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Use of Preservation in North Carolina Wetland and Stream Mitigation

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Review
This working paper was reviewed by multiple experts outside the Nicholas Institute for Environmental Policy Solutions. It is intended to present existing data to stimulate discussion and inform debate on emerging issues.

SUMMARY

To better protect the nation's wetlands and streams, the Clean Water Act allows use of compensatory mitigation to replace the benefits of lost wetlands and streams.

This study summarizes North Carolina's use of preservation for compensatory mitigation by private mitigation banks and a state-operated in-lieu fee (ILF) program. Within private mitigation banks, preservation activities have generated 5.6% of wetland credits and 9.1% of stream credits since 2008. Within the state in-lieu fee program run by the Division of Mitigation Services, 45.0% of wetland credits and 6.2% of stream credits have resulted from preservation. However, a majority of the wetland credits generated by preservation in the ILF program came from one site described as unusually large by program staff.

Since 2008, North Carolina's ILF program and mitigation banks have continued to use preservation at relatively low rates for both wetland and stream mitigation. Mitigation providers have stated that the clarity of the state's preservation policy makes it easier for preservation to be included in projects in North Carolina than in projects in some other states. Notably, between 2012 and 2015, no wetland preservation was used for mitigation by the ILF program.

INTRODUCTION

Wetlands and streams provide a number of valuable ecological services, including diverse habitat, water filtration, and protection from storms (Dudgeon et al. 2006; Brander, Florax, and Vermaat 2006). More than 50% of wetlands in the lower 48 states have been lost or degraded since the 1700s due to human development and agriculture, resulting in degradation of these important services (Moreno-Mateos et al. 2012; Gibbs 2000), and nearly half of the nation's streams are in poor biological condition (EPA 2016).

The U.S. Fish and Wildlife Service (FWS) periodically assesses the status and trends of the nation's wetlands, including those that are privately owned. Across the most recent study period (2004–2009), it found no statistically significant change in total wetland acreage (Dahl 2011). However, wetland loss was not consistent across wetland types. Freshwater, forested wetlands, for instance, lost 633,000 acres, while freshwater ponds increased by more than 200,000 acres (Dahl 2011, see Table 1). Changes in wetland acreage also vary across regions; FWS notes that the Southeast and the Prairie Pothole Region of the Midwest had higher rates of wetland loss over the study period (Dahl 2011).

A national goal of "no net loss" of wetland acreage was first established under George H.W. Bush in 1989. Although the most recent wetland report by the FWS indicates that the goal is nearly achieved on a national scale, specific regions and wetland categories are experiencing significant loss. There is concern that measuring acreage may be an insufficient method to ensure "no net loss" of ecological services provided by wetlands (e.g. Moreno-Mateos et al. 2012; Turner, Redmond, and Zedler 2001). This concern has led to refinements in how wetlands are assessed in mitigation programs across the country.

The U.S. Environmental Protection Agency (EPA) conducts a national rivers and stream assessment (NRSA) that provides information on the ecological condition of the nation's rivers and streams and on their key stressors. The most recent NRSA report (2008–2009) showed that nearly half of the nation's streams are in poor biological condition because of sediment loads, nutrient pollution, loss of riparian vegetation, and riparian disturbance from roads, pastures, and parking lots, among other causes. The report also showed that while biological conditions and phosphorus pollution worsened since the 2004 Wadeable Streams Assessment, riparian vegetative cover and riparian disturbance improved (EPA 2016). The assessment suggests that the effects of stream mitigation are observed in the decline in riparian disturbance.

To better protect the nation's wetlands and streams, the Clean Water Act (CWA) includes a mechanism to limit the dredging or filling of the waters of the United States. This policy includes a role for compensatory mitigation where impacts to wetlands and streams occur.

This study reviews the role of wetland and stream preservation in North Carolina as a mitigation mechanism under the CWA framework.

MITIGATION UNDER THE CLEAN WATER ACT

Section 404 of the Clean Water Act establishes a system for regulating the dredging or filling of the waters of the United States. Activities that result in these actions must obtain a 404 permit from the Army Corps of Engineers (hereafter, the Corps) (33 U.S.C. 1344). Jurisdiction and enforcement is shared between the federal and state governments. Following a determination by the Corps that a 404 permit is needed (i.e., a project impacts the waters of the United States), a state-issued 401 water quality certification is also required (33 U.S.C. 1341). A federal permit with a state certificate must be approved for a project to move forward. Together these permits ensure that activities are not degrading federal or state waters. Projects that do not require a 404 permit from the Corps (i.e., those that impact wetlands that are not considered waters of the United States) may still require a state permit according to state law.

Prior to issuing a 404 permit, the Corps may require permittees to develop a plan to describe how any unavoidable impacts to waters of the United States are to be mitigated. Permittees must "take all appropriate and practicable steps to avoid and minimize adverse impacts" and then must mitigate unavoidable impacts (33 C.F.R. 332). Permittees can mitigate these impacts by creating or establishing new aquatic resources where they did not formerly exist, by enhancing the function of existing aquatic resources, or by preserving already existing aquatic resource by reducing threats to their loss (33 C.F.R. 332).

In 2008, the Corps released updated regulations to further explain the appropriate mechanisms for compensatory mitigation (33 C.F.R. 332). To be appropriate, preservation activities must show that the aquatic resources "are under threat of destruction or adverse modifications" (33 C.F.R. 332.3(h)). Additionally, "to the extent appropriate and practicable the preservation shall be done in conjunction with aquatic resource restoration, establishment, and/or enhancement activities" (33 C.F.R. 332.3(h)).[1] Some argue that preservation of existing wetlands and streams is the least preferred method of mitigation, because it provides no direct increase in function or acreage (Owley 2015).

Three avenues are available for any compensatory mitigation: permittee-responsible mitigation, in-lieu fee (ILF) programs, and mitigation banks (33 CFR 332). ILF programs allow permittees to pay a fee based on the extent of impacts to aquatic resources. These funds are used by state agencies or non-profit organizations to provide the necessary mitigation. Mitigation banks perform advanced mitigation in exchange for "credits." These credits can be bought by permittees to meet their mitigation requirements.

[1] Full definitions of these activities can be found in the appendix in Table 2.

ASSESSING THE ROLE OF PRESERVATION IN MITIGATION

Concerns remain over the function of re-established or created wetlands (Moreno-Mateos et al. 2012; Turner, Redmond, and Zedler 2001). Moreno-Mateos et al. (2012) conducted a meta-analysis of 621 wetland sites around the world. They found that restored wetlands provided diminished ecological services compared with reference wetlands many decades after project completion across almost all biological and chemical measures for a variety of wetland types and habitats. Created wetlands have also been shown to have lower rates of carbon sequestration and denitrification (Hossler et al. 2011). Thus, achieving "no net loss" of wetland acreage through restoration may not be sufficient to maintain aquatic function.

Similar concerns are raised about the limited functions that restored stream systems can provide. Many studies find declines in sensitive insect taxa or other indications of decline in stream function (Sundermann et al. 2011). A study by Sudduth et al. (2011) suggests that one of the problems with stream restoration, in the short term, is the clearing of stream-bank vegetation, which leads to significantly higher stream temperatures. However, when assessed after 10 years, stream bank restoration projects have often generated increases in fish diversity (Simaika et al. 2015). A fundamental question for stream restoration concerns how piecemeal restoration on available or low-cost lands, which are often embedded in highly impacted environments (e.g., urban and agricultural lands), can replace the functions of a large-scale system of wetlands and streams (Sudduth et al. 2007; Bernhardt and Palmer 2011).

> Preservation means the removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.
>
> Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation.
>
> *—CFR 281 Environmental Protection Agency § 230.93*

Preservation is likely to have greater rates of success in maintaining aquatic functions and to be less expensive than restoration (Kauffman et al. 1997; NRC 1992). Before updates to mitigation rules, preservation of high-quality aquatic systems was more commonly used, but these sites were often not at risk of conversion so they were not supporting a policy of no-net loss. Under current policy, preservation can only be used in mitigation programs in which lands or waters are at risk of loss. If it is assumed that a

restored wetland or stream provides the same ecosystem function as that of an original wetland or stream, preservation of a wetland or stream at risk of loss is functionally equivalent to replacement of the lost wetland or stream by a restored mitigation site. However, if a preserved site maintains functions better than a restored site, preservation would be the better option, because restoration would result in a net loss of function. Thus the relative potential outcomes of preservation and restoration may be a useful consideration in determining whether and where preservation should be used. Other environmental markets make use of preservation as a mechanism for conservation, although the context in which it is used is a bit different. Avoided deforestation and avoided grassland conversion for lands at risk of conversion have been identified as carbon offset opportunities in carbon markets (Kindermann et al. 2008; Diaz et al. 2014), which are focused on a single service rather than a complete habitat. Habitat preservation is a common strategy in endangered species mitigation (Boisvert 2015), but the primary focus is on maintaining the species not on no net loss of habitat.

Existing Research on Compensatory Mitigation Activities

Analysis of the use of preservation in compensatory mitigation is limited. A study of wetland mitigation in northeast Florida found that preservation was the most common method of mitigation in both acreage and permit count (Goldberg and Reiss 2016). A prior assessment of the earlier state-run mitigation program in North Carolina (Ecosystem Enhancement Program) by BenDor, Sholtes, and Doyle (2009) found that restoration was by far the most common method for mitigating stream impacts, but preservation was preferred for riparian wetland impacts.

MITIGATION IN NORTH CAROLINA

This study assesses the role of preservation in compensatory mitigation for wetlands and streams in North Carolina through two primary mitigation mechanisms: mitigation banks and the Division of Mitigation Services (DMS) ILF program.

North Carolina Mitigation Law

In North Carolina, the Corps' Wilmington District determines whether a project impacts waters of the United States, and the Division of Water Resources (DWR) is the state agency responsible for issuing 401 certificates. Under state law, if mitigation for unavoidable impacts is needed, a 401 permit will only be issued upon submission of an appropriate mitigation plan (15A NCAC 02h .0506). DWR works collaboratively with the Corps and other state and federal agencies as part of the Interagency Review Team (IRT) to oversee mitigation requirements and provide guidance based on the federal mitigation rule (Hill et al. 2013; North Carolina Interagency Review Team 2013).

Rules released by the state stipulate the specific mitigation requirements to comply with the federal mitigation rule (15A NCAC 02H .0506). The required ratio of wetland credits to impacted acres is dependent on the impacted wetland's location within the watershed—from 4:1 for wetlands within 150 feet of the high water line to 1:1 for those farther than 1,000 feet from the high water line. The mitigation method also affects this ratio; a single credit is generated by one acre of restoration through re-establishment, one and a half acres of restoration through rehabilitation, two acres of enhanced wetland, three acres of created wetlands, or five acres of high-quality preservation. The preservation ratio can vary from 5:1 to 10:1, depending on the quality of the site. At a minimum, one acre of wetland must be created or restored for each acre impacted before enhancement or preservation credits can be utilized. In addition, given the state's no-net loss requirement, regulatory agencies and the DMS agreed in 2011 to apply a 10%

limit to the amount of preservation that could be included in new projects. Preservation above these limits is allowed, but it will not be credited by DMS or banks.

North Carolina also has a separate provision to manage isolated surface waters that are not covered by section 404 of the Clean Water Act (15A NCAC 02H .1301). In these cases, mitigation is required at a ratio of two credits per one acre of wetland or linear foot of impacted stream. The ratio multipliers and restrictions on preservation described above also apply to isolated surface waters (15A NCAC 02H .1305).

North Carolina law established the Division of Mitigation Services (DMS) to implement stream and wetland mitigation with the purpose of achieving "a net increase in wetland acres, functions, and values in each major river basin" (G.S. **§** 143-214.9). As of 2011, North Carolina requires the use of compensatory mitigation banks when they are available before use of the DMS ILF mitigation program (G.S. **§** 143-214.11). The North Carolina Department of Transportation has developed a separate memorandum of agreement to enable DMS to provide advanced mitigation for Department of Transportation stream and wetland impacts (NCDEQ and NCDOT 2016).

Data Analysis

Data used in this study comes from two databases: a voluntary federal database of mitigation bank activity and a state-maintained databases on the ILF mitigation program. The two databases may differ in their accuracy and completeness, but conversations with practitioners and DMS staff suggest that both provide a generally reliable representation of mitigation activity. This study summarizes the data provided by these databases. It is not a statistical analysis.

Preservation by Mitigation Banks

Data on mitigation bank sites in North Carolina was obtained from the federal Regulatory In lieu fee and Bank Information Tracking System (RIBITS) mitigation database.[2] The "Credit Tracking" report on RIBITS provides information on the number of credits generated, the type of mitigation activity performed, and the size of the project (in acres or linear feet for wetlands and streams, respectively). Although information on credit availability is not always up to date for NC projects on RIBITS, initial project approval information is generally accurate (Chad Evenhouse, RES, pers. comm., 6/8/16). Only bank sites that were labeled *approved* or *sold out* as of December 31, 2015, were included in this analysis; those labeled *pending* or *withdrawn* and those approved prior to 2008 were excluded. Mitigation activity was summarized across mitigation type and date.

Wetlands

These are the key findings for wetland preservation by mitigation banks:

- Mitigation banks have initiated 1,721 acres of wetland preservation since 2008 (appendix Table 3).
- Since 2008, 5.6% of credits generated have resulted from preservation activities corresponding to 20.9% of total wetland acreage mitigated (Figure 1).
- There is significant annual variation in credit generation and activity type (Figure 2).

[2] RIBITS was developed by the U.S. Army Corps of Engineers to provide mitigation and conservation bank program and crediting information. It can be accessed at https://ribits.usace.army.mil/. For this study, data were accessed August 2016.

- Since 2008, the number of banks that have performed wetland mitigation is 18, of which 11 have earned preservation credits (Figure 3). Of these 11 banks, 3 initiated projects in which more than 80% of the acreage was mitigated through preservation.
- Mitigation banks' preservation ratios ranged from 5:1 (5 acres preserved for each credit generated) to 7:1.

Figure 1. Wetland mitigation by activity type performed by mitigation banks since 2008

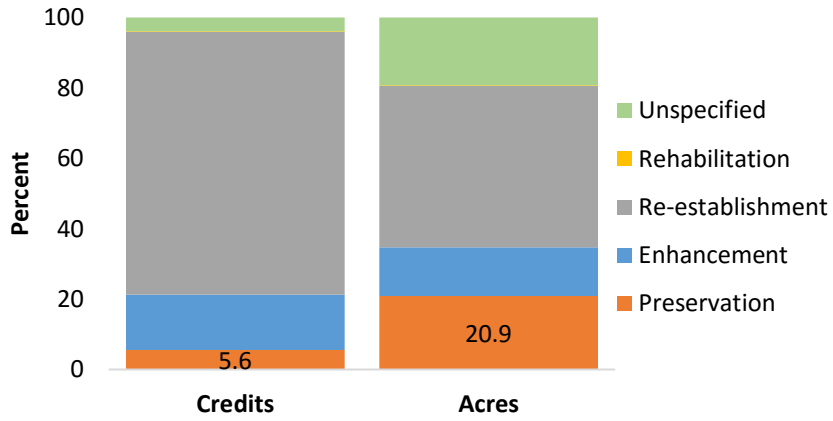
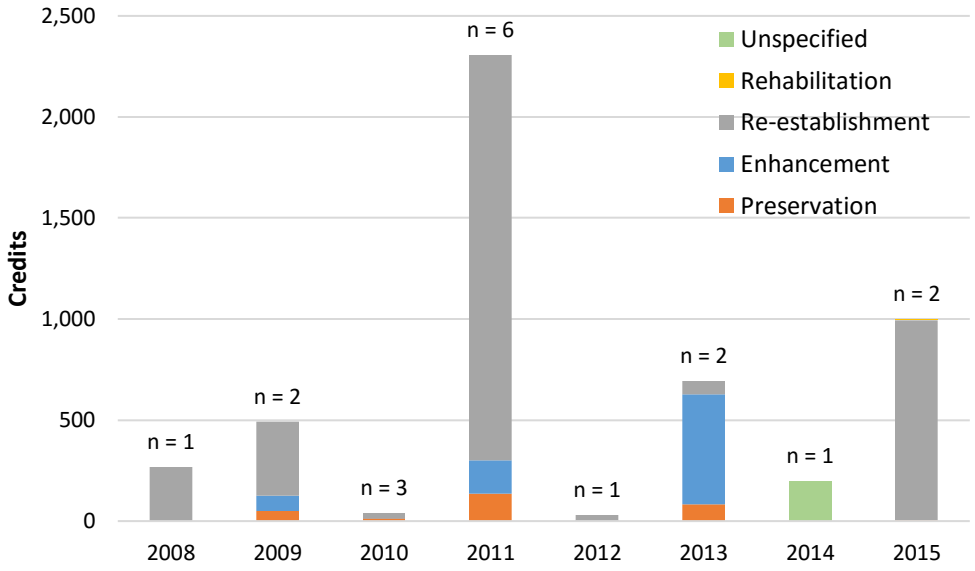
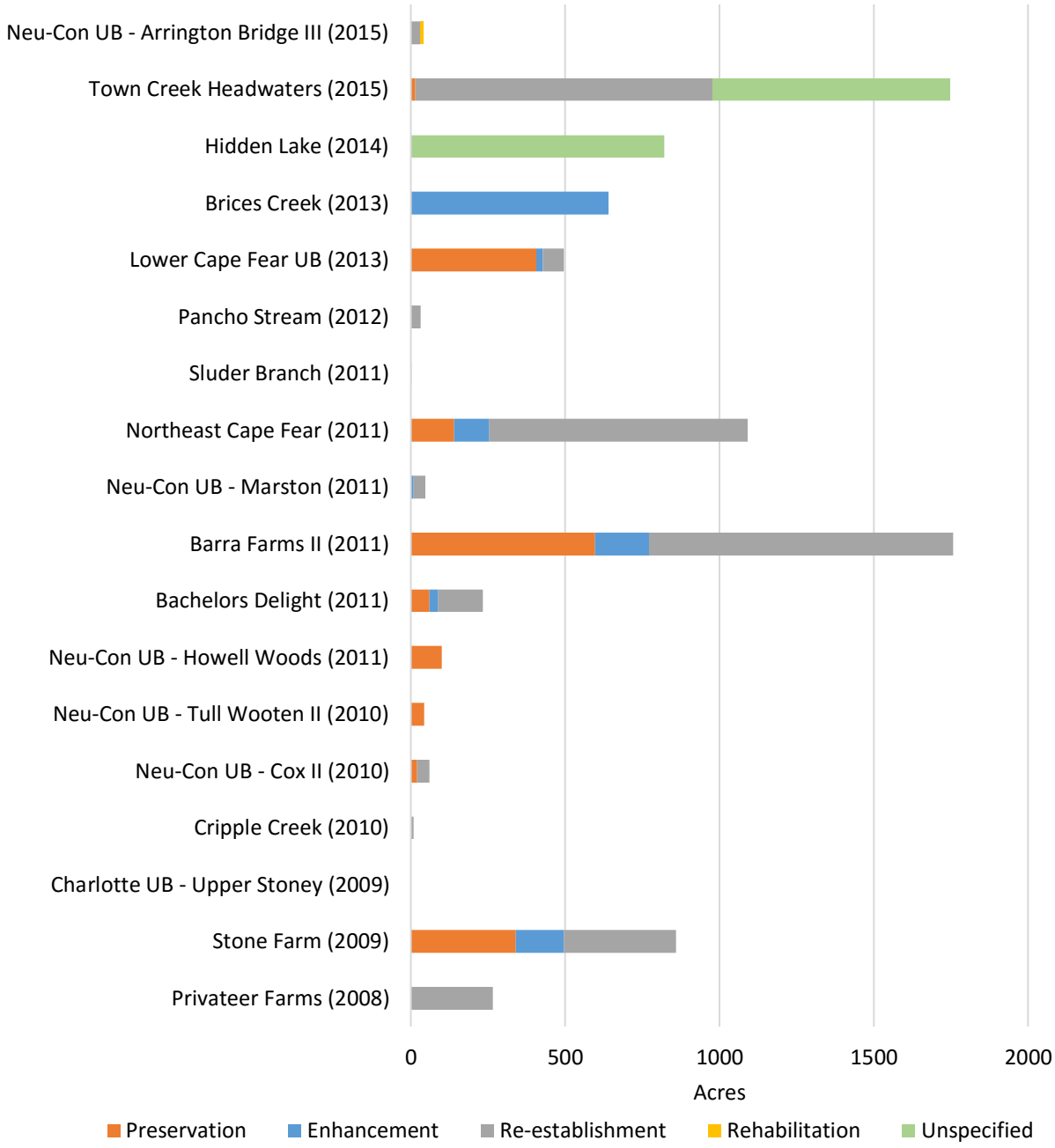


Figure 2. Annual fluctuations in wetland mitigation activity performed by mitigation banks



Note: Number of total banks initiated each year indicated by n value.

Figure 3. Types of wetland mitigation activities in individual mitigation banks



Note: Year of first credit initiation is indicated in parentehsis. Credits are initiated when mitigation plans are approved, but they are released according to a credit release schedule. "UB" = Umbrella Bank. See appendix (Table 3) for full ledger.

Streams

These are the key findings for stream preservation by mitigation banks:

- Banks have initiated 44,761 linear feet of stream preservation since 2008 (appendix Table 3).
- Since 2008, 9.1% of credits generated have resulted from preservation activities corresponding to 28.0% of total linear feet of streams mitigated (Figure 4).
- There is significant annual variation in credit generation and activity type (Figure 5).
- Since 2008, a total of 19 banks have performed stream mitigation, 6 of which have earned preservation credits (Figure 6). Of these, four banks initiated projects where over 33% of linear feet mitigated were through preservation.
- Mitigation banks' preservation ratios range from 2:5 (2.5 linear feet preserved for each credit generated) to 7:5.

Figure 4. Stream mitigation by activity type performed by mitigation banks since 2008

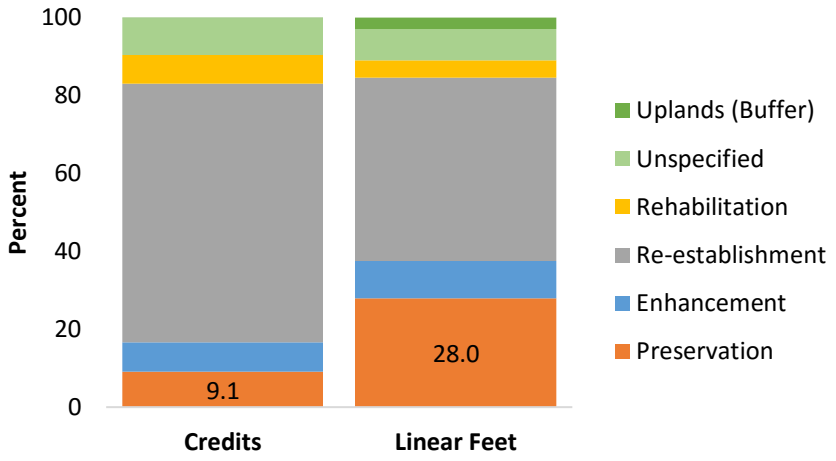
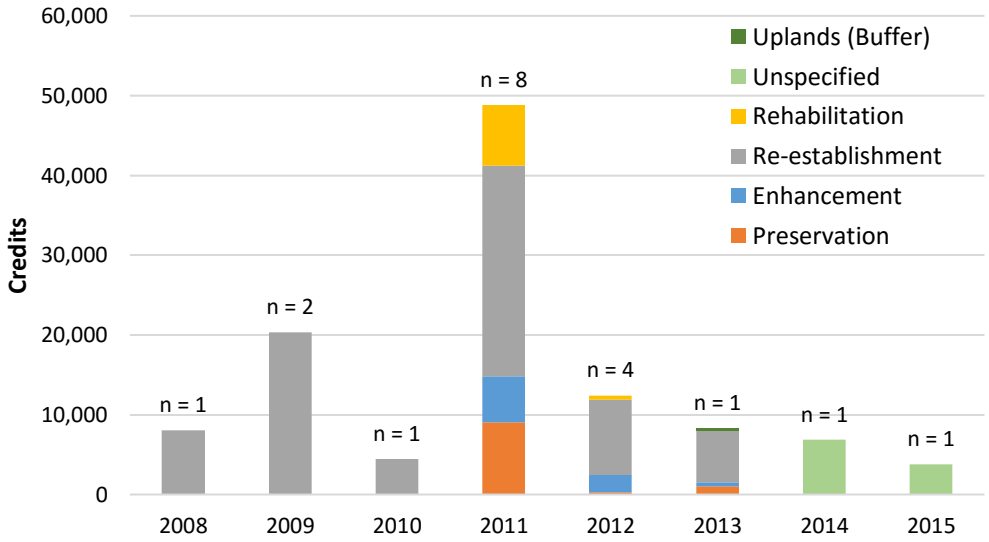
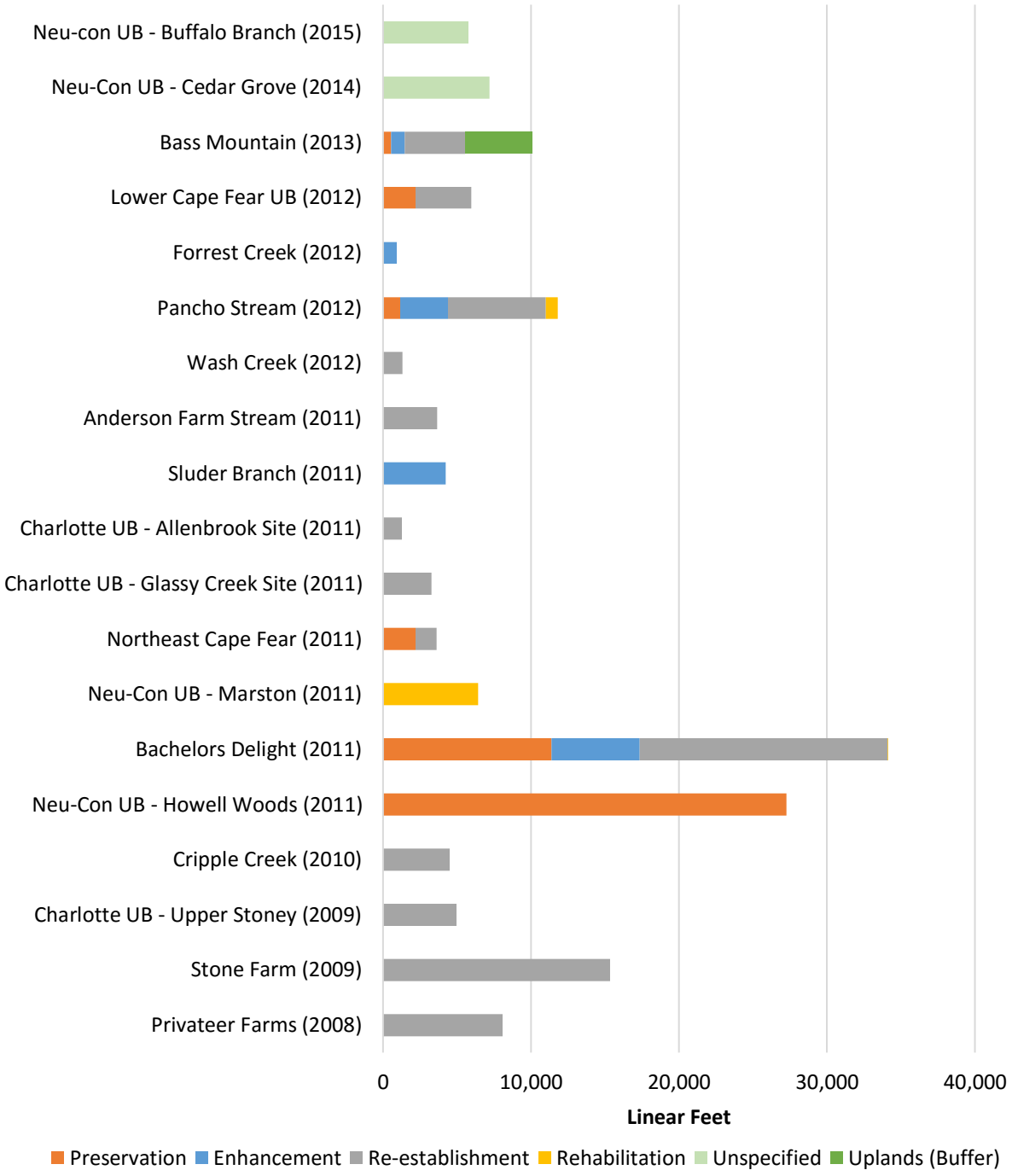


Figure 5. Annual fluctuations in stream mitigation activity performed by mitigation banks



Note: Number of total banks initiated each year indicated by n value.

Figure 6. Types of stream mitigation activity in individual mitigation banks



Note: Year of first credit initiation is indicated in parentehsis. Credits are initiated when mitigation plans are approved, but they are released according to a credit release schedule. "UB" = Umbrella Bank. See appendix (Table 3) for full ledger.

Preservation for Division of Mitigation Services

Data on mitigation performed for the North Carolina Division of Mitigation Services was obtained from DMS staff and cross checked with the online DMS project database.[3] The "Active Credit" ledger provided by DMS staff was cross checked with the online DMS data to identify project initiation dates. Dates for credit and mitigation activities were recorded on the basis of the year of the post-construction monitoring baseline document or the as-built drawings. These dates were used because several years can elapse between development of an initial mitigation plan and installation of a project. Any activities from the credit ledger without a project start date were excluded, as were any projects outside the study period (2008–2015). Because the project start date for some of the credit activities was not identifiable, this dataset should be considered a sample of all DMS activities.

All projects categorized as *coastal marsh, riparian wetland,* or *non-riparian wetland* (n=90) were included in the wetland mitigation analysis; those categorized as *cold stream, cool stream,* or *warm stream* (n=153) were included in the stream mitigation analysis. Mitigation activity was summarized across mitigation type and date. The summary of findings for both wetlands and streams is shown below.

Wetlands

These are the key findings for wetland preservation in DMS projects:

- DMS projects have resulted in 4,628 acres of wetland preservation since 2008. However, 3,781 acres came from a single project in 2008 (appendix Table 4).
- Since 2008, 45.0% of credits generated have resulted from preservation activities corresponding to 77.0% of total acreage of mitigated wetland (Figure 6). Discussions with DMS staff reveal that the large project from 2008 is unusual, and projects of its magnitude are not representative of typical DMS activity. When that project is removed from the dataset, preservation activities account for only 12.1% of credits generated and 38.0% of total acres of mitigation.
- From the DMS sample of 90 wetland sites, 31 have earned preservation credits. The one unusually large site represents more than 83% of the mitigated acreage (3,780 acres). With that site removed, 765 acres were mitigated by DMS between 2008 and 2011. Since 2011, only 81.4 acres of wetlands have been preserved through DMS projects (Appendix Table 4 and Figure 7).
- Nearly all projects used a preservation ratio of 5:1.

[3] DMS maintains a publicly available spreadsheet of mitigation projects at https://deq.nc.gov/about/divisions/mitigation-services/dms-projects. For this study, data were accessed August 2016.

Figure 6. Wetland mitigation by activity type performed by DMS since 2008

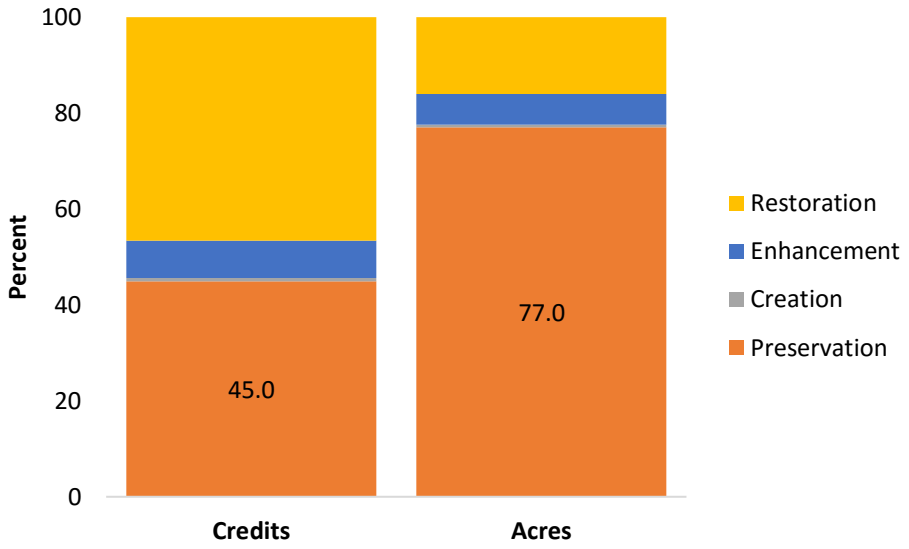
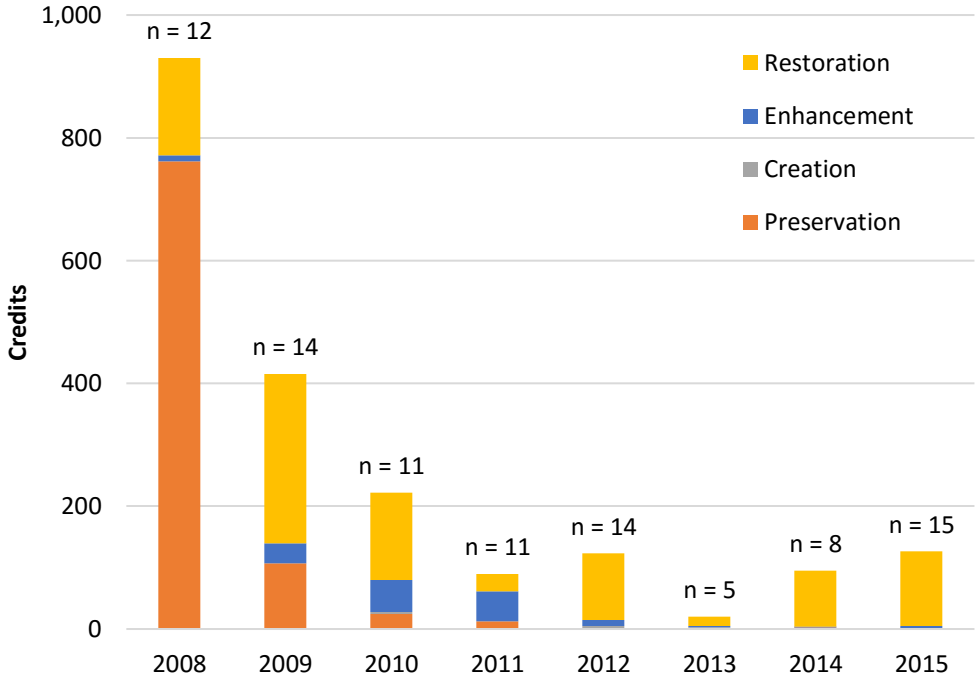


Figure 7. Annual fluctuations in wetland mitigation activity performed by DMS



Note: Number of total project sites initiated each year indicated by n value.

Streams

These are the key findings for stream preservation in DMS projects:

- DMS projects have resulted in 241,018 linear feet of stream preservation since 2008 (appendix Table 4).
- Since 2008, 6.2% of credits generated have resulted from preservation activities corresponding to 21.9% of total linear feet of mitigated stream (Figure 8).
- Of the DMS sample of 153 stream sites, 63 have earned preservation credits. The top 10 preservation sites collectively represent 52.9% of all stream preservation credits.
- The use of stream preservation has been fairly consistent over the eight-year period (Figure 9).
- Nearly all projects used a preservation ratio of 5:1.

Figure 8. Stream mitigation by activity type performed by DMS since 2008

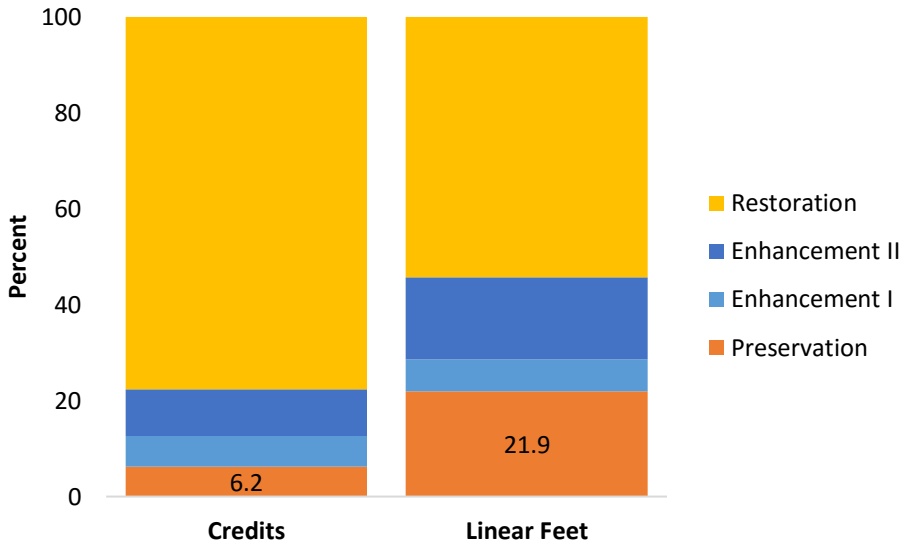
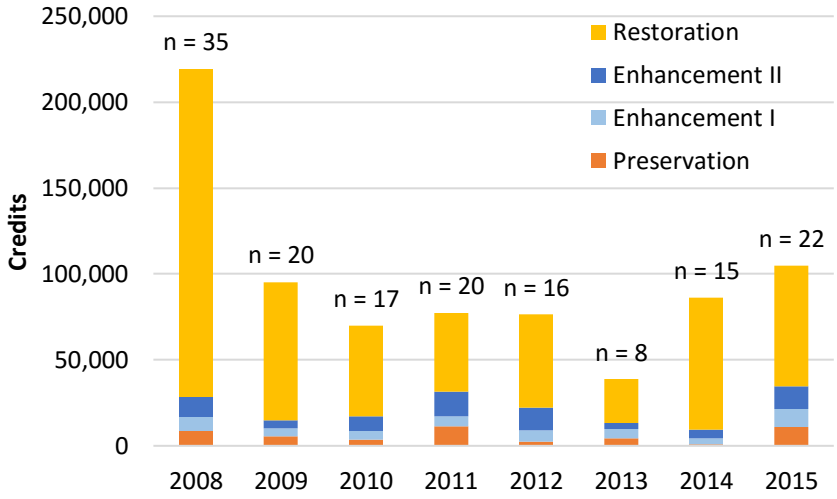


Figure 9. Annual fluctuations in stream mitigation activity performed by DMS



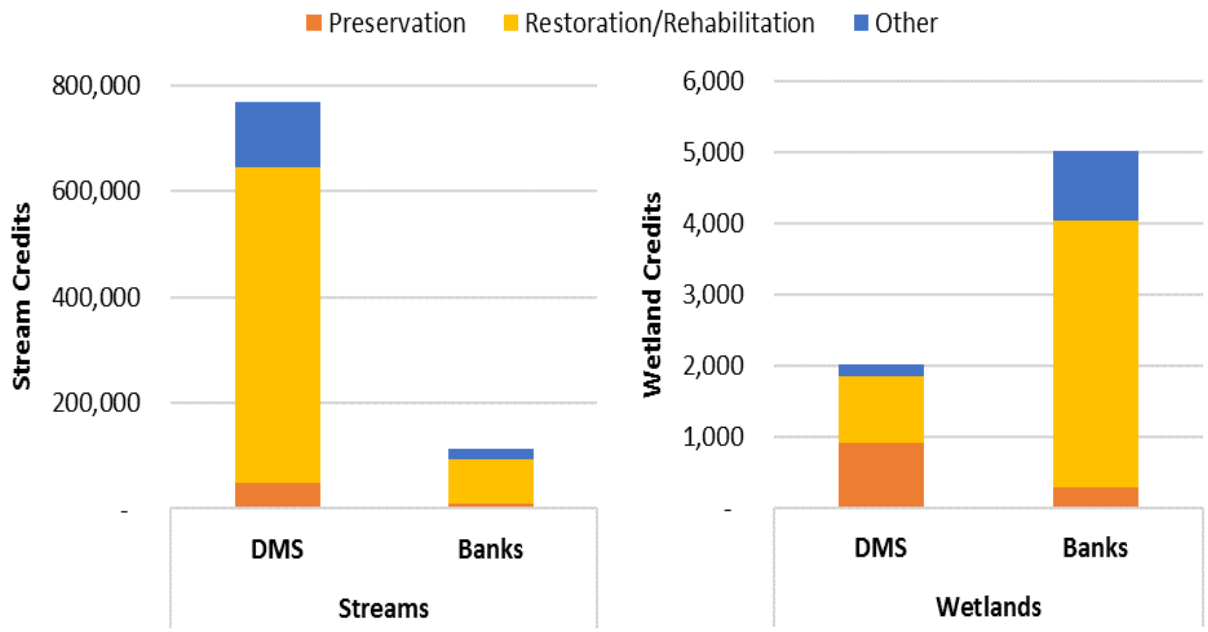
Note: Number of total project sites initiated each year indicated by n value.

DISCUSSION

Preservation activities account for at least 20% of area (acres or linear feet) mitigated by mitigation banks and state ILF projects. Between 2008 and 2015, the ILF program was responsible for most of the stream mitigation while banks generated most of the wetland credits. However, the ILF program used preservation more than banks for both wetlands and streams (Figure 10).

Even when the one unusually large wetland preservation site is removed from the ILF program data, the proportion of wetland acres mitigated through preservation remains higher for the ILF program (38% ILF versus 21% banks), but the total acres mitigated through preservation are greater for the banks (846 ILF versus 1,721 banks).

Figure 10. Comparing preservation across mitigation mechanisms



The single large DMS wetland project (Roquist site) alone is responsible for more wetland preservation than all other DMS and bank wetland projects combined. The reduction in wetland preservation after 2011 in the DMS program is striking. This reduction may be in part due to an overall shift away from wetland mitigation work by DMS (Figure 11).

Figure 11. Fluctuations in mitigation activity by DMS and mitigation banks

As noted above, the 2011 update to state law that required private developers and local governments to utilize available mitigation banks before the ILF program may be one primary driver of this shift, but the shift may also result from state agency preference. The NC IRT has an unofficial policy to prefer mitigation projects in which fewer than 10% of credits result from preservation (DMS staff, pers. comm. 8/18). Another reason could simply be that land values have been increasing and are often very high in areas needing wetland credits, making the 5:1 ratio cost prohibitive for preservation.

The data may underestimate overall preservation and restoration, especially of wetlands. DMS staff note that data from some projects may not capture a site's actual wetland preservation and restoration. One reason: mitigation providers may only seek and thus receive credit for one type of restoration or preservation, even when other types are produced. This may be especially true for stream-only projects where ancillary wetland restoration or preservation (e.g., floodplain development or connectivity) created by the project are not credited because there is no need for those credits in the service area.

CONCLUSION

In North Carolina, since 2008 both the state's ILF program and mitigation banks have continued to use preservation at relatively low rates in both wetland and stream mitigation. Mitigation providers have stated that the clarity of the state's preservation policy makes it easier for preservation to be included in projects in North Carolina than in projects in some other states. Notably, between 2012 and 2015 no wetland preservation was used for mitigation by the ILF program. This review did not examine why this may be.

APPENDIX

Table 1. Status of U.S. wetland loss (2004–2009)

	Estimated Acres, 2009	Increase (Decrease) in Acres since 2004	Percent Change
Marine Intertidal	227.8	8.5	3.9%
Estuarine Intertidal Non-vegetated	1,017.70	18.3	1.8%
Estuarine Intertidal Vegetated	4,539.70	-110.9	-2.4%
All Intertidal Wetlands	5,785.20	-84.1	-1.4%
Freshwater Ponds	6,709.30	207.2	3.2%
Freshwater Emergent	27,430.50	267.8	1.0%
Freshwater Shrub	18,511.50	180.1	1.0%
Freshwater Forested	51,623.30	-633.1	-1.2%
All Freshwater Wetlands	104,274.60	21.9	0.0%
All Wetlands	110,059.80	-62.3	-0.10%

Source: Dahl (2011).

Table 2. Definitions of mitigation activities

	North Carolina (15A NCAC 02h .0506)	**Federal Guidance** (33 C.F.R. § 332.2)
Compensatory mitigation (US)		Restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.
Restoration (NC) / Re-establishment (US)	Re-establishment of wetland hydrology and vegetation in an area where it previously existed	Manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.
Creation (NC) / Establishment (US)	Construction of a wetland in an area where wetlands did not exist in the recent past	Manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area and functions.
Enhancement	Increasing one or more of the functions of an existing wetland by manipulation of vegetation or hydrology	Manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area
Preservation	Protection of wetlands through purchase, donation or conveyance of a conservation easement to an appropriate government or non-profit agency for management	Removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Table 3. List of stream and wetland mitigation bank sites in North Carolina (2008–2015)

Bank Name	Preservation		Enhancement		Re-estab.		Other		Total stream		Preservation		Enhancement		Re-estab.		Other		Total wetland	
	LF	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*
Anderson Farm Stream					3,663	3,663			3,663	3,663										
Bachelors Delight	11,400	4,560	5,928	3,977	16,761	16,786		1,212	34,089	26,535	61	11.6	28	14	145	145			234	170.6
Barra Farms II											596	85	175	87.5	987	987			1758	1159.5
Bass Mountain	544	109	938	514	4,044	4,044	4,558	314	10,084	4,981										
Brices Creek													640	534.6					640	534.6
Charlotte UB - Allenbrook Site					1,265	1,265			1,265	1,265										
Charlotte UB - Glassy Creek Site					3,264	3,264			3,264	3,264										
Charlotte UB - Upper Stoney					4,980	4,980			4,980	4,980		0.73							0	0.73
Cripple Creek					4,487	4,487			4,487	4,487			1.9	0.95	6.9	6.9			8.8	7.85
Forrest Creek			930	930					930	930										
Hidden Lake																	821	199.4	821	199.4
Lower Cape Fear UB	2,209	883			3,775	3,949			5,984	4,832	407	81.4	20	10	68.4	68.4			495.4	159.8
Neu-Con UB - Cox II											20.5	4.1			40.5	20.8			61	24.9
Neu-Con UB - Arrington Bridge III															29.37	29.37	11.87	3.14	41.24	32.51

Bank Name	Preservation		Enhancement		Re-estab.		Other		Total stream		Preservation		Enhancement		Re-estab.		Other		Total wetland	
	LF	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*LF*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*	*Ac*	*Cr*
Neu-con UB - Buffalo Branch							5,766	3,769	5,766	3,769										
Neu-Con UB - Cedar Grove Site							7,196	6,862	7,196	6,862										
Neu-Con UB - Howell Woods	27,248	3,633							27,248	3,633	100.6	20							100.6	20
Neu-Con UB - Marston							6,416	6,416	6,416	6,416			8.6	4.3	37.7	37.7			46.3	42
Neu-Con UB - Tull Wooten II											42.5	8.5							42.5	8.5
Northeast Cape Fear	2,184	873			1,427	1,427			3,611	2,300	140	20.1	114	57	837	837			1091	914.1
Pancho Stream	1,176	235	3,221	1,288	6,596	6,596	803	535	11,796	8,654	0.5	0.1	1.5	0.75	29	29			31	29.85
Privateer Farms					8,066	8,066			8,066	8,066					266.5	266.5			266.5	266.5
Sluder Branch			4,253	1,781					4,253	1,781			0.5	0.25					0.5	0.25
Stone Farm					15,338	15,338			15,338	15,338	339	48	157	78	364	364			860	490
Town Creek Headwaters											14	2.8			963	963	771		1748	965.8
Wash Creek					1,323	1,323			1,323	1,323										
Grand Total	**44,761**	**10,293**	**15,270**	**8,490**	**74,989**	**75,188**	**24,739**	**19,108**	**159,759**	**113,079**	**1,721**	**282**	**1,147**	**787**	**3,774**	**3,755**	**1,604**	**203**	**8,246**	**5,027**

Table 4. List of DMS stream and wetland mitigation projects (2008-2015)

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
601 East Stream	215	43	412	275			3,396	3,396	4,023	3,714										
601 North II			225	150	615	246	3,169	3,169	4,009	3,565										
601 North							3,036	3,036	3,036	3,036										
601 West							4,532	4,532	4,532	4,532										
Abbey Lamm					829	332	4,400	4,400	5,229	4,732					0.40	0.20	1.00	1.00	1.40	1.20
Adkins Branch							7,533	7,453	7,533	7,453										
Agony Acres	1,807	361	353	235	1,726	690	5,309	5,309	9,195	6,596										
Armstrong Property							2,200	2,200	2,200	2,200							20.00	20.00	20.00	20.00
Badin Inn							4,174	4,174	4,174	4,174										
Bear Basin																	8.60	8.60	8.60	8.60
Bear Creek							4,061	4,061	4,061	4,061										
Beaverdam Creek							3,014	3,014	3,014	3,014										
Beaverdam Swamp					290	116	10,084	10,084	10,374	10,200					2.00	1.00	8.00	8.00	10.00	9.00
Best Site	19,807	3,961	1,303	869	812	325	5,023	5,023	26,945	10,178							5.25	5.25	5.25	5.25
Big Cedar Creek	539	108			1,171	468	11,103	11,103	12,813	11,679										
Bishop Road											564.70	96.55					51.20	44.65	615.90	141.20
Blockhouse Creek	436	87	931	621			4,798	4,798	6,165	5,506										
Bobs Creek	6,794	1,359	238	159	402	161	929	929	8,363	2,607	0.35	0.07							0.35	0.07
Bowl Basin																	11.70	11.70	11.70	11.70
Briles	508	102	1,156	771			1,394	1,394	3,058	2,266										
Brock			1,850	1,233					1,850	1,233										
Brown Marsh Swamp							5,004	5,004	5,004	5,004							5.00	5.00	5.00	5.00
Buffalo Flats													1.20	0.40			14.60	14.60	15.80	15.00
Byrd's Creek			2,182	1,455	2,050	820	3,096	3,096	7,328	5,371										
Candiff Creek	1,200	240	265	177	1,492	597	4,081	4,081	7,038	5,094										
Cane Creek	1,122	215	5,414	3,609	2,937	1,175	11,856	11,856	21,329	16,855										
Cane Creek (FD)	1,506	301			5,708	2,283	4,164	4,164	11,378	6,748										
Cat Creek			2,334	1,556	2,193	877	3,996	3,996	8,523	6,429					1.42	0.71	6.87	6.87	8.29	7.58
Cedar Creek			680	453	4,584	1,834	2,989	2,989	8,253	5,276							13.72	13.72	13.72	13.72

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
Chapel Creek					330	132	961	961	1,291	1,093										
Clarks Creek	7,844	1,569							7,844	1,569										
Cochran Branch							1,820	1,820	1,820	1,820					0.11	0.05	4.24	4.24	4.35	4.29
Coddle Creek Tributary	1,540	118	1,295	863			975	975	3,810	1,957										
Collins Site			500	333			8,551	8,551	9,051	8,884										
Columbus Swamp															2.50	1.25	33.00	33.00	35.50	34.25
Crooked Creek #2					4,429	1,772	1,718	1,718	6,147	3,490			3.90	1.30	1.00	0.50	6.70	6.70	11.60	8.50
Cutawhiskie creek	2,593	519					2,899	2,899	5,492	3,418					1.10	0.55	11.57	11.57	12.67	12.12
Davis Branch	766	153	1,229	819	396	158	2,258	2,258	4,649	3,389										
Devils Racetrack			76	51	154	62	18,484	18,268	18,714	18,380							63.30	62.10	63.30	62.10
Dog Bite Creek			1,114	743			2,574	2,574	3,688	3,317										
Duke Swamp							5,382	5,382	5,382	5,382					8.20	4.10	10.70	10.70	18.90	14.80
Dye Branch II							3,685	3,685	3,685	3,685										
East Buffalo Creek	8,475	1,695	375	250	2,080	832	509	295	11,439	3,072										
East Fork of the Pigeon River	2,075	415							2,075	415	11.69	2.33			2.26	1.13			13.95	3.46
Elk Branch			2,564	1,709			5,363	5,363	7,927	7,072										
Ellington Branch							5,062	5,062	5,062	5,062										
Farrar Dairy	1,240	248			180	72	11,561	11,561	12,981	11,881	45.93	9.18			22.12	11.06	43.80	43.80	111.85	64.04
Five Mile Branch	1,425	143			11,849	5,925			13,274	6,067	1.90	0.38					48.00	48.00	49.90	48.38
Fletcher-Meritor site							4,265	4,265	4,265	4,265							6.70	6.70	6.70	6.70
Floogie Site							10,827	10,827	10,827	10,827							25.19	25.19	25.19	25.19
Foust Creek					1,143	420	4,357	4,350	5,500	4,770							5.06	4.00	5.06	4.00
Glade Creek	784	157					2,738	2,738	3,522	2,895	0.26	0.05							0.26	0.05
Goodman Property	3,205	641					4,396	4,396	7,601	5,037										
Goose Creek							1,358	1,358	1,358	1,358										
Greenbrier Creek	4,455	891	4,461	2,974					8,916	3,865	6.93	1.38							6.93	1.38
Harrell Site							6,808	6,808	6,808	6,808							15.00	15.00	15.00	15.00
Heath Dairy Road	636	127	960	640			7,756	7,756	9,352	8,523	1.18	0.23			0.60	0.30			1.78	0.53
Helms	192	38			1,345	538			1,537	576					0.40	0.20			0.40	0.20

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
Herman Dairy Farm			330	220			4,560	4,560	4,890	4,780					2.25	1.12	8.40	8.40	10.65	9.52
Hofler Property																	23.00	23.00	23.00	23.00
Hogan Creek	5,699	1,139	1,200	1,200	346	138	2,612	2,612	9,857	5,089										
Holly Grove	2,402	480			4,830	1,932	13,298	13,298	20,530	15,710					1.08	0.54			1.08	0.54
Hopewell Stream	821	164	866	577	6,584	2,634	4,037	4,037	12,308	7,412										
Hoppers Creek - Melton Farm	1,071	214			1,257	503	2,293	2,293	4,621	3,010					0.33	0.16	1.23	1.23	1.56	1.39
Irwin Creek Whitehurst Road			980	653					980	653										
Jacksonville Country Club					376	150	3,109	3,109	3,485	3,259										
Jacobs Ladder Site			306	204	140	56	4,971	4,971	5,417	5,231										
Jacobs Landing Site					109	44	4,484	4,484	4,593	4,528										
Jarmans Oak					1,205	482	6,418	6,418	7,623	6,900					6.10	3.05	9.74	9.74	15.84	12.79
Johnson Site (Hunting Creek)					417	167	2,159	2,159	2,576	2,326										
Junes Branch							3,162	3,162	3,162	3,162										
Lewis Creek							1,750	1,750	1,750	1,750										
Little Alamance Creek			1,621	1,081	825	330	282	282	2,728	1,693										
Little Buffalo Creek	2,378	476	1,244	829	7,723	3,089	2,017	2,017	13,362	6,411										
Little Grassy Creek	13,915	2,783			8,633	2,255			22,548	5,038										
Little River	210	21			3,593	1,437			3,803	1,458	48.70	9.74			54.80	22.61			103.50	32.35
Little River Farm	2,409	482			11,029	4,412	515	515	13,953	5,408										
Little Troublesome	1,081	146					2,188	2,188	3,269	2,334	4.50	0.90			1.90	0.95			6.40	1.85
Little Troublesome Creek							4,968	4,968	4,968	4,968			4.90	1.63	3.70	2.81	8.60	8.60	17.20	13.04
Little White Oak Creek							18,290	18,290	18,290	18,290										
Logan Creek	287	57	1,038	692	341	136	3,444	3,444	5,110	4,330										
Lyle Creek					1,384	554	5,411	5,411	6,795	5,965			2.90	0.96			6.60	6.60	9.50	7.56
Martins Creek II	21,327	4,265	832	555	1,475	590	3,408	3,408	27,041	8,817					1.60	0.80	5.17	5.17	6.77	5.97
McCain Property							2,417	2,417	2,417	2,417										

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
McIntyre Creek @ Hornets Nest							5,129	5,129	5,129	5,129										
McIntyre Property															77.10	7.71	18.30	9.07	95.40	16.78
McKee Creek			1,078	719	2,988	1,195	1,505	1,505	5,571	3,419										
Meadowbranch											0.87	0.08			44.78	22.39	2.88	2.88	48.53	25.35
Meredell Farm Site	3,619	724	1,771	1,181	2,648	1,059	3,717	3,717	11,755	6,681										
Middle South Muddy Creek	9,796	1,959	172	115	24	10	1,989	1,989	11,981	4,072										
Mill Creek	14,848	2,970	1,710	1,140	4,348	1,739	983	983	21,889	6,832										
Moore Property																	44.55	44.55	44.55	44.55
Moores Fork	4,279	856	3,382	2,255	5,711	2,284	6,215	6,215	19,587	11,610										
Morgan Creek	7,491	1,498	1,797	1,198	1,629	652	7,799	7,799	18,716	11,147										
Morgan Creek (French Broad)			558	372			3,700	3,700	4,258	4,072					0.35	0.17	0.97	0.97	1.32	1.14
Morgan Creek Floodplain											5.61	1.12					14.37	14.37	19.98	15.49
Muddy Creek							2,787	2,787	2,787	2,787										
Muddy Run II Site			708	472	727	291	9,976	9,976	11,411	10,739							4.92	4.92	4.92	4.92
Muddy Run Site							6,702	6,702	6,702	6,702										
Neighbors Br./ Walton Crawley Br.	3,139	628	202	135	1,863	745	2,456	2,456	7,660	3,964	1.29	0.25			1.62	0.81	0.52	0.52	3.43	1.58
Newfound Creek			2,525	1,683	1,490	596	5,719	5,719	9,734	7,998					0.70	0.35			0.70	0.35
Newtown					100	40	5,248	5,248	5,348	5,288	0.15	0.03					3.38	3.38	3.53	3.41
Norkett Branch					2,255	902	9,196	9,196	11,451	10,098										
North Fork Mountain Creek							5,299	5,299	5,299	5,299			3.27	1.63			1.17	1.17	4.44	2.80
North Muddy Creek	3,313	663	337	225	336	134	3,974	3,974	7,960	4,996	2.50	0.50			3.70	1.85	14.00	14.00	20.20	16.35
Northgate Park			1,247	831			867	867	2,114	1,698										
Oakley Crossroads					329	132	3,789	3,789	4,118	3,921	1.13	0.22							1.13	0.22
Owls Den							2,468	2,468	2,468	2,468							9.59	8.93	9.59	8.93
Paschal GC							2,919	2,766	2,919	2,766										
Pee Dee Stream			618	412			6,092	6,092	6,710	6,504										
Perry Property							2,439	2,439	2,439	2,439	25.32	5.06			1.29	0.64	16.70	16.70	43.31	22.40

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
Pinch Gut Tributary					292	117	10,525	10,525	10,817	10,642										
Plum Creek															7.33	3.66	67.58	67.58	74.91	71.24
Poplin Ridge Site	1,192	238	3,340	2,227	951	380	3,696	3,520	9,179	6,365										
Pott Creek II Wetlands											3.38	0.67	4.57	1.52					7.95	2.19
Powell Property							3,340	3,340	3,340	3,340							48.20	48.20	48.20	48.20
Puzzle Creek			320	213			4,753	4,731	5,073	4,944										
Rockwell Pastures			1,137	758	5,304	2,122	10,851	10,851	17,292	13,731							1.70	1.70	1.70	1.70
Rocky Branch	6,000	1,200	206	137	173	69	3,761	3,761	10,140	5,168										
Roquist	1,915	383							1,915	383	3781.40	756.28					36.50	36.50	3817.9	792.78
Sandy Creek			1,850	1,233					1,850	1,233					2.20	1.10			2.20	1.10
Scaly Bark Creek	700	140			3,596	1,438	4,875	4,875	9,171	6,453										
Sink Hole Creek	1,145	229					4,574	4,574	5,719	4,803										
Sliver Moon																	14.00	14.00	14.00	14.00
Snowbird Tributaries	7,387	1,477			171	68	467	467	8,025	2,013										
South Fork Wetlands											0.12	0.02	7.21	2.40	0.55	0.27	2.73	2.73	10.61	5.42
St Clair Creek							3,274	3,274	3,274	3,274							2.80	2.80	2.80	2.80
Stanley's II																	7.60	6.94	7.60	6.94
Stanleys Slough							4,274	4,274	4,274	4,274							3.60	3.11	3.60	3.11
Stillhouse Creek			155	103			978	938	1,133	1,041										
Stricker Branch							2,889	2,889	2,889	2,889										
Summit Seep															0.18	0.09	3.91	3.91	4.09	4.00
Suther	3,583	717			3,004	1,202	608	608	7,195	2,526	1.67	0.33			4.26	2.13	7.29	7.29	13.22	9.75
Tate Farm	13,869	2,774	124	83	13,057	5,223	2,003	2,003	29,053	10,082	0.02	0.00			3.98	1.99	3.80	3.80	7.80	5.79
Thompson's Fork and Tributary	356	71	390	260			4,663	4,663	5,409	4,994										
Three Mile Creek	6,811	1,362	618	412	875	350	5,673	5,673	13,977	7,797					2.30	1.15	2.50	2.50	4.80	3.65
Timberlake							5,000	5,000	5,000	5,000										
Tributaries of Wicker Branch			640	427	1,990	723	1,390	1,390	4,020	2,540										
Twin Bays																	10.60	10.60	10.60	10.60
Underwood			1,180	787	3,292	1,317	4,661	4,661	9,133	6,764			6.91	2.30	0.34	0.17	6.59	6.59	13.84	9.06

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
Upper Silver Creek					342	137	4,843	4,843	5,185	4,980			0.99	0.33	3.27	1.63	4.88	4.88	9.14	6.84
Upper South Hominy Creek	1,093	219	522	348	2,342	937	1,994	1,994	5,951	3,497	0.24	0.04			1.11	0.55			1.35	0.59
Upper UT to Cane Creek							6,691	6,691	6,691	6,691	2.00	0.40			1.35	0.67			3.35	1.07
UT Bear Creek							4,551	4,551	4,551	4,551					0.39	0.19			0.39	0.19
UT Clarke Creek	1,051	210	2,847	1,887	308	123			4,206	2,220	0.13	0.02	0.13	0.04	0.16	0.08	1.02	1.02	1.44	1.16
UT Neuse (The Big Ditch)							2,132	2,102	2,132	2,102										
UT Rocky River - Harris Road Middle							2,615	2,615	2,615	2,615					8.20	4.10			8.20	4.10
UT to Altamahaw					1,477	739			1,477	739					0.03	0.01			0.03	0.01
UT to Bald Creek	839	168	472	315	2,635	1,054	1,401	1,401	5,347	2,937					1.23	0.61			1.23	0.61
UT to Cane Creek			433	289	2,478	991	3,314	3,314	6,225	4,594										
UT to Crab Creek	2,067	413			496	198	4,198	4,198	6,761	4,810	4.70	0.94	0.20	0.06	3.70	1.85	7.90	7.90	16.50	10.75
UT to Hauser Creek	108	22			93	37	2,350	2,350	2,551	2,409										
UT to Haw	1,465	293			2,200	880			3,665	1,173	0.05	0.01			1.75	0.87			1.80	0.88
UT to Haw					2,428	971			2,428	971	0.30	0.06			2.00	1.00			2.30	1.06
UT to Haw River	1,848	370			10,598	4,239			12,446	4,609										
UT to Jumping Run Creek			1,935	1,290			7,318	7,318	9,253	8,608					2.60	1.30	70.91	70.91	73.51	72.21
UT to Lilliput Creek	5,132	1,026					3,238	3,238	8,370	4,264	108.19	21.63			90.36	45.18	7.67	7.67	206.22	74.48
UT to Little Coharie Creek					700	280	1,590	1,590	2,290	1,870										
UT to Martins Creek			1,286	857	1,911	764	3,330	3,330	6,526	4,952					0.30	0.15			0.30	0.15
UT to Mill Swamp			600	400			3,606	3,606	4,206	4,006							4.00	4.00	4.00	4.00
UT to Millers Creek Site							2,709	2,709	2,709	2,709							8.77	8.00	8.77	8.00
UT to Sandy Creek							2,505	2,505	2,505	2,505										
UT to South Fork Creek					2,724	545	3,994	3,994	6,718	4,539					0.14	0.07	0.72	0.72	0.86	0.79
UT To The Lumber River	6,300	1,260			463	185	4,285	4,285	11,048	5,730										
UT to Uwharrie	722	144	901	601	163	65	5,945	5,945	7,731	6,755	0.93	0.18							0.93	0.18
Valleyfields Farm	9,006	1,801					9,350	9,350	18,356	11,151	1.70	0.34			3.80	1.90	3.10	3.10	8.60	5.34

Project Name	Preservation		Enhancement I		Enhancement II		Restoration		Total stream		Preservation		Creation		Enhancement		Restoration		Total wetland	
	LF	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*LF*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*	*AC*	*CR*
Watts Property							750	750	750	750							20.40	20.40	20.40	20.40
Wells Creek #2	1,180	236			1,909	764			3,089	1,000										
Wolf Pond							4,513	4,513	4,513	4,513										
Zack's Fork Ck							3,765	3,765	3,765	3,765										
GRAND TOTAL	**241,018**	**47,771**	**73,395**	**49,319**	**187,400**	**74,439**	**597,649**	**596,711**	**1,099,462**	**768,239**	**4,628**	**909**	**36**	**13**	**385**	**158**	**962**	**941**	**6,011**	**2,021**

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