Upper Neuse River Basin Association

Memorandum

To: Deborah Amaral, NC Ecosystem Enhancement Program

From: Chris Dreps, Upper Neuse River Basin Association

Copy: Little Lick Creek Local Watershed Plan Technical Team Members

Date: December 5, 2005

Re: Little Lick Creek Technical Memorandum #4—Priorities for watershed restoration in Little Lick Creek

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A central objective of the Little Lick Creek Local Watershed Plan is to identify and prioritize restoration projects throughout the 21 square-mile watershed. Toward this end, the Little Lick Creek Technical Team and Project Partners have conducted GIS analysis, fieldwork, and simple modeling to identify a host of potential restoration projects and prioritize those projects.

This draft technical memorandum presents the priority stream, buffer and wetland restoration projects and the priority stormwater retrofit recommendations in Little Lick Creek's watershed. The draft memo is divided into three sections. Section 1 describes the general approach used for prioritization, describing how need was assessed and focusing on the criteria and methodology for prioritizing watershed restoration projects. Section 2 presents the priority buffer restoration, stream repair, and stormwater retrofit projects. Section 3 presents general conclusions, placing these priority projects in the context of the Little Lick Creek watershed restoration approach. This draft memorandum builds on and supersedes *Little Lick Creek Technical Memorandum #3—Setting priorities for watershed restoration projects.*

General Prioritization Approach

Prioritizing restoration projects in Little Lick Creek was a months-long process that began in the winter of 2005 with general assessments of the 13 subwatersheds identified for monitoring and analysis. The Upper Neuse River Basin Association (UNRBA), Triangle J Council of Governments (TJCOG), and Center for Watershed Protection (CWP) worked with technical stakeholders (Little Lick Creek Technical Team) to gather geographic information systems (GIS) habitat and water quality data to assess watershed conditions. These initial findings are described in *Little Lick Creek Technical Memorandum #1: Initial watershed characterization, existing water quality data, stakeholder process, and project goals.*

Little Lick Creek Restoration Assessment

During the Spring and Summer of 2005, project partners assessed land use and water quality conditions in the 13 subwatersheds. The NC Division of Water Quality conducted subwatershed monitoring, described in Appendix 1 (Water Quality Monitoring in the Little Lick Creek Watershed, Durham County 2005). NC DWQ sampled:

- Physical and chemical parameters in subwatersheds 1-6, 7-10, and 13;
- Benthic macroinvertebrates in subwatersheds 1, 2, 5, and 9 (reference site); and
- Toxicity levels in subwatersheds 1, 2, 3, and 5.

Appendix 1 discusses the findings of the water quality and biological monitoring. Overall, the NC DWQ reports little variation among sites for most of the parameters sampled. However, there are some sites with water quality concerns. These include (from Appendix 1):

- • Dissolved oxygen results were often below the 4.0 mg/L instantaneous and 5.0 mg/L daily average concentrations at all monitoring sites. Low concentrations increased in frequency as temperature increased (see results for the second datasonde deployment).
- • Results for temperature were always lower at the reference site (subwatershed 09) than other monitoring sites.
- • The highest specific conductance (mean > 300 µS/cm) was observed in subwatershed 03 at Holder Rd. (See Specific Conductance, datasonde). This sampling location is downstream of the confluence of two tributaries. (Further investigation is warranted to determine which tributary is contributing to the high specific conductance. These tributaries became dry over the late summer, and fall of 2005 due to drought conditions.)
- • A very high result for ammonia collected during stormflow was observed in subwatershed 05 at Stallings Rd. (is this the result of fertilization from the golf course?)
- • Concentrations for TKN are significantly higher at the Stallings Rd sample site than the sampling station upstream at Mineral Springs Rd, both sites are in subwatershed 05.
- • Nitrite and nitrate concentrations are the greatest in subwatersheds 01, 02, 03, 04, and 05. These are the subwatersheds with the greatest percentage of impervious surface, although it is not know whether impervious surface is a factor explaining the higher concentrations.
- • The lowest phosphorus concentrations where observed in subwatershed 09 (Santee Rd – the reference watershed.) Low concentrations were also observed in subwatershed 10 (Rogers Rd.)
- • Residues (fixed, suspended and volatile), turbidity and concentrations of aluminum and iron were the greatest in subwatershed 08 (Fletchers Chapel Rd.) This may be the result of a sediment and erosion control issue with Cardinal Lake. Additional sampling may show results similar to those observed in other subwatersheds.

The Triangle J Council of Governments assessed current and future ("build-out") land use conditions by subwatershed (described in LLC Technical Memorandum #1). The

Little Lick Creek project partners and Technical Team used the GIS analysis and initial monitoring in characterizing Little Lick Creek's 13 subwatersheds, which guided project partners in selecting areas of focus for restoration fieldwork (Appendix 3 provides 13 summary spreadsheets). Table 1 summarizes the general land use, using levels of impervious cover, from Technical Memorandum #1.

Sub-watershed	Acres	Sq. Miles	Current Impervious Cover (%)	Future (Buildout) Impervious Cover (%)
1	1,323	2.1	20	38
2	920	1.4	15	35
3	910	1.4	11	31
4	1,158	1.8	18	30
5	999	1.6	22	28
6	1,168	1.8	16	24
7	967	1.5	6	29
8	868	1.4	7	27
9	1,172	1.8	4	16
10	733	1.1	5	17
11	926	1.4	5	9
12	960	1.5	1	6
13	1,230	1.9	2	7
LLC Total	13,332	20.8	11	23

Table 1: Little Lick Creek current and expected future impervious cover

Based on findings from these assessments, project partners and technical team members decided to concentrate limited resources and staff time conducting fieldwork in subwatersheds 1 through 8 and a few other locations of apparent human impact in subwatersheds 9-13, particularly the main stem in subwatershed 13. The following sections describe the steps from conducting fieldwork to assessing and prioritizing restoration projects in Little Lick Creek.

Little Lick Creek Restoration Fieldwork

The first step in the Little Lick Creek restoration prioritization process was to conduct fieldwork investigations to identify the most promising restoration projects watershed-wide. Center for Watershed Protection staff guided staff from the City of Durham Stormwater Services, Durham City-County Planning, Durham County Engineering, NC Division of Water Quality, and the Upper Neuse River Basin Association to conduct two stages of fieldwork:

January 2005—Unified Stream Assessment (USA) to assess general stream corridor conditions and identify major impacts to water quality and aquatic habitat; and

March 2005—Upland Subwatershed and Site Reconnaissance (USSR) to identify "hot spots" of pollution and identify promising opportunities for stormwater retrofit projects to remedy existing stormwater problems.

During USA fieldwork, project partners walked and assessed over 30 stream miles (41%) of Little Lick Creek and tributaries, focusing primarily on impacted reaches in the urbanized, upstream subwatersheds (1-8). Table 2 shows the general channel conditions by subwatershed.

Sub-watershed	Stream Length Assessed (feet)	Percent of Total Length Assessed	Range of Reach Scores (0-160 possible)	Average Reach Score	Reach Conditions
1	19,694	52%	69-109	88	Poor
2	17,697	97%	31-129	98	Poor
3	11,649	43%	67-109	93	Poor
4	17,816	49%	61-125	90	Poor
5	21,294	83%	38-137	83	Poor
6	16,842	55%	83-109	95	Poor
7	9,006	32%	103-127	115	Fair
8	25,165	88%	86-148	115	Fair
9	894	2%	134	134	Good
10	9,819	55%	62-158	109	Fair
11	1,993	6%	100	100	Poor
12	3,641	15%	92-141	122	Good
13	4,142	10%	90-111	62	Poor
LLC Total	159,652	41%	31-158	96	Poor

Table 2: Little Lick Creek stream reach conditions by subwatershed

In assessing the findings from Table 2, it is important to understand that the focus of the fieldwork was to encounter restoration opportunities; therefore, the fieldwork results are inherently biased toward reaches in poor condition. However, the high percentages of total stream length assessed in many of the subwatersheds provides confidence of the poor conditions in the upper watershed.

In summary, the GIS analysis and USA fieldwork identified:

- 25 potential stream repair projects
- 23 riparian buffer restoration projects
- One potential wetland restoration project
- 52 inspection and enforcement action recommendations
- 444 sand filter-type onsite wastewater treatment systems (only a portion were field-verified)
- 10 needed homeowner education interventions
- 47 instances where maintenance is required
- 20 problem trash sites
- Over 20 potential stormwater retrofit projects

Appendix 4 is a technical memorandum from the Center for Watershed Protection describing, in detail, the USA processes and findings.

During USSR fieldwork, project partners conducted a windshield tour of the watershed to identify potential stormwater retrofits and pollution "hot spots" such as problem dumpsters, gas stations, outdoor storage areas, vehicle operations, restaurants, and other potentially polluting sites. The GIS analysis and USSR fieldwork identified:

- Over 60 potential stormwater retrofit projects that would treat over 530 acres of runoff
- 38 potential pollution hotspots
- Several enforcement action recommendations
- Multiple problem erosion and sediment control sites
- 6 potential land preservation sites

Appendix 5 is a technical memorandum from the Center for Watershed Protection describing, in detail, the USSR processes and findings.

Project Prioritization Criteria

Once projects identified during fieldwork were completed, the Center for Watershed Protection (CWP) presented findings to the Little Lick Creek Technical Team, and project partners and Technical Team members identified criteria to guide the project prioritization process.

The Little Lick Creek Local Watershed Plan will prioritize the potential stream restoration, buffer restoration, and stormwater retrofit projects. Only one potential wetland restoration project was identified; therefore, the plan will not include a wetland prioritization process. The CWP presented the homeowner education, inspection and enforcement, maintenance, pollution hotspots, land protection, land protection, trash cleanup, and monitoring opportunities to the local government project partners. All types of projects found during fieldwork will be included as part of the Little Lick Creek Local Watershed Plan's comprehensive watershed management recommendations. Appendices 4 and 5, the CWP's USA and USSR memoranda, specify all the projects identified during fieldwork.

The Project Partners and Technical Team selected project prioritization criteria based upon the project goals, originally identified in Technical Memorandum #1. These are listed below.

1. Improve hydrology of the Little Lick Creek Watershed
2. Restore and protect aquatic and riparian habitat
3. Improve water quality
4. Protect water quality and habitat in Falls Lake
5. Improve natural conditions for people living in the watershed
6. Foster community stewardship of the watershed

To best achieve these goals, the Project Partners and Technical Team selected three general categories of prioritization criteria: environmental benefits, community support, and project feasibility criteria. The watershed management goals address environmental benefits and community support. Environmental benefits include such factors as water quality benefits, channel protection, or habitat benefits. These are the direct benefits that might improve the overall functioning of the watershed.

Community support criteria measure whether a project or group of projects can be built or maintained by volunteers, will align with community goals, or will provide good educational opportunities for nearby schools and the general public.

The Technical Team agreed that projects should also be rated based on their implementation feasibility. Feasibility considerations include construction cost, number of stakeholders, ease of access, ease of maintenance, or utility conflicts. Although the goals of this project do not directly address feasibility, these considerations are crucial in determining whether a project can be undertaken.

The Project Partners and Technical Team selected stream and buffer restoration and stormwater best management practice retrofit criteria during the summer and fall of 2005. The Technical Team offered general guidance to the UNRBA and CWP about the relative priority level of each criterion (low, medium, or high), the UNRBA and CWP agreed upon criteria weightings, and the Technical Team reviewed these through e-mail and at a subsequent meeting.

Stream Repair and Buffer Restoration Criteria

The Little Lick Creek Technical Team agreed upon general criteria for use in prioritizing the environmental benefits, potential for community support, and the feasibility of 24 potential stream repair and 25 potential buffer restoration projects in the Little Lick Creek watershed. The majority of the projects were located in subwatersheds 1-5, the upper, more urbanized portion of the watershed. Subwatersheds 1-5 account for 17 (71%) of the potential stream restoration projects and 18 (78%) of the potential buffer restoration projects.

Tables 3-5 show the stream and buffer restoration criteria.

Environmental Benefits	
1) Aquatic and Riparian Habitat and Water Quality (The project's potential to restore aquatic and riparian habitat and water quality)	***Points***
The practice will restore significant lengths of stream or buffer (over 500')	1
The practice will reconnect existing forest/buffer/quality areas (based on reach buffer & floodplain connections information from USA field sheets)	2
The practice will address a significant impact to water quality or habitat (for example, a severe erosion problem or non-forested riparian area)	2
2) Falls Lake (The project has the potential to reduce nutrients or other pollutants of concern for the downstream Falls Lake Reservoir)	***Points***
• The practice removes significant amounts of nutrients or other pollutants	2

Table 3: Environmental benefits criteria for stream and buffer restoration prioritization

The highest potential environmental benefits score that a project can receive is 7, or 41% of the total possible points.

Community Benefits or Support	
1) Aesthetics (the practice improves aesthetics)	***Points***
• The project has a potential to improve aesthetics in a public area	2
• The project has a potential to improve aesthetics on private land	1
• The project has a potential to be regarded as aesthetically unpleasing	Zero
2) Stewardship (The project fosters long-term public involvement, educates citizens, or involves people in its implementation)	***Points***
The project fosters long-term public involvement (eg, monitoring or watchdog efforts)	1
The project educates (is visible)	1

Table 4: Community benefits criteria for stream and buffer restoration prioritization

The highest potential community support criteria score is 4, or 24% of the total possible project score.

Implementation Feasibility	
1) Cost per linear foot of restoration	***Points***
• Low cost per foot	2
• Moderate cost per foot	1
• High cost per foot	Zero
2) Access (How feasible is the project in the proposed location? Is there access?)	***Points***
• Good location and access	2
• Good location or good access, but not both	1
• Poor location and access	Zero
3) Ownership (Is the land publicly owned? Has the landowner shown interest?)	***Points***
• Publicly owned land or privately-owned land with interested landowner	Flag
• Privately owned land, landowner's interest unknown	Zero
4) Maintenance burden (Are there significant maintenance costs?)	***Points***
• Maintenance burden is light or can part of a regular landscaping maintenance	1 to 2
• Maintenance cost or frequency is relatively high	Zero
5) Long-term physical viability of project (Is the upstream catchment going to stress the project over the long-term?)	***Points***
• Catchment is built-out or unbuilt-upon with little likelihood of development	Flag
• The catchment has the potential for future growth	Zero
6) Implementing agency (does the project meet NC EEP or some other minimum criteria that make implementation more likely?)	***Points***
• The project meets meets NC EEP min. length requirements for stream (1500 feet) or buffer (1000 feet) restoration and stands a chance for implementation	Flag
• The project does not meet NC EEP criteria; however, it meets other applicable criteria (such as NC Coop. Ext., NC DWQ 319 program, or Durham City/County criteria)	Flag
• The project does not meet any project partner criteria	Zero

Table 5: Implementation feasibility criteria for stream and buffer restoration prioritization

The highest potential implementation feasibility criteria score is 6, or 35% of the total possible project score. In addition, there are several "make or break" implementation feasibility criteria that the Little Lick Creek Technical Team agreed might be critical to the implementation of a project. Such criteria cannot be adequately measured based on score; therefore, these are given "flags" that are shown in the final project scoring spreadsheets (Tables 9-11) and shown on accompanying maps (Figures 1-3). The flagged criteria include:

- Projects on publicly-owned land or where owners are actively interested in partnering;
- Projects where the upstream land is built-out or protected and therefore expected to be stable; and
- Projects that meet NC EEP or other potential funding agency's minimum criteria.

Stormwater Retrofit Criteria

The Project Partners and Technical Team selected stormwater retrofit prioritization criteria following a process identical to that used for restoration project prioritization. Tables 6-8 show the stormwater retrofit criteria.

Environmental Benefits	
1) Hydrology (The project's potential to use infiltration and channel protection to reduce erosive velocities--function of the total area treated)	***Points***
• Significant channel protection and recharge (over 5 acres)	5
• Some infiltration and channel protection (1-5 acres)	3
• Little or no infiltration (volume control on less than 1 acre)	1
2) Aquatic and Riparian Habitat (The project's potential to restore aquatic and riparian habitat)	***Points***
• Would add significant natural areas (forest or wetlands) to the watershed	4 to 5
• Would add some natural areas (forest or wetlands) to the watershed	1 to 3
• Would not add natural areas (forest or wetlands) to the watershed	Zero
3) Water Quality (The project's ability to treat water quality)	***Points***
• The practice removes significant nutrients or sediment (or treats a hot spot)	4
• Partially treats or improves the water quality volume	2 to 3

Table 6: Environmental benefits criteria for stormwater retrofit prioritization

The highest potential stormwater retrofit environmental criteria score is 14, or 58% of the total possible project score.

Community Benefits or Support	
1) Aesthetics (improves aesthetics)	***Points***
• The project has a potential to improve aesthetics in a public area	2
• The project has a potential to improve aesthetics on private land	1
• The project has a potential to be regarded as aesthetically unpleasing	Zero
2) Stewardship (The project fosters long-term public involvement and/or has the potential to educate citizens	***Points***
The project fosters long-term public involvement (eg, monitoring, maintenance, or watchdog efforts)	1
The project educates (is visible)	1

Table 7: Community benefits criteria for stormwater retrofit prioritization

The highest potential stormwater retrofit community support criteria score is 4, or 17% of the total possible project score.

Implementation Feasibility	
1) Cost per Impervious Area treated	***Points***
• Low cost per acre treated	2
• Moderate cost per acre treated	1
• High cost per acre treated	Zero
2) Access (How feasible is the project in the proposed location? Is there good access?)	***Points***
• Good location and access	2
• Good location or good access, but not both	1
• Poor location and access	Zero
3) Ownership (Is the land publicly owned? Has the landowner shown interest?)	***Points***
• Publicly owned land	Flag
• Privately owned land with interested landowner	Flag
• Privately owned land, landowner's interest unknown	Zero
4) Maintenance burden (Are there significant maintenance costs associated with the project?)	***Points***
• Maintenance burden is light or can part of a regular landscaping maintenance	2
• Maintenance cost or frequency is moderate	1
• Maintenance cost or frequency is relatively high	Zero
6) Implementing agency (does the project meet NC EEP or some other minimum criteria that make implementation more likely?)	***Points***
• The project meets meets NC EEP criteria and therefore stands a good chance for implementation	Flag
• The project does not meet NC EEP criteria; however, it meets some other criteria (such as NC Coop. Ext., NC DWQ 319 program, or Durham City/County criteria)	Flag
• The project does not meet any project partner criteria	Zero

Table 8: Implementation feasibility criteria for stormwater retrofit prioritization

The highest potential stormwater retrofit implementation feasibility criteria score is 6, or 25% of the total possible project score.

The UNRBA conducted three separate runs of the 1) stream and buffer and 2) stormwater retrofit spreadsheet analyses to calibrate the results based on Technical Team guidance. The potential stream and buffer restoration and stormwater retrofit projects received cumulative scores and were categorized as high, higher, and highest priority projects. The following section discusses the results.

Results: Watershed Restoration Priorities

The analysis identifies and prioritizes 118 potential projects. Among those are 16 high or highest priority buffer restoration, 7 high or highest priority stream repair, and 51 high or highest priority stormwater retrofit project opportunities. Figures 1-3 and Tables 7-9 detail the potential buffer restoration, stream repair, and stormwater retrofit priority scores by individual criteria.

Buffer Restoration Priorities

This section describes the 24 priority buffer restoration priorities identified in Little Lick Creek. Since these projects were identified during fieldwork by project partners using Center for Watershed Protection methodologies, they are all considered feasible, priority projects. Figure 1 and Table 9 further divide these projects into priority (yellow), high priority (orange), and highest priority (red) projects.

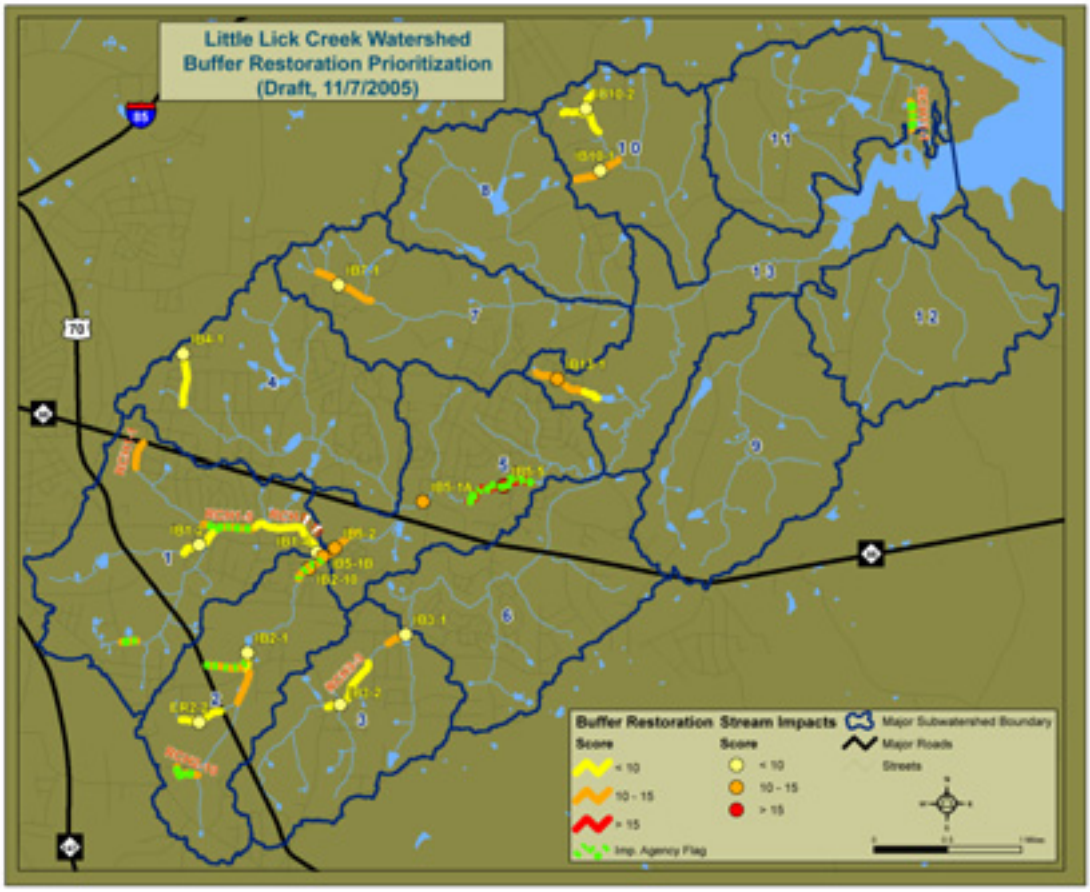


Figure 1: Buffer Restoration Priorities in Little Lick Creek

Table 9: Buffer Restoration Priorities in Little Lick Creek

Reach ID	Site ID	Description (including constraints)	Estimated Stream Length (feet)	Environmental Benefits Score (of 7 pts.)	Community Support Score (of 4 pts.)	Feasibility Score (of 6 pts.)	Cumulative Score (of 17 pts.)	Flags*
RCH1-1		25' to 50' buffer entire length of reach. Invasive species (kudzu) removal. Stream paralleled by sewer ROW. Mainly residential area.	1,000	7	1	6	14	
RCH1-13	IB1-2	Reforestation needed on right bank. Constrained by residential backyards.	540	3	1	4	8	
RCH1-15	IB1-4	Buffer through mobile home park (could combine w/ IB 2-10 & IB5-1B)	700	4	1	4	9	O
RCH1-5		Buffer needed entire length of left bank; constrained by homeowner fences and sheds.	1,900	5	2	4	11	EEP
RCH1-7		Entire reach has no buffer on either side. Left bank restricted by sewer. Portions of right bank restricted by proximity of houses.	560	5	1	4	10	
RCH2-1	IB2-1	300 ft possible restoration but homes 25 ft from stream; results in low restoration potential; homeowner education on invasive stilt grass.	300	3	1	4	8	
RCH2-10		Backyards mowed to stream; homeowner education and reforestation.	400	3	2	6	11	
RCH2-14	IB2-10	Mobile home community with no buffer and moderately highly maintained landscaping -- one landowner work with them to maintain buffer (could combine w/ IB 1-4 & IB5-1B)	1,370	5	1	5	11	EEP
RCH2-2		Possible 50 ft buffer; old agriculture property mowed to the stream edge; adjacent to a soon to be developed parcel	1,030	6	1	6	13	EEP
RCH2-3		150 ft of inadequate buffer due to homeowner mowing	150	4	1	6	11	
RCH2-6	ER2-2	Eroded, actively downcutting banks due to change in land use; parcel that has been cleared with less than 10 ft buffer. Find out if slated for development and have slopes protected and replanted.	650	4	1	4	9	
RCH3-1	IB3-1	Approximately 300' on the left bank and 350' on the right bank is restorable. 10-15' width buffer can likely be restored on left bank; 25-50' on right bank. Houses and agricultural land uses.	300-350	3	2	5	10	
RCH3-3	IB3-2	Small buffer (10'-25) existing on 1 residential buffer. Potential for bigger buffer. Stream is incised at this location (potential to combine buffer restoration on 2 tributaries)	770-1,100	2	1	4	7	

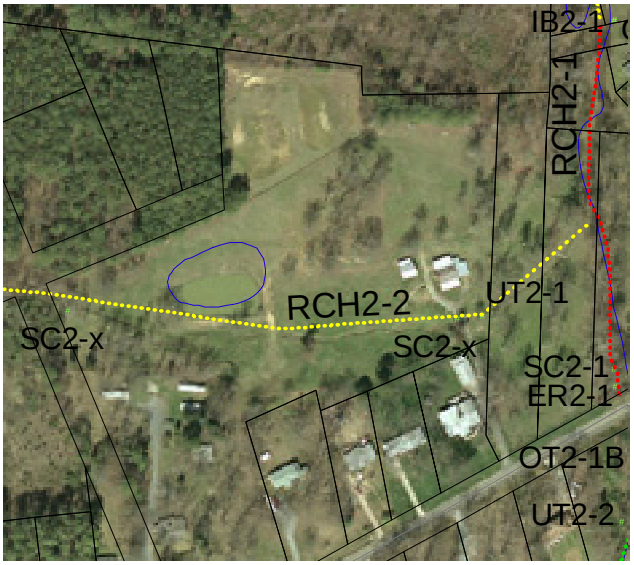
Reach ID	Site ID	Description (including constraints)	Estimated Stream Length (feet)	Environmental Benefits Score (of 7 pts.)	Community Support Score (of 4 pts.)	Feasibility Score (of 6 pts.)	Cumulative Score (of 17 pts.)	Flags*
RCH4-3	IB4-1	Unbuffered segment upstream of Mansfield Rd (mowed to edge of stream on church property); noticeable aquatic vegetation; consider riparian buffer planting (nearby homeowner or church).	**270**	**3**	**2**	**4**	**9**	
RCH5-10B	IB5-5	+/- 1400 LF of buffer enhancement possible. Unstable banks make project more challenging, but can use a combination of trees and shrubs. Plan with golf course architect to avoid tree/play conflicts. (Could combine w/ ER 5-7, ER 5-9)	**1,400**	**6**	**4**	**7**	**17**	**O, EEP**
RCH 5-1	IB5-1A	Potential reforestation along left bank of main stem. May meet EEP criteria, esp. if combined w/ extra 450' buffer need across meadow.	**900-1,350**	**6**	**2**	**5**	**13**	**EEP**
RCH5-3	IB5-1B	Potential reforestation in ROW, constrained by gas easement (*could be combined w/ IB 1-4 and IB 2-10)	**200?**	**4**	**2**	**6**	**12**	**O, EEP**
RCH5-3	IB5-2	Buffer enhancement (but note location of sanitary). Some existing buffer reforestation.	**150**	**4**	**2**	**6**	**12**	**O**
RCH7-1	IB7-1	Encroachment by new residential subdivision from both clearing and moving of fill resulting in small erosion channels. This buffer should be reestablished with new planting and future grading should be watched more closely to avoid similar impacts.	**200**	**4**	**2**	**4**	**10**	
RCH10-3	IB10-1	Reforestation on homeowner property (could combine w/ER 10-3, a stream repair project)	**150**	**3**	**2**	**5**	**10**	
RCH10-4B	IB10-2	Inadequate buffer. Reforestation.	**330**	**2**	**2**	**4**	**8**	
RCH11-1		Not written in a form; most of reach is in power easement.	**750**	**5**	**2**	**3**	**10**	**O**
RCH13-1	IB13-1	Construction and fill material adjacent to stream; reforestation needed.	**200**	**5**	**2**	**4**	**11**	
RCH13-2		Homes and trucking business mowed up to 10 ft from stream edge; beaver may be reforestation barrier	**450**	**3**	**2**	**3**	**8**	

* Flags: O=public ownership or willing landowner; EEP=project meets EEP minimum length criteria.

Table 9 (continued): Buffer Restoration Priorities in Little Lick Creek

The following are example high-priority buffer restoration opportunities.

Reach 2-2



Reach 2-2 is a headwaters tributary of Little Lick Creek located in subwatershed 2. The reach starts just to the east of I-70 and parallels Pleasant Dr. The proposed project would restore buffer along both sides of approximately 1000 feet of stream. The reach scored 13 of 17 possible points in the prioritization process, and the project meets EEP minimum length criteria.

The land is privately-owned pasture behind a handful of residences. There is one owner, who expressed interest at the time of the field visit. Constraints include a stream crossing (SC 2-X) between the owner's home and a large storage shed. The properties upstream and north of the reach are being developed. The reach has several impacts, including a trash dump, on the upstream and south side property.

Reach 2-14, Impacted Buffer 2-10

IB 2-10 would add buffer to more than 1,000 feet of stream along Reach 2-14 in a mobile home park in subwatershed 2. The project is one of the most highly scoring buffer restoration opportunities and appears to meet NC EEP minimum length criteria on a low-order stream.

This project could be combined with IB 1-4 and IB5-1 to creatle a larger collection of buffer restoration projects. The project could also be combined with a large -scale stormwater retrofit project, SR2-1.

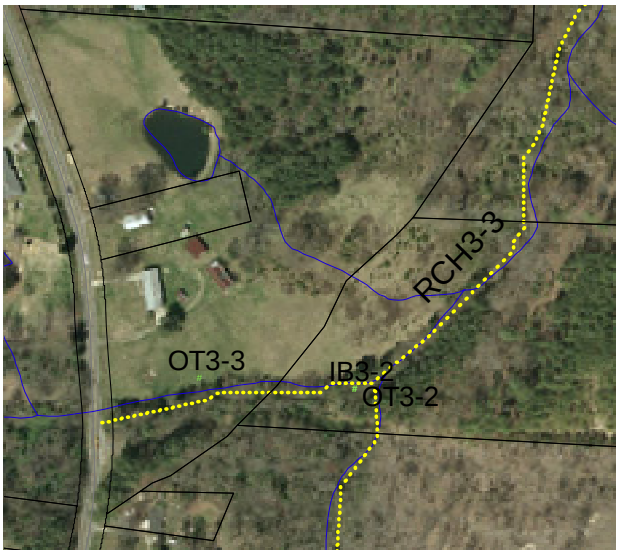
The property is over 50 acres of mobile home park. The major constraint is potential conflicts with adjacent yards, although the park owner appears to make decisions about site management.

Reach 5-1, Impacted Buffer 5-1A

This project can be combined with Reach 5-7 to present up to 1,350 feet of buffer restoration or enhancement. The project is on private land north of the Mineral Springs-NC 98 intersection, behind Mineral Springs Shopping Center. The project is located on project Reach 5-1 in subwatershed #5. Buffer restoration and enhancement are needed along the left bank of the main stem of Little Lick Creek. Buffer restoration and enhancement are also needed along Reach 5-7, a tributary to Little Lick Creek that enters before the creek crosses Mineral Springs Road and continues to the northeast (Reach 5-9).

The project might also be combined with a relatively high-priority stormwater retrofit (SR 5-1) that would treat 5 acres of commercial impervious area from the Mineral Springs Shopping Center.

Reach 3-3, Impacted Buffer 3-2



This project presents an opportunity to enhance and restore buffer along Reach 3-3 and a first-order tributary along 3-3 (with a farm pond). The total distance of the buffer restoration/enhancement could be as much as 1,100 feet, not including a buffer on the farm pond. The project scores only 7 out of 17 total prioritization points; however, it meets EEP minimum distance criteria on a low-order stream.

One landowner owns both the major tracts that include the potential project, and the back of a third property, just south of the pond, could have minor effects.

Reach 5-10B, Impacted Buffer 5-5

This potential project is located along project reach 5-10B, located in subwatershed 5 on the main stem of Little Lick Creek. The opportunity exists for approximately 1400 linear feet of potential buffer enhancement. The potential project is located along fairway of hole #16.

Buffer enhancement is needed on a section of stream that crosses the fairway in front of the tee box. Here, using low shrubs or raising the tee box would be necessary. There is also need for restoring the left bank buffer located adjacent to the fairway. Here, larger trees could be used, but a 50-foot buffer would require adaptations to the fairway. Other constraints include unstable banks and two stormwater outfalls from an adjacent neighborhood (these outfalls could be addressed as part of the project.

The buffer restoration project has the potential to be combined with other stream repair and buffer projects. The Crossings Golf Club has a willing landowner, and the superintendent is interested in this and other projects. Use of a combination of trees and shrubs may address these conflicts.

Stream Repair Priorities

This section describes the potential stream repair projects identified in Little Lick Creek. Since these projects were identified during fieldwork by project partners using Center for Watershed Protection methodologies, they are all considered feasible, priority projects. Figure 2 and Table 10 further divide these projects into priority (yellow), high priority (orange), and highest priority (red) projects.

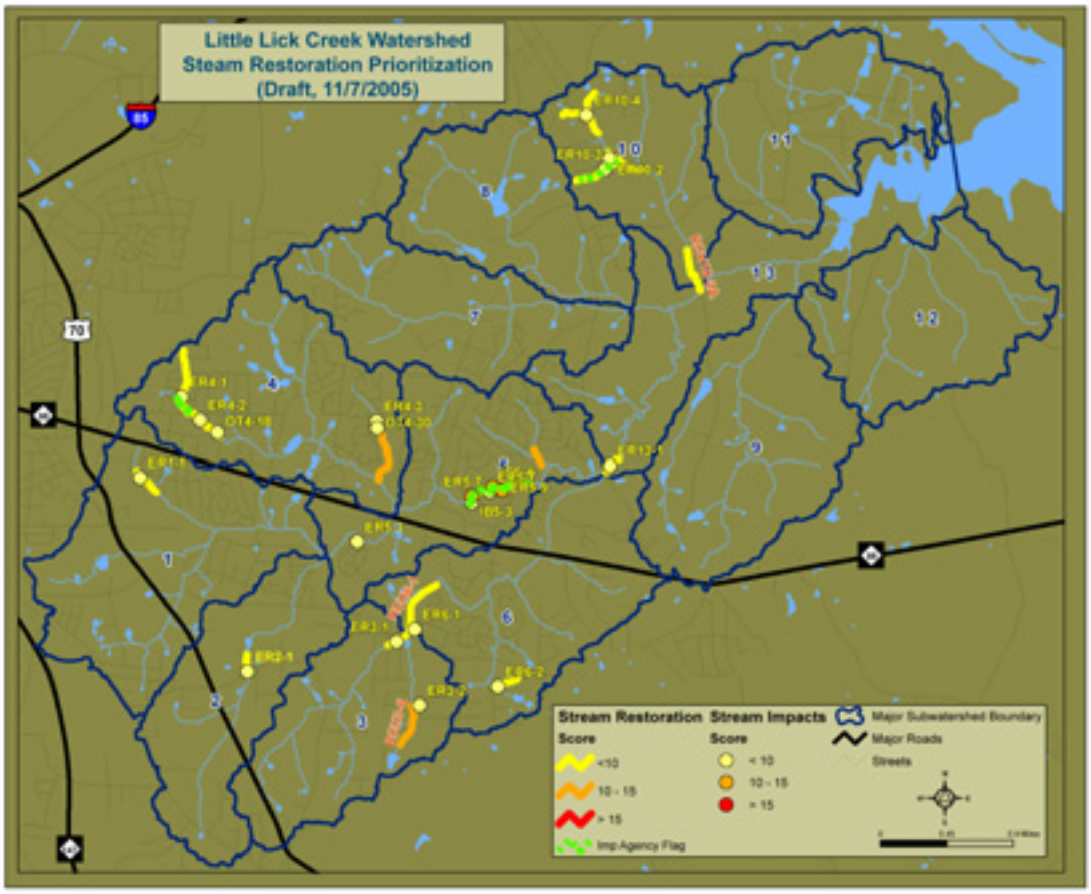


Figure 2: Stream Repair Priorities in Little Lick Creek

Table 10: Stream Repair Priorities in Little Lick Creek

Reach ID	Site ID	Description (including constraints)	Environmental Benefits Score (of. 7 pts.)	Community Support Score (of 4 pts.)	Feasibility Score (of 6 pts.)	Cumulative Score (of. 17 pts.)	Flags*
RCH1-2	ER1-1	6' headcut.	3	1	4	8	
RCH2-1	ER2-1	Massive erosion (12-14 ft high banks)	3	2	4	9	O
RCH3-1	ER3-1	Bank failure with widening and downcutting. Intermittent channel in suburban area. Bank heights 6', with 65 to 90 degree banks.	3	1	3	7	O
RCH3-6	ER3-2	Active downcutting and widening adjacent to homeowner property. 5 for severity and good access. Pouring paint in stream.	5	1	4	10	
RCH4-3	ER4-1	Head cut (2.5 ft drop) in forested area migrating upstream from confluence with RCH4-4; access difficult (poison ivy, too)	4	1	4	9	
RCH4-4		Length of reach, both sides for stream repair; right bank for buffer reforestation (200 ft) plus invasive plant removal on left bank.	5	1	3	9	EEP
RCH4-5	OT4-18	Outfall located at eroding meander bend at Charlestown Rd. apartments. Pipe section has fallen off; sheet flow from parking area likely contributing to bank failure.	4	1	3	8	
RCH4-5	ER4-2	Head cut on steep slope associated with combined drainage from OT4-14 and OT4-15. Room in forested area for step pool or other control feature	5	1	3	9	
RCH4-9	ER4-3	Severe head cut with exposed sewer line crossing below	5	1	4	10	
RCH4-9	OT4-30	Localized stream repair; potential outfall retrofit; homeowner losing his backyard	4	1	3	8	
RCH5-10B	ER5-7	Same area as IB5-3. In addition to hard bank repair, another approach might include using root wads	5	4	3	12	O, EEP
RCH5-10B	ER5-8	Meander bend along 14th hole is actively moving and eroding. Needs stream repair, but fairway is major constraint. Potential for rootwad revetment.	6	4	2	12	O, EEP
RCH5-10B	ER5-9	Same area as IB5-5. Bank shaping is another option, with shrub plantings to bioengineer a more stable bank. Good floodplain access exists, but channel is still actively moving as evidenced by sanitary stack in middle of stream.	6	4	2	12	O, EEP

Reach ID	Site ID	Description (including constraints)	Environmental Benefits Score (of. 7 pts.)	Community Support Score (of 4 pts.)	Feasibility Score (of 6 pts.)	Cumulative Score (of. 17 pts.)	Flags*
RCH5-10B	IB5-3	Golf course hole #11 has no vegetative buffer which is causing severe erosion. Because near the green, shrubs or even a hardlined stream repair practice may be best alternative (e.g., bolder revetment, imbricated riprap)	**5**	**2**	**2**	**9**	**O, EEP**
RCH5-10B	IB5-4	Buffer is absent along this stream crossing of the fairway. Shrub plantings should not measurably affect the hole. Consider bank shaping along with bioengineering to provide support.	**6**	**4**	**2**	**12**	**O, EEP**
RCH5-13		Series of braided channels on City property -- possible locations for replanting and open up channel to floodplain	**5**	**2**	**3**	**10**	**O**
	ER5-3	Minor headcut that will continue without stabilization	**3**	**1**	**4**	**8**	
	ER5-7	Severe erosion, bank failure & scour; threat to green & bridge	**5**	**2**	**2**	**9**	**EEP**
RCH6-1	ER6-1	60ft of erosion; 4 ft banks on ephemeral channel; actively eroding with 3/4 severity (associated with OT6-9)	**3**	**1**	**1**	**5**	
RCH6-5	ER6-2	Sediment deposition in channel; some headcutting and source seems to be from a farm operation where sand is stockpiled; tractors; off of Holder Rd	**2**	**2**	**4**	**8**	
RCH10-2	ER10-2	Steep headcut at the end of Suitt Rd. Bank heights 6' to 12'. Needs stabilization. Ranks 4 for severity.	**3**	**1**	**3**	**7**	
RCH10-3	ER10-3	300' of eroding stream with 6' to 10' banks. Stream restoration may be in design - KCI survey monuments and flagging found. Possible retrofit of homeowner - 1/2 ac of impervious on 1 ac lot (could combine w/IB10-1, a buffer restoration project)	**6**	**1**	**1**	**8**	
RCH10-4	ER10-4	Provide grade control in existing incised channel. Severity 4. Not an easy restoration project. 50' length of 30" CMP in stream.	**4**	**0**	**1**	**5**	
RCH13-3	ER13-1	150 ft eroded stream bank; left bank only; pasture abuts stream; eroding to fence	**5**	**1**	**3**	**9**	

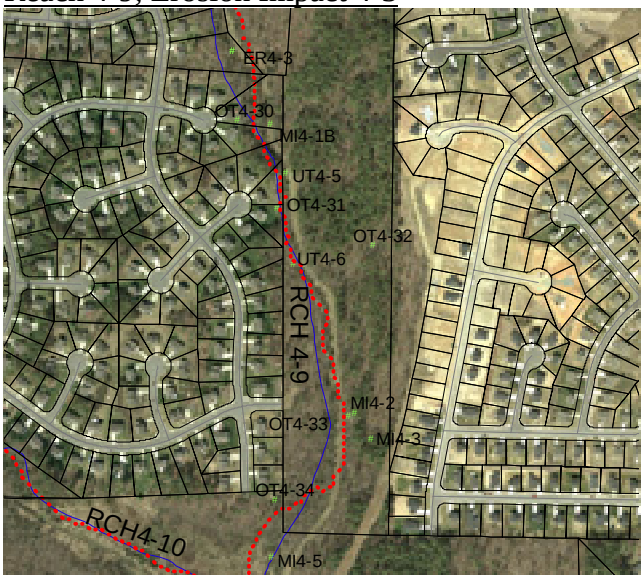
* Flags: O=public ownership or willing landowner; EEP=project meets EEP minimum length criteria.

Table 10 (continued): Stream Repair Priorities in Little Lick Creek

Reach 3-6, Erosion Impact 3-2

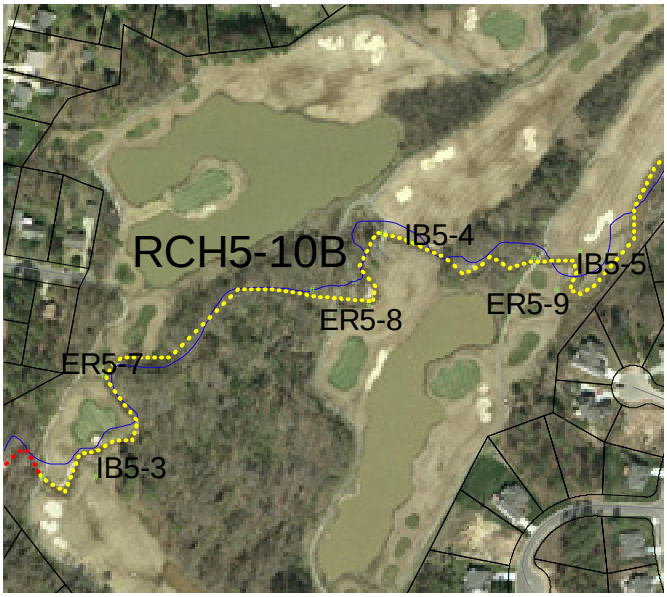
ER 3-2 is a portion of a first (possibly second)-order stream experiencing very severe, active downcutting and widening adjacent to homeowner property. There is a need for bank and channel stabilization. The project is located directly upstream of the crossing at Pennock Rd. This active erosion is contributing to the poor condition of the downstream reach (Reach 3-7). Four landowners would be involved.

Reach 4-9, Erosion Impact 4-3



The potential project is a severe head cut with exposed sewer line crossing downstream. The project is located along project Reach 4-9 parallel to and west of Lodestone Dr. in subwatershed 3. Reach 4-9 is generally in poor condition. A bank and streambed stabilization project in this location would prevent future erosion of the reach. A plethora of stormwater outfalls contributes to the conditions of the creek despite a significant buffer around the reach.

The most severe impact, located at the north end of the reach, is on private property. Most of the downstream land is owned by the neighborhood's homeowners association.



<u>Reach 5-10B, Erosion Impacts 5-7, 5-8, 5-9, and Impacted buffers 5-3 and 5-4</u>Reach 5-10B is a high-priority reach because of the location of multiple stream repair projects along the same reach. The reach is located on the main stem of Little Lick Creek as it flows through holes 11, 13, 16, and 17 of The Crossings Golf Club in subwatershed 5. All the stream repair projects score highly in the prioritization analysis.

Each of the erosion impacts is severe and active (see the photo of ER 5-8).

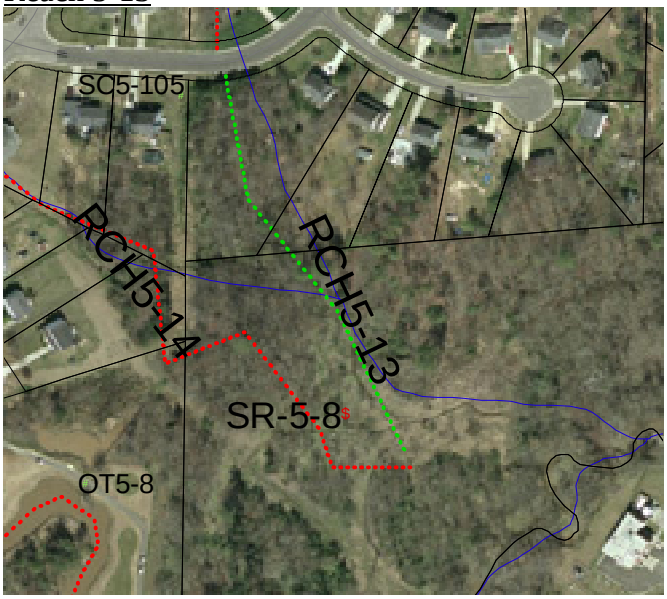
Potential Project ER 5-8 on Little Lick Creek

The impacted buffers are areas of the stream that are also desperately in need of bank stabilization, such as IB 5-3, the bank that is eroding into the 11th sandtrap and green (see the photo).

Potential Project IB 5-3 on Little Lick Creek

Combining the projects into one large stream repair and buffer restoration project is suggested. The landowner is interested, and the project offers great potential to improve conditions on the golf course and prevent damage to fairways and greens. The major constraint is that of making restoration work on a golf course. Several of the projects cross fairways, so buffer plantings would need to stay low or playing areas would need to be raised.

Reach 5-13



This entire reach provides an opportunity to open up a series of braided channels to a large floodplain and to provide replantings on Durham City property. There is also potential to create a combined land protection, restoration, and stormwater retrofit project. The stormwater retrofit fieldwork and analysis identifies a high-priority retrofit project (SR 5-8) on this property. That project could provide pre-treatment at surrounding outfalls and level spreaders. Because Reach 5-13 drains 80 acres of built-out, residential land, this site may also be an opportunity for the NC State Cooperative Extension Program to locate a stormwater retrofit project as part of its current effort in the Neuse Basin.

This opportunity is valuable not only because it lies on publicly-owned property, but also because Reach 5-13 is rated as “good” condition by the field stream survey (see Appendix 4, the Unified Stream Assessment description). There are very few potential stream repair projects along reaches in good condition.

Stormwater Retrofit Priorities

Figure 3 and Table 11 describe the stormwater retrofit priorities identified in Little Lick Creek. The analysis identifies 70 potential stormwater retrofit projects. All of these projecs were identified through fieldwork. Thus, all are considered feasible, priority projects (see Appendix 5 for a description of the Unified Site and Subwatershed Reconnaissance methodology and findings). The map and spreadsheet show these projects divided into three prioritization categories; high (yellow); higher (orange); and highest (red) priority.

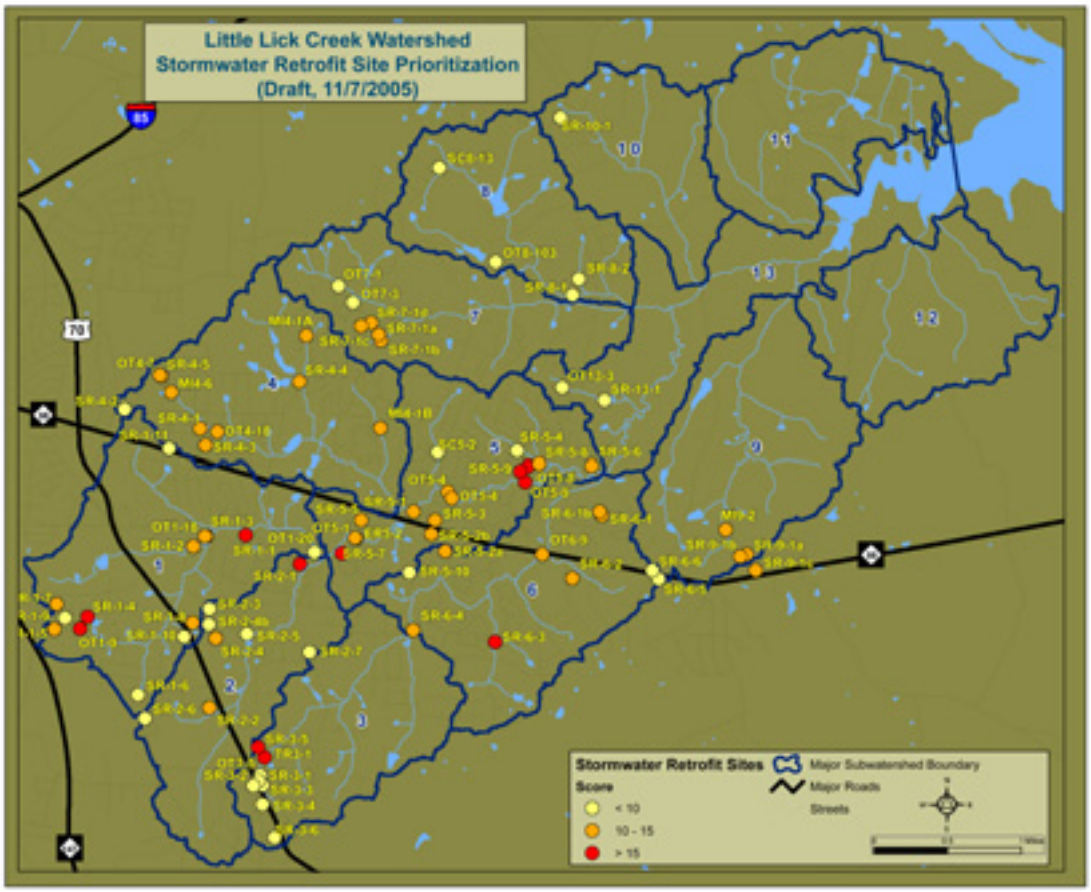


Figure 3: Stormwater Retrofit Priorities in Little Lick Creek

Table 11: Stormwater Retrofit Priorities in Little Lick Creek

Site ID	Retrofit Type Recommended	Drainage Area (Acres)	Priority Retrofit Description	Environmental Benefits Score (of poss. 14 pts.)	Community Support Score (of poss. 4 pts.)	Implementation Feasibility Score (of poss. 6 pts.)	Cumulative Score (poss. 24 pts.)	Flags (O=ownership)
SR 1-1	Stormwater Wetland	**15**	Divert Lynn Rd drainage ditches to a constructed wetland on park property.	**12**	**4**	**4**	**20**	**O**
OT1-18 / SR 1-2	Pocket Wetland with EDD	**4**	Pocket wetland with some extended detention. City suggested allow wetland to develop without creating structural changes.	**7**	**1**	**4**	**12**	
SR 1-3	Pocket Wetland with ED	**4**	Establish pocket wetland with extended detention, allow pond to naturalize	**7**	**1**	**4**	**12**	
OT1-9 / SR 1-4	Stormwater Wetland	**14 & 9**	Constructed wetland and drainage system in public park to treat residential area. 14 acres drains to historic pond. Could divert additional 9 acres (including 6 heavily urbanized) to current turf area.	**12**	**4**	**4**	**20**	**O**
SR 1-5	Wet Pond	**6**	Create wet pond/shallow wetland - will require grading and reconfiguring pavement	**7**	**1**	**5**	**13**	
SR 1-6	Stream Repair	**3-6**	Use vegetation as visual barrier and stream buffer.	**6**	**3**	**1**	**10**	
SR 1-7	Raingardens / Bioretention	**2.5**	Rain gardens/bioretention or grass filter strips in parking lot.	**5**	**2**	**4**	**11**	
SR 1-8	Raingardens / Bioretention		Use level spreader and grass strip pretreatment with a bioretention cell which ties back into the storm drain system.	**5**	**2**	**4**	**11**	
SR 1-9	Raingardens/ Bioretention		Raingardens	**3**	**2**	**4**	**9**	
SR 1-10	Raingardens / Bioretention		Rain gardens; pre-treat flows before discharging to forested buffer	**3**	**2**	**4**	**9**	
SR 1-11	Raingardens / Bioretention		Rain gardens	**3**	**2**	**4**	**9**	
OT1-20	Wetlands / Infiltration			**7**	**0**	**2**	**9**	
SR 2-1	Stormwater wetland; bioretention	**51**	Wetland creation; bioretention; stream buffer and upland reforestation; use of grass swale and grass filter strips. Remove concrete channels where velocities allow.	**13**	**2**	**3**	**18**	
SR 2-2	Raingardens / Bioretention		Parking lot treatment using bioretention strips. Pretreat flows discharging via concrete chute behind building. Keep forested filter function behind building.	**7**	**0**	**4**	**11**	
SR 2-3	Raingardens/ Bioretention		rain gardens; keep grass filter strip function	**3**	**2**	**4**	**9**	

Site ID	Retrofit Type Recommended	Drainage Area (Acres)	Priority Retrofit Description	Environmental Benefits Score (of poss. 14 pts.)	Community Support Score (of poss. 4 pts.)	Implementation Feasibility Score (of poss. 6 pts.)	Cumulative Score (poss. 24 pts.)	Flags (O=ownership)
SR 2-4	Pond retrofit		If not treated by the Amberlynn Valley ponds downstream, retrofit these to tie them in.	**7**	**1**	**5**	**13**	
SR 2-4B	Enforcement		Enforcement to ensure that wet ponds are constructed as designed.	**N/A**	**N/A**	**N/A**	**N/A**	
SR 2-5	Pond repair/ Enforcement		Pond repair/maintenance and enforcement.	**N/A**	**N/A**	**N/A**	**N/A**	
SR 2-6	Grass filter strip		Grass filter strip on west side of property	**3**	**1**	**5**	**9**	
SR 2-7	Raingardens/ Porous Pvmt.		Raingardens, Porous pavement	**5**	**2**	**2**	**9**	
	Infiltration/ Bioretention?			**13**	**0**	**2**	**15**	
OT3-5 / SR 3-1	Sand filters	**0.75**	Capture runoff from building, road, fueling area with two sandfilters.	**6**	**0**	**2**	**8**	
SR 3-2	Sand filters, oil grit separator	**2**	Install two sandfilters along route 70; use OGS to pretreat diesel fueling area, which is currently uncovered.	**8**	**0**	**2**	**10**	
SR 3-3	Sand filters		3 sand filters and pave 1/4 acre lot	**6**	**0**	**2**	**8**	
SR 3-4	Sand filter	**1.5**	filter at exit point to capture parking lot and building	**8**	**0**	**2**	**10**	
TR3-1 / SR 3-5	Diversion berms; Pretreatment		Berms to prevent large areas to sheet flow over bare soil. Pre-treat before discharge to wooded area to capture sediment.	**10**	**1**	**5**	**16**	
SR 3-6	Enforcement		Remove grease from pond.	**N/A**	**N/A**	**N/A**	**N/A**	
SR 4-1	Raingardens/ Bioretention		Use curb cuts to divert runoff from parking lot into bioretention cells in existing turf areas. Tie back into storm drain.	**7**	**2**	**4**	**13**	
SR 4-3	Raingardens/ Bioretention		Use curb cuts to divert runoff from parking lot into bioretention cells in existing turf areas. Tie back into storm drain.	**7**	**2**	**3**	**12**	
SR 4-4	Pre-treatment; Land Preservation		Add pretreatment forebay/plunge pool at outfalls. Possible tree impacts reduces aesthetics score.	**7**	**2**	**5**	**14**	**O**
SR 4-5 / OT4-7 / MI 4-6	Stormwater wetland		Use pre-treatment forebays at outfalls. Diabase sill on this reach, caddisflies found during fieldwork (MI 4-6)	**7**	**0**	**4**	**11**	
MI4-1			Potential for on-site retrofits.	**7**	**2**	**3**	**12**	
OT4-18			Possible retrofit.	**8**	**1**	**3**	**12**	
SR 5-1	Bioretention	**5**	Flowsplitter to divert WQ flows to bioretention cell on west side of site using existing turf area. Back strip of land-grass filter strip w/ stone level spreader. Poss.linear bioretention.	**7**	**3**	**4**	**14**	

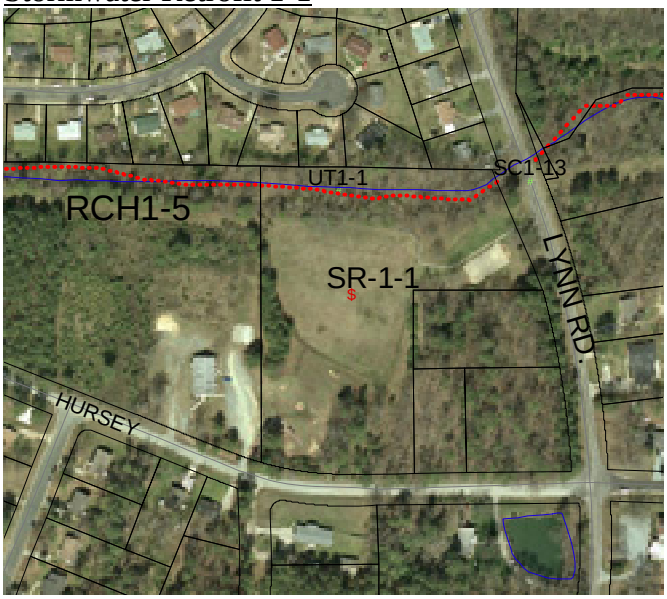
Site ID	Retrofit Type Recommended	Drainage Area (Acres)	Priority Retrofit Description	Environmental Benefits Score (of poss. 14 pts.)	Community Support Score (of poss. 4 pts.)	Implementation Feasibility Score (of poss. 6 pts.)	Cumulative Score (poss. 24 pts.)	Flags (O=ownership)
SR 5-2a	Bioretention		Biofiltration cell for bus loop area, behind row of trees. Use curb cut to divert flows.	7	4	4	15	O
SR 5-2b	Bioretention		Excavate vegetated strips between parking rows to create bioretention.	7	4	4	15	O
SR 5-3	Bioretention	2.5	Enhance turf area to include stone level spreader, grass filter strip and bioretention.	7	3	4	14	
SR 5-4	Residential On-lot		Buffer plantings and raingardens	3	3	4	10	
SR 5-5	Stormwater wetland	4	Create small shallow wetland to treat parking runoff. Plenty of head available to water quality flows out of the storm drains. Note: wetland could be amenity for folks living there.	9	2	3	14	
SR 5-6	Land Preservation		Use city property's existing wet pond to treat residential runoff by diverting storm drains; allow forested wetland to treat runoff	10	1	3	14	O
SR 5-7	Shallow wetland	19	Create shallow wetland areas at outfalls in floodplain. If possible, divert additional flows from steep channel to south. Owner willing to create additional forested buffer area.	12	2	4	18	O
SR 5-8	Land Preservation		Add pre-treatment at outfalls if possible. Use level spreaders when possible. Preserve small trib.- floodplain. connection	10	1	4	15	O
OT5-8 / SR 5-9	Wet pond		Use golf course water features as wet ponds to treat subdivision runoff. Will require reconfiguring storm drains. Owner willing.	10	3	6	19	O
OT5-9 / SR 5-9	Wetland		Use golf course water features as wet ponds to treat subdivision runoff. Will require reconfiguring storm drains. Owner willing.	10	3	4	17	O
SR 5-10	Raingardens, Porous Pavement		Raingardens, Porous pavement	3	3	4	10	
ER5-2 / OT 5-1	Rain gardens		Rain garden potential? Stilling basin?	7	3	4	14	
SC5-2	Stilling basin		Channel forced around sediment; needs to be dredged and possibly used as a large stilling basin needing frequent maintenance.	0	0	1	1	
OT5-4	Bioretention, swales		Good potential location for retrofit (bioretention, swale)	8	0	4	12	O
SR 6-1	Retrofit existing pond	6-8	Evaluate existing dry pond for ext detention;	7	0	5	12	
SR 6-1B	Stream Repair		grade ctrl structures in eroded fairway channel; no-mow zone along channel bank	7	3	4	14	O
SR 6-2	Enforcement/ Bioretention	4 to 5	Possible enforcement recommendation. Consider pond device at outfall if BMP was not required for this site; also 2 curb cuts have potential for bioretention	7	2	3	12	

Site ID	Retrofit Type Recommended	Drainage Area (Acres)	Priority Retrofit Description	Environmental Benefits Score (of poss. 14 pts.)	Community Support Score (of poss. 4 pts.)	Implementation Feasibility Score (of poss. 6 pts.)	Cumulative Score (poss. 24 pts.)	Flags (O=ownership)
SR 6-3	Add pre-treatment forebay	230	Add forebay at road crossing. Does forebay just treat water quality?	8	2	6	16	
OT6-9 / SR 6-4	Wet pond	6	Wet pond, level spreader, plunge pool	7	1	4	12	
SR 6-5	Sand filter		Add underground sandfilter near each exit	5	0	2	7	
SR 6-6	Bioretention/ Raingarden	< 1	Available areas for retrofit limited but include NC-98 ROW and grass area behind buildings	5	2	3	10	
SR 7-1a	Stormwater wetland	4-5	Reroute drainage, constructed wetland, bioretention area. Trees would be sacrificed	9	2	4	15	O
SR 7-1b	Pocket wetland	1.5	pocket wetland and swales to capture baseball diamond runoff	7	4	4	15	O
SR 7-1c	Bioretention	2	Biofiltration to treat parking lot; using existing lawn area and yard inlet	7	4	4	15	O
SR 7-1d	Bioretention	2	On lot biofiltration strips in large student/bus parking lot	7	4	4	15	O
OT7-1	Retrofit existing swale		Modify outfall to treat water quality.	4	2	4	10	
OT7-3	Bioretention/ raingargens		Look for opportunities to reduce runoff with onlot practices or perhaps with retrofit to cul-de-sac.	3	1	2	6	
SR 8-1	Land Preservation		Preserve buffering effect of these wetlands.	N/A	N/A	N/A	N/A	
SR 8-2	Land Preservation		potential for conservation easements here	N/A	N/A	N/A	N/A	
OT8-103	Retrofit of existing pond		Retrofit dry detention basin (extended dd or wetland?)	3	0	4	7	
SR 9-1a/ MI 9-2	Raingardens/ Bioretention	0.7	Disconnect roof drains from storm drain system on this side of the building.	4	4	4	12	O
SR 9-1b / MI 9-2	Wet swale	3.3	enhance existing swale	5	4	5	14	O
SR 9-1c / MI 9-2	Bioretention	1.5	Use level spreader and grass strip pretreatment with a bioretention cell in the existing turf area near the school entrance off Baptist Rd.	4	4	4	12	O
SR 10-1	Bioretention; Stmwtr. wetland	1.5 or 7.5	Capture and infiltrate or sheet flow roof leader runoff	7	3	2	12	
SR 13-1	Land Preservation		Preserve farm pond currently treating runoff from stream through highly developed area	1	0	2	3	
SR 13-1b	Wetland Creation		Hydrologically connect to floodplain of Little Lick and tributary.	13	1	3	17	
OT13-3	Swale		Potential water quality swale.	5	0	5	10	

Table 11 (continued): Stormwater Retrofit Priorities in Little Lick Creek

The following are examples of some of the highest priority stormwater retrofit opportunities identified through this prioritization process.

Stormwater Retrofit 1-1



This is an opportunity to treat 15 acres of suburban area stormwater runoff with a stormwater wetland at Birchwood Park, a Durham City property on Lynn Rd. in subwatershed 1. This is one of the two highest-scoring retrofit opportunities in Little Lick Creek. The area beside Lynn Rd. may not have sufficient space for a stormwater wetland, so some other method may be necessary. However, the public exposure and education value of this project may warrant a demonstration wetland. The project could be combined with a high-priority buffer restoration opportunity along Reach 1-5 (the buffer restoration project would involve private landowners adjacent to the park).

A potential constraint to this project is that the retrofit would be best located on the area that is now the home for a popular basketball court. People from the surrounding neighborhoods play at this court. However, the court is old, and it is possible that people would welcome a new court even if it has to be relocated nearby. This project also has a high potential for community involvement because a local girl scout troop has adopted this section of the creek through the Durham City Adopt-A-Stream program.

Stormwater Retrofit 1-4

SR 1-4 is an opportunity to treat up to 23 acres of urban residential, commercial, and industrial runoff with a constructed wetland and drainage system. The project could be located at the site of a historic pond in CR Woods Park, a city-owned property between Angier and East End Avenues in subwatershed 1. The project is one of the two highest scoring retrofit sites in Little Lick Creek.

At a minimum, the constructed wetland could treat 14 acres of residential runoff in an area of the park that appears to be lightly used. The project could use drainage to divert up to 9 additional acres of runoff from heavily urbanized areas nearby.

Like other projects recommended for public parks, it is very important to present this opportunity to community leaders and determine how this could be done in a way to meet community goals (education for children or neighborhood/park beautification). Like the proposed project at Birchwood Park, this project may interfere with current patterns of park use, so asking the users how this could be avoided, or how current uses could be improved upon, is a key. There may be an opportunity to combine the project with SR1-9, which recommends rain gardens in a local church parking lot, and a stormwater or water quality education campaign.

Stormwater Retrofit 2-1

SR 2-1 is a one of the highest-priority stormwater retrofit opportunities identified in Little Lick Creek. The project could treat 51 acres, all within one mobile home park, using stormwater wetland, bioretention, grass swales, and grass filter strips. The project could also be combined with high-priority buffer restoration opportunities along Reaches 1-15 and 2-14.

The potential restraint involves landowner cooperation. It is recommended that the City Stormwater Services Division work with this landowner to discuss how this project could benefit water quality, neighborhood appearance, and general quality of life in this area.

Stormwater Retrofit 5-9

SR 5-9 is another potential project on the Crossings Golf Club property. This project could treat 10 or more acres of runoff from a neighboring residential development to the north of hole 16. The project would use the water features along this golf hole to treat the runoff, which would require configuring the storm drainage system.

One interesting aspect of this project is the potential to combine it with several nearby projects. The high priority buffer restoration and stream repair projects recommended for Reach 5-10B are on the main stem of Little Lick Creek just upstream of the confluence with the catchment that drains to SR5-9 (Reach 5-14), so the combination of these projects would provide multiple hydrology and water quality benefits to the stream as it exits golf course property onto City-owned property.

Additional opportunities exist on the City property, location of the former wastewater treatment plant. This property is the location of a high-priority stream repair and stormwater retrofit opportunity (Reach 5-13 and SR 5-6). Reach 5-14 drains 88 acres onto city-owned property. This site may be of interest to NC State Cooperative Extension as it searches for sites of this size for stormwater retrofit projects. The property is also a high priority for land protection (discussed in Technical Memo #2 and in the final plan).

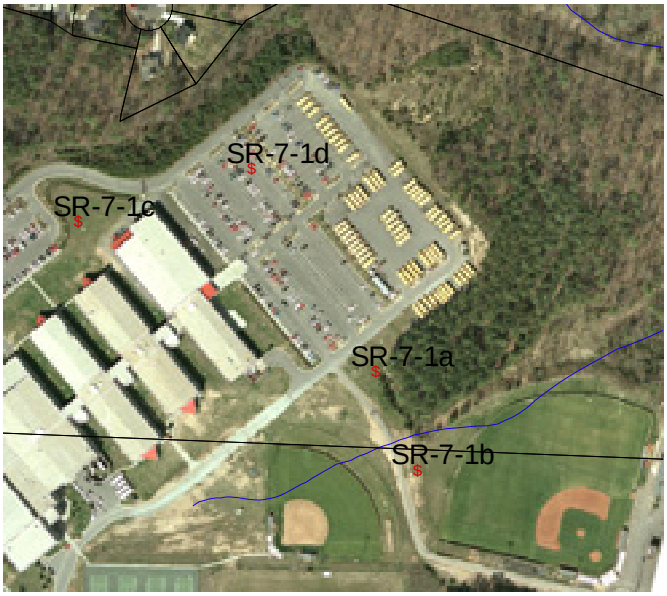
Stormwater Retrofit 6-3

SR 6-3 could drain up to 230 acres along project stream Reach 6-3. The project could occur mainly on homeowner association-owned property immediately to the south of Nichols Farm Rd. A forebay could be added at the road crossing to provide water quality treatment for the upstream area.

The project would be in the stream, which is in poor condition and ends in the large pond just downstream.

The area is upstream of the community's pond and playground, an area that receives heavy foot traffic. The project would be highly visible and, therefore, a good educational opportunity. Potential constraints include the adjacent property owners and a gas line easement in the Nichols Farm Rd. right-of-way. If the project is well-constructed and includes an educational component, it could be seen as an amenity.

Stormwater Retrofit 7-1



SR 7-1 is a combination of four potential stormwater retrofit opportunities on one large, publicly-owned property in subwatershed 7. The recommendation is to create stormwater wetland, pocket wetland, and bioretention areas that could treat over 10 acres on the 78-acre property of Southern High School.

SR 7-1a would combine bioretention and stormwater wetland to treat a large (4-5 acre) area of parking lot runoff. SR 7-1b would use pocket wetland and swales to treat runoff from the baseball diamond. SR 7-1c would treat the western-most parking lot using biofiltration on an existing yard area with an inlet. SR 7-1d would treat the student and bus lots using biofiltration strips in the parking area.

These projects would provide excellent opportunities to treat water quality and hydrology in subwatershed 7. In addition, these projects would provide an excellent educational opportunity for teachers and students in the high school. It is possible that teachers and students could become involved with the design and implementation of the projects, and who knows what wonderful ideas could come from the project! Field staff noticed potential opportunities for rooftop collection and additional treatment from the track. There are also other similar opportunities at Neal Middle School (SR 9-1) and Oak Grove Elementary (SR 5-2).

Combining Watershed Restoration Projects

Figure 4 is a map of the combined results of the analysis. The map shows stream repair opportunities in blue, buffer restoration opportunities in green, and stormwater retrofit opportunities in yellow, orange, or red. Stream reaches that contain both stream repair and buffer restoration opportunities are shown in red.

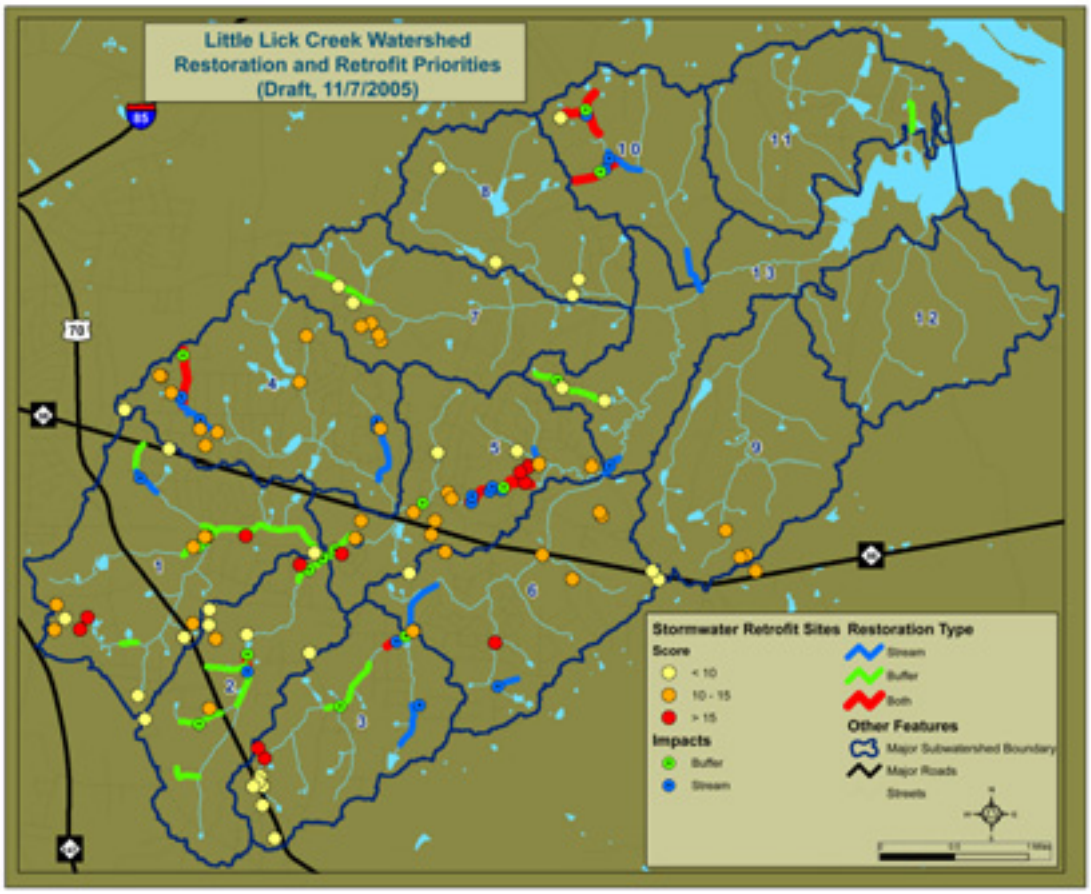


Figure 4: Stream and Buffer Restoration and Stormwater Retrofit Priorities in Little Lick Creek

As is displayed by the previous section's detailed descriptions of various high-priority opportunities, the great majority of these opportunities are in subwatersheds 1-5, the headwaters of Little Lick Creek. Eighteen (18) of 24 stream repair opportunities, 18 of 24 buffer restoration opportunities, and 48 of 70 stormwate retrofit opportunities are in these subwatersheds. In all, 71% of all projects are in subwatersheds 1-5.

There also exist numerous opportunities for combining projects. The Little Lick Creek Technical Team recommended that project partners search for opportunities to implement groupings of projects. These "clusters" should receive special consideration. In particular, the Technical Team recommended:

- Implementing stormwater retrofit projects upstream of stream repair projects to reduce the hydrologic stress on these projects.
- Implementing new buffers in areas that have stormwater outfalls with some retrofit, such as level spreaders, to ensure that the buffer is not bypassed (this is primarily for pollution removal purposes, and the technical team agrees that buffer restoration is a cost-effective way to achieve bank stabilization, temperature regulation, and habitat benefits, and stand alone projects are warranted).

Project Partners assessed projects by subwatershed and looked for clusters of in-stream project opportunities with stormwater retrofits. Table 12 summarizes the findings by subwatershed and identifies areas where there exist groupings of restoration, repair, and retrofit opportunities.

	Stream Repair	Buffer Restoration		Stormwater Retrofits		
Sub-shed	# Stream Repair	# Buffer Restoration	Restoration Length (feet)	# Retrofits	Min. Drainage Area (Acres)	Clusters of Projects
1	1	5	4,700	12	57.5	1) Near Angier Ave., 3 retrofit projects could treat >20 acres upstream of RCH 1-7. 2) SR 1-11 is upstream of RCH 1-1, a high-scoring buffer project. 3) 3 buffer restoration needs and 4 retrofits near the outflow of subshed 1.
2	1	6	3,900	9	51	1) Combine several buffer restoration projects with one stream repair project where Pleasant Rd. crosses LLC. 2) At confluence of subsheds 1 and 2, there are 3 large buffer restoration opportunities and 4 retrofit opportunities..
3	2	2	1070	6	4	1) 5 potential retrofits are within a strech of stream (RCH 3-4) near Miami Blvd. 5 hotspots are also in this area, so retrofits could be combined with education and enforcement. 2) 2 buffer restoration and 1 severe stream repair need lie upstream of Holder Rd. Downstream is a stream repair and retrofit need. (Note: monitoring at this site found high levels of calcium, magnesium, and fecal coliforms, and many potentially failing septic systems are nearby).
4	6	1	270	6		1) 3 stream repair, 1 buffer restoration, and 4 stormwater retrofit needs in the area around Ross St. north of NC 98.
5	8	4	2,650	15	30.5	1) Immediately downstream of the confluence of subsheds 1 and 2, are 3 large buffer restoration opportunities and 4 retrofit opportunities. 2) Reach 5-10B, Crossings Golf Club, has 5 potential stream repair, 1 buffer restoration, and 2 stormwater retrofit opportunities. Downstream on city-owned land is another potential, large-scale repair opportunity.
6	2	0	0	7	247	1) Reach 6-1 contains a second stream repair need and retrofit opportunity. 2 buffer restoration and 1 severe stream repair need lie upstream in Subshed 2 across Holder Rd. (Note: see subshed 3).
7	0	1	200	6	10	1) Reach 7-1 has a buffer restoration need and two opportunities to retrofit stormwater outfalls. 2) Just downstream of Reach 7-1 are several large-scale retrofit opportunities on county land, at Southern High School.
8	0	0	0	3		Two retrofits at outflow of subshed 8 involve protecting lands that are currently treating stormwater runoff.
9	0	0	0	3	5.5	SR 9-1 a, b, and c: retrofit opportunities at Neal Middle School, upstream of the LLC monitoring reference site.
10	3	2	500	1		1) Within a 1/2 mile stretch to the east of Fletcher's Chapel and Redwood Roads, Reaches 10-2, 10-3, and 10-4 have several stream repair and buffer restoration opportunities, as well as a stormwater retrofit need.
11	0	1	750	0	0	
12	0	0	0	0	0	
13	1	2	650	3		Reaches 13-1 and 13-2 have buffer restoration needs and 2 potential stormwater retrofit sites.
Total	**24**	**24**	**14,690-15,520**	**71**	**405.5**	

Table 12: Summary of project opportunities, and major groupings of projects, by subwatershed

Conclusions

This technical memorandum identifies and prioritizes the most important riparian buffer restoration, stream repair, and stormwater retrofit opportunities in the Little Lick Creek Watershed. The general conclusions include:

- 118 potential projects are identified and prioritized. Among those are 16 high or highest priority buffer restoration, 7 high or highest priority stream repair, and 51 high or highest priority stormwater retrofit project opportunities

Watershed Restoration Priorities in Little Lick Creek			
	Buffer Restoration	Stream Repair	Stormwater Retrofit
Priority	8	17	19
High Priority	15	7	43
Highest Priority	1	0	8

- Many of these projects exist in clusters, and implementing these clusters together is expected to have the greatest benefit to hydrology, water quality, and aquatic habitat.
- There are many opportunities to implement highly-visible restoration, repair, and retrofit projects that will have strong educational benefits.
- Overall, buffer restoration, stream repair, and stormwater retrofit projects can improve the watershed's water quality, particularly the hydrology and sediment loading. However, this protection is limited and illustrates the need for comprehensive watershed management. The Center for Watershed Protection's Watershed Treatment Model (WTM) predicts that the greatest reductions in nutrients will come from upgrades to or inspection and repair of septic systems. The WTM predicts that the greatest reductions in sediments (TSS) will come from improved erosion and sediment control practices and protection of riparian buffers. The WTM is included in Appendix 2.
- Assessing the environmental benefits of individual buffer, stream, or retrofit project is a necessary step toward implementing and designing these projects. Nutrient removal and detailed cost analyses were not a part of this prioritization, although the priority scores do consider the relative nutrient or sediment removal benefits and relative cost of the various projects. These important analyses should be completed, potentially as a part of project Phase 4.
- The LLC LWP will focus on 10 comprehensive recommendations for watershed management in the 21 square-mile watershed. These include:

  Watershed restoration strategies

  1. Stream repair projects
  2. Buffer restoration projects
  3. Stormwater retrofit projects
  4. "Hot spot" detection & elimination (including onsite sand filter wastewater systems)

  Strategies to prevent future degradation

5. Critical lands protection (includes acquisition, easements, ordinance changes recs.)
6. Better site design and construction

Strengthening watershed stewardship

7. Improved enforcement of existing rules
8. Watershed outreach and education
9. Adopt-A-Stream programs
10. Stream monitoring

The UNRBA, Center for Watershed Protection, Project Partners, and LLC Technical Team will use the findings in this technical memorandum to craft recommendations geared toward watershed restoration (recommendations 1-4) and recommendation 10, stream monitoring. These recommendations will be provided as part of Little Lick Creek Technical Memorandum #5.

References

Hoyt, Sally (2005). Discussions with Sally Hoyt regarding the Center for Watershed Protection's assumptions for relative costs and maintenance of various stormwater retrofit practices.

Low Cost per impervious area treated	Medium	High Cost per impervious area treated
Stormwater Retrofits		
§ Retrofit of existing ponds § Swales § Grass Channels § Wet ponds § Grass Filter Strips § Diversion Berms § Pre-treatment forebays § Rain gardens	§ Bioretention § Wetlands § Buffer Plantings § Infiltration	§ Sand Filters § Porous Pavement § Oil-grit separator

Low Maintenance Requirements	Medium	High Maintenance Requirements
Stormwater Retrofits		
§ Swales § Grass Channels § Wet ponds § Grass Filter Strips § Diversion Berms § Pre-treatment forebays (because these are attached to wet ponds)	§ Rain gardens § Bioretention § Wetlands § Buffer Plantings	§ Infiltration § Sand Filters § Porous Pavement § Oil-grit separator

Winer, R. 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices. 2nd Edition. Center for Watershed Protection. Ellicott City, MD.

National Summary (Winer, 2000) of BMP Removal Rates

Table D-1: Median Bacteria and Organic Carbon Removal (%) by Stormwater Treatment Practice (Source: Winer, 2000)

BMP Group	Bacteria[1]	Organic Carbon[2]	Hydrocarbons
Filtration[3]	37	54	84[4]
Ponds	70	43	81[4]
Wetlands	78[4]	18	85[4]

1. Bacteria data include fecal streptococci, enterococci, fecal coliform, E. coli, and total coliform
2. Organic carbon data includes BOD, COD, and TOC removal data
3. Excludes vertical sand filters and filter strips
4. Data based on fewer than five data points

Table D-2: Median Pollutant Removal (%) of Stormwater Treatment Practices (Source: Winer, 2000)							
BMP Group	**TSS**	**TP**	**Sol P**	**TN**	**NO_x**	**Cu**	**Zn**
Bioretention[1]	N/A	65	N/A	49	16	97	95
Filtration[2]	86	59	3	38	-14	49	88
Infiltration	95[1]	70	85[1]	51	82[1]	N/A	99[1]
Ponds	80	51	66	33	43	57	66
Wetlands	76	49	35	30	67	40	44

1. Data based on fewer than five data points
2. Excludes vertical sand filters and filter strips

NOTES:

- N/A indicates that the data are not available.
- TSS = Total Suspended Solids; TP = Total Phosphorus; Sol P= Soluble Phosphorus; TN = Total Nitrogen; NOx = Nitrate and Nitrite Nitrogen; Cu = Copper; Zn = Zinc

Appendices

Appendix 1—NC Division of Water Quality Memorandum: Water Quality Monitoring in the Little Lick Creek Watershed, Durham County 2005

Appendix 2—Watershed Treatment Model

Appendix 3—Summary spreadsheets from 13 Little Lick Creek subwatersheds

Appendix 4—Unified Stream Assessment findings

Appendix 5—Unified Subwatershed and Site Reconnaissance findings