Understand the Plan: Developing Methods to Report Bacteria TMDL Credit

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Brown AND Caldwell

Overview

- Background
- Bacteria reduction approaches
- Metrics & reporting
- Achieving a TMDL & setting better goals
- Conclusion

Virginia MS4 Permits

- Phase II General Permit
  - 106 Active Permits
- Phase I Individual Permits
  - 11 Active Permits

Virginia TMDL Process

- Impaired Waters
- Total Maximum Daily Loads
- TMDL Implementation Plans
  - Developed by DEQ on a watershed scale
- TMDL Action Plans
  - Developed by individual municipalities

Local TMDL Action Plans

- Phase II Permit
  - Year 2 – TMDLs approved prior to July 9, 2008
  - Year 3 – TMDLs approved between July 9, 2008 and July 1, 2013
- Phase I Permits
  - Year 2 – TMDLs approved prior to permit approval date

Other TMDL Reporting Requirements

- Annual reporting
  - Progress toward goals defined in Action Plan
  - Monitoring results
- Estimated date for achieving waste load allocations
  - Required at reapplication for Phase II Permits
  - Required in Phase I Action Plans

What are Bacteria TMDLs?

- Describes the total loading a water can receive while still maintaining its designated use
- Sources
  - Human
  - Pet
  - Wildlife
  - Livestock

Pollutants of Concern

- Fecal indicator bacteria
  - Fecal Coliform for shellfish waters
  - *E. coli* for freshwater
  - *Enterococci* for transitional waters
- Testing methodology
  - Single sample maximums
  - Geometric means

VA Water Quality Criteria

Indicator	Geometric Mean	Single Sample Maximum
Freshwater (per 100 mL)		
E. coli	126	235
Transition and Saltwater (per 100 mL)		
Enterococci	35	104

Reference: Code of Virginia 9VAC25-260-170 (2010)

MD Water Quality Criteria

	Geometric Mean	Single Sample Maximum			
Indicator	All Areas	Frequent Contact	Moderate Contact	Occasional Contact	Infrequent Contact
Freshwater (per 100 mL)					
Enterococci	33	61	78	107	151
E. coli	126	235	298	410	576
Marine Water (per 100 mL)					
Enterococci	35	104	158	275	500

Reference: Code of Maryland 26.08.02.03-3 (2014)

Approaches to Reduce Bacteria

- Focus on bacteria sources
  - Coordination with utilities
  - Programmatic measures
- Wet weather reductions
  - Runoff Reduction
  - Environmental site designs
- Stream Restoration

Coordination with Utilities

- Primary human sources
  - Straight pipes
  - Septic tanks
  - I & I
  - Overflows
- Usually not operated by MS4

Programmatic Measures

Approaches to Reduce Bacteria – Runoff Reduction

- Bacteria removal mechanisms[1]
  - UV Radiation
  - Predation
  - Sedimentation
  - Exposure To Air
  - Filtration

Example BMP Descriptions and Theoretical Removal Mechanisms[2]	
BMP Type	Treatment Mechanisms Relevant to Pathogen Removal
Dry Detention Basin	Drying, sun exposure, sedimentation
Wet pond	Sun exposure, sedimentation
Stormwater Wetland	Sun exposure, sedimentation, some drying
Sand Filter	Drying, sedimentation, filtration
Bioretention	Drying, sun exposure, sedimentation, filtration
Grassed Swales	Sedimentation, sun exposure, drying
Proprietary Devices	Varies based on manufacturer: normally sedimentation and sometimes filtration

[1]Pathogens in Urban Stormwater Systems
[2]Urban Waterways Removal of Pathogens in Stormwater

A Runoff Reduction Case Study

Wetland 1

Wetland 2

Study referenced from the Journal of Environmental Engineering December 2009. Article *Indicator Bacteria Removal in Storm-Water Best Management Practices in Charlotte, North Carolina* written by J.M. Hathaway, W.F. Hunt, and S. Jadlocki

Developing Metrics

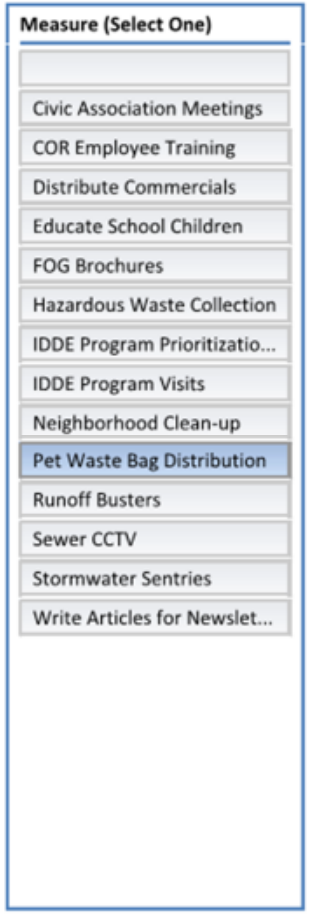
Developing Metrics

- Semi-quantitative approach
  - Degree of implementation
  - Measurable goals
- Programs may be operated by other municipal departments

Developing Metrics

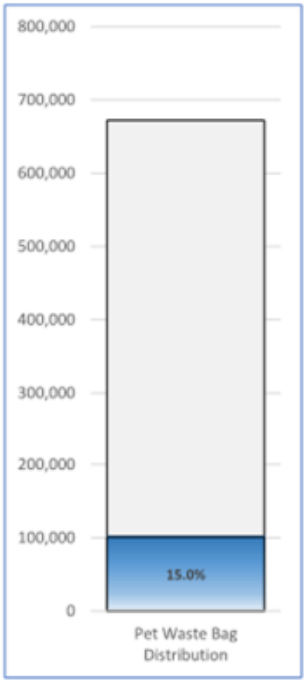
- Tracking goals for programmatic measures

Measure		2014
Pet Waste Bag Distribution	Actual	34,400
	Target	56,000
Neighborhood Clean-up	Actual	
	Target	
Hazardous Waste Collection	Actual	200
	Target	215,000
FOG Brochures	Actual	200
	Target	215,000
Distribute Commercials	Actual	
	Target	
Write Articles for Newsletters	Actual	
	Target	
COR Employee Training	Actual	
	Target	
Educate School Children	Actual	341
	Target	20,000
Civic Association Meetings	Actual	
	Target	215,000



Pet Waste Bag Distribution

Year	Actual	Estimated
2014	34,400.00	56,000.00
2015	66,670.00	56,000.00
2016	0.00	56,000.00
2017	0.00	56,000.00
2018	0.00	56,000.00
2019	0.00	56,000.00
2020	0.00	56,000.00
2021	0.00	56,000.00
2022	0.00	56,000.00
2023	0.00	56,000.00
2024	0.00	56,000.00
2025	0.00	56,000.00
Grand Total	101,070.00	672,000.00
Percentage	15.0%	



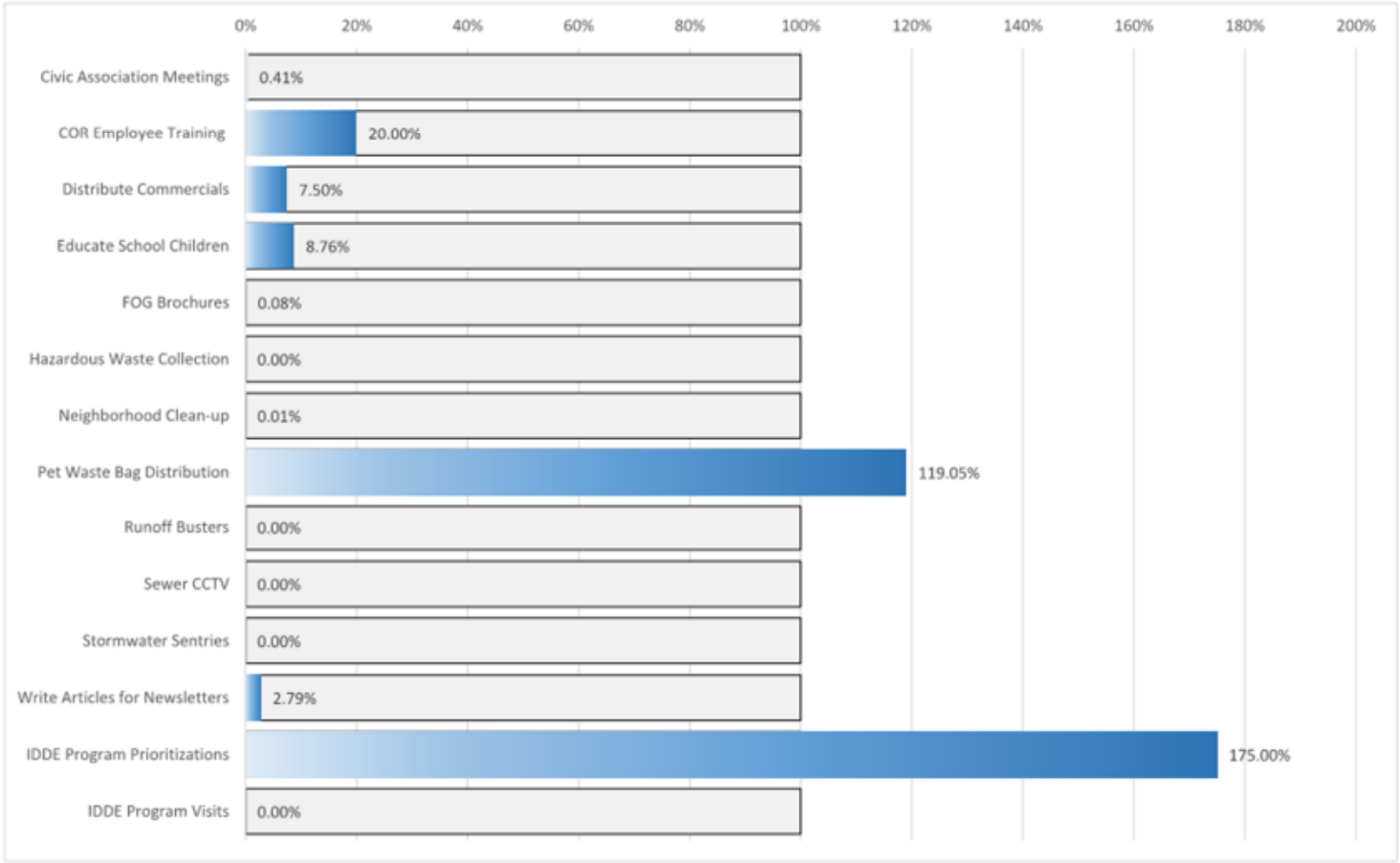
Reporting

2015 Measure Data

Measure	Actual	Estimated	Percent	Actual (Cum.)	Targets (Cum.)	Percent (Cum.)
Civic Association Meetings	878	215,000	0.4%	878	430,000	0.2%
COR Employee Training	20	100	20.0%	20	100	20.0%

Measure (Select Multiple)

- Civic Association Meetin
- COR Employee Training
- Distribute Commercials
- Educate School Children
- FOG Brochures
- Hazardous Waste Collect
- IDDE Program Prioritizati
- IDDE Program Visits
- Neighborhood Clean-up
- Pet Waste Bag Distributi
- Runoff Busters
- Sewer CCTV
- Stormwater Sentries
- Write Articles for Newsle



Monitoring

- Single sample maximums
- Geometric mean (if available)
- Trend analysis

DEQ Enterococcus Monitoring Results at Station BRK004.14					
Date Range	No. of Samples	Min Cts/100mL	Max Cts/100mL	Avg Cts/100mL	Inst. Max Exceedances
2002-2012	61	N/A	N/A	478	74%
2012-2013	11	25	2,000	639	73%

Achieving a TMDL

- Current methodology
  - removal of bacteria without consideration of the source
- Chickahominy River and Tributaries Bacterial Implementation Plan (developed by DEQ)
  - Percent required bacterial load reductions
    - ~~Wildlife direct and land based – 77%~~
    - Livestock direct – 100%
    - Agricultural land based – 99%
    - Human direct – 100%
    - Human and pet land based – 99%

Reference: *Chickahominy River and Tributaries Implementation Plan*, MapTech, Inc. (2016)

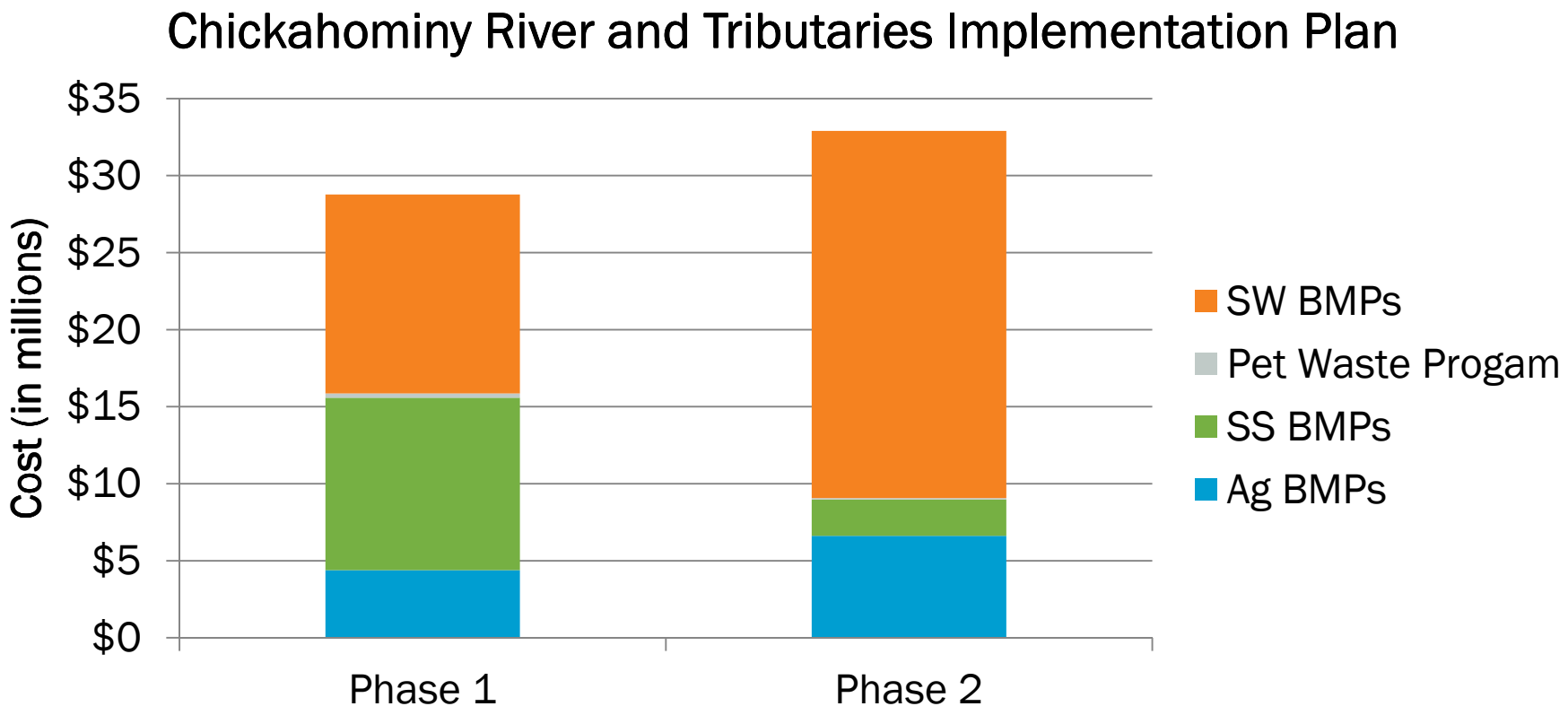
Achieving a TMDL

Best Management Practice	Stage 1 Years 1-10	Stage 2 Years 11-20
Septic System Pump Outs (systems)	5,234	5,234
Septic Repairs, Replacements, Installations (systems)	177	0
Sewer Connections (systems)	245	
Pet waste pickup and composter program (%program)	75%	25%
Stormwater Treatment (acres)	*300*	*5,400*
Vegetated Buffers (linear feet)	*10,000*	*10,000*
Residential Education Program (%program)	100%	0%
Technical Assistance (FTE)	*7.5*	*7.5*

Reference: *Chickahominy River and Tributaries Implementation Plan*, MapTech, Inc. (2016)

Achieving a TMDL

- Current methodology
  - removal of bacteria without consideration of the source



Reference: MapTech, Inc. (2016)

Is there a better way?

2012 EPA Recreational WQ Criteria

- WQ Criteria developed based upon health risks
- Bacteria is easier to identify than other pathogens
- States have the option to adopt other scientifically defensible criteria

EPA Recommended Recreational Criteria

Indicator	Geometric Mean (cfu per 100 mL)	Statistical Threshold Value (cfu per 100 mL)
E. coli (freshwater)	126	410
Enterococci (marine and freshwater)	35	130

Reference: EPA (2012)

VA Water Quality Criteria

Indicator	Geometric Mean	Single Sample Maximum
Freshwater (per 100 mL)		
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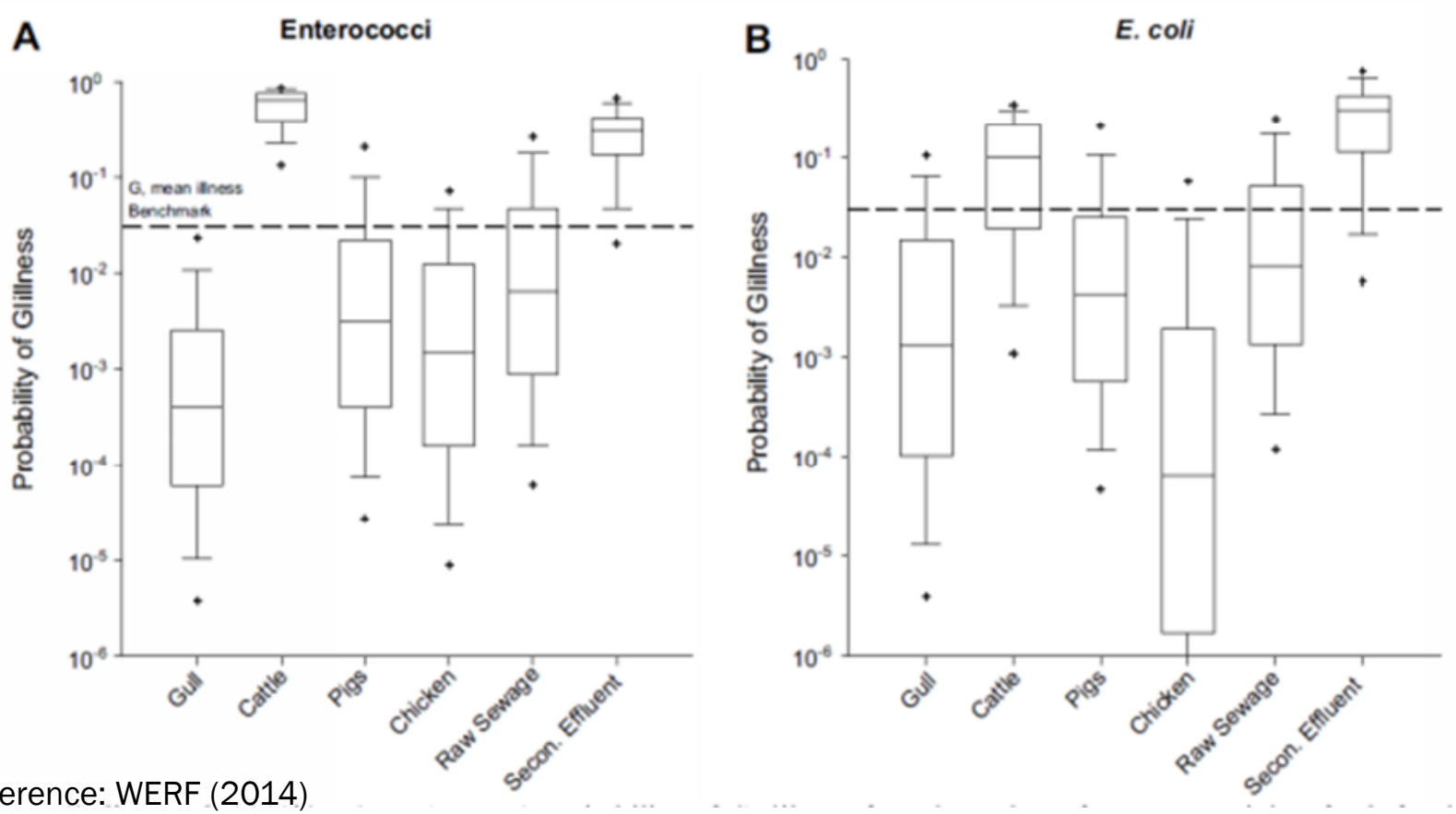
What makes people sick?

Figure 2-2. QMRA-based Probability of Gastrointestinal Illness from Ingestion of Water Containing Fresh Fecal Contamination from Various Sources
(Soller et al. 2010b)



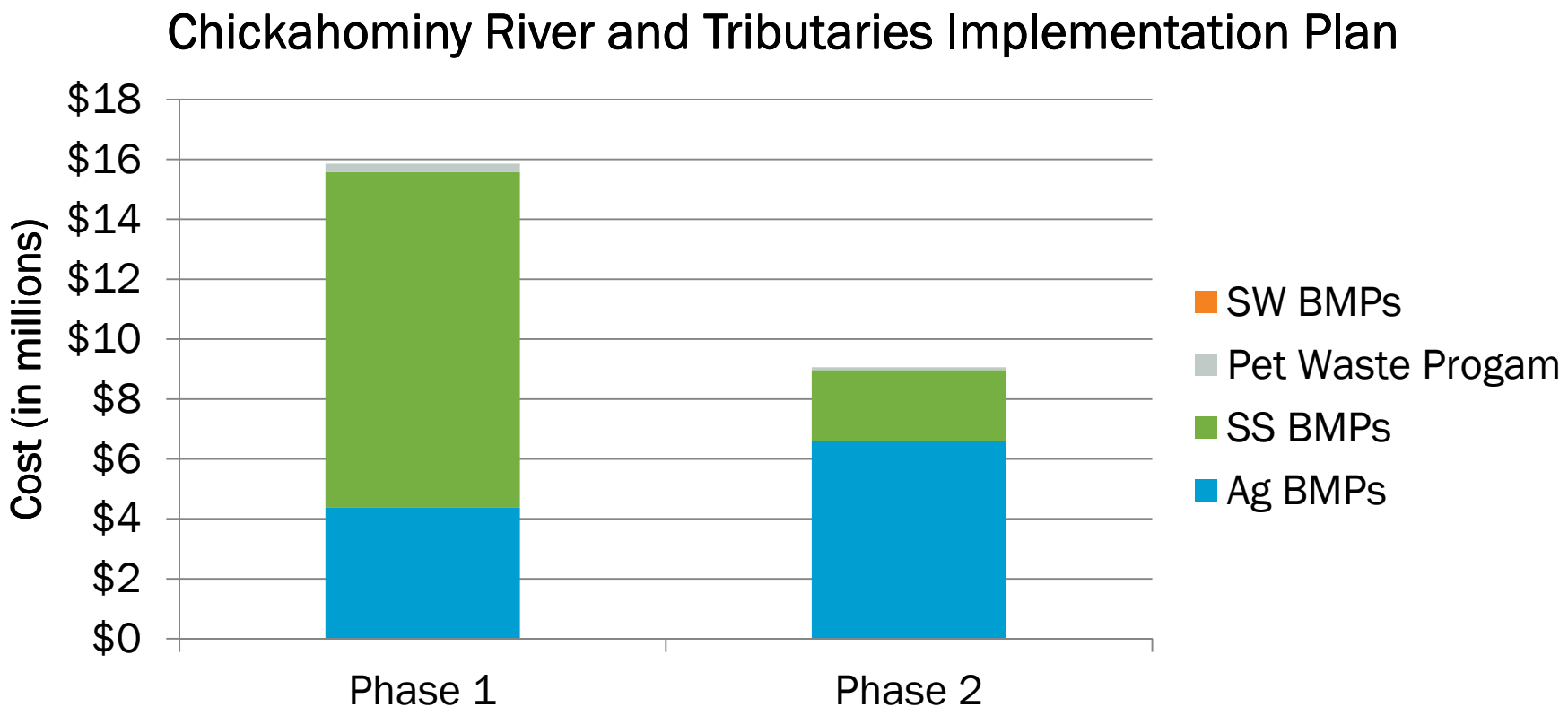
Reference: WERF (2014)

Microbial Source Tracking Technology

- Using BST to understand human and animal contributions and reductions
  - Presence or absence testing
  - Select one or more sources to test
- Prioritize removing sources that impact people
  - Reducing the probability of illness

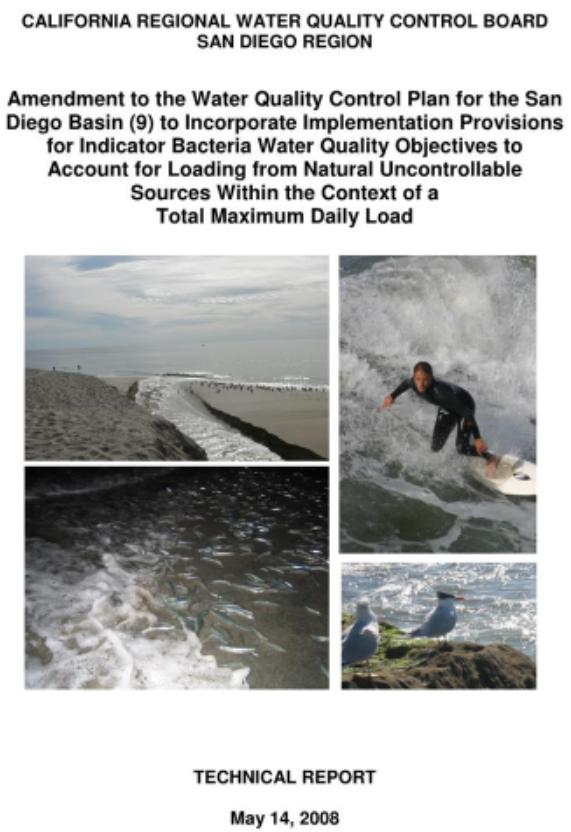
Focused Approach to Implementation

- Removing the stormwater BMPs



Reference: MapTech, Inc. (2016)

Another Approach – San Diego, CA


CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

Amendment to the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Implementation Provisions for Indicator Bacteria Water Quality Objectives to Account for Loading from Natural Uncontrollable Sources Within the Context of a Total Maximum Daily Load

TECHNICAL REPORT

May 14, 2008

- Identify and quantify bacteria sources
- Eliminate “controllable” anthropogenic sources
- Determine the remaining exceedances
- Remaining exceedances become allowable exceedances

Conclusion

- MS4 Action Plans are a first step to addressing bacteria on a large scale
- A variety of projects and programs are already being implemented
- Metrics need to be developed to track progress
- MST analysis may increase the precision of early implementation
- The future of implementation may change focus to MST

Questions?

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