ADDRESSING URBAN STORMWATER RUNOFF IN THE WHITE OAK RIVER WATERSHED:

An Alternative Solutions Analysis

Printed August 6, 1999

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INTRODUCTION

Reducing or minimizing impacts on water quality from urban stormwater can be viewed through two lenses. First, there are ***tools*** that can be employed to manage sources of stormwater. These include engineered solutions (such as wet detention ponds) and preventive, non-engineered measures (such as conservation of land adjacent to surface waters). Second, there are ***mechanisms*** for getting the tools implemented. Mechanisms include local policy options, securing money to initiate projects, and educating people in the watershed to try to change their behaviors.

The ultimate goal is the protection and improvement of water quality. The White Oak River Watershed Advisory Board has decided that the implementation of tools that will reduce current levels of stormwater runoff and/or prevent the escalation of the amount of runoff reaching surface waters is the first area that they want to address in this pursuit.

In support of the Board's initial focus on urban stormwater management, extension staff have prepared a broad brush summary of information on this subject. The following chart briefly summarizes the information that is provided within the tables contained in this document, and provides the table numbers and page numbers for easy reference. A table that describes current local government policies related to urban stormwater management in the watershed is also included for reference.

Approach	Table #	General Comments	Page #
Tools	1,2	Methods of reducing stormwater runoff	
Preventative Measures	1	Source reduction of stormwater is generally more cost-effective than treating stormwater. Some types may be politically challenging.	3
Engineered Solutions	2	Can be expensive unless planned for early-on.	7
Mechanisms	3-5	Means of implementing tools	
Policy Instruments	3	Can be effective but also may be costly for governments to implement. Regulations may be difficult to pass for political reasons, but there are other alternatives such as incentives and voluntary measures.	8
Educational Approaches	4	Opportunities listed for educating the public are relatively cost-effective and simple to implement.	9
Resources for Projects	5	Various funding opportunities are available for getting projects on the ground.	10
Existing Policy			
Current Local Government Policy	6	Current zoning, subdivision regulations, and stormwater regulations in the White Oak River watershed counties and municipalities are highlighted.	12

How do You Evaluate Tools and Mechanisms for Addressing Urban Stormwater Runoff?

The tools available are varied and have associated with them both quantitative and qualitative advantages and disadvantages. Some sparse economic research on the tools is available. Board members may evaluate the advantages and disadvantages, as well as general economic costs and benefits of implementing the various solutions. One way to approach the evaluation may be to ask broad questions concerning your goals and values. Questions to consider include:

- What are the goals for addressing the effects of stormwater runoff on shellfish closures in the White Oak River?

- Which solutions may be environmentally effective, economically advantageous, and politically feasible?

- Would any of the solutions also address other problems associated with stormwater runoff in the White Oak River watershed? (Are there other benefits gained from implementing a solution besides the benefits to shellfishing?)

- What types of trade-offs are you willing to make to achieve your goals?

What is the Role of the Extension Team?

The local and central office extension staff that work with the White Oak River Watershed Advisory Board are available to help the Board implement the decisions that they will make with respect to addressing urban stormwater. This support can take a variety of forms:

- Seek expertise to design and locate identified projects of interest
- Write grant proposals to secure funds for potential projects
- Help organize or coordinate educational workshops or tours
- Write up recommendations to be presented to particular local governments

The extension team can provide support for activities that you decide to pursue with respect to this issue, but can not serve as advocates for your recommendations.

TABLE 1: TOOLS FOR PREVENTING URBAN STORMWATER RUNOFF POLLUTION

TOOLS: PREVENTATIVE	DEFINITION	BENEFITS	COSTS/DISADVANTAGES	PERFORMANCE
1. Riparian Buffers/ Greenways[1, 2, 3]	Linear areas of open space located along stream or river corridors	▪ Trap pollutants suspended in stormwater runoff, reduce pollution runoff ▪ Reduce erosion and sedimentation ▪ Protect stream or wetland from future disturbance or encroachment ▪ May increase property values ▪ Increase tax base through increased property values ▪ Can provide recreational opportunities ▪ Protect development sites from flooding ▪ Protect wildlife habitat	▪ Requires significant local government staff time and resources ▪ Expensive to create in areas already built out ▪ Limited capability to remove urban stormwater pollutants in urbanized areas ▪ Less land area for developers ▪ Cost of land varies depending on location ▪ Buffers may contain sources of bacteria, such as wildlife and pets	*On general water quality:* Effective in removing sediment and nutrients from runoff and septic system effluent in rural and agricultural areas on flat soils in East Coastal plain. *On bacteria removal:* Currently, no data exist on performance of forested or grass buffers in removal of bacteria from urban stormwater runoff. Studies on agricultural grass filters suggest a modest capability to remove fecal coliforms from runoff.
2. Land Acquisition	Purchasing land to keep in natural state	▪ Provide wildlife habitat ▪ Provide cultural/ historical preservation areas ▪ Provide recreational opportunities ▪ Forested areas provide economical benefits- reduce A/C costs, increase property values, control stormwater and erosion ▪ Less restoration & rehabilitation required	▪ Land purchase may be expensive depending on location ▪ Costs are higher in urban/suburban areas	Depends upon location and size of area conserved, whether it is critical habitat, aquatic corridor, hydrologic reserve, water pollution hazard, cultural/historical reserves

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3. Conservation Easements	A voluntary agreement between a private landowner and a municipality or non-profit to restrict development, management, or use of the land	Same as for land acquisition AND: ▪ Tax reduction for property owner (property, income, and/or estate) ▪ Property owner retains ownership of land	▪ Requires local government staff time and resources ▪ Somebody must monitor property to assure easement is not violated	Same as for land acquisition
4. Limiting Impervious Surfaces[4,5]	Limiting the built-upon area (paved roads, driveways, rooftops) of a lot	▪ Reduces potential for flooding ▪ Imperviousness is easily measurable ▪ Imperviousness can estimate cumulative impact on water resources ▪ Can be controlled through land use regulation ▪ Reduces construction costs ▪ Reduces maintenance costs for local governments ▪ May increase property values ▪ Creates pedestrian friendly areas ▪ Creates sense of community ▪ Less asphalt reduces heat absorbed, therefore reducing cooling costs	▪ Requires local government staff time ▪ Reduced parking space	*On general water quality:* Studies show a direct relationship between the amount of impervious surface in a watershed and the watershed's water quality, therefore limiting or mitigating the impact of imperviousness should benefit water quality. *On bacteria loading:* Documentation linking the percent impervious surface in a watershed to bacterial loading does not exist.
5. Limiting Densities[6]	Establishing minimum lot sizes	▪ Guarantees sufficient land area for on-site septic systems	▪ May not decrease impervious surface area ▪ Large lots increase infrastructure costs (more roads to pave, longer water lines, etc.)	Most common type of land-use control used to protect watersheds from urban development, but if impervious surfaces aren't limited, its effectiveness in protecting water quality is limited.

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TOOLS: PREVENTATIVE	DEFINITION	BENEFITS	COSTS/DISADVANTAGES	PERFORMANCE
6. Cluster Development[7, 8] (Open space designs/zoning)	Homes or other buildings on a development parcel are clustered on small lots with the remaining land set aside as open space	▪ Can reduce impervious cover ▪ Reduces stormwater runoff and pollutant loads ▪ Concentrates runoff where it can be most effectively treated ▪ Reduces erosion potential ▪ Reduces cost of building infrastructure ▪ Reduces maintenance costs for local government ▪ Provides compensation for lots lost for buffers ▪ May provide wildlife habitat ▪ Preserves rural nature of community ▪ May provide recreational uses ▪ Can support other community goals like farmland preservation and affordable housing	▪ Increases homeowner association fees ▪ Requires significant local government staff time ▪ If not planned well, open space could become fragmented and/or ▪ Open space could be used for purposes not conducive to improved water quality ▪ Potential conflicts between residents & agricultural practices ▪ Maintenance of open space may be required	Performance depends on amount of impervious surface allowed, the type use of the open space, and location of septic systems
7. Improving Septic Systems [2]	May include installation of improved septic systems in new development, inspection and regular maintenance of existing systems, updating of old systems, and the detection and repair of illicit/illegal discharges.	▪ Reduces likelihood of septic system failures (failed system may reduce property value) ▪ Innovative systems have higher nutrient removal rate, lower failure rates, or perform on poor soils. ▪ Regular system pump-out may prevent failures	▪ Pump-out of a system costs a homeowner $150-$250 ▪ Average cost of innovative septic systems are 25%-75% greater than conventional systems ▪ Innovative septic systems may have higher maintenance costs	Effluent from poorly maintained or failing septic systems can be an important source of pathogens and nutrients. Some case studies show how communities have reopened closed shellfish beds after improving septic systems.[9]

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8. Pet Waste Collection	Pet owners remove and dispose of pet wastes rather then allowing wastes to enter stormwater systems or streams	▪ Reduces amount of pollutants in runoff	▪ Requires some local governmental staff time if an ordinance is adopted ▪ Requires education of citizens	*On bacteria loading:* Pet waste is a contributing source of bacteria in runoff that can be controlled easily and effectively

[1] *Greenways and Stream Buffers*. March 1998. **Streamlines**. NC DWQ. Vol. 3, No. 1.
[2] Schueler, Tom. *The Economics of Watershed Protection*. June 1997. **Watershed Protection Techniques**. Vol. 2, No. 4. Center for Watershed Protection; Elliot, MD.
[3] *Microbes and Urban Watersheds.* April 1999. **Watershed Protection Techniques.** Vol. 3, No. 1. Center for Watershed Protection; Elliot, MD.
[4] *Limiting Impervious Surfaces Protects Water Quality*. July 1996, **Streamlines**. NC DWQ. Vol. 1, No. 5.
[5] *The Importance of Imperviousness*. Fall 1994. **Watershed Protection Techniques**. Vol. 1. No.3. Center for Watershed Protection; Elliot, MD.
[6] **Effective Watershed Management for Surface Water Supplies**. 1991. AWWA Research Foundation and AWWA.
[7] *Smaller Lots, Happier Residents?* September/October 1998. **Nonpoint Source News-Notes**. US EPA. Issue 53.
[8] Arendt, Randall. *"Open Space" Zoning: What It Is & Why It Works.* July/August 1992. **Planning Commissioners Journal**. Issue 5.
[9] Buttermilk Bay case study, in the **Rapid Watershed Planning Handbook**. Oct. 1998. Center for Watershed Protection; Elliot, MD. P. 11.38.; Sanitary Surveys, Mason County, Washington case study in **Stormwater Strategies: Community Responses to Runoff Pollution**. May 1999. Natural Resources Defense Council; NY, NY. P. 212.

TABLE 2: ENGINEERED SOLUTIONS FOR URBAN STORMWATER MANAGEMENT[1]

SOLUTION	DESCRIPTION	ESTIMATED AVG. COST	PERFORMANCE IN BACTERIAL REDUCTION (BENEFIT)
Wet Detention Ponds	A pool or reservoir designed to collect and treat stormwater runoff.	Costs are primarily associated with land value and excavation.	Wet detention ponds can remove approximated 65% of fecal coliform bacteria during treatment.[1]
Stormwater Wetlands	A constructed wetland is like a shallow wet detention pond that has a variety of wetland vegetation within it. Stormwater moves slowly through the wetland and is treated.	Costs are primarily associated with land value, excavation and wetland design.	Stormwater wetlands can remove approximately 65%-75% of bacteria.[2]
Infiltration Trenches/Wells	A deep trench or well filled with stone and a sand filter that collects runoff and provides some treatment prior to filtering into the groundwater.	Costs are mainly related to excavation and hauling and placing stone.	Appears to be limited – especially for bacteria not adsorbed to sediment particles.
Sand Filters	Provides treatment through settling and then passing stormwater through a sand chamber. Good for heavily developed areas.	Expensive. Requires construction and maintenance. Costs about $36,000 per acre treated.	Sand filters can remove approximately 51% of fecal coliform bacteria from stormwater.[2]
Bio-retention areas and Rain Gardens	An infiltration device through which stormwater drains within a couple of days. Composed of soil for growing trees and other plants underlain with a porous and permeable sandy soil.	Excavation, land area, vegetation and the drainage system contribute to the cost of this system.	Although little data are available on the effectiveness of this relatively new BMP, this approach should be relatively effective at removing bacteria since it relies on soil filtration as a treatment methods. Limited use in areas with high water tables due to reduced area for infiltration.
Level Spreaders	A component of a larger stormwater management system, level spreaders are used to spread concentrated stormwater flow out so that it can be treated more effectively as it flows through a buffer area.	In itself, this engineered approach is relatively inexpensive (approximately $10 per linear foot).	Difficult to estimate since its performance would be dependent upon the type of BMPs with which it is associated.
Swales	Grassy ditches with a 'v' shape that maximizes waters' contact with the grass.	Costs mainly associated with excavation and earth moving.	Not a good practice for removing bacteria. Actually exports bacteria.[3]
Alternative Pavement	A pavement that allows some water to pass through. Not as strong as traditional asphalt.	About 25% higher than asphalt, but doesn't require as much stormwater treatment – which saves $.	In estuarine areas, alternative pavement could promote die-off of bacteria in the water column by reducing freshwater inputs.

[1] *Watershed Protection Techniques: A Periodic Bulletin on Urban Watershed Restoration and Protection Tools*. Volume 3, Number 1, April 1999.
[2] Brown, Whitney and Thomas Schueler, Center for Watershed Protection, August 1997. *National Pollutant Removal Performance Database for Stormwater BMPs.*

TABLE 3: INSTRUMENTS FOR IMPLEMENTING POLICY

INSTRUMENT	DESCRIPTION	COSTS	BENEFITS
Incentives	Benefits that can be obtained through a specific behavior. Encourages environmentally beneficial behavior.	Relative to other approaches, costs of incentives can be low.	Generally speaking, individuals would rather alter their behavior using their free will (as opposed to being told what to do through a regulation).
Tax[2]	Certain behaviors may be rewarded by reduced taxes. For example, by donating a conservation easement, a landowner may become eligible for federal and state tax incentives (income and/or estate taxes).	Depending upon the level of participation in the tax incentive offered, this approach could have significant costs associated with it.	Better to encourage positive behavior than to mandate it.
Voluntary	Local governments encourage citizens in their community to protect water quality (see table on Education.)	Efforts to encourage local citizens' protection of water quality would likely include costs associated with educational materials.	Education of the community on local issues of concern. Communication between citizens and local officials.
Regulatory Relief	This would be used in conjunction with local regulations and would exempt entities from portions of the rules if certain actions, such as pet waste management, were implemented.	Any costs of this approach would be associated with the implementation and enforcement of associated regulations.	Rewards people for doing the right thing.
Regulation	Local rules that require specific actions to reduce or limit stormwater runoff.	Developing, implementing and enforcing local regulations can be costly. An ordinance adoption can cost as much as $15,000[1] Depending upon the existing resources of the local government, this approach could also require additional staff resources.	Accelerates environmentally beneficial behavior.
Zoning	Partitioning land within a local jurisdiction for specific uses. Can require some land to be set aside as open space.	Same as above.	Land use can be thoughtfully and carefully planned out. Developers will know what areas are available for building houses or commercial structures.
Subdivision Regulations	Local requirements for design of subdivisions. Can require that these types of development provide a certain level of stormwater management.	Aside from costs associated with development of the regulations, developers may incur additional costs to comply with the rules.	There area many design practices and structural BMPs that are available for developers to use to reduce stormwater from subdivisions. They can easily be incorporated into subdivision plans at the early stages of plan development.
Power of Public Spending	Local governments set an example for the community by ensuring that development projects (schools, roads and other infrastructure) are sited and built with methods that minimize impacts on water quality.	Some additional costs may be associated with projects that are designed and implemented to protect the environment.	Local government leads by example. Local and state government can influence growth patterns by carefully locating infrastructure.

[1] Center for Watershed Protection, October 1998. *Rapid Watershed Planning Handbook – A Resource Guide for Urban Subwatershed Management.*
[2] Preserving Open Space. October 1996. *Streamlines*: *Newsletter for NC Water Supply Watershed Administrators*. NC DWQ, NC DENR. Vol.1, No. 7.

TABLE 4: EDUCATIONAL APPROACHES

APPROACH	DESCRIPTION	COSTS	BENEFITS
Newsletters	Periodical publications distributed to a list of appropriate people. Can be printed or in electronic form (distributed through email).	Costs associated with newsletters include printing and mailing and production. The size of the publication and the mailing list will influence the cost.	A good way to keep people apprised of an ongoing project. Can deliver multiple messages.
Festivals	Organized celebrations with a focused subject (like the local seafood festival). The focus could be the river or water quality protection.	Costs associated with festivals are variable but likely include organization, rentals, advertising, etc.	Brings people together around an issue or subject in a positive way.
Mailings with bills	Flyers inserted into utility bills (like your power bill).	Production and printing. May be able to work with utility company to add to the bills for free.	Reach a large number of people in the area.
Public service announcements	Short ads on radio or TV.	Some radio and TV stations will do a PSA for free as a community service. Still would have the cost of development of the announcement.	Many people listen to the radio and watch TV. Good way to reach people.
Workshops	Targeted educational program. For example, the Board could organize a workshop for local developers to educate them on simple ways they could alter their activities to protect water quality.	Organization, advertising.	Good way to reach a specific audience with pertinent information.
Tours	Trips that offer visits to different sites in an area. Can be geared toward viewing various solutions or problems in a watershed. Can be targeted to local government officials or other specific audiences.	Transportation, organization.	People often understand concepts better when they have seen them applied in the real world.
Newspaper articles or ads	Local newspapers publish an article on the decisions or recommendations of the Board. Also, Board could place an informational ad in the paper informing the local community of their efforts or any activities they've scheduled (like a festival).	If the newspaper did an article on their own, the cost would be negligible. Placing and advertisement for a festival or other activity would have cost associated with it, but that cost would vary depending upon things like which newspaper it was put in and how large it was.	Newspapers can potentially reach a significant audience in a local community.

TABLE 5: POTENTIAL RESOURCES FOR PROJECTS TO ADDRESS URBAN STORMWATER

RESOURCE	DESCRIPTION	RECIPIENT	ELIGIBLE PROJECTS
FEDERAL			
EPA Water Quality Cooperative Agreements	Grants to support creation of unique approaches to meeting stormwater, combined sewer, sludge, pre-treatment requirements	State agencies, local public agencies, non-profits, etc.	Research, experiments, training, surveys, studies related to cause & effects, extent, prevention
EPA Wetlands Protection Development Grants	Funds individual wetlands projects	Indian tribes, states, local govts.	
EPA Environmental Education Grants	Project grants which require a non-federal 25% match	Local, tribal, state govts., universities, non-profits	Must meet one of various listed educational goals
EPA 319 Grants	Project grants which require a non-federal match		Must involve restoration, educational component
STATE			
Clean Water Management Trust Fund	Small to large grants for addressing surface water pollution	State agencies, local govts., non-profits	Land acquisition, restoration, repair failing waste systems, repair or eliminate septic systems, eliminate illegal drainage, improve stormwater controls and management, facilitate planning that targets reduction in surface water pollution
NC Wetlands Restoration Program	Works with property owners to restore wetlands, pays for restoration, provides expertise.	Property owners	Suitable wetlands restoration projects that meet certain criteria.
Water Resources Development Project Grant Program	Non-federal matching grants for a percentage of project's cost	Local governments	Projects include navigation, flood control, drainage, stream restoration, beach protection, recreation, aquatic weed control
Division of Parks & Recreation Adopt-A-Trail Grant Awards	Project grants	Local govts., non-profits, private trail groups	For recreational trail building, maintenance, brochures and maps
Div. Parks & Rec. NC National Trails Program	Grants require a 20% match of funds or in-kind contributions from applicants	Federal, state, and local governments	Trails and trail facilities open to the public

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RESOURCE	DESCRIPTION	RECIPIENT	ELIGIBLE PROJECTS
Div. Community Assistance Community Planning Program	Professional planners from NC DCA help with local projects at no cost other than travel reimbursement and supplies.	Local governments and community organizations	Tasks such as growth management and planning, infrastructure planning and analysis, and watershed ordinances.
NC Cooperative Extension Project Funds	Grants for educational projects	Cooperative Extension faculty	Varies by fund
LOCAL			
User Fees	Cities and Counties can charge individual properties monthly user fees based on their contribution of stormwater	Local governments	
Impact/facility fees	Local enabling legislation required to charge one-time fees related to the impact generated by a new development project	Local governments	New development projects
Special Assessments	One-time assessments can be levied against properties in proportion to the benefit each receives from a specific stormwater project	Local governments	
Permit & Inspection fees	Local governments can set fees to cover the cost of permitting and inspection programs	Local governments	
NONPROFIT ORGANIZATIONS			
National, local, and regional land conservancies	Provide assistance with land conservation, acquire and manage lands in the public interest. Provide expert guidance in conservation and tax credit options available.	Private landowners, local governments	Land acquisition, easements for conservation purposes
Corporate and Private Foundations	Grants	Varies	Varies