MIDS Credits: Dry Swales

MIDS Work Group Meeting

June 15, 2012

Outline

- Review:
  - Modeling Process
  - Calculator
  - Draft Drawing

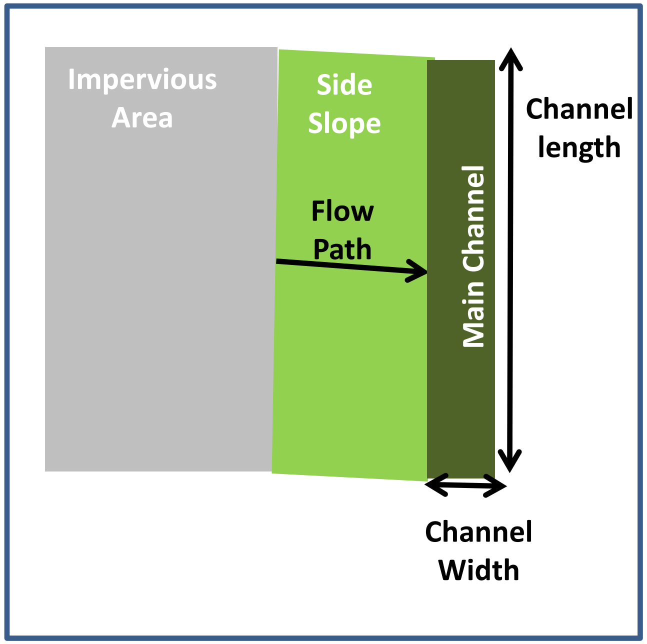
- Next Steps

Modeling Process to Quantify Volume Reduction

- Break swales into components
  - side slope
  - main channel
  - bioretention base
  - check dams
  - underdrain
- Make each component additive for volume reductions

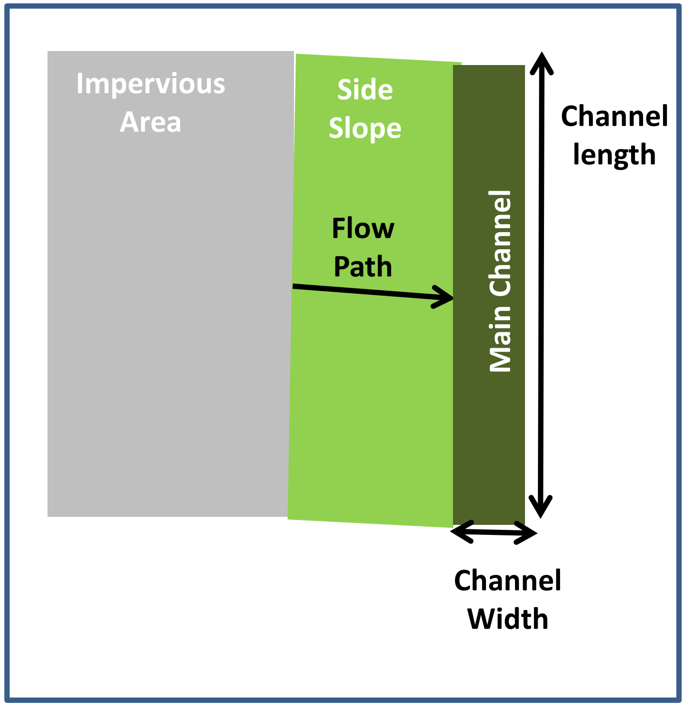
Modeling Process
Side Slopes of Grass Channel

- Use P8
- Run 58 years of Twin Cities precipitation and 1.1 inch event storm
- Modeled as a very wide grass swale
- Parameters (384 model runs)
  - Slope (Side Slope): 3H:1V, 4H:1V, 5H:1V
  - Flow path length: 10, 20, 30, 50 ft
  - Infiltration rate: 0.2, 0.6, 1.0, 1.6 in/hr
  - Impervious area/side slope area: 1, 3, 7
  - Manning's n: 0.25 (short grass), 0.35 (high grass)



Modeling Process
Main Channel of Grass Channel

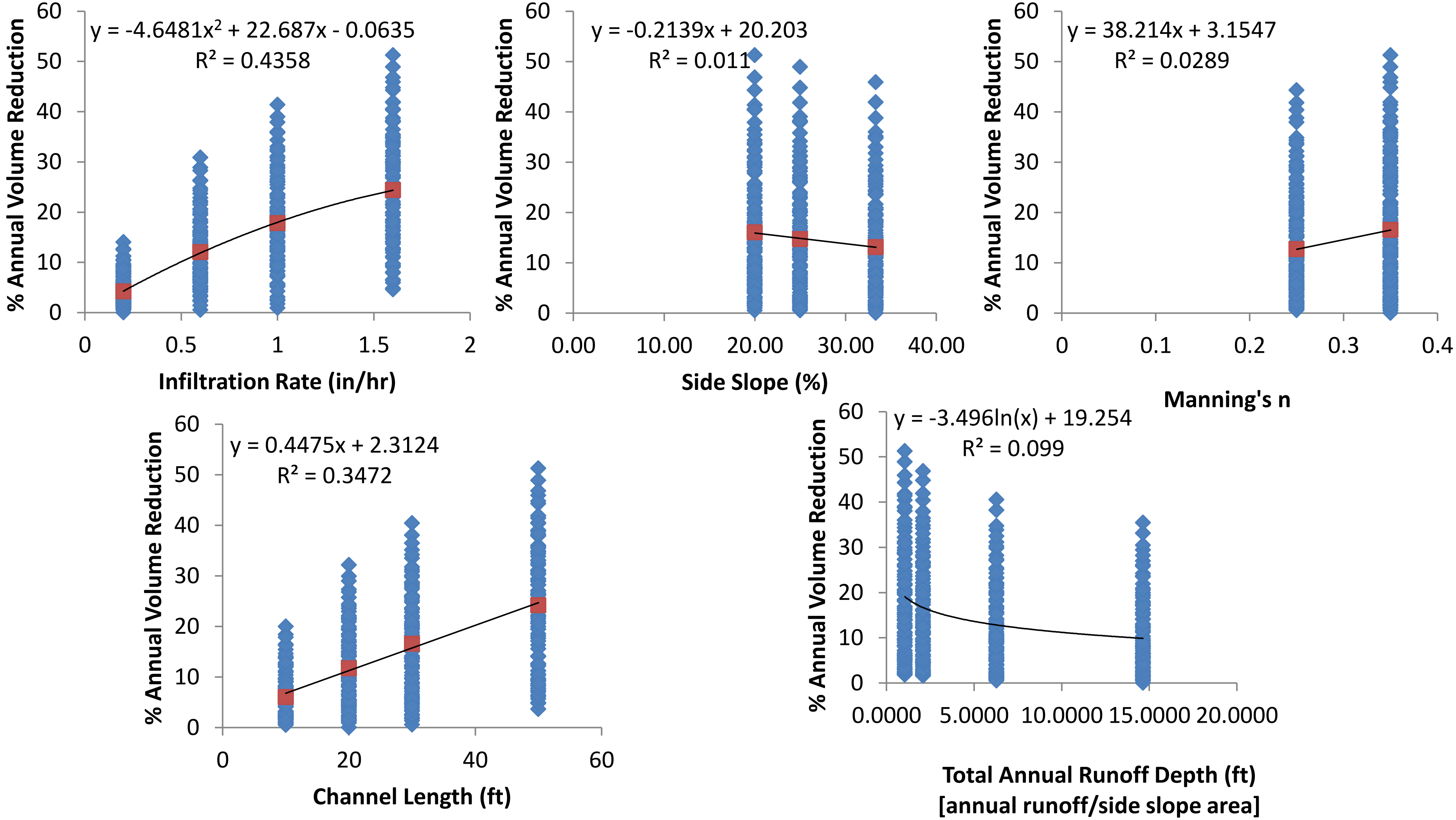
- Use P8
- Run 58 years of Twin Cities precipitation and 1.1 inch event storm
- Parameters (total of 432 model runs)
  - Channel slope: 1%, 2%, 3%, 4%
  - Infiltration rate: 0.2, 0.6, 1.0, 1.6 in/hr
  - Impervious Area/Channel Area: 5, 20, 40
  - Manning's n: 0.25 (short grass), 0.35 (high grass)
  - Bottom Width: 4, 8 ft
  - Channel Length: 150, 300, 700 ft



Modeling Process Procedure

- Run model simulations
- Develop relationship between volume reduction and design parameters using multivariate regression analysis
- Use relationship to calculate volume reduction percentage in calculator
- Combine runoff reductions from side slope and main channel

Modeling Process Results
Side Slope Annual Volume Reduction by Parameter



Calculator Overview

(yellow)	Parameters to be entered
(green)	Parameters calculated

Total Volume Reduction

Total Annual Volume Reduction	74%
Total Event Volume Reduction (1.1 inch 15 minute duration storm)	14%

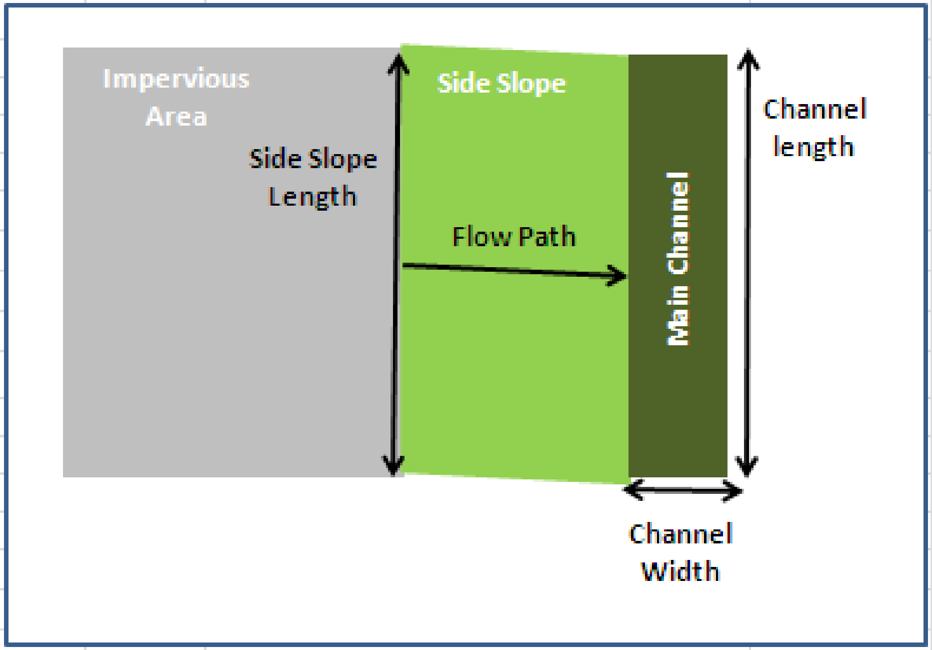
Impervious Area	1	acres
Annual	31	inches
Event	1.1	inches

Side Slope Parameters

Slope (%)	33
Infiltration Rate (in/hr)	0.8
Manning's n	0.35
Flow Path (ft)	10
Side Slope Length(ft)	1320
Annual Volume Reduction	5%
Event Volume Reduction	3%

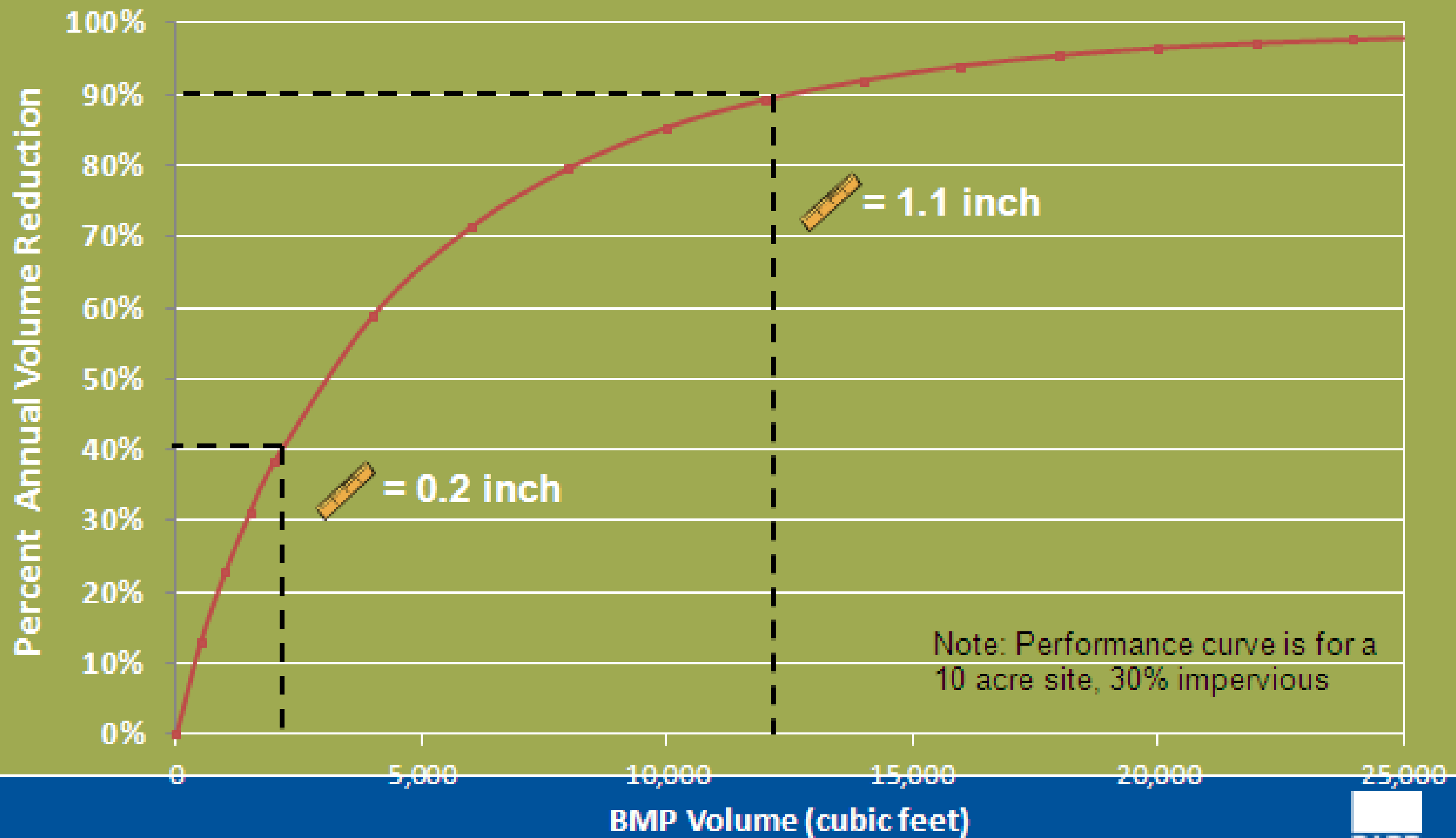
Main Channel Base Parameters

Channel Length (ft)	1320
Channel Width (ft)	5
Slope (%)	1
Infiltration Rate (in/hr)	0.8
Manning's n	0.35
Annual Volume Reduction	72%
Event Volume Reduction	11%



Calculator | Side Slope Models | Base Channel Models

Use Bioretention Performance Curves to Quantify Compliance with 1.1-inch Rule



These values are within the range reported in literature (0-98% reduction) but are different than LRRB values.

Volume Reduction Summary

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Reference	Grass Channel	Dry Swale
Virginia Design specifications (Grass Channels)	**10% - HSG Soils C and D** **20% - HSG Soils A and B** **30% - with Compost Amended Soils**	
Virginia Design specifications (Dry Swales)		**4[illegible]% - [illegible]evel Design 1** **60[illegible] - [illegible]ev[illegible]l De[illegible]ign 2**
Weiss, Gulliver and Erickson (2010).	**50%** (Barrett 2[illegible], semiar[illegible] regions) **30%** (Ru[illegible] 200[illegible] FL)	
CSN (2009) Virginia Calculator	**0%** (Schueler 1[illegible], VA) **40%** (Strecker et a[illegible] 004, USA) **0%** (UNHSC 200[illegible]) **[illegible]%** (Liptan and Murase 2000, OR)	**98%** (Horner et al. 2003, WA) **46 to 54%** (Stagge 2006, MD) **90%?** (Barrett et al, 1998, TX)
Rossman (2009) SWMM model (K_{sat} 1.0 in/hr, slope 1.3%, I inch precip)	**11%**	
International Stormwater Database (2011)	**[illegible]8%** = Average (13 studies, 84 events) **41%, 85%** (Yu et al. 1993, VA) **19%, 27%, 35%, 42%, 65%** (City of Portland 1999, OR) **60%** (Wa State 1999, WA) **27%, 41%, 46% 65%, 76%** (CA DOT, 2002)	

0-98%

Some Differences Between LRRB Method and MIDS Method

	U of MN/LRRB	Barr/MIDS
Infiltration Modeling Process	Green Ampt method	Constant infiltration rate
Infiltration Rate	Initially faster infiltration rate (some cells in grid >39 in/hr) and mean final rates of 1.3-0.4 in/hr, depending on measured rate at cells	Rates in MN Stormwater Manual: 1.63 - <0.2 in/hr, depending on soil
Precipitation	Various rainfall intensities, including a 1-inch 24-hour event	58 continuous years of real storms at 1-hour time increments
	Unclear if intense events were analyzed	1.1 inches in 15 minutes (~10 year event) and 1.1 inches in 30 minutes (~2 year event)
Real Life Volume Reduction Monitoring	None	None

Drawing

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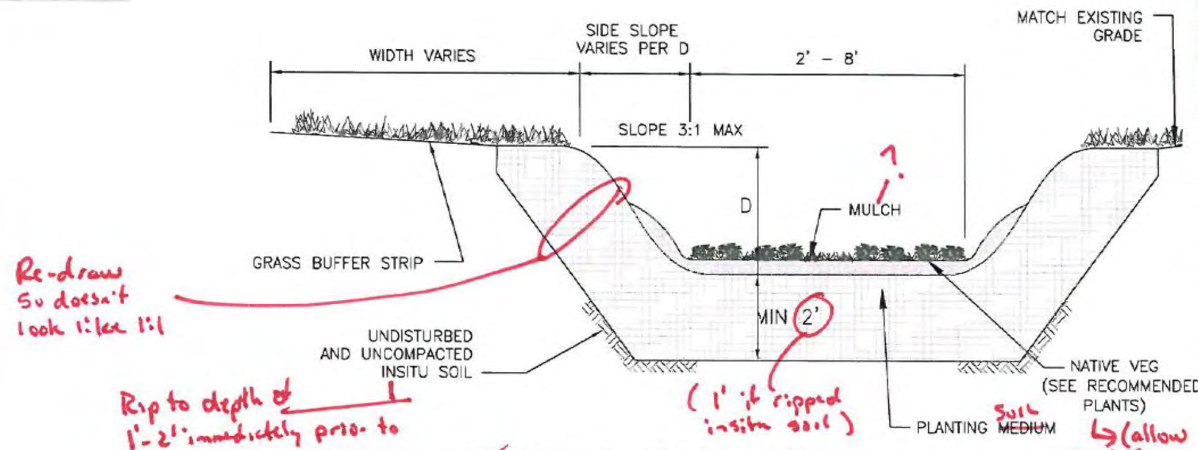
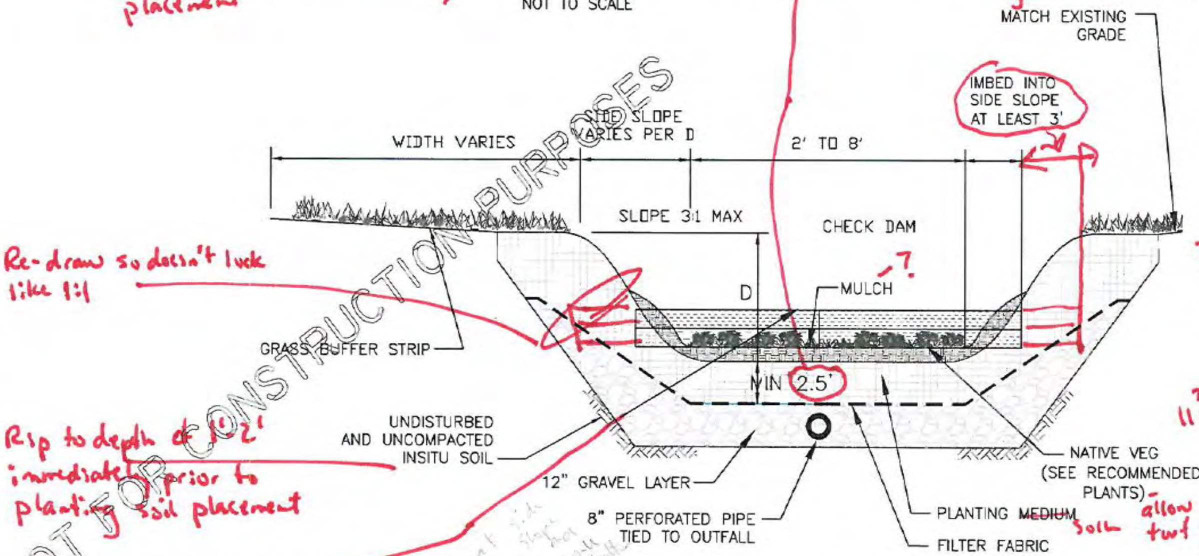
only seed if same seed as final



TYPICAL WET SWALE CROSS-SECTION

NOT TO SCALE



TYPICAL DRY SWALE CROSS-SECTION (WITH CHECKDAM)

NOT TO SCALE

CONSTRUCTION SEQUENCING:

1. PERFORM CONTINUOUS INSPECTIONS OF EROSION CONTROL PRACTICES.
2. INSTALL SILT FENCE ALONG THE PERIMETER OF THE SITE TO PREVENT SEDIMENT FROM LEAVING THE SITE DURING THE CONSTRUCTION PROCESS.
3. ALL DOWNGRADIENT PERIMETER SEDIMENT-CONTROL BMPS MUST BE IN PLACE BEFORE ANY UP GRADIENT LAND-DISTURBING ACTIVITY BEGINS.
4. REMOVE TOPSOIL FROM THE SITE AND PLACE IN TEMPORARY STOCKPILE LOCATION. TEMPORARY SEED THE STOCKPILE.
5. INSTALL UNDERGROUND UTILITIES (WATER, SANITARY SEWER, ELECTRIC AND PHONES) TAKING THE LOCATION AND FUNCTION OF STORM WATER BMPS INTO CONSIDERATION.
7. SEED AND MULCH DISTURBED AREAS ON SITE.
8. CONSTRUCT THE ROADS TAKING THE LOCATION AND FUNCTION OF STORM WATER BMPS INTO CONSIDERATION.
9. PERFORM ALL OTHER SITE IMPROVEMENTS TAKING THE LOCATION AND FUNCTION OF THE STORM WATER BMPS INTO CONSIDERATION.
10. FINAL GRADE THE SITE.
11. STABILIZE THE SITE BY IMPLEMENTING THE NATIVE SEEDING AND PLANTING PORTION OF THE LANDSCAPING PLAN.
12. INSTALL THE EROSION CONTROL BLANKET AND COIR ROLL/CHECK DAMS.
13. REMOVE THE SILT FENCE AFTER THE SITE IS STABILIZED PER PROJECT ENGINEER APPROVAL.

GENERAL NOTES:

1. INSTALL ALL TEMPORARY EROSION CONTROL MEASURES (IN ACCORDANCE WITH MnDOT GENERAL CONDITIONS 2573) PRIOR TO THE START OF ANY CONSTRUCTION OPERATION THAT MAY CAUSE ANY SEDIMENTATION OR SILTATION AT THE SITE.
2. INSTALL STORM DRAIN INLET PROTECTION TO PREVENT CLOGGING OF THE STORM SEWER AND SEDIMENT LOADS TO DOWNSTREAM STORM WATER FACILITIES OR WATERBODIES.
4. GRADING OF THE SWALE SHALL BE ACCOMPLISHED USING LOW-IMPACT EARTH-MOVING EQUIPMENT TO PREVENT COMPACTION OF THE UNDERLYING SOILS. SMALL TRACKED DOZERS AND BOBCATS WITH RUNNER TRACKS ARE RECOMMENDED.
5. EXCAVATE THE SWALE TO THE SPECIFIED DEPTH (ELEVATION). IT IS RECOMMENDED THAT ALL SUB MATERIAL BELOW THE SPECIFIED ELEVATION SHALL BE LEFT UNDISTURBED, UNLESS OTHERWISE DIRECTED BY THE ENGINEER. – rip
6. GRADE TO THE DEPTH (ELEVATION) SPECIFIED IN THE CONSTRUCTION DOCUMENTS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
7. IN THE EVENT THAT SEDIMENT IS INTRODUCED INTO THE BMP DURING OR IMMEDIATELY FOLLOWING EXCAVATION, THIS MATERIAL WILL NEED TO BE REMOVED FROM THE SWALE PRIOR TO INITIATING THE NEXT STEP IN THE CONSTRUCTION PROCESS. THIS IS ESPECIALLY IMPORTANT IF THE SWALE HAS BEEN DESIGNED TO INFILTRATE STORM WATER: SEDIMENT THAT HAS BEEN WASHED INTO THE SWALE DURING THE EXCAVATION PROCESS CAN SEAL THE PERMEABLE MATERIAL SIGNIFICANTLY REDUCING THE INFILTRATION CAPACITY OF THE SOILS.
8. MATERIAL EXCAVATED FROM THE SWALE(S) SHALL BE DISPOSED OF ON-SITE AT LOCATIONS (STOCKPILE AREAS) DESIGNATED BY ENGINEER.
9. NON-STANDARD COMPONENT: CLEAN, WASHED 1.5 TO 3.5-INCH GRAVEL SHALL BE PLACED IN THE BOTTOM OF THE SWALE TO THE DEPTH SPECIFIED IN THE CONSTRUCTION DOCUMENTS. GRAVEL SHOULD BE PLACED IN LIFTS AND LIGHTLY COMPACTED WITH PLATE COMPACTORS.
10. NON-STANDARD COMPONENT: THE PERFORATED PIPE (UNDERDRAIN) SHALL BE LAID DIRECTLY ON THE GRAVEL BED. GRADE AND ALIGNMENT SHALL NOT VARY FROM THE PRESCRIBED GRADE BY MORE THAN 0.03 FEET (9 MM) AT ANY POINT. THE JOINTS BETWEEN SECTIONS OF PIPE SHALL BE CONNECTED IN A FASHION ACCEPTABLE TO ENGINEER. ONCE THE PIPE IS IN PLACE, IT SHALL BE COVERED IMMEDIATELY WITH GRANULAR MATERIAL AS SPECIFIED IN THE CONSTRUCTION DOCUMENTS. THE GRANULAR MATERIAL SHALL BE OF UNIFORM DEPTH ON BOTH SIDES OF THE PIPE. SPECIAL INLETS AND SPECIAL DEVICES AT THE OUTLET END OF THE PIPE SHALL BE CONSTRUCTED AS SHOWN IN THE PLANS.
12. PORTIONS OF SWALE TO BE PLANTED SHALL RECEIVE 3" OF WOODCHIP MULCH (MnDOT TYPE 6).
13. PORTIONS OF SWALE TO BE SEEDED SHALL BE MULCHED WITH CLEAN GRAIN STRAW (MnDOT TYPE 3) AT A RATE OF 2 TONS PER ACRE.
14. SEEDING AND INSTALLATION OF EROSION CONTROL BLANKET SHALL BE COMPLETED WITHIN 48 HOURS OF FINAL GRADING.

S2 erosion control blanket — wash away?

→ Maximum flow velocity shall be 1 fps or less. Computation of tributary flow is required. (straw mulch will wash away)
→ Slope shall not exceed 5% (1 to 2% recommended maximum)
→ Vegetation shall form a complete ground cover or there will be on-going erosion and water quality issues
Need spec for check dam material, bottom needs to be embedded, need erosion control over top
– might be simpler gravel/drain tile/fabric combo

NO.	REVISION DESCRIPTION	DATE	BY

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

Print Name:

Sign Name:

Date ______ License No. ______

Date | Designed By | Drawn By

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155-4194
Phone: (651) 296-6300
TTY: (651) 282-5332
WEBSITE: www.pca.state.mn.us

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WET AND DRY SWALES

Sheet No. ___ of ___ Sheets

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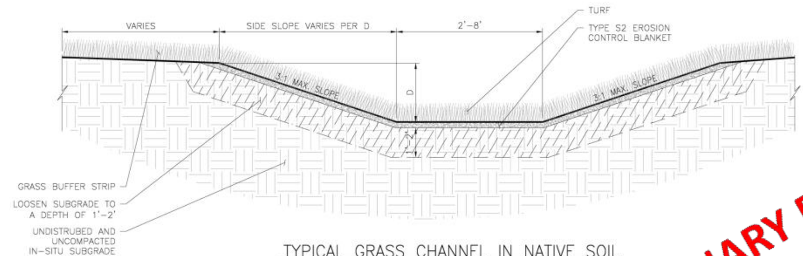
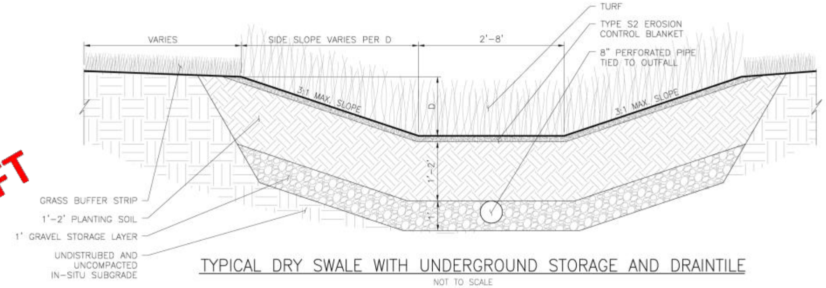


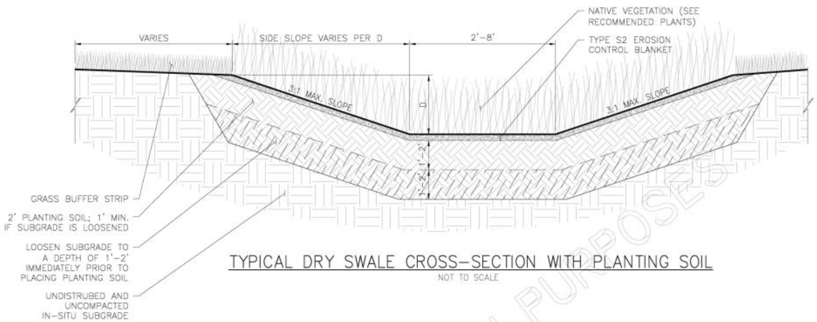
TYPICAL GRASS CHANNEL IN NATIVE SOIL

NOT TO SCALE



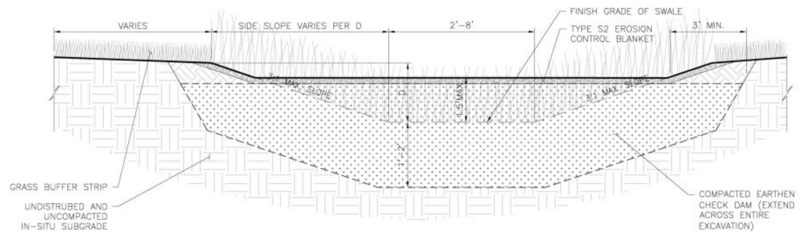
TYPICAL DRY SWALE WITH UNDERGROUND STORAGE AND DRAINTILE

NOT TO SCALE



TYPICAL DRY SWALE CROSS–SECTION WITH PLANTING SOIL

NOT TO SCALE



TYPICAL DRY SWALE CROSS–SECTION (WITH CHECKDAM)

NOT TO SCALE

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13. PORTIONS OF SWALE TO BE SEEDED SHALL BE COVERED WITH TYPE S2 EROSION CONTOL BLANKET.
14. SEEDING AND INSTALLATION OF EROSION CONTROL BLANKET SHALL BE COMPLETED WITHIN 48 HOURS OF FINAL GRADING.

NO.	REVISION DESCRIPTION	DATE	BY

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

Print Name:
Sign Name:
Date: License No.

Date
Designed By
Drawn By

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155-4194
Phone: (651)-296-6300
TTY: (651)-282-5332
WEBSITE: www.pca.state.mn.us/

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Sheet No.
of
Sheets

Next Steps

- Wait until LRRB study results out this fall
  - Will include real world monitoring site in Madison, WI
- U of MN will compare and contrast modeling results
- Complete suggested cross section detail by June 30
- Use preliminary, potentially conservative MIDS values for now, update with LRRB results by March 2013 for calculator update by end of summer 2013

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