Lick Creek Local Watershed Restoration Plan Management Strategy #1: Erosion and Sediment Control on New Development

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*subject to NPDES Phase II stormwater requirements)

Description
Excessive sediment in streams can degrade aquatic habitat by smothering insect life and fish spawning habitat, reducing the water's available oxygen, and increasing nutrient levels. When forested land is disturbed to accommodate new construction, the loss of vegetation and addition of impervious cover (pavement and rooftops) significantly alters hydrology, increasing surface water runoff and changing the timing of water delivery to streams. Under natural conditions, stream size and shape is naturally formed to accommodate base flows and storm flows; however, when the hydrologic regime is altered and discharge is increased, the size and shape of a stream changes to accommodate a new flow regime, often resulting in erosion of stream banks and incising. Sediment relocated from stream banks is deposited downstream where it may have negative impacts on water quality and aquatic life.

Indicators of the problem and current conditions
Stormwater flows and sediment levels in streams downstream of active construction or agricultural areas can be elevated, especially during storm events (when most sediment is moved). High stormwater flows can destroy habitat for aquatic invertebrates. The Lick Creek Partners are monitoring hydrology, sediments, and aquatic invertebrates in several key watershed locations.

Durham County Engineering Department is responsible for ensuring that all new developments follow state and local sediment and erosion control (SEC) regulations. Durham has relatively strong SEC regulations, requiring a significant level of plan review, regular inspections, and potentially high penalties

for noncompliance. However, fieldwork carried out by the Lick Creek Partners concluded that extensive erosion and sediment control violations were occurring at active construction sites throughout the watershed (e.g. broken or bulging silt fences, poor inlet protection, and sediment-filled ponds), resulting in extensive sediment deposition in adjacent streams, wetlands, and lakes (CWP 2007), and potentially contributing to degraded water quality and aquatic habitat (CWP 2007). The CWP (2007) suggests that many of these sediment-laden discharges can be attributed to lack of maintenance on structural sediment and erosion control practices.

Future threats

The majority of the southwestern portion of the Lick Creek watershed is expected to undergo a massive transformation in terms of development. In particular, Subwatersheds 1 through 8 are within the City of Durham's Urban Growth Area and are therefore expected to undergo the most development of all the subwatersheds (Fraley-McNeal et al. 2007). With such high levels of development expected in relatively undisturbed areas of the Lick Creek watershed with soils already prone to erosion (Triassic Basin), implementation and maintenance of optimal erosion and sediment control measures will be nothing short of critical for preserving the aquatic integrity of Lick Creek.

Recommended Strategies

1. Perform a comparison of the number of construction sites to the number of construction sites with violations as a measure of how widespread the lack of compliance is.
2. Increase the inspection frequency of active construction sites in Durham County. Sites are currently visited once per month.
    a. Raise the fees for sediment and erosion control permits in Durham County to support increased inspection frequency. Has this been done recently?
3. Penalties sufficient to deter noncompliance? If group says no, craft a recommendation to increase
4. Formalize the coordination between Durham County and City of Durham regarding site stabilization approval prior to approval of stormwater ponds and storm drains.
5. Emphasize the amount of current construction and the average annual amount of construction until build-out. These figures were calculated as part of the Lick Creek Watershed Treatment Model (Fraley-McNeal et al. 2007).
6. Sediment and erosion control should be required for all construction projects. What is the current threshold? Does it vary by area? What should the thresholds be reduced to? Can't be ANY size?
7. NCDWQ should inspect pond-draining projects prior to the onset of draining to prevent sediment discharge. What problem does this address?
8. Contractor, engineering, and erosion control regulator training for Durham County regulations should be provided on an annual basis.

Costs:

- Jurisdiction: database of construction sites, inspectors and support staff time, equipment (e.g., digital camera, GPS unit, laptop), vehicles, and legal support

- Builders: erosion control BMP planning, installation, maintenance, corrective measures, and repairs; training

Funding Opportunities:

- Plan review and permitting fees
- State grants for program development
- Stormwater plan review fees?
- Inspections and maintenance fees
- Financial performance bonds/guarantees/agreements
- Operation permit issuance and re-issuance fees
- Re-inspection fees

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

Fraley-McNeal, L., Hoyt, S., and Kitchell, A. (2007). *Lick Creek—Watershed Treatment Model Analysis*. [Online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo062007.pdf [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #2: Managing Timber-Harvesting and Sites Classified as "Agricultural"

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description
Removal of perennial trees and shrubs that obstruct, diffuse, and evapotranspirate runoff more that other types of land cover increases the amount of runoff leaving the area. This additional runoff damages stream structure and helps carry sediment, pesticides, and fertilizers to waterways. Excessive sediment in streams can degrade aquatic habitat by smothering insect life and fish eggs, and destroying fish spawning habitat, clogging the gills of aquatic species (e.g. fish and mussels), reducing the water's available oxygen, and increasing nutrient levels. Because agricultural areas inherently provide less consistent vegetative cover than natural Piedmont forested conditions, the potential for deleterious stormwater runoff is higher. Pesticides and herbicides have been associated with agricultural runoff in several studies conducted by the US Geologic Survey (USGS).

Indicators of the problem and current conditions
Indicators of uncontrolled sediment include excessive turbidity, low dissolved oxygen content, excessive sedimentation on inside stream bends, the loss of porous substrate conditions, and the loss of visible pool and riffle sequences. Furthermore, sediment levels downstream of active construction or agricultural areas can be exacerbated during storm events (when most sediment is moved), further impairing conditions for aquatic life. The Lick Creek Partners are monitoring rainfall, discharge, turbidity, TSS, nitrogen, phosphorus, and aquatic invertebrates in several key watershed locations.

The Lick Creek Partners observed turbid conditions in streams draining from properties with large areas of exposed soil that are zoned agriculture and are not required to have grading permits from the County (CWP 2007). Properties deemed agricultural are not subject to local erosion and sediment control regulations, even if their current use does not include row crops or pastures. Furthermore, many mining operations are also not subject to local sediment and erosion requirements, and "soil" farms (for the manufacturing of top soil) may possibly also qualify for mining exemptions if they are excavating soil to mix with soil amendments. A considerable area of denuded and compacted soil was observed near a power transfer station in the Rocky Branch subwatershed.

Durham County officials have no regulatory authority to require sediment and erosion controls (SEC) at these sites regardless of sediment discharges from the site or downstream water quality complaints. Complaints on sites classified as agricultural must be directed to the NC Division of Water Quality (NCDWQ) Raleigh Regional Office at (919) 571-4718. (The local Soil and Water Conservation District [SWCD] office should also be notified.)

Future threats

According to NCDWQ's 2006 Integrated 305(b) and 303(d) Report (NCDWQ 2006), agriculture is a significant cause of stream use impacts in the state; however, in general, local governments cannot apply restrictions other than lot size to agriculturally zoned districts (UNRBA 2007b). Within agricultural zones, USDA-Natural Resources Conservation Service (NRCS) standards and guidance may affect where facilities are sited and Voluntary Agricultural District designations help ensure that rezoning decisions factor into existing agricultural operations (UNRBA 2007b).

Nontraditional agricultural operations (e.g., horse boarding, nurseries, stockpiling, community-supported agriculture, etc.) are on the rise and present management challenges because even though they are considered agriculture (and therefore cannot be regulated by the local government other than to protect public health), they may have significant amounts of impervious cover, fertilizer or pesticide use, and land disturbance and also because local SWCDs may not have been made aware of them.

Recommended Strategies

The Upper Neuse Watershed Management Implementation Plan Recommendation Sheet 14 (http://www.unrba.org/downloads.htm) provides an excellent discussion on Forestry Best Management Practices Education and Outreach and recommends the following implementation steps:

1. Identify lands in the jurisdiction with forest cover and those that are classified as forestry for present-use value.
2. Compile contact information for owners of those lands and make it available to agencies conducting outreach or training in your area.
3. Meet with local NC Division of Forest Resources (NCDFR) County Rangers to learn more about forests, challenges forest landowners face, how forest harvesting differs from land-clearing work related to development, inspections for water quality, and other services

NCDFR provides. In Orange County, NCDFR Foresters have led field trips to help local government staff recognize potentially noncompliant operations.

4. Encourage forest owners who wish to manage and/or harvest their forestland to work closely with NCDFR and/or private consulting foresters on pre-harvest plans, forest regeneration programs, courtesy Forest Practices Guidelines (FPG) exams, and Best Management Practices (BMP) implementation.
5. Help disseminate existing information and educational materials to local landowners and citizens (e.g., pamphlets, websites, NCDFR contact information, etc.) and help landowners obtain technical assistance. Target education and outreach efforts based on Basic Steps 1 and 2. For example, staff can make sure forestry landowners are aware of the NCDFR's Forestry Stewardship Program.
6. Develop a notification program that will notify a NCDFR County Ranger if forestry activities are suspected of contributing to an identifiable water quality concern.
7. To avoid creating disincentives for landowners who continue to manage their land for forestry, promote the values of "working forests" when implementing land-use management policies or the Present Use-Value Taxation program for forestry. (Although present-use valuation may reduce property tax revenue, forestry costs less to support than other land uses.)
8. Because ecological and economic conditions change for forestry activities over time, allow some flexibility in the development and execution of forest management plans as long as local water quality is being maintained.
9. Pay special attention to tracts where the land use is to be converted from forestry to development. It is important that such sites have their riparian buffers maintained in accordance with the future, developed use. (Buffer requirements are often less restrictive for timber operations because tree harvesting does not permanently compact soil or add impervious surfaces, whereas development does.) The following measures would provide additional protection on sites that are slated for development:
    a) Enforce required buffer widths during development, regardless of the amount of riparian vegetation left after timber harvesting.
    b) Impose a waiting period for new development (I think Durham County has this already) that would take place on sites where buffers were harvested. The waiting period should be sufficient to allow buffers to reestablish to more closely meet the standards in effect for new development generally (e.g., five years).
    c) Require developers to restore any buffers that were not maintained to local and/or state standards for new development before permitting clearing or grading of the site.
10. Evaluate effects of bona fide forestry operations on local streams.

The Upper Neuse Watershed Management Implementation Plan Recommendation Sheet 15 (http://www.unrba.org/downloads.htm) provides an excellent discussion on Agricultural Best Management Practices Education and Outreach and recommends the following implementation steps for encouraging voluntary water quality improvement projects and decreasing water quality impacts from silvicultural and agricultural operations:

1. Encourage local farmers to seek assistance from Cooperative Extension, SWCD, NCDWQ, NRCS, and other organizations to voluntarily reduce water quality impacts, for example, by installing and maintaining agricultural BMPs.
2. Encourage Voluntary Agricultural Districts (VADs) in the County. VAD status is an important step toward implementing other agricultural conservation agreements, and it provides an important mechanism for entities to work together.
3. Create a memorandum of understanding for how the County will address animal and agricultural issues between local departments and agencies. (Orange County has this type of MOU between its Planning Department and Orange County SWCD.) Update the MOU on a regular basis or as conditions change. Ensure that nontraditional agricultural operations are included.
4. Participate in county-level SWCD determinations of priority areas for agricultural BMP installation and annual work plan updates (which take place between April and June). (Districts can receive input at any time.)
5. Participate in annual NRCS interested stakeholders meetings (generally in November or December) to help coordinate conservation and planning efforts.
6. Obtain data on farmlands, pastures, lagoons, and spray fields from the local SWCD and the Farm Services Agency (FSA) on a regular basis. Consider this information when planning county land use (fragmented farmlands are less viable farmlands). (The FSA is currently undertaking a digital mapping initiative of agricultural areas nationwide that shows farm boundaries down to individual fields. The NRCS also includes agriculture in its National Resources Inventory effort, a statistical survey of land use and natural resource conditions and trends on non-Federal U.S. lands.)
7. Encourage farmers to participate in local and regional watershed and land use planning efforts.
8. Could Soil & Water staff inspect receiving waters when they do site visits to see if there is offsite sedimentation occurring? Can they prioritize topsoil farms and dirt farms for this type of site visits? How else could we deal with this type of exempt operations? Nurseries? Others?
9. If problems with an agricultural operation in the Upper Neuse Basin are suspected, report these problems to the NCDWQ Raleigh Regional Office at (919) 571-4718 **and** to the local SWCD office. Soil and Water staff could

In addition, the NCDWQ should investigate how the regulations can be clarified to continue to exempt the target farming operations while disallowing these abuses of the exemption.

Costs:

- NCDFR County Ranger offices and staff
- Staff time to interface with NCDFR County Rangers and Water Quality Foresters
- Staff time to conduct and participate in educational efforts on forest stewardship, forestry BMPs, FPGs, and Neuse Buffer Rules
- Staff time to help landowners obtain basic information about forestry (e.g., directing requests to appropriate NCDFR staff and the NCDFR website)
- Staff time to coordinate with agricultural conservation agencies, attend meetings, etc.

- Staff time to work with the agricultural community
- Funds for cost-share matching assistance

Funding Opportunities:

- USEPA Nonpoint Source Section 319(h) grants
- NCDFR (USFS) Forest Stewardship Program and Southern Pine Beetle Prevention Program
- NCSU Forest Education & Outreach Program (http://www.ces.ncsu.edu/nreos/forest/feop/)
- General funds
- Bonds
- Grants
- Land conservancies and trusts
- Landowners
- Section 319 nonpoint source grants
- There are numerous programs to help farmers pay for BMP installation, such as EQIP, CRP, CREP, the NC Agriculture Cost Share Program, the Landowner Incentive Grant Program, and the Smithfield Agreement. Local SWCDs can provide guidance on the appropriateness of these funding sources for various projects.

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

N.C. Division of Water Quality (NCDWQ). 2006. *North Carolina 303(d) List*. [Online]. Available at: http://h2o.enr.state.nc.us/tmdl/documents/303d_Report.pdf [accessed May 15, 2008].

Upper Neuse River Basin Association (UNRBA). 2003. *Upper Neuse Watershed Management Plan*. [Online]. Available at: ftp://ftp.tjcog.org/pub/unrba/finlplan.pdf [accessed May 15, 2008].

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Upper Neuse River Basin Association (UNRBA). 2007b. *Upper Neuse Watershed Management Implementation Recommendation #15*. [Online]. Available at: http://www.unrba.org/downloads.htm [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #4: Impacts from Infrastructure Crossing the Stream Corridor

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description
The installation of utility crossings may remove riparian vegetation and alter stream hydrology, causing incision that may inhibit streams from over-banking during high rainfall events, a key component to maintaining an active floodplain. An active floodplain can serve as a water storage facility during storm and flood events, and riparian vegetation along floodplains helps prevent erosion and provides aquatic habitat.

Indicators of the problem and current conditions
A build-up of debris at culvert mouths or evidence of erosion around headwalls and/or embankments may indicate poor flow alignment, and the build-up of sediment at the mouth of culverts may indicate hydrologic modification. Reduced velocity at the mouth of culverts and scouring at the base of culverts may also be indicators of hydrologic modification. These changes can impact macroinvertebrate communities and may inhibit the passage of fish and/or the suitability of spawning habitat.

During their 2007 fieldwork, the Lick Creek Partners observed that extensive riprap was present at most new infrastructure crossings, accompanied by steep side slopes (CWP 2007). The partners noted that some road crossing culverts in new developments were not flow-aligned, and that a surprising number showed evidence of erosion around headwalls and/or embankment failure. Many of the new developments in the watershed had gravity sewers that run parallel to the main stem of Lick Creek and cross it and its tributaries frequently in relatively short distances. Furthermore, it appears that the utility easements

associated with the utility lines are encroaching into forested buffers. Design standards for sewer crossings and stream culverts could be modified to minimize the effect on the stream or wetland function..

Future threats

As development in the watershed continues (up to approximately 40% impervious cover in possible in some subwatersheds), and more land areas are incorporated into the city, it is inevitable that public utilities will be installed to service new communities. This means that the stream reaches in Lick Creek are likely to see many additional utility crossings in the coming decades.

Recommended Strategies

1. Create a database of planned, active construction, and existing stream crossings for infrastructure. Does this exist somewhere already?
2. Follow-up with structural repairs identified in the CWP's 2007 memo, Lick Creek Fieldwork: Findings and Recommendations (Appendix A, Table A-2: Enforcement).
3. Review criteria for stream crossings. Determine if design criteria for sewers needs revision or if more stringent oversight is needed. Who would do this?
4. Review proposed infrastructure mapping to determine number and location of stream crossings; propose alternative layouts or designs (i.e. to reduce number of crossings). Could this be incorporated into the planning process somehow? Maybe as part of the permit application?
5. Change Durham Unified Development Ordinance (UDO) language governing the location of sewer lines [UDO 8.5.5(J)(3)] to make local practice consistent with statewide Neuse Buffer Rules.
6. Convene an interdepartmental task group to discuss the possibility of maintaining existing vegetation or at least encouraging re-vegetation with native grasses at a greater height in the mowed right-of-way.
7. ~~Encourage the use of bioretention with underdrain systems in landscaped areas of parking lots to slowing discharge and provide stormwater treatment. Reviewers: do you think that this is applicable?~~
8. What other tools are there to reduce impacts from utility installations? Reduce side slopes? Make sure culverts are sized to account for increases in development? Thoughts?
9. Recommend inspections of utilities crossing streams to ensure that utility lines aren't getting exposed and/or damaged?? (related IDDE mandate)

Costs:

- Jurisdiction: database of crossings (planned, active construction, and existing crossings), inspectors and support staff time, equipment, and vehicles

Funding Opportunities

- Plan review fees
- Utility fees
- General funds

UNRBA – Heather Saunders – hsaunders@tjcog.org / (919) 558-9319

- Clean Water Management Trust Fund
- Impact fees?

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #5: Riparian Buffer and Floodplain Encroachment

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

The removal of riparian vegetation along stream corridors can have severe impacts on stream stability and flooding. Riparian vegetation helps slow water velocities during flood events when a stream overtops its banks and also helps keep soil in place through root structures. Removal of this vegetation may cause extensive and destructive flooding because there is no control on discharge, which contributes to in-stream erosion and bank-cutting. Protecting riparian vegetation, particularly trees can help minimize loss of a landowner's property due to stream bank collapse and erosion. Furthermore, riparian areas remove nutrients and evapotranspirate runoff. Riparian buffers and floodplains also provide aquatic habitat in the form of backwater sloughs, intermittent water storage areas, root structures and masses, and shade. These habitat types provide spawning areas for fish and aquatic invertebrates and play a critical role in maintaining the stability of the aquatic food chain by providing a diversity of habitats.

Although many federal, state, and local regulations apply to these areas, some only require impacts to be subject to a permitting process, and they may not be implemented and enforced consistently. Insufficient or inaccurate information about riparian features in the development process may be partly responsible for the amount of impacted buffers observed in Lick Creek (see Lick Creek Management Strategy #7:

Delineation of Stream and Wetland Boundaries). Also, private landowners are often unaware that they have buffers on their property and that they should remain vegetated with native trees or woody shrubs, when possible.

Indicators of the problem and current conditions

The most obvious indicator of floodplain and buffer encroachment is the lack of riparian vegetation adjacent to streams and waterways. Other indicators include bank erosion, channelization, and sedimentation. The most egregious form of buffer and floodplain encroachment is placement of parking lots and other impervious surfaces close to streams. Such impervious cover can result in even greater discharge and sedimentation, further exacerbating the problems described above.

Fieldwork carried out by the Lick Creek Partners observed a multitude of impacts to stream and wetland buffers at recently constructed and active development sites, as well as in timber harvesting areas (CWP 2007). Observed impacts included the clearing of riparian vegetation, sedimentation, stream degradation, encroachment, and the deposition of fill materials adjacent to waterways. Furthermore, the Lick Creek Partners noted that many of these impacts were permitted by the NCDWQ as variances from the Neuse River Basin Buffer Rule (CWP 2007). Recommendations from the CWP (2007) suggest "Approval of buffer impacts should be linked with more stringent oversight of erosion and sediment control, stormwater management, and education efforts, as loss of buffer function leaves the respective stream or wetland more susceptible to degradation".

Future threats

A good portion of the Lick Creek watershed is expected to reach between 20 to 40% at buildout (Subwatersheds 1, 2, 3, 4, 5, 6, 7, and 8). If previous development patterns continue, more riparian vegetation and stream buffers will be encroached upon by new subdivisions and infrastructure. A continued policy of permitting riparian buffer impacts threatens riparian corridors that are supposed to be protected and compromises the integrity of previous modeling efforts that were used to develop the Neuse River Nutrient Management Strategy, which assumed that these buffers would be maintained as development occurs. Increased erosion, flooding, sedimentation, and aquatic habitat degradation are all likely consequences of further buffer and floodplain encroachment.

Recommended Strategies

1. Discourage applicants from applying for variances to buffer requirements. Explore alternative site configurations that reduce buffer impacts.
2. Expand riparian buffer protections. Some suggested approaches:
    a) Utilize the wider buffer requirement suggested in the East Durham Open Space Plan (300 ft from top of bank on each side).
    b) Expand buffers to protect floodplains.

    c) Alternatively, create and enforce a system of riparian buffer requirements that restricts development in riparian areas based on environmental factors, such as floodplains, soils, and/or steep slopes. (Areas in the Upper Neuse critical to water quality were

identified through the Upper Neuse Clean Water Initiative.) A system based on such factors would be more complicated to implement than prescribing buffer width, but it could be more protective and/or offer more flexibility. Additional enforcement would be needed to ensure that this system provides a level of protection comparable to the prescriptive approach.

3. Visit and document any location where illicit buffer impacts are known or suspected.
    a) Citizen Buffer Watch Group like Stream Watch or Muddy Water Watch?
    b) Who would maintain this database? Enforce or follow-up on compliance?
4. Monitor riparian buffers during construction for compliance with development rules and conditions.
5. Conduct post-development site visits to ensure that buffers have been managed as required by ordinance. Riparian buffers constitute the most effective stormwater management tool, buffers should receive the same level of oversight as other stormwater management controls. UNRBA (2003) describes an efficient and effective approach.
6. Educate local officials, inspectors, NCDWQ and residents on the ecological services provided by mature vegetation, wetlands, streams, floodplains, and riparian buffers.
7. Indirect impacts to wetlands need to be considered during impact review process. Additional wetland protections may be called for.
8. Natural drainage design should be incorporated for new developments.
9. The value of zero-order, ephemeral drainages has been documented and supports environmentally sensitive design and low-impact development. The use of direct piped discharge to natural drainage channels (e.g., curb and gutter) should be discouraged.
10. Change Durham Unified Development Ordinance (UDO) language governing the location of sewer lines [UDO 8.5.5(J)(3)] to make local practice consistent with statewide Neuse Buffer Rules.
11. Create stronger protections for small (less than one acre) wetland areas adjacent to intermittent streams that currently escape protection (these are not shown on the USGS or Soil Conservation Service maps).
12. Do not allow manmade stormwater management features within the stream buffer.
13. Do not plat single-family residential lots inside designated riparian buffers.
14. Increase incentives to preserve existing trees and forested areas on sites slated for development.

Costs

- Database of planned, active, and illicit riparian buffer impacts
- Improving ordinances for riparian protections
- Plan reviewer trainings
- Field inspectors and support staff time, equipment, and vehicles
- Outreach materials and staff time

Funding Opportunities

- Plan review fees

- Utility fees
- General funds
- Impact fees?

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations.* [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

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Lick Creek Local Watershed Restoration Plan Management Strategy #6: Protection of High-Quality Streams and Wetlands through Land Conservation

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

High quality streams and wetlands provide irreplaceable water quality and aquatic habitat benefits such as water storage, pollutant removal, aquatic and terrestrial habitat, erosion control, and recreation. In addition, the protection of these systems can be used to teach citizens about natural resource systems and can provide invaluable conservation benefits in terms of breeding and foraging areas for fish and birds.

Indicators of the problem and current conditions

An excess of degraded stream and wetland systems, a decline in macroinvertebrate community diversity, loss of riparian buffers and streamside vegetation, and a disappearance in fish species all suggest a loss of high-quality streams and wetlands. Furthermore, a lack of pristine stream and wetland areas is an obvious indicator that conservation measures within the watershed are lacking.

The Lick Creek watershed is already experiencing degraded water quality conditions (Line and Penrose 2007) and Lick Creek itself has been listed as impaired on the State's 303(d) list since 1998 (NCDWQ 2008). In addition, the watershed is also expected to experience significant development and increases in impervious cover (UNRBA 2008), especially in the subwatersheds that fall within Durham's Urban Growth Area (UGA). Given the combination of declining water quality and expected increases in impervious cover, stream and wetlands are under threat from both pollutant loading and hydrologic changes from increased impervious cover and land clearing. According to the Lick Creek Watershed Treatment Model Analysis (Fraley-McNeal et al. 2007), Subwatersheds 1 through 8 generally have lower levels of open green space and protected land areas than Subwatersheds 9, 10, and 11.

Future threats

A good portion of the land that is directly adjacent to Falls Lake (mostly in Subwatersheds 9, 10, and 11) is owned and protected by the U.S. Army Corps of Engineers (USACE) and is preserved as open space in perpetuity. However, more than half of the Lick Creek watershed falls within the City of Durham's UGA, which suggests that high-quality streams or wetlands in this zone are at risk of being altered, removed, impaired, and/or degraded as a result of development. According to the Watershed Treatment Model Analysis (McNeal et al. 2007), most of the subwatersheds in the Lick Creek watershed are expected to see increases in the amount of open space and protected land area; however, percentage increases do not reflect the current levels of protected area in the watershed and cannot be used to evaluate whether sufficient green spaces and critical lands are protected to maintain water quality, especially since Lick Creek is already impaired. Every effort should be made to preserve as many existing high-quality aquatic and riparian systems as possible, starting with areas identified in the Upper Neuse Clean Water Initiative (UNCWI) Conservation Plan (Trust for Public Land 2006). Land preservation and conservation opportunities become scarcer and more expensive as development proceeds and urban services are extended. Long-term planning and a coordinated acquisition approach are critical for this strategy to be successful.

Recommended Strategies

1. Protect the lands with highest conservation value identified Lick Creek Critical Lands technical memorandum (UNRBA 2008) in perpetuity using voluntary measures such as land acquisition and permanent conservation easements.
2. Because unprotected headwaters significantly impact water quality and because they currently receive little to no protection, finding ways to protect headwater drainage networks should be a high priority.

3. Preserve a large portion of Lick Creek Critical Lands (UNRBA 2008) by prohibiting development and disturbance within the 1% annual chance floodplain.
4. Prioritize acquisition or conservation of tracts or tract segments with riparian features most likely to be developed or altered, or that are exempted from current ordinances.
5. Identify which Lick Creek Critical Lands (UNRBA 2008) are most vulnerable to future development or impacts from adjacent development. For sites slated for development, ensure plan review staff encourage open space protection. Also ensure that Sediment & Erosion and stormwater regulations are strictly enforced on Lick Creek Critical Lands and on adjacent developing tracts.
6. Small (less than one acre), developed tracts make up 48% of the total tracts with high value lands. Educate landowners about the ecological and water quality value of maintaining these lands in an undisturbed state, and seek conservation easements to protect riparian features.
7. ~~The City and County of Durham's urban growth area was recently expanded. Durham should consider returning the boundary to its previous location (based on the Falls Lake Critical Area?).~~
8. Create stronger protections for all riparian features that currently escape protection, including small (1/10 acre) wetlands.
9. ~~Use mitigation funds from wetland impacts or the Neuse Nutrient Offset Fees to purchase stream corridor parcels.~~
    a. ~~If you mean in-tact stream corridors that is harder, since the money usually goes toward restoring or enhancing disturbed sites. If the buffer is disturbed, nutrient offset would be best option.~~

Costs

- Fee-simple acquisitions and use rights/conservation easements (NCEEP estimates $11,000 an acre for Durham)
- Outreach materials and staff time
- Staff time to revise development ordinances, enhance plan review, and enforce codes

Funding Opportunities

- Clean Water Management Trust Fund
- 319 NPS Grant Program
- Watershed management/protection "fee" paid by residents or businesses in the watershed.
- Existing and future state and local bonds
- Citizen donations (cash, land, easements, etc.)
- Agricultural conservation programs (e.g., CRP, CREP, WRP, etc.)
- NC Ecosystem Enhancement Program (if land protection is tied to specific water quality benefits such as nitrogen reduction)
- Utility fees (water & sewer, stormwater)
- State mitigation bank?

References

Fraley-McNeal, L., Hoyt, S., and Kitchell, A. (2007). *Lick Creek—Watershed Treatment Model Analysis*. [Online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo062007.pdf [accessed May 15, 2008].

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Lick Creek Local Watershed Restoration Plan Management Strategy #7: Delineation of Stream and Wetland Boundaries

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

Accurate stream and wetland delineation is a crucial aspect to protection. Section 401 and 404 of the Clean Water Act implicitly protect intermittent and perennial streams and wetlands from development and encroachment. State and federal agencies rely on local consultants to delineate these areas based on criteria established and monitored by the US Army Corps of Engineers (USACE). While all delineations are required to be visited and approved by a USACE representative, the CWP (2007) expressed concern that delineations in the watershed under-represent the actual amount of streams and wetlands in the watershed. Moreover, delineation does not guarantee protection, as impacts are permitted to riparian areas and mistakes may be made during plan review and/or construction (see Lick Creek Management Strategy #5, Buffer and Floodplain Encroachment).

Indicators of the problem and current conditions

The Lick Creek Partners (CWP 2007) used stream and wetland layers from various sources during their fieldwork including U.S. Geologic Survey (USGS) 1:24,000 quadrangle maps, Durham Stormwater Services Hydro-l and Hydro-p mapping, Digital Elevation Model (DEM)-generated streams, and National Wetlands Inventory (NWI) mapping. The Lick Creek Partners observed that many small, first-order DEM-generated streams were not captured by USGS or Durham mapping, but were verified as flowing streams by field teams. In addition, field teams noted significant differences between the NWI layer and wetland locations in the field. Furthermore, in many cases, wetland delineation flagging did not appear to fully cover the true wetland extent.

Future threats

Under current regulations, only streams that are depicted on an USGS 1:24,000 quadrangle maps or on U.S. Department of Agriculture Soil Survey maps are protected by the Neuse River Basin buffer rules. This means that any actual intermittent or perennial stream in the watershed that does not show up on these maps does not have protected buffers and is at risk of being impacted during development. Moreover, in practice, the Soil Survey maps may not be consulted because they are not always available in a digital format in Durham. This means that some streams, especially intermittent streams, might not be receiving adequate protection.

Recommended Strategies

1. ~~Create stronger protections for small (less than one acre) wetland areas adjacent to intermittent streams that currently escape protection (these are not on the USGS or SCS maps). Do not allow stormwater management facilities within the wetland or its buffer.~~
2. Create and enhance local protection of intermittent and ephemeral drainages and wetlands.
3. Digitize the Soil County survey maps. Consolidate with USGS 1:24,000 quadrangle maps and Durham's riparian features GIS layer and use the consolidated GIS layer for plan review.
4. Ground truth riparian maps (ground-truthing may be partly done by volunteers).
5. Delineate and protect streams upstream of current points, to a designated catchment size. The Federal Emergency Management Act (FEMA) delineation begins at a 1 square-mile drainage area.
6. Have staff verify stream and wetland locations when development proposals are first submitted.
7. Ensure that all plan review stages utilize best available data based on steps listed above.
8. A local wetland inventory should be conducted to revise NWI maps.
    a. Wetland delineations associated with recent developments could contribute to the inventory.
    b. Incorporate this revised inventory into the compiled riparian feature GIS layer.

Costs

- Staff time to ground-truth maps and/or coordinate volunteer ground-truthing teams
- Staff time to revise development ordinances, enhance plan review, visit development sites, and enforce codes

Funding Opportunities

- Plan review fees
- Clean Water Management Trust Fund?
- Impact fees?

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #8: Major Watershed Restoration Projects

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

Lick Creek has been listed as "impaired" by the State due to its inability to support aquatic life and low levels of dissolved oxygen (NCDWQ 2006). In addition, fieldwork conducted as part of this planning process has revealed that sedimentation is another major problem in terms of aquatic habitat and water quality. Furthermore, a large majority of the watershed falls within the Triassic Basin, which is represented by highly erodible and relatively impermeable soils. While stream restoration alone is likely not enough to reverse the impairment in the watershed, it is an important component to restoring water quality conditions. In many circumstances, because of massive stream incision, a stream channel will not become stable and fully functioning without some for of assistance through restoration efforts.

Major restoration projects include practices such as stormwater retrofits, stream restoration, floodplain reconnection, and large buffer plantings that require engineering design, construction by a contractor, long-term maintenance, and/or project management by a local government. Stabilizing the many sections

of stream that are actively eroding will significantly reduce the amount of sediment in these streams. In addition, restoration may enable a stream to better transport sediment under varying flow conditions, reduce flow velocities along and/or near the banks, remove nutrients and sediment through flooding, stabilize stream banks, provide habitat for aquatic life, and prevent loss of soil.

Indicators of the problem and current conditions

Multiple major restoration opportunities that could help restore lost ecosystem functions have already been identified for the Lick Creek watershed (UNRBA 2007; Table A-6: Major Restoration in Attachment A). Almost 25 acres of drainage area could receive water quality treatment by stormwater retrofits and one linear mile of stream buffer could be reforested (CWP 2007). The NCEEP and UNRBA are currently developing a Project Atlas that will catalog potential major restoration projects, such as those listed in the Lick Creek Watershed Restoration Priorities memorandum (UNRBA 2007), and are facilitating implementation of restoration projects among local stakeholders and NCEEP.

Future threats

As the watershed becomes more developed, major restoration projects will likely become more difficult, costly, and scarce due to encroaching urbanized land uses and because land costs rise as urban services are extended. It is therefore imperative to ensure that restoration opportunities already identified are factored into future planning efforts and implementation begins as soon as possible. Delaying implementation will result in higher costs.

Recommendations

1. Ensure that new potential restoration projects are incorporated into the NCEEP Project Atlas for Lick Creek, including nutrient offset buffer restoration opportunities and projects that do not meet current NCEEP mitigation credit criteria.
2. Partner with NCEEP and UNRBA to implement high-priority stream and buffer repair opportunities, focusing first on projects where development is likely to take place in the near future (Fraley-McNeal et al. 2007) and/or on publicly owned land that are visible, accessible, and/or provide opportunities for community outreach/involvement.
3. Regulatory agencies should work with NCEEP to develop mitigation credit strategies that address urban and urbanizing watershed stressors, such as stormwater retrofits and land preservation, that traditional mitigation project do not.
4. Conduct annual stream walks and/or review aerial photography in the watershed to identify new restoration opportunities. Some of this work may be able to be conducted by volunteers and/or in conjunction with efforts to enforce riparian buffer protection regulations (see Lick Creek Management Strategy #5, Buffer and Floodplain Encroachment).
5. Coordinate with UNRBA, NCEEP, and other agencies implementing restoration projects to encourage owners of properties that have been identified as high-priority stream and buffer restoration opportunities to participate in restoration efforts.
6. During reviews of development plans and building permit applications, check to see if any potential watershed restoration projects exist on the parcel. If so, ensure that the potential

restoration project will not be compromised by encroachment or excessive sedimentation or runoff (during construction or afterward).

a) Include the UNRBA Project Atlas in the plan review checklist.
b) Note that if the developer sets aside open space as a local stipulation of the development, the NCEEP cannot get mitigation credit for working on the same piece of land. However, other funding sources, such as CWMTF, may be available.
c) Update stormwater ordinance language to include requirements or consideration of LID designs as mitigation. (See Recommendation #2 regarding NCEEP mitigation credit for nontraditional projects.)

7. Institutionalize a goal to further reduce stream or buffer restoration needs due to new development.

Costs:

- Land acquisition and associated fees
- Planning and construction costs
- Landowner outreach
- Staff time for plan review

Funding Opportunities

- NC Ecosystem Enhancement Program (http://www.nceep.net): a statewide, non-regulatory program to restore, enhance, preserve and protect wetlands, streams, and riparian areas in the State. The program funds planning efforts and can fund "traditional" compensatory mitigation projects (stream repair, riparian buffer restoration) directly or as a part of a comprehensive watershed management approach.
- Local or user water, stormwater, or other utility fees
- Private landowners may contribute cash (especially in jurisdictions where there is a stormwater fee and a credit for project implementation) or may donate or allow easements on the project land
- North Carolina Clean Water Management Trust Fund: Riparian land acquisition and restoration projects (www.cwmtf.net)
- U.S. Environmental Protection Agency Nonpoint Source Program Section 319 grants: Stream restoration planning, implementation and monitoring (www.epa.gov/owow/nps/cwact.html)
- Division of Soil & Water Conservation, which administers cost share and grant programs such as the Conservation Reserve Enhancement Program (CREP) to establish and protect riparian buffers (www.enr.state.nc.us/DSWC/pages/crep.html)
- USDA-Natural Resources Conservation Service (NRCS), which administers cost share and grant programs for water quality restoration and protection (www.nrcs.usda.gov/programs/programs_faq.html)
- Conservation on Private Lands (www.nfwf.org/programs/nrcsnacd.cfm), a partnership between the National Fish and Wildlife Foundation and NRCS to support conservation and stewardship of private lands.

- Five-Star Restoration Matching Grants Program (http://www.nfwf.org/programs/5star-rfp.cfm), which awards between $5,000 and $20,000 to restoration projects with a community component.
- U.S. Geological Survey Cooperative Water Program (http://water.usgs.gov/coop): assists local and state agencies with water-quality and hydrologic investigations, including monitoring and quantifying the effectiveness of BMPs and restoration efforts

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

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Lick Creek Local Watershed Restoration Plan Management Strategy #9: Restoration Projects to be Implemented by Volunteers

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

Opportunities exist for small restoration projects that can serve as "quick wins" for on-the-ground implementation. These projects are fairly simple to design and relatively inexpensive compared to major restoration projects. Additionally, volunteers can often accomplish these projects with the technical assistance of local government staff and/or extension agents. Examples include trash cleanups, simple buffer plantings, and small stormwater retrofits such as rain gardens.

Current conditions

Multiple volunteer restoration opportunities have already been identified for the Lick Creek watershed (UNRBA 2007) and efforts are underway to see implementation of some of these projects on the ground through a Home Depot Foundation Grant that was awarded to UNRBA via the Center for Watershed Protection. Furthermore, the NC Ecosystem Enhancement Program and UNRBA are currently working on a project atlas that will catalog volunteer projects such as those listed in the Lick Creek Watershed Restoration Priorities memorandum (UNRBA 2007).

Future threats

As the watershed becomes more developed, volunteer restoration opportunities will likely multiply. However, a reliance on post-impact mitigation efforts should be avoided and every effort made to preserve existing aquatic systems as they provide a suite of environmental services such as water storage and pollutant removal that are difficult to replace. Volunteer restoration projects will have the most benefit in areas that are only slightly impacted; alone, they cannot bring an impaired watershed back to health. In addition, space for tree and buffer plantings will also likely become more limited as watershed residents add appurtenant structures to their properties. Repairing watershed impacts after the fact is difficult, time consuming, and expensive. Therefore volunteer restoration projects will possible address future impacts by providing an outreach educational opportunity to demonstrate the importance of protecting existing buffers.

Recommendations

1. Continue outreach to landowners with lands intersecting buffer restoration opportunities to encourage them to implement volunteer restoration, retrofit, and land protection projects identified during this planning process. Most people will not know of the opportunities without outreach. Start with opportunities at public schools. Involve teachers and other staff who may be able to champion these projects.
2. Continue working with partner organizations to obtain grants and other resources to implement volunteer restoration projects on both public and private properties, such as buffer plantings, rain gardens, etc.
3. Conduct annual stream walks and/or review aerial photography in the watershed. Stream walks will help identify new restoration opportunities and strengthen riparian buffer protection stewardship.

Costs:

- Implementation of restoration and other management practices (designs, materials, staff time, installation, maintenance, monitoring, volunteer coordination, etc.)
- Voluntary conservation easements and fee-simple acquisitions
- Planning and construction costs
- Landowner outreach

Funding Opportunities:

- Local or user water, stormwater, or other utility fees
- Private landowners may contribute cash (especially in jurisdictions where there is a stormwater fee and a credit for project implementation), may donate land, or may allow easements on the project land
- North Carolina Clean Water Management Trust Fund: Riparian land acquisition and restoration projects (www.cwmtf.net)
- U.S. Environmental Protection Agency Nonpoint Source Program Section 319 grants: Stream restoration planning, implementation and monitoring (www.epa.gov/owow/nps/cwact.html)

- Division of Soil & Water Conservation, which administers cost share and grant programs such as the Conservation Reserve Enhancement Program (CREP) to establish and protect riparian buffers (www.enr.state.nc.us/DSWC/pages/crep.html)
- USDA-Natural Resources Conservation Service (NRCS), which administers cost share and grant programs for water quality restoration and protection (www.nrcs.usda.gov/programs/programs_faq.html)
- Conservation on Private Lands (www.nfwf.org/programs/nrcsnacd.cfm), a partnership between the National Fish and Wildlife Foundation and NRCS to support conservation and stewardship of private lands.
- Five-Star Restoration Matching Grants Program (http://www.nfwf.org/programs/5star-rfp.cfm), which awards between $5,000 and $20,000 to restoration projects with a community component

References

Upper Neuse River Basin Association (UNRBA). 2007. *Lick Creek Watershed Restoration Priorities*. [Online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo101507.pdf [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #10: Suspicious Discharges from Onsite Wastewater Systems

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Stakeholder Review: Oct. 2008;
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Implementation Scale: Regional and local
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Description

Onsite wastewater systems are prevalent throughout Lick Creek. Due to the geology, traditional septic onsite wastewater system designs are not possible in many locations, and there are a significant number of sand filter systems that discharge directly to streams. Because these are more complex than conventional onsite wastewater systems, they are more prone to failure and are supposed to be permitted by the state and inspected by the County Health Department annually (15A NCAC 18A .1961). Fieldwork from Little Lick Creek in 2005 and Lick Creek in 2007 confirm that many of these systems are failing (most are nearing 30 to 50 years old) and that they are frequently not sufficiently maintained or inspected.

Finding a solution to this problem is complex for many reasons:

- Many of these systems are aging systems owned by low-income households or on low-rent properties
- Many of these systems could be connected to the City's sewer system, but the hook-up fees and plumbing costs can be prohibitive
- Because these systems are permitted by the state, it is the state's responsibility to monitor and enforce regulations of their NPDES permits, not the responsibility of Durham County Environmental Health
- The City has a program for detecting and stopping illicit discharges, but it is unclear whether the County does?

According to the UNRBA (2006), failing septic systems can contribute to elevated levels of nutrients, bacteria, and other contaminants in surface waters and ground waters within the watershed. Furthermore, UNRBA suggests that in many places, there is no systematic method of capturing and tracking information on locations of specific failing systems and assuring their improvements. Although the state requires that some systems (those with pumps or advanced technologies) installed after 1992 be inspected on a regular basis by the local health department, the majority of systems are not inspected regularly. Additionally, most counties lack the resources and funding to carry out this state-mandated inspection program.

Indicators of the problem and current conditions

Fecal coliform, or more specifically *e. coli* bacteria in receiving waters, is the major indicator of untreated onsite wastewater system discharges. A secondary indicator may be elevated levels of ammonia, which primarily originates from human and animal wastes. Non-functioning or malfunctioning onsite wastewater systems can cause high levels of fecal coliforms even during periods of low flow because these systems run all the time.

Although sand filter and other potentially problematic systems are not as numerous in the Lick Creek Watershed as they are in Little Lick, pollution from these systems can be a serious problem in small, concentrated areas within these subwatersheds. In particular, fieldwork teams observed a concentrated number of onsite wastewater system discharges to the stream in a residential neighborhood near Olive Branch Rd., Bookman Rd., Hester Rd., and Rondelay Rd.

Future threats

The potential future threat from malfunctioning onsite wastewater systems is not substantially increasing, as most systems at high risk of failure are already near the age threshold when failures become most probable. New housing developments in the watershed are annexed into the city and are served by the city's sewer system. However, experience from Little Lick Creek shows that many existing dwellings with such systems have not been hooked up to City sewer, even when service is available nearby, because of the expense associated with new hookups. This creates islands of homes with aging, substandard onsite wastewater systems on poorly drained soils.

Recommended Strategies

1. Create, implement, and maintain a GIS database of existing on-site septic systems and well locations. Maintain a database of mailing addresses for properties, current property owners, and inspections information (histories, system type, etc.) using GIS or another database that can be joined with the GIS database (EPA has a Microsoft Access tool called TWIST to assist localities with this). Maybe this already exists?
2. Create a task force with other stakeholders such as NC Division of Environmental Health to explore opportunities to prevent and address onsite wastewater treatment system failures and ensure that high-risk onsite systems (such as sand filter systems) are hooked up to available

public sewer systems.

3. Create and implement a mechanism to educate on-site wastewater system owners and users about their systems, maintenance, and the possible need for an NPDES permit (landowners may need assistance with this process). The GIS database could be used to help target these efforts. Choose one of the two alternative approaches described below to conduct outreach.
    a. Conduct outreach at regular intervals, e.g., on an annual basis. NCSU and North Carolina Cooperative Extension have numerous educational publications on maintenance of onsite wastewater systems available in hard copy and on the web at: http://www.soil.ncsu.edu/about/publications/index.php.
    b. Provide information to new owners at time of property transfer. (For example, Wake County distributes NCCE fact sheets to new homeowners with a video or CD copy of the NCSU video "Septic Tanks" via realtors, local Wake County Extension Center, and the Wake County Dept. of Environmental Services.)
4. Maintain a list of certified installers and inspectors in your area and update applicable ordinances to require that all inspections, installations, and repairs of systems be performed by a certified inspector. The NC On-Site Wastewater Contractors and Inspectors Certification Board (http://www.deh.enr.state.nc.us/osww_new//NCOSW_Cert.htm) certifies people who construct, install, and repair on-site wastewater systems.
5. Help low-income onsite wastewater system owners obtain funding to cover costs associated with converting to City sewer service through cost sharing, capital improvements, or restoration/mitigation funding.
6. If landowners with systems that should have NPDES permits are not complying with the law, pursue enforcement actions.

Costs:

- Inspectors, vehicles, equipment, legal support, etc.
- GIS database of systems
- Educational materials and programs
- System maintenance, repairs, replacements, tap-ons to sewer, inspections, upgrades to more suitable treatment systems (including community systems)

Funding Opportunities:

- Clean Water Management Trust Fund
- Inspection fees
- Onsite wastewater management utility/enterprise
- Impact fees on new systems
- Section 504 Loan & Grant Program (administered through USDA)
- NC Division of Community Assistance
- NC Rural Communities Assistance Project
- State Clean Water Revolving Funds (Recent changes to the EPA budget have reduced CWRF funding levels nationally but have also specified that a part of this national funding is directed for

decentralized technologies. Hence, county management programs, system upgrades, etc. may be fundable to a greater extent than in the past from this funding source. However, changes may be needed to local NC CWRF authorization language to utilize funds this way.)

References

Upper Neuse River Basin Association (UNRBA). 2007. *Upper Neuse Watershed Management Implementation Recommendation #6.* [Online]. Available at: http://www.unrba.org/downloads.htm [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #11
Targeted Outreach and Education

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
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Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description
The Lick Creek fieldwork teams identified several locations where targeted education to watershed residents, businesses, and the development community is needed regarding illicit discharges and best management practices. Practices such as uncovered fuel storage, poor waste storage, and poor stream buffer management reveals opportunities for education to help landowners and business owners better follow regulations and best management practices.

Fieldwork, subsequent site visits, and talks with local stakeholders all underscore the need to "educate local elected officials and the public on the impacts of impervious cover to aquatic systems, the susceptibility of the Lick Creek watershed to future impairment due to growth potential and Triassic conditions, and potential management techniques to minimize future impacts (i.e. buffers, better site design, post-construction stormwater quality treatment)" (CWP 2007). The UNRBA and other stakeholders should work together in an effort to raise general awareness of these pressing issues and stimulate support for initiatives to address them.

Indicators of the problem and current conditions
Many poor practices can be observed throughout the Lick Creek watershed, including the following:

- Homes and businesses along stream buffers storing or disposing of waste, often hazardous materials, in the riparian buffer;
- Poor maintenance of on-site wastewater treatment systems, particularly of sand filter-type systems;
- Vehicle maintenance and repair operations discharging toxins such as solvents, waste oil, antifreeze, and other fluids to surface waters;

- Gas stations discharging fuel (primarily diesel), a significant source of copper, zinc, and petroleum hydrocarbons;
- Outdoor materials storage, including hazardous materials, lacking secondary containment areas and adequate labeling of storage containers;
- Restaurant pollution source control, including improper grease storage, wash water disposal, and dumpster management.

Furthermore, in many cases, landowners and businesses were observed to have mowed their vegetation to the edge of water bodies, leaving no riparian buffer along waterways other than grasses. The Lick Creek watershed is one of the fastest-growing areas in Durham County, so educating local elected officials and the public is important and timely.

Future threats

As Lick Creek becomes more densely developed, the stormwater runoff, impacted buffers, stream erosion, erosion and sediment control violations, sewer leaks, and failing onsite wastewater systems that degrade water quality and aquatic life in Lick Creek are likely to become more prevalent. These stressors contribute to degraded water quality conditions, have negative impacts on aquatic life, and increase the costs of water treatment. In addition, the erosive nature of Triassic Basin soils makes the Lick Creek watershed even more susceptible to water quality degradation. Regulatory programs alone cannot address all the stressors in the Lick Creek watershed; education and other voluntary measures are critical to restoring water quality, especially was the watershed continues to become more urbanized.

Recommendations

1. Educate elected officials about the need for stronger ordinance language and adoption of watershed management practices.
2. Provide educational materials (including applicable regulations) to all streamside landowners on a regular basis about the value and function of streams and riparian buffers and the impacts of littering, illicit discharges, poor lawn care, and improper septic system maintenance.
3. Tie education for residents into the volunteer restoration projects.
4. Educate area businesses about pollution prevention.
    a) Conduct outreach presentations and discussions with small auto repair and sales shops, gas stations, business storing materials outdoors, and restaurants with recurring pollution incidents.
5. Educate all landowners in Lick Creek with on-site wastewater treatment systems about proper maintenance and inspections (especially sand filter-type systems). (See Management Strategy #10, Suspicious Discharges, Recommendation #3.)
6. Conduct mailings and/or outreach to landowners to encourage them to implement the restoration, retrofit, and land protection projects recommended throughout this plan. Most people will not know of the opportunities without outreach. Start with opportunities at public schools. Involve teachers and other staff who may be able to champion these projects. (See Management Strategy #9, Recommendation #1).

7. There are many citizens who understand the value of clean streams and water supplies. The City of Durham has an "Adopt-a-Stream" program that trains citizens to detect common water quality problems. Some criteria for targeting sites for volunteer programs include stream reaches:
    a) With easy access to the stream;
    b) Where at least one, but preferably a group of, interested citizens live;
    c) Downstream of areas with high densities of septic systems;
    d) Downstream of active construction sites;
    e) Where known impacts exist; and
    f) Near schools, where science classes could establish long-term water quality monitoring sites.

Costs:

- Staff time to plan, develop, coordinate, conduct, publicize, and evaluate outreach activities
- Developing, printing, and/or distributing educational materials
- Staff overhead (e.g., vehicles, office furniture and supplies, etc.)
- If participating in a partnership, cost shares or other dues

Funding Opportunities:

- Stormwater fees
- Water supply utility funds
- General funds
- State, federal, and private grants
- In-kind contributions from volunteers, nonprofits, and other organizations (e.g., the Eno River Association has its own Streamwatch program)
- Direct donations
- Resources leveraged through cross-jurisdictional collaboration (e.g., CWEP)

References

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations.* [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

Lick Creek Local Watershed Restoration Plan Management Strategy #12: Long-Term Monitoring Program for the Lick Creek Watershed

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham*, and City of Raleigh*, NC Division of Water Quality (*Subject to NPDES Phase II stormwater requirements)

Description
The design of a long-term monitoring plan depends, to a large extent, on the goal of the monitoring. Monitoring locations, monitoring frequencies, monitoring parameters, and monitoring duration all depend on the goal. The goals of the long term monitoring program proposed for the Lick Creek watershed are to (1) document the effects of development on water quality in a subwatershed, (2) document changes in pollutant inputs from the overall watershed to Falls Lake, and (3) document the effects of restoration efforts in a given subwatershed. The monitoring plan as outlined below is aimed at meeting these goals. The long-term monitoring may also be used to help determine the cause of the biological impairment, which is thought to be, at least partially, a result of development in the watershed (NCDENR 2008). The monitoring plan is described in greater detail at: http://www.unrba.org/lick/downloads.shtml.

Indicators of the problem, current conditions, and future threats
NCSU's two-year monitoring effort for this planning effort and Durham Stormwater Services' (DSS) long-term monitoring have been gathering data on various water quality and aquatic habitat parameters.

This water quality monitoring has revealed water quality degradation in Subwatersheds 1, 4, and 7, in addition to water quality degradation on the main stem of Lick Creek just upstream of its confluence with Falls Lake. The parameters of concern include sediment (turbidity and Total Suspended Solids), fecal coliforms, and nutrients.

While DSS's long-term monitoring can be used to depict general water quality and aquatic habitat trends in the watershed, their long-term monitoring efforts are not expected to explicitly gage improvements achieved or degradation to specific subwatersheds. Durham's current long-term monitoring program will not tell us whether specific sites such as new developments or large sites with agricultural exemptions are complying with regulations, which is needed in order to meet Goals 1 and 2 of the long-term monitoring plan. Furthermore, more monitoring is needed to determine exactly where the largest sources of pollution are. When specific sources of pollutants are identified, specific actions can be identified and taken to eliminate those sources.

In some cases, such as in Rocky Branch Creek, existing water quality problems may be due to one or two site-specific practices that are unlikely to be repeated in other areas throughout the watershed (e.g. a large agricultural operation). If this is the case, working with landowners to change practices may result in improvements, and monitoring might reveal those improvements, which is necessary for achieving Goal 3 of the long-term monitoring plan. Furthermore, in order to develop and assess an effective Nutrient Management Strategy for Falls Lake, it will be imperative that nutrient reductions can be monitored and accounted for.

Furthermore, as an example, water quality monitoring being conducted by DSS and the NCSU Water Quality Group revealed dissolved oxygen (DO) levels were depressed below the NC instantaneous water quality standard at all monitoring locations during summer months. However, short-term monitoring of this parameter occurred during a period of significant drought. DO may have worsened during the drought due to stagnant or pooled water. Other potential causes, for example continuous sources of ammonia and other oxygen consuming wastes, may have become more pronounced during this period and may have contributed to the low DO values. Long-term monitoring would provide a clearer picture of the true water quality trends over time and reduce uncertainty in water quality reporting.

The greatest threat to Lick Creek's water quality is likely to be urban development of the watershed within Durham's Urban Growth Area. Current monitoring of Subwatersheds 1 and 2 has hinted that new development, especially active construction sites, is causing water quality degradation. If this is the case, some level of monitoring efforts should be continued in Lick Creek's urbanizing subwatersheds (1-8) to assess the extent to which pollution is occurring. In addition, it will be important to monitor how a transition from agricultural lands to developed lands will affect water quality in the watershed. This assessment will allow local planners and governments to implement water quality improvement measures more effectively by focusing on the actual sources of pollution (runoff vs. pesticides, for example). This will also become increasingly important to water managers as the Falls Lake Nutrient Management Strategy is developed.

Recommended Strategies

1. A detailed long-term monitoring plan (Draft Lick Creek Long-Term Monitoring Recommendations) has been developed by the NC State Water Quality Group and is available at http://www.unrba.org/lick/downloads.shtml. Long-term monitoring recommendations are summarized in Table 1.

Table 1. Summary of long term monitoring recommendations.

Site	Location	Measurements	Frequency/ number
L1	Lick Creek near Southview Road	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2-4 storms/yr
		Benthic macroinvertebrates	2x/yr
		Discharge	monthly
L3	Rocky Branch at Kemp Road	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2-4 storms/yr
		Discharge	monthly
L5	Unnamed tributary	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2-4 storms/yr
		Discharge	monthly
L6	Lick Creek upstream of confluence with tributary of L5	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2-4 storms/yr
		Discharge	monthly

[1] Field & laboratory: field=DO, Cond, pH, and temp; lab= turbidity, TKN, NH_4-N, NO_x-N, TP, TSS, FC (e coli). Storm samples will likely not be analyzed for FC. For analysis methods refer to Quality Assurance Project Plan.

2. Seek additional partners and funding to implement the portions of the Lick Creek long-term monitoring program not implemented by Durham Stormwater Services (i.e. additional monitoring sites, permanent/monumented cross-sections).
3. Update the long-term monitoring plan at appropriate intervals. Who would do this and at what interval?
4. Form Stream Watch volunteer stream monitoring groups, especially in areas where data are needed to help reach the goals of the long-term monitoring plan. The UNRBA could possibly pioneer this project or assist local governments in developing their own programs.
5. The UNRBA should investigate the feasibility of compiling and utilizing volunteer monitoring data for assessment purposes.

Costs

- Additional staff time and other resources to conduct additional monitoring

- Resources required for the purchase of equipment, the training of volunteer monitors, and the tracking of volunteer monitoring data.

Funding Opportunities:

- Regional or cooperative programs such as the Triangle Area Water Supply Monitoring Project
- Stormwater fees
- Water utility fees
- Grants (EPA Section 319 grant, for example)

References

NCDENR 2008

Line, D., 2008. *Draft Recommendations for Long Term Monitoring Of Lick Creek.* [Online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo20090213.pdf

Lick Creek Local Watershed Restoration Plan Management Strategy #13 (proposed as #3):

Stormwater Management and Regulation

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Stakeholder Review: Oct. 2008;
Stakeholder Approval:
Implementation Scale: Regional and local
Applicable Jurisdictions: Durham County, Wake County, City of Durham* (*Subject to NPDES Phase II stormwater requirements)

Description

The use of structural stormwater best management practices (BMPs) is likely to become more and more important as the watershed continues to be developed and more rules are enacted governing their use. As development replaces natural drainage systems with human-made structures, BMPs must effectively remove pollutants over the long term if Upper Neuse water bodies are to meet water quality standards. However, according the UNRBA (2007; Upper Neuse Watershed Management Implementation Recommendation #4), BMPs often deteriorate after construction if not properly maintained because of vegetative competition, orifice blocking, media clogging, structural failure, etc. Without regular maintenance, devices may not provide the environmental benefits for which they were designed and may cause public health risk or property damage. Annual inspections and follow-up measures help ensure that BMPs continue to perform at expected levels.

Indicators of the problem and current conditions/Future Threats

Local and state regulations do not require new developments with less than 23% impervious cover to design post-construction stormwater controls to treat water quality. Many developments within the Lick Creek watershed only have 1-year detention dry ponds for post-construction stormwater treatment. According to CWP (2003), water quality, hydrology, physical stream quality, and biological integrity all

begin to show signs of degradation around 10% impervious cover. The new developments in Lick Creek are being designed to be just under the threshold for impervious cover at which Neuse rules require water quality treatment. In developments in the Lick Creek watershed, the 1-year detention requirements have been met with numerous small ponds.

CWP (2007) suggests that these ponds are unimaginative in their use of space within the site and are impacting streams and stream buffers and that innovative site designs that incorporate stormwater management into roadway right-of-ways or site designs that will minimize the total runoff will result in less buffer encroachment and stream impact from stormwater treatment facilities. In their 2007 memo, the Center for Watershed Protection (CWP) points out that current stormwater requirements fail to give adequate incentives for the use of environmentally sensitive site and stormwater design (e.g. better site design or low impact development) that minimize impervious cover and use trees and un-compacted pervious to maintain a predevelopment hydrologic regime.

The current rate-control-only stormwater practices are approved with the knowledge that the municipality will in the future return to retrofit the facilities to provide water quality treatment. The need to retrofit is driven by existing Neuse rules, the MS4 NPDES program, and the official impairment designations of streams and water bodies such as Lick Creek and Falls Lake. Water quality trends and modeling show that the current program will not prevent additional degradation of Falls Lake. The cost of the future water quality retrofits that may be required to meet a Falls Lake TMDL will be borne by taxpayers as retrofits become part of local government budgets or as they are funded via state and federal grants. Cost-effective opportunities are missed when water quality concerns are not sufficiently addressed at the time of new development.

Committee: should site design recommendations be discussed here or in a separate management strategy? The focus on BMPs/treatment standards does not go far enough to preventing impacts in the first place, especially in Triassic soils and the fact that we need to be managing development for more than just pollutants.

Recommendations

1. Create and maintain a GIS database of BMPs. Is this already being done? The GIS database should include latitude/longitude locations of each BMP. Suggested attributes to collect for a BMP GIS database include BMP type, location on the parcel, latitude/longitude, owner, date completed, photographs, and/or as-built drawings (if possible). Consider how inspections records can be integrated or referenced.
    a) This information could be obtained from the developer during the permitting phase and then verified by the local government at a later date.
    b) This information can be collected by the local government during plan reviews and site inspections.
2. Require post-construction water quality treatment and monitoring for all new developments in order to meet overall water quality goals of Lick Creek, Falls Lake, and the Neuse River Basin. Low impact and better site design should always be considered first (see Lick Creek Management Strategy #3).

3. In addition to the 1-year detention requirement, which provides some channel protection storage, discharge volume criteria should be considered. A performance criterion which limits the increase in volume, rather than peak discharge, could help spur the use of environmentally sensitive design (LID/BSD).
4. Increase nutrient offset fee to push the economic incentive towards providing stormwater management rather than paying a nitrogen offset fee. Would this be effective?
5. Continue to strengthen As-Built certification requirements to place more responsibility on the design professional. [SB1]Current regulations require 'As-Built' drawings that certify the facility was built in accordance with the approved plans, but there is no requirement for the design professional to inspect construction or verify conformance.
    a) As an interim strategy, Stormwater Services should inspect new construction so that improper construction can be corrected while the contractor is still at the work site. This has been successful, but currently requires additional staff time.*[SB2]*.
6. Staff levels should be reviewed annually for adequacy and be increased as necessary.
7. Contractor, engineering, and stormwater control regulator training should be required on a regular basis, but at minimum annually.
8. Annual inspections should be performed by qualified professionals of all BMPs, both structural and nonstructural, to ensure they are maintained and functioning properly. ("Qualified professional" is usually interpreted to mean a landscape architect, land surveyor, engineer, or an employee of the city or county; the term is not officially defined.) What ordinance language defines qualified professional in Durham/Durham County?
9. Analyze the effectiveness of BMPs and make adjustments to stormwater standards, preferably eventually to include revising development patterns and impervious cover requirements, to reduce impacts of development on water quality.
10. Enforce penalties for not complying with maintenance and inspections requirements.

Costs:

- Jurisdiction: developing GIS database, hiring new inspectors and support staff, conducting inspections and follow-up actions, training, managing program, equipment (e.g., cameras, lights, tape measures, handheld GPS unit), vehicles
- Public: maintenance, repairs
- Developer?

Funding Opportunities:

- U.S. Geological Survey Cooperative Water Program (http://water.usgs.gov/coop): assists local and state agencies with water-quality and hydrologic investigations, including monitoring and quantifying the effectiveness of BMPs and restoration efforts
- Development plan review fees
- BMP plan review fees
- Inspections and maintenance fees
- Local or user water, stormwater, or other utility fees

- Financial performance bonds/guarantees/agreements
- Operation permit issuance and re-issuance fees
- Re-inspection fees

References

Center for Watershed Protection (CWP). 2003. *Impacts of Impervious Cover on Impervious Streams*. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection (CWP). 2007. *Lick Creek Fieldwork: Findings and Recommendations*. [online]. Available at: ftp://ftp.tjcog.org/pub/unrba/lick/techmemo060707.pdf [accessed May 15, 2008].

Upper Neuse River Basin Association (UNRBA). 2007b. *Upper Neuse Watershed Management Implementation Recommendation #4*. [Online]. Available at: http://www.unrba.org/downloads.htm [accessed May 15, 2008].