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RISK PERCEPTIONS AFTER A COAL WASTE IMPOUNDMENT FAILURE: A SURVEY ASSESSMENT[1]

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ABSTRACT

In mid October of 2000, a rupture occurred at the bottom of a coal waste reservoir owned by Martin County Coal Corporation (MCCC-Massey). Impounded slurry and sludge materials from the reservoir traveled through underground mine works and burst through two mine portals on opposite sides of the mountain releasing more than 300 million gallons of coal waste into creeks and waterways of Martin County, KY. This paper examines people's reactions to the Martin County coal waste disaster by examining levels of reported concern and perceptions of risk across the impacted community of Martin County in comparison to similar coal mining communities in the same watershed as well as elsewhere in Kentucky and West Virginia. Door-to-door, drop-off/ pick-up methods were used to survey people's perceptions. As predicted, findings show a significant difference in public opinion over the risks associated with coal waste impoundments between the impacted county in comparison to other counties. The other robust predictors of perceived risks were quality of life and trust measures. Other factors found to be significant in some previous studies of risk perceptions, such as home ownership and occupation could also account for some differences in risk perceptions within and across counties. Overall, we conclude that our survey findings on trust are consistent with others who have theorized

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about the institutional interconnection between public trust and risk concerns regarding technological hazards. In our discussion, we address the need for government agencies, that are responsible for responding to and mitigating environmental hazards, to act in ways that merit public trust, restore public confidence, and alleviate public anxiety.

Just after midnight on October 11, 2000, a rupture occurred at the bottom of a coal waste reservoir owned by the Martin County Coal Corporation (MCCC-Massey). Impounded slurry and sludge materials traveled through underground mine works and burst through two mine portals releasing more than 300 million gallons of coal waste into creeks and waterways of Martin County, Kentucky. The sludge contained high concentrations of heavy metals and covered some areas with more than six feet of residue that had to be removed as part of the cleanup process. Cleanup and removal operations were initiated immediately after the event and were completed about six months later. However, public concerns about long-term contamination persisted for some time.

The impoundment failure in Martin County was the largest coal waste spill in U.S. history (Mueller 2000a) and was nearly twice the size of the 1972 Buffalo Creek, West Virginia coal waste disaster that killed more than 120 persons and injured hundreds of others (Erikson 1976). While the event did not result in the loss of human life, it inundated creek banks and disrupted public water intake systems in communities along the Big Sandy River and through to the Ohio River. The Kentucky Department of Fish and Wildlife Resources documented extensive environmental damage to the area watershed extending beyond local creeks into the Big Sandy, including 60-miles of fish kill (Davis 2001). As the sludge plume moved downriver, towns in both Kentucky and West Virginia were placed in a heightened *state of alert* and made preparations to close water intakes and rely on emergency water provisions.

In Martin County, the public water intake was temporarily shut down and an emergency water line was routed from an unaffected creek for months following the spill (Ball 2000). After a series of disruptions in the temporary supply, which included a loss of water service on Christmas Eve, the water utility began to draw water from its permanent intake on the impacted Tug Fork of the Big Sandy River. Our field research showed that there were many complaints about the quality of the public water and widespread public fear that the water was contaminated and posed a health threat. Though the U.S. Environmental Protection Agency (EPA) and other officials proclaimed the water "safe," this did not alleviate public concern (Adkins 2001a, 2001b; Ball 2001). Local concerns culminated during a March 2001 public meeting. One of the things that residents realized was that, among other

things, EPA officials did not have accurate information concerning the source of water, as officials were seemingly unaware that the county had shifted to its permanent water intake several months earlier (McSpirit, Hardesty, and Welch 2002:48). Overall, our field research indicated that the coal waste spill had a significant effect on collective and individual perceptions of risk and these findings were reinforced in our survey results which are reported in the following paper.

This paper examines risk perceptions in the aftermath of the Martin County coal waste spill, based on surveys conducted in two Kentucky counties (Martin and Perry) and two counties (Mingo and Wyoming) in West Virginia. The four counties that comprise our sampling frame are largely representative of the Central Appalachian coal mining region and therefore, can provide some important insights into risk concerns over coal waste impoundments among coalfield residents. We naturally hypothesize and expect that risk concerns will be higher among residents in the impacted community of Martin over other counties.

Apart from the event itself, public perceptions of risk are influenced by institutional and political responses that are socially constructed. While confidence in regulatory agencies is critical to maintaining a sense of security, technological accidents and disasters challenge this trust. Slovic, Layman, and Flynn (1991) have suggested that public fear and opposition to hazardous technologies often reflects a crisis in confidence in institutional managers and regulators. In addition, conceptual work on social capital and disasters suggests that risk perceptions are also influenced by quality of life and community well-being (Ritchie and Gill 2007). The following paper examines the above influences, as well as other sociodemographic factors, in understanding public concerns over coal waste impoundments in Appalachia.

Risk Perceptions and Disasters

Distinctions between natural and technological disasters have been debated in the disaster literature for several years (e.g., Couch and Kroll-Smith 1985; Kroll-Smith and Couch 1991; Gill and Picou 1998; Quarantelli 1985, 1992, 1998). Instead of reifying these distinctions, we can use them to examine events on a natural-technological continuum with overlapping qualities and effects (e.g., Gill 2007; Gill and Ritchie 2006; see also Green et al. 1990). Compared to natural disasters, technological disasters tend to be more damaging to the social fabric of impacted communities (Erikson 1976, 1994; Freudenburg 1997; Gill 1994; Gill and Picou 1998; Picou et al. 1992; Ritchie 2004; Ritchie and Gill 2007) and cause greater psychosocial stress and disruption (Ahearn and Cohen 1984; Baum and Fleming

1993; Baum et al. 1992; Edelstein [1988] 2004; Freedy, Kilpatrick and Resnick 1993; Freudenburg and Jones 1991; Gleser, Green, and Winget 1981; Green et al. 1990; Green and Lindy 1994; Picou and Gill 1997; Smith and North 1993; Smith et al. 1986; Vyner 1988). One reason for these differences is that technological disasters represent a loss of control over processes *perceived to be controllable* whereas natural disasters result from processes beyond human control (Baum and Fleming 1993). Loss of control fosters perceptions of recreancy; that is, "the failure of experts or specialized organizations to execute properly responsibilities to the broader collectivity with which they have been implicitly or explicitly entrusted" (Freudenburg 2000:116; see also Freudenburg 1993; Freudenburg and Pastor 1992). Damage to public trust and security is heightened when these events involve toxic substances that elude detection by human senses and create long term uncertainty. Erikson (1994) refers to these events as 'a new species of trouble.'

"Technological disasters and resulting environmental contamination represent not only 'a new species of trouble,' but a special brand of risk as well" (Ritchie 2004:85). Risks are always constructed in sociocultural and individual contexts (Douglas and Wildavsky 1982). Furthermore, contemporary conceptions of risks are situated in conditions of late modernity (Beck 1992, 2001; Giddens 1990, 1991). As Beck states, "[world risk society's] central themes and perspectives have to do with *fabricated uncertainty* within our civilization: risk, danger, side-effects, insurability, individualization and globalization" (2001:19). These collective constructions include issues of trust, particularly in institutions to act responsibly. Here, Giddens (1990, 1991) situates ontological security within a balance of trust and acceptable risk. In modernity, technological risks are typically defined as publicly acceptable when industry and regulatory performance have tended to win—*or at least manage*—public confidence and public opinion. However, public insecurity, anxiety, and distrust are heightened when technological *hazards* become *dangers* because of slippages or failures in risk management.

Under conditions of modernity, this sense of collective security rests upon a balance of trust and acceptable risk. Giddens states, "if basic trust is not developed or its inherent ambivalence not contained, the outcome is persistent existential anxiety" (1990:100). Collective feelings of dread and anxiety are exacerbated each time government or industry officials attempt to conceal, misrepresent, and/or ignore environmental and public health risks posed by technology in favor of creating a regulatory response structure that would buttress industrial and economic activity (Bethel 1972; Bethel and McAteer 1978; Gephart 1984; Levine 1982; Molotch 1970; Picou and Gill 2000; Slovic, Layman and Flynn 1993).

The nexus between public insecurity/distrust and social constructions of technological risks has been empirically documented in survey research on public risk perception. Bord and O'Connor (1992), for example, found low levels of trust in local, state and federal officials as increasing overall levels of concern over cleanup and mitigation of a toxic chemical site. Freudenburg (1993) found that those who reported no trust in science and technology, business capability, and the federal government were significantly more likely to report high levels of concern over a nuclear waste facility. Slovic et al. (1991) contend that breakdowns of public trust in the scientific, industrial and regulatory apparatus tend to increase public fear levels that, in turn, may lead to heightened opposition to industries and technologies which are seen as dangerous. Other studies have identified similar interconnections between trust and reported levels of anxiety among the public (e.g., Kasperson, Golding and Tuler 1992; Desvousges et al. 1993, Spies et al. 1998; Flynn et al. 1992). Thus, individual feelings about trust and perceptions of risk are seemingly bound and contingent upon macro systems and structural conditions that create and maintain either a sense of security or insecurity.

Case research on technological disasters provides additional insights into these micro-macro linkages. Case studies of the Santa Barbara oil spill (1969), Buffalo Creek coal waste flood (1972), Love Canal hazardous waste contamination (1978), Three Mile Island nuclear accident (1978), Centralia underground mine fire (1962-1987), *Exxon Valdez* oil spill (1989), and other communities impacted by technological mishaps reveal patterns of responses that contribute to how risks are social constructed and interpreted: First, conflict emerges between the principle responsible party, government agencies, stakeholder groups, and the public over the magnitude and extent of harm and appropriate responses to be taken—in some cases there may even be denial of any problem/responsibility and thus, no response. Contending groups may emerge to voice public concerns, present claims, and try to persuade government officials to act on their behalf. Particularly in cases of contamination, a polarization among the public may even develop as individuals interpret the situation differently; regulators, responsible parties and contending stakeholders use various scientific means to legitimate their claims. The claims can also involve legal action, but litigation is sometimes a long, drawn-out affair that often leaves plaintiffs with diminished faith in the legal system as well. In the end, whatever the resolution, communities and victims of technological events may have lingering concerns about the health, safety, and security of their community, as well as diminished trust in authorities, along with a heightened sense of awareness that a similar event might befall them and their community again.

Case studies have shown that political influences on regulatory responses to technological risks, hazards, and disasters are often at odds with public sentiment. For example, in the aftermath of Santa Barbara oil spill, legal actions by citizens to impose a moratorium on offshore drilling in local coastal waters were thwarted by the federal government, which systematically underestimated the magnitude of the spill and damages to the coastal environment (Molotch 1970). In their study of the *Exxon Valdez* oil spill, Picou and Gill (2000) found stress, anxiety, and social disruption to be compounded by a politically charged cleanup, site mitigation, and impact assessment process that contributed to further declines in institutional trust and increases in political skepticism among local residents.

Moreover, conflicting scientific interpretations of data on physical impacts combined with different regulatory approaches to risk abatement and site mitigation politicizes agency responses and sometimes leads to community mobilization and citizen/ stakeholder activism (Clark 1988; Etzkowitz 1984; Sterling and Arundel 1985). Citizen responses to a toxic waste site at Love Canal (Fowlkes and Miller 1987; Levine 1982) and to the nuclear accident at Three Mile Island in Pennsylvania (Walsh 1987, 1988) demonstrate conditions of political conflict and the inability of science to provide absolute proof. Moreover, these events demonstrate how ambiguity inherent in exposure to contaminants can polarize residents into activists and those that want to downplay or discount potential risks and hazards. Many case studies describe social corrosion from these internal community controversies over definitions of risk (Erikson 1976; Freudenburg and Jones 1991; Kroll-Smith 1995; Gill and Picou 1998).

Hypotheses

Literature on community impacts of technological disasters suggests the following standard hypotheses: 1) Martin County residents (impact area) will have higher levels of risk perceptions than residents living in less affected areas; 2) Martin County residents will have lower levels of institutional trust than other residents and 3) will report lower levels of overall quality of life than other residents.

Other conceptual work on risks and technological disasters suggests two other hypotheses regarding general attitudes toward risks: 1) levels of institutional trust will be inversely related to risk perceptions; and 2) quality of life levels will also be inversely related to perceived risks. In addition, some groups face greater vulnerabilities in the wake of a disaster than others, but the research is less clear on the relationships between sociodemographic variables and risk perceptions in the

aftermath of technological disasters (e.g., see Picou and Gill 1997). When significant relationships have been found, females tend to be more stressed and have higher levels of risk concern than males (e.g., see Hamilton 1985; Levine 1982), while older individuals tend to be less stressed and concerned (e.g., Fowlkes and Miller 1987; Hamilton 1985; Kroll-Smith and Couch 1990). In one case, higher income households showed more stress and concern over disasters impacts (Hamilton 1985), but in another, homeowners tended to downplay risks (Fowlkes and Miller 1987). Other research shows individuals employed in an 'offending' industry as having less stress and risk concern (Kroll-Smith and Couch 1990; Levine 1982; Walsh 1987) and still other case studies have tended to verify occupation as a possible predictor of risk perceptions in environmentally impacted communities (Brody and Fleishmann 1993; Kroll-Smith and Couch 1990; Levine 1982; Picou and Gill 1997).

Bord and O'Conner (1992), on the other hand, note that under conditions of "imminent threat" as in the case of a technological disaster or accident—where overall public fear levels might be heightened—demographic factors may lose some of their predictive power in accounting for differences in reported levels of concern. Consequently, we expect demographic predictors to have less of an influence in Martin County and perhaps more of an influence in explaining variations in public risk perceptions in non-impacted communities. Although the influence of sociodemographic factors on risk perceptions remains tenuous, public trust and confidence in corporate actors and governmental agencies remains a consistent and robust predictor of perceived risk. Therefore, we expect that of all our variables, institutional trust/ distrust will be a consistent and significant predictor of risk perceptions (Dietz, Dan and Shwom 2007).

Methodology

Our methodological approach uses an *ex post* design that requires the identification of an area (control community) that compares to the impact area in sociodemographic, economic, and physical characteristics but differs by event impacts (see Gill and Picou 1998). We first identified Perry County, Kentucky as our initial control community. Perry County is similar to Martin on several characteristics. As Table 1 shows, both Perry and Martin are located in eastern Kentucky, and both rely on coal extraction for a significant portion of their economic production. Likewise, both counties have roughly one coal waste impoundment every 30 to 50 square miles. Perry County also shares somewhat similar population, poverty, and education characteristics with Martin County. But

while Perry residents were well aware of the Martin County coal waste disaster, their county was not directly impacted by the spill because of its location in a different watershed (Kentucky River) than that of Martin (Big Sandy River).

Our research team surveyed Martin County in the spring (March) of 2001 and Perry County in the fall (September) of 2001 on coal waste impoundments, water quality, quality of life, and institutional trust levels. In 2005 (April), under another grant contract, we surveyed citizens in Mingo and Wyoming Counties in West Virginia on the similar issues related to coal mining, environmental quality and coal waste impoundments. These counties were chosen because they too are heavy coal producing counties with a number of coal waste impoundments present in each county. As with Martin and Perry, Table 1 shows that there is roughly one impoundment per 30 to 50 square miles. Moreover, Mingo County is located in the same watershed as Martin County (Big Sandy) and had its water supply temporarily disrupted by the 2000 impoundment failure. Neighboring Wyoming County borders Logan County, site of the 1972 Buffalo Creek disaster and many residents remember this event. Again, Table 1 provides a summary of general geographic, impoundment, population and economic characteristics of each of the four surveyed counties in our sampling frame.

Data used in this analysis were collected from surveys administered in all four counties. Survey development began early on with field observations and semi-structured field interviews with more than 30 Martin County residents. From our field observations and interviews, we identified a number of community-based concerns to be addressed in our survey. We then modified standard community impact and risk assessment surveys used by Picou and Gill (1995a; 1995b) and Freudenburg (1993) to reflect events across our particular case. Prior to distribution, surveys were pretested in undergraduate sociology classes at Eastern Kentucky University (EKU), whose student population primarily hails from eastern Kentucky. Using feedback from these students, we made revisions and further fine-tuned our survey.

Sampling Methods

Several university survey teams, consisting of one faculty member (driver) and three undergraduate students (one to keep the record of contacts and two to go door-to-door) distributed the survey to a sample of Martin County residents living in the impacted area between Wolf Creek and Coldwater Creek (see Figure 1). This area, the most densely populated part of the county, includes most of the county's 12,000 residents (U.S. Census 2000).

Table 1. A COMPARISON OF STUDY SITES BY U.S. CENSUS CHARACTERISTICS AND OTHER PHYSICAL AND ECONOMIC DIMENSIONS.

	MARTIN KY	PERRY KY	MINGO WV	WYOMING WV
Land area (sq. miles)[1]...	231	342	422	500
Active coal waste impoundments[2].....	5	16	11	5
Coal production–1999 (tons)[3].	10,398,740	12,812,669	20,695,645	9,987,079
Per capita coal production–2000. ...	826	435	763	412
Population size[1].....	12,578	29,390	27,100	24,225
% Below poverty level-1999[1].	37	29	25	22
High school grads-2000 (% of pop. age 25+)[1].	54	58	60	64
B.A. or higher-2000 (% of pop. age 25+)[1]. ...	9	9	7	7
No. employed in mining[4].	932	1,209	1,556	1,016

Sources: [1]U.S. Census Bureau, State and County Quick Facts. [2]Coal Impoundment Location and Information System. [3]Kentucky Geological Survey, Coal Production Data; West Virginia Mining Statistics, 1996-2006; [4]Kentucky State Data Center, Bureau of Economic Analysis, Regional Economic Information System; West Virginia Mining Statistics. All data available from all sites online, retrieved: June 2007.

A 'drop-off/pick-up' method comparable to that used elsewhere (Steele et al. 2001) was used to distribute surveys door-to-door. Surveys were distributed to every sixth home on every primary, secondary, and 'holler' back road within the defined survey area in March 2001, approximately five months after the event occurred. Of the 467 surveys distributed, 290 surveys were successfully picked up (response rate 62 percent). Several months later, we administered the same survey to Perry County residents using similar drop-off/ pick-up methods and a similar sampling interval. The Perry County sample was drawn from the city of Hazard and from a rural catchment area between several large coal waste impoundments (see Figure 1). Between our survey teams, we distributed a total of 502 surveys with a total of 249 surveys completed (response rate 50 percent).

Figure 1. Martin and Perry Counties, Kentucky: Survey Distribution Areas.

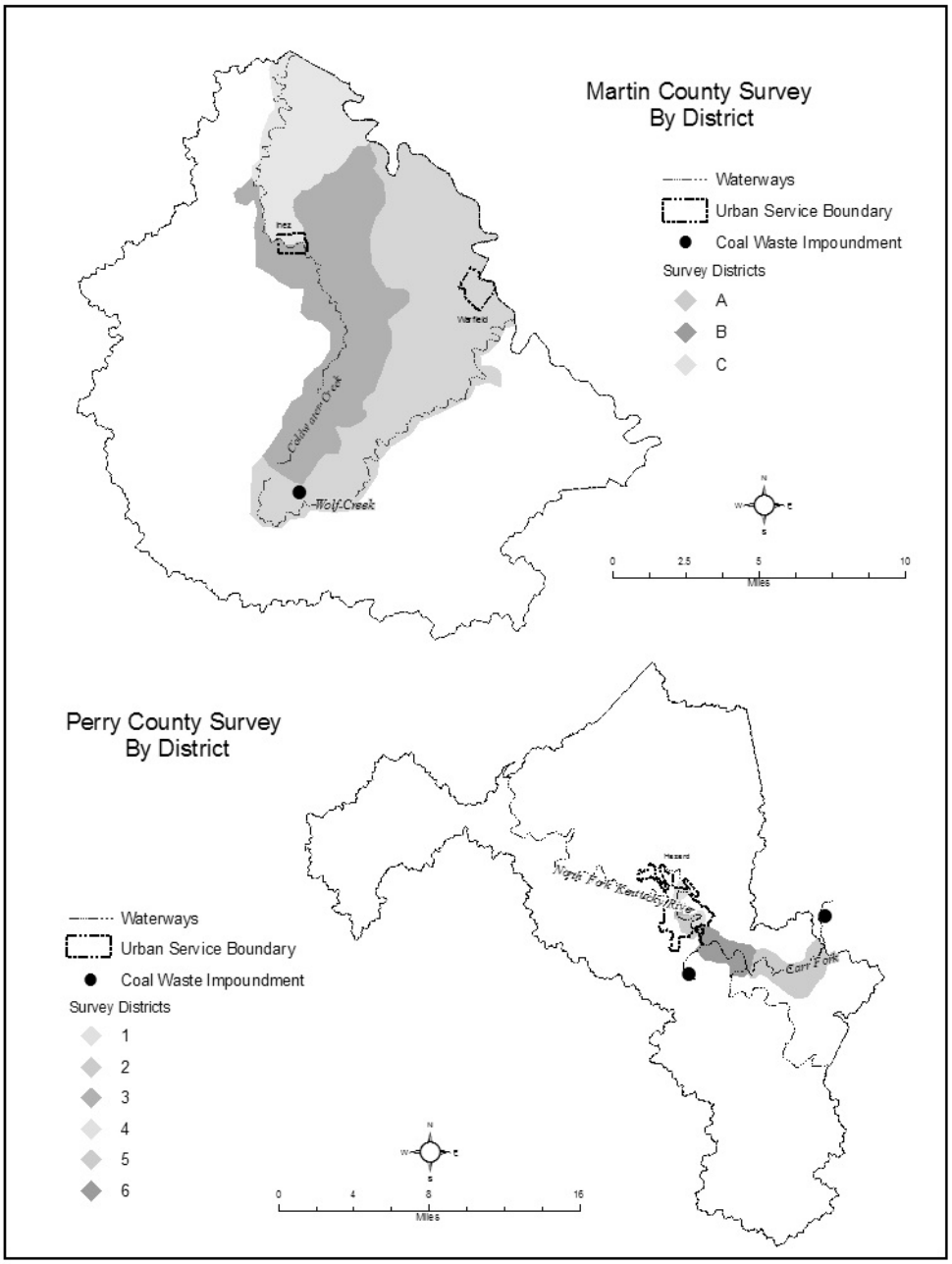
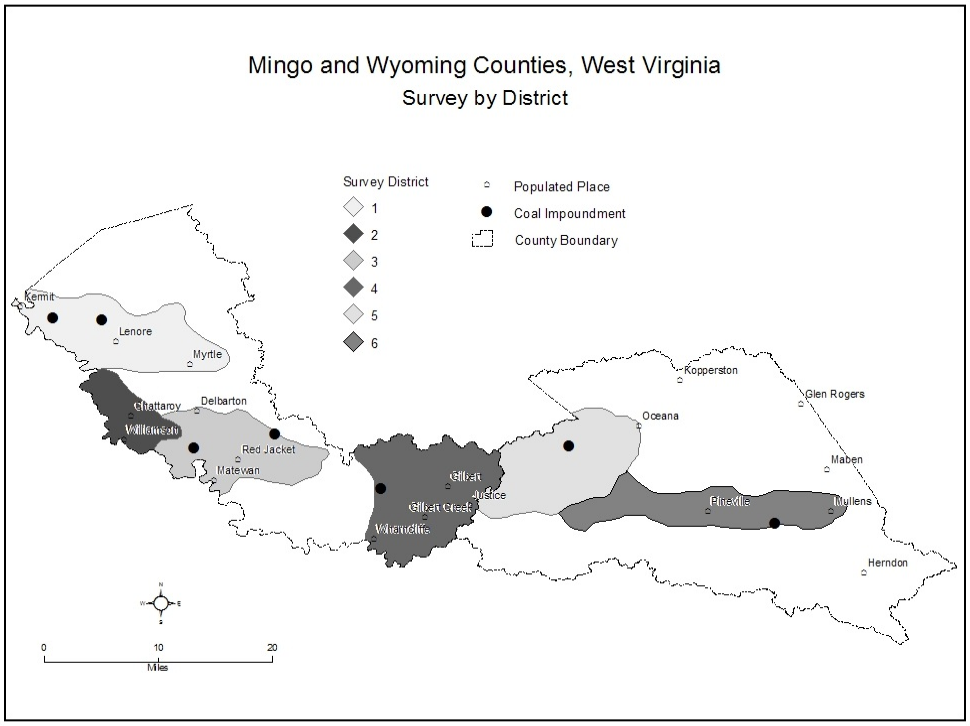


Figure 2 summarizes the areas of West Virginia that were surveyed in 2005 using the same systematic, drop-off/pick-up methods with teams of faculty and undergraduates. In West Virginia, however, a larger sampling fraction (every 12th house) was used due to a larger terrain to cover within a shorter, contracted time period. In Mingo County, we distributed 363 surveys and picked up 157 (responses rate 43%). In Wyoming County, we contacted 228 households and collected 96 surveys (response rate 42%).

Figure 2. MINGO AND WYOMING COUNTIES, WEST VIRGINIA: SURVEY DISTRIBUTION AREAS.



A review of demographic characteristics shows the Martin County sample to be largely representative of the county's general population insofar as our sample reflected county employment rates and income levels. For example, 7 percent of our sample was unemployed in March 2001 compared to official state unemployment rates of 6 percent. With respect to income levels, the 2000 U.S. Census reported the median household income in Martin County at $22,000.00 ($22,497.00) per year and almost one-half (47 percent) of surveyed residents reported household incomes of

$20,000 or less. In terms of education, however, our sample appears to be slightly more educated than is typical in Martin County with 13 percent reporting more than 16 years of education (a Bachelors Degree or Professional Degree), whereas U.S. Census data for Martin County reveals 6 percent of the county workforce (over the age of 25) holding at least a Bachelor's Degree.

Likewise, our Perry County sample was similar in census population characteristics: Unemployment rates and income levels were comparable to the general population although the sample's educational level was higher than that recorded for the county by the U.S. Census (26 percent for sample with a bachelor's or professional degree in comparison to 9 percent for county). The same can be said for Mingo and Wyoming Counties, W.Va., a comparison of sample versus population characteristics, shows U.S. Census data reporting 7 percent of both Mingo and Wyoming County residents having a college degree or higher whereas 16 and 12 percent of surveyed residents reported having graduated from college. Thus, our survey data may slightly over represent college-educated residents across all four counties.

Indicators and Measures

Dependent Variable. The dependent variable in our analysis was an index measuring perceptions of risk from coal waste. Specific concerns about coal waste were first identified from our semi-structured interviews. Particular concerns from our interviews included coal waste toxicity, impacts on public water systems and human health and not knowing the extent of environmental impacts. These items were then developed for inclusion in the survey.

Our risk perception scale was based on selecting four survey items that best measured the above expressed concerns among residents: Two of the items came from responses to the stem, "How much of a problem are the following in your county?" with response categories consisting of: not a problem (= 1); a slight problem (= 2); a moderate problem (= 3); and a serious problem (= 4), with items consisting of 'coal waste' and 'drinking water.' The other two questions came from responses to the stem, "Please rate each item," with response categories consisting of: strongly disagree (= 1); disagree (= 2); neutral (= 3); agree (= 4); and strongly agree (= 5) with items consisting of 'we may never know the extent of the damage caused by the spill in Martin County' and 'coal sludge is not hazardous.' The latter item was reverse coded to maintain symmetry with the other scales. The selected four items were summed to create a risk perception index with scores ranging from 5 to 18 based on data from all four counties. Higher scores indicate greater concern

over coal waste and impoundments. The average level of perceived risk was 14.7 (s=2.8) (α = .70).

Factor analyses on our survey data (n=476) showed the above survey questions to be associated and separate from other survey questions that measured the dimensions of public trust and quality of life. Factor loadings on the survey questions that were used to construct our indices on risk, trust and quality of life are presented in Table 2.

Table 2. FACTOR LOADINGS[a] FOR RISK PERCEPTIONS ON COAL WASTE, PUBLIC TRUST IN INSTITUTIONS AND COMMUNITY QUALITY OF LIFE: MARTIN, PERRY, MINGO AND WYOMING COUNTIES (N=476).

	COMPONENT		
	1	2	3
Concerns with coal waste.	.519	.429	.773
Concerns with drinking water.	.324	.460	.747
We may never know extent of damage caused by the spill.	.445	.318	.737
Coal sludge is not hazardous.	-.302	-.213	-.636
Trust in the coal company.	-.781	-.426	-.617
Trust in the local government.	-.794	-.582	-.470
Trust in state agencies.	-.881	-.472	-.415
Trust in spill cleanup companies.	-.891	-.445	-.559
Trust in the EPA.	-.851	-.366	-.337
Quality of local government.	.477	.690	.381
Quality of natural environment.	.437	.663	.656
Job opportunities.	.390	.750	.327
Outdoor recreational opportunities.	.331	.754	.336
Quality of life in community.	.391	.800	.357
As a place to raise children.	.337	.735	.282
Opportunities for young people.	.390	.789	.367

[a]Note: The Extraction Method = Principal Component Analysis; Rotation Method =Oblimin.

An institutional trust index was created by summing six items from a series based on the following stem: "Please tell us how you feel about each group or agency." Response categories consisted of: strongly disagree (= 1); disagree (= 2); neutral (= 3); agree (= 4); and strongly agree (= 5). Specific items were, "I have

trust in …:" 1) the coal company; 2) local government; 3) State agencies; 4) spill clean-up companies; and 5) the Environmental Protection Agency. Our institutional trust scale ranged from 5 to 25 with higher scores indicating greater levels of trust. The scale mean was 12.4 (s=4.9) (α = .90).

A quality of life index was created by summing seven items from a series based on the following stem: "In general, how would you rate your community?" Response categories consisted of: very good (= 1); good (= 2); fair (= 3); poor (= 4); very poor (= 5). Specific items were: 1) the quality of local government is…; 2) the quality of the natural environment is…; 3) job opportunities are …; 4) outdoor recreational opportunities are…; 5) the quality of life in this community is …; 6) as a place to raise children, this community is …; and 7) opportunities for young people are.... Items were reverse coded so that high scores reflected a better quality of life. The scale ranged from 7 to 35 with a mean of 14.78 (s=4.5) (α = .82).

Socio-demographic variables included gender, age, education, income, mining and home ownership and were coded as follows: Gender (0= male, 1 = female); Age (number of years); Education (less than high school, high school, some college, college degree); Income (under $10,000, $10,000-$20,000, $21,000-$40,000, $41,000-$60,000 and over $60,000); home ownership (do not own = 0, own = 1). Other sociodemographic variables, including presence of dependent children in the household, source of drinking water (public versus private well), years lived in the community, type of dwelling, and employment (employed, unemployed, housewife, retired, disabled), were examined but are not included because preliminary analyses indicated they were not significantly nor consistently associated with either the risk index or any of the separate risk perception variables. We do, however, examine employment linkages to the local coal economy by using the following question: "Is any person in your household involved in the mining industry—either through being employed, the sale of mineral rights, or through other business-related activities?" (no = 0 and yes = 1). This question was broadly worded to protect the anonymity of coal industry employees (coal miners especially) in the event that our data was subpoenaed in future disaster-related litigation (see Picou 1996). Indeed, a subpoena for survey and other data was received in April 2005.

Results

Community Comparisons

We begin with the following hypotheses: 1) Martin County residents (impact area) will have higher levels of risk perceptions than residents living in the other three counties; 2) Martin County residents will have lower levels of institutional

trust than other residents; and 3) Martin County residents will report lower quality of life levels than those in other coal producing counties. ANOVA results of our analysis support all three hypotheses. Table 3 shows Martin County residents, on average, reporting significantly higher scores (mean=16.4) on the risk perception index than residents in Perry (13.3), Mingo (13.6) and Wyoming (13.6) counties (F=63.1, *df*=603, sig. <.000). In addition, ANOVA tests show (F=19.5, *df*=614, sig. <.000) Martin County residents reporting, on average, lower scores on institutional trust (10.8) than residents in Perry (14.1), Mingo (13.4) and Wyoming (11.9) counties. The same applies for quality of life with ANOVA results (F=60.2, *df*=713, sig. <.000) significantly lower in Martin (12.4) than in the other three counties respectively (17.2, 15.1, 15.0).

Table 3. ANOVA Tests for Levels of Quality of Life, Trust, and Risk Perceptions Comparisons Between Martin (Impacted Area) and Perry County, Kentucky and Mingo and Wyoming County, West Virginia (Less-Impacted Areas).

	Descriptive		ANOVA		
	n	Mean	F	df	Post Hoc Tests
Risk Perceptions					
Martin	255	16.4	63.1***	603	[a]Martin > Perry, Mingo, Wyoming [b]Perry = Mingo, Wyoming
Perry	178	13.3			
Mingo	113	13.6			
Wyoming	58	13.6			
Institutional Trust					
Martin	235	10.8	19.5***	614	[a]Martin < Perry, Mingo, Wyoming [b]Perry > Wyoming; Perry=Mingo
Perry	164	14.1			
Mingo	134	13.4			
Wyoming	82	11.9			
Quality of Life					
Martin	266	12.4	60.2***	713	[a]Martin < Perry, Mingo, Wyoming [b]Perry > Mingo, Wyoming
Perry	229	17.2			
Mingo	139	15.1			
Wyoming	89	15.0			

* *p*=<.05; ***p*=<.01; *** *p*=<.001

[a] *Note:* The first reported *Scheffe Tests* identify significant differences (.05) between the impacted area (Martin) to less impacted areas (Perry, Mingo, Wyoming).

[b] *Note:* The second reported *Scheffe Tests* compare and look for differences across less impacted areas, -Perry in comparison to Mingo and Wyoming Counties.

Given clearly observable differences in risk perceptions over coal waste impoundments, as well as levels of public trust and quality of life between impacted and less-impacted coal mining communities, our next line of inquiry was a separate examination of, first, the Martin County sample and then our other set of cases. This analysis might allow us to examine possibly different dynamics between attitudinal and sociodemographic variables with risk perceptions between impacted and less impacted communities.

Correlation analyses presented in Table 4 strongly supports our hypotheses regarding trust and quality of life as inversely related to coal waste risk concerns in both disaster impacted (above diagonal) as well as in less impacted (below diagonal) counties. In both sets of analyses, the correlation between trust and quality of life with risk perceptions were robust (sig. <.000) in their statistical significance (For Martin, trust r = -.57, q-life r = -.37; for other counties, trust r = -.56. q-life r = -.45).

Table 4. CORRELATION MATRIX FOR SOCIODEMOGRAPHIC VARIABLES, QUALITY OF LIFE, TRUST AND RISK PERCEPTIONS: CORRELATIONS FOR IMPACTED, MARTIN COUNTY, KENTUCKY (ABOVE DIAGONAL) AND FOR LESS IMPACTED COUNTIES, PERRY, MINGO AND WYOMING COUNTIES (BELOW DIAGONAL).

	Risk	Trust	Q of Life	Gender	Age	Ed	Income	Mining	Home
Risk	–	-.57***	-.37***	.12	-.09	.01	-.17*	-.15*	-.14*
Trust	-.56***	–	.42**	-.07	.04	-.10	.15*	.18**	.04*
Q of Life	-.45***	.60***	–	-.10	.03	.08	.21**	.05	0.12
Gender	.09	.04	-.02	–	-.29***	.03	-.13*	-.09	-.04
Age	.09	-.13*	.00	-.12**	–	-.29***	-.06	-.20**	.25***
Ed	.05	.02	.07	.08	-.21***	–	.45***	.14*	.04
Income	-.06	.07	.10	-.21***	-.02	.39***	–	.32***	.32***
Mining	-.13*	.11*	-.01	-.10*	-.10*	-.00	.27***	–	.17**
Home	-.03	.03	.06	-.17***	.31***	.05	.30***	.14**	–

*p=<.05; **p=<.01; ***p=<.001

Table 4 also shows (sig. <.05) that within Martin County, higher income (r = -.17), mining households (r = -.15) and homeowners (r = -.14) tended to slightly downplay the possible environmental risks associated with coal waste impoundments. In other counties, the only sociodemographic factor that was significant was mining household (r =-.13) insofar as households tied to the mining industry, as in the case of Martin County, tended to somewhat discount the environmental risks associated with coal waste.

Correlation results also suggest that mining may also exert an indirect influence on risk perceptions. Across both Martin (r =.18, sig. <.001) and other counties (r =.11, sig. <.05), mining household was a significant predictor of levels of trust. Here, households that were connected to the mining industry either through employment or other business-related activities reported slightly less distrust of the company, government, agencies and regulators than other households. Correlations presented in Table 4 also show that other demographic factors such as income, homeownership, gender and age may also be indirectly associated with risk perceptions through their slight effect on either institutional trust or quality of life.

The above correlations are reinforced through block regression methods. Table 5 presents the standardized Beta coefficients and goodness of fit (adjusted R^2) for the following three respective models: Model 1 tests only the effect of place and shows impacted place (.50) to be a robust predictor of risk perceptions over coal waste impoundments (R^2 =.24). The next model, Model 2 (R^2 =.50) is perhaps our most efficient model for predicting coal waste risk perceptions among Appalachian residents: Living in the 2000 impacted area of Martin County (.30), institutional trust (-.41) and quality of life (-.19) were principal factors in explaining risk perceptions. Model 3 in Table 5 shows two sociodemographic characteristic as possibly significant in predicting risk concerns, when controlling for impact area

Table 5. BLOCK REGRESSION FOR VARIABLES RELATED TO RISK PERCEPTIONS OF COAL WASTE IMPOUNDMENTS AMONG APPALACHIAN RESIDENTS (N = 399)

	Model 1 Beta	Model 2[a] Beta	Model 3 Beta
Impacted Area			
Martin (=1).	.50***	.30***	.29***
Attitudes			
Trust.		-.41***	-.39***
Quality of Life.....		-.19***	-.19***
Characteristics			
Gender.....			.05
Age.			.03
Income.			-.03
Mining Households.			-.09*
Home Ownership...			-.08*
Adjusted R^2.	.24	.50	.51

* p=<.05; **p=<.01; *** p=<.001

[a] *Note*: Model 2= Reduced Model

and attitudes (trust and quality of life): Across counties, mining households (-.09) and homeowners (-.08) tend to minimize the risks associated with coal waste impoundments.

Overall, our regression findings indicate that the main predictors of risk perceptions are impact area, trust and quality of life. Other factors found to be significant in some previous studies, such as industry employment and home ownership could account for some of the possible differences in risk perceptions over coal waste and coal waste impoundments across our four county area. Here, the principal sociodemographic factor, based on a review of both correlation and regression results, seems to be mining household. Those involved in the mining sector were, predictably, more likely to minimize and discount the environmental risks associated with coal waste impoundments and, based on other correlations, were more likely to report higher levels of confidence in regulatory agencies and government officials to keep them safe.

Discussion: Agency Slippage and Public Distrust

Our survey findings suggest that the impact of the Martin County coal waste spill on the attitudes and opinions of local residents echoes the findings of many previous studies of post-disaster communities. While mining households were more likely to downplay the risks associated with coal waste impoundments, survey results indicate that compared to other households in other counties, Martin Countians, irrespective of type of employment and occupation, expressed significantly higher levels of distrust, as well as higher levels of concern about the quality of life in their community and the future environmental risks posed by impoundments and coal sludge in the wake of the 2000 impoundment failure.

These survey findings reinforce the literature regarding heightened perceptions of risk, public distrust and lower overall perceptions of quality of life in post disaster communities. In addition, our survey findings validate our own case research in Martin County. In the months following the spill, for example, interviews with local residents indicated that many did not believe official claims from either the company or government regulatory agencies that the water supply remained safe and uncontaminated by the spill. Evidently interviewees distrusted the information provided by the coal company and its representatives because the corporation had an economic interest in minimizing the environmental risks associated with the spill to circumvent possible liabilities. But many residents expressed equal levels of distrust with government officials and regulatory agencies as they were seen as connected to the coal company.

Such local suspicions and distrust over regulatory agencies likely developed within the first days of the event when the EPA regional office (Region 4) dispatched an on-site coordinator to oversee environmental assessment and cleanup of the coal slurry spill. To the surprise of many, the coordinator located the command and control center on coal company property, -a decision which seemed, to many locals, to place the government in direct collusion with the corporation from the start. When citizens later questioned officials about this decision, they were told that the corporation (MCCC-Massey) had made computers and fax machines available for their use (McSpirit, field notes March 18, 2002).

Within the next days and weeks, the EPA began formal coordination of its response actions with MCCC-Massey on company property, through a unified command structure, under its authority under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Otherwise known as "Superfund," this law authorizes federal agencies to establish a unified command post for state, federal and company officials when responding to environmental releases that pose an imminent and substantial threat to the public and the environment. But as the EPA worked with MCCC-Massey to begin cleanup, assessment and response operations, such as setting up emergency water lines and supplies, citizens continued to question the location of emergency services and environmental recovery efforts on coal company property of which the public had no access (Grayson 2000).

As stated at the outset of this paper, the public was particularly concerned about the impact of the spill on the watershed and drinking water. At the first public meeting on October 17, citizens were further surprised to find that the EPA would be relying upon state regulators and MCCC-Massey and its subcontractors to collect water data to assess the environmental impact of the spill as opposed to conducting its own independent federal assessment of the disaster's impact (Adkins 2000). Throughout October, through the unified command post, the EPA, company representatives and the state regulators, issued repeated declarations of public water safety; yet public concerns about the safety of the water remained high (Kentucky State Environmental Quality Commission 2004; McSpirit et al. 2002; Scott et al. 2005). In the weeks and months ahead, reports came in about foul odors, taste and consistency (a powdery substance) of the public drinking water, while others reported developing skin rashes from washing and bathing.

By November, allegations began to appear in the regional newspaper that MCCC-Massey had been editing press releases from the unified command post. When questioned, the EPA on-site coordinator (OSC) acknowledged that the

corporation did have input into the press releases but denied that the corporation had the final word. Nevertheless, the OSC also confirmed that he had not been in Martin County when recent press statements had been released (Mueller 2000b). By December, MCCC-Massey's legal team declared the sludge spill "an act of God" (Ball 2000), a legal plea which further angered local residents who saw the company as attempting to shirk its responsibility for the disaster.

A crucial series of events unfolded from January to March 2001, when the EPA began negotiations with MCCC-Massey to yield its authority under CERCLA. In a series of letters and closed door meetings, the EPA elected to settle with the company for minor violations under the Clean Water Act. This shift in statutory authority reversed several case precedents that had characterized coal waste as a potentially hazardous substance. But, to be fair, there were other regulatory statutes, namely -the Resource Conservation and Recovery Act (the Beville Amendment), that does not classify coal slurry as a hazardous material and this point of law was used to provide legal justification for the negotiated settlement. In the end, the shift away from CERCLA relinquished the federal government's authority to sue the company for damages to natural resources or to include the public in any further environmental recovery efforts. In fact, based on an open records review of who was represented in these negotiations, the record shows that there was already little input from the public, county or state in these final negotiations between EPA and MCCC-Massey.

On March 13, 2001, local residents were informed of the EPA decision and settlement at a final EPA public meeting. EPA Region 4 told the several hundred residents present that the agency was yielding jurisdiction over final matters of environmental cleanup, monitoring and restoration to the coal company. At this meeting, the EPA went ahead and informed the public that the corporation would not be fined for actions or inactions that caused the disaster, reasoning that the cost of cleanup was punishment enough. Residents reacted angrily to the news. "Have you been bought off?" one angry resident yelled from the back of the crowd (Adkins 2001a).

We have written about these observations and interviews in more detail elsewhere (see McSpirit et al. 2005; Scott et al. 2005) and they tend to show the EPA often acting in ways that did not merit much trust and confidence of local residents. Rather than acting in ways that demonstrated its independent authority to protect the environment and human health, it appeared to residents that MCCC-Massey, rather than the EPA, was taking the lead in environmental response and

assessment and as one resident aptly put it, that is like "putting the fox in charge of the henhouse" (McSpirit et al. 2005:41).

Conclusion

In August 2002, in a major shift of events, the state of Kentucky, invoking its own legal authority under CERCLA, sued the Martin County Coal Corporation for $1 million in damages to the state's natural resources. Still later, in March 2005, as a result of year-long efforts by our research team, the Kentucky State Environmental Quality Commission, and a final legislative act by Kentucky's General Assembly, $150,000 of the settlement was made available to conduct an independent, outside assessment of the public water system with full citizen oversight and participation. This independent research effort has been coordinated by our research team at Eastern Kentucky University, with researchers at the University of Kentucky, and in partnership with: 1) a group of concerned Martin County citizens, 2) the county water utility and 3) the Kentucky State Division of Water. Recently completed findings from this year-long independent, community-based assessment of the public water supply yielded similar conclusions to earlier assessments of no long-term impacts of the 2000 spill on public drinking water quality or the public water supply (McSpirit and Wigginton 2006; LaSage and Caddell 2006). Moreover, our evaluation of the public water plant, by an outside evaluator, showed that due to changes in management and due to heavy oversight by the state's own Division of Water and Public Service Commission since the 2000 event, the water utility was making significant strides in management, treatment and distribution of a good quality, water product (Hansen and McSpirit 2006). These findings were made widely available to residents through a flyer that was inserted in the county water district's 2006 Consumer Confidence Report that was sent to each household. Wide circulation of our findings was our effort at further restoring public confidence in the water utility and drinking water supply and, as a community development effort, was our effort at assisting the county in its own efforts at community recovery.

To close, our survey findings and case research reflect the literature on agency slippage (recreancy), public distrust and heightened levels of public anxiety in the face of technological breakdowns. But we believe that the community action component of our research may have some important applications for others working in the field of communities and disaster: Our initial case research and survey findings showed, for example, a regulatory response that seemed to favor the coal company and as a consequence, the governmental/ agency response did not

merit nor warrant public trust or confidence. Since then our research team had been advocating and working with others to push for more public involvement in environmental recovery decisions in Martin County and for an independent outside evaluation of environmental impacts of the sludge spill outside the purview of the offending coal company. This advocacy between our team, local citizens, state commissions and state regulatory agencies culminated in what we believe to be an important legal precedent regarding the public's legal rights in disaster response and environmental assessment. *The precedent being*: The state legal opinion that deemed that natural resource damage settlement monies could be used to fund and initiate independent outside assessments of environmental impacts rendered by an event and that these outside assessments could include full citizen oversight and participation (for details, see McSpirit and McCoy 2005). This new precedent, we believe, marks an important breakthrough in possibly loosening some of the hold that industry has had over regulatory response, assessment and monitoring in the face of technological hazards and disasters in the U.S. We encourage other researchers, working in disaster-impacted communities to consider and invoke this new precedent when applicable.

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