Carroll County Maryland's Regional Stormwater Management Strategy

CWEA

June 8th, 2016

Martin B. Covington, III, PE

NPDES & TMDL Compliance

Modified, Enhanced, and Enlarged Sand Filters

As of 2016
25 Carroll County Modified Sand Filters

FACILITY	DRAINAGE AREA	IMPERVIOUS AREA	INCHES OF TREATMENT	TN REDUCTION (LBS/YEAR)	TP REDUCTION (LBS/YEAR)	TSS REDUCTION (TONS/YEAR)
Marriott Wood I Facility #1	3.00	0.56		11.52	1.04	0.28
Hickory Ridge	23.75	4.80	3.80	116.80	10.73	2.92
Bateman SWM Pond	47.25	7.40	6.80	228.31	19.56	5.14
Marriott Wood I Facility #2	7.12	2.04	4.63	36.15	3.72	1.07
Marriott Wood II	11.62	1.92	6.19	56.34	4.89	1.30
Elderwood Village	15.28	4.94	2.22	76.77	8.32	2.38
Collins Estate	32.68	6.36	2.99	160.26	14.56	3.94
Oklahoma II Foothills	23.72	6.06	2.36	102.04	9.99	2.81
Oklahoma Phase I	24.44	7.27	3.99	124.60	12.98	3.74
Edgewood	38.00	12.12	2.70	195.27	20.86	6.07
Upper Patapsco Phase I -Naganna Pond	24.50	10.00	2.70	130.03	15.27	4.60
High Point	9.40	1.82	2.58	46.08	4.18	1.13
Westminster High School	115.00	42.12	3.38	601.25	67.66	20.09
Brimfield	34.69	17.23	4.12	189.93	24.18	7.48
Upper Patapsco Phase II -Hoff Pond	77.30	2.98	52.57	356.27	24.42	5.54
Heritage Heights	21.40	4.10	6.96	104.82	9.48	2.56
Clipper Hills - Gardenia	33.19	11.08	3.13	171.49	18.49	5.46
Clipper Hills - Hilltop	43.82	13.40	3.47	224.09	23.40	6.82
Wilda Drive	6.75	1.60		26.43	2.56	0.70
Diamond Hills Section 5	51.80	16.26	2.16	259.37	27.37	7.91
Carrolltowne 2A Gemini Drive	87.73	34.43	2.56	463.02	53.12	16.05
Benjamin's Claim	47.10	15.78	2.31	237.67	26.09	7.58
Eldersburg Estates 3-5	34.90	8.16		136.50	13.15	3.61
Benjamin's Claim Basin B	1.33	0.55		5.56	0.66	0.20
Braddock Manor West	49.30	7.65		187.07	16.04	4.15
Totals	865.00	240.00		4248.00	433.00	124.00

History
Began in 2000

Modified Sand Filters
(or the Herring/Frock Method)

* Myron Frock (who had worked with S.C.S. for many years) pointed out that grassed waterways used in agriculture to prevent soil erosion in fields also proved remarkably effective at filtering the water, particularly when underlain with drain "tile."
* The typical agricultural waterway consists of a perforated HDPE pipe surrounded by 4-inches to 6-inches of stone and overlain by sod.

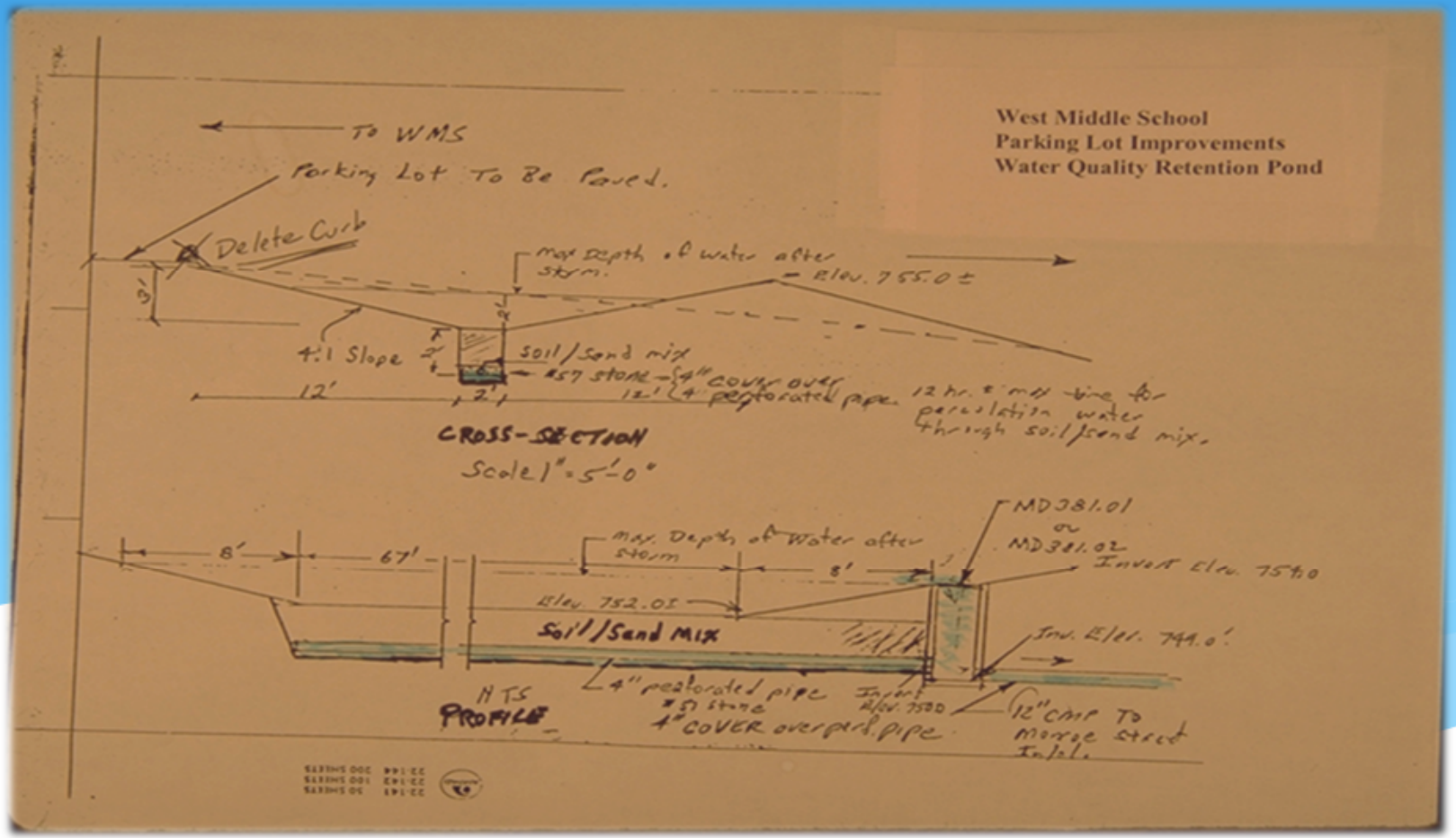
Modified Sand Filters
(or the Herring/Frock Method)

To modify the agricultural waterway for stormwater treatment we:

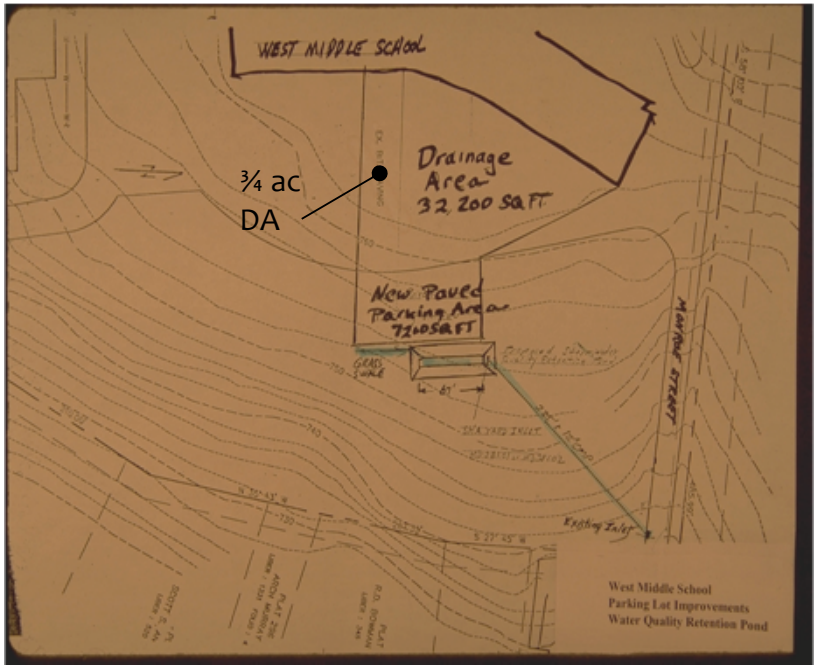
- added 2 feet of stone below the underdrain
  - This creates an underground reservoir of water that will infiltrate if the soil conditions permit.
- Mixed 2 parts construction sand to one part native soil above the underdrain.
  - This creates a man-made sandy loam conducive to infiltration.

First Facilities

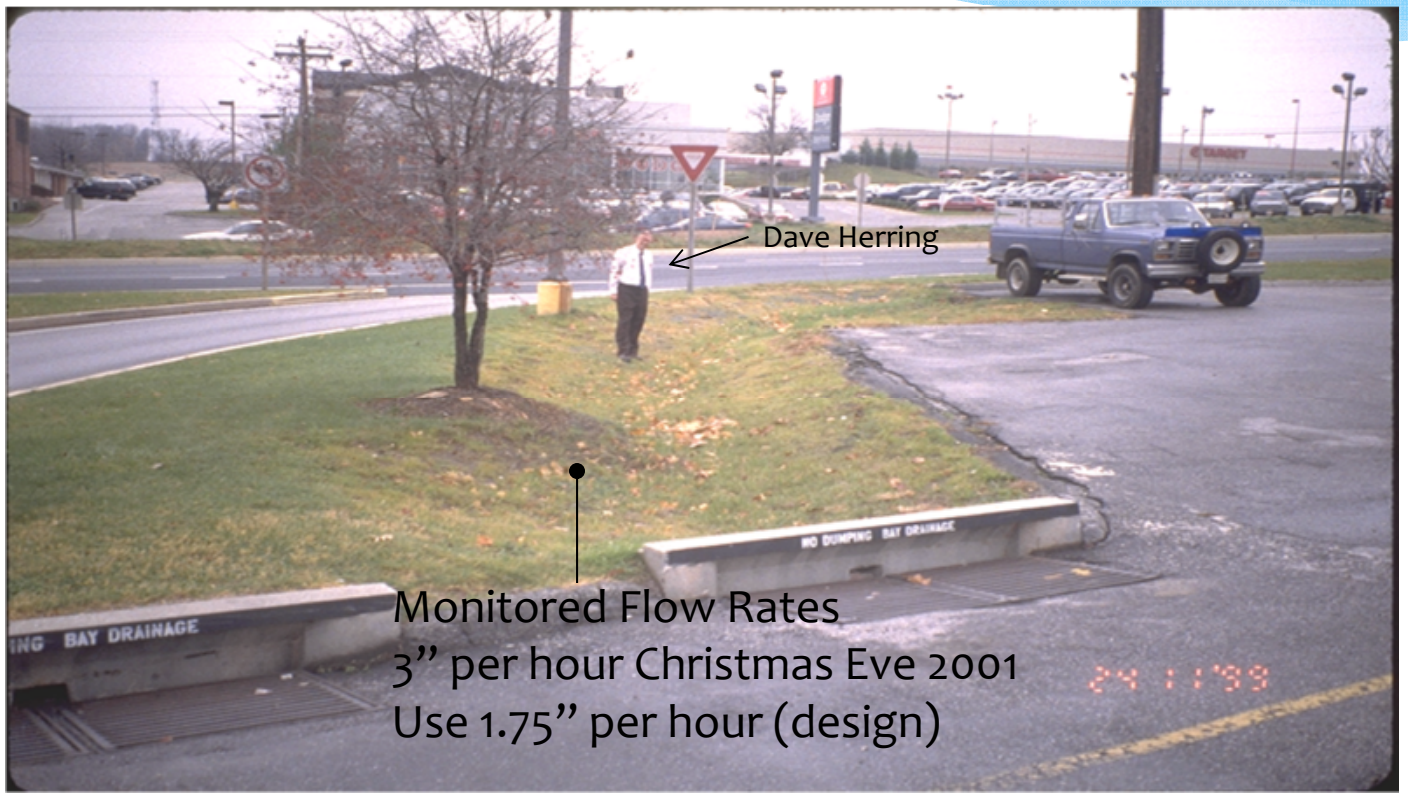
West Middle School
(Dave Herring)



West Middle School



Friendly's Retrofit



Laboratory Results - Davis

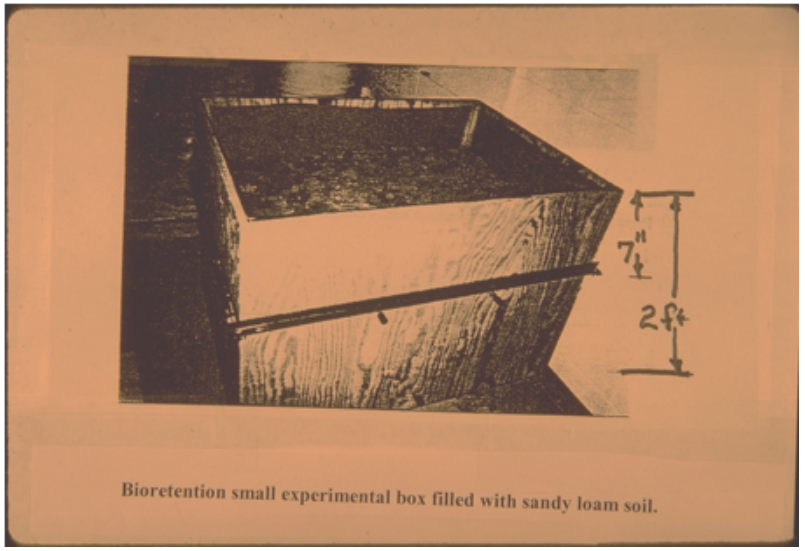
During each experiment:

* Between 75 and 86% of copper in runoff was absorbed by soil
* Between 82 and 91% of lead in runoff was absorbed by soil
* Between 58 and 82% of zinc in runoff was absorbed by soil

Making the appropriate substitutions and unit conversions, it can be shown:

* That a 2-foot deep sand/soil mixture can filter 1-foot of runoff 5,250 times
* If it rains once every 3 days on average, this system will function for 40 years
* Decided to use 18” layer for design

Lab Test
Dr. Davis UMD 1998

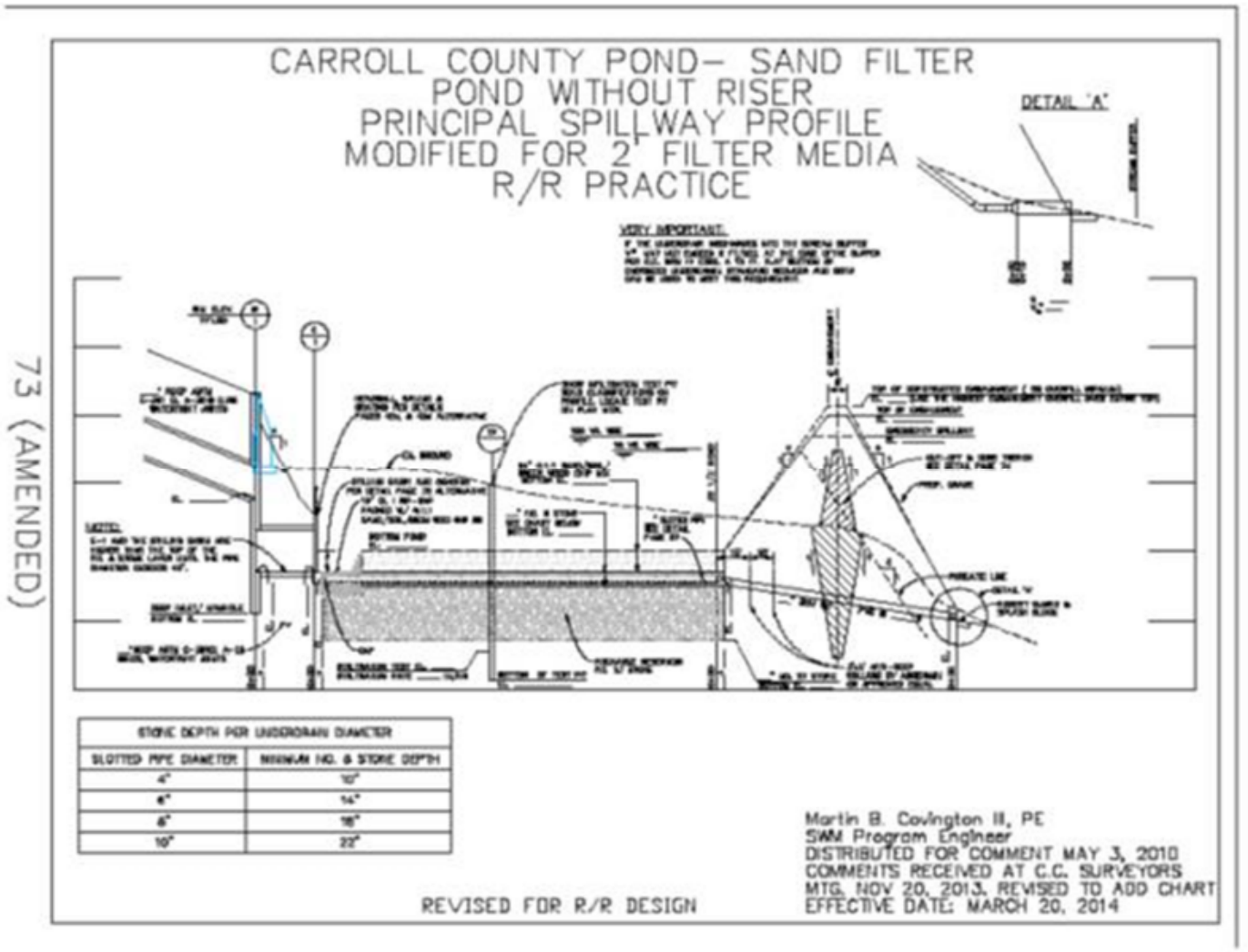


Bioretention small experimental box filled with sandy loam soil.

Current Design 2016

Unique Characteristics:

1. No Riser- all design flows through sand control
2. Drop Structures and Level Pipes – No rip-rap inflows and Forebays in facility
3. Total Capture of 2 year storm, difference in 10 year runoff volume
4. Sand layer across entire bottom of facility
5. No limit on drainage area size
6. Q_{10} captured and conveyed to pond



Westminster High School Pond Retrofit

Information

DA - 115 acres IA - 42 acres

Volume to Spillway 3.4”/IA

	ST Practice	RR Practice
TN	601 lbs/year	781 tons/year
TP	67 lbs/year	80 tons/year
TSS	20 tons/year	21.5 tons/year

Constructed in 2013

Cost $1,100,00

$26,000/IA

Hydrologic Results

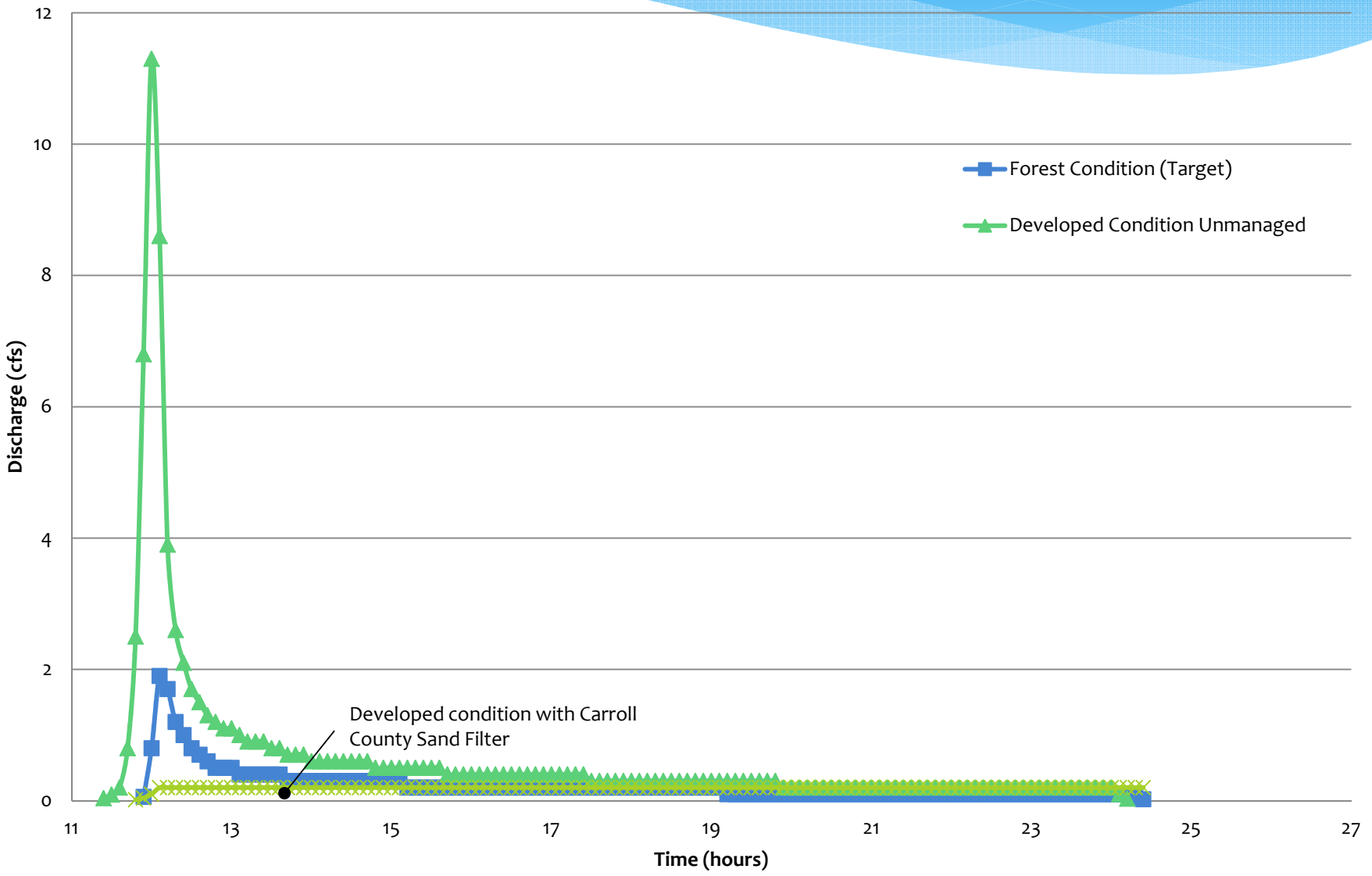
Bankful "Channel Shaping" Flow

(Wolman & Leopold, 1957)

* 1.07 to 2.7 years (agricultural watersheds)
* (USGS, 554) reduced to 0.7 years with 20% impervious

Figure 5

2 Year Storm Runoff - 10 Acre - B Soil
Forest vs 30% Impervious (Developed) Unmanaged & Managed



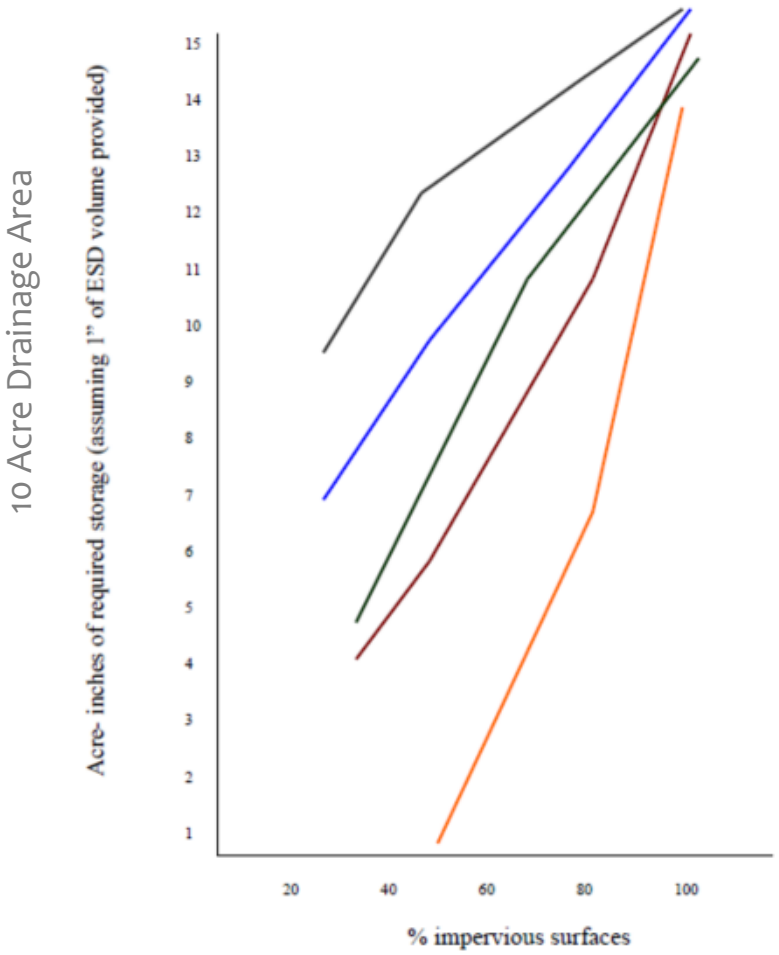
Regional Facilities in the Age of ESD Volume Based Design

Sizing

The Carroll County ESD short cut method may be used:

a. Multiply 2.5" by all **impervious surface** in the drainage area to the structural practice or the difference in 10 year direct runoff if downstream impacts are a concern
b. Subtract all ESD volumes provided in the drainage area
c. Provide the rest of the volume in a structural BMP

Sizing Structural BMPs when Full ESD Cannot be Provided:



Chapter 5 MDE Reduced RCN Method for Entire Drainage Area (1" ESD Volume Provided)

- A Soil
- B Soil
- C Soil
- D Soil

Carroll County Short Cut Method

- P= 2.5" over Impervious Surfaces Only

  Minus the 1" of ESD Volume

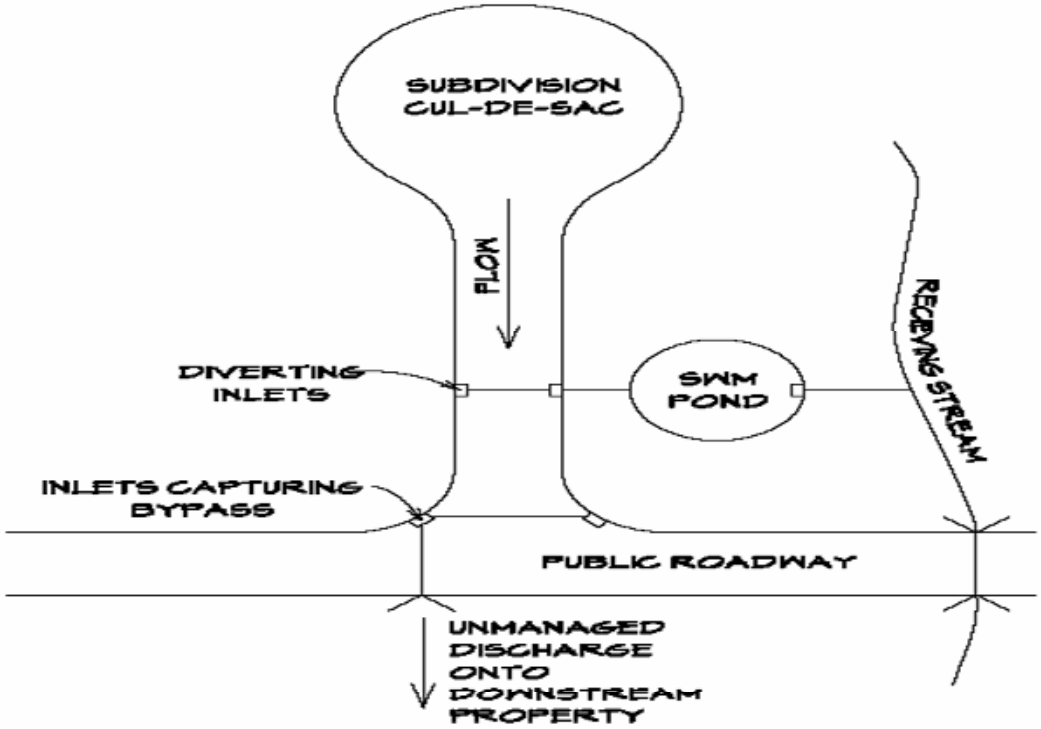
Note: No storage required for A soils with Reduced RCN's less than 42.

September 23, 2010
M.B. Covington, III, P.E.
Carroll County Stormwater Management Engineer

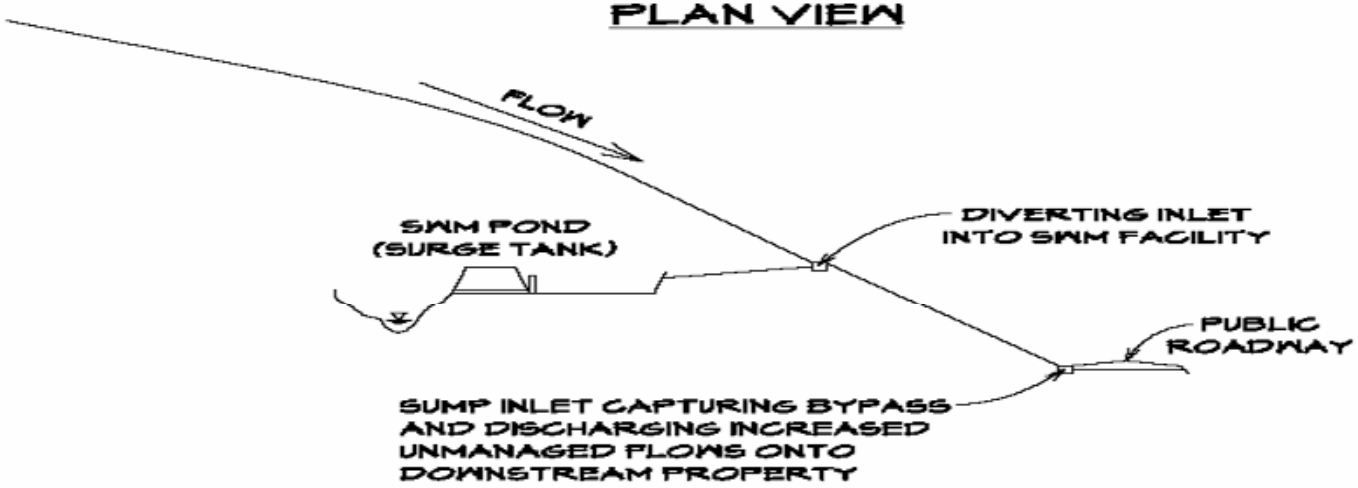
Stormwater Management
vs
Stormwater Drain Design Standards

Why Do Downstream Properties Continue to be Flooded?

If the storm drain system is unable to completely capture the stormwater management design flow, the peak flows will not be managed no matter how the stormwater management ponds are designed and constructed.



PLAN VIEW



PROFILE VIEW

FIGURE 2: SCHEMATIC
NTS

Quote of the Day

“Engineers have always designed storm drains this way. If you tell anyone about this you’ll never work in Consulting Engineering again”… 2005

All jurisdictions in Maryland and throughout most of the nation mandate the use of the Natural Resource Conservation Service (SCS), TR-55 "Urban Hydrology for Small Watersheds".

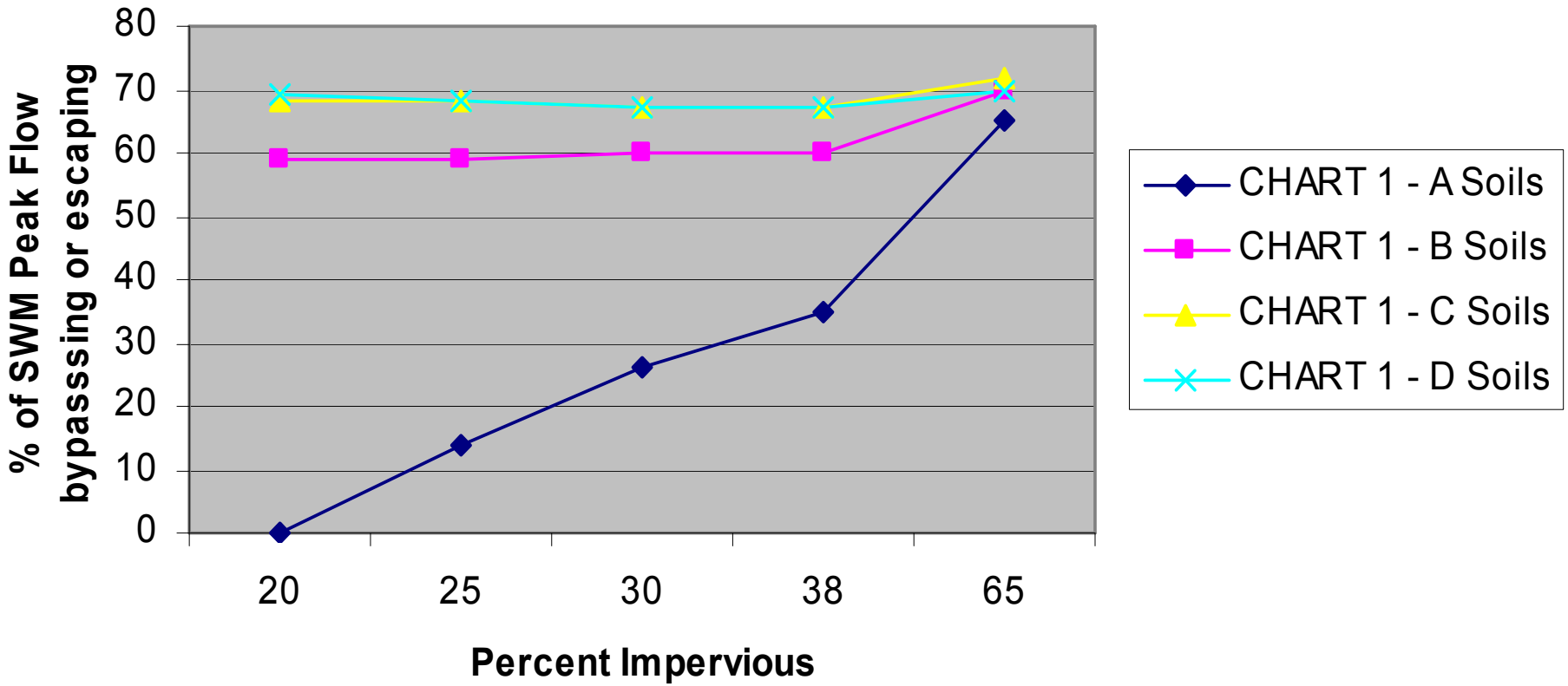
Maryland's criteria, which are typical of many State Highway Administrations, require that "All storm drain systems shall be designed using the Rational Method".

And that:

* 2-year Inlet Design shall be used
* Inlets on grade shall be spaced to pick up at least 85% of the total gutter flow.

If water can not go into the inlets how can it reach the pond?

10 Year SCS vs 2 Year Rational



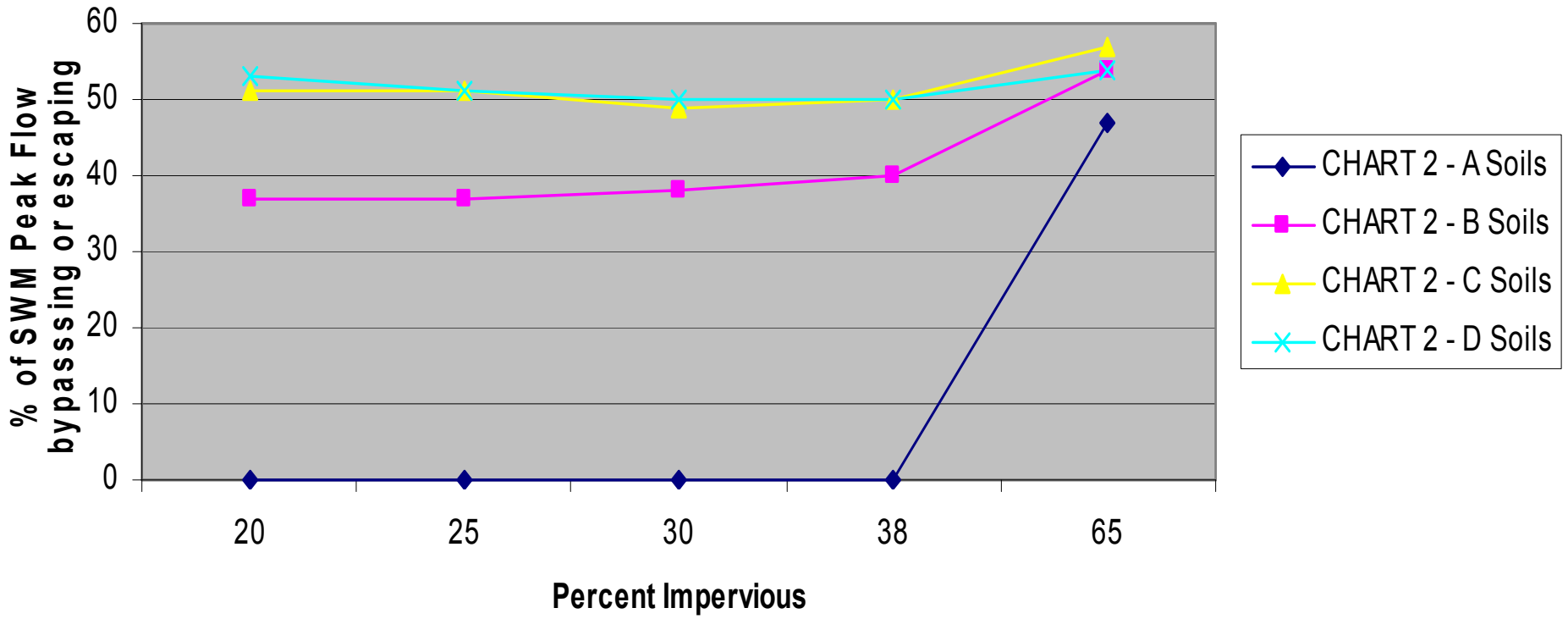
Does This Really Happen?


Intercepted Flow
Bypass Flow
'98 1 3

Stormwater Management Pond Only ¼ Full (SWM not a problem)

Downstream Property Flooded

10 Year SCS vs 10 Year Rational



Recommendations

SHA and DPW criteria should be revised to require 150% capture of the Rational Method 10 year storm runoff capturing all bypass flows from upstream inlets at all drainage area divides.

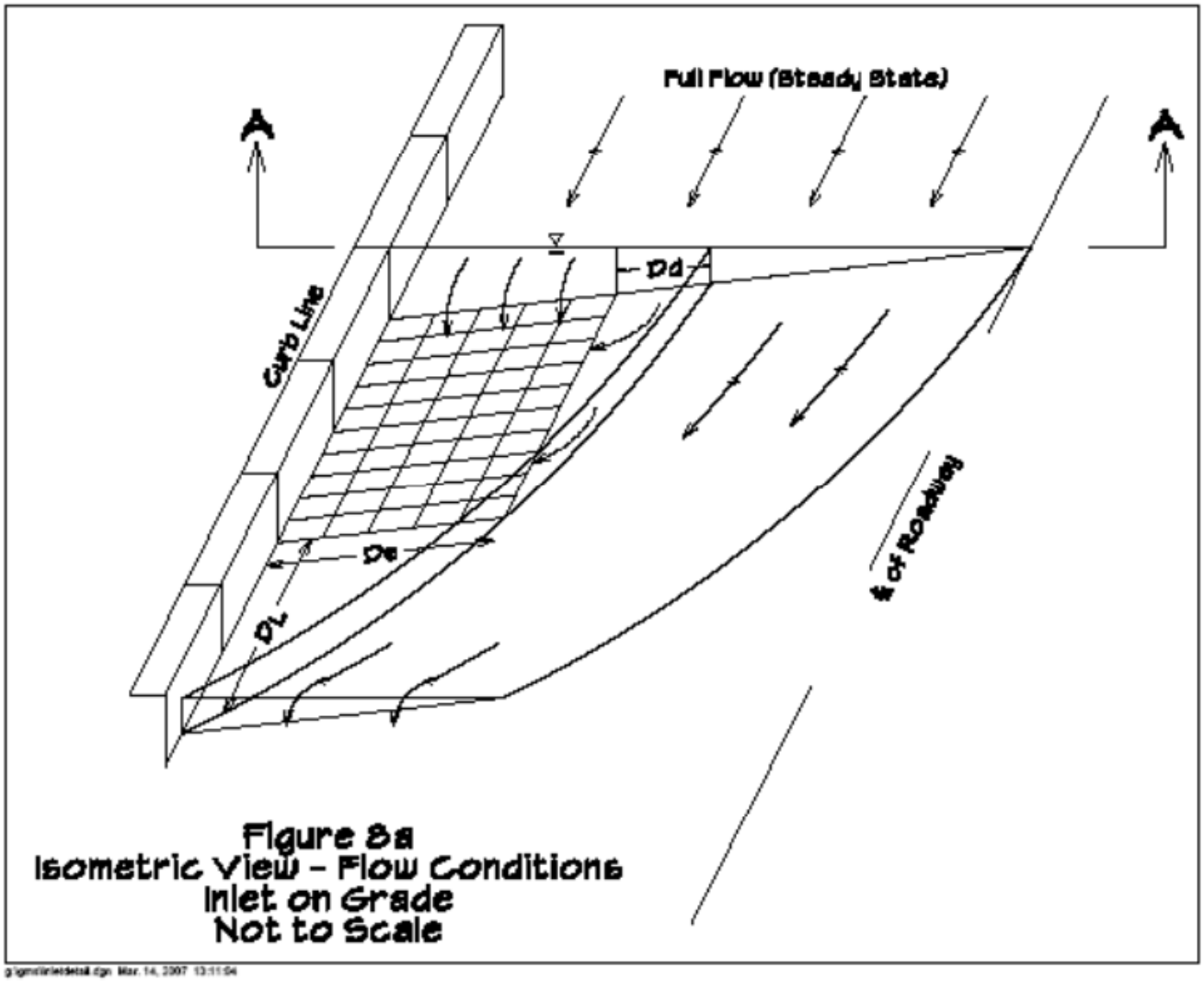


Figure 8a
Isometric View - Flow Conditions
Inlet on Grade
Not to Scale

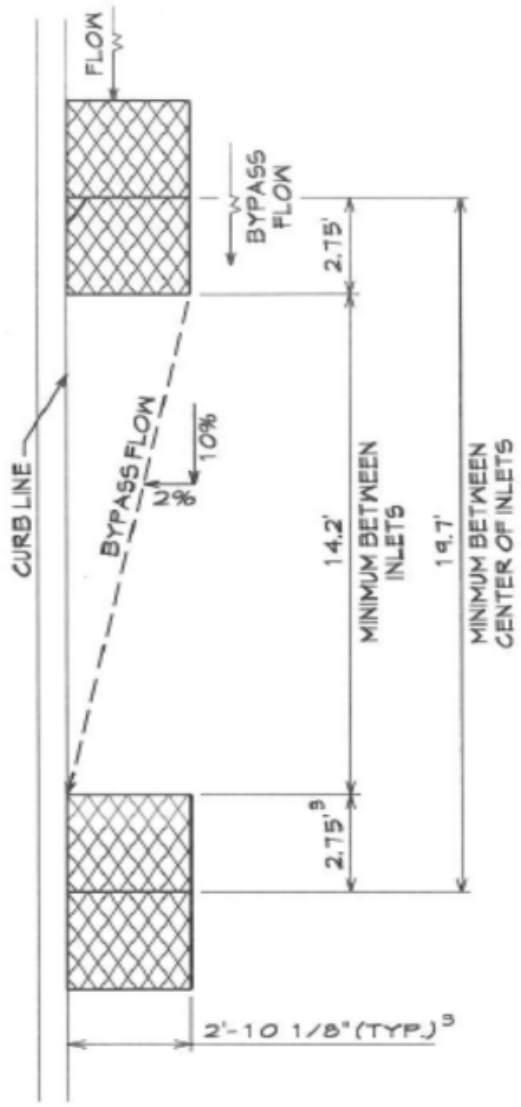
g:\gmc\inletdetail.dgn Mar. 14, 2007 13:11:04

Inlet Capacity

* Everyone knows how to design inlets!
* They've been studied forever.

* Not True!
* They were studied a long time ago.
* Conditions have Changed!!

SPACING HYDRAULICALLY INDEPENDENT INLETS ON GRADE



CRITERIA

1. 10% MAXIMUM ROADWAY GRADE PER § 2.6.1 1, C.C. DESIGN MANUAL ROADS & STORM DRAINS
2. 2% MINIMUM CROSS SLOPE PER PLATES 15-27, C.C. DESIGN MANUAL ROADS & STORM DRAINS
3. PLATE 71, C.C. DESIGN MANUAL ROADS & STORM DRAINS

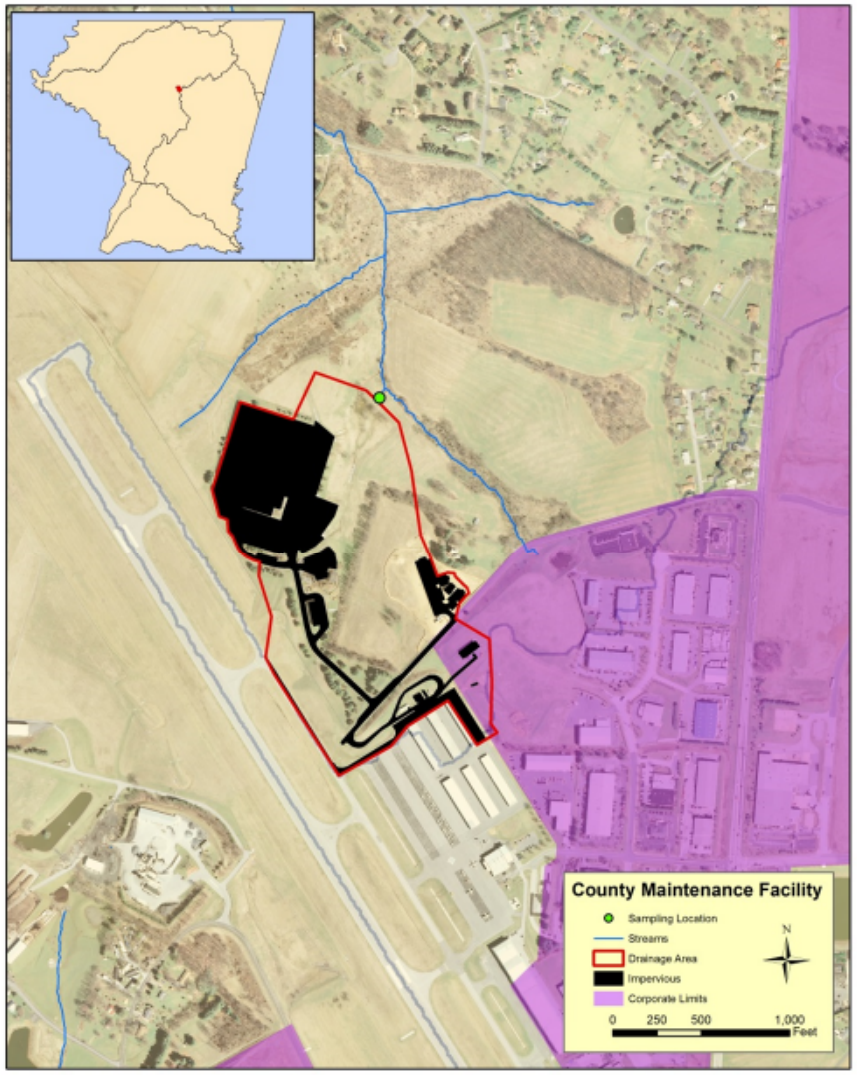
POLICY

TO BE CONSIDERED HYDRAULICALLY INDEPENDENT INLETS ON GRADE MUST BE AT LEAST 20 FEET APART CENTER TO CENTER.

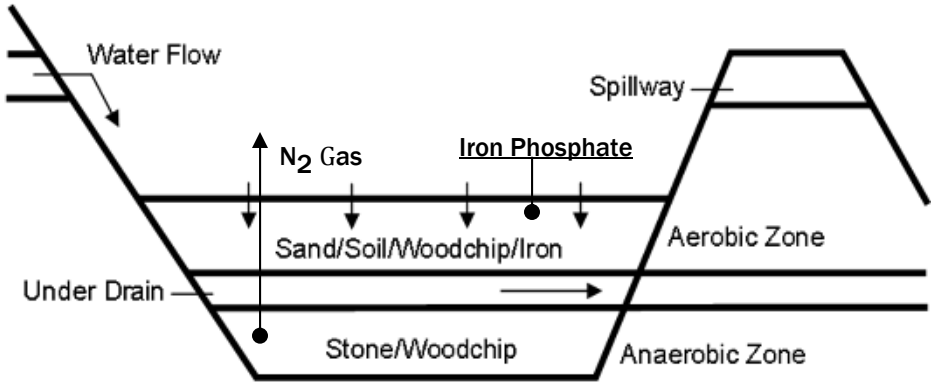
MARTIN B. COVINGTON III, P.E.
SWM PROGRAM ENGINEER
C.C. GOVERNMENT

DISTRIBUTED AT THE C.C. SURVEYORS MEETING AUGUST 16, 2006

Future Design Improvements
Carroll County Maintenance Facility



- Double Pipe Creek Watershed
- Partnership
  - Center for Watershed Protection
  - Carroll County Government
- Standard vs. Enhanced sand filter
  - MDE Alternative/Innovative Technology Review
- Construction scheduled April, 2016



Questions?

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Details at:

http://ccgovernment.carr.org/ccg/resmgmt/doc/Forms/swm.supplement.pdf?x=1464697527476