Government/Urban Working Group #2 Handout

James River and Tributaries – Richmond TMDL Implementation Plan Development
Goochland, Powhatan, Henrico, Chesterfield Counties and City of Richmond, VA

Total Maximum Daily Load (TMDL) Study Results

Almond, Bernards, Falling, Gillie, Goode, No Name, Powhite, and Reedy Creeks and the James River riverine and tidal do not meet water quality standards for bacteria. These standards are designed to identify waters that are not suitable for "primary contact recreation" (swimming) because of the risk of illness. The TMDL study identified the sources of bacteria and how much each source category needs to be reduced so that the stream is safe for swimming and other recreational activities.

The implementation plan will outline a staged approach to meet the reductions to human, pet, and agricultural sources determined in the TMDL study. Wildlife is considered a background condition and reductions to wildlife bacteria loads are not explicitly addressed in the TMDL implementation plan.

Goals of Meeting

- Review the pollutant reductions that the implementation plan must meet.
- Discuss preliminary estimates of implementation measures that will result in reductions in urban loads.
- Document existing efforts underway to address bacteria in urban areas of the James River watershed.
- Identify additional measures needed to reduce the bacteria load that the implementation plan can address.

Bacteria load reductions required to meet the TMDL

Table 1. Allocation scenarios for reducing current bacteria in JR-Richmond area impairments.

Impairment	Percent Reductions to Existing Bacteria Loads: Wildlife Direct	Wildlife Land Based	Livestock Direct	Agricultural Land Based	Human Direct	Human and Pet Land Based	City of Richmond CSO Program Project Plan Scenario
Almond	0	0	91	0	100	85	Alternative E and a 52% reduction
Bernards	0	38	99	93	100	96	NA
Falling	0	0	0	0	100	13	NA
Gillie	0	0	0	0	100	94	Alternative E and a 95% reduction
Goode	0	0	0	0	100	96	NA
No Name	0	0	0	0	100	94.5	NA
Powhite	0	0	40	0	100	86	NA
Reedy	0	0	0	0	100	0	NA
All upstream Impairments Allocated:							
JR (riverine)	0	63	96	99	100	99	Alternative E
JR (tidal)	0	0	0	0	100	0	Alternative E

Reductions to Wildlife loads will not be specifically addressed in the implementation plan.

Potential measures to address urban sources of bacteria and/or stormwater volume

- Green roofs
- Roof Runoff Detention (Rain barrels)
- Bioretention basins
- Pervious pavement/pavers
- Rain Gardens
- Stormwater planters
- Tree boxes
- Wetlands
- Detention/Retention Ponds
- Infiltration trenches
- Riparian buffers
- Street sweeping
- Failing septic system repairs/replacements (residential WG)
- Straight pipe corrections (residential WG)
- Pet waste disposal (residential WG)

Low Impact Development (LID) BMPs can be used to reduce stormwater volumes and peak flows in urban landscapes and reduce the likelihood and degree of combined-sewer overflows. These various practices include green roofs, bioretention basins, and roof runoff detention systems, and permeable pavement.

Green Roofs

Extensive green roofs, defined as having 3-4 inches of soil (engineered substrate), can be installed on large flat rooftops like those of commercial and industrial buildings of adequate structural integrity. Extensive green roofs have the potential to retain up to one inch of rainfall. A green roof allows for the complete retention of smaller storms, as well as detention and attenuation of flows, in excess of its capacity.

Bioretention Basins

Bioretention basins are excavated areas backfilled with a sand/soil mixture, planted with native vegetation, and used to detain, filter, and infiltrate water. They can be located in median strips, parking lot islands, unused odd areas, and easements. Implementation of bioretention basins could reduce volumes flowing into combined-sewers by detaining, evapotranspiring, and infiltrating water.

Roof Runoff Detention Systems

Roof runoff detention systems, such as rain barrels used for residences, capture rainwater from rooftops and keep it from flowing into combined sewer systems. The water can then be applied to lawns and gardens or allowed to slowly drain, ideally infiltrating into a pervious surface over time. By allowing the runoff detention system to drain, it guarantees that all the capacity is available for the next storm event. Each runoff detention system on its own represents a small reduction of stormwater volume to the combined-sewers, but collectively, on the scale of a neighborhood, can be substantial.

Permeable Pavement

Permeable pavement is an alternative to asphalt or concrete surfaces, which allows rainwater to infiltrate, thus reducing stormwater runoff. There are various types of permeable pavement, including porous concrete, grid pavers, and reinforced turf grids. Permeable pavement is best suited in low-volume areas, such as walkways and parking lots.

Table 2. Stormwater Low Impact Development (LID) cost and volume efficiency estimates.

BMP	Unit	Cost/Unit	Cost/ft²-treated	Rainfall Retention/ Detention Capacity [1]	Annual Rainfall Retained/ Detained [2]
Green Roof	ft^2	\$15 - 30	\$15 - 30	1.0"	49%
Roof Runoff Detention	50-gal barrel	\$100 - 150	\$0.40 - 0.60	0.32"	51%
Bioretention	acre-treated	\$10,000 - 90,000	\$0.23 - 2.07	0.38"	56%
Permeable Pavement	ft^2	\$10 - 15	\$10 - 15	0.75"	76%
Rain Gardens	acre-treated	\$5,000			
Stormwater Planters					
Tree Boxes					
Wetlands					
Detention/Retention Ponds	acre-treated	\$3,400			
Infiltration Trenches	acre-treated	\$5,285			
Riparian Buffers	acre	\$360			
Street Sweeping	lane miles/year	\$29			

[1]This depth of rainfall is a function of what the practice is designed to retain/detain with full available storage capacity.
[2]This calculated percentage is per-unit area, and is a function of precipitation and the practice's ability to recharge its storage capacity.

Questions for the group:

- Of these Stormwater BMPs, are any more likely to be installed than others?
- Are any Stormwater BMPs missing from this list?
- Do you have costs and bacteria removal efficiencies for any BMPs?
- Are there any stormwater BMPs (not part of the Richmond LTCP) installed in the watershed? How much/many?

Modeling Assumptions

The following assumptions will be used for the analysis and modeling of the LID Practices unless different information is gathered during UGWG meetings:

Green Roofs

- Consider all buildings (private and publicly owned) greater than 10,000 ft^2
- Assume 80% of building footprint was available for green roof application
- Assume the buildings were structurally sound and capable of supporting the green roof materials
- Assume 3-4 inch deep extensive green roof
- Assume capability of retaining 1 inch of rainfall

- Use evapotranspiration rates to calculate "recharge" of storage capacity

Roof Runoff Detention Systems (rain barrels)

- Consider all buildings with 800 – 3,600 ft^2 footprint
- Assume a 50 gallon capacity for every 250 ft^2 of roof space
- Assume that detention system drains completely each day

Bioretention Basins

- Consider all parking lots
- Assume basins sized for 0.75 inches of rainfall retention
- Assume bioretention basin is sized to 10 percent of area-treated
- Assume bioretention basin is of sufficient design to drain completely each day
  - Assume soils of adequate percolation, *or* sufficient under-drain design

Permeable Pavement

- Consider all parking lots
- Assume 1 inch of rainfall infiltration, available each day

Ongoing Urban Control Measures

- City of Richmond's LTCP
  - Taken into account with modeling
  - Allows James River riverine and tidal segments to meet standard!
- Chesterfield County's Riparian Stewardship Program
  - Acres or feet of stream installed? Along which streams?
- Others? Do any Counties/City have mandatory Pet Waste Pick-up Programs? Enforced? Can improve?

The Residential Information is included here to garner feedback from VDH:

Residential Waste Treatment BMPs Needed

In order to meet the water quality standards, BMPs are needed to effectively treat the waste from residential homes. Table 3 shows the estimated needs in all impaired watersheds. It was estimated that 5% of the failing septic systems would need new alternative treatment systems installed. Of the remaining failing septic systems, 70% would be corrected with conventional septic systems and 30% would be septic system repairs. It was also estimated that all of the straight pipe corrections would be with standard septic systems. The number of septic tank pump-outs needed was estimated as 50% of the number of currently installed septic systems.

Table 1. Estimated Residential Waste Treatment BMPs Needed (non-cumulative).

Impairment	Potential Failing Septic Systems	Potential Straight Pipes	Septic System Repairs	New Septic Systems	Alternative Systems	Septic Pump-Outs
Almond Creek	35	2	10	25	2	148
Bernards Creek	43	3	12	32	2	601
Falling Creek	152	7	43	108	8	2,853
Gillies Creek	81	21	23	75	4	281
Goode Creek	4	2	1	5	0	37
James River (riverine)	779	113	222	631	39	3,867
James River (tidal)	470	60	134	372	24	4,797
No Name Creek	6	1	2	5	0	51
Powhite Creek	44	4	13	33	2	644
Reedy Creek	5	4	1	8	0	59
Project Total	**1,619**	**217**	**461**	**1,294**	**81**	**13,338**

Questions for VDH:

- Does the breakdown between septic repairs, new septic systems, and new alternative systems apply in these watersheds?
- Does Sewer Hook-up need to be added to the estimates for urban areas? In which watersheds would they be applicable? At what % of the total need?

Residential NPS BMPs Needed

In order to meet the water quality standards, additional BMPs are needed that prevent dog waste bacteria from traveling to surface waters. Table 4 shows the estimated residential NPS BMPs needed.

Table 4. Estimated Residential land-based BMPs Needed.

Control Measure Unit	Pet Waste Education Program System	Pet Waste Composters Number
Almond Creek	1	544
Bernards Creek	1	73
Falling Creek	1	0
Gillies Creek	1	5,840
Goode Creek	1	3,100
James River (lower)	1	19,679
James River (tidal)	1	0
No Name Creek	1	305
Powhite Creek	1	2,493
Reedy Creek	1	0

Residential BMP Cost Estimates

The costs in Table 5 are consistent with the Lynchburg IP and other IPs in Virginia.

Table 5. Estimated Costs of Residential BMPs.

Residential Control Measure	Unit	Cost per Unit
Septic Systems Pump-outs (RB-1)	System	$220
Septic System Repair (RB-3)	System	$3,500
Septic System Installation/Replacement (RB-4)	System	$4,000
Alternative Waste Treatment System Installation (RB-5)	System	$15,000
Pet Waste Education Program	System	$3,750
Pet Waste Composters	Composters	$50

Question for VDH:

- Do these costs apply in these watersheds?