HYDROLOGY REPORT

RAN 5 PROJECT
JEFFERSON COUNTY, WEST VIRGINIA

PREPARED FOR

ROXUL USA INC.
4594 CAYCE ROAD,
BYHALIA, MS 38611

030-2302
SEPTEMBER 2017

PREPARED BY

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600 WHITE OAKS BOULEVARD,
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SECTION 1 – GENERAL

NARRATIVE

This project consists of the construction of a new Industrial Manufacturing Facility along Northport Avenue. The site is located within Jefferson County, WV. The project will include new buildings, asphalt employee parking lot, asphalt truck trailer storage area, asphalt drive lanes and concrete pavement. The design includes a concrete lined settling pond, a 60 mil HDPE lined reuse pond and a 60 mil HDPE lined stormwater detention pond. The stormwater management facilities for this site have been designed to satisfy the City of Ranson and WV MS4 requirements for water quality and quantity control.

The settling and reuse pond will be used to control 24.7 acres of the post-development area. The settling pond is split into 2 bays. Runoff will be directed into a trough with keyways that allow water to flow into the bays. The keyways will have a weir system that will allow a bay to be shut down in order to clean out debris that has settled out of the stormwater runoff. A concrete weir separates the settling pond from the reuse pond. Once runoff reaches an elevation of 562.0' in the settling pond, it flows into the reuse pond. Water that collects in the reuse pond will then be used as process water for the manufacturing facility. At no point will water be discharged from these ponds.

The Stormwater Detention Pond will be used to control 48.9 acres of the post-development area. It has been designed to minimize the post development runoff for the 2 year and 10 year storm events. It utilizes a 48" diameter riser structure with three 6" low flow orifices to control the varying storm frequencies. A 36" gate valve will be installed in the outlet pipe as a safety feature. In the event of an accidental discharge of toxic material into the basin, the gate valve will be used to prevent this material from leaving the site.

The following table lists the stormwater quality BMPs that will be used in each contributing drainage area.

	TARGET TREATMENT VOLUME	**OBTAINED TREATMENT VOLUME**
Level II Water Quality Swale	23,432 CF	23,432 CF
Level I Bioretention	6,534 CF	6,534 CF
Rainwater Harvesting	46,555 CF	46,555 CF

Contributing Drainage Area A will incorporate eight Level II water quality swales which will provide 58,300.2 cubic feet of storage and Level I bioretention areas which will provide 148,779.8 cubic feet of storage. The total target volume for this drainage area is 78,517 cubic feet. We have obtained a volume of 29,966 cubic feet leaving a deficit of 48,551 cubic feet (See WV MS4 Stormwater Compliance Spreadsheet Results in this report). Within this drainage area we are also using five Flexstorm Pure Filters (See manufacturer's information within this report) which will be filtering 7.4 acres of impervious and 5.9 acres of pervious surface. Flexstorm Pure Filters are rated for >80% removal efficiency of street sweep- size particles, 99% TSS removal of OK-110 US Silica Sand and 97% total petroleum hydrocarbon removal. We are requesting these filter bags be considered in the reduction in our treatment volume deficit.

Contributing Drainage Area B will incorporate rainwater harvesting as a means to satisfy stormwater reduction compliance. Water collected within this drainage area will be used as process water within the manufacturing facility. Roxul USA, Inc. intends to use 158,503 gallons per day for manufacturing purposes. The settling/reuse basin which receives the drainage from this drainage area has a storage capacity of 644,003 cubic feet. The total target volume for this drainage area is 54,686 cubic feet. We have obtained a volume of 46,555 cubic feet leaving a deficit of 8,131 cubic feet. Within this drainage area, two Zurn Z-1189 Oil/Water Separators will be used. One will treat water coming from a truck wash station and the other will treat runoff from the diesel fuel tank area.

Eight water quality swales will be used within Contributing Drainage Area A in order to help bring the site into MS4 compliance. The site will also utilize four ditches which will convey water to the stormwater and E&S facilities. Ditches D-1 and D-2 will be used to collect offsite water and direct it into the stormwater system of Contributing Drainage Area B. Ditches D-3 and D-4 are temporary ditches which will be used to direct water into Sediment Basin 1 during earthmoving activities. As soon as disturbed areas are fully stabilized, these ditches will be removed and Sediment Basin 1 will be converted into a stormwater basin. The following chart shows specifications for the swales and ditches used within this site.

SWALES AND DITCHES SPECIFICATIONS

	1" Rainfall V	10 Yr. V	10 Yr. Surface El.	25 Yr. Surface El.	Free board	Peak Flow	Bottom Width	Side	Depth	Slope
Swale 1	1.21 fps	4.27 fps	0.55'	0.61'	0.95'	15.6 cfs	5'	3:1	1.5'	2.4%
Swale 2	1.69 fps	3.58 fps	0.29'	0.31	1.21'	6.09 cfs	5'	3:1	1.5'	3.7%
Swale 3	1.21 fps	2.38 fps	0.43'	0.46	1.07'	6.44 cfs	5'	3:1	1.5'	1.0%
Swale 4	1.20 fps	2.43 fps	0.31'	0.34	1.19'	4.47 cfs	5'	3:1	1.5'	1.5%
Swale 5	0.79 fps	3.09 fps	0.48'	0.54	1.02'	9.54 cfs	5'	3:1	1.5'	1.4%
Swale 6	0.70 fps	1.81 fps	0.14'	0.15	1.36'	1.37 cfs	5'	3:1	1.5'	2.5%
Swale 7	0.96 fps	2.30 fps	0.30'	0.33	1.20'	4.08 cfs	5'	3:1	1.5'	1.4%
Swale 8	0.66 fps	1.24 fps	0.16'	0.17	1.34'	1.09 cfs	5'	3:1	1.5'	1.0%
Ditch D-1	0.54 fps	2.92 fps	0.54'	0.61	0.46'	4.86 cfs	2'	3:1	1'	1.3%
Ditch D-2	1.13 fps	4.73 fps	1.52'	1.68	0.48'	36.2 cfs	2'	3:1	2'	1.1%
Ditch D-3	3.63 fps	7.75 fps	1.96'	2.13	0.54'	120.3 cfs	2'	3:1	2.5'	1.9%
Ditch D-4	3.96 fps	8.85 fps	1.82'	1.98	0.59'	123.1 cfs	2'	3:1	2.5'	2.7%

STORMWATER MANAGEMENT BASIN SPECIFICATIONS

Sediment Basin #1

Drainage Area – 48.9 ac
Required Storage Volume – 176,040 cf
Wet Storage Volume – 108,479 cf
Dry Storage Volume – 108,479 cf
Total Storage Volume – 216,958 cf
25 Year Elevation – 562.34'
Cleanout Elevation – 558.20'
Riser – 48", Barrel – 36"
Bottom Elevation – 557.0'
Embankment Elevation – 566.0'
Riser Elevation – 561.0'
Low Flow Orifice – (1) 7" Hole @ 559.2'
Outfall Elevation – 555.65'

Sediment Basin #2

Drainage Area – 16.2 ac
Required Storage Volume – 58,320 cf
Wet Storage Volume – 71,461 cf
Dry Storage Volume – 71,461 cf
Total Storage Volume – 142,922 cf
25 Year Elevation – 576.30’
Cleanout Elevation – 573.7’
Riser – 36”, Barrel – 24”
Bottom Elevation – 573.0’
Embankment Elevation – 577.0’
Riser Elevation – 576.0’
Low Flow Orifice – (1) 6” Hole @ 574.5’
Outfall Elevation – 571.34’

Stormwater Basin

Drainage Area – 48.9 ac
25 Year Elevation – 562.32’
Cleanout Elevation – 558.20’
Riser – 48”, Barrel – 36”
Bottom Elevation – 557.0’
Embankment Elevation – 566.0’
Riser Elevation – 561.0’
Low Flow Orifice – (3) 6” Hole @ 559.2’
Outfall Elevation – 555.65’

Settling/Reuse Basin

Drainage Area – 24.7 ac
25 Year Elevation – 560.76’
Bottom Elevation – 554.0’
Embankment Elevation – 564.0’

Pre & Post Development Analysis

The majority of the proposed pre-developed site drains into the small valley north of the proposed Sediment Basin 1. We used this point when analyzing the pre-developed runoff in the chart below. There are two water quantity control structures that will be used to control the proposed site. A stormwater basin will be used in Contributing Drainage Area A which will discharge into our pre-developed analysis point. Contributing Drainage Area B will be control by use of the settling/reuse pond. Water

collected by this facility will at no times be discharged, but will be used as process water within the manufacturing facility.

The pre-developed analysis point has a contributing drainage area of 61.5 acres all of which is predominately covered in scrub brush and forested area. During post development, 48.9 acres of Drainage Area A will be routed through the stormwater basin and be discharged into our pre-developed analysis point. Drainage Area B contains 24.7 acres of drainage area which will be routed into the settling/reuse point which will in turn be used in the manufacturing facility. At no time will this basin discharge. The following table summarizes the pre and post development peak runoff rates for the proposed site. The project site is located in a known Karst area. Adjustment factors of 0.33 (2-yr storm), 0.43 (10-yr storm) and 0.50 (100-yr storm) have been used to determine the pre-developed Karst adjusted peak flow rates.

Storm Event	Pre-Dev Peak	Pre-Dev Karst Adjusted	Post-Dev Peak From Storm Basin	Post-Dev Peak Routed Thru Storm Basin	Post-Dev Peak Routed Thru Reuse Basin
2 year	115.72 cfs	38.19 cfs	1.564 cfs	89.79 cfs	72.65 cfs
10 year	255.37 cfs	109.81 cfs	3.646 cfs	162.44 cfs	129.74 cfs
100 year	419.20 cfs	209.60 cfs	41.07 cfs	244.01 cfs	194.22 cfs

Contributing Drainage Area Analysis

The following table shows a breakdown of the drainage areas for each contributing drainage area.

CONTRIBUTING DRAINAGE AREA A

Drainage Area	Total Area (AC)	Impervious (AC)	Pervious (AC)	CN	Adjusted CN
Swale 1	3.34	0.73	2.61	83	73
Swale 2	1.05	0.77	0.28	93	73
Swale 3	1.08	0.89	0.19	95	73
Swale 4	0.75	0.63	0.12	95	73
Swale 5	2.10	0.30	1.80	82	73
Swale 6	0.24	0.16	0.08	92	73
Swale 7	0.74	0.42	0.32	90	73
Swale 8	0.18	0.16	0.02	96	73
DI #4	0.77	0.61	0.16	94	73
DI #6	3.47	3.47	0.00	98	73
DI #7	1.11	0.66	0.45	90	73
DI #8	1.39	1.23	0.16	96	73
DI #9	1.74	1.49	0.25	95	73
DI #10	0.38	0.00	0.38	79	73
MH #11	6.85	0.00	6.85	79	73
DI #13	1.65	0.58	1.07	86	73
DI #14	1.62	1.40	0.22	95	73
DI #15	2.50	2.28	0.22	96	73
Bioretention	3.00	1.60	1.40	89	73

CONTRIBUTING DRAINAGE AREA B

Drainage Area	Total Area (AC)	Impervious (AC)	Pervious (AC)	CN	Adjusted CN
DI #22	1.33	1.28	0.05	97	81
DI #23	1.07	1.07	0.00	98	81
DI #24	0.85	0.85	0.00	98	81
DI #25	0.85	0.85	0.00	98	81
DI #26	0.55	0.55	0.00	98	81
DI #27	0.80	0.80	0.00	98	81
Ditch D-1	1.17	0.00	1.17	79	81
Ditch D-2	8.72	0.00	8.72	79	81
DI #29	1.01	1.01	0.00	98	81
DI #30	0.26	0.26	0.00	98	81
DI #31	0.89	0.89	0.00	98	81
DI #32	1.65	1.65	0.00	98	81
DI #33	0.53	0.53	0.00	98	81
DI #34	1.50	1.05	0.45	92	81
DI #35	0.45	0.45	0.00	98	81
DI #36	0.46	0.46	0.00	98	81
DI #38	0.57	0.57	0.00	98	81
DI #39	0.60	0.36	0.24	90	81
DI #40	1.39	0.88	0.51	91	81

Hydrology Assumptions

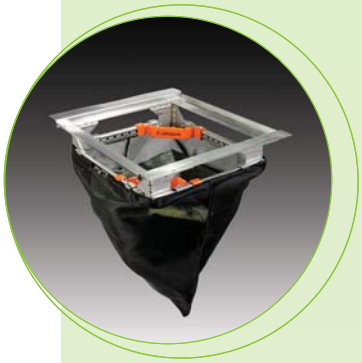
- Time of Concentration of 6 (min) was used to model the watershed.
- Runoff Coefficients – SCS Runoff Method
    - Pervious areas were analyzed utilizing a runoff coefficient (C) value of 79 for lawn areas.
    - Impervious areas were analyzed utilizing a runoff coefficient (C) value of 98.
- Determining Runoff
    - The SCS Runoff Method was used to determine the flows that enter the detention facilities.

Flexstorm Pure Filter Maintenance and Inspection

1. Inspection should occur following any rain event >½".
2. Post construction inspections should occur 4 times per year. In snowfall affected regions additional inspections should take place before and after snowfall season.
3. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than 3 times/year.

At 50% saturation the average 2'x2' Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil and should be serviced. To recover the oils the filter can be centrifuged or passed through a wringer. Oil skimmer pouches start to turn black when saturated, indicating time for replacement. Each ClearTec Rubberizer pouch will absorb ~62oz (4 lbs) of oil before needing re-placement. Dispose of all oil contaminated products in accordance with EPA guidelines. ClearTec Rubberizer, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

FLEXSTORM® PURE PERMANENT INLET PROTECTION



SPECIFY WITH CONFIDENCE

State DOTs and Municipalities across the country now have a universal structural BMP to address the issue of storm sewer inlet protection: FLEXSTORM PURE Inlet Filters.

The FLEXSTORM PURE system is the preferred choice for permanent inlet protection and storm water runoff control. Constructed of versatile stainless steel, FLEXSTORM PURE Inlet Filters will fit any drainage structure and are available with site-specific filter bags providing various levels of filtration. Whether you're the specifier or the user, it's clear to see how FLEXSTORM PURE Inlet Filters outperform the competition.

APPLICATIONS:

Car Washes	Gas Stations
Commercial	Parking Lots
Loading Ramps	Dock Drains
Industrial	Maintenance

FEATURES:

- Stainless Steel filter framing is custom configured to fit perfectly into any drainage structure, whether a standard design or obstructed inlet opening
- Filtered Flow Rates and Ultimate Bypass Rates are designed to meet your specific inlet requirements
- Multiple Filter Bags are available targeting site specific removal of trash, litter, leaves, or small particles, oil and grease
- Filters work below grade with an ultimate bypass allowing inlet area to drain with a full bag
- Units install in seconds and are easily maintained with the FLEXSTORM Universal Removal Tool (no heavy machinery required)

BENEFITS:

- Receive payback on your investment: durable stainless steel framing provides extended service life while replaceable filter bags handle loads with a safety factor of 5
- Meet stringent removal requirements:
  - –FX filter bags are rated for > 80% removal efficiency of street sweep-size particles
  - –PC/PC+ filter bags have been tested to 99% TSS removal of OK-110 US Silica Sand and 97% TPH (total petroleum hydrocarbon) removal
- Help prevent fines: FLEXSTORM Inlet Filters comply with EPA NPDES initiatives as a temporary or permanent BMP
- Available through 5,000 ADS distributors nationwide
- If not in stock, orders up to 100 pcs can ship within 48 hours

ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including selecting the proper filter, specifications, installation and more. Also try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com

FLEXSTORM PURE INLET FILTERS SPECIFICATION

IDENTIFICATION

The installer shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number, exact grate size and clear opening size, or other information will be necessary to finalize the FLEXSTORM part number and dimensions. The units are shipped to the field configured precisely to fit the identified drainage structure.

MATERIAL AND PERFORMANCE

The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile filter bag attached to the frame with a stainless steel locking band. The filter bag hangs suspended at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment. The standard Woven Polypropylene FX filter bags are rated for 200 gpm/sqft with a removal efficiency of 82% when filtering a USDA Sandy Loam sediment load. The Post Construction PC filter bags are rated for 137 gpm/sqft and have been 3rd party tested at 99% TSS removal to 110 micron and 97% TPH removal of used motor oil hydrocarbon mix.

INSTALLATION

Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drain- age structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8", which is the thickness of the steel hangers. For wall mount units, follow instructions for attaching the stainless steel mounting brackets using the provided concrete fasteners.

INSPECTION FREQUENCY

Construction site inspection should occur following each 1⁄2" or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with mild year round rainfall and four times per year (every three months Feb–Nov) in areas with summer rains before and after the winter snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

MAINTENANCE GUIDELINES

Empty the filter bag if more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift from the drainage structure. Dispose of the sediment or debris as directed by the Engineer or Maintenance Contract in accordance with EPA guidelines.

As an alternative, an industrial vacuum may be used to collect the accumulated sediment. Remove any caked on silt from the sediment bag and reverse flush the bag with medium spray for optimal filtration. Replace the bag if torn or punctured to 1⁄2" diameter or greater on the lower half of the bag. Post Construction PC/PC+ Bags should be maintained prior to 50% oil saturation. The average 2' x 2' PC filter bag will retain approx. 96 oz (5.4 lbs) of oil at which time it should be serviced or replaced. It can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. It may also be recycled for its fuel value through waste to energy incineration. When utilizing the Cleartec Rubberizer Pouches in the + bags, note that these oil skimmers will gradually turn brown and solidify as they become saturated, indicating time for replacement. Each pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. The spent media may also be recycled for its fuel value through waste to energy incineration. Dispose of all oil contaminated products in accordance with EPA guidelines.

FILTER BAG REPLACEMENT

Remove the bag by loosening or cutting off the clamping band. Take the new filter bag, which is equipped with a stainless steel worm drive clamping band, and use a screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band.

Lift Handles ease installation and maintenance

Replaceable Sediment Bag

1/8" thick steel hangers& channels; precision stampings **configured to fit each individual casting**

CAD drawings, work instructions and test reports on website: ***www.inletfilters.com***

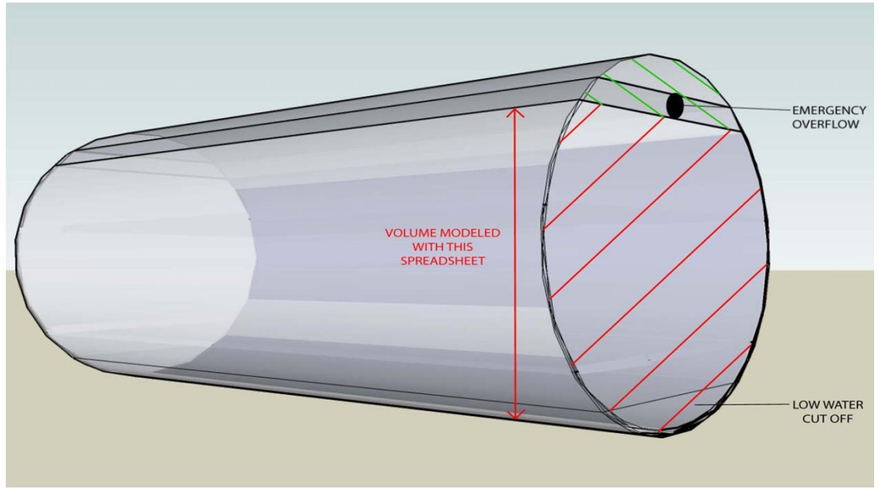
For more information on FLEXSTORM Inlet Filters and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710
Try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com.

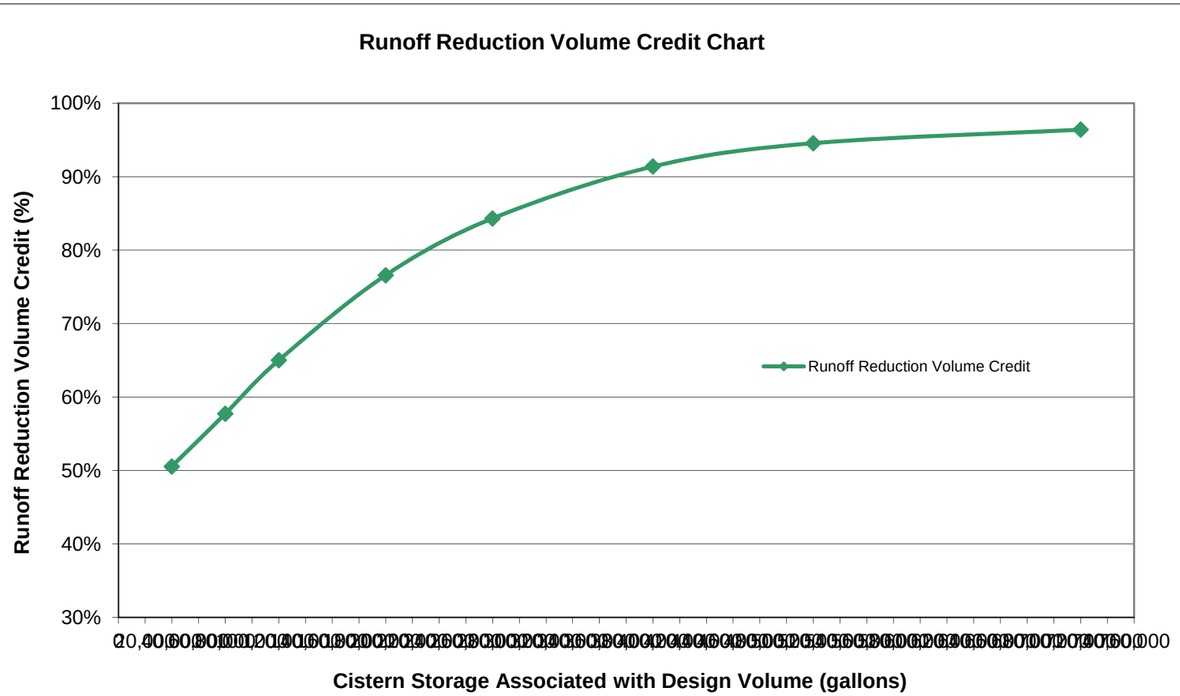
RUNOFF REDUCTION VOLUME: RESULTS FOR PRECIP <=1"

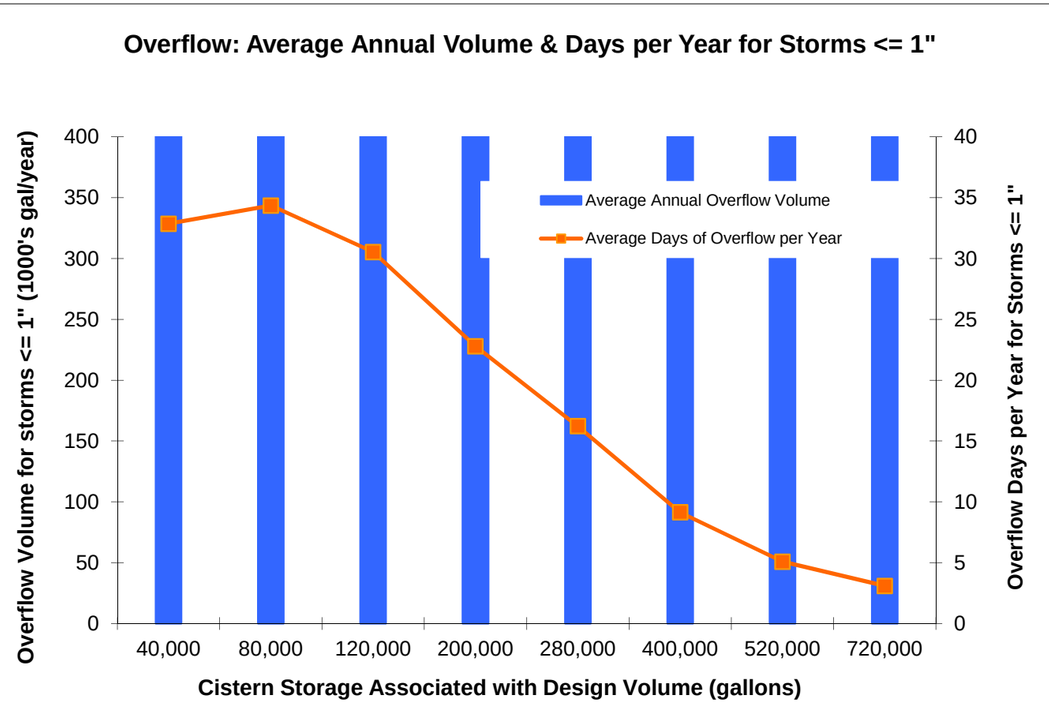
Cistern Storage Associated with Design Volume (gallons)	Average Annual Overflow days for storms <=1" (days/year)*	Average Annual Overflow Volume for storms <= 1" (1000's gal/year)*	Runoff Reduction Volume Credit
40,000	33	6,457	51%
80,000	34	5,521	58%
120,000	31	4,570	65%
200,000	23	3,058	77%
280,000	16	2,050	84%
400,000	9	1,125	91%
520,000	5	711	95%
720,000	3	471	96%

Total Annual Volume contributed to cistern inlet by storms <=1" (1000's gal/year) = 13058

* Excludes overflow that occurs for storms > 1"

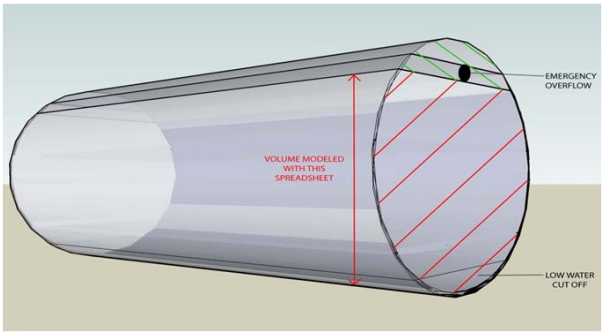




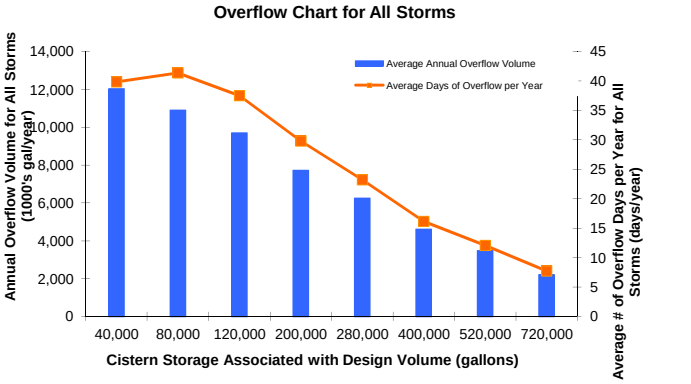


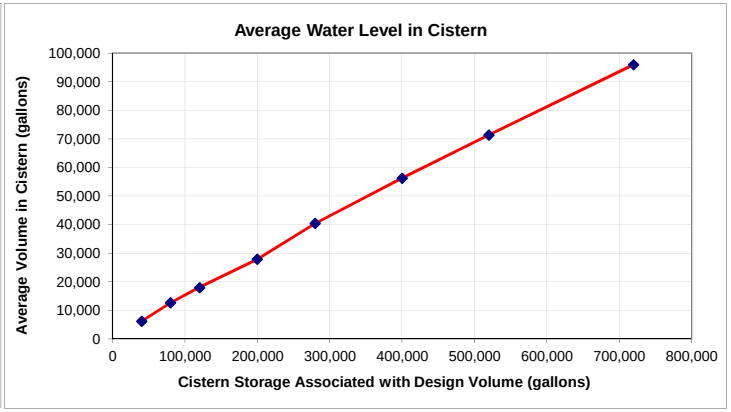
RESULTS: USING PRECIPITATION DATA FROM ALL STORMS

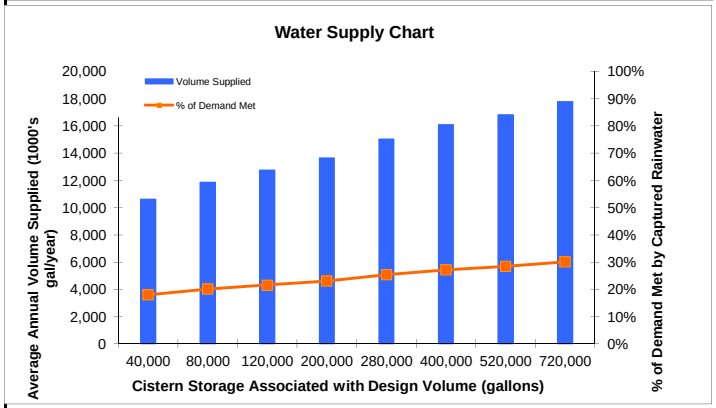
Cistern Storage Associated with Design Volume (gallons)	Average Annual Overflow days for all storms (days/year)	Average Annual Overflow Volume for all storms (1000's gal/year)	Average Annual "Dry" days (days/year)	Average Cistern Volume	% of Demand Met by Captured Rainwater	Annual Volume Supplied, Demand Met (1000's gal/year)
40,000	40	12,034	325	6,150	18%	10,608
80,000	41	10,894	324	12,612	20%	11,870
120,000	38	9,705	322	17,950	22%	12,749
200,000	30	7,731	317	27,899	23%	13,643
280,000	23	6,244	305	40,374	25%	15,033
400,000	16	4,612	295	56,226	27%	16,079
520,000	12	3,484	294	71,270	28%	16,818
720,000	8	2,201	284	95,924	30%	17,788

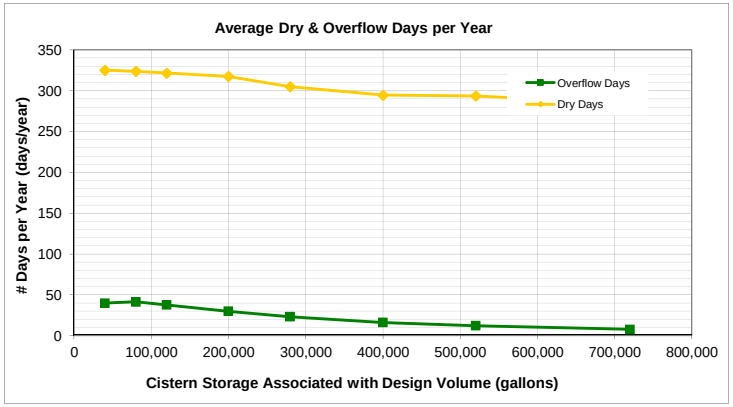


NOTE: CALCULATIONS ON THIS SHEET INCLUDE ALL PRECIPITATION EVENTS









West Virginia MS4 Stormwater Compliance Spreadsheet v2.0; April 2013

Site Data Summary

Site Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	*0.00*
Turf (acres)	0.00	44.30	0.00	0.00	44.30	*60.19*
Impervious (acres)	0.00	29.30	0.00	0.00	29.30	*39.81*
					73.60	*100.00*

Site Rv	0.50
Post Development Treatment Volume (ft3)	133,203

Total Runoff Volume Reduction (ft3)	76,520

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	*0.00*
Turf (acres)	33.10	11.20	0.00	0.00	0.00	*44.30*
Impervious (acres)	15.80	13.50	0.00	0.00	0.00	*29.30*
						73.60

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	*0.00*
Turf (acres)	0.00	33.10	0.00	0.00	33.10	*67.69*
Impervious (acres)	0.00	15.80	0.00	0.00	15.80	*32.31*
					48.90	

BMP Selections

Practice	Credit Area (acres)	Runoff Reduction (ft3)	Downstream Practice
Water Quality Swale, Level 2	16.00	**23,432**	
Bioretention, Level 1 or Urban Bioretention (4.2.3.B)	3.00	**6,534**	

Total Impervious Cover Treated (acres)	5.94
Total Turf Area Treated (acres)	13.06

Drainage Area B Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	*0.00*
Turf (acres)	0.00	11.20	0.00	0.00	11.20	*22.90*
Impervious (acres)	0.00	13.50	0.00	0.00	13.50	*27.61*
					24.70	

BMP Selections

Practice	Credit Area (acres)	Runoff Reduction (ft3)	Downstream Practice
To Rainwater Harvesting (4.2.8)	13.50	**46,555**	

Total Impervious Cover Treated (acres)	13.50
Total Turf Area Treated (acres)	0.00

Channel and Flood Protection

	Weighted CN	1-year storm Adjusted CN	2-year storm Adjusted CN	10-year storm Adjusted CN
Target Rainfall Event (in)		2.70	3.35	5.15
D.A. A CN	73	0	0	58
D.A. B CN	81	0	0	0
D.A. C CN	0	0	0	0
D.A. D CN	0	0	0	0
D.A. E CN	0	0	0	0