BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO CLEAN	)	R-12-009
CONSTRUCTION OR DEMOLITION	)	(Rulemaking – Land)
DEBRIS (CCDD) FILL OPERATIONS:	)	
PROPOSED AMENDMENTS TO 35 ILL.	)	
Adm. Code 1100	)	

NOTICE OF FILING

TO: SEE ATTACHED SERVICE LIST

PLEASE TAKE NOTICE that I have filed today with the Illinois Pollution Control Board the Pre-Filed Testimony of Dr. William Roy and Pre-Filed Testimony of Claire A. Manning, a copy of which is herewith served upon you.

Dated: March 5, 2012

Respectfully submitted,

PUBLIC BUILDING COMMISSION OF CHICAGO

By: /CManning

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PROOF OF SERVICE

I, Claire A. Manning, certify that I have served the attached Notice of Filing and Pre-Filed Testimony of Dr. William Roy and Pre-Filed Testimony of Claire A. Manning, by U.S. Mail, first class postage prepaid, on March 5, 2012 to the following:

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO CLEAN CONSTRUCTION OR DEMOLITION DEBRIS (CCDD) FILL OPERATIONS: PROPOSED AMENDMENTS TO 35 ILL. Adm. Code 1100	)	R-2012-009 (Rulemaking – Land)

PRE-FILED TESTIMONY OF DR. WILLIAM ROY

My name is William Roy. I am a Senior Geochemist with the Illinois State Geological Survey, as well as a Professor at the University of Illinois at Urbana-Champaign.

I also contract privately and independently with various associations and companies, primarily to provide research and consulting advice within my areas of expertise. In December 2011, I was contacted by Claire Manning, on behalf of the Public Building Commission of Chicago. M s. Manning requested my services in evaluating the record before the Illinois Pollution Control Board ("Board") in R-2012-009, as well as the Board's First Notice Proposal, dated February 2, 2012. The evaluation was for the purpose of providing science-based testimony to the Board concerning the IEPA's proposed "maximum allowable contaminants" applicable to the definition of "uncontaminated soil."

EDUCATION AND EXPERIENCE

A complete copy of my vitae is attached to this pre-filed testimony. Exhibit 1. In summary, I have earned the following academic degrees:

1977 BS, Geology, Indiana University, Bloomington

1980 MA, Geology, Indiana University, Bloomington

1985 Ph.D., Soil Physical Chemistry, University of Illinois, Urbana-Champaign

Below is a chronological list of my professional experience, as it relates to the soil and Clean Construction and Demolition Debris (CCDD) considerations relevant in this rulemaking:

1978-1979 Associate Faculty, Indiana University-Purdue University, Indianapolis, IN

1980-1986 Assistant Geochemist, Illinois State Geological Survey

1986-1993 Associate Geochemist, Illinois State Geological Survey

1986-1995	Assistant Professor of Soil Chemistry (Adjunct), Department of Agronomy, University of Illinois
1991-1997	Associate Editor, *Journal of Environmental Quality*.
1993-1999	Geochemist, Illinois State Geological Survey
1995-2006	Associate Professor of Soil Chemistry (Adjunct), Department of Natural Resources and Environmental Sciences, University of Illinois
1998-1999	Acting Head of the Energy and Environmental Engineering Section
1999-present	Senior Geochemist, Illinois State Geological Survey
2003-2008	Associate Editor, *Soil Science Society of America Journal,* (Division S-2: Soil Chemistry)
2007-present	Professor, Department of Nuclear, Plasma, and Radiological Engineering (Adjunct), University of Illinois.

Additionally, my research experience has led to previous involvement in the development of state environmental regulations and policies related to soil and soil standards. As a member of the Technical Advisory Group, Agrichemical Facility Response Action Program Board for the Illinois Department of Agriculture (IDOA) from 1997 to 2008, I conducted laboratory and field-scale research that helped establish soil cleanup objectives for nitrogen-containing fertilizers. Working closely with IDOA, as well as tangentially with IEPA, soil cleanup objectives were promulgated in TITLE 8: AGRICULTURE AND ANIMALS, CHAPTER I: DEPARTMENT OF AGRICULTURE, SUBCHAPTER i: PESTICIDE CONTROL, PART 259, AGRICHEMICAL FACILITY REPSONSE ACTION PROGRAM.

I also conducted research on the environmental fate and movement of pesticides from point sources for the IDOA, as follows:

- Roy, W. R., I. G. Krapac, W. S. Dey, and E. Mehnert. 1993. Pesticides in geologic materials at agrichemical facilities in Illinois: Definitions of "contamination," *in* Agrichemical Facility Site Contamination Study. Illinois Department of Agriculture, Chapter 5, 38 p.

- Roy, W. R., E. Mehnert, I. G. Krapac, and W. S. Dey. 1994. Pesticides in soil materials at agrichemical facilities: What *is* "contamination?" *in* Proceedings of

the 1994 Illinois Agricultural Pesticide Conference, University of Illinois, Champaign, IL, Jan. 5-6, 1994, p. 153-163.

- Roy, W. R. and I. G. Krapac. 2006. Guidance for Conducting Site Assessments at Retail Agrichemical Facilities. Illinois Department of Agriculture, 75 p.

- Krapac, I. G., W. R. Roy, C. A. Smyth, and M. L. Barnhardt. 1995. Occurrence and distribution of pesticides in soil at agrichemical facilities in Illinois. *Journal of Soil Contamination*, **4**, 206-226.

- Roy, W. R. and I. G. Krapac. 2006. Potential soil cleanup objectives for nitrogen-containing fertilizers at agrichemical facilities. *Soil and Sediment Contamination*, 15, 241-251.

A more comprehensive list of my research and publications is included in Exhibit 1. In addition to this R2012-009 project, I am also the lead investigator in a 5-year project funded by the U.S. Environmental Protection Agency entitled "Protecting Drinking Water by Reducing Uncertainties Associated with Geologic Carbon Sequestration in Deep Saline Aquifers" with a budget of $897,225. See http://sequestration.org/associatedprojects/williamroy.html

SCOPE OF ASSIGNMENT RELATED TO R2012-009

Ms. Manning has provided me with the entire record in this proceeding, which I have reviewed as follows: the IEPA proposal, errata sheet changes, IEPA testimony, the testimony from the other participants, relevant portions of Record, the Pre-First Notice Comments, and the hearing exhibits. I also reviewed a report on soil in the City of Chicago, published by the United States Geological Survey and various other reports concerning soil data in Illinois, as reflected in this document. I also conducted literature searches for published papers on the subject of CCDD in additional to other papers that had the potential to provide useful information on the question of appropriate standards for uncontaminated soils that are used as fill in CCDD fill operations, which are quarries, mines or other excavations permitted by IEPA for the acceptance of such materials. I was asked to then to provide the Board with expert testimony related to the proposed rules in relation to the definition of "uncontaminated soil" set forth in P.A. 96-1416: "soil that

does not contain contaminants in concentrations that pose a threat to human health and safety and the environment." 415 ILCS 5/3.160. My testimony at this hearing focuses, then, on the concept of "uncontaminated" in the context of soil and CCDD placement in quarries.

On the basis of my evaluation of the record evidence thus far presented in this proceeding, as well as on my knowledge of and experience with the chemistry and nature of soil in the environment, I offer the Board the following opinions:

- Neither science nor data justifies the IEPA's proposed maximum contaminant levels required to ensure protection of groundwater at or near CCDD fill operations.
- The IEPA's proposed maximum contaminant levels fail to consider the conditions in which soil will be placed, a necessary consideration for purposes of defining uncontaminated in the context of soil placement in CCDD fill operations.
- While TACO may be an appropriate methodology for defining uncontaminated soil in the context of soil placement in quarries, it should be used with more realistic input parameters.
- The IEPA's strictest use of the TACO methodology is arbitrary in the context of defining uncontaminated soil for purposes of placement in CCCD fill operations.
- The IEPA's application of pH, which forms the basis of its proposed maximum contaminant levels for CCDD soils, is not based upon a ctual or expected conditions or upon actual or expected data and, accordingly, is arbitrary.

THE CHEMISTY OF SOIL

Soil pH

Soil pH is often the major variable that controls the environmental chemistry of potential groundwater contaminants in porous media such as soil and CCDD. Because of this important relationship, the Board needs to pay careful attention to pH values used to define maximum contaminant levels. When a sample of soil or CCDD is mixed with water, the resulting pH of the liquid phase will be the product of chemical reactions between the liquid and solid phases. Ranges in pH measurements can be qualitatively predicted by having information about the

mineralogical composition of the sample. Soil pH can vary from less than pH 2 for some coal strip mine soil piles to greater than 10 in sodic soils. Humid-region soils which have been subject to long periods of leaching such as the reddish soils of South Carolina have pH values of 4.5 to 7.2. Alkaline pH values are often related to the presence of carbonate minerals (Table 1).

Table 1. Mechanisms that control soil pH (from Hassett and Roy, 1990)	
2 to 4	Oxidation of reduced sulfur minerals.
4 to 5.5	Exchangeable Al^{3+}. Dissolution of soil minerals.
5.5 to 6.8	Exchangeable H^{+}. Weak-acid groups on soil organic matter and soil minerals. Dissolved carbon dioxide gas.
6.8 to 7.2	Weak-acid groups on soil organic matter and soil minerals. Dissolved carbon dioxide gas.
7.2 to 8.5	Dissolution of carbonates such as calcite ($CaCO_3$). Dissolved carbon dioxide gas.
8.5 to 10.5	Exchangeable sodium and dissolution of sodium carbonate.

If gibbsite ($Al(OH_3)$) or clay minerals dissolve, they contribute Al^{3+} to the soil solution. Trivalent aluminum hydrolyzes (reacts with water) to form aluminum hydroxide species and acidity:

$$Al^{3+} + H_2O = AlOH_2^{+} + H^{+}$$

Aluminum can, therefore buffer soil acidity between values of 4.5 and 5.5. At pH values greater than 5.5, the solubility of Al^{3+} is small enough that it is not effective in buffering soil pH, and other mechanisms become more important. For example, if a soil sample or a CCDD sample contains calcite or crushed concrete, the resulting pH will be in the range of 7.2 to 8.5. For example, when carbonates dissolve, the anion of weak base is released such as the carbonate ion (CO_3^{2-}) which will hydrolyze forming the bicarbonate and hydroxide ions which of course make the soil solution basic:

$$CaCO_{3calcite} = Ca^{2+} + CO_3^{2-}$$

$$CO_3^{2-} + H_2O = HCO_3^- + OH^-$$

Both the pH and mineralogy of Illinois soils have been studied. For example, in studies conducted by the Illinois State Geological Survey (ISGS) (Cahill, 2012), 137 soil cores were collected in a State-wide assessment of soil properties. The pH values of the samples from the 137 cores ranged from pH 3.6 to 8.7 with a median value of 6.64. This median pH is in agreement with the mean pH of 6.4 for A and E horizons of 34 major soil types in Illinois (Garcia-Paredes et al., 2000). Of the 820 samples tested in the ISGS study, 79% yielded a pH in the range of 5 to 8. Data for Cook, Du Page, Kane, and Will Counties are shown in Table 2. As shown in the depth profiles, the surface samples tended to be more acidic when compared to the deeper samples. Soil formation is an acidifying process. The parent material normally has a pH of around 7, and when calcareous, it yields a pH value greater than 8. It was reported in the ISGS study, that "calcareous till or drift . . . was penetrated in many cores, mainly in northern Illinois . . . carbonate minerals in the till . . . impose[d] an alkaline pH on the samples."

Table 2. Soil pH values and corresponding depths for four northern Illinois Counties (from Cahill, in preparation).

Cook County		Du Page County		Kane County		Will County	
Depth (feet)	pH	Depth (feet)	pH	Depth (feet)	pH	Depth (feet)	pH
0 to 0.6	7.3	0 to 0.6	7.7	0 to 0.9	6.2	0 to 0.8	6.9
0.6 to 1.1	7.3	2.6 to 3.6	7.7	1.1 to 1.7	6.7	1.1 to 1.6	7.5
1.1 to 2.0	8.1	3.6 to 4.2	6.3	1.7 to 2.1	6.9	1.6 to 2.2	8.1
2.0 to 2.6	8.1	4.2 to 4.8	6.8	2.1 to 2.5	7.3	2.2 to 2.8	8.2
3.4 to 3.7	8.1	4.8 to 5.3	7.6	2.5 to 3.3	8.2	2.8 to 3.2	8.2
4.0 to 4.6	8.2	6.6 to 7.3	7.9	3.3 to 4.0	8.2	3.2 to 4.0	8.2
		3.4 to 4.0	8.0				
0 to 0.5	6.5					0 to 1.0	7.3
1.2 to 2.0	7.1					1.0 to 1.5	7.0
2.2 to 2.8	7.4					1.5 to 2.0	6.9
3.9 to 4.2	7.7					2.0 to 2.6	6.7
5.1 to 5.8	7.2					2.6 to 3.4	7.0
5.8 to 6.4	7.5					3.4 to 4.0	8.0

During the development of this document, no information was located about the pH of CCDD samples in Illinois. However, a recent study in Florida (Wang et al., 2012) reported that leachate,

generated using laboratory columns containing a synthetic sample of construction and demolition debris yielded a pH of 6.4. This publication also compiled pH data from five other studies on the leaching of construction and demolition wastes. The results ranged from 6.45 to 7.6. Delay et al (2007) reported that the pH of a demolition waste in Germany was 11.9. The composition of the waste sample was not given. Similarly, Trankler et al. (1996) reported that the pH of demolition wastes in Germany ranged from 9.5 t o 12.5. The waste samples were derived from the demolition of buildings, and the presence of concrete may explain the relatively basic pH observations.

A major concern about the land disposal of excavated soil and CCDD material is the possibility of leaching potential groundwater contaminants after emplacement. The specific leaching mechanisms depend on the physicochemical form of the potential contaminants. When water via precipitation or groundwater flows through CCDD and CCDD soil, potential contaminants may be mobilized via:

1. Dissolution of solid phases such as paint chips, or metals fragments,
2. Desorption from soil particles such as clays or soil organic matter.

Sorption is the process by which ions are concentrated at solid-liquid interfaces by soils and clays. Cations are sorbed by negative charges on clay surfaces. Anions are sorbed by negative charges on the surface of soil particles. In general, the sorption of inorganic solutes is pH dependent: the extent of sorption of cations increases with an increase in pH (less acidic). The extent of the sorption of anions is often the opposite: sorption increases under acidic conditions. This is why, in part, pH is often the “master variable” that controls the environmental fate of potential groundwater contaminants. Hydrophobic organic molecules are sorbed soil organic matter. Consequently, the greater the clay or organic matter content, the greater the capacity of the soil to sorb these constituents from solution. Desorption is the opposite of sorption. In theory, desorption should be completely reversible like that of any reversible chemical reaction. However, experimental measurements have shown sorption hysteresis: the backward (desorption) reaction is not always reversible. Once sorbed, a fraction of the sorbate will remain with the sorbent. Many reasons have been given for the lack of reversibility such as the formation of chemical bonds or the diffusion of the sorbate into the sorbent. It has been observed

that the lack of reversibility may increase with an increase in the contact time between the sorbate and the sorbent. The overall impact of these soil chemical processes is that not all of the mass of a given contaminant in soil is available to leach into groundwater.

To help illustrate the environmental soil chemistry of CCDD soil, three potential groundwater contaminants were chosen for discussion: arsenic which occurs as anion ($HAsO_4^{2-}$) in solution, lead, which occurs as a cation (Pb^{2+}) in water, and benzopyrene which is a hydrophobic solute.

Arsenic

Arsenic is a metalloid element. Arsenic occurs in nature with oxygen, sulfur, and chlorine in inorganic forms, and with carbon and hydrogen in organoarsenic compounds. Naturally-occurring arsenic can occur as an accessory element in sulfide minerals and in organic forms. Shacklette and Boerngen (1984) estimated arsenic concentrations in U.S. soils ranges from less than 0.1 t o 97 mg/kg with a mean of 5.2 $\pm$ 2.23 mg/kg. Potential sources of arsenic to groundwater result from arsenical pesticides glass production, and industrial emissions.

In groundwater, arsenic occurs as the 3+ and 5+ oxidation states. Arsenic as arsenate ($As(V)O_4$) occurs under relatively pH neutral and oxidized solutions, and as arsenite ($As(III)O_2$) in reduced groundwater. The kinetics of the As(V)−As(III) transformation are thought to be slow. Arsenic acid (H_3AsO_4) is a triprotic acid that dissociates in three steps:

$$H_3AsO_4 \leftrightharpoons H_2AsO_4^- + H^+$$

$$H_2AsO_4^- \leftrightharpoons HAsO_4^{2-} + H^+$$

$$HAsO_4^{2-} \leftrightharpoons AsO_4^{3-} + H^+$$

The concentration of inorganic arsenic in groundwater may be controlled by the solubility of arsenic-containing minerals. Arsenic as arsenate can form relatively insoluble compounds with iron and barium, and can form more soluble compounds with aluminum, and various divalent ions. Barium arsenate is predicted to be the least-soluble As(V)-containing solid waste in oxidized solutions that contain sufficient Ba^{2+} to be in equilibrium with barite ($BaSO_4$). Calcium arsenate may also be important in controlling the solubility of arsenate. In acidic solutions, iron

arsenates may control the solubility of arsenate. In reduced groundwater, the concentration of arsenite may be limited by arsenite sulfides. It has, however, not been demonstrated that such solid-phase controls occur frequently. It may more likely that arsenic co-precipitates with iron and manganese oxyhydroxides in oxidized solutions, and as metal sulfides in reduced soils and sediments.

The concentration of arsenic in groundwater may be influenced sorption-desorption interactions with metal oxides and hydroxides. The sorption of arsenate increases with decreasing pH. The extent arsenic sorption depends of its oxidation state. In general, arsenate is more strongly sorbed by oxides than arsenite. The extent of arsenate sorption has been correlated to the total iron content of soils, free-iron oxide content, the amount of ammonium oxalate-extractable iron, the amount of ammonium oxalate-extractable aluminum, and to a lesser extent, the clay content and surface area. There appears to be no relationship between the arsenic sorption and the organic matter content.

Arsenic sorption may not be reversible. Elkhatib et al. (1984) found that arsenite sorption was not reversible from West Virgina soils. Ladeira and Ciminelli (2004) applied the Toxicity Characteristic Leaching Procedure (TCLP) to gibbsite, goethite, and an Oxisol soil sample after the sorbents had been equilibrated with arsenic-containing solutions. The authors reported that only 0 to 2.3 of the As(V) could be extracted using the TCLP while the method extracted 8 to 29% of the applied arsenic as As(III).

Qi and Donahoe (2008) characterized the leachability of arsenic from soils that had received applications of arsenic-containing herbicides for five decades. One of the extractants used was Synthetic Acid Rain procedure. The authors concluded that of the residual amounts of arsenic in the in soil samples, 55% was present on irreversible sorption sites. These studies show that not all of the arsenic detected in a soil sample is available to leach into groundwater.

Lead

Lead is a post-transition. It commonly occurs as galena (PbS), cerussite ($PbCO_3$), and angelesite ($PbSO_4$). Potential sources of lead to groundwater include smelting and mining, the production of batteries, waste incineration, leaded gasoline (before 1996), and lead-containing paint.

In groundwater, lead occurs in only the 2+ oxidation day. Lead reacts with bicarbonate, chloride, hydroxide, and sulfate ions to form ion pairs such as $PbCl_2^0$. In groundwater with pH values of less than 7, Pb^{2+} dominates. $PbSO_4^0$ and $PbCl^+$ can also be important. In alkaline water, $PbCO_3^0$, $Pb(CO_3)_2^{2-}$ and $Pb(OH)_2^0$ dominate.

The concentration of lead in groundwater is controlled by both mineral solubility and by sorption-desorption interactions. In a classic paper on lead chemistry (Hem, 1976), if the concentration of lead in the soil system is less than the equilibrium concentrations required to precipitate as solid phases, the distribution of the amount in water and the amount sorbed can be calculated from the cation ion exchange capacity of the soil and the selectivity coefficients that control the extent of the reaction.

The aqueous solubility of lead can be controlled by a number of hydroxide, carbonate, phosphate, sulfide, and sulfate solid phases. Lead hydroxide can limit the amount of lead in groundwater:

$$Pb^{2+} + 2H_2O \rightleftharpoons 2H^+ + Pb(OH)_c$$

Cerrusite ($PbCO_3$) can be most stable form of lead, particular in CO_2-rich groundwater:

$$Pb^{2+} + CO_{2(g)} + H_2O \rightleftharpoons PbCO_3$$

In relatively acidic solutions (less than pH 6), anglesite ($PbSO_4$) may limit the amount of lead in groundwater:

$$Pb^{2+} + SO_4^{2-} \rightleftharpoons PbSO_4$$

The sorption of lead is pH dependent; the extent of sorption increases with an increase in pH. The extent of lead sorption has been correlated with the cation exchange capacity and the organic matter content of geologic media. In a study by Patkowska et al. (2005), the authors studied the

sorption of cadmium, copper, chromium, lead, and zinc by a brownfield soil. A brownfield soil is a type of urban soil, and a likely surrogate for a CCDD soil. The authors reported that the urban soil contained 386 mg/kg of lead and yielded a reaction pH of 6.69. When they attempted to measure lead sorption at pH 7, all of the lead and copper (5 to 20 mg/L) precipitated. Because of the relatively insoluble nature of lead in water under pH conditions greater than about 7, it will not occur in significant concentrations.

Dermatas et al. (2006) applied the TCLP to soils sample containing lead. The samples were collected from an US Army firing range. The range soils can be viewed as yet another type of urban soil. The authors found no pattern between the concentration of lead on the TCLP extracts and the amount of lead in the soil samples. The authors concluded that the leachability of the lead in the TCLP extracts was controlled by lead carbonate precipitation-dissolution reactions.

The desorption of lead from soil may also be pH dependent and not reversible. Fig. 1 presents an excellent example showing that the amount of lead that was desorbed or leached was reduced when the pH of liquid phase was greater than about pH 4. As another and recent example, Srivastava et al. (2008) observed that the desorption of lead from the mineral kaolinite could be characterized as a rapid reaction followed by a slower reaction. The extent of release decreased with aging. The authors concluded from experimental observations that the decrease in lead desorption with time was the result of the formation of a polynuclear lead-hydroxide complex at the kaolinite surface. These studies show that not all of the lead detected in a soil sample is available to leach into groundwater.

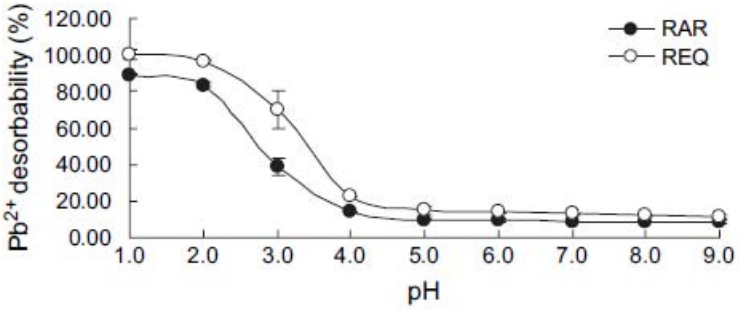

Figure 1. Lead desorption as a function of pH (Yang et al., 2006).

Benzopyrene

Benzopyrene is only sparing soluble in water because the compound is hydrophobic ("water-fearing"). The solubility of the compound is only about 1.62 µg/L at 25° C (HSDB, 2012). As such, it's soil chemistry in CCDD soils is very different from arsenic and lead. Benzopyrene will be sorbed by soil organic matter via hydrophobic partitioning out of water, and onto the hydrophobic surfaces of the organic matter. An increase in the amount of organic matter will result in an increase of the amount of benzopyrene removed from solution. The soil-organic carbon partition coefficient (Koc) is a compound-specific indicator of leachability. The Koc of benzopyrene can be estimated from its solubility in water as about 480,000 (see Roy and Griffin, 1985). Experimentally, Koc values of 270,000 to 1,100,000 have been reported (HSDB, 2012). The magnitude of these values suggest that benzopyrene is immobile in saturated soil-water systems. For comparisons, the Koc of chlorobenzene is 318, and has a "medium mobility" according to the mobility classification system of Roy and Griffin (1985). These studies show that not all of the benzopyrene detected in a soil sample is available to leach into groundwater.

CCDD soil leaching studies

No CCDD leaching studies were located for Illinois. However, studies conducted in other States were located. Jang and Townsend (2001) conducted laboratory extractions using the Synthetic Precipitation Leaching Procedure (SPLP). The CCDD samples (referred to as simply C&D in other States) were the soil fines that were collected at 14 C&D waste recycling facilities in Florida. The goal of the study was to study the leachability of organic compounds from the samples. Although benzopyrene was not specifically included in the study, the authors reported that six samples contained between 6.4 and 18.6 mg/kg of pyrene. They found that only about 0 to 0.5% of the pyrene leached into solution. Pyrene, like benzopyrene is a hydrophobic compound that is sparingly soluble in water. The authors concluded that organic chemicals in the recovered fine fraction of C&D debris did not pose significant risk to groundwater quality.

Townsend et al. (2004) conducted laboratory extraction studies using the SPLP with soil fines that were collected at 13 C&D waste recycling facilities in Florida. The authors noted that the initial pH of the SPLP solution was 4.2. After contact with the C&D samples, the pH of the

suspensions ranged from 6.4 to 10.4 in which metals are less soluble. The authors mentioned that it was likely that unreacted cement or concrete dust was present in the samples which would neutralize the acidity in the initial extractant. As a result, lead was not soluble in solution (Table 2) whereas it as present in samples. The amount of lead in the C&D samples ranged from less than 50 to 1,000 mg/kg. The authors concluded that arsenic most frequently exceeded a risk-based target level in Florida, and may be the only element "most likely to limit reuse [of C&D fines]."

Table 2. Elemental concentrations in C&D samples and laboratory extracts (from Townsend et al., 2004).

Element	Mean concentration in C&D samples (mg/kg)	SPLP leachate concentrations (mg/L)
Arsenic	4.4	10
Cadmium	2.0	2.0
Chromium	21	14.0
Lead	92	less than 0.01
Nickel	76	14.0
Zinc	290	80

Wang et al. (2012) conducted column leaching studies using a synthetic C&D waste sample composed of 40% concrete, 45% wood, and15% dry wall. The authors reported that the concentrations of arsenic in the leachate was less than 4 µg/L during the entire experiment.

SOILS AND THE QUARRY ENVIRONMENT

Relevant CCDD soil properties

It is apparent from the information above that pH is a major soil property that will determine whether CCDD material can be stored in quarries without adversely impacting groundwater quality. While the use of pH values based on surface soils (which tend to be the most acidic in soil profile), may be most environmentally conservative, they may over predict both the solubility and mobility of heavy metals from CCDD collected a deeper depths. One aspect of quarry disposal that has not been mentioned is pH. The equilibrium pH of calcium carbonate (the major component of limestone) is 8.2. Therefore any transient acidity created by surface soils mixed with deeper, less acidic material may be neutralized and eventually buffered by the

limestone remaining in the quarry. One possible safeguard would be to add a portion of crushed limestone to each truck load to neutralize any unwanted acidity. On another note, it has been said that it is not possible to average pH values. This is not true. The average of pH 5 and pH 7 is not pH 6. Because the "p notation" means the negative, base-10 log of the number, pH values must be converted as 10^{-5} and 10^{-6} which yields an average of pH 5.26.

Another important soil property is the organic matter content. Soil organic matter can sorb both inorganic and organic solutes and thus minimize their impacts on groundwater quality.

Urban Soils

Because CCDD can be generated and disposed in urban environments, there is a need to better understand the chemical composition of urban soils. Urban soils can be any soil material in an urban or industrial area. Such soils may be severely compacted, disturbed by excavations and re-burial, or buried by gravel, asphalt, or concrete. Such soils may also be exposed to urban and industrial emissions from sources that range from garden chemicals to large factories or coal-fired power plants. Urban soils can serve as sinks for otherwise routine, non-point emissions of gases, particulates, and urban runoff. When compared with soils in rural, non-agricultural environments, elevated heavy metal concentrations are almost *universally* reported for urban soils (Pouyat et al., 2010). Most heavy metal sources in urban landscapes have been associated with roadside environments. According to ATSDR (2007), studies conducted in Maryland and Minnesota indicated that within large, light-industrial, urban settings such as Baltimore, the largest soil lead levels generally occur near inner-city areas, especially where heavy traffic flows have long prevailed, and that the amount of lead in the soil was correlated with the size of the city. In 1981, soil lead levels in the Minneapolis/St. Paul inner-city area were 60 times larger (423 mg/kg) than levels found in rural Minnesota (6.7 mg/kg).

Because anthropogenic combustion processes are a major source of PAHs in soils, soil concentrations have tended to increase over the last 100 to 150 years, especially in urban areas (ATSDR, 1995). Of particular relevance is the study by Kay et al. (2003). Surface (0 to 6 inches) soil samples were collected at 57 locations in properties owned by the city of Chicago. PAH compounds

were found to be ubiquitous in the surface soils of Chicago. The authors found, for example, elevated concentrations of benzopyrene (greater than 4.08 mg/kg) in the northern and western part of the city. The authors concluded that the PAHs were the result of the incineration of wood, coal, and trash, motor vehicles, coking operations, wood preservative, and other sources.

Kay et al. (2003) also measured the concentration of 43 inorganic constituents in the surface soils. The concentrations of lead ranged from 13 to 1,910 mg/kg with a mean of 395 $\pm$ 492 mg/kg. The authors noted that the arithmetic mean of the lead in Chicago soils was about 20 times larger than the surrounding agricultural areas. The authors also concluded that the mean concentrations of arsenic, mercury, copper, molybdenum, selenium, and zinc were 2 to 6 times larger than the surrounding agricultural soils. Shacklette and Boerngen (1984) estimated that the geometric mean of the background concentrations of lead in US soils was 16 mg/kg. Enhanced levels of lead in soil appear to be characteristic of large urban areas throughout the world (Table 3). In the study of Chirenje et al (2004), surface (0 to 0.2 m) soil samples were collected in Florida to characterize the distribution of lead from non-point sources in urban areas such as industrial emissions, the former use of lead-containing gasoline, lead-based paints and pipes. The median concentration of lead in commercial properties in Miami was 146 mg/kg, whereas the median concentration of lead in residential properties in Gainesville (a smaller city than Miami) was 20.4 mg/kg. Additional information from the study is given in Table 3. It is obvious that definitions of "uncontaminated soil" in Illinois must take into account the fact that the soils may have been exposed to non-point anthropogenic additions long after the glaciers covered the landscape with glacial deposits. These additions should not lead the Board to conclude that the presence of such in soils makes the soil a ready source of contamination.

Table 3. Soil lead concentrations near large cities (Pouyat et al., 2010).

City	Soil lead concentration (mg/kg)
Chicago, Illinois	395 $\pm$ 494
Hong Kong	88 $\pm$ 62
Ibadan, Nigeria	95 $\pm$ 127
Seville, Spain	156
Baltimore, Maryland	231
Miami, Florida[1]	223 (arithmetic mean of commercial properties)
London, England[1]	340 $\pm$ 153

	range: 60 to 789

[1]Source: Chirenje et al., 2004

SUMMARY

A soil pH that is less than five is not typical for the soils in Illinois. Strongly acidic soils are not consistent with the mineralogical composition of typical soils in Illinois. Maximum contaminant levels should reflect realistic soil pH values. Moreover, a limestone quarry that is used for CCDD fill operations will also not be acidic because of the presence of calcium carbonate, which would also buffer changes in pH. Urban soils will contain anthropogenic constituents such as lead from non-point sources. However, not all of mass of these constituents is available to leach into groundwater. The lack of actual data on the chemical and mineralogical composition of CCDD in Illinois, the leachability of CCDD, and the lack of any field data relevant to CCDD fill operations in Illinois impede the Board's ability to move forward in establishing *science-based* maximum contaminant levels that are protective of groundwater quality.

References

ATSDR. 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Agency for Toxic Substances and Disease Registry
(on-line at http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=122&tid=25)

ATSDR. 2007. T oxicological Profile for Lead. Agency for Toxic Substances and Disease Registry (on-line at http://www.atsdr.cdc.gov/ToxProfiles/tp13-c6.pdf)

Cahill, R. Chemical Composition of Soils in Illinois. Illinois State Geological Survey. Open File Report (in review).

Chirenje, T., L. Q. Ma, M. Reeves, and M. Szulczewski. 2004. Lead distribution in near-surface soils of two Florida cities: Gainsville and Miami. *Geoderma*, **119**, 113-120.

Delay, M., T. Lager, H. D. Schulz, and F. H. Frimmel. 2007. Comparison of leaching tests to determine and quantify the release of inorganic contaminants in demolition waste. *Waste Management*, **27**, 248-255.

Dermatas, D., G. Shen, M. Chrysochoonu, D. G. Grubb, N. Menounou, and P. Dutko. 2006. Pb speciation versus TCLP release in army firing range soils. *Journal of Hazardous Materials*, **136**, 34-46.

Elkhatib, E. A., O. L. Bennett, and R. J. Wright. 1984. Arsenite sorption and desorption in soils. *Soil Science Society of America Journal*, **48**, 1025-1030.

Garcia-Paredes, J. D., K. R. Olson, and J. M. Lang. 2000. Predicting corn and soybean productivity for Illinois soils. *Agricultural Systems*, **64**, 151-170.

Hassett, J. J. and W. R. Roy. 1990. Soil Chemistry: Equilibrium Concepts. Lecture notes for Soils 307, Soil Chemistry. Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, Chapter 3: Mechanisms that control soil acidity or alkalinity.

Hazardous Substance Data Base. 2012.
On-line at http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~8JX5aI:3

Hem, J. D. 1976. Geochemical controls on lead concentrations in stream water and sediments. *Geochimica et Cosmochimica Acta*, **40**, 599-609.

Jang, Y. C. and T. G. Townsend. 2001. Occurrence of organic pollutants in recovered soil fines from construction and demolition waste. *Waste Management*, **21**, 703-715.

Kay, R. T., T. L. Arnold, W. F. Cannon, D. Graham, E. Morton, and R. Bienert. 2003. Concentration of polynuclear aromatic hydrocarbons and inorganic constituents in ambient

surface soils, Chicago, Illinois: 2001-02. Water-Resources Investigations Report 03-4105. U.S. Geological Survey.

Ladeira, A. C. Q. and V. S. T. Ciminelli. 2004. Adsorption and desorption of arsenic in an oxisol and its constituents. *Water Research*, **38**, 2087-2094.

Patkowska, J. M., A. Hursthouse, and H. Przybyla-Kij. 2005. The interaction of heavy metals with urban soils: sorption behavior of Cd, Cu, Cr, Pb, and Zn with a typical mixed brownfield deposit. *Environment International,* **31**, 513-521.

Pouyat, R. V., K. Szlavecz, I. D. Yesilonis, P. M. Groffman, and K. Schwarz. 2010. Chemical, Physical, and Biological Characteristics of Urban Soils in Aitkenhead-Peterson, J. and A. Volder (eds), Urban Ecosystem Ecology, Agronomy Monograph 55, American Society of Agronomy.

Qi, Y., and R. J. Donahoe. 2008. The environmental fate of arsenic in surface soil contaminated by historical herbicide application. *Science of the Total Environment*, **405**, 246-254.

Roy, W. R, and R. A. Griffin. 1985. Mobility of organic solvents in water-saturated soil materials. *Environmental Geology and Water Sciences*, **7**, 241-247.

Shacklette, H. T. and J. G. Boerngen. 1984. Element concentrations in soils and other surficial materials of the conterminous United States. U.S. Geological Survey Professional Paper 1270.

Srivastava, P., M. Grafe, B. Singh, and M. Balasubramanian. 2008. Cadmium and lead desorption from kaolinite. Chapter 8. Developments in Earth and Environmental Sciences, M. O. Barnett and D. B. Kent (eds), Elsevier.

Tankler, J. O. V., I. Walker, and M. Dohmann. 1996. Environmental impact of demolition waste—an overview on 10 years of research and experience. *Waste Management*, **16**, 21-26.

Townsend, T., T. Tolaymat, K. Leo, and J. Jambeck. 2004. Heavy metals in recovered fines from construction and demolition debris recycling facilities in Florida. *Science of Total Environ*ment, **332**, 1-11.

Wang, W., S. Sikora, H. Kim, B. Dubey, and T. Townsend. 2012. Mobilization of iron and arsenic from soil by soil and demolition debris landfill leachate. *Waste Management* (in press).

Yang, J. Y., X. E. Yang, Z. L. He, T. Q. Li, J. L. Shentu, and P. J. Stoffella. 2006. Effects of pH, organic acids, and inorganic ions on lead desorption from soils. *Environmental Pollution*, **143**, 9-15.

Exhibit 1

January 10, 2011

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Education

1977 Indiana University, Bloomington, IN; BS, Geology
1980 Indiana University, Bloomington, IN; MA, Geology
Thesis: Glacial Chronology of the South Boulder River Valley, Montana
1985 University of Illinois, Urbana-Champaign, IL; Ph.D., Soil Physical Chemistry
Dissertation: On the Competitive Adsorption of Oxyanions by Soils

Professional Experience

1977-1979	Laboratory Assistant, Geochemistry Section, Indiana Geological Survey
1978-1979	Associate Faculty, Indiana University-Purdue University, Indianapolis, IN
1980-1984	Assistant Geochemist I, Illinois State Geological Survey
1984-1986	Assistant Geochemist, Illinois State Geological Survey
1986-1993	Associate Geochemist, Illinois State Geological Survey
1986-1995	Adjunct Assistant Professor of Soil Chemistry, Department of Agronomy, University of Illinois
1988-present	Appointment to the Graduate Faculty, UIUC
1993-1999	Geochemist, Illinois State Geological Survey
1995-2006	Adjunct Associate Professor of Soil Chemistry, Department of Natural Resources and Environmental Sciences, University of Illinois
1998-1999	Acting Head of the Energy and Environmental Engineering Section
1999-present	Senior Geochemist, Geochemistry Section
2007-present	Adjunct Professor, Department of Nuclear, Plasma, and Radiological Engineering, College of Engineering, University of Illinois.

Professional Organizations and Activities

Member, Technical Advisory Group, Agrichemical Facility Response Action Program Board, IL Dept. of Agriculture, 1997-2008
Member, Illinois Clean Coal Institute Program Committee, 1999
Symposium organizer and Co-Chair, "An Interdisciplinary Look at Soils," April, 2000, Geological Society of America, North Central Meeting, Indianapolis, IN
Member, Natural Resources and Environment Working Group, Illinois Council on Food and Agricultural Research, 2005-2008
Member, Livestock and Urban Waste Recycling Research Team, 2002-2007
Member, Competitive Journals Subcommittee: SSSAJ 5-year Review Team, 2003.
Member, Coal Preparation Society of America, 2004-2008
Member, American Nuclear Society (Decommissioning and Waste Management Divisions), 2008-
Member, Soil Science Society of America, 1981-

Professional Recognition

Awards

1993 Distinguished Achievement Award, Illinois State Geological Survey
2003 Donald A. Holt Achievement Award, Illinois Council for Food and Agricultural Research
2004 Service Recognition Award, College of Agricultural, Consumer and Environmental Sciences, University of Illinois at Urbana-Champaign
2007 Editor's Citation for Excellence as Associate Editor, Soil Science Society of America
2008 Safety Recognition Award, Illinois State Geological Survey

Editorial Boards

Editorial Board, Associate Editor, *Journal of Environmental Quality*, 1991-1997 (two terms)
Editorial Board, Associate Editor of Division S-2 (Soil Chemistry), *Soil Science Society of America Journal*, 2003-2008 (two terms)
Editorial Board, *Journal of Hazardous Materials*, 1995-2008
Editorial Board, *International Journal of Applied Environmental Sciences*, 2005-present

Co-Editor, *Journal of Environmental Quality*, symposium papers on nonpoint-source pollutants in the vadose zone (see JEQ, 1999, 28, p. 357-512)

Teaching

Invited lecturer, NATO Advanced Study Institute, Italy, 1992

The (UIUC) Incomplete List of Teachers Ranked as Excellent by their Students: Fall 2001, Spring 2002, Fall 2002 (ranked as Outstanding), Spring 2003, Fall 2003, Spring 2004, Fall 2004, Spring 2005, Fall 2005, (did not teach in 2006 and 2007) Spring, 2008, Spring 2009, and Spring 2010.

Panels

Peer Review Panelist, Physics Section, U.S. Environmental Protection Agency, 1997
Peer Review Panelist, Environmental Chemistry Section, U.S. EPA, 1997

Panel of PhD Examiners, Dept. of Biotechnology, Bharathiar University, India, 2003-
Proposal Review Panel, Small Business Innovation Research–Air, Water, and Soils. U. S. Department of Agriculture, 2005
Proposal Review Panel, Small Business Innovation Research Program, Water and Wastewater Management and Coal Bed Methane and Oil & Gas. U.S. Environmental Protection Agency, 2007.

Current Proposal Reviewer for

The U.S. Environmental Protection Agency's National Center for Environmental Research
The United States–Israel Binational Agricultural Research and Development Fund
USDA's National Research Initiative Competitive Grants Program (Soil and Soil Biology, and Watershed Processes and Water Resources)
USDA's Small Business Innovation Research Program (Air, Water, and Soils topic area)
Cooperative Grants Program of the U.S. Civilian Research and Development Foundation

Major Research Interests

General: geochemistry, soil/environmental chemistry
Specific: equilibrium distribution and thermodynamics of chemical constituents at solid-liquid interfaces, solid-phase equilibria of natural and anthropogenic materials in aqueous, solution, environmental impacts of coal utilization, chemical fate and transport of contaminants in soil and groundwater, coal cleaning, carbon geosequestration, and radioactive waste management

Internal Committee/Board Activities:

Quality Assurance Committee, 1989
Evaluation Committee–Scientific Staff, 1993
Contracts and Grants Work Group, 1993
Committee on Staff Recognition, 1994, 1996, 2002, and 2003
Scientific Program Committee, 1995
Editorial Review Board, Illinois State Geological Survey, 1995-2001

Search Committees: Technical Editor (1986), Environmental Geology Group Head (1997), Assistant Chemical Engineer (1998), Head of the Economic Geology Group (1999), Contract and Grant Accountant (1999), Coordinating Technical Editor/Writer (2000), Supportive Technician I (2001), Supportive Technician II (2001), Supportive Technician II (2005), Associate Chemist (2007), Supportive Geologist I (2007), Associate Environmental Geochemist I (2008), Visiting Assistant Geochemist (2009), Post Doctoral Research Associate (2010), Visiting Research Specialist

(2010), and Associate Environmental Geochemist (2010)

Joint Scientific Survey Strategic Planning Committee, 1998
Chair, ISGS Seminar Committee, 1998-2000
Member, Coal Advisory Committee, 1999-2000
Chief's Implementation Committee, 1998-1999
Services (Technical) Committee, NRES, 1999-2002
Safety Committee, 2005-present
Chair of Safety Committee, 2007-present
Chemical Hygiene Officer, 2005-present
2008 Open House Committee
2009, 2010, 2011 Expo Committee

Department Committee

Nuclear Reactor Committee, Department of Nuclear, Plasma, and Radiological Engineering, College of Engineering, University of Illinois, 2009-

Courses Taught

Geology 107, *Man and his Geologic Environment.* An introduction to environmental geology. Lecture. Fall and spring semesters. Indiana University-Purdue University, Indianapolis, IN (1978-1979)

NRES 100, *Fundamentals of Environmental Science.* An introduction to environmental sciences, issues, and values. Lecture. Fall and spring semesters. University of Illinois (2001-2005). Guest lectures (2008- present)

NRES 381, *Environmental Research Methods*. Practical application of laboratory, field, and instrumental methods to environmental research with soils and water. Lecture and laboratory/field sections. University of Illinois (1998-2005)

NPRE 397, *Independent Study in Radioactive Waste Management.* Section number: 23880 (2010-present)

NPRE 442. *Radioactive Waste Management.* An overview of radiological concepts and measurement, the fuel cycle and waste classification, Federal regulations and regulatory agencies, radiochemistry and environmental fate of radionuclides, low- and high-level waste characteristics and management, risk assessment, and an international perspectives on radioactive waste management. University of Illinois, Spring semesters (2008-present)
Website: http://npre442.ne.uiuc.edu/

Management Workshops Attended

"How to Deal with Difficult People."1999. Human Resources Development, UIUC.
"Conducting Effective Staff Performance Appraisals."1999. Human Resources Development, Supervisory Training. 1999. Faculty/Staff Assistance Program, UIUC.
Academic Advisor Training Workshop. 1999. The Campus Academic Advising Commission and the Office of the Provost, UIUC.

Recent presentations

"The Geochemistry of Geosequestration" An invited seminar given in the Department of Geology, Southern Illinois University, October 15, 2009

"Protecting Drinking Water by Reducing Uncertainties Associated with Geologic Carbon Sequestration in Deep Saline Aquifers" DOE/EPA Collaborative Review - Tracking Geologically Sequestered CO2: Monitoring, Verification, and Accounting (MVA), Simulation, and Risk Assessment. Pittsburgh, PA, March 23-24, 2010.
Available at http://www.netl.doe.gov/publications/proceedings/10/doe-epa/index.html

Publications

Abstracts (*Speaker of presentation)

Roy, W. R.* and R. D. Hall. 1979. Glacial Geology of the South Boulder Valley, Tobacco Root Range, Montana. Geological Society of America, Abstracts with Program, vol. 11, p. 300.

Hall, R. D.* and W. R. Roy. 1979. Weathering characteristics and soil development of glacial deposits of Bull Lake, Wyoming. Geological Society of America, Abstracts with Program, vol. 11, no. 6, p. 274.

Roy, W. R.* and R. D. Hall. 1979. Soil geomorphology of tills in the South Boulder Valley of Montana. Tobacco Root Geological Society, Fourth Annual Meeting, Program with Abstracts, p. 13.

Roy, W. R.* and R. D. Hall. 1980. Re-evaluation of the Bull Lake Glaciation through re-study of the type areas and studies of other locations. Geological Society of America, Abstracts with Program, vol. 12, no. 6, p. 291.

Griffin, R. A.* and W. R. Roy. 1983. Solid wastes from coal conversion: Geochemical and toxicological comparisons with coal fly ash. American Association for the Advancement in Science Annual Meeting, Detroit, Mich., May 26-31, 1983.

Roy, W. R.*, R. A. Griffin, and I. G. Krapac. 1987. Laboratory extraction of solid wastes:

experiences and observations. Waste Management Technology Center Workshop on Leaching Tests, Oak Ridge, TN, p. 19, July 21-24, 1987.

Roy, W. R.* 1989. Geochemical fate of deep-well injected hazardous wastes in Illinois. International Symposium on Class I and II Injection Well Technology, Underground Injection Practices Council Research Foundation, Dallas, TX, May 8-11, 1989, p. 65.

Roy, W. R.* 1991. Geochemical modeling and transformation of two injection-well wastes: long-term laboratory studies. American Geophysical Union, Spring Meeting, Baltimore, MD, May 28-June 1, 1991, Program and Abstracts, p. 110-111.

Dreher, G. B.*, W. R. Roy, and J. D. Steele. 1992. The use of FBC wastes in the reclamation of coal slurry solids. Abstracts of Papers, Center for Research on Sulfur in Coal, Tenth Annual Contractor's Technical Meeting, Urbana, IL, Aug. 4-6, 1992, p. 44.

Barnhardt, M. L.*, W. R. Roy, and I. G. Krapac. 1993. Spatial distribution of pesticides in soil at two Illinois agrichemical facilities. Agronomy Abstracts, 1993 American Society of Agronomy Annual Meeting, Cincinnati, OH, Nov. 7-12, 1993. p. 26.

Dreher, G. B.*, W. R. Roy, and J. D. Steele. 1993. Geochemistry of FBC waste-coal slurry solid mixtures. Abstracts of Presentation, Illinois Clean Coal Institute, Eleventh Annual Contractor's Technical Meeting, Urbana, IL, Aug. 3-5, 1993, p. 43.

Roy, W. R.*, I. G. Krapac, and S. F. J. Chou. 1994. Atrazine Leaching From Fill Materials at Retail Agrichemical Facilities. Agronomy Abstracts, 1994 American Society of Agronomy Annual Meeting, Seattle, WA, Nov. 13-18, 1994. p. 60.

Roy, W. R.*, I. G. Krapac, and S. F. J. Chou. 1996. Movement of Atrazine in a Gravel-Fill Test Cell. Agronomy Abstracts, 1996 American Society of Agronomy Annual Meeting, Indianapolis, IN, Nov. 3-8, 1996. p. 35.

Heidari, M.* and W. R. Roy. 1997. Attenuation and Release of Agrichemicals in the Unsaturated Zone. Geological Society of America Annual Meeting, Denver, Colorado,. Oct. 28-31, 1996, p. 23.

Roy, W. R.*, G. B. Dreher, J. D. Steele, R. G. Darmody, and D. Tungate. 1997. Direct revegetation of coal slurry after amendment with FBC residues. Abstracts of Presentations, Illinois Clean Coal Institute, 15th Annual Contractor's Technical Meeting, Urbana, IL, July 29-30, 1997, p. 27.

Roy, W. R., K. M. Henry, and J. M. Lytle. 1998. The Illinois Basin Coal Sample Program. Abstracts of Presentations, Illinois Clean Coal Institute, 16th Annual Contractor's Technical Meeting, Urbana, IL, July 28, 1998, p. 20.

Roy, W. R.*, S. F. J. Chou, I. G. Krapac, and D. Keefer. 2000. Pesticide storage and release in unsaturated soil, North-Central Section Meeting, Geological Society of America, Indianapolis, Indiana, April 6-7, 2000, p. A-58.

Krapac, I. G.*, W. S. Dey, W. R. Roy, and B. G. Jellerichs. 2000. Groundwater quality near livestock manure pits, North-Central Section Meeting, Geological Society of America, Indianapolis, Indiana, April 6-7, 2000, p. A-22.

Larson, T. H.* and W. R. Roy. 2000. The distribution of and possible geologic controls on ammonia in Illinois groundwater. Proceedings 45th Annual Midwest Ground Water Conference, Columbus, Ohio, October 17-19, 2000, p 31.

Tsui, L.* and W. R. Roy. 2003. The Effects of Compost Age on Atrazine Removal from Tile Drainage. 2003 ASA-CSSA-SSSA Annual Meetings, Denver, CO, Nov. 2-6, 2003.

De Mello*, J. W. V., J. W. Stucki, W. R. Roy, and J. Talbott.2004. Arsenic mobilization and mineralogy of anomalous soils from Brazil. Gorges, Clays, and Couless. Program and Abstracts of the 41st Annual Meeting of The Clay Mineral Society, Richland, Washington State, June 19-23, 2004, p. 55.

Khan, L. A., C. Manrique, and W. R. Roy. 2005. New Methods for Producing Cleaner Coal at Lower Costs. The Electric Power 2005 Conference and Exhibition. McCormick Place, Chicago, April 5-7, 2005.

Mello, J. W .V, J. L. Talbott, J. Scott, W. R. Roy, and J. W. Stucki. 2006. Arsenic biogeochemistry in soils from gold mining areas in Brazil under anaerobic incubation. Abstracts. 18th World Congress of Soil Science. Philadelphia, PA. July 9-15, 2006.

Berger*, P., E. Mehnert, and W. R. Roy. 2009. Geochemical modeling of carbon sequestration in the Mt. Simon Sandstone. Geological Society of America Symposium Sessions, North-Central Section, 43rd Annual Meeting, April 2-3, 2009.

Book Reviews

Roy, W. R. 1990. In situ immobilization of heavy-metal contaminated soils. *Journal of Environmental Quality*, vol. 19, p. 623.

Roy, W. R. 1991. The Chemistry of Soils. *Journal of Geological Education,* vol. 39, p. 434-435.

Roy, W. R. 1993. Mobility and Degradation of Organic Contaminants in Subsurface Environments. *Water Resources Bulletin*, vol. 29, p. 326.

Roy, W. R. 1994. Electrochemical Methods in Soil and Water Research. *Journal of Environmental Quality*, vol. 23, p. 623.

Roy, W. R. 1994. Contaminant Hydrogeology. *Journal of Geological Education*, v. 42, p. 531-532.

Roy, W. R. 1995. Environmental Chemistry of Soils. *Journal of Environmental Quality*, vol. 24, p. 199-200.

Roy, W. R. 1996. Thermodynamics of Natural Systems. *Journal of Environmental Quality*, vol. 25, p. 926.

Roy, W. R. 1997. Environmental Geology. *Journal of Environmental Quality*, vol. 26, p. 320-321.

Roy, W. R. 1998. Pesticide Profiles: Toxicity, Environmental Impacts, and Fate. *Journal of Environmental Quality*, vol. 27, p. 984.

Roy, W. R. 2009. Decommissioning and Radioactive Waste Management. *Nuclear Technology*, 166, 201-202.

Technical reports and symposia contributions (*Speaker of presentation)

Roy, W. R., R. G. Thiery, R. M. Schuller, and J. J. Suloway. 1981. Coal fly ash; a review of the literature and proposed classification system with emphasis on environmental impacts, Environmental Geology Notes 96, Illinois State Geological Survey, Champaign, IL 61820, 69 p.

Roy, W. R.* and R. D. Hall. 1981. Glacial geology of the South Boulder Valley, Tobacco Root Range, Montana, *in* Tucker, T. E. (ed.), Montana Geological Society Field Conference and Symposium Guidebook to Southwest Montana, Montana Geological Society, Billings, p. 125-132.

Goodwin, J. H., I. G. Krapac, P. C. Reed, and W. R. Roy*. 1982. Assessment of potential agricultural and industrial uses of lime-water softening waste slurry, *in* Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, p. 495-521.

Suloway, J. J., W. R. Roy, T. M. Skelly, D. R. Dickerson, R. M. Schuller, and R. A. Griffin. 1983. Chemical and toxicological properties of coal fly ash. Environmental Geology Notes 105, Illinois State Geological Survey, Champaign, IL 61820, 70 p.

Roy, W. R., T. M. Skelly, I. G. Krapac, R. A. Griffin, D. R. Dickerson, R. M. Schuller, J. J. Suloway, and N. F. Shimp. 1984. Geochemical properties and toxicological effects on aquatic life of coal wastes. Environmental Geology Notes 107, Illinois State Geological Survey, Champaign, IL 61820, 124 p.

Roy, W. R.*, C. C. Ainsworth, R. A. Griffin, and I. G. Krapac. 1984. Development and application of batch adsorption procedures for designing earthen landfill liners, *in* Seventh Annual Madison Waste Conference, University of Wisconsin, Madison, Sept. 11-12, 1984, p. 390-398.

Roy, W. R.*, C. C. Ainsworth, S. F. J. Chou, R. A. Griffin, and I. G. Krapac. 1985. Development of standardized batch adsorption procedures: experimental considerations, *in* Proceedings of the Eleventh Annual Research Symposium of the Solid and Hazardous Waste Research Division, U.S. Environmental Protection Agency, Cincinnati, OH, April 29-May 1, 1985, U.S. EPA 600/9-85/013, p. 169-178.

Griffin, R. A. and W. R. Roy. 1985. Interaction of organic solvents with saturated soil-water systems. Environmental Institute for Waste Management Studies, Open File Report No. 3, University of Alabama, 86 p.

Griffin, R. A.*, W. A Sack, W. R. Roy, C. C. Ainsworth, and I. G. Krapac. 1985. Batch type 24-hour distribution ratio for contaminant adsorption by soil materials, *in* Lorenzen, D., et al. (Eds), Hazardous and Industrial Solid Waste Testing and Disposal, American Society for Testing and Materials, STP 933, v. 6, p. 390-408.

Griffin, R. A., and W. R. Roy. 1986. Feasibility of land disposal of organic solvents: Preliminary Assessment. Environmental Institute for Waste Management Studies, Open File Report No. 10, University of Alabama, 57 p.

Lisowksi, E. A, R. A. Olson, W. R. Roy, and D. B. Thompson. 1986. Geochemistry and biology of Sulphur River, Parker's Cave, Kentucky. Cave Research Foundation, 1985 Annual Report, Cave Books Publishers, St. Louis, MO, p. 26-27.

Roy, W. R., and R. A. Griffin. 1987. Vapor-phase movement of organic solvents in the unsaturated zone. Environmental Institute for Waste Management Studies, Open File Report No.16, University of Alabama, 37 p.

Griffin, R. A., W. R. Roy, J. K. Mitchell, and R. A. Mitchell. 1987. Assessment of the feasibility and limitations of land disposal of organic solvents. Environmental Institute for Waste Management Studies, Open File Report No. 19, University of Alabama, 47 p.

Krapac, I. G., W. R. Roy, R. A. Griffin, and T. Beissel. 1988. Potential impact of material to be excavated from the Illinois SSC tunnel on surface water and groundwater resources. Environmental Geology Notes 126, Illinois State Geological Survey, Champaign, IL 61820, 19 p.

Roy, W. R., and R. A. Griffin. 1988. Surfactant- and chelate-induced decontamination of soil materials: current status. Environmental Institute for Waste Management Studies, Open File Report No. 21, University of Alabama, 44 p.

Roy, W. R., S. C. Mravik, I. G. Krapac, D. R. Dickerson, and R. A. Griffin. 1989. Geochemical interactions of hazardous wastes with geological formations in deep-well systems. Environmental Geology Notes 130, Illinois State Geological Survey, Champaign, IL 61820, 52 p.

McKenna, D. P., T. J. Bicki, W. S. Dey, W. R. Roy, M. V. Miller, D. D. Coleman, S. F. J. Chou, and J. Valkenburg. 1989. Persistence and mobility of selected pesticides in loessial soils of Illinois. Illinois Department of Energy and Natural Resources, ILENR/RE-EH-89/22, 93 p.

Roy, W. R., B. Seyler, J. D. Steele, D. M. Moore, and I. G. Krapac. 1990. Geochemical interactions of two deep-well injected wastes with geological formations: long-term laboratory studies. Environmental Geology 137-HWRIC 054, Illinois State Geological Survey-Hazardous Waste Research and Information Center, Champaign, IL 61820, 17 p.

McKenna, D. P.*, J. B. Risatti, W. R. Roy, I. G. Krapac, and E. Mehnert. 1991. Groundwater contributions to atrazine loadings in streams, *in* Proceedings of the First Annual Conference of the Illinois Groundwater Consortium, Springfield, IL, April 2, 1992, p. 41-43.

Roy, W. R., I. G. Krapac, S. F. J. Chou, and R. A. Griffin. 1992. Batch-type procedures for estimating soil adsorption of chemicals. U.S. Environmental Protection Agency, Technical Resource Document, U.S. EPA/530/-SW-87-006-F, 100 p.

Roy, W. R.*, D. P. McKenna, I. G. Krapac, S. F. J. Chou, and E. Mehnert. 1992. Groundwater contributions to atrazine loadings in streams: First-year summary, *in* Proceedings of the Second Annual Conference of the Illinois Groundwater Consortium, Springfield, IL, April 27-28, 1992, p. 115-123.

Roy, W. R., I. G. Krapac, W. S. Dey, and E. Mehnert. 1993. Pesticides in geologic materials at agrichemical facilities in Illinois: Definitions of "contamination," *in* Agrichemical Facility Site Contamination Study. Illinois Department of Agriculture, Chapter 5, 38 p.

Krapac, I. G., W. R. Roy, C. A. Smyth, and M. L. Barnhardt. 1993. Occurrence and distribution of pesticides in soil at agrichemical facilities in Illinois, *in* Agrichemical Facility Site Contamination Study. Illinois Department of Agriculture, Chapter 3, 46 p.

Barnhardt, M. L., B. L. Herzog, W. R. Roy, and I. G. Krapac. 1993. Cost-effective procedures for site assessments at agrichemical facilities in Illinois, *in* Agrichemical Facility Site Contamination Study. Illinois Department of Agriculture, Chapter 6, 44 p.

Roy, W. R.*, I. G. Krapac, S. F. J. Chou, J. B. Risatti, W. S. Dey, and E. Mehnert. 1993. Movement of atrazine and metabolites in a small watershed, *in* Proceedings of the Third Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 31-April 1, 1993, p. 167-176.

Roy, W. R.*, S. F. J. Chou, and I. G. Krapac. 1993. Fate and transport of atrazine in surficial materials at agrichemical facilities, *in* Proceedings of the Third Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 31-April 1, 1993, p. 250-258.

Chou, S. F. J.*, and W. R. Roy. 1993. An inter-laboratory comparison of soil and water pesticide analyses, *in* Proceedings of the Third Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 31-April 1, 1993, p. 285-298.

Krapac, I. G.*, W. R. Roy, C. A. Smyth, and M. L. Barnhardt. 1994. Pesticides in soils at agrichemical facilities in Illinois *in* Proceedings of the 1994 Illinois Agricultural Pesticide Conference, University of Illinois, Champaign, IL, Jan. 5-6, 1994, p. 141-152.

Roy, W. R.*, E. Mehnert, I. G. Krapac, and W. S. Dey. 1994. Pesticides in soil materials at agrichemical facilities: What *is* "contamination?" *in* Proceedings of the 1994 Illinois Agricultural Pesticide Conference, University of Illinois, Champaign, IL, Jan. 5-6, 1994, p. 153-163.

Barnhardt, M. L.*, W. R. Roy, I. G. Krapac, B. L. Herzog, M. H. Riggs, and C. A. Smyth. 1994. Site assessments and remediation alternatives for agrichemical facilities, *in* Proceedings of the 1994 Illinois Agricultural Pesticide Conference, University of Illinois, Champaign, IL, Jan. 5-6, 1994, p. 164-183.

Roy, W. R.*, S. F. J. Chou, and I. G. Krapac. 1994. Fate and transport of atrazine in fill materials at agrichemical facilities: Second year summary, *in* Proceedings of the Fourth Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 23-24, 1994, p. 88-98.

Roy, W. R.*, S. F. J. Chou, and I. G. Krapac. 1994. Evaluation of pesticide releases from retail agrichemical facilities during the 1993 flooding in Illinois, *in* Proceedings of the Fourth AnnualConference of the Illinois Groundwater Consortium, Makanda, IL, March 23-24, 1994, p. 154-164.

Dreher, G. D.*, W. R. Roy, and J. D. Steele. 1994. Laboratory studies of fluidized bed combustion residues in mixtures with coal slurry solids, *in* Proceedings of Management of High Sulfur Coal Combustion Residues: Issues and Practices, Coal Combustion Residues Management Program (Southern Illinois University), et al., Springfield, IL, April 5-7, 1994, p. 91-101.

Roy, W. R.*, S. F. J. Chou, and I. G. Krapac. 1995. Fate and transport of atrazine in fill materials at agrichemical facilities: A status report, *in* Proceedings of the Fifth Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 29-30, 1995, p. 117-131.

Roy, W. R.*, I. G. Krapac, and S. F. J. Chou. 1996. Fate and transport of atrazine in fill materials at agrichemical facilities: An update, *in* Proceedings of the Sixth Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 27-28, 1996, p. 261-270.

Dreher, G. D., W. R. Roy, and J. D. Steele. 1996. Laboratory studies on the codisposal of fluidized-bed combustion residue and coal slurry solid. Environmental Geology 150, Illinois State Geological Survey, Champaign, IL 61820, 28 p.

Heidari, M.*, W. R. Roy, and I. G. Krapac. 1997. Role of unsaturated zone in the storage and transmittal of agrichemical: Preliminary results, *in* Proceedings of the Biannual Conference of the Illinois State Section of the American Water Resources Association, Bloomington, IL, Oct. 22, 1996.

Roy, W. R., G. B. Dreher, J. D. Steele, R. G. Darmody, and D. Tungate, 1997, Direct revegetation of coal slurry after amendment with FBC residues, Final Technical Report, Illinois Clean Coal Institute. Available at http://www.icci.org/reports.html

Tungate, D. E.*, R. G. Darmody, G. B. Dreher, W. R. Roy, and J. D. Steele. 1997. Codisposal of FBC by-products and coal slurry solids: characterization of materials, *in* National Meeting of the American Society for Surface Mining and Reclamation, Austin, Texas, May 10-15, 1997.

Heidari, M.*, W. R. Roy, D. Keefer, A. J. Valocchi, L. Xu, I. G. Krapac. 1997. Impact of agricultural chemical use on stream water quality under normal and flood conditions: Preliminary results *in* Proceedings of the Seventh Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, March 26, 1996, p. 94-108.

Heidari, M.*, D. Keefer, W. R. Roy, I. G. Krapac, A. J. Valocchi, and K. Ghiassi. 1998. Movement of contaminants in alluvial aquifers during light and heavy (flood) rainfall conditions: Field data collection and model simulation *in* Proceedings of the Eighth Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, April 1-2, 1998, p. 1-21.

Roy, W. R.*, I. G. Krapac, M. Heidari, and K. Ghiassi. 1998. Pesticide storage and release in unsaturated soils: field experiments *in* Proceedings of the Eighth Annual Conference of the Illinois Groundwater Consortium, Makanda, IL, April 1-2, 1998, p. 202-214.

Krapac, I. G.*, W. S. Dey, C. A. Smyth, and W. R. Roy. 1998. Impacts of bacteria, metals, and nutrients on groundwater at two hog confinement facilities *in* Animal Feeding Operations and Ground Water: Issues, Impacts, and Solutions Conference, National Ground Water Association, St. Louis, MO, Nov. 4-5, 1998, p. 29-50.

Roy, W. R.*, M. Heidari, I. G. Krapac, D. A. Keefer, S. F. J. Chou, and J. S. Lee. 1999. Pesticide storage and release in soil: Results of a field experiment *in* Proceedings of the Ninth Annual Conference of the Illinois Groundwater Consortium, Carbondale, IL, April 1, 1999, p. 77-90.

Krapac, I. G.*, W. S. Dey, W. R. Roy, B. G. Jellerichs, C. Smyth. 2000. Groundwater quality near livestock manure pits *in* Proceedings of the 8th International Symposium on Animal, Agricultural

and Food Processing Wastes, American Society of Agricultural Engineers, Publication 701P0002, Des Moines, Iowa, Oct. 9-11, 2000, p. 710-718.

Roy, W. R.*, I. G. Krapac, S. F. J. Chou, and F. W. Simmons. 2000. Atrazine dissipation in unsaturated soil under dry and flood conditions *in* Proceedings of the Tenth Annual Conference of the Illinois Groundwater Consortium, Carbondale, IL, April 13, 2000, p. 59-67.

Chou, M., M.-I., W. R. Roy, E. S. Robitz, S. C. Kung, and K. K. Ho. 2002. Effects of chlorine content in coal on furnace wall corrosion under low NOx Conditions. Illinois Minerals 123, Illinois State Geological Survey, Champaign, IL 61620, 10 p.

Khan, L.*, W. R. Roy, and K. K. Ho. 2002. The significance of Illinois Coal and the Illinois State Geological Survey Washer *in* 27th Technical Conference on Coal Utilization and Fuel Systems. B. A. Sakkestad (ed.), Coal Technology Association, Gaithersburg, MD, ISBN 0-932066-27-03, pp. 631-639.

Khan, L. A.*, W. R. Roy, and J. Hirshi. 2003. A road map for a secure source of energy: a minerals engineering perspective *in* 28th Technical Conference on Coal Utilization and Fuel Systems. B. A. Sakkestad (ed.), Coal Technology Association, Gaithersburg, MD, p. 851-860.

Roy, W. R.*, J. J. G. Glessner, I. G. Krapac, and T. H. Larson. 2003. Possible Geological-Geochemical Sources of Ammonium in Groundwater: Preliminary Results *in* Proceedings of the Twelfth Annual Conference of the Illinois Groundwater Consortium, Carbondale, IL, April 22, 2003. Available at http://www.siu.edu/worda/igc/proceedings/index.html

Krapac, I. G.*, S. Koike, M. T. Meyer, D. D. Snow, S.-F. J. Chou, R. I. Mackie, W. R. Roy and J. C. Chee-Sanford. 2004. Long-Term Monitoring of the Occurrence of Antibiotic Resistant Genes in Groundwater near Swine Confinement Facilities in Proceedings of the 4th International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water. National Ground Water Association, Minneapolis, MN, Oct. 13-15, p. 158-172.

Khan L. A.*, W. R. Roy, C. Manrique, T. Fogarty, A. Atti, D. Wiley, and J. Hirshi. 2005. New Methods for Producing Cleaner Coal at a Lower Cost. The Electric Power 2005 Conference and Exhibition. McCormick Place, Chicago, April 5-7, 2005.

Hensel, B., W. R. Roy, J. Mavis, C. Ekert, and K. Ladwig. 2005. Chemical Constituents in Coal Combustion Product Leachate: Boron. Electric Power Research Institute, Palo Alto, CA. Report no. 1005258.

Roy, W. R. and I. G. Krapac. 2006. Guidance for Conducting Site Assessments at Retail Agrichemical Facilities. Illinois Department of Agriculture, 75 p.

Tsui, L.* and W. R. Roy. 2007. The Potential Applications of Using Compost Chars for Removing Environmental Pollutants From Solution *in* Carbon 2007, International Conference on Carbon, American Carbon Society, Seattle, WA, July 15-20, Paper B013.

Roy, W. R., B. Hensel, and B. Hennings. 2008. Gross Alpha and Gross Beta Measurements in Coal Combustion Product Leachate. Electric Power Research Institute, report number 1015546, EPRI, Palo Alto, CA.

Roy, W. R. and I. G. Krapac. 2009. Potential Soil Cleanup Objectives for Nitrogen-Containing Fertilizers at Agrichemical Facilities. Open File Report 2009-2, Illinois State Geological Survey, 71 p.

Ewing, R., C. E. Singer, and P. P.H. Wilson (M. A. Rosenstein, and W. R. Roy, eds). 2009. 'Plan D' for Spent Nuclear Fuel. Program in Arms Control, Disarmament, and International Security, University of Illinois at Urana-Champaign (available at http://acdis.illinois.edu/)

Berger, P. M., W. R. Roy, E. Mehnert, I. G. Krapac. B. Wimmer, and A. Iranmanesh. 2010. Impact of Carbon Dioxide Sequestration on Reservoir Brine Composition at an Enhanced Oil Recovery Site in Fayette County, Illinois. Open File Report 2010-1, Illinois State Geological Survey, 15 p.

Butler, S.*, W. R. Roy, and Z. Lasemi. 2010. Short-Term Leaching Behavior of Mixtures of Swine Manure and Flue Gas Desulfurization Byproducts *in* The Proceedings of the 35th International Technical Conference of Clean Coal & Fuel Systems, Clearwater, Florida, June 6-10, 1358-1369.

Peer-reviewed journal papers

Lechler, P. J., W. R. Roy, and R. K. Leininger. 1980. Major and trace element analysis of 12 Kentucky reference soils by inductively coupled plasma. Soil Science, vol. 130, p. 238-241.

Roy, W. R. and R. A. Griffin. 1982. A proposed classification system for coal fly ash in multidisciplinary research. Journal of Environmental Quality, vol. 11, p. 563-568.

Roy, W. R., R. A. Griffin, D. R. Dickerson, and R. M Schuller. 1984. Illinois Basin coal fly ashes. 1. Chemical characterization and solubility. Environmental Science and Technology, vol. 18, p. 734-739.

Roy, W. R. and R. A. Griffin. 1984. Illinois Basin coal fly ashes: 2. equilibria relationships and qualitative modeling of ash-water reactions. Environmental Science and Technology, vol. 18, p. 739-742.

Roy, W. R. and R. A. Griffin. 1985. Mobility of organic solvents in water-saturated soil materials. Environmental Geology and Water Sciences, vol. 7, p. 241-247.

Roy, W. R., J. J. Hassett, and R. A. Griffin. 1986. Competitive coefficients for the adsorption of arsenate, molybdate, and phosphate mixtures by soils. Soil Science Society of America Journal, vol. 50, p. 1176-1182.

Roy, W. R., J. J. Hassett, and R. A. Griffin. 1986. Competitive interactions of phosphate and molybdate on arsenate adsorption. Soil Science, vol. 142, p. 203-210.

Roy, W. R., and R. A. Griffin. 1987. Estimating threshold values for the land disposal of organic solvent-contaminated wastes. Journal of Hazardous Materials, vol. 15, p. 365-376.

Krapac, I. G., W. R. Roy, R. A. Griffin, and T. Beissel. 1988. Impact of dolomite and shale spoil materials on Illinois water quality: laboratory studies. Transactions of the Illinois State Academy of Science, vol. 81, p. 99-112.

Roy, W. R. 1988. Preliminary assessment of the solution equilibria of Sulphur River, Parker Cave, Kentucky. The National Speleological Society Bulletin, vol. 50, p. 37-41.

Roy, W. R., J. J. Hassett, and R. A. Griffin. 1989. Quasi-thermodynamic basis of competitive adsorption coefficients for anionic mixtures in soils. Journal of Soil Science, vol. 40, p. 9-15.

Roy, W. R., R. A. Griffin, J. K. Mitchell, and R. A. Mitchell. 1989. Limitations and feasibility of the land disposal of organic solvent contaminated-wastes. Environmental Geology and Water Sciences, vol. 13, p. 225-231.

Roy, W. R. and R. A. Griffin. 1990. Vapor-phase interactions and diffusion of organic solvents in the unsaturated zone. Environmental Geology and Water Sciences, vol. 15, p. 101-110.

Roy, W. R., B. Seyler, J. D. Steele, S. C. Mravik, D. M. Moore, I. G. Krapac, J. M. Peden, and R. A. Griffin. 1991. Geochemical transformations and modeling of two deep-well injected hazardous wastes. Ground Water, vol. 29, p. 671-677.

Roy, W. R., and R. A. Griffin. 1991. An analytical model for in-situ extraction of organic vapors. Journal of Hazardous Materials, vol. 26, p. 301-317.

Dreher, G. B., W. R. Roy, and J. D. Steele. 1991. Leaching behavior of fine-coal cleaning waste solids. Journal of Coal Quality, vol. 10, p. 29-36.

Roy, W. R., I. G. Krapac, and J. D. Steele. 1993. Sorption of cadmium and lead by clays from municipal incinerator ash-water suspensions. Journal of Environmental Quality, vol. 22, p. 537-543.

Roy, W. R., and I. G. Krapac. 1994. Adsorption and desorption of atrazine and de-ethylatrazine by low organic carbon geologic materials. Journal of Environmental Quality, vol. 23, p. 549-556.

Krapac, I. G., W. R. Roy, C. A. Smyth, and M. L. Barnhardt. 1995. Occurrence and distribution of pesticides in soil at agrichemical facilities in Illinois. Journal of Soil Contamination, vol. 4, 206-226.

Roy, W. R., S. F. J. Chou, and I. G. Krapac. 1995. Off-site movement of pesticide-contaminated fill from agrichemical facilities during the 1993 flooding in Illinois. Journal of Environmental Quality, vol. 24, 1034-1038.

Roy, W. R., I. G. Krapac, and S. F. J. Chou. 1999. Chemical fate and transport of atrazine in soil gravel materials at agrichemical distribution facilities. Journal of Soil Contamination, vol. 8, 365-387.

Roy, W. R., I. G. Krapac, S. F. J. Chou, and F. W. Simmons. 2001. Pesticide storage and release in unsaturated soil in Illinois, USA. Journal of Environmental Science and Health, Part B. Pesticides, Food Contaminants, and Agricultural Wastes, B36(3), 245-260.

Krapac, I. G., W. S. Dey, W. R. Roy, C. A. Smyth, E. Storment, S. L. Sargent, J. D. Steele. 2002. Impacts of swine manure pits on groundwater quality. Journal of Environmental Pollution, 202, 475-492.

Tsui, L. S., W. R. Roy, and M. A. Cole. 2003. Removal of dissolved textile dyes from wastewater by a compost sorbent. *Coloration Technology*, **119** (1), 14-18.

Roy, W. R. and I. G. Krapac. 2006. Potential soil cleanup objectives for nitrogen-containing fertilizers at agrichemical facilities. *Soil and Sediment Contamination*, **15**, 241-251.

De Mello, J. W. V., W. R. Roy, J. Talbott, and J. W. Stucki. 2006. Mineralogy and arsenic mobility in arsenic-rich Brazilian soils and sediments. *Journal of Soils and Sediments*, **6** (1), 9-19.

Tsui, L. and W. R. Roy. 2007. The effect of compost age on atrazine removal from solution. *Journal of Hazardous Materials*, **139**, 79-85.

Tsui, L., I. G. Krapac, and W. R. Roy. 2007. The feasibility of applying immature yard-waste compost to remove nitrate from agricultural drainage effluents: a preliminary assessment. *Journal of Hazardous Materials*, **144**, 585-589 .

Roy, W. R., L. A. Khan, J. H. Goodwin, C. Manrique, J. Kaineg, J. Chambers and J. Hirschi. 2007. The Motorless-Rotorless Flotation Cell. *Coal Preparation Society of America Journal*, **6**, 27-29.

De Mello, J., J. Talbott, J. Scott; W. R. Roy, and J. W. Stucki. 2007. Arsenic speciation in arsenic-rich Brazilian soils from gold mining sites under anaerobic incubation. Environmental Science and Pollution Research, **6**, 388-396.

Tsui, L. and W. R. Roy. 2008. The potential applications of using compost chars for removing the hydrophobic herbicide atrazine from solution. *Bioresource Technology*, **99**, 5673-5678.

Berger, P. M., W. R. Roy, and E. Mehnert. 2009. Geochemical modeling of carbon sequestration, MMV, and EOR. *Energy Procedia*, **1**: 3437-3444.

Glessner, J. J. G. and W. R. Roy. 2009. Paleosols in central Illinois as potential sources of ammonium in groundwater. *Ground Water Monitoring and Remediation*, **29**, 56-64.

Berger, P. M., and W. R. Roy. 2010. Potential for iron oxides to control metal releases in CO_2 sequestration scenarios. *Energy Procedia* (in review).

Book Chapters

Roy, W. R. 1993. Adsorption-desorption methodologies and selected estimation techniques for transport-modeling parameters. p. 169-188. *In* Petruzzelli, D. and F. G. Helfferich (eds.), Migration and Fate of Pollutants in Soils and Subsoils. Springer-Verlag, Berlin, Germany.

Roy, W. R. 1994. Groundwater contamination from municipal landfills in the USA, p. 411-446. *In* Adriano, D. C., A. K. Iskandar, I. P. Murarka (eds.) Contamination of Groundwaters, Science Reviews, Northwood, UK.

Roy, W. R. 2000. The Environmental Fate and Movement of Organic Solvents in Water, Soil, and Air, (Section 17.1), and Fate-Based Management of Organic Solvent-Containing Wastes (Section 17.2), p. 1149-1169. *In* Wypych, G. (ed.) Handbook of Solvents, ChemTec Pub., Toronto, Canada.

Roy, W. R. 2004. The Environmental Fate of Plasticizers. Chapter 18, p. 591-614. *In* Wypych, G. (ed.) Handbook of Plasticizers, ChemTec Pub., Toronto, Canada

Roy, W. R. 2005. Remediation of Pesticide Contaminated Soil at Agrichemical Facilities *in* Jay H. Lehr, J. H. and J. Keeley (Eds.) Water Encyclopedia: Surface and Agricultural Water. p. 651-654. John Wiley & Sons, Ostrander, Ohio.

Roy, W. R. 2005. Iron *in* Jay H. Lehr, J. H. and J. Keeley (Eds.) Water Encyclopedia: Oceanography; Meteorology; Physics and Chemistry; Water Law; and Water History, Art, and Culture, p. 496-499. John Wiley & Sons, Ostrander, Ohio.

Roy, W. R. 2006. The Environmental Fate of Antistatics. Chapter 20, p. 305-312. *In* J. Pionteck and Wypych, G. (Ed.) Handbook of Antistatics, ChemTec Pub., Toronto, Canada.

Singer, C. and W. R. Roy. 2010. Nuclear Fuel Cycles. Nuclear Power. 2011 Wiley Energy Encyclopedia (submitted May 3, 2010).

Formal (Non-Teaching) Student Involvement

Undergraduates and Interns

1990. Scott Harding. Student Special Problem (A493, Dept. of Agronomy, UIUC.) Geochemical modeling of barite authigenesis in soils.

1991-1992. Laura Alberga. Visiting Scholar, National Research Council, Water Research Institute, Bari, Italy.

1993. Shilpa Ghia. Student Special Problem (A300, Dept. of Agronomy, UIUC.) Adsorption-desorption of sulfate by soil from FBC-coal slurry leachate.

2000. S. Maskel. Supervisor of undergraduate intern. NRES, UIUC. Geological-Geochemical Controls of Ammonium in Groundwater.

2001. M. E. Vianzon. Supervisor of undergraduate intern. Dept. of Chemical Engineering, UIUC. Compost-based sorbents for agricultural pollutants.

2002. Bonny A. Chou. Supervisor of undergraduate intern. Dept. of Chemical Engineering, UIUC. Impact of swine facilities on groundwater quality.

2003. Janet Krenn. NRES 295 Undergraduate Research Advisor.

Graduate Students

1991-1994. Keith Mitchell. Member of M.S. committee. Dept. of Agronomy, UIUC. Use of a Geographic Information System to Determine the Impact of Weed Management Practices on Surface Water Quality.

1992-1994. Siyuan Shen. Member of Ph.D. committee. Dept. of Agronomy, UIUC. Effects of Structural Iron Reduction on the Hydraulic Conductivity and Potassium Fixation of Smectite Clays and Soils.

1995-1997. Dongfang Huo. Member of Ph.D. committee. NRES, UIUC. Infrared Study of Oxidized and Reduced Nontronite and Ca-K Competition in the Interlayer.

1994-1998. C. Xu. Member of Ph.D. committee. NRES, UIUC. Pesticide Adsorption and Degradation Properties as Influenced by Iron Oxidation States in Clays Minerals.

1997-present. K. Lee. Member of Ph.D. committee. NRES, UIUC. Electrodialysis Method for Potassium Extraction in Clays and Soil.

1998-2000. P. M. Huggins. Member of M.S. committee, and director of research. Department of Nuclear Engineering, UIUC. Sorption and Desorption of Cesium and Europium by Naturally Magnetic Mineral Phases.

1998-2001. V. Schifano. Member of Ph.D. committee. Department of Civil Engineering, UIUC. Electrical Treatment of Clay.

2000-2003. L. C. Johns. Ph.D. Advisor. NRES, UIUC. Watershed water chemistry.

2000-2004. Lo Tsui. Ph.D. Advisor. NRES, UIUC. Compost bioreactors for removing agricultural chemicals from tile drainage water.

2002-2006. Justin Glessner. M.S. Advisor. NRES, UIUC. Geological-Geochemical Controls of Ammonium in Groundwater.

2004. Hongbo Zhang. Member of M.S. committee. NRES. UIUC. Techniques for modeling complexometric titration of natural water samples.

Summary of Grant/Contract Work Involvement

Co-Principal Investigator. Use of Batch Adsorption Procedures for Designing Earthen Liners for Landfills. U.S. Environmental Protection Agency, EPA CR-810245-01, 1982-1984, $223,598.

Principal Investigator. Geochemical Interactions of Hazardous wastes with Geological Formations in Deep-Well Systems. U.S. Environmental Protection Agency, EPA CR-813147-01, 1986-1987, $99,215.

Principal Investigator. Geochemical Investigations of Hazardous Wastes with Geological Formations in Deep-Well Systems. Hazardous Waste Research and Information Center (Illinois), HWR 86015, 1986-1987, $24,992.

Co-Investigator. Factors Affecting the Management of Coal Aggregate Flotation Waste Solids. Center for Research on Sulfur in Coal (Illinois), CRG 15, 1987-1988, $83,882.

Co-Investigator. Factors Affecting Management of Fine-Coal Cleaning Wastes Solids. Center for Research on Sulfur in Coal (Illinois), CRG 20, 1988-1989, $82,518.

Principal Investigator. Geochemical Fate of Deep-Well Injected Hazardous Wastes. Hazardous Waste Research and Information Center (Illinois), HWR 89066, 1989-1990, $14,867.

Principal Investigator. Mobility of Incinerator-Ash Leachate in Soil. U.S. Environmental Protection Agency, EPA CR812650-0 (ROY), 1989-1992, $50,000.

Principal Investigator. Groundwater Contributions to Atrazine Loadings in Streams. U.S. Dept. of Agriculture Cooperative State Research Service, AG SIU 90-02, 1990-1993, $102,850.

Principal Investigator. Procedures and Guidelines for Addressing Pesticide Contamination at Agrichemical Facilities in Illinois. Illinois Dept. of Agriculture, SAGR 0567 PEST CONT, 1990-1993, $116,725.

Co-Investigator. The Use of FBC Wastes in Reclamation of Coal Slurry Solids. Center for Research on Sulfur in Coal (Illinois), SENR/SIU D-0953, 1991-1992, $55,693.

Co-Investigator. Validation of Analytical Methods by an Inter-Laboratory Comparison. U.S. Dept. of Agriculture Cooperative State Research Service, AG SIUC 92-01, 1992, $5,000.

Co-Investigator. Geochemistry of FBC Waste-Coal Slurry Solid Mixtures. Center for Research on Sulfur in Coal (Illinois), SENR/SIU-ICCI D0982, 1992-1993, $55,698.

Principal Investigator. Fate and Transport of Pesticides in Surficial Materials at Agrichemical Facilities. U.S. Dept. of Agriculture Cooperative State Research Service, AGSIU ROY, 1992-1995, $171,398.

Co-Investigator. Geochemistry of a Reclaimed Coal Slurry Impoundment. Illinois Clean Coal Institute, SENR/SIU ICCI D0982, 1993-1994, $53,417.

Principal Investigator. Evaluation of Pesticide Releases from Retail Agrichemical Facilities During the Mississippi Flood of 1993. U.S. Dept. of Agriculture Cooperative State Research Service, AG SIU 93-01 ROY, 1993-1995, $5,000.

Co-Investigator. Effects of Livestock Facilities on Groundwater Quality in Selected Areas of Illinois: Site Monitoring of Groundwater. Illinois Council on Food and Agricultural Research, IDA CFAR 96-1 GS, 1996-1997, $73,150.

Co-Investigator. Mechanism of Transport of Nutrients in Alluvial Aquifers During Normal and Flood Conditions: A Variable Saturated Modeling Approach. U.S. Dept. of Agriculture Cooperative State Research Service, 1996-1997, $59,312.

Principal Investigator. Direct Revegetation of Coal Slurry After Amendment with FBC Residues. Illinois Clean Coal Institute, IDCCA ICCI WR1014ANT, 1996-1997, $82,594.

Principal Investigator. Mechanism of Transport of Nutrients in Alluvial Aquifers During Normal and Flood Conditions: Phase III. Field Experimentation and Validation of the Hypothesis. U.S. Dept. of Agriculture Cooperative State Research Service, 1997-1999, $50,788.

Co-Investigator. Effects of Livestock Facilities on Groundwater Quality: Site Monitoring. Illinois Council on Food and Agricultural Research, IDA CFAR 98E-20, 1997-1998, $28,000.

Principal Investigator. Illinois Basin Coal Sample Program. Illinois Clean Coal Institute, IDCCA C1435 ICCI, 1997-1998, $52,327.

Co-Investigator. Monitoring Groundwater Quality Near Livestock Waste Pits and Lagoons. Illinois Council on Food and Agricultural Research, 1998-2000, $60,579.

Co-Investigator. Groundwater Quality Near Livestock Waste Facilities That Utilize Deep Pit Systems. ISGS Environmental Protection Trust Fund, IDNR K/L/O-1246 ANT, 1998-2000, $16,200.

Co-Investigator. Scale-up of the ISGS Froth Washer for Testing in a Commercial Plant. Illinois Clean Coal Institute, IDCCA 98-1/4.1A-1, 1998-1999, $149,093

Co-Investigator. Viruses, Antibiotics, Bacteria, and Nutrients in Groundwater at Swine Facilities. Illinois Council on Food and Agricultural Research, IDACF 01E-19-5-GS, 2000-2001, $51,084

Co-Investigator. Testing of the ISGS Washer To Recover Fine Coal. Illinois Clean Coal Institute, IDCCA K/R-1718 ANTIC, 2001-2002, $352,745

Principal Investigator. Guidance Document for Conducting Site-Assessments at Retail Agrichemical Facilities. Illinois Department of Agriculture. IDOA 957-UI-AFRAP, 2001-2002, $20,000

Co-Investigator. Filtration of Concentrates from the ISGS Washer. Illinois Clean Coal Institute, 2001-2002, $128,442.

Principal Investigator. Possible Geological-Geochemical Controls of Ammonium in Groundwater. U.S. Dept. of Agriculture Cooperative State Research Service, 2002-2003, $45,000.

Co-Investigator. Optimum Filtration in the ISGS Press with Dewatering Agents. Illinois Clean Coal Institute, 2002-2003, $138,044.

Co-Investigator. Design, Fabrication, and Testing of an Automated Motorless/Rotorless Cell. Illinois Clean Coal Institute, 2002-2003, $98,826.

Co-Investigator. Demonstration of ISGS Washer Retrofit at Galatia Coal Processing Plant. Illinois Clean Coal Institute. Feb. 1, 2004 to Jan. 31, 2005, $242,087.

Co-Investigator. Fabrication of the Scaled-Up ISGS Intelligent Filter Press. Illinois Clean Coal Institute. IDCEO ICCI K-1289. Feb. 1, 2004 to Sept. 30, 2004, $64,529

Co-Investigator. Pathway to Commercialization of the Motorless Rotorless Cell. Illinois Clean Coal Institute. IDCEO ICCI K 1104. Sept.1, 2004 to August 31, 2005, $103,196.

Co-Investigator. Laboratory and Field Testing and Upgrade of a Larger ISGS Filter Press. Illinois Clean Coal Institute. IDCEO ICCI K 1146. Sept.1, 2004 to August 31, 2005, $188,675.

Principal Investigator. Chemical Constituents in Coal Combustion By-Product Leachate: Boron. Natural Resource Technology. June 30 to Dec. 31, 2004, $1,443.

Principal Investigator. Potential Soil-Cleanup Objectives for Nitrogen-Containing Fertilizers: A Field Study. Illinois Department of Agriculture. Sept. 1, 2004 to June 30, 2005, $24,500.

Co-Investigator. Fabrication and Testing of a Large ISGS Intelligent Filter Press. Illinois Clean Coal Institute. April 1, 2006 to Nov. 31, 2006, $102,541.

Co-Investigator. Understanding the Nature of Coal Combustion Byproducts as Manure Fertilizer Additives. Illinois Clean Coal Institute. Sept. 1, 2008 to August 31, 2009, $39,993.

Principal Investigator. Protecting Drinking Water by Reducing Uncertainties Associated with Geologic Carbon Sequestration in Deep Saline Aquifers. U.S. Environmental Protection Agency. Nov. 16, 2009 to Nov. 15, 2012, $897,225.

Co-Principal Investigator. An Evaluation of the Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins. U.S. Department of Energy. Nov. 2009 to Nov. 2013. $4,890,000.

Co-Investigator. Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois Basin. Illinois Clean Coal Institute. Jan. 1, 2010 to December 31, 2010, $250,000.

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO CLEAN	)	R-2012-009
CONSTRUCTION OR DEMOLITION	)	(Rulemaking – Land)
DEBRIS (CCDD) FILL OPERATIONS:	)	
PROPOSED AMENDMENTS TO 35 ILL.	)	
Adm. Code 1100	)	

PRE-FILED TESTIMONY OF CLAIRE A. MANNING

I offer this testimony to provide the Illinois Pollution Control Board (Board) with information with which I am personally knowledgeable, by virtue of my experience and also by my representation of the Public Building Commission of Chicago (PBC) in this matter, and in the negotiation and adoption of the enabling legislation that serves as the genesis for this proceeding, and in an enforcement action that served, in part, as the impetus for that legislative effort.

I. Legislative Framework.

The three driving principles that the Illinois Environmental Protection Agency (IEPA) sets forth in its Statement of Reasons may be those that have formed the basis of the IEPA's proposal to the Board, but they should not be equated to those that drove the underlying legislation. As the former Chairman of the Board (1993 – 2002) I am intimately familiar with the statutory responsibilities of the Board and the IEPA in the context of state environmental rulemaking. A s I was a key participant in the legislative initiative and discussions that led to this rulemaking, on be half of the PBC, I am also qualified to inform the Board as to my understanding of the legislative efforts behind P.A. 96-1416 and P.A. 97-1237, the legislative enactments that form the basis of this rulemaking.

First, the legislation was not driven by any demonstrated concern (or actual evidence) that CCDD or uncontaminated soil was causing any environmental or groundwater pollution as a

result of placement in permitted CCDD operations. Rather, the final adopted legislation resulted from a three-year initiative driven, in substantial part, by a problem that public construction agencies and CCDD fill operations were having over the IEPA's unclear, unpromulgated, and overly stringent definition of "uncontaminated soil" for these purposes. In particular, the IEPA's enforcement standard for uncontaminated soil was commonly known as a "from God and the Glaciers" standard (i.e., if the soil was not so pristine that it was "from God and the Glaciers" it could not properly be utilized as CCDD fill). As the IEPA explained in a 2006 letter to one CCDD fill operation:

> Finally, you questioned what criteria the Illinois EPA would use to determine whether the sampled material was contaminated. As I mentioned to you on the phone, the Illinois EPA deems uncontaminated soil to have zero non-naturally occurring compounds or elements present, and for naturally occurring compounds or elements present, only those levels one would expect given the readily available literature."

As virtually all soil in the City of Chicago and other urban areas contains non-naturally occurring materials due to anthropogenic conditions, the IEPA's position subjected public construction agencies and permitted CCDD fill operations to enforcement whenever analytical testing established the presence of non-naturally occurring materials. Although a contractor or engineer might deem the levels of such materials safe for consideration as CCDD soil, and appropriate for placement in a quarry without risk to the environment, an authorizing public agency would risk IEPA enforcement in authorizing such transfer. In one instance, the PBC, deferring to IEPA's articulated enforcement standard, endured a contractor challenge over a decision that excavated soil be landfilled.

In order to avoid contractor disputes and environmental enforcement in the future, public agencies and CCDD fill operations sought a legislative solution: require environmental regulations which would sensibly define "uncontaminated soil" in the context of use as quarry fill – so as to be responsible stewards of the environment and, since the cost to dispose such soil in landfill is 3 – 4 times that of use as CCDD fill, responsible stewards of taxpayer dollars in public works projects as well.

After three years of negotiating various pieces of legislation, the driving parties finally agreed to SB 3721, an IEPA-drafted bill which:

(a) Enhanced regulatory requirements applicable to CCDD operations and site excavation owners and contractors;

(b) Brought "soil only" fill operations (clean soil fill operations) into the regulatory scheme;

(c) Allowed for fees and fines to the IEPA and delegated counties;

(d) Importantly, required the Board to develop, through its broad statutory rulemaking authority and public rulemaking process, a definition of uncontaminated soil for use as fill in CCDD fill operations that: "*does not contain contaminants in concentrations that pose a threat to human health and safety and the environment."* 415 ILCS 5/3.160

II. Board's Authority and Responsibility

The Board has been vested by the legislature with the responsibility of utilizing technical expertise and record information in the creation of environmental regulations and has a long history of doing so, independently, with the input of the regulated community and the IEPA in the context of public regulatory hearings. Important here, Section 27 of the Act states that the Board " may make different provisions as required by circumstances for different contaminant sources and for different geographical areas" and requires the Board to take into consideration, in all rulemakings, the technical feasibility and economic reasonableness of any proposed rule. 415 ILCS 5/27.

Further, while the IEPA may seek input from the regulated community prior to the filing of any proposed rule with the Board, such input is not required and, in any event, is not relevant to the Board's consideration of the IEPA rule proposal.

Here, the major issue PBC has with the Board's First Notice Opinion and Order is its wholesale acceptance of the IEPA's proposed definition of uncontaminated soil (the establishment of MACs based upon the strictest application of TACO possible). There is

simply no technical support justifying the proposed standards as reflective of the statutory mandate: that the Board establish a workable definition for uncontaminated soil, in the context of placement in CCDD fill operations, that considers whether a specific concentration of contaminants would, or would not, *pose a threat to human health, safety and the environment in the context of use as fill in CCDD fill operations.*

With respect, the Board's First Notice Opinion and Order is wrong in its refusal to consider a "qualitative" definition for uncontaminated soil, as that is what is inherently required by the above-referenced definition. Moreover, site specific considerations are also mandated, in any consideration of use of background, by virtue of the definitional language itself: "Any background concentration set forth in 35 Ill. Adm. Code 742 that is adopted as a maximum concentration must be based upon the location of the quarry, mine, or other excavation where the soil is used as fill material." Thus, if the Board uses a TACO application to define uncontaminated soil, that application might vary depending on the site of placement.

The Board cannot avoid a realistic and technically justified definition for uncontaminated soil in the context of CCDD placement in this rulemaking – as the legislature required that it do so. To adopt the IEPA's proposed standard is to do just that, as it is not justified by science and it is neither workable nor technically required for environmental protection. See Testimony of Dr. William Roy. Instead, the proposed standard virtually ensures that no urban soil will be allowed to be taken to quarries for use as fill and, as well, will drive up the costs for public construction and public works projects, for no environmental gain, at time when our economy is most ill equipped to handle unnecessary public expenditures. The uncontaminated soil standard must be revisited in the context of placement of soil in CCDD fill operations.

III. Economic Reasonableness.

Costs that are necessary to ensure environmental protection and responsibility are reasonable. Costs that do not equate to such protection are not. Utilization of public funds to dispose of soil in a landfill, when that soil is otherwise clean enough to be safely used as fill in a CCDD fill operation is inherently unreasonable.

PBC does not object to the costs associated with site investigation and, where warranted by such investigation, testing. Its projects are large ones, and investigations are generally part of the standard project costs. However, PBC seeks clarification regarding the Board's First Notice Opinion as it relates to such. For example, where a Phase I Investigation determines there is a Recognized Environmental Condition (REC) the PBC assumes testing would be designed to evaluate the risk posed by the REC ("Target Compounds" or "Priority Pollutant" lists) and that testing of all of the soil related to the site, utilizing the entire gamut of TACO parameters, is unnecessary and unreasonable. PBC requests confirmation that such is not required. Also, PBC also seeks clarification of the Board's basis for its apparent acceptance of IEPA's refusal to allow commingling of soil at an excavation site, particularly when it is for the purpose of achieving a sound level of environmental safety in a specific load, so that use as CCDD fill would be safe and appropriate.

Finally, as stated above, PBC strongly objects to the proposed overly stringent, one-size-fits-all MACs, as they are not justified by technical or science considerations; nor are they supported by the record, nor by legislative history. Further, the costs are significant, in the millions for PBC alone. This is because of the significant cost differences required for hauling soil to a quarry for use as fill v. transferring soil to a landfill for disposal. For example, for the twenty currently planned PBC projects, PBC estimates that disposal at a permitted Subtitle D facility would cost approximately $20.6 million, while disposal at a CCDD facility would cost approximately $5.7 million. The nearly $15 million difference, a four-fold increase, in costs cannot be justified in light of the doubtful environmental impact.

Again, PBC urges the Board to reconsider the risks v. benefits associated with adoption of the IEPA's proposed MACs, especially given the risk-based, context-driven definition of uncontaminated soil established by the legislature.

IV. Conclusion

On behalf of PBC, I appreciate the opportunity to provide this testimony and look forward to answering any questions the Board may have regarding this testimony.

Dated: March 5, 2012

Respectfully submitted,

PUBLIC BUILDING COMMISSION OF CHICAGO

By: /CManning

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