
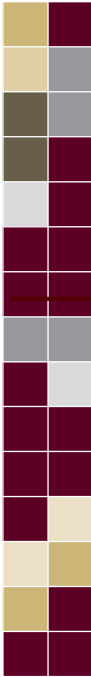



North Central Texas Water Quality Project

Stakeholder Meeting
Watershed Protection Plan
Development for the
Cedar Creek Watershed
 November 20, 2008
 Kaufman, Texas
 Agriculture is Life.









Economic Analyses of BMPs for The Cedar Creek Watershed

M. Edward Rister
Allen W. Sturdivant
Ronald D. Lacewell
and others
Department of Agricultural Economics


Funding provided by the Natural Resources Conservation Service (NRCS), Environmental Protection Agency (EPA) and Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture (CSREES). Research conducted under Hatch project #s H-9050 and TEX09161.

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Problem




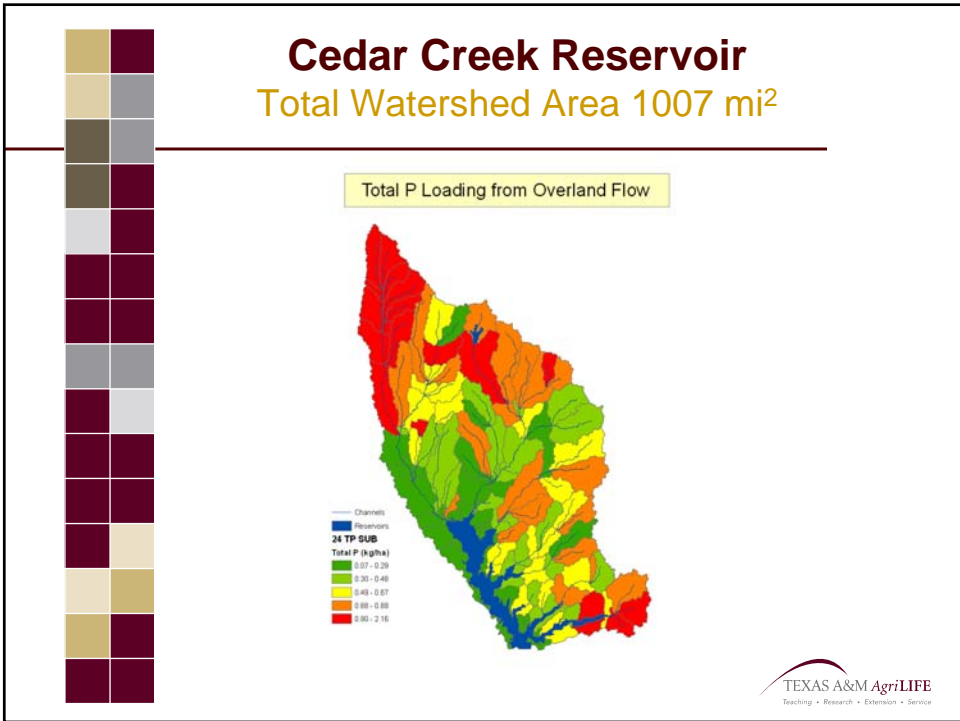
- **Tarrant Regional Water District (TRWD) owns/operates 4 major water-supply reservoirs (impacting 1.6 million)**
 - » **realizing increased/problematic levels of:**
 - **sediments**
 - **nutrients (nitrogen, phosphorous)**
 - » **seeking to reduce/prevent intrusion via most cost-effective portfolio of BMPs**



» **seeking to reduce/prevent intrusion via most cost-effective portfolio of BMPs**









Best Management Practices (BMP)



- **BMP:** “As defined by the EPA, methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources.”

Source: [Texas Watershed Steward Handbook](#)
and David Waidler





Best Management Practices (BMP) Categories



- **Cropland**
- **Pasture & Rangeland**
- **Urban**
- **Channel**
- **Watershed**
- **Reservoir ‘In-Lake’**
- **Construction**
- **Waste Water Treatment Plants**






Best Management Practices (BMP) Challengers


HANDOUT A


#001	Cropland to Grass	#301A	Rip. Buff. Strips — non-crit.
#001A	Contour Farming	#302	Rip. Buff. Strips — critical
#003	Nutrient Mgmt	#401A1	Wetland – L. Kings Creek
#004	Filter Strip	#401B1	Wetland - End Cedar Creek
#006	Grassed Waterways	#402	Grade Stabilization
#007	Terracing	#501	Hypolimnetic Aeration
#101	Prescribed Grazing	#502B	P Inactivat. with Alum – 1/3
#105	Pasture Planting	#505	Hypolimnetic Water Rel.
#107	Crit. Pasture Planting	#701	WWTP - - Level I to II
#s 201-9	Phase II Urb. BMPs	#702	WWTP - - Level I to III
#210	Vol. Urb. Nut. Mgmt		
#211	Req. Urb. Nut. Mgmt 2,000 ft Buffer Strip		



What's Most Cost Effective (of 40+ BMPs) ?

- **Classic Economic Decision Problem**
- **Identify the most economic-efficient BMPs on the basis of annualized cost of reducing P, N, & Sediment inflows into the Cedar Creek reservoir**
- **How to select the 'optimal' portfolio of BMPs?**








Objective of BMP Economic Analyses





Identifying how to obtain the most 'bang' for the 'bucks'!




Status of BMP Economic Analyses




- **Revised results obtained!**
- **First phase of validation during early September with TRWD and other team members.**
- **Second phase of validation was on September 11, 2008 in Kaufman.**
- **Third phase of validation involved ag producer feedback October 7-9, 2008.**
- **Follow-up meeting with TRWD and other team members on October 30-31, 2008 to finalize analyses.**
- **Sharing “final” results today.**
- **Report writing continues.**





RESULTS!










Expected (Probable) BMP Adoption Rates: 1

HANDOUT B

BMP	Type	Description	Adoption Rates		
			Current	Maximum	Marginal
#001	Cropland	Cropland to Grass	0.0%	20.0%	20.0%
#001A	Cropland	Contour Farming	30.0%	75.0%	15.0%
#003	Cropland	Fertilizer/ Nutrient Mgmt	0.0%	75.0%	75.0%
#004	Cropland	Filter Strip	0.0%	75.0%	50.0%
#006	Cropland	Grassed Waterways	10.0%	50.0%	10.0%
#007	Cropland	Terracing	50.0%	75.0%	15.0%
#101	Pasture & Rangeland	Prescribed Grazing	10.0%	50.0%	25.0%
#105	Pasture & Rangeland	Pasture Planting	5.0%	50.0%	40.0%
#107	Pasture & Rangeland	Critical Pasture Planting	70.0%	90.0%	20.0%
#s 201 - 209	Urban	Phase II Urban BMPs	0.0%	100.0%	65.0%
#210	Urban	Voluntary Urban Nutrient Mgmt	10.0%	25.0%	15.0%
#211	Urban	Required Urban Nutrient Mgmt in 2,000 ft Reservoir Buffer Strip	10.0%	80.0%	70.0%






Expected (Probable) BMP Adoption Rates: 2

HANDOUT C


BMP	Type	Description	Adoption Rates		
			Current	Maximum	Marginal
#301A	Channel	Riparian Buffer Strips — except critical areas	0.0%	50.0%	20.0%
#302	Channel	Riparian Buffer Strips — critical areas	0.0%	10.0%	10.0%
#401A1	Watershed	Wetland - Lower Kings Creek (SB 54)	0.0%	100.0%	100.0%
#401B1	Watershed	Wetland - End Cedar Creek (SB 70)	0.0%	100.0%	100.0%
#402	Watershed	Grade Stabilization	0.0%	100.0%	100.0%
#501	Reservoir 'In-Lake'	Hypolimnetic Aeration	0.0%	100.0%	100.0%
#502B	Reservoir 'In-Lake'	P Inactivation with Alum – 1/3 of Reservoir	0.0%	100.0%	100.0%
#505	Reservoir 'In-Lake'	Hypolimnetic Water Release from Reservoir	0.0%	100.0%	100.0%
#701	WWTP	WWTP - - from Level I to Level II	0.0%	100.0%	100.0%
#702	WWTP	WWTP - - from Level I to Level III	0.0%	100.0%	100.0%







Adjusted SWAT/WASP/ERNST BMP Efficacies : 1

HANDOUT D

BMP	Type	Description	Efficacy Rates		
			P	N	Sed
#001	Cropland	Cropland to Grass	-7.00%	-3.70%	-5.60%
#001A	Cropland	Contour Farming	-1.29%	-0.21%	-1.29%
#003	Cropland	Fertilizer/ Nutrient Mgmt	-1.50%	0.00%	0.00%
#004	Cropland	Filter Strip	-15.00%	-8.50%	-11.00%
#006	Cropland	Grassed Waterways	-0.18%	-0.31%	-0.57%
#007	Cropland	Terracing	-2.10%	-0.45%	-2.10%
#101	Pasture & Rangeland	Prescribed Grazing	-1.56%	-4.33%	-2.22%
#105	Pasture & Rangeland	Pasture Planting	-2.36%	-6.57%	-3.37%
#107	Pasture & Rangeland	Critical Pasture Planting	-1.87%	-4.19%	-2.95%
#s 201 - 209	Urban	Phase II Urban BMPs	-10.0%	-10.99%	-5.00%
#210	Urban	Voluntary Urban Nutrient Mgmt	-1.56%	-0.98%	-0.28%
#211	Urban	Required Urban Nutrient Mgmt in 2,000 ft Reservoir Buffer Strip	-1.11%	-2.20%	0.00%






Adjusted SWAT/WASP/ERNST BMP Efficacies : 2


HANDOUT E

			Efficacy Rates		
BMP	Type	Description	P	N	Sed
#301A	Channel	Riparian Buffer Strips — except critical areas	-0.80%	-0.70%	-3.64%
#302	Channel	Riparian Buffer Strips — critical areas	-0.13%	-0.08%	-0.51%
#401A1	Watershed	Wetland - Lower Kings Creek (SB 54)	-1.61%	-1.90%	-2.98%
#401B1	Watershed	Wetland - End Cedar Creek (SB 70)	-0.63%	-1.04%	-1.58%
#402	Watershed	Grade Stabilization	-2.30%	-1.60%	-2.40%
#501	Reservoir 'In-Lake'	Hypolimnetic Aeration	-1.60%	0.00%	0.00%
#502B	Reservoir 'In-Lake'	P Inactivation with Alum – 1/3 of Reservoir	-3.15%	0.00%	0.00%
#505	Reservoir 'In-Lake'	Hypolimnetic Water Release from Reservoir	-0.65%	0.00%	0.00%
#701	WWTP	WWTP - - from Level I to Level II	-4.60%	-1.60%	0.00%
#702	WWTP	WWTP - - from Level I to Level III	-5.30%	-2.70%	0.00%

BMP Activity Constraints

BMP	Category	Description	Binary Possibilities
#s 201 – 209	Urban	Phase II Urban BMPs	0,1
#211	Urban	Required Urban Nutrient Mgmt in 2,000 ft Reservoir Buffer Strip	0,1
#401A1	Watershed	Wetland - Lower Kings Creek (SB 54)	0,1
#401B1	Watershed	Wetland - End Cedar Creek (SB 70)	0,1
#501	Reservoir 'In-Lake'	Hypolimnetic Aeration	0,1
#502B	Reservoir 'In-Lake'	P Inactivation with Alum – 1/3 of Reservoir	0,1
#701	WWTP	WWTP - - from Level I to Level II	0,1
#702	WWTP	WWTP - - from Level I to Level III	0,1
#001A & #007	Cropland	Contour Farming & Terracing	Either one but not both
#701 & #702	WWTP	From Level I to II or III	Either one but not both



BMP Financial Economics: 1



Handout F

BMP	Description	Initial Costs	AE of Initial & Cap. Repl. Costs	AE of Operating Costs	AE of All Costs
#001	Cropland to Grass	\$ 1,407,766	\$ 75,927	\$ 779,506	\$ 855,433
#001A	Contour Farming	\$ 30,000	\$ 6,910	\$ 94,867	\$ 101,777
#003	Nut. Mgmt	\$ 15,000	\$ 1,435	\$ 1,995,917	\$ 1,997,352
#004	Filter Strip	\$ 135,532	\$ 31,172	\$ 132,218	\$ 163,390
#006	Grassed Waterways	\$ 69,414	\$ 8,946	\$ 62,591	\$ 71,537
#007	Terracing	\$ 408,772	\$ 52,682	\$ 99,314	\$ 151,995
#101	Prescribed Grazing	\$ 3,089,907	\$ 166,652	\$ 40,068	\$ 206,720
#105	Past. Planting	\$ 1,900,943	\$ 244,989	\$ 457,040	\$ 702,029
#107	Crit. Pasture Planting	\$ 270,701	\$ 62,353	\$ 27,128	\$ 89,481
#s 201 - 209	Phase II Urban BMPs	\$ -	\$ -	\$ 2,295,967	\$ 2,295,967
#210	Vol. Urb. Nut. Mgmt	\$ -	\$ -	\$ 285,720	\$ 285,720
#211	Req. Urban Nut. Mgmt in Res. Buffer	\$ 350,000	\$ 18,877	\$ 129,780	\$ 148,657



BMP Financial Economics: 2



Handout G

BMP	Description	Initial Costs	AE of Initial & Cap. Repl. Costs	AE of Operating Costs	AE of All Costs
#301A	Rip. Buffer Strips — non crit. areas	\$ 2,160,000	\$ 171,860	\$ -	\$ 171,860
#302	Rip. Buffer Strips — crit. areas	\$ 3,500,000	\$ 188,770	\$ -	\$ 188,770
#401A1	Wetland - Lower Kings Creek	\$12,408,654	\$ 669,252	\$ 202,796	\$ 872,048
#401B1	Wetland - End Cedar Creek	\$ 9,572,193	\$ 473,012	\$ 217,304	\$ 690,316
#402	Grade Stabilization	\$ 330,000	\$ 42,530	\$ -	\$ 42,530
#501	Hypolimnetic Aeration	\$ 1,200,000	\$ 95,478	\$ 301,478	\$ 396,956
#502B	P Inactivation with Alum	\$ 6,700,000	\$ 863,480	\$ -	\$ 863,480
#505	Hypolimnetic Water Release	\$ -	\$ -	\$ 1,836,774	\$ 1,836,774
#701	WWTP - - Level I to Level II	\$ 6,865,942	\$ 370,310	\$ 72,299	\$ 442,609
#702	WWTP - - Level I to Level III	\$11,957,148	\$ 644,900	\$656,739	\$ 1,301,640



BMP Financial Economics: 3



Handout H

BMP	Description	AE Costs per Engl. Ton of P Reduction	AE Costs per Engl. Ton of N Reduction	AE Costs per Engl. Ton of Sed Reduction	Ranked Order for Least Cost		
					P	N	Sed
#001	Cropland to Grass	\$ 58,760	\$ 14,777	\$ 31	7	9	9
#001A	Contour Farming	\$ 38,063	\$ 30,357	\$ 16	5	15	6
#003	Nut. Mgmt	\$ 640,267	\$ ∞	\$ ∞	20	19	16
#004	Filter Strip	\$ 5,238	\$ 1,229	\$ 3	1	1	1
#006	Grassed Waterways	\$ 193,486	\$ 14,697	\$ 25	17	8	8
#007	Terracing	\$ 34,802	\$ 21,588	\$ 15	4	13	5
#101	Prescribed Grazing	\$ 63,899	\$ 3,049	\$ 19	8	4	7
#105	Past. Planting	\$ 143,162	\$ 6,831	\$ 42	16	6	10
#107	Crit. Pasture Planting	\$ 22,967	\$ 1,366	\$ 6	3	2	3
#s 201 -209	Phase II Urban BMPs	\$ 110,418	\$ 13,357	\$ 93	12	7	14
#210	Vol. Urb. Nut. Mgmt	\$ 87,973	\$ 18,666	\$ 203	10	12	15
#211	Req. Urban Nut. Mgmt in Res. Buffer	\$ 64,267	\$ 4,317	\$ ∞	9	5	16



BMP Financial Economics: 4




Handout I

BMP	Description	AE Costs per Engl. Ton of P Reduction	AE Costs per Engl. Ton of N Reduction	AE Costs per Engl. Ton of Sed Reduction	Ranked Order for Least Cost		
					P	N	Sed
#301A	Rip. Buffer Strips — non crit. areas	\$ 103,296	\$ 15,692	\$ 10	11	10	4
#302	Rip. Buffer Strips — crit. areas	\$ 698,212	\$ 150,815	\$ 75	21	18	12
#401A1	Wetland - Lower Kings Creek	\$ 260,443	\$ 29,335	\$ 59	18	14	11
#401B1	Wetland - End Cedar Creek	\$ 526,872	\$ 42,424	\$ 88	19	17	13
#402	Grade Stabilization	\$ 8,891	\$ 1,699	\$ 4	2	3	2
#501	Hypolimnetic Aeration	\$ 119,294	\$ ∞	\$ ∞	14	19	16
#502B	P Inactivation with Alum	\$ 131,807	\$ ∞	\$ ∞	15	19	16
#505	Hypolimnetic Water Release	\$ 1,358,750	\$ ∞	\$ ∞	22	19	16
#701	WWTP - - Level I to Level II	\$ 46,266	\$ 17,681	\$ ∞	6	11	16
#702	WWTP - - Level I to Level III	\$ 118,090	\$ 30,813	\$ ∞	13	16	16




Which BMPs to Select?



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-- optimization component (LINDO)




- **Four scenarios for consideration**
 - (A) Base, focused on reducing P by 35%
 - (B) Base, with value accorded also reducing sediment
 - (C) Perceived “Most Likely” adoption path
 - (D) No Ag BMPs
- **Model results of importance**
 - Objective function value (AE)
 - Initial costs
 - BMPs in the solution
 - Other details available


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-- optimization component (LINDO)



(A) Base, focused on reducing P by 35%







BMP ECONOMICS[®] RESULTS

-- optimization component (LINDO)

Handout J





Labels	Units	A	B	C	D
Description	n/a	Base	Sed Reduction Valued	Most Unlikely BMPs elim.	No Ag BMPs
Total AE Cost	\$	\$ 2.029 M			
AE Initial & Cap. Repl. \$s	\$	\$ 0.763 M			
AE Operating \$	\$	\$ 1.266 M			
Initial \$s	\$	\$ 11.784 M			
Reductions in P	%	35			
Reductions in P	English tons	72.79			
Marginal Cost of Another Unit of P Reduction	\$/English tons	\$ 63,899			
Average Cost per Unit of P Reduction	\$/English tons	\$ 27,874			
Reductions in N	%	25.1			
Reductions in N	English tons	392.15			
Marginal Cost of Another Unit of N Reduction	\$/English tons	nc			
Average Cost per Unit of N Reduction	\$/English tons	\$ 5,174			
Reductions in Sed	%	25.5			
Reductions in Sed	English tons	126,469.0			
Marginal Cost of Another Unit of Sed Reduction	\$/English tons	nc			
Average Cost per Unit of Sed Reduction	\$/English tons	\$ 16			



BMP ECONOMICS[®] RESULTS

-- optimization component (LINDO)


Handout K

Labels		A	B	C	D
Description		Base	Sed Reduction Valued	Most Unlikely BMPs elim. (only 28.84% P)	No Ag BMPs
001	301A	001			
001A	302				
003	401A				
004	401B	004			
006	402		402		
007	501	007			
101	502B	101			
105	505				
107	701	107	701		
201209	702				
210					
211		211			

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BMP ECONOMICS[®] BASE RESULTS

-- details of the optimal solution

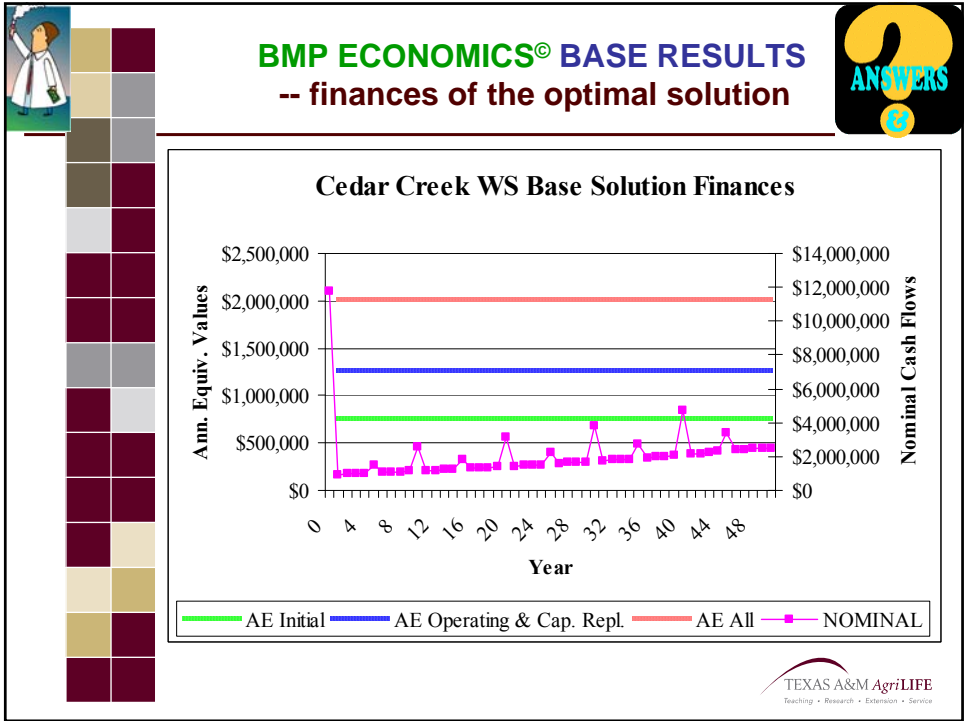
Handout L

BMP	Description	Marg. Units Affected	Units	Activity Level in Optimal Solution (%)	NPV of Construct. Costs Only	AE of Initial Construct. and Capital Replace. Costs	AE of Operating and Mainten. Costs	AE of All Costs	Marginal P Reduction (Engl tons)	Cum. P Red. (Engl tons)	Marg. AE Cost per Engl. Ton of P Red.
004	Filter Strip	947.5	acs	100	\$135,332	\$31,172	\$132,218	\$163,390	-31.2	-31.20	\$ 5,238
402	Grade Stabilization	33	struct.	100	\$330,000	\$42,530	\$ -	\$42,530	-4.78	-35.98	\$ 8,891
107	Critical Pastureland Area Planting	511.4	acs	100	\$270,701	\$62,353	\$27,128	\$89,481	-3.9	-39.88	\$ 22,967
007	Terracing	77.4	acs	100	\$408,772	\$52,682	\$99,314	\$51,995	-4.37	-44.25	\$ 34,802
001A	Contour Farming	1,625.80	acs	0a	0a	0a	0a	0a	0a		\$ 38,063
701	All Nine (9) WWTP -- from Level I to Level II	1	WWTP group	100	\$6,865,942	\$370,310	\$72,299	\$442,609	-9.57	-53.82	\$ 46,266
001	Cropland to Grass	7,959.00	acs	100	\$1,407,766	\$75,927	\$779,506	\$855,433	-14.56	-68.38	\$ 58,760
101	Prescribed Grazing	102.5	acs	65.22	\$2,015,237	\$108,690	\$26,132	\$134,822	-2.11	-70.49	\$ 63,899
211	Required Urban Nutrient Management in 2,000 ft Buffer Strip around the Reservoir	1	total specific d urban area	100	\$350,000	\$18,877	\$129,780	\$148,657	-2.31	-72.80	\$ 64,267
Totals					\$11,783,750	\$762,541	\$1,266,377	\$2,028,917	-72.80		Avg= \$ 27,874




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-- optimization component (LINDO)

(B) Base, with value credited for reducing sediment @ \$4,200 per ac-ft


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BMP ECONOMICS[®] RESULTS

-- optimization component (LINDO)


Handout J



Labels	Units	A	B	C	D
Description	n/a	Base	Sed Reduction Valued	Most Unlikely BMPs elim.	No Ag BMPs
Total AE Cost	\$	\$ 2,029 M	\$ 1,780 M		
AE Initial & Cap. Repl. \$s	\$	\$ 0,763 M	\$ 0,763 M		
AE Operating \$	\$	\$ 1,266 M	\$ 1,266 M		
Initial \$s	\$	\$ 11,784 M	\$ 11,783 M		
Reductions in P	%	35	35		
Reductions in P	English tons	72.79	72.79		
Marginal Cost of Another Unit of P Reduction	\$/English tons	\$ 63,899	\$ 57,201		
Average Cost per Unit of P Reduction	\$/English tons	\$ 27,874	\$ 27,874		
Reductions in N	%	25.1	25.1		
Reductions in N	English tons	392.15	392.15		
Marginal Cost of Another Unit of N Reduction	\$/English tons	nc	nc		
Average Cost per Unit of N Reduction	\$/English tons	\$ 5,174	\$ 5,174		
Reductions in Sed	%	25.5	25.5		
Reductions in Sed	English tons	126,469.0	126,469.0		
Marginal Cost of Another Unit of Sed Reduction	\$/English tons	nc	nc		
Average Cost per Unit of Sed Reduction	\$/English tons	\$ 16	\$ 16		




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BMP ECONOMICS[®] RESULTS

-- optimization component (LINDO)


Handout K




Labels		A	B	C	D
Description		Base	Sed Reduction Valued	Most Unlikely BMPs elim. (only 28.84% P)	No Ag BMPs
001	301A	001	001		
001A	302				
003	401A				
004	401B	004	004		
006	402		402	402	
007	501	007	007		
101	502B	101	101		
105	505				
107	701	107	701	107	701
201209	702				
210					
211		211	211		

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- Blocked from being included in the solution




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BMP ECONOMICS[®]

-- optimization component (LINDO)



(C) Perceived “Most Likely” adoption path







BMP ECONOMICS[®] RESULTS


-- optimization component (LINDO)

Handout J



Labels	Units	A	B	C	D
Description	n/a	Base	Sed Reduction Valued	Most Unlikely BMPs elim.	No Ag BMPs
Total AE Cost	\$	\$ 2.029 M	\$ 1.780 M	\$ 3.131 M	
AE Initial & Cap. Repl. \$s	\$	\$ 0.763 M	\$ 0.763 M	\$ 2.809 M	
AE Operating \$	\$	\$ 1.266 M	\$ 1.266 M	\$ 0.322 M	
Initial \$s	\$	\$ 11.784 M	\$ 11.783 M	\$ 9.819 M	
Reductions in P	%	35	35	35	
Reductions in P	English tons	72.79	72.79	72.79	
Marginal Cost of Another Unit of P Reduction	\$/English tons	\$ 63,899	\$ 57,201	\$ 38,063	
Average Cost per Unit of P Reduction	\$/English tons	\$ 27,874	\$ 27,874	\$ 27,874	
Reductions in N	%	25.1	25.1	27.1	
Reductions in N	English tons	392.15	392.15	423.65	
Marginal Cost of Another Unit of N Reduction	\$/English tons	nc	nc	nc	
Average Cost per Unit of N Reduction	\$/English tons	\$ 5,174	\$ 5,174	\$ 4,789	
Reductions in Sed	%	25.5	25.5	22.6	
Reductions in Sed	English tons	126,469.0	126,469.0	111,978.4	
Marginal Cost of Another Unit of Sed Reduction	\$/English tons	nc	nc	nc	
Average Cost per Unit of Sed Reduction	\$/English tons	\$ 16	\$ 16	\$ 18	






BMP ECONOMICS® RESULTS


-- optimization component (LINDO)


Handout K



Labels		A		B		C		D	
Description		Base		Sed Reduction Valued		Most Unlikely BMPs elim. (only 28.84% P)		No Ag BMPs	
001	301A	001		001					
001A	302					001A			
003	401A								
004	401B	004		004		004			
006	402		402		402		402		
007	501	007		007					
101	502B	101		101					
105	505								
107	701	107	701	107	701	107	701		
201t209	702					201t209			
210									
211		211		211					


Cell Background Color Legend:
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■ In solution at partial level
■ Blocked from being included in the solution







BMP ECONOMICS®

-- optimization component (LINDO)



(D) No Ag BMPs






BMP ECONOMICS[®] RESULTS


-- optimization component (LINDO)

Handout J



Labels	Units	A	B	C	D
Description	n/a	Base	Sed Reduction Valued	Most Unlikely BMPs elim.	No Ag BMPs
Total AE Cost	\$	\$ 2.029 M	\$ 1.780 M	\$ 3.131 M	\$ 9.095 M
AE Initial & Cap. Repl. Ss	\$	\$ 0.763 M	\$ 0.763 M	\$ 2.809 M	\$ 5.750 M
AE Operating \$	\$	\$ 1.266 M	\$ 1.266 M	\$ 0.322 M	\$ 3.345 M
Initial Ss	\$	\$ 11.784 M	\$ 11.783 M	\$ 9.819 M	\$ 50.639 M
Reductions in P	%	35	35	35	28.84
Reductions in P	English tons	72.79	72.79	72.79	59.98
Marginal Cost of Another Unit of P Reduction	\$/English tons	\$ 63,899	\$ 57,201	\$ 38,063	\$ 1,358,750
Average Cost per Unit of P Reduction	\$/English tons	\$ 27,874	\$ 27,874	\$ 27,874	\$ 33,827
Reductions in N	%	25.1	25.1	27.1	22.2
Reductions in N	English tons	392.15	392.15	423.65	347.11
Marginal Cost of Another Unit of N Reduction	\$/English tons	nc	nc	nc	nc
Average Cost per Unit of N Reduction	\$/English tons	\$ 5,174	\$ 5,174	\$ 4,789	\$ 845
Reductions in Sed	%	25.5	25.5	22.6	16.4
Reductions in Sed	English tons	126,469.0	126,469.0	111,978.4	81,314.2
Marginal Cost of Another Unit of Sed Reduction	\$/English tons	nc	nc	nc	nc
Average Cost per Unit of Sed Reduction	\$/English tons	\$ 16	\$ 16	\$ 18	\$ 25


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BMP ECONOMICS[®] RESULTS

-- optimization component (LINDO)

Handout K



Labels		A	B	C	D
Description		Base	Sed Reduction Valued	Most Unlikely BMPs eliminated	No Ag BMPs (only 28.84% P)
001	301A	001	001		301A
001A	302			001A	302
003	401A				401A
004	401B	004	004	004	401B
006	402		402		402
007	501	007	007		501
101	502B	101	101		502B
105	505				505
107	701	107	701	107	701
201t209	702			201t209	201t209
210					210
211		211	211		211

Cell Background Color Legend:

- In solution at maximum level
- In solution at partial level
- Blocked from being included in the solution

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Conclusions



- 35% P reduction is achievable
- Base annual costs are approx. \$2 million
- Up front, time 0 costs are approx. \$12 million
- A portfolio of BMPs is optimal
- Inclusion of ag-related BMPs is cost-effective
- Optimal economic solution is based on a myriad of factors





What's Next?



- Interested in your perspectives today
- Preparing the final report



Questions?



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Thank You
Collaborators & Supporters !



*~ Bringing Economics, Finance, Accounting, and
Computer Modeling to Water Planning in the Cedar
Creek Watershed and beyond!~*

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