Post-Construction BMP Implementation on the State Highway System

A LOOK INTO MEETING NPDES REQUIREMENTS WITH COST EFFECTIVE POST-CONSTRUCTION BMP STRATEGIES

Construction versus Post-Construction BMPs

- Construction BMPs are temporary in nature and are designed to keep sediment from leaving the site. Examples of construction BMPs are ditch checks, silt fence, and erosion control blankets.
- Post-Construction BMPs are permanent in nature and are designed to infiltrate or retain runoff, generally a 1 inch rain storm.   This runoff can contain heavy metals, petroleum products, litter, etc.

Construction BMPs

Why Control Post-Construction Runoff Control?

- Development has covered the ground in impervious surfaces (parking lots, roads, side walks, etc.) causing stormwater to accumulate
- Which results in-
  - urban flooding
  - increased volume of water entering adjacent waterways
  - pollutants picked up from impervious surfaces
  - added stress to streams in dense urban areas which are already degraded & impaired.

    - 1,218 stream miles are already impaired by urban runoff and storm sewer discharges. (IEPA 2009)

Federal Legislation

- Clean Water Act:
- 1948 - Federal Water Pollution Control Act (FWPC)
- Amendments:
  - FWPC Amendments of 1972
  - Clean Water Act of 1977
  - Water Quality Act of 1987

Clean Water Act

- 1972 amendment established regulation of pollution discharge from point and nonpoint sources such as sewer systems and ditches
- Regulation is through Section 402 of the CWA – the NPDES permit program
- NPDES stands National Pollution Discharge Elimination System

NPDES

- A MS4 is a Municipal Separate Storm Sewer System
- •Phase I, issued in 1990, requires medium and large cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. There are approximately 750 Phase I MS4s.
- •Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. There are approximately 6,700 Phase II MS4s.

NPDES permit

- For Illinois, the MS4 program is regulated by the ILR40 permit
- IDOT was included in the small and medium category in 1999.
- IDOT maintains:
  - 2,185 Illinois Interstate system miles
  - 42,095 State lane miles of highways
  - All of these lane miles have ditches

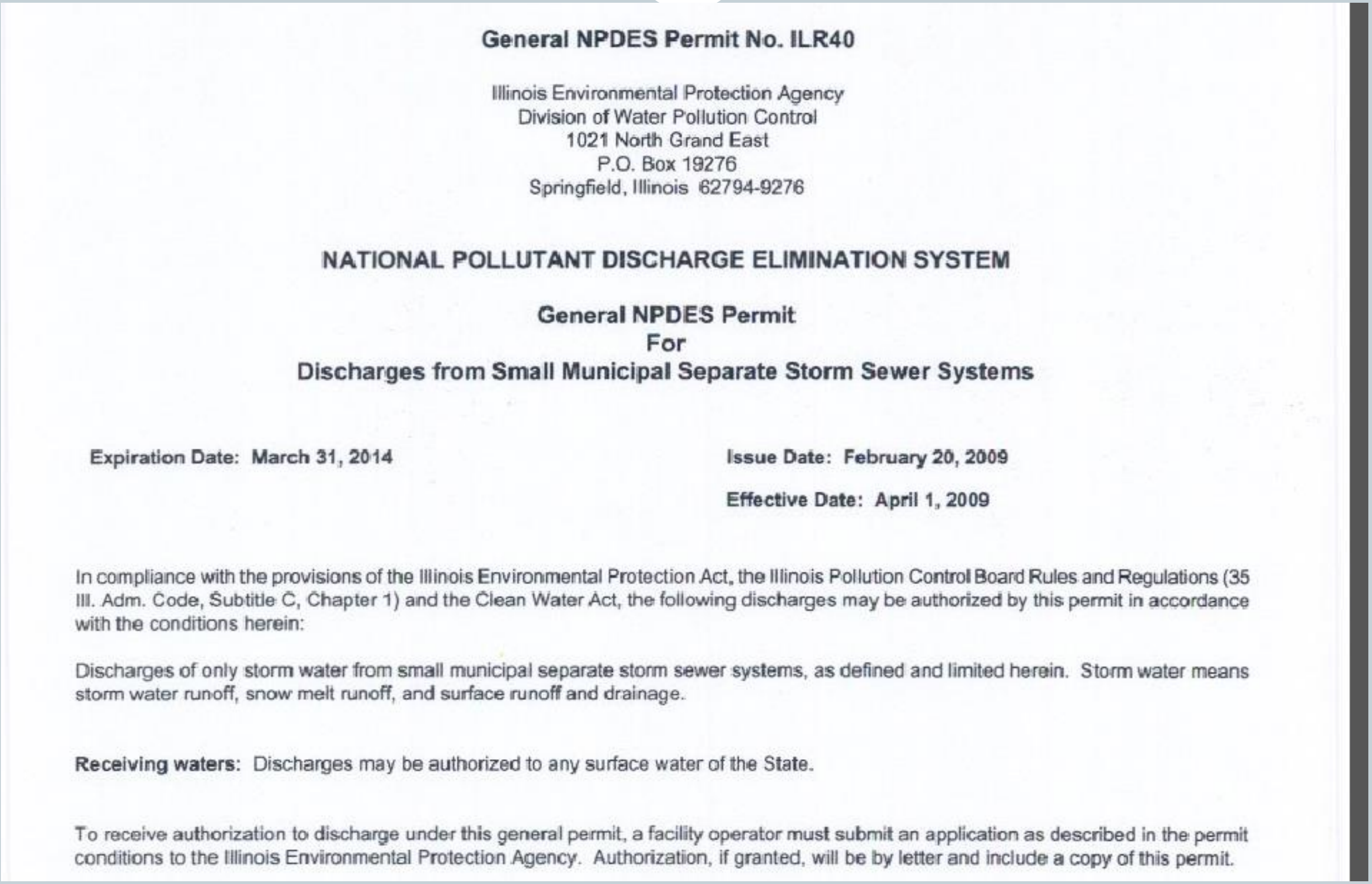
MS4 Requirements

- All MS4 are required to following 6 minimum control measures
  - Public Education and Outreach
  - Public Participation/Involvement
  - Illicit Discharge Detection and Elimination
  - Construction Site Runoff Control
  - Post-Construction Runoff Control
  - Pollution Prevention/Good Housekeeping

ILR40 permit

- The ILR40 permit described how Illinois MS4s meet NPDES requirements
- While the USEPA is the authorized agency to regulate NPDES under the Clean Water Act, the IEPA is designated by the USEPA to issue and enforce NPDES requirements in the state

ILR40 permit



General NPDES Permit No. ILR40

Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 North Grand East
P.O. Box 19276
Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

General NPDES Permit
For
Discharges from Small Municipal Separate Storm Sewer Systems

Expiration Date: March 31, 2014

Issue Date: February 20, 2009

Effective Date: April 1, 2009

In compliance with the provisions of the Illinois Environmental Protection Act, the Illinois Pollution Control Board Rules and Regulations (35 Ill. Adm. Code, Subtitle C, Chapter 1) and the Clean Water Act, the following discharges may be authorized by this permit in accordance with the conditions herein:

Discharges of only storm water from small municipal separate storm sewer systems, as defined and limited herein. Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage.

Receiving waters: Discharges may be authorized to any surface water of the State.

To receive authorization to discharge under this general permit, a facility operator must submit an application as described in the permit conditions to the Illinois Environmental Protection Agency. Authorization, if granted, will be by letter and include a copy of this permit.

State Regulation

- USEPA knows not enough is being done to control post-construction runoff and funds a workgroup at the IEPA with other stakeholders
- Illinois passes Green Infrastructure for Clean Water Act (415 ILCS 56/) in 2009
- Also in 2009 the ILR40 MS4 permit is amended
- The revised permit had more requirements including for post-construction runoff control

Green Infrastructure for Clean Water Act

- Law requires a report to the Governor's office
- Report was called Using Green Infrastructure to Manage Urban Stormwater Quality: A Review of Selected Practices and State Programs
- Report recommended Performance Standards developed by the IEPA as well as discussed what other states were doing

Workgroup

- Following year, IDOT was part of a joint workgroup with the IEPA, AISWCD, local agencies, and other stakeholders.
- The workgroup was tasked with developing a recommendation documentation for the IEPA.
- The ideal was pre-development hydrology but that was easier said than done

Workgroup

- The recommendation document discussed performance standards for post-construction BMPs.
- The document also gave a framework for implementing post-construction BMPs with agreed upon definitions, requirements, and how compliance can be monitored.


association of illinois SOIL & WATER conservation districts

AISWCD

Stormwater Performance Standard Recommendations

Prepared by:
PDSWRS Workgroup and AISWCD for submission to Illinois Environmental Protection Agency

June 30, 2013

Workgroup

- The workgroup begin outlining volume reduction strategies
- The amount of pollutants entering a waterway is proportional to the volume of runoff and this volume contributes to the erosion of waterways
- Workgroup focus on strategies for controlling volume of runoff

NPDES Permits

- Prior to finalization of the Performance Standards Recommendations document, IEPA released a modified ILR10 construction permit that required post-construction BMPs to maximum extent practicable.
- At this point, we have a requirement but not nearly as much guidance as one would have liked.
- The workgroup document was finalized June 2013 and is available on AISWCD’s website.

Challenges

- Linear project versus Area project:

1) Linear project - highways, freeways, roads, etc.

2) Area project - residential and commercial development.

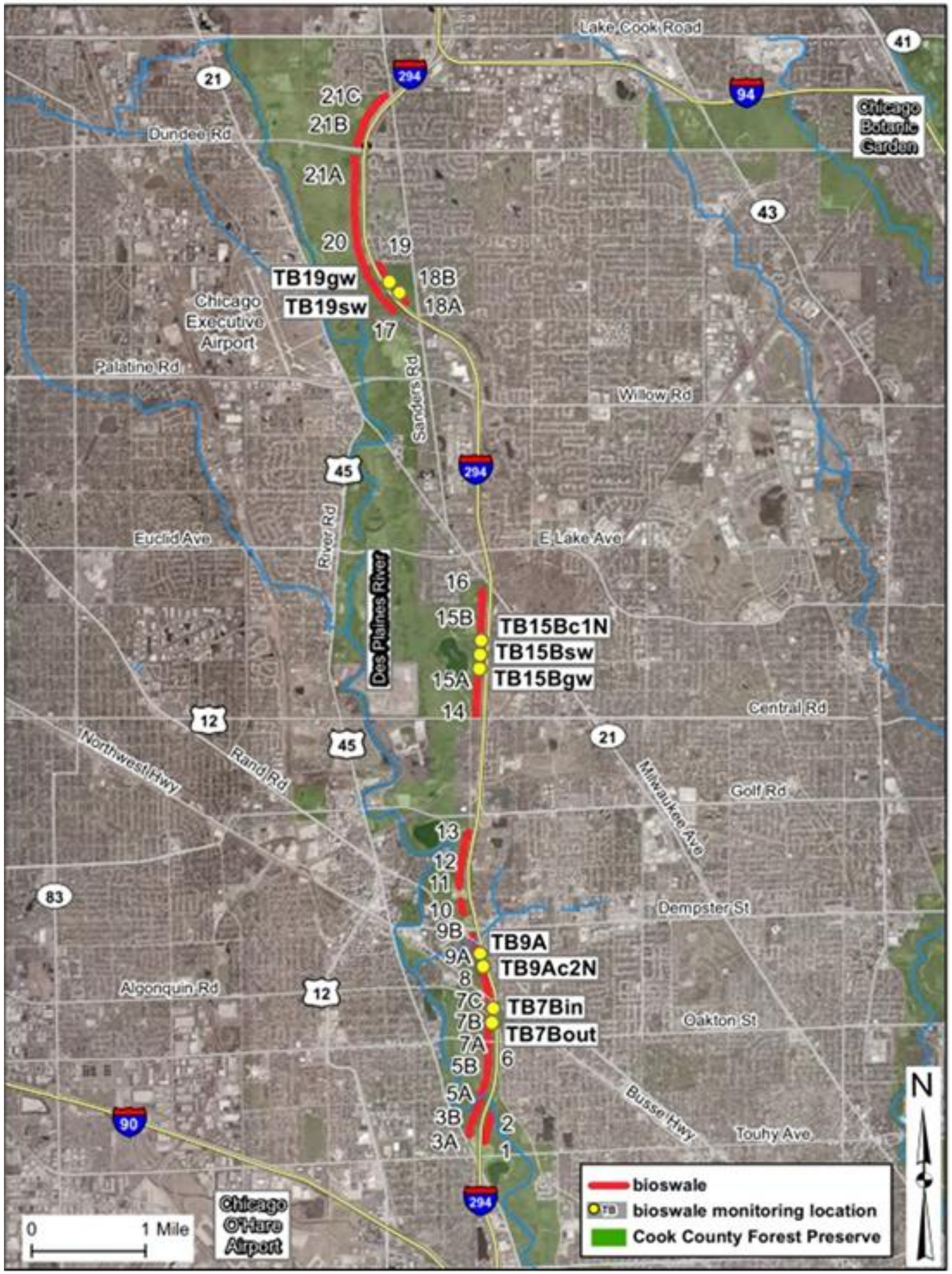
- Both can be Development (new) or Redevelopment (existing).

Challenge 1 - Drainage

- An area project typically drains to one outfall. Depending on size, a single, appropriately sized BMP may be all that is needed for post-construction runoff.
- Picture run off from a parking lot that feeds into a detention pond – something like…

Drainage

- Linear projects typically have multiple outfalls along the route.
- Multiple BMPs will most likely have to installed along entire corridor to control run off.



Lake Cook Road
Dundee Rd
Chicago Botanic Garden
Chicago Executive Airport
Palatine Rd
Willow Rd
Sanders Rd
Euclid Ave
E Lake Ave
River Rd
Des Plaines River
Central Rd
Northwest Hwy
Rand Rd
Milwaukee Ave
Golf Rd
Dempster St
Algonquin Rd
Oakton St
Busse Hwy
Touhy Ave
Chicago O'Hare Airport
21C
21B
21A
20
19
18B
18A
17
TB19gw
TB19sw
16
15B
15A
14
TB15Bc1N
TB15Bsw
TB15Bgw
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12
11
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9B
9A
8
7C
7B
7A
6
5B
5A
3B
3A
2
1
TB9A
TB9Ac2N
TB7Bin
TB7Bout
bioswale
bioswale monitoring location
Cook County Forest Preserve
0
1 Mile
N

BMP selection

- There are numerous BMPs available but it can difficult to know which is the correct one to use
- One way to start sort out BMPs is by their function
- Many are related, like a family

BMP Selection (aka the Naming Convention)

- Examples:

  - Swales (Bioswale, Vegetated, Dry)
  - Basins (Detention, Infiltration, Wetland)
  - Created Wetlands (Rain Gardens, Stormwater wetland)
  - Permeable Surface (Pavement, brick)

- And what is the difference of between all these?

BMP Selection

- the difference is design and function
  - design is typically due to space
  - function would be the goal of the BMP

Pros and Cons of BMPs

- At IDOT, discussions started about pros and cons of different BMPs for highways
- We knew some BMPs were better than others and some in the wrong place could be dangerous


EASTHAMPTON
SPEED LIMIT 40
CYPRESS KNOLL

BMP Selection

- Infiltration
  - Bioswale
  - Grassed Swales
  - Infiltration Basin
  - Infiltration Trench
  - Permeable Interlocking Concrete Pavement
  - Pervious Concrete Pavement
  - Porous Asphalt Pavement

Bioswale during rain event

BMP Selection

- Retention/Detention Basin)

Dry Detention Basin (Ponds

In-Line Storage

Stormwater (Created) Wetland

Wet Basin

Detention Basin

BMP Selection

- Filtration
  - Bioretention (Rain Gardens)
  - Catch Basin Inserts
  - Sand and Organic Filters
  - Vegetated Filter Strip

Research

- We knew we would need research to implement cost effective post-construction BMPs.
- An Illinois Center for Transportation research project was proposed to develop a cost – performance matrix using available literature and analyzing existing post-construction BMPs
- ICT Project R27-147

Research

- Subject of research is effective post-construction BMPs to infiltrate and retain stormwater
- Currently there is not a lot of information on how to select a BMPs for post-construction runoff control

Research

- SIU-E Department of Civil Engineering was selected to do the research.
- Interim Report was received June 2015.

Interim Report

- Normally-dry vegetated BMPs have considerable volume reduction capacity
  - Vegetated filter strips, vegetated swales, bioretention, and grass-lined detention basin

- Wet practices have minimal volume reduction capacity

Interim Report

BMP Category	Number of Monitoring Studies	25th Percentile	Median	75th Percentile
Biofilter_Grass Strips	16	18%	34%	54%
Biofilter_Grass Swales	13	35%	42%	65%
Bioretention (with underdrains)	7	45%	57%	74%
Detention Basins_Surface, Grass Lined	11	26%	33%	43%
Retention (Wet) Ponds_Surface	20	2%	11%	18%
Wetland Basins/Channels	11	3%	4%	5%

Relative Volume Reduction Table

Interim Report

BMP Category	On Site Volume Reduction Capacity1.	Suitability for linear projects in urban areas
Detention Basin	Low (Can be high if infiltration practice added)	Yes, if large foot print available
Retention Basin	Low	Yes, if large foot print available
Constructed Wetland Channel/Basin	Low	Yes, if large foot print available
Infiltration Basin/Trench	High	Yes
Permeable Pavement	Low (Can be high if infiltration practice included)	No
Vegetated Filter Strip	High	Yes
Bioswale	High	Yes
Bioretention (without underdrain)	No Data, but expected to be low to medium	Yes

BMP Suitability Table

Interim Report

BMP	Costs		Maintenance	Effective Life (yeas)	References
	Capital	O&M			
Manufactured Treatment Devices	Low – Moderate	Moderate – High	High; Frequent cleanouts	10 -50	FHWA, 2000 CDOT, 2004 NRML, 2002
Bioretention	Moderate	Low	Mowing/plant replacement	20 – 50	
Retention and Detention Basins	Moderate – High	Low	Moderate; annual inspection and debris removal	20 – 50	
Infiltration Basin	Moderate	Moderate	High; sediment and debris removal from the surface	5 – 10 , before deep tilling is required	
Infiltration Trench	Moderate – High	Moderate	High; sediment and debris removal from the top	10 – 15	
Filtration Structures	Moderate – High	Moderate – High	High; biannual to annual media removal	5 - 20	
Vegetated Filter Strip (VFS)	Low	Low	Low; mowing and edge debris removal, scraping to maintain sheet flow	20 - 50	

Cost – Maintenance Table

Research Findings

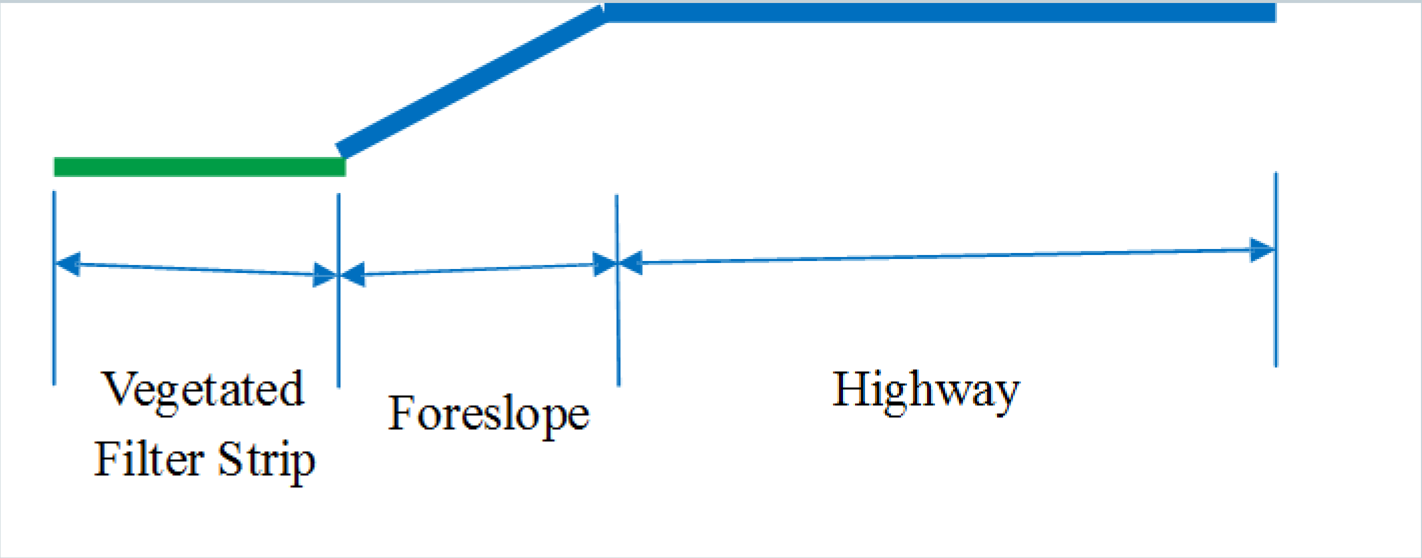
- Vegetated filters strips are highly efficient and tend to have lower costs.
- What is a vegetated filter strip?

  - improved topsoil layer that encourages soil infiltration,

  - a dense mat of sod and thatch acting as a filter, and

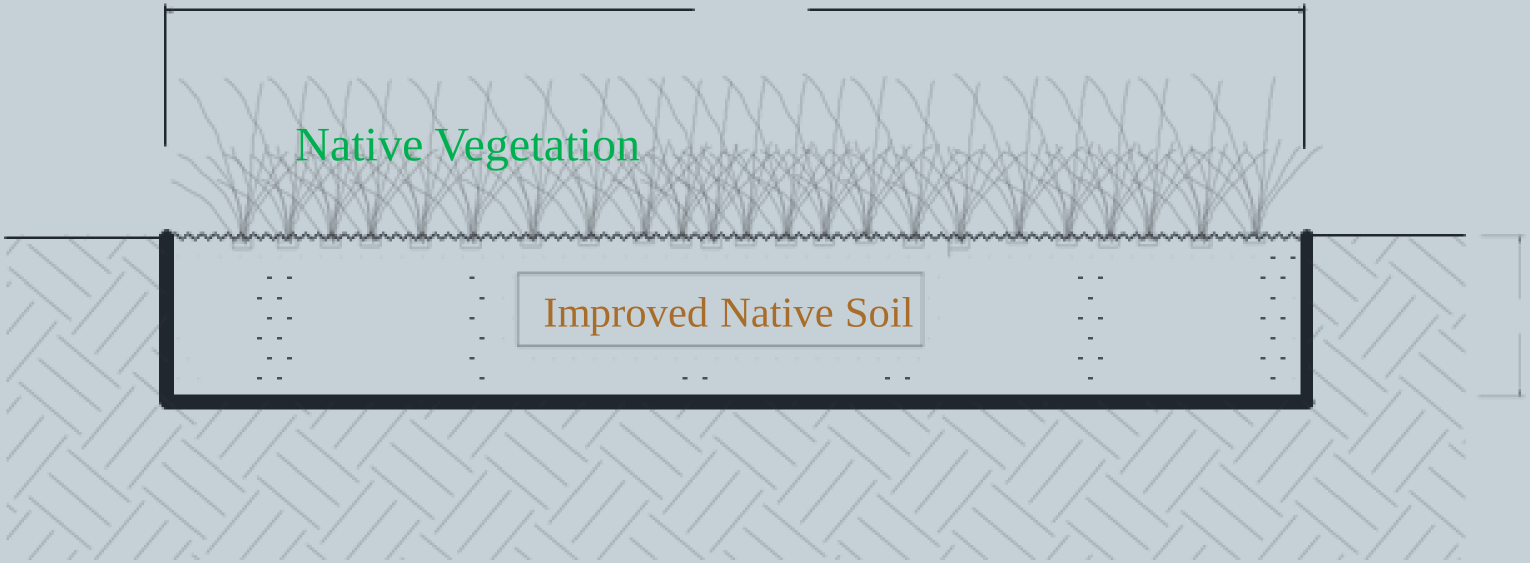
  - a vigorous stand of vegetation to resist erosion

Interim Report



Vegetated Filter Strip
Cross Section

Interim Report



Cross section of a vegetated filter strip

Example - Infiltration Trench Construction Cost

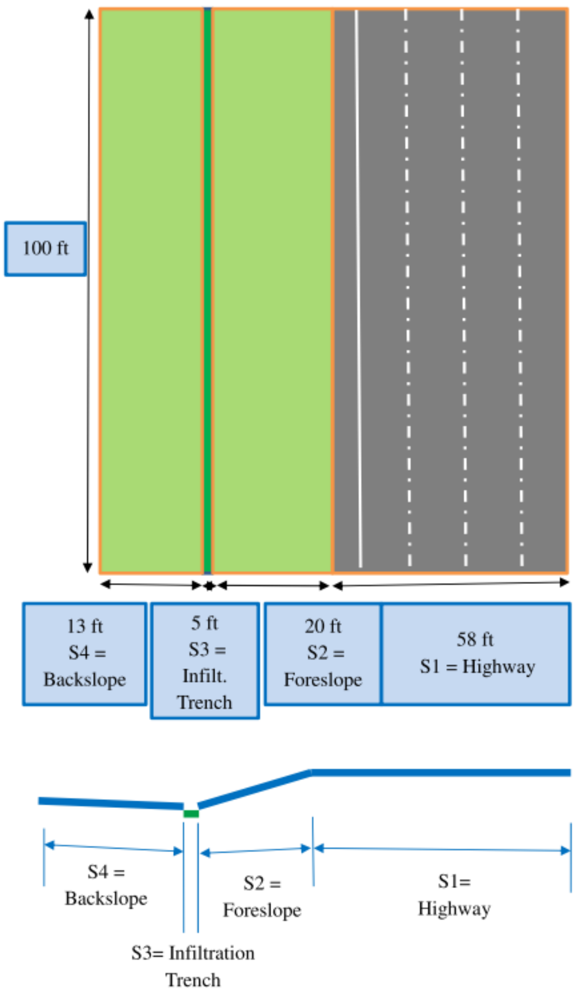


Figure 45 Infiltration trench draining an idealized catchment

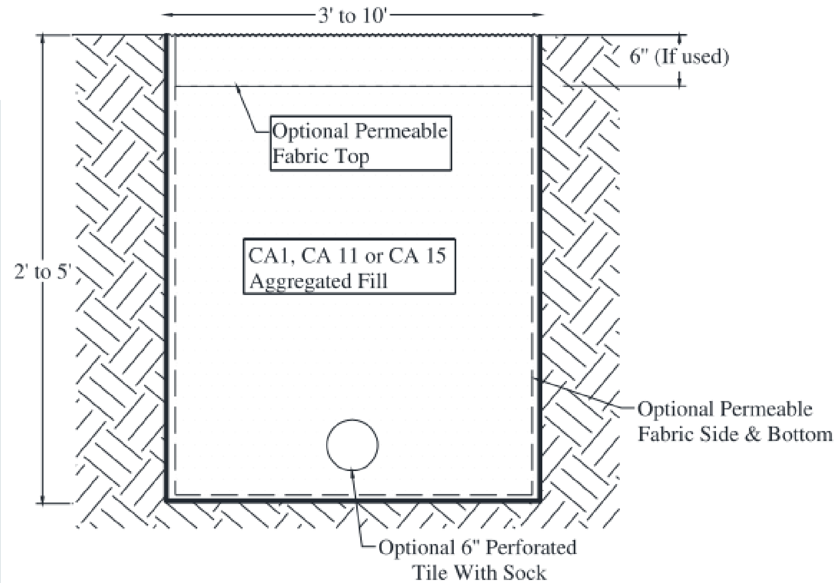


Figure 46 Cross sectional area of an infiltration trench

- **Excavation & Hauling,**
- **Aggregate,**
- **Placement,**
- **Fabric,**
- **Drain pipe,**
- **Grading,**
- **Supervision**

Example - Infiltration Trench Construction Cost

Table 37 Infiltration trench cost for different widths and depths

Width (feet)	Infiltration Depth (feet)	$ Per Lineal Foot
4	2	$25.74
4	3	$32.42
4	4	$39.10
6	2	$34.04
6	3	$43.91
6	4	$53.78
8	2	$42.34
8	3	$55.40
8	4	$68.46
10	2	$50.64
10	3	$66.89
10	4	$83.14

Example – Infiltration Trench Maintenance Cost

- Cause: Accumulated dead vegetation, trash, surface sediment
- Maintenance: cleanup, debris removal, replacement of surface aggregates
- Provided
  - Cleanup costs
  - Aggregate replacement costs for various trench widths

Example - Infiltration Trench Expected Life

Table 38 Infiltration trench time to failure due to void loss

Trench Width	Trench Depth (feet)	Back Slope Width (feet)	Foreslope Width (feet)	Pavement Width (feet)	RUSLE - T (tons per acre)	Years to 40% Void Capacity Loss
4	3	14	20	58	0.5	100
4	3	14	20	58	1.0	50
4	3	14	20	58	10.0	5
6	3	12	20	58	0.5	153
6	3	12	20	58	1.0	77
6	3	12	20	58	10.0	8
8	3	10	20	58	0.5	209
8	3	10	20	58	1.0	105
8	3	10	20	58	10.0	10
10	3	8	20	58	0.5	267
10	3	8	20	58	1.0	134
10	3	8	20	58	10.0	13
Failure occurs when accumulated sediment = 40% of original storage volume						

Takeaway Points

- BMPs have to be sized correctly in order to be effective
- An escape route should be built into the BMP to prevent failure if a high volume rain storm occurs
- Agencies should use a menu approach to picking BMPs so cost and design can be considered


THANK
YOU