Michael Baker INTERNATIONAL

We Make a Difference

What Makes a BMP Successful?

Lessons Learned in Stormwater Best Management Practice (BMP) Assessment and Design

May 18, 2017

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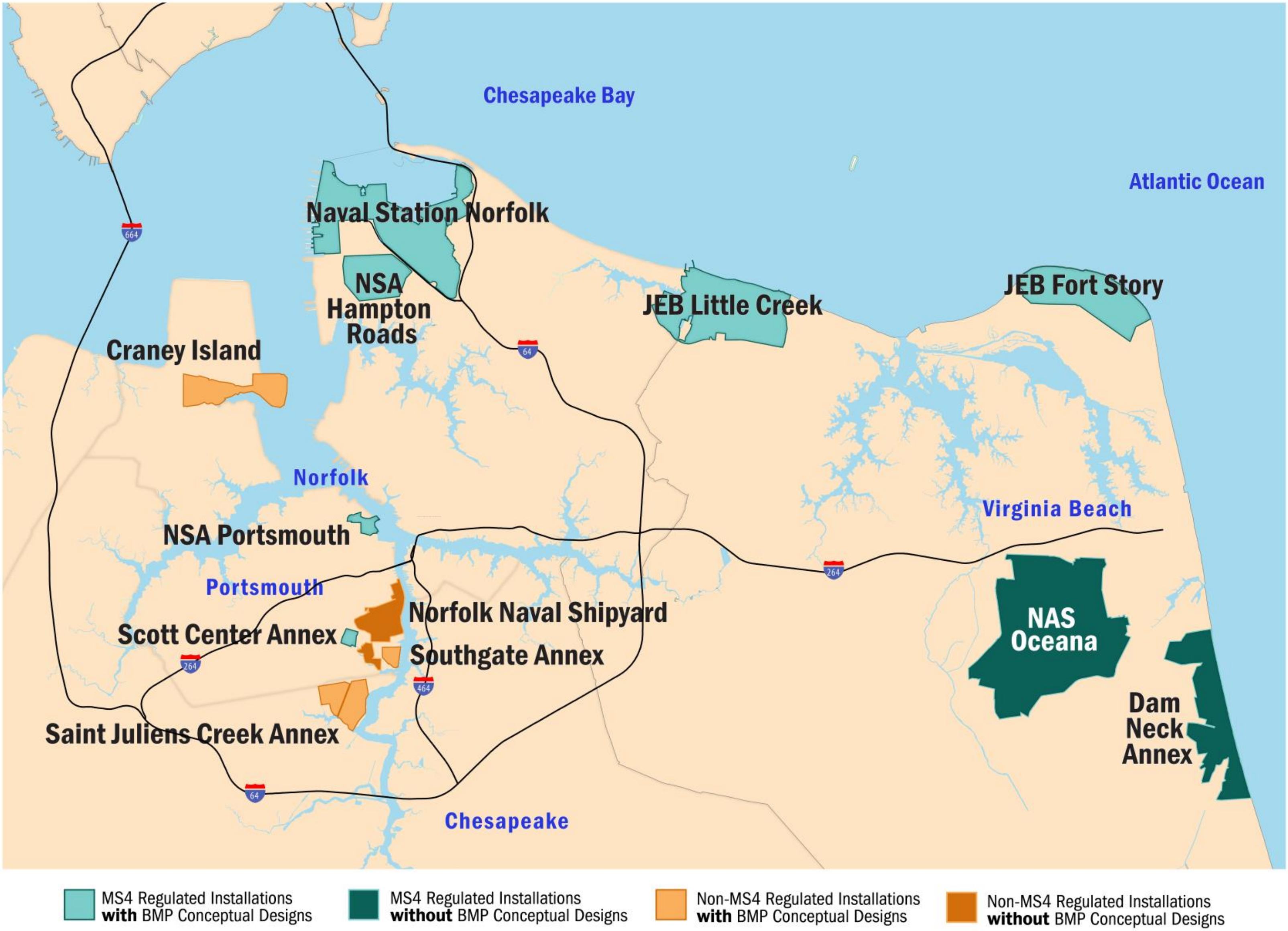
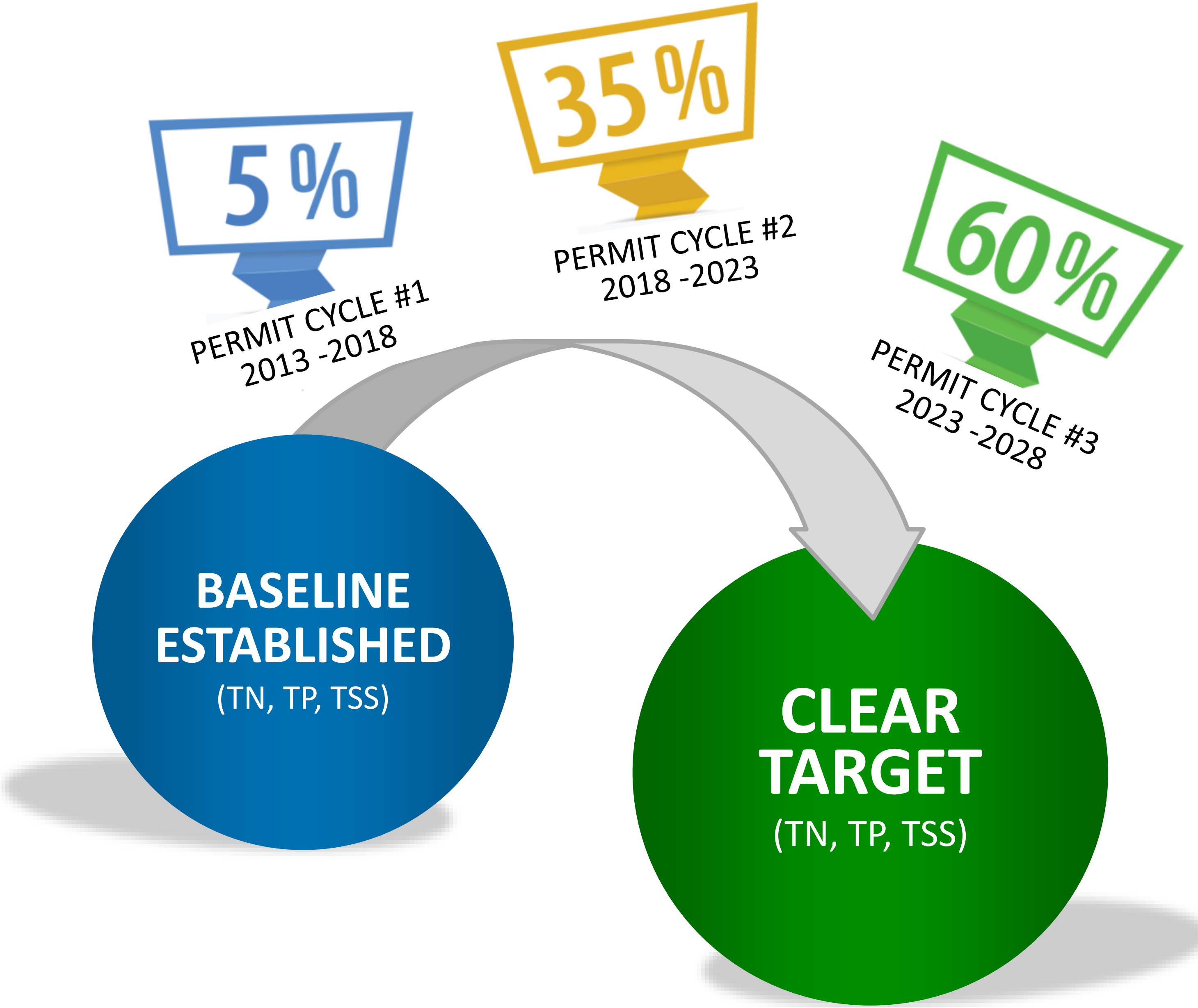
Presentation Outline

1. Background
    - 100 conceptual designs for BMPs
    - MS4 Requirements for the Chesapeake Bay TMDL- Second Permit Cycle
2. Our Process to Improve BMP Success
    - Site Selection
    - Design Phase
3. Select Encountered Problems and Solutions

Background

Project Location:




5%
35%
60%
PERMIT CYCLE #1
2013 -2018
PERMIT CYCLE #2
2018 -2023
PERMIT CYCLE #3
2023 -2028
BASELINE ESTABLISHED
(TN, TP, TSS)
CLEAR TARGET
(TN, TP, TSS)

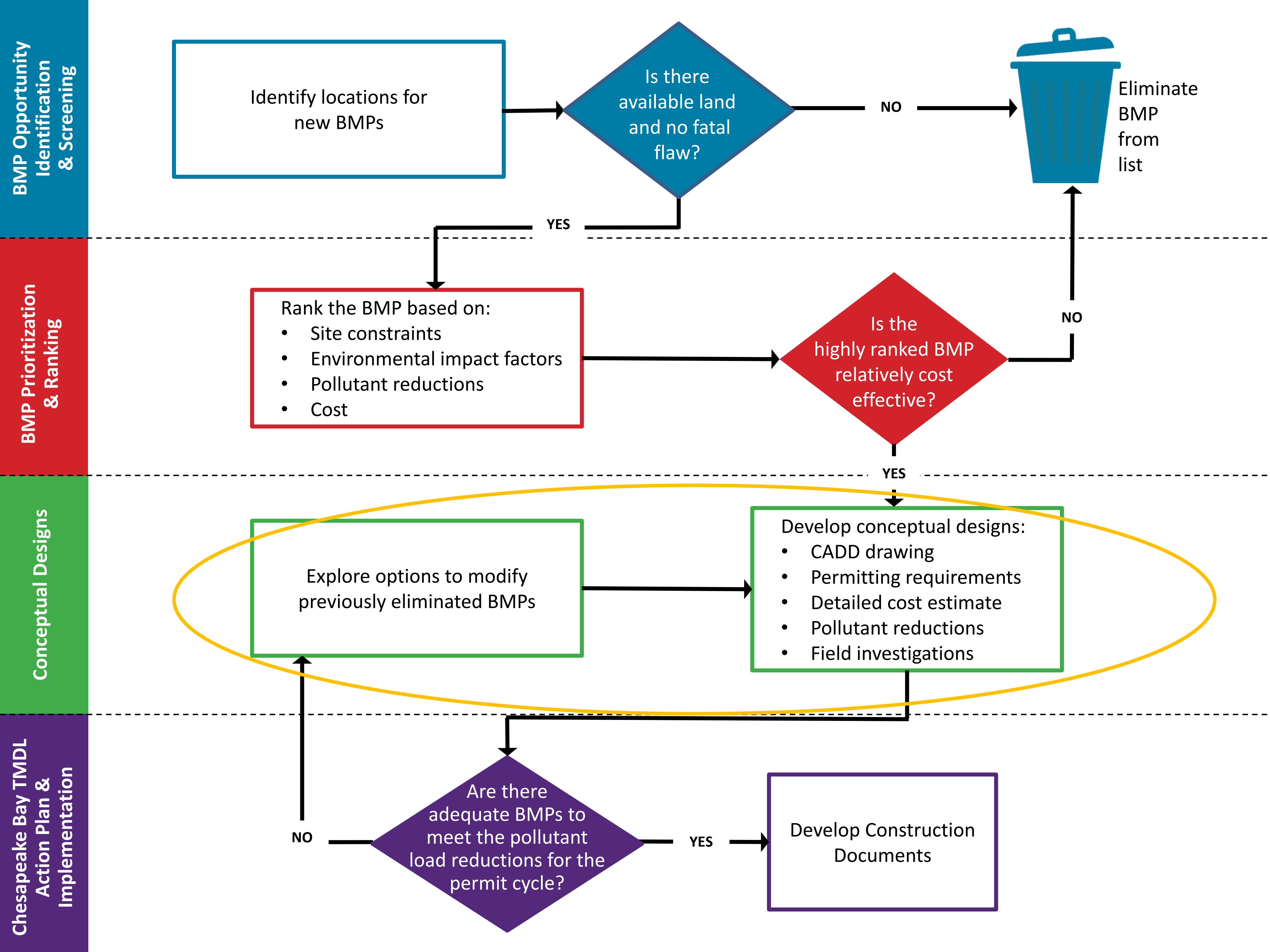
Our Process to Improve BMP Success

1 Identification

2 Prioritization & Ranking

3 Conceptual Designs

4 Implementation



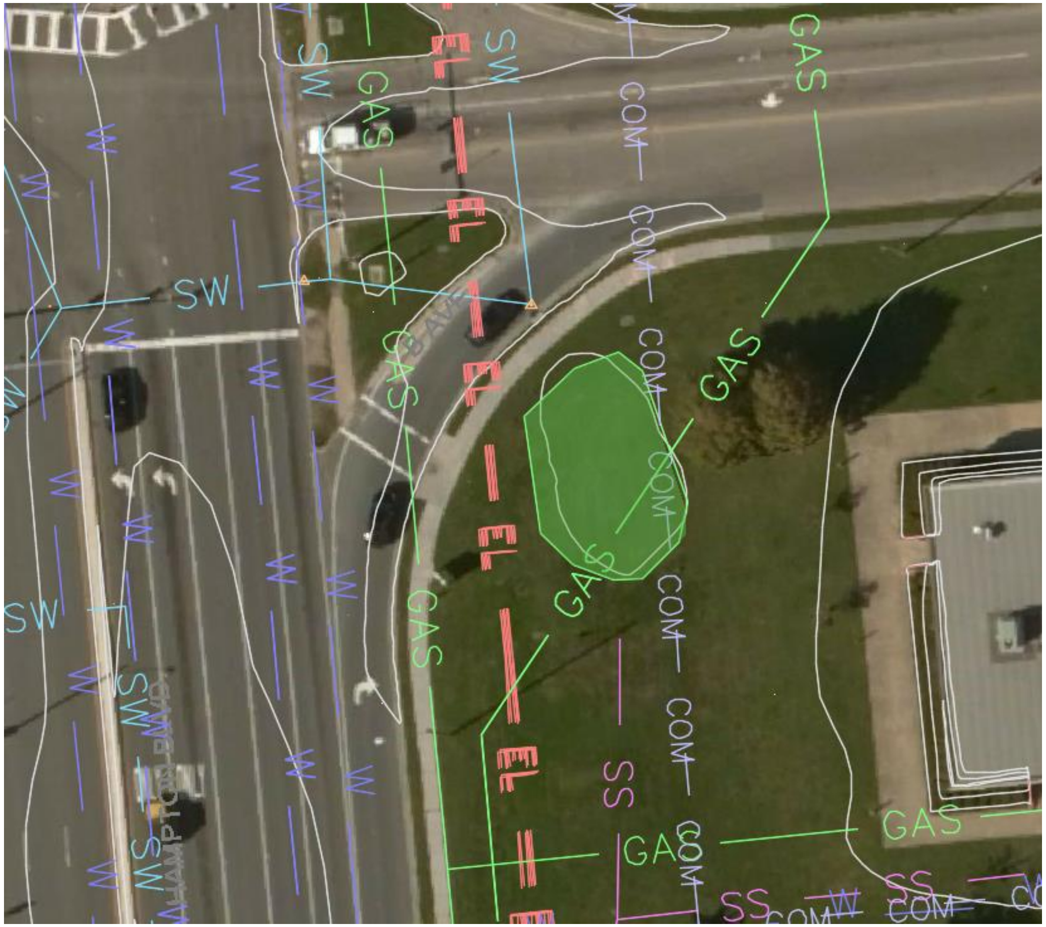
BMP Opportunity Identification & Screening
BMP Prioritization & Ranking
Conceptual Designs
Chesapeake Bay TMDL Action Plan & Implementation
Identify locations for new BMPs
Is there available land and no fatal flaw?
NO
Eliminate BMP from list
YES
Rank the BMP based on:
• Site constraints
• Environmental impact factors
• Pollutant reductions
• Cost
Is the highly ranked BMP relatively cost effective?
NO
YES
Explore options to modify previously eliminated BMPs
Develop conceptual designs:
• CADD drawing
• Permitting requirements
• Detailed cost estimate
• Pollutant reductions
• Field investigations
Are there adequate BMPs to meet the pollutant load reductions for the permit cycle?
NO
YES
Develop Construction Documents

Field Investigations are Critical

- Out of date GIS information (building demolition, new utilities, etc.)
- Interior vs. Exterior Downspouts
- Collect depths from the surrounding storm sewer inlets and manholes. Identify potential sites to tie in underdrains and overflow structures
- Determining flow direction (especially in paved areas)

Check the Site for Fatal Flaws

- Cultural or Historically Significant Sites
- Flooding History that would negatively affect certain types of BMP
- Unavoidable and significant utility conflicts



Example of proposed BMP with fatal utility conflicts

Meet with Stakeholders

- Planners
- Public Works Staff
- Continue to communicate on new ideas, constraints, or maintenance requirements.

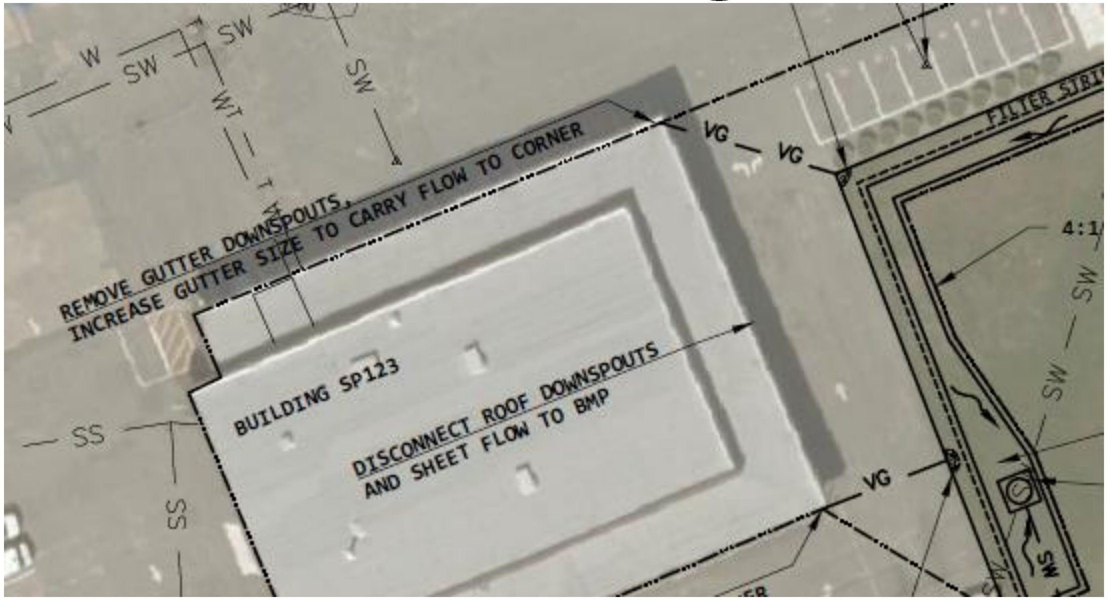
NAVFAC Naval Facilities Engineering Command

Finally- Rank the potential BMPs

- Yes/No/Maybe

ProjectID	Facility	Proposed BMP	Result Based on Field Visit	Yes/No/ Maybe	Explanation for N/P	Severity 1=low 3=high	Planners?
SM-002A-2	SCA	Rain Garden	Try to avoid trees, disconnect gutters. Could also try to bring parking lot (north) RO to rain garden via a valley gutter. Potential utility issues (electric, thermal and sewer are in the area on N side of building.)	Y			X
SM-002A-3	SCA	Wet Swale	This is apparently a BMP surrounding another BMP. Also, there doesn't seem to be enough room for it.	N	limited returns		
SM-002A-3 Alternative	SCA	Rain Garden	Alternative to create small rain garden to treat parking lot runoff then tie into existing BMP	M		1	
SM-002A-5	SCA	structed wetl	Shape could be altered based on what the final plans are for these ballfields. May or may not need to be accessible to pedestrians/ sports spectators	Y			

Maximize Drainage Area



Conveyance swales? Disconnect downspouts? Valley Gutters? (Check slope on all of these to see if feasible.)

Space Available vs Space Needed

Surface Area Determined with VRRM (Virginia Runoff Reduction Method)

Land Use Type	Drainage Area	Rv	Treatment Volume	Storage Depth[2]	Surface Area Required
	[SF]		[CF]	[FT]	[SF]
Impervious	9,952	0.95	788	1.275	618
Grass	13,886	0.2	231	1.275	182
Sand	0	0.6	0	1.275	0
BMP Footprint (Runoff Reduction)[1]	**809**	0	0	1.275	0
TOTAL =	24,647		1,019		**799**

[1] Assume that the filter media can store all rain falling within the footprint of the BMP itself (from top of berm down), therefore the runoff coefficient for the BMP component of the drainage area is 0.

[2] The storage depth was calculated using the ponding depth as well as the volume of the voids in the filter media and gravel layers of the BMP.

Remember setbacks from buildings and utilities!

Choose a practice -start with highest removal and work down from there as you check:

- Online or offline?
- Water Table (infiltration vs. wet practice)
- Soils? (level 1 and level 2 in Virginia)
- Tie In (if needed)
- Flowpath length, geometry
- Pretreatment requirements

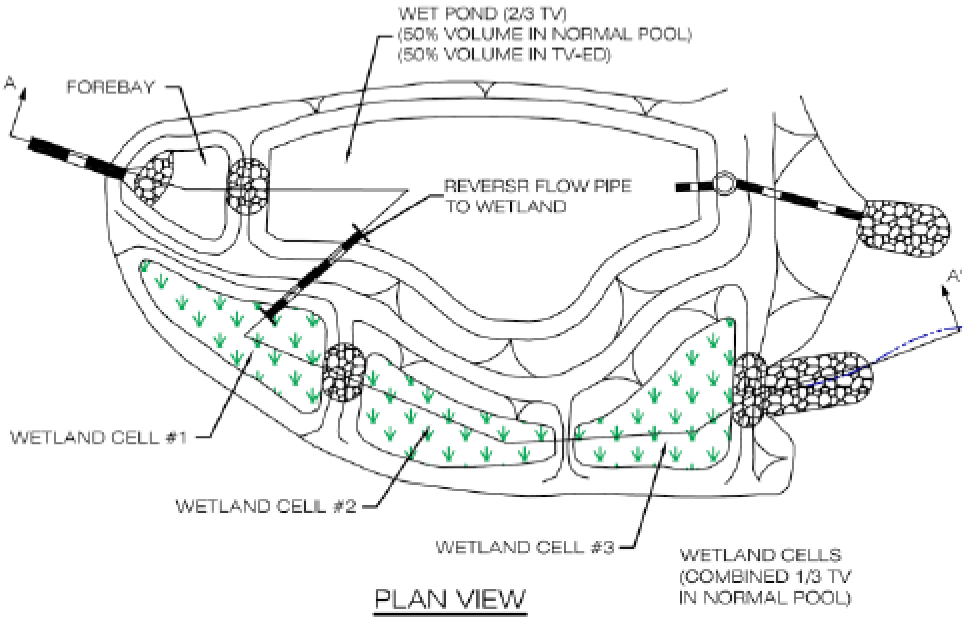
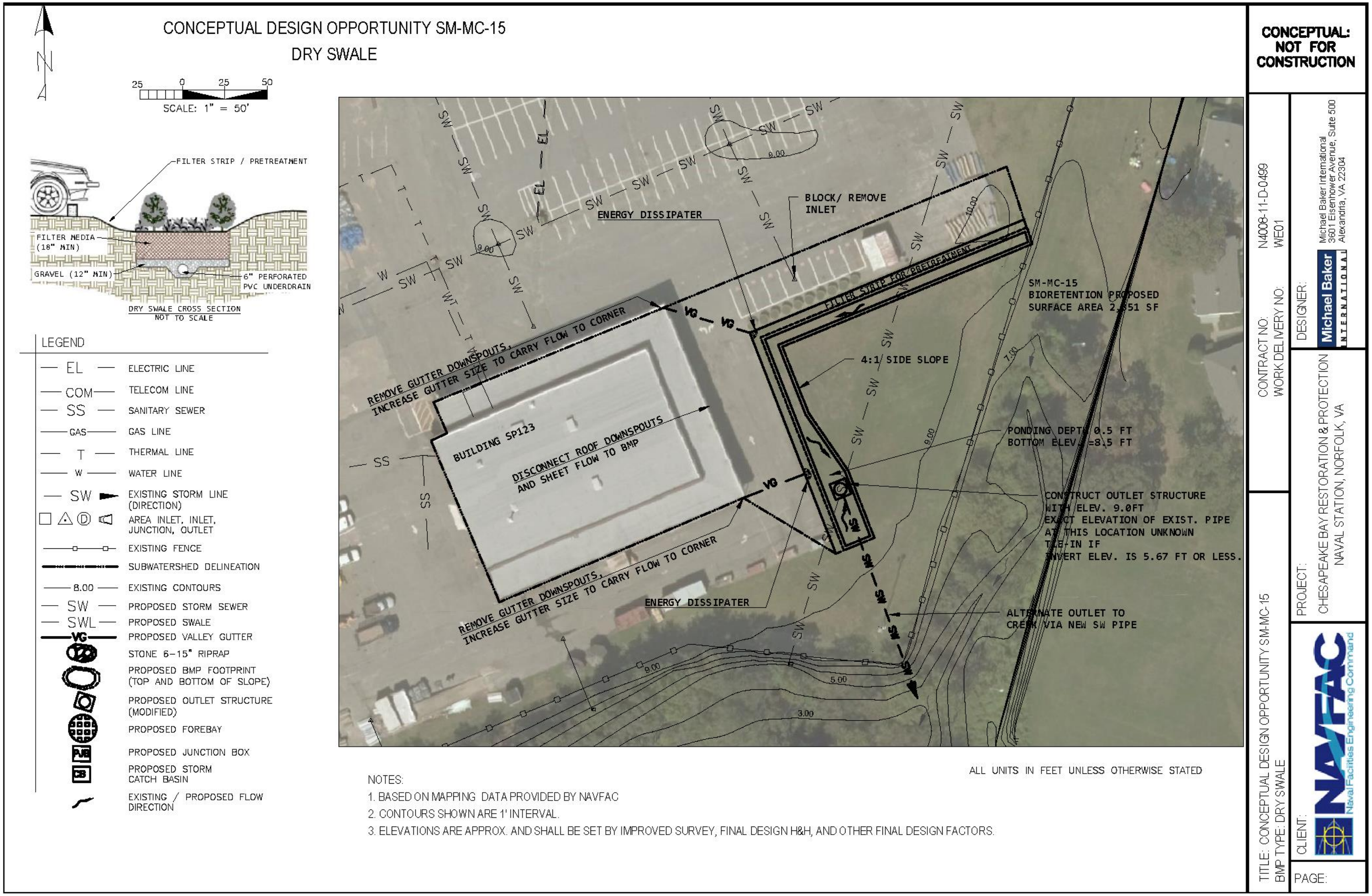


Diagram Credit: Virginia BMP Clearinghouse

Virginia BMP Clearinghouse Removal Efficiencies by BMP Practice

Summarized List of Practices	Virginia BMP Clearinghouse Established Efficiencies		Chesapeake Bay Program Established TSS Efficiency
	TN	TP	TSS
Grass Channel	28%	23%	50%
Permeable Pavement 1	59%	59%	55%
Permeable Pavement 2	81%	81%	55%
Infiltration 1	57%	63%	95%
Infiltration 2	92%	93%	95%
Bioretention 1	64%	55%	55%
Bioretention 2	90%	90%	55%
Urban Bioretention	64%	55%	55%
Dry Swale 1	55%	52%	55%
Dry Swale 2	74%	76%	55%
Wet Swale 1	25%	20%	50%
Wet Swale 2	35%	40%	50%
Filtering Practice 1	30%	60%	80%
Filtering Practice 2	45%	65%	80%
Constructed Wetland 1	25%	50%	60%
Constructed Wetland 2	55%	75%	60%
Wet Pond 1	20%	45%	60%
Wet Pond 2	30%	65%	60%
Extended Detention Pond 1	10%	15%	60%
Extended Detention Pond 2	24%	31%	60%

Example of Conceptual Drawing

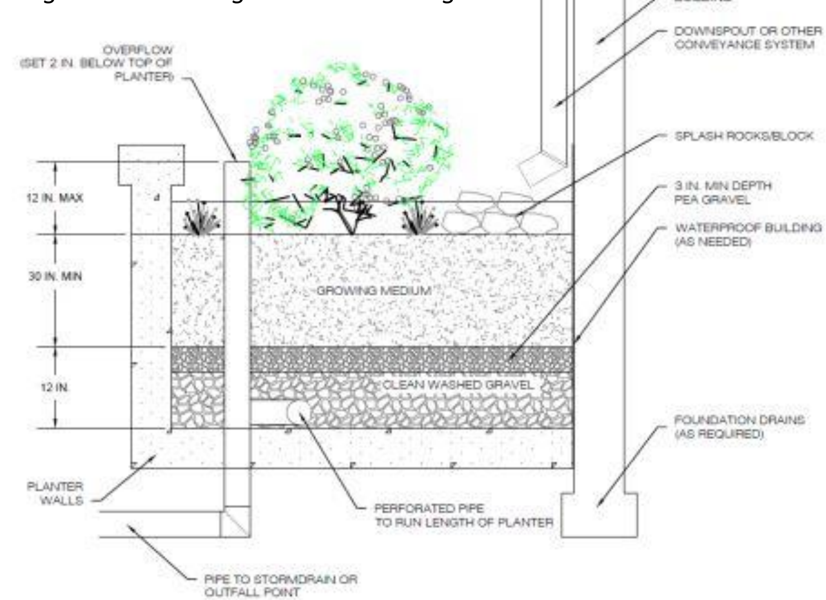


A Few Problems and Solutions

Land Constraints

Use storage depth calculation to minimize the surface area needed

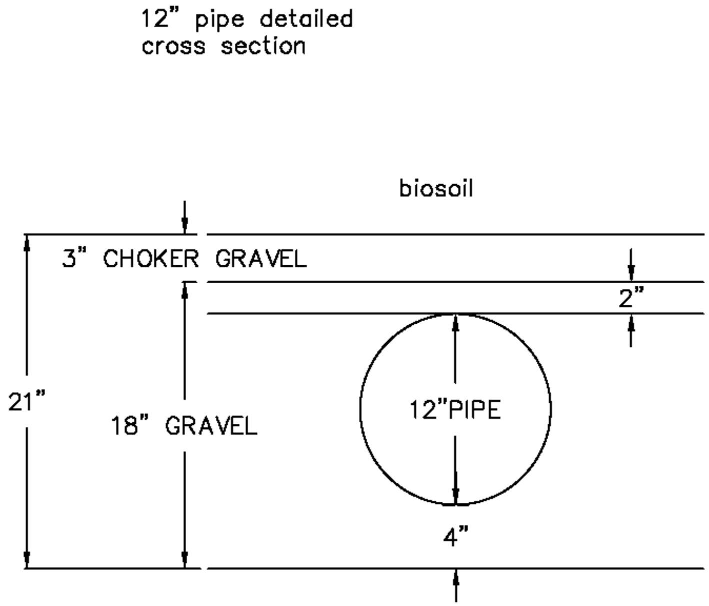
Diagram Credit: Virginia BMP Clearinghouse

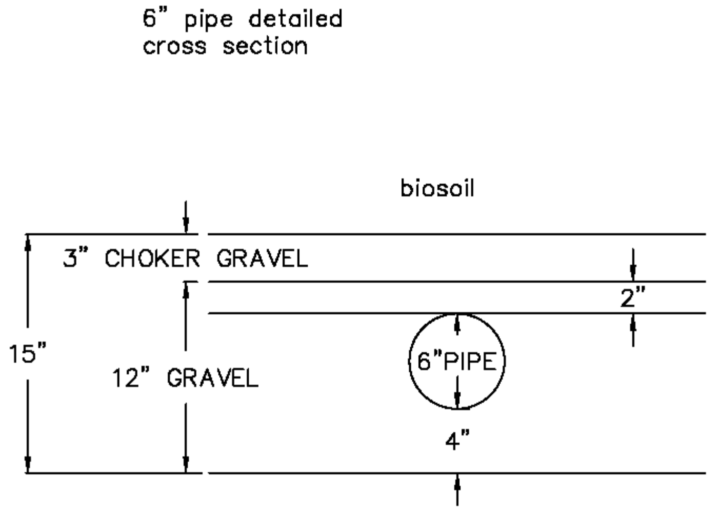


	Example	Void Ratio	Storage Depth With Voids	Storage Depth Without Voids
Ponding Depth	0.5 feet	1.00		
Gravel Depth	1.0 feet	0.40	1.275	0.5
Biosoil Depth	1.5 feet	0.25		
			Surface Area	Surface Area
			819 sq. ft.	**2,088 sq. ft.**

Limitations of Existing Storm System and High Water Tables

- Accurately account for the total depth. If 1' of clearance from the water table is unavailable, consider level one or wet practice





*Limitations of Using Wet Practices

(the solution to one problem can be the cause of another)

- Generally lower pollutant reduction rates
- Bird Air Strike Hazard (BASH) complications near airports or flight paths

Coastal/Tidal Influences and Sea Level Rise

- Larger Pipes and Forebays
- Design Inland (LID)
- Plant Selection (salt tolerant, native species)

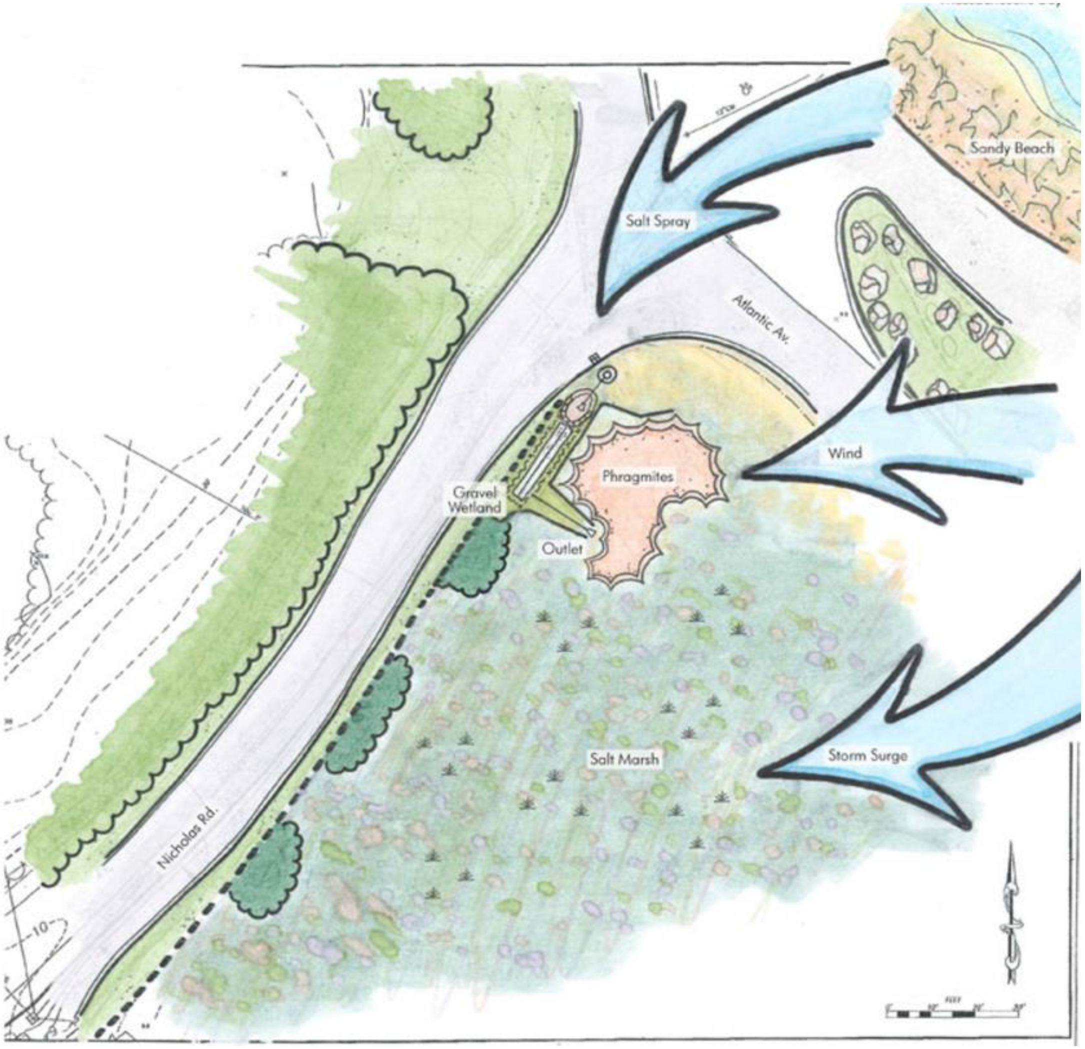


Diagram Credit: mass.gov/eea, Climate Change Stormwater BMPs Factsheet

Cost

- Try to maximize the size or group smaller projects together (for retrofits) to minimize mobilization cost

Design Costs				
Field survey and basemap prep	DAY	1	$ 1,500	$ 1,500
Infiltration test	EA	1	$ 450	$ 450
Geotechnical Evaluation	EA	1	$ 3,500	$ 3,500
Engineering (Max of 10% Construction or $20,000)	LS	1	$ 20,000	$ 20,000
Permitting	LS	1	$ 3,000	$ 3,000
	Design Cost Subtotal			**$ 28,450**

When Traditional BMP Retrofits Are Not Possible, or Are Not Enough

- Non-Traditional BMPs
  - Floating Islands
  - Shoreline Restoration
  - Stream Restoration
- Non-Structural BMPs
  - Street Sweeping
  - Filter Strips
  - Land Use Conversion

Highlights for Improving BMP Success

- Stakeholder Coordination
- Avoid Complications
  - Utilities
  - BASH
  - BMP Total Depth vs. Water Table
  - Existing Topography for Overland Conveyance
- Maximize Efficiency
  - Maximize Drainage Area
  - BMP Type
  - Appropriate Sizing
  - Group Small Projects Together

Thank you!

Any questions or ideas?