MONITORING YEAR 3 ANNUAL REPORT
Final

LYLE CREEK MITIGATION SITE
Catawba County, NC
DENR Contract 003241
NCEEP Project Number 94643

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EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) completed a full-delivery project for the North Carolina Ecosystem Enhancement Program (NCEEP) to restore and enhance 6,795 linear feet (LF) of perennial and intermittent stream channel and to restore and create 9.5 acres (ac) of riparian wetland on a full delivery site in Catawba County, NC. The project stream reaches consist of UT1, UT1A, UT1B (stream restoration) and UT1C and UT1D (stream enhancement level II). The project wetland areas consist of RW1 and RW2 (wetland restoration and creation).

The Lyle Creek Mitigation Site, hereafter referred to as the site, is located west of NC Highway 10/ North Main Street in the Town of Catawba, NC on an active tree farm surrounded by woods and residential land use (see Figure 1). The site is located in the Catawba River Basin Hydrologic Unit Code (HUC) 03050101140010, and North Carolina Division of Water Resources (NCDWR) Subbasin 03-08-32, which is within a NCEEP Targeted Local Watershed. This HUC qualifies as a service area for an adjacent HUC; as a result, the Lyle Creek Mitigation Site was submitted for mitigation credit in the Catawba River Basin HUC 03050103. The site is located on one parcel owned by the Garmon Family.

Prior to construction activities, the project streams were regularly modified and maintained and therefore lacked bedform diversity, habitat, and riparian buffer. The lack of bedform diversity combined with continued anthropogenic disturbance resulting in degraded aquatic habitat, altered hydrology, and water quality concerns such as lowered dissolved oxygen levels. The primary goals of the project were to provide ecological and water quality enhancements to the Catawba River Basin while creating a functional riparian corridor at the site level, providing wetland habitat and ecological function, and restoring a Piedmont Bottomland Forest as described by Schafale and Weakley (1990). These goals were achieved by restoring 5,411 LF of perennial and intermittent stream channel and 6.6 ac of wetland area, enhancing 1,384 LF of intermittent stream channel and creating 2.9 ac of wetland area. Approximately 179 LF of stream was excluded from the total project credit calculations from crossings (farm roads and power line easements). Figure 2 and Table 1 present the restoration design for the site.

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

- Wetland areas will be disked to increase surface roughness and better capture rainfall which will improve connection with the water table for groundwater recharge. Adjacent streams will be stabilized and established with a floodplain connection to promote hydrologic transfer between wetland and stream;
- A channel with riffle-pool sequences and some rock and wood structures will be created in the steeper project reaches and a channel with run-pool sequences and woody debris structures will be created in the low sloped project reaches for macroinvertebrate and fish habitat. Introduction of wood including root wads and woody 'riffles' along with native stream bank vegetation will substantially increase habitat value. Gravel areas will be added as appropriate to further diversify available habitats;
- Adjacent buffer areas will be restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas will be restored and enhanced to provide wetland habitat;
- Sediment input from eroding stream banks will be reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles

Construction and planting activities were completed by River Works in April 2012. A Conservation Easement held by the State of North Carolina has been recorded with the Catawba County Register of

Deeds on the 26.62-acre Lyle Creek project study area within the Garmon parcel. The conservation easement protects the project area in perpetuity.

Monitoring Year 3 (MY3) monitoring and site visits were completed during May-June 2014 to assess the conditions of the project. Except for GWG #6, the site has met the required hydrologic and vegetation success criteria for MY3. All streams within the site are stable and meeting the MY3 success criteria with the exception of the discrete location within the upstream portion of UT1A. The site's overall average stem density of 405 stems/acre is greater than the 320 stem/acres density required for MY3 and the site has met the MY5 stream hydrology attainment requirement as all streams have experienced at least two bankfull events in separate years. All groundwater gages except GWG # 6 met the success criteria for wetland hydrology.

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APPENDICES

Section 1: PROJECT OVERVIEW

The Lyle Creek Mitigation Site is a full-delivery stream and wetland restoration project for the NCEEP in Catawba County, NC. The Site is located in the Catawba River Basin HUC 03050101140010, and NCDWR Subbasin 03-08-32, which is within a NCEEP Targeted Local Watershed. This HUC qualifies as a service area for an adjacent HUC; as a result, the Lyle Creek Mitigation Site was submitted for mitigation credit in the Catawba River Basin HUC 03050103. The Site is located west of NC Highway 10/ North Main Street in the Town of Catawba, NC, on an active tree farm surrounded by woods and residential land use. The Site is bounded by Lyle Creek to the north, NC Highway 10/ North Main Street to the east and an elevated railroad right-of-way to the south.

The project stream reaches consist of UT1, UT1A, UT1B (stream restoration) and UT1C and UT1D (stream enhancement level II). The project wetland areas consist of RW1 and RW2 (wetland restoration and creation). Mitigation work within the Site included restoring and enhancing 6,795 LF of perennial and intermittent stream channel and restoring and creating 9.5 ac of riparian wetland. The stream and wetland areas were planted with native vegetation to improve habitat and protect water quality. Construction and planting activities were completed by River Works in April 2012. The Site is located on one parcel owned by the Garmon Family. A Conservation Easement held by the State of North Carolina has been recorded with the Catawba County Register of Deeds on the 26.62-acre Lyle Creek project study area within the Garmon parcel. The conservation easement protects the project area in perpetuity.

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

1.1 Project Goals and Objectives

Prior to construction activities, the project streams were regularly modified and maintained and therefore lacked bedform diversity, habitat, and riparian buffer. The primary impacts to the project streams were the result of mowing, ditching, vegetation maintenance, and dredging associated with tree farming activities. As a result of the aforementioned land activities, the onsite streams were incised and overly wide with shallow flow. The streams were unable to maintain their channel form and subsequently filled in with sediment, organic matter, and vegetation. In-stream bedform diversity was extremely poor and the longitudinal profile was dominated by shallow runs. The lack of bedform diversity combined with continued anthropogenic disturbance resulted in degraded aquatic habitat, altered hydrology (related to loss of floodplain connection and lowered water table), and water quality concerns such as lower dissolved oxygen levels (due to shallow flow with few re-aeration points). Table 4 in Appendix 1 and Tables 10a, 10b, and 10c in Appendix 4 present the pre-restoration conditions in detail.

The primary goals of the project were to provide ecological and water quality enhancements to the Catawba River Basin while creating a functional riparian corridor at the site level, providing wetland habitat and ecological function, and restoring a Piedmont Bottomland Forest as described by Schafale and Weakley (1990). These goals were achieved by restoring 5,411 LF of perennial and intermittent stream channel and 6.6 ac of wetland area, enhancing 1,384 LF of intermittent stream channel and creating 2.9 ac of wetland area. Approximately 179 LF of stream crossings (farm roads and power line easements) were excluded from the total project credit calculations. The Site's riparian areas were also planted to stabilize streambanks and wetland areas, improve habitat, and protect water quality. The ecological uplift can be summarized as starting from tree farming-impacted streams and wetlands and moving to stable channels and wetlands in a protected riparian corridor. Restoration of dimension, pattern, and profile

was implemented for UT1, UT1A, and UT1B; enhancement of profile and dimension was implemented for UT1C and UT1D. Wetland restoration and creation included RW1 and RW2. UT1A and UT1B discharge into an anastomosed wetland complex upstream of their confluence with UT1 as depicted in Figure 2. This anastomosed wetland complex was not proposed for stream mitigation credit. Figure 2 and Table 1 present the implemented design for the Site.

Monitored enhancements to water quality and ecological processes established in the mitigation plan (approved 8/2011) are outlined below, followed by expected project benefits which are associated with restoration, but will not be monitored as part of this project:

Monitored Project Goals

- Wetland areas will be disked to increase surface roughness and better capture rainfall which will improve connection with the water table for groundwater recharge. Adjacent streams will be stabilized and established with a floodplain elevation to promote hydrologic transfer between wetland and stream;
- A channel with riffle-pool sequences and some rock and wood structures will be created in the steeper project reaches and a channel with run-pool sequences and woody debris structures will be created in the low sloped project reaches for macroinvertebrate and fish habitat. Introduction of wood including root wads and woody 'riffles' along with native stream bank vegetation will substantially increase habitat value. Gravel areas will be added as appropriate to further diversify available habitats;
- Adjacent buffer areas will be restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas will be restored and enhanced to provide wetland habitat; and
- Sediment input from eroding stream banks will be reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles.

Expected Project Benefits

- Chemical fertilizer and pesticide levels will be decreased by filtering runoff from adjacent tree farm operations through restored native buffer zones and wetlands. Offsite nutrient input will be absorbed onsite by filtering flood flows through restored floodplain areas and wetlands, where flood flows can disperse through native vegetation and be captured in vernal pools. Increased surface water residency time will provide contact treatment time and groundwater recharge potential;
- Sediment from offsite sources will be captured during bankfull or greater flows by deposition on restored floodplain areas where native vegetation will slow overland flow velocities;
- Restored riffle/step-pool sequences on the upper reach of UT1A, where distinct points of re-aeration can occur, will allow for oxygen levels to be maintained in the perennial reaches. Small log steps on the upstream portion of UT1B and UT1 Reach 1 Upper will also provide re-aeration points; and
- Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Pools will form below drops on the steeper project reaches and around areas of woody debris on the low-sloped project reaches. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.

The design 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 stream restoration success criteria for the Site follows the approved performance criteria presented in the NCEEP Mitigation Plan Template (version 1.0, 11/20/2009) and the Stream Mitigation Guidelines issued in April 2003 by the U.S. Army Corps of Engineers (USACE) and NCDWR. Annual monitoring and quarterly site visits will be conducted to assess the condition of the finished project for five years, or until success criteria are met. The stream restoration reaches (UT1, UT1A, and UT1B) of the project were assigned specific performance criteria components for stream morphology, hydrology, and vegetation. The enhancement reaches (UT1C and UT1D) were documented through photographs and visual assessments to verify that no significant degradational changes are occurring in the stream channel or riparian corridor. Monitoring for wetland vegetation will extend seven years beyond completion of construction. The wetland restoration and creation sections have been assigned specific performance criteria for hydrology and vegetation. The final mitigation plan was submitted and accepted by the NCEEP in August 2011. Construction activities were completed by River Works, Inc. in April 2012. Baseline monitoring (MY0) and as-built survey was conducted between April and May 2012. Annual monitoring will be conducted for seven years: stream and vegetation assessment will be conducted for five years and wetland assessment will be conducted for seven years. The final monitoring activities will be conducted in 2018 with the close-out anticipated to commence in 2019 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 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 Lyle Mitigation Plan (approved 8/2011).

1.2.1 Vegetative Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008). A total of 35 vegetation monitoring plots were established during the baseline monitoring within the project easement areas using a standard 10 meter by 10 meter plot. The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of year five of the monitoring period. The interim measure of vegetative success for the site will be the survival of at least 320 planted stems per acre at the end of year three of the monitoring period.

The site was re-planted in late winter 2012 in response to the dead bare roots observed during the MY1 vegetative survey. Most likely, the mortality of planted stems during year 1 was a result of dry soil conditions, low precipitation, and/or from grass suffocation or crowding of planted stems. The MY2 vegetation survey resulted in an 11% increase in stem presence due to supplemental planting and the re-sprout of existing bare roots. After the MY2 vegetation survey an additional supplemental planting was warranted within the vicinity of plots 4, 6 and 19.

The MY3 vegetative survey was completed in June 2014. The annual vegetation monitoring resulted in an average planted stem density of 405 stems per acre, which is greater than the interim requirement of 320 stems/acre. Of 35 plots assessed, five did not meet the 320 stems/acre interim requirements and only one of the five did not meet the year 5 criteria of 260 stems/acre. Total stem densities ranged from 283 –

1246 stems per acre with an overall average of 553 stems per acre indicating a strong presence of volunteer species. Between two and nine native woody species were documented in the vegetation plots with 22 species present site wide.

1.2.2 Vegetative Areas of Concern

The MY3 vegetation monitoring and visual assessment revealed few vegetation areas of concern, mostly carrying over from MY2. Invasive species have been identified onsite, including Kudzu (*Pueraria lobata*), Johnson grass (*Sorghum halepense**)***, and cattails (*Typha latifolia)*. The presence of these species does not currently appear to be affecting the survivability of planted stems, however, as discussed in the maintanence plan Wildlands will perform maintenance as needed. Please refer to Appendix 3 for vegetation summary tables and raw data tables and to Appendix 2 for vegetation plot photographs, the vegetation condition assessment table and Figures 3.0-3.3 for the Integrated Current Condition Plan View which outlines these areas of concern.

Maintenance Plan

The mortality of the bare roots is likely due to crowding or suffocation as early successional weeds and grasses are rapidly taking hold within the project area. Areas with poor stem survival will be evaluated during Winter 2014/2015 to determine whether or not supplemental planting will be required. Currently the invasive species identified on the site do not appear to be negatively affecting planted stems. Visual assessment will be performed in 2014/2015 to determine if any additional maintenance is necessary to promote survival of the remaining planted stems. In order to keep the invasive species Kudzu under control, Wildlands treated the invasive areas around the upstream extents of UT1A and UT1B during the Fall of 2014 using a glyphosate concentration.

1.2.3 Stream Assessment

Morphological surveys for MY3 were conducted in May 2014. The majority of the streams within the Site have met the success criteria for MY3 with the exception of a short length of UT1A. Aggradation was observed along UT1A from station 301+75 to 304+34. This area of concern is further described below. Aggradation was also observed along UT1B from station 201+46 to 204+75 during the MY3 survey. Following the survey, a field assessment was completed which showed the sediment load in UT1B had naturally transported downstream and stream features were functioning as designed. Due to the natural rehabilitation of the reach there are no reportable areas of concern within UT1B for MY3. Please refer to Appendix 2 for the visual assessment table, Integrated Current Condition Plan View (CCPV), photographs, and Appendix 4 for morphological data and plots. It should be noted that the morphological plots in Appendix 4 show the aggradation in UT1B at the time of survey but do not depict the stream's natural rehabilitation condition observed during a follow-up field assessment.

Surveyed riffle cross-sections fell within the parameters defined for channels of the appropriate Rogsen stream type with the exception of cross-section 9 along UT1A and cross section 12 along UT1B. Both UT1A and UT1B experienced aggradation from the contributing upstream watershed during MY3. Aggradation increased in MY3 and has impacted channel flow capacity along UT1A. On May 9, 2014, during MY3, an additional cross section was installed at station 300+94 on UT1A. This cross section has been installed upstream of the aggraded section of UT1A to characterize the steeper, upstream section of the reach. This cross-section will be monitored within the guidelines presented in the mitigation plan. The sedimentation in UT1B was observed during the MY3 morphological survey but was not observed during a site visit in July 2014. Due to the natural rehabilitation of UT1B there are no reportable areas of concern

along this reach. In general cross-sections along UT1 show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio.

The surveyed longitudinal profile data for the stream restoration reaches illustrates that the bedform features are maintaining lateral and vertical stability throughout UT1, and the lower sections of UT1A and UT1B. In UT1, UT1B and the downstream sections of UT1A the riffles and runs 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. In the upper sections of UT1A and UT1B aggradation has occurred due to sedimentation from the contributing upstream watershed. In the aggraded section of UT1A, the sediment load has extended above the top of bank. Prior to the morphological survey, UT1B's riffles and runs had become less steep and deeper than pools and pools had become steeper and less shallow and resembled meandering riffles or runs (Appendix 4, Longitudinal Profile Plots). Although this data is reported in the appendices, it is not an area of concern due to the natural rehabilitation of the reach following the transport of the sediment downstream.

At the downstream end of UT1, near the confluence with Lyle Creek, minor aggradation has occurred. This aggradation is most likely attributed to backwater conditions from Lyle Creek. However due to the sand/silt nature of the substrate throughout the project, fluctuations in bed elevations were observed and expected. These fluctuations within UT1 are temporary and seem to typically correspond to storm events.

In-stream structures, such as brush mattresses and sod mats used to enhance channel habitat and stability on the outside bank of meander bends are providing stability and habitat as designed. 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.

Maintenance Plan

During MY3 aggradation rates increased along UT1A and UT1B. This aggradation is due to upstream bank erosion and mass wasting occurring upstream of the Site that is outside of the conservation easement. Wildlands expects UT1A to naturally transform with the input of sediment and will continue monitoring the aggraded sections to determine if the stream will evacuate the sediment. UT1B will continue to be monitored for increased sediment loading in future monitoring years.

1.2.4 Hydrology Assessment

At the end of the five-year monitoring period, two or more bankfull events must have occurred in separate years within the restoration reaches. During MY3, one or more bankfull or greater events were recorded on UT1, UT1A and UT1B using a crest gage. Bankfull events were also recorded in previous monitoring years, therefore, the success criteria has been met for the five-year monitoring period. Due to high sedimentation rates on UT1A, the crest gage located at cross section 9 was relocated to station 305+16 on UT1A downstream of the aggraded section of the stream. Please refer to table 14 in Appendix 5 for hydrologic data.

1.2.5 Wetland Assessment

Ten groundwater monitoring gages were established during the baseline monitoring throughout the wetland restoration and creation areas. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the wetland project area. Historical growing season data is not available for Catawba County therefore the growing season currently used for success criteria was applied from nearby Iredell County growing season data. This growing season runs

from April 8th to October 27th (202 days). However, additional growing season data are being collected by two soil temperature loggers that were installed, one within each wetland. These probes will be used to better define the growing season using the threshold soil temperature of 41 degrees or higher measured at a depth of 12 inches (USACE, 2010) in subsequent monitoring years. If the probes indicate a longer growing season than that adapted from Iredell County, the growing season will be adjusted based on on-site soil temperature conditions. A barotroll logger and a rain gage were also installed onsite.

All groundwater monitoring gages were downloaded on a quarterly basis and will be maintained on an as needed basis. The success criteria for wetland hydrology is to have a free groundwater surface within 12 inches of the ground surface for seven percent of the growing season, which is measured on consecutive days under typical precipitation conditions. All groundwater gages except Groundwater Gage 6 (GWG 6) met the annual wetland hydrology success criteria for MY3. Please refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

1.2.6 Benthic Macroinvertebrate Assessment

Prior to site construction, three macroinvertebrate assessment locations were established at the Lyle Creek Mitigation Site (UT1 Upper Reach, UT1 Lower Reach and UT1B) as shown on Figure 3. These sites were sampled before construction (December 2011) and during MY-2 (January 2014). Sampling was conducted using the Standard Qualitative Method (Qual 4) in compliance with the North Carolina Rapid Bioassessment *Standard Operating Procedures for Benthic Macroinvertebrates* set by NCDENR (2012). Samples were assessed and identified at the species level by Pennington & Associates, Inc. Sampling results show Ephemeroptera + Plecoptera + Trichoptera (EPT) taxa richness increased from pre-construction (Poor) to post-construction (Fair) on UT1 Lower and UT1B. ETB richness scores on UT1 lower increased from 1 to 12 from pre-construction to MY2 while UT1b increased from 6 to 7 between pre-construction and MY2. EPT taxa richness along UT1 Upper remained fair between pre- and post-construction with a richness score of 13 during pre-construction and 12 during MY2. The NC Biotic Index improved for all sampling locations showing pollutant intolerant bugs have become more abundant across the site. UT1 upper improved from 5.76 to 4.27, UT1 lower improved from 7.06 to 6.26, and UT1B improved from 7.67 to 6.13.

1.3 Monitoring Year 3 Summary

With the exception of a short reach within the upstream portions of UT1A, the streams within the Site are stable and functioning as designed. The average stem density for the Site is on track to meet the MY5 success criteria; however, a portion of the individual vegetation plots did not meet the current success criteria as noted in the Integrated Current Condition Plan View map. A vegetation maintenance plan will be implemented in late winter 2014/2015 to determine whether or not supplemental plantings will be warranted for the portions of the site with low stem density. There have been three bankfull events recorded in separate monitoring years along each restored project reach since construction commenced; therefore, the Site has met the MY5 stream hydrology attainment requirement. All groundwater gages with the exception of GWG 6 met the wetland hydrology success criteria for MY3.

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 NCEEP's website. All raw data supporting the tables and figures in the appendices are available from NCEEP upon request.

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). Longitudinal and cross-sectional data were collected using a total station and were georeferenced. All Integrated Current Condition Plan View mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using was Pathfinder and ArcView. 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-NCEEP Level 2 Protocol (Lee et al., 2008).

Section 3: REFERENCES

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APPENDIX 1. General Tables and Figures

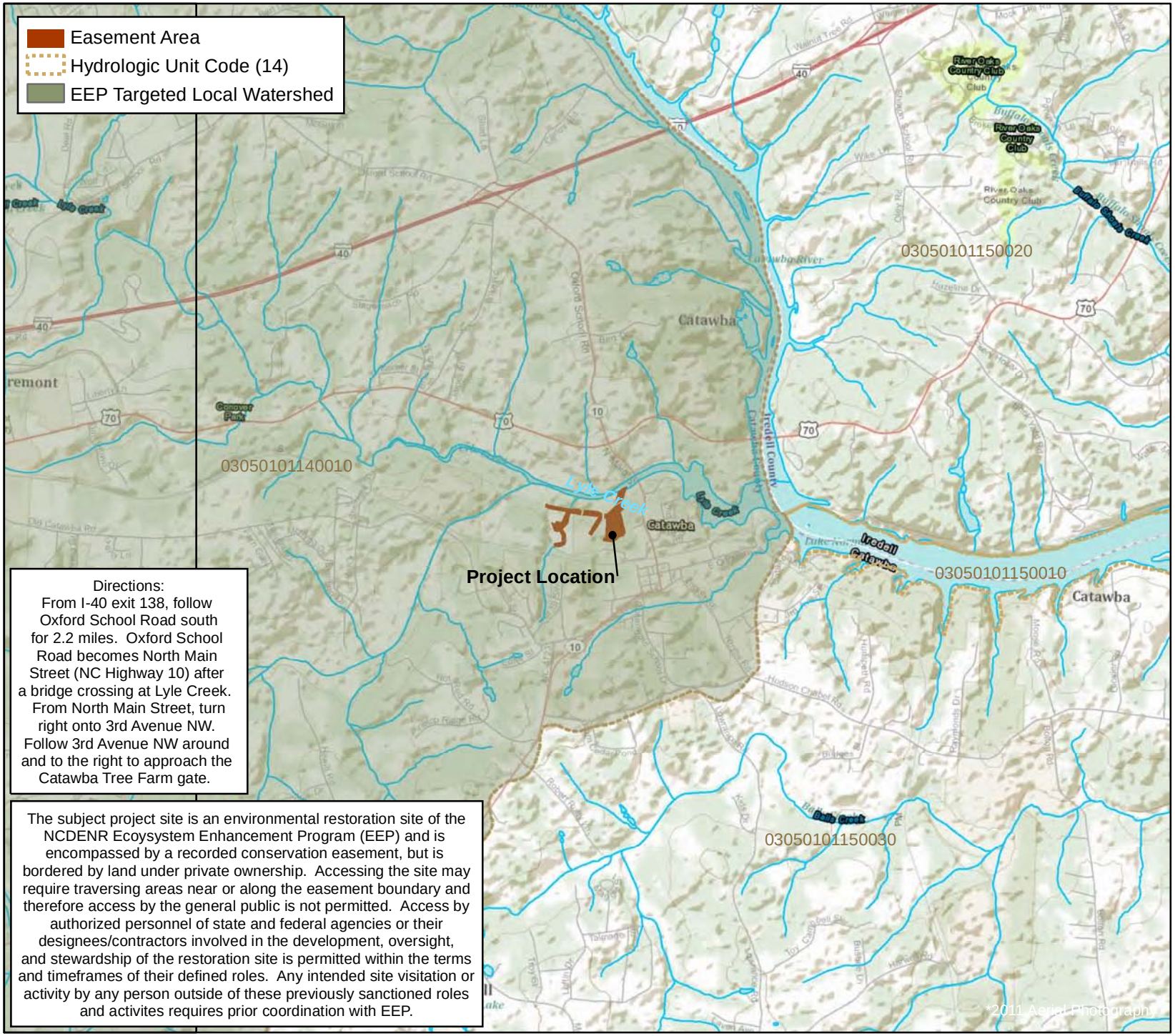

Figure 1. Project Vicinity Map
Lyle Creek Mitigation Site
EEP Project Number 94643
Monitoring Year 3

Catawba County, NC

WILDLANDS ENGINEERING

Figure 2. Project Component/ Asset Map
Lyle Creek Mitigation Site
EEP Project Number 94643
Monitoring Year 3

Catawba County, NC

- Stream Restoration
- Stream Enhancement
- Braided Reach (no credit)
- Wetland Restoration
- Wetland Creation
- Conservation Easement
- Railroad
- Power Lines
- Irrigation Lines
- Parcels

N

0 225 450 ft

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Table 1. Project Components and Mitigation Credits
Lyle Creek Mitigation Site (NCEEP Project No.94643)
Monitoring Year 3

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offet	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,965	N/A	7.57	N/A	N/A	N/A	N/A	N/A	N/A

Project Components

Reach ID	As-Built Stationing/ Location	Existing Footage (LF)	Approach	Restoration or Restoration Equivalent	As-Built Mitigation Length/Area (LF/acres)	Mitigation Ratio
UT1	100+00-141+30	4,071	Priority 1/2	Restoration	3,951 LF[1]	1:1
UT1a	300+00-306+15	1,141	Priority 1	Restoration	615 LF[2]	1:1
UT1b	201+52-209+97	890	Priority 1/2	Restoration	845 LF[3]	1:1
UT1c	400+00-406+77	695	in-stream structures, grading, planting	Enhancement II	677 LF[4]	2.5:1
UT1d	500+00-507+07	760	in-stream structures, grading, planting	Enhancement II	707 LF	2.5:1
RW1	N/A	N/A	grading, planting	Restoration	5.8 AC	1:1
RW1	N/A	N/A	grading, planting	Creation	1.1 AC	3:1
RW2	N/A	N/A	grading, planting	Restoration	0.8 AC	1:1
RW2	N/A	N/A	grading, planting	Creation	1.8 AC	3:1

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)		Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine				
Restoration	5,411	6.6					
Enhancement							
Enhancement I							
Enhancement II	1,384						
Creation		2.9					
Preservation							
High Quality Preservation							

[1] Excludes 179 LF in crossings (farm road and power line easements). Includes length from station 125+42 to 125+60 where left bank buffer width ranges from 48.5' to 50'. The right bank buffer width in this area exceeds 100'.

[2] Excludes downstream 306 LF of UT1a that is in the anastomosed wetland complex

[3] Excludes downstream 243 LF of UT1b that is in the anastomosed wetland complex

[4] Includes length from station 4+48 to 6+11 where left bank buffer width ranges from 28.7' to 50'. The right bank buffer width in this area ranges from 65.5' to 102.6'.

Table 2. Project Activity and Reporting History
Lyle Creek Mitigation Site (NCEEP Project No.94643)
Monitoring Year 3

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	May 2011	August 2011
Final Design - Construction Plans	October 2011	December 2011
Construction	Jan-Apr 2012	April 2012
Temporary S&E mix applied to entire project area*	April 2012	April 2012
Permanent seed mix applied to reach/segments	April 2012	April 2012
Bare root and live stake plantings for reach/segments	April 2012	April 2012
Baseline Monitoring Document (Year 0 Monitoring - baseline)	April 2012	July 2012
Year 1 Monitoring	October 2012	December 2012
Year 2 Monitoring	October 2013	November 2013
Year 3 Monitoring	June 2014	December 2014
Year 4 Monitoring	2015	December 2015
Year 5 Monitoring	2016	December 2016
Year 6 Monitoring	2017	December 2017
Year 7 Monitoring	2018	December 2018

*Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table
Lyle Creek Mitigation Site (NCEEP Project No.94643)
Monitoring Year 3

Designer	**Wildlands Engineering, Inc.**
	1430 S. Mint St, Suite 104
	Charlotte, NC 28203
Emily Reinicker, PE, CFM	704.332.7754
Construction Contractor	**River Works, Inc.**
	6105 Chapel Hill Rd
	Raleigh, NC 27607
Bill Wright	336.279.1002
Planting Contractor	**River Works, Inc.**
	6105 Chapel Hill Rd
	Raleigh, NC 27607
George Morris	336.279.1002
Seeding Contractor	**River Works, Inc.**
	6105 Chapel Hill Rd
	Raleigh, NC 27607
George Morris	336.279.1002
Seed Mix Sources	**Green Resource**
Nursery Stock Suppliers	**ArborGlen**
	Superior Tree
	Mellow Marsh Farm
Monitoring Performers	**Wildlands Engineering, Inc.**
	Kirsten Y. Gimbert
Stream, Vegetation, and Wetland Monitoring POC	704.332.7754, ext. 110

Table 4. Project Information and Attributes
Lyle Creek Mitigation Site (NCEEP Project No.94643)
Monitoring Year 3

Project Information							
Project Name	Lyle Creek Mitigation Site						
County	Catawba County, NC						
Project Area (acres)	26.62						
Project Coordinates (latitude and longitude)	35° 42' 39.218" N, 81° 4' 54.628" W						
Project Watershed Summary Information							
Physiographic Province	Piedmont						
River Basin	Catawba						
USGS Hydrologic Unit 8-digit	03050101						
USGS Hydrologic Unit 14-digit	03050101140010						
DWQ Sub-basin	Catawba River Subbasin 03-08-32						
Project Drainiage Area (acres)	315						
Project Drainage Area Percentage of Impervious Area	5%						
CGIA Land Use Classification	50% Forested, 20% Developed, 17% Agricultural, 8% Shrubland, 5% Herbaceous Uplanc						
Reach Summary Information							
Parameters	**UT1**	**UT1A**	**UT1B**	**UT1C**	**UT1D**	**RW1**	**RW2**
Length of reach (linear feet) - Post-Restoration	3,941 [1]	615 [2]	845 [3]	677	707	N/A	N/A
Drainage area (acres)	315	56	78	26	9	96	134
NCDWQ stream identification score	Lyle Creek - 11-76-(4.5)						
NCDWQ Water Quality Classification	Lyle Creek - WS-IV;CA						
Morphological Desription (stream type) of Pre-Existing	F5 [4], F6 [4], G6 [4]	F6 [4]	F6 [4]	F6 [4]	F6 [4]	N/A	N/A
Morphological Desription (stream type) of Design	B5c, C6	B6c, C6	C6	C6	C6	N/A	N/A
Evolutionary trend (Simon's Model) - Pre- Restoration	Stage II - Channelized						
Underlying mapped soils	Chewacla loam	Chewacla loam	Wehadkee fine sandy loam	Chewacla loam	Congaree complex	Chewacla loam and Wehadkee fine sand	Chewacla loam
Drainage class	somewhat poorly drained	somewhat poorly drained	frequently flooded	somewhat poorly drained	moderately well drained	somewhat poorly drained and frequently flooded	somewhat poorly drained
Soil Hydric status	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slope	0-2%	0-2%	0-2%	0-2%	0-2%	0-2%	0-2%
FEMA classification	AE[5]						
Native vegetation community	Palustrine Emergent System						
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	X					
Division of Land Quality (Dam Safety)	N/A	N/A	N/A				
Endangered Species Act	X	X	Lyle Creek Mitigation Plan: two federally listed species, the bald eagle (*Haliaeetus leucocephalus*) and dwarf-flowered hearleaf (*Hexastylis naniflora*), are currently listed in Catawba County. Studies found "no individual species, critical habitat, or suitable habitat was found to exist on the site" (letter to USFWS; no response was received within the 30-day time frame from USFWS)				
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO and THPO)				
Coastal Zone Management Act (CZMA)/Coastal Area Management	N/A	N/A	N/A				
FEMA Floodplain Compliance	X	X	No-rise certification and floodplain development permit approved by Catawba County floodplain administrator.				
Essential Fisheries Habitat	X	X	Project area has warm water fisheries; found no reason to object to the restoration project (letter from NCWRC).				

[1] Excludes 200 LF of crossings

[2] Excludes 306 LF of UT1a in the anastomosed wetlands complex

[3] Excludes 243 LF of UT1b in the anastomosed wetlands complex

[4] The Rosgen classification system is for natural streams. These channels have been heavily manipulated by man and therefore the Rosgen classification system is not applicable. These classifications are provided for illustrative purposes only.

[5]The project area does not have an associate regulated floodplain; however, the project reaches and wetland areas area located within the floodway and flood fringe of Lyle Creek.

APPENDIX 2. Visual Assessment Data

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 125 250 ft

N

Figure 3.1 Integrated Current Condition Plan View (key)
Lyle Creek Mitigation Site
NCEEP Project Number 94643
Monitoring Year 3

Catawba County, NC

WILDLANDS ENGINEERING

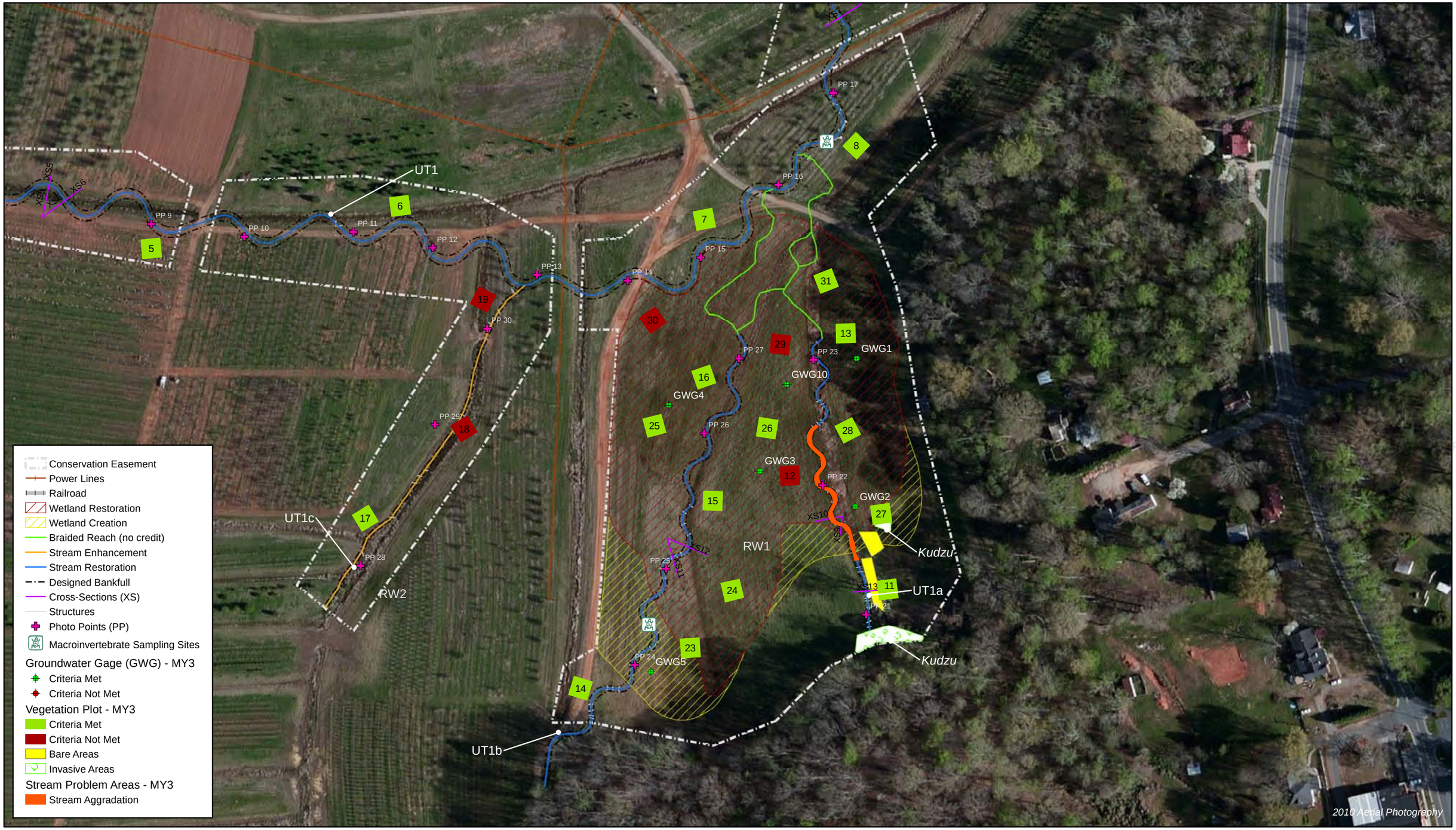
Ecosystem Enhancement Program

0 75 150 ft

N

Figure 3.1 Integrated Current Condition Plan View (Sheet 1 of 3)
Lyle Creek Mitigation Site
NCEEP Project Number 94643
Monitoring Year 3

Catawba County, NC



WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 ft

N

Figure 3.1 Integrated Current Condition Plan View (Sheet 2 of 3)
Lyle Creek Mitigation Site
NCEEP Project Number 94643
Monitoring Year 3

Catawba County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 ft

N

Figure 3.1 Integrated Current Condition Plan View (Sheet 3 of 3)
Lyle Creek Mitigation Site
NCEEP Project Number 94643
Monitoring Year 3

Catawba County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Upper (700 LF)
Monitoring Year 3

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%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	8	9			89%			
		Lenth Appropriate	9	9			100%			
	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			0	0	100%	0	0	100%
	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%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	40	40			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	39	39			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	24	24			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	40	40			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

Table 5b. Visual Stream Morphology Stability Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Lower (2,558 LF)
Monitoring Year 3

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%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	24	24			100%			
	3. Meander Pool Condition	Depth Sufficient	29	29			100%			
		Lenth Appropriate	29	29			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	29	29			100%			
		Thalweg centering at downstream of meander bend (Glide)	29	29			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	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%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	34	34			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	30	30			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%.	34	34			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

Table 5c. Visual Stream Morphology Stability Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 2 (883 LF)
Monitoring Year 3

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%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12			100%			
	3. Meander Pool Condition	Depth Sufficient	10	10			100%			
		Lenth 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%	0	0	100%
	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%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	16	16			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	13	13			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	16	16			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

Table 5d. Visual Stream Morphology Stability Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1A (615 LF)
Monitoring Year 3

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			1	259	58%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient[1]	12	20			60%			
		Lenth Appropriate	11	11			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	11	11			100%			
		Thalweg centering at downstream of meander bend (Glide)	11	11			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	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%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	43	43			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	43	43			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	35	35			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	43	43			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.[1]	10	10			100%			

[1] Pools are expected to fill in slightly and re-scour over time due to the fine-grained substrate in the system.

Table 5e. Visual Stream Morphology Stability Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1B (997 LF)
Monitoring Year 3

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%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	11	11			100%			
	3. Meander Pool Condition	Depth Sufficient	19	19			100%			
		Lenth 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%	0	0	100%
	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%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	31	31			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	31	31			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	21	21			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	31	31			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			100%			

Table 6. Vegetation Condition Assessment Table
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Planted Acreage **26.2**

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage*
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0.00%
Low Stem Density Areas^	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	5	0.1	0.5%
		Total	**5**	**0.1**	**0.5%**
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	0	0	0%
		Cumulative Total	**5**	**0.1**	**0%**

Easement Acreage **26.62**

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).	1000	4	0.23	0.9%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

^Acreage calculated from vegetation plots monitored for site.

Stream Photographs

	
Photo Point 1 – looking upstream (05/05/2014)	Photo Point 1 – looking downstream (05/05/2014)
	
Photo Point 2 – looking upstream (05/05/2014)	Photo Point 2 – looking downstream (05/05/2014)
	
Photo Point 3 – looking upstream (05/05/2014)	Photo Point 3 – looking downstream (05/05/2014)

	
Photo Point 4 – looking upstream (05/05/2014)	Photo Point 4 – looking downstream (05/05/2014)
	
Photo Point 5 – looking upstream (05/05/2014)	Photo Point 5 – looking downstream (05/05/2014)
	
Photo Point 6 – looking upstream (05/05/2014)	Photo Point 6 – looking downstream (05/05/2014)

	
Photo Point 7 – looking upstream (05/05/2014)	Photo Point 7 – looking downstream (05/05/2014)
	
Photo Point 8 – looking upstream (05/05/2014)	Photo Point 8 – looking downstream (05/05/2014)
	
Photo Point 9 – looking upstream (05/05/2014)	Photo Point 9 – looking downstream (05/05/2014)

	
Photo Point 10 – looking upstream (05/05/2014)	Photo Point 10 – looking downstream (05/05/2014)
	
Photo Point 11 – looking upstream (05/05/2014)	Photo Point 11 – looking downstream (05/05/2014)
	
Photo Point 12 – looking upstream (05/05/2014)	Photo Point 12 – looking downstream (05/05/2014)

	
Photo Point 13 – looking upstream (05/05/2014)	Photo Point 13 – looking downstream (05/05/2014)
	
Photo Point 14 – looking upstream (05/05/2014)	Photo Point 14 – looking downstream (05/05/2014)
	
Photo Point 15 – looking upstream (05/05/2014)	Photo Point 15 – looking downstream (05/05/2014)

	
Photo Point 16 – looking upstream (05/05/2014)	Photo Point 16 – looking downstream (05/05/2014)
	
Photo Point 17 – looking upstream (05/05/2014)	Photo Point 17 – looking downstream (05/05/2014)
	
Photo Point 18 – looking upstream (05/05/2014)	Photo Point 18 – looking downstream (05/05/2014)

	
Photo Point 19 – looking upstream (05/05/2014)	Photo Point 19 – looking downstream (05/05/2014)
	
Photo Point 20 – looking upstream (05/05/2014)	Photo Point 20 – looking downstream (05/05/2014)
	
Photo Point 21 – looking upstream (05/05/2014)	Photo Point 21 – looking downstream (05/05/2014)

	
Photo Point 22 – looking upstream (05/05/2014)	Photo Point 22 – looking downstream (05/05/2014)
	
Photo Point 23 – looking upstream (05/05/2014)	Photo Point 23 – looking downstream (05/05/2014)
	
Photo Point 24 – looking upstream (05/05/2014)	Photo Point 24 – looking downstream (05/05/2014)

	
Photo Point 25 – looking upstream (05/05/2014)	Photo Point 25 – looking downstream (05/05/2014)
	
Photo Point 26 – looking upstream (05/05/2014)	Photo Point 26 – looking downstream (05/05/2014)
	
Photo Point 27 – looking upstream (05/05/2014)	Photo Point 27 – looking downstream (05/05/2014)

	
Photo Point 28 – looking upstream (05/05/2014)	Photo Point 28 – looking downstream (05/05/2014)
	
Photo Point 29 – looking upstream (05/05/2014)	Photo Point 29 – looking downstream (05/05/2014)
	
Photo Point 30 – looking upstream (05/05/2014)	Photo Point 30 – looking downstream (05/05/2014)

	
Photo Point 31 – looking upstream (05/05/2014)	Photo Point 31 – looking downstream (05/05/2014)
	
Photo Point 32 – looking upstream (05/05/2014)	Photo Point 32 – looking downstream (05/05/2014)
	
Photo Point 33 – looking upstream (05/05/2014)	Photo Point 33 – looking downstream (05/05/2014)

	
Photo Point 34 – looking upstream (05/05/2014)	Photo Point 34 – looking downstream (05/05/2014)

Vegetation Photographs

	
Vegetation Plot 1 (06/26/2014)	Vegetation Plot 2 (06/26/2014)
	
Vegetation Plot 3 (06/26/2014)	Vegetation Plot 4 (06/26/2014)
	
Vegetation Plot 5 (06/26/2014)	Vegetation Plot 6 (06/26/2014)

	
Vegetation Plot 7 (06/26/2014)	Vegetation Plot 8 (06/26/2014)
	
Vegetation Plot 9 (06/26/2014)	Vegetation Plot 10 (06/26/2014)
	
Vegetation Plot 11 (06/26/2014)	Vegetation Plot 12 (06/26/2014)

	
Vegetation Plot 13 (06/26/2014)	Vegetation Plot 14 (06/26/2014)
	
Vegetation Plot 15 (06/26/2014)	Vegetation Plot 16 (06/26/2014)
	
Vegetation Plot 17 (06/26/2014)	Vegetation Plot 18 (06/26/2014)

Vegetation Plot 19 (06/26/2014)

Vegetation Plot 20 (06/26/2014)

Vegetation Plot 21 (06/26/2014)

Vegetation Plot 22 (06/26/2014)

Vegetation Plot 23 (06/26/2014)

Vegetation Plot 24 (06/26/2014)

	
Vegetation Plot 25 (06/26/2014)	Vegetation Plot 26 (06/26/2014)
	
Vegetation Plot 27 (06/26/2014)	Vegetation Plot 28 (06/26/2014)
	
Vegetation Plot 29 (06/26/2014)	Vegetation Plot 30 (06/26/2014)

Vegetation Plot 31 (06/26/2014)

Vegetation Plot 32 (06/26/2014)

Vegetation Plot 33 (06/26/2014)

Vegetation Plot 34 (06/26/2014)

Vegetation Plot 35 (06/26/2014)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment
Lyle Creek Mitigation Site (NCEEP Project No. 94643)
Monitoring Year 3

Plot	MY3 Success Criteria Met (Y/N)	Tract Mean
1	Y	
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	N	
13	Y	
14	Y	
15	Y	
16	Y	
17	Y	
18	N	86%
19	N	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	N	
30	N	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	

Table 8. CVS Vegetation Plot Metadata
Lyle Creek Mitigation Site (NCEEP Project No. 94643)
Monitoring Year 3

Report Prepared By	*Kenton Beal*
Date Prepared	*7/3/2014 13:08*
database name	*Lyle MY3 cvs-eep-entrytool-v2.3.1.mdb*
database location	*Q:\ActiveProjects\005-02123 Lyle Creek Mitigation FDP\Monitoring\Monitoring Year 3\Vegetation Assessment*
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	*Description of database file, the report worksheets, and a summary of project(s) and project data.*
Plots	*Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.*
Stem Count 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	94643
project Name	Lyle Creek Mitigation Site
Description	Stream and Wetland Mitigation
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	35
Sampled Plots	35

Table 7. Planted and Total Stem Counts
Lyle Creek Mitigation Site(NCEEP Project No. 94643)
Monitoring Year 3

			Current Plot Data (MY3 2014)																																				
			94643-WEI-0001			94643-WEI-0002			94643-WEI-0003			94643-WEI-0004			94643-WEI-0005			94643-WEI-0006			94643-WEI-0007			94643-WEI-0008			94643-WEI-0009			94643-WEI-0010			94643-WEI-0011			94643-WEI-0012			94643-WEI-0013		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	boxelder	Tree	1	1	1							1	1	1										1	1	1				2	2	2									
Alnus serrulata	hazel alder	Shrub	1	1	1	1	1	1				3	3	3	2	2	2	1	1	1	2	2	2	2	2	2	1	1	1											
Betula nigra	river birch	Tree																									2	2	2				1	1	1	1	1	1	3	3	3
Callicarpa americana	American beautyberry	Shrub																																						
Carpinus caroliniana	American hornbeam	Tree										1	1	1										1	1	1														
Celtis laevigata	sugarberry	Tree				4	4	4																1	1	1														
Cephalanthus	buttonbush	Shrub																																						
Cephalanthus occidentalis	common buttonbush	Shrub																																		1				
Cercis canadensis	eastern redbud	Tree																																						
Cornus florida	flowering dogwood	Tree																									1													
Diospyros virginiana	common persimmon	Tree							1	1	1				3	3	3				1	1	1							1	1	1								
Fraxinus pennsylvanica	green ash	Tree				1	1	1	1	1	1				2	2	2	2	2	2	1	1	1	4	4	6	1	1	1	1	1	1	3	3	3	1	1	1	6	6	7
Hibiscus	rosemallow	Shrub															1																								
Juglans nigra	black walnut	Tree																																						
Liquidambar styraciflua	sweetgum	Tree																																	2					
Liriodendron tulipifera	tuliptree	Tree				1	1	1				1	1	3	1	1	1	3	3	3	1	1	1	2	2	2	1	1	1				1	1	1	1	1	1			
Nyssa sylvatica	blackgum	Tree	4	4	4				2	2	2																						1	1	1	2	2	2	4	4	4
Platanus occidentalis	American sycamore	Tree	4	4	4	1	1	1	3	3	3							2	2	2	3	3	3						1	6	6	26	4	4	4	1	1	1	1	1	1
Populus	cottonwood																															7								
Populus deltoides	eastern cottonwood	Tree																																						
Prunus serotina	black cherry	Tree																																						
Quercus michauxii	swamp chestnut oak	Tree							4	4	4	2	2	2																						1	1	1			
Quercus phellos	willow oak	Tree				1	1	1				1	1	1	2	2	2										2	2	2												
Quercus rubra	northern red oak	Tree													1	1	1																								
Rosa carolina	Carolina rose	Shrub																																						
Salix	willow	Shrub or Tree																																						
Salix nigra	black willow	Tree																																						
Salix sericea	silky willow	Shrub																																						
Ulmus alata	winged elm	Tree																																						
Stem count			10	10	10	9	9	9	11	11	11	9	9	11	11	11	12	8	8	8	9	9	9	10	10	12	9	9	11	8	8	35	10	10	12	6	6	7	15	15	16
size (ares)			1			1			1			1			1			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	4	6	6	6	5	5	5	6	6	6	6	6	7	4	4	4	6	6	6	5	5	5	6	6	8	3	3	4	5	5	6	5	5	6	5	5	5
Stems per ACRE			404.7	404.7	404.7	364.2	364.2	364.2	445.2	445.2	445.2	364.2	364.2	445.2	445.2	445.2	485.6	323.7	323.7	323.7	364.2	364.2	364.2	404.7	404.7	485.6	364.2	364.2	445.2	323.7	323.7	1416	404.7	404.7	485.6	242.8	242.8	283.3	607	607	647.5

Color for Density

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 7. Planted and Total Stem Counts
Lyle Creek Mitigation Site(NCEEP Project No. 94643)
Monitoring Year 3

			Current Plot Data (MY3 2014)																																		
			94643-WEI-0014			94643-WEI-0015			94643-WEI-0016			94643-WEI-0017			94643-WEI-0018			94643-WEI-0019			94643-WEI-0020			94643-WEI-0021			94643-WEI-0022			94643-WEI-0023			94643-WEI-0024			94643-WEI-0025			94643-WEI-0026		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	boxelder	Tree										4	4	4									1	1	1	1														
Alnus serrulata	hazel alder	Shrub													2	2	2	1	1	1				1	1	1				2	2	2				1	1	1			
Betula nigra	river birch	Tree				5	5	5	2	2	2	4	4	4							1	1	4	1	1	1	3	3	3	1	1	1	3	3	4	3	3	3			
Callicarpa americana	American beautyberry	Shrub																																						
Carpinus caroliniana	American hornbeam	Tree																														2	2	2						
Celtis laevigata	sugarberry	Tree	1	1	1										1	1	1															1	1	1						
Cephalanthus	buttonbush	Shrub																																						
Cephalanthus occidentalis	common buttonbush	Shrub						5															3																	
Cercis canadensis	eastern redbud	Tree																																						
Cornus florida	flowering dogwood	Tree																																						
Diospyros virginiana	common persimmon	Tree										1	1	1																										
Fraxinus pennsylvanica	green ash	Tree	10	10	10	3	3	6	6	6	6				1	1	1	2	2	2	2	2	4	1	1	3	3	3	3	3	3	3	2	2	2	4	4	4	1	1	1
Hibiscus	rosemallow	Shrub																																						
Juglans nigra	black walnut	Tree																																						
Liquidambar styraciflua	sweetgum	Tree																																						
Liriodendron tulipifera	tuliptree	Tree				4	4	4																			1	1	1												
Nyssa sylvatica	blackgum	Tree							5	5	5																			3	3	3	3	3	3				4	4	4
Platanus occidentalis	American sycamore	Tree													1	1	1	4	4	4	8	8	8	6	6	16	1	1	1							3	3	3	4	4	4
Populus	cottonwood																																							
Populus deltoides	eastern cottonwood	Tree																																						
Prunus serotina	black cherry	Tree																																						
Quercus michauxii	swamp chestnut oak	Tree													1	1	1				1	1	1										1	1	1						
Quercus phellos	willow oak	Tree													1	1	1				1	1	1				2	2	2												
Quercus rubra	northern red oak	Tree																																						
Rosa carolina	Carolina rose	Shrub																					10																	
Salix	willow	Shrub or Tree																																						
Salix nigra	black willow	Tree																																						
Salix sericea	silky willow	Shrub			10																																			
Ulmus alata	winged elm	Tree																					5																	
	Stem count		11	11	21	12	12	20	13	13	13	9	9	9	7	7	7	7	7	7	13	13	37	10	10	22	10	10	10	9	9	9	12	12	13	11	11	11	9	9	9
	size (ares)		1			1			1			1			1			1			1			1			1			1			1			1			1		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		2	2	3	3	3	4	3	3	3	3	3	3	6	6	6	3	3	3	5	5	9	5	5	5	5	5	5	4	4	4	6	6	6	4	4	4	3	3	3
	Stems per ACRE		445.2	445.2	849.8	485.6	485.6	809.4	526.1	526.1	526.1	364.2	364.2	364.2	283.3	283.3	283.3	283.3	283.3	283.3	526.1	526.1	1497	404.7	404.7	890.3	404.7	404.7	404.7	364.2	364.2	364.2	485.6	485.6	526.1	445.2	445.2	445.2	364.2	364.2	364.2

Color for Density

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 7. Planted and Total Stem Counts
Lyle Creek Mitigation Site(NCEEP Project No. 94643)
Monitoring Year 3

			Current Plot Data (MY3 2014)																										Annual Means											
			94643-WEI-0027			94643-WEI-0028			94643-WEI-0029			94643-WEI-0030			94643-WEI-0031			94643-WEI-0032			94643-WEI-0033			94643-WEI-0034			94643-WEI-0035			MY3 (2014)			MY2 (213)			MY1 (2012)			MY0 (2012)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																											10	10	11	11	11	12	14	14	14	24	24	24
Alnus serrulata	hazel alder	Shrub	1	1	1							4	4	4				2	2	2	2	2	2	4	4	4				33	33	33	33	33	33	13	13	13	25	25	25
Betula nigra	river birch	Tree				6	6	6	4	4	4							2	2	2	5	5	5				4	4	4	51	51	55	52	52	55	52	52	52	71	71	71
Callicarpa americana	American beautyberry	Shrub																																15						
Carpinus caroliniana	American hornbeam	Tree																											4	4	4	4	4	4	2	2	2	17	17	17
Celtis laevigata	sugarberry	Tree																3	3	3										11	11	11	13	13	13	13	13	13	15	15	15
Cephalanthus	buttonbush	Shrub																																3						
Cephalanthus occidentalis	common buttonbush	Shrub						5						15			5						1									35			19						
Cercis canadensis	eastern redbud	Tree																																1						
Cornus florida	flowering dogwood	Tree																						1	1	1				1	1	2									
Diospyros virginiana	common persimmon	Tree													1	1	1													8	8	8	8	8	9	8	8	8	10	10	10
Fraxinus pennsylvanica	green ash	Tree	1	1	1	3	3	3				3	3	3	3	3	3							2	2	2	1	1	1	74	74	84	77	77	88	63	63	63	69	69	69
Hibiscus	rosemallow	Shrub																													1									
Juglans nigra	black walnut	Tree																																1						
Liquidambar styraciflua	sweetgum	Tree																													2			3						
Liriodendron tulipifera	tuliptree	Tree																											17	17	19	20	20	21	20	20	20	52	52	52
Nyssa sylvatica	blackgum	Tree																2	2	2	2	2	2				6	6	6	38	38	38	40	40	40	38	38	38	48	48	48
Platanus occidentalis	American sycamore	Tree	5	5	5	1	1	1	3	3	3				4	4	4													65	65	96	68	68	97	66	66	66	88	88	88
Populus	cottonwood																														7									
Populus deltoides	eastern cottonwood	Tree												3																	3			7						
Prunus serotina	black cherry	Tree																																3						
Quercus michauxii	swamp chestnut oak	Tree													2	2	2										2	2	2	14	14	14	12	12	12	12	12	12	14	14	14
Quercus phellos	willow oak	Tree	7	7	7	1	1	2																5	5	5				23	23	24	22	22	22	21	21	21	27	27	27
Quercus rubra	northern red oak	Tree																												1	1	1									
Rosa carolina	Carolina rose	Shrub																					2									12			32						
Salix	willow	Shrub or Tree																																36						
Salix nigra	black willow	Tree																																1						
Salix sericea	silky willow	Shrub															1						1						1			13									
Ulmus alata	winged elm	Tree																														5									
		Stem count	14	14	14	11	11	17	7	7	7	7	7	25	10	10	16	9	9	9	9	9	13	12	12	12	13	13	14	350	350	478	360	360	527	322	322	322	460	460	460
		size (ares)	1			1			1			1			1			1			1			1			1			35			35			35			35		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.86			0.86			0.86			0.86		
		Species count	4	4	4	4	4	5	2	2	2	2	2	4	4	4	6	4	4	4	3	3	6	4	4	4	4	4	5	14	14	22	12	12	23	12	12	12	12	12	12
		Stems per ACRE	566.6	566.6	566.6	445.2	445.2	688	283.3	283.3	283.3	283.3	283.3	1012	404.7	404.7	647.5	364.2	364.2	364.2	364.2	364.2	526.1	485.6	485.6	485.6	526.1	526.1	566.6	404.7	404.7	552.7	416.2	416.2	609.3	372.3	372.3	372.3	531.9	531.9	531.9

Color for Density

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
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reaches 1 and 2
Monitoring Year 3

Parameter	Gauge	Regional Curve									Pre-Restoration Condition[1]						Reference Reach Data								Design						As-Built/Baseline					
		UT1 Reach 1			UT1 Reach 2			UT1 Reach 3			Reach 1		Reach 2		Reach 3		UT to Lyle Creek		UT to Catawba River		UT to Lake Wheeler		Westbrook Lowlands		UT1 Reach 1 Upper		UT1 Reach 1 Lower		UT1 Reach 2		UT1 Reach 1 Upper		UT1 Reach 1 Lower		UT1 Reach 2	
		LL	UL	Eq.	LL	UL	Eq.	LL	UL	Eq.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																																				
Bankfull Width (ft)											23.1	31.5	19.4		10.0		15.2		13.8		10.6		9.7		8.0		15.2		12.4		4.6		11.9		19.1	11.8
Floodprone Width (ft)											43.0	48.0	62.0		34.0		38+		80+		N/A[5]		100+		17.6+		33.4+		27.3+		66.7		62.6		79.6	69.7
Bankfull Mean Depth											0.65		0.93		1.05		0.5		1.5		1.3		0.8		0.6		0.8		0.9		0.6		0.6		0.7	1.0
Bankfull Max Depth											1.1		1.5		1.7		1.4		2.0		2.2		1.1		1.0		1.2		1.4		0.9		1.4		1.6	1.8
Bankfull Cross-sectional Area (ft^2)	n/a										14.9	19.2	18.1		10.5		7.3		20.8		17.4		8.0		4.6		12.4		11.5		2.7		8.8		13.1	11.7
Width/Depth Ratio											35.8	48.8	20.8		9.5		31.7		9.1		6.5		12.0		13.9		18.6		13.4		7.7		20.8		27.7	11.8
Entrenchment Ratio											1.5	1.8	3.2		3.4		2.5+		5.8+		15.7		2.2+		2.2+		2.2+		2.2+		2.2+		2.2+		2.2+	2.2+
Bank Height Ratio											1.6	3.0	1.4	2.3	1.7	2.4	1.0		1.0		N/A[5]		1.0		1.0		1.0		1.0		1.0		1.0		1.0	1.0
D50 (mm)											Very Fine Sand		Silt		Silt[2]		Fine Sand		V.Coarse Sand		V. Fine Gravel		Coarse Sand													
Profile																																				
Riffle Length (ft)											-		-		-		-		-		-		-		-	-	-	-	-	-	7	23	10	75	27	47
Riffle Slope (ft/ft)											0.0030	0.0260	0.0033	0.0060	0.0030	0.0110	0.0055	0.0597	0.011	0.03	0.043		N/A[6]		0.0167	0.0283	0.0025	0.0032	0.0000	0.0005	0.0025	0.0598	0.0000	0.0289	0.0020	0.0180
Pool Length (ft)											-		-		-		-		-		-		-		6	32	12	76	19	53	10	39	6	81	15	62
Pool Max Depth (ft)	n/a										1.9	2.3	2.5	5.9	4.1	5.6	1.7		2.9		1.4		1.5		1.2	1.8	1.6	2.4	1.8	2.7	1.2	2.9	1.4	3.6	2.1	3.4
Pool Spacing (ft)*											2.2	3.2	2.5	5.9	4.1	5.6	15	28	31	60	42		16	59	14.0	41.0	55.6	114.2	62.2	96.1	23	49	51	131	48	99
Pool Volume (ft^3)																																				
Pattern																																				
Channel Beltwidth (ft)											N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	21		55		26	64	14	20	N/A	N/A	36	78	41	65	N/A	N/A	36	78	41	65
Radius of Curvature (ft)											N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	19	32	31	56	8	34	15	27	N/A	N/A	27	48	27	34	N/A	N/A	27	48	27	34
Rc:Bankfull Width (ft/ft)	n/a										N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	1.3	2.1	2.2	4.1	0.8	3.2	1.5	2.8	N/A	N/A	2	3	2	3	N/A	N/A	2	3	2	3
Meander Wave Length (ft)											N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	39	44	65	107	40	191	50		N/A	N/A	100	166	113	161	N/A	N/A	100	166	113	161
Meander Width Ratio											N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	1.3		4		6	11	1.4	2.1	N/A	N/A	2	5	3	5	N/A	N/A	2	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										0.013/0.08/0.12/ 0.3/1.2/4.8		0.0016/0.008/ 0.019/0.13/0.26/0.9		-		n/a/0.1/0.2/0.5/4.0/ 8.0		0.3/0.4/1.8/12.8/25.2/ 90.0		N/A		N/A								-		-	-
Reach Shear Stress (Competency) lb/ft^2											Reach 1 Upper: 0.48, Reach 1 Lower: 0.06, Reach 2: 0.24														0.49		0.07		0.26		-		-		-
Max part size (mm) mobilized at bankfull											Reach 1 Upper: 30, Reach 1 Lower: 4, Reach 2: 15														30		5		16		-		-		-
Stream Power (Capacity) W/m^2																																				
Additional Reach Parameters																																				
Drainage Area (SM)											0.10	0.16	0.16	0.35	0.35	0.49	0.25		1.60		0.4		0.9													
Impervious Cover Estimate (%)											5%						-		-		-		-													
Rosgen Classification											F5[2]		F6[2]		G6[2]		C5		E5		E4		E/C5		B5c		C6		C6		Bc		C		C	
Bankfull Velocity (fps)											0.7	0.9	0.8		2.7										3.0		1.2		2.4		-		-		-	
Bankfull Discharge (cfs)		17	24	-	24	42	-	42	52	-	14		15		28		33		119		N/A[7]		N/A[6]		14		15		28							
Q-NFF regression											37		65		79																					
Q-USGS extrapolation	n/a										8	15	15	31	31	49																				
Q-Mannings											-		-		-		-																			
Valley Length (ft)											-		-		-		-		-		-		-		651		2012		692							
Channel Thalweg Length (ft)											4017						-		-		-		-		761		2369		520		700		2558		883	
Sinuosity (ft)											1.2		1.0		1.1		1.7		1.3		1.6		1.2		1.1		1.3		1.3		1.1		1.3		1.3	
Water Surface Slope (ft/ft)											0.012		0.0011		0.0036[4]		0.0048		0.0046		0.006		0.0022		0.0142		0.0013		0.0047		0.0140		0.0015		0.0047	
Bankfull Slope (ft/ft)											0.012		0.0011		0.0036[4]		-		-		-		-		0.0142		0.0013		0.0047		0.0140		0.0015		0.0049	

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

[1]Pre-Restoration Reaches differ from the as-built/baseline reaches.

[2]Channel was straightened, moved, and/or maintained to prevent pattern formation prior to restoration.

[3]The Rosgen classification system is for natural streams. These channels have been heavily manipulated by man and therefore theRosgen classification system is not applicable. These classifications are provided for illustrative purposes only.

[4]UT1 Reach 3 drops down to meet the Lyle Creek water surface elevation, which accounts for a channel slope steeper than the valley slope.

[5]Data not provided in reference reach report (Lowther, 2008).

[6]Data not provided in Neu-Con Umbrella Wetland and Stream Mitigation Bank Westbrook Lowgrounds Site Specific MitigationPlan (Environmental Bank and Exchange, 2002).

[7]Lowther reported a range of possible discharges from 46.8 to 108.9 cfs based on different Manning's 'n' estimation techniques(Lowther, 2008).

Table 10b. Baseline Stream Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1A and UT1B
Monitoring Year 3

Parameter	Gauge	Regional Curve						Pre-Restoration Condition[1]				Reference Reach Data		Design								As-Built/Baseline							
		UT1A			UT1B			UT1A		UT1B				UT1A	Upper	UT1A	Lower	UT1B 200+00 to 203+20		UT1B 203+21 to 207+18		UT1B 207+18 to 209+97		UT1A	Upper	UT1A	Lower	UT1B 200+00 to 203+20		UT1B 203+21 to 207+18		UT1B 207+18 to 209+97	
		LL	UL	Eq.	LL	UL	Eq.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	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							8.7		16.3		refer to table 5a		6.5						8.0				4.6				12.8					
Floodprone Width (ft)								21.0		42.0				14.3+						11.0+				30.5				67.3					
Bankfull Mean Depth								0.53		0.48				0.5						0.6				0.4				0.1					
Bankfull Max Depth								0.8		1.0				0.8						1.0				0.8				1.0					
Bankfull Cross-sectional Area (ft^2)								4.6		7.9				3.2						5.0				2.1				1.3					
Width/Depth Ratio								16.5		33.6				13.3						12.8				10.4				122.2					
Entrenchment Ratio								2.4		2.6				2.2+						2.2+				N/A				N/A					
Bank Height Ratio								0.8		1.0				1.0						1.0				N/A				N/A					
D50 (mm)								Silt[2]		Silt[2]																							
Profile																																	
Riffle Length (ft)	n/a							-	-	-	-	refer to table 5a		-	-	-	-	-	-	-	-	-	-	8	19	10	23	19	31	15	22	10	20
Riffle Slope (ft/ft)								0.0035	0.0320	0.0056	0.0160			0.0350	0.0571	0.0156	0.0192	0.0263	0.0309	0.0145	0.0218	0.0045	0.0079	0.0353	0.0477	0.0086	0.0290	0.0224	0.0593	0.0072	0.0323	0.0032	0.0217
Pool Length (ft)								-	-	-	-			4	14	10	25	18	64	15	22	16	20	5	12	12	34	23	40	17	41	28	42
Pool Max Depth (ft)								1.1		1.6				1.25	1.45	1.05	1.45	1.6	1.8	1.2	1.8	1.4	1.7	1.0	1.9	1.2	1.9	1.2	2.1	1.3	2.4	1.9	2.2
Pool Spacing (ft)								35	68	28	87			13	30	31	52	49	63	37	58	49	57	4	33	29	90	43	71	34	61	46	66
Pool Volume (ft^3)																																	
Pattern																																	
Channel Beltwidth (ft)	n/a							N/A^2	N/A^2	N/A^2	N/A^2	refer to table 5a		N/A	N/A	25	35	35	39	23	39	29	41	N/A	N/A	25	35	35	39	23	39	29	41
Radius of Curvature (ft)								N/A^2	N/A^2	N/A^2	N/A^2			N/A	N/A	14	20	19	27	16	26	19	26	N/A	N/A	14	20	19	27	16	26	19	26
Rc:Bankfull Width (ft/ft)								N/A^2	N/A^2	N/A^2	N/A^2			N/A	N/A	2	3	2	3	2	3	2	3	N/A	N/A	2	3	2	3	2	3	2	3
Meander Wave Length (ft)								N/A^2	N/A^2	N/A^2	N/A^2			N/A	N/A	53	82	83	106	78	86	79	90	N/A	N/A	53	82	83	106	78	86	79	90
Meander Width Ratio								N/A^2	N/A^2	N/A^2	N/A^2			N/A	N/A	4	5	4	5	3	5	4	5	N/A	N/A	4	5	4	5	3	5	4	5
Substrate, Bed and Transport Parameters																																	
Ri%/Ru%/P%/G%/S%	n/a											refer to table 5a																					
SC%/Sa%/G%/C%/B%/Be%																																	
d16/d35/d50/d84/d95/d100								-		-														N/A									
Reach Shear Stress (Competency) lb/ft^2								0.35		0.06				0.84		0.28		0.6		0.32		0.12		-									
Max part size (mm) mobilized at bankfull								20		4				60		17		38		20		7		-									
Stream Power (Capacity) W/m^2																																	
Additional Reach Parameters																																	
Drainage Area (SM)	n/a							0.05		0.13		refer to table 5a																					
Impervious Cover Estimate (%)																																	
Rosgen Classification								F6[3]		F6[3]				B6	C6			C6						C				E					
Bankfull Velocity (fps)								2.0		1.6				2.8				2.6						-				-					
Bankfull Discharge (cfs)								8		13				9				13															
Q-NFF regression								-		-																							
Q-USGS extrapolation								4	9	10	18																						
Q-Mannings								-		-																							
Valley Length (ft)								-		-				190	352			279		326		227											
Channel Thalweg Length (ft)								1141		890				201	414			320		398		279		201	414			320		398		**279**	
Sinuosity (ft)								1.0		1.0				1.1	1.2			1.1		1.2		1.2		1.1	1.2			1.1		1.2		1.2	
Water Surface Slope (ft/ft)								0.0106		0.0085				0.0284	0.0095			0.0131		0.0086		0.0032		0.0296	0.0089			0.0187		0.0080		**0.0039**	
Bankfull Slope (ft/ft)								0.0106		0.0085				0.0284	0.0095			0.0161		0.0086		0.0032		0.0294	0.0091			0.0190		0.0079		0.0039	

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

[1]Pre-Restoration Reaches differ from the as-built/baseline reaches.

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[3]The Rosgen classification system is for natural streams. These channels have been heavily manipulated by man and therefore theRosgen classification system is not applicable. These classifications are provided for illustrative purposes only.

[4]UT1 Reach 3 drops down to meet the Lyle Creek water surface elevation, which accounts for a channel slope steeper than the valley slope.

[5]Data not provided in reference reach report (Lowther, 2008).

[6]Data not provided in Neu-Con Umbrella Wetland and Stream Mitigation Bank Westbrook Lowgrounds Site Specific MitigationPlan (Environmental Bank and Exchange, 2002).

[7]Lowther reported a range of possible discharges from 46.8 to 108.9 cfs based on different Manning's 'n' estimation techniques(Lowther, 2008).

Table 11. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross-Section)
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reaches 1 and 2, UT1A and UT1B
Monitoring Year 3

Parameter	UT1 Reach 1 Upper												UT1 Reach 1 Lower											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)						Cross-Section 4 (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																								
Bankfull Width (ft)	4.6	5.8	6.1	5.1			13.6	10.8	10.3	10.6			19.1	13.7	18.2	15.5			21.6	15.3	17.4	16.4		
Floodprone Width (ft)	66.7	65.4	65.4	65.4			---	---	---	---			62.6	63.4	55.7	55.7			---	---	---	---		
Bankfull Mean Depth (ft)	0.6	0.5	0.4	0.3			1.0	0.9	0.8	0.5			0.7	0.7	0.6	0.5			1.0	1.0	1.0	1.0		
Bankfull Max Depth (ft)	0.9	0.8	0.8	0.9			2.4	1.9	1.8	1.1			1.6	1.3	1.5	1.5			2.4	2.2	2.2	2.2		
Bankfull Cross-Sectional Area (ft^2)	2.7	2.7	2.3	1.7			14.2	9.8	8.1	5.1			13.1	9.0	10.8	8.1			22.0	16.1	17.9	17.0		
Bankfull Width/Depth Ratio	7.7	12.8	16.0	15.2			13.0	12.0	13.0	22.2			27.7	20.9	30.7	29.6			21.1	14.6	16.9	15.8		
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			N/A	N/A	N/A	N/A			1.0	1.0	1.1	1.0			N/A	N/A	N/A	N/A		

	UT1 Reach 1 Lower												UT1 Reach 2											
	Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)						Cross-Section 7 (Riffle)						Cross-Section 8 (Pool)					
based on fixed bankfull elevation	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Bankfull Width (ft)	15.6	14.4	18.0	15.9			11.9	12.4	13.5	13.4			11.8	8.7	14.7	12.1			23.6	16.9	22.7	21.0		
Floodprone Width (ft)	---	---	---	---			79.6	80.3	76.9	76.9			69.7	70.8	65.9	65.9			---	---	---	---		
Bankfull Mean Depth (ft)	1.0	1.0	0.8	0.9			0.7	0.7	0.7	0.6			1.0	1.1	0.8	0.9			1.2	1.3	1.1	1.0		
Bankfull Max Depth (ft)	2.1	1.9	1.9	1.9			1.4	1.2	1.4	1.4			1.8	1.7	1.8	1.7			3.0	2.1	2.7	2.9		
Bankfull Cross-Sectional Area (ft^2)	16.4	13.7	14.8	13.8			8.1	8.5	8.8	7.6			11.7	9.4	11.8	10.9			27.4	21.3	24.4	20.9		
Bankfull Width/Depth Ratio	14.9	15.1	21.9	18.3			17.3	18.0	20.8	23.6			11.8	8.0	18.3	13.5			20.3	13.4	21.0	21.1		
Bankfull Entrenchment Ratio	N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+			2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	N/A	N/A	N/A	N/A			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			N/A	N/A	N/A	N/A		

	UT1A												UT1B											
	Cross-Section 9 (Riffle)						Cross-Section 10 (Pool)						Cross-Section 11 (Riffle)						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																								
Bankfull Width (ft)	4.6	1.9	2.1	0.2			5.9	---	2.7	0.0			12.8	3.1	4.8	2.8			6.0	6.4	8.5	4.7		
Floodprone Width (ft)	30.5	31.4	27.0	200+			---	---	---	---			67.3	66.5	64.2	53.8			---	---	---	---		
Bankfull Mean Depth (ft)	0.4	0.3	0.4	0.1			0.6	---	0.3	0.0			0.1	0.3	0.5	0.4			0.8	0.6	0.4	0.3		
Bankfull Max Depth (ft)	0.8	0.4	0.6	0.1			1.0	---	0.5	-0.1			1.0	1.1	1.0	0.7			1.2	1.0	0.7	0.5		
Bankfull Cross-Sectional Area (ft^2)	2.1	0.6	0.8	0.0			3.3	---	0.9	0.0			1.3	1.0	2.3	1.2			4.5	3.9	3.1	1.3		
Bankfull Width/Depth Ratio	10.4	6.2	5.2	2.5			10.7	---	8.0	0.0			122.2	9.8	10.0	6.4			8.0	10.6	23.4	17.9		
Bankfull Entrenchment Ratio	N/A	N/A	N/A	N/A			N/A	---	N/A	N/A			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	N/A	N/A	N/A	N/A			N/A	---	N/A	N/A			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A		

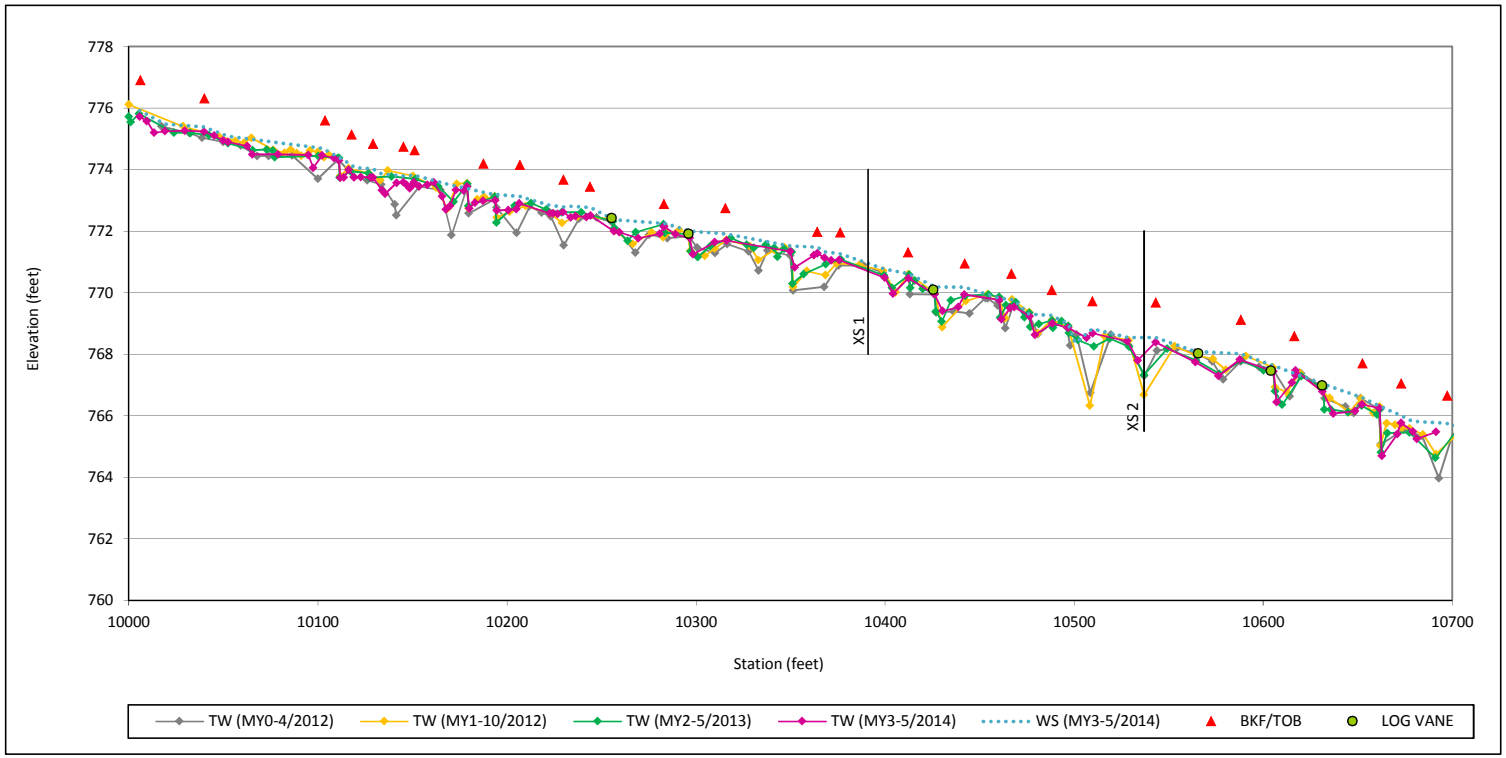
	UT1A					
	Cross-Section 13 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation						
Bankfull Width (ft)	---	---	---	5.7		
Floodprone Width (ft)	---	---	---	54.9		
Bankfull Mean Depth (ft)	---	---	---	0.4		
Bankfull Max Depth (ft)	---	---	---	1.0		
Bankfull Cross-Sectional Area (ft^2)	---	---	---	2.0		
Bankfull Width/Depth Ratio	---	---	---	16.3		
Bankfull Entrenchment Ratio	---	---	---	2.2+		
Bankfull Bank Height Ratio	---	---	---	1.0		

Table 12a. Monitoring Data - Stream Reach Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Upper
Monitoring Year 3

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	4.6		5.8			6.1			5.1								
Floodprone Width (ft)	66.7		65.4			65.4			65.4								
Bankfull Mean Depth	0.6		0.5			0.4			0.3								
Bankfull Max Depth	0.9		0.8			0.8			0.9								
Bankfull Cross-sectional Area (ft^2)	2.7		2.7			2.3			1.7								
Width/Depth Ratio	7.7		12.8			16.0			15.2								
Entrenchment Ratio	2.2+		2.2+			2.2+			2.2+								
Bank Height Ratio	1.0		1.0			1.0			1.0								
D50 (mm)																	
Profile																	
Riffle Length (ft)	7	23	3	12	26	4	10	23	2	13	34						
Riffle Slope (ft/ft)	0.0025	0.0598	0.0043	0.0230	0.0518	0.0100	0.0260	0.0505	0.0096	0.0307	0.0879						
Pool Length (ft)	10	39	10	16	26	8	20	28	4	13	50						
Pool Max Depth (ft)	1	3	0.3	0.7	2.4	0.3	0.8	1.1	0.5	1.3	2.5						
Pool Spacing (ft)	23	49	17	29	61	12	39	61	8	27	68						
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	Bc		Bc			Bc			Bc								
Channel Thalweg Length (ft)	700		700			700			700								
Sinuosity (ft)	1.1		1.1			1.1			1.1								
Water Surface Slope (ft/ft)	0.0140		0.0147			0.0147			0.0150								
Bankfull Slope (ft/ft)	0.0140		0.0146			0.0150			0.0150								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	N/A		N/A			N/A			N/A								
% of Reach with Eroding Banks			0%			0%			0%								

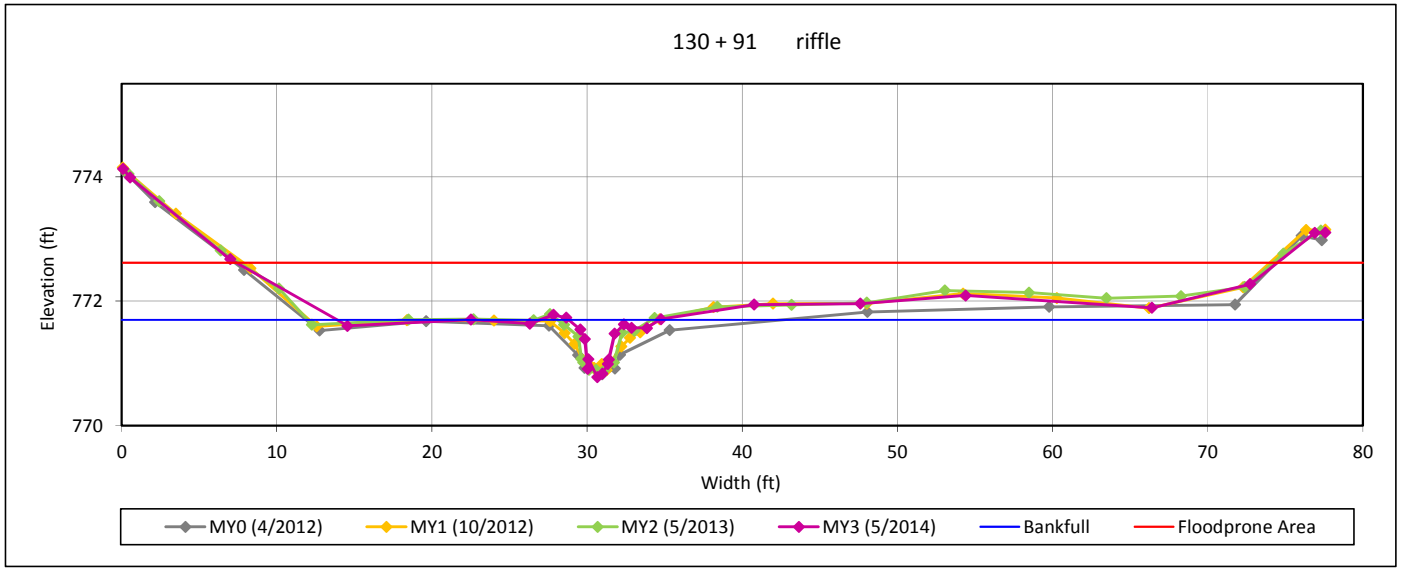
(-): Data was not provided
N/A: Not Applicable

Longitudinal Profile Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Upper
Monitoring Year 3



Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 1 - UT1 Reach 1 Upper



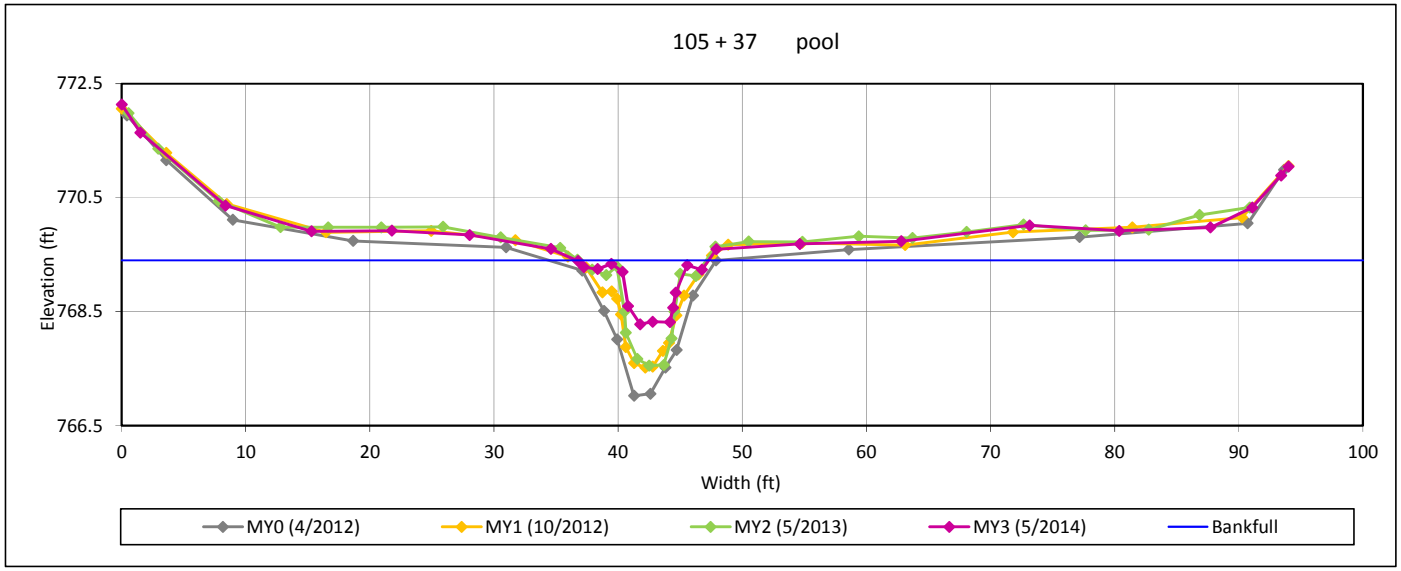
Bankfull Dimensions	
1.7	x-section area (ft.sq.)
5.1	width (ft)
0.3	mean depth (ft)
0.9	max depth (ft)
6.0	wetted parimeter (ft)
0.3	hyd radi (ft)
15.2	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 2 - UT1 Reach 1 Upper



Bankfull Dimensions	
5.1	x-section area (ft.sq.)
10.6	width (ft)
0.5	mean depth (ft)
1.1	max depth (ft)
11.4	wetted parimeter (ft)
0.4	hyd radi (ft)
22.2	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

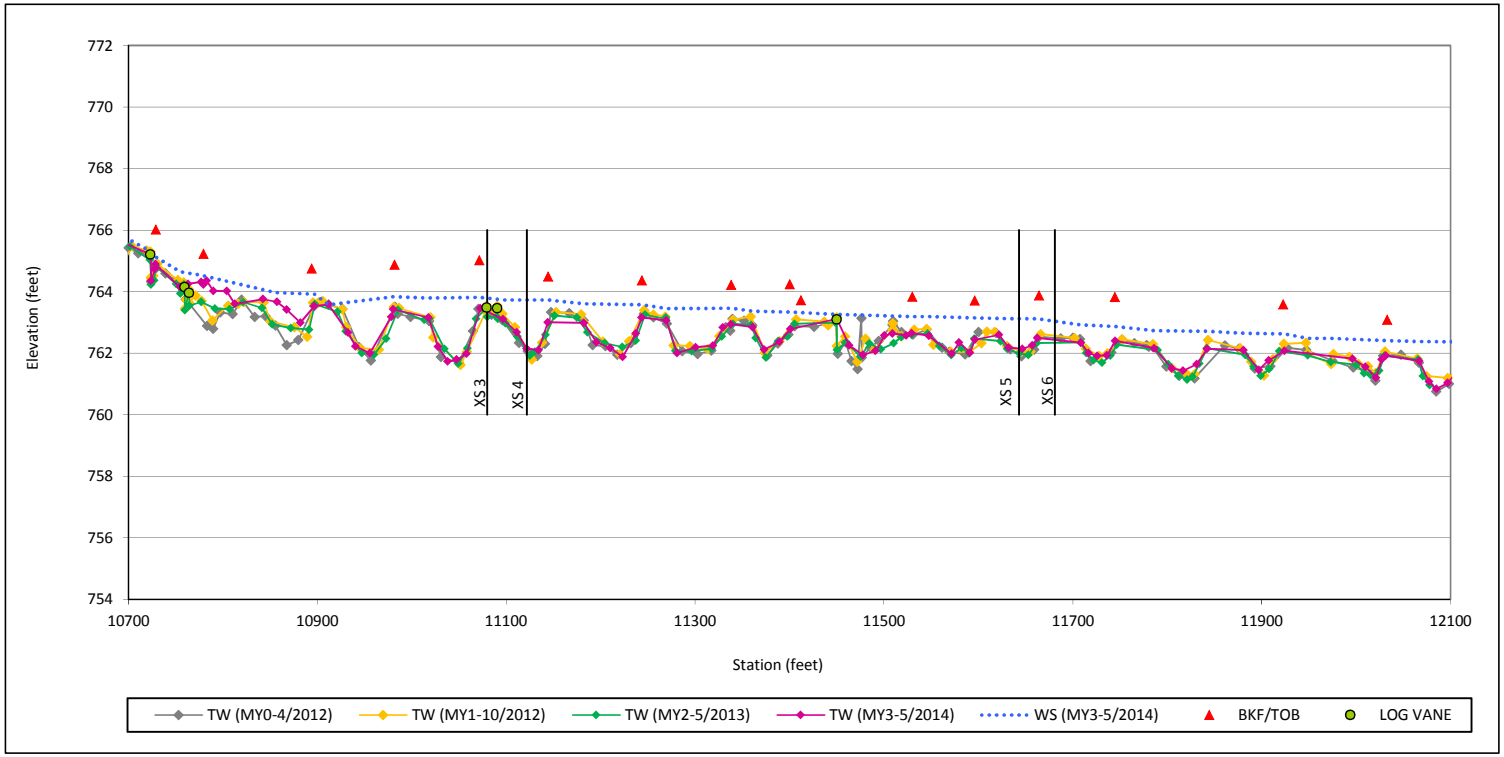
View Downstream (5/2014)

Table 12b. Monitoring Data - Stream Reach Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Lower
Monitoring Year 3

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	12.3	22.4	13.3	15.2	17.1	13.5	17.0	20.5	13.4	15.7	16.4						
Floodprone Width (ft)	62.6	79.6	63.4	71.9	80.3	55.7	66.3	76.9	55.7	66.3	76.9						
Bankfull Mean Depth	0.5	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.5	0.7	1.0						
Bankfull Max Depth	1.5	1.7	1.3	1.3	1.3	1.5	1.5	1.5	1.4	1.7	2.2						
Bankfull Cross-sectional Area (ft^2)	10.1	14.3	9.5	9.6	9.7	8.8	10.1	11.5	7.6	10.9	17.0						
Width/Depth Ratio	36.8	35.0	18.5	24.3	30.1	20.8	28.8	36.8	15.8	21.0	29.6						
Entrenchment Ratio	2.2+	2.2+	2.2+	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	1.1	1.1	1.0	1.0	1.0						
D50 (mm)																	
Profile																	
Riffle Length (ft)	10	75	8	28	70	12	31	81	15	35	80						
Riffle Slope (ft/ft)	0.000	0.029	0.000	0.005	0.025	0.001	0.005	0.026	0.0006	0.0051	0.0283						
Pool Length (ft)	6	81	12	56	95	5	54	81	5	46	79						
Pool Max Depth (ft)	1.4	3.6	0.7	1.2	2.0	0.4	1.2	1.9	1.9	2.3	4.0						
Pool Spacing (ft)	51	131	29	82	118	35	80	117	39	86	124						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	36	78															
Radius of Curvature (ft)	27	48															
Rc:Bankfull Width (ft/ft)	2	3															
Meander Wave Length (ft)	100	166															
Meander Width Ratio	2	5															
Additional Reach Parameters																	
Rosgen Classification	C		C			C			C								
Channel Thalweg Length (ft)	2558		2558			2558			2558								
Sinuosity (ft)	1.3		1.3			1.3			1.3								
Water Surface Slope (ft/ft)	0.0015		0.0024			0.0025			0.0024								
Bankfull Slope (ft/ft)	0.0015		0.0024			0.0023			0.0024								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	N/A		N/A			N/A			N/A								
% of Reach with Eroding Banks			0%			0%			0%								

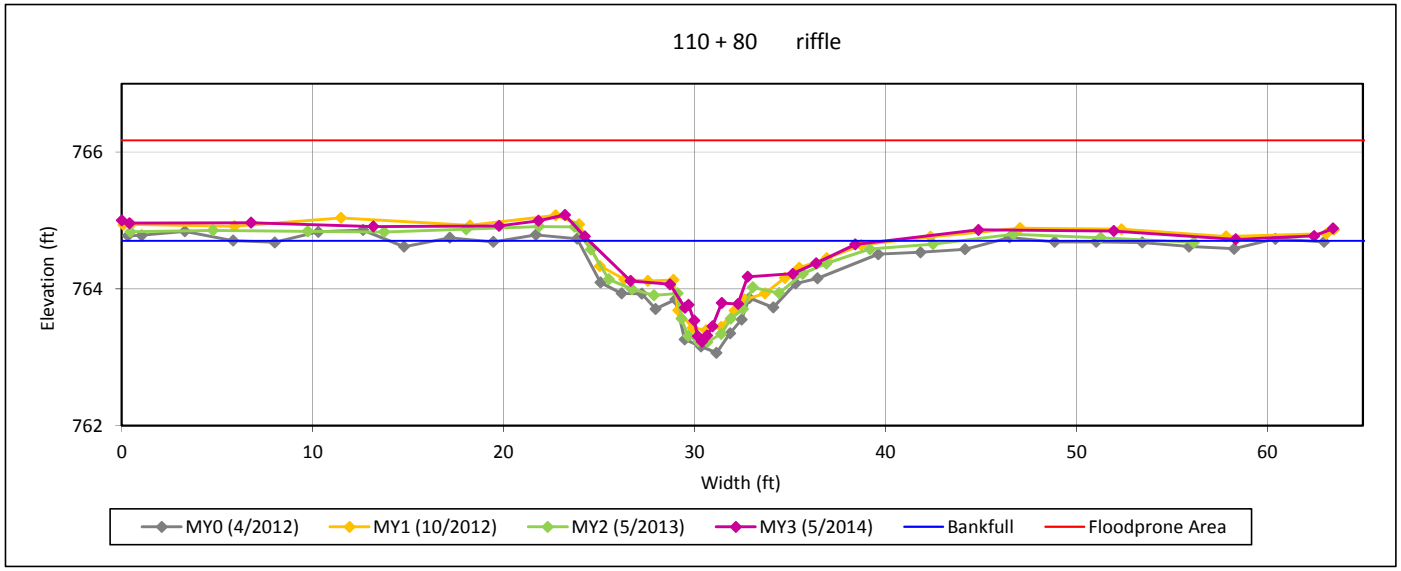
(-): Data was not provided
N/A: Not Applicable

Longitudinal Profile Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 1 Lower
Monitoring Year 3



Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 3 - UT1 Reach 1 Lower



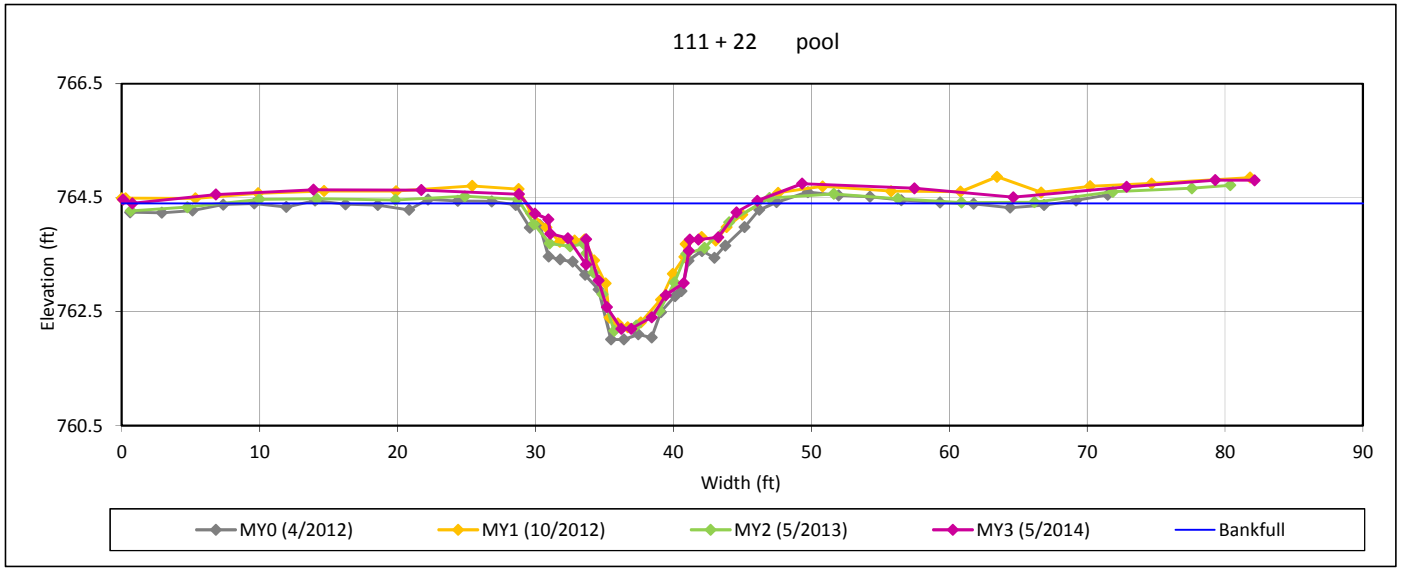
Bankfull Dimensions	
8.1	x-section area (ft.sq.)
15.5	width (ft)
0.5	mean depth (ft)
1.5	max depth (ft)
16.2	wetted parimeter (ft)
0.5	hyd radi (ft)
29.6	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 4 - UT1 Reach 1 Lower



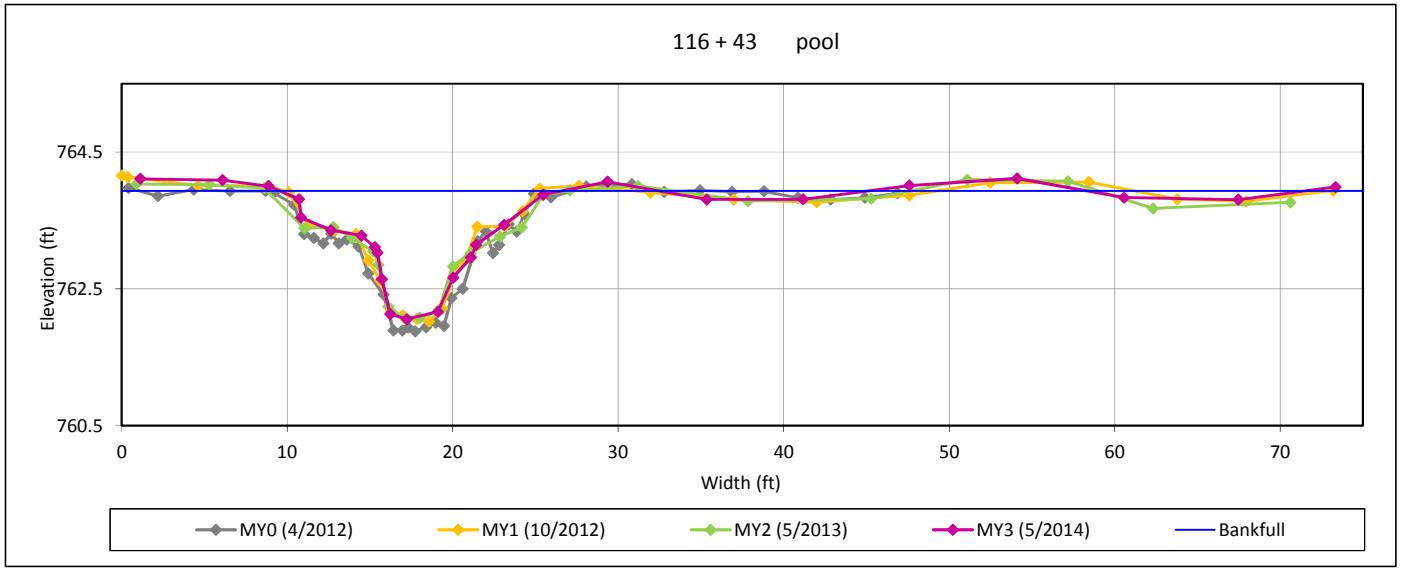
Bankfull Dimensions	
17.0	x-section area (ft.sq.)
16.4	width (ft)
1.0	mean depth (ft)
2.2	max depth (ft)
18.2	wetted parimeter (ft)
0.9	hyd radi (ft)
15.8	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 5 - UT1 Reach 1 Lower



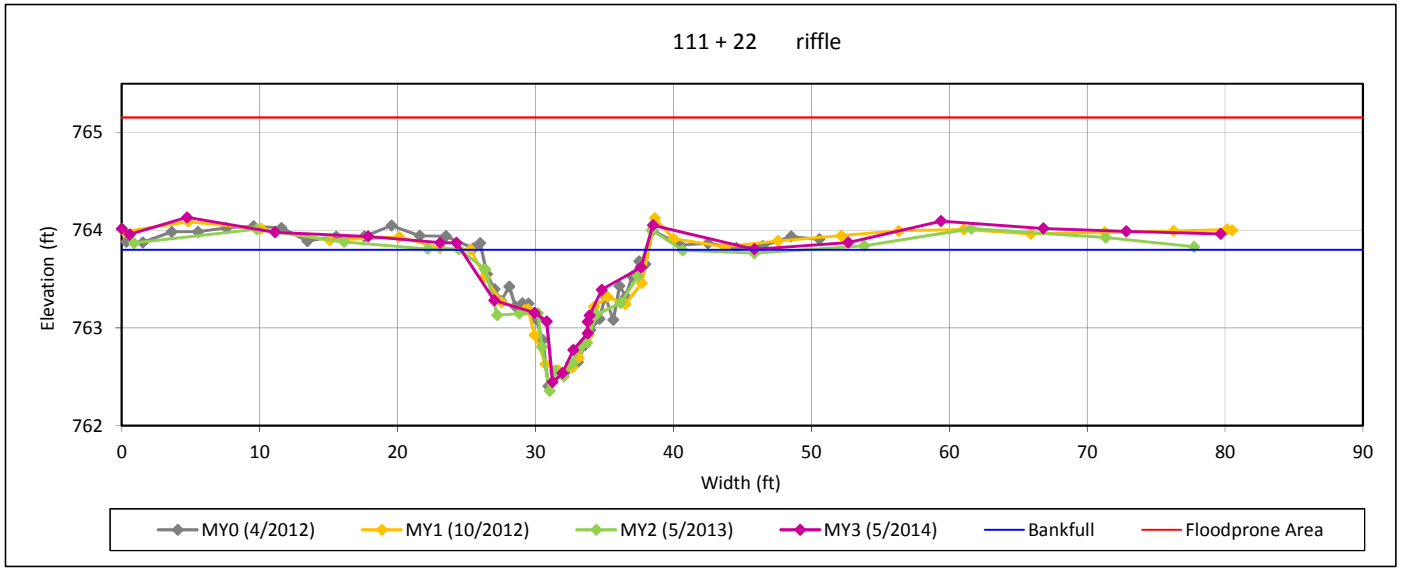
Bankfull Dimensions	
13.8	x-section area (ft.sq.)
15.9	width (ft)
0.9	mean depth (ft)
1.9	max depth (ft)
16.8	wetted parimeter (ft)
0.8	hyd radi (ft)
18.3	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 6 - UT1 Reach 1 Lower



Bankfull Dimensions	
7.6	x-section area (ft.sq.)
13.4	width (ft)
0.6	mean depth (ft)
1.4	max depth (ft)
14.1	wetted parimeter (ft)
0.5	hyd radi (ft)
23.6	width-depth ratio

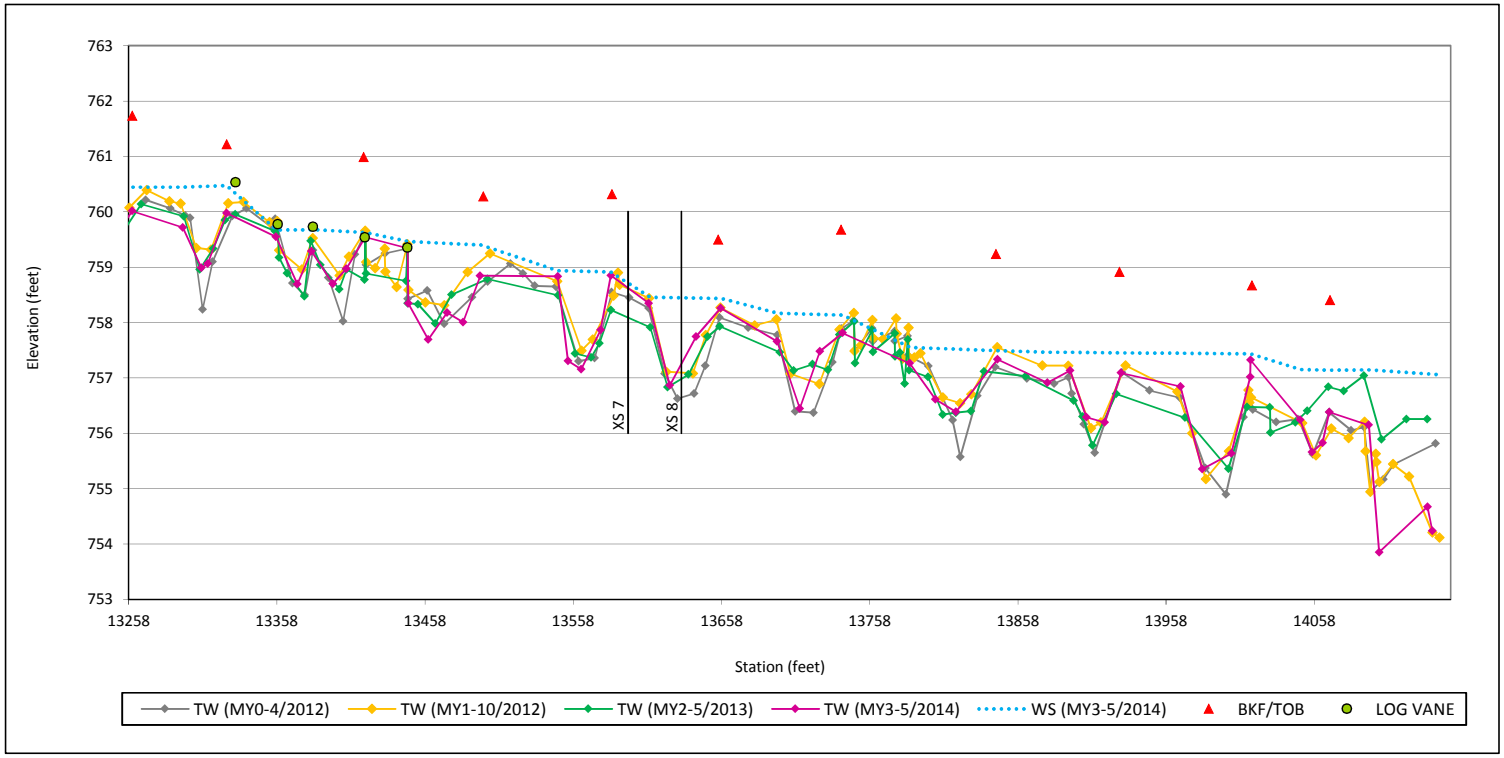
Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Table 12c. Monitoring Data - Stream Reach Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 2
Monitoring Year 3

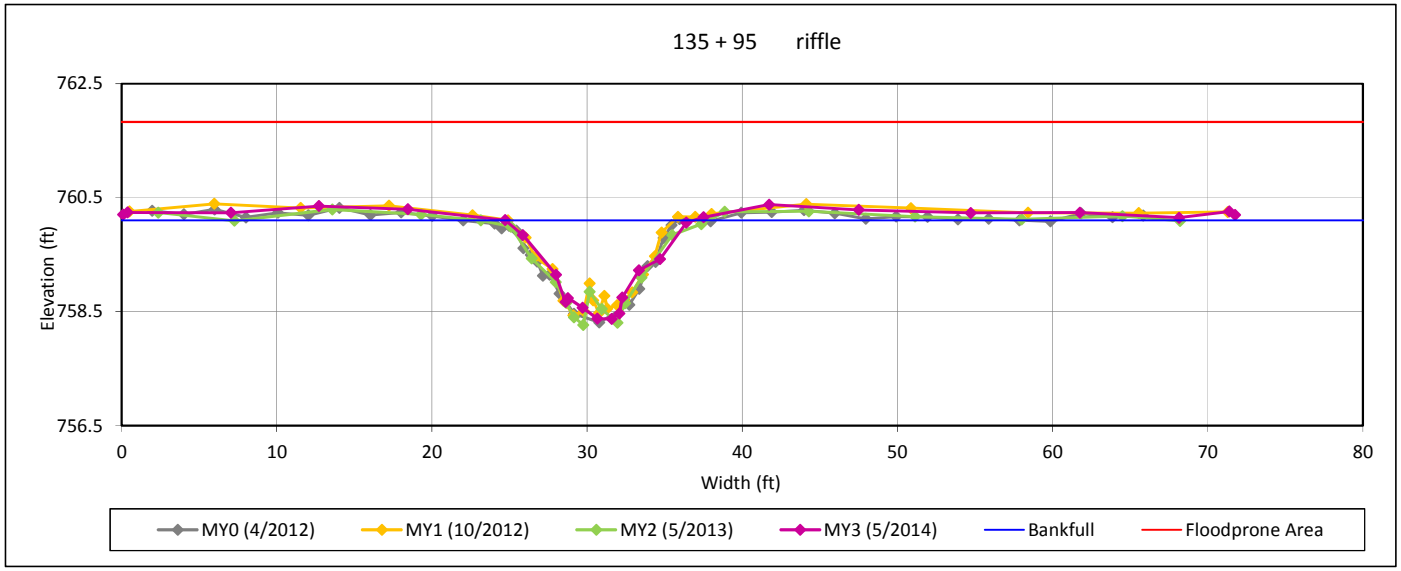
Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	11.8		8.7			14.7			12.1								
Floodprone Width (ft)	69.7		70.8			65.9			65.9								
Bankfull Mean Depth	1.0		1.1			0.8			0.9								
Bankfull Max Depth	1.8		1.7			1.8			1.7								
Bankfull Cross-sectional Area (ft^2)	11.7		9.4			11.8			10.9								
Width/Depth Ratio	11.8		8.0			18.3			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)																	
Profile																	
Riffle Length (ft)	27	47	11	24	48	27	34	48	20	37	64						
Riffle Slope (ft/ft)	0.002	0.018	0.002	0.013	0.021	0.000	0.008	0.016	0.0003	0.0071	0.0231						
Pool Length (ft)	15	62	20	46	68	28	44	58	20	44	63						
Pool Max Depth (ft)	2	3	0.9	1.3	1.8	1.0	1.5	2.5	0.8	1.8	4.0						
Pool Spacing (ft)	48	99	37	78	96	26	78	108	54	79	105						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	41	65															
Radius of Curvature (ft)	27	34															
Rc:Bankfull Width (ft/ft)	2	3															
Meander Wave Length (ft)	113	161															
Meander Width Ratio	3	5															
Additional Reach Parameters																	
Rosgen Classification	C		C			C			C								
Channel Thalweg Length (ft)	883		883			883			883								
Sinuosity (ft)	1.3		1.3			1.3			1.3								
Water Surface Slope (ft/ft)	0.0047		0.0049			0.0049			0.0039								
Bankfull Slope (ft/ft)	0.0049		0.0049			0.0046			0.0035								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	N/A		N/A			N/A			N/A								
% of Reach with Eroding Banks			0%			0%			0%								

Longitudinal Profile Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1 Reach 2
Monitoring Year 3



Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 7 - UT1 Reach 2



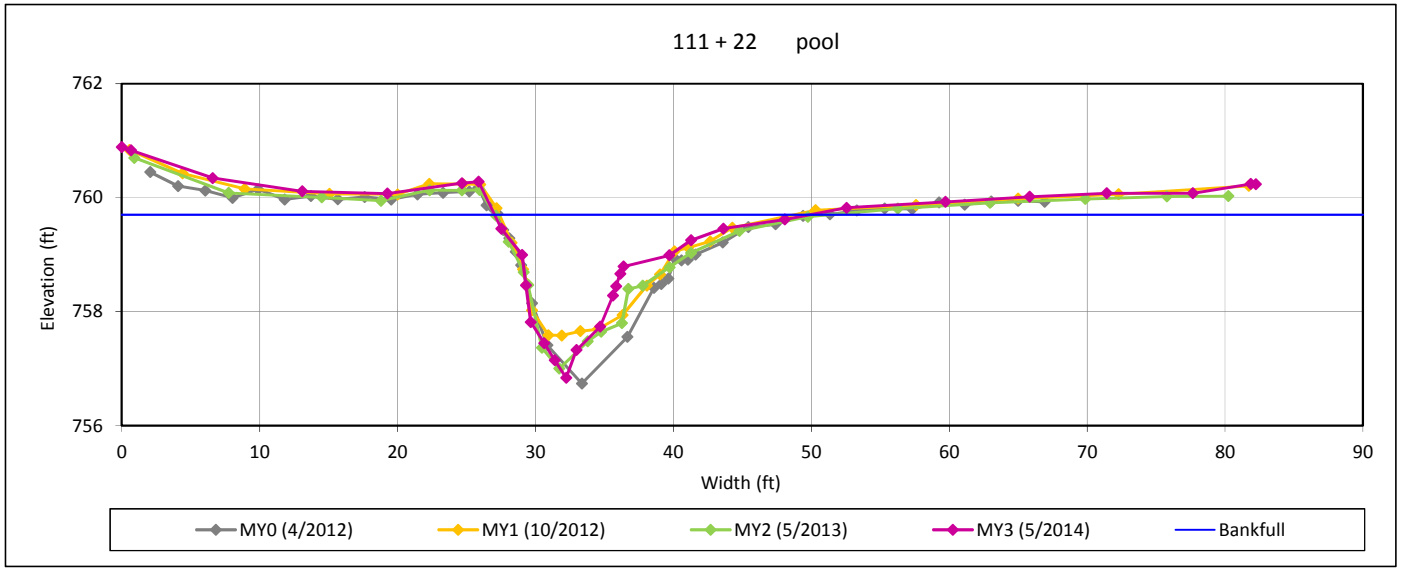
Bankfull Dimensions	
10.9	x-section area (ft.sq.)
12.1	width (ft)
0.9	mean depth (ft)
1.7	max depth (ft)
12.8	wetted parimeter (ft)
0.8	hyd radi (ft)
13.5	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 8 - UT1 Reach 2



Bankfull Dimensions	
20.9	x-section area (ft.sq.)
21.0	width (ft)
1.0	mean depth (ft)
2.9	max depth (ft)
22.6	wetted parimeter (ft)
0.9	hyd radi (ft)
21.1	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Table 12d. Monitoring Data - Stream Reach Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1A
Monitoring Year 3

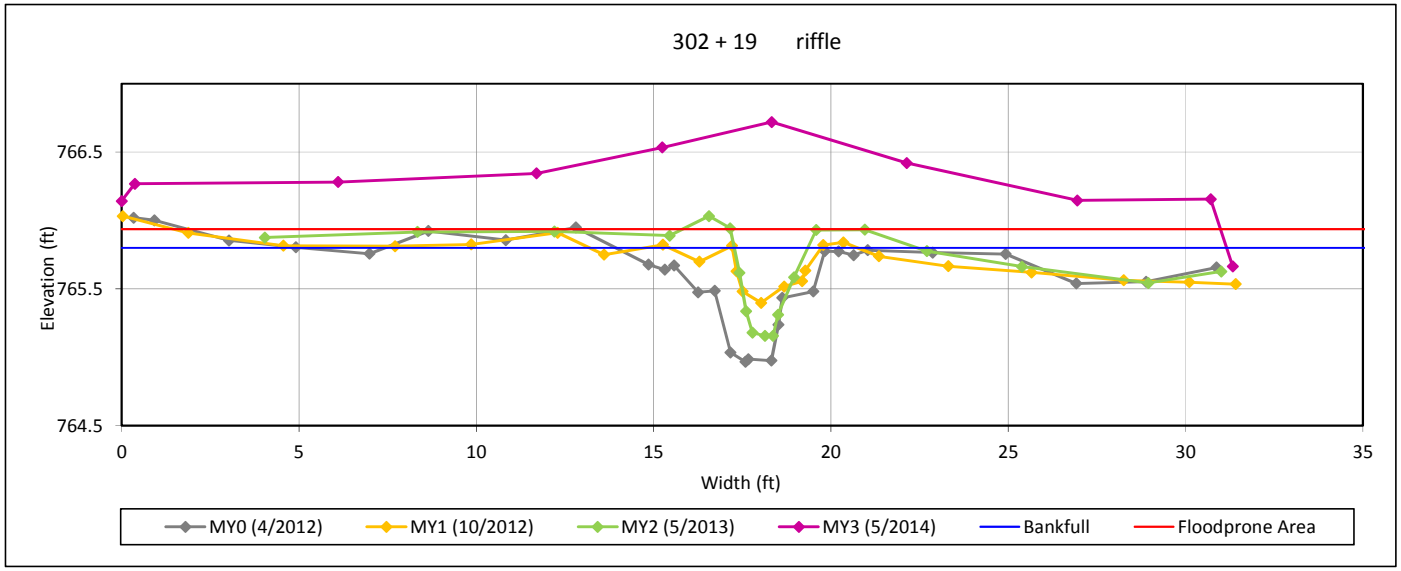
Parameter	As-Built/Baseline				MY-1		MY-2		MY-3		MY-4		MY-5	
	UT1A Upper		UT1A Lower											
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle														
Bankfull Width (ft)	4.6				1.9		2.1		0.2					
Floodprone Width (ft)	30.5				31.4		27.0		0					
Bankfull Mean Depth	0.4				0.3		0.4		0.1					
Bankfull Max Depth	0.8				0.4		0.6		0.1					
Bankfull Cross-sectional Area (ft^2)	2.1				0.6		0.8		0.0					
Width/Depth Ratio	10.4				6.2		5.2		2.5					
Entrenchment Ratio	N/A				N/A		N/A		N/A					
Bank Height Ratio	N/A				N/A		N/A		N/A					
D50 (mm)														
Profile														
Riffle Length (ft)	8	19	10	23	4	27	9	31	8	46				
Riffle Slope (ft/ft)	0.035	0.048	0.009	0.029	0.000	0.056	0.007	0.046	0.0032	0.0442				
Pool Length (ft)	5	12	12	34	4	31	4	30	7	22				
Pool Max Depth (ft)	1.0	1.9	1.2	1.9	0.2	1.1	0.2	1.0	1.3	3.2				
Pool Spacing (ft)	4	33	29	90	12	55	5	88	7	185				
Pool Volume (ft^3)														
Pattern														
Channel Beltwidth (ft)	N/A	N/A	25	35										
Radius of Curvature (ft)	N/A	N/A	14	20										
Rc:Bankfull Width (ft/ft)	N/A	N/A	2	3										
Meander Wave Length (ft)	N/A	N/A	53	82										
Meander Width Ratio	N/A	N/A	4	5										
Additional Reach Parameters														
Rosgen Classification	C		E		C/E		C/E		N/A*					
Channel Thalweg Length (ft)	201		414		615		615		615					
Sinuosity (ft)	1.1		1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0296		0.0089		0.0162		0.0159		0.0154					
Bankfull Slope (ft/ft)	0.0294		0.0091		0.0160		0.0159		0.0168					
Ri%/Ru%/P%/G%/S%														
SC%/Sa%/G%/C%/B%/Be%														
d16/d35/d50/d84/d95/d100	N/A		N/A		N/A		N/A		N/A					
% of Reach with Eroding Banks					0%		0%		0%					

N/A: Not Applicable

Longitudinal Profile Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1A
Monitoring Year 3

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 9 - UT1A



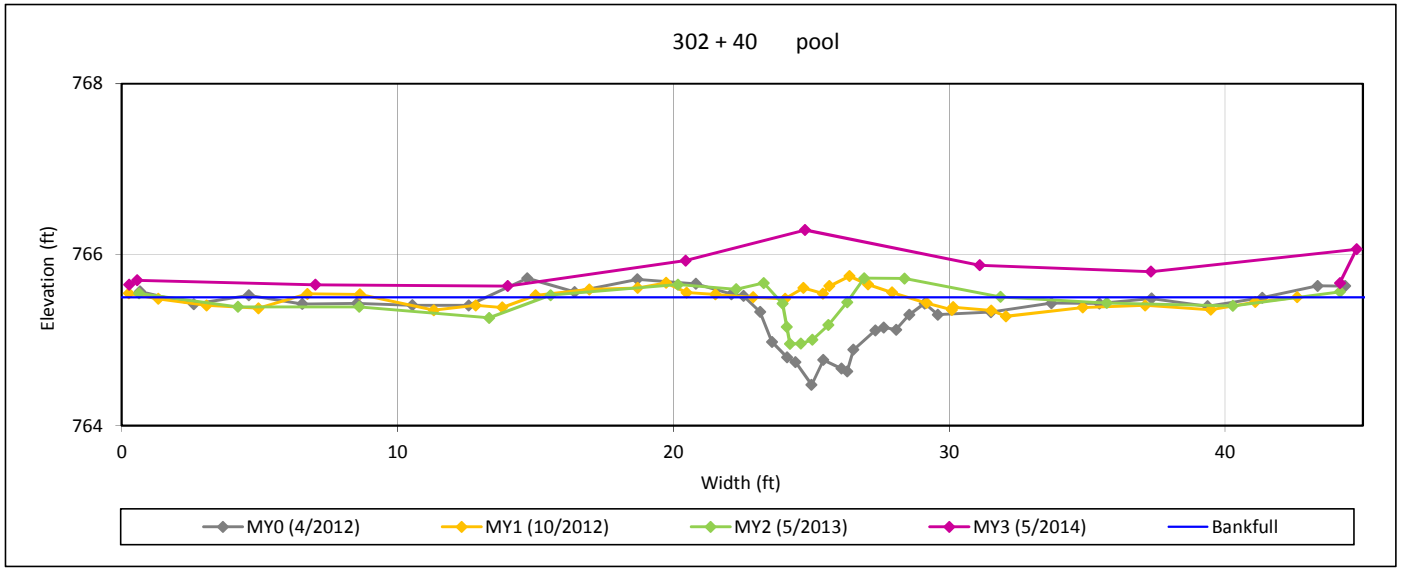
Bankfull Dimensions	
0.0	x-section area (ft.sq.)
0.2	width (ft)
0.1	mean depth (ft)
0.1	max depth (ft)
0.2	wetted parimeter (ft)
0.1	hyd radi (ft)
2.5	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 10 - UT1A



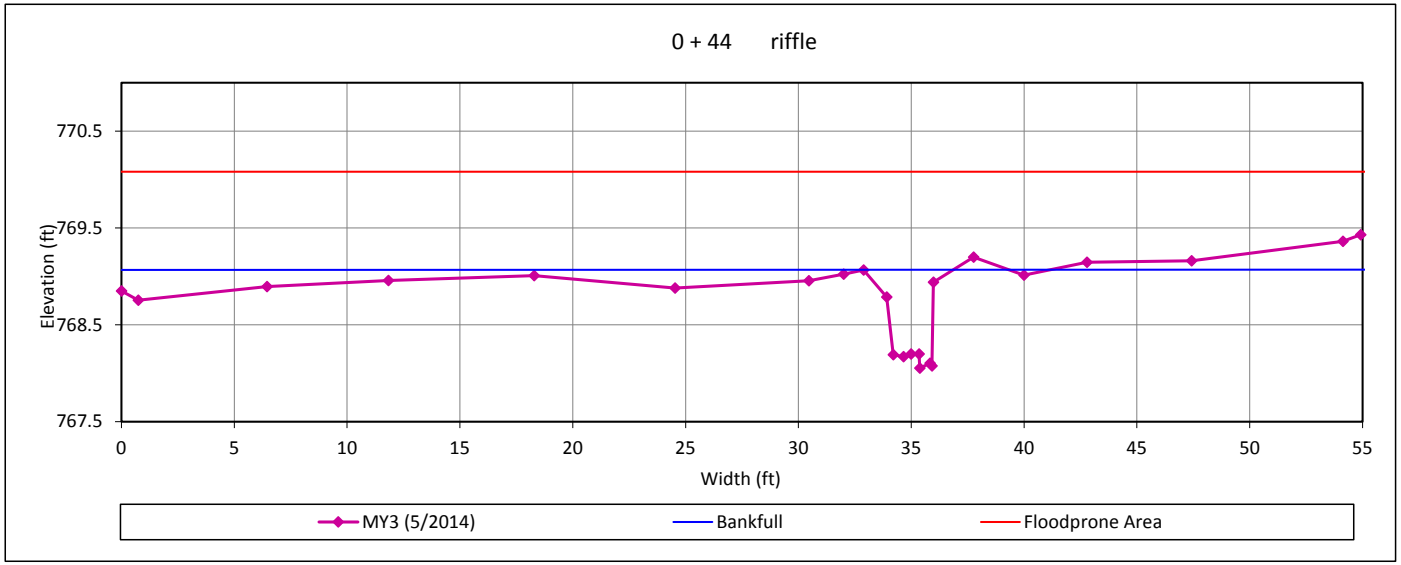
Bankfull Dimensions	
0.0	x-section area (ft.sq.)
0.0	width (ft)
0.0	mean depth (ft)
-0.1	max depth (ft)
0.0	wetted parimeter (ft)
0.0	hyd radi (ft)
0.0	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 13 - UT1A



Bankfull Dimensions	
2.0	x-section area (ft.sq.)
5.7	width (ft)
0.4	mean depth (ft)
1.0	max depth (ft)
7.1	wetted parimeter (ft)
0.3	hyd radi (ft)
16.3	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

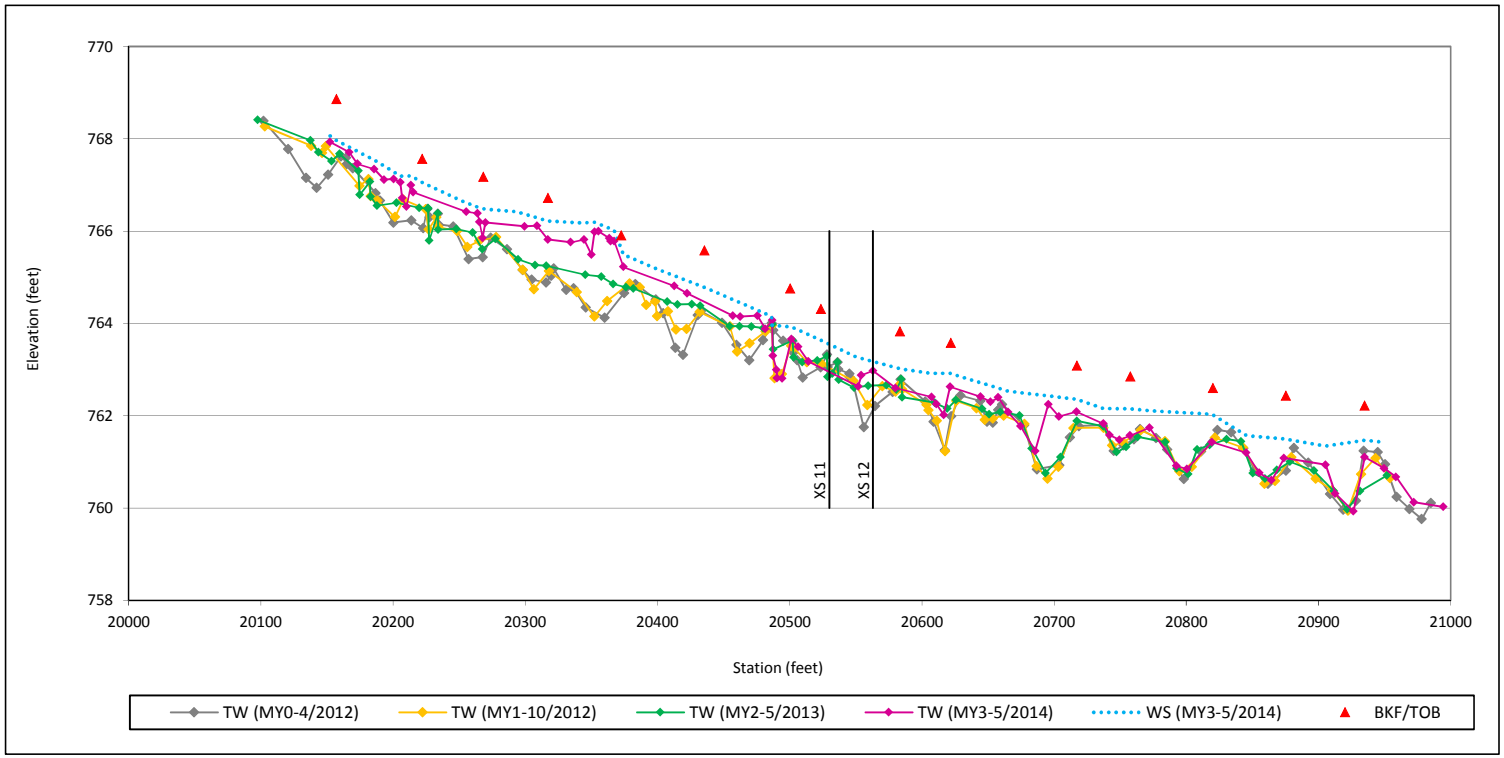
Cross Section was installed during MY3

Table 12e. Monitoring Data - Stream Reach Data Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1B
Monitoring Year 3

Parameter	As-Built/Baseline						MY-1		MY-2		MY-3		MY-4		MY-5	
	UT1B 200+00 to 203+20		UT1B 203+21 to 207+18		UT1B 207+18 to 209+97											
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	12.8						3.1		4.8		2.8					
Floodprone Width (ft)	67.3						66.5		64.2		53.8					
Bankfull Mean Depth	0.1						0.3		0.5		0.4					
Bankfull Max Depth	1.0						1.1		1.0		0.7					
Bankfull Cross-sectional Area (ft^2)	1.3						1.0		2.3		1.2					
Width/Depth Ratio	122.2						9.8		10.0		6.4					
Entrenchment Ratio	N/A						N/A		N/A		N/A					
Bank Height Ratio	N/A						N/A		N/A		N/A					
D50 (mm)																
Profile																
Riffle Length (ft)	19	31	15	22	10	20	15	35	9	40	15	112				
Riffle Slope (ft/ft)	0.0224	0.0593	0.0072	0.0323	0.0032	0.0217	0.0048	0.0589	0.0020	0.0340	0.0046	0.0164				
Pool Length (ft)	23	40	17	41	28	42	11	44	14	55	6	52				
Pool Max Depth (ft)	1.2	2.1	1.3	2.4	1.9	2.2	0.4	1.5	0.1	1.5	1.7	3.1				
Pool Spacing (ft)	43	71	34	61	46	66	28	77	32	79	51	140				
Pool Volume (ft^3)																
Pattern																
Channel Beltwidth (ft)	35	39	23	39	29	41										
Radius of Curvature (ft)	19	27	16	26	19	26										
Rc:Bankfull Width (ft/ft)	2	3	2	3	2	3										
Meander Wave Length (ft)	83	106	78	86	79	90										
Meander Width Ratio	4	5	3	5	4	5										
Additional Reach Parameters																
Rosgen Classification	E						C/E		C/E		C/E					
Channel Thalweg Length (ft)	320		398		279		997		997		997					
Sinuosity (ft)	1.1		1.2		1.2		1.2		1.2		1.2					
Water Surface Slope (ft/ft)	0.0187		0.0080		0.0039		0.0085		0.0086		0.0085					
Bankfull Slope (ft/ft)	0.0190		0.0079		0.0039		0.0081		0.0083		0.0085					
Ri%/Ru%/P%/G%/S%																
SC%/Sa%/G%/C%/B%/Be%																
d16/d35/d50/d84/d95/d100	N/A						N/A		N/A		N/A					
% of Reach with Eroding Banks							0%		0%		0%					

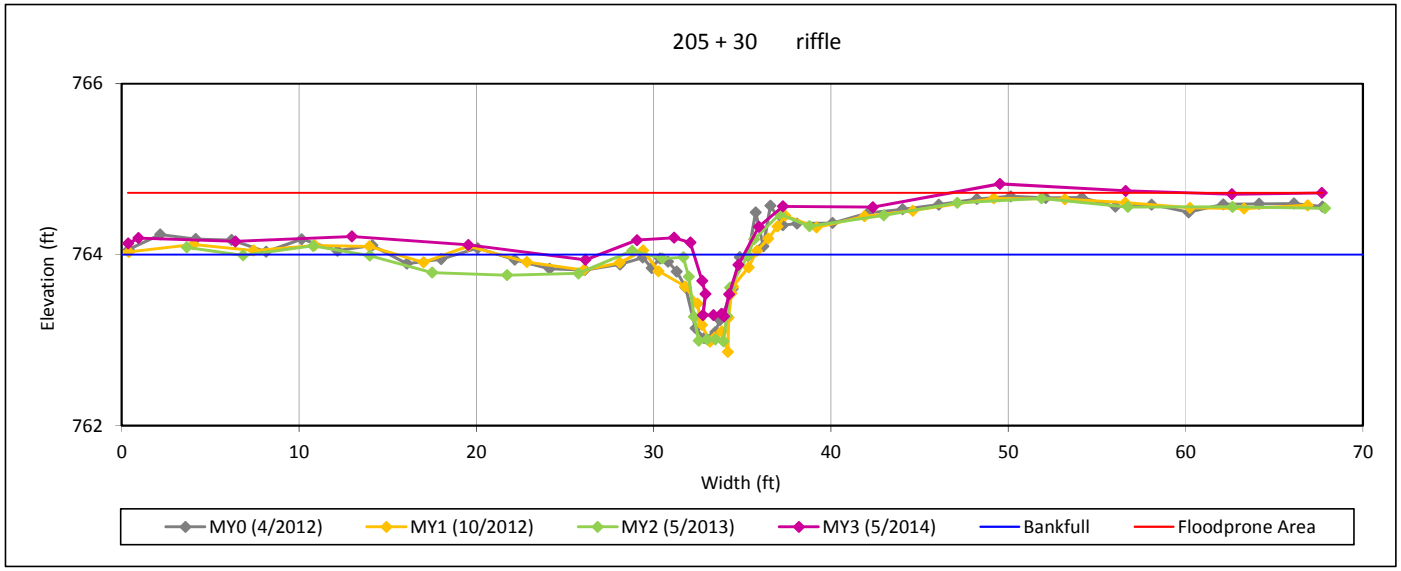
(-): Data was not provided
N/A: Not Applicable

Longitudinal Profile Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1B
Monitoring Year 3



Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 11 - UT1B



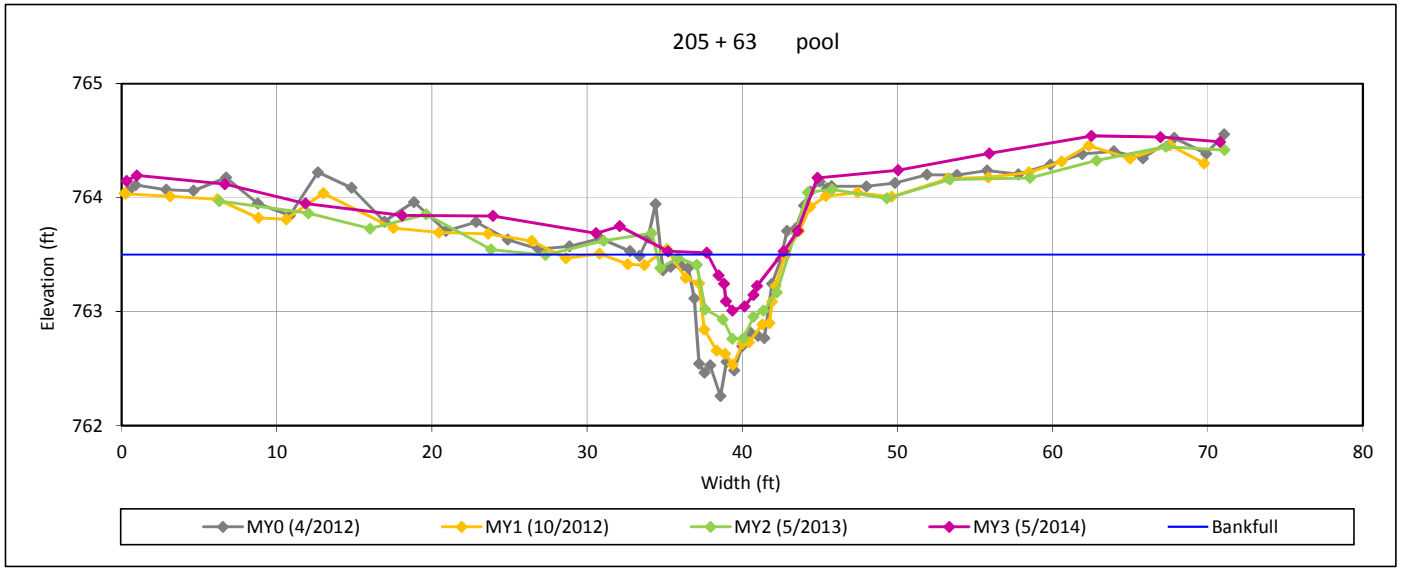
Bankfull Dimensions	
1.2	x-section area (ft.sq.)
2.8	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
3.6	wetted parimeter (ft)
0.3	hyd radi (ft)
6.4	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

Cross-Section Plots
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3

Cross Section 12 - UT1B



Bankfull Dimensions	
1.3	x-section area (ft.sq.)
4.7	width (ft)
0.3	mean depth (ft)
0.5	max depth (ft)
4.9	wetted parimeter (ft)
0.3	hyd radi (ft)
17.9	width-depth ratio

Survey Date: May-14
Field Crew: KB, AT

View Downstream (5/2014)

APPENDIX 5. Hydrology Summary Data and Plots

Table 13. Verification of Bankfull Events
Lyle Creek Mitigation Site (EEP Project No. 94643)
UT1, UT1A, and UT1B
Monitoring Year 3

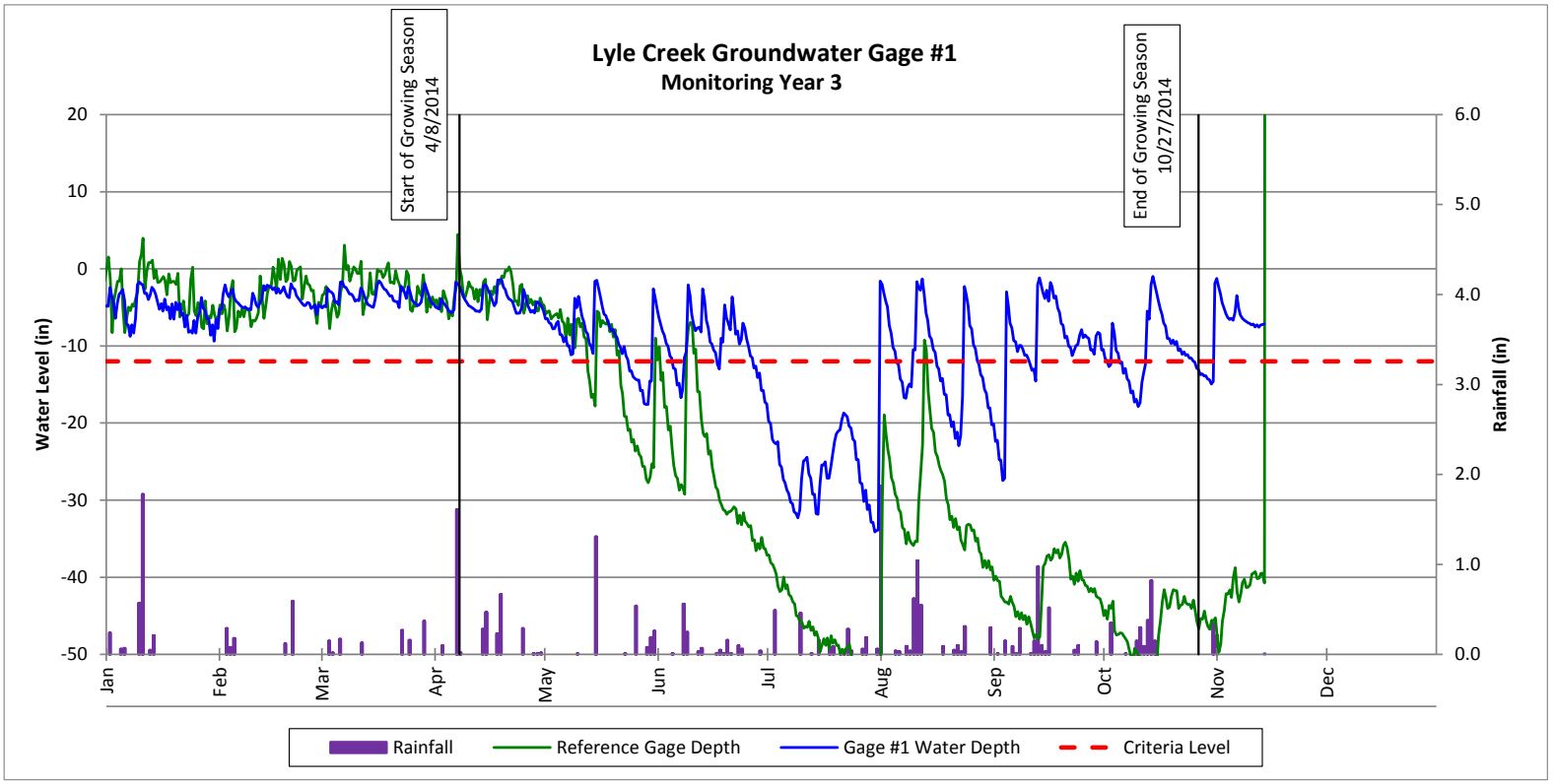
Reach	Date of Data Collection	Date of Occurrence	MY of Occurrence	Method
UT1	5/11/2012	U	1	Crest Gage
	10/31/2013	U	2	Crest Gage
UT1A	7/10/2012	U	1	Crest Gage
	3/7/2013	U	2	Crest Gage
	6/30/2014	5/15/2014	3	Crest Gage
UT1B	7/10/2012	U	1	Crest Gage
	3/7/2013	U	2	Crest Gage
	6/30/2014	5/15/2014	3	Crest Gage

Table 14. Wetland Gage Attainment Summary
Lyle Creek Mitigation Site (EEP Project No. 94643)
Wetlands RW1 and RW2
Monitoring Year 3

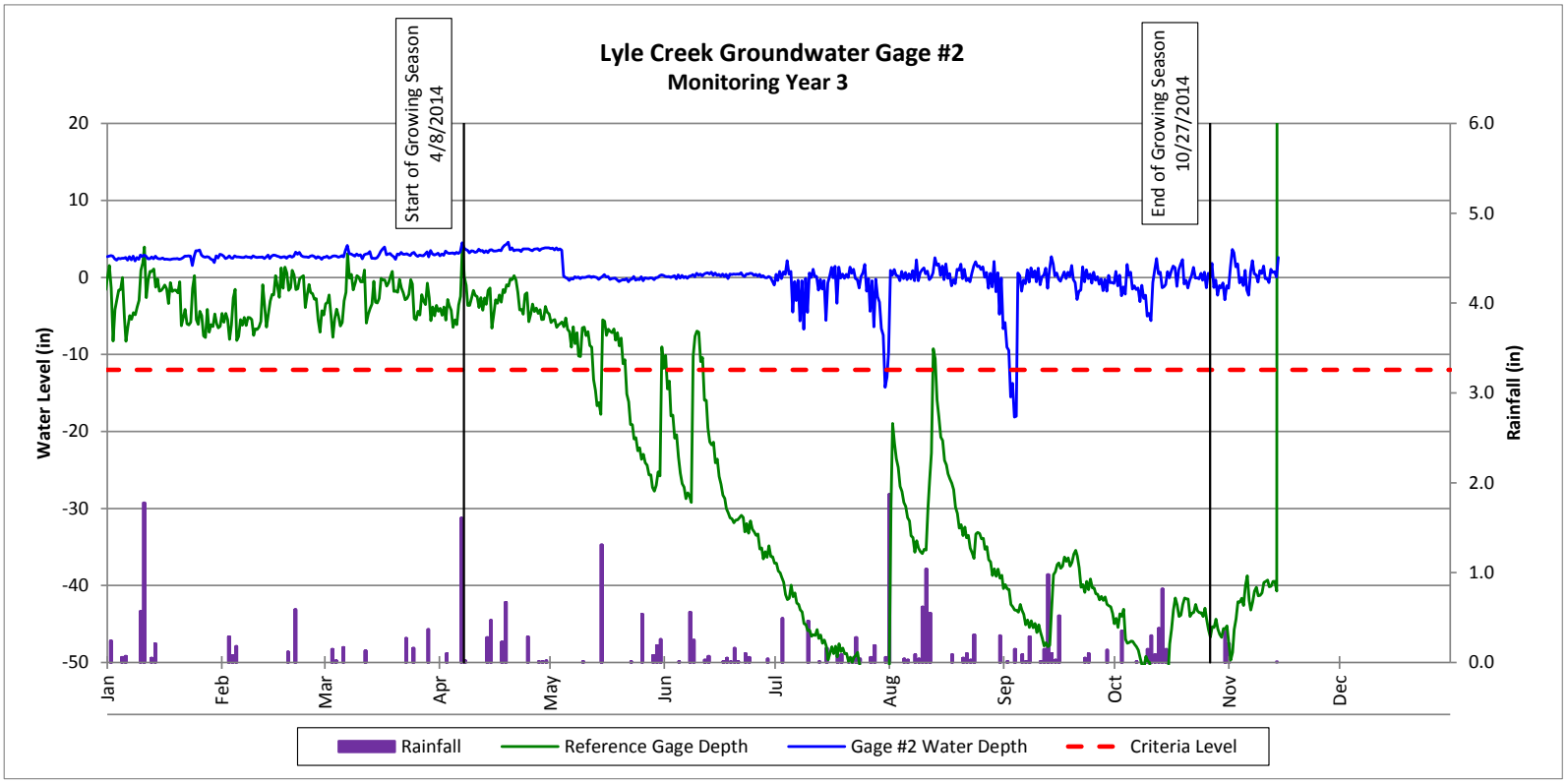
Summary of Groundwater Gage Results for Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2012)	Year 2 (2013)	Year 3 (2014)	Year 4 (2015)	Year 5 (2016)	Year 6 (2017)	Year 7 (2018)
1	No/5 Days (2.5 %)	Yes/49 Days (24 %)	Yes/47 Days (23 %)				
2	No/0 Days (0 %)	Yes/93 Days (46 %)	Yes/113.5 Days (56 %)				
3	Yes/29 Days (14 %)	Yes/49 Days (24 %)	Yes/52.5 Days 26 %)				
4	Yes/27 Days (13 %)	Yes/54.5 Days (27 %)	Yes/47 Days (23 %)				
5	No/11 Days (5 %)	Yes/41.5 Days (20.3 %)	Yes/52.5 Days (26 %)				
6	No/5 Days (2.5 %)	Yes/16 Days (7.8 %)	No/10 Days (5 %)				
7	Yes/22 Days (11 %)	Yes/179 Days (88 %)	Yes/49.5 Days (25 %)				
8	No/12 Days (6 %)	Yes/53 Days (26 %)	Yes/44.5 Days (22 %)				
10	N/A	Yes/180 Days (88 %)	Yes/45.5 Days (23 %)				
11	N/A	Yes/80 Days (39 %)	Yes/50.5 Days (25 %)				

N/A: gages were installed after MY1

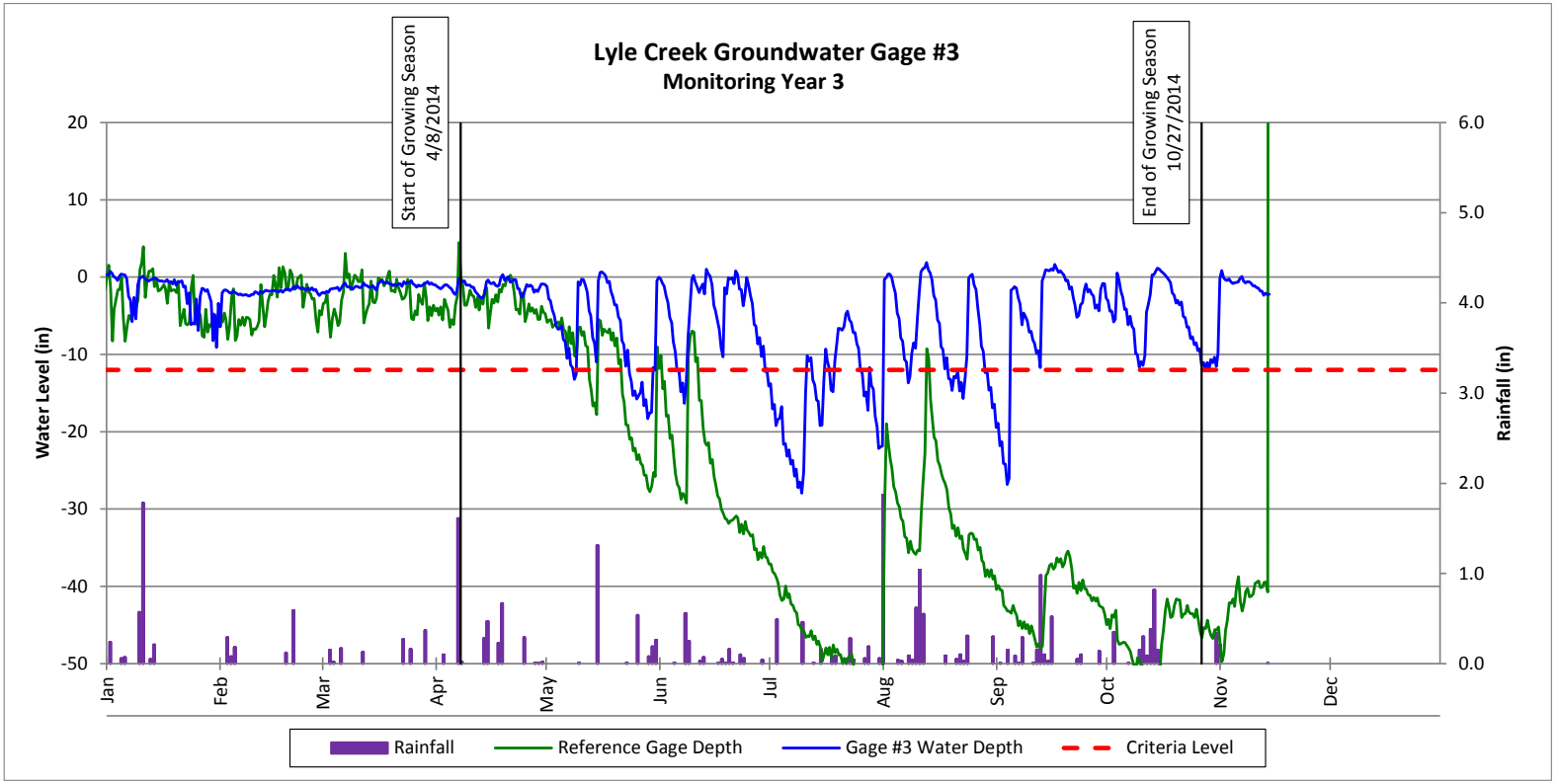
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



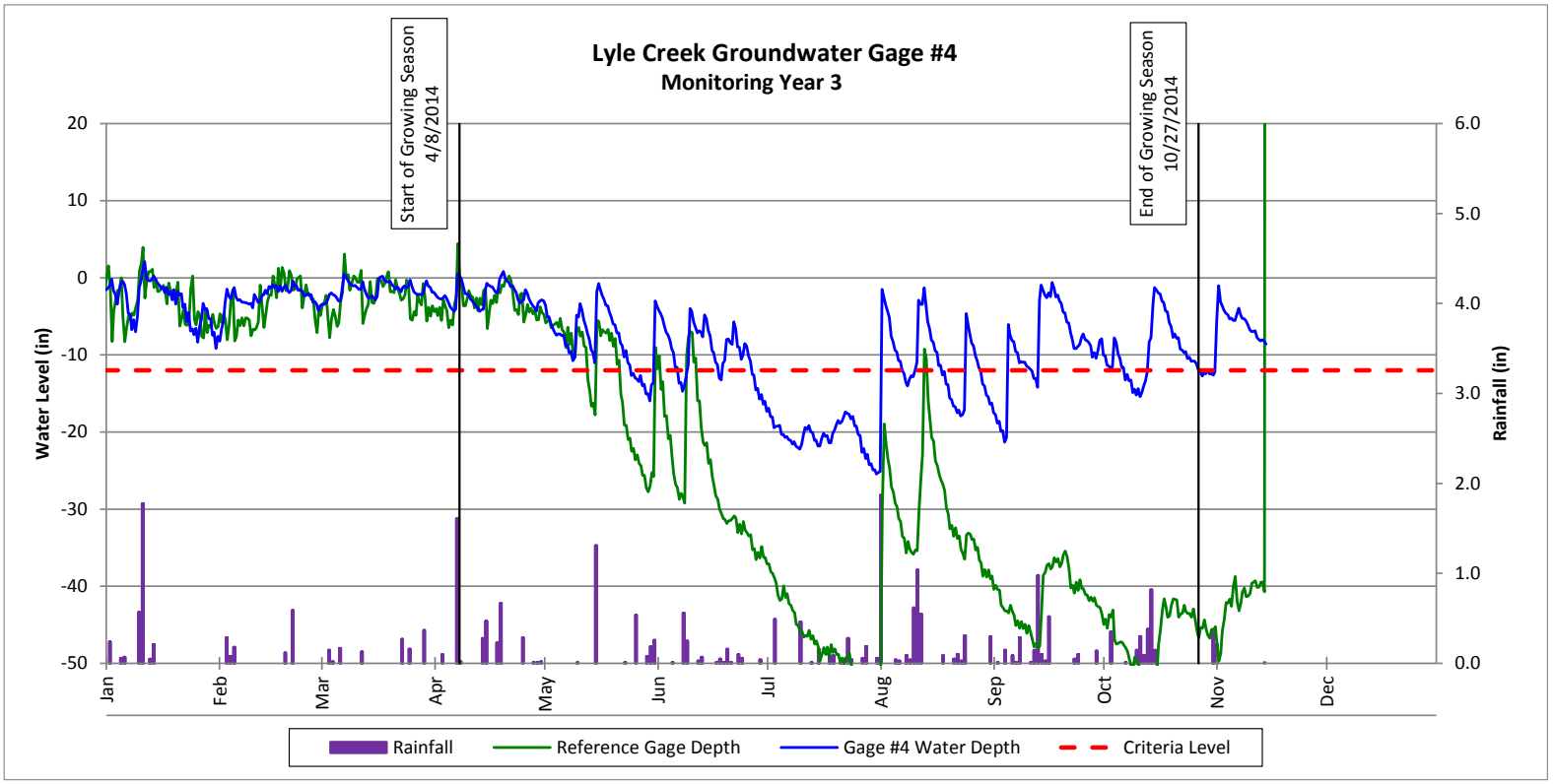
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



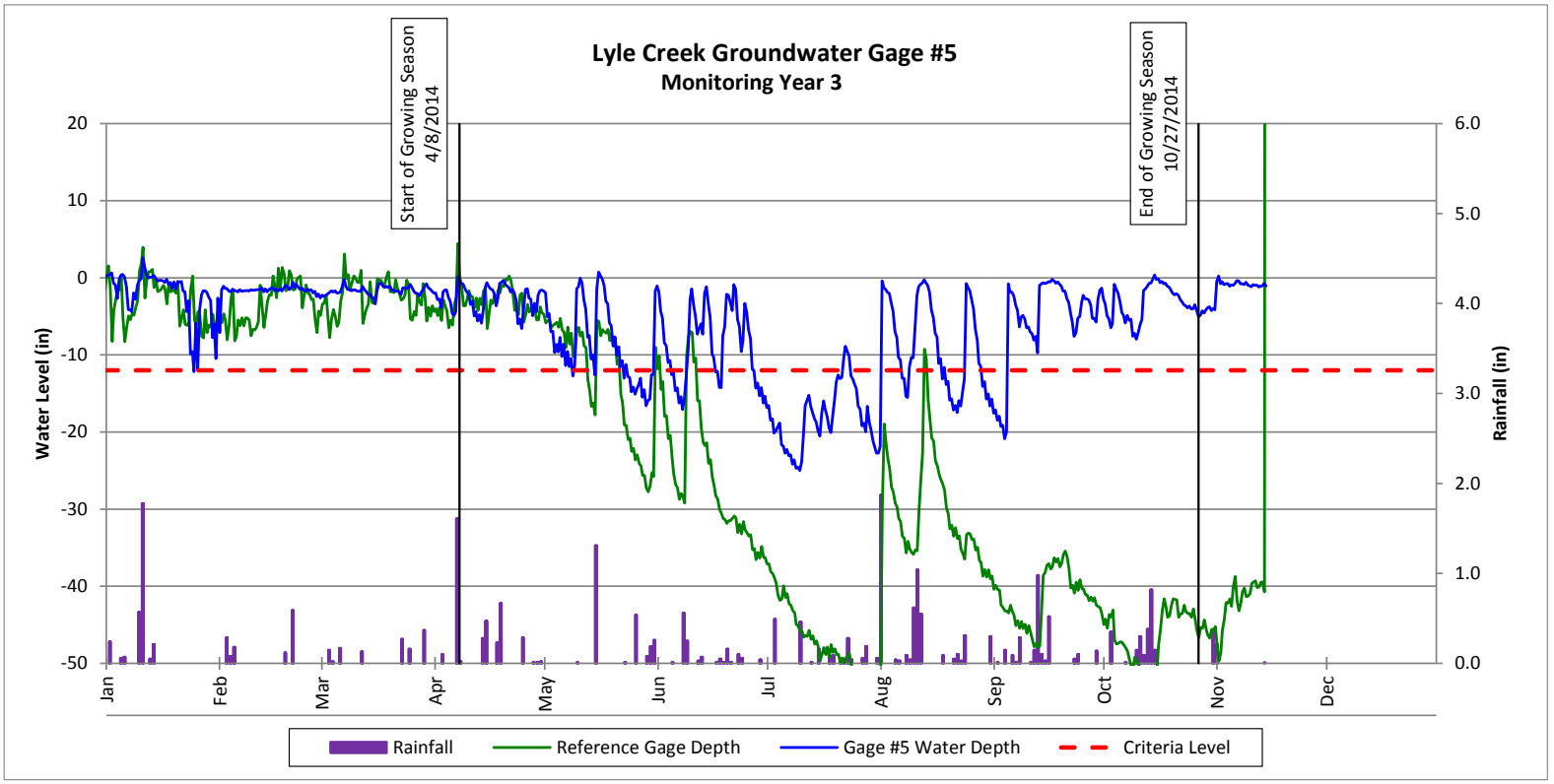
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



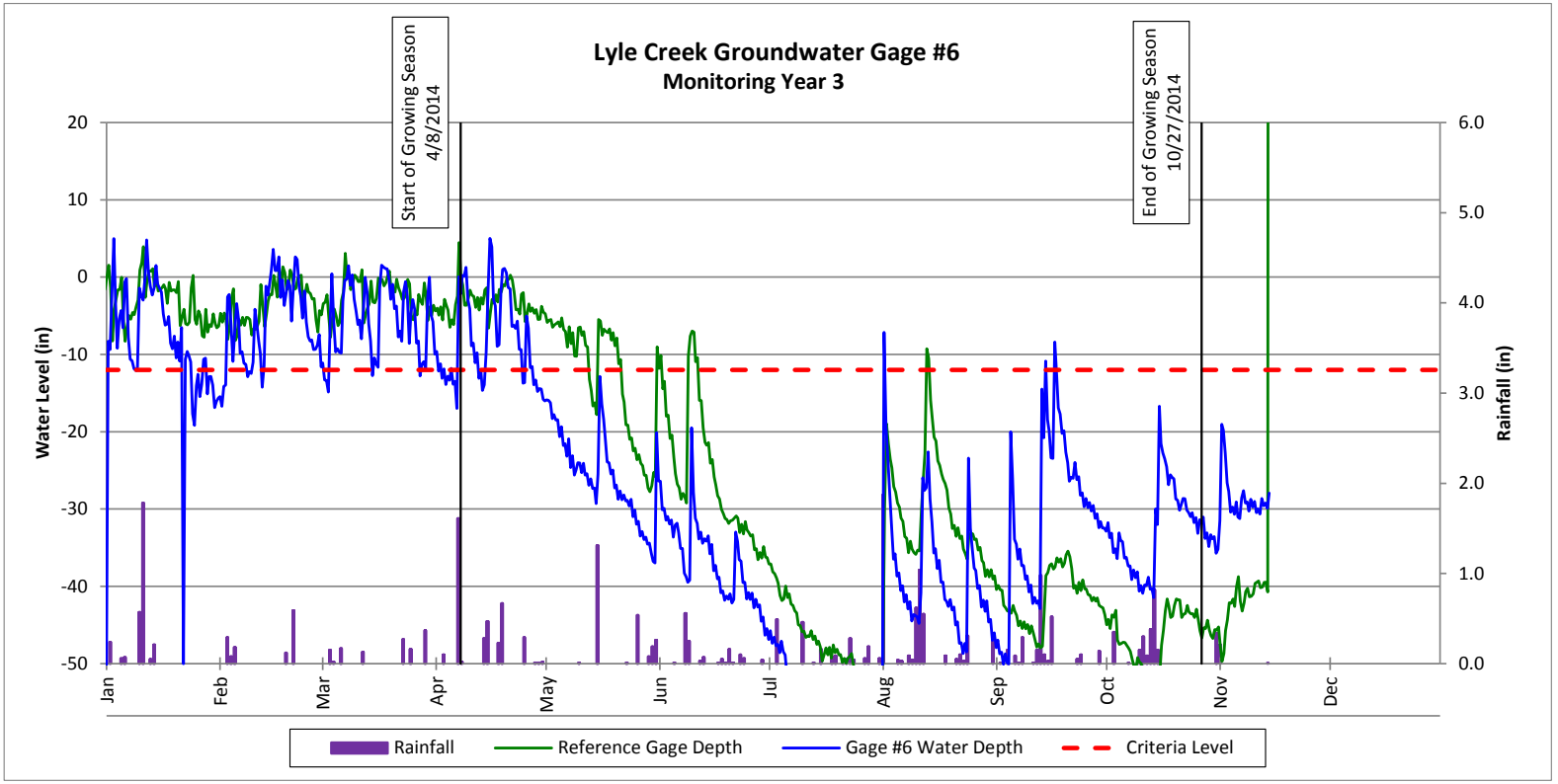
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



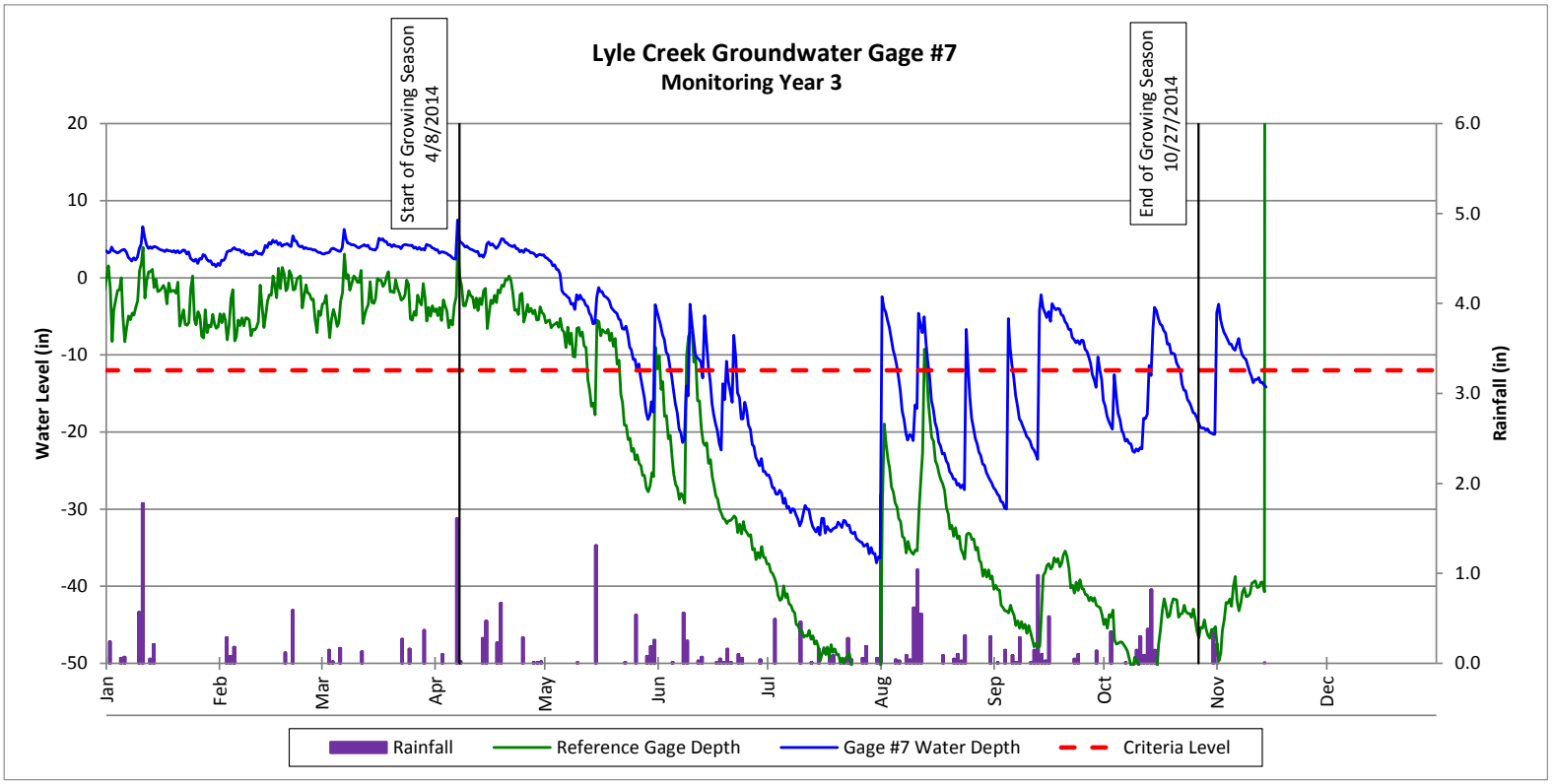
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



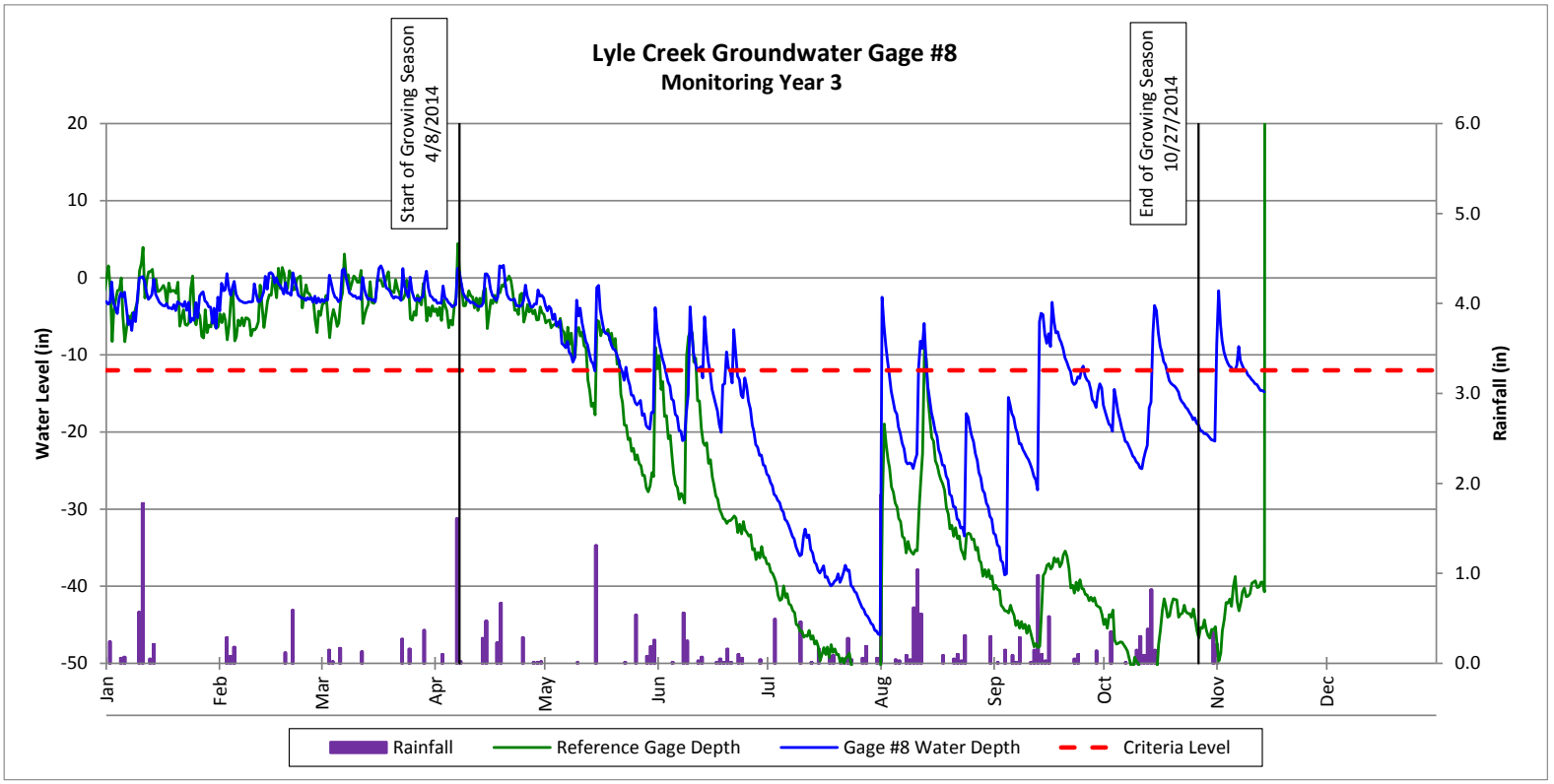
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW2
Monitoring Year 3



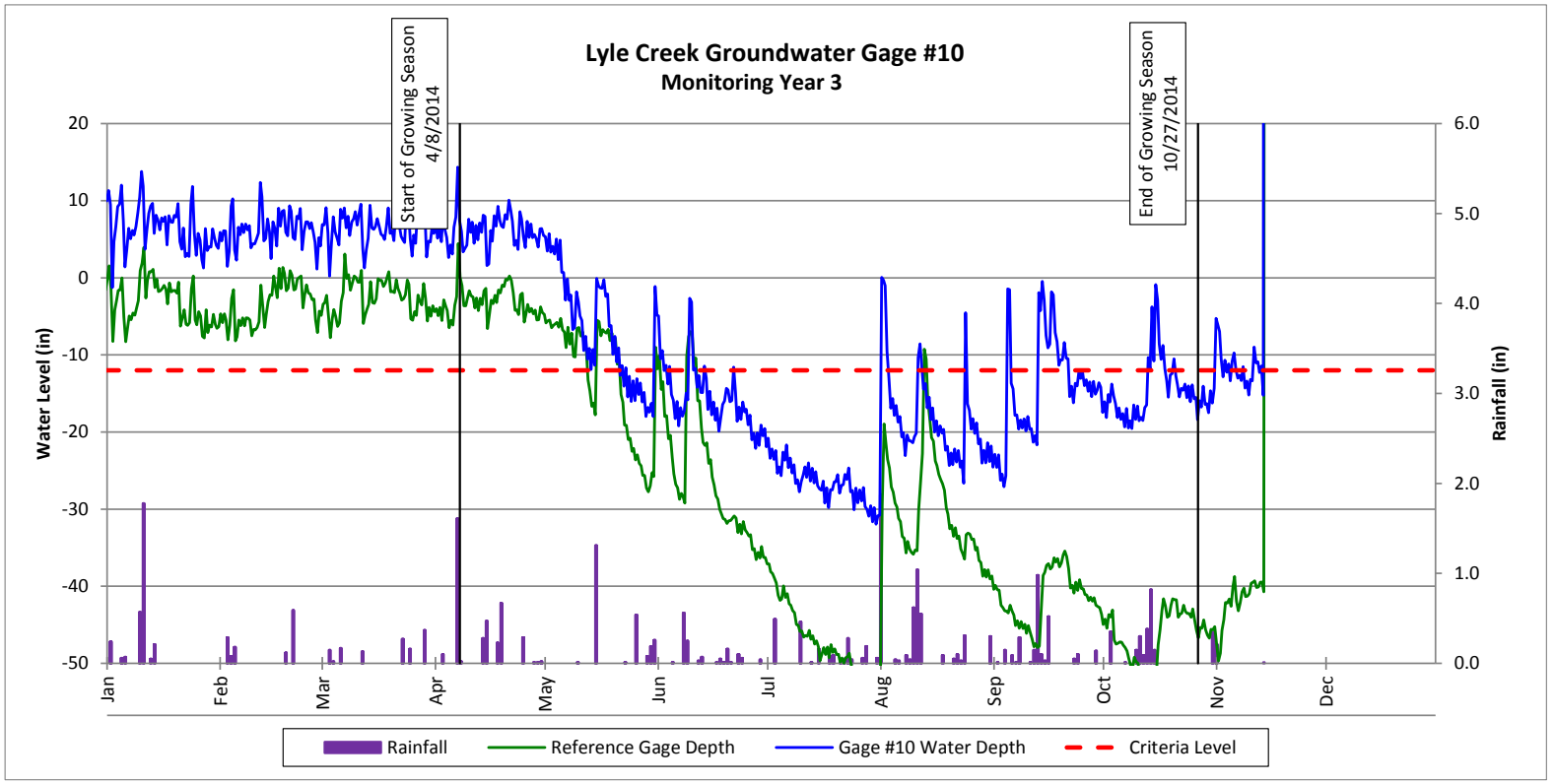
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW2
Monitoring Year 3



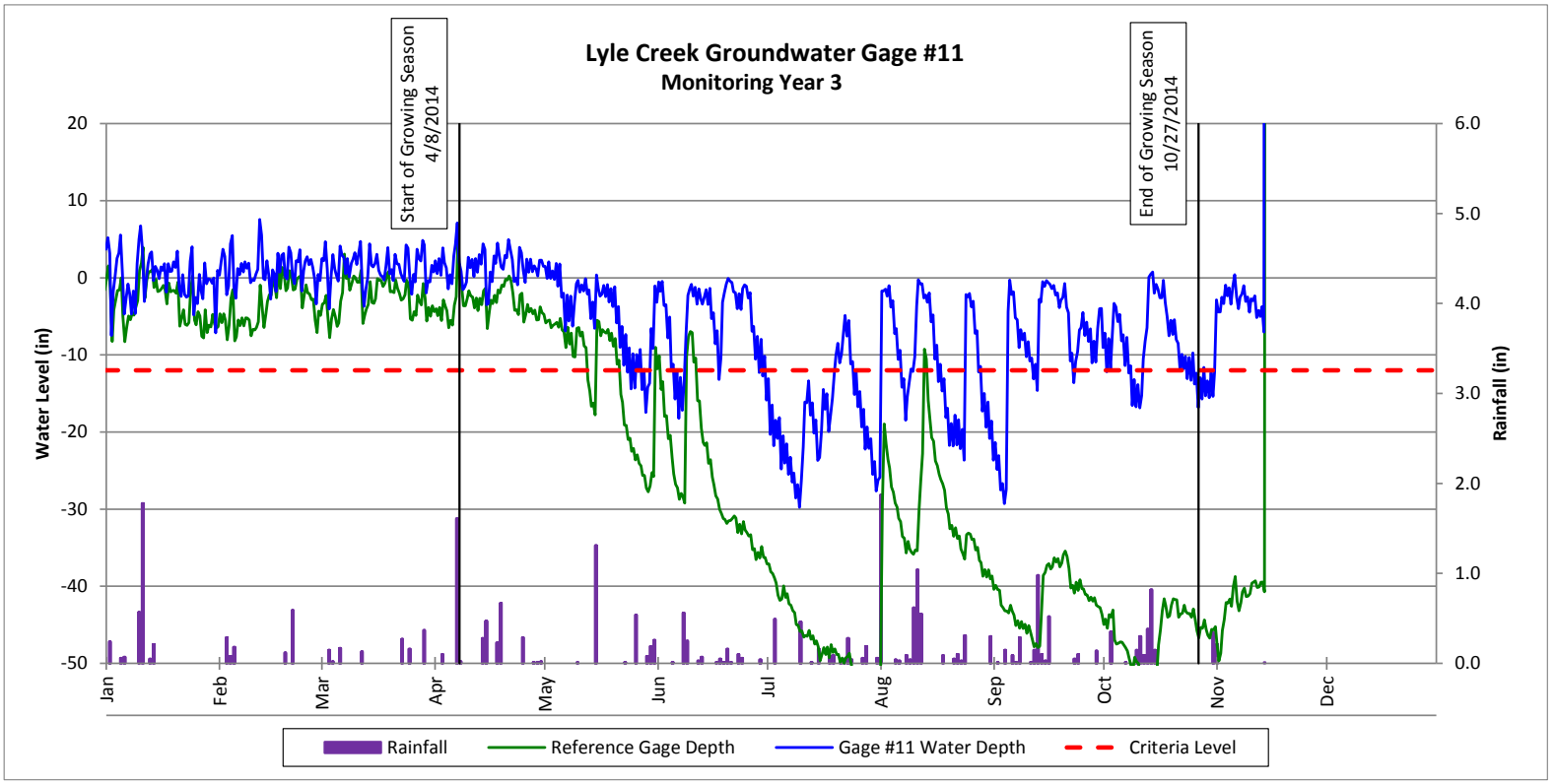
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW2
Monitoring Year 3



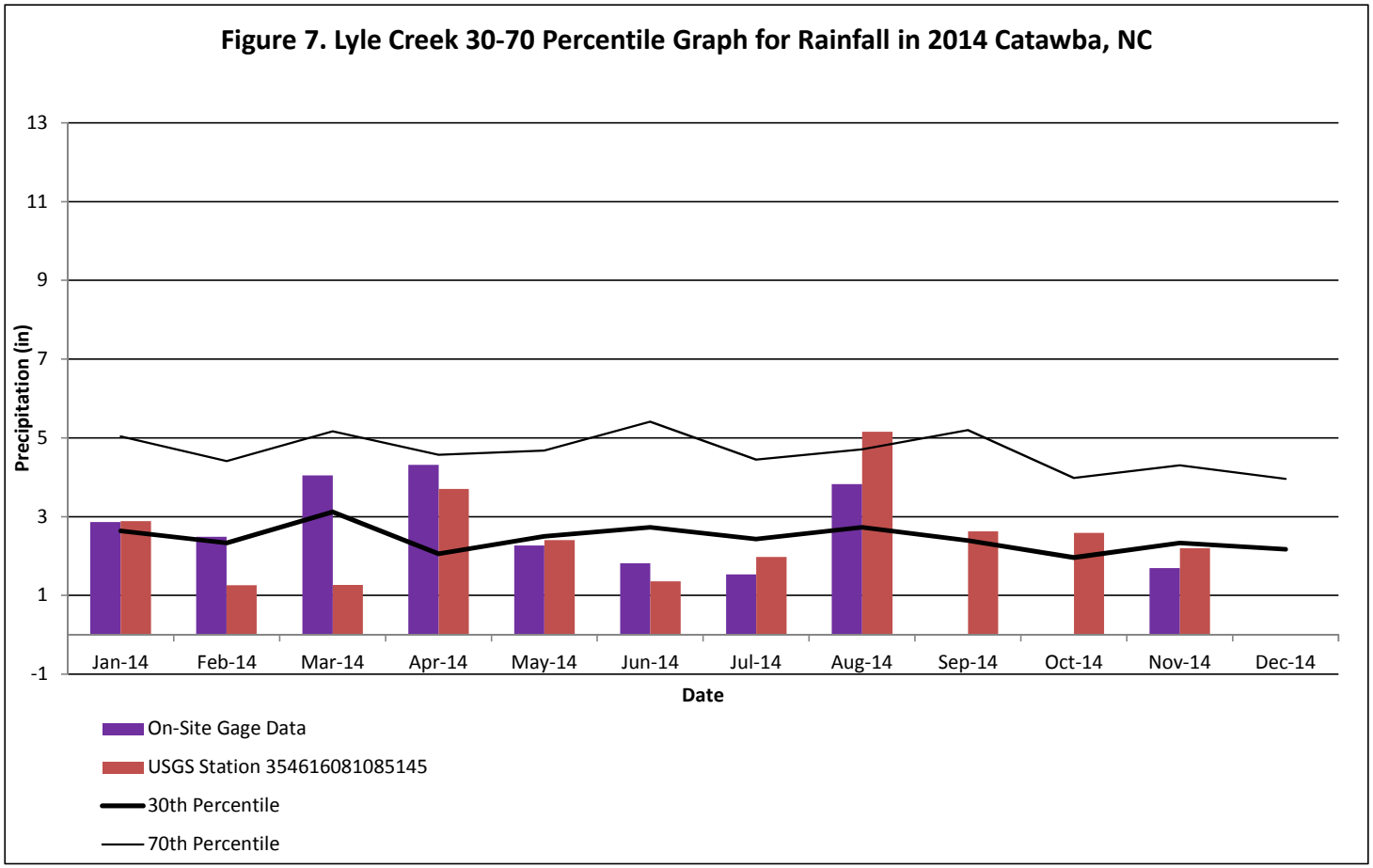
Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW2
Monitoring Year 3



Groundwater Gage Plots
Lyle Creek Mitigation Site(EEP Project No. 94643)
Wetland Number: RW1
Monitoring Year 3



Monthly Rainfall Data
Lyle Creek Mitigation Site (EEP Project No. 94643)
Monitoring Year 3



[1] 2014 rainfall collected by onsite rainfall gage and USGS station 354616081085145

[2] 30th and 70th percentile rainfall data collected from weather station Catawba 3 NNW, NC1579 (USDA, 2002)

[3] Onsite rainfall gage malfunctioned in September and October, 2014