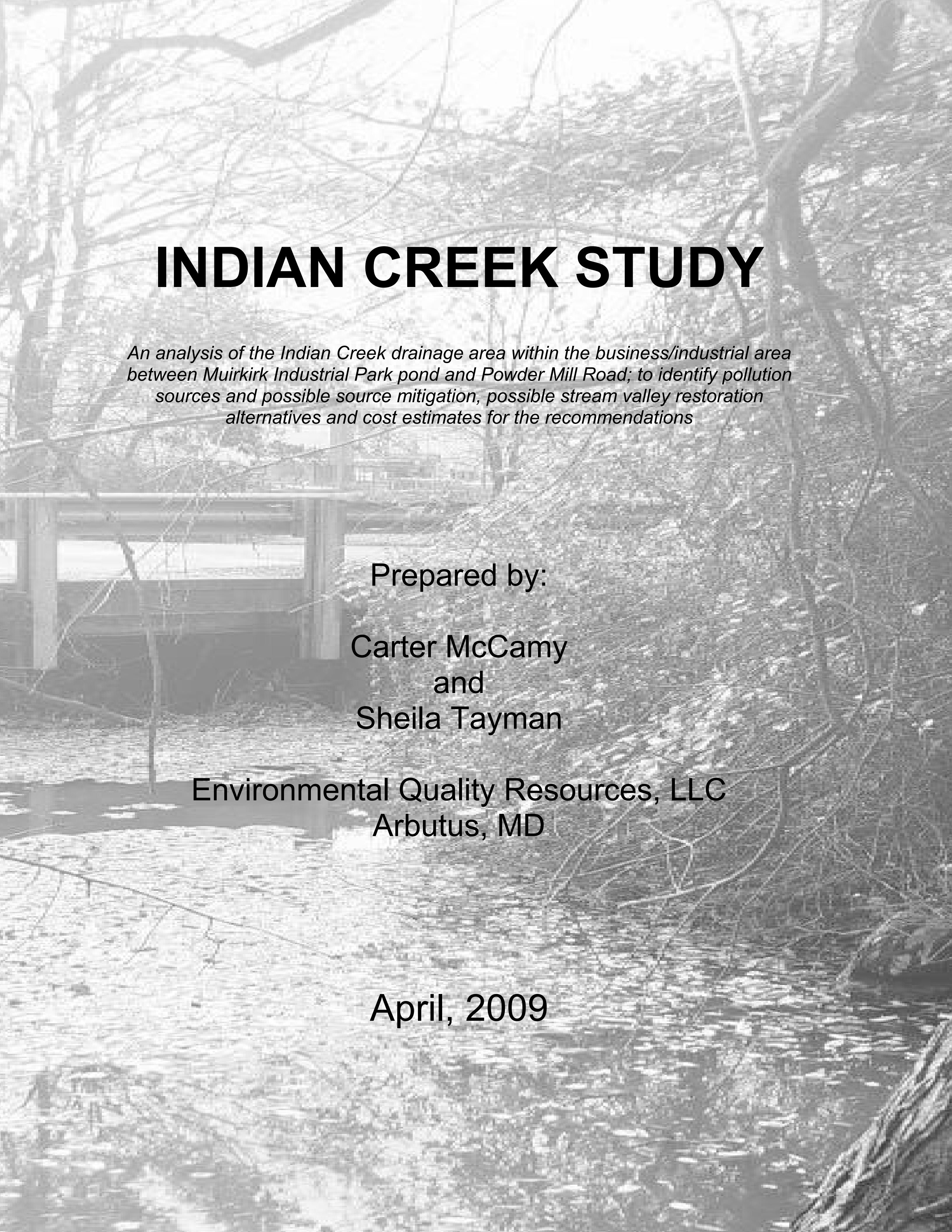

INDIAN CREEK STUDY

An analysis of the Indian Creek drainage area within the business/industrial area between Muirkirk Industrial Park pond and Powder Mill Road; to identify pollution sources and possible source mitigation, possible stream valley restoration alternatives and cost estimates for the recommendations

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April, 2009

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INTRODUCTION

This study provides an analysis of the Indian Creek watershed within the business/industrial area between Muirkirk Industrial Park pond and Powder Mill Road; to identify pollution sources and possible source mitigation, possible stream valley restoration alternatives and cost estimates for the recommendations.

Indian Creek is a free-flowing, Class Use I tributary of the Northeast Branch of the Anacostia River. Located in Prince George's County, MD, the stream is in the Coastal Plain physiographic province. The land use for Indian Creek watershed includes forest, agricultural lands (including both pasture and row crop). sand and gravel quarries, garden apartments. single family residences. industrial, institutional and commercial areas, and Government complexes.[1] The study area is within the Beltsville industrial area, which is mostly impervious surfaces comprised of roadways, parking areas, buildings and storage lots. Indian Creek has been greatly impacted within this area, as a result of little or no stormwater management to protect the stream from stormflow, sedimentation, and pollutant loading. The stream is impacted upstream by existing sand and gravel mining[2] and to some extent uncontrolled stormwater from older residential communities.

Methods

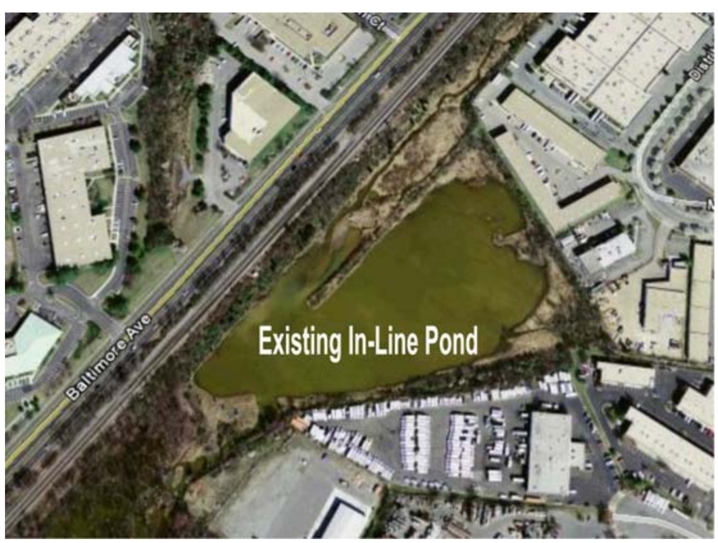
Physical inspection of the stream segment provides the basis for this report. Specifically, impacted areas within the stream and the adjacent stream banks were noted. These impacts include man-made channelization (concrete channels, hard armoring), untreated pipe outfalls, vegetative cover, stormwater facilities, adjacent land use, possible pollutant sources, fish passage barriers, erosion, channel cutting, and sedimentation. The report additionally reflects areas where the stream shows signs of favorable habitat and resistance to adverse change. Research of existing studies has been conducted and where applicable, included in this report. Aerial mapping also provides information regarding specific locations within the study area as they relate to adjacent businesses and impervious surfaces.

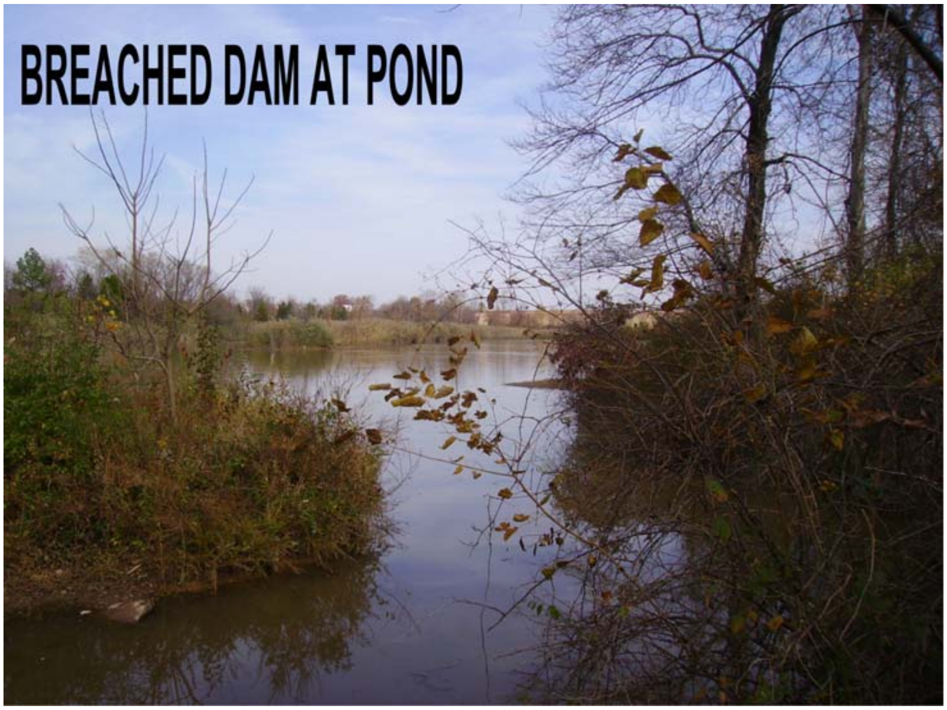
The report will address the condition of the stream first, and specific in-stream recommendations. The adjacent properties and their potential impacts and possible remedies will be addressed secondly. As with any rehabilitation of a watershed, a holistic approach will maximize any time and money spent for the work.

SPECIFIC IN-STREAM RECOMMENDATIONS

Stream Reach I – The Existing SWM Pond

Approximately 2600 linear feet south of Muirkirk Road, at Mid-Cities Avenue, there is an existing pond. It appears to have been built when the adjacent industrial area was developed. An estimate of age is 30 years old. It is approximately 6 acres in size with a well-vegetated buffer. Currently, this pond is not being maintained. The control structure was constructed of galvanized metal and is in disrepair. The dam, located on the southwest side, is failing and is breached in several locations. It is unlikely the pond has been dredged, therefore design volume capacity is not present.





This pond offers a significant opportunity for improving the quality of Indian Creek downstream of this point. A stormwater retrofit design should follow recommendations provided in the *2000 Maryland Stormwater Design Manual, Vol. I&II (Maryland Department of the Environment)*, under the guidance of the Prince Georges County Department of Environmental Resources. The design should include the following changes to the existing pond:

- Re-establish stormwater volume control
- Rebuild the dam
- Rebuild the Control Structure and Outfall Barrel to meet current standards
- Provide, if possible, fish passage at the dam
- Establish a Circuitous Route for Stream and Storm Flow inputs into the pond. They should be directed through the facility in a manner to maximize resident time within the pond to increase potential deposition of sediments and heavier pollutants.
- Install a Forebay at any Pipe Outlet into the Pond
- Grade a Safety /Planting Bench around the perimeter of the pond to improve safety and increase nutrient uptake by emergent native plant species. This will improve habitat value as well.
- Install Shade Trees on the Western side of the pond to lower water temperatures.
- Replace the Existing Safety Fence around the pond.
- Install Access Roads at several key locations to the waters edge.
- Install a Stable Outfall Structure below the pond, designed to spread the discharged water into the existing wetland, maintaining the hydrology as possible.
- Develop and Implement a Maintenance Program for the pond. This should include annual mowing of the dam face, invasive species control, inspections of all structures,

and inspection for erosion. A plan to remove sediment deposition, including funding should be included.

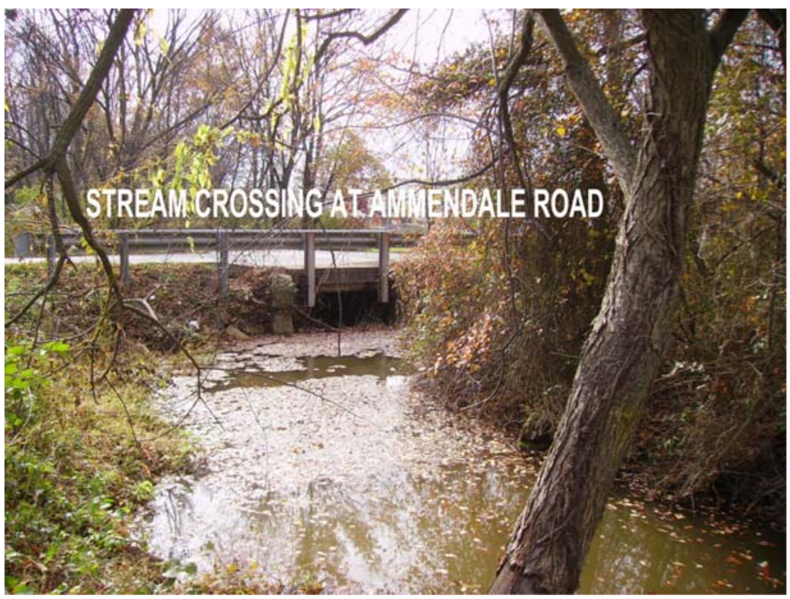
- Signage should be installed to include: awareness of the stormwater management value of the pond, description of the habitat value, and a safety plan in the event of a chemical spill, or life threatening incident. Phone numbers for information on each subject should be included.

Stream Reach II – The Wetland Below the Pond

Below the existing stormwater management pond, there is a wetland of fair value. It is approximately 1 acre in size, occupying about 400 linear feet of the stream length. This wetland is hydrologically supported by overflow water of the pond. The area is flat, so the water has created a broad flooded area. This area provides flood attenuation during stormevents, and wildlife habitat not commonly found in much of Indian Creek. The braided channel has sufficient depth to allow migration of fish. This area should be fenced and allowed to remain as a natural treatment system with habitat value.

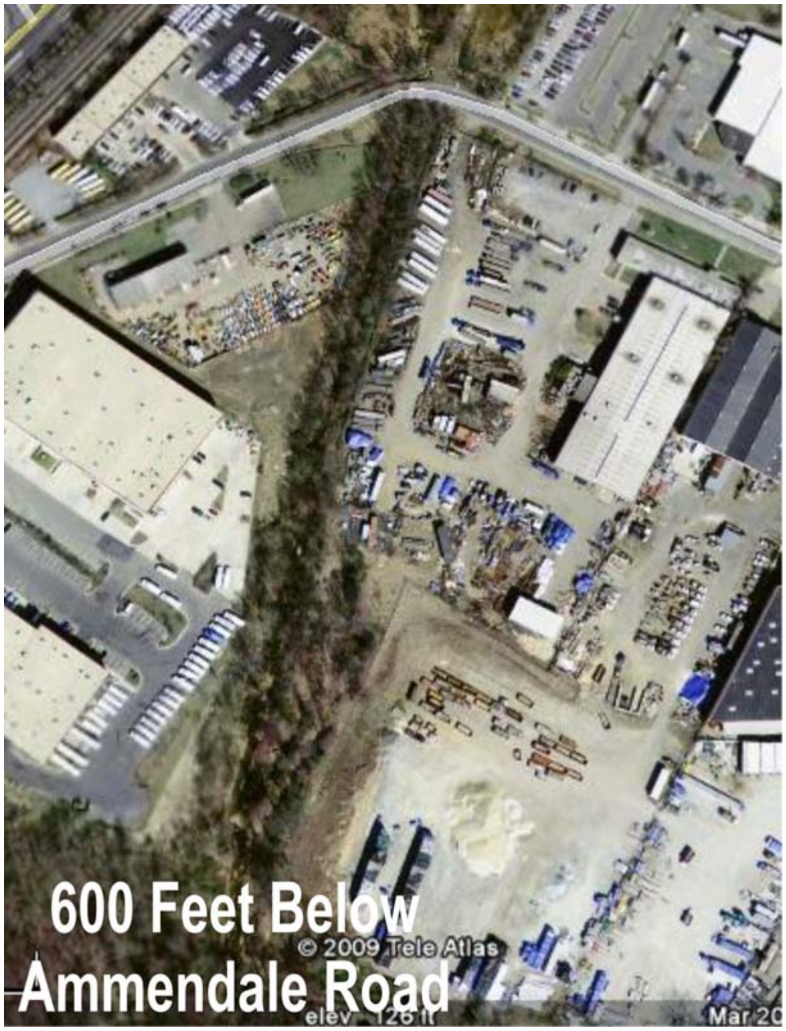
The wetland benefits from the constraining point at the Ammendale Road Crossing. Here, the roadway crosses Indian Creek utilizing pipes. This "structure" behaves like a stormwater management control device, backing up stormflows during heavy rain events. This flooding provides for sediment deposition within the wetland and improves ground saturation.

Once, the watershed is better managed for stormwater, improvements in diversity of native plant species, control of invasive species, and other habitat improvements could be considered for this wetland area.



Stream Reach III – Below Ammendale Road for 600 Linear Feet

The section of stream below Ammendale road, for a distance of 600 linear feet, is contained within a 100-foot corridor. For most of this length, Indian Creek is stable and well vegetated. Sediment loading, trash, and pollutant loads from adjoining properties impact the stream quality.

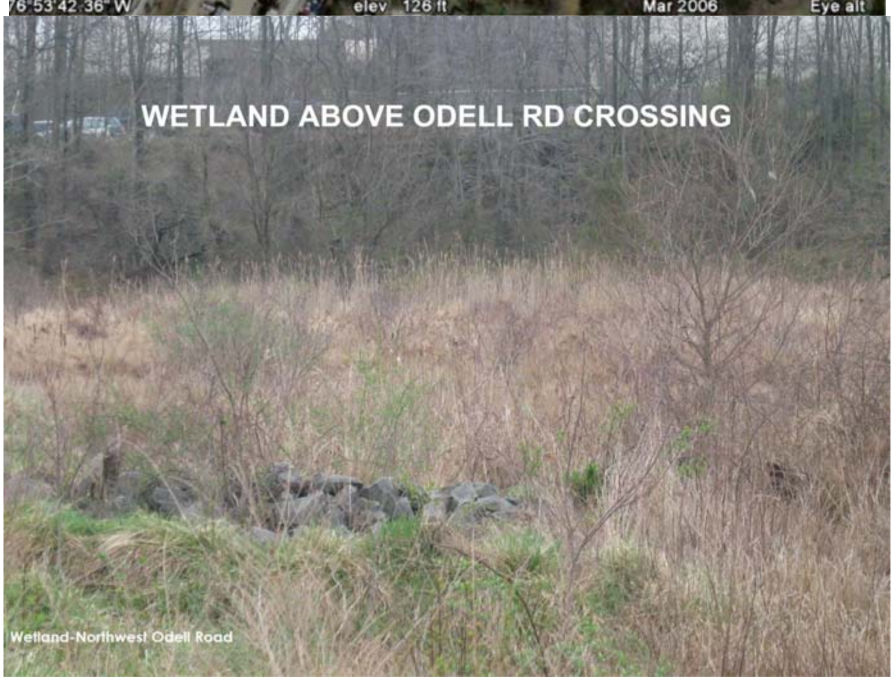

600 Feet Below
Ammendale Road
© 2009 Tele Atlas


EQUIPMENT STORAGE NEXT TO STREAM

Specific recommendations for improvements on adjacent properties can be found in the next section.

Stream Reach IV – Above Odell Road 800 Linear Feet

This section of the stream is somewhat buffered from adjoining properties. The streambank is well vegetated, is relatively stable and has an adjacent floodplain wetland of significance. The wetland appears to be about 1.5 acres in size and currently is vegetated primarily in cattail (t.latifolia). Some of the adjoining properties have their own stormwater facilities, which is out of the norm for the watershed study area. Little restoration is needed in this reach.



Stream Reach V – Below Odell Road for 700 Linear Feet

Below Odell Road, Indian Creek has been channelized in a concrete swale. This conveyance channel has little or no habitat value, except in the small areas where woody vegetation overhangs portions of the channel. Little in-stream sedimentation has occurred, as each stormflow scours the bottom. It can be assumed that containment within a prescribed bankfull event was necessary to protect adjacent properties.

Land uses typical within the study area are present here, with little stormwater protection. The ready-mix plant shown in the photograph above is permitted for stormwater discharge with MDE and has control measures in place. Other properties can be retrofitted with on-lot facilities, and the stream could be restored using a soil bioengineering system of soil layering, matting and live stakes.

Soil bioengineering allows the designer to create a stable slope, capable of withstanding bankfull stormevents. “The result provides for habitat and protection of adjacent properties. Soil bioengineering methods offer a broad range of mechanical benefits when installed as retrofits to damaged urban stream systems. Geotechnically they are able to offer immediate soil reinforcement up to a depth of twelve feet (12'). The use of brushlayers with natural or synthetic geogrids, is especially useful where space is constrained, as these methods may be constructed very steeply, 1H to 1V and in some cases as steep as .25H to 1V. The installed vegetation offers many added values in that hydrologically the embedded branches serve as horizontal drains converting parallel seepage flow to vertical flow. This improves the factor of safety thus offering improved overall slope stability. Surface protection and reinforcement is further increased when live branches develop roots and top growth. The roots tend to consolidate the soil particles by reinforcing the soil mantle thus reducing the possibility of slips and displacements. The top leaf and branch growth provides direct bank protection as well as reducing the velocities and redirects the flow away from the bank.”[3]

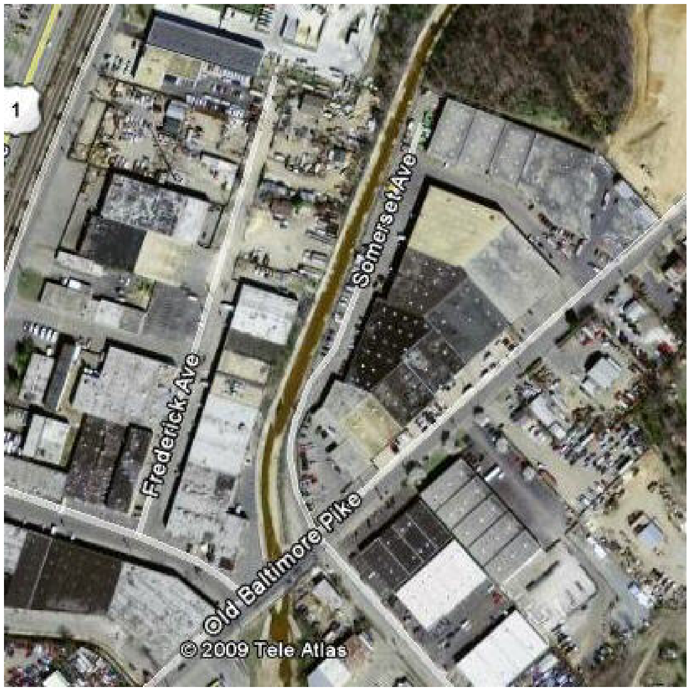
Environmental Quality Resources, LLC – Long Leaf, NC Stream Restoration

Environmental Quality Resources, LLC – Long Leaf, NC Stream Restoration

The side slopes can be stabilized with soil bioengineering, the stream bottom is typically designed to minimize excessive gradient slope by installing a cobble bottom with stone drop structures and pools if needed. This method increases habitat, allows for fish passage, and decreases stream velocity.

ENVIRONMENTAL QUALITY RESOURCES, LLC LONG BRANCH CREEK

Stream Reach VI – 600 Feet Above Old Baltimore Pike Crossing

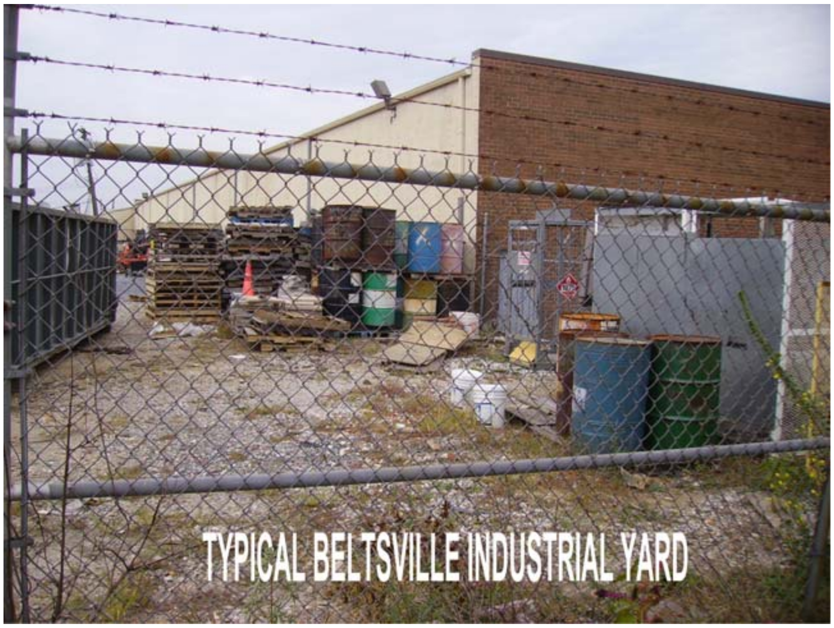


Again, this portion of Indian Creek has been confined to a concrete channel. The slight bend in the stream directly above Old Baltimore Pike will be a point of potential erosion if the stream channel is re-established in a more natural way. The erosive flows can be managed by installing an imbricated stone wall at this point. Imbricated stone walls are a method of hard armoring with natural stone materials. An alternative form of protection can be a gabion stone wall, inter-planted with native shrubs and trees.

ENVIRONMENTAL QUALITY RESOURCES, LLC LINDOVER CREEK

ENVIRONMENTAL QUALITY RESOURCES, LLC BIG BRANCH STREAM

Adjacent properties, within this reach are mostly impervious, older facilities, with no visible stormwater management. Each lot provides an opportunity for quality and quantity controls.



Stream Reach VII –600 Feet Below Old Baltimore Pike Crossing

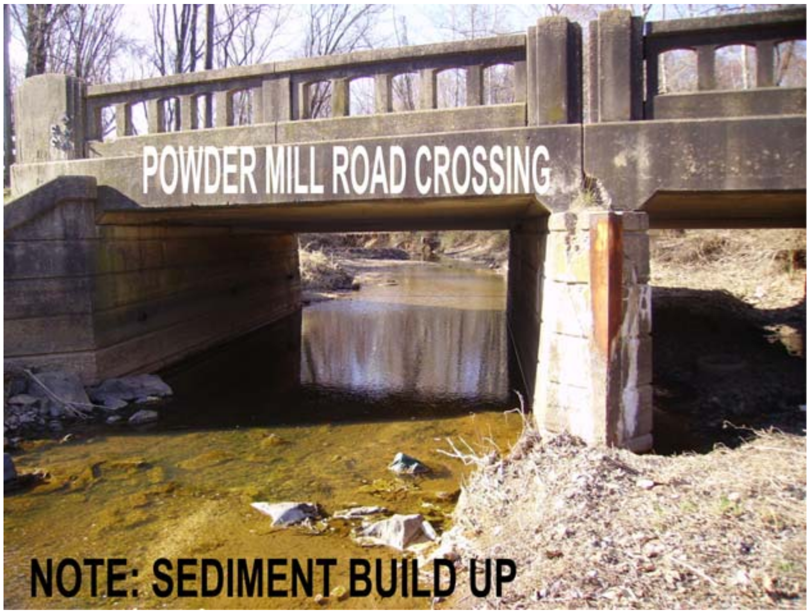
This section of Indian Creek is below the concrete channel and has flow input from a western branch. Stream velocities are higher here than above the concrete channel, as the upstream channel is straight and has a low resistance value. The bedding material in this area is much coarser, including some cobble up to 6”. Because the stream width increases here, the channel has become braided flowing in many smaller channels, leaving sediment deposition from upstream sources. If the upstream channel is corrected, there is room within the stream channel to excavate out the deposited silt and cobble, offering the opportunity to create some meander in the stream, along with deeper pools. These measures will help Indian Creek downstream, and will provide better habitat.

The stream has some woodland buffering along its east bank, but the west bank is still dominated by industrial uses.

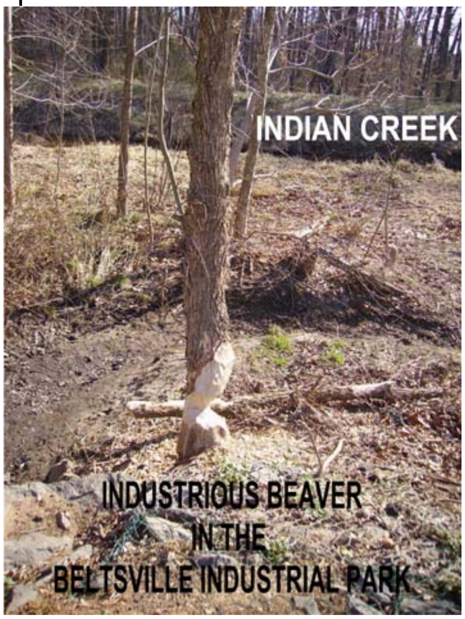
Stream Reach VIII –600 Feet Above Powder Mill Road

This reach is very similar to the 600 feet upstream. The channel width is wide, and deposition of sand, gravel and cobble is heavy. The adjacent properties on the west side are light industrial, which have no stormwater controls.

Stream improvement/restoration opportunities exist in this area. Removal of built up sediment throughout this section and below Powder Mill Road offers an opportunity to create some flood attenuation as the area for flood water would be increased. The design should include some form of meander, to slow the stream velocity as possible. Below Powder Mill Road Indian Creek has a bend, which is already eroding. This area certainly would need to be included in any stream restoration associated with this section.



This reach has some woody overhang on the east side of the stream. A beaver is active along this section, causing damage to planted trees on the western side.



Adjacent Properties Impacts and Possible Remedies

Pollution Prevention

Pollution prevention within the Indian Creek study area is the most important and most cost effective way to improve stream conditions. Prince Georges County provides a number of programs to assist businesses in meeting their legal and community responsibilities to minimize pollutant impacts.

Pollution prevention, or P2, is an environmental protection concept based on the principle that it is easier to stop pollution at the source than it is to clean It up once it has entered the environment. P2 focuses on the reduction or elimination of pollution at the source, before it goes into the dumpster, down the storm drain, out the smokestack or is taken away by the waste hauler. Like footprints in sand on the beach, nearly everything we do leaves an imprint.

Successful P2 programs begin with a change in attitude and the recognition that the best way to control pollution is to eliminate the process that creates it. Simple measures, such as equipment and process modifications, improved housekeeping, inventory control and preventive maintenance can help to eliminate waste. By identifying inefficiencies and substituting cleaner, cheaper and smarter solutions to everyday business practices, we can control pollution.

Runoff from rain or snowmelt becomes contaminated when it comes into contact with detergents, toxic metals, oil, grease, de-icing salts and other chemicals. These pollutants are carried by stormwater to nearby storm drains, streams and rivers that eventually flow into the Chesapeake Bay. Traditionally, stormwater management has focused on end-of-the-pipe regulations, where pollutants are captured by best management practices before water is discharged to local streams. However, P2 efforts focus on waste before it is generated as the best way to prevent water pollution.[4]

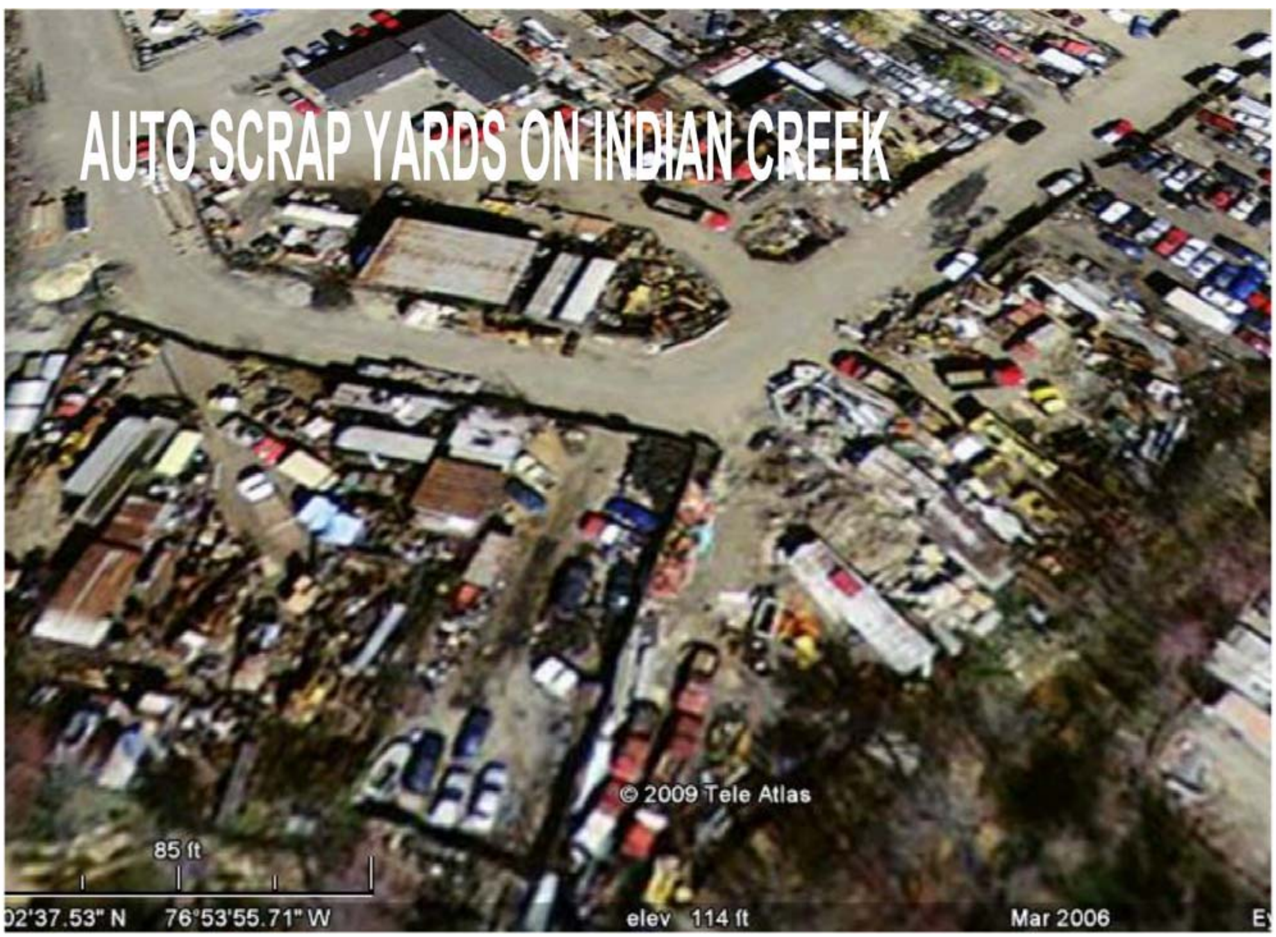
Permitting is required for a range of industrial facilities, and is managed in the State of Maryland by the Maryland Department of the Environment (MDE). MDE's Water Management Administration (WMA) issues permits to protect Maryland's water resources by controlling industrial and municipal wastewater discharges. Surface water discharges are regulated through combined State and federal permits under the National Pollutant Discharge Elimination System (NPDES).

Many of the industries within the Indian Creek study area are required to have permits to meet the regulations that guide MDE. Uses such as transportation facilities, scrap yards and auto salvage yards should have these permits, and should be managing for surface water pollution runoff. Based on observations along Indian Creek, it would appear that many of the businesses are not in compliance with MDE regulations. Other businesses may not be required to have a specific permit, but should employ basic best management practices to minimize pollutants from leaving their sites.

Common requirements for coverage under an industrial stormwater permit include development of a written stormwater pollution prevention plan (SWPPP), implementation of control measures, and submittal of a request for permit coverage, usually referred to as the Notice of Intent or NOI. The SWPPP is a written assessment of potential sources of pollutants in stormwater runoff and control measures that will be implemented at a facility to minimize the discharge of these pollutants in runoff from the site. These control measures include site-specific best management practices (BMPs), maintenance plans, inspections, employee training, and reporting. The procedures detailed in the SWPPP must be implemented by the facility and updated as necessary with a copy of the SWPPP kept on-site. The industrial stormwater permit also requires collection of visual, analytical, and/or compliance monitoring data to determine the effectiveness of implemented BMPs.

Auto Salvage Yards

Aerial photography and ground truthing reveal a number of auto scrap yards in Beltsville. Many of these facilities have been in place for decades. The potential for pollutant runoff from these sites is great, and compliance to required permits and good housekeeping practices should be enforced.



Typical Scrap Yard

The following table details the potential sources for pollution and what pollutants would be expected to be generated from those sources.

Industrial Activities, Pollutant Sources, and Associated Pollutants at Automobile Salvage Yards

Activity	Pollutant Source	Pollutant
Vehicle dismantling	Oil, anti-freeze, batteries gasoline. diesel fuel, hydraulic fluids, electrical switches	Oil and grease, ethylene glycol, heavy metals
Misc. Parts Storage	Batteries. chrome bumpers, wheel balance weights, tires, rims, filters, radiators, catalytic converters, engine blocks, huh caps, doors, drivelines. galvanized metals. mufflers	Sulfuric acid. heavy metals, oil brake dust, petroleum hydrocarbons, total suspended solids (TSS)
Outdoor Vehicle and Equipment Storage	Leaking engines, chipping and eroding bumpers, chipping paint, galvanized metal	Oil and grease, arsenic, organics, heavy metals, total suspended solids (TSS)
Vehicle and Equipment Maintenance	Paint cleaning	Cleaning solvents, oil and grease, heavy metals, acid /alkaline wastes
	Greasy rags; oil filters, air filters. batteries; hydraulic fluids, transmission fluids, radiator fluids, degreasers Fluids replacement. including oil hydraulic fluids, transmission fluid, radiator fluids	Oil, heavy metals, chlorinated solvents, acid/alkaline wastes, oil, heavy metals,
Liquid Storage Above Ground Storage Tanks	External corrosion and installation problems	Fuel. oil and grease, heavy metals
	Installation problems	
	Spill due to operator error	
Illicit Connection to Storm Sewer	Sanitary water in storm system	Bacteria, Biochemical Oxygen demand (BOD), suspended solids
	Floor drains	Oil and grease, heavy metals, chlorinated solvents, fuel, ethylene glycol
	Vehicle washwaters	Oil and grease, detergent, metals, chlorinated solvents, phosphorus, suspended total solids (TSS)
	Radiator flushing wastewater	Ethylene glvcol
	Leaking underground storage tanks	Materials stored or previously stored

5

All auto scrap yards, and yards that store damaged or “dead” vehicles should be permitted, and should have best management practices employed. Several simple practices can be implemented at a low cost. These practices include:

- Berm the perimeter of the facility, with the low point being protected with some form of filtering device
- Install engineered stormwater treatment systems. These can be simple stormdrain sumps, or more refined structural devices. Manage for both quantity and quality
- Employ oil sorbent booms in all drainage areas
- Have Emergency Spill Kits at every site
- Post emergency procedures for spills and educate the employees of the importance of managing for pollutant discharges
- Clean up spills immediately, keep the site clean
- Cover any storage area that has any potential for spills
- Put all storage barrels in an area where spills can be managed
- Keep weekly logs to record maintenance and inspection of facilities

See the EPA website *Stormwater Fact Sheet for Automobile Storage Yards* for detailed information.

Transportation Facilities

Within the study area, there a many properties being used to park or store trucks, trailers, autos and other mechanical equipment. Permitting for these facilities is dependent on a number of factors, which can be driven by the number of vehicles stored, maintenance activities performed, fueling, and proximity to a stream or other waterbody. The Maryland Department of the Environment is responsible for this decision matrix and should be consulted by any property owner who stores, maintains or fuels vehicles.

The causes and prevention of pollution are very similar to auto scrap yards. See the EPA website *Stormwater Fact Sheet for Transportation Facilities* for detailed information.

Scrap and Waste Recycling

Similar in nature to automobile salvage yards, scrap and waste recycling facilities have the potential to generate a broad range of pollutants. These sites require permitting as well and are typically engaged in processing, reclaiming, and wholesale distribution of scrap, metals, paper, cardboard, glass and animal hides. If the facility is classified as a waste recycling facility, the activities on-site would include reclaiming and recycling liquid wastes such as used oil, antifreeze, mineral spirits and industrial solvents. If the facility receives materials already sorted from non-industrial sources, the site would be commonly called a material recovery facility.

Many of the land uses within the Beltsville Industrial Park could fall into these industrial classifications. Properties along the Indian Creek were noted to have numerous transformers stored, stockpiles of debris and soils, waste drywall and other building materials, including steel beams and pipes. All of these materials can have an impact on a receiving stream if not managed.

Common Activities, Pollutant Sources and Associated Pollutants at Scrap Recycling and Waste Recycling Facilities

Activity	Pollutant Source	Pollutant
Stockpiling and Storage of Materials	Leaking various fluids Deterioration of materials	PCB's, oil and grease, lubricants, paint pigments, ionizing radioactive isotopes, battery acid, petroleum products, infectious/bacterial contamination, Total Kjeldahl nitrogen (TKN), chemical residue
Material Processing, shredders, scrubbers, shearers, compactors, choppers	Spillage from pumps, scrubbers, filters, machines	Oil and grease, hydraulic fluids, mercury, lead, fuels, heavy metals
Material Processing electrical control systems, including transformers	Oil leakage from transformers, leakage from mercury float switches, faulty detection devices	PCB's, mercury, petroleum products
Outdoor material storage	Deterioration of paper, wood products, aluminum beverage cans	Biological oxygen demand (BOD)
Outdoor Vehicle and Equipment Storage	Leaking engines, chipping and eroding bumpers, chipping paint, galvanized metal	Oil and grease, arsenic, organics, heavy metals, total suspended solids (TSS)

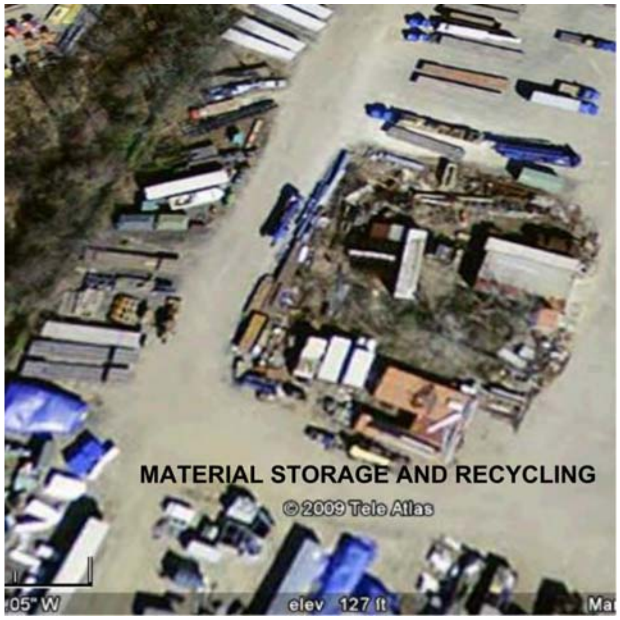
Vehicle and Equipment Maintenance	Paint cleaning	Cleaning solvents, oil and grease, heavy metals, acid /alkaline wastes

6

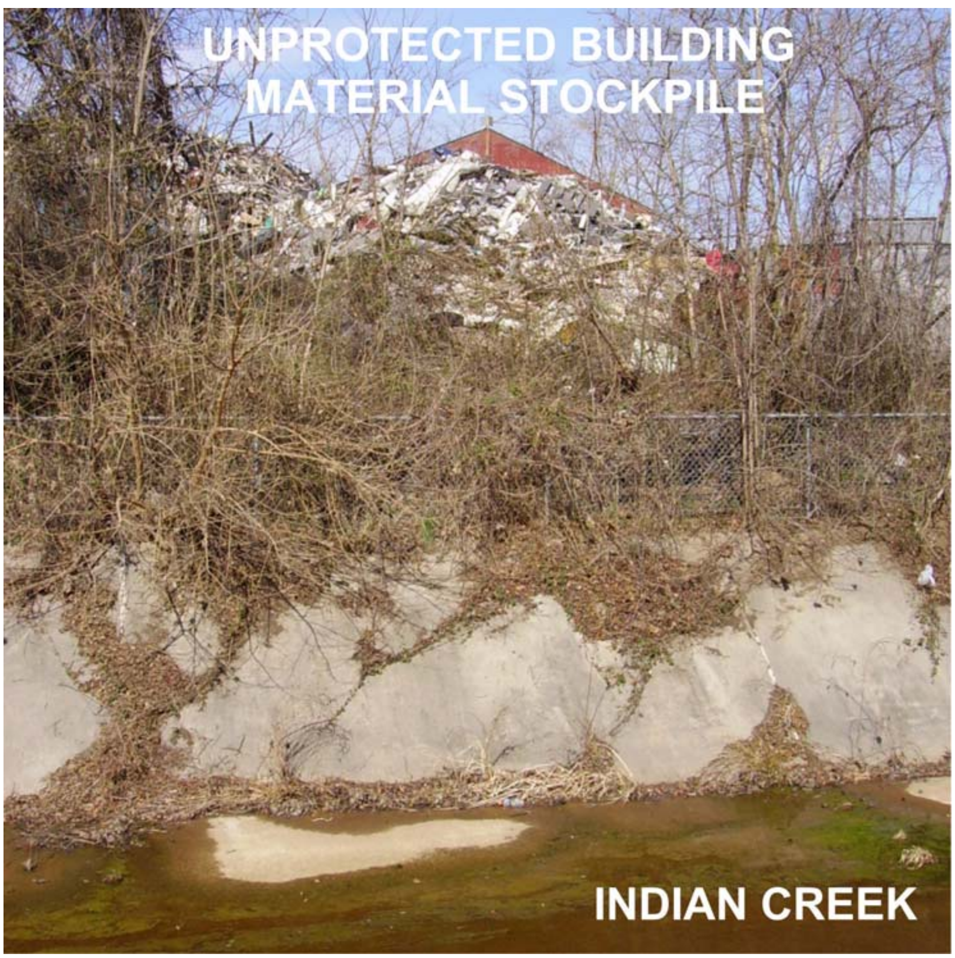
Scrap Recycling and Waste Recycling Facilities should have best management practices employed. Several simple practices can be implemented at a low cost. These practices include:

- Berm the perimeter of the facility, with the low point being protected with some form of filtering device
- Install engineered stormwater treatment systems. These can be simple stormdrain sumps, or more refined structural devices. Manage for both quantity and quality
- Minimize stormwater drainage in areas of concern on-site
- Check in-coming materials for leaks or possible pollutants, maintain a list of acceptable materials
- Use drip pans under equipment waiting to be salvaged
- Employ oil sorbent booms in all drainage areas
- Have Emergency Spill Kits at every site
- Schedule frequent inspection of all equipment
- Post emergency procedures for spills and educate the employees of the importance of managing for pollutant discharges
- Clean up spills immediately, keep the site clean
- Cover any stored materials that has any potential for spills
- Cover degradable materials
- Put all storage barrels in an area where spills can be managed
- Keep weekly logs to record maintenance and inspection of facilities

See EPA website *Stormwater Fact Sheet for Scrap Recycling and Waste Recycling Facilities* for detailed information.

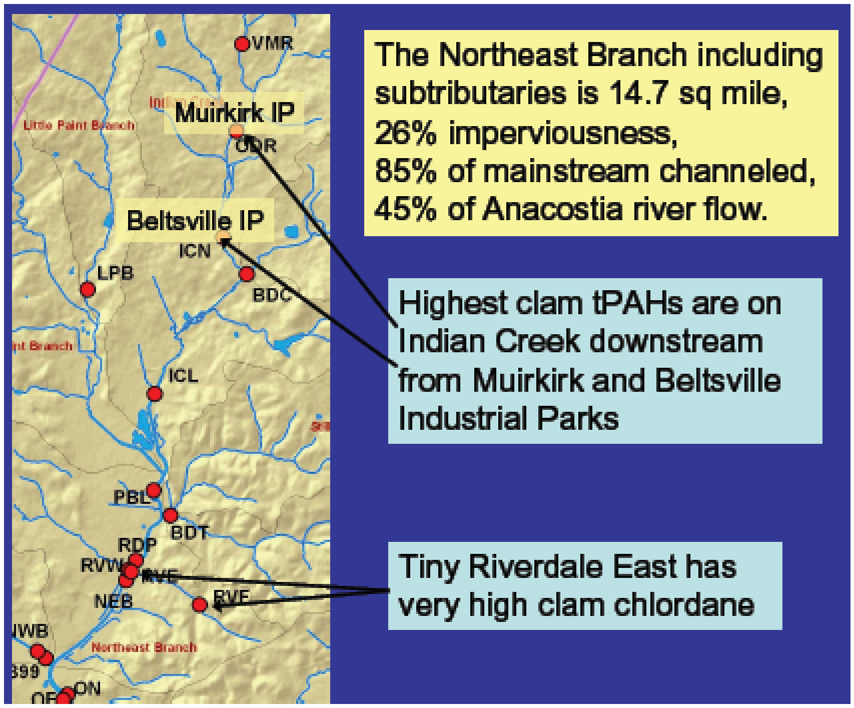


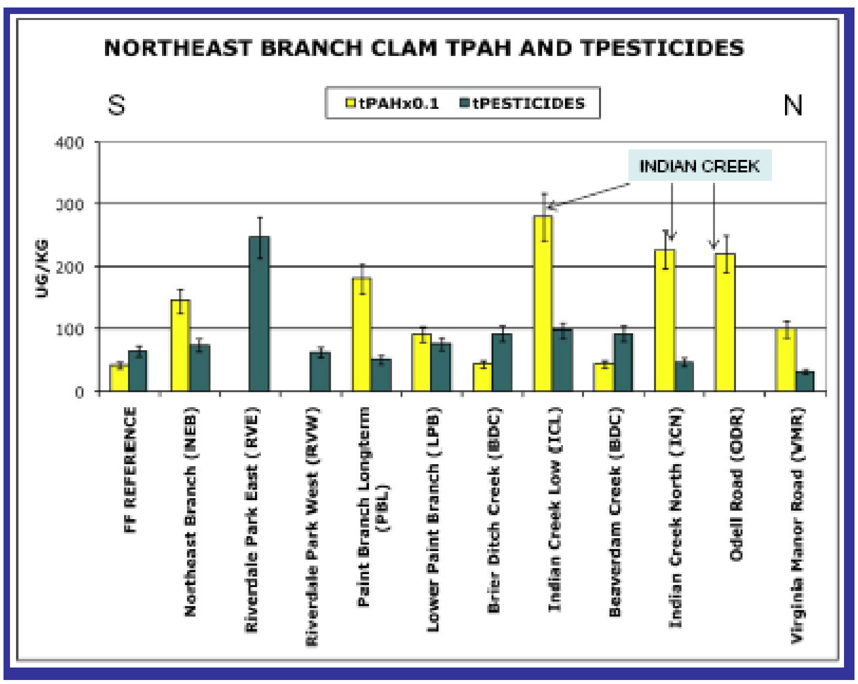
General Non-Point Source Pollution



The highly industrialized use within the study area has many forms of pollutant loading, most of which does not require a permit. Simple storage of trash, barrels, and trucks, along with parking areas, rooftops and automobile traffic all contribute to the degrading of Indian Creek. Simple housekeeping measures would improve some of these problems. Adding some type of water quality and quantity structure to each outfall area should be considered.

The impact of chemical pollutants is dramatically exhibited in a study conducted by Dr. Harriette L. Phelps of the University of the District of Columbia.[7] The 2007 study shows a significantly higher level of tPAHS (total Polycyclic Aromatic Hydrocarbons) on Indian Creek as compared to the reference site. This indicates pollutant loading from uncontrolled parking lot runoff (Phelps). The USEPA has identified PAH's as a priority pollutant, with some of these compounds being identified as possible human carcinogens.[8] The following illustrations, from Phelps, detail the area of concern and levels of compounds found.



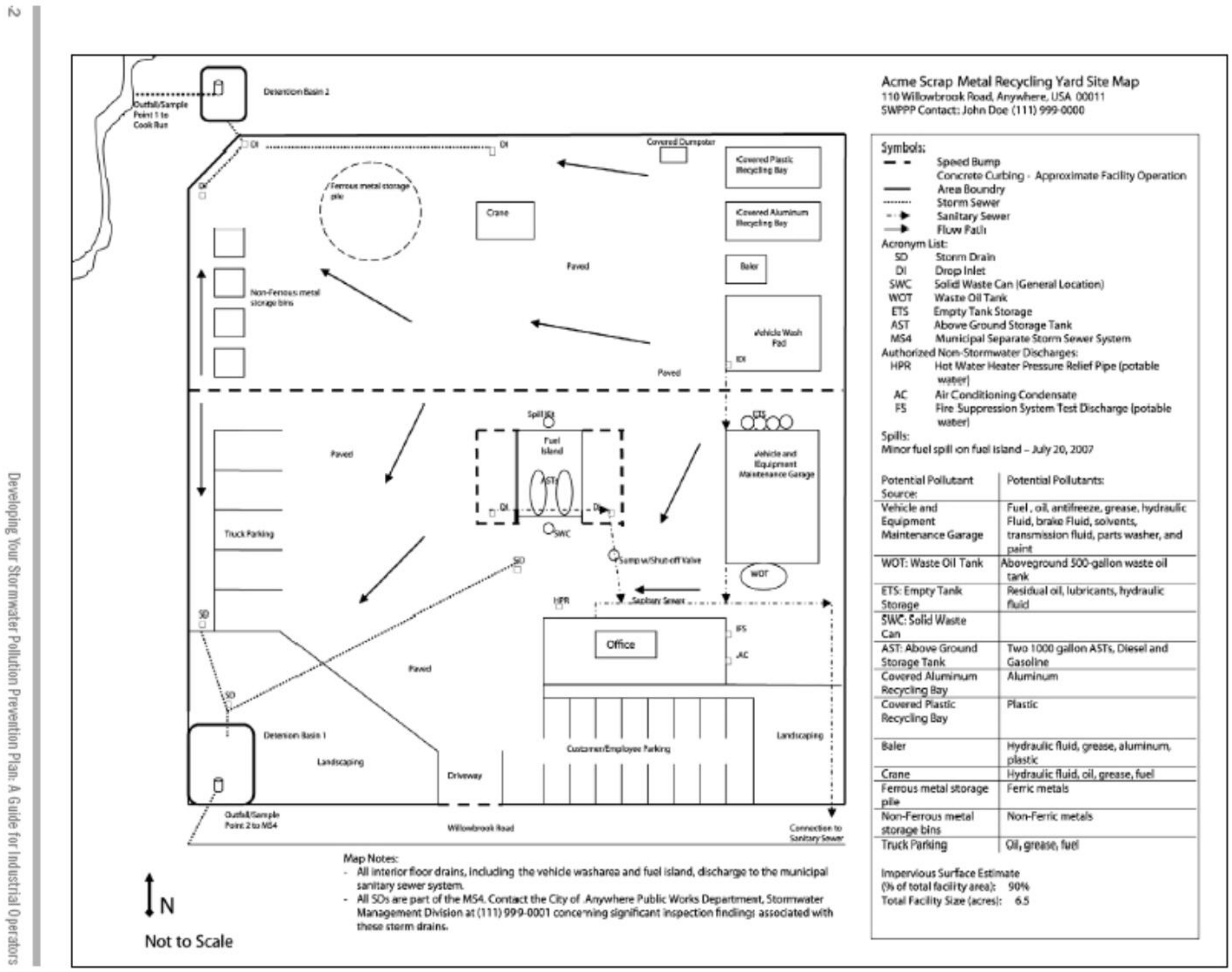


Another significant example of chemical pollution in this section of Indian Creek occurred as a result of improper handling and storage of tetrachloroethene. This is a chemical used in dry cleaning, and was distributed by W.P. Ballard and Company. In December of 1988, MDE was contacted concerning possible tetrachloroethene in the ground. Subsequent testing revealed high levels of the contaminant in the soil and groundwater. Ballard accepted responsibility and has submitted a Voluntary Clean Up plan with MDE. The cost and long-term pollution of the environment could have been avoided if the site had been properly designed with appropriate Best Management Practices (BMP's)[9]

Typical Best Management Practices (BMP's) for Industrial Applications

The following applications are only a few of the many methods that have been developed to protect receiving waterways from stormwater pollution. One of the least expensive, yet most effective BMP's for industrial properties is **Good Housekeeping**. Regular clean up of trash, covering of items stored including barrels, debris and disabled vehicles, and sweeping of parking lots goes a long way to protect the environment.

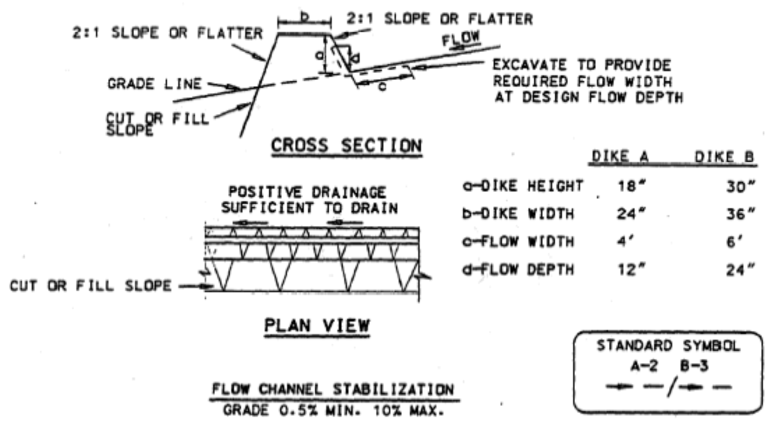
TYPICAL STORMWATER POLLUTION PROTECTION SITE PLAN



www.EPA/NPDES/pub/industrial/_swppp_guide.pdf

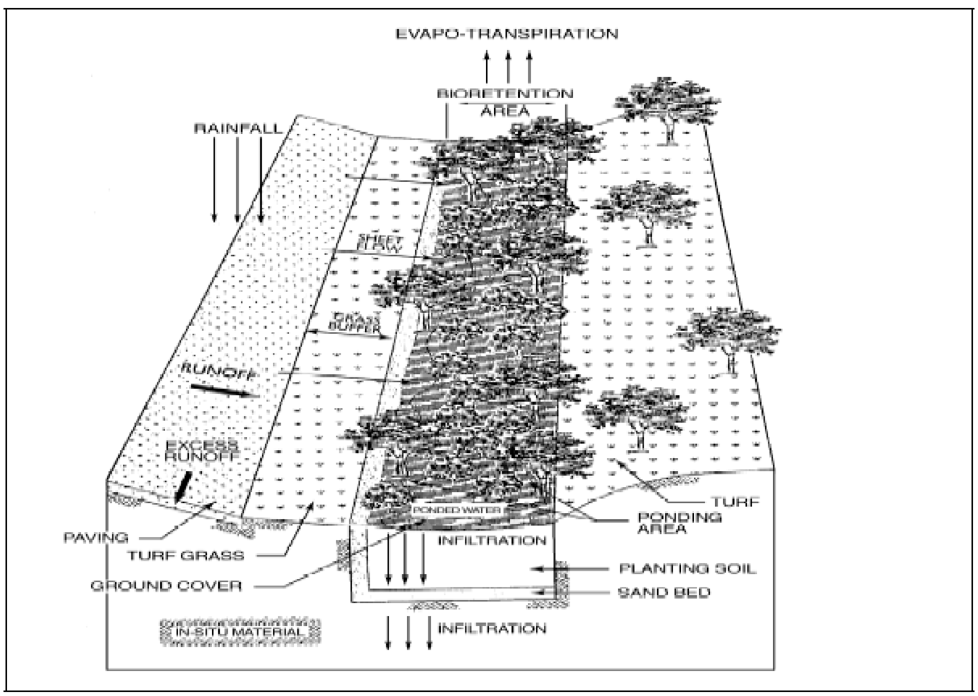
RECOMMENDED PRACTICES FOR INDUSTRIAL LOTS

Permanent Earth Berms: Berms around a property can divert stormwater to an area where the water can be treated and water quantity control can occur.



Source: MDE Soil and Erosion Control Specification

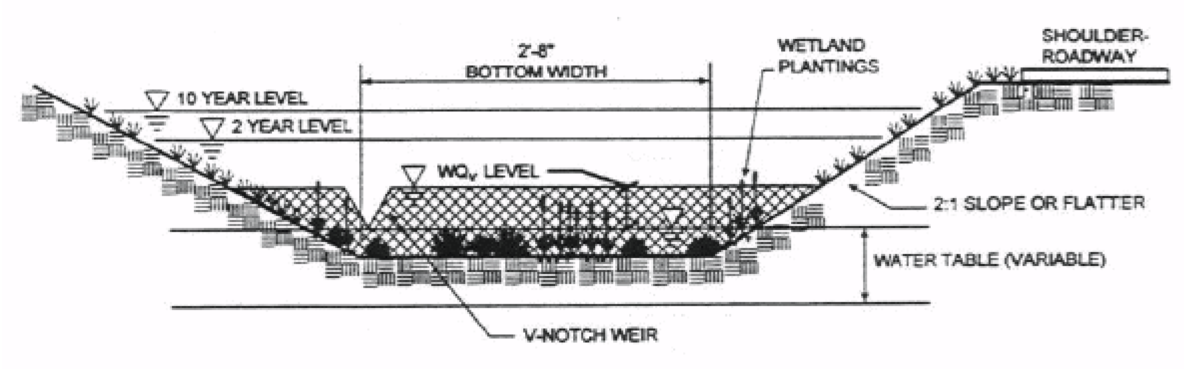
Bioretention/Rain Garden:



Source: PGDER, 1993.

Bioretention is a stormwater Best Management Practice developed in Prince Georges County, MD. This method can provide for water quantity and quality control. Bioretention facilities are often installed to capture water from parking lots and roof runoff. Trash, debris, sediments and chemical pollutants can be trapped in these areas utilizing the natural properties of plants, microbes and soils to remove soluble pollutants. Looking like landscaped areas, the treatment system is easy to maintain, provides habitat and a aesthetic appeal. Site maintenance crews can generally pick up trash and scoop out sediments on a monthly basis. More intensive maintenance is required when the soils get clogged up with sediment fines. Groundwater infiltration is possible where soils are acceptable, and most bioretention facilities have an underdrain.[10]

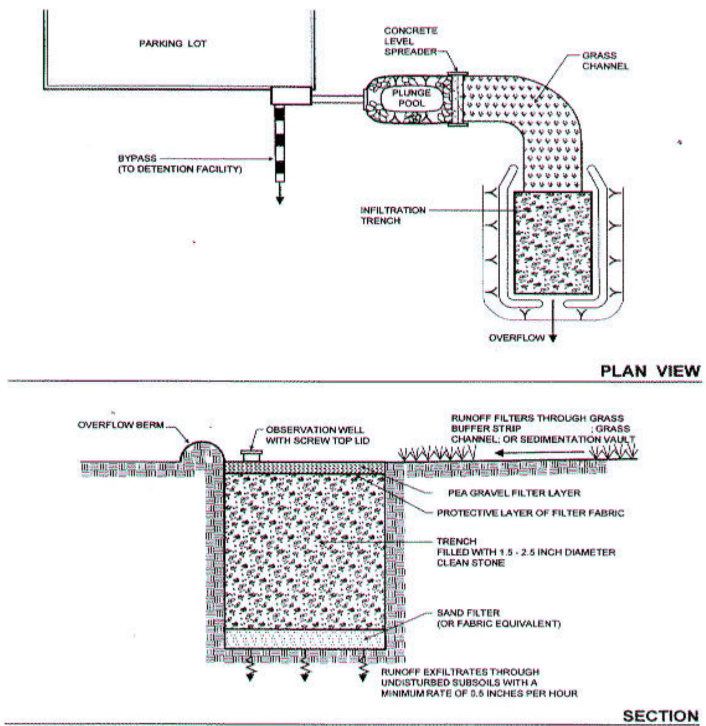
Wet/Bio Swale: Wet swales are another type of surface facility that utilizes natural processes to treat stormwater runoff. As in the bioretention system, the wet swale is very effective at capturing debris, trash and sediments from parking lots, roadways and roofs. Some treatment of soluble pollutants does occur within the created wetland. This type of BMP is particularly applicable where a high water table exists. By adding pools and steps, this swale system becomes an effective way to slow stormflows as well.



Source: MDE Wet Swale

AT AMMENDALE ROAD CROSSING
WEST SIDE

Infiltration Trench:
An infiltration trench (a.k.a. infiltration galley) is a rock-filled trench with no outlet that receives stormwater runoff. Stormwater runoff passes through some combination of pretreatment measures, such as a swale or sediment basin, before entering the trench. Runoff is then stored in the voids of the stones, slowly infiltrated through the bottom and into the soil matrix over a few days. The primary pollutant removal mechanism of this practice is filtering through the soil.[11] This system also captures trash and debris.



Source: MDE Infiltration Trench

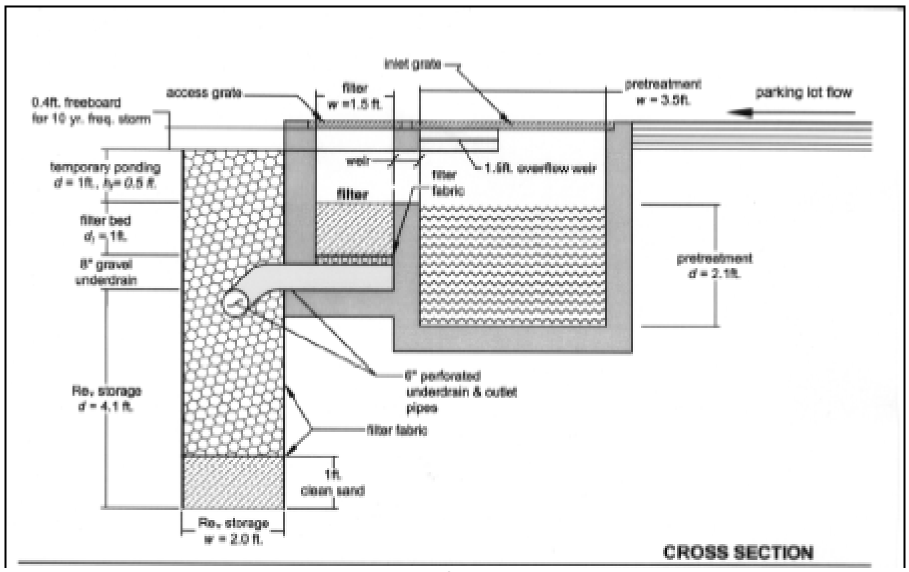
Permeable Paving: There are several paving options, which allow for rainwater to permeate through parking lot paving, into the ground. This method of groundwater recharge should only be used where parking of automobiles and light-trucks occurs. Materials available include porous concrete, porous asphalt and a wide range of pre-cast grid materials. All methods require an under base of gravel and sand, and is usually only used where good soil infiltration rates can be found. Frequent vacuuming is necessary to clean the surface of sediments.

Stream Buffer: If possible a minimum of 50 feet should be dedicated at each lot for a stream buffer. This area should be vegetated in native trees and shrubs, providing habitat, shading, aesthetic appeal, and as another trapment for debris and trash from industrial uses. Where possible a wider buffer is preferred to allow for migration of terrestrial species along the stream bank.

Underground BMP Solutions for Industrial Sites

There are a number of proprietary systems as well as open market designs. These systems can provide both quantity and quality control. They become expensive if the drainage area is large, particularly when providing quantity control for impervious surfaces.

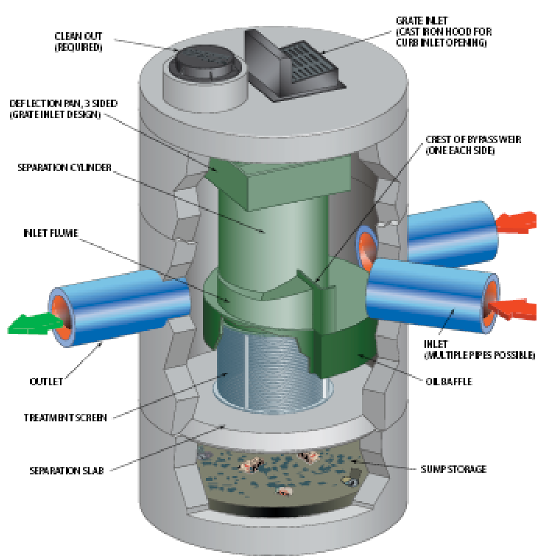
Parking Lot Sand Filter



MDE Water Quality Design

Proprietary Underground System for Water Quality Only

Hydrodynamic separators (HDS) are small, flow-through devices that remove sediment, trap debris, and separate floating oils from runoff.



Contech Stormwater Solutions

Underground Quantity Storage

Underground Storage is normally used in ultra-urbanized areas. These areas include shopping centers, small industrial sites, within cities, or any site where land is at a premium and must be allocated to roadways, parking and buildings. Underground storage allows for release of rain from a large impervious area over an extended period of time. This retention time would be of great benefit in reducing peak stormflows into Indian Creek. Cost of these facilities can be prohibitive for implementation.

Cost Estimates
To prepare accurate costs, an estimator needs engineered plans, including survey, design, materials, soil conditions, etc. The costing listed here provides a general estimate of what certain measures will cost, which can then be applied to the stream work and the stormwater control work. In most cases costs are derived from real cost estimates from projects bid in Maryland in the last 2 years.

<u>IN-STREAM WORK</u>

Stream Reach I - Existing Pond Retrofit

The pond is approximately 6 acres in size. A retrofit project will require survey, design, permitting, contracting and construction. Survey, design and permitting will cost about $75,000. Assuming an average depth of silt accumulation of 2 feet, approximately 20,000 cubic yards of wet material must be dredged, hauled and disposed of offsite. The dam will need to be rebuilt with stable compactable material, including a core trench. A new control structure and outfall barrel will need to be installed, discharging to a new outfall. The entire area will require regrading, seeding, landscaping, and access roads will need to be installed and a new fence will be required around much of the site. All of this work must be done with some form of bi-pass water control, and stormevent protection.

Estimated Total Cost: $ 1,075,000[12]
Stream Reach II – The Wetland Below the Pond

This wetland area can be left as is, but it would prosper into a highly functional wetland if invasive species were controlled and the plant diversity was increased with plantings. Invasive species work should be implemented over a minimum of five years. Other habitat improvements could be added, but are not high priority requirements.
Cost Estimate: $30,000 for invasives management+$40,000 in plants
Estimated Total Cost: $70,000

Stream Reach III – Below Ammendale Road for 600 Linear Feet

This reach is currently stable in most points and has a vegetated streambank. If a stream restoration project is proposed, this reach could be included. Sediment removal, trash cleanup, and minor stabilization would be reasonable to assume.
Estimated Total Cost: $30,000

Stream Reach IV – Above Odell Road 800 Linear Feet

This stream reach is in good condition. Some work could be done to improve the diversity and habitat within the floodplain wetlands.
Cost Estimate: $30,000 for invasives management+$30,000 in plants
Estimated Total Cost: $60,000

Stream Reach V – Below Odell Road for 700 Linear Feet

This reach begins the concrete channelized section. The concrete was placed to allow adjacent land users to maximize land-use. To keep the properties protected from stormevents, a very comprehensive analysis will be needed, along with survey, engineering design, bioengineering design, permitting, contracting and construction. The work will be difficult as access will be limited to the actual stream channel in most cases. There may be utility relocations, but that is not considered in this budget. The 56,000 square feet of existing concrete must be removed in stages, and new stabilization installed; all of this in an active stream. Assume $50,000 for design, permitting and survey.
Estimated Total Cost: $373,900[13]

Stream Reach VI – 600 Feet Above Old Baltimore Pike Crossing

This reach would be constructed along with Reach V, with the same needs and concerns.
Estimated Total Cost: $ 320,485

Stream Reach VII –600 Feet Below Old Baltimore Pike Crossing

Because there is sufficient stream bank-to-bank width, this reach offers the opportunity to

reconfigure the stream into a meander. Sinuosity in streams is normal, and allows for the stream to "absorb" increased flow velocities that occur during stormevents. This type of reconstruction must be designed with the grade, soil types, width of work area, contributing watershed and vegetation as combined factors in developing the plan. It is likely much of the sand and silts will be removed from the stream. Existing cobble will be left for use as a bottom substrate. Stabilization with bioengineered practices would be likely, possibly utilizing a stone toe at the stream bank, with coir logs, matting and vegetative stabilization. In areas where higher velocities will occur, stone may be required for stability. This stone can be interplanted to improve the habitat and aesthetics. Stone grade structures, with riffles and pools could further decrease flow velocity and add habitat. All of the design should allow for migratory fish passage. Assume $50,000 for design, survey and permitting. Construction costs based on similar work.
Estimated Total Cost: $223,800[14]

Stream Reach VIII –600 Feet Above Powder Mill Road
Assume the same level work as stream reach VI.
Estimated Total Cost: $223,800

TOTAL ESTIMATED COST FOR IN-STREAM WORK: $2,376,985

ADJOINING PROPERTY WORK

There is approximately 200 acres of impervious area draining to the study area. Most of it has no stormwater quantity or quality control. Currently, most of the land uses do not require any stormwater controls or Best Management Practices. However, in a best-case-scenario, each owner should implement practices to protect the environment, and in certain cases should be required to implement a plan.

To provide an accurate cost for this work would require a field survey of each individual property. A stormwater pollution prevention plan then could be developed, and costs assigned to each work activity required to meet the plan. However, a budget number can be assigned for many of the best management practices recommended, and from that, general cost budgets for certain sized lots can be determined.

Costs for Specific Best Management Practices

Stormwater Pollution Prevention Plan:
Work typically will require the development of a site plan of existing conditions. The operators and owner must develop a description of the uses on site and daily activities, including all potential sources of pollution. The preparer then must detail the best management practices most applicable to the activities so a written plan can be developed. A final site plan with the written document, maintenance activities, inspection processes, and a monitoring plan are then ready for review and submittal to permitting agencies if required.

One-Acre Site: Estimated Cost $15,000
Five-Acre Site: Estimated Cost $30,000

Permanent Berms: Typically constructed in stabilized earth, or in certain cases asphalt on paving.
Estimated Cost: $10/foot

Bioretention/Rain Garden:
One-Acre Drainage Area: Estimated Cost (Design) $9,000+ (Construction) $35,000
Estimated Total Cost: $44,000
Five-Acre Drainage Area: Estimated Cost (Design) $20,000+ (Construction) $75,000[15]
Estimated Total Cost: $95,000

Wet/Bio Swale:
One-Acre Drainage Area: Estimated Cost (Design) $3,000+ (Construction) $25,000
Estimated Total Cost: $28,000
Five-Acre Drainage Area: Estimated Cost (Design) $6,000+ (Construction) $40,000[16]
Estimated Total Cost: $46,000

Infiltration Trench:
One-Acre Drainage Area: Estimated Cost (Design) $8,500+ (Construction) $40,000
Total Estimated Cost: $48,500
Five-Acre Drainage Area: Estimated Cost (Design) $14,000+ (Construction) $65,000[16]
Estimated Total Cost: $79,000

Permeable Paving/Pavers: Includes stone base and drains
Estimated Cost: (Design) $2/sf+ (Construction) $10 - $15/square foot
Estimated Total Cost /square foot: $12-17

Stream Buffer: Requires dedication of property, probably, fencing, signs and landscaping. Assume 400 linear feet for one-acre lot, 800 linear feet for a 5-acre lot.
One-Acre Lot: Estimated Cost $5,000
Five-Acre Lot: Estimated Cost $10,000

Parking Lot Sand Filter/Proprietary Underground System:
One-Acre Drainage Area: Estimated Cost (Design)$12,000+ (Construction) $25,000
Total Estimated Cost: $37,000
Five-Acre Drainage Area: Estimated Cost (Design) $26,000+ (Construction) $60,000[17]
Estimated Total Cost: $86,000

Underground Quantity Storage: In most cases, existing paving will be required to be removed, and earth removed in the volume required for the facility. One-acre drainage will require 1,000 sf of paving removed, and dirt removed to a depth of 6 feet. A five-acre drainage area will require 5,000 sf of paving removed to a depth of 6 feet for earth removal.
One-Acre Drainage Area: Estimated Cost: (Demolition) $5,200+(Storage Facility) $54,450+(Repair Paving) $3,500
Estimated Total Cost: $63,150
Five-Acre Drainage Area: Estimated Cost (Demolition) $26,000+(Storage Facility) $272,250+(Repair Paving) $17,500
Estimated Total Cost: $315,750

Cost for a Sample Five-acre Pollution Prevention Plan and Stormwater Quality Retrofits

Stormwater Pollution Prevention Plan	$30,000
400-Linear Feet of Perimeter Berm:	$ 4,000
1-Bioretention Facility	$95,000
Stream Buffer	*$10,000*
Total Retrofit Cost for 5 Acre Sample Site	**$139,000**

If this assumption is applied to the impervious area within the study, the total to retrofit the adjoining properties along Indian Creek would be **$5,560,000.**

Conclusions

The section of Indian Creek, located within the Beltsville Industrial Park has been critically impacted by the land use around it. The area was developed before any stormwater regulations were in place and before awareness of environmental impacts due to imperviousness and non-point pollution were understood. The stream today shows an amazing resilience to these impacts, providing some natural filtration of pollutants and a range of habitat for wildlife.

A holistic approach to stream management is the only way to improve the stream quality. The existing in-stream stormwater pond below Muirkirk Road offers an excellent start to managing sediment input and volume control for the land uses above this point. An engineered plan for rebuilding this facility is very standard in approach and construction.

Further in-stream work should not be considered until the issues with the contributing watershed are addressed. Since most of this land is privately held, a combination of enforcement of existing regulations coupled with volunteer participation by landowners would be an effective approach. The cost for the total watershed retrofit would be high, but if broken down by lot, the cost could be manageable. Landowners will expect assistance from the government, which could be in the form of consulting, design and aid in construction costs.

Once the contributing watershed has been "cleaned up", additional work within Indian Creek should be considered. Removal of the concrete channel would improve habitat and would reduce stream velocity, removal of built up sediments would offer a flooding area for peak stormevents. The two wetlands noted in this report are excellent candidates for invasive species control to promote better diversity of native plants. All of this work will have a tremendous impact on the balance of Indian Creek below the Industrial Park, and will help improve the quality of the Anacostia River.

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[13] EQR. 2008. Ballenger Creek Elementary School Stream Restoration.

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[16] EQR. 2008. SHA DBOM Charles County SWM

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