APPENDIX P

STREAM AND WETLAND MITIGATION PLAN FOR THE PROPOSED LIBERTY FUELS MINE

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STREAM AND WETLAND MITIGATION PLAN FOR THE PROPOSED LIBERTY FUELS LIGNITE MINE

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INTRODUCTION

This mitigation plan describes the conceptual approach to compensatory mitigation for unavoidable impacts to forested, herbaceous, and scrub-shrub wetlands, and perennial and intermittent streams that will occur as a result of the proposed Liberty Fuels lignite surface mining operation in Kemper and Lauderdale Counties, Mississippi. The project will encompass the construction of an advanced technology coal power plant by Mississippi Power Company, and the North American Coal Corporation (NACC) lignite coal surface mining operation that will fuel it. The project was chosen under DOE's Clean Coal Power Initiative (CCPI) to demonstrate Integrated Gasification Combined-Cycle (IGCC) technology.

STREAM MITIGATION

Existing Condition of Streams

Barry A. Vittor & Associates, Inc. conducted detailed assessments of stream habitats at eight locations in the mine study area. These assessments were designed to characterize streams with regard to structure/morphology, water quality, and biological communities; study results have been presented in a report to North American Coal Corporation. In addition, Vittor & Associates analyzed recent topographic data and aerial imagery, and information available in the MARIS website to estimate the classification and dimensions of intermittent and perennial streams within the mine study area. These information sources were compiled in GIS and were used to estimate potential mining activity impacts on streams. The proposed mining operations would result in temporary impacts to portions of six named creeks within the proposed mining area (**Figure 1**). The creeks that would be impacted are Chickasawhay Creek, Penders Creek, Dry Creek, Bales Creek, and Tompeat Creek. All of these streams are upstream of Okatibbee Lake, which is a large, man-made impoundment. Based on the 2009 Mobile District Corps of Engineers (COE) stream Standard Operating Procedures (SOP) guidelines, all perennial and intermittent streams that will be impacted are either impaired or somewhat impaired. The impacts will occur in 1st and 2nd order perennial streams, and intermittent streams that are best characterized by the Rosgen Field Guide for Stream Classification as Type F

streams. Typically these streams have deeply entrenched channels (<1.4 entrenchment ratio), low gradients (generally <2%), moderate-to-high width/depth ratios (>12), low-to-moderate sinuosity (>1.2), and sandy/clay channel substrate. They have highly erodible banks and are susceptible to mass wasting in areas where riparian vegetative densities are low.

The current degraded quality of the streams is the result of extensive commercial forestry activities, the network of roads and bridges throughout the area, and the decades-old practice of channelizing, ditching, and straightening streams and converting hardwood forest and floodplain forest to pasture land or small farms by private land owners.

Stream Impacts

Primary impacts to streams will occur during excavation within a given mining block and would involve the loss of existing stream and stream riparian zones within that block on a year-by-year basis. The stream impacts within a given annual mine block will occur during the initial disturbance and will have an average duration of five to ten years. The disturbance will not be permanent. The streams and riparian zones will be restored in accordance with the overall reclamation/mitigation plan that will be implemented incrementally as mining is completed in each block. During the entire life-of-mine period approximately 230,080 linear feet of intermittent or perennial stream and 66,429 linear feet of ephemeral stream will be displaced and reestablished by mining operations. These stream impacts will not occur simultaneously, but rather will occur incrementally during the life-of-mine period. In accordance with the COE March 2009 SOP for stream mitigation, ephemeral stream impacts are accounted for through wetland mitigation measures.

A sample ADVERSE IMPACT WORKSHEET is presented as **Figure 2**. It illustrates the Total Mitigation Credits Required under various scenarios that could occur in the Kemper County mine site. Computations are based on impacts to 1,000 linear feet of 1st or 2nd Order Perennial Stream or an Intermittent Stream, where the Existing Condition of the stream is either Somewhat Impaired or Impaired, and the Dominant Impact factor used is

Morphologic Change. The total mitigation credits that could be required to offset stream impacts range from 2,050 for a 1000-foot reach of impaired intermittent stream, to 3,450 for a 1000-foot reach of somewhat impaired perennial stream.

Stream Mitigation Approach

The initial step in the stream mitigation approach will entail collecting additional baseline data for each of the streams using a stable reference reach for each stream. Information to be collected will focus on dimension metrics including width/depth ratio, bank height ratio, entrenchment ratio, as well as pattern and profile metrics including slope, bed features, sinuosity, meander/width ratio, and radius of curvature. Stream SOP data sheets will be provided for each "Reference Reach" stream. Baseline data would also include rapid bioassessment studies conducted on reference reach streams. Those baseline data will be used as a model for the design of both the relocated/diverted streams and the restored/reclaimed streams.

Prior to beginning mining operations within a block, any intermittent or perennial stream that would be immediately impacted will be relocated/diverted around the block and tied back into the natural stream channel at a point downstream. This mitigative action will maintain an uninterrupted flow through the system. The relocated/diverted streams will be constructed according to the Stream Mitigation SOP Guidelines to "reflect the overall dimension, pattern, and profile of natural referenced stable conditions". Although some stream functions may be lost for a period of time (up to 24 months) in the newly constructed streams, it is expected that during their five to ten year life the diverted/relocated streams will develop functional quality surpassing that of the impacted natural streams, considering that the existing condition of all the natural streams in the Kemper County site are either impaired or somewhat impaired. Studies of similar diversion and reference streams at the Red Hills Mine (Choctaw Co.) have shown that mining block diversion streams achieve functional values equal to natural streams within five years. Even though the enhanced functions provided by the diverted/relocated stream will be lost when the mining of the block is stopped and reclamation/restoration actions are completed, some mitigation credit is merited for this action. The diverted/relocated

stream will be left in place until the restoration of the natural streambed is completed and the stream can be returned to its natural course.

Additional stream mitigation will be accomplished through the restoration of the natural streambed during the reclamation process. Any impacted stream will be reestablished in its original location and will be constructed to the specifications of the stable reference reach stream. A minimum 50-foot wide riparian corridor of vegetated species will be planted along the restored streams to mimic the species diversity, composition, and structure of the reference reach habitats.

A sample IN-STREAM WORK, STREAM CHANNEL/STREAMBANK RESTORATION AND RELOCATION WORKSHEET is provided in **Figure 3** and reflects the total credits generated for Stream Relocation and Stream Channel Restoration under scenarios that could occur on the Kemper County site. Values shown are based on Relocation and Restoration (Net Benefit) of 1,000 linear feet of 1st or 2nd Order Perennial Stream in either Somewhat Impaired or Impaired pre-impact condition. Diverted/relocated streams could produce moderate numbers of mitigation credits, as shown in **Figure 3**. Replacement of somewhat-impaired streams by diverted/relocated channels could generate 650 net credits per 1000 feet of stream, while replacement of impaired steams by diverted/relocated channels could generate 825 net credits per 1000 feet. Final reclamation/restoration of the pre-mine stream could produce 3,050 to 3,400 credits per 1000 feet. The cumulative effect of stream diverted/relocated channel construction and reestablishment of pre-mine streams is estimated to more than balance the losses of stream values due to mining.

WETLAND MITIGATION

Existing Wetland Conditions

Barry A. Vittor & Associates, Inc. conducted wetland surveys in the mine study area between the months of June and October, 2008. In addition to several months of on-site observation of accessible lands in the 31,260-acre study area, Vittor & Associates biologists documented the quality of wetland habitat at 53 individual locations. The

quality of each wetland habitat was evaluated using the Wetland Rapid Assessment Procedure (WRAP). The WRAP is a rating index that was developed by the South Florida Water Management District to assist in the regulatory evaluation of mitigation sites. In 2007, the Mobile, Alabama District Corps of Engineers (COE) began using the WRAP to evaluate the habitat quality of jurisdictional wetlands as defined by the 1987 Corps of Engineers Wetland Delineation Manual. Each of the 53 evaluated wetlands were categorized as one of the following vegetation/land use types: planted pine (PP), hardwood forest (H), pine-hardwood forest (PH), hardwood-pine forest (HP), bottomland forest (BF), shrub land (S), and fields (F). Wetlands that were classified as vegetation types PP, H, PH, HP, and BF are forested wetlands; fields (pastures, hay fields, "deer plots", or any area cleared of forest cover and maintained in an herbaceous state) represent herbaceous wetlands; and scrub-shrub wetlands were designated as Shrub Land under the vegetation/land use types.

Many of the wetlands observed in the project area are associated with large creeks, the confluences of small creeks, man-made ponds, and a very small number of seepage slopes. A vast majority of the small streams and creeks observed have steep, deeply incised-banks, apparently caused by heavy erosion caused by deforestation and ditching to facilitate pastureland or silvicultural use. Wetlands rarely exist alongside the deeply incised stream banks, due to drawdown effects of increased drainage. The wetland types most commonly evaluated were planted pine and bottomland forest. The hardwood bottoms associated with the major creeks such as Chickasawhay Creek, Penders Creek and Okatibbee Creek, are generally forested with medium-to-high quality wetlands with mature hardwood canopies dispersed along the creek channel. The floodplains of these creeks are where the majority of the wetlands are located. Wetlands were also frequently documented in fields in the study area due to the common practice of converting floodplain forests to pastureland, rangeland and hunting plots. These areas have low densities of canopy and shrub species, and are often planted in non-native grasses and forbs. Forested hardwood wetlands have also been converted into row-planted pine plantations. Large stands of loblolly pine (*Pinus taeda*) are commonly managed for commercial timber production by large industry and private landowners throughout the study area. On average PP wetlands received low WRAP scores and they account for a

large percentage of low-quality wetlands within the study area. Only two Shrub Land wetlands were evaluated during the WRAP surveys. These wetlands account for a small percentage of all wetlands mapped within the study area, and are generally low-to-medium quality.

Of the 53 WRAPs performed in the study area 14 were performed on lands in which NACC currently proposes to conduct surface mining operations. The purpose of evaluating these wetlands was to determine overall quality of wetlands in the area and to provide NACC with the information needed to perform the reclamation of wetlands impacted by mining operations. Due to the extensive impacts to wetland quality and function associated with current and previously implemented land management practices inside the study area, it is feasible to create a functional lift of the wetlands through the establishment of the following proposed NACC reclamation activities: re-contouring incised stream beds and drainage courses; replanting pine dominated wetlands with native hardwoods; removal of beaver dams; and replacement of improperly placed or non-functional culverts. The baseline information provided by the WRAPs that evaluate conditions prior to mining impacts could be compared to WRAPs that project post-reclamation wetland function, to provide a reasonable estimate of functional lift achieved through NACC's reclamation activities. Vittor & Associates performed WRAPs that project the functional lift achieved at the ten-year and 40-year stages of reclamation at the 14 WRAP locations located within the proposed mine blocks. Estimated WRAP values of 40-year post-reclamation wetlands were compared with the existing condition WRAPs to determine the net change in wetland function. The proposed post-reclamation change in wetland function and COE-mandated Temporal Loss Factors were applied to the impacted wetlands in order to provide an estimate of the acreages of preserved and enhanced wetlands that will be required, in addition to reclamation activities, to achieve mitigation for wetland impacts resulting from the time lag between the initiation of impacts to wetlands and the reestablishment of their pre-mine wetland quality.

Wetland Impacts

There are approximately 5,994 acres of wetlands located within the 31,260-acre study area. Approximately 13,375 acres (excluding linear facilities) will be impacted over a 40-year period by the construction of the power plant and the associated surface mining operation, including 2,374 acres of wetlands (**Figure 1**). The impact to the wetlands associated with the surface mining operation will not occur simultaneously; rather as the years advance and the disturbances advance, the acres of wetland mitigation will also advance. The wetland impacts will occur in incremental steps as the mining advances through the mine block area. This will include 979 acres of high quality wetlands, 950 acres of medium quality wetlands, and 445 acres of low quality wetlands. The quality of wetlands vary throughout each mine block; as a result, disturbance in a mine block impacts a variety of wetlands and does not necessarily target one key quality category. The majority of all wetland impacts will occur in forested wetlands (1,956 acres); whereas, relatively small acreages of scrub-shrub wetlands (247 acres) and herbaceous wetlands (181 acres) will be impacted by the mining operation.

Wetland Mitigation Approach

The reclamation of impacted wetlands will be performed upon the completion of mining. Impacted wetlands will be restored to a hydrologic condition that will adequately support wetland vegetation and overall function. The reclamation lands that are owned by NACC will be replanted with native hardwood species; leased lands will be replanted in accordance with contractual rights of the property owner. Mitigation will be accomplished through the preservation of high and/or medium quality wetlands that will not be disturbed by mining activity, and through the enhancement of low quality wetlands. Preserved wetlands will primarily consist of high-quality hardwood wetlands located within the study area. Wetlands that will be enhanced as part of mitigation will primarily consist of low-quality herbaceous wetlands that occur in the extensive areas of wet fields located inside the study area. Wet pasture will be converted to hardwood wetlands as part of the enhancement measures. In addition to the conversion of wet pasture to hardwoods, some areas of low-quality pine dominated forested wetlands may be converted to hardwood wetland ecosystems to fulfill a portion of the mitigation

requirements.

The following conditions will likely be prevalent in the evaluated wetlands after ten years of reclamation activities: native hardwood trees will be approximately 15 to 20 feet in height; the shrub layer will be very thick due to a relatively open canopy; herbaceous vegetative growth will be inhibited by shading and competition with shrub species; exotic species will be controlled and will account for less than ten percent of species composition in the canopy, shrub and herbaceous layers; hydrologic function will improve; and in cases where the wetland is buffered by other impacted wetlands there will be an increased value in both buffer quality and water quality input.

In areas where high WRAP scores were recorded prior to the surface mining operations the determination was made that there would generally be a slight increase in score for Wetland Hydrology after ten years, and projected a decreased score in the Wetland Overstory and Wetland Ground Cover parameters. A large majority of wetlands in the study area were observed to have some extent of decreased hydrologic function due to ditching, erosion of upland soils into wetlands, improperly sized/placed culverts, and reduced drainage areas. The proposed reclamation will address and correct most of those hydrology problems. Wildlife Utilization scores will likely remain stable due to the influence of surrounding uplands and land use on the determination of the parameter's score. When evaluating the ten-year and 40-year scores for the Upland/Wetland Buffer parameter it was assumed that the surrounding land use types associated with the upland buffers will typically be consistent with those prior to mining. Pastureland, pine plantation, and agricultural fields are the land use practices most commonly observed in the uplands throughout the study area.

In areas where medium WRAP scores were recorded in the study area, there will generally not be a significant change in wetland function after the first 10 years of reclamation; however, a majority of the planted pine forest, herbaceous field, and scrub-shrub wetland types (which generally received low pre-mine WRAP scores) within the mine block will either gain functional lift or be restored to their pre-mine state within the

first ten years of reclamation. WRAP scores for these wetland types will typically increase in the Wetland Canopy, Wetland Ground Cover, and Field Hydrology parameters through the establishment of adequate wetland hydrology and re-planting of native hardwoods. Due to the time lag for hardwood maturation, areas defined as high-quality forested wetlands will not gain functional lift from their pre-mine state within the first 10 years of reclamation.

Vittor & Associates believes that the following conditions will likely be prevalent in the evaluated wetlands after 40 years of reclamation activities: the middle-aged hardwood stand will create a relatively closed canopy; the shrub layer will be significantly thinned down from the 10-year densities; herbaceous vegetative growth will benefit from a lack of competition with shrub species; exotic species will be controlled in the canopy, shrub and herbaceous layers; hydrologic function will improve; and the wetlands themselves will act as buffers and wildlife corridors.

A majority of the projected 40-year post-reclamation WRAP scores reflected a functional lift from the pre-mining wetlands. Typically the wetlands will be improved due to a more natural composition of native wetland vegetation and more desirable densities in the vegetative layers. Wildlife will benefit from increased cover, food availability, and roosting/nesting habitat. Mature hardwoods will produce nutrient-rich mast for deer, squirrels, rodents and other wildlife. Wetlands soils will be stabilized by the root mass of the maturing forest and will help buffer streams during rain events. As previously mentioned, the upland buffers were considered to mirror present day conditions and did not account for any increase in functional lift for the evaluated wetlands.

To provide an estimation of the net change in wetland qualities the differences between pre-mine and 40-year post-reclamation WRAP scores were calculated for each of the 14 mine block wetlands that were evaluated (see results in **Table 1**). No scrub-shrub wetlands were evaluated within the currently proposed mine block; however, the 40-year post-reclamation WRAP scores were projected for two scrub-shrub wetlands within the study area that are representative of the overall quality of scrub-shrub wetlands located

within the mine block. The estimated functional lift values in **Table 1** were used to determine the number of wetland credits that will be required to mitigate for the temporal loss of wetland function due to mining operations (**See Table 2**).

In accordance with the policies of the Mobile District Corps of Engineers, NACC proposes to offset half of the temporal loss of wetland function associated with its mining activities through preservation of high and/or medium quality wetlands, and half through enhancement of low quality wetlands. During extensive field surveys the widespread conversion of high and medium quality forested wetlands to two predominant forms of land use were observed: pasture (which accounts for nearly all acres classified as low quality herbaceous wetland) and row-planted pine (which accounts for a large portion of the acreage classified as low quality forested wetland). Vittor & Associates acknowledged the likelihood that high and medium quality forested wetlands that are not owned by NACC are susceptible to being converted to pasture or row-planted pine, and accounted for that probability by using the average loss of function associated with the conversion to pasture and planted pine to determine the credit value per acre of preserved high and medium quality forested wetlands. That value was then divided into the total credits needed to achieve 50 percent preservation (233.5) to determine the acreage of both medium and high quality wetlands that will need to be preserved (**Table 3**). Vittor & Associates believes that the preservation of wetlands in the study area, where land use practices often diminish wetland quality, will provide a significant benefit to wetland function over time. Based on the calculations in **Table 3** NACC will need to set aside approximately 577 acres of high quality wetlands, or 1,038 acres of medium quality wetlands, to achieve the preservation requirement.

Low quality herbaceous and forested wetland types are prevalent throughout the study area. These wetland types generally receive low WRAP scores in the Wetland Canopy and Wetland Ground Cover parameters, and can be successfully enhanced by replacing undesirable canopy species with proper densities of native hardwoods, and by reestablishing wetland hydrology in areas that had been partially drained by farming. The average WRAP for high quality forested wetlands was used as the achievable target for

enhancement wetlands. The average WRAP score of both herbaceous and forested low quality wetlands in the study area was subtracted from the estimated WRAP score of enhanced wetlands to obtain the average functional lift (per acre) of each wetland type. The functional lift values were then divided into the total credits needed to achieve 50 percent enhancement (233.5 units) to determine the acreage of both low quality forested and low quality herbaceous wetlands that will need to be enhanced (see **Table 4**). Based on these calculations NACC will need to enhance 491 acres of low quality herbaceous wetlands, or 614 acres of low quality forested wetlands to achieve the enhancement mitigation requirement (see **Table 4**).

Wetlands that are preserved or enhanced on Company-owned property will be deed restricted and maintained in perpetuity in accordance with Clean Water Act, Section 404 compensatory mitigation guidelines. An accepted compensatory mitigation plan will be provided to the COE prior to the impact of any streams or wetlands.

MITIGATION MONITORING

Monitoring of the stream and wetland reclamation/mitigation sites will be conducted annually for at least five years after a mine block is reclaimed. Stream monitoring will include measurement of physical parameters including stream pattern, profile, and dimension metrics, water temperature, dissolved oxygen content, pH, stream substrate characteristics, erosion patterns, and biological parameters that may include density and diversity of reptiles, amphibians, fish, freshwater mussels, or other fauna at sites in the stream above, within, and below the restored reach. Monitoring of the restored riparian buffers will include documenting the present vegetative species composition, density, and structure including average species height and diameter (dbh). Photographic documentation will be included in the monitoring effort. Wetland mitigation area monitoring will address growth and percent survival of planted wetland trees, percent cover by ground-cover and shrub species, presence/absence of exotic invasive plant species, and evidence of wildlife utilization of the site. Annual monitoring reports will be provided to the appropriate State and Federal agencies.

CRITERIA FOR SUCCESS

Stream mitigation will be considered successful if the restored stream banks are stable with no substantial degradation, the stream is maintaining the pattern, profile and dimension of the reference reach stream, riparian buffer vegetation is achieving the reference reach target habitats in plant species diversity, density and structure, and stream habitats and aquatic populations indicate a positive trend in composition, density, and diversity. Wetland mitigation success criteria will include a minimum 75 percent survival rate for planted trees; a ground-cover of at least 50 percent after two growing seasons; and an average height of ten feet for wetland trees, within ten years of planting.

REMEDIAL ACTIONS

If the restored stream and riparian buffers fail to achieve target success criteria in terms of stream bank stability, riparian buffer vegetation, stream channel stability, or biological indicators, reasons for failure will be evaluated and adaptive management actions will be planned, approved, and implemented. Similarly, if reclaimed wetlands fail to meet the goals of hydrologic regime or vegetative cover, remedial actions will be considered, such as planting alternative species of trees, introducing additional suitable wetland herbaceous or graminoid plants (seeding or transplanting), and/or modifying post-reclamation contours. Such measures will be addressed through discussions with the cognizant regulatory and resource agencies.

FIGURE 1

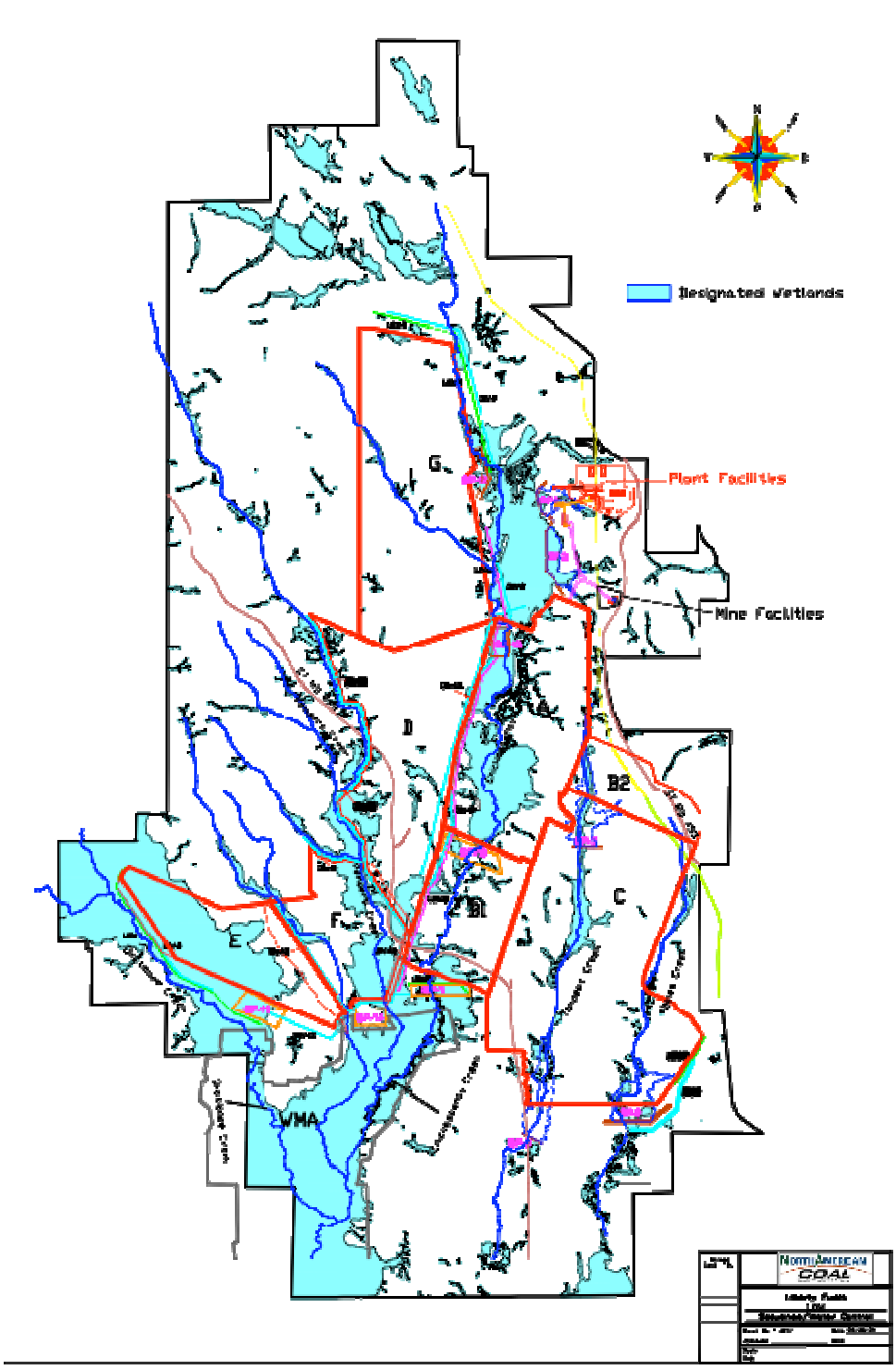
Designated Wetlands
Plant Facilities
Mine Facilities
G
D
B2
B1
C
F
E
WMA

FIGURE 2
ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET

Stream Type Impacted	Intermittent 0.1			1st or 2nd Order Perennial Stream 0.8			>2nd Order Perennial Stream 0.4		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Impaired 0.1			Somewhat Impaired 0.8			Fully Functional 1.6		
Duration	Temporary 0.05			Recurrent 0.1			Permanent 0.3		
Dominant Impact	Shade/ Clear 0.05	Utility Crossing 0.15	Below Grade Culvert 0.3	Armor 0.5	Detention/ Weir 0.75	Morpho-logic Change 1.5	Impound-ment (dam) 2.0	Pipe >100′ 2.2	Fill 2.5
Cumulative Impact Factor	<100′ 0	100′-200′ 0.05	201′-500′ 0.1	501-1000′ 0.2	>1000 linear feet (LF) 0.1 for each 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)				

Factor	Somewhat Impaired 1st or 2nd Perennial Dominant Impact Type 1	Impaired 1st or 2nd Perennial Dominant Impact Type 2	Somewhat Impaired Intermittent Dominant Impact Type 2	Impaired Intermittent Dominant Impact Type 2	Dominant Impact Type 2
Stream Type Impacted	0.8	0.8	0.1	0.1	
Priority Area	0.1	0.1	0.1	0.1	
Existing Condition	0.8	0.1	0.8	0.1	
Duration	0.05	0.05	0.05	0.05	
Dominant Impact	1.5	1.5	1.5	1.5	
Cumulative Impacts Factor	0.2	0.2	0.2	0.2	
Sum of Factors	M= 3.45	2.75	2.75	2.05	
Linear Feet Of Stream Impacted in Research	LF= 1,000	1,000	1,000	1,000	
M X LF	3,450	2,750	2,750	2,050	

Total Mitigation Credits Required = (MXLF) = _____

FIGURE 3
IN-STREAM WORK
STREAM CHANNEL/STREAMBANK RESTORATION AND RELOCATION WORKSHEET

Stream Type	Intermittent 0.05	1st or 2nd Order Perennial Stream 0.4	>2nd order Perennial Stream (Bankfull width)			
			>15′ 0.4	15′-30′ 0.6	30′-50′ 0.8	>50′ 1.0
Priority Area	Tertiary 0.05		Secondary 0.2		Primary 0.4	
Existing Condition	Impaired 0.4		Somewhat Impaired 0.05			
Net Benefit	Stream Relocation 0.1		Stream Channel Restoration/Stream Bank Stabilization			
			Moderate 1.0	Good 2.0	Excellent 3.5	
Streambank Stability	Stable Banks 0.4		Moderately Stable Banks 0.2			
Instream Habitat	>5 Cover types 0.35	5 Cover types 0.25	4 Cover types 0.15	3 Cover types 0.1		
Timing of Mitigation	Before 0.15		During 0.05	After 0		

Factors	Somewhat Impaired Net Benefit 1	Impaired Net Benefit 2	Net Benefit 3	Net Benefit 4	Somewhat Impaired Net Benefit 5	Impaired Net Benefit 6
Stream Type	0.4	0.4			0.4	0.4
Priority Area	0.05	0.05			0.05	0.05
Existing Condition	0.05	0.4			0.05	0.4
Net Benefit	0.1	0.1			2.0	2.0
Bank Stability	0.4	0.4			0.4	0.4
Instream Habitat	0.15	0.15			0.15	0.15
Timing of Mitigation	0.15	0.15				
Sum Factors (M)=	1.3	1.65			3.05	3.4
Stream length in Reach (do not count each bank separately) (LF)=	1,000	1,000			1,000	1,000
Credits (C) = M x LF	1,300	1,650			3,050	3,400
Mitigation Factor Use (MF) = 0.5 or 1.0	0.5	0.5			1.0	1.0
Total Credits Generated C x MF=	650	825			3,050	3,400

Total Channel Restoration/Relocation Credits Generated = _____

Table 1. Net Change in Mine Block WRAP Values (Pre-Mine Vs. Proposed Post-Reclamation)

WRAP ID	Wetland Type (Pre-Mine)	WRAP Score (Pre-Mine)	10 - Year		40 - Year	
			WRAP Score (Post-Reclamation)	Net Change	WRAP Score (Post-Reclamation)	Net Change
WRAP 3	Forested - Planted Pine	0.49	0.61	0.12	0.74	0.25
WRAP 8	Forested - Planted Pine	0.47	0.69	0.22	0.86	0.39
WRAP 13	Forested - Hardwood	0.72	0.74	0.02	0.82	0.10
WRAP 19	Forested - Bottomland Forest	0.67	0.72	0.05	0.78	0.11
WRAP 22	Forested - Bottomland Forest	0.81	0.72	-0.09	0.86	0.05
WRAP 23	Forested - Bottomland Forest	0.83	0.72	-0.11	0.86	0.03
WRAP 29	Forested - Hardwood	0.61	0.67	0.06	0.88	0.27
WRAP 31	Forested - Bottomland Forest	0.61	0.77	0.16	0.86	0.25
WRAP 32	Herbaceous - Field	0.51	0.77	0.26	0.88	0.37
WRAP 35	Herbaceous - Field	0.44	0.63	0.19	0.73	0.29
WRAP 36	Forested - Mixed Pine/Hardwood	0.61	0.76	0.15	0.83	0.22
WRAP 43	Herbaceous - Field	0.28	0.60	0.32	0.80	0.52
WRAP 47	Forested - Bottomland Forest	0.83	0.71	-0.12	0.83	0.00
WRAP 49	Forested - Mixed Hardwood/Pine	0.45	0.67	0.22	0.83	0.38
WRAP 48*****	Scrub-Shrub	0.42	0.57	0.15	0.71	0.29
WRAP 51*****	Scrub-Shrub	0.61	0.60	-0.01	0.71	0.10

***** WRAP scores for scrub-shrub wetlands were not recorded within the currently proposed mine block; however, the scrub-shrub scores listed in **Table 1.** were obtained in close proximity to the mine block and are representative of the overall qualities of scrub-shrub wetlands within the study area.

Table 2. Wetland Credits Required to Achieve Mitigation for Temporal Loss

Wetland Type	Average WRAP Score Within Proposed Mine Blocks (Existing Conditions)	Average Functional Lift - 40 Years (Post Reclamation)	Time(yrs) Required for Compensatory Mitigation	Temporal Loss Factor (YS = +3)	Wetland Acreage Impacted	Wetland Credits Required for Mitigation	Wetland Credits Accrued by Reclamation	Post-Reclamation: Net Gain (+) or Loss (-) of Wetland Credits
Herbaceous - Low Quality	0.36	0.41	4.0	0.9025	222.50	21.69	91.23	69.53
Herbaceous - Medium Quality	0.58	0.37	5.0	0.8871	14.99	1.69	5.55	3.85
Scrub/Shrub - Low Quality	0.42	0.29	6.0	0.8727	0.27	0.03	0.08	0.04
Scrub/Shrub - Medium Quality	0.61	0.10	9.0	0.8288	180.41	30.89	18.04	-12.85
Forested - Low Quality	0.45	0.34	13.0	0.7757	221.82	49.76	75.42	25.67
Forested - Medium Quality	0.63	0.19	18.0	0.7141	754.43	215.69	143.34	-72.35
Forested - High Quality	0.81	0.03	43.0	0.4789	979.44	510.38	29.38	-481.00

Total Wetland Credits Required : 467.10

Table 3. Acreages Required for Alternative Wetland Types to Achieve 50% Mitigation (233.5 Credits) Through Preservation

Wetland Type Offered as Preservation	Average WRAP Score of Wetland Type Within the Study Area	Average WRAP Score of Low Quality Herbaceous Wetlands in Study Area	Average WRAP Score of Low Quality Forested Wetlands in Study Area	Average Wetland Function Preserved (Per Acre) Through the Avoidance of Conversion of Wetland Type to Low Quality Herbaceous or Low Quality Forested Wetland*	Acreage Required to Achieve 50% Preservation (233.5 credits)
Forested - High Quality	0.81	0.36	0.45	0.41	**576.54**
Forested - Medium Quality	0.63	0.36	0.45	0.23	**1037.78**

* During extensive field surveys BVA observed extensive conversion of High and Medium Quality Forested wetlands to two predominant forms of land use; Pasture (which accounts for nearly all acres classified as Low Quality Herbaceous wetland) and Row Planted Pine (which accounts for a large portion of the acreage classified as Low Quality Forested wetland). BVA acknowledged the likelihood that High and Medium Quality Forested wetlands are susceptible to being converted to Pasture or Row Planted Pine, and accounted for that probability by using the average loss of function associated with Pasture and Planted Pine to determine the credit value per acre of preserved High and Medium Quality Forested wetlands.

Table 4. Acreages Required for Alternative Wetland Types to Achieve 50% Mitigation (233.5 Credits) Through Enhancement

Wetland Type Being Restored	Average WRAP Score of Wetland Type Within the Study Area	Wetland Quality Achieved by Enhancement*	Functional Lift Achieved (Per Acre) by the Enhancement of Low Quality Herbaceous or Low Quality Forested Wetland Types*	Acreage Required to Achieve 50% Enhancement (233.5 credits)
Herbaceous - Low Quality	0.36	0.81	0.45	**491.27**
Forested - Low Quality	0.45	0.81	0.36	**614.08**

* Low Quality Herbaceous and Forested Wetland Types are prevalent throughout the study area. These wetland types generally receive low WRAP scores in the Wetland Canopy and Wetland Ground Cover parameters, and can be successfully enhanced by replacing undesirable canopy species with proper densities of native hardwoods. BVA used the average WRAP for High Quality Forested wetlands as the achievable wetland quality of enhanced wetlands.