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Watershed Planning: Tips, Tools & Lessons Learned

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D H E C
PROMOTE PROTECT PROSPER
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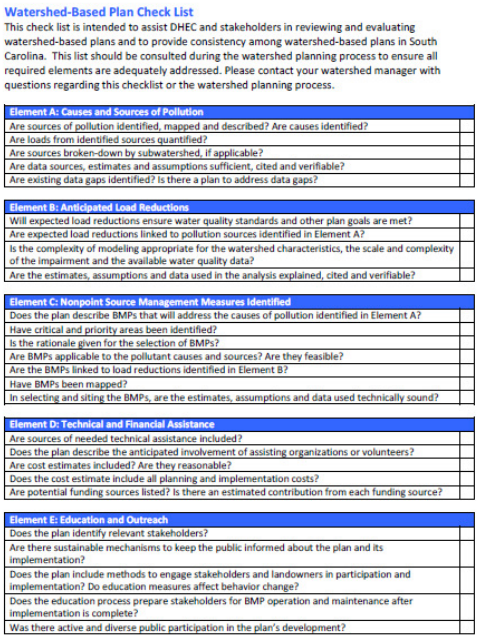
Overview

Purpose: to outline DHEC's expectations for watershed based plans and provide tools and suggestions to help meet those expectations

EPA's 9 required elements of a watershed based plan (WBP)

- Definition
- Lessons Learned
- Examples
- Tools
- Questions

9 Elements are required but your methodology is flexible



Watershed-Based Plan Check List

This check list is intended to assist DHEC and stakeholders in reviewing and evaluating watershed-based plans and to provide consistency among watershed-based plans in South Carolina. This list should be consulted during the watershed planning process to ensure all required elements are adequately addressed. Please contact your watershed manager with questions regarding this checklist or the watershed planning process.

Element A: Causes and Sources of Pollution	
Are sources of pollution identified, mapped and described? Are causes identified?	
Are loads from identified sources quantified?	
Are sources broken-down by subwatershed, if applicable?	
Are data sources, estimates and assumptions sufficient, cited and verifiable?	
Are existing data gaps identified? Is there a plan to address data gaps?	

Element B: Anticipated Load Reductions	
Will expected load reductions ensure water quality standards and other plan goals are met?	
Are expected load reductions linked to pollution sources identified in Element A?	
Is the complexity of modeling appropriate for the watershed characteristics, the scale and complexity of the impairment and the available water quality data?	
Are the estimates, assumptions and data used in the analysis explained, cited and verifiable?	

Element C: Nonpoint Source Management Measures Identified	
Does the plan describe BMPs that will address the causes of pollution identified in Element A?	
Have critical and priority areas been identified?	
Is the rationale given for the selection of BMPs?	
Are BMPs applicable to the pollutant causes and sources? Are they feasible?	
Are the BMPs linked to load reductions identified in Element B?	
Have BMPs been mapped?	
In selecting and siting the BMPs, are the estimates, assumptions and data used technically sound?	

Element D: Technical and Financial Assistance	
Are sources of needed technical assistance included?	
Does the plan describe the anticipated involvement of assisting organizations or volunteers?	
Are cost estimates included? Are they reasonable?	
Does the cost estimate include all planning and implementation costs?	
Are potential funding sources listed? Is there an estimated contribution from each funding source?	

Element E: Education and Outreach	
Does the plan identify relevant stakeholders?	
Are there sustainable mechanisms to keep the public informed about the plan and its implementation?	
Does the plan include methods to engage stakeholders and landowners in participation and implementation? Do education measures affect behavior change?	
Does the education process prepare stakeholders for BMP operation and maintenance after implementation is complete?	
Was there active and diverse public participation in the plan's development?	

•The content of this presentation is based on the experience of watershed planners throughout the southeast as well as EPA.

•This presentation has been formatted to discuss EPA's nine required elements for watershed based plans in order from A through I. The nine elements do follow a logical sequence, but that sequence does not necessarily have to be followed. Watershed planners may find that some elements should be developed simultaneously or in a different order.

•A copy of DHEC's "Watershed-Based Plan Check-List" may be obtained by contacting your watershed manager.

Building Partnerships

- Identify driving forces/common goals for watershed planning and restoration
- Two types of watershed stakeholders:
  - Those affected by the plan
  - Those that are interested in the plan
- Include a variety of opinions, backgrounds and expertise

•The watershed planning process really begins with partnership building.

•When choosing partners, consider partner goals and motivations for participation including regulatory as well as community drivers.

•Include those that may be affected by the plan including those who live or work in the watershed, whose business or leisure activities are affected by water quality problems or who may be able to help implement the plan. Also consider those not directly affected by the plan but that may have relevant expertise or interest in the plan.

Element A: Identifying Causes & Sources of Impairment

An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed based plan (and to achieve any other watershed goals identified in the watershed based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded stream-bank needing remediation).

•The cause of an impairment is not necessarily the same as the source of the impairment. For example, the cause of a macroinvertebrate impairment may be excess sedimentation. However, the source of the sediment may be runoff from construction sites.

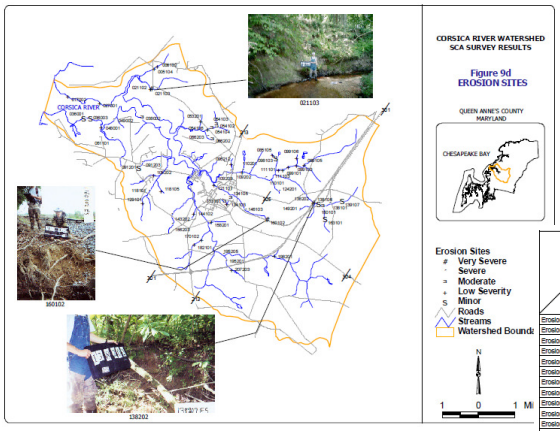
Element A: Lessons Learned

- Use the best available data. Note data quality as you compile it.
- Identify data gaps.
- Use maps (during planning, in your plan).
- Determine relative contributions from each source, not just the overall reductions needed.
- Identify pathways of pollution.
- Define critical areas. Where are your hot spots?

Element A is the foundation of your plan. Thorough watershed characterization will make it easier to write the subsequent plan elements.

•Element A is also the baseline from which plan success will be measured.

Element A: Examples



Erosion Site	021103	06/25/2003	Widening	Natural	1037	4	Forest	Forest	No		1	2	2
Erosion Site	138202	06/09/2003	Widening	Below Channelization	7230	4	Forest	Forest	No		1	5	4
Erosion Site	160102	06/03/2003	Widening	Below Road Crossing	3430	4	Crop Field	Forest	No		1	4	2
Erosion Site	061101	06/24/2003	Widening	Bend at Steep Slope	4380	1	Forest	Forest	No		2	2	4
Erosion Site	066203	07/07/2003	Downcutting	Bend at Steep Slope	1000	1.5	Forest	Forest	No		2	2	4
Erosion Site	091203	06/24/2003	Downcutting	Bend at Steep Slope	3200	1	Forest	Forest	No		2	2	2
Erosion Site	098104	05/12/2003	Widening	Bend at Steep Slope	1720	2	Forest	Forest	No		2	3	4
Erosion Site	109102	05/27/2003	Widening	Land Use Change Upstream	1720	3	Forest	Forest	No		2	4	3
Erosion Site	109203	06/03/2003	Widening	Bend at Steep Slope	1480	2	Forest	Forest	No		2	3	2
Erosion Site	110101	05/27/2003	Widening	Bend at Steep Slope	1390	1	Forest	Forest	No		2	2	3
Erosion Site	110201	06/03/2003	Widening	Bend at Steep Slope	3080	2	Forest	Forest	No		2	3	4
Erosion Site	118101	06/24/2003	Widening	Natural	2060	2.5	Lawn	Forest	No		2	2	2
Erosion Site	124201	06/09/2003	Widening	Bend at Steep Slope	2280	3	Forest	Forest	No		2	4	3
Erosion Site	138101	06/11/2003	Widening	Bend at Steep Slope	1725	3	Crop Field	Crop Field	No		2	3	3
Erosion Site	143202	06/17/2003	Widening	Below Road Crossing	4600	3	Forest	Forest	No		2	5	1
Erosion Site	146103	06/03/2003	Widening	Bend at Steep Slope	3060	2	Forest	Forest	No		2	3	4
Erosion Site	149201	06/09/2003	Widening	Land Use Change Upstream	1715	1	Forest	Forest	No		2	2	4
Erosion Site	155203	06/17/2003	Widening	Below Road Crossing	1630	2	Pasture	Pasture	No		2	2	2
Erosion Site	195201	06/17/2003	Widening	Below Road Crossing	1000	1	Forest	Forest	No		2	3	3
Erosion Site	195205	06/17/2003	Widening	Below Road Crossing	3700	1	Forest	Forest	No		2	3	4
Erosion Site	054102	07/01/2003	Widening	Bend at Steep Slope	470	4	Crop Field	Crop Field	No		3	2	3
Erosion Site	054103	07/01/2003	Widening	Bend at Steep Slope	300	4	Crop Field	Crop Field	No		3	3	3
Erosion Site	054104	07/01/2003	Widening	Bend at Steep Slope	475	4	Crop Field	Crop Field	No		3	3	3
Erosion Site	066202	07/01/2003	Downcutting	Bend at Steep Slope	700	4	Forest	Forest	No		3	3	3
Erosion Site	133101	06/03/2003	Widening	Bend at Steep Slope	375	5	Forest	Forest	No		3	4	2
Erosion Site	134105	06/03/2003	Widening	Bend at Steep Slope	570	4	Forest	Forest	No		3	4	2
Erosion Site	160101	06/11/2003	Widening	Bend at Steep Slope	480	4	Crop Field	Crop Field	No		3	3	3
Erosion Site	005102	06/25/2003	Widening	Bend at Steep Slope	900	3	Forest	Forest	No		4	2	2

Table 1.5

CAUSE – EFFECT
Fecal Coliform Stream Loading Sequence:

Potential Sources → Availability of Sources → Delivery Fraction → Resulting Stream Concentration

Tables 1.1 through 1.4 represent each of the four steps and are expressed as percent delivery from each of the available sources.

Element A: Examples

Table 6.1. Potential pollutant sources in the Plum Creek Watershed.

Potential Sources	Bacteria	Nutrients	Other
Urban			
Urban Runoff	X	X	X
Pets	X	X	
Wastewater			
Septic Systems	X	X	X
Wastewater Treatment Facilities	X	X	X
Agriculture			
Sheep and Goats	X	X	
Horses	X	X	
Cattle	X	X	
Cropland		X	X
Wildlife			
Deer	X	X	
Feral Hogs	X	X	X
Oil and Gas Production			X

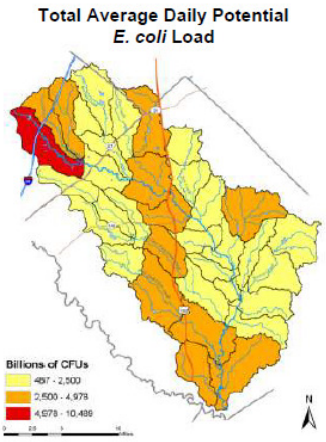
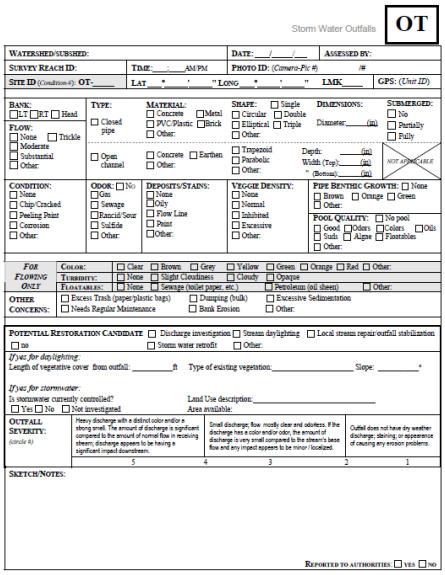


Figure 6.1. Estimate of total potential bacteria contribution by all sources by subwatershed.

Element A: Tools



Storm Water Outfalls **OT**

WATERSHED/SUBSHED: DATE: ___/___/___ ASSESSED BY:

SURVEY REACH ID: TIME: ___:___ AM/PM PHOTO ID: (*Camera-Pic #*) /#

SITE ID (*Condition-#*): OT-____ LAT ___ ° ___ ' ___ " LONG ___ ° ___ ' ___ " LMK____ GPS: (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe ☐ Open channel

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Diameter:____(in) Depth: ____(in) Width (Top):____(in) * (Bottom):____(in) NOT APPLICABLE

SUBMERGED: ☐ No ☐ Partially ☐ Fully

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Flammables ☐ Other:

FOR FLOWING ONLY

COLOR: ☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:

TURBIDITY: ☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque

FLOATABLES: ☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE: ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes, for daylighting:
Length of vegetative cover from outfall: _____ft Type of existing vegetation:_____ Slope: _____°

If yes, for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:_____
Area available:

OUTFALL SEVERITY: (*circle #*)

5 — Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.

4 3 2

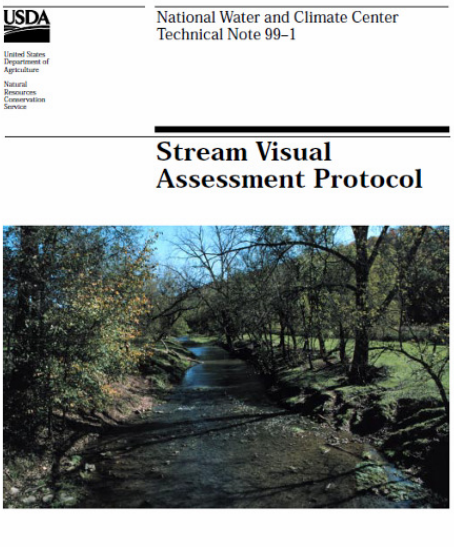
1 — Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.

Outfall does not have dry weather discharge, staining, or appearance of causing any erosion problems.

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

http://awsps.org/center-publications/cat_view/65-tools/95-field-sheets/134-usa.html



USDA
United States Department of Agriculture
Natural Resources Conservation Service

National Water and Climate Center
Technical Note 99–1

Stream Visual Assessment Protocol

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044776.pdf

Do a visual assessment of your watershed- write down what you find- incorporate your findings into your data analysis

Element A: Questions to Ask

Are sources of pollution identified, mapped and described? Are causes identified?

Are loads from identified sources quantified?

Are the sources broken down by sub-watershed, if applicable?

Are data sources, estimates and assumptions sufficient, cited and verifiable?

Are existing data gaps identified? Is there a plan to address data gaps?

Setting Goals

The end goals of implementation are restored water quality of the impaired waters and subsequent de-listing of both streams from the Commonwealth of Virginia's Section 305(b)/303(d) list within 10 year for Little Creek and 12 years for Beaver Creek.

The goal of this watershed-based plan is to provide a road map toward meeting West Virginia's numeric and narrative water quality criteria. Streams not meeting water quality standards are placed on a statewide list of impaired streams called the 303(d) list. Improving water quality so these streams are once again clean and can be removed from this list is the primary goal of this plan.

The Crane Creek Watershed Association is a citizen-based group united for and working to maintain, protect, and further improve the natural environment within the Crane Creek Watershed. Our vision for the watershed is to be a place where people enjoy hiking trails, scenic parks, and fishing and swimming in the creeks and ponds within the watershed, and where environmentally-sound development codes protect the health of the watershed by taking into account impacts on water quality, water quantity, and wildlife habitat. The Association will achieve this vision by providing a unified voice to the appropriate governmental agencies to enforce existing laws and discourage actions that will be harmful to the watershed. The association will foster partnerships to improve knowledge of existing conditions, take action to correct identified problems, and educate citizens and public officials on the state of Crane Creek Watershed.

The goal of the ACW Protection Plan is to reduce the addition (*i.e.*, loading) of pollutants such as oxygen-demanding substances, nitrogen, phosphorus and sediment to the Arroyo Colorado and to improve natural habitat to the degree necessary to meet the uses designated by the State of Texas and specified in the State's Water Quality Standards (30 TAC §§307.1-307.10). Although not specifically targeted for reduction, fecal bacteria loading to the Arroyo Colorado is also expected to diminish as an ancillary effect of ACW Protection Plan implementation.

- Watershed goals should explicitly be stated in the plan.
- Consider watershed goals early in the planning process.

Element B: Estimated Load Reductions

An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for row crops; eroded streambanks, etc.).

Element B: Lessons Learned

- Use TMDL information, don't just copy it.
- Expected reductions from implementation don't necessarily equal reductions needed to meet water quality standards. Understand the cause and effect relationship between pollutant loads and waterbody response.
- Provide load reduction estimates at the same scale and scope as in Element A.
- Consider synergistic effects of multiple practices.
- Consider multiple scenarios to meet your target reductions but choose one that will be implemented!

Element B: Examples

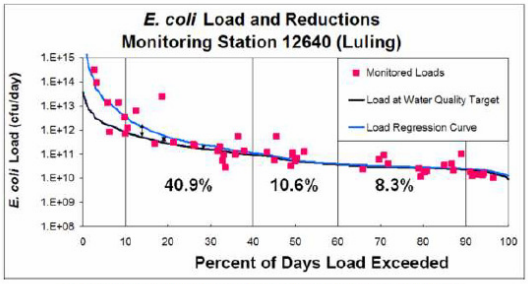


Figure 5.4. *E. coli* load duration curve for station 12640 near Luling in Caldwell County.

Table 5.1. Annual load characteristics and *E. coli* reductions for each station (in billions of cfu).

Monitoring Station	Mean Annual *E. coli* Load (cfu/year)	Minimum 95% CI[1]	Maximum 95% CI[1]	Load Reduction (cfu/year)	Target Load (cfu/year)
Uhland (17406)	1.12E+05	8.74E+04	1.36E+05	7.28E+04	3.92E+04
Lockhart (12647)	4.26E+05	2.46E+05	6.06E+05	6.39E+04	3.62E+05
Luling (12640)	3.02E+07	1.04E+07	5.01E+07	1.24E+07	1.78E+07

[1] The 95% confidence interval for minimum and maximum nutrient loads.

Pollutant Reduction Needed			
Region	*E. coli* Bacteria	Phosphorus	Nitrate
Uhland	65%	27%	43%
Lockhart	15%	49%	80%
Luling	41%	0%	1%

Element B: Examples

Table 20: Fecal coliform reductions by subwatershed and agricultural best management practice (counts/year)

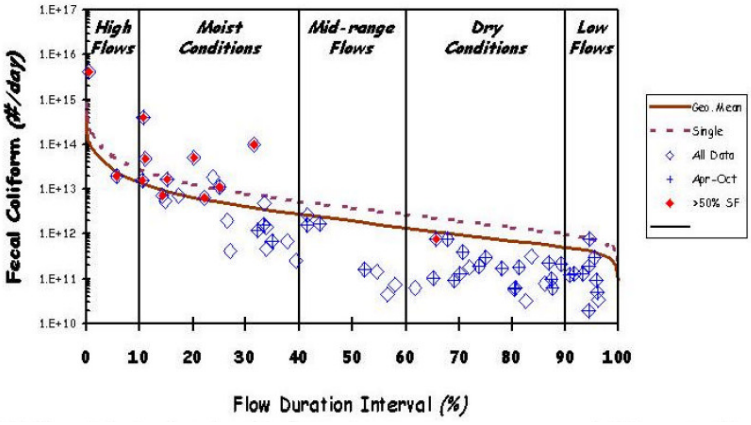
Agricultural intensity	Stream	SWS	Fencing	Riparian buffer	Total
High	**Crooked Run**	1048	6.7E+12	2.01E+12	8.71E+12
	Wolf Creek	1040	7.77E+12	2.33E+12	1.01E+13
	Short Creek	1039	1.27E+13	3.8E+12	1.65E+13
Moderate	**Wolf Creek**	1038	7.21E+11	2.16E+11	9.37E+11
	Levisee Creek	1041	1.13E+13	3.4E+12	1.47E+13
Low	**Wolf Creek**	1045	5.27E+11	1.58E+11	6.85E+11
	Wolf Creek	1043	2.11E+11	6.32E+10	2.74E+11
	House Branch	1049	4.75E+11	1.43E+11	6.18E+11
	Adkins Branch	1044	5.98E+11	1.79E+11	7.77E+11
	Toney Hollow	1042	6.57E+11	1.97E+11	8.54E+11
Total			4.17E+13	1.25E+13	5.42E+13

Impaired streams appear in bold. SWS=subwatershed in the TMDL. UNT=unnamed tributary. Reduction efficiencies from Hardy et al. (2007).

Table E.2. Annual Load Reductions from Recommended Practices

Management Practice	N (lbs/ac/year)	P (lbs/ac/year)	TSS (lbs/ac/year)	Bacteria (billion/ac/year)
Lawn Care Education	0.236	0.005	0.000	0.000
Pet Waste Education	0.029	0.004	0.000	0.253
Erosion and Sediment Control	0.009	0.011	10.921	0.000
Impervious Cover Disconnection	0.009	0.001	0.248	0.393
Structural Stormwater Management Practices (including retrofits)	0.005	0.001	0.487	0.738
Riparian Buffers	0.125	0.006	9.462	0.000
Septic System Education	0.004	0.000	0.013	0.029
Illicit Connection Removal	0.022	0.006	0.158	12.909
SSO Repair/ Abatement	0.004	0.001	0.028	3.160
Channel Protection	0.000	0.000	0.218	0.000
Total Reduction per Watershed Acre	**0.44**	**0.03**	**21.54**	**17.48**
	N (lbs/year)	**P (lbs/year)**	**TSS (lbs/year)**	**Bacteria (billion/year)**
Total Reduction in the Entire Watershed	**19,124**	**1,489**	**655,347**	**754,875**
% Reduction over Existing Conditions	**8.5%**	**5.6%**	**7.1%**	**15.9%**

Element B: Tools

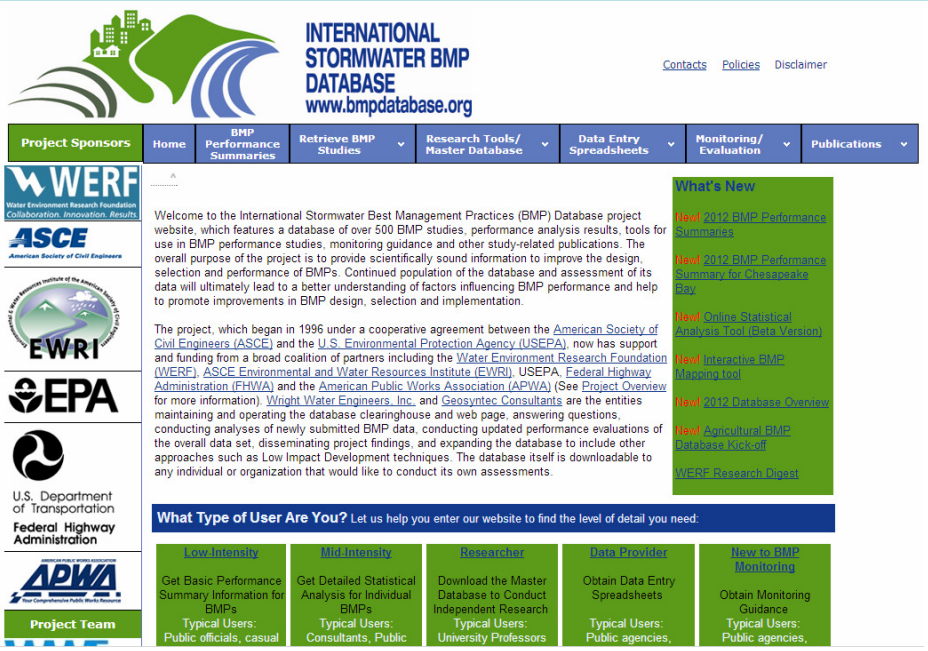


http://www.in.gov/idem/nps/2624.htm

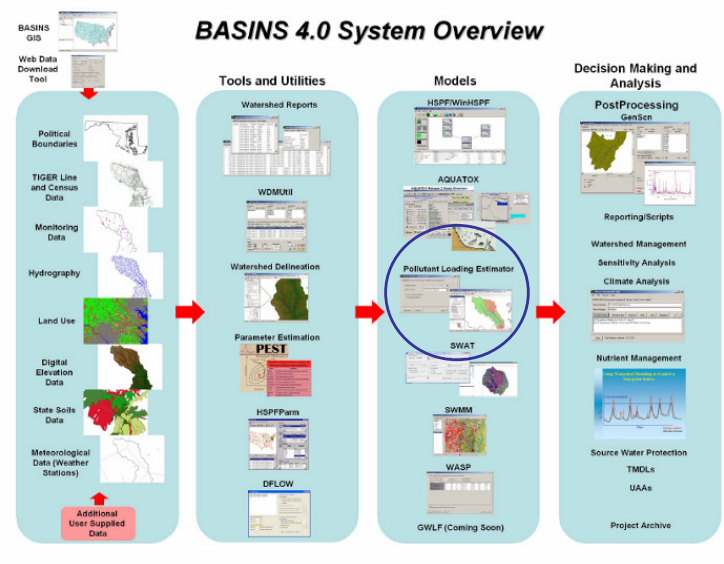
•There are many models available for determining load reductions. Load duration curves are the most frequently used for bacteria load reduction calcuations.

•Indiana's website features several load reduction tools and tutorials.

Element B: Tools



Element C: Tools



http://cfpub.epa.gov/crem/knowledge_base/crem_report.cfm?deid=74924

•PLOAD, a GIS-based loading tool, is part of the EPA BASINS model system. It allows users to determine pollutant loads and see the change in loading based on applied BMPs.

Element B: Questions to Ask

Will expected load reductions ensure water quality standards and other plan goals will be achieved?

Are expected load reductions linked to a pollution sources identified in Element A?

Is the complexity of modeling used appropriate for the watershed characteristics, the scale and complexity of the impairment, and the extent of water quality data?

Are estimates, assumptions and other data used in the analysis cited and verifiable?

Element C: Identification of Management Measures

A description of the NPS management measures that will be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

Element C: Lessons Learned

- Consider three types of BMPs: practices that treat the **source** of pollution, practices that treat or reduce pollution in **transport**, and **in-waterbody** practices.
- Determine what BMPs are already in place.
- Plan to apply BMPs in critical areas.
- Come up with a system to prioritize your BMPs.
- Choose BMPs that you are reasonably sure will be implemented!
- Consider cost in your evaluation of BMPs.

•An education campaign to encourage proper pet waste disposal would be an example of treating/reducing the source of pollution. Installing a bioswale is an example of treating pollution in transport. Stream bank stabilization would be an example of in-waterbody treatment of pollution.

Element C: Examples

Table 3-1: Existing Plans

Plan / Program	Author	Date	Status	Relevance
Waterbody Management Plan for the May River	SCDHEC-OCRM	2008	Active	High
A Baseline Assessment of Environmental and Biological Conditions in the May River, Beaufort County South Carolina	SCDNR, USGS, NOAA	2004	Complete	High
Town of Bluffton 319 - Program Project - Fecal Load Reduction in the May River Watershed Project	Town of Bluffton	2009	Active	High
Town of Bluffton Phase I - Study and Preliminary Design Pilot Project Design for 319 Grant (BMPs)	T&H	2010	Active	High
Water Quality Concerns in the May River: Analysis of Monitoring Data Collected by The Town of Bluffton and Palmetto Bluff Development	DNR	2010	Complete	High

Element C: Examples

Table 1. Stormwater Retrofit Opportunities in the Crane Creek Watershed

Site ID	Ranked Priority	Location	Jurisdiction	Retrofit Concept	Drainage Area (ac)	Impervious Cover (%)	WQv (cf)	Tv/WQv	Cost
A-RRI-21A	High	Ashley Oaks	Town	Pond Repair	32.2	20	40326	100%	$71,810
E-RRI-31A	High	Longleaf Middle School	County	Pond repair, site stabilization	14.6	35	19344	100%	$15,000
E-RRI-31B	High	Longleaf Middle School	County	rain gardens	0.46	100	1586	100%	$16,653
E-RRI-32	High	Killian Park	County	Bioretention area	0.5	100	1724	91%	$16,391
G-RRI-38	High	North Spring Park	County	Bioretention area	2.7	100	9311	100%	$97,755
G-RRI-39	High	North Springs Elementary	County	Pond vegetation	N/A	N/A	N/A	N/A	$5,000
I-RRI-17A	High	W.J. Keenan High School	County	Downspout disconnection, bioretention areas	5.89	100	20312	81%	$94,786
I-RRI-17C	High	W.J. Keenan High School	County	pond modification	9.64	80	40417	100%	$5,000
K-RRI-6	High	Forst Hills Elementary School	County	Downspout disconnection, bioretentation areas	0.6	100	2069	100%	$21,725

Element C: Examples

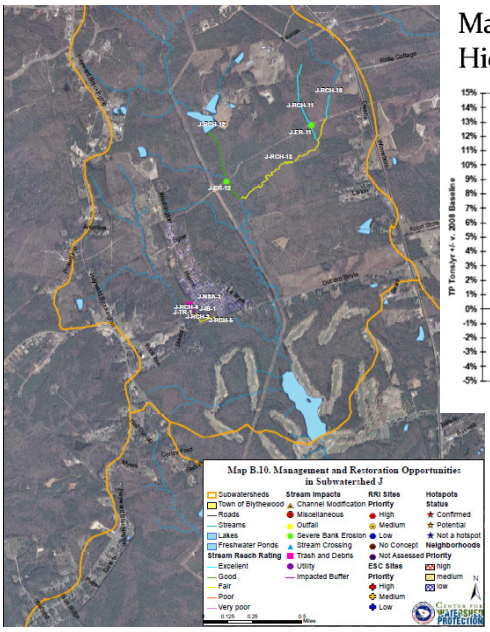
Table 4-1: Potential Strategies for Pollutant Sources of Interest

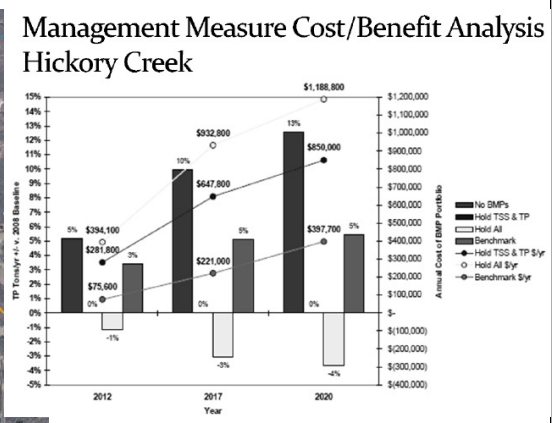
POLLUTANT SOURCE: SEPTIC		
Type of Project	**Pros**	**Cons**
Connect septic areas to sewer	• Effective - removes septic as a source • New development in areas served by sewer allows for more flexible site design.	• High initial capital cost Feasibility along May River • Property owners resistance to paying utility fees
Septic Inspection Program	• Identifies potential sources • Ease of implementation • Low implementation cost • Program can be customized to critical areas	• Only identifies problems, does not address them • Jurisdiction issues • Availability of inspectors
Septic Maintenance Program	• Addresses potential sources • Medium cost, with alternative funding options • Good success rate when incorporated with education, social marketing, and shared-costs programs • Program can be customized to critical areas	• Jurisdiction issues • Property owner accountability o Problems must be identified o Reluctance to participate because of perception of being "in trouble" for problems o Resistance to paying for maintenance/ upgrades o Economic hardship for low- or fixed-income residents.
Septic Policy/ Ordinance	• Low implementation cost • Requires limited resources • Preventative measure	• Political/ jurisdictional considerations • Feasibility of enforcement
Property Owner Assoc. Covenants, &, Restrictions	• Low implementation cost • Requires limited resources • Preventative measure	• Need consensus and voluntary support • Feasibility of enforcement
Septic System Cleaning Incentive Program	• Addresses potential sources • Medium implementation cost • Good success rate when incorporated with education, social marketing, and shared-costs programs • Program can be customized	• Jurisdiction issues • Reduces property owner accountability • Need to develop a prioritization process that is perceived as "fair" to meet budget constraints
Septic retrofits	• Replace/upgrade with innovative septic technologies (e.g., recirculating sand filters) • Reduce pollutant loads in critical areas (e.g. stream buffer) • Adapt to soils that are not well suited for septic systems	• Cost • Increased maintenance requirements

Table 4-1: Potential Strategies for Pollutant Sources of Interest

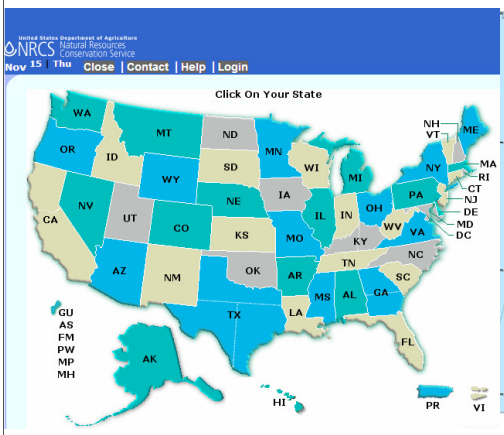
POLLUTANT SOURCE: ALTERED HYDROLOGY		
Type of Project	**Pros**	**Cons**
Wetland Restoration/ Retrofit Ditching	• Reduces velocity • Increases holding time • Reduces re-suspension of sediment/fecal coliform	• Need to obtain easements • Possible high initial cost • Requires multiple permits • Can affect developed area tailwater and increase flooding
Retrofit lagoons/ ponds	• Can increase detention time/reduce pollutant loading • Limit flushing wetlands • Fairly low construction cost	• Need to obtain easements • High design cost • O&M expenses • Does not reduce runoff volumes
Incentives to encourage LID/retrofits	• Provides volume control and pollutant load reductions • More involvement from private community in maintaining/managing controls • Encourages land donation/trade from private land developers/commercial properties (i.e. allow the use of their land for LID features, paid for by the Town or in exchange for a user fee reduction). • Encourages higher standard of maintenance and management of stormwater controls by those living in the private community	• Need support from developers, contractors, and property owners • Lack of knowledge of LID techniques • Reluctance of designers/developers for liability of newer technology/concepts • Cost of incentives to Town/County • Long Term O&M expenses
Runoff Reduction (e.g. pervious pavement, rainwater and stormwater harvesting)	• Reduce runoff volume • Reduce pollutant loading from runoff • Reduce use/cost of treated water bill • Upgrades can be incorporated during maintenance efforts	• Must entice public to cooperate • May increase maintenance burden and installation cost • Harvesting is not as reliable a source of water as public or well water
Design Storm Recommendations / Alternative Design Storms	• Increase water quality • Reduce erosion • Allow for increased regulation of site	• Code / ordinance update and adoption • Plan review enforcement

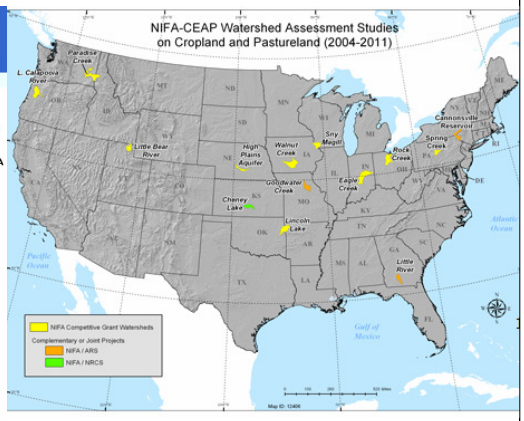
Element C: Examples





Element C: Tools





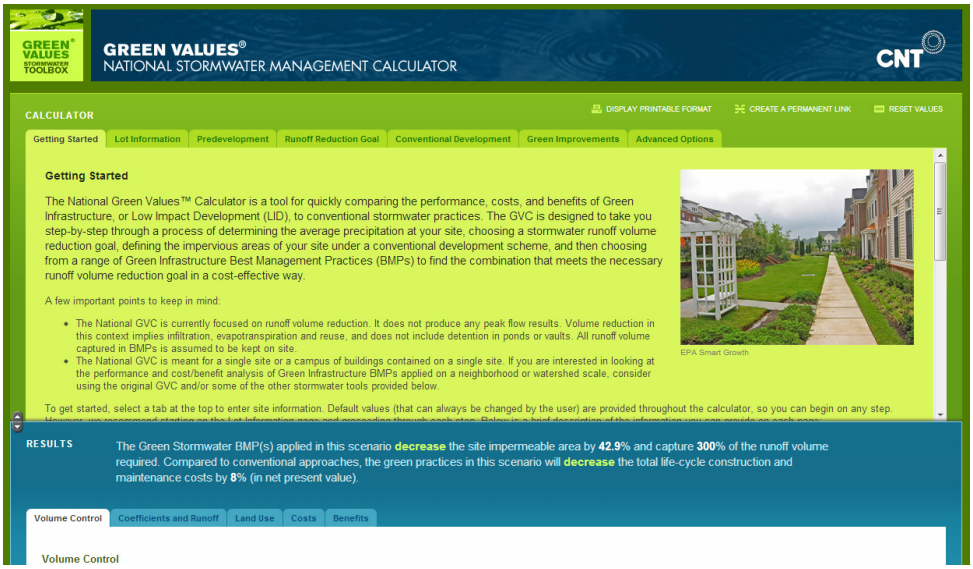
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?&cid=stelprdb1047821

•The NRCS technical field guide includes standard practices and costs by county. The USDA also periodically publishes an agricultural census by state and county.

•USDA's National Institute of Food and Agriculture and NRCS jointly funded 13 projects to evaluate the effects of conservation practices on water quality at the watershed scale. Their findings are summarized in a series of online reports and fact sheets.

Element C: Tools



http://greenvalues.cnt.org/national/calculator.php

Element C: Questions to Ask

Does the plan list and describe BMPs that will address the sources of pollution identified in Element A?

Have critical and priority areas been identified?

Is the rationale given for the selection of BMPs?

Are BMPs applicable to the pollutant causes and sources? Are they feasible?

Are the BMPs linked to load reduction identified in Element B?

Have BMPs been mapped?

In selecting and siting the BMPs, are the estimates, assumptions and other data used in this analysis technically sound?

Questions?

Element D: Technical and Financial Assistance

An estimate of the amounts of technical and financial assistance needed, associated cost, and/or the sources and authorities that will be relied upon, to implement this plan. Expected sources of funding, States should consider Section 319 programs, State Revolving Funds, USDA's EQIP and CRP, and other relevant Federal, State, local and private funds to assist in implementing this plan.

Element D: Lessons Learned

- Leverage existing funding sources by finding common stakeholder goals
- Consider funding sources that aren't specifically water-related.
- Understand your costs upfront.
- Don't exclude practices *solely* on the basis of cost.
- Work with a variety of partners to ensure maximum eligibility for funding sources.

Element D: Examples

Table 5

BMP	Number, size, area, etc.	Estimated Costs
Grazing land Vegetation Improvements	250-A	25,500
Fencing for Rotational Grazing	30,000-ft on 150-A	15,000
Fencing for Livestock Exclusion	20,000-ft on 100-A	16,000
Livestock Stream Crossings Installed	25	60,000
Conservation Tillage	1,540-A	185,000 (over 3 years)
Livestock Water Supply	10	10,000
Riparian Buffers Expanded/Installed	Expand Existing to 300-ft Establish new (min. 35-ft)	40,000
Conservation Plans for Pesticide Management	1500-A cropland 250-A pastureland	Incorporated in Technical Assistance /Coordinator
Conservation Plans for Soil Erosion	80% of cropland	Incorporated in Technical Assistance /Coordinator
Technical Assistance / Coordinator	3 years	100,000

Table 17: Estimated costs of best management practices by subwatershed

Agricultural intensity	Stream	SWS	Fencing	Riparian buffer	Stream crossings	Alternative watering sources	Total
High	**Crooked Run**	1048	$9,252	$3,700	$17,700	$9,000	$39,652
	Wolf Creek	1040	$12,504	$5,000	$23,600	$12,000	$53,104
	Short Creek	1039	$12,716	$5,100	$23,600	$12,000	$53,416
Moderate	**Wolf Creek**	1038	$1,540	$600	$5,900	$3,000	$11,040
	Levisee Creek	1041	$14,840	$6,000	$23,600	$12,000	$56,440
Low	**Wolf Creek**	1045	$4,080	$1,600	$11,800	$6,000	$23,480
	Wolf Creek	1043	$2,380	$1,000	$5,900	$3,000	$12,280
	House Branch	1049	$6,232	$2,500	$11,800	$6,000	$26,532
	Adkins Branch	1044	$2,352	$900	$5,900	$3,000	$12,152
	Toney Hollow	1042	$8,720	$3,500	$17,700	$9,000	$38,920
Total	Total		$74,616	$29,900	$147,500	$75,000	$327,016

Source: Hardy et al. (2007), Meyer and Olsen (2005). Impaired streams appear in bold. SWS=subwatershed in the TMDL. UNT=unnamed tributary. RM=river mile.

Element D: Examples

Table 5-2: SEPTIC, WILDLIFE AND VARYING SHORT-TERM PROJECTS FOR IMPLEMENTATION

Project Type	Description	Justification	Approximate Cost
Septic	Develop a Septic Policy/ Ordinance	Needed in order to develop an inspection and maintenance program	<$10,000 one time cost
	Property Owner Association Covenants, Codes, Restrictions	Codes should be consistent with septic policy ordinance.	<$20,000 one time cost
Wildlife/Domestic Animals	Dog waste: Install signs to pick up after pets as well as pet waste stations	Good and broadly accepted, community-wide stewardship practice to institute	$50-75 per sign and steel post. One time installation cost. 4 hours per week maintenance
Varying	Education	Specific education efforts identified in Wildlife, Septic and Altered Hydrology matrices	Vary based on media used.
	Unified Development Ordinance Amendments	Use to regulate on-lot practices for new residential development.	One time cost to develop ordinance estimated 8 hours per week (400 hrs of total work)
	Transfer of Development Rights	Reduce impervious surfaces and runoff for future sites within the May River Watershed	Varies based on interested developers/land owners. Main costs will include legal counsel and land acquisition.

Element D: Examples

Table 5.4: Potential Funding Mechanism

Project Name	Potential Funding Mechanism					
	Municipal / Regional Programs and Funds	Local Authorities / Opportunities	State Authorities / Opportunities	Federal Authorities / Opportunities	Non-Governmental / Non-Profit Organization	Private Partnering (funds or in-kind services)
BMP Project Recommendations						
Area L– Construct New Stormwater Ponds	✓	✓	✓	✓		✓
Area A – Construct New Stormwater Ponds and Modify Existing Pond	✓	✓	✓	✓		✓
Area C – Construct New Stormwater Pond	✓	✓	✓	✓		✓
Area J – Construct New Stormwater Pond / Modify Existing Pond	✓	✓	✓	✓		
Area D – Construct Earthen Ditch Blocks	✓	✓	✓	✓	✓	✓
Area E - Construct Earthen Ditch Blocks	✓	✓	✓	✓	✓	✓
Area N - Construct Earthen Ditch Blocks	✓	✓	✓	✓	✓	✓
Area B – Construct New Stormwater Pond	✓	✓	✓	✓		✓
Area F – Modify Existing Stormwater Ponds	✓	✓	✓	✓		✓
Area G – Modify Existing Stormwater Pond	✓	✓	✓	✓		✓
Area AG – Construct New Stormwater Pond	✓	✓	✓	✓		✓
Area H – Modify Existing Stormwater	✓	✓	✓	✓		✓

Element D: Examples

Table 5-6: Potential Responsibilities for Each Project Area and Project Type

Oscar Frazier Community Park

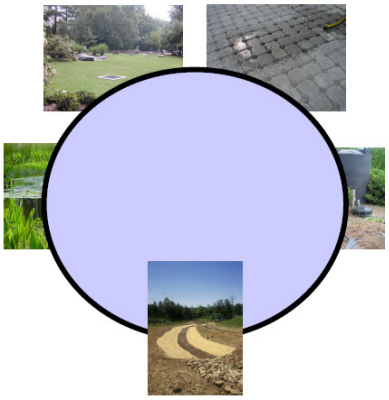
Type of Project	Potential Responsible Parties/Partners	Responsibility	Recommended Documentation of Responsibility
Pet Waste Management	Town	• Provide land & pet waste stations • Funding • Maintenance	• Maintenance Agreement; Contract for waste disposal
	Local Businesses (e.g. pet supply companies; pet services)	• Donate supplies • Funding	• Voluntary; • Written agreement • Can allow advertising on the pet waste signs in exchange for supplying the pet waste station)
	Non-profit organizations (e.g. schools, scouts)	• Education/Marketing campaign	• Voluntary; • Written agreement
	Pet owner groups	• Social marketing campaign	• Voluntary; • Written agreement
Rain gardens	Town	• Provide land • Funding • Maintenance	• Maintenance Agreement
	Local Businesses (e.g. landscaping companies, nurseries, home improvement stores)	• Donate supplies & services • Funding	• Voluntary; • Written agreement • Can allow advertising on signs within the rain gardens saying who provided/donated the supplies/land in exchange for the donation
	Non-profit organizations (e.g. garden club, scouts)	• Gardening services; • Education/Marketing campaign	• Voluntary; • Written agreement
Pervious pavement	Town	• Provide land • Funding • Maintenance	• Maintenance Agreement
	Local Businesses (e.g. landscaping	• Donate supplies & services • Funding	• Voluntary; • Written agreement

Page

Element D: Tools

Stormwater BMP Costs

Division of Soil & Water Conservation
Community Conservation Assistance Program



Prepared By:
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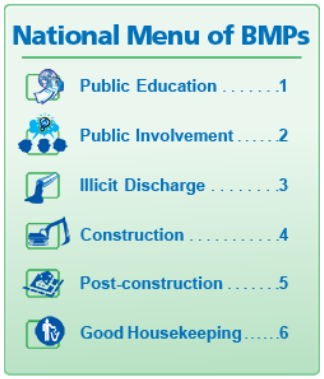
North Carolina State University

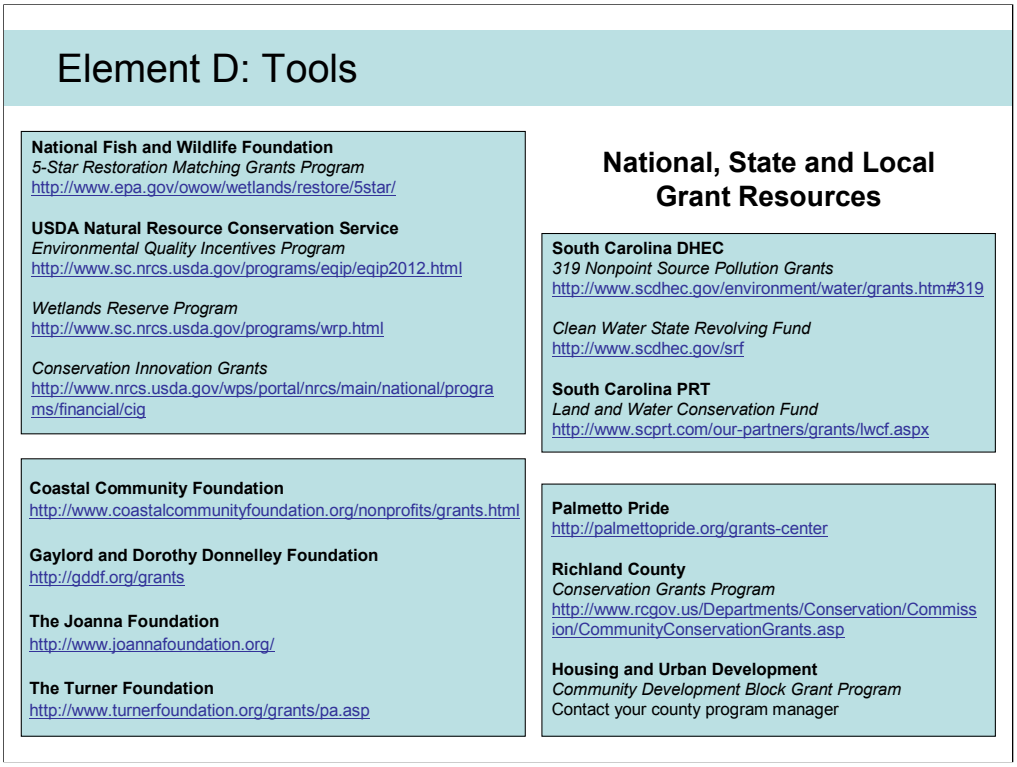
Submitted To:
North Carolina Department of Environment and Natural Resources

http://www.bae.ncsu.edu/stormwater/PublicationFiles/DSWC.BMPcosts.2007.pdf

National Menu of Stormwater Best Management Practices



http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm



•While not a comprehensive list, this slide contains links to a variety of funding sources that could be used for watershed plan implementation.

•It may be useful to list deadlines for grant and other funding opportunities in your plan, if possible.

Element D: Questions to Ask

Are sources of technical assistance included?

Does the plan describe the anticipated involvement of assisting organizations or volunteers?

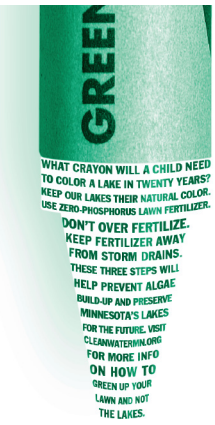
Are cost estimate included? Are the reasonable?

Does the cost estimate include all planning and implementation costs?

Are potential funding sources listed? Is there an estimated contribution from each source?

Element E: Education & Outreach

An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.



Element E: Lessons Learned

- Outreach should be included in your planning process in three ways: during plan development, as part of the implementation and after implementation to ensure maintenance and project longevity.
- Use a message tailored to each unique audience.
- Just like every other BMP, evaluate the effectiveness of your outreach strategy.
- Include an outreach professional in your partnership.

•Outreach strategies should use a marketing approach to affect behavior change.

Element E: Examples

Figure 8.2. Plum Creek Watershed Partnership logo.

1.3. Thorn Creek Watershed Stakeholders

The following 107 individuals volunteered or were invited to participate in the Thorn Creek Watershed Planning process. Several also participated in the Technical Advisory Committee (TAC) or Steering Committee (SC).

Name	Organization	TAC	SC
Dees Anderson	Openlands Project		
Katie Armstrong	Former Village Trustee, Village of Park Forest		
Marcus Arnold	Transportation Planner, South Suburban Mayors & Managers Association		
Steve Aultz			
Cindy Bakkom	Superintendent of Public Programs and Education, Forest Preserve District of Will County		•
Diane Banta	National Park Service		
Janet Bazek			
James Biliotta	Board Member, Will County		
Lynn Boerman	C2000 Ecosystem Administrator, Illinois Department of Natural Resources Region 2		•
Tim Bradford	Assistant to Supervisor, Rich Township		
Scott Bullard	Forest Preserve District of Cook County	•	
Margaret Burns-Westmeyer	Beautification Committee, Chicago Heights		•
Steven M. Bylina Jr.	General Superintendent, Forest Preserve District of Cook County		
Roland Carlson	Village of Thornton		•
Mary Carrington	Governors State University		
Joseph Christofanelli	Manager, Village of Glenwood		
Karen D'Arcy	Governors State University	•	•
James Daugherty	District Manager, Thorn Creek Basin Sanitary District	•	•
Don De Graff	President, Village of South Holland		
Kristi DeLaurentiis	South Suburban Coordinator, Metropolitan Planning Council		•
Anthony DeLuca	Mayor, City of Chicago Heights		
Marcy DeMauro	Forest Preserve District of Will County		
Donna Dettbarn	Supervisor, Monee Township		
Rose Marie DeWitt	Will/South Cook Soil & Water Conservation District		•
Charles Dieringer			
Judy Dolan-Mendelson			
Kerry Durkin	Village of Glenwood		
Stuart Fagan	President Governors State University		
Stina Fish	URS Corporation		
Bud Fleming	Cook County Department of Planning & Development		
Mark Franz	Manager, Village of Homewood		
Mary Ann Gearhart	Will County Board		

Element E: Examples

4.8.7. SOURCES OF IMPAIRMENT AND OUTREACH STRATEGY

Impairment	Source	Target Audiences	Priority	Messages	Delivery Mechanism	Responsible Organization*	Timeline
Fecal Coliform, Dissolved Oxygen, Phosphorus/Nitrogen, Toxics, Hydrologic Modification	Urban runoff	Homeowners, other landowners, general public	2	Route downspouts to pervious areas, keep car in good repair, wash car on lawn or at commercial facilities, use nontoxic products, use natural landscaping, etc.	Brochures given out at events or mailed with garbage or wastewater bills, radio PSAs and other print or broadcast media, etc. Collect existing educational materials or create new ones. Consider per-connection wastewater fee to pay for ongoing education.	TCEP, TCRC	3–7 years
Toxics	Road salt and storage / highway maintenance and runoff	Municipal and highway officials and crew	2	Salt runoff is contributing to lower water quality; alternative deicing agents and improved application techniques are available.	Training in use of alternative deicing agents or more careful management of salt application. Approach county and municipal transportation departments at management level. Fund and develop training course.	SSMMA	0–3 years
Fecal Coliform, Dissolved Oxygen, Phosphorus/Nitrogen, Toxics	Point discharges / illicit stormsewer connections	General public, businesses, institutions, municipalities	1	Community should support comprehensive program for detecting illicit stormsewer connections. Pollution prevention in industrial processes and institutional operations in the watershed is important to decrease amount of permitted point discharge.	Public information (brochures, radio, etc.) on stormsewer connections. Educate businesses on pollution prevention strategies specific to the industry, provide information on funding and technical assistance available. Devise incentive program for recognizing achievements of specific businesses in pollution prevention.	TCEP, TCRC, IEPA	0–3 years
Phosphorus/Nitrogen	Agricultural activity	Farmers and owners of agricultural land	2	Utilize incentive programs to plant and maintain buffers, install other BMPs	Distribute literature from Natural Resource Conservation service on conservation incentive programs through targeted outreach.	TCEP, TCRC, SWCD	3–7 years
Fecal Coliform, Dissolved Oxygen	Animal waste	Residents, municipal officials, agricultural operators	2	Pick up after your pets; discourage geese from congregating around detention areas.	Brochures given out at events or mailed with garbage or wastewater bills, radio PSAs, etc.	TCEP, TCRC, SWCD	3–7 years
Fecal Coliform, Dissolved Oxygen	Sanitary sewer overflows / failure	Municipalities and wastewater facility operators	1	Reducing sanitary overflow, pump station failures, and system leaks are an important part of improving water quality; make commitment and seek funding to upgrade systems; ensure that system performance agreements are being met.	Direct outreach to municipal officials; provide information on successful wet weather flow reduction programs and funding available.	NIPC, TCEP, TCRC, TCBSD	3–7 years
Hydrologic Modification	Development (land use conversion)	Municipalities and developers	1	Ordinances needed to prevent building in floodplains, to protect riparian buffers, etc. Cook County stormwater program now in development can provide guidance and direction.	NIPC and SSMMA hold workshop on water resources ordinances for municipal officials. Meet with municipal and county staff annually; request updates at TCEP meetings.	NIPC, SSMMA	0–3 years
Dumping And Debris	Lack of enforcement	Municipalities, forest preserve districts	1	Law enforcement is the best means of stopping dumping; existing regulations have to be enforced to be effective; benefit of enforcement outweighs added cost.	Outreach to elected officials to raise awareness of problem of non-enforcement.	SSMMA	0–3 years

*NIPC = Northeastern Illinois Planning Commission; TCEP = Thorn Creek Ecosystem Partnership; TCRC = Thorn Creek Restoration Coalition; SSMMA = Southwest Suburban Mayors and Managers Association; SWCD = Soil and Water Conservation District

Element E: Tools

http://www.scdhec.gov/environment/water/npstoolbox/

Element E: Tools

http://www.efc.unc.edu/projects/serwqan/Mills%20River/MillsRiver.swf

Element E: Questions to Ask

Does the plan identify relevant stakeholders?

Are there sustainable mechanisms to keep the public informed about the plan and its implementation?

Does the plan include methods to engage stakeholders and landowners in participation and implementation? Do education measures affect behavior change?

Does the education process prepare stakeholders for BMP operation and maintenance after implementation is complete?

Was there active and diverse public participation in the plan's development?

Questions?

Elements F, G, H:
Implementation Schedule, Milestones & Evaluation Criteria

Element F
A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

Element G
A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Element H
A set of criteria that will be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

Elements F, G, H: Lessons Learned

- Include all projects in your schedule, even if they will take a long time.
- Estimate when water quality standards will be met.
- Include a process to revise your watershed plan if progress has not been adequate.
- Consider your criteria for determining success early.
- Find a way to quantify all parts of your plan.

Elements F, G, H: Examples

Table 4-9: PHASE I IMPLEMENTATION SCHEDULE

Action Items	Status
Create Impervious Surface Map	Complete
Final SCDHEC 319 Grant Report	In Progress
RV / Campground Waste Management Plan	Complete
Rain Barrel/Rain Garden Program	Complete
Pet Waste Stations	Complete
Social Marketing Campaign	In Progress
Delineate May River Watershed	In Progress
Unified Development Ordinance Overhaul	In Progress
Pilot Projects	In Progress
Construction Site Inspection Program	In Progress
Ditch Enhancement / Erosion Prevention	In Progress
Transfer of Development Rights Program	In Progress
*Develop Model to Predict Fecal Coliform, stormwater volume, and other indicators	Short-term

PHASE	I – Assess & Reclaim				II – Evaluate and Plan		
Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Prereclamation monitoring: mines, benthics, water quality	■	■	■	■			
Eddie Wall Site Part I - Reclamation	■						
Eddie Wall Site Part II - Reclamation		■					
Fagan Mill Site - Reclamation			■				
Little Laurel Highwall Site - Reclamation			■				
Mine Field Site - Reclamation				■			
Postreclamation monitoring: mines, water quality	■	■	■	■	■	■	
Water Quality / Benthic monitoring to support delisting of streams						■	
Phase II monitoring to determine reclamation needs					■	■	
Phase III plan development; and Phase I revision if needed.						■	■
Educational Outreach	■	■	■	■			■

Elements F, G, H: Examples

Table 8-2. Crab Orchard Creek Restoration Milestones.

	Reclamation	Education	Assessment
Year 1	2 limestone treatment ponds constructed; 1 wetland constructed.	1 public meeting held; 1 article submitted to paper.	Pre-reclamation monitoring of Eddie Walls Site. Baseline benthic monitoring at established TMDL sites.
Year 2	44 acres regraded and stabilized.	1 article submitted to paper; brochure/display developed.	Monitoring of Laurel Creek and Smith Branch.
Year 3	1 limestone treatment pond constructed; 1 wetland/settling pond constructed; 11 acres regraded and revegetated; 1 highwall and 2 existing sediment ponds backfilled.	1 article submitted to paper; 1 public meeting/outreach event.	Pre-reclamation monitoring of Fagan Mill Site. Post-reclamation monitoring of Eddie Walls Site.
Year 4	2 limestone treatment ponds constructed; 1 wetland/settling pond constructed.	1 article submitted to paper.	Pre-reclamation monitoring of Mine Field Site and Little Laurel Highwall. Post-reclamation monitoring of Fagan Mill Site.
Year 5	--	--	Post-reclamation monitoring of Mine Field Site and Little Laurel Highwall.
Year 6	--	--	Water quality monitoring to determine if reclamation effective to restore Crab Orchard Creek and tributaries. pH, and benthics must meet standards identified in Section 6.0 above.
Year 7	Develop a plan for Phase III reclamation projects if needed, and any Phase I sites where reclamation was not successful.	Report on restoration project; Public meeting to share results; 1 article submitted to paper.	

Elements F, G, H: Examples

Table 31: Expected improvements in stream segments due to remediation activities

Subwatershed	Segments	Projects causing improvement	Expected year for improvement		
			Meets standards	*Improved WVSCI*	*Improved fish communities*
Kanes Creek	Mainstem above RM 3.2	Valley Highwall #3	2007	2008	2009
	UNT RM 3.2	Valley Point #12, Kanes Creek South site 1	2007	2008	2009
	Entire subwatershed down to UDCI 5	Sandy Run Highwall, Portals and Kanes Creek South site 3	2008	2009	2010
Laurel Run	Entire subwatershed	Burk Mine Drain	2008	2009	2010
Deckers Creek	Mainstem above Dillan Creek	Dalton site, and Kanes and Laurel subwatersheds	2008	2009	2010
Dillan Creek	From headwaters to Swamp Run	Dillan Creek #1	2009	2010	2011
Deckers Creek	Mainstem above Deep Hollow	Bretz (Methany) mine drainage, Glady Run Strips	2009	2010	2011
Deep Hollow	Entire subwatershed	Beulah Chapel portals	2010	2011	2012
Hartman Run	Entire subwatershed	Hartman Run Mine Drainage I and II	2010	2011	2012
Deckers Creek	Entire watershed	Cumulative projects, additional adaptive projects	2011	2012	2013

Elements F, G, H: Questions to Ask

Does the schedule include a logical sequence of actions needed to meet plan goals?

Is the schedule appropriate based on the complexity and size of the watershed?

Are the identified milestones measurable and attainable?

Does the plan identify milestones with completion time-frames?

Does the plan include progress evaluations and revisions as needed?

Are criteria measurable and quantifiable?

Does the criteria measure progress towards load reduction goals?

Does the plan include a process to determine if reductions are being met?

Elements I: Monitoring

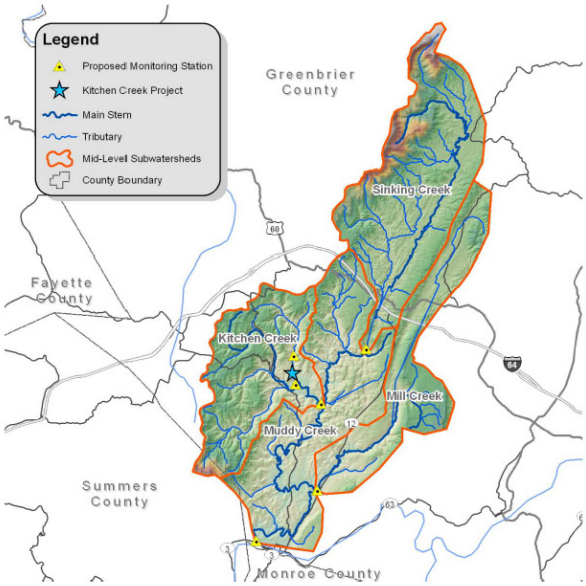
A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Elements I: Lessons Learned

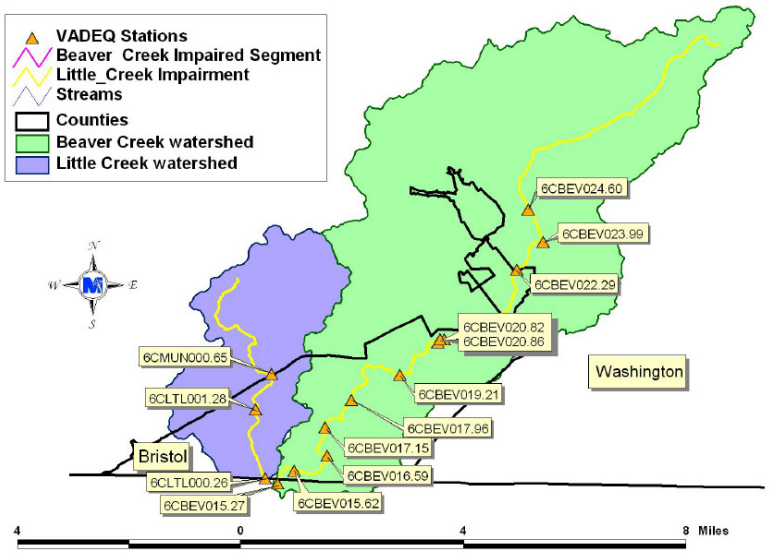
- Identify gaps in monitoring early. Have a plan to address those gaps.
- Does your monitoring plan tie water quality improvements back to your implementation?
- Determine how much data you'll need to determine success and how long it will take to gather that much data.
- Determine if and who will need a QAPP for monitoring. Factor that into your implementation schedule.

Elements I: Examples

Figure 12: Proposed monitoring stations



Elements I: Examples



Elements I: Examples

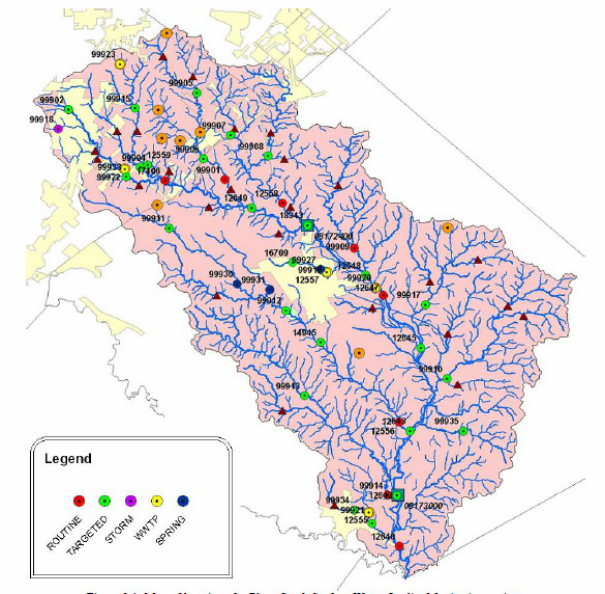


Figure 9.1. Map of locations for Plum Creek Surface Water Quality Monitoring project.

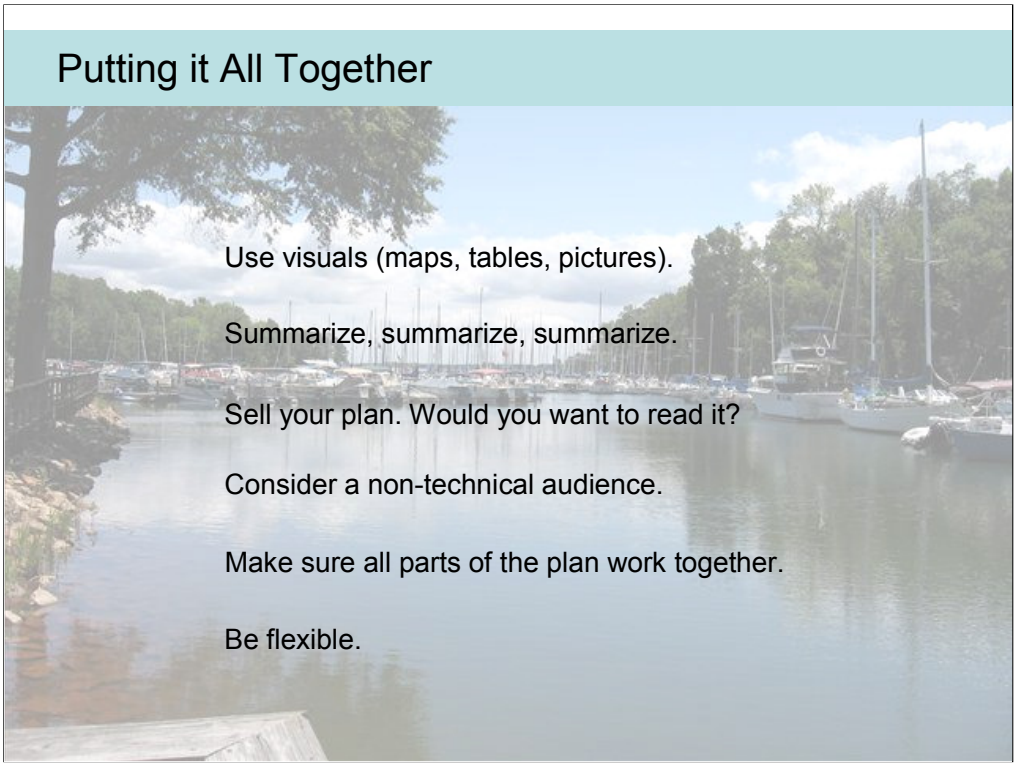
Elements I: Questions to Ask

Does the plan describe how monitoring will be used to evaluate the effectiveness (in reducing loads to the waterbody) of the implementation efforts?

Will the monitoring plan effectively measure the evaluation criteria identified in Element H?

Are the monitoring methods, including parameters, number of sites, and frequency of sampling, appropriate and adequate?

Will the monitoring method link the load reduction from implementation to improvements in the waterbody?



•Try to summarize technical portions of your plan for a non-technical audience. For example, consider elected officials or other audiences that may need to sign-off on the plan or agree to implement certain portions of the plan.

Putting it All Together

Table 2-1: Nine Key Elements of Proposed Management Measures

(a) Causes and Sources of Bacterial Impairment	(c) Management Measures and Targeted Critical Areas	(b) Estimated Potential Load Reduction (org/yr)	(d) Technical and Financial Assistance Needed for Each Measure	(e) Education Component for Each Measure (and Other Education)	(f) Schedule of Implementation for Each Measure	(g) Interim, Measurable Milestones for Each Measure	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
STORM WATER RUNOFF POINT SOURCES, Existing Load = 5.55E+15 org/yr, Required Load Reduction = 1.67E+15 org/yr (30%)									
Avian land deposition (urban runoff)[1]	bird feeding ban at River Walk and City Parks in riparian areas	1.8E+14 (2%)	$100,000	signs and exhibits, public awareness programs	2007-2009	Fewer birds observed along riparian areas	reduction in runoff-related bacteria concentrations basin-wide	routine basin monitoring	COSA
	bird exclusion/deterrent practices and devices at River Walk and selected riparian areas		$100,000	education of COSA Parks staff by Texas Parks and Wildlife	2007-2009	Fewer birds roosting along riparian areas	reduction in runoff-related bacteria concentrations basin-wide	routine basin monitoring	COSA
Pet land deposition (urban runoff)	increase awareness and enforcement of pet control ordinance	2.6E+14 (3%)	already funded, additional funds could be used to expand public awareness campaign and enforcement	public awareness program at Community Link Centers: (Valley View, South Park, McCreless, and Las Palmas)	2007-2009	pet owner participation, number of citations and complaints	reduction in runoff-related bacteria concentrations basin-wide	routine basin monitoring	COSA
	expand Pooper Scooper programs		expand existing program to all City Parks: $100,000	signs and exhibits, community education, mitt dispensers and disposal	2007-2009	pet owner participation, number of citations and complaints; increase in number of mitts used per year	reduction in runoff-related bacteria concentrations basin-wide	routine basin monitoring	COSA

Putting it All Together

Table 10.1. Responsible party, implementation milestones, and estimated financial cost for management measures.

Management Measure	Responsible Party	Unit Cost	Number Implemented			Total Cost
			Year			
			1-3	4-6	7-10	
Urban Stormwater Management Measures						
Pet Waste Collection Stations	City of Kyle	$620/station installation $85 annual/station	10	4	4	$22,040[1]
Pet Waste Collection Stations	City of Lockhart	$620/station installation $85 annual/station	10	4	4	$22,040
Pet Waste Collection Stations	City of Luling	$620/station installation $85 annual/station	6	2	2	$12,475
Pet Waste Collection Stations	City of Buda	$620/station installation $85 annual/station	10	4	4	$22,040
Comprehensive Urban Stormwater Assessment	City of Kyle	$30,000/survey	1	---	---	$30,000[1]
Retrofit Stormwater Detention Basins	City of Kyle	$35,000 engineering $50,000/basin	2	---	---	$135,000[1]
Initiate Street Sweeping Program	City of Kyle	$110,000/sweeper	---	---	---	$110,000[2]
Comprehensive Urban Stormwater Assessment	City of Lockhart	$25,000/survey	1	---	---	$25,000
Manage Urban Waterfowl Populations	City of Lockhart	---	---	---	---	N/A
Comprehensive Urban Stormwater Assessment	City of Luling	$20,000/survey	1	---	---	$20,000
Rehabilitate Stormwater Retention Pond	City of Luling	$500,000/pond	1		---	$500,000
Initiate Street Sweeping Program	City of Buda	$150,000/sweeper	1	---	---	$150,000[2]
Wastewater Management Measures						
Wastewater Upgrade (TSS Reduction)	WWTF Operators	$500,000/ 1 MGD facility		3	7	$6,000,000
Wastewater Upgrade (Phosphorus Removal)	WWTF Operators	$60,000/facility (includes material costs)		3	7	$600,000
Voluntary Monthly *E. coli* Monitoring	WWTF Operators	$22/month/facility	---	---	---	$31,000
Voluntary Monthly Phosphorus Monitoring	WWTF Operators	$25/month/facility	---	---	---	$35,000
Sanitary Sewer Pipe Replacement	City of Kyle	$1,000,000/year	2,400 ft	2,400 ft	3,200 ft	$10,000,000[3]
Lift Station SCADA Installation	City of Kyle	$12,000/station	3	4	---	$84,000
Sanitary Sewer Pipe Replacement	City of Lockhart	$320,000/year	1,800 ft	1,800 ft	2,400 ft	$3,200,000[3]
Initiate Sanitary Sewer Inspection Program	City of Luling	$17,000/camera	1	---	---	$17,000[2]

Putting it All Together

AgriLIFE RESEARCH & EXTENSION
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arroyo colorado watershed protection

arroyocolorado.org

The Arroyo Colorado, an ancient channel of the Rio Grande, flows 90 miles through Hidalgo, Cameron and Willacy counties in the Lower Rio Grande Valley of Texas. Water flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff and base flows from shallow groundwater. Elevated levels of fecal coliform bacteria and low dissolved oxygen have severely impacted recreational use of the lower Arroyo Colorado for fishing and swimming. In 2002, the Texas Commission on Environmental Quality (TCEQ) determined in a Total Maximum Daily Load study that a 90 percent reduction of nutrients and biochemical oxygen demand was needed to achieve healthy waters.

The Arroyo Colorado Watershed Partnership (ACWP) was established to help restore the watershed, and in 2007, the partnership published the Arroyo Colorado Watershed Protection Plan (AC WPP) that identified and addressed impairments and concerns in the watershed.

Since 2007, the Texas Water Resources Institute (TWRI) has coordinated the Arroyo Colorado program working closely with the ACWP, TCEQ and Texas State Soil and Water Conservation Board (TSSWCB) to implement projects to improve water quality of the Arroyo Colorado.

Completed Projects

- Education of Best Management Practices in the Arroyo Colorado
- Arroyo Integrated Farm Management Program
- Pesticide Education in the Coastal Zone of the Arroyo Colorado
- Public Service Announcements for the Arroyo Colorado Watershed
- Monitoring of Arroyo Colorado Wastewater Treatment Plants
- SWAT Modeling Simulation of the Arroyo Colorado Watershed
- Arroyo Colorado Watershed Protection Plan Implementation
- Enhancing Water Quality and Dredged Material for the Port of Harlingen (Phase I)
- Arroyo Colorado Agricultural Nonpoint Source Assessment

TWRI is currently coordinating three projects directed toward achieving the goals set in the AC WPP and updating the plan. The updated AC WPP will guide the implementation efforts in the watershed from 2015 into the future.

Cost-Share Education

- Continue education programs and enhance coordination of outreach and education of TSSWCB projects
- Increase the adoption rate of best management practices and water quality management plans by producers
- Reach producers that have not yet participated in technical and financial assistance programs in the Arroyo Colorado watershed

twri.tamu.edu

texas water resources institute

arroyo colorado watershed protection

Sustainability of the ACWP and Continued Implementation of the AC WPP

- Successfully continue implementation of the AC WPP by maintaining local steering committee and work group support and infrastructure
- Assess the increase in local stakeholder knowledge of watershed functions
- Implement tasks and goals outlined in the AC WPP
- Develop a sustainable program to support the AC WPP

Update of the AC WPP

- Review original AC WPP to identify data gaps and emerging issues in the watershed. Once identified, the data gaps and emerging issues will be addressed by incorporating them into AC WPP update.
- Complete SWAT, EDFC & WASP models with the resulting loading reductions incorporated into AC WPP update

Projects Accomplishments

- Projects have resulted in completion of 75 percent of the goals set in the AC WPP.
- Agricultural producers have adopted best management practices resulting in 109,188 acres under water quality management plans.
- Ten Wastewater Treatment Plants (WWTPs) have completed construction on upgrades/expansion to the WWTP infrastructure.
- Three cities, La Feria, San Juan and San Benito, have installed constructed wetlands at their respective WWTP to act as polishing ponds to treat the effluent before entering the Arroyo.
- Twenty-two colonias, 2,629 connections and more than 175 residents have been connected to central wastewater systems.
- More than 45,000 individuals have viewed the watershed demonstration model.
- Approximately 7,000 agriculture producers have attended educational meetings and workshops.
- The annual soil testing campaigns, partly funded through an ACWP project, have educated more than 6,200 producers and collected almost 3,900 soil samples.

Collaborators

- Arroyo Colorado Watershed Partnership
- Texas AgriLife Extension Service
- Texas AgriLife Research
- Texas Water Resources Institute
- Texas A&M University – Kingsville
- Texas A&M University Spatial Sciences Laboratory
- USDA Natural Resources Conservation Service
- University of Texas at Brownsville
- University of Texas at Arlington
- Allen Plummer and Associates

Funding Agencies

- Texas State Soil and Water Conservation Board
- Texas Commission on Environmental Quality
- Texas General Land Office
- U.S. Environmental Protection Agency

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•Remember that a watershed-based plan is a tool and therefore only useful if it's implemented. Use the momentum generated during the planning process to encourage implementation

Questions for Discussion

- Are there plan elements you still have questions about?
- Which element(s) do you find most challenging?
- How can DHEC better assist you in your watershed planning efforts?
- If you have experience with watershed planning, what advice, tips best practices can you share?