Elizabeth River Runoff: Win-Win Solutions

Addressing stormwater in an urban watershed:

EVALUATING SITES,

SEEKING INNOVATIVE REMEDIES,

IMPLEMENTING NEW DESIGNS

THE Elizabeth River Project

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THE Elizabeth River Project

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The Elizabeth River Project is an independent non-profit organization representing the watershed that unites four cities: Chesapeake, Norfolk, Portsmouth, and Virginia Beach, Virginia.
Our mission is to restore the Elizabeth River to the highest practical level of environmental quality through government, business and community partnerships.

Cover photos: A view of downtown Norfolk from the Elizabeth River; two views of Stormwater Team at work.

Introduction

Our downtowns share stormwater issues with any highly urbanized area. As is true elsewhere, four hundred years of development of our urban waterfront bring the thorniest of stormwater challenges: no available land for conventional practices; about 70 acres of highly impervious urban streets, interstates, parking lots, sidewalks and rooftops drain to a single pumping station; riverbanks are entirely bulkheaded; the antiquated stormwater infrastructure discharges untreated runoff directly into the river; the minimal elevation above sea level means much of downtown is enclosed by floodwalls.

This guide describes how over thirty widely varying sites in and near downtown Norfolk were evaluated by a team led by engineer William F. Hunt, P. E., urban stormwater specialist from North Carolina State University, to seek solutions to this knotty problem. Land uses ran the gamut from salvage yards to boatyards to upscale waterfront backyards. Of a wide range of downtown sites examined, seven were evaluated in detail and five were identified for potential stormwater practices. A number of the team's proposals have already been implemented, including six riparian buffers.

The Elizabeth River Project's highly successful partnership approach, with all stakeholders involved, is the key to this effort's positive effect on water quality, and its promise of win-win solutions for all.

Goals

The purpose of this guide is to offer well-designed alternatives for addressing runoff other than the traditional stormwater pond. We present the cream of the sites we evaluated and the rationales for the stormwater innovations chosen. A particular site's characteristics are given, then a description of its recommended practice, with advantages, concerns and cost estimates.

We hope this guide may motivate others in urban watersheds of the Chesapeake Bay to "think out of the box" about urban runoff.

If we facilitate further action at participating Elizabeth River sites, that meets our highest aim, given our mission.

Engineer Cindy Linkenhoker of the City of Portsmouth (left), Lyle Jackson of the Elizabeth River Project (center), and stormwater expert Bill Hunt (right) plan a stormwater wetland on Paradise Creek.

River Star Industries: A Target Audience

One of the goals of this project was to make runoff recommendations to the Elizabeth River Project's River Star industries. All *voluntarily* prevent pollution and/or restore critical habitat. Peer reviews demand continued progress, plus documented results in pounds of pollution reduced and acres of wildlife habitat conserved or restored .

Participation calls for efforts beyond compliance. For instance, to earn "Model Level" status, a River Star must not only demonstrate exemplary environmental stewardship, but mentor others.

River Stars soon see many benefits of "doin' right by the river," garnering financial savings and reaping publicity that no amount of advertising can produce.

Doin' right by the river
RIVERSTARS

We are most grateful to the River Stars participating in this project: ***Norfolk Boat Works, People for the Ethical Treatment of Animals, Southeastern Public Service Agency, Norfolk Naval Shipyard, Virginia Zoological Park, Norfolk Environmental Commission, United States Coast Guard Integrated Support Command, United States Maritime Administration, and Virginia Port Authority.***

In 2002, River Star ***Nova Chemicals*** *hosted a delegation from China to share the success of the River Stars partnership model.*

Stormwater Sites Assessed

River Star program participants appear in ***Bold Italics*** *throughout*

Focus Area 1: Downtown Norfolk/Atlantic City

Floodwall Pumping Station	Floating wetland garden
Nauticus Basin	Manual scooping
Corps of Engineers parking lot	Buffer strip
Norfolk Boat Works boatyard	Rain garden
Southampton Avenue drain	Silt filter device
Plum Point property	Simple repair
Midtown Tunnel area	Detention pond
People for the Ethical Treatment of Animals (PETA)	Rain garden
Lovitt Avenue property	Habitat restoration
Harbor Park parking lots	Permeable pavement
"R2" parking area	Permeable pavement

Focus Area 2: Paradise Creek, Portsmouth

Peck Iron & Metal site	Stormwater Wetland
Cooper-Reid lot	Stormwater Wetland
Southeastern Public Service Agency	Mechanical retrofits and buffer
Cradock Mid. School East	Conventional BMP
Cradock Mid. School West	Bioretention
Norfolk Naval Shipyard New Gosport Site	Riparian buffer

Additional Sites Assessed

Lenox Subdivision	Stormwater wetland construction
River's Edge Development	Low Impact Development (LID)
Virginia Zoological Park	LID and riparian buffer
Ernie Morgan Environmental Center	Stormwater reuse
Myrtle Avenue park	Bioretention area
Knitting Mill Creek Riparian buffer	
Steamboat Creek playground	Riparian buffer
Roberts Rowing Center	Bioretention area
US Maritime Administration	Bioretention area
US Coast Guard Integrated Support Command	Bioretention area
Midtown Tunnel	Bioretention area

Practice Selection Considerations

Watershed Characteristics

In an urban watershed like that of the Elizabeth River, every rainfall's impact is magnified by high imperviousness and absence of natural spongy wetlands to slow and filter the flow.

Urban stormwater engineer William F. Hunt uses the following criteria for selecting urban best management practices:

• pollutants to be treated,

• size of watershed,

• imperviousness of watershed, and

• amount of available land.

Stormwater best management practices as normally applied vary widely in their costs and spatial requirements. Their ongoing maintenance demands are often a major concern. Sometimes the characteristic that most recommends a practice for a given purpose, such as its high removal rate of suspended particles, is the very thing that causes that practice (wells and infiltration trenches) to fail.

Effectiveness

The variable of special concern to us is *effectiveness*. Some practices address toxics; some slow sedimentation (reduction of suspended particles); some reduce the flow of phosphorus and nitrate into aquifers and watercourses to improve the health of aquatic plants; some are "nitrate leakers" (negative removal). Management practices are compared in terms of relative effectiveness in Hunt's publication *Urban Waterways/Urban Stormwater Best Management Practices (BMPs)*, published by North Carolina State University Cooperative Extension.

Our partners demand an excellent cost/benefit ratio for each implementation. The practice must match the site's particular needs and the funder's budget. Many experts say the best thing to do about stormwater in terms of "bang for the buck" is to plant a tree (or several - a riparian buffer). One ranking of practices in terms of overall effectiveness looks like this (Braune and Wood, South Africa, 1999):

Best: Minimize impermeable area with detention ponds, retention dams, riparian buffers and wetlands.

Moderate: Use porous pavements, infiltration basins and wetland channels.

Least: Put in grass buffers, swales, and percolation trenches.

Wetlands and Buffers

Most of the stormwater practices developed under this grant that are now completed or in planning stages are riparian buffers and stormwater wetlands.

Stormwater wetlands remove nearly 80% of suspended solids (very high) and remove more nitrate-nitrogen than any other practice, usually well over 40%.

Riparian buffers remove all types of pollutants, including sediment, phosphorus, and nitrate. They rank very high (80%) in removal of suspended solids and moderate (40%) in removal of nitrates.

Unfortunately, urban areas seldom offer sufficient space to build these.

A big opportunity to develop public awareness of the problem of stormwater is so enticing, it can more than make up for any shortcomings of a given practice in terms of toxics removal or nitrogen uptake. Education is not a benefit considered by the above ranking systems, but contributes to long-term watershed health. By educating the citizens about their watershed and its issues, especially the role of stormwater in ongoing pollution of the river, we stand to make a major change in the behavior of the citizenry and of future generations. By helping every resident and visitor become a good steward of the watershed, we insure the Elizabeth's recovery and future health.

Permeable Paving: Hidden Benefits

An additional practice recommended by our stormwater team for early implementation is permeable pavement, at the "R2" site in Town Point Park and at the Corps of Engineers parking lot's sidewalk. (This was also recommended for the "River's Edge" development site.) By the above formulations, it has only a moderate effectiveness level, and it can carry a substantial price tag. However, it has two big advantages.

The first is that it does not require "new" space to be made available; it can replace existing pavement, if vehicular use is light, infrequent or absent. Therefore it strongly recommends itself in this highly urbanized environment as it permits placing a practice where there is room for no other kind.

Secondarily, by placing permeable pavement on part of the popular Elizabeth River Trail, we gain the attention of a large segment of the public. Not only do walkers, joggers, bicyclists and skateboarders find the pavement underfoot, they will be exposed to large educational signs that explain why stormwater is an issue and what they can do about it. At the "R2" site, the pavement would be placed at a heavily frequented spot between a popular yacht marina, a festival marketplace, and a cruise ship dock, right in the public eye.

The Corps sidewalk project is poised to proceed once funding is in place.

Industrial Stormwater Re-Use

Given that stormwater runoff is the No. 1 source of new pollution in our watershed, anything that serves to reduce the amount of runoff reaching the river has to be beneficial.

One goal of the Elizabeth River Project's Watershed Action Plan is to make stormwater re-use the new standard for business and industry. The timeliness of this goal has been emphasized by the recent severe drought conditions in our region. Not only is runoff the source of pollution for our river; it also wastes a precious resource, fresh water.

An innovative River Star industry on the Southern Branch of the Elizabeth, Southern States

This lift station handles stormwater from 70 acres of downtown

Cooperative Chesapeake Fertilizer plant, collects runoff from several their site and pumps it to a large storage tank. It draws its manufacturing process water from this tank. This system is so efficient that the plant no longer discharges stormwater to the river except in unusually heavy rain events.

Residential Stormwater Re-Use

The Elizabeth River Project stormwater project team discovered that it is neither expensive nor difficult for ordinary citizens to address storm water issues in urban residential neighborhoods with another type of innovation: bringing back grandmother's rain barrel! We have produced an additional publication describing how and why a back-yard rain barrel is an achievable, sustainable, affordable project in urban areas, especially in this time of drought: Call us for a copy of *Everybody Needs a Rain Barrel*. Its distribution to urban property owners will encourage an ethic of re-use throughout the watershed.

Publicity and Public Relations

Part of raising public consciousness of stormwater issues involves first getting the public's attention to the gravity of the problem. One innovative solution developed under this grant has the potential for international publicity. The Floating Wetland Garden of Norfolk would then actually exemplify four of these benefits: *Treatment* (the effect of wetland plantings), *Reduction* (of the flow of stormwater to the pumping station and directly into the river), *Education* (with appropriate signage in a high-traffic location), and *Publicity* (likely to be substantial for such an innovative and highly transferrable practice).

Possible location for the Floating Wetland Garden: downtown cove with lift station (right), condominiums at left; the battleship Wisconsin *is in this cove too.*

When a thousand visitors get off a cruise ship, they should see clean water.

Focus Area 1: Downtown Norfolk/Atlantic City

Downtown Norfolk is much like other older urban waterfronts: Highly developed, highly impervious, with an old stormwater system. Many merchants here are concerned about the impression unsightly floating trash makes on residents and visitors, since downtown is on the riverbank. A special concern of stormwater investigators was their discovery that 70 acres of the downtown area drains to one spot, at a lift station where it stormwater is collected and pumped into the river.

Nearby is the Atlantic City neighborhood, where there is a surge of interest in major redevelopment. Here a small boatyard caters to do-it-yourself sailors, a walking and biking trail winds through brambles, a major medical center spawns expanding parking lots, and military installations vie with private companies for a prime waterfront view. There's a Civil War fort to remind walkers of the neighborhood's strong ties to the past, and an old seafood warehouse that still processes clams for chowder. The area is on the fringe of downtown and the redevelopment plans present an opportunity for sound stormwater practices to be incorporated.

Best Sites for Action

Downtown lift station
Nauticus basin
US Army Corps of Engineers Parking Lot/City Sidewalk

Sites Assessed

Downtown lift station . . . . .Floating Wetland Garden
Nauticus waterfront basin . . . . .Manual scooping
US Army Corps of Engineers lot . . .Buffer/permeable pavement
Norfolk Boat Works boatyard . . . . .Rain garden and buffer
Midtown Tunnel . . . . .Stormwater wetland
PETA Headquarters building . . . . . .Rain garden

Site for Action: Floating Wetland Garden

Site Descriiption

The need is great for addressing runoff and land is lacking in downtown Norfolk, heart of the Elizabeth River watershed. The area is nearly completely impermeable, typical of cities of this size. Over 70 acres of downtown streets, parking lots and rooftops funnel to one outfall where a concrete floodwall is the interface between land and water. Here a municipal lift station collects the runoff and sends it in a rush into the harbor.

Practice Description

While an adequate amount of land to completely capture and treat the first flush of downtown's stormwater is not available, a percentage of it could be diverted onto one or more barges. From the surface, the floating gardens would be exactly that - a garden of attractive stormwater wetland vegetation species planted on a barge. The highly visible site could very easily be converted into an additional tourist destination.

The size of the floating garden will range from 0.25 to 0.50 acres or more. The barge or barges would need a drainage system, overlaid by soil, and would be connected to existing downtown stormwater systems. A pump would be necessary to divert the runoff to the wetland.

Among several unoccupied downtown bulkheads suitable for permanent mooring of a barge is a spot near Nauticus, the National Maritime Center, adjacent to Harbour Place Condominiums, opposite the *Wisconsin* in the same cove. This is adjacent to the lift station on Boush Street that receives runoff from more than 70 acres of downtown Norfolk.

The floating wetland garden could be a tourist attraction as is the battleship Wisconsin*, also moored in downtown Norfolk.*

Advantages

A portion of the runoff from much of downtown Norfolk would be treated, and there is no other evident place where this could be done.

Wetlands have the highest pollutant removal percentages for most nutrients and heavily urbanized areas usually have the highest nutrient runoff loads.

The floating wetland would be free of river water, so plantings could include attractive species such as Pickerelweed, Rose Mallow, Southern Blue Flag Iris, and Soft Stem Bulrush.

The site could very easily be an additional attractive tourist destination in this high-visibility spot, offering opportunities to educate multitudes of visitors and citizens on urban stormwater issues.

It would be a model project for other large coastal communities, where runoff is very difficult to manage due to spatial constraints.

The project's nature would make it a candidate for national and international acclaim. It would be one of the most unique and innovative stormwater projects ever. The publicity for the city and all involved would be enormous.

Concerns

A hydrographic study is needed to determine how big the floating wetland would need to be. If large wetland barges will only treat 5-10% of runoff from small to moderate storms (such as 0.50" or similar), it would probably be too expensive to pursue.

Can the lift station be relatively easily retrofitted with a pump? The required pump may need to be installed outside the building.

Would the aesthetics associated with the stormwater wetland and the pipe that connects it to the lift station be problematic? While the pipe's diameter would be a relatively small 24-36" nominal diameter, it could appear unsightly to some people. Many wetlands bloom nine months of the year in this climate, but million-dollar condominiums are close by. The blooming wetland would be attractive to most people, but others could dislike the wetland looks or slight sulphuric odor.

Are we likely to secure donation of the most costly component, the barge? In this world-class port, very likely.

Would there ever be a risk of the floating wetland sinking or breaking free during a storm? Can be an engineering parameter from the outset.

What type of vegetation works well for a site that is receiving only fresh water, but is exposed to salt spray? Vegetation selection will be critical.

Is docking a barge in the quay acceptable with the city and neighbors? Local property owners will need to accept the wetland's presence. If the wetland can be treated as an amenity, this issue may be quickly solved.

What type of maintenance should be expected, and by whom? City of Norfolk is likely to accept the maintenance burden.

Costs

These costs are difficult to gauge due to the likelihood that a large part of the materials and labor would be donated or offered at a low price. The highest costs for construction are listed as follows:

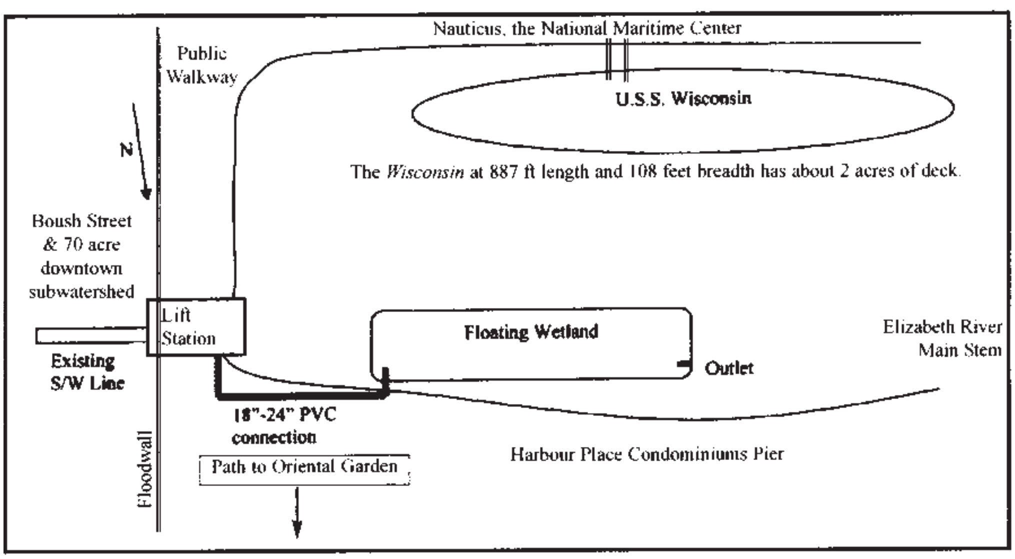
The Elizabeth River is the centerpiece for the cities of Norfolk and Portsmouth. The number one source of new pollution in the river is stormwater runoff.

- Barge acquisition and conversion, $250,000 - $400,000
- Soil purchase, transport, and placement, $50,000 - $80,000
- Wetland plant purchase, transport, and placement, $30,000
- Lift Station retrofitting, $30,000 - $50,000
- Pipe purchase and installation, $10,000 - $20,000
- Engineering, $40,000 - $50,000
- System maintenance, minimum life of 20 years, $30,000 for 20 years

This gives a potential range in cost of approximately $450,000 to $700,000.

Other Considerations

Another option to explore would be to treat much of downtown Norfolk by utilizing an expensive, yet tried option of pumping and directing stormwater to relatively vacant areas adjacent to downtown. The cost of a similar type project in Washington, NC, ranged from $2,000,000 to $3,000,000, though the cost in Norfolk would obviously change with the scope of the exact project.



Site for Action: Floating Litter Downtown

Site Description

Visible debris is a big consideration for downtown merchants as an important component of the public's experience of downtown and the riverscape around it. Large quantities of floating trash accumulate in the corners and eddies of this shoreline. Litter is the most tangible sign of the river's poor health, a source of toxics, and a reminder of historic neglect. The party stepping up to this issue is the Downtown Norfolk Council, a self-taxing association of businesses in the heart of downtown, strongly motivated to effectively address litter and so improve the public's impression of the neighborhood.

Litter lands in the harbor three main ways: First, it is washed from the street into storm drains. This may be a minor source since the opening in the grates of the downtown stormwater inlets are quite small, keeping much of the litter out of the storm drain. However, street debris is still trapped in the wet well near the pumping station before it reaches the river (more than 70 acres of downtown watershed drain to this spot). Second, it is carried across the river on tides and currents and wind – a source of visible pollution such as fast food containers and larger items that originated outside downtown. Third, it is blown from Town Point Park and nearby trash cans and dumpsters, a source of visible garbage plus sedimentation, mulch, leaves and organics; this is considered minor, due to an aggressive street-cleaning and sidewalk-cleaning program now in place.

The Stormwater Team interviewed a city dockmaster, an employee of a harbor tour ship docked at the park, and a maintenance man at Nauticus, each of whom was tasked with dipping trash out of the harbor at frequent intervals. They clean, respectively, Waterside Marina, Otter Berth, and the north and south basins and the fountains at Nauticus, the worst pockets for collecting floating objects. The workers agreed that timbers, hats, and miscellaneous objects largely arrive from the other side of the water, the river rather than the land.

Hordes of residents and visitors enjoy the downtown Norfolk waterfront, a destination that must remain "as clean as Disneyland."

Practice Description

The Stormwater Team researched a range of options, with broadly varying price tags and feasibilities. The option chosen by the downtown merchants: Manual scooping. Their employees are now spending more time seeking out visible pollutants and removing them promptly, while preventing trash from falling or blowing into the water. Since the Downtown Norfolk Council employs personnel for related tasks in this location, more trash pickup on land and water was inexpensive to add. On a waterfront with different community resources, a modest Whaler-type open boat, possibly donated, staffed by an operator with nets similar to those used for trawling, would amplify the efforts of waterfront personnel at hot spots where trash is out of reach and out of control. Juvenile justice diversion groups such as the one using a patrol boat as a floating classroom at Nauticus might be positioned to take on the work for a small donation, if boat and nets were provided. Scout groups, yacht clubs, fraternal organizations and service clubs are likely sources of labor and enthusiasm, for the work or for fundraising to purchase equipment.

Advantages

Immediate results. Modest outlay for equipment, maintenance, storage, trash hauling and personnel costs. Flexible as budgets change and trash quantities ebb and flow.

Concerns

A dedicated dumpster might be needed. Personnel costs can be prohibitive, along with liability and training, if scoopers are expected to handle heavy or contaminated items.

Costs

Storm drain retrofit devices might be worth considering, although the number of units is daunting. A wide range of devices are available, some specially designed to handle debris as well as toxics. CDS has separators to capture pollution, removing suspended solids with no moving parts, can treat up to 300 cfs (major storm), cost $7,000 up each, with simple maintenance at only $300 up/year. A "Stormceptor" can cost as much as $65,000 per unit, and removes much from the storm drain's flow.

Expensive to own and operate but the best bet for offshore sources, capturing debris before it gets to shore: Skimmer boats. Two boat manufacturers, Advanced Marine ("Hydro-Skimmer") and United Marine International ("Trashcat"), produce appropriate vessels.

Other Considerations

Some methods of addressing *visible* pollutants like litter also address *invisible* ones like petrochemicals and organics, and these are preferred, budget permitting. Although litter arrives in the river via wind and ignorance in addition to stormwater flows, effectively managing stormwater would have an immediate and impressive effect on the amount of litter that needs to be removed, while offering a chance to educate the public to its harms.

Site for Action: US Army Corps of Engineers Parking Lot and City Sidewalk

Site Description

The U.S. Army Corps of Engineers has a paved employee parking lot which is graded in an unusual way. It drains to one edge, about 200 feet long, like a tipped tabletop, instead of funneling to one corner, which is the norm. This sheet flow, sweeping across rudimentary fringe vegetation plus a concrete sidewalk totalling about ten feet in width, carries a visible load of dirt, sediment and a variety of pollutants into the gutter of Southampton Avenue, which drains to a curb inlet and then straight into the nearby main stem of the Elizabeth, creating a “delta” plume when it rains.

Three features make this location enticing for a stormwater innovation: A visible flow of pollution, ideal for a buffer strip, occuring in such an urban environment; and the added educational opportunity beckoning because the next phase of the popular Elizabeth River Trail is overlaid on this sidewalk, and will feature educational signage for walkers and bicyclists.

Practice Description

A proposed buffer would be created by removing the sidewalk and edging it with topsoil. For the Elizabeth River Trail, permeable pavement chosen to meet Americans with Disabilities Act standards can then be placed, with educational signage appropriate to this high-visibility location. The buffer strip between lot and path will encourage infiltration, and will replace unsightly, sparse weeds. The combination will provide treatment, slow flow, reduce sedimentaion, teach the public, and beautify the cityscape.

Southampton Avenue is discolored by parking lot sedimentation and runoff. This sidewalk can be replaced with permeable pavement (sample shown in inset), with a buffer along the fence.

Advantages

A buffer strip is a simple practice. There is very little engineering involved and construction should not be too difficult. It may not be wide enough to encourage mass infiltration, which was a concern among stakeholders.

The installation of a buffer strip will dramatically decrease the need for maintenance. In the long term this will save the city some money.

The likelihood of having services donated to construct this practice appears to be high. If substantive work is performed gratis, the cost-benefit relationship would be very high.

There is a reasonable drop in elevation from the parking lot to the street. The width, 8 to 10 feet, is sufficient to settle out some sedimentation, which is not a surety in most ultra-urban settings.

Perhaps other buffer strips in ultra-urban areas could follow.

Concerns

Proximity to street and parking lot, while not a huge concern, is a minor worry because water infiltrating the soil could theoretically impact the adjoining street. The soil is considered good, so this concern is considered remote.

Location of the Elizabeth River Trail is a concern because it must meet rigid Americans with Disabilities Act (ADA) standards. With permeable pavement done correctly, wheelchair users are not inconvenienced.

The amount of watershed treated is relatively small (estimated to be 2 acres). The purpose of the project is for demonstration and to relieve downstream landowners of a continuing nuisance.

Costs

A vegetated filter strip is the least expensive treatment option. Adding the permeable pavement to accommodate the Elizabeth River Trail increases the cost, which could be under $10,000 for site preparation, plus from $10,000 up for permeable paving. There are big savings if the City of Norfolk removes the concrete sidewalk and hauls it away. Total topsoil costs might run approximately $6,000 to fill the area under the permeable pavement. If the buffer strip is seeded with bermuda or centipede grass the cost would decrease, but native plants, chosen for low maintenance, would enhance the educational value and only add about $5,000 to the cost. If very little work on the project were done in house, the cost of the project might not justify the results.

Other Considerations

Many partners are enthusiastic about this project. The US Army Corps of Engineers, which owns the parking lot, has already set aside some money in its budget. The City of Norfolk is willing to assist with the demolition of the old sidewalk. The Rotary Club of Norfolk has indicated interest. The EPA's Chesapeake Bay Program is considering matching funding to make this a demonstration project for federal agencies around the Bay.

On Earth Day 2002, the community of Cradock turned out to clean up debris in Paradise Creek and planted a 4.5-acre riparian buffer.

Focus Area 2: Paradise Creek, Portsmouth

On the banks of Paradise Creek, a small tributary of the Elizabeth River, one finds a diverse mix of land uses, including small businesses, established neighborhoods, old "brownfields" sites, and major industrial activities such as the ***Norfolk Naval Shipyard*** and a regional trash-to-energy plant, ***Southeastern Public Service Agency (SPSA)***. The goal of the Elizabeth River Project is to restore this entire subwatershed by 2007.

Stormwater plans will be crucial to this success. Paradise Creek was chosen for our model restoration initiative because of its compact watershed size, its wide array of users, its residents' willingness to contribute their efforts to its recovery, and its mirroring of the degradation confronted elsewhere in the Elizabeth River watershed, now underway. "Return to Paradise!" is our rallying cry for this creek.

Best Sites for Action

Norfolk Naval Shipyard
Peck Iron and Metal
Cooper Avenue at Reid Street
Southeastern Public Service Agency

Sites Assessed

Norfolk Naval Shipyard . . . . .Riparian buffer
Peck Iron & Metal . . . . .Stormwater wetland
Cooper-Reid lot . . . . .Stormwater wetland
Southeastern Public Service Agency . . . . .Retrofits and buffer
Cradock Middle School Outfall E. . .Conventional BMP
Cradock Middle School Outfall W. .Bioretention area

Implemented: Norfolk Naval Shipyard's New Gosport Housing Area

Site Description

Norfolk Naval Shipyard's New Gosport landfill, on Paradise Creek, was designated a Superfund site for disposal decades ago of toxic sandblast material. The Navy site was re-engineered to create 1.9 acres of pristine wetlands in cooperation with Elizabeth River Project. The site was transformed from toxic wasteland to wetland in a few months. More than 20,000 wetland plants were installed and the project saved the shipyard about $750,000. Upland from the wetland is a slope with some vegetation, to a grassy area with a few mature trees, which was the former Gosport Housing site (the houses were removed several years ago). Erosion was beginning to occur along the slope, and runoff was channeling down the slope and the concern was that it would put undue stress on the wetland. A 4.5-acre riparian buffer and no-mow zone were created on Earth Day 2002 to stabilize the slope, treat some of the runoff, and add valuable habitat.

Practice Description

Riparian buffers, forested areas alongside a river or creek, remove all types of pollutants, including sediment, phosphorus, and nitrate. The buffers often act as shoreline stabilizers and add valuable habitat for a variety of wildlife.

Level spreaders might be a future option to add at this site if the riparian buffer does not address the erosion problem. Level spreaders spread the flow of the runoff out, creating a thin sheet flow to pass through the buffer, which will reduce the channeling.

Advantages

The riparian buffer requires little maintenance, except to water it until it is established. Riparian buffers are very effective at treating runoff. The riparian buffer is the perfect choice for the Gosport site as it is the perfect compliment to the newly created wetland and is one of the few practices that will work well to reduce erosion.

Costs

The 4.5-acre riparian buffer of native trees was planted for approximately $10,000 including design, plants, mulch, and site preparation.

Concerns

There is some concern that there will be significant tree loss, because of the quality of the soil.

Other Considerations

New Gosport is at the "headwaters" of Paradise Creek, which is an ideal location for restoration. Headwaters were identified as a high priority for restoration, conservation and pollution prevention in a master plan developed for the Elizabeth River Project by URS Corp.

Underway: Peck Iron & Metal Scrapyard

Site Description

Adjacent to Paradise Creek, the Peck Iron and Metal site had served as a recycling yard for metal products for more than 50 years.

Peck Land Co. became an active partner with the Elizabeth River Project in 2001 and construction is scheduled for early 2003 for a major stormwater demonstration project, along with enhanced wetlands and forested buffers plus a new conservation easement at this site.

Our assessment showed that most of the runoff from the site sheetflowed into a "relic" tidal wetland cove, because of a berm along the shoreline. This same berm partially disconnected the tidal wetland from the creek. Some of the runoff from the site flowed through an old pipe crossing the relic wetland, ultimately dumping directly into the creek.

Practice Description

Two stormwater wetlands will be created along the edge of the tidal wetland to capture and treat the runoff from the site. One small linear wetland will be sited along an open ditch that runs along the western boundary of the property. A second larger wetland will be constructed to intercept three drainage swales that drain much of the property. Diversion dikes will be constructed to channel some surface flow from upland areas into the stormwater wetlands.

The total size of the two wetlands to serve this drainage area would be approximately half an acre. During heavy rain, should capacity be exceeded, the runoff would overflow across a long linear, broad-crescent weir into the restored tidal wetland. This weir helps diffuse the flow as it enters the tidal wetland. Native vegetation in the stormwater wetlands include Common Rush, Cattails, Pickerelweed, and Soft Stem Bulrush.

In addition to stormwater enhancements, the relic wetland will be reconnected to the creek by removing the berm. The wetland will also be enlarged by 9,000 square feet and enhanced with a riparian buffer around the perimeter and along the entire shoreline. The restoration project will culminate in a permanent conservation easement of more than five acres bordering the creek, with a forested buffer to be planted.

This former recycling yard is the future site of a model stormwater wetland and riparian buffer.

Runoff is a significant problem at the Peck site.
Construction of a stormwater wetland is funded for 2002-03.

Advantages

The watershed area is more than 35 acres and much of the runoff currently drains straight into Paradise Creek without treatment. Ample room exists to construct the two stormwater wetlands and the riparian buffer. The landowner is willing and has already begun planning for the BMPs to be constructed. Due to the "Brownfield" nature of this site, stormwater improvements could have a significant impact on water quality on the adjacent creek. The existing tidal wetland is perfectly situated for polishing any runoff overflow from the stormwater wetlands.

The riparian buffer will treat the runoff from a portion of the site, create valuable habitat, and has an added bonus of screening the industrial site from the residential neighborhood across the creek.

Concerns

There is a potential buyer interested in redeveloping the site. Will the BMPs be adequate for the future industrial activity? The buyer is meeting cooperatively with the stormwater team as this goes to press. While an environmental assessment has been conducted, is there unidentified contamination?

This a large multi-faceted project, and the complexities of permitting, construction, and timing of plantings all are variables that must be addressed.

Costs

Assuming the stormwater wetlands in total comprise about half an acre, an approximate cost for the stormwater wetlands alone should range from $30,000 to $60,000 depending upon the amount to be excavated. The majority of the cost is borne by excavation and hauling; however, additional money would be needed to create the two weirs. The diversion dike construction could total 1,000 linear feet and may increase the total cost, perhaps by another $10,000. The restoration of the tidal wetland could cost between $20,000 to $35,000. Total cost for the project could easily reach over $100,000, but may be as low as $60,000.

Other Considerations

This project was funded in 2002 by a Community Legacy Grant, Small Watershed Program, with matching funds from NOAA, Oceans Trust, and Omega Protein.

Site for Action: Cooper Street at Reid Avenue

Site Description

We were excited to find a vacant lot at the base of a 70-acre watershed draining much of the Cradock neighborhood of Portsmouth. The site of the proposed wetland is immediately adjacent to Paradise Creek. The wetland would be sited next to a residential area comprised of single family homes and an apartment complex. The available land is owned by the apartment owners and is contiguous to the apartment's parking lot, which floods during heavy rain or extreme tides.

A stormwater wetland is the most effective way to remove nutrients, particularly nitrogen and phosphorus, from urban watersheds, and less risky than a wet pond (with its greater depth), but enough space for one is rare in such a highly developed area. With the high water table and available space, this spot is suitable.

Practice Description

The stormwater wetland will be shallow with two forebays, where portions of two subwatersheds would drain into the wetland. The practice would be kept separate from tidal waters of Paradise Creek. The wetland would be planted with freshwater vegetation such as Rose Mallow, Pickerelweed, Rush, and Iris. To provide a continual water source, the wetland will be constructed by excavating to the seasonally low ground water table. Since the the water table is so close to the surface, pumps may be needed to bring the stormwater up from the pipes to the wetland.

Advantages

This wetland has several outstanding advantages:

1. The proposed wetland's proximity to Paradise Creek. Once treated the water will directly drain into Paradise Creek.

2. An opportunity to treat a significant portion of the runoff from a 70-acre developed watershed.

This vacant lot at the corner of Cooper and Reid was an inspiration to stormwater investigators looking for a practice site near Paradise Creek, who recommend constructing a stormwater wetland here.

3. From the predominantly stable urban residential composition of the watershed the target pollutants are likely to be nitrogen and phosphorus. Stormwater wetlands such as this are regarded as the premier practices to treat these two pollutants.

4. Public visibility. There may be an opportunity to incorporate a public park into the stormwater wetland.

5. Principal benefit of using pumps: excavation volume and total cost dramatically decrease. Average excavation depth will be reduced from five feet to one foot. Because some regrading may be required, some of the excavated soil can be used on site.

Concerns

The stormwater wetland may not alleviate local flooding on the apartment parking lot.

It still must be determined as to how much of the 70 acre watershed could be treated by this stormwater wetland.

There is no definite landowner agreement, however initial discussion with the property owners indicates an interest on their part. One possible solution is for the City of Portsmouth to acquire either the property or an easement to the property. This would relieve the tax burden on the landowner and could make the project more palatable to them.

Another concern would be addressed by the city assuming control of the BMP: conducting maintenance of the wetland and the pumps.

A physical concern with this project is the pipe invert depth. The two culverts, which drain underneath the field, may be deep. If that were to be the case, the potential cost would increase.

Costs

To capture runoff and allow free-flow to Paradise Creek, 1 or 2 pumps should be installed. Total pump costs range from $20,000 to $30,000:

- Pump purchase, $7,000 to $10,000
- Control box & sensors, $4,000 to $5,000
- Manhole 4' diameter by 6' depth, $3,000 to $4,000
- Grating, $1,000
- Installation, $5,000 to $10,000

The cost of excavation could range from $10-15/cubic yard, which is substantially higher than first estimated. Optimistically, a one foot excavation would be $10,000 to $20,000.

Other costs include vegetation and outlet construction. Estimated costs for each are $5,000 to $7,000 and $5,000 to $10,000, respectively.

Total costs range from $40,000 to $70,000. If the parking lot needs to be raised to reduce the flooding, costs could escalate substantially. In addition, if the soil needs to be hauled over 2 miles the costs could even increase more. If the soil is of reasonable quality, there is a possibility that it could be used at the site or nearby and therefore the cost of hauling would be eliminated.

Investigators determined pipe slopes this way.

Underway: Southeastern Public Service Agency (SPSA)

Site Descripton

This regional trash-to-energy plant presents an expanse of parking lot and rooftop. An industrial site, it hosts heavy trucks carrying residential and commercial waste.

The site's drainage flows to a single outfall, then channels through a modest riparian buffer on Paradise Creek, which provides minimal treatment for the runoff. There is very limited room near the outfall for a BMP.

SPSA, a River Star, not only wants to improve the environment, but also desires to be a good neighbor. A tree planting was implemented in November 2002 to screen the industrial facility from the neighborhood across the creek. The trees also act as a buffer for a small portion of runoff on the site.

Practice Description

The southern edge of the parking lot borders Paradise Creek. Here there is some available green space that could be potentially retrofitted with small bioretention areas or raingardens.

A portion of the parking lot would need to be closed off temporarily for construction of the BMP's. If significant paved areas re-grading is necessary, the project costs could balloon. When placing the bioretention areas, excavation will be necessary and utilities could restrict the size and depth of the bioretention areas.

Since demand on the parking lot is high and tearing it up would create a major disruption, a feasible alternative to bioretention is installation of mechanical retrofits. Mechanical inserts such as Inceptor or Stormceptor would need regular maintenance and are costly, but would be able to effectively treat much of the runoff.

While runoff improvement is being pursued, an urban forest was planted in fall of 2002. The buffer was designed by a student volunteer for a graduate-level sustainable landscaping class. The buffer, which also serves as a screen to the

Facing Paradise Creek: one confronts acres of impervious surface at SPSA's enormous waterfront trash facility. Even this stormwater issue can be solved to the satisfaction of all partners.

*Volunteers plant an urban forest at **SPSA** that will act as a screen and a buffer. This trash-to-energy-plant, also a River Star, is located on Paradise Creek.*

neighborhood, includes native trees such as Holly, Red Maple, Wax Myrtle and Loblolly Pine. The one-acre site of the planting was also turned into a no-mow zone to add habitat value.

Concerns

The site is difficult to retrofit for many reasons. First, the parking lot is very close to the water's edge. Secondly, the site has been filled, and the elevation is quite high, compared to the outfall pipe, which, in comparison, is fairly low, making natural devices such as stormwater wetlands difficult, if not impossible.

The mechanical retrofits will require more maintenance than bioretention and will be more costly; however, employees currently change oil socks in all the inlets regularly, so maintenance is not expected to be a concern.

Costs

If bioretention is chosen, the amount of regrading of the parking lot will influence costs. Other items to cover include diversion of traffic, and modification of the inlets. If the stormwater is to be routed from the parking lot to the BMP, the lot will need to cut into and resealed. Shallow excavation of the devices could be expected to cost between $5,000 and $10,000. However, improvements to the parking lot and paved areas could range in cost from an additional $5,000 to $20,000, depending on which inlets are retrofitted for diversion.

The mechnical retrofits vary widely in price from $5,000 to $25,000 each. With four inlets the cost could run from $20,000 to $100,000.

The urban forest that serves as a screen and a buffer cost approximately $1,500 for the trees. The design was donated and volunteers provided planting labor.

Other Considerations

Bio-retention areas or rain gardens can be expensive if appearance is not a factor; permeable pavement would not withstand the heavy truck traffic; and proprietary drain devices can also be costly.

In consideration of the value and the high demand of the parking lot, mechanical retrofits are likely to be the best choice to treat runoff for this site, in spite of the higher cost.

Additional Sites Assessed

This degraded ditch in the Lenox neighborhood is being transformed into a large stormwater wetland.

Best Site for Action

River's Edge Development

Sites Assessed

Lenox Subdivision	Wetland construction
River's Edge Development	Low Impact Development (LID)
US Coast Guard ISC	Inlet device
Virginia Zoological Park	LID practices
Ernie Morgan Env. Center	Stormwater reuse
Myrtle Avenue	Raise streets; rain garden
Knitting Mill Creek	Riparian buffer
Steamboat Creek	Riparian buffer
Roberts Rowing Center	Rain garden

Site for Action: River's Edge Development

Site Description

River's Edge in Chesapeake is a plan for an environmentally-friendly development on an old steel mill site with lots of possibilities. The developer is open to employing innovative stormwater practices throughout his property. Because the Elizabeth River Project and others are able to "get in at the ground floor" there is a chance River's Edge could be a relatively ecologically sound neighborhood.

Three features make the site especially enticing for stormwater practices. Firstly, a large portion of the site is in sandy soils. Secondly, the seasonally high water table throughout much of the buildable land is several feet below the surface. Thirdly, there is a surprising amount of fall to the river banks along the back side of the proposed home sites.

Practice Description

The first two features above make the site ideal for permeable pavement as well as simple backyard rain gardens. Because traffic will be light in certain areas (a limited amount of daily traffic and relatively light vehicles), permeable pavement is an option for driveways plus some roadways.

The third will allow surface flow to be directed into communal rain gardens. The developer has already allocated space for this larger rain garden construction.

Finally, in a relatively low draw a wetland could be created into which stormwater runoff would flow and be treated. The wetland would run the length of one of the streets.

Advantages

The use of the permeable pavement will reduce the developer's stormwater quantity mitigation requirement in addition to allowing for infiltration of pollutants into the shallow groundwater.

The developer is planning to leave a substantial amount of the site as buffers and wetlands through which the groundwater will flow. These practices will treat infiltrated pollutants passing through their root zones in the shallow groundwater.

A large constructed wetland and riparian buffers make the new proposed development very rain-friendly.

Concerns

The plans for this development have not passed significant regulatory hurdles, including wetlands permitting and zoning variances. The development may never be built, in spite of excellent environmental potential for both execution and model practices.

Costs

Since the stormwater improvements can be in place early in the construction process, the increase in cost attributable to installing permeable pavement may be minimized and easily passed on to "green" homebuyers.

Other Considerations

With a little effort it might be possible to incorporate even more "green" principles here.

Stakeholders representing a broad range of interests met with Bill Hunt (right) and the Stormwater Team to evaluate proposals for action.

Stakeholder Involvement

The Elizabeth River Project strived to bring all stakeholders and technical experts in priority focus areas of the Elizabeth River to the table to inform them of this project, determine their concerns, solicit their opinions of progress to date, and request their guidance in making plans for the future. Many of these representatives provided key data and invaluable assistance on site visits.

The list included: laymen (citizens in affected neighborhoods), technical experts (engineers from the Stormwater Department), and decision-makers (representatives from River Star industries and city, state, and regional agencies such as the Norfolk Public Works Department, the Virginia Department of Environmental Quality, and the Environmental Protection Agency).

A Stormwater Roundtable was held March 27, 2002, at the Sheraton Norfolk Waterside Hotel, in addition to one-on-one visits and interviews. During the Roundtable, proposed projects were ranked for Water Quality Impact, Funding Likelihood, Innovation Value, Priority, Roadblocks, Opportunities, Cost Effectiveness, Neighborhood Support, Transferability, and Public Visibility, with plenty of opportunity for comments and discussion.

The will of participants was that the most feasible site to implement would be the Corps of Engineers parking lot, since the usual barriers (funding, participating partnerships) are perceived to be negligible. However, the Floating Wetland Garden ranked high for transferability, visibility and innovation value.

Stormwater Stakeholders for the Win-Win Project

Cheryl Atkinson, United States Environmental Protection Agency Region III

Diana Bailey, US Army Corps of Engineers

Mike Barbachem, URS Corp.

Cherryl Barnett, Elizabeth River Project Board

Mike Barnett, ***Southeastern Public Service Authority***

Sharon Baumman, ***US Navy*** Regional Environmental Group

Holly Baumstark, ***Southeastern Public Service Authority***

Joe Braun, Norfolk homeowner

Ernie Brown, Virginia Dept. of Conservation & Recreation

John Carlock, Hampton Roads Planning District Commission

Cathy Coleman, Downtown Norfolk Council

Richard Conti, Nauticus, The National Maritime Center

Faculty and students of Cradock Middle School

John Deuel, Friends of Norfolk's Environment and ***Norfolk Environmental Commission***

Wilkie Din, ***US Navy*** Regional Environmental Group

Charlie Dolbey, Dolbey Marine

Rick Gregor, ***Island Estates***

Eric Gunderson, Southern Branch Nursery

Gary Heflin, ***United States Coast Guard - Integrated Support Command, Portsmouth***

Ron Holcomb, ***United States Coast Guard - Integrated Support Command, Portsmouth***

Mike Host, ***Norfolk Naval Shipyard***

William H. Hunt, North Carolina State University

John Keifer, City of Norfolk

Deborah H. Lamb, US Army Corps of Engineers

Cindy Linkenhoker, ***City of Portsmouth's Greenwood Drive Project***

Mark Mansfield, US Army Corps of Engineers

Dave McGuigan, United States Environmental Protection Agency Region III

Kathy Mooney, ***Norfolk Naval Shipyard***

Michael Nickelsburg, Tidewater Community College

City of Norfolk, Virginia

Pinar Ozdural, Old Dominion University

David Peck, JSP Land Company

Melanie Pesola, ***Norfolk's Business Partners for Clean Water***

City of Portsmouth, Virginia

Rob and Kathy Powell, ***Norfolk Boat Works***

Walter Priest, Virginia Institute of Marine Science

Steve and Peggy Rahimpour, Paradise Creek homeowners

Kathleen Redfern, Back Porch Group

Buz Rees, City of Norfolk

Roseanne Scott, ***People for the Ethical Treatment of Animals***

Madeleine Sly, Harbor Place Condominiums

Meade Stith, US Army Corps of Engineers

Mr. and Mrs. Stringer, Pilot House Condominiums

Karen Truxal, US Army Corps of Engineers

Kristi Unzicker, ***US Navy*** Regional Environmental Group

Hugo Valverde, Hampton Roads Planning District Commission

Howard Webb, Webb Technologies, Inc.

Scott Whitehurst, Norfolk Department of Public Utilities