

Memorandum

Date: April 29, 2005

To: Chris Dreps
Upper Neuse River Basin Association

From: Sally Hoyt and Jennifer Tomlinson
Center for Watershed Protection

Re: Summary of Field Work Activities in Little Lick Creek –
March 2005



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Introduction

The Little Lick Creek Watershed technical team conducted field assessment work from March 14-18, 2005 in support of the development of the Little Lick Creek Watershed Plan. The fieldwork was primarily organized and headed up by the Center for Watershed Protection (CWP). Substantial and valuable support was also provided by Upper Neuse River Basin Association (UNRBA), City of Durham Stormwater Services Division, and the Durham County Erosion and Stormwater Control Division.

The purpose of this memo is to document the field activities, provide a general summary of preliminary findings from the fieldwork, and to map locations of potential hotspots and retrofit opportunities. Copies of field sheets and a CD-ROM containing photos taken during the assessments will be provided under separate cover.

This technical memo is organized into the following parts:

Key Findings – summarizes and groups the findings of the upland assessment and stormwater retrofit inventory fieldwork.

Restoration Projects – addresses the organization of the field data, and presents potential restoration sites by restoration project type.

Appendix – includes profile sheets for retrofit examples and pollution source control practices

This memo should be used in conjunction with the supporting maps that highlight retrofit and hotspots sites. The Triangle J Council of Governments will compile these maps, which will also show the results from the Unified Stream Assessment that was conducted in January 2005.

The Hotspot Site Investigation (HSI) and Stormwater Retrofit Inventory methods were used to assess upland pollution sources and restoration opportunities. The HSI is part of the Unified Subwatershed and Site Reconnaissance (Wright et al. 2004), a field survey to evaluate potential pollution sources and restoration opportunities within urban watersheds. Hotspots are defined as commercial, industrial, institutional, municipal, or transportation-related operation that generate higher levels of pollutants or present a higher risk for spills or illicit discharges. The HSI creates an inventory of hotspot sites and ranks the potential severity of each hotspot found within a subwatershed. The HSI looks specifically at vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure. Prior to going into the field, some potential hotspot sites

Little Lick Creek – Hotspot and Retrofit Fieldwork

were identified using aerial photographs and parcel identification. Additional sites were identified during the fieldwork.

A Stormwater Retrofit Inventory looks at candidate sites for retrofits in the watershed by examining areas where changes can be made to better to reduce nutrient loading and channel erosion. Applications of different retrofit practices vary according to the impervious cover and land use as well as the restoration goals being pursued. For the Little Lick assessment, our goal was to identify projects over a range of drainage areas and land uses that will reduce nutrient loads to Falls Lake.

Most of the potential projects - both hotspot and retrofit - presented in this document are related to the current conditions observed during fieldwork. Many opportunities for watershed restoration were found during the upland assessment. Combining these opportunities with those that were identified during the stream corridor assessment (conducted in January 2005) will provide the building blocks for a broad-based and balanced restoration approach for the watershed.

During the retrofit inventory, a few potential land preservation opportunities were identified (e.g. forests and wetland/floodplain areas that currently function as filter strips and buffers, reducing runoff volumes and improving water quality). These sites were visited to look for structural retrofits, but the field teams recommended preservation as a more effective option.

The field teams for the upland assessment and retrofit inventory consisted of members of many of the project partner organizations, including:

UNRBA (Chris Dreps)

Center for Watershed Protection (Sally Hoyt, Jennifer Tomlinson)

City of Durham Stormwater Services Division (Jonathon Baker, Dave Brown, Jake Chandler, John Cox)

Durham County Erosion and Stormwater Control Division (Joe Albiston and Joe Pearce)

Field teams for each day of fieldwork are listed below.

Date	Mon 3/14	Tues 3/15	Wed 3/16	Fri 3/18
Team 1	Hoyt Tomlinson Albiston	Tomlinson Dreps Baker	Hoyt Tomlinson Baker	Hoyt
Team 2	Brown Chandler Dreps	Brown Chandler	Brown Chandler	
Team 3		Hoyt Albiston		

Hotspot Site Investigation Key Findings

The HIS identified fifty sites in the Little Lick Creek watershed and assessed the potential pollution severity of 34 sites. These sites are identified on the maps and in this report by a site ID in the following format: HS-[subwatershed ID number]-[site number]. All of the visited sites are listed in Table A-1 in Appendix A. Sites are listed by hotspot type and in Table A-2.

Several storm water pollution issues in the watershed were evident as re-occurring site problems. These impacts range from enforcement issues to the need for education on pollution prevention. The key findings relate to:

- Vehicle maintenance and repair
- Gas station pollution source control
- Outdoor materials storage
- Restaurant pollution sources control
- Dumpster management

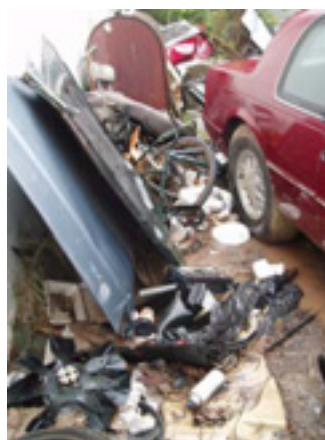
These key findings are summarized below with a description of the impact to the watershed and an example of a specific site. Pollution prevention practices, enforcement and education should be applied to all of the hotspots discussed below. Details regarding best management practices and education materials can be found in Appendix B.

Vehicle Maintenance and Repair

A large number of vehicle maintenance and repair operations exhibited pollution source control problems spanning several categories (improper materials storage, illicit discharge, and vehicle storage). These operations can exert a significant impact on water quality by generating toxins such as solvents, waste oil, antifreeze, and other fluids. Several of these locations were visited during a rain event and runoff carrying these pollutants was observed.

Several small repair shops typified pollution problems found at automotive repair business. Problems observed included improper storage of engines, junked cars, antifreeze and batteries. Auto parts could be stored in a covered area, and storage tanks should have secondary containment. Additionally, vehicles stored outdoors should be inspected regularly for leaks or have drip pans placed under them.

The current North Carolina Central University study addressing these small businesses should be contacted. Perhaps pollution source control measures are already part of their effort or could be connected. Education of small business owners is also a potential role for the Durham Stormwater Services public education coordinator.



HS-1-6 Mecanico y Eléctrica Automática (3209 Angier): Improper materials storage (antifreeze, oil, etc.). This site had a strong chemical odor, many leaking cars, and excessive trash.



HS-1-4 Improper materials storage and disposal at GP Campbell Body Shop (left). Evidence of fuel runoff from cars was seen in the drainage ditch during a rain event. HS-2-1 Tellis Automotive Center (right) on South Miami Blvd



HS-1-1 Leaking fuel tank and improper materials storage at Technical Automotive.

Gas Station Pollution Source Control

Gas stations have the potential to directly contribute oil, grease, and gasoline to storm water and can be a significant source of copper, zinc, and petroleum hydrocarbons. Types of pollution observed at gas stations throughout the watershed include uncovered fueling stations (primarily diesel) and fuel runoff from the parking lot.

Practices most applicable at existing gas stations include covering and berming all fueling areas to keep stormwater separate from fuel sites and contain spills. Additionally, several potential gas station retrofits were identified during the retrofit inventory.



HS-3-5 Uncovered diesel fueling station at Hess gas station on U.S. 70

Outdoor Materials Storage

Unprotected outdoor storage areas can generate a wide range of storm water pollutants such as sediment, nutrients, toxic materials, and oil and grease. Unprotected outdoor storage problems were observed at a variety of businesses and include: lack of secondary containment, improper labeling of storage containers, and uncovered outdoor storage. The main pollution source control objectives at these sites should be to cover, contain, and reduce the materials being stored.



HS-1-2A and HS-2-2 At Park East Ventures (left) no pollutant source was confirmed, but rusty, uncovered fuel storage tanks and oil/antifreeze barrels were placed near a highly eroding area. At B & R Construction (right), unlabelled barrels contained unknown materials.



HS-4-2 Durham Area Transport Authority (DATA): Uncovered diesel fueling area lacked secondary containment. Diesel was observed leaking across the parking lot into the storm drain inlet behind the bldg.

Restaurant Pollution Source Control

Reoccurring pollution control issues at restaurants in the Little Lick Creek watershed were grease storage, wash water disposal and dumpster management.

All sites contained outdoor grease storage containers, and several showed evidence of proper collection by a hauling or rendering company. However, some containers were not properly used, maintained or emptied and grease was draining to storm drains or drainage channels. Possible evidence of illicit discharges of wash water was observed. Dumpster management problems included overflowing receptacles and lack of drain plugs.

Both grease and wash water illicit discharges were observed at the Cookout fast food restaurant at the junction of Peyton and South Miami Blvd. The dumped grease was present in the BMP riprap area in several locations, which could eventually eliminate the functionality of the BMP. Potential evidence of an illicit discharge of wash water was found, as a curb PVC outlet drains to the BMP from the side of the building.

Restaurant pollution prevention can involve simple and low-cost practices to prevent grease discharges such as installing a grease trap and/or using a grease hauling or rendering service. To prevent pollution by improper wash water discharge, equipment, garbage cans and floors should be cleaned in a designated indoor area such as a mop/utility sink or floor area with a drain connected to the sanitary sewer.



HS-3-1 Grease globules and wash water stain in channel and riprap leading to BMP at Cookout fast food restaurant. (above and left)

HS-5-4 Grease collection system at Home Plate restaurant. (right)

Dumpster Management

Many dumpsters can be significant pollution sources, especially when overflowing and/or left open. Open dumpsters allow rainfall to mix with the waste and when a leak occurs, it creates a source of oil, bacteria, metals, trash, grease, nutrients and other pollutants. Dumpster management issues were observed throughout the watershed at multiple types of businesses. Often other potential pollution sources, such as lack of secondary containment, were observed on sites in conjunction with improper dumpster management. Those sites were addressed under previous pollution source control categories. Dumpsters should be routinely inspected and a reputable solid waste disposal contractor should be used.





HS-1-5 and HS-5-2 Poor dumpster management and outdoor storage at Goss Carpet and Tile and Oak Crossing shopping center.

Retrofit Assessment Findings

Sixty potential retrofit sites were identified and visited. All of these sites are described briefly in Table A-3 in Appendix A. Stormwater Retrofits are labeled using the following convention:

SR-[*subwatershed ID number*]-[*site number*].

Selected sites fell into one of several categories: residential areas that are densely developed, upstream of a stream reach in poor condition, or built prior to requirements for stormwater management; large impervious areas such as shopping centers, schools, and churches; and other public property including parks. Recommended stormwater retrofits include bioretention, sand filters, stormwater wetlands, stormwater ponds, and rain gardens.

Key findings and recommendations regarding stormwater retrofits in the Little Lick Creek watershed are:

In residential areas:

- Use on-lot stream buffers and rain gardens in older neighborhoods.
- Preserve existing forests and wetlands as filter areas.
- Convert existing dry ponds to wet ponds or stormwater wetlands.
- Construct stormwater controls for apartment complexes and mobile home communities.

In commercial, institutional, and public lands:

- Address commercial areas on-site controls and pollution source control measures.
- Retrofit the three public schools as demonstration/education sites.
- Outreach to churches to maintain and enhance sheet flow off parking lots.
- Treat larger drainage areas in City of Durham parks.

The applicability of restoration projects by land use and example projects are discussed below. All of the potential stormwater retrofits identified are included in the restoration projects table.

Residential Areas

Older, densely developed residential areas of the watershed typically lack stream buffers or common space, restricting possible stormwater retrofit locations. More recent developments were built with dry ponds, which provide quantity control but do not improve water quality. These ponds can often be repaired or retrofitted. Apartment complexes, a third category of residential sites in the watershed, contain a high level of imperviousness, making them targets for retrofit.

Little Lick Creek – Hotspot and Retrofit Fieldwork

The development along Tyne and Hadrian in subwatersheds 5, 7, and 13 exemplifies the lack of stream buffers and common space in older neighborhoods. Downstream stormwater retrofits at the golf course (SR-5-9) or the preservation of wetland and forest filtration function at the Durham property that formerly housed the sewer treatment plant (SR-5-8) are possible projects for the portion of the neighborhood in subwatershed 5.

In subwatershed 13, the neighborhood drains to one of many farm ponds that dot the Little Lick Creek watershed. Runoff receives water quality benefits from passing through this pond located east of Stallings Rd. However, as the pond is on a separate, private property, there is no guarantee that it will exist in the future. Preservation of this and other historic farm ponds for water quality purposes presents an alternative to building new facilities.

This neighborhood spanning subwatersheds 5, 7 and 13 could also be prioritized for a homeowner education campaign targeting pollution source control and the installation of residential on-lot stormwater controls such as rain gardens and stream buffers (e.g. SR-5-4).

Two large mobile home communities, located along the mainstem of Little Lick Creek in subwatersheds 2 and 5 provide possible opportunities for stormwater retrofits. These areas could be treated with a combination of structural measures (bioretention, shallow wetlands, and wet swales) and reforestation and stream repair techniques.

Stormwater outfalls that currently discharge to forested areas receive passive stormwater treatment as flows infiltrate in the forested buffer area. However, if these downstream, forested areas are developed in the future, this treatment function will be lost.



SR-5-9 involves enhancing existing golf course water features to provide water quality treatment for runoff from the adjacent subdivision.



SR-5-6 Forested area where flows from Armitage Dr discharge.



SR-4-4 In Twin Lakes development the stream buffer area roughly parallels Chance St to the west.

Little Lick Creek – Hotspot and Retrofit Fieldwork

Retrofit of existing stormwater facilities is an attractive potential project because the drainage paths to the facility are established and providing water quality benefits can be as simple as changing the pond's riser configuration. For poorly maintained facilities, ensuring that the facility is repaired and maintained as designed will improve the water quality and channel protection benefits. Dry pond retrofits are exemplified by the two ponds at Pendleton Apartments (SR-1-2 and SR-1-3).

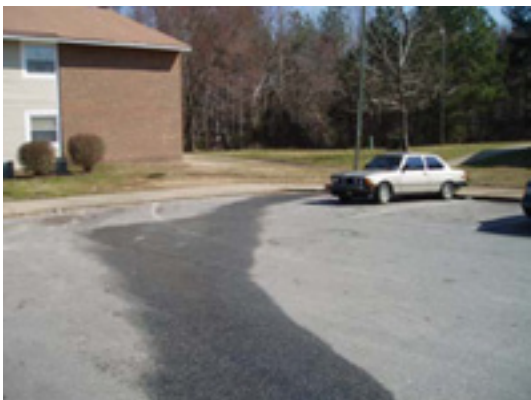


SR-1-3 Existing Dry pond at Pendleton Apartments.

Apartment complexes are a good target for stormwater treatment due to the concentration of impervious area, the evidence of vehicle repairs conducted in the parking lots, and the dumpster management concerns. Apartment complexes in Little Lick Creek Watershed are situated on parcels large enough for on-site retrofits. Parking lot runoff can be diverted to bioretention cells in the turf areas of the property. Untreated apartment complexes that are targeted for retrofit are the Rochelle Manor Apartments (SR-4-1), the apartments on Salvone (SR-4-3), and the Bentwood Apartments (SR-4-5)



Bentwood Apartments (SR-4-5) is a potential retrofit site. These photos depict the existing forested wetland area where the parking lot storm drain system discharges. Grass parking lot islands also provide a potential retrofit site.



SR-4-1 Potential retrofit site at Rochelle Manor; SR-4-3 Retrofit location at Salvone Apartments

Commercial Areas

The commercial and institutional areas centered along Route 70, Route 98, and Angier Ave are highly impervious. Commercial areas are addressed as hotspots, with pollution source control measures recommended. These shopping centers, industrial parks, auto repair businesses and other sites can also be addressed with on-site stormwater retrofits as opportunities arise.

In general, commercial site parking lots can be retrofit with bioretention either in the parking lot or along the perimeter of the site. Gas station runoff can be directed to underground sand filters at the current storm drain inlets. Small shallow wetlands or bioretention cells are possible at the institutional sites. As a minimum measures, pretreatment could be provided to the runoff that currently leaves each of the sites - DATA, Meadows Assisted Living, and Agape Corner - and enters the forested area that serves as a filter strip. However, there is no guarantee that this land will continue to be forested/undeveloped.



SR-5-3 The parking lot behind the Oak Crossing shopping Center drains to a grass area that could be utilized for stormwater treatment (left). SR-3-2 Sand filters could be installed to capture the first flush of runoff before it leaves the site (right)

Schools

Stormwater retrofit concepts are presented for each of the three Durham schools in the watershed – Neal Middle, Oak Grove Elementary, and Southern High School. These projects can serve as demonstration and educational areas in addition to improving water quality.



SR-9-1 Neal Middle School has several potential locations for retrofits including this bus parking lot. (left) SR-5-2B Oak Grove Elementary potential bioretention site in teacher/visitor parking lot. (right)



SR-7-1d and SR7-1c at Southern High School would provide bioretention as water quality treatment for the bus parking lot (left) and teacher/staff parking lot (right).

Church Outreach

Church parking lot runoff throughout the watershed could be addressed through an outreach campaign. Lots are either asphalt or gravel, most without curb and gutter, and stormwater sheet flows over grass areas. Infiltration can be promoted with perimeter rain gardens. Also, the current filtering function of the grass or forested areas should be identified, so that the parking lots are not expanded into these areas or “upgraded” with curb and gutter. Another option is to use porous concrete to pave the lots. This material is more expensive than typical asphalt, so economic incentives or cost-sharing arrangement would be needed for implementation. Outreach to churches also provides a forum for discussing watershed protection with Little Lick Creek watershed residents.



SR-1-8 Living Waters Christian Community, on Miami Boulevard. This large parking lot drains to a yard inlet that could be converted to a bioretention area. SR-1-7 Orange Grove Baptist Church located off Angier Avenue. This large impervious area provides few options for stormwater treatment without reducing the number of parking spaces.

Large-scale Retrofits

Opportunities for large-scale retrofits on publicly owned land are constrained, but include two Durham parks that capture flows from urbanized areas. Roadway runoff could be diverted to Birchwood Park (SR-1-1), located on Lynn Road. Runoff from residential areas may be diverted to turf areas in the CR Wood Park (SR-1-4).

Little Lick Creek – Hotspot and Retrofit Fieldwork



SR-1-1 The basketball courts at Birchwood Park would be relocated to take advantage of the low spot for stormwater treatment. SR-1-4 The low spot depicted in CR Wood Park (right) may be a historic pond.

Chandler Property east of Stallings Road (SR-13-1b) is a potential large-scale wetland creation area. Currently used as cow pasture, this parcel is located adjacent to the confluence of mainstem of Little Lick Creek and an unnamed tributary. Much of this land could be hydrologically connected to the mainstem and tributary, creating new wetland habitat. In addition, the existing farm pond on the property is recommended for preservation, as detailed previously in this memo.

References

Wright, T., C. Swan, K. Capiella, and T. Schueler. 2004. Unified Subwatershed and Site Reconnaissance: A User's Manual. Manual 11 in the *Urban Subwatershed Restoration Manual Series*. Ellicott City, MD. Downloadable at <http://www.cwp.org>

Little Lick Creek USSR Technical Memo

Appendix A

Table A-1
Little Lick Creek - Hotspot Site Investigation

All Hotspot Sites				
Subshed ID	Site ID	Site Name	Hotspot Confirmation*	Project Type
1	HS 1-1	Technical Automotive	Confirmed	Vehicle Operations
	HS-1-2A	Park East Ventures - Construction equipment sales and rental	Potential	Outdoor Storage
	HS-1-2B	Equipment Sales and Service	Potential	Outdoor Storage
	HS-1-3	Private junkyard	Potential	Vehicle Operations
	HS-1-4	GP Campbell Body shop	Confirmed	Vehicle Operations
	HS-1-5	Goss Carpet and Tile	Not a Hotspot	Dumpster Maintenance
	HS-1-6	Mečanico y Eléctrica Automática (3209 Angier)	Confirmed	Vehicle Operations
	HS-1-7	Fennell's Auto Service Center	Potential	Vehicle Operations
	HS-1-8	Bob's Radiator & Muffler	Not a Hotspot	Vehicle Operations
	HS-1-9	VW Repair	Not a Hotspot	Vehicle Operations
	HS-1-10	Quality Auto	Not Assessed**	Vehicle Operations
	HS-1-11	Triangle Auto Mart	Not a Hotspot	Vehicle Operations
	HS-1-12	Dry Cleaner	Not Assessed	Other Commercial
	HS-1-13	Gann Industrial Supplies (Warehouse)	Not Assessed	Other Commercial
	HS-1-14	Alcan Cement industrial	Not Assessed	Industrial
	HS-1-15	Auto Body Shop	Not Assessed	Vehicle Operations
	HS-1-16	Old strip mall	Not Assessed	Other Commercial
	HS-1-17	Latin American Restaurant	Not Assessed	Restaurant
	HS-1-18	Car wash	Not Assessed	Other Commercial
HS-1-19	Industrial Park	Not Assessed	Other Commercial	
2	HS-2-1	Tellis Automotive Center	Severe	Vehicle Operations
	HS-2-2	B & R Construction	Potential	Outdoor Storage
	HS-2-4	Construction and equipment repair at Glover Rd and Angiers	Potential	Outdoor Storage
	HS-2-5	Bilboa food mart and Gas Station	Potential	Gas Station
	HS-2-6	Herndon's Paint and Body	Not a Hotspot	Vehicle Operations
	HS-2-7	Carolina Livery	Not Assessed	Vehicle Operations
	HS-2-8	Gas Station	Not Assessed	Gas Station
	HSI2-3	O'Neal's Upholstery	Not a Hotspot	Outdoor Storage
3	HS-3-1	Cookout Fast Food Restaurant	Confirmed	Restaurant
	HS-3-2	City Auto Salvage	Confirmed	Outdoor Storage
	HS-3-3	American Hero Sub Shop	Potential	Restaurant
	HS-3-4	FMC Grading (Construction Company)	Not Assessed	Outdoor Storage
	HS-3-5	Wilco - Hess Gas Station	Confirmed	Gas Station
	HS-3-6	Paint Business	Not Assessed	Other Commercial
4	HS-4-1	Quality Electric	Not a Hotspot	Outdoor Storage
	HS-4-2	Durham Area Transit Authority	Severe	Outdoor Storage
	HS-4-3	Salvone Apartments	Not a Hotspot	Other
5	HS-5-1	BP Gas Station	Potential	Gas Station
	HS-5-2	Oak Crossing Shopping Center	Potential	Dumpster Maintenance
	HS-5-3	Oak Grove Elementary School	Potential	Other
	HS-5-4	Home Plate Restaurant	Potential	Restaurant
	HS-5-5	The Grove Café & Hernandez Auto	Not a Hotspot	Vehicle Operations
	HS-5-6	Matthews Body Shop	Not a Hotspot	Vehicle Operations
6	HS-6-1	BP Gas Station and other shops	Not a Hotspot	Gas Station
8	HS-8-1	Popes Minimart/BP Gas Station	Not Assessed	Gas Station
	HS-8-2	Oak Grove Memorial Gardens	Not Assessed	Other
	HS-8-4	RV Parts Store	Not Assessed	Outdoor Storage
	HS-8-5	Hurley Paint	Not Assessed	Outdoor Storage
	HS-8-6	Triplets Towing	Not Assessed	Outdoor Storage
9	HS-9-1	Neal Middle School	Not a Hotspot	Other
	HS-9-2	Durham Polaris	Not a Hotspot	Outdoor Storage
*Hotspot Confirmation is based on the methodology explained in Wright et al.				
** "Not Assessed" indicates that the site was not fully evaluated for hotspot potential either because the site was not accessible or the focus of the visit was on retrofit assessment.				

Table A-2
Little Lick Creek - Hotspot Site Investigation

Assessed Hotspot Sites				
Project Type	Hotspot Confirmation*	Site ID	Site Name	Description
Dumpster Maintenance	Potential	HS-5-2	Oak Crossing Shopping Center	Shopping center contains restaurants, bank. Grassy area on rear of property is potential for retrofit. Education on proper dumpster maintenance and grease storage.
	Not a Hotspot	HS-1-5	Goss Carpet and Tile	Education on proper dumpster maintenance and upkeep for carpet and foam
Gas Station	Confirmed	HS-3-5	Wilco - Hess Gas Station	Possible illicit discharge (fuel runoff from lot), uncovered diesel fueling station.
	Potential	HS-2-5	Bilboa food mart and Gas Station	Fuel runoff from lot during wet weather. Retrofit- grass buffer needed around property. Secondary containment for tank is present.
	Potential	HS-5-1	BP Gas Station	*Tie into retrofit on HS-5-2 property
	Not a Hotspot	HS-6-1	BP Gas Station and other shops	overcrowded parking lot; possible retrofit site; Hardware store, liquor store, restaurant
Outdoor Storage	Severe	HS-4-2	Durham Area Transit Authority	Bus maintenance facility. Illicit discharge of diesel directly to groundwater via drainage ditch. Include in education efforts on proper fuel storage and clean-up of spills/leaks. Retrofit potential on rear of property, eroding around storm drain.
	Confirmed	HS-3-2	City Auto Salvage	Erosion major issue and 20 acre site is good for several erosion control measures. Manager very open to retrofit possibilities
	Potential	HS-1-2A	Park East Ventures - Construction equipment sales and rental	*Potential retrofit site on rear of property, massive erosion in BMP, possible education on storage of old fuel and chemical barrels
	Potential	HS-1-2B	Equipment Sales and Service	Potential to address similar education issues as HSI2-B (proper equipment and junk storage) - did not go on property
	Potential	HS-2-2	B & R Construction	Education on proper storage of degreaser, gasoline, oil, etc. Potential illicit discharge: numerous old barrels leaking but relatively contained in gravel lot
	Potential	HS-2-4	Construction and equipment repair at Glover Rd and Angiers	Education on proper storage of tires, old junk, trucks, and dumpster maintenance
	Not a Hotspot	HSI2-3	O'Neal's Upholstery	Back of site full of junked cars. Education on proper storage and disposal of oil, junk cars, carpet, etc. Trash clean up in small stream needed
	Not a Hotspot	HS-4-1	Quality Electric	Electric repair shop. Unidentifiable containers on site, possibly empty
	Not a Hotspot	HS-9-2	Durham Polaris	Lawn mower and recreational vehicle sales & service. Some outdoor storage covered
Restaurant	Confirmed	HS-3-1	Cookout Fast Food Restaurant	Illicit discharge (waste cooking oil dumped in rip rap of BMP also dark discharge from building to parking lot and into BMP (wash water?). Include in education efforts on proper waste cooking oil disposal and storage as well as wash water disposal.
	Potential	HS-3-3	American Hero Sub Shop	Education on proper waste cooking oil disposal & dumpster upkeep; Illicit discharge of cooking oil and container washing (evidence suggests washing in drainage ditch leading to stream)
	Potential	HS-5-4	Home Plate Restaurant	Possible illicit discharge from overflowing waste cooking oil container and leaking dumpster. Education on proper upkeep of used cooking oil container and dumpster
Other	Potential	HS-5-3	Oak Grove Elementary School	*Education opportunities for native landscaping, litter cleanup. Rear of Building, possible retrofit site
	Not a Hotspot	HS-4-3	Salvone Apartments	
	Not a Hotspot	HS-9-1	Neal Middle School	Education: Rain garden for downspouts near ball field, native planting, and litter prevention. A lot of trash in drainage ditches on property

Table A-2
 Little Lick Creek - Hotspot Site Investigation

Assessed Hotspot Sites				
Project Type	Hotspot Confirmation*	Site ID	Site Name	Description
Vehicle Operations	Severe	HS-2-1	Tellis Automotive Center	Education on proper storage of tires, engines, and oil. Potential illicit discharge: 8 full barrels leaking oil via black corrugated pipe to adjacent woodland
	Confirmed	HS 1-1	Technical Automotive	Education on storage of auto parts(engines), oil, antifreeze, possible Illicit discharge of oil behind building (from old oil storage tank) to drainage-small erosion control needed. Possible tie-in with education for multiple nearby small automotive businesses
	Confirmed	HS-1-4	GP Campbell Body shop	Potential illicit discharge and education on car parts and oil storage. Many cars stored on property leaking oil and/or gasoline directly to drainage ditch to groundwater, no room for buffer or other control.
	Confirmed	HS-1-6	Me�anico y El�etrica Autom�tica (3209 Angier)	Education on proper storage of oil & car parts. Potential illicit discharge from storage of oil and other fluids. Junkyard a mess, Strong chemical odor on site
	Potential	HS-1-3	Private junkyard	Small junkyard near small stream, near new development. Potential for education regarding storage of car parts, batteries, etc.
	Potential	HS-1-7	Fennell's Auto Service Center	Tire storage an issue
	Not a Hotspot	HS-1-8	Bob's Radiator & Muffler	
	Not a Hotspot	HS-1-9	VW Repair	Cars stored outside
	Not a Hotspot	HS-1-11	Triangle Auto Mart	Auto sales. Small operation
	Not a Hotspot	HS-2-6	Herndon's Paint and Body	Maintenance operations indoors; materials neatly contained.
	Not a Hotspot	HS-5-5	The Grove Caf� & Hernandez Auto	Vehicles on gravel lot, outdoor storage
Not a Hotspot	HS-5-6	Matthews Body Shop	Possible outdoor welding? Drains to front of lot to NC 98 ROW	

*Hotspot Confirmation is based on the methodology explained in Wright et al.

Table A-2
 Little Lick Creek - Hotspot Site Investigation

Potential Hotspot Sites - Not Assessed				
Project Type	Hotspot Confirmation	Site ID	Site Name	Description
Gas Station	Not Assessed **	HS-8-1	Popes Minimart/BP Gas Station	
		HS-2-8	Gas Station	Gas Station on Miami Blvd
Industrial		HS-1-14	Alcan Cement industrial	
Other		HS-8-2	Oak Grove Memorial Gardens	Cemetery
Other Commercial		HS-3-6	Paint Business	
		HS-1-19	Industrial Park	Large warehouses in industrial park south of Angier and RR tracks on watershed boundary. Granite sales operation.
		HS-1-18	Car wash	
		HS-1-16	Old strip mall	
		HS-1-13	Gann Industrial Supplies (Warehouse)	
		HS-1-12	Dry Cleaner	
Outdoor Storage		HS-8-6	Triplets Towing	Towing and Vehicle Storage
		HS-8-5	Hurley Paint	Painting contractor appears to be based out of home. Painting supplies stored in driveway?
		HS-8-4	RV Parts Store	Auto Sales
		HS-3-4	FMC Grading (Construction Company)	
Restaurant		HS-1-17	Latin American Restaurant	old grease trap?
Vehicle Operations		HS-2-7	Carolina Livery	Livery, primarily small buses, run out of 70 Parkside shopping center
		HS-1-15	Auto Body Shop	
		HS-1-10	Quality Auto	Cars stored outside

** "Not Assessed" indicates that the site was not fully evaluated for hotspot potential either because the site was not accessible or the focus of the visit was on retrofit assessment.

Table A-3: Stormwater Retrofit Sites
Little Lick Creek - March Fieldwork

Subshed ID	Site ID	Site Name	Existing Site Description	Owner	DA (ac)	Drainage Area Land Use or Property Type	Type of Retrofit	Retrofit Description	Constraints
1	SR-1-1	Birchwood Park	Existing City park, adjacent to church, contains basketball courts, baseball field.	City of Durham	15	Large-scale	Stormwater Wetland	Divert Lynn Rd drainage ditches to a constructed wetland on park property.	Sanitary line conflict, conflict with park facilities, may require relocation of facilities
1	SR-1-2	Pendleton Townhomes, Dry Pond 1	Existing dry pond adjacent to apartments. Pond needs maintenance. Slopes need further stabilization.	PT Durham Limited Partnership c/o Winn Residential	4	Residential	Pocket Wetland with ED	Pocket wetland with some extended detention. City suggested allow wetland to develop without creating structural changes.	
1	SR-1-3	Pendleton Townhomes, Dry Pond 2	Existing dry pond adjacent to apartments. Pond needs maintenance. Slopes need further stabilization.	Private	4	Residential	Pocket Wetland with ED	Establish pocket wetland with extended detention, allow pond to naturalize	
1	SR-1-4	CR Wood Park	Possible historic wet pond in park near residential area.	City of Durham	14 and 9	Large-scale	Stormwater Wetland	Constructed wetland and drainage system in public park to treat residential area. 14 acres drains to historic pond. Could divert additional 9 acres (including 6 heavily urbanized) to current turf area.	Power and sewer easement; forested area downstream of pond area may be impacted if pond drainage area is enlarged.
1	SR-1-5	Industrial Park	Industrial park drains to damaged stormdrain near granite operation, collapsed inlet, discharge on north side of property	Private	6	Commercial	Wet Pond	Create wet pond/shallow wetland will require grading and reconfiguring pavement	Some trees in NE corner of lot, could be impacts to foundation if detain water in ponds
1	SR-1-6	Deliverance Temple	Gravel parking lot for small church is divided by a ditch. Used motor oil barrels are used to mark ditch.	Immanuel Holiness Mission Church	3 to 6	Church	Stream Repair	Use vegetation as visual barrier and stream buffer.	parking lot with undefined spaces, and residential; no vegetation in ditch but forested area downstream
1	SR-1-7	Orange Grove Baptist	Two asphalt parking lots.	Orange Grove Baptist	2.5	Church	Raingardens/Bioretenion	Rain gardens/bioretenion or grass filter strips in parking lot.	The parking area would have to be re-stripped, possibly reducing the number of spaces.
1	SR-1-8	Living Waters Christian Community	Parking lot drains to low point and is captured by storm drain inlet. Site of historic farm pond.	Living Waters Christian Community		Church	Raingardens/Bioretenion	Use level spreader and grass strip pretreatment with a bioretention cell which ties back into the storm drain system.	Parking lot slopes need to be evaluated.
1	SR-1-9	Zion Temple	Asphalt Parking lot	Zion Temple		Church	Raingardens/Bioretenion	Raingardens	Zion Temple
1	SR-1-10	Calvary Baptist	Asphalt Parking lots; One overflow lot.	Calvary Baptist		Church	Raingardens/Bioretenion	Rain gardens; pre-treat flows before discharging to forested buffer	
1	SR-1-11	True Life Ministries	Asphalt Parking lot - building for sale or rent	True Life Ministries		Church	Raingardens/Bioretenion	Rain gardens	Small site with limited turf area.
2	SR-2-1	Whispering Pines Mobile Park	Mobile park with high percentage of turf and no stream buffer. Maintenance staff indicate that they (2 people) mow full time in the summer. Tenants are responsible for landscaping their own lots.	Sherrri Hutchins	51	Residential	Stormwater wetland; bioretention	Wetland creation; bioretention; stream buffer and upland reforestation; use of grass swale and grass filter strips. Remove concrete channels where velocities allow.	Owner's land management goals are unknown.

Table A-3: Stormwater Retrofit Sites
Little Lick Creek - March Fieldwork

Subshed ID	Site ID	Site Name	Existing Site Description	Owner	DA (ac)	Drainage Area Land Use or Property Type	Type of Retrofit	Retrofit Description	Constraints
2	SR-2-2	70 Parkside Shopping Center	Shopping Center is home to Beach Bingo and Livery. Stormwater facility shown in GIS at this location, but not found in the field.	Parkside Properties		Commercial	Raingardens/Bioretenion	Parking lot treatment using bioretention strips. Pretreat flows discharging via concrete chute behind building. Keep forested filter function behind building.	
2	SR-2-3	Evangel Assembly of God	Parking lot sheet flows to existing grass area	Evangel Assembly of God		Church	Raingardens/Bioretenion	rain gardens; keep grass filter strip function	slope
2	SR-2-4	Apartments	Apartment complex. No stormwater management seen. Many landscaped islands. Storm drain system.	Parkwood Common Limited Partnership		Residential	Pond retrofit	If not treated by the Amberlynn Valley ponds downstream, retrofit these to tie them in.	
2	SR-2-4B	Amberlynn Valley 2	New townhomes. SWM indicated in GIS but not seen - not fully investigated due to active construction.	Amberlynn Valley HOA		Residential	Enforcement	Enforcement to ensure that wet ponds are constructed as designed.	
2	SR-2-5	Lynn Hollow Pond Repair	Pond under construction at time of field work. Significant stabilization problems need to be corrected.	Lynn Hollow HOA		Residential	Pond repair	Pond repair/maintenance and enforcement.	
2	SR-2-6	Bilboa food mart	Parking lot sheet flows to west side of property. Discharges to natural channel.	Larry Swain		Commercial	Grass filter strip	Grass filter strip on west side of property	Limited space
2	SR-2-7	Fuller Memorial Presbyterian	Gravel parking lot. Runoff sheet flows to forested area.	Fuller Memorial Presbyterian		Church	Raingardens, Porous Pavement	Raingardens, Porous pavement	
3	SR-3-1	Circle K/76 Gas Station	Several stormwater outfalls.	Circle K Corporation	0.75	Commercial	Sand filters	Capture runoff from building, road, fueling area with two sandfilters.	Expense; underground utilities; steep banks.
3	SR-3-2	Hess/Wilco	Entire site drains to Route 70 frontage.	Susan Mann Williams	2	Commercial	Sand filters, oil grit separator	Install two sandfilters along route 70; use OGS to pretreat diesel fueling area, which is currently uncovered.	Underground Storage tanks
3	SR-3-3	American Hero	Parking lot is mostly asphalt with some gravel are in the back. Flow leaves the site at three points.	Lunnette Byrd		Commercial	Sand filters	3 sand filters and pave 1/4 acre lot	Sanitary pump station on site. Sanitary line may be a conflict.
3	SR-3-4	Burrel Auto Repair	One exit point for this 100% impervious site.	Thee and Frances Dixon	1.5	Commercial	Sand filter	filter at exit point to capture parking lot and building	
3	SR-3-5	City Auto Salvage	Large auto salvage operation. Approx 10 acres of bare, sandy soil where cars are stored. Significant erosion with sediment knocking down fence, transported to forested area and stream adjacent to junkyard. Adjacent land has same owner.	Joseph Guariglia		Commercial	Diversion berms; Pretreatment	Use berms to prevent large areas to sheet flow over bare soil. Provide pre-treatment before discharge to wooded area to capture sediment.	
3	SR-3-6	Cookout	Waste cooking oil dumped in rip rap of BMP also dark discharge from building to parking lot and into BMP.	Reeves Family		Commercial	Enforcement	Remove grease from pond.	

Table A-3: Stormwater Retrofit Sites
Little Lick Creek - March Fieldwork

Subshed ID	Site ID	Site Name	Existing Site Description	Owner	DA (ac)	Drainage Area Land Use or Property Type	Type of Retrofit	Retrofit Description	Constraints
4	SR-4-1	Rochelle Manor Apartments	Inlets in lower corners of ea. Parking area and in front of office/community center	Rochelle Manor (Westminister Company)		Residential	Raingardens/ Bioretention	Use curb cuts to divert runoff from parking lot into bioretention cells in existing turf areas. Tie back into storm drain.	
4	SR-4-2	Durham Area Transit Authority	Erosion around existing storm drain inlet.	C & T Leasing		Commercial			DATA plans to vacate property after September 2005
4	SR-4-3	Salvone Apts	Drains away from Rochelle, inlets in lower parking lot, outfalls towards stream & Charlestown Rd.	Edgewood Properties		Residential	Raingardens/ Bioretention	Use curb cuts to divert runoff from parking lot into bioretention cells in existing turf areas. Tie back into storm drain.	Property currently receives low level of maintenance
4	SR-4-4	Twin Lakes (Chance and Chandler)	Outfalls to forested stream corridor	City of Durham		Residential	Pre-treatment; Land Preservation	Add pretreatment forebay/plunge pool at outfalls	Space limitations; tree impacts
4	SR-4-5	Bentwood Apartments	Outfalls discharge to wooded area that acts as wetland	Roberts Construction Company		Residential	Stormwater wetland	Use pre-treatment forebays at outfalls.	
5	SR-5-1	Mineral Springs Shopping Center	Untreated commercial strip mall adjacent to stream buffer. Local storm drain collection system that appear to discharge to the west side of parcel.	WRI/Raleigh LP	5	Commercial	Bioretention	Use flowsplitter to divert water quality flows to bioretention cell on west side of site using existing turf area. Use back strip of land as grass filter strip with stone level spreader. Also possible to use linear bioretention.	Property ownership of turf area. Proximity to sewer lines. Existing trees/wetlands
5	SR5-10	Oak Grove Free Will Baptist	Existing gravel lot	Oak Grove Free Will Baptist		Church	Raingardens, Porous Pavement	Raingardens, Porous pavement	
5	SR-5-2A	Oak Grove Elementary Bus Loop	Roof drains tie into storm drains N & S; yard inlets located in playground. Bus loop drains to south side of property.	Durham Pubic Schools Board of Education		School	Bioretention	Biofiltration cell for bus loop area, behind row of trees. Use curb cut to divert flows.	Constrained space.
5	SR-5-2B	Oak Grove Elementary Parking	Drains inlets on west and north side of lot. Existing vegetated islands with small trees.	Durham Pubic Schools Board of Education		School	Bioretention	Excavate vegetated strips between parking rows to create bioretention.	Impacts to existing trees in vegetated islands.
5	SR-5-3	Oak Crossing Shopping Center	Shopping center with roof drains discharging to back parking lot/access area. Flow through dumpster area to turf.	Oak Crossing General Partners	2.5	Commercial	Bioretention	Enhance turf area to include stone level spreader, grass filter strip and bioretention.	Onsite sanitary sewer through parking lot.
5	SR-5-4	Lightwood and Tyne	Buffer plantings	Individual Homeowners		Residential	Residential On-lot	Buffer plantings and raingardens	
5	SR-5-5	Meadows Assisted Living	Existing storm drain system captures flows from parking lot and roadways. In disrepair in vicinity of storage shed.	Hazel and Steven Powell	4	Institutional	Stormwater wetland	Create small shallow wetland to treat parking runoff. Plenty of head available to water quality flows out of the storm drains.	

Table A-3: Stormwater Retrofit Sites
Little Lick Creek - March Fieldwork

Subshed ID	Site ID	Site Name	Existing Site Description	Owner	DA (ac)	Drainage Area Land Use or Property Type	Type of Retrofit	Retrofit Description	Constraints
5	SR-5-6	Armitage Dr	Outfalls from Armitage Drive discharge to City of Durham property that is forested and contains excavated wet pond.	City of Durham		Residential	Land Preservation	Use existing wet pond of Durham property to treat residential runoff by diverting storm drains; allow forested wetland to treat runoff	Wet pond is approx. 10 feet from mainstem of Little Lick Creek. Berm slowly being breached due to animal activity.
5	SR-5-7	Mobile Home Community	Steeply sloped mobile home community. Homes and roads discharge to several points including steep channels and flat floodplain areas. Floodplain area appears to keep standing water.	Larry and Reginald Rogers	19	Residential	Shallow wetland	Create shallow wetland areas at outfalls in floodplain. If possible, divert additional flows from steep channel to south. Spoke to owner. Would be willing to create additional forested buffer area	Gas main through floodplain. Owner's land management plans.
5	SR-5-8	Former WWTP property	Flows from densely developed neighborhood along Tyne and Hadrian discharges to this area. Forested floodplain provides some treatment.	City of Durham		Residential	Land Preservation	Add pre-treatment at outfalls if possible. Use level spreaders when possible. Preserve connection of small tributaries to the floodplain.	forested/wetland area
5	SR-5-9	Golf Course	Golf course with multiple water features	RDC Golf of North Carolina		Residential	Wet Pond	Use golf course water features as wet ponds to treat subdivision runoff. This will require reconfiguring some storm drains.	Elevations need to be further investigated.
6	SR-6-1	Morning View Dry Pond	Existing dry pond and golf course channel	Private - Unknown	6 to 8	Residential	Retrofit existing pond	Evaluate existing dry pond for ext detention;	Pond may have been designed too small or constructed incorrectly
6	SR-6-1B	Golf Course Channel	golf course channel	RDC Golf of North Carolina		Residential	Stream Repair	grade ctrl structures in eroded fairway channel; no-mow zone along channel bank	Golf course
6	SR-6-2	Durham Memorial Baptist Church	missing BMP - potential for pond, bioretention	Durham Memorial Baptist Church	4 to 5	Church	Enforcement/ Bioretention	Consider pond device at outfall if BMP was not required for this site; also 2 curb cuts have potential for bioretention	On site storm drains
6	SR-6-3	Grove Park at Nichols Farm Dr	Roadway culvert	DR Horton Inc	0.5 sq. miles	Residential	Add pre-treatment forebay	add forebay at road crossing	SS line, riparian area
6	SR-6-4	Grove Park at Crossview Lane	unmanaged eroded outfall	Grove Park Community Association	6	Residential	Wet pond	wet pond, level spreader, plunge pool	SS sewer and easement, tree save area may be impacted by pond creation
6	SR-6-5	Shell Station	Gas station drains to two exits	Watkins Development Company		Commercial	Sand filter	Add underground sandfilter near each exit	
6	SR-6-6	BP Gas Station	Parking area heavily used	Frankie Wilson	< 1	Commercial	Bioretention/ Raingarden	Available areas for retrofit limited but include NC-98 ROW and grass area behind buildings	
7	SR-7-1a	Southern HS Student and bus lot 1	Bus parking lot and part of building drain to this point.	Durham Pubic Schools Board of Education	4 to 5	School	Stormwater wetland	Reroute drainage, constructed wetland, bioretention area	Trees will be sacrificed

Table A-3: Stormwater Retrofit Sites
Little Lick Creek - March Fieldwork

Subshed ID	Site ID	Site Name	Existing Site Description	Owner	DA (ac)	Drainage Area Land Use or Property Type	Type of Retrofit	Retrofit Description	Constraints
7	SR-7-1b	Southern HS Athletic Fields	Baseball diamond drains to this point.	Durham Pubic Schools Board of Education	1.5	School	Pocket wetland	pocket wetland and swales to capture baseball diamond runoff	Treats small area
7	SR-7-1c	Southern HS Staff Parking	Teacher parking lot drains to storm drain inlets. Downstream, yard inlet is in mowed area.	Durham Pubic Schools Board of Education	2	School	Bioretention	Biofiltration to treat parking lot; using existing lawn area and yard inlet	sanitary sewer line
7	SR-7-1d	Southern HS Student and bus lot 2	Bus and Student parking lot with small amount of islands.	Durham Pubic Schools Board of Education	2	School	Bioretention	On lot biofiltration strips in large student/bus parking lot	
8	SR-8-1	Annie Barbee Property	20 acre property currently forested with wetlands. Downstream of area undergoing heavy development.	Annie Barbee Estate		Residential	Land Preservation	Preserve buffering effect of these wetlands.	
8	SR-8-2	Reach 8-11	Good quality well buffered stream.	Various owners		Residential	Land Preservation	potential for conservation easements here	
9	SR-9-1A	Neal Middle School Roof Drains	Roof drains tied into storm drains and discharge to forested channel.	Durham Pubic Schools Board of Education	0.7	School	Raingardens/ Bioretention	Disconnect roof drains from storm drain system on this side of the building.	soil properties in vicinity of school. Tree impacts.
9	SR-9-1B	Neal Middle Track	Runoff from portion of school building, loading dock, and athletic fields drains to existing swale which was wet at time of visit.	Durham Pubic Schools Board of Education	3.25	School	Wet swale	enhance existing swale	
9	SR-9-1C	Neal Middle Bus Parking	*This is actually out of the watershed. Bus parking area drains toward intersection of Baptist Rd and NC-98	Durham Pubic Schools Board of Education	1.5	School	Bioretention	Use level spreader and grass strip pretreatment with a bioretention cell in the existing turf area near the school entrance off Baptist Rd.	
10	SR-10-1	Redwood Academy / Agape Corner	Former Private School; under redevelopment as recreation center. Roof drains connected to storm drain system. Flooding in walkways. Downstream channel in poor condition.	Agape Corner	1.5 or 7.5	Former Private school	Bioretention; Stormwater wetland	Capture and infiltrate or sheet flow roof leader runoff	Location of existing septic field, adjacent to baseball field and recreation building
13	SR-13-1	Chandler Farm Pond	Existing farm pond	Chandler Family		Residential	Land Preservation	Preserve farm pond currently treating runoff from stream through highly developed area	
13	SR-13-1b	Chandler Property	Agricultural property used to pasture cows	Chandler Family		Large-scale	Wetland Creation	Hydrologically connect to floodplain of Little Lick and tributary.	

Little Lick Creek USSR Technical Memo

Appendix B

H-6	Hotspot Source Area: Outdoor Materials	
	OUTDOOR STORAGE	

Description

Protecting outdoor storage areas is a simple and effective pollution prevention practice for many commercial, industrial, institutional, municipal, and transport-related operations. The underlying concept is to prevent runoff contamination by avoiding contact between outdoor materials and rainfall (or runoff). Unprotected outdoor storage areas can generate a wide range of storm water pollutants, such as sediment, nutrients, toxic materials, and oil and grease (Figure 1).

Materials can be protected by installing covers, secondary containment, and other structures to prevent accidental release. Outdoor storage areas can be protected on a temporary basis (tarps or plastic sheeting) or permanently through structural containment measures (such as roofs, buildings, or concrete berms). Table 1 summarizes pollution prevention practices available for outdoor storage areas.



Figure 1: Mulch Stored Outdoors at a Garden Center

Application

Many businesses store materials or products outdoors. The risk of storm water pollution is greatest for operations that store large quantities of liquids or bulk materials at sites that are connected to the storm drain system. Several notable operations include nurseries and garden centers, boat building/repair, auto recyclers/body shops, building supply outlets, landfills, ports, recycling centers, solid waste and composting facilities, highway maintenance depots, and power plants. Attention should also be paid to industrial operations that process bulk materials, which are often regulated under industrial storm water NPDES permits.

Primary Training Targets

Owners, site managers, facility engineers, supervisors, and employees of operations with loading/unloading facilities are the primary training target.

Feasibility

Outdoor storage protection can be widely applied in all regions and climate zones, and requires routine monitoring by employees. Most operations have used covering as the major practice to handle outdoor storage protection (U.S. EPA, 1999). The strategy is to design and maintain outdoor material storage areas so that they:

- Reduce exposure to storm water and prevent runoff
- Use secondary containment to capture spills
- Can be regularly inspected
- Have an adequate spill response plan and cleanup equipment

Table 1: Pollution Prevention Practices for Protecting Outdoor Storage Areas	
<ul style="list-style-type: none"> • Emphasize employee education regarding storage area maintenance • Keep an up-to-date inventory of materials stored outdoors, and try to minimize them • Store liquids in designated areas on an impervious surface with secondary containment • Inspect outdoor storage containers regularly to ensure that they are in good condition • Minimize storm water run-on by enclosing storage areas or building a berm around them • Slope containment areas to a drain with a positive control (lock, valve, or plug) that leads to the sanitary sewer (if permitted) or to a holding tank • Schedule regular pumping of holding tanks containing storm water collected from secondary containment areas 	

Implementation Considerations

Covers - The use of impermeable covers is an effective pollution prevention practice for non-hazardous materials. Covers can be as simple as plastic sheeting or tarps, or more elaborate roofs and canopies. Site layout, available space, affordability, and compatibility with the covered material all dictate the type of cover needed for a site. In addition, the cover should be compatible with local fire and building codes and OSHA workplace safety standards. Care should be taken to ensure that the cover fully protects the storage site and is firmly anchored into place.

Secondary Containment - Secondary containment is designed to contain possible spills of liquids and prevent storm water run-on from entering outdoor storage areas. Secondary containment structures vary in design, ranging from berms and drum holding areas to specially-designed solvent storage rooms (Figure 2).



Figure 2: Secondary Containment of Storage Drums Behind a Car Repair Shop

Secondary containment can be constructed from a variety of materials, such as concrete curbs, earthen berms, plastic tubs, or fiberglass or metal containers. The type of material used depends on the substance contained and its resistance to weathering. In general, secondary containment areas should be sized to hold 110% of the volume of the storage tank or container unless other containment sizing regulations apply (e.g., fire codes).

If secondary containment areas are uncovered, any water that accumulates must be collected in a sanitary sewer, a storm water treatment system, or a licensed disposal facility. Water quality monitoring may be needed to determine whether the water is contaminated and dictate the method of disposal. If the storm water is clean, or an on-site storm water treatment practice is used, a valve should be installed in the containment dike so that excess storm water can be drained out of the storage area and directed either to the storm drain (if clean) or into the storm water treatment system (if contaminated). The valve should always be kept closed except when storm water is drained, so that any spills that occur can be effectively contained. Local sewer authorities may not allow discharges from a large containment area into the sewer system, and permission must be obtained prior to discharge. If discharges to the sanitary sewer system are prohibited, containment should be provided, such as a holding tank that is regularly pumped out.

Employee training on outdoor storage pollution prevention should focus on the activities and site areas with the potential to pollute storm water and the proper techniques to manage material storage areas to prevent runoff contamination.

Training can be conducted through safety meetings and the posting of on-site informational signs. Employees should also know the on-site person who is trained in spill response.

Cost - Many storage protection practices are relatively inexpensive to install (Table 2). Actual costs depend on the size of the storage area and the nature of the pollution prevention practices. Other factors are whether practices are temporary or permanent and the type of materials used for covers and containment. Employee training can be done in connection with other safety training to reduce program costs. Training costs can also be reduced by using existing educational materials from local governments, professional associations or from EPA's National Compliance Assistance Centers (<http://www.assistancecenters.net>).

Table 2: Sample Equipment Costs for Outdoor Storage Protection	
Storage Protection Device	Cost
Concrete Slab (6")	\$3.50 to \$5.00 per ft ²
Containment Pallets	\$50 to \$350 based on size and # of barrels to be stored
Storage buildings	\$6 to \$11 per ft ²
Tarps & Canopies	\$25 to \$500 depending on size of area to cover
<i>Sources: Costs were derived from a review of Ferguson et al., 1997 and numerous websites that handle proprietary spill control or hazardous material control products</i>	

Resources

California Stormwater Quality Association. 2003 California Stormwater BMP Handbook: Industrial and Commercial.
<http://www.cabmphandbooks.com/>

Rouge River National Wet Weather Demonstration Project. Wayne County, MI.
<http://www.rougeriver.com/geninfo/rougeproj.html>

Storm Water Management Fact Sheet: Coverings. USEPA, Office of Water,
<http://www.epa.gov/owm/mtb/covs.pdf>

EPA Office of Wastewater Management Storm Water Management Fact Sheet: Coverings
<http://www.epa.gov/owm/mtb/covs.pdf>

California Stormwater Quality Association Factsheet: Outdoor Storage of Raw Materials
<http://www.cabmphandbooks.com/Documents/Municipal/SC-33.pdf>

Alameda Countywide Clean Water Program Outdoor Storage of Liquid Materials
http://www.cleanwaterprogram.com/outdoor_storage_liquid_fact_sht.pdf

Washtenaw County, MI Community Partners for Clean Streams Fact Sheet Series #1: Housekeeping Practices
http://www.ewashtenaw.org/content/dc_drnbmp1.pdf

<h1>H-1</h1>	Hotspot Source Area: Vehicles	
	VEHICLE MAINTENANCE AND REPAIR	

Description

Vehicle maintenance and repair operations can exert a significant impact on water quality by generating toxins such as solvents, waste oil, antifreeze, and other fluids. Often, vehicles that are wrecked or awaiting repair can be a storm water hotspot if leaking fluids are exposed to storm water runoff (Figure 1). Vehicle maintenance and repair can generate oil and



Figure 1: Junkyard and Potential Source of Storm Water Pollution

grease, trace metals, hydrocarbons, and other toxic organic compounds. Table 1 summarizes a series of simple pollution prevention techniques for vehicle maintenance and repair operations that can prevent storm water contamination. You are encouraged to consult the Resources section of this sheet to get a more comprehensive review of pollution prevention practices for vehicle maintenance and repair operations.

Application

Pollution prevention practices should be applied to any facility that maintains or repairs vehicles in a subwatershed. Examples include car dealerships, body shops, service stations, quick lubes, school bus depots, trucking companies, and fleet maintenance operations at larger industrial, institutional, municipal or transport-related operations. Repair facilities are often clustered together, and are a major priority for subwatershed pollution prevention.

Table 1: Pollution Prevention Practices for Vehicle Maintenance and Repair Activities
<ul style="list-style-type: none"> • Avoid hosing down work or fueling areas • Clean all spills immediately using dry cleaning techniques • Collect used antifreeze, oil, grease, oil filters, cleaning solutions, solvents, batteries, hydraulic and transmission fluids and recycle with appropriate agencies • Conduct all vehicle and equipment repairs indoors or under a cover (if done outdoors) • Connect outdoor vehicle storage areas to a separate storm water collection system with an oil/grit separator that discharges to a dead holding tank, the sanitary sewer or a storm water treatment practice • Designate a specific location for outdoor maintenance activities that is designed to prevent storm water pollution (paved, away from storm drains, and with storm water containment measures) • Inspect the condition of all vehicles and equipment stored outdoors frequently • Use a tarp, ground cloth, or drip pans beneath vehicles or equipment being repaired outdoors to capture all spills and drips • Seal service bay concrete floors with an impervious material so cleanup can be done without using solvents. Do not wash service bays to outdoor storm drains • Store cracked batteries in a covered secondary containment area until they can be disposed of properly • Wash parts in a self-contained solvent sink rather than outdoors

Primary Training Targets

Owners, fleet operation managers, service managers, maintenance supervisors, mechanics and other employees are key targets for training.

Feasibility

Pollution prevention techniques for vehicle repair facilities broadly apply to all regions and climates. These techniques generally rely on changes to basic operating procedures, after an initial inspection of facility operations. The inspection relies on a standard operations checklist that can be completed in a few hours.

Implementation Considerations

Employee training is essential to successfully implement vehicle repair pollution prevention practices. The connection between the storm drain system and local streams should be emphasized so that employees understand why any fluids need to be properly disposed of. It is also important to understand the demographics of the work force; in some communities, it may require a multilingual education program.

Cost - Employee training is generally inexpensive, since training can be done using posters, pamphlets, or videos. Structural practices can vary based on what equipment is required. For instance, solvent sinks to clean parts can cost from \$1,500 to \$15,000, while spray cabinets may cost more than \$50,000. In addition, proper recycling/disposal of used or spilled fluids usually requires outside contractors that may increase costs.

Resources

Stormwater Management Manual for Western Washington: Volume IV -- Source Control BMPs.
<http://www.ecy.wa.gov/biblio/9914.html>

California Stormwater Quality Association. 2003 California Stormwater BMP Handbook: Industrial and Commercial.
<http://www.cabmphandbooks.com/>

Coordinating Committee For Automotive Repair (CCAR) Source: US EPA CCAR-GreenLink®, the National Automotive Environmental Compliance Assistance Center CCAR-GreenLink® Virtual Shop <http://www.ccar-greenlink.org/>

Auto Body Shops Pollution Prevention Guide. Peaks to Prairies Pollution Prevention Information Center.
<http://peakstoprairies.org/p2bande/autobody/abguide/index.cfm>


Massachusetts Office of Technical Assistance for Toxics Use Reduction (OTA). Crash Course for Compliance and Pollution Prevention Toolbox <http://www.state.ma.us/ota/pubs/toolfull.pdf>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities.
<http://www.swrcb.ca.gov/stormwtr/murp.html>

US EPA. Virtual Facility Regulatory Tour: Vehicle Maintenance. FedSite Federal Facilities Compliance Assistance Center.
<http://permanent.access.gpo.gov/websites/epago v/www.epa.gov/fedsite/virtual.html>

City of Santa Cruz. Best Management Practices for Vehicle Service Facilities (in English and Spanish).
<http://www.ci.santa-cruz.ca.us/pw/pdf/vehiclebmp.pdf>

City of Los Angeles Bilingual Poster of BMPs for Auto Repair Industry
<http://www.lastormwater.org/downloads/PDFs/autopstr.pdf>

<h1>H-2</h1>	Hotspot Source Area: Vehicles	
	<h2>VEHICLE FUELING</h2>	

Description

Spills at vehicle fueling operations have the potential to directly contribute oil, grease, and gasoline to storm water, and can be a significant source of lead, copper and zinc, and petroleum hydrocarbons. Delivery of pollutants to the storm drain can be sharply reduced by well-designed fueling areas and improved operational procedures. The risk of spills depends on whether the fueling area is covered and has secondary containment. The type, condition, and exposure of the fueling surface can also be important. Table 1 describes common pollution prevention practices for fueling operations.

Application

These practices can be applied to any facility that dispenses fuel. Examples include retail gas

stations, bus depots, marinas, and fleet maintenance operations (Figure 1). In addition, these practices also apply to temporary above-ground fueling areas for construction and earthmoving equipment. Many fueling areas are usually present in urban subwatersheds, and they tend to be clustered along commercial and highway corridors. These hotspots are often a priority for subwatershed source control.



Figure 1: Covered Retail Gas Operation Without Containment for Potential Spills

Table 1: Pollution Prevention Practices For Fueling Operation Areas

- Maintain an updated spill prevention and response plan on premises of all fueling facilities (see Profile Sheet H-7)
- Cover fueling stations with a canopy or roof to prevent direct contact with rainfall
- Design fueling pads for large mobile equipment to prevent the run-on of storm water and collect any runoff in a dead-end sump
- Retrofit underground storage tanks with spill containment and overfill prevention systems
- Keep suitable cleanup materials on the premises to promptly clean up spills
- Install slotted inlets along the perimeter of the “downhill” side of fueling stations to collect fluids and connect the drain to a waste tank or storm water treatment practice. The collection system should have a shutoff valve to contain a large fuel spill event
- Locate storm drain inlets away from the immediate vicinity of the fueling area
- Clean fuel-dispensing areas with dry cleanup methods. Never wash down areas before dry clean up has been done. Ensure that wash water is collected and disposed of in the sanitary sewer system or approved storm water treatment practice
- Pave fueling stations with concrete rather than asphalt
- Protect above ground fuel tanks using a containment berm with an impervious floor of Portland cement. The containment berm should have enough capacity to contain 110% of the total tank volume
- Use fuel-dispensing nozzles with automatic shutoffs, if allowed
- Consider installing a perimeter sand filter to capture and treat any runoff produced by the station

Primary Training Targets

Training efforts should be targeted to owners, operators, attendants, and petroleum wholesalers.

Feasibility

Vehicle fueling pollution prevention practices apply to all geographic and climatic regions. The practices are relatively low-cost, except for structural measures that are installed during new construction or station remodeling.

Implementation Considerations

Fueling Area Covers - Fueling areas can be covered by installing an overhanging roof or canopy. Covers prevent exposure to rainfall and are a desirable amenity for retail fueling station customers. The area of the fueling cover should exceed the area where fuel is dispensed. All downspouts draining the cover or roof should be routed to prevent discharge across the fueling area. If large equipment makes it difficult to install covers or roofs, fueling islands should be designed to prevent storm water run-on through grading, and any runoff from the fueling area should be directed to a dead-end sump.

Surfaces - Fuel dispensing areas should be paved with concrete; the use of asphalt should be avoided, unless the surface is sealed with an impervious sealant. Concrete pads used in fuel dispensing areas should extend to the full length that the hose and nozzle assembly can be pulled, plus an additional foot.

Grading - Fuel dispensing areas should be graded with a slope that prevents ponding, and separated from the rest of the site by berms, dikes or other grade breaks that prevent run-on of urban runoff. The recommended grade for fuel dispensing areas is 2 - 4% (CSWQTF, 1997).

Cost - Costs to implement pollution prevention practices at fueling stations will vary, with many of the costs coming upfront during the design of a new fueling facility. Once a facility has implemented the recommended source control

measures, ongoing maintenance costs should be low.

Resources

Best Management Practice Guide – Retail Gasoline Outlets. Prepared by Retail Gasoline Outlet Work Group.
http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/la_ms4_tentative/RGO_BMP_Guide_03-97_.pdf

Stormwater Management Manual for Western Washington: Volume IV -- Source Control BMPs.
<http://www.ecy.wa.gov/biblio/9914.html>

California Stormwater Quality Association. 2003 California Stormwater BMP Handbook: New Development and Redevelopment.
<http://www.cabmphandbooks.com/>

City of Los Angeles, CA Best Management Practices for Gas Stations
<http://www.lacity.org/SAN/wpd/downloads/PDFs/gasstation.pdf>

City of Dana Point Stormwater Best Management Practices (BMPs) For Automotive Maintenance And Car Care
<http://www.danapoint.org/water/WC-AUTOMOTIVE.pdf>


Alachua County, FL Best Management Practices for Controlling Runoff from Gas Stations
http://environment.alachua-county.org/Natural_Resources/Water_Quality/Documents/Gas%20Stations.pdf

California Stormwater Regional Control Board Retail Gasoline Outlets: New Development Design Standards For Mitigation Of Storm Water Impacts
http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/la_ms4_tentative/RGOpaper.pdf
http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/la_ms4_tentative/RGOPaperSupplement_12-01_.pdf

Canadian Petroleum Products Institute Best Management Practices Stormwater Runoff from Petroleum Facilities
<http://www.cppi.ca/tech/BMPstormwater.pdf>

City of Monterey (CA). Posters of Gas Station BMPs.
<http://www.monterey.org/publicworks/stormeduc.html>

Pinole County, CA Typical Stormwater Violations Observed in Auto Facilities and Recommended Best Management Practices (BMPs)
<http://www.ci.pinoles.ca.us/publicworks/downloads/AutoStormwater.pdf>

<h1>H-8</h1>	Hotspot Source Area: Waste Management	
	<h2>DUMPSTER MANAGEMENT</h2>	

Description

Dumpsters provide temporary storage of solid wastes at many businesses. Most dumpsters are unregulated hotspots that can be a significant pollution source in many subwatersheds. Many dumpsters are open, which allows rainfall to mix with the wastes, creating a potent brew affectionately known as “dumpster juice.” When combined with the inevitable spillage, dumpsters can be a source of trash, oil and grease, metals, bacteria, organic material, nutrients, and sediments. Poor dumpster management can make a site unsightly, create unpleasant odors, and attract rodents (Figure 1). Table 1 lists some common pollution prevention practices for dumpsters.

Application

Every business generates waste as a part of its daily operations and temporarily stores it pending disposal by an independent contractor. Nearly every hotspot site has a ubiquitous dumpster located somewhere behind the building. Several



Figure 1: Dumpster Site with Typical Signs of Poor Management (trash accumulation, dumpster without lid, dumpster near storm drain)

factors should be evaluated to determine whether an individual dumpster could be a pollution source. The first is whether the dumpster pad is directly connected to the storm drain system. The second factor is how frequently the dumpster is emptied. Frequently emptied dumpsters usually have more spillage and are open more often and exposed to rainfall. The last factor is the type and moisture content of wastes thrown in the dumpster, which can include trash, yard waste, building rubble, food, or other waste products.

Good dumpster management is particularly important to reduce trash loadings to a stream. Several kinds of hotspots deserve scrutiny if they exist in a subwatershed, including dumpsters serving convenience stores, fast food restaurants, shopping centers, recycling centers, solid waste collection areas and hospitals. It may be useful to target waste haulers as well, since the placement of temporary open dumpsters for demolition, remodeling and other construction purposes can be a problem in some subwatersheds.

Primary Training Targets

Key education targets are the managers and employees that use the dumpster.

Feasibility

Dumpster pollution prevention practices can be applied in all regions and climate zones.

Table 1: Pollution Prevention Practices for Dumpsters

<ul style="list-style-type: none"> • Locate dumpsters on a flat concrete surface that does not slope or drain to the storm drain system • Install a secondary containment system such as a berm or curb around the dumpster if it is connected to the storm drain • Install protective covers or lids to keep rainfall from accumulating in the dumpster or secondary containment area • Close lids at dumpsters located at vehicle service areas, fast food restaurants, and convenience stores • Install an oil and grease separator or sump pit for dumpsters that receive waste with a high moisture content • Place clear and visible signs on dumpsters indicating what kind of waste can be accepted • Never throw oil and grease or other liquids into a dumpster - provide alternative disposal locations for impermissible substances • Close and secure lids properly when the dumpster is not being loaded or unloaded • Empty dumpsters on a frequent basis to prevent overflowing or storage outside the dumpster • Repair leaking or damaged dumpsters immediately • Never use bleach and soap to clean the container unless the wash water is sent to the sanitary sewer system • Pick up and sweep trash and litter from around the dumpster regularly

Implementation Considerations

Dumpster pollution prevention practices can be hard to implement. Perhaps the greatest challenge is changing the mindset of employees about proper disposal techniques. Since dumpster practices require additional effort, owners need to train staff and inspect dumpsters more frequently. Lastly, dumpster practices that require liquids/oil and grease separation or secondary containment may be costly for many small businesses.

Target Areas for Education and Enforcement- Education and enforcement should be targeted to specific types of dumpsters that are known hotspots and/or have high potential for environmental contamination. These include:

- Foodservice dumpsters that produce waste with high moisture content and oil and grease that can be easily carried by storm water runoff (Figure 2)
- Automobile service dumpsters that can potentially produce a high volume of wastes, such as oil and grease, cleaning fluids, used parts, filters, and rags

- Industrial dumpsters that produce a high volume and variety of wastes
- Dumpsters with multiple contributors, such as multi-family units, and institutional facilities
- Temporary dumpster locations at small construction sites, demolition projects, and redevelopment projects



Figure 2: Restaurant Waste Barrels Without Secondary Containment

Routine Inspection - Dumpsters should be routinely inspected for the following problems:

- Cracks or dents in the dumpster that may permit storm water run-on
- Poorly functioning lids that cannot be closed or secured
- Hydraulic hoses with cracks or leaks (if applicable)
- Presence of impermissible substances in the container
- Liquid leaking from the container and/or signs of previous leakage, which are often indicated by stains or deposits on ground or storm drain inlets

Working with Solid Waste Disposal Contractor - Choosing a reliable and environmentally-conscious waste disposal contractor is important to prevent storm water contamination. Routine maintenance and emptying of the dumpster by the solid waste disposal contractor should be performed on a regular basis. If concerns about the condition of the dumpster or collection process arise (e.g. dumpster put in wrong location, dented corners, infrequent dumping, etc.), the service should be contacted immediately.

Cost - Proper dumpster management is a relatively inexpensive storm water pollution prevention practice and avoids the liability for spills and/or containment. Operational costs depend on the volume and type of waste, frequency of maintenance (e.g., replacing damaged containers), and whether additional protective measures need to be installed, such as secondary containment systems, canopies, and signs.

Operational costs are primarily related to training workers on proper dumpster management. Frequent training is needed to maintain compliance by workers, particularly in high turnover businesses.

Resources

California Stormwater BMP Handbook: Industrial and Commercial
<http://www.cabmphandbooks.com/>

Storm Water BMP #4. Solid Waste Containers (Dumpsters/Compactors)
http://www.cleancharles.org/stormwater_bmp4.shtml

North Central Texas Council of Governments (NCTCOG) Building Maintenance BMP Fact Sheet
http://www.dfwstormwater.com/P2/PDF/p2bldg_bmps.pdf

San Mateo Countywide Storm Water Pollution Prevention Program: Storm Water Best Management Practices for Supermarkets and Grocery Stores
<http://www.flowstobay.org/pdfs/bmp/Food/grocery.pdf>

Harvard University Stormwater Bmp: Solid Waste Container
http://www.uos.harvard.edu/ehs/env_sbmp4.shtml

California Stormwater Quality Association Factsheet: Waste Handling and Disposal
<http://www.cabmphandbooks.com/Documents/Municipal/SC-75.pdf>

City of Rancho Santa Margarita Waste Handling and Disposal
<http://www.cityofrsm.org/civica/filebank/blobload.asp?BlobID=1772>

Stanford University SLAC Stormwater BMP Factsheet: Waste Handling and Disposal
<http://www.slac.stanford.edu/esh/epr/Stormwater/BMP9.html>