Aquatic Resource Assessment for Coal Mining Permits in West Virginia

Lower Villag

Appalachian Stream Mitigation Workshop

April 11-15, 2011 Lexington, KY

Alison Rogers Regulatory Project Manager USACE Huntington District



US Army Corps of Engineers BUILDING STRONG_®

Evolution of Stream Assessment

- West Virginia Stream Condition Index (WVSCI)
 - Implemented in 2000
 - Benthic Macroinvertebrate
 Based Metric
 - Biotic Community & Water Quality Assessment Measure
- Water Chemistry
- Aquatic Habitat Quality
 - Rapid Bioassessment Procedures (RBP) Habitat Assessment Value (HAV) – Revised and Released in 1999





Evaluation of Earlier Stream Assessment



- Applicable to High & Low Gradient Stream Types
- Rapid Assessment
- Ratio Based Mitigation
- Temporal Losses Captured on a Percent per Year Basis
- Ecological Assessment Variable i.e. Subject to Best Professional Judgment
- No Functional Assessment Methods Available



Litigation Driven Evolution

Expanded Assessment Tools

- Numerous Decisions to Legal Challenges
 - Most Notably Chambers March 2007; Overturned on Appeal February 2009
- Industry/Applicants/Agents
 - Riffle-Pool Assessments



 Various Studies to Better Understand Stream Function – leaf pack degradation, periphyton colonization, aquatic salamander surveys

USACE

- Development of the Interim Functional Assessment Approach (IFAA) – Short Term Assessment Tool (2007)
- Development of the Hydrogeomorphic Approach (HGM) – Long Term Assessment Tool (2010)



Interim Functional Assessment Approach (IFAA)

- Released June 2007; Implemented August 2007
- Assessment of Stream & Watershed Condition
- Strengths
 - Assesses the Capacity of High Gradient Streams to Perform Four Categories of Functions
 - Hydrology, Biogeochemical, Plant Community, Habitat
 - Rapid Assessment
- Weaknesses
 - Limited Use (High Gradient Streams)
 - Problematic When Proposed Mitigation Targets Low Gradient Streams



Hydrogeomorphic Approach (HGM)

- Draft Operational Guidebook Released July 2010; Training for Agencies & Potential Applicants November 2010
- Region-Specific Model
- Strengths
 - Incorporates Field Measured Variables to Produce a Functional Capacity Index (FCI) Ranging from 0 to 1.0
 - Assesses the Capacity of High Gradient Streams to Perform Three Categories of Functions
 - Hydrology, Biogeochemical Cycling, Habitat
 - Rapid Assessment
- Weaknesses
 - Limited Use (High Gradient Streams)



The Missing Piece?



A Method to Evaluate High Gradient Stream Impacts and Proposed Rehabilitation on Low Gradient Streams...

Ecological Currency



West Virginia Stream & Wetland Valuation Metric (WV SWVM)

- Comprehensive Metric that Generates an Ecological Currency (Debit/Credit)
- Combines Current Assessment Measures including, WVSCI, Water Chemistry, RBP HAV, and HGM
- Benefits
 - Addresses "The Missing Piece" Issue
 - Consistent with Final Rule on Compensatory Mitigation
 - Debit & Credit Inputs Data Driven
 - Captures Temporal Losses as Debits
 - Shift from Ratio-Based Mitigation to Ecological-Based Mitigation



Example #1: Underground Mine

- Entry Types
 - Drift
 - Shaft/Slope
 - Box Cut
- Typical Impacts
 - Excavation to "Daylight" Coal Seam
 - Temporary Storage of Excavated Materials
 - Temporary Sediment and Drainage Control System
 - Access/Haul Road(s)
 - Staging/Operation Area



Review of PCN Under Terms and Conditions of NWP 50

- Proposed Underground Mine located in Wyoming County, West Virginia
- Drift Entry Face-Up Excavation Required
- Activities Requiring Discharge into Waters of the U.S. (Ephemeral and Perennial Waters)
 - Face-Up Excavation (Ephemeral Waters)
 - Construction of Temporary Excess Material Storage Site (Ephemeral Waters)
 - Installation of Temporary Sediment and Drainage Control System (Ephemeral Waters)
 - Reinstallation of a Haul Road Crossing (Perennial Water)







Stream Impact Evaluation

- Impacts (Temporary):
 - 949 feet ephemeral channel
 - 150 feet of perennial channel
- Ephemeral Channel Characteristics:
 - WVSCI & Water Chemistry: Dry, not collected
 - HAV Scores (range): 104 to 123
 - HGM FCI (Avg FCI = 0.86):
 - Hydrology = 0.86
 - Biogeochemical Cycling = 0.94
 - Habitat = 0.78
 - WV SWVM Debits: 1,167.1 (8 yr temporal loss)



USACE EU E NO (Droleet Name)	_		OHU Du	a No.11	INDACTOR		11 at	97 595705	Lon	81 40597	MEATUED.		1000 EQE	DATE	Eshnuan	0.00 0011
USACE FILE NO Project Name:			SUIRU	N NO.11	(In Decim	NORDINATES: al Degrees)	Lat	37.335765	Lon.	61.40537	WEATHER:	3	unny, sor	DATE:	rebruarj	y 28, 2011
STREAM CLASSIFICATION:		Ephemeral		IMPACT STREAM/SITE ID A (% stream slope, watershed size (acre	ND SITE DES eage), unaltered or	CRIPTION: Impairments)		Channel Slope 5-38%, 49 ac W	atershed, L	in-Impaired Forestiand	MITIGATION STREAM CLASS./SI (% stream slope, watershed size (ac	TE ID AND SIT reage), unaltered o	E DESCRIPTIO Impairments)	Channel Slope 5-38%, 49 ac Watershe	d, Un-Impair	ed Forestland
STREAM IMPACT LENGTH:	949	FORM O MITIGATI	OF F ON:	Permittee Responsible-Onsite	MIT COO (In Decim	RDINATES: al Degrees)	Lat.	37.595765	Lon.	81.40537	PRECIPITATION PAST 48 HRS:		,	Mitigation Length:	9	49
Column No. 1- Impact Existing	g Condition (De	bit)		Column No. 2- Mitigation Existing Con	dition - Baselin	e (Credit)	-	Column No. 3- Mitigation P Post Completic	rojected at Fi on (Credit)	ve Years	Column No. 4- Mitigation Proj Post Completion (eoted at Ten Ye Credit)	ме	Column No. 5- Mitigation Projecte	d At Maturity ((Credit)
HGM Score (attach data forms):		Average		IGM Score (attach data forms):		Average		HGM Score (attach data forms):		Average	HGM Score (attach data forms):		Average	HGM Score (attach data forme):		Average
Hydrology	0.85		8	lydrology				Hydrology	0.7		Hydrology	0.73		Hydrology	0.81	
Biogeochemical Cycling	0.94	0.85333333	E	Biogeochemical Cycling		0		Biogeochemical Cycling	0.62	0.586666667	Biogeochemical Cycling	0.64	0.62666667	Biogeochemical Cycling	0.91	0.8166667
Habitat	0.77		ł.	labitat				Habitat	0.44		Habitat	0.51		Habitat	0.73	
PART I - Physical, Chemical and	Biological Indi	oators		PART I - Physical, Chemical and B	Sielegical India	ators		PART I - Physical, Chemical a	and Biologica	I Indicators	PART I - Physical, Chemical and	Biological India	ators	PART I - Physical, Chemical and I	Biological Indi	oators
	Points Range Scale	Site Score	- 1		Points Range Scale	Site Score			Points Ran Scale	ge Site Score		Points Range Scale	Site Score		Points Rang Scale	ge Site Score
PHYSICAL INDICATOR (Applies to all streams	s classifications)		F	PHYSICAL INDICATOR (Applies to all streams	classifications)			PHYSICAL INDICATOR (Applies to all streams	classifications)		PHYSICAL INDICATOR (Applies to all stream	s classifications)		PHYSICAL INDICATOR (Applies to all streams	classifications)	
USEPA RBP (High Gradient Data Sheet)				JSEPA RBP (High Gradient Data Sheet)				USEPA RBP (High Gradient Data Sheet)			USEPA RBP (High Gradient Data Sheet)			USEPA RBP (High Gradient Data Sheet)		
 Epifaunal Substrate/Available Cover 	0-20	0	1	. Epifaunal Substrate/Available Cover	0-20			1. Epifaunal Substrate/Available Cover	0-20	0	1. Epifaunal Substrate/Available Cover	0.20	0	 Epifaunal Substrate/Available Cover 	0.20	0
2. Embeddedness	0-20	12	2	Embeddedness	0-20			2. Embeddedness	0-20	13	2. Embeddedness	0.20	16	2. Embeddedness	0.20	18
3. Velocity/ Depth Regime	0-20	0	2	. Velocity/ Depth Regime	0-20			3. Velocity/ Depth Regime	0.20	0	3. Velocity/ Depth Regime	0-20	0	3. Velocity/ Depth Regime	0.20	0
4. Sediment Deposition	0-20	11	4	. Sediment Deposition	0-20			4. Sediment Deposition	0-20	12	4. Sediment Deposition	0-20	16	4. Sediment Deposition	0-20	18
5. Channel Flow Status	0-20 0-1	0	-	. Channel Flow Status	0-20 0-1			5. Channel Flow Status	0.20 0	0	5. Channel Flow Status	0-20 0-1	0	5. Channel Flow Status	0-20 0-1	0
6. Channel Alteration	0-20	18	6	Channel Alteration	0-20			6. Channel Alteration	0-20	12	6. Channel Alteration	0-20	15	6. Channel Alteration	0-20	15
Frequency of Riffles (or bends)	0-20	0	2	. Frequency of Riffles (or bends)	0-20			Frequency of Riffles (or bends)	0-20	0	Frequency of Riffles (or bends)	0-20	0	Frequency of Riffles (or bends)	0.20	0
8. Bank Stability (LB & RB)	0-20	1/	8	. Bank Stability (LB & RB)	0-20			8. Bank Stability (LB & RB)	0-20	16	8. Bank Stability (LB & RB)	0-20	18	8. Bank Stability (LB & RB)	0-20	18
9. Vegetative Protection (LB & RB)	0-20	14	9	Vegetative Protection (LB & RB)	0-20			9. Vegetative Protection (LB & RB)	0-20	12	9. Vegetative Protection (LB & RB)	0-20	18	9. Vegetative Protection (LB & RB)	0-20	20
10. Riparian Vegetative Zone Width (LB & RB)	0-20	18	1	 Riparian Vegetative Zone Width (LB & RB) 	0-20			10. Riparlan Vegetative Zone Width (LB & RB)	0.20	20	 Riparian Vegetative Zone Width (LB & RB) 	0-20	18	 Riparian Vegetative Zone Width (LB & RB) 	0.20	20
Total RBP Score	Marginal	90	- 8	otal RBP Score	Poor	0		Total RBP Score	Marginal	85	Total RBP Score	Marginal	101	Total RBP Score	Marginal	109
Sub-Total	at and Descended D	0.45		Sub-Total	and December Of	U		Sub-Total	t and Research	0.425	Sub-Total	at and December 0	0.505	Sub-Total	and December 0	0.545
CREMICAL INDICATOR (Apples to mermite	nt and Perennial S	coarris)		REMICAL INDICATOR (Applies to mermitten	and Perennial of	earrs)		CREMICAL INDICATOR (Apples to Internitien	t and Peterman	oreans)	CHEMICAL INDICATOR (Apples to Internate	nt and Perennial S	reams)	CHEMICAL INDICATOR (Applies to Internitien	and Perennia o	(deams)
WVDEP Water Quality Indicators (General	0		1	VVDEP Water Quality Indicators (General)				WVDEP Water Quality Indicators (General)			WVDEP Water Quality Indicators (General	0		WVDEP Water Quality Indicators (General)		_
Specific Conductivity				peolific Conductivity	-			Specific Conductivity	_		Specific Conductivity			Specific Conductivity		
<-99 - 90 points	0-90	70.91			0-90			<=99 - 90 points	0-90	70	<=99 - 90 points	0.00	70	<=99 - 90 points	0.00	70
pH			5	н				pH			pH			pH		
	0-80 0-1	7.1			5-90				5-90	7		5-00 0-1	7		5-90 0-1	7
e.e.e.e.e.e.points				0				no			e.e-e.e = ee ponts			e.e-e.e = ee ports		
		-	- F							-			-			-
	10-30	2			10-30			>5.0 = 30 points	10-30	2	>5.0 = 30 points	10-30	2	>5.0 = 30 points	10-30	2
Sub-Total		1	2	Bub-Total		0		Sub-Total	• •	0.55	Sub-Total		1	Sub-Total		1
BIOLOGICAL INDICATOR (Applies to Intermit	tient and Perennial	i Streams)	E	BIOLOGICAL INDICATOR (Applies to Intermitte	ent and Perennial	Streams)		BIOLOGICAL INDICATOR (Applies to Intermi	ittent and Pere	nnial Streams)	BIOLOGICAL INDICATOR (Applies to Intern	nittent and Perenr	ial Streams)	BIOLOGICAL INDICATOR (Applies to Intermi	ttent and Perenr	nial Streams)
WV Stream Condition Index (WVSCI)			3	VV Stream Condition Index (WVSCI)				WV Stream Condition Index (WVSCI)			WV Stream Condition Index (WVSCI)			WV Stream Condition Index (WVSCI)		
Grav Zona	0-100 0-1	61.1			0-100 0-1			Grav Terra	0-100 0-	61	Grav Topo	0-100 0-1	65	Greet	0-100 0-1	68
Grey Zone		0.011		hade Testeri		0		Grey Zone		0.01	Grey Zone		0.05	Good		0.08
300-10tal		0.611	8	sub-100al		v		oub-rotal		0.61	300-10ta		0.60	Sub-Total		0.60
PART II - Index and U	Init Soore		I	PART II - Index and Uni	lt Soore			PART II - Index an	d Unit Soore		PART II - Index and U	nit Soore	1	PART II - Index and Ur	nit Soore	1
Index	Linear Feet	Unit Score	[Index	Linear Feet	Unit Soore		Index	Linear Fee	t Unit Soore	Index	Linear Feet	Unit Soore	Index	Linear Feet	Unit Soore
0.770166667	949	730.888167		0	949	0		0.5575	949	529.0675	0.6725	949	638,2025	0.779166667	949	739.42917



	(See instruction	PART III - Impact Factors page to insert default values for MITIGATION BANKING ar
Temporal Loss-Construction		
Note: Reflects duration of aquatic functional loss between the time of an impac mitigation (credit).	ot (debit) and completion of compensatory	% Add. Mitiga
Years	8	
Sub-Total	0.18484	
Temporal Loss-Maturity		0+6
Note: Period between completion of compensatory mitigation measures and the function (i.e. maturity of two stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to provide exception matter and detributed to the stratum to the strat	he time required for maturity, as it relates	Sub-Total
corridor).	wann npanan stream or wettand builer	
		Final Index Score
% Add. Mitigation	Temporal Loss-Maturity (Years)	(Debit)
		1.229806667
30%	30	
ub-Total	0.2748	

Loi	ng-term Protection
% Add. Mitigation and Monitoring Period	Long-Term Protection (Years)
0 + 5/10 Year Monitoring	101
Sub-Total	0

	PART IV - Inde	ex to Unit Score (Conversion
Final Index Score (Debit)	Linear Feet	Unit Score (Debit)	ILF Costs (Offsetting Debit Units)
1.229806667	949	1167.086527	\$933,669.22

		PART	V- Comparison of	Unit Scores and Projec	ted Balance				
Final Unit Score (Debit) [No Net Loss Value]	1167.086527	Mitigation Existing Condition - Baseline (Credit)	0	Mitigation Projected at Five Years Post Completion (Credit)	529.0675	Mitigation Projected at Ten Years Post Completion (Credit)	638.2025	Mitigation Projected At Maturity (Credit)	739.4291667
FINAL PROJECTED NET BALANCE					529.0675		638.2025		739.4291667

Part VI - Mitiga	tion Considera	tions (Incentives
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Extent of Stream Restoration *Note1: Reference the Instructional handout to determine the correct Restoration Levels (below) for your pr *Note2: Place an "X" in the appropriate category (only select one).	oject
Level I Restoration	
Level II Restoration	
Level III Restoration	

*Note ¹ : Refer	Extend ence Instructional handout for the *Note ² : Enter the buffer width *Note ³ : Selec	ed Upland Buffer Zone definitions of the Buffer Zone Mitigation Extents and Types (below) for each channel side (Left Bank and Right Bank) t the appropriate mitigation type
Buffer Width		Left Bank
	0-50	Preservation and Re-vegetation
50	51-150	Preservation
Buffer Width		Right Bank
	0-50	Preservation and Re-vegetation
50	51-150	Preservation
Average Buffer Width/Side	50	

Site	Impact Unit Yield (Debit)	Mitigation Unit Yield (Credit)
4th LD Unnamed Branch	1167.086527	998.229375



Stream Impact Evaluation

- Perennial Channel Characteristics:
 - WVSCI: 70.1 (Good Range)
 - Water Chemistry: 340 µs/cm conductivity; all parameters within acceptable ranges
 - HAV Scores (range): 134
 - HGM FCI: Perennial Stream not applicable
 - WV SWVM Debits: 173.1 (8 year temporal loss)



USACE FILE NOJProject Name:		still	Run No.11	IMPACT C	DORDINATES: La nal Degrees)	•	37.589159	Lon.	81.41906	WEATHER:		Sunny	DATE:	February	28, 2011
STREAM CLASSIFICATION:		Perennial	IMPACT STREAM/SITE ID A (% stream slope, watershed size (acr	ND SITE DES reage), unaltered o	CRIPTION: r Impairments)	Channel S	iope 2-4%, 684 ac Wat	ershed, Un-Imp	aired Forestland	MITIGATION STREAM CLASS/SI (% stream slope, watershed size (ac	TE ID AND SIT reage), unaltered or	E DESCRIPTION: Impairments)	Channel Slope 2-4%, 684 ac Watershei	i, Un-Impaire	d Forestland
STREAM IMPACT LENGTH:	150	FORM OF MITIGATION:	Permittee Responsible-Onsite	MIT COC (In Deale	RDINATES: La nal Degrees)	L .	37.589159	Lon.	81.41906	PRECIPITATION PAST 48 HRS:	(Mitigation Length:	15	50
Column No. 1- Impact Existing	Condition (De	bit)	Column No. 2- Mitigation Existing Con	dition - Baselin	ne (Credit)	Colu	nn No. 3- Mitigation Proj Post Completion	ected at Five Yea (Credit)	a	Column No. 4- Mitigation Pro) Post Completion (eoted at Ten Yea Credit)	R.C.	Column No. 6- Mitigation Projecter	At Maturity (C	redit)
HGM Score (attach data forms):		Average	HGM Score (attach data forms):		Average	HGM Score (at	tach data forms):		Average	HGM Score (attach data forms):		Average	HGM Score (attach data forms):		Average
Hydrology			Hydrology			Hydrology				Hydrology			Hydrology		
Biogeochemical Cycling		0	Biogeochemical Cycling		0	Biogeochemical	Cyoling		0	Blogeochemical Cycling		0	Biogeochemical Cycling		•
PART I - Physical, Chemical and	Biological Indi	oators	Habitat PART I - Physical, Chemical and E	Biological Indio	ators	PARTI	- Physical, Chemical and	Biological Indio	ators	PART I - Physical, Chemical and	Biological Indio	ators	Habitat PART I - Physical, Chemical and B	liological Indio	ators
	Points Range Scale	Site Score		Points Range Scale	Site Score			Points Range Scale	Site Score		Points Range Scale	Site Score		Points Range	Site Score
PHYSICAL INDICATOR (Applies to all streams	classifications)		PHYSICAL INDICATOR (Applies to all streams	classifications)		PHYSICAL INDIK	CATOR (Applies to all stream	is classifications)		PHYSICAL INDICATOR (Applies to all streams	s classifications)		PHYSICAL INDICATOR (Applies to all streams	lassifications)	
USERA DRR (Max Gradient Data Shart)			USERA DER (Web Gradiesi Deis Sheet)				ab Gradient Data Sheeth			USERA RRR (Mah Gradiest Data Shart)			USERA RRR (Mah Gradieri Deis Shari)		
1. Epifaunal Substrate/Available Cover	0-20	11	1. Epifaunal Substrate/Available Cover	0-20		1. Epifaunal Subs	trate/Available Cover	0-20	13	1. Epifaunal Substrate/Available Cover	0-20	16	1. Epifaunal Substrate/Available Cover	0-20	16
2. Embeddedness	0-20	13	2. Embeddedness	0-20		2. Embeddednes	5	0-20	15	2. Embeddedness	0-20	16	2. Embeddedness	0-20	16
3. Velocity/ Depth Regime	0-20	8	3. Velocity/ Depth Regime	0-20		3. Velocity/ Depth	Regime	0-20	13	3. Velocity/ Depth Regime	0-20	15	3. Velocity/ Depth Regime	0-20	15
4. Sediment Deposition	0-20	0	4. Sedment Deposition	0-20		4. Sediment Depr	osition	0-20	13	4. Sedment Deposition	0-20	16	4. Sediment Deposition	0-20	16
5. Channel Flow Status 5. Channel Alteration	0-20 0-1	13	5. Channel Alteration	0-20 0-1		5. Channel Flow	tion	0-20 0-1	10	5. Channel Alteration	0-20 0-1	15	5. Channel Alteration	0.20 0-1	16
7. Frequency of Riffles (or bends)	0-20	12	7. Frequency of Riffles (or bends)	0-20		7. Frequency of F	Riffles (or bends)	0-20	13	7. Frequency of Riffles (or bends)	0-20	15	7. Frequency of Riffles (or bends)	0-20	15
8. Bank Stability (LB & RB)	0-20	12	8. Bank Stability (LB & RB)	0-20		8. Bank Stability (LB & RB)	0-20	12	8. Bank Stability (LB & RB)	0-20	16	8. Bank Stability (LB & RB)	0-20	18
9. Vegetative Protection (LB & RB)	0-20	12	9. Vegetative Protection (LB & RB)	0-20		9. Vegetative Pro	tection (LB & RB)	0.20	12	9. Vegetative Protection (LB & RB)	0-20	16	9. Vegetative Protection (LB & RB)	0-20	20
10. Riparian Vegetative Zone Width (LB & RB)	0-20	8	10. Riparian Vegetative Zone Width (LB & RB)	0-20		10. Riparlan Veget	ative Zone Width (LB & RB)	0-20	18	10. Riparian Vegetative Zone Width (LB & RB)	0-20	18	10. Riparian Vegetative Zone Width (LB & RB)	0-20	20
Total RBP Score	Marginal	102	Total RBP Score	Poor	0	Total RBP Score		Suboptimal	127	Total RBP Score	Suboptimal	154	Total RBP Score	Suboptimal	163
CHEMICAL INDICATOR (Applies to Intermitter	t and Perennial S	treams)	CHEMICAL INDICATOR (Applies to Intermitten	t and Perennial St	(reams)	CHEMICAL INDI	CATOR (Applies to Intermit	ent and Perennial St	teams)	CHEMICAL INDICATOR (Applies to Intermitte	nt and Perennial St	reams)	CHEMICAL INDICATOR (Applies to Intermittent	and Perennial Str	eams)
WVDEP Water Quality Indicators (General))		WVDEP Water Quality Indicators (General)			WVDEP Water G	uality Indicators (Genera	ai)		WVDEP Water Quality Indicators (General	ŋ		WVDEP Water Quality Indicators (General)		
Specific Conductivity			Specific Conductivity	_		Specific Conduc	itivity			Specific Conductivity	-		8 peoific Conductivity		
300-399 - 70 points	0-90	340	DH	0-90		300 DH	-399 - 70 points	0-90	340	300-399 - 70 points	0-90	340	300-399 - 70 points	0-90	340
6.0-8.0 = 80 points	0-80 0-1	6.7		5-90 0-1		6.0	8.0 = 80 points	5-90 0-1	6.7	6.0-8.0 = 80 points	5-90 0-1	6.7	5.0-8.0 = 80 points	5-00 0-1	6.7
DO		-	DO			DO				DO			DO		
Sub-Total	10-30	0.9	Sub-Total	10-30	0	>5 Sub-Total	.0 = 30 points	10-30	0.55	>5.0 = 30 points Sub-Total	10-30	0.9	>5.0 = 30 points Sub-Total	10-30	0.9
BIOLOGICAL INDICATOR (Applies to Intermit	tent and Perennia	(Streams)	BIOLOGICAL INDICATOR (Applies to Intermit	tent and Perennial	Streams)	BIOLOGICAL IN	DICATOR (Applies to Inter	mittent and Perenn	ial Streams)	BIOLOGICAL INDICATOR (Applies to Intern	nittent and Perenn	ial Streams)	BIOLOGICAL INDICATOR (Applies to Intermi	tent and Perenni	ial Streams)
WV Stream Condition Index (WVSCI)			WV Stream Condition Index (WVSCI)			WV Stream Con	dition Index (WVSCI)			WV Stream Condition Index (WVSCI)			WV Stream Condition Index (WVSCI)		
Good	0-100 0-1	70.1		0-100 0-1			Good	0-100 0-1	70	Good	0-100 0-1	72	Greet	0-100 0-1	74
Sub-Total		0.701	Sub-Total		0	Sub-Total			0.7	Sub-Total		0.72	Sub-Total		0.74
PART II - Index and U	nit Soore		PART II - Index and Un	nit Soore			PART II - Index and U	Jnit Soore		PART II - Index and U	init Soore		PART II - Index and Ur	lt Soore	
Index	Linear Feet	Unit Soore	Index	Linear Feet	Unit Soore		Index	Linear Feet	Unit Score	Index	Linear Feet	Unit Soore	index	Linear Feet	Unit Soore
0.703666667	150	105.55	0	150	0	0	628333333	150	94.25	0.796666667	150	119.5	0.818333333	150	122.75



PART III - Impact Factors (See instruction page to insert default values for MITIGATION BANKING and ILF)

Temporal Loss-Cor	nstruction
Note: Reflects duration of aquatic functional loss between the tim	e of an impact (debit) and completion of compensatory
mitigation (cred	dit).
Years	8
Sub-Total	0.16888
Temporal Loss-M	Maturity
to function (i.e. matunty of tree stratum to provide organic matter corridor).	r and detritus within riparian stream or welland buffer
% Add. Mitigation	
	Temporal Loss-Maturity (Years)
30%	Temporal Loss-Maturity (Years)

Lo	ng-term Protection
% Add. Mitigation and Monitoring Period	Long-Term Protection (Years)
0 + 5/10 Year Monitoring	101
Sub-Total	0

	PART IV - Index to Unit Score Conversion					
Final Index Score (Debit)	Linear Feet	Unit Score (Debit)	ILF Costs (Offsetting Debit Units)			
1.154013333	150	173.102	\$138,481.60			

	PART V- Comparison of Unit Scores and Projected Balance								
Final Unit Score (Debit) [No Net Loss Value]	173.102	Mitigation Existing Condition - Baseline (Credit)	0	Mitigation Projected at Five Years Post Completion (Credit)	94.25	Mitigation Projected at Ten Years Post Completion (Credit)	119.5	Mitigation Projected At Maturity (Credit)	122.75
FINAL PROJECTED NET BALANCE	1				94.25		119.5		122.75

	Part VI - Mitigation	n Considerations (Incer	itives)		
Extent of Stream Restoration "Note1: Reference the Instructional handout to determine the correct Restoration Levels (below) for your pre "Note2: Place an "X" in the appropriate category (only select one). I evel L Restoration	oject		*Note ¹ : Refe	Extend rence Instructional handout for the *Note ² : Enter the buffer width *Note ³ : Selec	led Upland Buffer Zone definitions of the Buffer Zone Mitigation Extents and Types (below) for each channel side (Left Bank and Right Bank) st the appropriate mitigation type
Level II Restoration			Buffer Width		Left Bank
Level III Restoration	х			0-50	Preservation and Re-vegetation
		-	50	51-150	Preservation
			Buffer Width		Right Bank
				0-50	Preservation and Re-vegetation
			50	51-150	Preservation

50 Average Buffer Width/Side

50

Site	Impact Unit Yield (Debit)	Mitigation Unit Yield (Credit)
Unnamed Branch	173.102	227.0875



Stream Mitigation Evaluation

- WV SWVM Credits:
 - Re-establishment of 949 feet of Ephemeral Channel after 8 years with NCD Techniques
 - Generates 998.2 Credits
 - Outstanding Debit Balance of 168.9
 - Applicant Proposes Rehabilitation of a 550-foot degraded reach of Unnamed Branch:
 - Offset Temporal Loss
 - Priority 3 Restoration Proposed
 - Level 3 Restoration Incentive
 - 116.7 Credits
 - Outstanding Debit Balance: 52.2



USACE FILE NO/Project Name:		Still	Run No.11	IMPACT COORDINATES: Lat (In Decimal Degrees)	it.	37.595765	Lon.	81.40537	WEATHER:	Sunny	DATE:	February 28, 2011
STREAM CLASSIFICATION:		Perenniai	IMPACT STREAM/SITE ID AI (% stream skope, watershed size (acre	ID SITE DESCRIPTION: age), unaltered or impairments)		Channel Slope 2-4%, 684 ac Water	shed, Un	Impaired Forestland	MITIGATION STREAM CLASSJSIT (% stream slope, waterabed size (scr	TE ID AND SITE DESCRIPTION: reage), unaltered or impairments)	Channel Slope 2-4%, 684 ac Watershe	d, Un-Impaired Forestland
STREAM IMPACT LENGTH:	0	FORM OF MITIGATION:	Permittee Responsible-Onsite	MIT COORDINATES: Lat (In Decimal Degreec)	it.	37.588921	Lon.	81.419489	PRECIPITATION PAST 48 HRS:	0	Mitigation Length:	550
Column No. 1- Impact Existing	Condition (Del	bit)	Column No. 2- Mitigation Existing Cond HGM Score (attach data forms):	lition - Baseline (Credit)	но	Column No. 3- Mitigation Project Post Completion (C) GM Score (attach data forma):	ted at Five redit)	Years	Column No. 4- Mitigation Proje Poet Completion ((HGM Score (attach data forms);	ooted at Ten Years Credit)	Column No. 5- Mitigation Projecte	d At Maturity (Credit)
Hydrology		Average	Hydrology	Average	Hyd	drology		Average	Hydrology	Average	Hydrology	Average
Biogeochemical Cycling Habitat		0	Biogeochemical Cycling Habitat	0	Blo	bitat		•	Biogeochemical Cycling Habitat	0	Blogeochemical Cycling Habitat	0
PART I - Physical, Chemical and	Biological India	Sile See	PART I - Physical, Chemical and B	Delete Bases Sile Scote		PART I - Physical, Chemical and B	lological in	Indicators	PART I - Physical, Chemical and	Biological Indicators	PART I - Physical, Chemical and I	Biological Indicators
	Scale Range	SHE SCORE		Scale Scale			Scale	ange bite book		Scale Scole		Scale Scale
PHYSICAL INDICATOR (Applies to all streams	classifications)		PHYSICAL INDICATOR (Applies to all streams of	lassifications)	PH	YSICAL INDICATOR (Applies to all streams of	classification	(5)	PHYSICAL INDICATOR (Applies to all streams	elassifications)	PHYSICAL INDICATOR (Applies to all streams	classifications)
Ordez A new final of states to data driver Detection Regime Letticate States and the states Channer Room Regime Container Accession Regime Container Accession Container Container Accession Container S. 6-6.0 - 45 points DO	9:30	0 0 Pearms) Streams)	Description of the second	0.02 11 0.02 13 0.02 8 0.02 8 0.02 12 0.02 12 0.02 12 0.02 8 0.02 12 0.02 8 0.02 8 0.02 0.51 0.02 8 0.03 0.51 0.040 0.51 0.040 0.51 0.040 0.41 6.40 0.41 6.40 0.41 6.40 0.51 0.40 0.41 6.41 0.51 0.42 0.51 0.40 0.41 0.51 0.51 0.400 0.1 0.51 0.30 0.51 0.30 0.51 0.30 0.51 0.701	0 сл. 0 сл.	PLA NOT Input Vision Columnation PLAND Columnat	9-20 9-20 9-20 9-20 9-20 9-20 9-20 9-20	13 15 13 13 13 13 12 12 12 13 14 15 13 13 13 14 15 15 0.585 14 340 64 60 6.7 5 0.9 64 70 0.7	DEE Andre (Ingle Statistics Cale Andre DEE Andre (Ingle Statistics Cover) Enforce Statistics Cover) Enforce Statistics Channel Adversion Content (Ingle Statistics Channel Adversion Cover Statistics Channel Adversion Cover Statistics Channel Adversion Cover Statistics Cov	0-20 16 0-20 16 0-20 15 0-20 15 0-20 15 0-20 15 0-20 15 0-20 16 0-20 15 0-20 16 0-20 16 0-20 16 0-20 16 0-20 16 0-20 16 0-20 16 0-20 16 0-20 15 0-20 16 0-20 15 0-20 15 0-20 15 0-20 15 0-20 15 0-20 15 0-20 5 0-20 5 0.5 0.5 0.5 0.5 0-20 0.72	Decomposition of the second seco	9.20 16 0.20 16 0.20 15 0.20 11 0.20 11 0.20 15 0.20 15 0.20 20 0.20 20 0.20 20 0.20 20 0.20 20 0.20 20 0.20 20 0.20 20 0.4050tmal 163 0.401 163 0.403 163 0.41 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 5.0 0.31 7.4
PART II - Index and U	nit Soore		PART II - Index and Uni	t Soore		PART II - Index and Uni	t Soore		PART II - Index and U	nit Soore	PART II - Index and Ur	nit Soore
Index	Linear Feet	Unit Soore	Index	Linear Feet Unit Soore		Index	Linear F	eet Unit Soore	Index	Linear Feet Unit Soore	Index	Linear Feet Unit Soore
0.325	0	0	0.703666667	550 387.01667		0.728333333	550	400.58333	0.796666667	550 438.166667	0.818333333	550 450.08333
									4		Ĩ	

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PART III - Impact Factors bage to insert default values for MITIGATION BANKING and ILF)

	(000 1104 404 011
Temporal Loss-Const	truction
*Note: Reflects duration of aquatic functional loss between the time of	of an impact (debit) and completion of compensatory
mitigation (credit)	
Years	1
Sub-Total	0
Temporal Loss-Ma	turity
voire. Period between completion or compensatory mitigation meas to function (i.e. maturity of tree stratum to provide organic matter an corridor).	ures and the time required for maturity, as it relates nd detritus within riparian stream or wetland buffer
% Add. Mitigation	
	Temporal Loss-Maturity (Years)
	Temporal Loss-Maturity (Years)
	Temporal Loss-Maturity (Years)
30%	Temporal Loss-Maturity (Years) 30

,	
Loi	ng-term Protection
% Add. Mitigation and Monitoring Period	Long-Term Protection (Years)
0 + 5/10 Year Monitoring	101
Sub-Total	0

PART IV - Index to Unit Score Conversion					
Final Index Score (Debit)	Linear Feet	Unit Score (Debit)	ILF Costs (Offsetting Debit Units)		
0.455	0	0	\$0.00		

	_	PART	V- Comparison of	Unit Scores and Projec	ted Balance		_		
Final Unit Score (Debit) [No Net Loss Value]	0	Mitigation Existing Condition - Baseline (Credit)	387.0166667	Mitigation Projected at Five Years Post Completion (Credit)	400.5833333	Mitigation Projected at Ten Years Post Completion (Credit)	438.1666667	Mitigation Projected At Maturity (Credit)	450.0833333
FINAL PROJECTED NET BALANCE	1				13.56666667		51.15		63.06666667

1		Part VI - Mitigation	Considerations (Incen	ntives)		
		i are i - intigation				
	Extent of Stream Restoration *Note1: Reference the Instructional handout to determine the correct Restoration Levels (below) for your pr *Note2: Place an "X" in the appropriate category (only select one).	oject		*Note1: Refe	Extend rence Instructional handout for the *Note ² : Enter the buffer width	ed Upland Buffer Zone definitions of the Buffer Zone Mitigation Extents and Types (below) for each channel side (Left Bank and Right Bank) the concernistic mitigation by the
	Level I Restoration				-Note : Selec	a the appropriate mugation type
	Level II Restoration			Buffer Width		Left Bank
	Level III Restoration	х			0-50	Preservation and Re-vegetation
		•		50	51-150	Preservation
				Buffer Width		Right Bank
					0-50	Preservation and Re-vegetation
				50	51-150	Preservation

Average Buffer Width/Side

50

Site	Impact Unit Yield (Debit)	Mitigation Unit Yield (Credit)
Unnamed Branch	0	116.6733333



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Stream Mitigation Evaluation

•	Rehabilitation of Haul Road Crossing on Unnamed	Impact/ Mitigation	Debit	Credit
	 Branch (150 feet) 173.1 Debits Rehabilitation Generates 227.1 Credits 	Temporary Fill/Ephemeral Stream Re-establishment	1,167.1	998.2
	 Outstanding Credit Balance: 54 	Stream Rehabilitation		116.7
	 Generated by Proposed Ecological Lift Offsets the 52.2 Debit Deficit Concrated by 	Temporary Crossing/Stream Rehabilitation	173.1	227.1
	Temporal Loss of	Total	1340.2	1342
	Ephemeral Channel During Mine Operation			ĨŦĬ

Example #2: Surface Mine

- Mining Methods
 - Full Extraction Area
 - Highwall/Contour
 - Combinations of Above Methods
- Typical Impacts
 - Permanent Excess Overburden Storage (Valley Fills)
 - Mine-Through of Streams
 - Temporary Sediment and Drainage Control System
 - Access/Haul Road(s)





Preliminary Stream Impact Evaluation

Impact Type	Perennial Impacts (feet)	Intermittent Impacts (feet)	Ephemeral Impacts (feet)
Valley Fill (Permanent)	1,505.0	6,262.0	3,251.0
Mine-Through (Permanent)		655.6	359.8
Sediment & Drainage Control (Temporary)	1,497.0	79.0	150.0
Stream Relocation (Temporary)	191.0	453.0	
Total	3,193.0	7,449.6	3,760.8

- Perennial, Intermittent, & Ephemeral Stream Impacts (Temporary & Permanent)
- WVSCI: 72.11 to 74.89
- Water Chemistry: Elevated Conductivity, Sulfates, Dissolved Solids, & Alkalinity
- HAV: 87 to 164

Preliminary Stream Mitigation Evaluation

- Mitigation Goal:
 - Establish, re-establish, and rehabilitate channels within the impacted watersheds to offset unavoidable losses to jurisdictional streams
- HGM Data: Field Work Conducted Prior to July 2010 Release
- WV SWVM: Applicant to Submit Information in Version 2.0

Mitigation Type		Length (feet)
Stream Establishment (Mine Reclamation)		2,914.0
Stream Establishment (Stream Relocations)		5,294.0
Stream Re-establishment (Mine Reclamation)		3,239.4
Stream Re-establishment & Rehabilitation within the Browning Fork & Canebrake Branch Watersheds		9,206.0
	Total	20,653.4



Summary

- WVSCI, Water Chemistry & RBP HAV
 - Characterize Stream Quality
- IFAA & HGM
 - Provide Functional Assessment Methodologies for High Gradient Streams
- WV SWVM
 - Combines Above Parameters
 - Quantifies Permanent & Temporal Loss
 - Quantifies Ecological Lift
 - Generates Ecological Currency



Questions?



