat water surface slopes. The longitudinal profiles show that the bank height ratios remain very near to 1.0 for the restoration reaches.

Degradation was documented in the enhancement section on SF4A (approximate STA 900+00-905+33) between MY0 and MY1. This section of the stream has down cut in several locations. The adjustments in SF4A's profile were not intended in the design, but the stream has not down cut to a lower elevation since MY1. The profiles show that SF4A bed has had little change in bed elevation since MY1. During MY3 the decision was made to repair SF4A at the beginning MY4. Details regarding the repair work are discussed below in section 1.2.7.

Pattern data will be collected in MY5 only if there are indicators from the profile or dimensions that significant geomorphic adjustments have occurred. No changes were observed during MY3 that indicated a change in the radius of curvature or channel belt width.

1.2.4 Stream Areas of Concern

During MY3 beaver activity was observed along SF4 and on the downstream section of SF4A. Live stakes along the banks of SF4 and SF4A, mainly black willow, were gnawed down by beaver. These live stake are expected to grow back during MY4, therefore no supplemental planting of live stakes is expected during MY4. Two beaver dams were removed from the Lindley Site, one on the middle section of SF4 and the other from the lower section of SF4A. These beaver dams backed water up onto the floodplain and caused vegetation to die in a few small areas. These areas will be seeded with a native grass mix to provide herbaceous cover during MY4. Also, the USDA was contacted to trap the beaver on the Site and is expected to remove most the beaver. Wildlands will make frequent site visits to make sure beaver activity isn't a problem in the future. During a site walk in December another beaver dam was discovered on the lower section of SF3. The USDA has been contacted to remove the beaver and their dam on this section of stream. This dam does not seem to have caused damage to the floodplain, but it will be evaluated once the beaver dam is removed.

SF4A will have repair work performed at the beginning of MY4. Details regarding the repair work are discussed below in section 1.2.7.

1.2.5 Hydrology Assessment

At the end of MY5, two or more bankfull events must have occurred in separate years within the restoration reaches. During MY3, Bankfull events were recorded on all the streams except for UT2 by crest gages and onsite observations (wrack lines). All streams on the Site have had bankfull events in multiple monitoring years, except for UT2. UT2 is the only stream on the Site that hasn't met the final success criteria for hydrology. Refer to Appendix 5 for hydrologic data and bankfull verification photographs.

1.2.6 Wetland Assessment

Fifteen groundwater monitoring gages were established within the wetland restoration, creation, and enhancement zones. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the Site. A barrotroll logger (to measure barometric pressure used in the calculations of groundwater levels with well transducer data) and a rain gage were also installed within the wetland areas on both the Harris and Lindley Sites. To provide data for the determination of the growing season for the wetland areas, two soil temperature probes were installed, one on each site. These probes are used to better define the beginning of the growing season using the threshold soil temperature of 41 degrees or higher measured at a depth of 12 inches (USACE, 2010). During MY1, and MY2 NRCS WETS Data was used to determine the growing season. After discussions with the United States Army Corps of Engineers (USACE), it was agreed to use on-site soil temperature data to determine the beginning of the growing season and use NRCS WETS data to determine the end of the growing season. During MY3, the beginning of the growing season was extended by 24 days based on data from the soil temperature probes. All monitoring gages were downloaded on a quarterly basis and maintained on an as needed basis. The success criteria for wetland hydrology for this project is to have a free groundwater surface within 12 inches of the ground surface for 7.5 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. All groundwater gages met the annual wetland hydrology success criteria for MY3. Refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

The USACE requested to have the pre-construction groundwater gage data overlain with the current monitoring year gage data to illustrate the hydrologic response of the wetlands associated with rainfall events. Wildlands overlaid the pre-construction groundwater well data with the closest monitoring

groundwater well data and rain data for the monitoring period. Refer to Appendix 5 for pre and post construction groundwater gage comparison plots.

1.2.7 Maintenance Plan

During MY1 SF4A incised up to two feet in areas. During MY2 and MY3 SF4A seemed to be stable and the incision had ceased. At the end of MY3 it was determined that SF4A's banks had active erosion and the stream needed to be repaired. The repair work will be completed during the beginning of MY4. Constructed riffles were originally built without sills and most of the rock from these riffles washed away during MY1. The repair work will incorporate log and rock sills in the constructed riffles to raise the elevation of the stream bed. Minor stream bank grading will be performed as necessary and native grass seed and live stakes will be planted in disturbed areas.

During MY3 wetland rilling was observed at the edge of the project easement on the Lindley site. This rilling was caused by water running off the adjacent field into the project wetlands where a lack of ground cover resulted in erosion of the cut slope. Since this area of the wetland was graded down several feet, the soil appears to have poor growing conditions. Soil samples will be taken in these areas to see what can be added to the soils to help the growing conditions. Minor grading will be performed to smooth out the areas where rilling is occurring. If topsoil is available onsite, it will be added to areas of rilling to help the growing conditions. Also, native grass seed will be added to create a well-established herbaceous ground cover.

As described in section 1.2.2 above, supplemental tree planting will be performed in the areas shown to have low stem density on Figures 3.0-3.3. Also, a native grass seed mix will be applied to areas with limited herbaceous cover.

1.3 Monitoring Year 3 Summary

All streams, except SF4A, on the Site are stable and functioning as designed. SF4A will have repair work perfomed during the beginning of MY4 to stabilize its bed and banks. The average planted stem density for the Site is on track to meeting the MY5 success criteria; however, seven individual vegetation plots out of 42 did not meet the MY3 success criteria as noted in the Integrated Current Condition Plan View. When volunteer stems are counted in these seven plots, all but one meet MY5 success criteria. Supplemental tree planting will be performed in a few areas. With the exception of UT2, there have been multiple documented bankfull events with the crest gage recordings along UT1, SF1, SF3, SF4, and SF4A since MY0. The MY5 stream hydrology attainment requirement has been partially met for the Site at this time. All groundwater gages met hydrology success criteria during MY3.

Section 2: METHODOLOGY

Geomorphic data was collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). Cross sectional data was collected using a total station and was georeferenced. All data collected for the Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS software. Crest gages were installed in surveyed riffle cross sections and monitored quarterly. Hydrology attainment installation and monitoring methods are in accordance with the USACE (2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-DMS Level 2 Protocol (Lee et al., 2008). Reporting follows the DMS Monitoring Report Template and Guidance Version 1.2.1 (DMS, 2009). 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. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 3: REFERENCES

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Harrelson, C.C., Rawlins, C.L., Potyondy, J.P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

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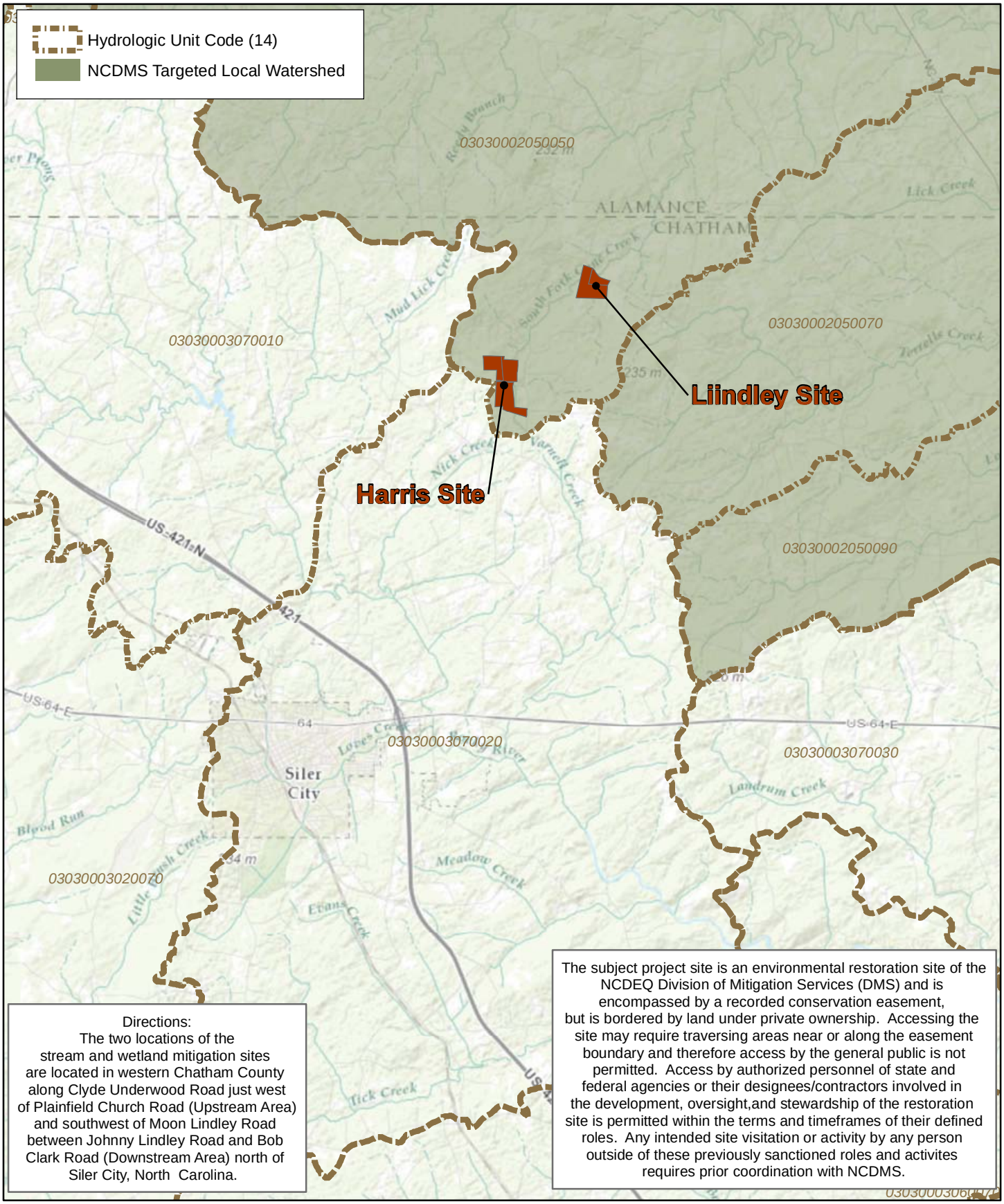
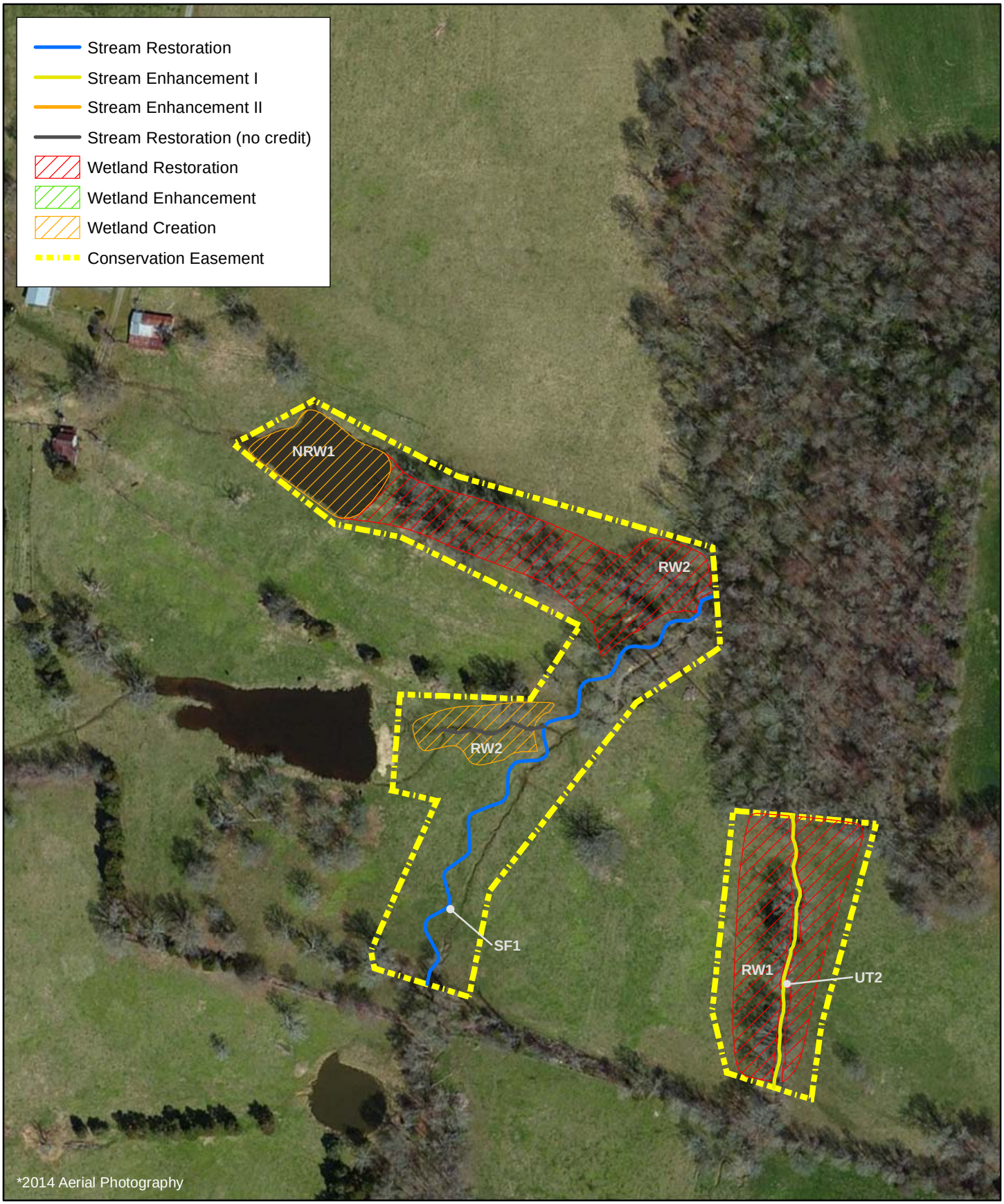
APPENDIX 1. General Tables and Figures



WILDLANDS ENGINEERING

Figure 1 Project Vicinity Map
Underwood Mitigation Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC



WILDLANDS ENGINEERING

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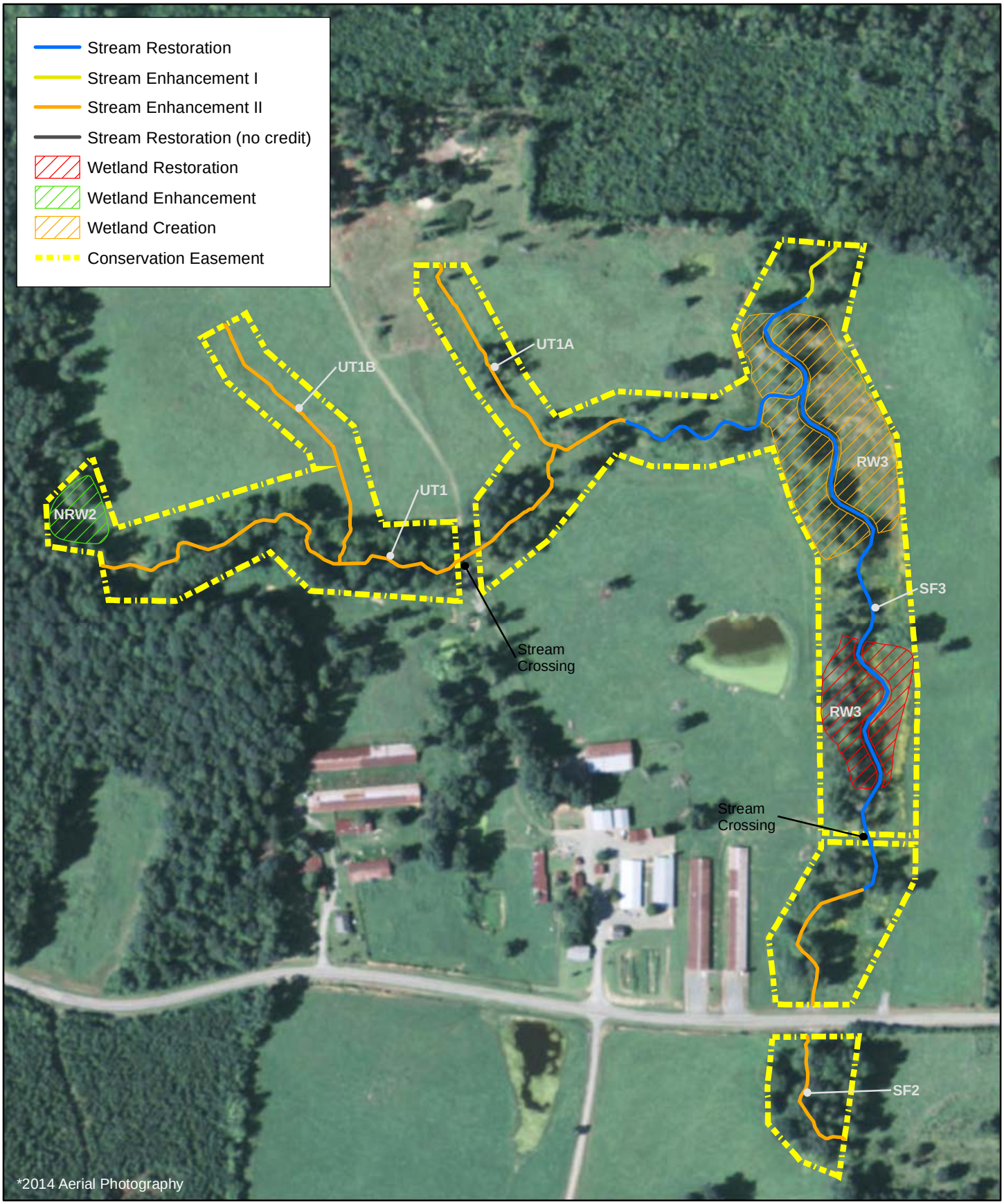
Figure 2a Project Component/Asset Map
Underwood Mitigation Site - Harris Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC



WILDLANDS ENGINEERING

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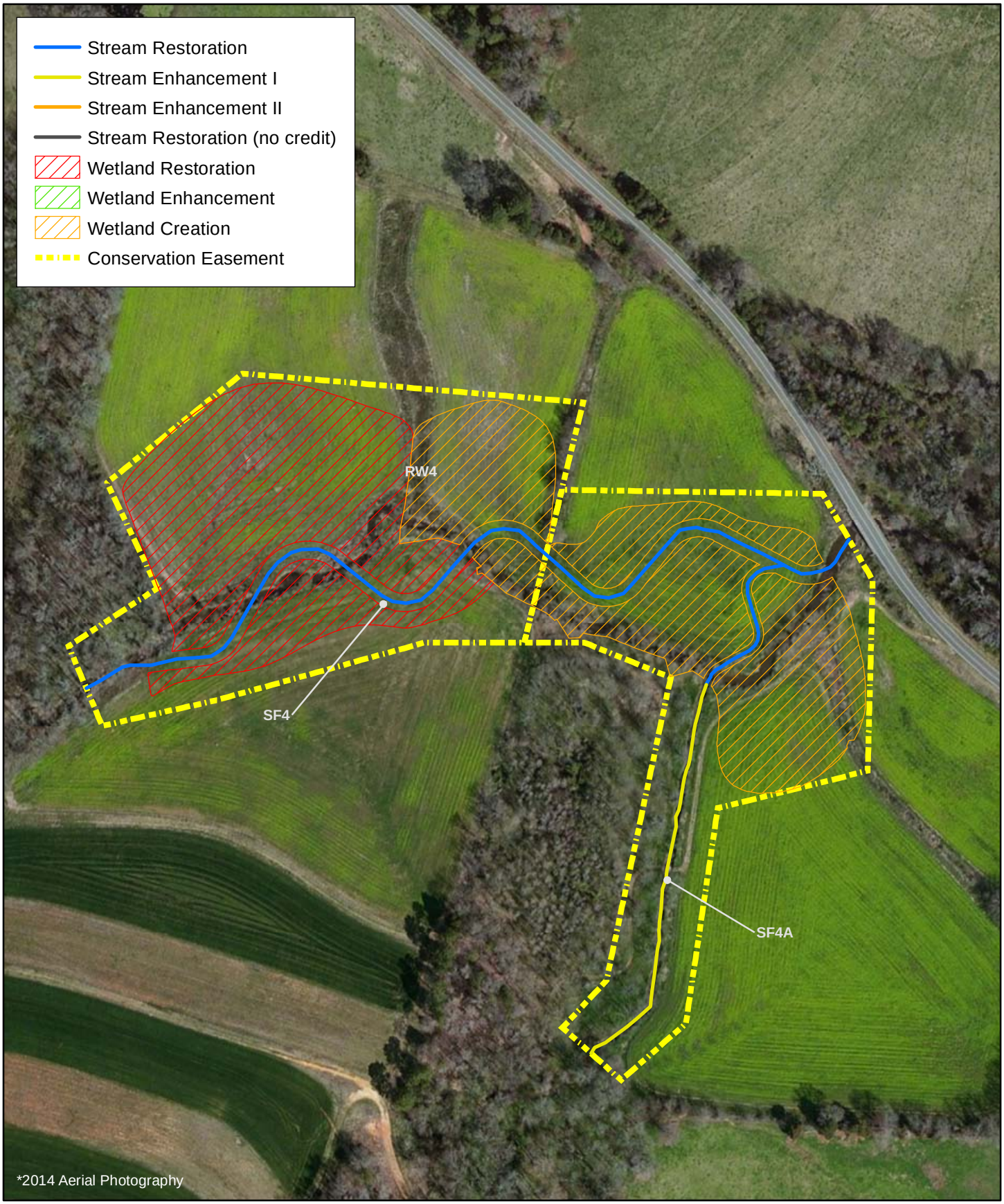
Figure 2b Project Component/Asset Map
Underwood Mitigation Site - Harris Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC



WILDLANDS ENGINEERING

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Figure 2c Project Component/Asset Map
Underwood Mitigation Site - Lindley Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC

Table 1. Project Components and Mitigation Credits
Underwood Mitigation Site (NCDMS Project No.94641)
Monitoring Year 3 - 2015

Mitigation Credits

	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	6,765		8.0		1.1		N/A	N/A	N/A

Project Components

Reach ID	As-Built Stationing/ Location (LF)	Existing Footage (LF)/ Acreage (Ac)	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF) / Acreage (Ac)*	Mitigation Ratio	Credits (SMU/ WMU)
Streams							
SF1	100+00-108+74	773	Priority 1	Restoration	874	1:1	874
SF2	300+00-303+02	302	N/A	Enhancement Level II	302	2.5:1	121
SF3	400+00-421+20	532	N/A	Enhancement Level II	359	2.5:1	144
		1,499	Priority 1	Restoration	1,586	1:1	1,586
		152	N/A	Enhancement Level I	153	1.5:1	102
SF4	800+00-814+29	1,450	Priority 1	Restoration	1,429	1:1	1,429
SF4A	900+00-908+66	0	Priority 1	Restoration	257	1:1	257
		609	N/A	Enhancement Level I	609	1.5:1	406
UT1	500+00-520+38	1,463	N/A	Enhancement Level II	1,468	2.5:1	587
		452	Priority 1	Restoration	515	1:1	515
UT1A	700+00-705+11	524	N/A	Enhancement Level II	511	2.5:1	204
UT1B	600+00-606+52	660	N/A	Enhancement Level II	652	2.5:1	261
UT2	0+00-4+18	421	N/A	Enhancement Level I	418	1.5:1	279
Wetlands							
RW1	N/A	1.25	N/A	Restoration	1.12	1:1	1.12
RW2	N/A	0.45	N/A	Creation	0.30	3:1	0.10
		0.50		Restoration	0.40	1:1	0.40
RW3	N/A	2.63	N/A	Creation	2.53	3:1	0.84
		1.33		Restoration	1.02	1:1	1.02
RW4	N/A	3.95	N/A	Creation	3.63	3:1	1.21
		3.65		Restoration	3.30	1:1	3.30
NRW1	N/A	1.20	N/A	Restoration	0.75	1:1	0.75
				Creation	0.45	3:1	0.15
NRW2	N/A	0.34	N/A	Enhancement	0.34	2:1	0.17

Component Summation

Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (sq. ft)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	4,661	5.84	-	0.75	-	-
Enhancement			-	0.34	-	-
Enhancement I	1,180					
Enhancement II	3,292					
Creation		6.46	-	0.45		
Preservation	-	-	-	-		-
High Quality Preservation	-	-	-	-		-

* Note that lengths do not match stationing because channel sections that do not generate credit have been removed from length calculations.

Table 2. Project Activity and Reporting History

Underwood Mitigation Site (NCDMS Project No.94641)

Monitoring Year 3 - 2015

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	September 2011	September 2011
Final Design - Construction Plans	July 2012	July 2012
Construction	November 2012	November 2012
Temporary S&E mix applied to entire project area[1]	November 2012	November 2012
Permanent seed mix applied to reach/segments	November 2012	November 2012
Bare root and live stake plantings for reach/segments	January 2013	January 2013
Baseline Monitoring Document (Year 0 Monitoring - baseline)	March 2013	March 2013
Year 1 Monitoring	September 2013	November 2013
Year 2 Monitoring	December 2014	December 2014
Year 3 Monitoring	October 2015	December 2015
Year 4 Monitoring	2016	December 2016
Year 5 Monitoring	2017	December 2017

[1]Seed and mulch is added as each section of construction is completed.

Table 3. Project Contacts Table

Underwood Mitigation Site (NCDMS Project No.94641)

Monitoring Year 3 - 2015

Designer	**Wildlands Engineering, Inc.**
Nicole Macaluso, PE	312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.**
	126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc**
	P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.**
	126 Circle G Lane Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers **Bare Roots** **Live Stakes**	 **ArborGlen, Inc** **Foggy Mountain Nursery**
Monitoring Performers	**Wildlands Engineering, Inc.**
Stream, Vegetation, and Wetland Monitoring POC	Jason Lorch 919.851.9986, ext. 107

Table 4. Project Baseline Information and Attributes
Underwood Mitigation Site (NCDMS Project No.94641)
Monitoring Year 3 - 2015

Project Information	
Project Name	Underwood Mitigation Site
County	Chatham County
Project Area (acres)	38 ac
Project Coordinates (latitude and longitude)	35° 48' 05"N, 79° 24' 10"W (Harris Site), 35° 49' 51"N, 79° 22' 60"W (Lindley Site)
Project Watershed Summary Information	
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province
River Basin	Cape Fear
USGS Hydrologic Unit 8-digit	03030002
USGS Hydrologic Unit 14-digit	03030002050050
DWQ Sub-basin	03-06-04
Project Drainiage Area (acres)	1,504 ac (Harris Site) and 3,362 ac (Lindley Site)
Project Drainage Area Percentage of Impervious Area	<1%
CGIA Land Use Classification	60% Forest Land, 39% managed herbaceous cover/agricultural, 1% unmanaged herbaceous/open water

Reach Summary Information

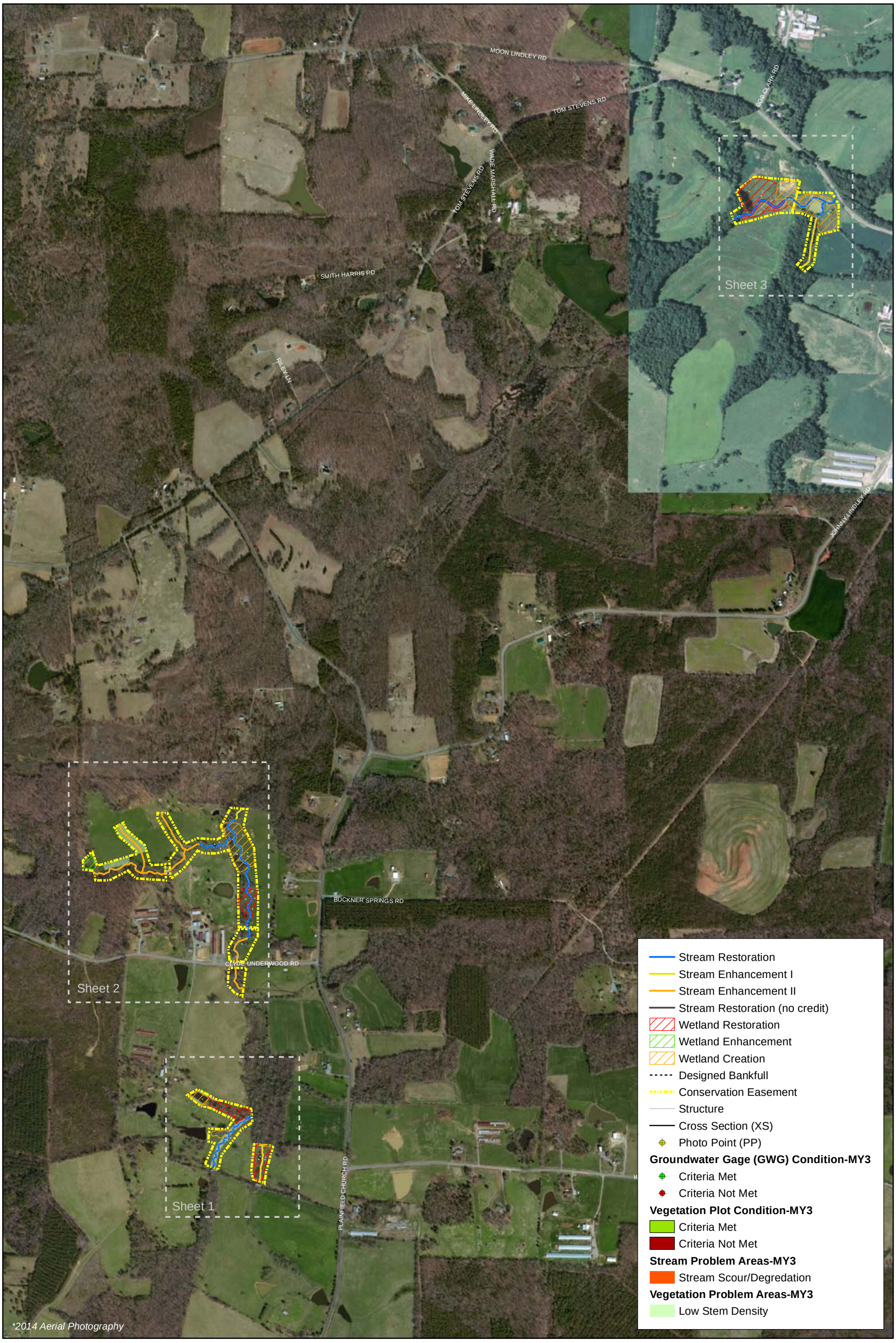
Parameters	SF1	SF2	SF3	UT1	UT1A	UT1B	UT2	SF4	SF4A
Length of reach (linear feet) - Post-Restoration	874	302	2,098	1,983	511	652	418	1,429	866
Drainage area (acres)	134	781	1,056	230	11	11	78	3,362	637
NCDWQ stream identification score	36.0/50.5/43.3			40.0	22.8	24.3	38.0	U	34.5
NCDWQ Water Quality Classification	WS-V, NSW	WS-V, NSW	WS-V, NSW	C	C	C	C	WS-V, NSW	C
Morphological Desription (stream type)	P	P	P	P	I	I	P	P	P
Evolutionary trend (Simon's Model) - Pre-Restoration	IV	IV	IV	IV	IV	IV	IV	IV	IV
Underlying mapped soils	Nanford-Baden Complex						Georgeville Silt Loam	Chewacla and Wehadkee	
Drainage class	---	---	---	---	---	---	---	---	---
Soil Hydric status	---	---	---	---	---	---	---	---	---
Slope	---	---	---	---	---	---	---	---	---
FEMA classification	---	---	---	---	---	---	---	AE	---
Native vegetation community	Piedmont bottomland forest								
Percent composition of 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 and DWQ 401 Water Quality Certification No. 3689
Waters of the United States - Section 401		X	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	X	X	Underwood Mitigation Plan; no critical habitat for listed species exists within the project area (USFWS correspondence letter)
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO)
Coastal Zone Management Act (CZMA) / Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	X	X	Approved CLOMR
Essential Fisheries Habitat	N/A	N/A	N/A

U: Unknown

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 500 1,000 1,500 2,000 Feet

Figure 3.0 Integrated Current Condition Plan View (Key)
Underwood Mitigation Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015
Chatham County, NC

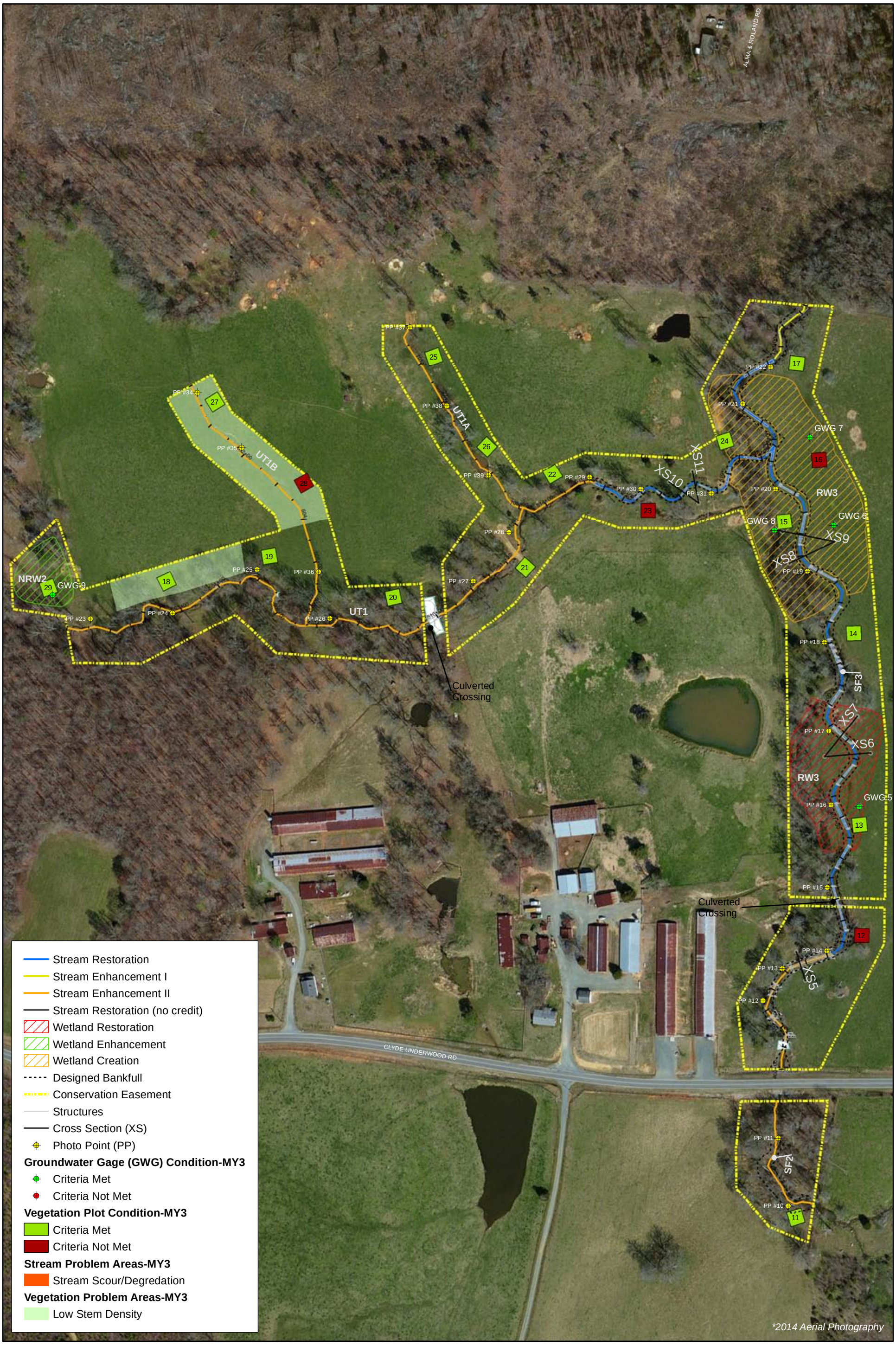
WILDLANDS ENGINEERING

0 50 100 150 200 Feet

N

Figure 3.1 Integrated Current Condition Plan View
(Sheet 1 of 3)
Underwood Mitigation Site - Harris Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC



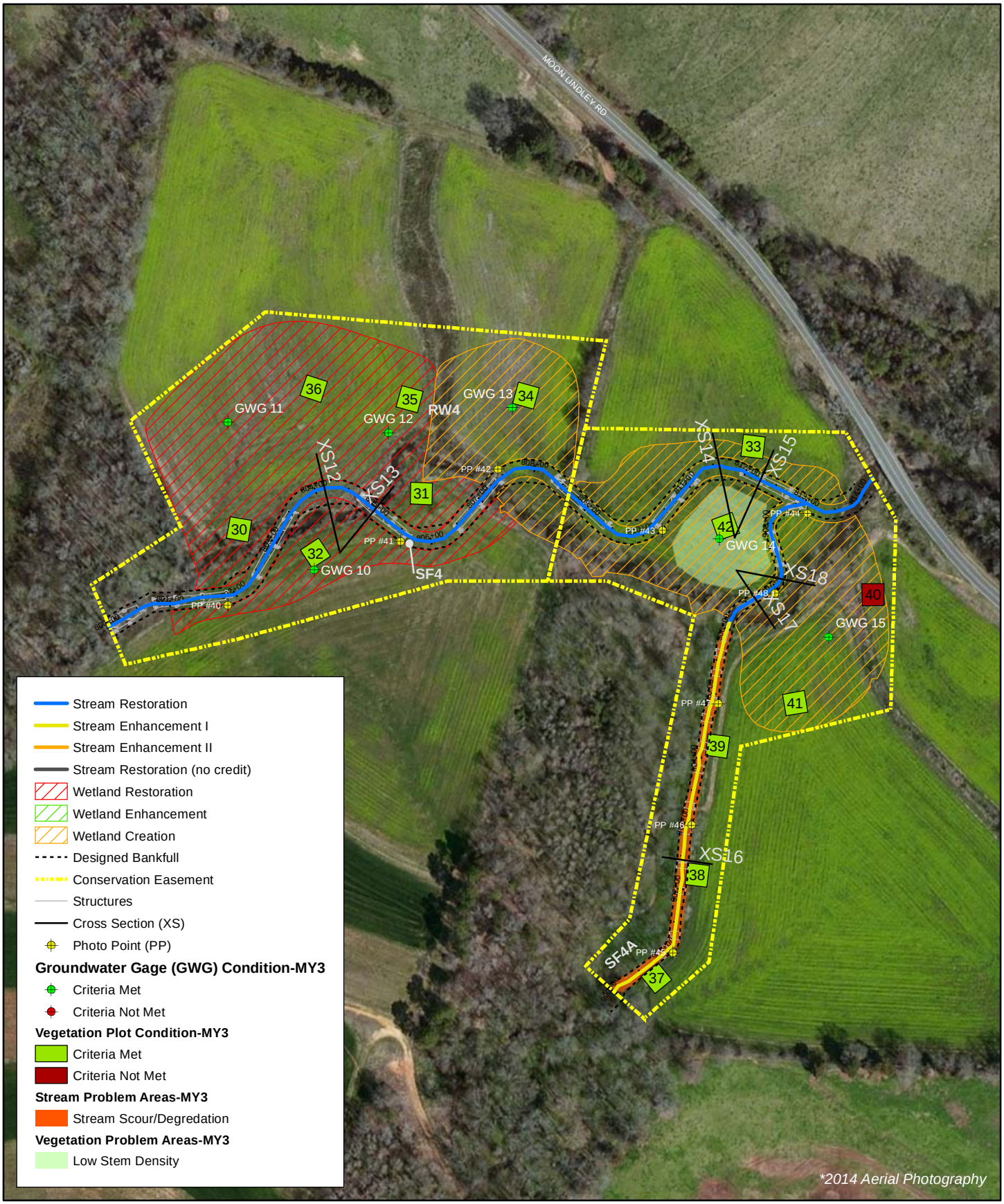
WILDLANDS ENGINEERING

0 100 200 300 400 Feet

N

Figure 3.2 Integrated Current Condition Plan View
(Sheet 2 of 3)
Underwood Mitigation Site - Harris Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 3.3 Integrated Current Condition Plan View
(Sheet 3 of 3)
Underwood Mitigation Site - Harris Site
NCDMS Project No. 94641
Monitoring Year 3 - 2015

Chatham County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; SF1 (874 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 (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	15	15			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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	10	10			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	10	10			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	10	10			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	10	10			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5b. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; UT2 (418 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 (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	10	10			100%			
	3. Meander Pool Condition	Depth Sufficient	10	10			100%			
		Length Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5c. Visual Stream Morphology Stability Assessment Table
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; SF2 (302 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 (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Length Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
		Thalweg centering at downstream of meander bend (Glide)	n/a	n/a			n/a			
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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 5d. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; SF3 (2,120 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]	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	19	19			100%			
	3. Meander Pool Condition	Depth Sufficient	19	19			100%			
		Length Appropriate	19	19			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	19	19			100%			
		Thalweg centering at downstream of meander bend (Glide)	19	19			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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[2]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	7	7			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	7	7			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	7	7			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	7	7			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 5e. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; UT1 (2,038 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]	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	7	7			100%			
		Length Appropriate	7	7			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		Thalweg centering at downstream of meander bend (Glide)	7	7			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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[2]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	15	15			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	15	15			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 5f. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; UT1A & UT1B (1,163 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 (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Length Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
		Thalweg centering at downstream of meander bend (Glide)	n/a	n/a			n/a			
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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 5g. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Lindley Site; SF4 (1,429 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 (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5h. Visual Stream Morphology Stability Assessment Table

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Lindley Site; SF4A (866 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]	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			1	533	38%			
	2. Riffle Condition	Texture/Substrate	8	10			80%			
	3. Meander Pool Condition	Depth Sufficient	7	9			78%			
		Length Appropriate	7	9			78%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	533	38%	1	533	57%
	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, caving, or collapse			0	0	100%	n/a	n/a	n/a
				TOTALS	1	533	100%	1	533	57%
3. Engineered Structures[2]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	2	2			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches. Approximately 533 LF of the stream bed has downcut along SF4A and riffles and pools have shifted downstream. Although these conditions were not intended in the design, the stream has maintained a stable bedform with riffles and pools at a lower elevation.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 6. Vegetation Condition Assessment Table
Undewood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Planted Acreage **38**

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.	0.10	0	0	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.10	6	3.2	8.4%
		Total	**6**	**3.2**	**8.4%**
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	0	0.0	0.0%
		Cumulative Total	**0**	**0.0**	**0.0%**

Easement Acreage **38**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	0	0.0	0.0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0.0	0.0%

Stream Photographs
Underwood (Harris Site)

	
Photo Point 1 – looking upstream *(04/23/2015)*	**Photo Point 1** – looking downstream *(04/23/2015)*
	
Photo Point 2 – looking upstream *(04/23/2015)*	**Photo Point 2** – looking downstream *(04/23/2015)*
	
Photo Point 3 – looking upstream *(04/23/2015)*	**Photo Point 3** – looking downstream *(04/23/2015)*

	
Photo Point 4 – looking upstream *(04/23/2015)*	**Photo Point 4** – looking downstream *(04/23/2015)*
	
Photo Point 5 – looking upstream *(04/23/2015)*	**Photo Point 5** – looking downstream *(04/23/2015)*
	
Photo Point 6 – looking upstream *(04/23/2015)*	**Photo Point 6** – looking downstream *(04/23/2015)*

	
Photo Point 7 – looking upstream *(04/23/2015)*	**Photo Point 7** – looking downstream *(04/23/2015)*
	
Photo Point 8 – looking upstream *(04/23/2015)*	**Photo Point 8** – looking downstream *(04/23/2015)*
	
Photo Point 9 – looking upstream *(04/23/2015)*	**Photo Point 9** – looking downstream *(04/23/2015)*

	
Photo Point 10 – looking upstream *(04/26/2015)*	**Photo Point 10** – looking downstream *(04/26/2015)*
	
Photo Point 11 – looking upstream *(04/26/2015)*	**Photo Point 11** – looking downstream *(04/26/2015)*
	
Photo Point 12 – looking upstream *(04/26/2015)*	**Photo Point 12** – looking downstream *(04/26/2015)*

	
Photo Point 13 – looking upstream *(04/26/2015)*	**Photo Point 13** – looking downstream *(04/26/2015)*
	
Photo Point 14 – looking upstream *(04/26/2015)*	**Photo Point 14** – looking downstream *(04/26/2015)*
	
Photo Point 15 – looking upstream *(04/26/2015)*	**Photo Point 15** – looking downstream *(04/26/2015)*

	
Photo Point 16 – looking upstream *(04/26/2015)*	**Photo Point 16** – looking downstream *(04/26/2015)*
	
Photo Point 17 – looking upstream *(04/26/2015)*	**Photo Point 17** – looking downstream *(04/26/2015)*
	
Photo Point 18 – looking upstream *(04/26/2015)*	**Photo Point 18** – looking downstream *(04/26/2015)*

	
Photo Point 19 – looking upstream *(04/26/2015)*	**Photo Point 19** – looking upstream *(04/26/2015)*
	
Photo Point 20 – looking upstream *(04/26/2015)*	**Photo Point 20** – looking downstream *(04/26/2015)*
	
Photo Point 21 – looking upstream *(04/26/2015)*	**Photo Point 21** – looking downstream *(04/26/2015)*

	
Photo Point 22 – looking upstream *(04/26/2015)*	**Photo Point 22** – looking downstream *(04/26/2015)*
	
Photo Point 23 – looking upstream *(04/23/2015)*	**Photo Point 23** – looking downstream *(04/23/2015)*
	
Photo Point 24 – looking upstream *(04/23/2015)*	**Photo Point 24** – looking downstream *(04/23/2015)*

	
Photo Point 25 – looking upstream *(04/23/2015)*	**Photo Point 25** – looking downstream *(04/23/2015)*
	
Photo Point 26 – looking upstream *(04/23/2015)*	**Photo Point 26** – looking downstream *(04/23/2015)*
	
Photo Point 27 – looking upstream *(04/23/2015)*	**Photo Point 27** – looking downstream *(04/23/2015)*

	
Photo Point 28 – looking upstream *(04/23/2015)*	**Photo Point 28** – looking downstream *(04/23/2015)*
	
Photo Point 29 – looking upstream *(04/26/2015)*	**Photo Point 29** – looking downstream *(04/26/2015)*
	
Photo Point 30 – looking upstream *(04/26/2015)*	**Photo Point 30** – looking downstream *(04/26/2015)*

	
Photo Point 31 – looking upstream *(04/26/2015)*	**Photo Point 31** – looking downstream *(04/26/2015)*
	
Photo Point 34 – looking upstream *(04/23/2015)*	**Photo Point 34** – looking downstream *(04/23/2015)*
	
Photo Point 35 – looking upstream *(04/23/2015)*	**Photo Point 35** – looking downstream *(04/23/2015)*

	
Photo Point 36 – looking upstream *(04/23/2015)*	**Photo Point 36** – looking downstream *(04/23/2015)*
	
Photo Point 37 – looking upstream *(04/23/2015)*	**Photo Point 37** – looking downstream *(04/23/2015)*
	
Photo Point 38 – looking upstream *(04/23/2015)*	**Photo Point 38** – looking downstream *(04/23/2015)*

	
Photo Point 39 – looking upstream *(04/23/2015)*	**Photo Point 39** – looking downstream *(04/23/2015)*

Stream Photographs
Underwood (Lindley Site)

	
Photo Point 40 – looking upstream *(04/21/2015)*	**Photo Point 40** – looking downstream *(04/21/2015)*
	
Photo Point 41 – looking upstream *(04/21/2015)*	**Photo Point 41** – looking downstream *(04/21/2015)*
	
Photo Point 42 – looking upstream *(04/21/2015)*	**Photo Point 42** – looking downstream *(04/21/2015)*

	
Photo Point 43 – looking upstream *(04/21/2015)*	**Photo Point 43** – looking downstream *(04/21/2015)*
	
Photo Point 44 – looking upstream *(04/21/2015)*	**Photo Point 44** – looking downstream *(04/21/2015)*
	
Photo Point 45 – looking upstream *(04/21/2015)*	**Photo Point 45** – looking downstream *(04/21/2015)*

	
Photo Point 46 – looking upstream *(04/21/2015)*	**Photo Point 46** – looking downstream *(04/21/2015)*
	
Photo Point 47 – looking upstream *(04/21/2015)*	**Photo Point 47** – looking downstream *(04/21/2015)*
	
Photo Point 48 – looking upstream *(04/21/2015)*	**Photo Point 48** – looking downstream *(04/21/2015)*

Vegetation Photographs
Underwood (Harris Site)

	
Vegetation Plot 1 *(06/22/2015)*	**Vegetation Plot 2** *(06/22/2015)*
	
Vegetation Plot 3 *(06/22/2015)*	**Vegetation Plot 4** *(06/22/2015)*
	
Vegetation Plot 5 *(06/22/2015)*	**Vegetation Plot 6** *(06/22/2015)*

	
Vegetation Plot 7 *(06/22/2015)*	**Vegetation Plot 8** *(06/22/2015)*
	
Vegetation Plot 9 *(06/22/2015)*	**Vegetation Plot 10** *(06/22/2015)*
	
Vegetation Plot 11 *(06/22/2015)*	**Vegetation Plot 12** *(06/22/2015)*

	
Vegetation Plot 13 (06/22/2015)	**Vegetation Plot 14** *(06/22/2015)*
	
Vegetation Plot 15 *(06/22/2015)*	**Vegetation Plot 16** *(06/22/2015)*
	
Vegetation Plot 17 *(06/22/2015)*	**Vegetation Plot 18** *(06/22/2015)*

Vegetation Plot 19 *(06/22/2015)*

Vegetation Plot 20 *(06/22/2015)*

Vegetation Plot 21 *(06/22/2015)*

Vegetation Plot 22 *(06/22/2015)*

Vegetation Plot 23 *(06/22/2015)*

Vegetation Plot 24 *(06/22/2015)*

Vegetation Plot 25 *(06/22/2015)*

Vegetation Plot 26 *(06/22/2015)*

Vegetation Plot 27 *(06/22/2015)*

Vegetation Plot 28 *(06/22/2015)*

Vegetation Plot 29 (*06/22/2015*)

Vegetation Photographs
Underwood (Lindley Site)

	
Vegetation Plot 30 *(06/22/2015)*	**Vegetation Plot 31** *(06/22/2015)*
	
Vegetation Plot 32 *(06/22/2015)*	**Vegetation Plot 33** *(06/22/2015)*
	
Vegetation Plot 34 *(06/22/2015)*	**Vegetation Plot 35** *(06/22/2015)*

	
Vegetation Plot 36 *(06/22/2015)*	**Vegetation Plot 37** *(06/22/2015)*
	
Vegetation Plot 38 *(06/22/2015)*	**Vegetation Plot 39** *(06/22/2015)*
	
Vegetation Plot 40 *(06/22/2015)*	**Vegetation Plot 41** *(06/22/2015)*

Vegetation Plot 42 *(06/22/2015)*

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site		
Plot	**MY3 Success Criteria Met (Y/N)**	**Tract Mean**
1	Y	
2	Y	
3	Y	
4	Y	
5	Y	
6	N	
7	Y	
8	Y	
9	Y	
10	N	
11	Y	
12	N	
13	Y	
14	Y	
15	Y	79%
16	N	
17	Y	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	N	
24	Y	
25	Y	
26	Y	
27	Y	
28	N	
29	Y	

Lindley Site		
Plot	**MY3 Success Criteria Met (Y/N)**	**Tract Mean**
30	Y	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	
36	Y	92%
37	Y	
38	Y	
39	Y	
40	N	
41	Y	
42	Y	

Table 8. CVS Vegetation Table - Metadata

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Database name	Underwood MY3 cvs-eep-entrytool-v2.3.1.mdb
Database location	F:\Projects\005-02125 Underwood\Monitoring\Monitoring Year 3\Vegetation Assessment
Computer name	KENTON
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	94641
project Name	Underwood Mitigation Site
Description	Stream and Wetland
Sampled Plots	42

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0001			94641-WEI-0002			94641-WEI-0003			94641-WEI-0004			94641-WEI-0005			94641-WEI-0006		
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**
Acer rubrum	red maple	Tree																		1
Betula nigra	river birch	Tree	2	2	3	1	1	1	2	2	2				1	1	1			
Cornus amomum	silky dogwood	Shrub																		
Fraxinus pennsylvanica	green ash	Tree	2	2	2	2	2	2	1	1	2	4	4	4	3	3	3			2
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree									5									10
Liriodendron tulipifera	tuliptree	Tree				1	1	1	1	1	1									
Platanus occidentalis	American sycamore	Tree	1	1	2	5	5	5	3	3	3	4	4	4	7	7	7	3	3	3
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree	4	4	4				6	6	6	4	4	4						
Quercus pagoda	cherrybark oak	Tree	4	4	4	2	2	2	1	1	1	1	1	1				3	3	3
Quercus phellos	willow oak	Tree	2	2	3	6	6	6							3	3	3	1	1	1
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub																		
		Stem count	15	15	18	17	17	17	14	14	20	13	13	13	14	14	14	7	7	20
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	6	6	6	6	6	6	6	6	7	4	4	4	4	4	4	3	3	6
		Stems per ACRE	607	607	728.4	688	688	688	566.6	566.6	809.4	526.1	526.1	526.1	566.6	566.6	566.6	283.3	283.3	809.4

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0007			94641-WEI-0008			94641-WEI-0009			94641-WEI-0010			94641-WEI-0011			94641-WEI-0012		
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**
Acer rubrum	red maple	Tree									6									
Betula nigra	river birch	Tree	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2
Cornus amomum	silky dogwood	Shrub											1	1						
Fraxinus pennsylvanica	green ash	Tree	3	3	3	1	1	1			10	3	3	3	3	3	3			100
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree									5									
Liriodendron tulipifera	tuliptree	Tree																		
Platanus occidentalis	American sycamore	Tree	3	3	3	5	5	5	1	1	1				4	4	4	3	3	13
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree	5	5	5	2	2	2				1	1	1	4	4	4			
Quercus pagoda	cherrybark oak	Tree							1	1	1				1	1	1			
Quercus phellos	willow oak	Tree				1	1	1	5	5	9				2	2	2	1	1	1
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub								2	2		5	5						
		Stem count	13	13	13	11	11	11	9	11	36	5	11	11	15	15	15	6	6	116
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	4	5	5	5	4	5	8	3	5	5	6	6	6	3	3	4
		Stems per ACRE	526.1	526.1	526.1	445.2	445.2	445.2	364.2	445.2	1457	202.3	445.2	445.2	607	607	607	242.8	242.8	4694

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0013			94641-WEI-0014			94641-WEI-0015			94641-WEI-0016			94641-WEI-0017			94641-WEI-0018		
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**
Acer rubrum	red maple	Tree																		
Betula nigra	river birch	Tree							6	6	6	3	3	3						
Cornus amomum	silky dogwood	Shrub											4	4						
Fraxinus pennsylvanica	green ash	Tree			100	1	1	1	3	3	3			100				3	3	3
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree			20									50						
Liriodendron tulipifera	tuliptree	Tree													4	4	4	1	1	1
Platanus occidentalis	American sycamore	Tree	16	16	16	5	5	5	4	4	4	2	2	7	1	1	1	2	2	2
Quercus	oak	Tree									2									
Quercus michauxii	swamp chestnut oak	Tree				2	2	2				1	1	1				3	3	3
Quercus pagoda	cherrybark oak	Tree				2	2	2	1	1	1				3	3	3			
Quercus phellos	willow oak	Tree				4	4	4	1	1	1	1	1	1	6	6	6	1	1	1
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub								1	4		4	4						
		Stem count	16	16	136	14	14	14	15	16	21	7	15	170	14	14	14	10	10	10
		size (ares)	1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	1	1	3	5	5	5	5	6	7	4	6	8	4	4	4	5	5	5
		Stems per ACRE	647.5	647.5	5504	566.6	566.6	566.6	607	647.5	849.8	283.3	607	6880	566.6	566.6	566.6	404.7	404.7	404.7

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0019			94641-WEI-0020			94641-WEI-0021			94641-WEI-0022			94641-WEI-0023			94641-WEI-0024		
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**
Acer rubrum	red maple	Tree																		
Betula nigra	river birch	Tree							1	1	1				1	1	1	1	1	1
Cornus amomum	silky dogwood	Shrub																		
Fraxinus pennsylvanica	green ash	Tree							1	1	1	1	1	1	1	1	1	1	1	1
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree									10									
Liriodendron tulipifera	tuliptree	Tree	1	1	1							1	1	1						
Platanus occidentalis	American sycamore	Tree	7	7	7	3	3	3	2	2	2	1	1	1	1	1	1	6	6	6
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree	2	2	2	4	4	4	1	1	1	7	7	7						
Quercus pagoda	cherrybark oak	Tree				3	3	3	2	2	2	2	2	2	2	2	2			
Quercus phellos	willow oak	Tree	1	1	1				1	1	1	3	3	3				3	3	3
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub																	2	2
		Stem count	11	11	11	10	10	10	8	8	18	15	15	15	5	5	5	11	13	13
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	4	3	3	3	6	6	7	6	6	6	4	4	4	4	5	5
		Stems per ACRE	445.2	445.2	445.2	404.7	404.7	404.7	323.7	323.7	728.4	607	607	607	202.3	202.3	202.3	445.2	526.1	526.1

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0025			94641-WEI-0026			94641-WEI-0027			94641-WEI-0028			94641-WEI-0029			94641-WEI-0030		
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**
Acer rubrum	red maple	Tree																		10
Betula nigra	river birch	Tree				1	1	1							7	7	7			
Cornus amomum	silky dogwood	Shrub																		
Fraxinus pennsylvanica	green ash	Tree				4	4	4	2	2	5	2	2	5	1	1	1	8	8	33
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree																		
Liriodendron tulipifera	tuliptree	Tree				1	1	1												
Platanus occidentalis	American sycamore	Tree	5	5	5	3	3	3			2			3	7	7	7			
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree	1	1	1	5	5	5	2	2	2									
Quercus pagoda	cherrybark oak	Tree	2	2	2	1	1	1	4	4	5				3	3	3	2	2	2
Quercus phellos	willow oak	Tree	4	4	4							2	2	2	1	1	1	1	1	1
Quercus rubra	northern red oak	Tree												2						
Salix sericea	silky willow	Shrub														2	2		2	2
		Stem count	12	12	12	15	15	15	8	8	14	4	4	12	19	21	21	11	13	48
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	4	6	6	6	3	3	4	2	2	4	5	6	6	3	4	5
		Stems per ACRE	485.6	485.6	485.6	607	607	607	323.7	323.7	566.6	161.9	161.9	485.6	768.9	849.8	849.8	445.2	526.1	1942

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0031			94641-WEI-0032			94641-WEI-0033			94641-WEI-0034			94641-WEI-0035			94641-WEI-0036		
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**
Acer rubrum	red maple	Tree																		
Betula nigra	river birch	Tree	4	4	4				1	1	1				1	1	1	3	3	3
Cornus amomum	silky dogwood	Shrub		1	1		1	1		1	1		3	3		1	1		2	2
Fraxinus pennsylvanica	green ash	Tree	2	2	2	4	4	4	4	4	4	4	4	4	1	1	1	3	3	3
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree																		
Liriodendron tulipifera	tuliptree	Tree																		
Platanus occidentalis	American sycamore	Tree	1	1	1	4	4	4	9	9	9	4	4	4	7	7	7			
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree							1	1	1									
Quercus pagoda	cherrybark oak	Tree	5	5	5	4	4	4				2	2	2	2	2	2	1	1	1
Quercus phellos	willow oak	Tree	1	1	1	1	1	1	3	3	3	2	2	2				5	5	5
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub		5	5		2	2					5	5					3	3
		Stem count	13	19	19	13	16	16	18	19	19	12	20	20	11	12	12	12	17	17
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	5	7	7	4	6	6	5	6	6	4	6	6	4	5	5	4	6	6
		Stems per ACRE	526.1	768.9	768.9	526.1	647.5	647.5	728.4	768.9	768.9	485.6	809.4	809.4	445.2	485.6	485.6	485.6	688	688

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Current Plot Data (MY3 2015)																	
			94641-WEI-0037			94641-WEI-0038			94641-WEI-0039			94641-WEI-0040			94641-WEI-0041			94641-WEI-0042		
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**
Acer rubrum	red maple	Tree												20			20			
Betula nigra	river birch	Tree				2	2	2	2	2	2				3	3	3	4	4	4
Cornus amomum	silky dogwood	Shrub														1	1		1	1
Fraxinus pennsylvanica	green ash	Tree				4	4	39	1	1	1			20			100	1	1	1
Juglans nigra	black walnut	Tree																		
Liquidambar styraciflua	sweetgum	Tree															70			
Liriodendron tulipifera	tuliptree	Tree																		
Platanus occidentalis	American sycamore	Tree	1	1	1	1	1	1	3	3	3	3	3	13	1	1	21	2	2	32
Quercus	oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree	6	6	6															
Quercus pagoda	cherrybark oak	Tree	5	5	5	1	1	1	1	1	1	2	2	2	4	4	4	1	1	1
Quercus phellos	willow oak	Tree	1	1	1				2	2	2				1	1	1	1	1	1
Quercus rubra	northern red oak	Tree																		
Salix sericea	silky willow	Shrub												20		3	3		1	1
		Stem count	13	13	13	8	8	43	9	9	9	5	5	75	9	13	223	9	11	41
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	4	4	4	4	5	5	5	2	2	5	4	6	9	5	7	7
		Stems per ACRE	526.1	526.1	526.1	323.7	323.7	1740	364.2	364.2	364.2	202.3	202.3	3035	364.2	526.1	9024	364.2	445.2	1659

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Underwood Mitigation Site (NCDMS Project Code 94641)

Monitoring Year 3 - 2015

			Annual Means											
			MY3 (2015)			MY2 (2014)			MY1 (2013)			MY0 (2012)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree			57			55						
Betula nigra	river birch	Tree	56	56	56	64	64	64	82	82	82	124	124	124
Cornus amomum	silky dogwood	Shrub		16	16		16	20	25	25	25	30	30	30
Fraxinus pennsylvanica	green ash	Tree	74	74	573	74	74	387	82	82	142	86	86	86
Juglans nigra	black walnut	Tree						1						
Liquidambar styraciflua	sweetgum	Tree			170			92						
Liriodendron tulipifera	tuliptree	Tree	10	10	10	15	15	16	20	20	20	35	35	35
Platanus occidentalis	American sycamore	Tree	140	140	221	143	143	193	144	144	204	145	145	145
Quercus	oak	Tree			2									
Quercus michauxii	swamp chestnut oak	Tree	61	61	61	62	62	62	71	71	71	87	87	87
Quercus pagoda	cherrybark oak	Tree	68	68	69	72	72	73	93	93	93	131	131	131
Quercus phellos	willow oak	Tree	67	67	72	69	69	69	72	72	72	64	64	64
Quercus rubra	northern red oak	Tree			2									
Salix sericea	silky willow	Shrub		37	60		37	66	39	39	39	38	38	38
		Stem count	476	529	1369	499	552	1098	628	628	748	740	740	740
		size (ares)		42			42			42			42	
		size (ACRES)		1.04			1.04			1.04			1.04	
		Species count	7	9	13	7	9	12	9	9	9	9	9	9
		Stems per ACRE	458.6	509.7	1319	480.8	531.9	1058	605.1	605.1	720.7	712	712	712

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; SF1 and UT2

		Pre-Restoration Condition				Reference Reach Data				Design				As-Built/Baseline			
Parameter	**Gage**	**SF1**		**UT2**		**Long Branch**		**UT to Cane Creek**		**SF1**		**UT2**		**SF1**		**UT2**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	n/a	7.6		7.0		14.8	18.6	8.2	11.8	8.8		7.1		9.0		16.6	
Floodprone Width (ft)		51.9		133.2		50+		40+		50+		200+		50+		200+	
Bankfull Mean Depth		1.2		1.4		1.3	2.1	0.9	1.0	0.7		0.6		0.7		0.8	
Bankfull Max Depth		2.2		1.8		1.9	2.9	1.5	1.7	1.0		0.7		1.1		1.1	
Bankfull Cross Sectional Area (ft^2)		9.5		9.6		25.0	34.6	8.5	10.7	6.5		4.2		6.3		13.6	
Width/Depth Ratio		6.2		5.2		7.9	13.8	7.9	13.1	12.0		12.0		12.9		20.4	
Entrenchment Ratio		6.8		18.9		3.4+		4.59+		2.2+		2.2+		2.2+		2.2+	
Bank Height Ratio		1.6		1.5		1.2	1.5	1.0	1.0	1.0		1.0		1.0		1.0	
D50 (mm)		4.7		6.1										119.3		145.5	
Profile																	
Riffle Length (ft)	n/a					---		---		---		---		11	36	7	25
Riffle Slope (ft/ft)[4]		0.011	0.0100	---		0.0130	0.0120	0.0120		0.0143	0.0255	0.0197	0.0353	0.0053	0.0283	0.0040	0.1512
Pool Length (ft)						---		---		---		---		16	34	16	51
Pool Max Depth (ft)		---		---		---		---		---		---		1.67		2.70	
Pool Spacing (ft)^		---		---		---		---		35	62	29	50	37	61	23	59
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	n/a	N/A		N/A		60		50	77	26	44	N/A		26	44	N/A	
Radius of Curvature (ft)		N/A		N/A		16	87	11.3	27.1	15	25	N/A		15	25	N/A	
Rc:Bankfull Width (ft/ft)		---		---		1.1	4.7	1	2.5	2	3	N/A		2	3	N/A	
Meander Length (ft)		N/A		N/A		66	191	29	96	62	106	N/A		62	106	N/A	
Meander Width Ratio		---		---		3.2	4.1	50	77	3	5	N/A		3	5	N/A	
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	n/a																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		N/A/0.9/4.7/20.9/87/362		N/A/N/A/6.1/62/128/256		---		---						SC/SC/SC/46.6/100/256		SC/SC/SC/58.6/111.2/180	
Reach Shear Stress (Competency) lb/ft^2[1]		---		---						0.42		---		0.39		N/A	
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2[2]																	
Additional Reach Parameters																	
Drainage Area (SM)	n/a	0.21		0.12		1.49		0.28		0.21		0.12		0.21		0.12	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%	
Rosgen Classification		E4		E4		C/E4		C/E4		C4		C4		C5		C5	
Bankfull Velocity (fps)		3.1		2.04						3.1		3.1		3.2		1.0	
Bankfull Discharge (cfs)		20		13.1		101	124	20.6	53.2	20		13.1		20		13.1	
Q-NFF regression		45.2		30.96													
Q-USGS extrapolation		---		---													
Q-Mannings		---		---													
Valley Length (ft)		---		---		---		---		---		---					
Channel Thalweg Length (ft)		773		421		---		---		878		421		874		418	
Sinuosity (ft)		1.1		1.0		1.30		1.20		1.2		1.0		1.2		1.0	
Water Surface Slope $(ft/ft)^2$		0.011		0.015		0.004		0.005		0.0102		0.0141		0.0104		0.0143	
Bankfull Slope (ft/ft)		---		---		0.006		---		---		---		0.0104		0.0145	

(---): Data was not provided
N/A: Not Applicable

[1]Design Parameters based on revised Shields Diagram.

[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.

[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.

[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 10b. Baseline Stream Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; SF3 and UT1

		Pre-Restoration Condition				Reference Reach Data				Design						As-Built/Baseline			
Parameter	**Gage**	**SF3**		**UT1**		**Long Branch**		**UT to Cane Creek**		**SF3-u/s of UT1**		**SF3-d/s of UT1**		**UT1**		**SF3**		**UT1**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**			**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																			
Bankfull Width (ft)		15.9		9.0		14.8	18.6	8.2	11.8	18.2		18.0		10.7		0.0	0.0	10.1	
Floodprone Width (ft)		48.6		14.2		50+		40+		50+		200+		>100		50+	0.0	100+	
Bankfull Mean Depth		1.8		0.8		1.3	2.1	0.9	1.0	1.5		1.5		0.9		0.0	0.0	0.9	
Bankfull Max Depth		2.4		1.5		1.9	2.9	1.5	1.7	2.1		2.1		1.3		0.0	0.0	1.6	
Bankfull Cross Sectional Area (ft^2)	n/a	28.9		7.2		25.0	34.6	8.5	10.7	27.5		27.1		9.6		0.0	0.0	9.5	
Width/Depth Ratio		8.8		11.1		7.9	13.8	7.9	13.1	12.0		12.0		12.0		0.0	0.0	10.7	
Entrenchment Ratio		3.1		1.6		3.4+		4.59+		2.2+		2.2+		>2.2		0.0	0.0	2.2+	
Bank Height Ratio		1.6		1.9		1.2	1.5	1.0	1.0	1.0		1.0		1.0		0.0	0.0	1.0	
D50 (mm)		4.7		1.0												50.6	63.3	73.8	
Profile																			
Riffle Length (ft)						---		---		---		---		---		12	103	11	26
Riffle Slope (ft/ft)		0.030	0.0500			0.0130	0.0120	0.0120		0.005	0.009	0.0078	0.0140	0.0118	0.0210	0.0003	0.0169	0.0023	0.0185
Pool Length (ft)	n/a					---		---		---		---		---		23	100	20	80
Pool Max Depth (ft)		---		---		---		---		---		---		---		0.0	0.0	2.5	
Pool Spacing (ft)^		---		---		---		---		---		---		---		53	166	58	76
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)		51	106	31	59	60		50	77	54	91	54	90	32	54	54	91	32	54
Radius of Curvature (ft)		27	105	10	83	16	87	11.3	27.1	31	51	31	50	21	30	31	51	21	30
Rc:Bankfull Width (ft/ft)	n/a	7	16	1	9	1	5	1	3	2	3	2	3	2	3	2	3	2	3
Meander Length (ft)		46	272	80	161	66	191	29	96	127	218	126	216	75	129	126	218	75	129
Meander Width Ratio		26	70	3	7	3	4	50	77	3	5	3	5	3	5	3	5	3	5
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%																			
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100	n/a	7.53/16.66/40.82/74.02/97.42/180		N/A/N/A/1/16/107.3/256		---		---								0.08/0.21/11/67.2/256/>2048		0.07/0.16/0.3/26.9/71.7/256	
Reach Shear Stress (Competency) lb/ft^2 [1]		---		---						0.35		0.52		0.37		#DIV/0!		0.37	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)		1.27		0.36		1.49		0.28		1.27				0.36		1.27		0.36	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%		<1%	
Rosgen Classification		E4		E/G5		C/E4		C/E4		C4		C4		C5		C4		C5	
Bankfull Velocity (fps)		3.7		5.87						3.0		3.4		3.2		#DIV/0!	#DIV/0!	3.2	
Bankfull Discharge (cfs)		81.5		30.3		101	124	20.6	53.2	81.5		99.8		30.3		81.5	99.8	30.3	
Q-NFF regression		159.7		65.7															
Q-USGS extrapolation	n/a	---		---															
Q-Mannings		---		---															
Valley Length (ft)		---		---		---		---		---		---		---					
Channel Thalweg Length (ft)		2,183		1,915		---		---		2,116				1,997		2,120		2,038	
Sinuosity (ft)		1.2		1.2		1.3		1.2		1.2		1.2		1.2		1.2		1.2	
Water Surface Slope (ft/ft) [2]		0.004		0.01		0.004		0.005		0.0036		0.0056		0.0084		0.0041		0.0075	
Bankfull Slope (ft/ft)		---		---		0.006		---		---		---		---		0.0047		0.0083	

(---): Data was not provided
N/A: Not Applicable

[1]Design Parameters based on revised Shields Diagram.

[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.

[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.

[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 10c. Baseline Stream Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Lindley Site; SF4 and SF4A

		Pre-Restoration Condition				Reference Reach Data				Design				As-Built/Baseline			
Parameter	**Gage**	**SF4**		**SFA**		**Long Branch**		**UT to Cane Creek**		**SF4**		**SFA**		**SF4**		**SFA**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	n/a	18.6		10.3		14.8	18.6	8.2	11.8	14.0		12.0		0.0	0.0	0.0	0.0
Floodprone Width (ft)		157.3		29.4		50+		40+		50+		200+		0.0	0.0	0.0	0.0
Bankfull Mean Depth		2.7		1.6		1.3	2.1	0.9	1.0	1.9		1.2		0.0	0.0	0.0	0.0
Bankfull Max Depth		4.0		2.2		1.9	2.9	1.5	1.7	2.3		1.7		0.0	0.0	0.0	0.0
Bankfull Cross Sectional Area (ft^2)		49.7		16.9		25.0	34.6	8.5	10.7	53.0		18.0		0.0	0.0	0.0	0.0
Width/Depth Ratio		6.9		6.3		7.9	13.8	7.9	13.1	14.0		12.0		0.0	0.0	0.0	0.0
Entrenchment Ratio		3.5		2.9		3.4+		4.59+		2.2+		2.2+		0.0	0.0	0.0	0.0
Bank Height Ratio		1.4		1.8		1.2	1.5	1.0	1.0	1.0		1.0		0.0	0.0	0.0	0.0
D50 (mm)		0.3		0.8										117.2	134.4	22.6	82.0
Profile																	
Riffle Length (ft)	n/a					---		---		---		---		51	112	41	79
Riffle Slope (ft/ft)		---		---		0.0130	0.0120	0.0120		0.0048	0.0085	0.0108	0.0193	0.0010	0.0098	0.0001	0.0210
Pool Length (ft)						---		---		---		---		54	123	28	79
Pool Max Depth (ft)		---		---		---		---		---		---		0.0	0.0	0.0	0.0
Pool Spacing (ft)^		---		---		---		---		---		---		146	210	71	110
Pool Volume (ft^3)																	
Pattern[3]																	
Channel Beltwidth (ft)	n/a	N/A		N/A		60		50	77	82	136	44	74	82	136	44	74
Radius of Curvature (ft)		N/A		N/A		16	87	11	27	46	76	25	41	46	76	25	41
Rc:Bankfull Width (ft/ft)		---		---		1	5	1	3	1.7	2.8	1.7	2.8	2	3	2	3
Meander Length (ft)		N/A		N/A		66	191	29	96	191	327	103	177	191	327	103	177
Meander Width Ratio		---		---		3	4	6	7	3	5	3	5	3	5	3	5
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	n/a																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		N/A/N/A/0.3/17.9/45.8/90		N/A/0.1/0.8/204./62.9/362		---		---						0.13/0.36/5.3/102.5/320.7/>2048		SC/0.12/1.4/44/71.3/362	
Reach Shear Stress (Competency) lb/ft^2[1]		---		---						0.32	0.63	---		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	n/a	5.26		1.00		1.49		0.28		5.26		1.00		5.26		1.00	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%	
Rosgen Classification		E5		E5		C/E4		C/E4		C5		C5		C4		C5	
Bankfull Velocity (fps)		5.9		5.26						3.9		3.7		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Bankfull Discharge (cfs)		247.4		67.3		101	124	20.6	53.2	204		67.3		204		67.3	
Q-NFF regression		432.92		134.59													
Q-USGS extrapolation		---		---													
Q-Mannings		---		---													
Valley Length (ft)		---		---		---		---		---		---					
Channel Thalweg Length (ft)		1450.0		609.0		---		---		1,424		868		1,429		866	
Sinuosity (ft)		1.3		1.1		1.3		1.2		1.2		1.0		1.2		1.1	
Water Surface Slope ($ft/ft)^2$		0.003		0.008		0.004		0.005		0.0034		0.0077		0.0033		0.0070	
Bankfull Slope (ft/ft)		---		---		0.006		---		0.0034		0.0077		0.0034		0.0067	

(---): Data was not provided
N/A: Not Applicable
[1]Design Parameters based on revised Shields Diagram.
[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.
[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.
[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross Section)
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris and Lindley Site

	SF1												UT2											
	Cross Section 1 (Riffle)						Cross Section 2 (Pool)						Cross Section 3 (Pool)						Cross Section 4 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	595.5						594.9						600.2						599.5					
Bankfull Width (ft)	8.4	9.0	8.2	7.8			11.7	13.9	10.9	10.4			15.0	19.4	15.7	14.2			16.6	18.6	17.4	16.9		
Floodprone Width (ft)	50+	50+	50+	50+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A			200+	200+	200+	200+		
Bankfull Mean Depth (ft)	0.7	0.7	0.6	0.6			0.9	0.9	0.9	0.8			1.6	1.4	1.5	1.6			0.8	0.9	0.8	0.8		
Bankfull Max Depth (ft)	1.0	1.1	1.0	0.9			1.7	2.1	1.9	1.9			2.7	2.7	2.6	2.6			1.1	1.4	1.2	1.2		
Bankfull Cross Sectional Area (ft^2)	5.6	6.3	4.8	4.6			12.8	12.2	9.9	8.8			24.2	26.2	23.1	22.5			13.6	18.6	14.1	13.9		
Bankfull Width/Depth Ratio	12.8	12.9	14.2	13.5			N/A	N/A	12.0	12.3			N/A	N/A	10.7	9.0			20.4	25.4	21.4	20.6		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.2	1.2	1.2	1.2			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		

	SF3																							
	Cross Section 5 (Riffle)						Cross Section 6 (Pool)						Cross Section 7 (Riffle)						Cross Section 8 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	567.8						575.0						574.7						572.9					
Bankfull Width (ft)	19.7	22.6	19.4	18.8			19.7	24.8	22.7	23.5			16.7	29.3	15.8	16.5			19.7	22.3	15.9	17.0		
Floodprone Width (ft)	200+	200+	200+	200+			N/A	N/A	N/A	N/A			200+	200+	200+	200+			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.6	1.5	1.5	1.5			1.6	2.0	1.9	1.8			1.2	1.0	1.2	1.2			1.4	1.7	1.6	1.6		
Bankfull Max Depth (ft)	2.3	2.5	2.4	2.4			2.3	4.1	3.7	3.7			2.2	2.6	2.2	2.2			3.0	3.5	3.0	3.0		
Bankfull Cross Sectional Area (ft^2)	30.5	34.5	29.9	28.3			30.5	50.2	43.1	41.4			20.6	29.8	19.2	19.5			28.0	36.9	26.2	27.6		
Bankfull Width/Depth Ratio	12.7	14.8	12.5	12.5			12.7	12.1	12.0	13.3			13.5	28.8	12.9	14.0			13.9	13.5	9.7	10.5		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		

	SF3						UT1						SF4											
	Cross Section 9 (Riffle)						Cross Section 10 (Riffle)						Cross Section 11 (Pool)						Cross Section 12 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	572.5						574.0						573.8						539.7					
Bankfull Width (ft)	15.9	24.2	14.9	15.4			12.6	10.1	11.3	10.6			14.2	19.4	12.0	13.4			33.3	34.1	29.8	29.6		
Floodprone Width (ft)	200+	200+	200+	200+			100+	100+	100+	100+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.2	1.1	1.0	1.1			0.8	0.9	0.8	0.8			1.3	0.9	1.2	1.1			2.2	2.1	2.4	2.4		
Bankfull Max Depth (ft)	1.8	2.3	1.8	1.7			1.5	1.6	1.5	1.4			2.6	2.5	2.3	2.4			4.9	4.7	4.9	4.8		
Bankfull Cross Sectional Area (ft^2)	19.0	27.0	15.5	16.2			10.5	9.5	9.5	8.1			17.7	17.0	14.6	15.0			74.4	72.2	70.7	71.7		
Bankfull Width/Depth Ratio	13.3	21.6	14.4	14.6			15.1	10.7	13.4	13.8			11.3	22.1	10.0	12.0			14.9	16.2	12.5	12.2		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		

	SF4																		SF4A					
	Cross Section 13 (Riffle)						Cross Section 14 (Pool)						Cross Section 15 (Riffle)						Cross Section 16 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	539.6						537.8						537.7						540.4					
Bankfull Width (ft)	27.3	26.7	26.0	28.8			38.7	44.4	45.4	47.6			27.6	27.3	26.2	28.3			23.7	17.3	13.9	14.9		
Floodprone Width (ft)	200+	200+	200+	200+			N/A	N/A	N/A	N/A			200+	200+	200+	200+			200+	200+	200+	200+		
Bankfull Mean Depth (ft)	1.8	2.9	1.9	1.8			1.8	1.8	1.8	1.8			1.9	2.0	2.1	1.9			0.9	1.6	1.8	1.7		
Bankfull Max Depth (ft)	3.0	2.9	2.9	3.1			4.3	4.6	5.0	5.0			3.2	3.0	3.2	3.1			2.3	2.8	3.0	3.1		
Bankfull Cross Sectional Area (ft^2)	49.5	49.0	49.7	51.8			70.6	78.1	82.2	86.0			51.2	53.8	53.9	53.3			20.4	27.1	25.2	25.5		
Bankfull Width/Depth Ratio	15.1	14.6	13.6	16.0			21.2	25.3	25.1	26.4			14.9	13.8	12.8	15.0			27.5	11.1	7.7	8.7		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+			2.2+	2.2+	2.2+	2.2+		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		

	SF4A											
	Cross Section 17 (Riffle)						Cross Section 18 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	537.3						536.9					
Bankfull Width (ft)	13.9	13.6	12.8	11.5			16.0	13.5	10.6	11.1		
Floodprone Width (ft)	200+	200+	200+	200+			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.3	1.2	1.2	1.2			1.4	1.6	1.9	1.6		
Bankfull Max Depth (ft)	2.1	2.1	2.4	2.3			2.8	3.4	3.0	2.7		
Bankfull Cross Sectional Area (ft^2)	17.5	16.1	15.2	13.9			22.9	21.0	20.5	18.3		
Bankfull Width/Depth Ratio	11.0	11.5	10.7	9.5			11.1	8.6	5.4	6.7		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		

Table 12a. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; SF1

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	8.4		9.0		8.2		7.8					
Floodprone Width (ft)	50+		50+		50+		50+					
Bankfull Mean Depth	0.7		0.7		0.6		0.6					
Bankfull Max Depth	1.0		1.1		1.0		0.9					
Bankfull Cross Sectional Area (ft^2)	5.6		6.3		4.8		4.6					
Width/Depth Ratio	12.8		12.9		14.2		13.5					
Entrenchment Ratio	2.2+		2.2+		2.2+		2.2+					
Bank Height Ratio	1.0		1.0		1.0		1.0					
D50 (mm)	23.3		27.8		31.0		34.6					
Profile												
Riffle Length (ft)	11	36	13	38	11	37	13	37				
Riffle Slope (ft/ft)	0.0053	0.0283	0.0008	0.0376	0.0077	0.0426	0.0111	0.0362				
Pool Length (ft)	16	34	15	30	15	33	18	36				
Pool Max Depth (ft)	1.7		2.1		1.9		1.7					
Pool Spacing (ft)	37	61	36	59	37	59	41	64				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	26	44										
Radius of Curvature (ft)	15	25										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	62	106										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5		C5		C5					
Channel Thalweg Length (ft)	874		874		874		874					
Sinuosity (ft)	1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0104		0.0104		0.0111		0.0101					
Bankfull Slope (ft/ft)	0.0104		0.0108		0.0104		0.0099					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/SC/46.6/100/256		SC/SC/SC/91.6/202.4/362		SC/0.2/9.7/42.0/128/256		SC/0.25/13.3/52.9/77.8/128					
% of Reach with Eroding Banks			0%		0%		0%					

Table 12b. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; UT2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	16.6		18.6		17.4		16.9					
Floodprone Width (ft)	200+		200+		200+		200+					
Bankfull Mean Depth	0.8		0.9		0.8		0.8					
Bankfull Max Depth	1.1		1.4		1.2		1.2					
Bankfull Cross Sectional Area (ft^2)	13.6		18.6		14.1		13.9					
Width/Depth Ratio	20.4		25.4		21.4		20.6					
Entrenchment Ratio	2.2+		2.2+		2.2+		2.2+					
Bank Height Ratio	1.0		1.0		1.0		1.0					
D50 (mm)	34.3		77.3		27.6		29.3					
Profile												
Riffle Length (ft)	7	25	3	24	4	13	4	27				
Riffle Slope (ft/ft)	0.0040	0.1512	0.0045	0.0775	0.0117	0.0373	0.0098	0.0387				
Pool Length (ft)	16	51	11	46	18	47	17	45				
Pool Max Depth (ft)	2.7		2.7		2.6		2.3					
Pool Spacing (ft)	23	59	21	60	21	55	23	58				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	N/A											
Radius of Curvature (ft)	N/A											
Rc:Bankfull Width (ft/ft)	N/A											
Meander Wave Length (ft)	N/A											
Meander Width Ratio	N/A											
Additional Reach Parameters												
Rosgen Classification	C5		C5		C5		C5					
Channel Thalweg Length (ft)	418		418		418		418					
Sinuosity (ft)	1.0		1.0		1.0		1.0					
Water Surface Slope (ft/ft)	0.0143		0.0149		0.0152		0.0141					
Bankfull Slope (ft/ft)	0.0145		0.0141		0.0141		0.0128					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/SC/110.1/163.3/256		SC/SC/SC/58.6/111.2/181		SC/0.5/17.4/58.6/99.5/128		SC/0.2/6.7/62.2/83.1/256					
% of Reach with Eroding Banks			0%		0%		0%					

Table 12c. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; SF3

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	15.9	19.7	22.6	29.3	14.9	19.4	16.5	18.8				
Floodprone Width (ft)	200+	200+	200+	200+	200+	200+	200+	200+				
Bankfull Mean Depth	1.2	1.6	1.0	1.5	1.0	1.5	1.1	1.5				
Bankfull Max Depth	1.8	2.3	2.3	2.6	1.8	2.4	1.7	2.4				
Bankfull Cross Sectional Area (ft^2)	19.0	30.5	27.0	34.5	15.5	29.9	16.2	28.3				
Width/Depth Ratio	12.7	13.5	14.8	28.8	12.5	14.4	12.5	14.6				
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+				
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
D50 (mm)	19.8	35.4	22.6	39.8	18.6	38.7	13.9	35.5				
Profile												
Riffle Length (ft)	12	103	29	100	18	102	17	100				
Riffle Slope (ft/ft)	0.0003	0.0169	0.0019	0.0129	0.0008	0.0131	0.0012	0.0128				
Pool Length (ft)	23	100	45	74	21	72	19	78				
Pool Max Depth (ft)	2.3	2.5	2.8	5.0	3.0	3.7	3.4					
Pool Spacing (ft)	53	166	50	151	42	156	41	155				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	54	91										
Radius of Curvature (ft)	31	51										
Rc:Bankfull Width (ft/ft)	1.7	3.0										
Meander Wave Length (ft)	126	218										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C5		C5					
Channel Thalweg Length (ft)	2,120		2,120		2,120		2,120					
Sinuosity (ft)	1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0041		0.0045		0.0043		0.0043					
Bankfull Slope (ft/ft)	0.0047		0.0047		0.0042		0.0043					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.08/0.21/11/67.2/256/>2048		0.50/16.47/26/66.8/119.3/180		0.42/9.38/17.3/53.7/90/>2048		1.41/8/17/70.2/111.2/256					
% of Reach with Eroding Banks			0%		0%		0%					

Table 12d. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Harris Site; UT1

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	12.7		10.1		11.3		10.6					
Floodprone Width (ft)	100+		100+		100+		100+					
Bankfull Mean Depth	0.8		0.9		0.8		0.8					
Bankfull Max Depth	1.5		1.6		1.5		1.4					
Bankfull Cross Sectional Area (ft^2)	10.5		9.5		9.5		8.1					
Width/Depth Ratio	15.1		10.7		13.4		13.8					
Entrenchment Ratio	2.2+		2.2+		2.2+		2.2+					
Bank Height Ratio	1.0		1.0		1.0		1.0					
D50 (mm)	21.1		40.8		39.3		33.9					
Profile												
Riffle Length (ft)	11	39	19	36	14	36	14	36				
Riffle Slope (ft/ft)	0.0023	0.0185	0.0016	0.0258	0.0025	0.0407	0.0012	0.0299				
Pool Length (ft)	20	80	18	51	25	53	23	52				
Pool Max Depth (ft)	2.6		2.5		2.3		2.7					
Pool Spacing (ft)	58	76	39	76	43	73	52	77				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	32	54										
Radius of Curvature (ft)	21	30										
Rc:Bankfull Width (ft/ft)	2.0	2.8										
Meander Wave Length (ft)	75	129										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5		C5		C 5					
Channel Thalweg Length (ft)	2,038		2,038		2,038		2,038					
Sinuosity (ft)	1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0075		0.0078		0.0070		0.0077					
Bankfull Slope (ft/ft)	0.0083		0.0058		0.0077		0.0091					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.07/0.16/0.3/26.9/71.7/256		SC/1.15/11/67.2/87.8/180		SC/0.20/6.7./45.0/84.1/362		SC/0.30/8.0/78.5/128.0/180.0					
% of Reach with Eroding Banks			0%		0%		0%					

Table 12e. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Lindley Site; SF4

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	27.3	27.6	26.7	27.3	26.0	26.2	28.3	28.8				
Floodprone Width (ft)	200+		200+		200+		200+					
Bankfull Mean Depth	1.8	1.9	2.0	2.9	1.9	2.1	1.8	1.9				
Bankfull Max Depth	3.0	3.2	2.9	3.0	2.9	3.2	3.1	3.1				
Bankfull Cross Sectional Area (ft^2)	49.5	51.2	49.0	53.8	49.7	53.9	51.8	53.3				
Width/Depth Ratio	14.9	15.1	13.8	14.6	12.8	13.6	15.0	16.0				
Entrenchment Ratio	2.2+		2.2+		2.2+		2.2+					
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
D50 (mm)	29.1	35.6	19	25	26.9	28.1	28.5	40.5				
Profile												
Riffle Length (ft)	51	112	31	111	46	115	50	119				
Riffle Slope (ft/ft)	0.0010	0.0098	0.0034	0.0119	0.0028	0.0075	0.0032	0.0072				
Pool Length (ft)	54	123	27	169	26	123	24	135				
Pool Max Depth (ft)	4.3	4.9	4.6	4.7	4.9	5.0	4.9					
Pool Spacing (ft)	146	210	151	211	150	210	138	221				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	82	136										
Radius of Curvature (ft)	46	76										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	191	327										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4					
Channel Thalweg Length (ft)	1,429		1,429		1,429		1,429					
Sinuosity (ft)	1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0033		0.0031		0.0031		0.0030					
Bankfull Slope (ft/ft)	0.0034		0.0034		0.0035		0.0031					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.13/0.36/5.3/102.5/320.7/>2048		SC/0.25/5.1/72.7/139.4/256		SC/1.41/16/69.7/115.7/>2048		0.17/4.98/18.2/135.2/246.5/>204					
% of Reach with Eroding Banks			0%		0%		0%					

Table 12f. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Lindley Site; SF4A

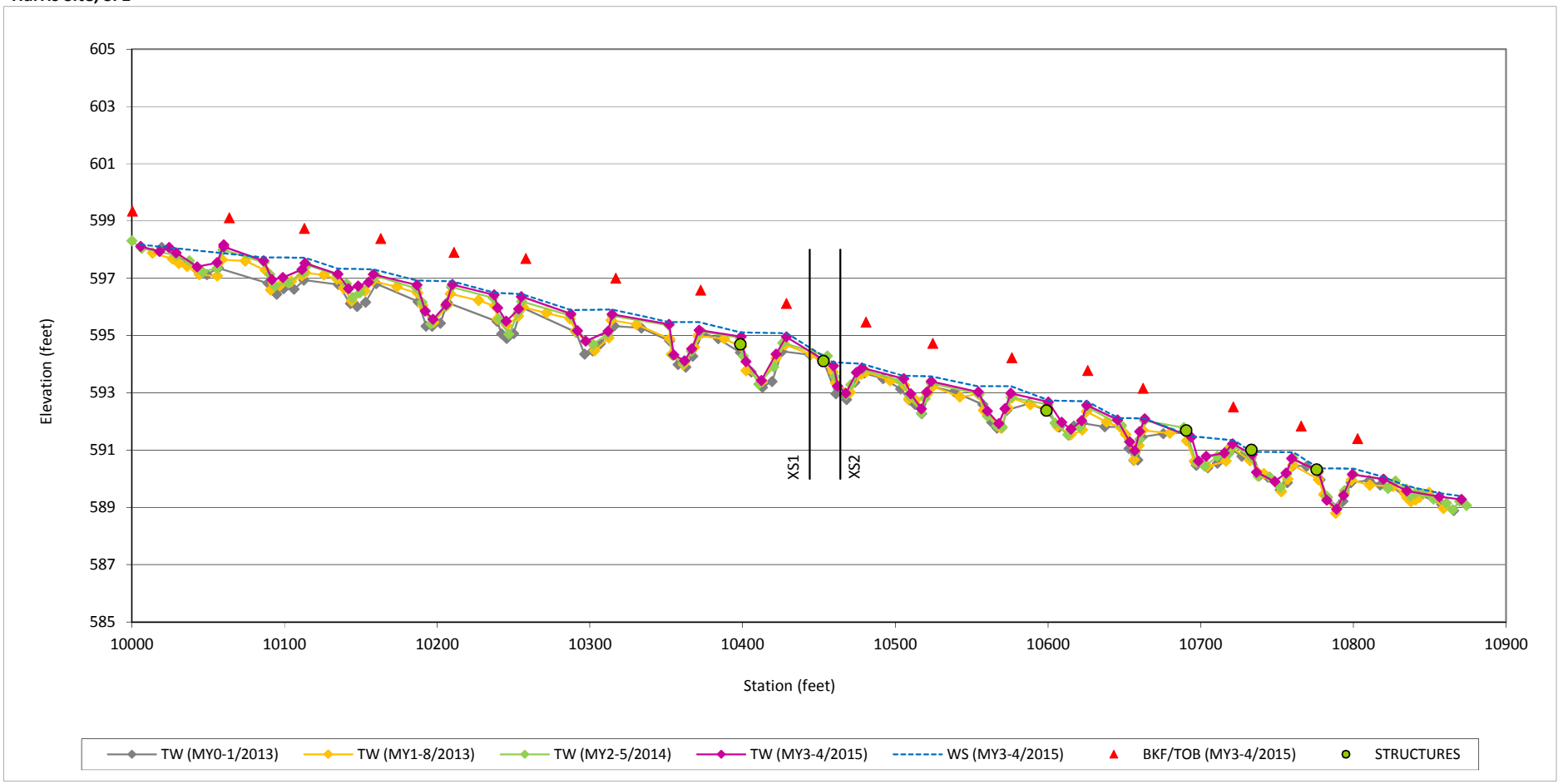
Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	13.9	23.7	13.6	15.4	12.8	13.9	11.5	14.9				
Floodprone Width (ft)	200+		200+		200+		200+					
Bankfull Mean Depth	0.9	1.3	1.2	1.7	1.2	1.8	1.2	1.7				
Bankfull Max Depth	2.1	2.3	2.1	2.8	2.4	3.0	2.3	3.1				
Bankfull Cross Sectional Area (ft^2)	17.5	20.4	16.1	26.3	15.2	25.2	13.9	25.5				
Width/Depth Ratio	11.0	27.5	9.0	11.5	7.7	10.7	8.7	9.5				
Entrenchment Ratio	2.2+		2.2+		2.2+		2.2+					
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
D50 (mm)	9.4	12.7	4.4	17.1	31.4	32	17	25.1				
Profile												
Riffle Length (ft)	41	79	6	75	5	52	5	67				
Riffle Slope (ft/ft)	0.0001	0.0210	0.0177	0.0321	0.0063	0.0577	0.0004	0.0483				
Pool Length (ft)	28	79	15	46	16	68	16	61				
Pool Max Depth (ft)	2.1	2.8	2.8	3.8	3.0		3.8					
Pool Spacing (ft)	71	110	32	111	35	104	35	109				
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	44	74										
Radius of Curvature (ft)	25	41										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	103	177										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5		C5		C5					
Channel Thalweg Length (ft)	866		866		866		866					
Sinuosity (ft)	1.1		1.1		1.1		1.1					
Water Surface Slope (ft/ft)	0.0070		0.0047		0.0049		0.0046					
Bankfull Slope (ft/ft)	0.0067		0.0077		0.0066		0.0067					
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.12/1.4/44/71.3/362		SC/0.10/0.3/48.8/123.6/256		0.93/5.6/12.8/42.0/85.0/180		SC/0.71/18.0/64.0/121.7/512					
% of Reach with Eroding Banks			43%		43%		50%					

Longitudinal Profile Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; SF1

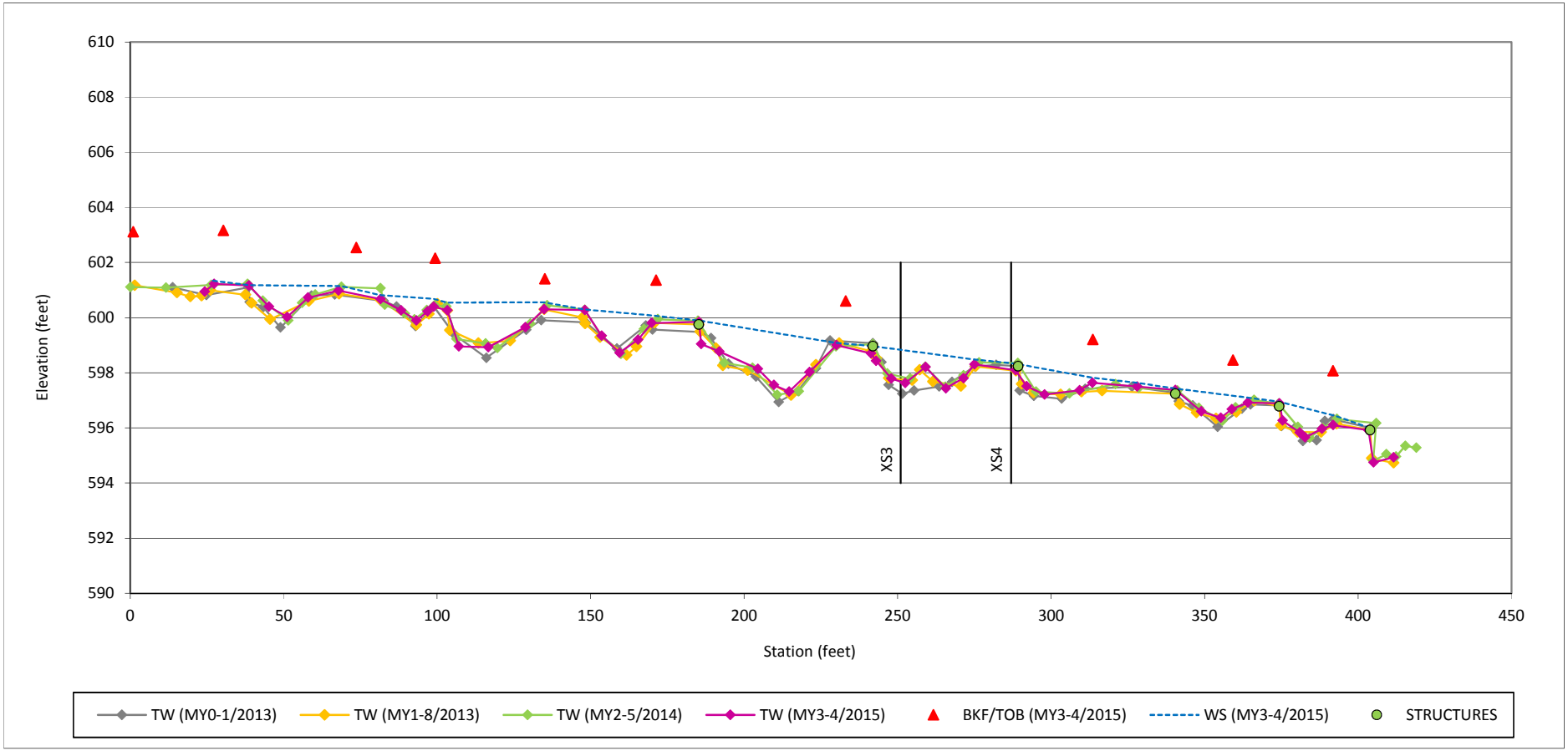


Longitudinal Profile Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; UT2



Longitudinal Profile Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

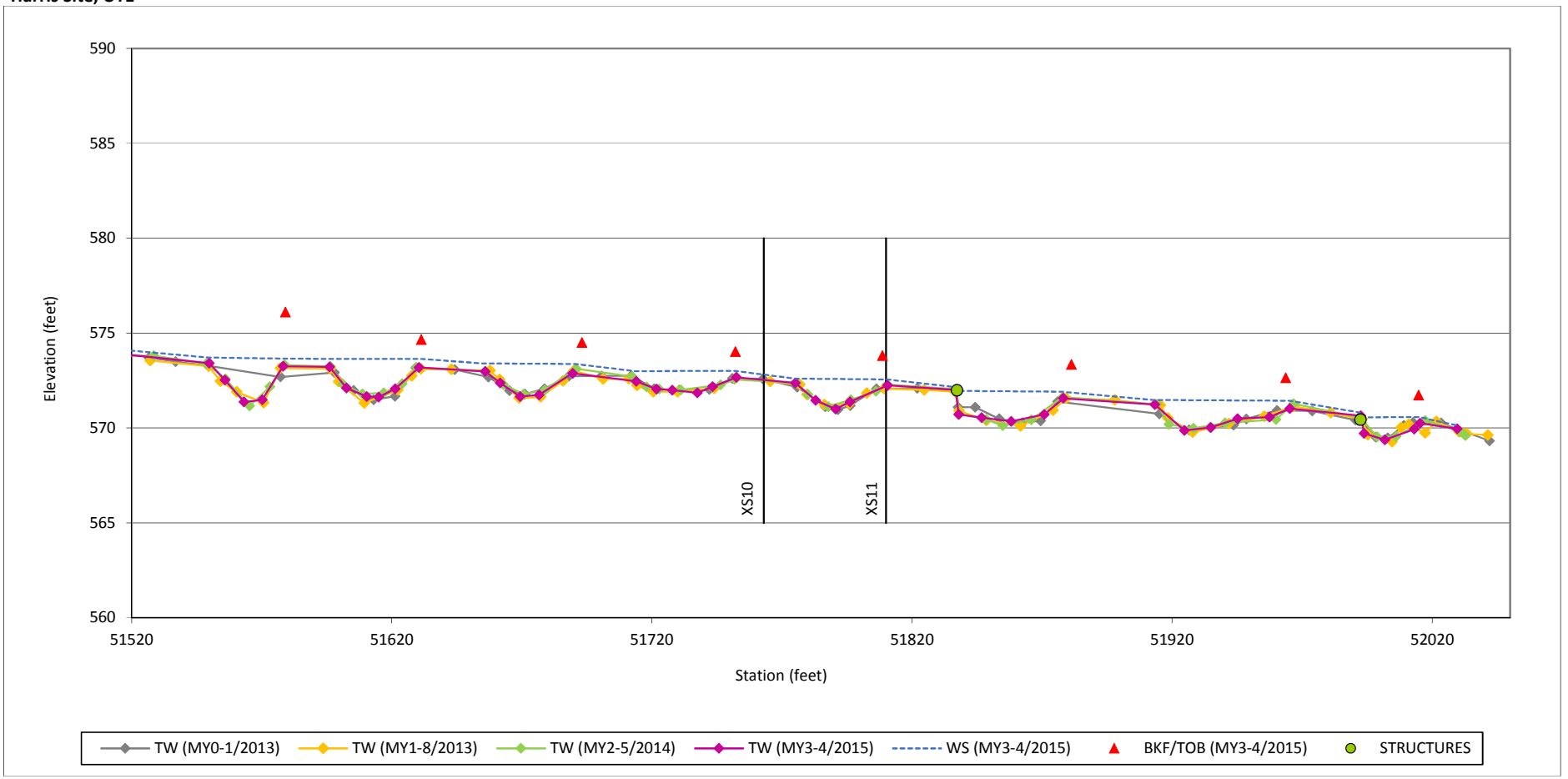
Harris Site; SF3

Longitudinal Profile Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Harris Site; UT1

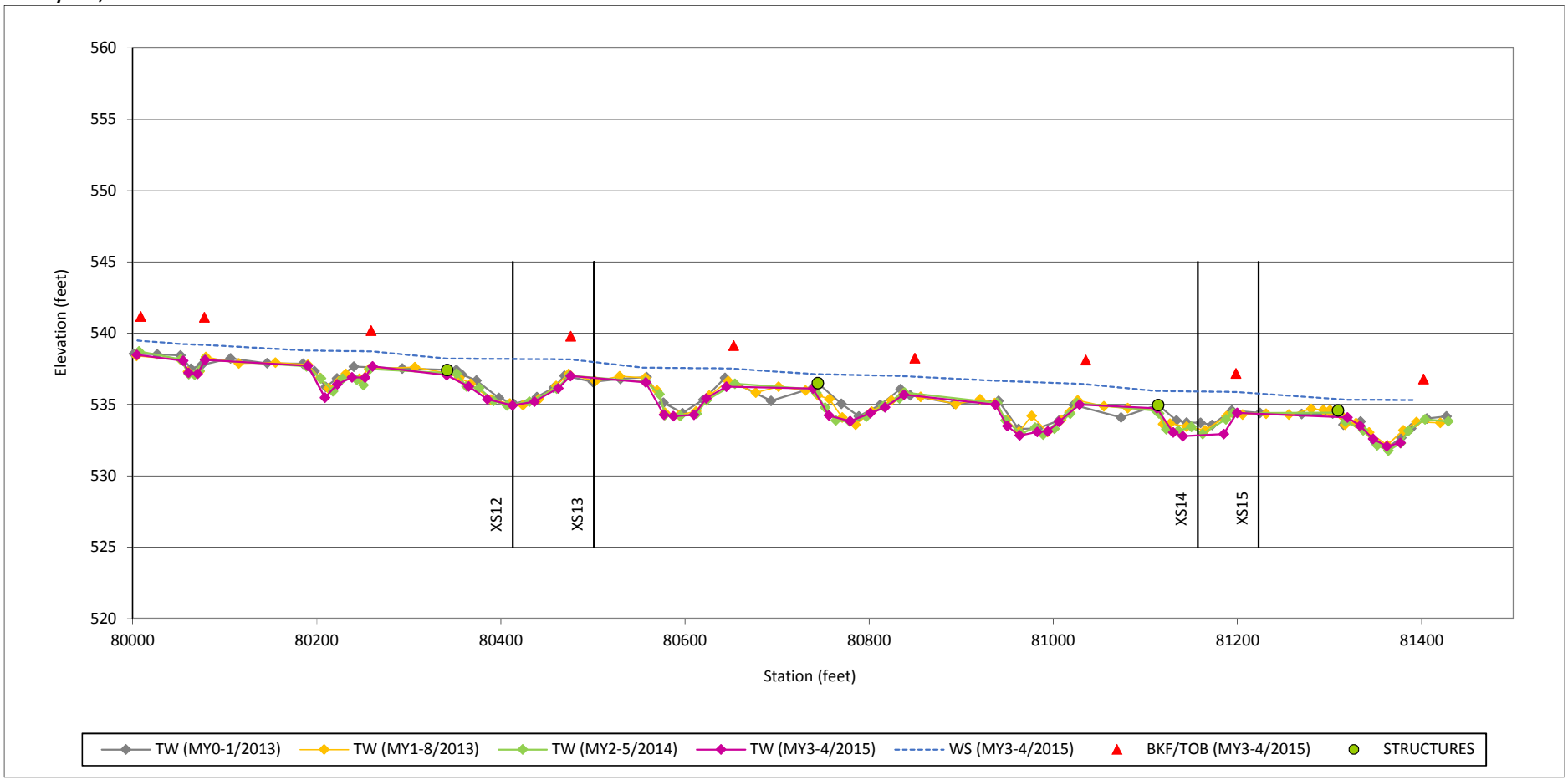


Longitudinal Profile Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Lindley Site; SF4



Longitudinal Profile Plots

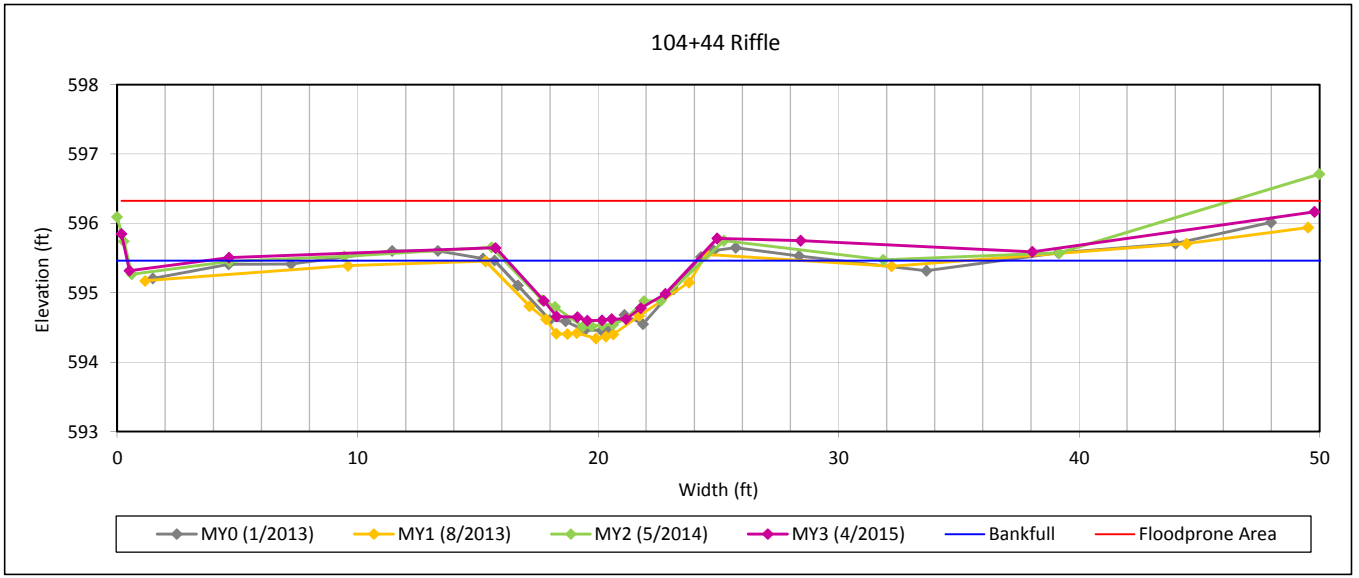
Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Lindley Site; SF4A

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 1 - SF1



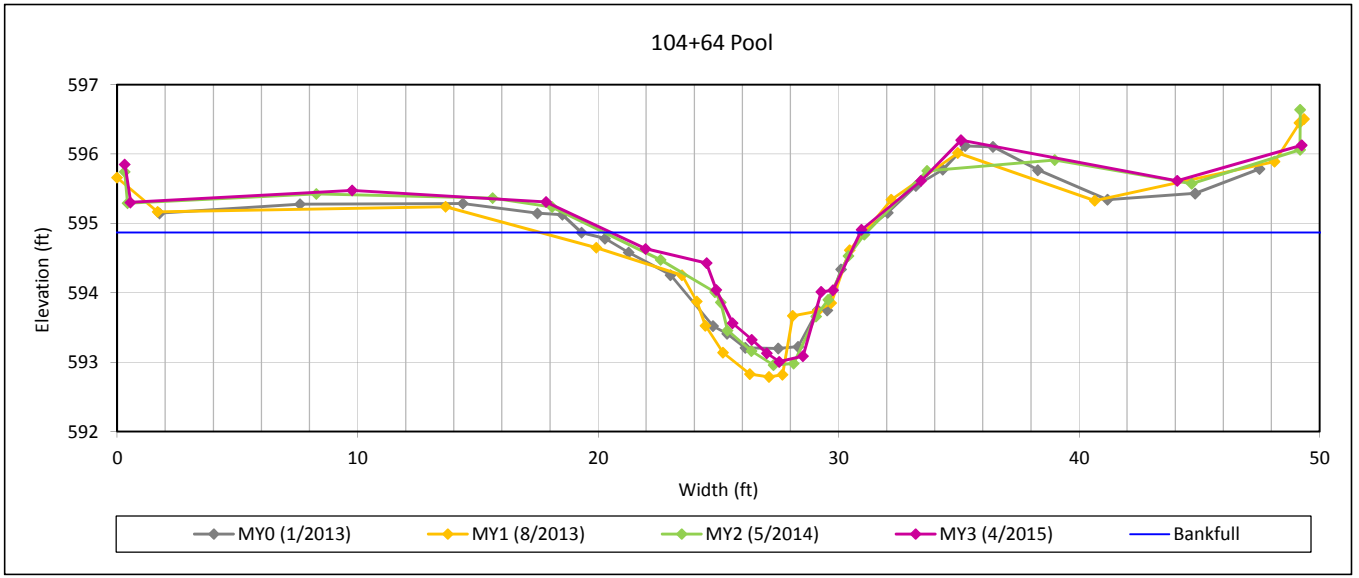
Bankfull Dimensions	
4.6	x-section area (ft.sq.)
7.8	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
8.1	wetted parimeter (ft)
0.6	hyd radi (ft)
13.5	width-depth ratio
50.0	W flood prone area (ft)
6.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 2 - SF1



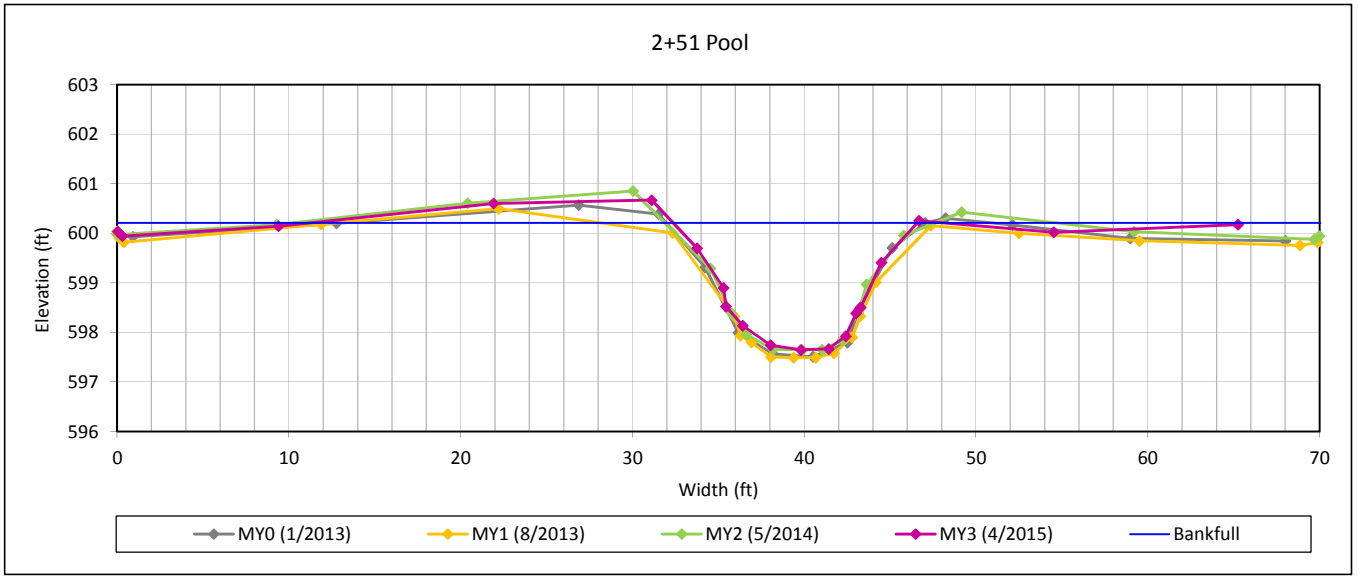
Bankfull Dimensions	
8.8	x-section area (ft.sq.)
10.4	width (ft)
0.8	mean depth (ft)
1.9	max depth (ft)
11.5	wetted parimeter (ft)
0.8	hyd radi (ft)
12.3	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 3 - UT2



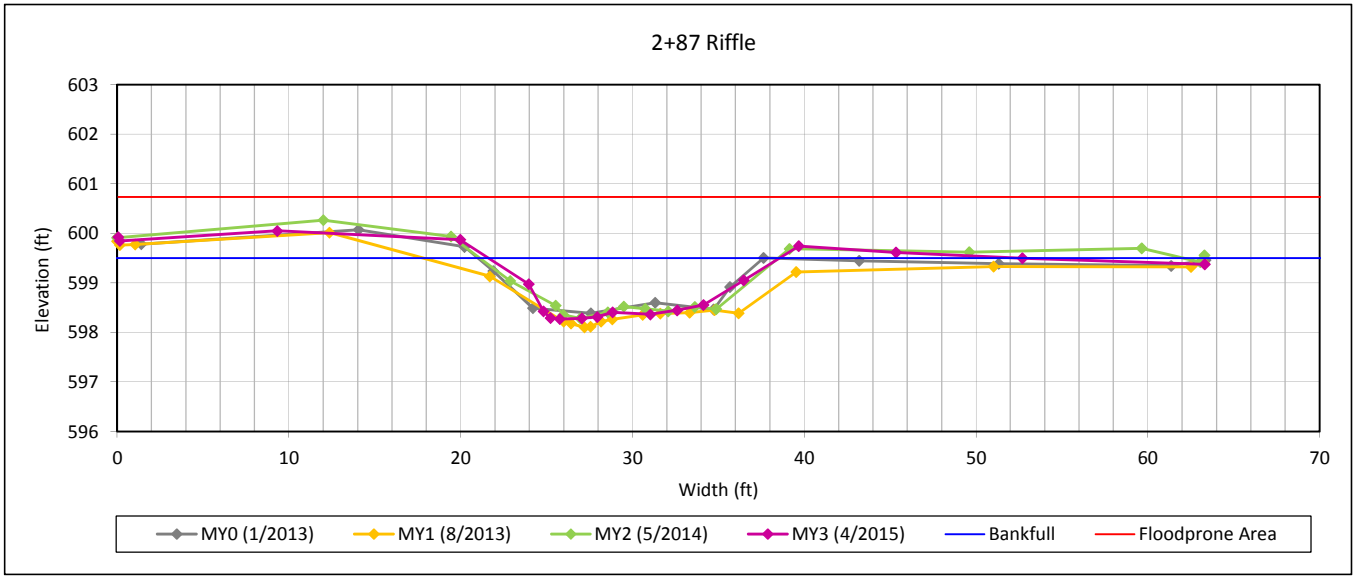
Bankfull Dimensions	
22.5	x-section area (ft.sq.)
14.2	width (ft)
1.6	mean depth (ft)
2.6	max depth (ft)
15.6	wetted parimeter (ft)
1.4	hyd radi (ft)
9.0	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 4 - UT2



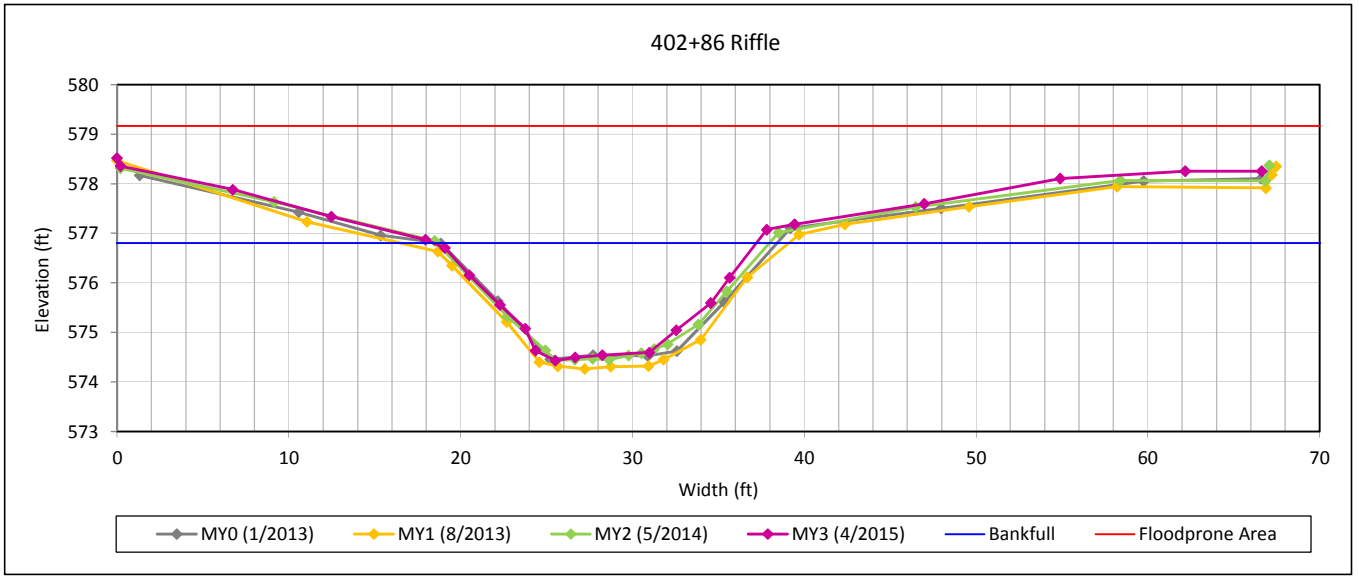
Bankfull Dimensions	
13.9	x-section area (ft.sq.)
16.9	width (ft)
0.8	mean depth (ft)
1.2	max depth (ft)
17.3	wetted parimeter (ft)
0.8	hyd radi (ft)
20.6	width-depth ratio
200.0	W flood prone area (ft)
11.8	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 5 - SF3



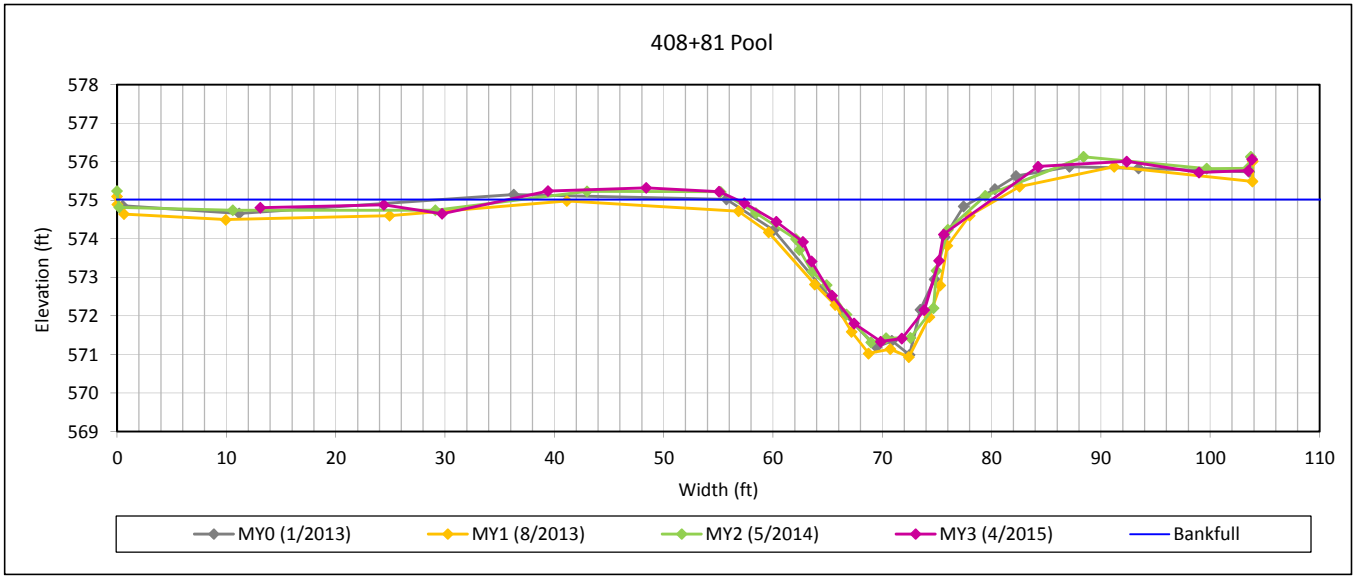
Bankfull Dimensions	
28.3	x-section area (ft.sq.)
18.8	width (ft)
1.5	mean depth (ft)
2.4	max depth (ft)
19.6	wetted parimeter (ft)
1.4	hyd radi (ft)
12.5	width-depth ratio
100.0	W flood prone area (ft)
5.3	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 6 - SF3



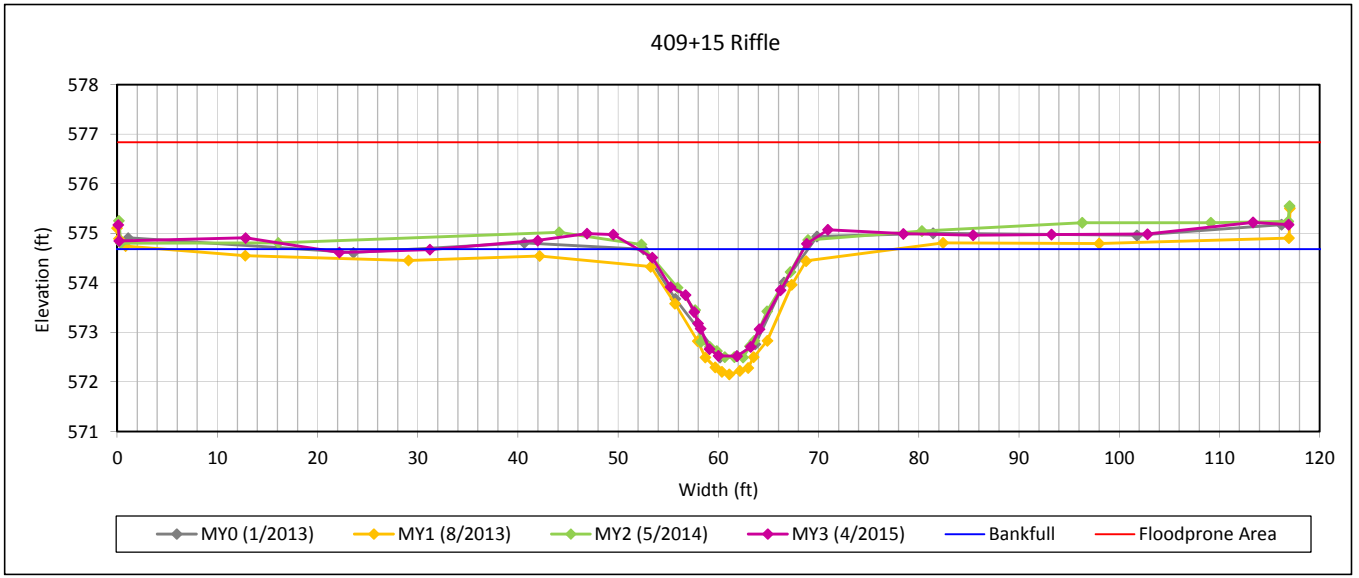
Bankfull Dimensions	
41.4	x-section area (ft.sq.)
23.5	width (ft)
1.8	mean depth (ft)
3.7	max depth (ft)
25.2	wetted parimeter (ft)
1.6	hyd radi (ft)
13.3	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 7 - SF3



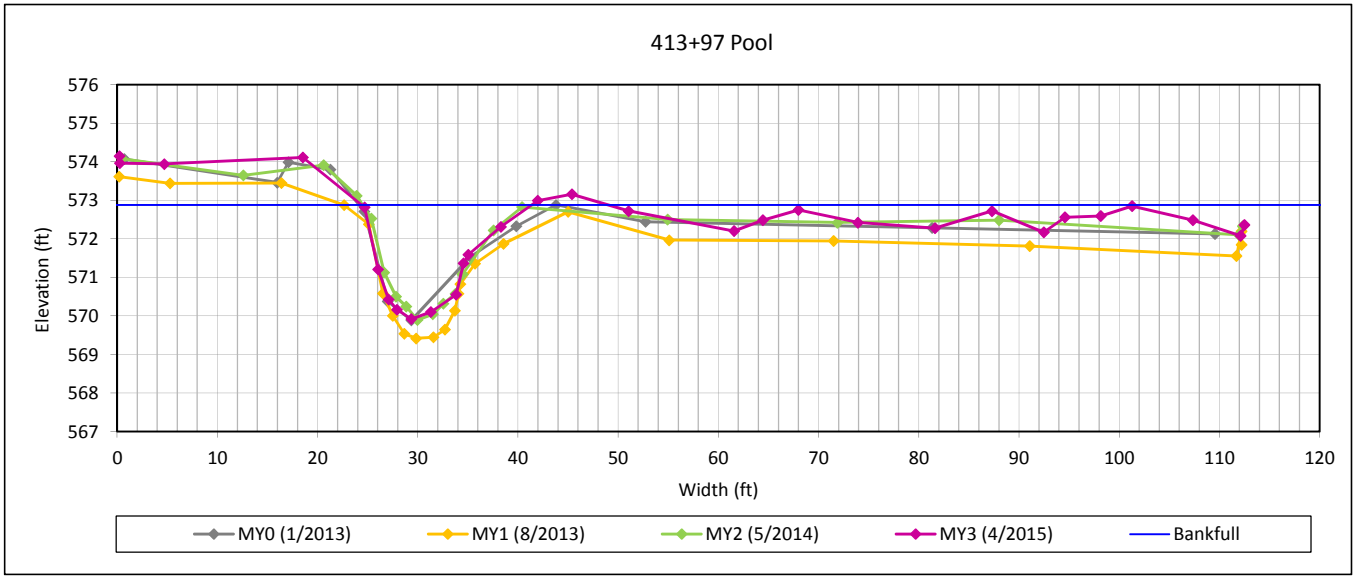
Bankfull Dimensions	
19.5	x-section area (ft.sq.)
16.5	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
17.3	wetted parimeter (ft)
1.1	hyd radi (ft)
14.0	width-depth ratio
200.0	W flood prone area (ft)
12.1	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 8 - SF3



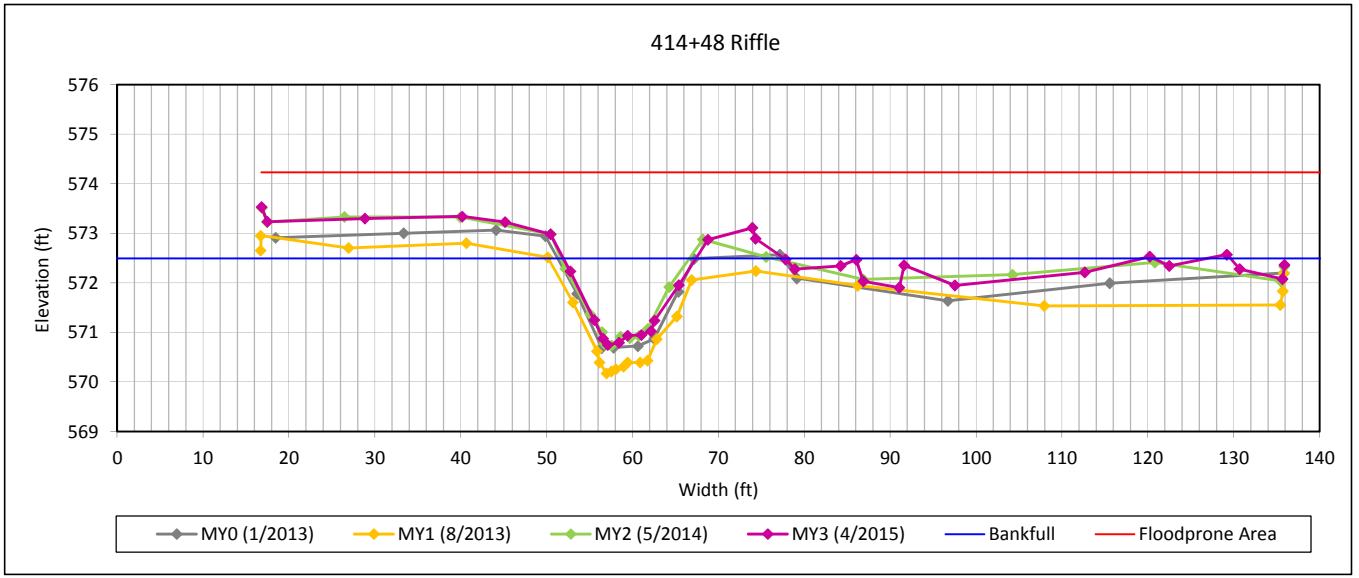
Bankfull Dimensions	
27.6	x-section area (ft.sq.)
17.0	width (ft)
1.6	mean depth (ft)
3.0	max depth (ft)
18.7	wetted parimeter (ft)
1.5	hyd radi (ft)
10.5	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 9 - SF3



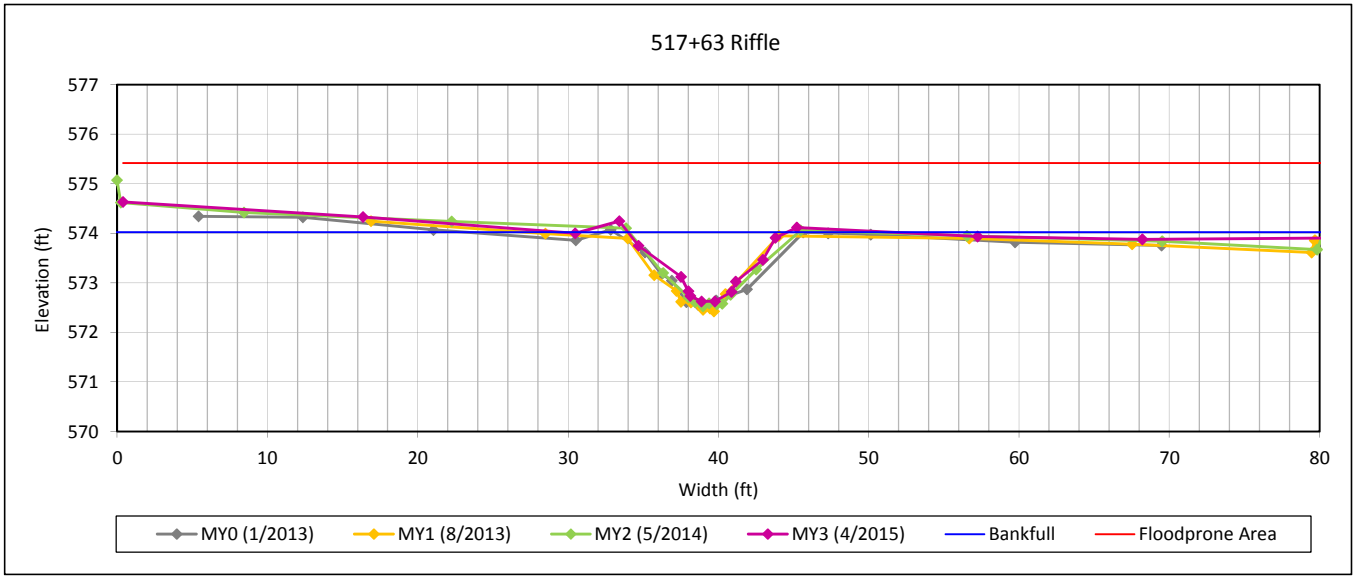
Bankfull Dimensions	
16.2	x-section area (ft.sq.)
15.4	width (ft)
1.1	mean depth (ft)
1.7	max depth (ft)
15.9	wetted parimeter (ft)
1.0	hyd radi (ft)
14.6	width-depth ratio
200.0	W flood prone area (ft)
13.0	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 10 - UT1



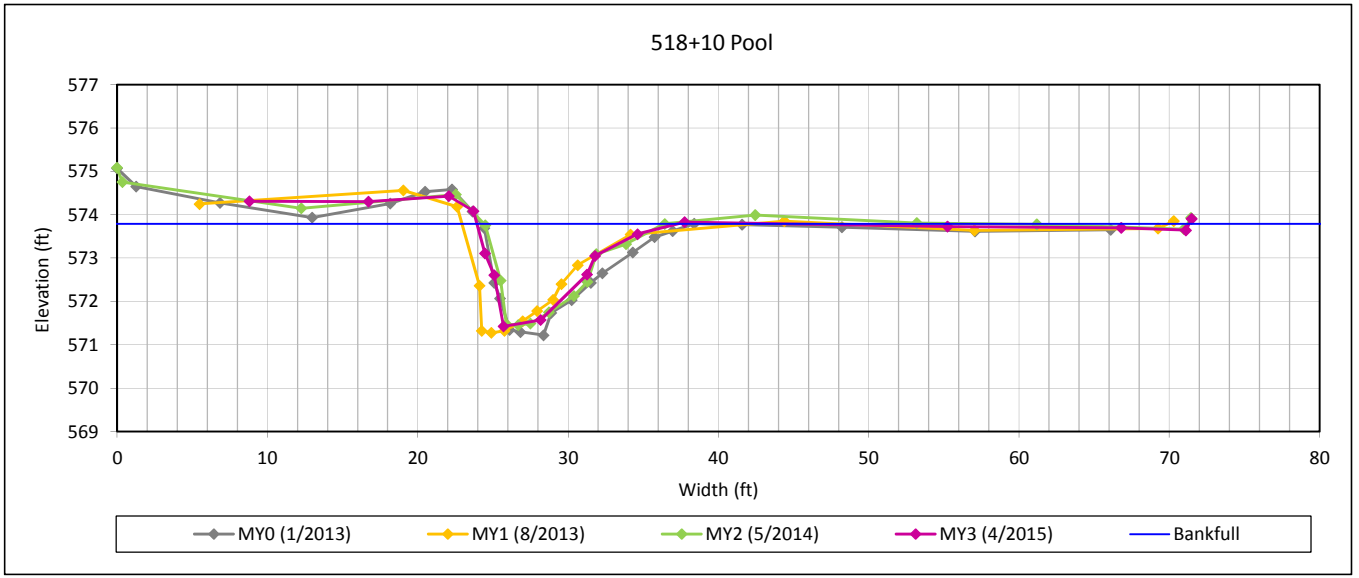
Bankfull Dimensions	
8.1	x-section area (ft.sq.)
10.6	width (ft)
0.8	mean depth (ft)
1.4	max depth (ft)
11.1	wetted parimeter (ft)
0.7	hyd radi (ft)
13.8	width-depth ratio
200.0	W flood prone area (ft)
18.9	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 11 - UT1



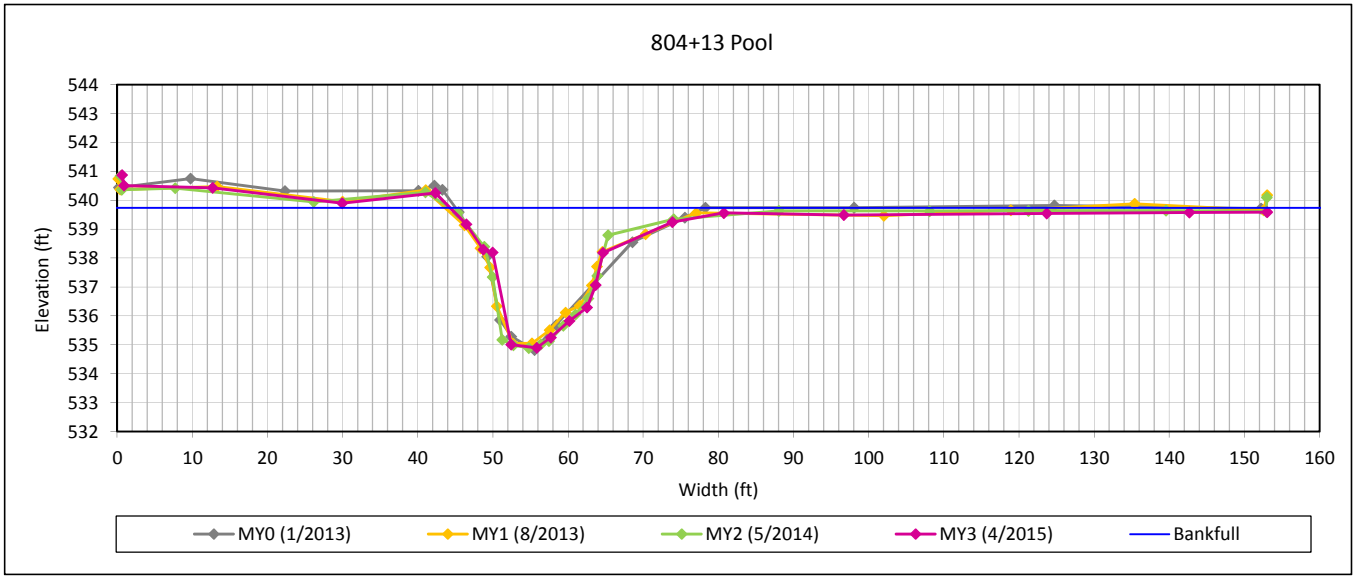
Bankfull Dimensions	
15.0	x-section area (ft.sq.)
13.4	width (ft)
1.1	mean depth (ft)
2.4	max depth (ft)
15.0	wetted parimeter (ft)
1.0	hyd radi (ft)
12.0	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 12 - SF4



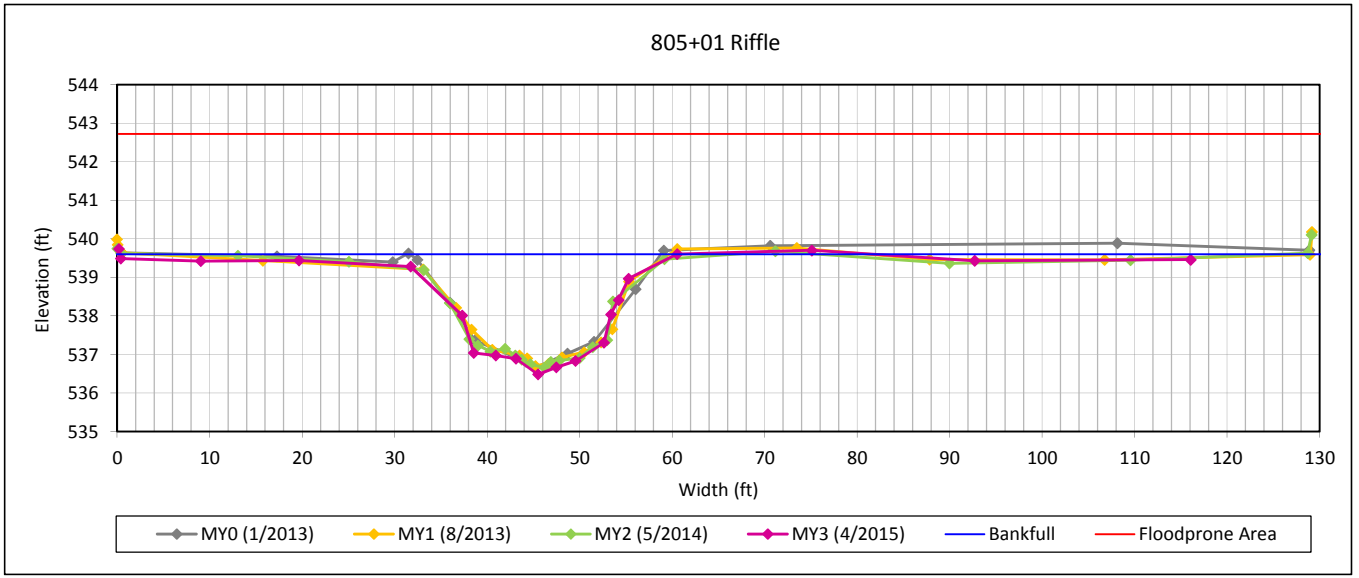
Bankfull Dimensions	
71.7	x-section area (ft.sq.)
29.6	width (ft)
2.4	mean depth (ft)
4.8	max depth (ft)
32.4	wetted parimeter (ft)
2.2	hyd radi (ft)
12.2	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 13 - SF4



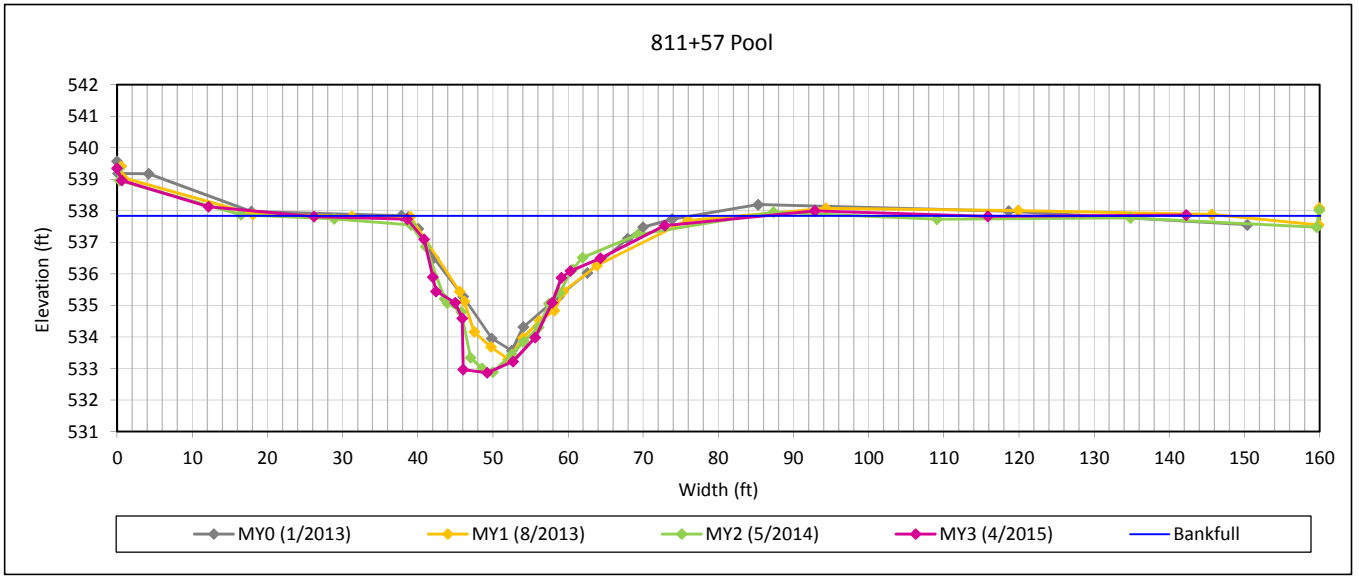
Bankfull Dimensions	
51.8	x-section area (ft.sq.)
28.8	width (ft)
1.8	mean depth (ft)
3.1	max depth (ft)
29.9	wetted parimeter (ft)
1.7	hyd radi (ft)
16.0	width-depth ratio
200.0	W flood prone area (ft)
6.9	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 14 - SF4



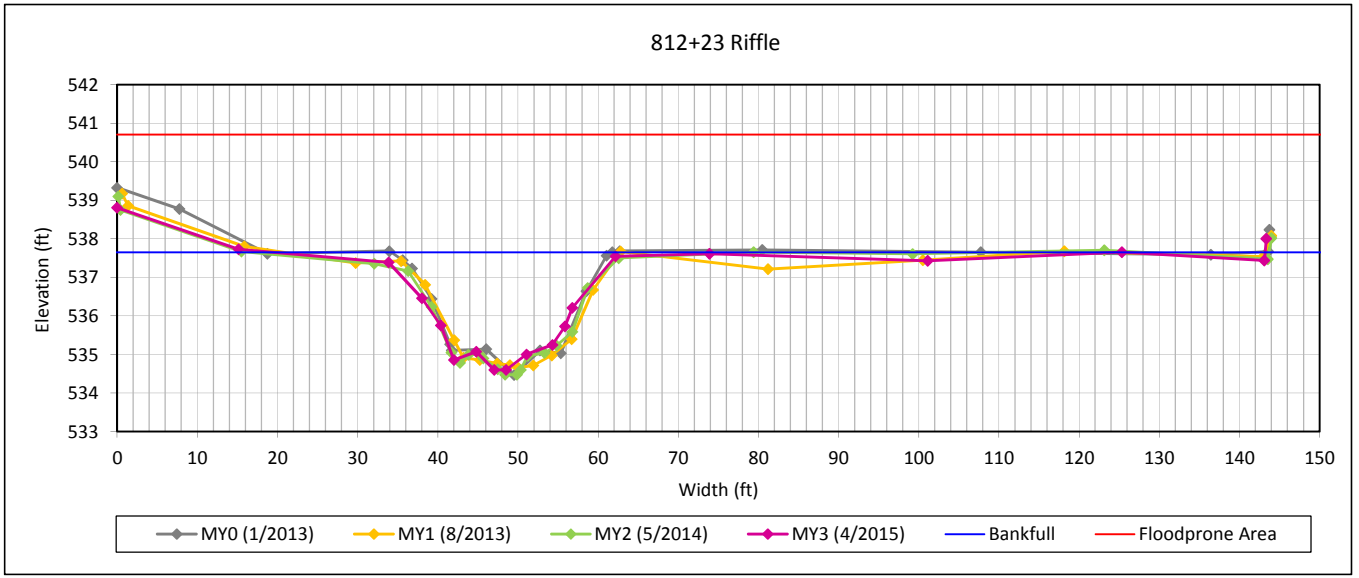
Bankfull Dimensions	
86.0	x-section area (ft.sq.)
47.6	width (ft)
1.8	mean depth (ft)
5.0	max depth (ft)
50.8	wetted parimeter (ft)
1.7	hyd radi (ft)
26.4	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 15 - SF4



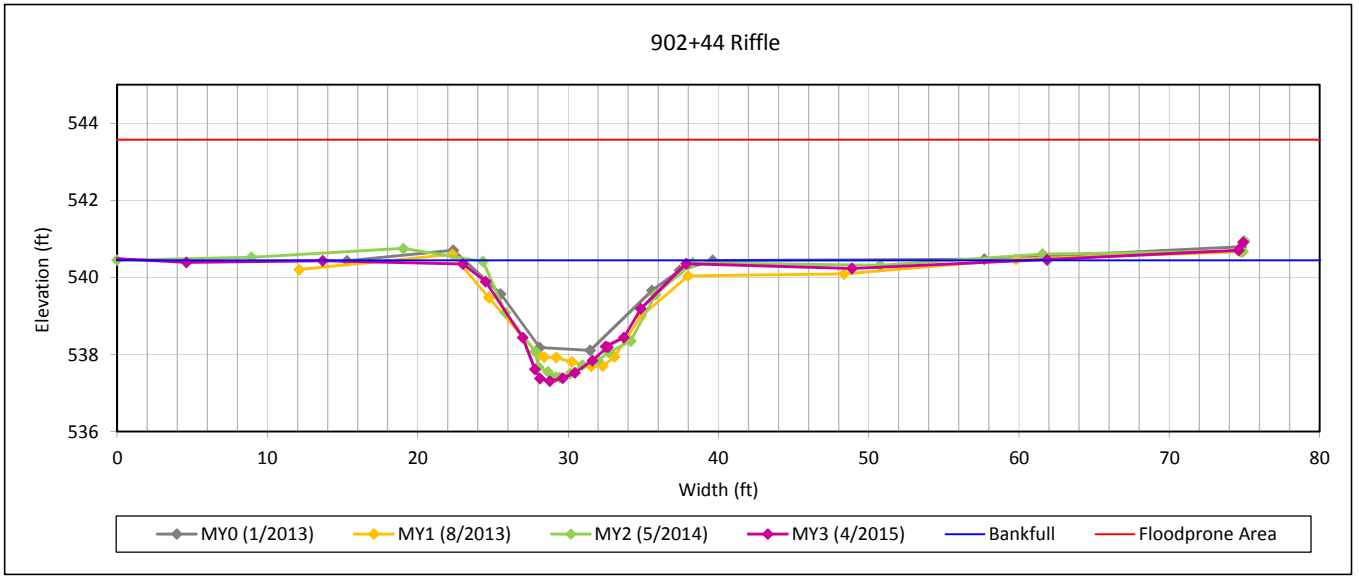
Bankfull Dimensions	
53.3	x-section area (ft.sq.)
28.3	width (ft)
1.9	mean depth (ft)
3.1	max depth (ft)
29.2	wetted parimeter (ft)
1.8	hyd radi (ft)
15.0	width-depth ratio
200.0	W flood prone area (ft)
7.1	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 16 - SF4A



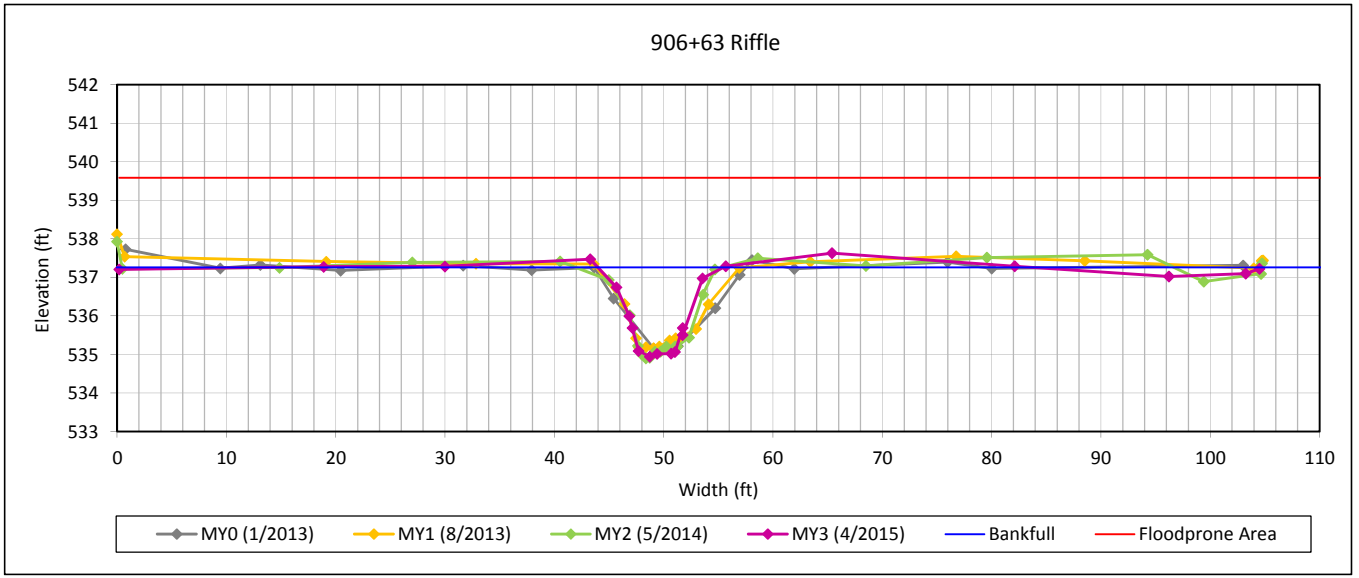
Bankfull Dimensions	
25.5	x-section area (ft.sq.)
14.9	width (ft)
1.7	mean depth (ft)
3.1	max depth (ft)
16.6	wetted parimeter (ft)
1.5	hyd radi (ft)
8.7	width-depth ratio
200.0	W flood prone area (ft)
13.5	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 17 - SF4A



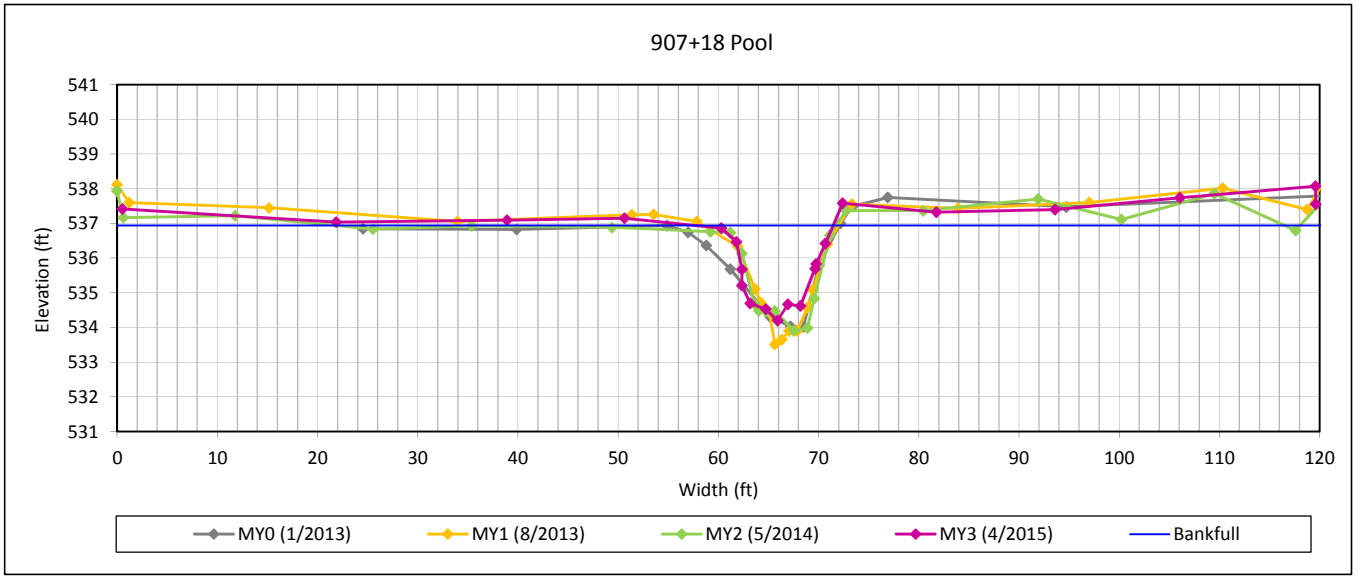
Bankfull Dimensions	
13.9	x-section area (ft.sq.)
11.5	width (ft)
1.2	mean depth (ft)
2.3	max depth (ft)
13.2	wetted parimeter (ft)
1.1	hyd radi (ft)
9.5	width-depth ratio
200.0	W flood prone area (ft)
17.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015

Cross Section 18 - SF4A



Bankfull Dimensions	
18.3	x-section area (ft.sq.)
11.1	width (ft)
1.6	mean depth (ft)
2.7	max depth (ft)
13.1	wetted parimeter (ft)
1.4	hyd radi (ft)
6.7	width-depth ratio

Survey Date: 4/2015
Field Crew: Wildlands Engineering

View Downstream

Reachwide and Cross Section Pebble Count Plots

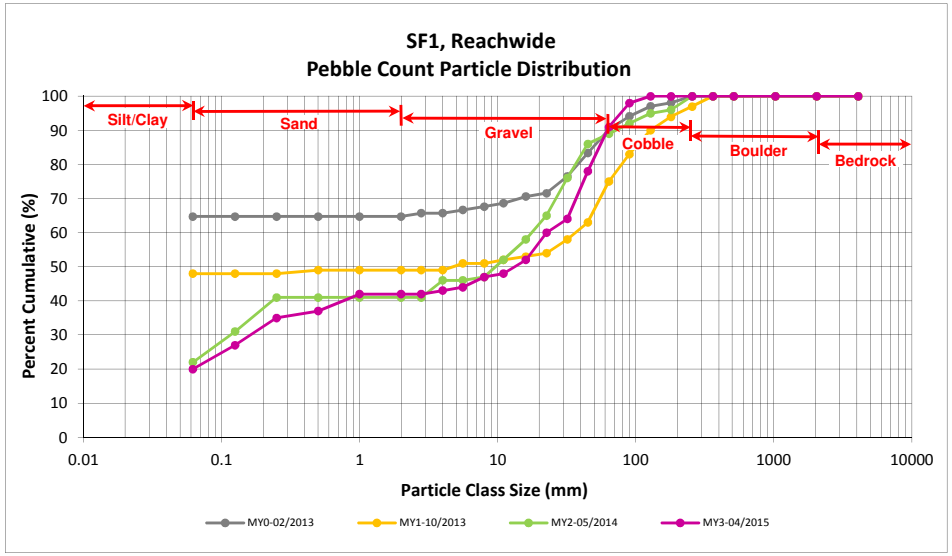
Underwood Mitigation Site (NCDMS Project No. 94641)

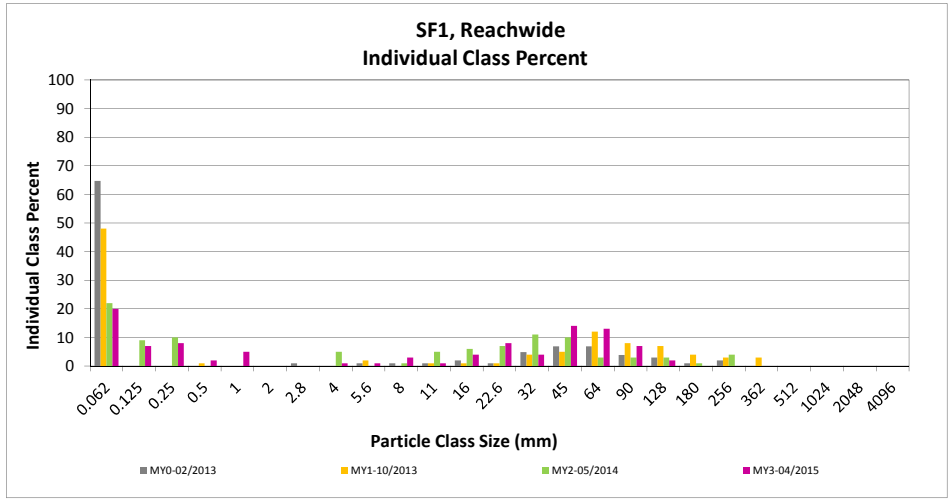
Monitoring Year 3 - 2015

SF1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		20	20	20	20
SAND	Very fine	0.062	0.125		7	7	7	27
	Fine	0.125	0.250		8	8	8	35
	Medium	0.25	0.50		2	2	2	37
	Coarse	0.5	1.0		5	5	5	42
	Very Coarse	1.0	2.0					42
GRAVEL	Very Fine	2.0	2.8					42
	Very Fine	2.8	4.0		1	1	1	43
	Fine	4.0	5.6		1	1	1	44
	Fine	5.6	8.0		3	3	3	47
	Medium	8.0	11.0		1	1	1	48
	Medium	11.0	16.0	3	1	4	4	52
	Coarse	16.0	22.6	7	1	8	8	60
	Coarse	22.6	32	4		4	4	64
	Very Coarse	32	45	14		14	14	78
	Very Coarse	45	64	13		13	13	91
COBBLE	Small	64	90	7		7	7	98
	Small	90	128	2		2	2	100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.25
D_{50} =	13.3
D_{84} =	52.9
D_{95} =	77.8
D_{100} =	128.0





Reachwide and Cross Section Pebble Count Plots

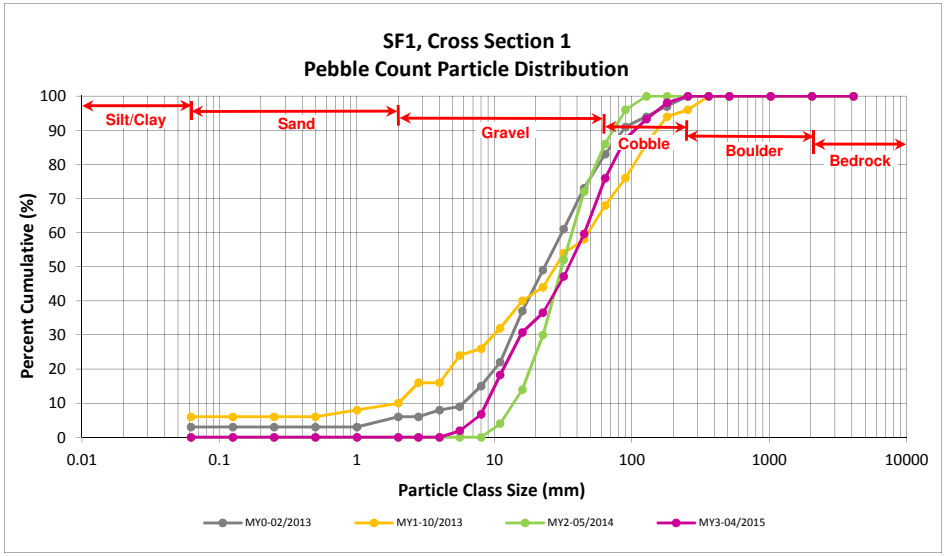
Underwood Mitigation Site (NCDMS Project No. 94641)

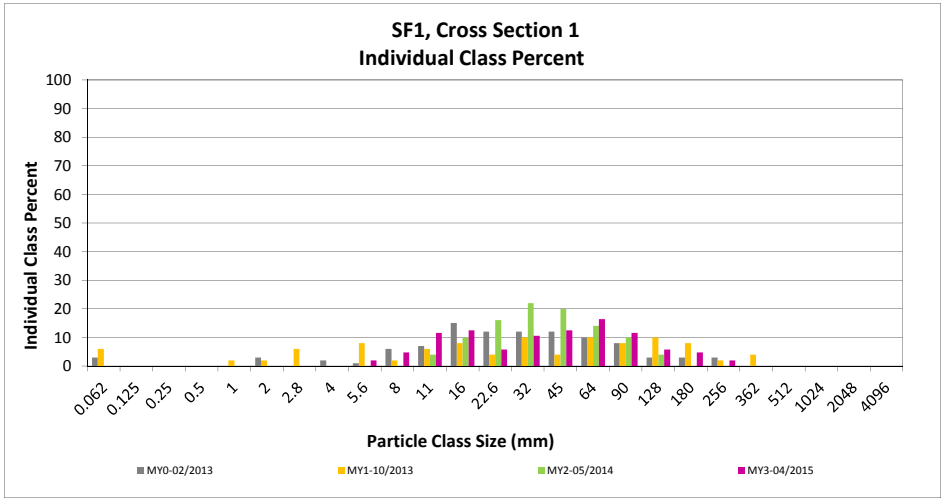
Monitoring Year 3 - 2015

SF1, Cross Section 1

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0			0
	Fine	4.0	5.6	2	2	2
	Fine	5.6	8.0	5	5	7
	Medium	8.0	11.0	12	12	18
	Medium	11.0	16.0	13	13	31
	Coarse	16.0	22.6	6	6	37
	Coarse	22.6	32	11	11	47
	Very Coarse	32	45	13	13	60
	Very Coarse	45	64	17	16	76
COBBLE	Small	64	90	12	12	88
	Small	90	128	6	6	93
	Large	128	180	5	5	98
	Large	180	256	2	2	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	104	100	100

Cross Section 1	
Channel materials (mm)	
D_{16} =	10.3
D_{35} =	20.6
D_{50} =	34.6
D_{84} =	81.2
D_{95} =	144.7
D_{100} =	256.0





Reachwide and Cross Section Pebble Count Plots

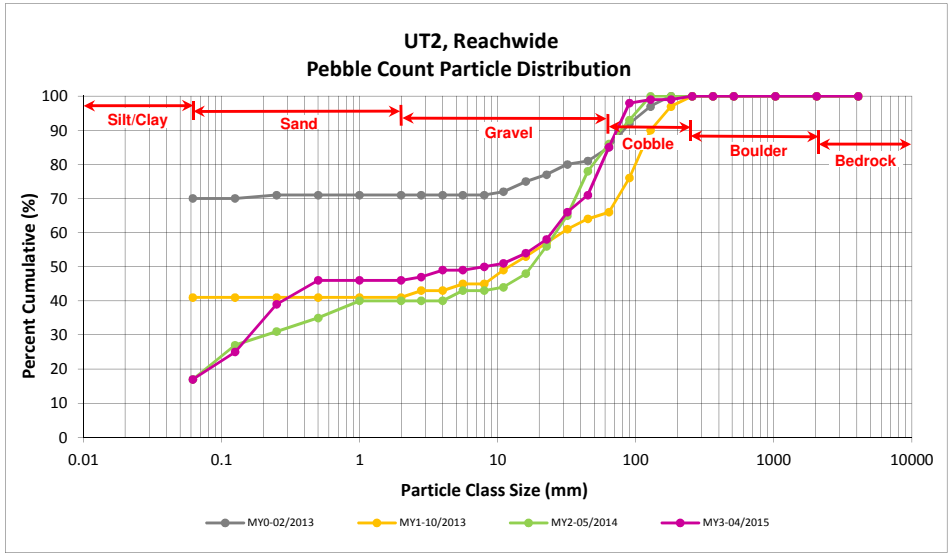
Underwood Mitigation Site (NCDMS Project No. 94641)

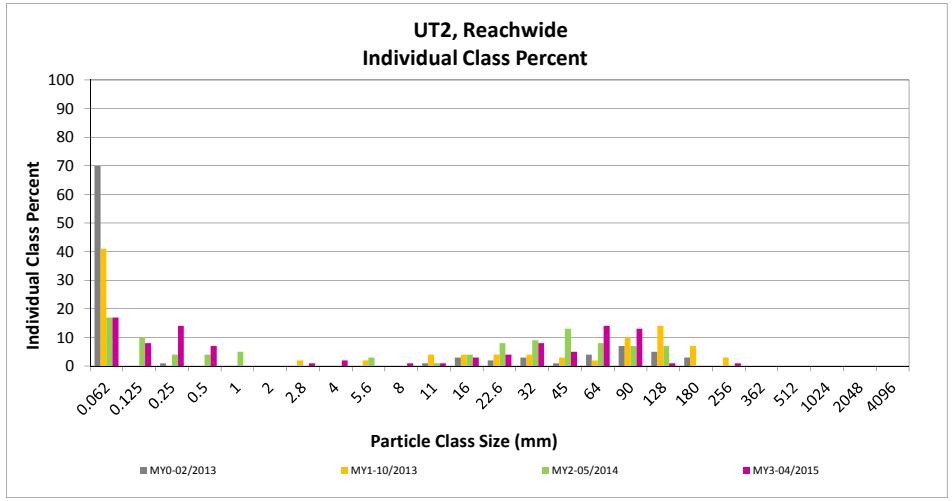
Monitoring Year 3 - 2015

UT2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		17	17	17	17
SAND	Very fine	0.062	0.125		8	8	8	25
	Fine	0.125	0.250		14	14	14	39
	Medium	0.25	0.50		7	7	7	46
	Coarse	0.5	1.0					46
	Very Coarse	1.0	2.0					46
GRAVEL	Very Fine	2.0	2.8		1	1	1	47
	Very Fine	2.8	4.0		2	2	2	49
	Fine	4.0	5.6					49
	Fine	5.6	8.0		1	1	1	50
	Medium	8.0	11.0	1		1	1	51
	Medium	11.0	16.0	3		3	3	54
	Coarse	16.0	22.6	4		4	4	58
	Coarse	22.6	32	8		8	8	66
	Very Coarse	32	45	5		5	5	71
	Very Coarse	45	64	14		14	14	85
COBBLE	Small	64	90	13		13	13	98
	Small	90	128	1		1	1	99
	Large	128	180					99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.21
D_{50} =	8.0
D_{84} =	62.4
D_{95} =	83.2
D_{100} =	256.0





Reachwide and Cross Section Pebble Count Plots

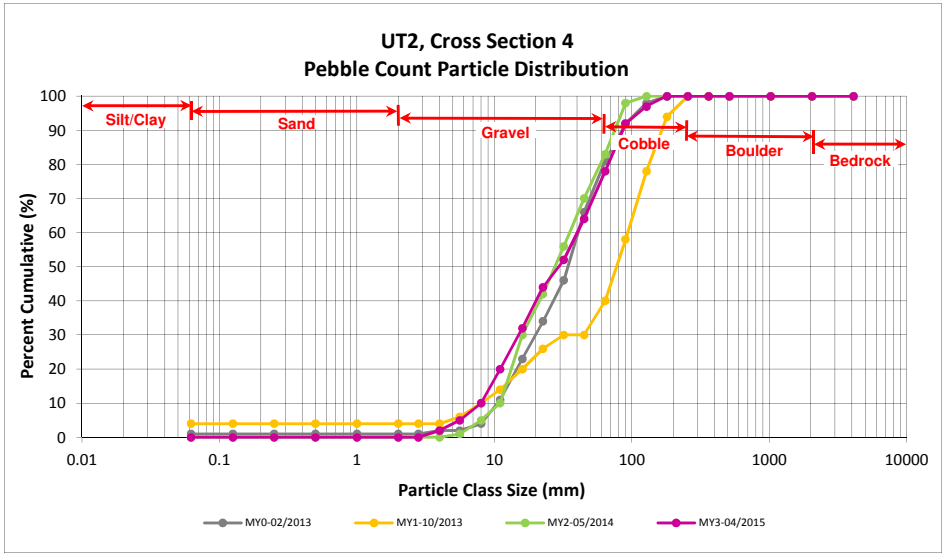
Underwood Mitigation Site (NCDMS Project No. 94641)

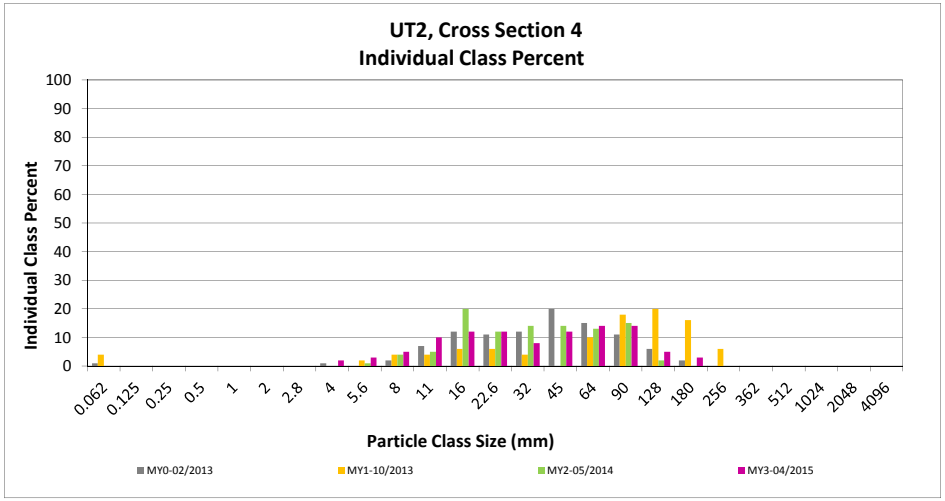
Monitoring Year 3 - 2015

UT2, Cross Section 4

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0	2	2	2
	Fine	4.0	5.6	3	3	5
	Fine	5.6	8.0	5	5	10
	Medium	8.0	11.0	10	10	20
	Medium	11.0	16.0	12	12	32
	Coarse	16.0	22.6	12	12	44
	Coarse	22.6	32	8	8	52
	Very Coarse	32	45	12	12	64
	Very Coarse	45	64	14	14	78
COBBLE	Small	64	90	14	14	92
	Small	90	128	5	5	97
	Large	128	180	3	3	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 4	
Channel materials (mm)	
D_{16} =	9.68
D_{35} =	17.44
D_{50} =	29.3
D_{84} =	74.1
D_{95} =	111.2
D_{100} =	180.0

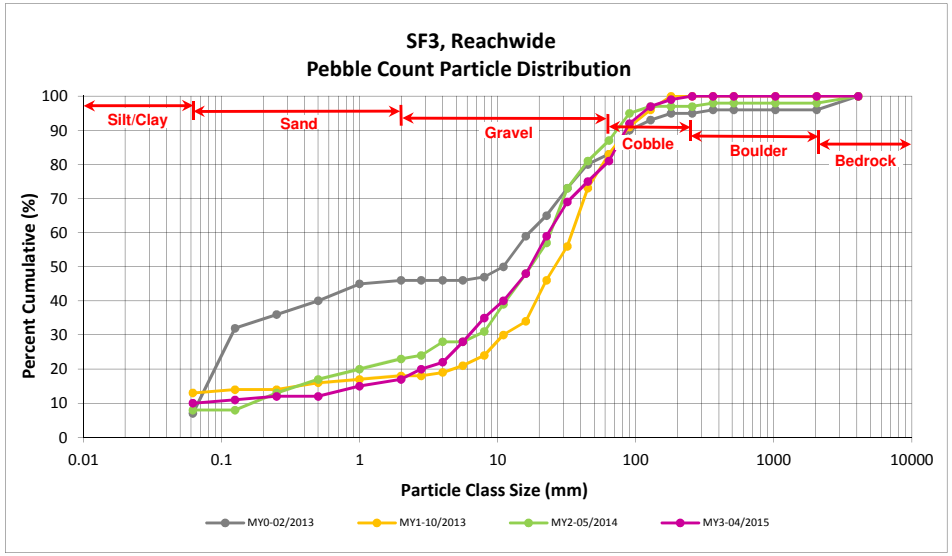


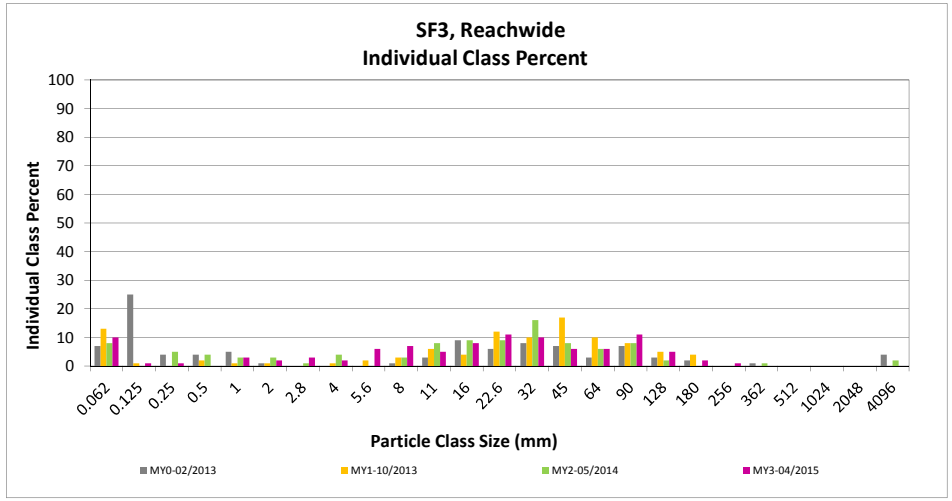


Reachwide and Cross Section Pebble Count Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015
SF3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		10	10	10	10
SAND	Very fine	0.062	0.125		1	1	1	11
	Fine	0.125	0.250		1	1	1	12
	Medium	0.25	0.50					12
	Coarse	0.5	1.0		3	3	3	15
	Very Coarse	1.0	2.0		2	2	2	17
GRAVEL	Very Fine	2.0	2.8		3	3	3	20
	Very Fine	2.8	4.0		2	2	2	22
	Fine	4.0	5.6	1	5	6	6	28
	Fine	5.6	8.0	2	5	7	7	35
	Medium	8.0	11.0	2	3	5	5	40
	Medium	11.0	16.0	3	5	8	8	48
	Coarse	16.0	22.6	6	5	11	11	59
	Coarse	22.6	32	7	3	10	10	69
	Very Coarse	32	45	6		6	6	75
	Very Coarse	45	64	5	1	6	6	81
COBBLE	Small	64	90	10	1	11	11	92
	Small	90	128	5		5	5	97
	Large	128	180	2		2	2	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	1.41
D_{35} =	8.00
D_{50} =	17.0
D_{84} =	70.2
D_{95} =	111.2
D_{100} =	256.0





Reachwide and Cross Section Pebble Count Plots

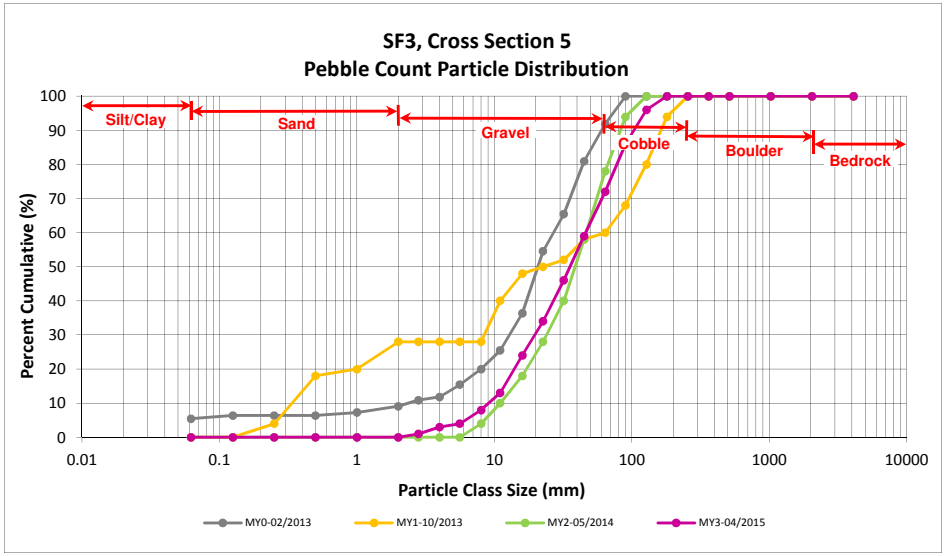
Underwood Mitigation Site (NCDMS Project No. 94641)

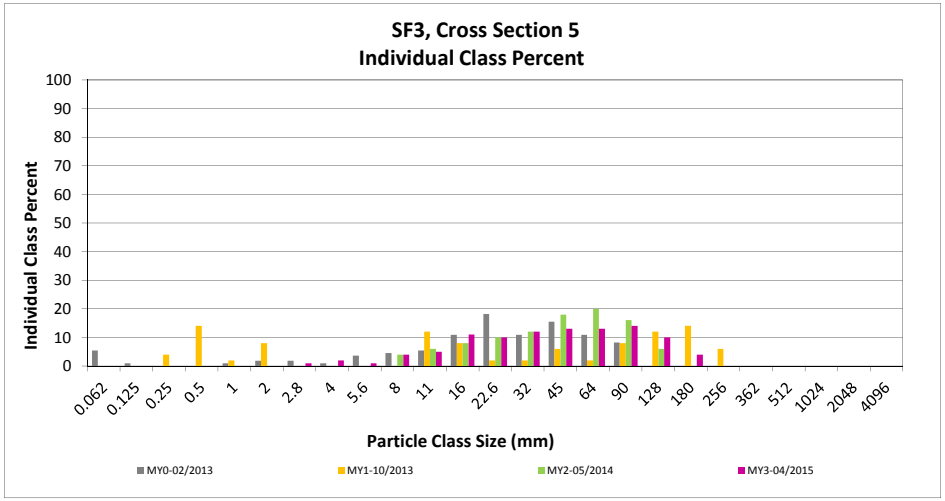
Monitoring Year 3 - 2015

SF3, Cross Section 5

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8	1	1	1
	Very Fine	2.8	4.0	2	2	3
	Fine	4.0	5.6	1	1	4
	Fine	5.6	8.0	4	4	8
	Medium	8.0	11.0	5	5	13
	Medium	11.0	16.0	11	11	24
	Coarse	16.0	22.6	10	10	34
	Coarse	22.6	32	12	12	46
	Very Coarse	32	45	13	13	59
	Very Coarse	45	64	13	13	72
COBBLE	Small	64	90	14	14	86
	Small	90	128	10	10	96
	Large	128	180	4	4	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 5	
Channel materials (mm)	
D_{16} =	12.18
D_{35} =	23.26
D_{50} =	35.5
D_{84} =	85.7
D_{95} =	123.6
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

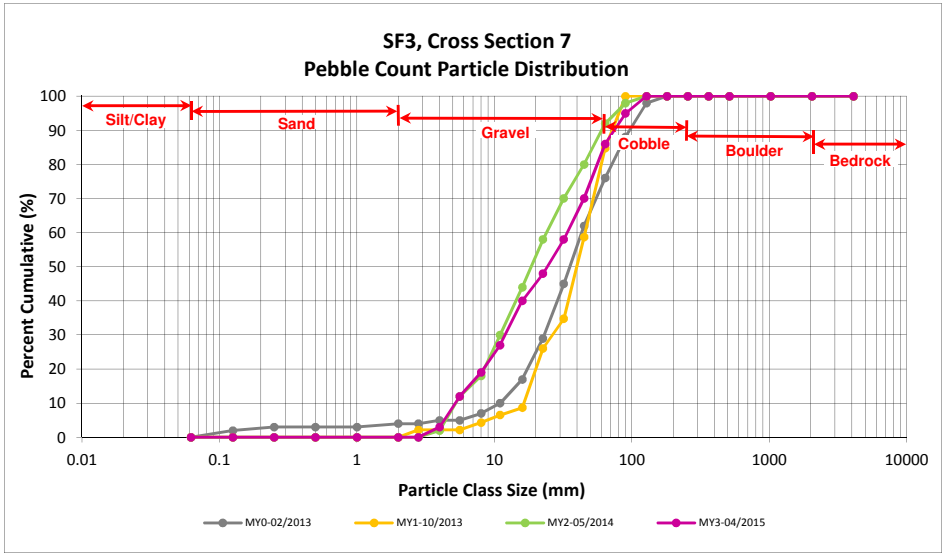
Underwood Mitigation Site (NCDMS Project No. 94641)

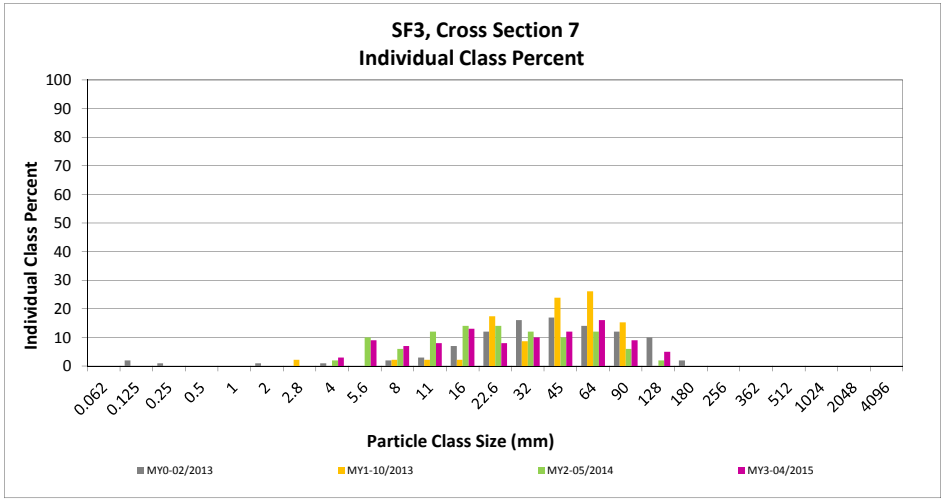
Monitoring Year 3 - 2015

SF3, Cross Section 7

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0	3	3	3
	Fine	4.0	5.6	9	9	12
	Fine	5.6	8.0	7	7	19
	Medium	8.0	11.0	8	8	27
	Medium	11.0	16.0	13	13	40
	Coarse	16.0	22.6	8	8	48
	Coarse	22.6	32	10	10	58
	Very Coarse	32	45	12	12	70
	Very Coarse	45	64	16	16	86
COBBLE	Small	64	90	9	9	95
	Small	90	128	5	5	100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 7	
Channel materials (mm)	
D_{16} =	6.87
D_{35} =	13.85
D_{50} =	24.2
D_{84} =	61.2
D_{95} =	90.0
D_{100} =	128.0





Reachwide and Cross Section Pebble Count Plots

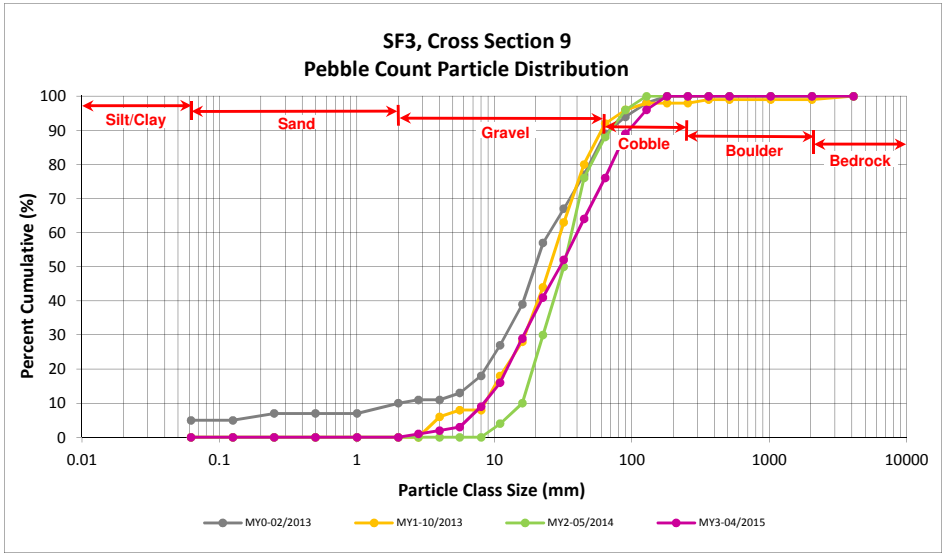
Underwood Mitigation Site (NCDMS Project No. 94641)

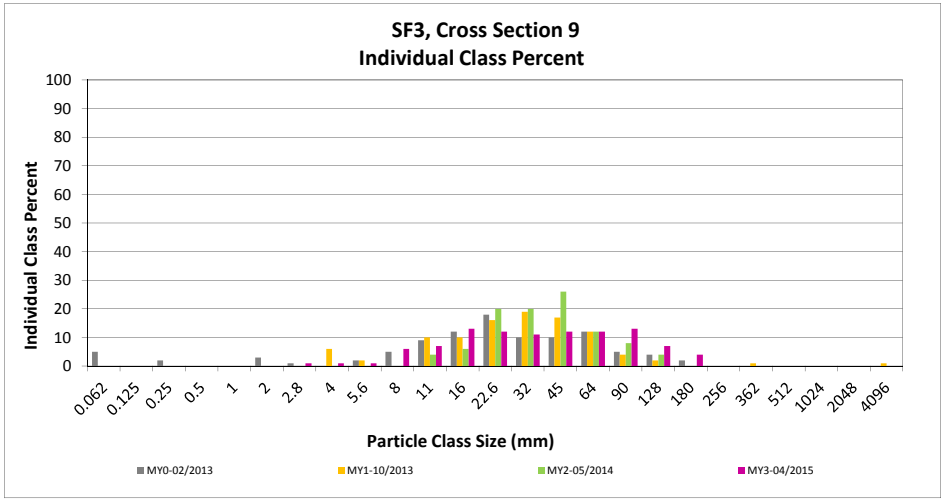
Monitoring Year 3 - 2015

SF3, Cross Section 9

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8	1	1	1
	Very Fine	2.8	4.0	1	1	2
	Fine	4.0	5.6	1	1	3
	Fine	5.6	8.0	6	6	9
	Medium	8.0	11.0	7	7	16
	Medium	11.0	16.0	13	13	29
	Coarse	16.0	22.6	12	12	41
	Coarse	22.6	32	11	11	52
	Very Coarse	32	45	12	12	64
	Very Coarse	45	64	12	12	76
COBBLE	Small	64	90	13	13	89
	Small	90	128	7	7	96
	Large	128	180	4	4	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 9	
Channel materials (mm)	
D_{16} =	11.00
D_{35} =	19.02
D_{50} =	30.0
D_{84} =	78.9
D_{95} =	121.7
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

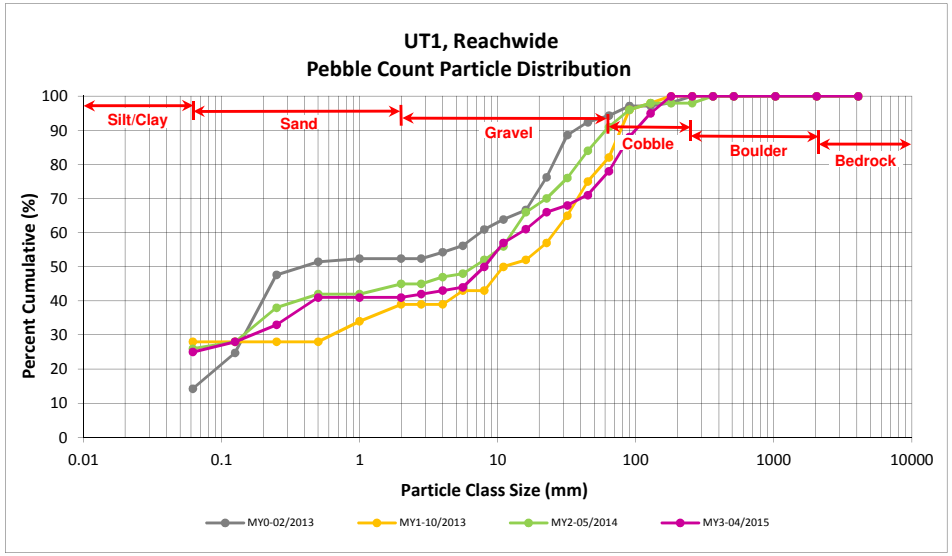
Underwood Mitigation Site (NCDMS Project No. 94641)

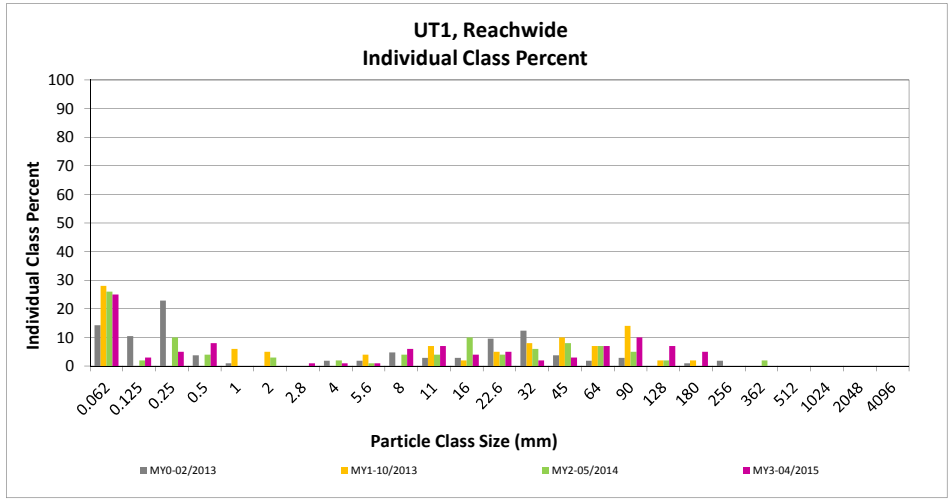
Monitoring Year 3 - 2015

UT1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	22	25	25	25
SAND	Very fine	0.062	0.125		3	3	3	28
	Fine	0.125	0.250		5	5	5	33
	Medium	0.25	0.50		8	8	8	41
	Coarse	0.5	1.0					41
	Very Coarse	1.0	2.0					41
GRAVEL	Very Fine	2.0	2.8		1	1	1	42
	Very Fine	2.8	4.0	1		1	1	43
	Fine	4.0	5.6	1		1	1	44
	Fine	5.6	8.0	3	3	6	6	50
	Medium	8.0	11.0	5	2	7	7	57
	Medium	11.0	16.0	4		4	4	61
	Coarse	16.0	22.6	3	2	5	5	66
	Coarse	22.6	32	2		2	2	68
	Very Coarse	32	45	3		3	3	71
	Very Coarse	45	64	5	2	7	7	78
COBBLE	Small	64	90	8	2	10	10	88
	Small	90	128	7		7	7	95
	Large	128	180	5		5	5	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.30
D_{50} =	8.0
D_{84} =	78.5
D_{95} =	128.0
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

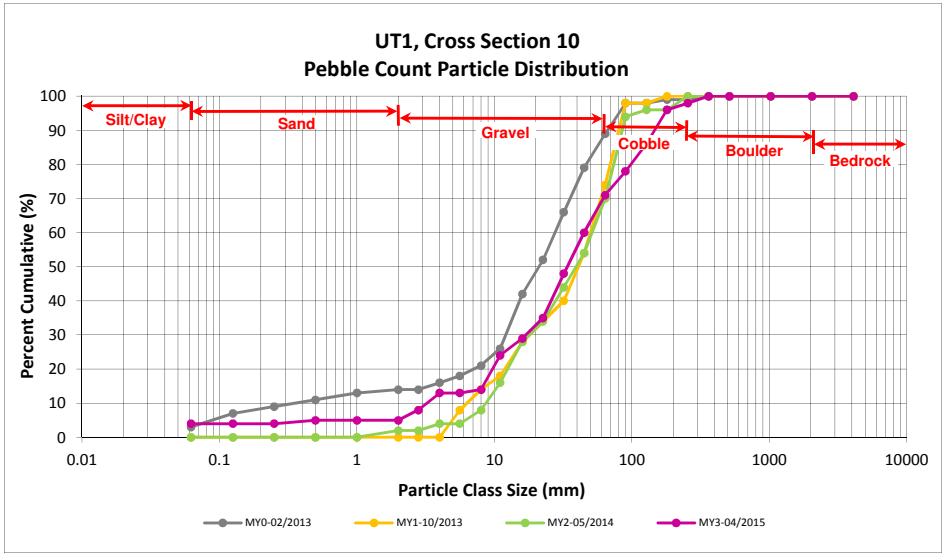
Underwood Mitigation Site (NCDMS Project No. 94641)

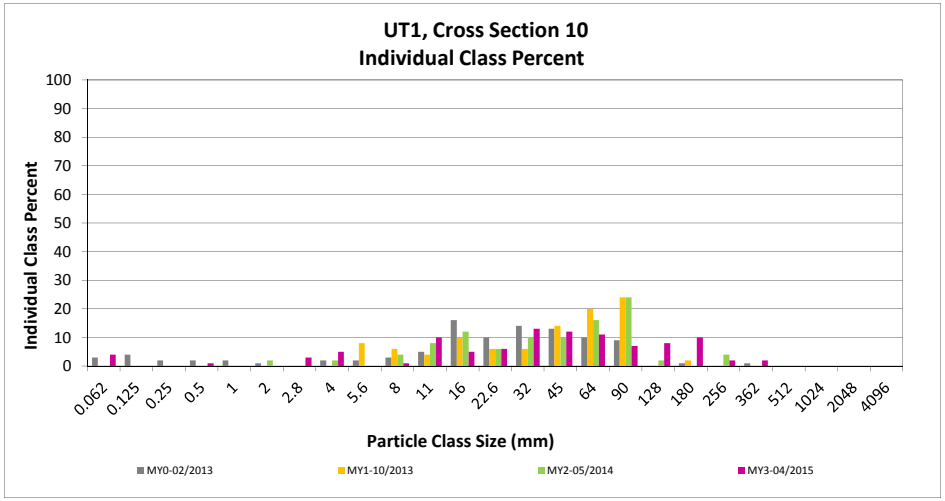
Monitoring Year 3 - 2015

UT1, Cross Section 10

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125			4
	Fine	0.125	0.250			4
	Medium	0.25	0.50	1	1	5
	Coarse	0.5	1.0			5
	Very Coarse	1.0	2.0			5
GRAVEL	Very Fine	2.0	2.8	3	3	8
	Very Fine	2.8	4.0	5	5	13
	Fine	4.0	5.6			13
	Fine	5.6	8.0	1	1	14
	Medium	8.0	11.0	10	10	24
	Medium	11.0	16.0	5	5	29
	Coarse	16.0	22.6	6	6	35
	Coarse	22.6	32	13	13	48
	Very Coarse	32	45	12	12	60
	Very Coarse	45	64	11	11	71
COBBLE	Small	64	90	7	7	78
	Small	90	128	8	8	86
	Large	128	180	10	10	96
	Large	180	256	2	2	98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 10	
Channel materials (mm)	
D_{16} =	8.53
D_{35} =	22.60
D_{50} =	33.9
D_{84} =	117.2
D_{95} =	174.0
D_{100} =	362.0





Reachwide and Cross Section Pebble Count Plots

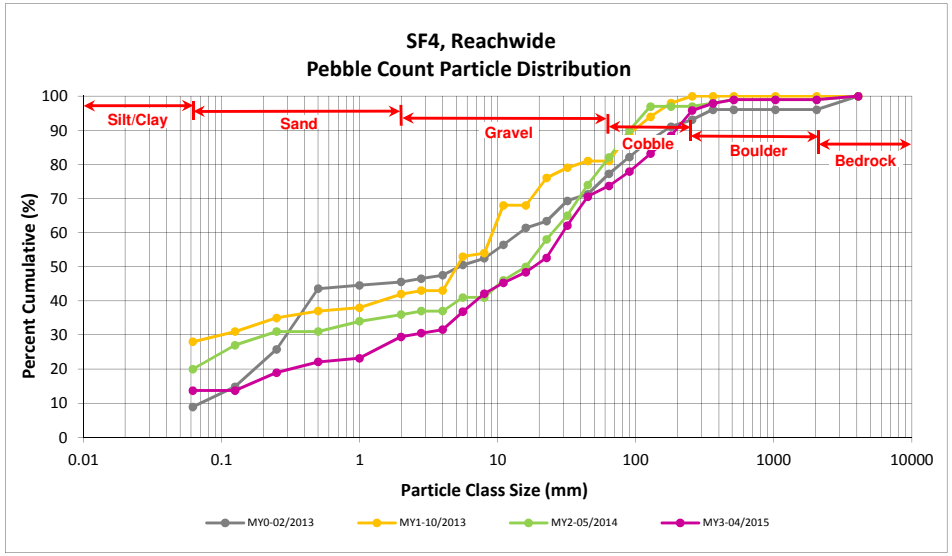
Underwood Mitigation Site (NCDMS Project No. 94641)

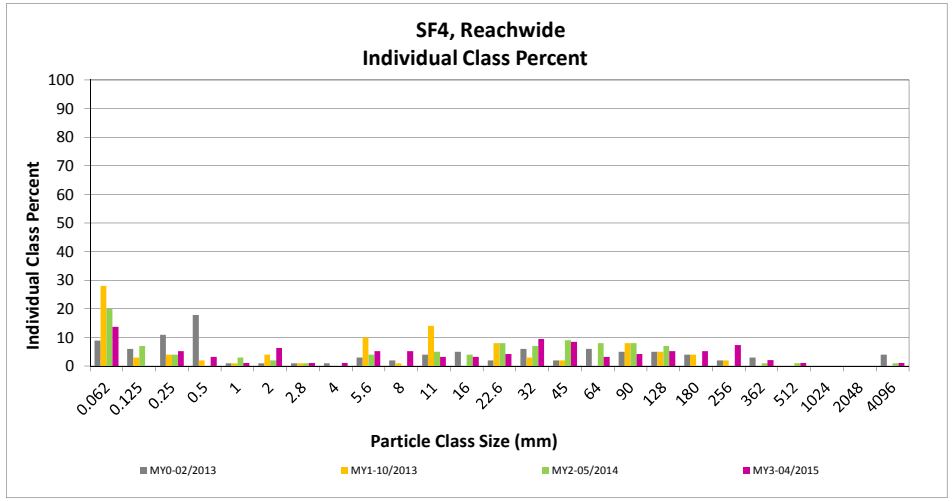
Monitoring Year 3 - 2015

SF4, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		13	13	14	14
SAND	Very fine	0.062	0.125					14
	Fine	0.125	0.250	3	2	5	5	19
	Medium	0.25	0.50	1	2	3	3	22
	Coarse	0.5	1.0		1	1	1	23
	Very Coarse	1.0	2.0	3	3	6	6	29
GRAVEL	Very Fine	2.0	2.8	1		1	1	31
	Very Fine	2.8	4.0	1		1	1	32
	Fine	4.0	5.6	2	3	5	5	37
	Fine	5.6	8.0	3	2	5	5	42
	Medium	8.0	11.0		3	3	3	45
	Medium	11.0	16.0	1	2	3	3	48
	Coarse	16.0	22.6	2	2	4	4	53
	Coarse	22.6	32	3	6	9	9	62
	Very Coarse	32	45	2	6	8	8	71
	Very Coarse	45	64	3		3	3	74
COBBLE	Small	64	90	4		4	4	78
	Small	90	128	5		5	5	83
	Large	128	180	5		5	5	88
	Large	180	256	7		7	7	96
BOULDER	Small	256	362	2		2	2	98
	Small	362	512	1		1	1	99
	Medium	512	1024					99
	Large/Very Large	1024	2048					99
BEDROCK	Bedrock	2048	>2048	1		1	1	100
			Total	**50**	**45**	**95**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.17
D_{35} =	4.98
D_{50} =	18.2
D_{84} =	135.2
D_{95} =	246.5
D_{100} =	>2048





Reachwide and Cross Section Pebble Count Plots

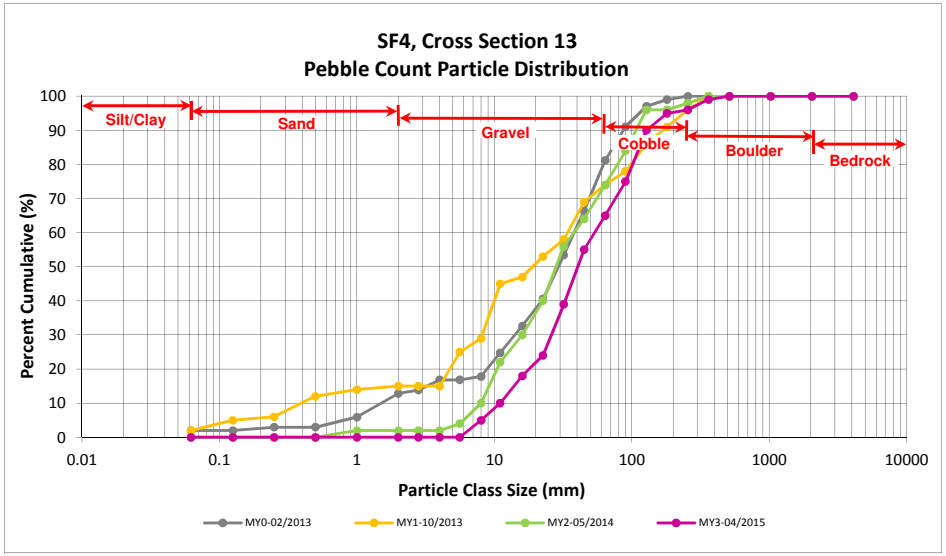
Underwood Mitigation Site (NCDMS Project No. 94641)

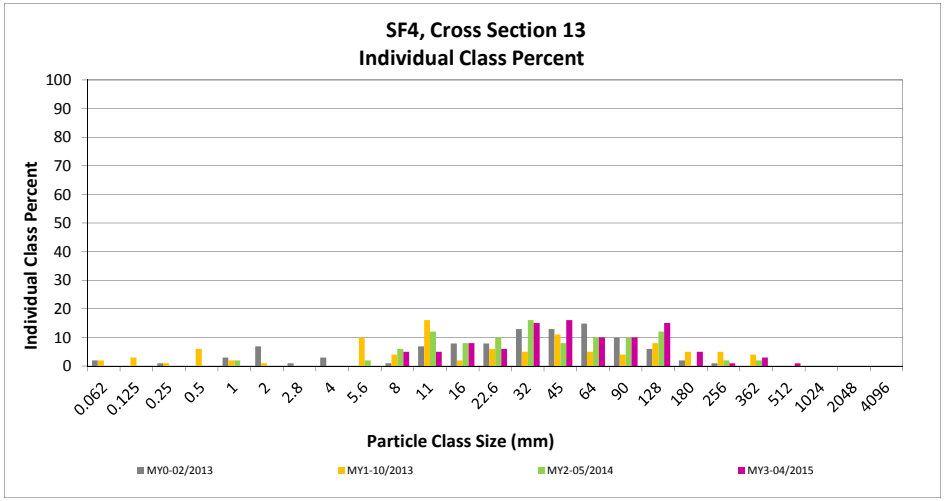
Monitoring Year 3 - 2015

SF4, Cross Section 13

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0			0
	Fine	4.0	5.6			0
	Fine	5.6	8.0	5	5	5
	Medium	8.0	11.0	5	5	10
	Medium	11.0	16.0	8	8	18
	Coarse	16.0	22.6	6	6	24
	Coarse	22.6	32	15	15	39
	Very Coarse	32	45	16	16	55
	Very Coarse	45	64	10	10	65
COBBLE	Small	64	90	10	10	75
	Small	90	128	15	15	90
	Large	128	180	5	5	95
	Large	180	256	1	1	96
BOULDER	Small	256	362	3	3	99
	Small	362	512	1	1	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 13	
Channel materials (mm)	
D_{16} =	14.57
D_{35} =	29.17
D_{50} =	40.5
D_{84} =	111.2
D_{95} =	180.0
D_{100} =	512.0





Reachwide and Cross Section Pebble Count Plots

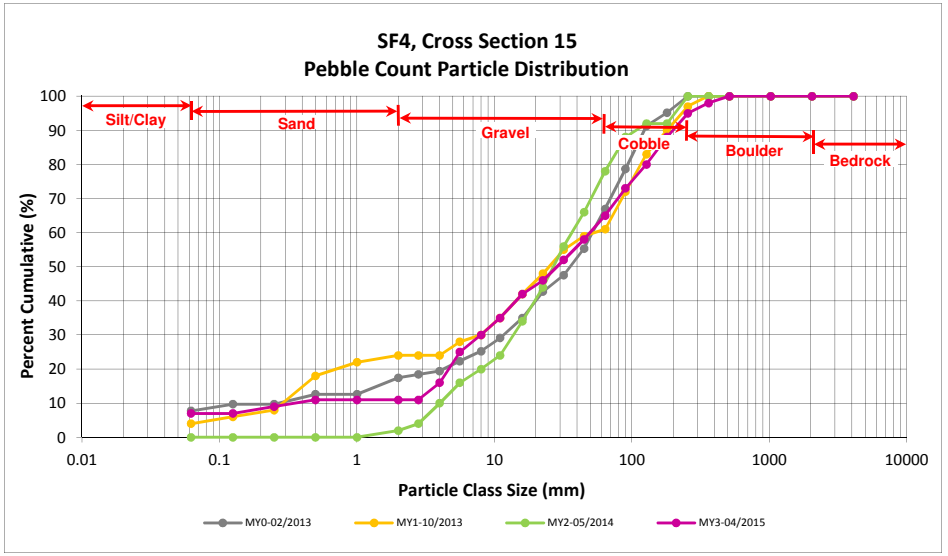
Underwood Mitigation Site (NCDMS Project No. 94641)

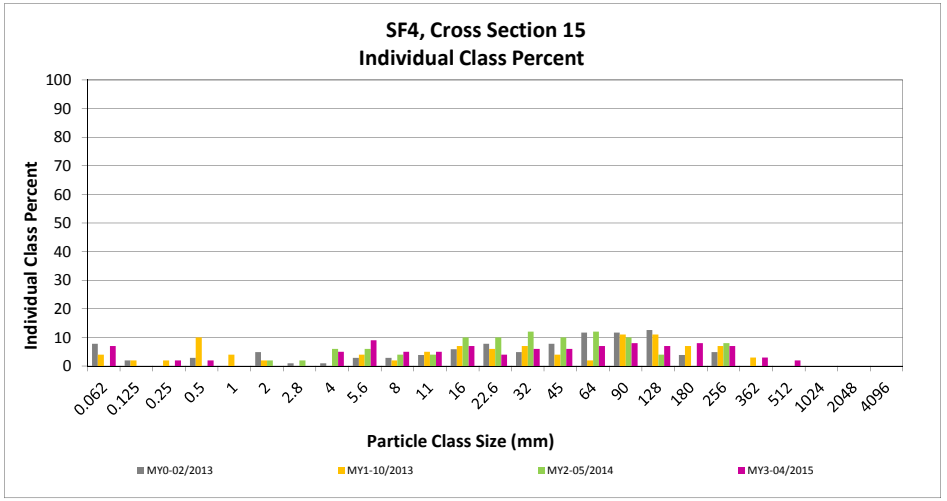
Monitoring Year 3 - 2015

SF4, Cross Section 15

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	7	7	7
SAND	Very fine	0.062	0.125			7
	Fine	0.125	0.250	2	2	9
	Medium	0.25	0.50	2	2	11
	Coarse	0.5	1.0			11
	Very Coarse	1.0	2.0			11
GRAVEL	Very Fine	2.0	2.8			11
	Very Fine	2.8	4.0	5	5	16
	Fine	4.0	5.6	9	9	25
	Fine	5.6	8.0	5	5	30
	Medium	8.0	11.0	5	5	35
	Medium	11.0	16.0	7	7	42
	Coarse	16.0	22.6	4	4	46
	Coarse	22.6	32	6	6	52
	Very Coarse	32	45	6	6	58
	Very Coarse	45	64	7	7	65
COBBLE	Small	64	90	8	8	73
	Small	90	128	7	7	80
	Large	128	180	8	8	88
	Large	180	256	7	7	95
BOULDER	Small	256	362	3	3	98
	Small	362	512	2	2	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross Section 15	
Channel materials (mm)	
D_{16} =	4.00
D_{35} =	11.00
D_{50} =	28.5
D_{84} =	151.8
D_{95} =	256.0
D_{100} =	512.0

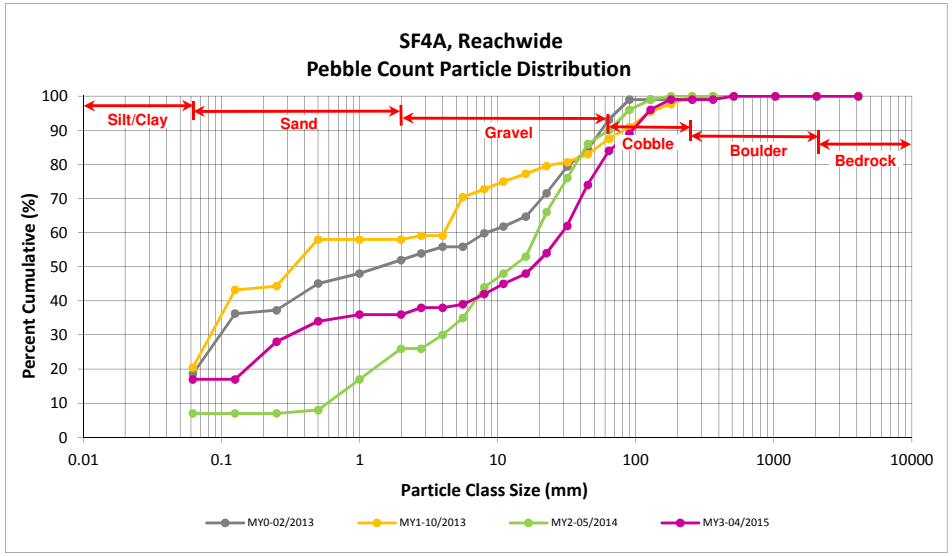


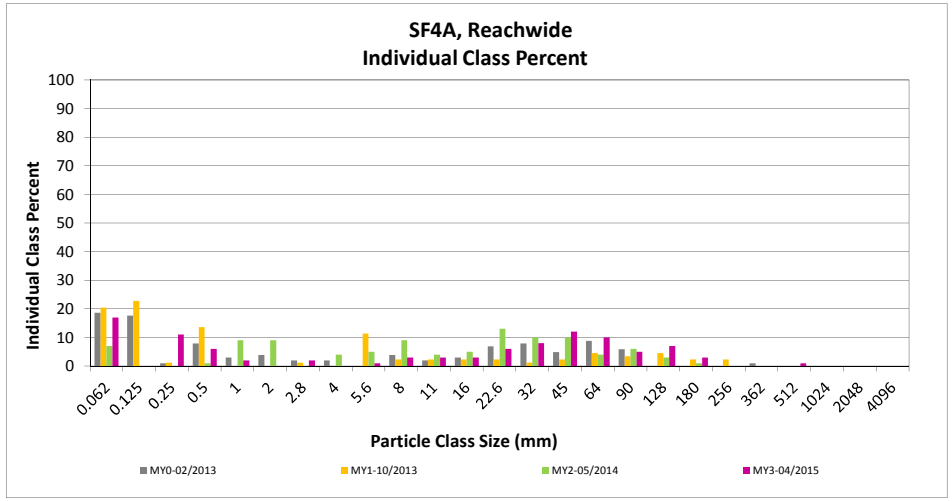


Reachwide and Cross Section Pebble Count Plots
Underwood Mitigation Site (NCDMS Project No. 94641)
Monitoring Year 3 - 2015
SF4A, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	13	17	17	17
SAND	Very fine	0.062	0.125					17
	Fine	0.125	0.250		11	11	11	28
	Medium	0.25	0.50	1	5	6	6	34
	Coarse	0.5	1.0		2	2	2	36
	Very Coarse	1.0	2.0					36
GRAVEL	Very Fine	2.0	2.8		2	2	2	38
	Very Fine	2.8	4.0					38
	Fine	4.0	5.6		1	1	1	39
	Fine	5.6	8.0	1	2	3	3	42
	Medium	8.0	11.0	3		3	3	45
	Medium	11.0	16.0	2	1	3	3	48
	Coarse	16.0	22.6	5	1	6	6	54
	Coarse	22.6	32	6	2	8	8	62
	Very Coarse	32	45	10	2	12	12	74
	Very Coarse	45	64	8	2	10	10	84
COBBLE	Small	64	90	3	2	5	5	89
	Small	90	128	4	3	7	7	96
	Large	128	180	2	1	3	3	99
	Large	180	256					99
BOULDER	Small	256	362					99
	Small	362	512	1		1	1	100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.71
D_{50} =	18.0
D_{84} =	64.0
D_{95} =	121.7
D_{100} =	512.0





Reachwide and Cross Section Pebble Count Plots

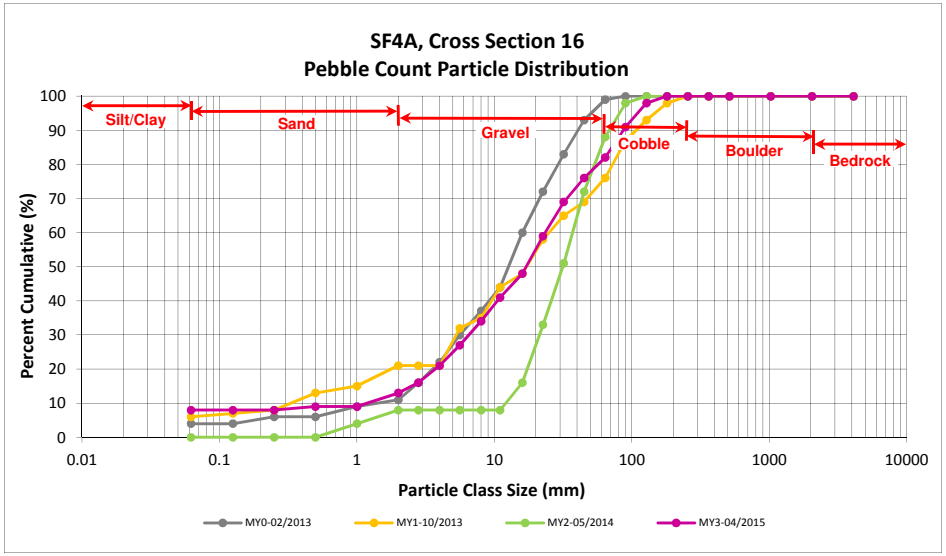
Underwood Mitigation Site (NCDMS Project No. 94641)

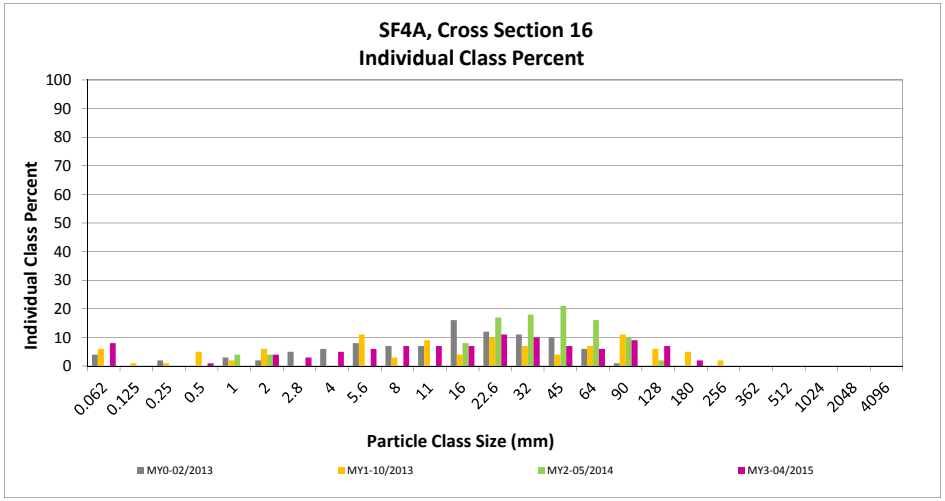
Monitoring Year 3 - 2015

SF4A, Cross Section 16

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	8	8	8
SAND	Very fine	0.062	0.125			8
	Fine	0.125	0.250			8
	Medium	0.25	0.50	1	1	9
	Coarse	0.5	1.0			9
	Very Coarse	1.0	2.0	4	4	13
GRAVEL	Very Fine	2.0	2.8	3	3	16
	Very Fine	2.8	4.0	5	5	21
	Fine	4.0	5.6	6	6	27
	Fine	5.6	8.0	7	7	34
	Medium	8.0	11.0	7	7	41
	Medium	11.0	16.0	7	7	48
	Coarse	16.0	22.6	11	11	59
	Coarse	22.6	32	10	10	69
	Very Coarse	32	45	7	7	76
	Very Coarse	45	64	6	6	82
COBBLE	Small	64	90	9	9	91
	Small	90	128	7	7	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 16	
Channel materials (mm)	
D_{16} =	2.80
D_{35} =	8.37
D_{50} =	17.0
D_{84} =	69.0
D_{95} =	110.1
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

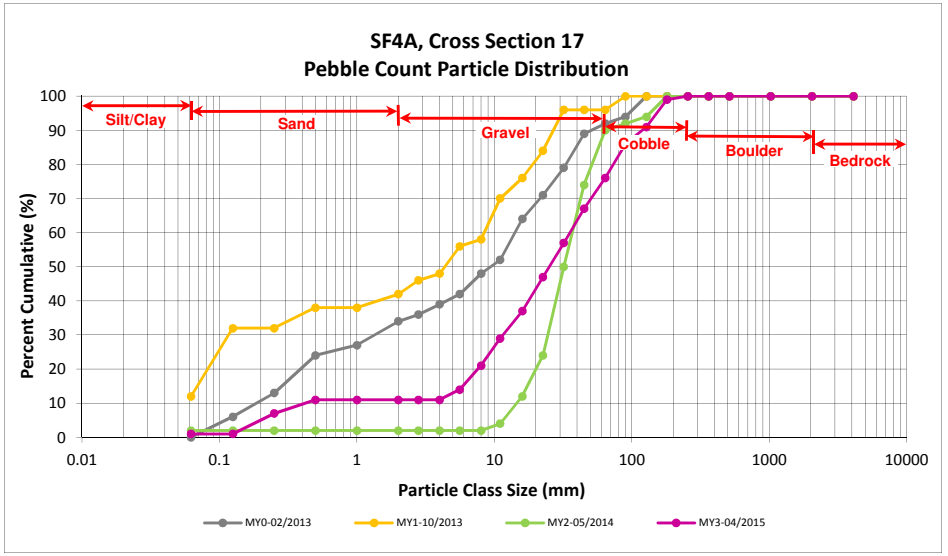
Underwood Mitigation Site (NCDMS Project No. 94641)

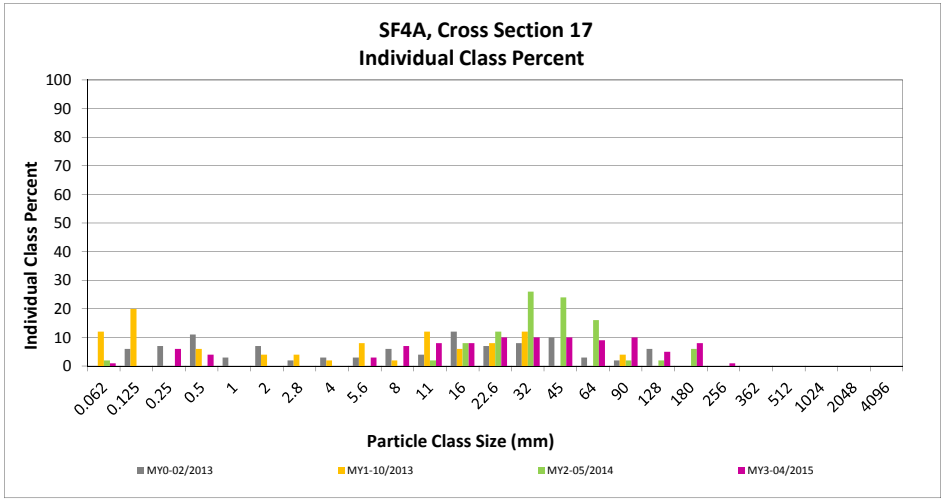
Monitoring Year 3 - 2015

SF4A, Cross Section 17

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	6	6	7
	Medium	0.25	0.50	4	4	11
	Coarse	0.5	1.0			11
	Very Coarse	1.0	2.0			11
GRAVEL	Very Fine	2.0	2.8			11
	Very Fine	2.8	4.0			11
	Fine	4.0	5.6	3	3	14
	Fine	5.6	8.0	7	7	21
	Medium	8.0	11.0	8	8	29
	Medium	11.0	16.0	8	8	37
	Coarse	16.0	22.6	10	10	47
	Coarse	22.6	32	10	10	57
	Very Coarse	32	45	10	10	67
	Very Coarse	45	64	9	9	76
COBBLE	Small	64	90	10	10	86
	Small	90	128	5	5	91
	Large	128	180	8	8	99
	Large	180	256	1	1	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 17	
Channel materials (mm)	
D_{16} =	6.20
D_{35} =	14.57
D_{50} =	25.1
D_{84} =	84.1
D_{95} =	151.8
D_{100} =	256.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 13. Verification of Bankfull Events

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Reach	Date of Data Collection	Approximate Date of Occurrence	Method
SF1	4/28/2015	1/2015-4/2015	Crest Gage/Visual (Rack Lines)
	10/14/2015	7/2015-10/2015	
UT2	*		
SF3	4/28/2015	1/2015-4/2015	
	10/14/2015	7/2015-10/2015	
UT1	4/28/2015	1/2015-4/2015	
	10/14/2015	7/2015-10/2015	
SF4	4/28/2015	1/2015-4/2015	
	10/14/2015	7/2015-10/2015	
SF4A	4/28/2015	1/2015-4/2015	
	10/14/2015	7/2015-10/2015	

*data collected, but level was below bankfull elevation

Table 14. Wetland Gage Attainment Summary

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 -2015

Summary of Groundwater Gage Results for Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)	Year 6 (2018)	Year 7 (2019)
1	Yes/44.5 Days (20.6 %)	Yes/35.5 Days (16.4 %)	Yes/65 Days (27.1%)				
2	Yes/51.5 Days (23.8 %)	Yes/38.5 Days (17.8 %)	Yes/59 Days (24.6%)				
3	Yes/23.5 Days (10.9 %)	Yes/31.5 Days (14.6 %)	Yes/29 Days (12.1%)				
4	Yes/19.5 Days (9.0 %)	Yes/31.5 Days (14.6 %)	Yes/59 Days (24.6%)				
5	Yes/25 Days (11.6 %)	Yes/32.5 Days (15.0 %)	Yes/65 Days (27.1%)				
6	Yes/22.5 Days (10.4 %)	Yes/21 Days (9.7 %)	Yes/28 Days (11.7%)				
7	Yes/44.5 Days (20.6 %)	Yes/31.5 Days (14.6 %)	Yes/32 Days (13.3%)				
8	Yes/22 Days (10.2 %)	Yes/23 Days (14.6 %)	Yes/61 Days (25.4%)				
9	Yes/98 Days (45.4 %)	Yes/41.5 Days (10.6 %)	Yes/68 Days (28.3%)				
10	Yes/96.5 Days (44.7 %)	Yes/36 Days (16.7 %)	Yes/67 Days (27.9%)				
11	Yes/66 Days (30.6 %)	Yes/40.5 Days (18.8 %)	Yes/61 Days (25.4%)				
12	Yes/23 Days (10.6 %)	Yes/32.5 Days (15.0 %)	Yes/28 Days (11.7%)				
13	Yes/22 Days (10.2 %)	No/12.5 Days (5.8 %)	Yes/27 Days (11.3%)				
14	Yes/21 Days (9.7 %)	Yes/32 Days (14.8 %)	Yes/29 Days (12.1%)				
15	Yes/163 Days (75.5 %)	Yes/57 Days (26.4 %)	Yes/80 Days (33.3%)				

* NRCS WETS data was used to determine the growing season for monitorg years 1 and 2. After discussions with the US Army Corps of Engineers, on-site soil temperature probe data is being used to determine the beginning of the growing season.

BANKFULL VERIFICATION PHOTOGRAPHS
Monitoring Year 3

SF1 – *(10/14/2015)*

SF3 – *(10/14/2015)*

UT1 – *(10/14/2015)*

SF4 – *(10/14/2015)*

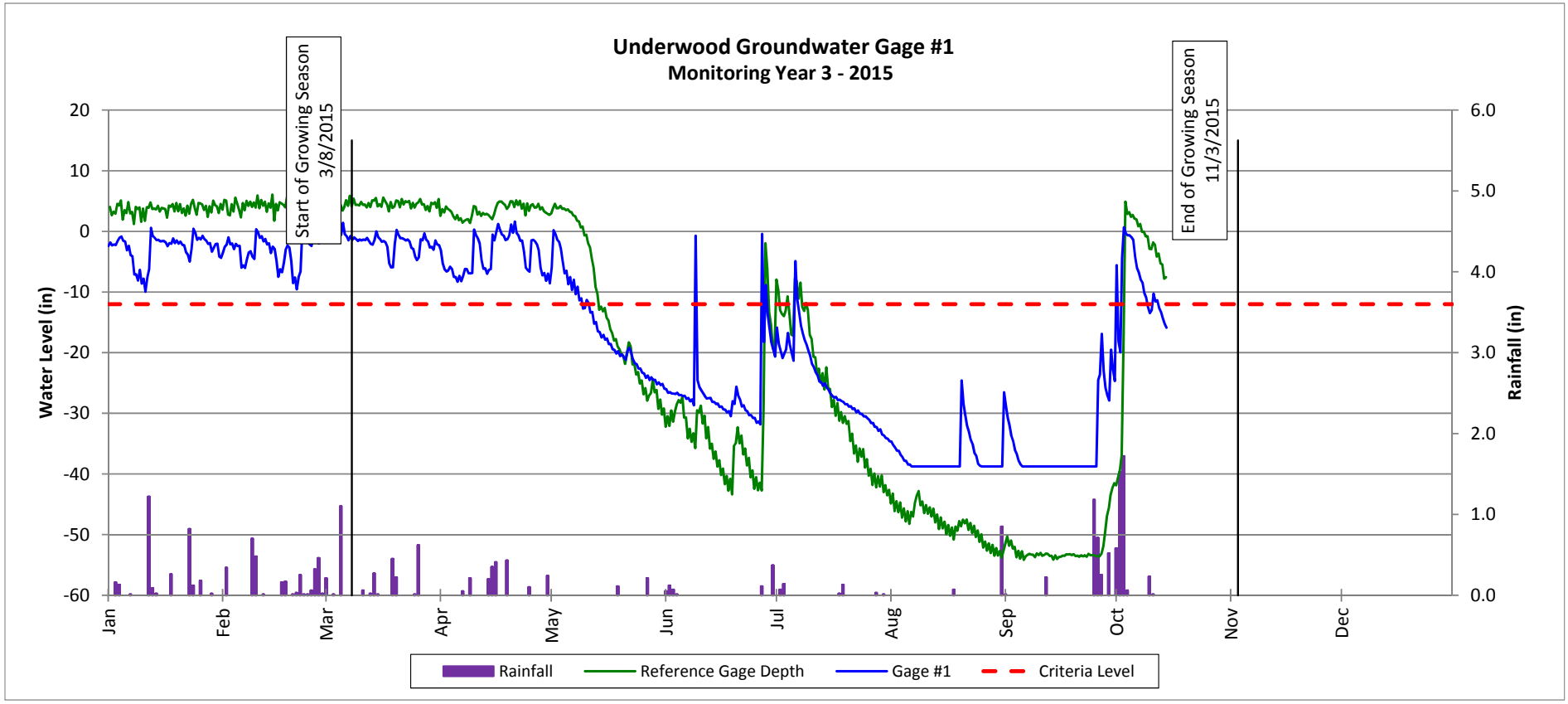
SF4A – *(10/14/2015)*

Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW1

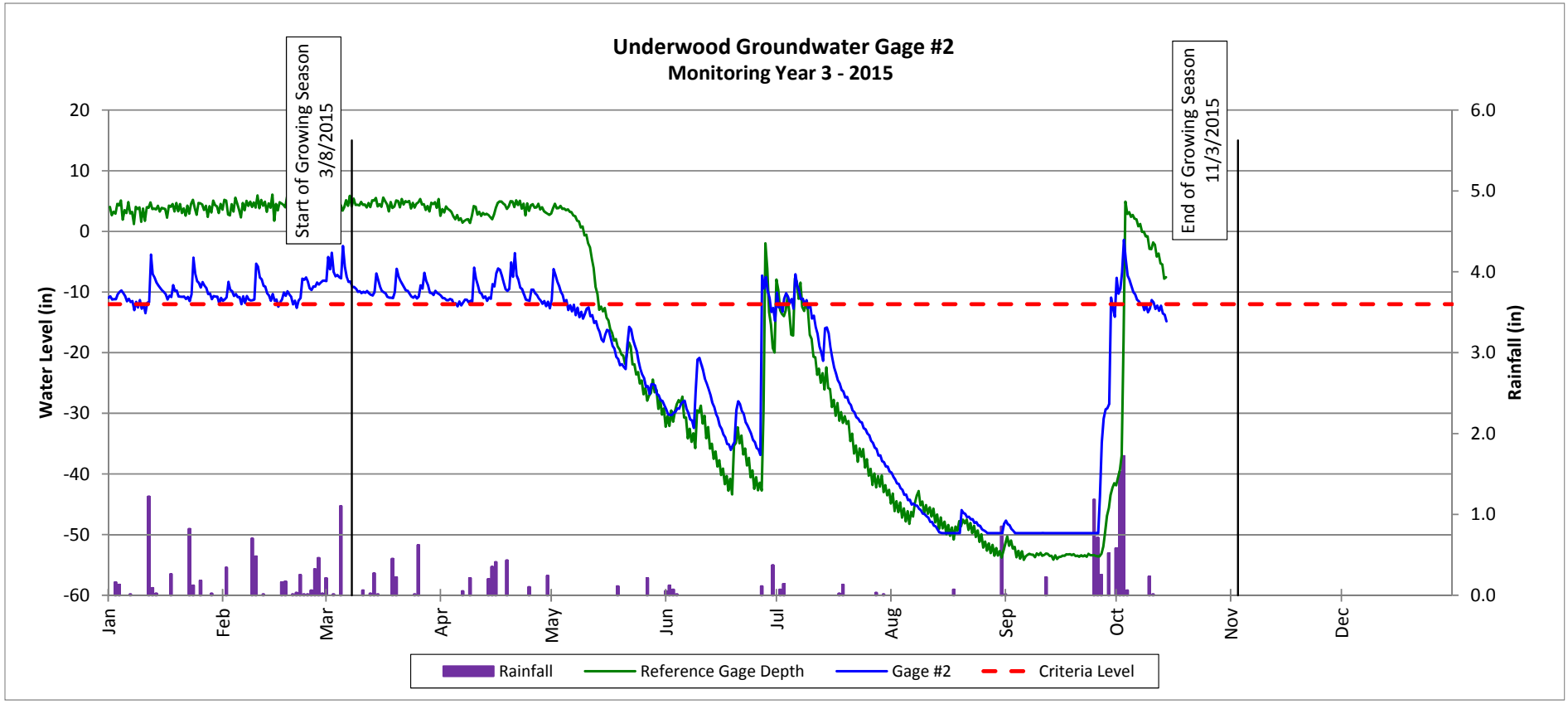


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW2

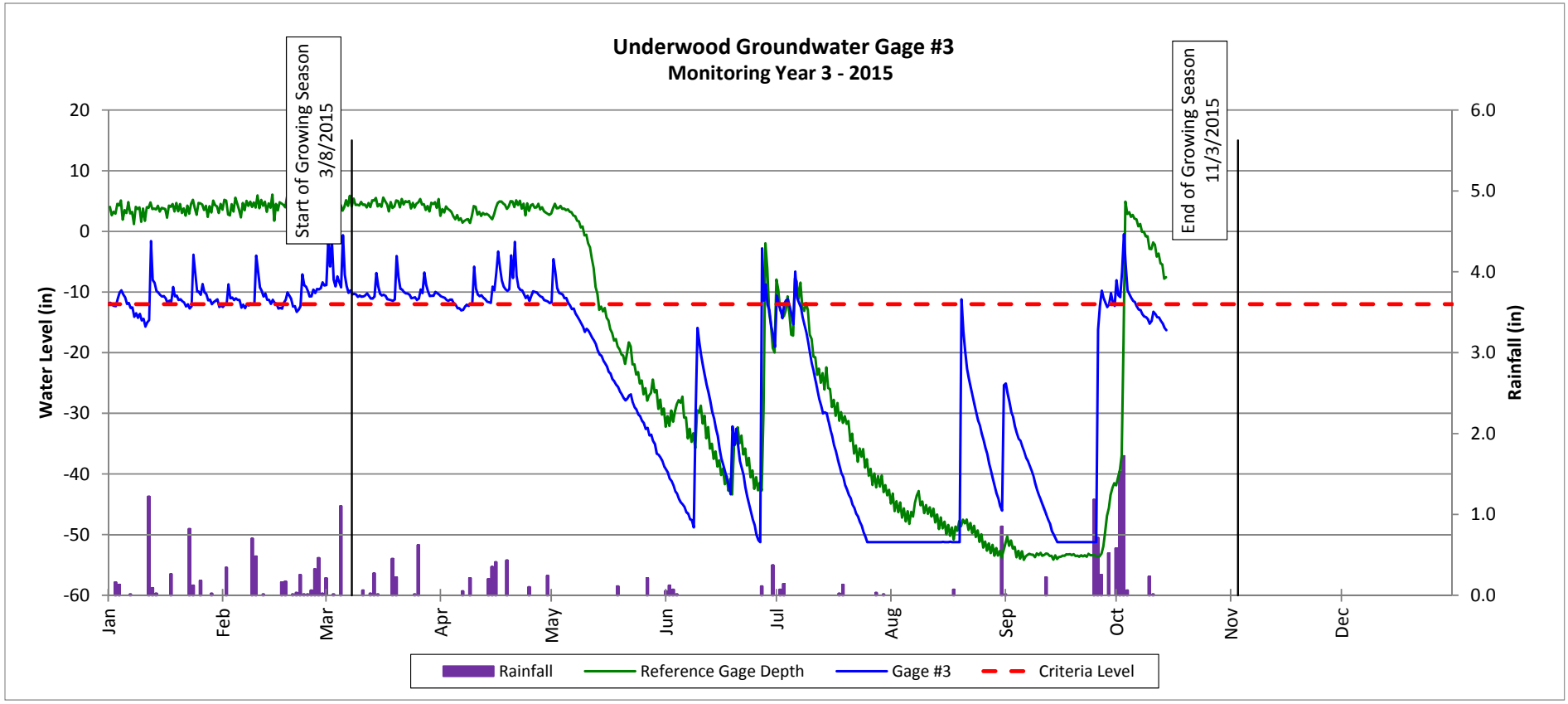


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; NRW1

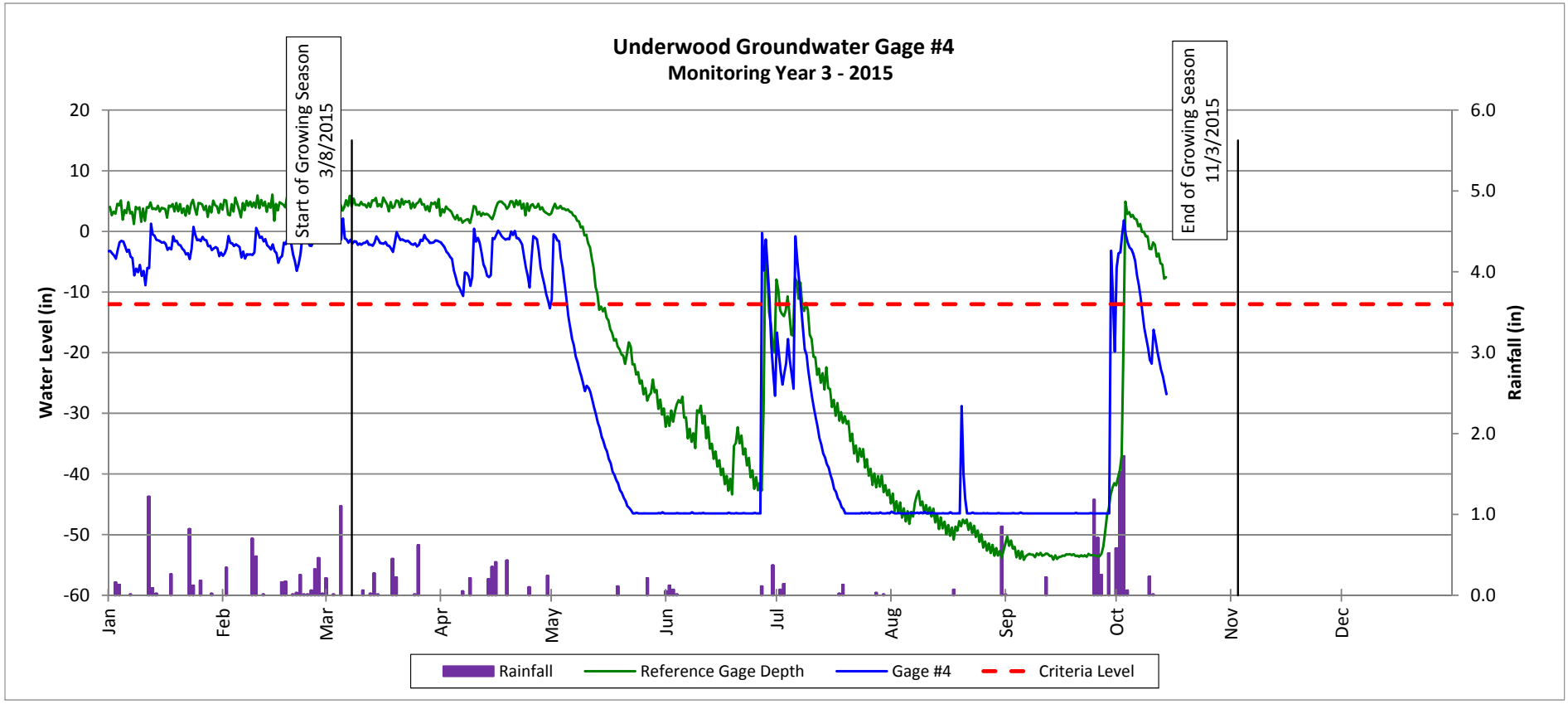


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW2

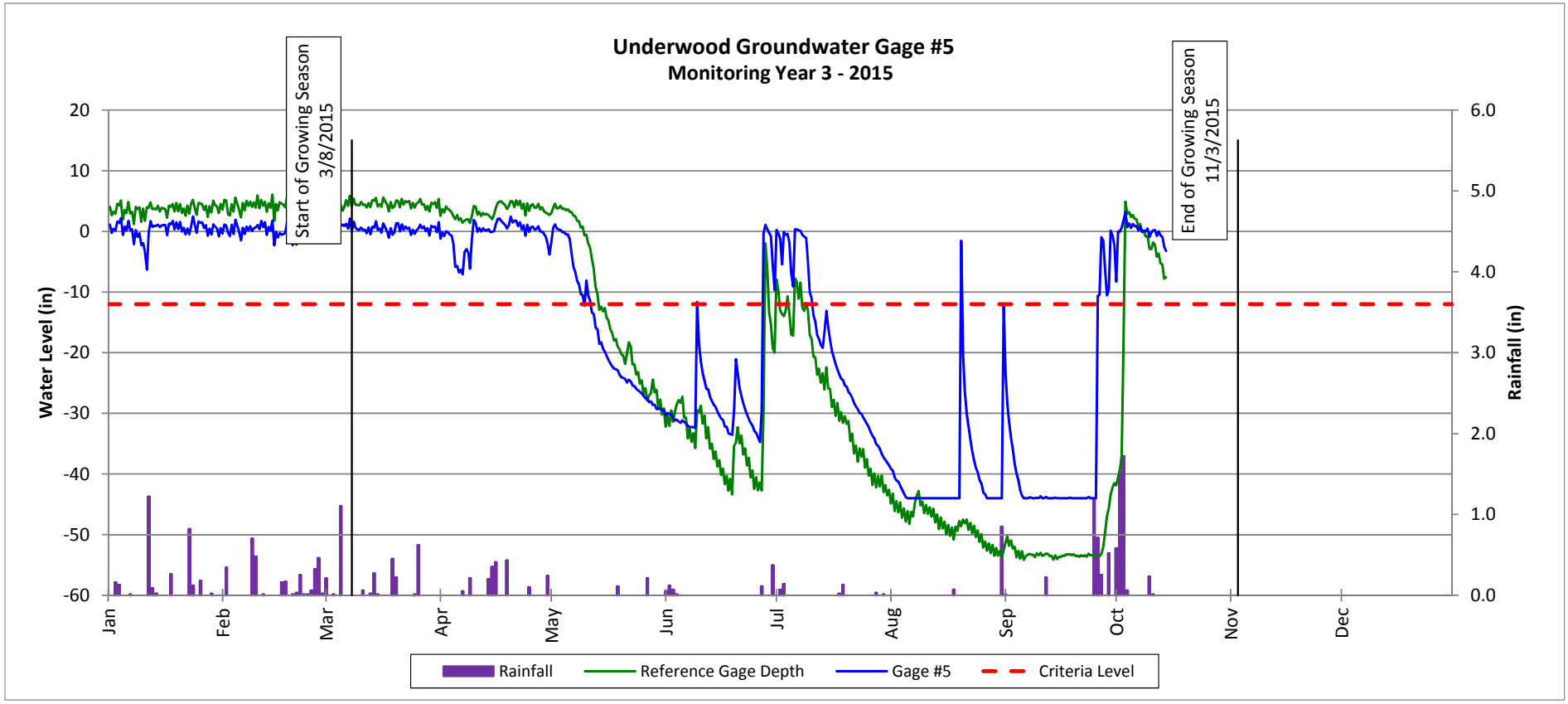


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW3

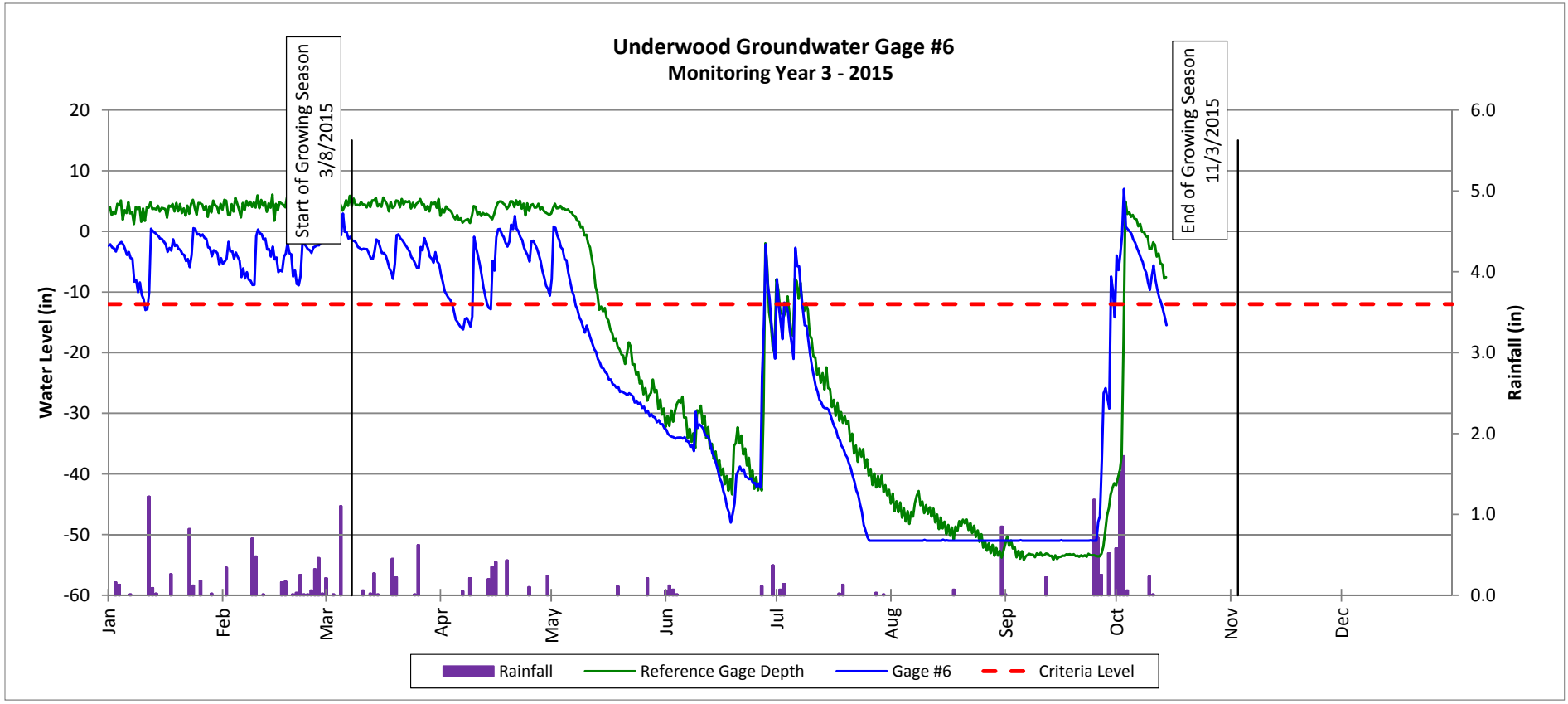


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW3

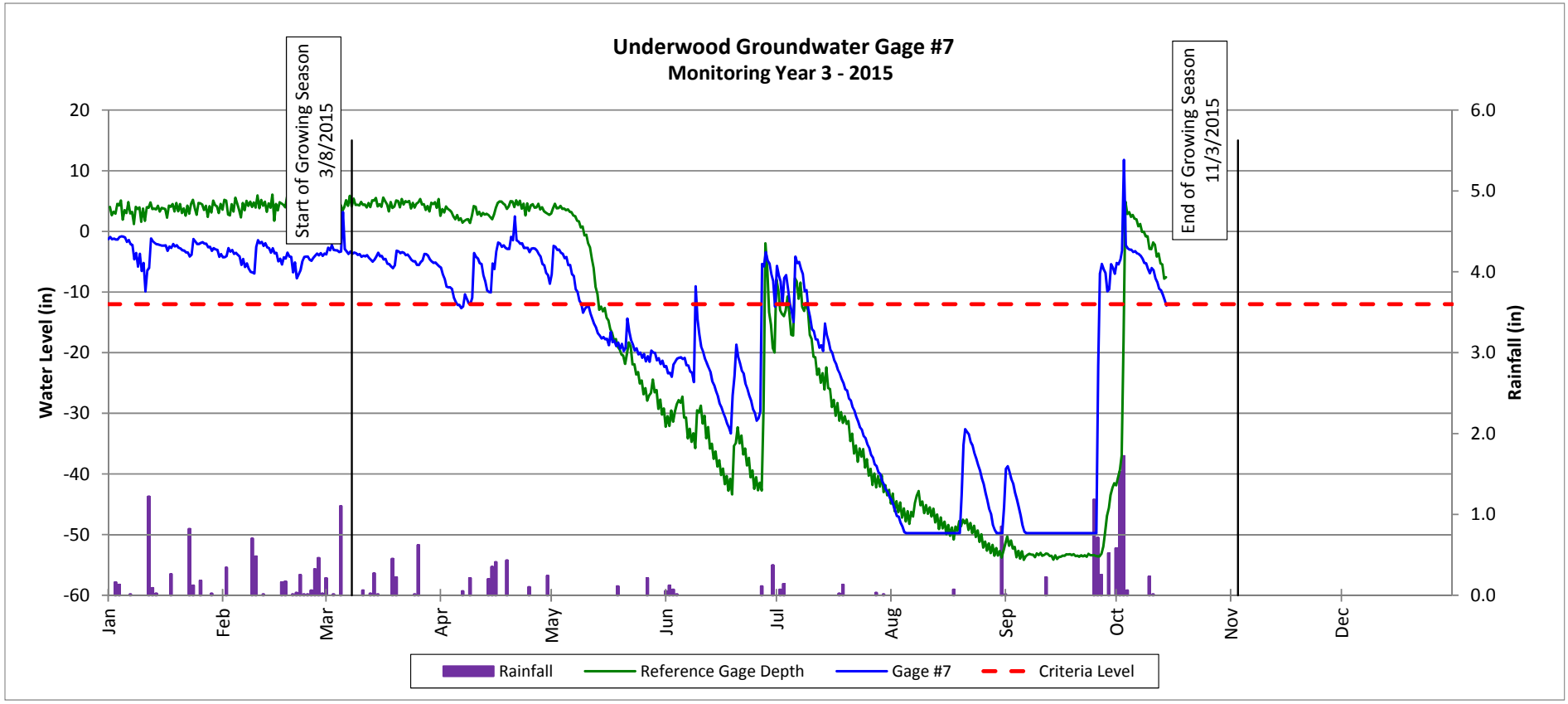


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW3

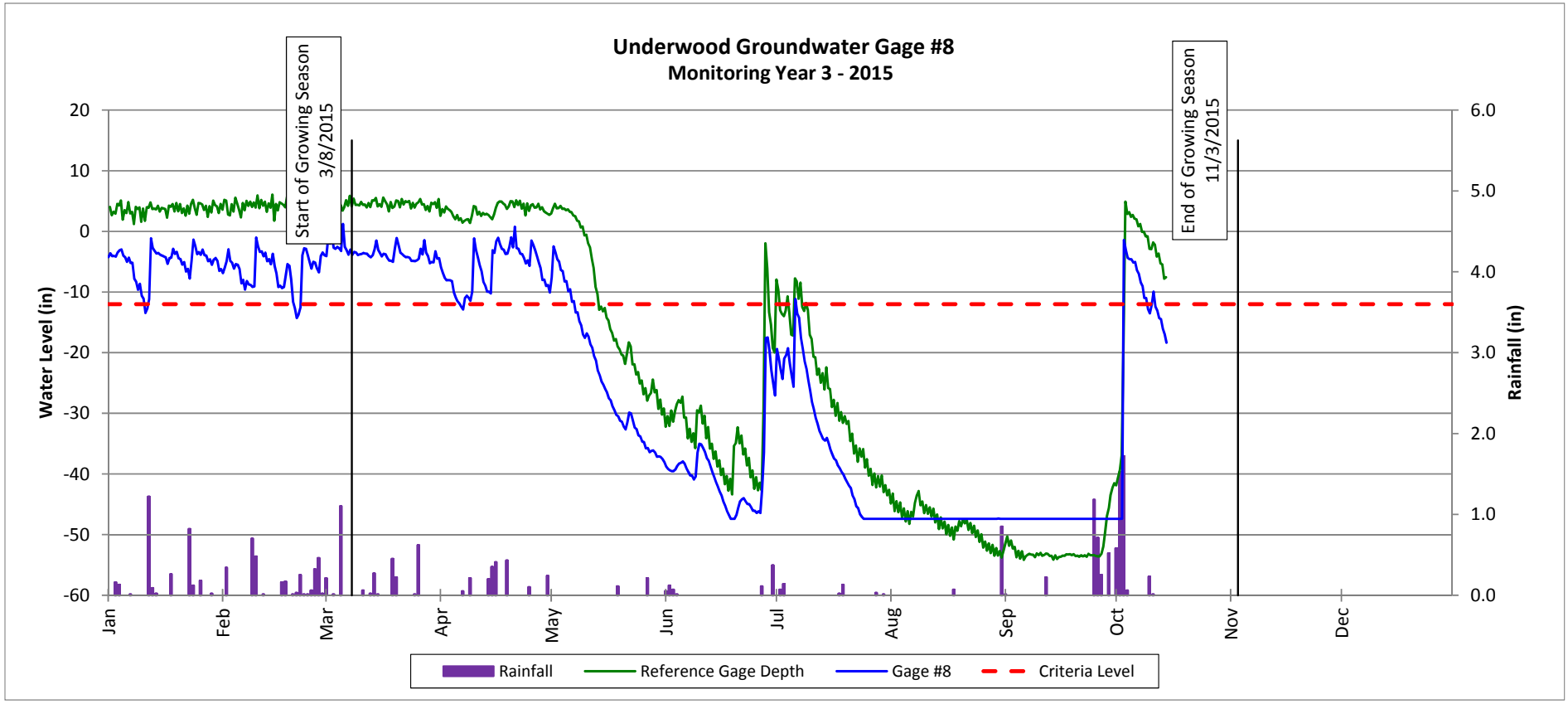


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; RW3

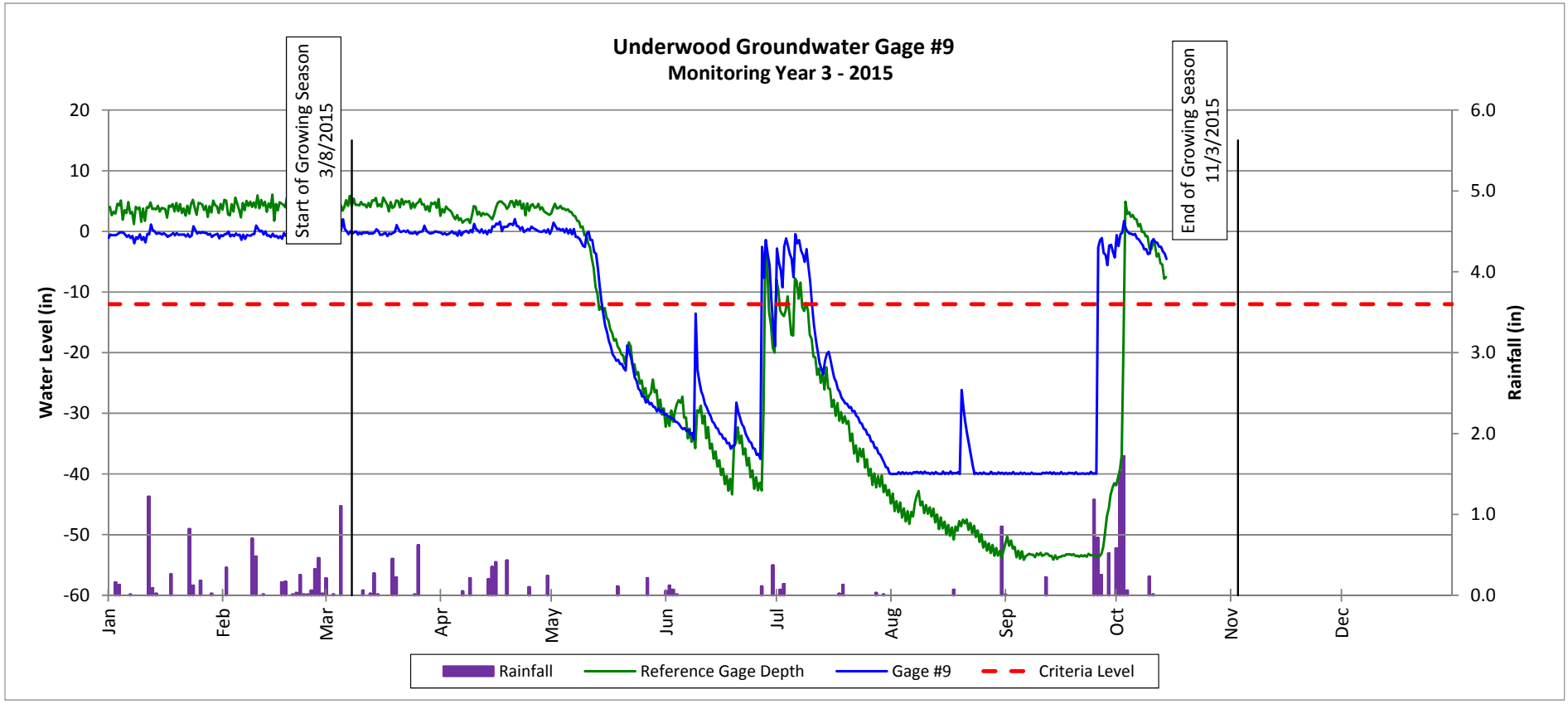


Groundwater Gage Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland Harris Site; NRW2

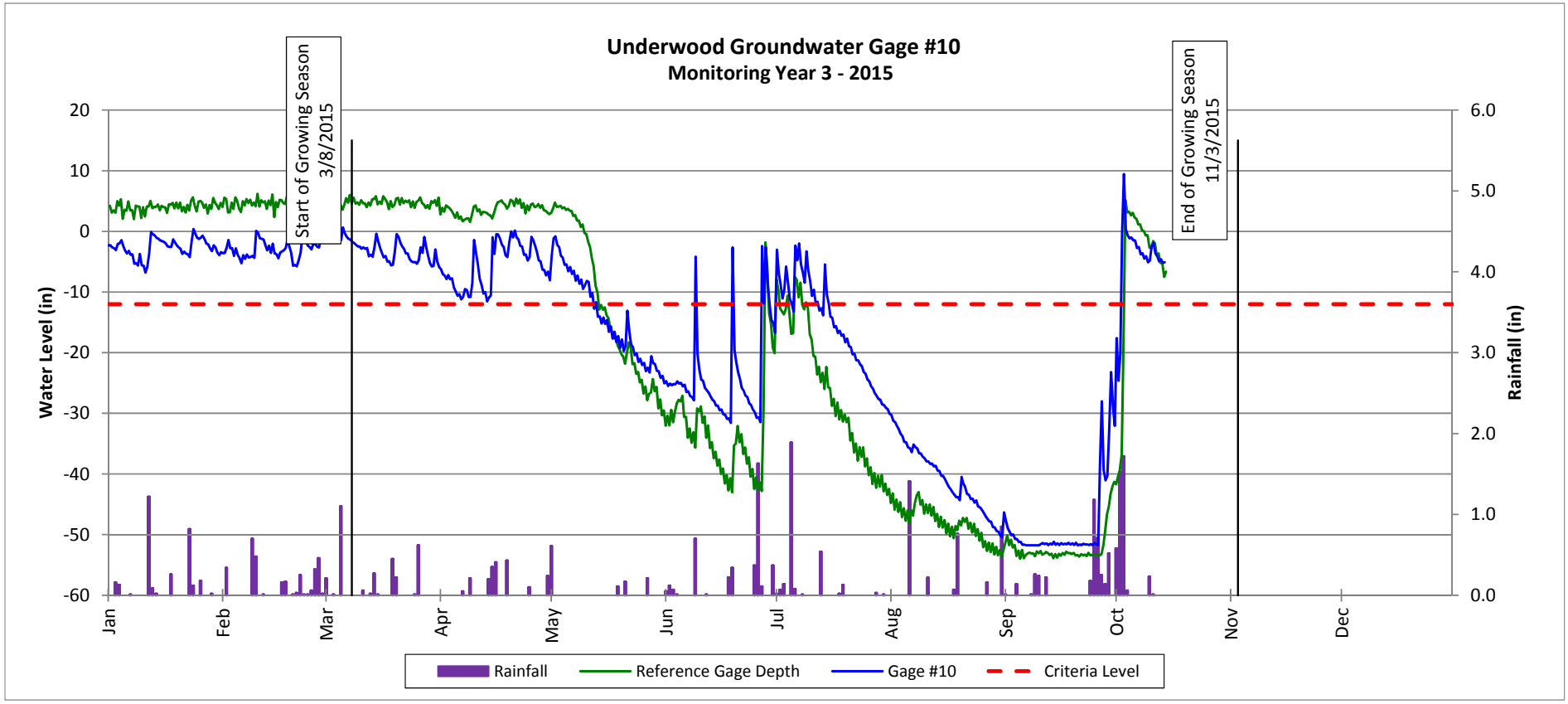


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4

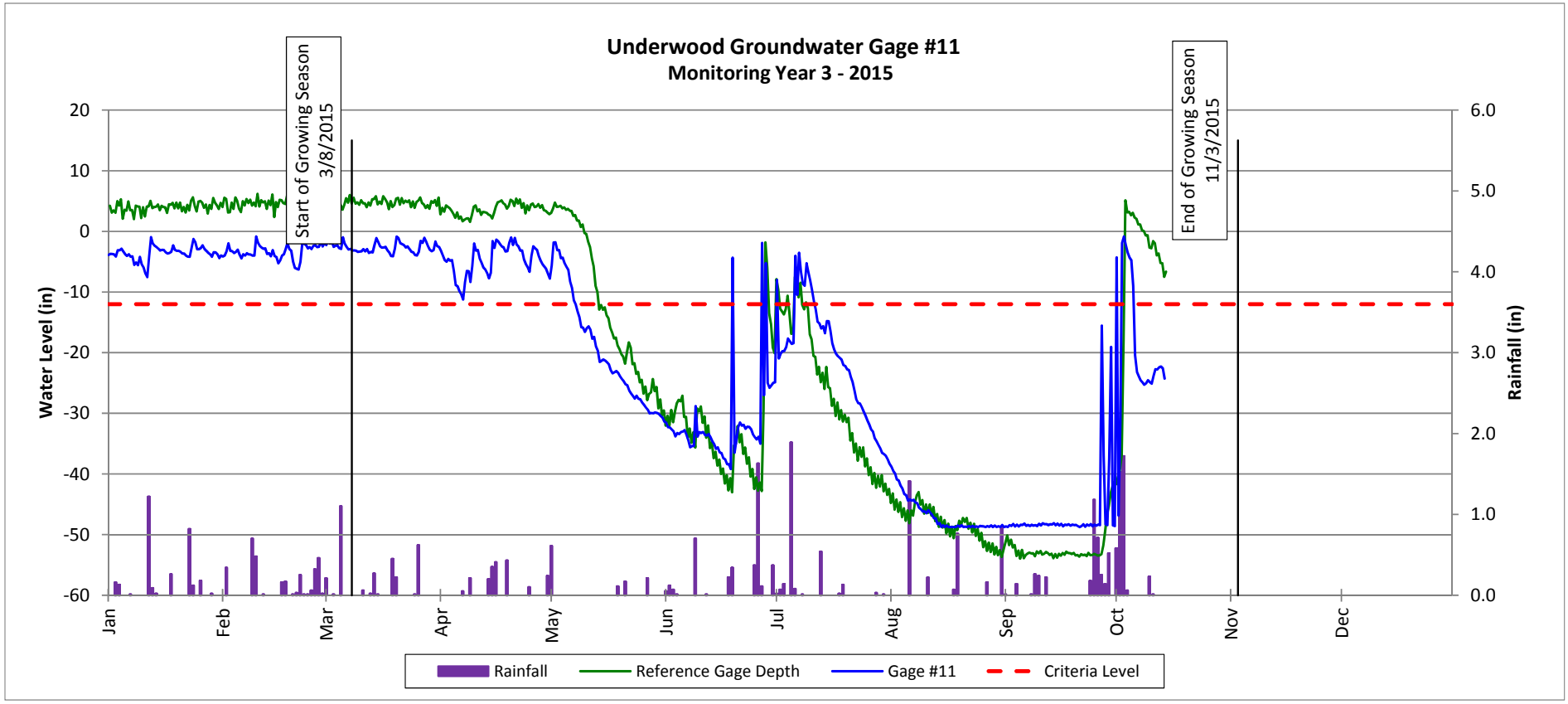


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4

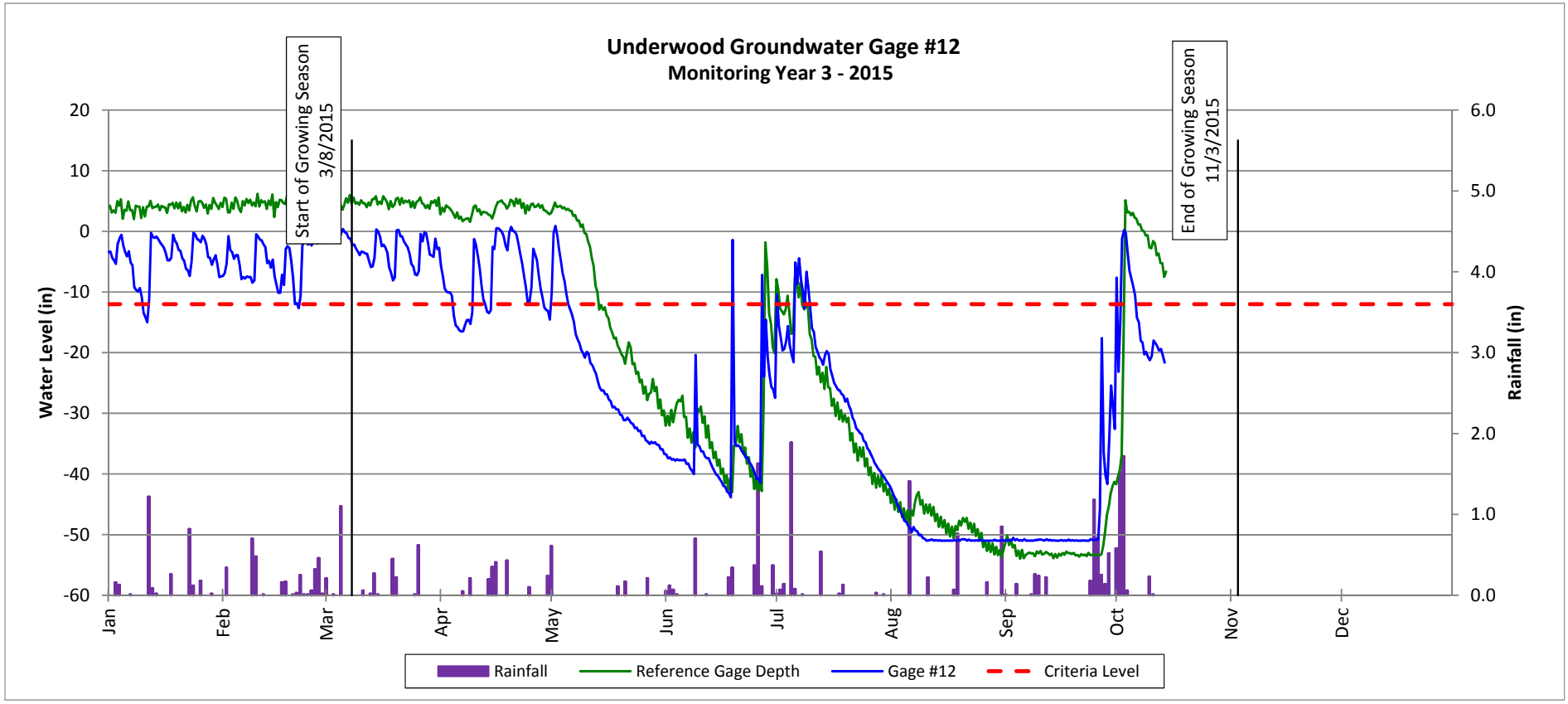


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4

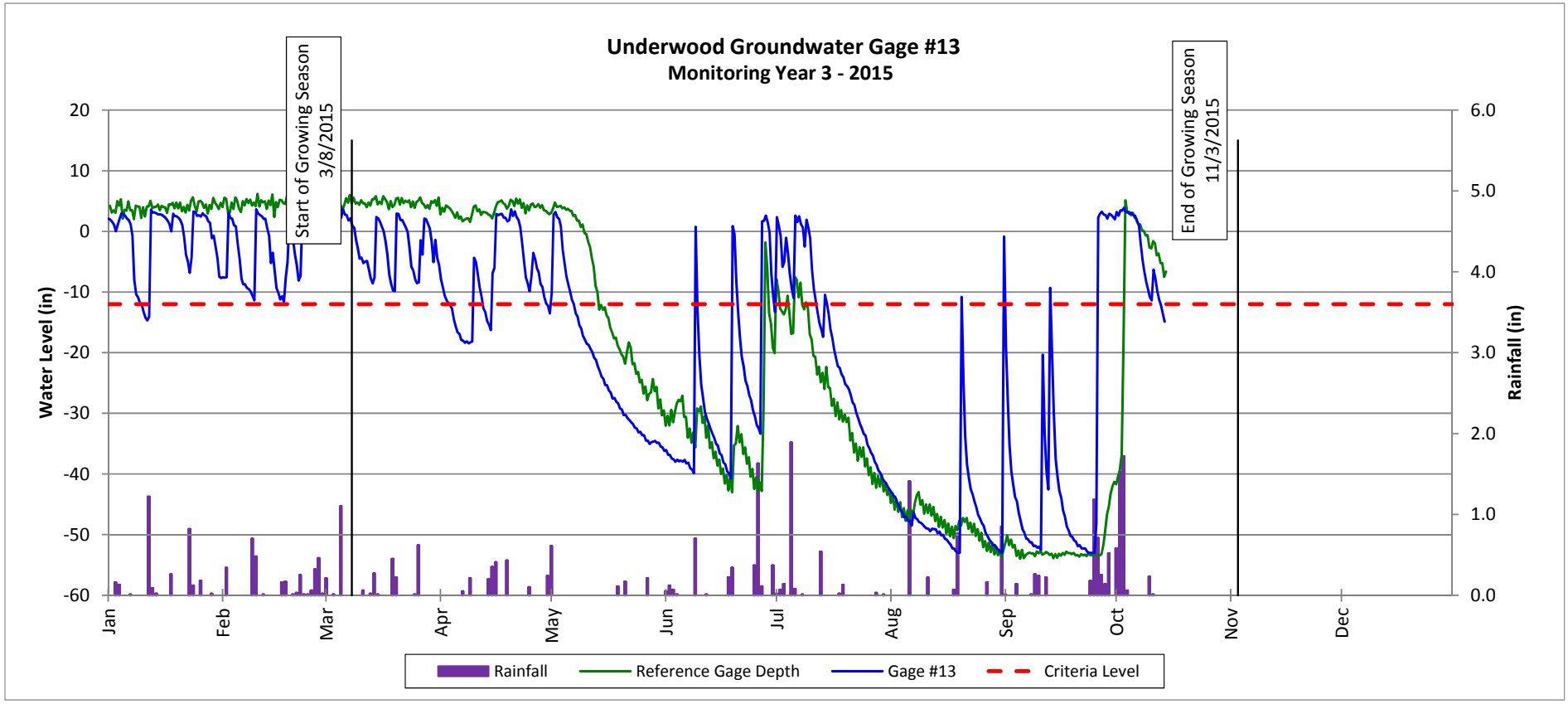


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4

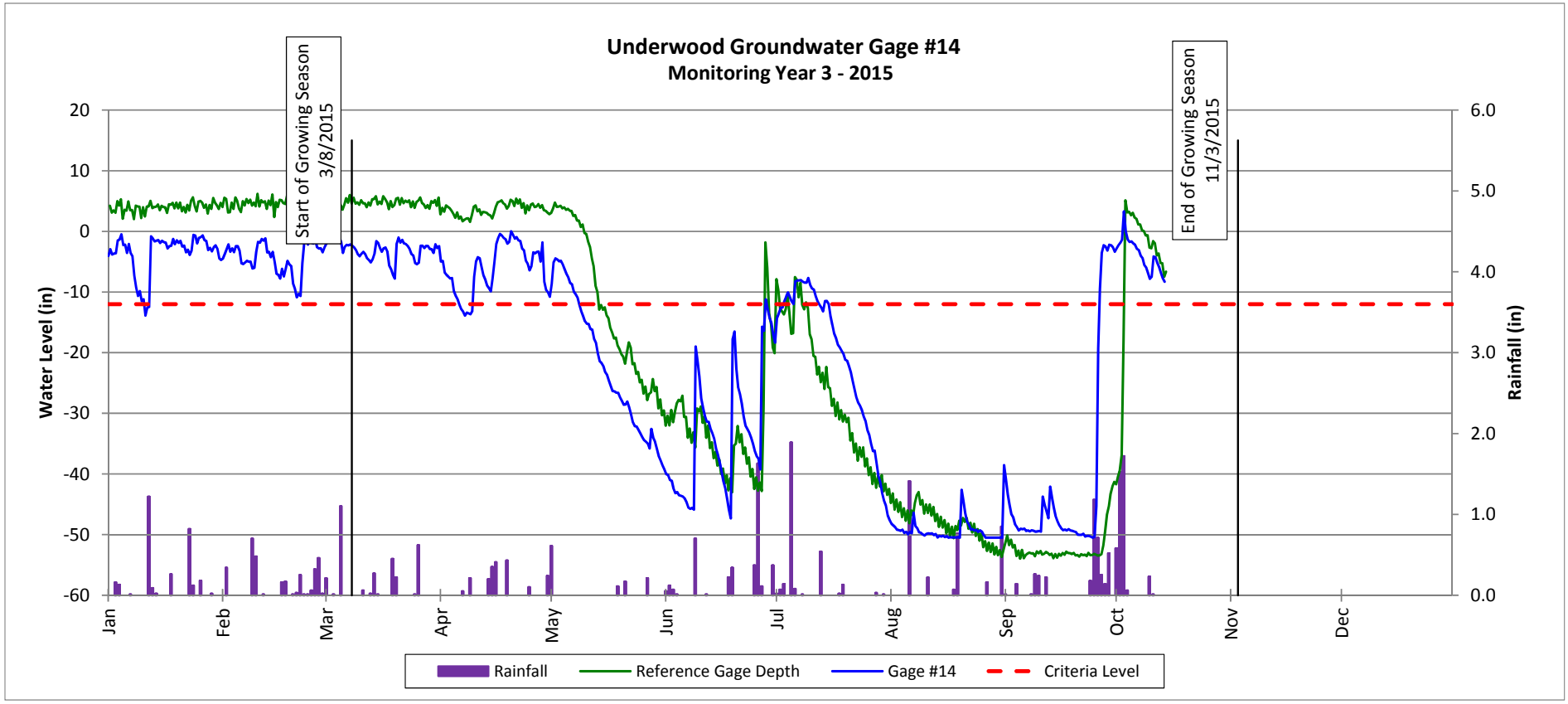


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4

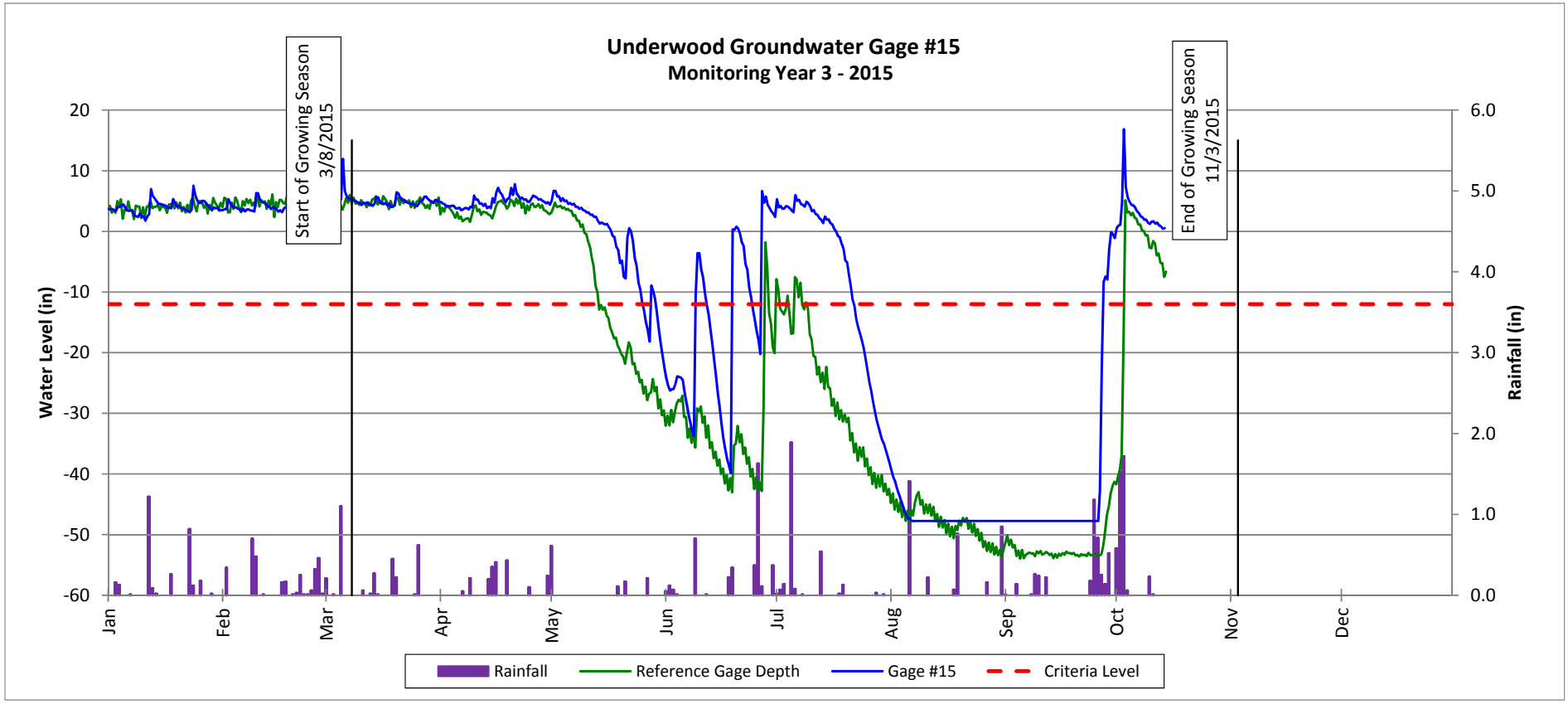


Groundwater Gage Plots

Underwood Mitigation Site (EEP Project No. 94641)

Monitoring Year 3 - 2015

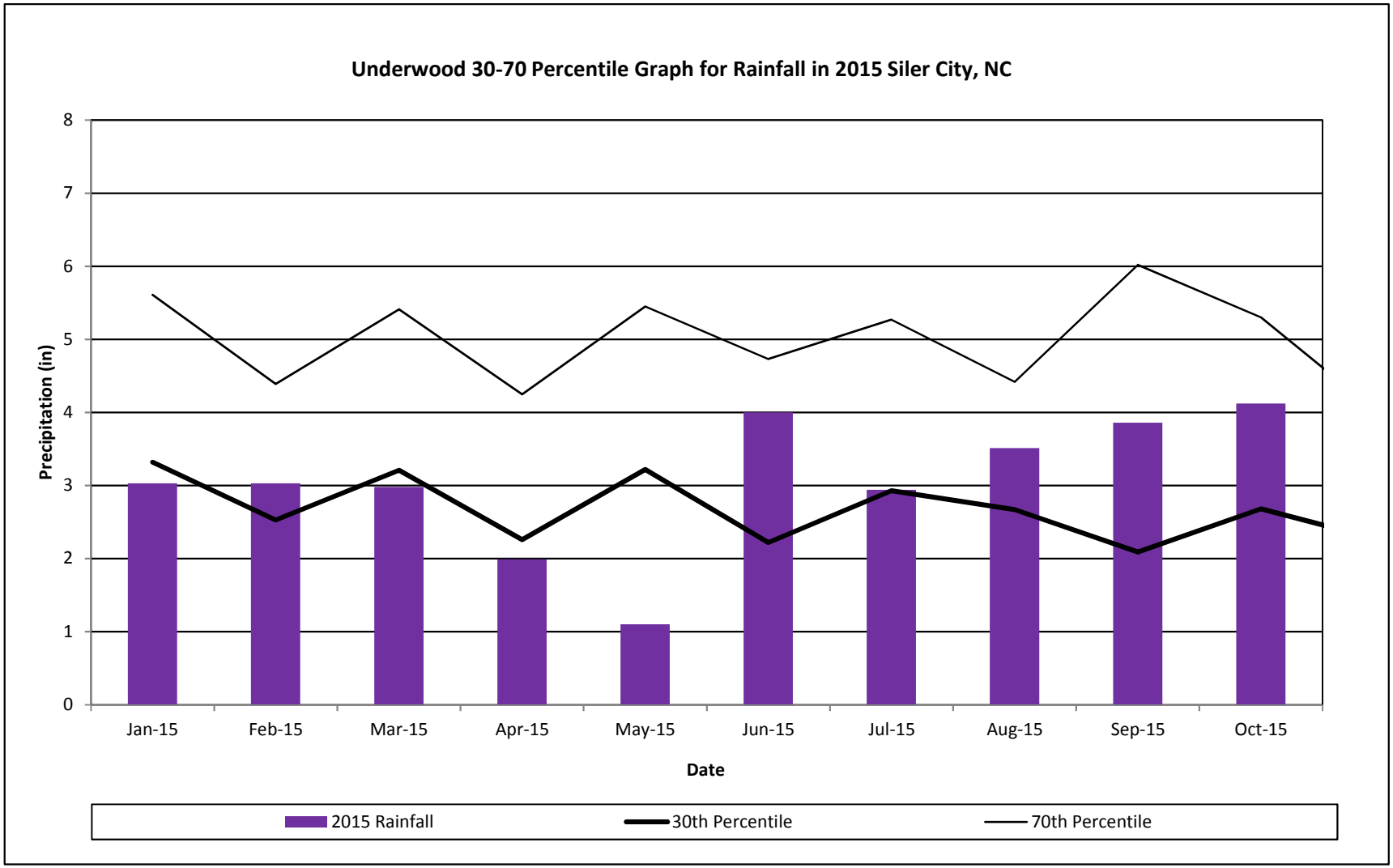
Wetland RW4



Monthly Rainfall Data

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 -2015



[1] 2015 rainfall collected by onsite rainfall gage.

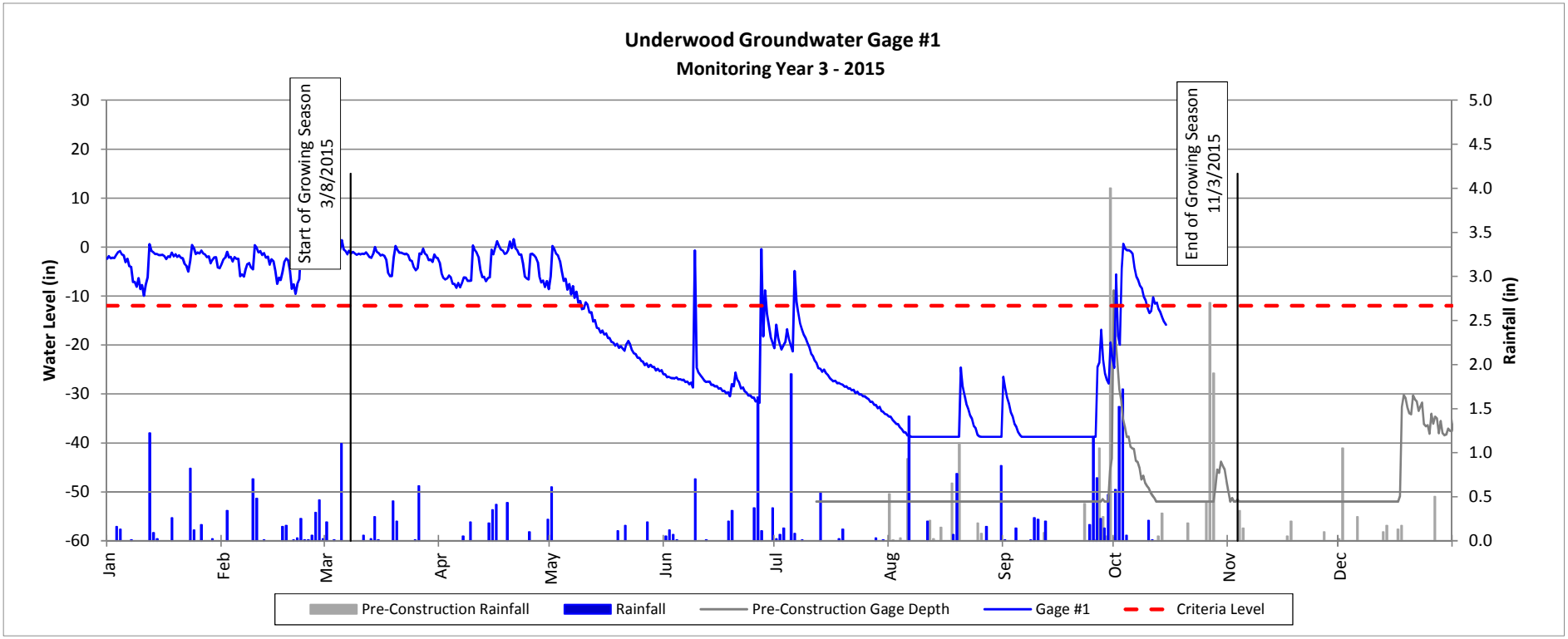
[2] 30th and 70th percentile rainfall data collected from weather station Siler City 2 S, NC7924 (USDA, 2002).

Pre and Post Construction Groundwater Gage Comparison Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW1

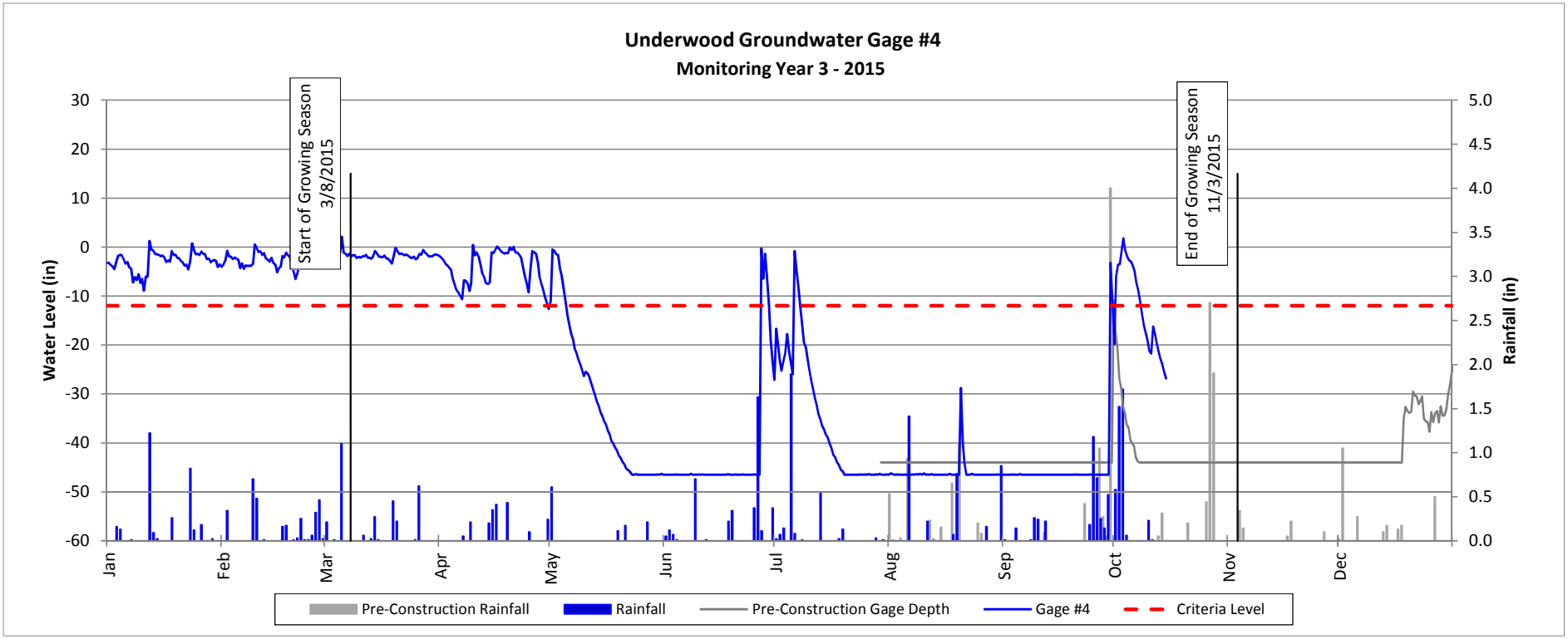


Pre and Post Construction Groundwater Gage Comparison Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW2

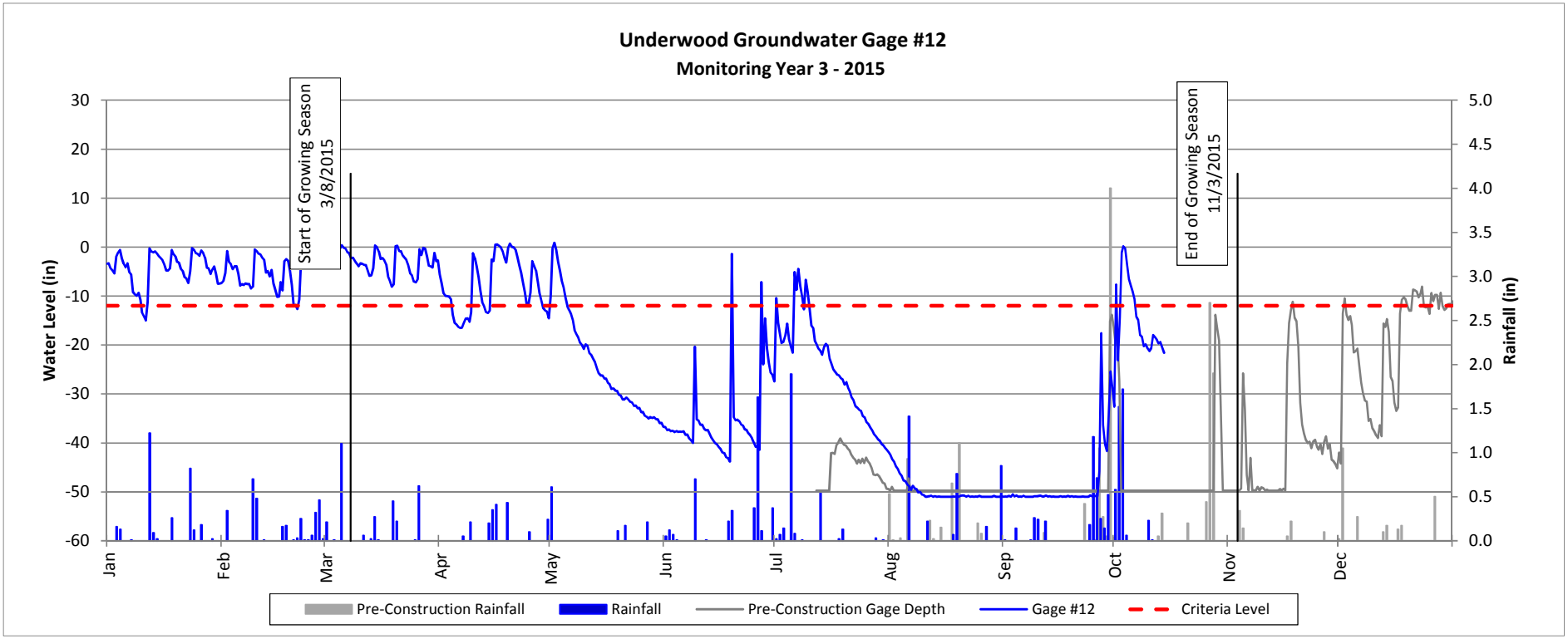


Pre and Post Construction Groundwater Gage Comparison Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4



Pre and Post Construction Groundwater Gage Comparison Plots

Underwood Mitigation Site (NCDMS Project No. 94641)

Monitoring Year 3 - 2015

Wetland RW4