FINAL PROJECT AGREEMENT

IBM East Fishkill Facility F006 Sludge Recycling Project

SEPTEMBER 2000

International Business Machines Corporation

EAST FISHKILL FACILITY/
HUDSON VALLEY
RESEARCH PARK
HOPEWELL JUNCTION, NY

Project XL
Environmental Excellence and Leadership

PREPARED BY

William F. Cosulich Associates, P.C.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

RLA/IBM1506(8/8/00)

FINAL PROJECT AGREEMENT

PROJECT XL PROGRAM
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY
F006 SLUDGE RECYCLING PROJECT

***Prepared for*:**

INTERNATIONAL BUSINESS MACHINES CORPORATION
East Fishkill Facility
Hopewell Junction, New York

Prepared by:

WILLIAM F. COSULICH ASSOCIATES, P.C.
330 Crossways Park Drive
Woodbury, New York

SEPTEMBER 2000

FINAL PROJECT AGREEMENT FOR
PROJECT XL PROGRAM
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

List of Appendices

List of Figures

List of Tables

TABLE OF CONTENTS (continued)

List of Tables (continued)

1.0 INTRODUCTION TO THE AGREEMENT

1.1 General Project Description and Purpose

The International Business Machines Corporation (IBM) East Fishkill facility, located in Dutchess County, New York, houses a broad spectrum of semiconductor research and development operations as well as facilities and operations involved in the manufacture of semiconductor and electronic computing equipment. As a result of various process operations associated with manufacturing, wastewater containing dissolved heavy metal and fluoride compounds is generated. Included among these manufacturing processes are electroplating operations. As a result of the on-site treatment of the wastewater that is produced by the electroplating operation, a residual sludge is generated. This sludge is designated as EPA Hazardous Waste No. F006. The IBM East Fishkill facility generates approximately 825 tons per year of this wastewater treatment sludge which is transported to Canada and disposed of in a permitted landfill.

The purpose of this XL project is to allow the recycling of a portion of IBM's F006 sludge as a raw material in the production of cement. Instead of being disposed of in a landfill, the sludge will be beneficially reused by a cement kiln.

In 1987, IBM petitioned the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (EPA) Region 2 to allow the recycling of F006 sludge as an ingredient in the manufacture of cement. At that time, based on the review of the petition submitted by IBM, EPA Region 2 and the NYSDEC approved the "use/reuse" exemption for the recycling of sludge as an ingredient in cement. Based on the available federal and New York State exemption in the Resource Conservation and Recovery Act (RCRA) hazardous waste management regulations, IBM entered into a contract with Independent Cement Corporation (ICC) to initiate the reuse of the sludge at ICC's cement kiln. The IBM sludge was reused as an ingredient in the manufacture of cement at ICC for approximately 3 years. During that timeframe, IBM recycled approximately 2,300 tons of sludge at this particular cement kiln.

On February 21, 1991, EPA published its final rule regarding the regulation of boilers and industrial furnaces (BIFs). In addition, the EPA had promulgated a number of new requirements in a continuing series of regulations pursuant to its Land Disposal Restriction rules. In light of this regulatory situation, IBM and ICC discontinued the program pending discussions with the EPA and the NYSDEC. Following discussions with the EPA and NYSDEC, the sludge recycling project was discontinued.

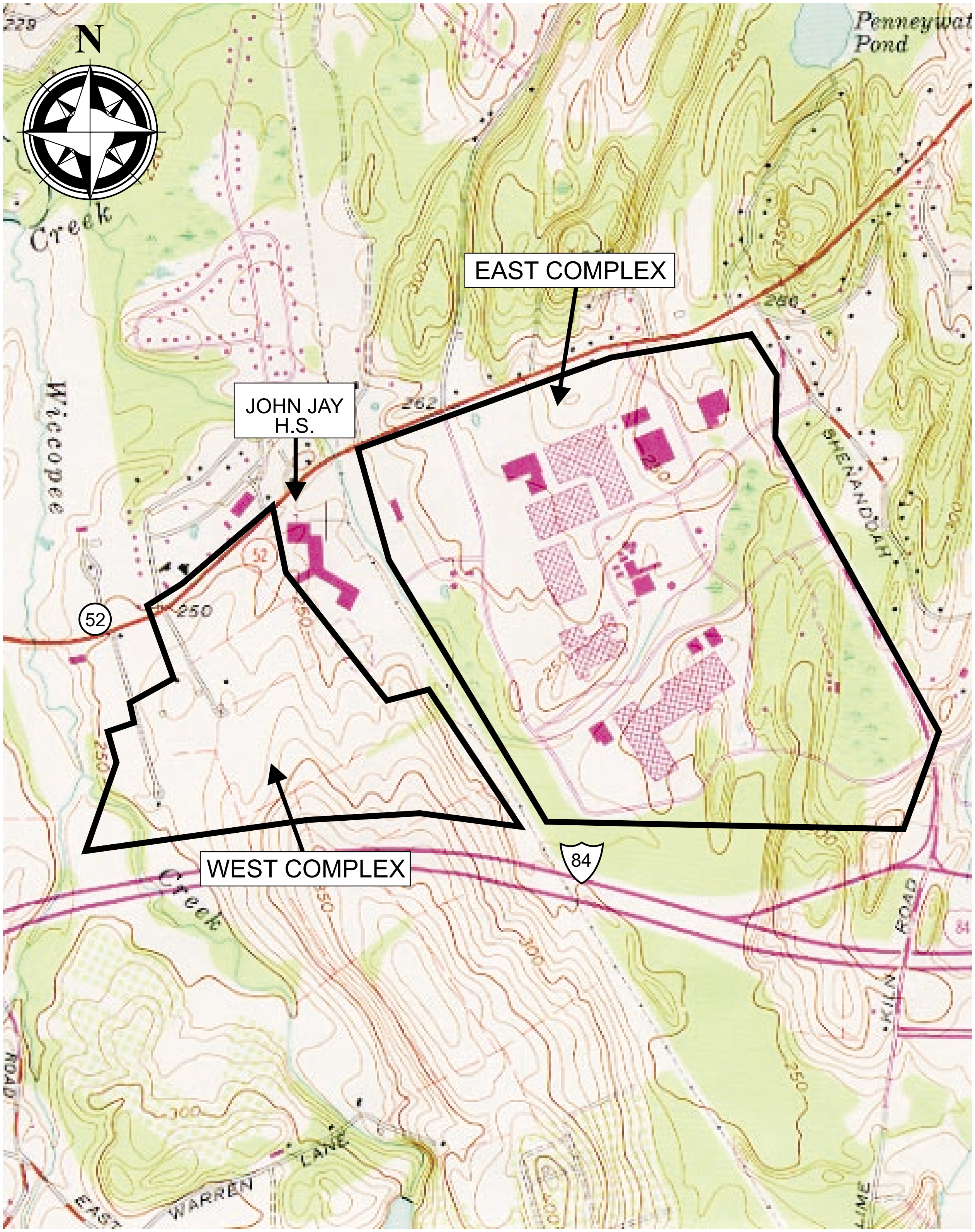
At this time, IBM believes that new government initiatives have emerged which may have changed the regulatory complexion of the situation and which could warrant a closer examination of this environmentally beneficial proposal. Therefore, IBM is sponsoring this XL Project in an effort to reinitiate its F006 sludge recycling program to include the sludge as an ingredient in the manufacture of cement.

The EPA, with the cooperation of State and local authorities, has initiated Project XL to work with interested companies to develop innovative approaches to environmental protection. Project XL encourages potential sponsors such as IBM to come forward with new approaches that can advance our nation's environmental goals perhaps more effectively and efficiently than the current regulatory framework, policy or procedures would typically allow.

1.2 Description of Facility and Geographic Area

The IBM East Fishkill facility is located on Lime Kiln Road in the Town of East Fishkill. The facility is bordered on the north by U.S. Route 52, to the south by U.S. Route 84 and is located approximately 10 miles east of the Hudson River. A facility location map is depicted on the United States Geological Survey topographical map (Hopewell Junction quadrangle), presented as Figure 1-1.

Manufacturing operations were initiated at the facility in April 1963 and the facility currently houses various research and development operations as well as the facilities and



SOURCE: U.S.G.S. HOPEWELL JUNCTION, NEW YORK QUADRANGLE (Photorevised 1981)

MAPSIBM1506(6/8/000)

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL, NEW YORK

SITE LOCATION MAP

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ENVIRONMENTAL ENGINEERS AND SCIENTISTS

FIGURE 1-1

operations involved in the manufacturing of semiconductor and electronic computing equipment. Applicable Standard Industrial Classification (SIC) Codes include the following:

- 3674 Semiconductor related devices- primary
- 3573 Electronic computing equipment- secondary

The facility consists of two complexes: an East Complex and a West Complex. All of IBM's principal product manufacturing areas are located within the East Complex, while the West Complex is primarily dedicated to advanced semiconductor research and development operations. In addition, a portion of the East Complex has been designated as the Hudson Valley Research Park, with both manufacturing and non-manufacturing tenants. Figures 1-2 and 1-3 present the site plans for the East and West Complexes, respectively**.**

The IBM East Fishkill facility has a comprehensive, long-standing and aggressive pollution prevention/waste minimization program that has been ongoing for over 20 years. The facility has been formally recognized by the EPA Region 2 offices for its outstanding achievements in pollution prevention by selecting IBM East Fishkill as the recipient of its 1996 Environmental Quality Award. IBM East Fishkill was also the recipient of the First Annual New York State Governor's Award for Pollution Prevention offered in 1994. In addition to the specific pollution prevention activities indicated above, IBM East Fishkill has received recognition for environmental protection from IBM Corporate and other private organizations. Examples include:

- IBM Corporation Environmental Affairs Technical Excellence Award for the development of a new process that minimizes waste generation during the manufacture of DRAM devices (1999)

- Industrial Achievement Award of the New York Water Environment Association (1998)

- IBM Corporation Environmental Affairs Technical Excellence Award for development of cryogenic aerosol surface cleaning process (1995)

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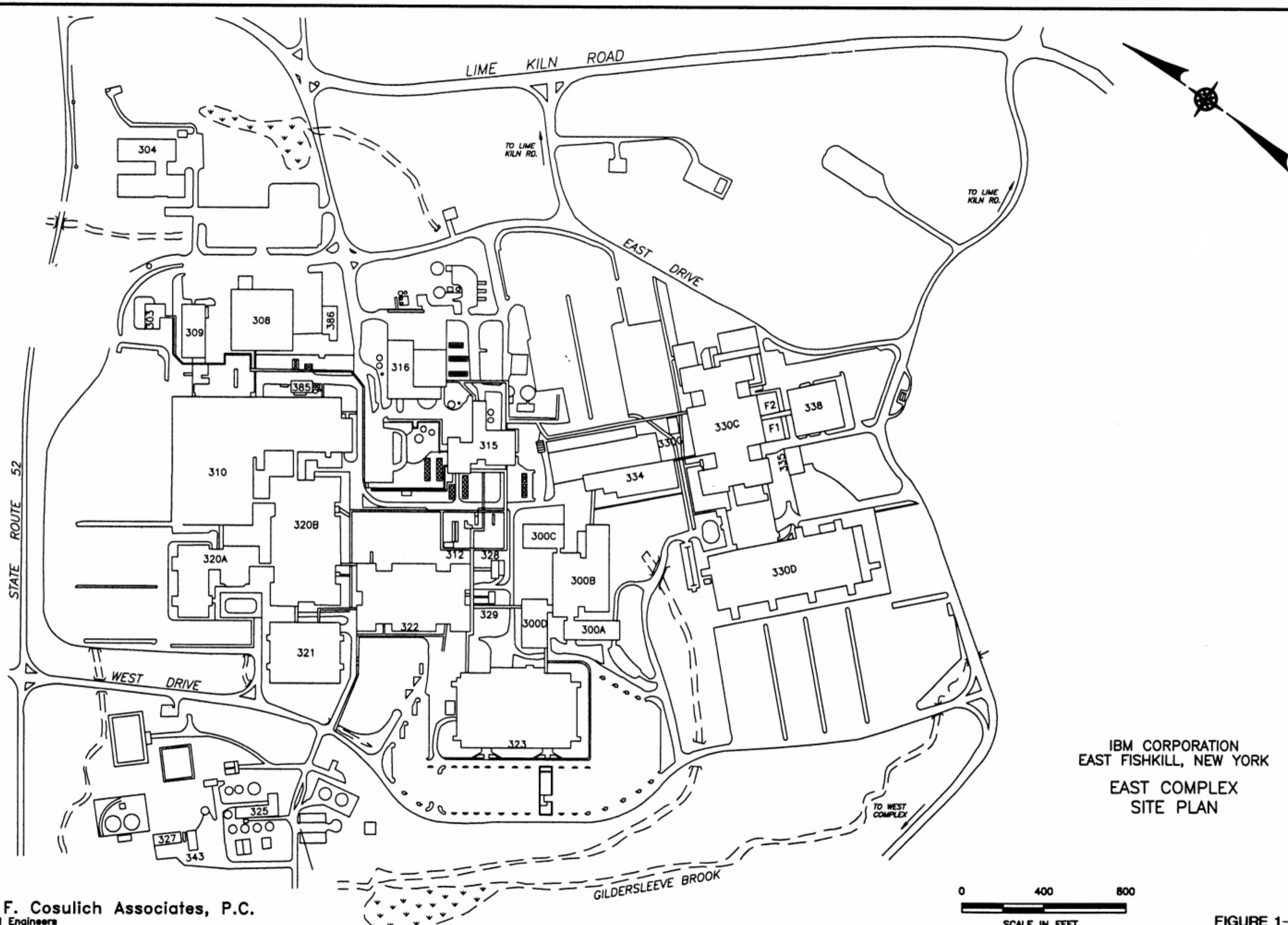

IBM CORPORATION
EAST FISHKILL, NEW YORK

EAST COMPLEX
SITE PLAN

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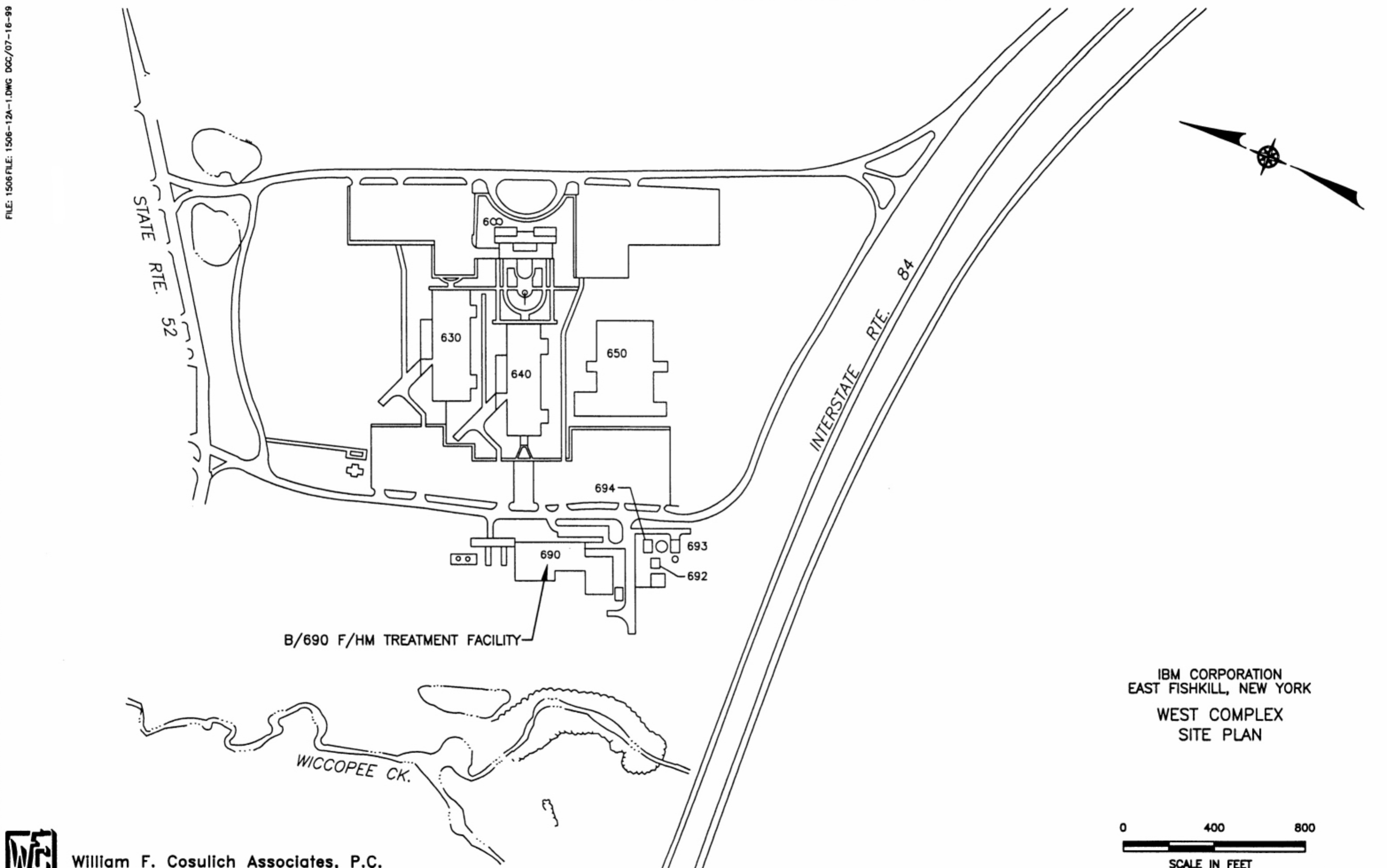
Environmental Engineers

FIGURE 1-2



FILE: 1506 FILE: 1506-12A-1.DWG DGC/07-16-99
STATE RTE. 52
INTERSTATE RTE. 84
600
630
640
650
690
694
693
692
B/690 F/HM TREATMENT FACILITY
WICCOPEE CK.
IBM CORPORATION
EAST FISHKILL, NEW YORK
WEST COMPLEX
SITE PLAN
0
400
800
SCALE IN FEET
William F. Cosulich Associates, P.C.
Environmental Engineers

FIGURE 1-3

- IBM Corporation Environmental Affairs Technical Excellence Award for replacement of J-100 (1992)
- IBM Corporation Environmental Award for development and implementation of a new process that utilizes ozonation to regenerate ferricyanide etching baths (1989)

However, notwithstanding these achievements, IBM continues to investigate advances on not only the pollution prevention and waste minimization fronts, but the recycling, reuse and reclamation frontiers as well. This is demonstrated by its commitment to re-implement a project designed to recycle the F006 sludge generated at its facility by utilizing it as an ingredient in the manufacture of a commercially available product—cement.

1.3 Purpose of the Agreement

This Final Project Agreement ("the Agreement" or "FPA") is a joint statement of the plans, intentions and commitments of the US Environmental Protection Agency (EPA), the New York State Department of Environmental Conservation (NYSDEC) and IBM to carry out this F006 Sludge Recycling Project. This project will be part of EPA's Project XL program to develop innovative approaches to environmental protection.

This Agreement does not create legal rights or obligations and is not an enforceable contract or a regulatory action such as a permit or a rule. This applies to both the substantive and the procedural provisions of this Agreement. While the parties to the Agreement fully intend to follow these procedures, they are not legally obligated to do so. Neither this Agreement nor any discussions among the parties about this Agreement gives any of the parties a right to sue for any alleged failure to implement its terms, either to compel implementation or to recover damages.

Federal flexibility and enforceable commitments described in this Agreement will be implemented and become effective through a legal implementing mechanism such as a rule or permit. A complete description of the specific legal implementing mechanism that will be used for this project is included in Section 4.2 of this document.

All parties to this Agreement will strive for a high level of cooperation, communication and coordination to assure successful implementation of the Agreement and the Project. This FPA and associated project materials are available to the public for review on the EPA Project XL Web Site at **http://www.epa.gov/ProjectXL** .

1.4 List of the Parties that will Sign the Agreement

This Final Project Agreement is entered into by the EPA, IBM and the NYSDEC and will serve to guide the working relationship of all parties in fulfilling the goals of the IBM East Fishkill F006 Sludge Recycling Project.

1.5 List of Project Contacts

IBM

Salvatore J. Tranchina, P.E., Manager
Environmental Engineering and Operations
International Business Machines Corporation
East Fishkill Facility
2070 Route 52, Building 325
Hopewell Junction, NY 12533
phone: (845) 892-1629
fax: (845) 892-4627
email: **tranchin@us.ibm.com**

EPA

Otis S. Kerns
Environmental Engineer
U.S. Environmental Protection Agency
Region 2
290 Broadway, 22nd. Floor
New York, NY 10007
phone: (212) 637-4139
fax: (212) 637-4949
email: **kerns.sam@epamail.epa.gov**

NYSDEC

Lawrence J. Nadler, P.E.
Chief, Technical Determination Section
Bureau of Hazardous Waste Management, Room 448
New York State Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233
phone: (518) 485-8988
fax: (518) 485-8769
email: ljnadler@gw.dec.state.ny.us

2.0 DETAILED PROJECT DESCRIPTION

2.1 Background

During the late 1980s and early 1990s, F006 sludge generated at the IBM East Fishkill facility was utilized in the manufacture of cement at the Independent Cement Corporation located in Catskill, New York. Background information regarding this sludge recycling program is provided below.

In 1987, IBM East Fishkill petitioned NYSDEC and EPA Region 2 to allow the recycling of its wastewater treatment sludge as an ingredient (raw material) in the manufacture of cement. At that time, both NYSDEC and EPA Region 2 concurred in written correspondence that IBM sludge utilized in manufacturing cement was exempt from Federal and New York State regulation as a solid waste since it was to be used as an ingredient in the manufacturing of a commercially available product. Given this concurrence, IBM entered into a contract with Independent Cement Corporation (ICC) to initiate the reuse of the sludge at ICC's cement kiln, and the IBM sludge was utilized to manufacture cement at ICC's facility for approximately 3 years (approximately 1988-1991). This situation changed in February 21, 1991, when EPA published its final rule regarding the regulation of boilers and industrial furnaces (BIF). In light of the BIF Rule, as well as changes/updates to both EPA's and NYSDEC's solid and hazardous waste regulations particularly regarding the Land Disposal Restriction rule, there was a re-evaluation of IBM's sludge recycling project.

In October of 1991, IBM discontinued the shipment of sludge to ICC's facility, and additional sludge recycling has not been implemented since, given the complicated legal and policy aspects of the updated Federal and State solid and hazardous waste regulations. Project XL offers an opportunity to restart the beneficial recycling of the sludge generated at IBM's facility through the implementation of this project.

2.2 Summary of Project and Description of Project Elements

2.2.1 General Description

As a result of manufacturing operations, wastewater containing dissolved heavy metal and fluoride compounds is produced by various process operations in a number of buildings throughout the IBM East Fishkill facility. IBM currently generates approximately 825 tons of F006 sludge annually and transports the material approximately 350 miles to Canada, for ultimate disposal of the material in a permitted landfill. The sludge is generated at two separate fluoride/heavy metal (F/HM) wastewater treatment facilities, one serving the West Complex (located in Building 690), and one serving the East Complex (located in Building 386). After processing, the sludge is accumulated in 25 cubic yard roll-off containers housed in sludge container loading bays inside the F/HM wastewater treatment facility buildings.

EPA has determined that the sludge generated as a result of the treatment of electroplating wastewater from the West Complex is not eligible for the recycling exemption cited in 40 CFR 261.2(e)(1)(i), and 6 NYCRR 371.1(c)(6)(i) in federal and state regulations, respectively. The recycling exemption excludes from regulation as a solid (and hazardous) waste a recyclable material that is used as an ingredient in the manufacture of a commercially available product that is not placed on the ground. Since the product made using IBM's sludge, cement, is typically placed on the ground, the recycling exemption does not apply. However, EPA and NYSDEC will propose a site-specific conditional exclusion to the solid waste definition for the duration of this XL project. This flexibility would allow IBM the opportunity to test the appropriateness of recycling its sludge outside the jurisdiction of the hazardous waste regulations.

As part of this XL project, IBM is proposing to utilize only the sludge generated in the Building 690 (B/690) F/HM Wastewater Treatment Facility (in the facility's West Complex) as an ingredient in the manufacture of cement.

To help clarify how IBM sludge would be utilized as an ingredient in the manufacture of cement, presented below is a brief discussion of the steps typically used in the cement making process:

1. Limestone is mined in the limestone quarry and trucked to the crusher. The limestone is crushed and sized and conveyed to the lime/iron ore/sand storage silos. The lime/iron ore/sand are then blended to predetermined specifications.

2. The lime/iron ore/sand blend is then mixed with water and processed in the "raw mill." The milled lime slurry is then pumped to the slurry blending and storage basins.

3. The lime slurry is then pumped into the "cold" end of the kiln and gravity fed down the entire length of the kiln (150 to 250 feet) while a countercurrent heated air flow is fan-forced in the opposite direction. As the lime slurry feeds down the kiln, it passes through drying, calcining and clinkering phases. The manufactured clinker is then "dropped" into the clinker cooler chamber which is at the same end of the kiln as the heat source.

4. The clinker (primary ingredient of cement) is then processed through a "ball mill" and mixed with gypsum. This mixture is then sent through a finish grinding mill and sent to bag packing machines and/or bulk storage silos. The end result of this process is cement.

With respect to this project, the IBM sludge will be commingled with the quarry materials as described in Step 1 above. It is important to note that the raw materials, including the IBM sludge, will have undergone a series of chemical reactions in the course of producing the cement that make them inseparable from the cement by physical means.

Although recycling of this sludge would be possible in the absence of the flexibility offered in this XL project, the existing regulatory requirements serve to discourage it. If the initial F006 Recycling Project is successful, IBM will consider undertaking additional waste minimization measures that will eventually improve the quality of the sludge generated at its B/386 F/HM Wastewater Treatment Facility to allow it to also be recycled into cement. However, the scope of this XL project is limited to the recycling of B/690 F/HM sludge.

2.2.2 Description of Manufacturing Operations

2.2.2.1 - Advanced Semiconductor Technology Center (ASTC)

The ASTC manufacturing area is located within B/650 on the West Complex of the facility. The ASTC area manufactures memory and logic chips as part of IBM's ongoing research and development operations. In general, manufacturing process steps include sputtering, low pressure chemical vapor deposition, reactant gas phase etchant, chemical vapor deposition, photolithography and wet etch/clean. Fluoride wastewater generated in B/650 is conveyed to the on-site F/HM wastewater treatment facility located in B/690. Sludge from the B/690 F/HM Wastewater Treatment Facility is collected in roll-off containers, classified as an F006 hazardous waste, transported off-site, stabilized and disposed in a permitted landfill.

2.2.3 Wastewater Treatment Sludge Characterization

Waste code F006 is defined at 40 CFR 261.31 as follows:

> "Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum."

40 CFR Part 261 Appendix VII, as well as the New York State regulatory analog found at 6 NYCRR 371, Appendix 22, identifies the hazardous constituents for which F006 waste is listed as including cadmium, hexavalent chromium, nickel and cyanide (complexed).

Since IBM conducts manufacturing operations that meet the definition of "electroplating operations," the wastewater treatment sludge is classified as a listed hazardous waste with the waste code F006.

2.2.4 Identification of Chemicals Utilized in Manufacturing and Wastewater Treatment Processes

In order to identify the constituents utilized in the manufacturing process that may be present in the wastewater treatment sludge, the IBM chemical management database was reviewed to identify any 40 CFR Part 261 Appendix VIII compounds which are utilized as part of the manufacturing process and are discharged to the F/HM and industrial wastewater treatment facilities. In addition, a review of those chemicals that are utilized to enhance treatment operations at each of the facility's wastewater treatment facilities was also undertaken. Chemicals identified during the database search included:

Chemicals Utilized in Manufacturing Processes	
1,1,1-Trichloroethane Saccharin Chromium Compounds Nickel Compounds Lead Compounds Mercury Compounds Copper Compounds	Silver Compounds Formaldehyde Benzene Methyl Chloroform Methyl Methacrylate Dibutyl Phthalate

Chemicals Utilized in Wastewater Treatment Operations	
Calcium Hydroxide (Lime) Concentrated Acid* Sodium Bisulfate Dilute Acids and Caustics* Sodium Sulfhydrate Betz Polymer 1123L (contains: Sodium Acrylate Copolymer, Hydrotreated Light Distillate, Proprietary Surfactant)	Drewplus ED-830, Foam Inhibitor (contains: Linear Primary Alcohols, Proprietary Organic Acid, Proprietary Surfactant, Aluminum Sulfate, Triethanolamine, Diethanolanine, Ethylene Oxide)

* Note: Concentrated acid and dilute acids and caustics refer to sulfuric acid, hydrochloric acid, phosphoric acid and sodium hydroxide.

2.2.5 Historical Wastewater Treatment Sludge Sampling and Analysis

IBM has historically conducted sampling and analysis of the wastewater treatment sludge generated at the facility in accordance with its waste analysis plan and quality assurance quality control plan contained in the Part 373 permit for the facility. Historical analytical data for the wastewater treatment sludge generated at the B/690 F/HM Wastewater Treatment Facility is presented on Table 2-1 and Table 2-2.

Table 2-1 provides analytical results obtained utilizing the Toxicity Characteristic Leaching Procedure (TCLP) method for sludge generated at the B/690 facility. Table 2-2 provides analytical results on a total concentration basis for sludge generated at the B/690 facility.

Tables 2-3 and 2-4 present a statistical summary of the analytical results presented on Tables 2-1 and 2-2. Standard statistical values presented for each compound include: Number of Samples, Range (minimum and maximum), Mean, Standard Deviation and Upper and Lower limits for the 95th Percentile Confidence Interval. The confidence interval is calculated as the mean plus the product of 't' times the standard deviation, where 't' is 1.96 for the 95th percentile confidence interval.

As part of a further evaluation of the suitability of utilizing the F006 sludge generated at the IBM East Fishkill facility in the manufacture of cement, the historical laboratory results were compared to the appropriate Land Disposal Restriction (LDR) treatment standards. After a careful review of this historical data in comparison to the LDR concentrations, it is evident that the sludge, prior to being recycled, inherently meets the land disposal restriction concentration thresholds. The comparison of the historical analytical results of the sludge versus the land disposal treatment standards for the constituents of concern is presented below.

TABLE 2-1
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

HISTORICAL F/HM SLUDGE SAMPLING TCLP ANALYTICAL RESULTS

Sample ID	9401497	9402352	9403497	9404213	9405001	9405690	9407380
Sample Type	SLDG	SLDG	SLDG	SLDG	SLDG	SLDG	SLDG
Sample Date	2/3/94	3/9/94	4/15/94	5/10/94	6/7/94	7/5/94	8/11/94
Units	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Chromium (total)	0.011	U	0.115	0.113	0.032	0.037	0.015
Chromium (hexavalent)	U	U	U	U	U	U	0.3
Nickel	0.01	U	0.02	0.01	0.01	0.01	0.01
Lead	U	U	0.01	U	0.02	U	U
pH (std. units)	12.1	11.7	11	11.2	11.2	11.5	11.4

Sample ID	9408170	9409537	9410190	9410520	9507541	9507543	9509577
Sample Type	SLDG	SLDG	SLDG	SLDG	SLDG	SLDG	SLDG
Sample Date	9/16/94	10/24/94	11/29/94	12/20/94	7/11/95	8/14/95	9/29/95
Units	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Chromium (total)	0.016	0.015	0.009	U	0.113	0.269	0.274
Chromium (hexavalent)	U	U	U	U	N/A	N/A	N/A
Nickel	0.01	0.01	U	0.01	U	0.01	0.12
Lead	U	U	U	0.02	0.02	0.01	U
pH (std. units)	11.3	11.4	11.8	11.6	11.3	9.5	10.3

Sample ID	9705727	9709794	9802208	9805895	9807999
Sample Type	FS	SOLID	SOLID	SLDG	SLDG
Sample Date	7/11/97	12/9/97	2/27/98	6/15/98	8/28/98
Units	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Nickel	0.09	U	0.05	7.073	U
Lead	U	U	U	U	0.02

Qualifiers:
U: Analyzed for but not detected
N/A: Compound not analzyed for

TABLE 2-2
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

HISTORICAL F/HM SLUDGE SAMPLING TOTAL ANALYTICAL RESULTS

Sample ID	**9500614**	**9501268**	**9502448**	**9502689**	**9503856**	**9504492**	**9505402**
Sample Type	**SLDG**	**SLDG**	**SLDG**	**SLDG**	**SLDG**	**SLDG**	**SLDG**
Sample Date	**1/12/95**	**2/02/95**	**2/27/95**	**3/20/95**	**4/11/95**	**5/8/95**	**6/9/95**
Units	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
Chromium (total)	5.3	8.15	57	21.7	18	21.75	28.05
Nickel	4.8	3.6	76.25	3.4	2.8	1.85	2.6
Lead	4	4.35	95.2	1.2	16	13.35	1.2
pH (std. units)	11.7	11.1	11.3	11.6	11.7	11.512	11.7

Sample ID	**9705727**	**9709794**	**9802208**	**9805895**	**9807999**
Sample Type	**FS**	**SOLID**	**SOLID**	**SLDG**	**SLDG**
Sample Date	**7/11/97**	**12/9/97**	**2/27/98**	**6/15/98**	**8/28/98**
Units	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
Cadmium	4.3	U	2.3	2	1.7
Chromium (total)	33.6	21	21	24	25
pH (std. units)	10.6	11.3	11.5	11.6	11.3
Cyanide (total)	U	U	U	U	U
Total Percent Solids	62.4	39.49	41.5	39.1	35.53

Qualifiers:
U: Analyzed for but not detected

TABLE 2-3
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

HISTORICAL F/HM SLUDGE SAMPLING TCLP ANALYSIS STATISTICAL SUMMARY

Analyte	Units	Number of Samples	MDL	Range		Mean	Std. Dev.	Lower 95th %	Upper 95th %
				Min	Max				
Chromium (total)	mg/l	14	0.003	ND	0.274	0.07	0.09	ND	0.25
Hexavalent Chromium	mg/l	11	0.005	ND	0.3	0.178	0.077	0.027	0.329
Lead	mg/l	19	0.01	ND	0.02	0.012	0.006	ND	0.024
Nickel	mg/l	19	0.01	ND	7.073	0.39	1.58	ND	3.48

Notes:

MDL = Method Detection Limit
ND = Not detected
Statistical summary assumes values less than MDL will average at 1/2 the MDL. Therefore, 0.5 x MDL was substituted for all "U" values when calculating the Mean and the Standard Deviation.

TABLE 2-4
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

HISTORICAL F/HM SLUDGE SAMPLING TOTAL ANALYSIS STATISTICAL SUMMARY

Analyte	Units	Number of Samples	MDL	Range		Mean	Std. Dev.	Lower 95th %	Upper 95th %
				Min	Max				
Cadmium	mg/kg	5	0.3	ND	4.3	2.14	1.26	ND	4.61
Chromium (total)	mg/kg	12	0.15	5.3	57	23.71	12.46	ND	48.13
Lead	mg/kg	7	0.5	1.2	95.2	19.33	31.44	ND	80.95
Nickel	mg/kg	7	0.15	1.85	76.25	13.61	25.59	ND	63.76
Cyanide (total)	mg/kg	5	0.003	ND	ND	ND	ND	ND	ND
pH	Std. Units	12	1	10.6	11.7	11.41	0.32	10.78	12.04
Total Percent Solids	Percent	5	0.05	35.53	62.4	43.60	9.59	24.80	62.41

Notes:

MDL = Method Detection Limit
ND = Not detected
Statistical summary assumes values less than MDL will average 1/2 the MDL. Therefore, 0.5 x MDL was substituted for all "U" values when calculating the Mean and the Standard Deviation.

Constituent of Concern	Historical Analytical Data Mean Concentration (mg/l TCLP)*	Land Disposal Restriction Treatment Standard (mg/l TCLP)
Cadmium	0.107**	0.11
Chromium (total)	0.07	0.60
Chromium (hexavalent)	0.178	–
Nickel	0.39	11

Constituent of Concern	Historical Analytical Data Mean Concentration (mg/kg)	Land Disposal Restriction Treatment Standard(mg/kg)
Cyanide (complexed)	Nondetect***	590

*TCLP, except where noted.
**On a total basis (results are divided by 20 for comparison to TCLP standards in accordance with EPA guidelines).
***Value reported is for total cyanide.

2.2.6 Current Wastewater Treatment Sludge Sampling and Analysis

In response to discussions with the EPA regarding the implementation of this F006 sludge recycling project, IBM collected samples of the sludge generated at the B/690 F/HM Wastewater Treatment Facility for analysis of appropriate Appendix VIII constituents. In order to develop a comprehensive list of applicable Appendix VIII constituents that would be analyzed as part of an evaluation of F006 sludge for recycling, the following was undertaken. First, IBM began with the full list of Appendix VIII chemical constituents. All chemical constituents for which the F006 sludge is listed were identified as a subset of that list. Next, as discussed previously, a comprehensive review of chemicals used in the manufacturing area which generate wastewater that is conveyed to the F/HM wastewater treatment facilities was conducted. In addition, Appendix VIII constituents associated with wastewater treatment operations were identified. Lastly, specific constituents requested by the EPA were identified including dioxins, furans, high volatile metals, low volatile metals and semivolatile metals were added.

Accordingly, Table 2-5 presents a summary of the Appendix VIII constituents of concern along with the appropriate method of analysis. IBM collected samples of the sludge generated at

TABLE 2-5
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

SUMMARY OF APPLICABLE AND APPROPRIATE APPENDIX VIII CHEMICAL CONSTITUENTS OF CONCERN

Constituent	Rationale	Method of Analysis
Cadmium	Listed Constituent	ICP, Method 6010 or A.A.-Direct Aspiration Method 7130, SW-846
Hexavalent Chromium	Listed Constituent, utilized in manufacturing process	Colorimetric, Method 7196, SW-846
Nickel	Listed Constituent, utilized in manufacturing process	ICP, Method 6010 or A.A.-Direct Aspiration Method 7520, SW-846
Cyanide (complexed)	Listed Constituent	Total and Amendable Cyanide Method 9012, SW-846
Volatile Organic Compounds	Chemicals utilized in manufacturing process	Volatile Organic Compounds by GC/MS Method 8260, SW-846
Semivolatile Organic Compounds	Chemicals utilized in manufacturing process	Semivolatile Organic Compounds by GC/MS Method 8270, SW-846
Arsenic	Requested by USEPA	ICP, Method 6010 or A.A.-Furnace Technique, Method 7060, SW-846
Beryllium	Requested by USEPA	ICP, Method 6010 or A.A.-Direct Aspiration Method 7090, SW-846
Cadmium	Requested by USEPA	ICP, Method 6010 or A.A.-Direct Aspiration Method 7130, SW-846
Chromium	Utilized in manufacturing process, requested by USEPA	ICP, Method 6010 or A.A.-Direct Aspiration Method 7140, SW-846
Lead	Utilized in manufacturing process, requested by USEPA	ICP, Method 6010 or A.A.-Direct Aspiration Method 7421, SW-846
Mercury	Utilized in manufacturing process, requested by USEPA	ICP, Method 6010 or A.A.-Direct Aspiration Method 7471, SW-846
Silver	Utilized in manufacturing process	ICP, Method 6010 or A.A.-Direct Aspiration Method 7760, SW-846
Formaldehyde	Utilized in manufacturing process	NYS ASP Method APC 44
Saccharin	Utilized in manufacturing process	Semivolatile Organic Compounds by GC/MS Method 8270, SW-846
Dioxins and Furans	Requested by USEPA	PCDDs and PCDFs by HRGC/LRMS, Method 8280, SW-846

the B/690 F/HM Wastewater Treatment Facility on February 8, 1999 and analyzed the samples for the constituents identified on Table 2-5. Tabulated analytical results are presented on Tables 2-6 through 2-9.

As part of acceptance into the Project XL Program, IBM agreed to undertake quarterly sampling of the sludge for analytical testing. Presented in Tables 2-10 and 2-11 is a summary of current analyses performed on sludge samples. Table 2-10 summarizes the Toxicity Characteristic Leaching Procedure (TCLP) analytical results and Table 2-11 summarizes the analytical results run on a total basis. It should be noted that although the current analytical results indicate that cadmium is present in the sludge in trace quantities, cadmium is not utilized in manufacturing operations at the IBM East Fishkill facility. Rather, the source of the cadmium is from impurities that are contained in the lime utilized in the treatment process.

2.2.7 Typical Wastewater Treatment Sludge Composition

Sludge that is generated at the B/690 F/HM Wastewater Treatment Facility is dry in appearance but typically contains approximately 50% water. The primary solid ingredient in the sludge is lime. Although the composition of the sludge will vary, typical sludge composition includes the following major constituents and approximate concentrations:

Major Constituent	Approximate Concentration
Water	50%
Calcium Hydroxide	15%
Calcium Carbonate	15%
Calcium Fluoride	8%
Various Sulfates	2% - 3%

2.2.8 Comparison of Typical Cement Feedstock and F006 Sludge Composition

Cement is a combination of the oxides of calcium, silicon, aluminum, and iron with lime and silica comprising approximately 85% of its mass. Common materials that are utilized in the

TABLE 2-6
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS VOLATILE ORGANIC COMPOUNDS

BUILDING	B/690	
SAMPLE IDENTIFICATION	CA-F Grab	
DATE OF COLLECTION	2/8/99	
DILUTION FACTOR	1	
PERCENT SOLIDS	39.5	
UNITS	(ug/kg)	
Chloromethane		U
Vinyl Chloride		U
Bromomethane		U
Chloroethane		U
Trichlorofluoromethane		U
1,1-Dichloroethene		U
Methylene Chloride	3.6	
trans-1,2-Dichloroethene		U
1,1-Dichloroethane		U
2,2-Dichloropropane		U
cis-1,2-Dichloroethene		U
Bromochloromethane		U
Chloroform		U
Carbon Tetrachloride		U
Benzene		U
1,2-Dichloroethane		U
1,1-Dichloropropene		U
Trichloroethene		U
1,2-Dichloropropane		U
Dibromomethane		U
Bromodichloromethane		U
cis-1,3-Dichloropropene		U
Toluene	1.6	J
trans-1,3-Dichloropropene		U
1,1,2-Trichloroethane		U
1,2-Dibromoethane		U
Tetrachloroethene		U
1,3-Dichloropropane		U
Dibromochloromethane		U
Chlorobenzene		U
1,1,1,2-Tetrachloroethane		U
Ethylbenzene		U
o-Xylene	2.1	J
m,p-Xylene	4.2	

TABLE 2-6 (continued)
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS VOLATILE ORGANIC COMPOUNDS

BUILDING	**B/690**
SAMPLE IDENTIFICATION	**CA-F Grab**
DATE OF COLLECTION	**2/8/99**
DILUTION FACTOR	**1**
PERCENT SOLIDS	**39.5**
UNITS	**(ug/kg)**
Styrene	U
Bromoform	U
Isopropylbenzene	U
Bromobenzene	U
1,1,1-Trichloroethane	U
1,1,2,2-Tetrachloroethane	U
1,2,3-Trichloropropane	U
n-Propylbenzene	U
2-Chlorotoluene	U
4-Chlorotoluene	U
1,3,5-Trimethylbenzene	U
tert-Butylbenzene	U
1,2,4-Trimethylbenzene	2.7
sec-Butylbenzene	U
1,3-Dichlorobenzene	U
4-Isopropyltoluene	U
1,4-Dichlorobenzene	U
1,2-Dichlorobenzene	U
n-Butylbenzene	U
1.2-Dibromo-3-chloropropane	U
1,2,4-Trichlorobenzene	U
Hexachlorobutadiene	U
Naphthalene	U
1,2,3-Trichlorobenzene	U
Dichlorodifluoromethane	U
Formaldehyde	U
TOTAL VOCs	14.2

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound found in the method blank as well as the sample.
J: Compound found at a concentration below the detection limit.

TABLE 2-7
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS SEMIVOLATILE ORGANIC COMPOUNDS

BUILDING	**B/690RR**
SAMPLE IDENTIFICATION	**CA-F Grab**
DATE OF COLLECTION	**2/8/99**
DILUTION FACTOR	**1**
PERCENT SOLIDS	**39**
UNITS	**(ug/kg)**
Phenol	U
bis(2-Chloroethyl)ether	U
2-Chlorophenol	U
1,3-Dichlorobenzene	U
1,4-Dichlorobenzene	U
1,2-Dichlorobenzene	U
2-Methylphenol	U
2,2'-oxybis(1-Chloropropane)	U
4-Methylphenol	U
N-Nitroso-di-n-propylamine	U
Hexachloroethane	U
Nitrobenzene	U
Isophorone	U
2-Nitrophenol	U
2,4-Dimethylphenol	U
bis(2-Chloroethoxy)methane	U
2,4-Dichlorophenol	U
1,2,4-Trichlorobenzene	U
Naphthalene	U
4-Chloroaniline	U
Hexachlorobutadiene	U
4-Chloro-3-methylphenol	U
2-Methylnaphthalene	U
Hexachlorocyclopentadiene	U
2,4,6-Trichlorophenol	U
2,4,5-Trichlorophenol	U
2-Chloronaphthalene	U
2-Nitroaniline	U
Dimethylphthalate	U
Acenaphthylene	U
2,6-Dinitrotoluene	U
3-Nitroaniline	U
Acenaphthene	U
2,4-Dinitrophenol	U
4-Nitrophenol	U

TABLE 2-7 (continued)
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS SEMIVOLATILE ORGANIC COMPOUNDS

BUILDING	**B/690RR**	
SAMPLE IDENTIFICATION	**CA-F Grab**	
DATE OF COLLECTION	**2/8/99**	
DILUTION FACTOR	**1**	
PERCENT SOLIDS	**39**	
UNITS	**(ug/kg)**	
Dibenzofuran		U
2,4-Dinitrotoluene		U
Diethylphthalate		U
4-Chlorophenyl-phenylether		U
Fluorene		U
4-Nitroaniline		U
4,6-Dinitro-2-methylphenol		U
N-Nitrosodiphenylamine		U
n-Nitrosodimethylamine		U
4-Bromophenyl-phenylether		U
Hexachlorobenzene		U
Pentachlorophenol		U
Phenanthrene		U
Anthracene		U
Di-n-butylphthalate		U
Fluoranthene		U
Pyrene		U
Butylbenzylphthalate		U
3,3'-Dichlorobenzidine		U
Benzo(a)anthracene		U
Chrysene		U
bis(2-Ethylhexyl)phthalate	140	J
Di-n-octylphthalate		U
Benzo(b)fluoranthene		U
Benzo(k)fluoranthene		U
Benzo(a)pyrene		U
Indeno(1,2,3-cd)pyrene		U
Dibenzo(a,h)anthracene		U
Benzo(g,h,i)perylene		U
Benzyl Alcohol		U
TOTAL PAHs	0	
TOTAL CaPAHs	0	
TOTAL SVOCs	140	

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound found in the method blank as well as the sample.
J: Compound found at a concentration below the detection limit.

TABLE 2-8
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS INORGANICS

BUILDING	B/690	
SAMPLE IDENTIFICATION	CA-F Comp.	
DATE OF COLLECTION	2/8/99	
DILUTION FACTOR	1	
PERCENT SOLIDS	40.1	
UNITS	(mg/kg)	
Arsenic	2.2	B
Beryllium	0.21	B
Cadmium	0.77	B
Chromium (Total)	20.0	
Lead	16.8	
Mercury		U
Nickel	8.0	
Silver	1.4	B
Cyanide, Amenable		U
Cyanide, Total		U

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound concentration is less than the CRDL, but greater than the IDL.

TABLE 2-9
INTERNATIONAL BUSINESS MACHINES CORPORATION EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY SLUDGE SAMPLING

TOTAL ANALYTICAL RESULTS DIOXINS AND FURANS

BUILDING	B/690
SAMPLE IDENTIFICATION	CA-F Grab
DATE OF COLLECTION	2/8/99
DILUTION FACTOR	1
PERCENT SOLIDS	39.1
UNITS	(ug/kg)
2,3,7,8-TCDD	U
1,2,3,7,8-PeCDD	U
1,2,3,4,7,8-HxCDD	U
1,2,3,6,7,8-HxCDD	U
1,2,3,7,8,9-HxCDD	U
1,2,3,4,6,7,8-HpCDD	U
1,2,3,4,6,7,8,9-OCDD	U
2,3,7,8-TCDF	U
1,2,3,7,8-PeCDF	U
2,3,4,7,8-PeCDF	U
1,2,3,4,7,8-HxCDF	U
1,2,3,6,7,8-HxCDF	U
2,3,4,6,7,8-HxCDF	U
1,2,3,7,8,9-HxCDF	U
1,2,3,4,6,7,8-HpCDF	U
1,2,3,4,7,8,9-HpCDF	U
1,2,3,4,6,7,8,9-OCDF	U
Total TCDD	U
Total PeCDD	U
Total HxCDD	U
Total HpCDD	U
Total TCDF	U
Total PeCDF	U
Total HxCDF	U
Total HpCDF	U

Qualifiers:
U: Analyzed for but not detected

TABLE 2-10
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

CURRENT TCLP ANALYTICAL RESULTS

Sample ID	9909590	0002183
Sample Type	Solid	Solid
Sample Date	11/1/99	3/27/00
Units	(mg/l)	(mg/l)
Arsenic	N/A	U
Cadmium	U	U
Chromium	0.0258	0.0180
Lead	U	U
Mercury	N/A	U
Nickel	U	0.0120
Silver	0.0056	0.0116

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound concentration is less than the CRDL,
but greater than the IDL.
N/A: Not analyzed for.

TABLE 2-11
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY
B/690 F/HM WASTEWATER TREATMENT FACILITY

CURRENT TOTAL ANALYTICAL RESULTS

Sample ID	CA-F Comp.		9909589		0002182	
Sample Type	Solid		Solid		Solid	
Sample Date	2/08/99		11/1/99		3/27/00	
Units	(mg/kg)		(mg/kg)		(mg/kg)	
Arsenic	2.2	B		N/A	1.281	
Cadmium	0.77	B	0.2590		0.2025	
Chromium	20		9.8006		6.0141	
Cyanide (amenable)		U		U		U
Cyanide (total)		U		U	0.671	
Lead	8		1.908		1.959	
Mercury		N/A		N/A		U
Nickel	8		8.3280		7.072	
Silver	1.4	B	0.1227			U

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound concentration is less than the CRDL,
but greater than the IDL.
N/A: Not analyzed for.

manufacture of cement are limestone, shells, and chalk or marl combined with shale, clay, slate, blast furnace slag, silica, sand and iron ore. Table 2-12 presents the typical raw mix analytical composition of cement.

In addition, Table 2-12 provides a comparison of the typical raw mix analytical composition of cement with the analytical composition of the IBM F006 sludge derived from elemental analysis.[1] This comparison documents the fact, excluding consideration of the hazardous constituents (which are well below LDR treatment standards), that the composition of sludge is similar to the typical raw material utilized in the manufacture of cement.

2.2.9 Effect of Sludge on Cement Product

The addition of the wastewater treatment sludge generated at the B/690 F/HM Wastewater Treatment Facility will have no measurable effect on the commercial properties or composition of the cement product. This conclusion is based on the fact that the composition of the sludge is similar to that of the naturally occurring or manmade materials typically utilized as a cement feed stock. A summary of the analytical results of feedstock samples obtained from five cement kilns in comparison to the IBM sludge is presented in Appendix A.

Prior to initiating the sludge recycling project in 1987, IBM conducted a detailed engineering evaluation of the recycling project.[2] In addition, in 1988, IBM conducted a "trial run" of the recycling of the sludge as an ingredient in the manufacture of cement and conducted chemical analysis of the cement with and without IBM sludge as an ingredient.[3] Based on these analytical results, which are presented on Table 2-13, it appears that the sludge has no measurable effect on the composition of the cement product. This XL project has the potential for providing additional data of this type.

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[1] A Trial Run of Recycling Lime Sludge into Portland Cement for IBM East Fishkill, February 1989, Brian W. Doyle Engineering, P.C.

[2] Initial Evaluation of the Conversion of Fluoride Sludge to Portland Cement, August 1986, Brian W. Doyle Engineering, P.C.

[3] A Trial Run of Recycling Lime Sludge into Portland Cement for IBM East Fishkill, February 1989, Brian W. Doyle Engineering, P.C.

Table 2-12

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

COMPARISON OF TYPICAL RAW MIX ANALYSIS FOR CEMENT AND IBM F006 SLUDGE

	Chalk	Clay	Limestone	Shale	Marl	Typical Raw Mix	IBM F006 Sludge
SiO_2	1.14	60.48	2.16	55.67	16.86	14.30	13.09
Al_2O_3*	0.28	17.79	1.09	21.50	3.38	3.03	5.94
Fe_2O_3	0.14	6.77	0.54	9.00	1.11	1.11	0.36
CaO**	54.68	1.61	52.72	0.89	42.68	44.38	41.33
MgO	0.48	3.10	0.68	2.81	0.62	0.59	0.89
S	0.01	n.d.	0.03	0.30	nil	nil	nil
SO_3	0.07	0.21	0.02	nil	0.08	0.07	8.45***
Loss On Ignition	43.04	6.65	42.39	4.65	34.66	35.86	28.65
K_2O	0.04	2.61	0.26	4.56	0.66	0.52	0.04
Na_2O	0.09	0.74	0.11	0.82	0.12	0.13	0.08
	99.97	99.96	100.00	100.20	100.17	99.99	98.83

Notes: Source: Lea's Chemistry of Cement and Concrete, Peter C. Hewlett, 4th edition (December 1997).

IBM F006 Sludge Composition Adapted from the document entitled, "A Trial Run of Recycling Lime Sludge into Cement for IBM East Fishkill, February 1989, Brian W. Doyle Engineering, P.C."

* Reported Values for $A1_2O_3$ also includes P_2O_5, TiO_2, and Mn_2O_3.

** As stated in Section 2.2.7, calcium is primarily present in the sludge as calcium hydroxide, calcium carbonate and calcium fluoride. The concentration of calcium is expressed as CaO in Table 2-12 to be consistent with literature values.

***Present as Sulfates.

TABLE 2-13
INTERNATIONAL BUSINESS MACHINES CORPORATION - EAST FISHKILL FACILITY

CHEMICAL ANALYSIS OF PORTLAND CEMENT WITH AND WITHOUT IBM SLUDGE AS AN INGREDIENT

Chemical Constituent	ICC Cement Product			
	4-18-88 w/o IBM Sludge (ppm)	6-2-88 w/IBM Sludge (ppm)	6-22-88 w/IBM Sludge (ppm)	7-4-88 w/o IBM Sludge (ppm)
Ca	458,680	458,880	463,920	427,540
Si	89,950	94,130	91,650	82,270
Fe	24,160	24,200	30,460	25,130
Al	18,380	17,960	18,250	16,800
Mg	6,330	5,580	4,990	5,780
Cr (total)	83	104	92	78
Ni	27	24	24	31
Cd	43	27	71	66
Pb	26	29	21	32
Ag	63	31	61	46

Source: A Trial Run of Recycling Lime Sludge into Portland Cement for IBM East Fishkill, Brian W. Doyle Engineering, P.C., February 1989.

Furthermore, in a letter dated May 19, 2000, EPA Region 2 raised the following question regarding the utilization of IBM F006 sludge in the manufacture of cement:

> *"One specific question worth noting…is the fate of the relatively high concentrations of calcium fluoride in the sludge when the sludge is used as an ingredient to produce cement and what, if any, impact the fluoride has on the cement product."*

In response to this comment, we offer the following. According to Construction Technology Labs (CTL), a wholly-owned subsidiary of the Portland Cement Association, the maximum fluoride concentration in cement *product* is typically between 0.5% to 0.6%. The IBM sludge (which is an *ingredient*) has a typical concentration of calcium fluoride (CaF_2) of approximately 8%, which yields an effective fluoride (F^-) concentration of approximately 4% in the sludge. After discussing the matter further with CTL, they concluded that utilizing the IBM sludge would not create any problems with regard to the quality of the cement product provided the sludge did not replace more than 10% of the limestone used as a raw material. Since IBM can only supply, on average, approximately 2.2 tons of the F006 sludge per day, and a typical cement kiln requires approximately 100 tons per hour of raw material, this is not a concern.

It should be noted that this type of analysis on raw material feedstocks is a customary practice in the cement manufacturing industry. Because the chemical make-up of raw materials (such as limestone, clay and shale) varies from site to site and even within the same site, cement manufacturers often must analyze the raw materials to determine the concentration, if any, of naturally occurring contaminants or other constituents relevant to the production of cement (such as fluoride) to ensure the appropriate blend of raw materials to yield a cement product with the desired product characteristics (or specifications). Such analysis and blending of raw materials can entail the blending of, for example, limestone from different quarries to achieve the appropriate concentration of calcium in the feedstock mix without introducing a naturally occurring constituent in one of the types of limestone at levels that could be detrimental to the specific type of cement being produced. The use of IBM's wastewater treatment sludge as an ingredient in cement manufacturing will be consistent with the use of analogous raw materials.

In addition, according to the report entitled, "Discussion of the Influence of Fluoride on Cement Kiln Operation," prepared by Brian W. Doyle Engineering, P.C. dated September 1, 1987 (see Appendix B), the addition of the IBM sludge to the feed of a typical cement kiln is expected to raise the fluoride content of the feed by approximately 0.03%. "…Since IBM's contribution of fluoride to the kiln feed will be an order of magnitude less than the amounts which are known to affect the kiln, it is unlikely that the fluoride will have a noticeable effect on cement plant operations."

2.2.10 Transport of Sludge to Cement Facility

IBM currently transports sludge off-site in lined 25 cubic yard roll-off containers to a permitted land disposal facility, where it undergoes stabilization by mixing with cement prior to land disposal. Transportation to the cement manufacturing facility will be conducted in the same manner; however, the distance to the cement kiln is expected to be less than the distance to the current permitted landfill.

2.2.11 Processing of Sludge at Cement Facility

As part of the previous sludge recycling project, sludge was transported to the cement kiln in 25 cubic yard dumpsters. The dumpsters were emptied in a segregated area at the cement plant and loaded into the cement kiln utilizing a bucket loader. Processing and handling of the sludge is proposed to be managed in a similar manner as part of the re-implementation of this recycling project. This will preclude the sludge from being placed, stored or staged directly on the land, it will provide protection of the material from precipitation events and any associated storm water runoff and it will otherwise assure that the sludge is not subject to any dispersion from wind. A more detailed discussion of these management practices is also presented in Section 3.8 - Evaluation, Monitoring and Accountability.

3.0 HOW THE PROJECT WILL MEET THE PROJECT XL ACCEPTANCE CRITERIA

3.1 Anticipated Superior Environmental Performance

Since 1985, the EPA has placed increasing emphasis on the environmentally sound recycling of hazardous waste as a preferred management scenario as opposed to treatment and disposal. However, RCRA regulations can often pose a major disincentive to recycling when one considers the time and resources required to apply for permits, increased transportation costs, and the stigma of labeling a substance a "hazardous waste," thus decreasing a product's competitiveness in the marketplace. This XL project explores an approach to allowing the recycling of a hazardous waste in an environmentally sound manner without the often complex and burdensome requirements of a RCRA management scenario.

By using the F006 sludge in the manufacture of cement, a number of environmental benefits can be realized. These include:

- This XL project's recycling focus provides the benefits of conserving natural resources by utilizing the F006 sludge as an ingredient in the manufacture of a commercially available product; cement. While the volume of sludge in question may be relatively insignificant when compared to the volume of raw materials typically processed by a cement kiln, the use of the F006 sludge will slow the consumption of non-renewable resources. Reuse of waste material in lieu of continuing to consume a nonrenewable resource, not to mention the oftentimes irreparable harm to the landscape as a direct result of surface mining/quarrying techniques, is an added benefit.

- This XL project will test the recycling of F006 sludge (that meets certain criteria) as an ingredient in the manufacture of a commercially available product. Such recycling would offer an environmentally beneficial alternative to ultimate disposal of the sludge in a permitted hazardous waste landfill. The current practice of disposing recyclable F006 sludge in hazardous waste landfills is an inefficient use of expensive and valuable landfill capacity which in and of itself is a limited resource. Landfilling represents a disposal option which is the least attractive and the lowest alternative on EPA's RCRA waste management hierarchy. An additional environmental benefit of this project is the conservation of that existing landfill capacity for disposal of other (non-recyclable) hazardous waste.

This XL project will result in superior environmental performance by promoting an environmentally sound recycling scenario. The experience and data gained from this project may also be useful to EPA in assessing whether broader regulatory relief for this type of recycling practice may be feasible and environmentally protective on a national level.

3.2 Flexibility and Other Benefits

Federal [40 CFR 261.2(e)(1)(i)] and New York State [371.1(c)(6)(i)(a)] regulations affecting the definition of a solid waste indicate…

"…(e) Materials that are not solid waste when recycled.

(1) Materials are not solid wastes when they can be shown to be recycled by being:

(i) Used or reused as ingredients in an industrial process to make a product, provided the materials are not being reclaimed, ..."

The regulation continues by placing some constraints on the applicability of the above exclusion.

"…(2) The following materials are solid wastes, even if the recycling involves use, reuse, or return to the original process (described in paragraphs (e)(1)(i) through (iii) of this section):

(i) Materials used in a manner constituting disposal, or used to produce products that are applied to the land; ...."

Given this constraint, IBM's sludge remains a solid waste and a listed hazardous waste (F006) because it is recycled into a product, cement, that will be "applied" to the land. Such use of IBM's F006 sludge is termed "use constituting disposal" (UCD). It is not subject to the exclusion from the definition of a solid waste (and thus from RCRA jurisdiction) described at 40 CFR 261.2(e)(1)(i) and 6 NYCRR 371.1(c)(6)(i)(a). Therefore, IBM's sludge is subject to RCRA requirements while being stored at the IBM site, transported to a cement kiln, and stored at the cement company while awaiting recycling. The cement kiln would be required to obtain a permit to store hazardous waste before the sludge could be to recycled in a manner constituting disposal, and this poses a great disincentive to recycling of F006 sludge. The cement kiln would also be required to monitor its cement kiln dust to demonstrate that the Bevill exclusion still applies to the dust. Finally, monitoring would be required to demonstrate that the cement product itself is in compliance with land disposal restrictions, and therefore, exempt from regulation.

To overcome these disincentives to recycling that apply when recycling is use constituting disposal, flexibility will be provided within the scope of this project. This flexibility, a conditional exclusion to the solid waste definition, can be offered because the sludge is relatively clean, the levels of contaminants are not significantly higher than the normal raw material, and its composition is similar to the raw material. The implementing mechanism (see Section 4.0) will allow the proposed project to proceed in an environmentally sound manner.

During this project, F006 sludge will be commingled with naturally occurring aggregate at a ratio of approximately 200:1 (naturally occurring quarry material: sludge). The reason for the relatively low volume of sludge is simply that there is not sufficient sludge available from the IBM East Fishkill facility in a given period of time to meet the volume requirements for raw materials at a typical cement kiln. (Beyond the constraint posed by the rate of generation of IBM's sludge, the level of constituents, such as fluoride, may lead to an increase in the ratio at which naturally occurring aggregate and sludge may be commingled.) Next, the aggregate/sludge mixture will move through the kiln at a temperature of approximately 2,700°F, where it undergoes complex chemical and physical changes. The kiln will be equipped with appropriate air pollution control equipment to capture any volatile metals and particulates. This air pollution control equipment is a necessary part of the cement production process with or without the addition of the F006 sludge. The end result of the process is cement, and the sludge has undergone chemical reactions in the course of producing the cement that make it inseparable from the cement by physical means.

Typically, the cement is utilized to make concrete. When the cement is mixed with water and sand or larger sized aggregate depending on its intended use, it undergoes a pozzolanic, exothermic reaction in which the crystalline structure of the final product undergoes a transformation. It may then be poured as a part of a structure, some portion of which could come into contact with the land. It is this contact of the product with the land that causes recycling of the sludge to be use constituting disposal. The flexibility provided by conditionally excluding IBM's sludge from the definition of a solid waste will ensure that the typical UCD limitations and associated RCRA requirements will not apply for the duration of this project.

As discussed in greater detail in Section 2.0 of this document, recent testing of the IBM F006 sludge has demonstrated that the sludge is comparable to the typical raw materials utilized in the production of cement as far as the chemical constituents and their concentrations are concerned. In addition, comparison of the sludge analytical results to the LDR treatment standards indicates that the sludge meets the land disposal restriction concentration thresholds prior to being recycled.

<u>Benefits</u>

There are actual benefits and potential benefits associated with this project. The potential benefits are far reaching and could have positive environmental and economic impacts. If a project such as this were approved on a small scale and carefully monitored, it could be transferable to similar situations across the country. Current EPA estimates of F006 sludge generation in the United States range from 360,000 tons to 500,000 tons per year on a dry weight basis.[4] As a result, the potential "transferability" of a recycling project such as this has broad-based applicability to a larger cross section of manufacturing operations throughout the United States.

In advancing this project, significant improvements will be made in achieving a more acceptable management practice for this waste stream rather than disposal in a landfill.

Other benefits include:

- More acceptable waste management option in EPA's hierarchy

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[4] Metal Finishing F006 Benchmarking Study, United States Environmental Protection Agency, October 1998.

- Cost savings due to lack of landfilling cost. It costs IBM approximately $39,000 to transport and dispose of the F006 sludge it generates in a typical year. While this project may not *generate* income, it surely will lend itself to reductions in the cost associated with disposal. Some portion of the transportation cost will likely remain as we believe most cement kilns will not pay to have the material transported to the site.

- Conservation of landfill capacity as a limited resource

- Conservation of natural resources resulting from a reduction in the volume of mining naturally occurring aggregate.

3.3 Cost Savings and Paperwork Reduction

Cost Savings

A number of cost savings may be realized from the implementation of this F006 sludge recycling project. In summary, these would include:

Disposal Costs – In calendar year 1998, the IBM East Fishkill facility disposed of over 800 tons of F006 sludge generated from its B/690 and B/386 operations via landfilling. Prior to landfilling, the sludge is stabilized as required by the Land Disposal Restrictions.

Assuming that IBM generates approximately 300 tons of F006 sludge at its B/690 F/HM Wastewater Treatment Facility, and it currently costs approximately $95 per ton to dispose of the material, this project could realize a disposal cost saving of up to $28,500 per year.

Transportation Costs - IBM spends approximately $35 per ton to transport its F006 sludge to a permitted landfill in Canada.

The specific transportation related costs are a function of the ultimate location of the kiln. While the kiln will likely accept the material at no cost, it is unlikely that the kiln will pay the transportation cost. Therefore, in reality the transportation component of the cost analysis may not realize any savings. However, as stated above, since the kiln utilized to recycle the F006 sludge will likely be located in closer proximity to the IBM East Fishkill facility relative to the existing landfill utilized for ultimate disposal, some transportation cost savings will likely be realized.

Avoided Costs

The following presents a discussion of the potential "avoided" costs associated with the recycling of F006 sludge as an ingredient in the manufacture of cement. The discussion has been organized into "paperwork costs," "disposal costs" and "regulatory costs."

Paperwork - As discussed earlier, the F006 sludge generated at the IBM East Fishkill facility is transported to Canada for ultimate disposal in a permitted landfill. Under this disposal scenario, costs are incurred by IBM related to the completion of "paperwork" required at the federal and New York State levels of government. In addition, costs associated with government representatives at the federal and state levels reviewing and monitoring that paperwork for accuracy, completeness and regulatory compliance are needed. Specific examples of such avoided "paperwork costs" include the following:

- *Export Notification* - In accordance with the RCRA hazardous waste management regulations, hazardous waste generated in the United States and transported to Canada must comply with a sophisticated export notification procedure involving representatives of EPA - Headquarters and Region 2, the New York State Department of Environmental Conservation as well as the Ministry of the Environment in Canada. There is a significant amount of time involved for IBM representatives to properly implement the export notification procedures and paperwork as well as resources at both the federal and state levels of government to receive, check and manage the notification process.

- *Hazardous Waste Manifests (United States and Canada)* - Shipments of hazardous waste from the United States to Canada require the execution of manifest/shipping documents for both the governments of the United States and Canada. Again, there is time involved for IBM personnel to properly prepare, review and manage the manifest systems for both countries, as well as federal and state regulators to review, process and track the manifests in both the United States and Canada to assure compliance. In addition, time is required for the transporter to properly complete its responsibilities in tracking/managing paperwork under the manifest system.

- *Annual Generator Report* - Lastly, under the current land disposal scenario, resources are expended at both the federal and primarily state levels to review and manage the annual generator reporting process. By implementing the sludge recycling program, costs associated with completing, reviewing and checking that portion of the annual generator report prepared for the facility and addressing the generation of F006 would be avoided.

Disposal - The principal avoided cost associated with this recycling project is the disposal costs. Once this project is on-line, sludge previously destined for disposal in a permitted landfill at $90 per ton will be transported to a kiln which will recycle the sludge as an ingredient in the manufacture of cement. In this manner, disposal costs are avoided.

In addition to direct costs associated with the transportation and disposal of F006 sludge in a landfill, there are fees/assessments in New York State that will be avoided if the sludge is recycled. In New York State, a hazardous waste generator is assessed $27 for each ton of hazardous waste disposed in a permitted landfill. The fee structure in New York State is designed to "penalize" those generators selecting land disposal as the ultimate disposal management scenario, with lesser per ton assessments charged for management options higher on EPA's hazardous waste management hierarchy. IBM could realize a cost savings of approximately $8,000 annually in waste generation and management fees.

3.4 Stakeholder Involvement and Support

Public participation is an integral part of the XL process, and as such, IBM has encouraged interested stakeholders to pursue an active role in project development. In addition to contacting a broad base of potential stakeholders in the local community, IBM has and will continue to conduct considerable outreach to a regional and national cross section of potentially interested parties.

As an example, prior to the submittal of the original Project XL Proposal, IBM prepared a Preproposal Technical Information Document as a means of initiating stakeholder involvement. This Preproposal Document was submitted to the EPA Region 2 and the Office of Solid Waste at EPA Headquarters in Washington, D.C. as well as the New York State Department of Environmental Conservation (NYSDEC).

Based on the review of the Preproposal Document, both the EPA Region 2 and Headquarters as well as the NYSDEC expressed support for the project. As a result, IBM contacted the EPA Project XL Coordinator, Ms. Aleksandra Dobkowski-Joy, to develop a strategy for identifying and convening a stakeholder group on a broader base that would involve the local community, IBM internal staff/employees as well as other national environmental groups.

In an effort to solicit additional stakeholders for assistance with this XL project, IBM prepared a document entitled, "Stakeholder Outreach Plan," dated June 2000 to outline the procedures developed to identify stakeholders, outline the overall objectives of the plan and initiate the implementation of a stakeholder participation program in support of the project. The Stakeholder Outreach Plan is available on the internet at the national XL website; http://www.epa.gov/projectxl.

In addition, presented below is a brief summary of some recent activities completed by IBM East Fishkill in meeting both the spirit and the letter of the Stakeholder Outreach Plan. IBM is undertaking these initiatives in an effort to continue to solicit interest from a targeted audience of environmental groups as stakeholders associated with this XL project.

Dutchess County Environmental Management Council: The mandate of the Dutchess County Environmental Management Council (EMC) is to make recommendations to county and local governments on all matters affecting the environmental quality of Dutchess County and to educate the decision-makers and the general public on these matters. The EMC is comprised of 21 representatives who advise their local governments and citizens on environmental issues. IBM requested a meeting with the EMC to present its proposal regarding the F006 sludge recycling project under the EPA's Project XL Program. The EMC responded by granting IBM permission to make a presentation at its April 26, 2000 meeting and sent out a notice of the meeting agenda to approximately 400 interested citizens and organizations on its mailing list in an effort to engender public interest. On the evening of April 26, 2000, IBM gave a presentation describing the project at the monthly EMC meeting which was followed by a question and answer session.

Town of East Fishkill Conservation Advisory Council: On May 3, 2000, IBM made a presentation before the Town of East Fishkill Conservation Advisory Council (CAC) regarding the F006 sludge recycling project under EPA's Project XL Program. Subsequent to the presentation, a question and answer period followed. Questions included topics such as the presence of volatile organic compounds in the sludge, whether any cement kilns have expressed interest in the project, how much sludge would be included in the cement, how would the cement kiln manage the sludge, and whether other generators of F006 sludge could implement the project. Following the one-hour presentation and discussion session, there was a general consensus among the CAC members that the project should be supported.

Atlantic States Legal Foundation, Inc: On June 15, 2000, representatives of IBM, EPA and IBM's consultant (William F. Cosulich Associates, P.C.) met with Mr. Samuel H. Sage, President of the Atlantic States Legal Foundation, Inc., to discuss the sludge recycling project. In addition, considerable discussion centered around how the Atlantic States Legal Foundation, Inc. could best serve the goals and objectives of the project by committing to a specific level of stakeholder involvement. At that time, various options for stakeholder involvement by Atlantic States Legal Foundation, Inc. were discussed and are under consideration.

3.5 Innovative Approach and Pollution Prevention

3.5.1 Pollution Prevention Activities Implemented at the IBM East Fishkill Facility

Pollution Prevention is the cornerstone of the IBM East Fishkill environmental philosophy. The East Fishkill Pollution Prevention Program has been ongoing for over 20 years and has been long recognized as an important factor in the planning and design of the process operations at the facility. The program has been recognized by being the recipient of the New York State Governor's Award for Pollution Prevention in 1994 as well as USEPA's Region 2's 1996 Environmental Quality Award among numerous others.

Specific pollution prevention projects which have been incorporated into the manufacturing processes associated with the ASTC and which directly affect the quality of sludge generated as a result of the treatment of electroplating wastewater include:

BSG Etch by Hydrofluoric Acid Vapor - This pollution prevention project involved replacing liquid hydrofluoric acid (HF) with hydrofluoric acid vapor in the BSG etch process. This resulted in a reduction in the quantity of HF liquid and sulfuric acid treated at the B/690 F/HM Wastewater Treatment Facility. This project was implemented in November 1998 and reduced sulfuric acid waste by 780 gallons per year and hydrofluoric acid waste by 156 gallons per year.

Removal of SMS Tool – This pollution prevention project involved removing the SMS tool from the process and converted existing SCP tools to run acid processes utilizing a smaller bath size. This project was implemented in February 1998 and reduced chromic/phosphoric acid waste by 8 gallons per week, hydrofluoric acid waste by 8 gallons per week and DI water flow to the B/690 F/HM Wastewater Treatment Facility by 7 gallons per minute.

FSI 100 Wafer Batching – This pollution prevention project involved modifying the batching requirements to allow the FSI 100 wafer tools to be run at or near capacity by combining compatible technologies. The process involved cleaning on one tool and cleaning and etching on the second tool. This project was implemented in April 1998 and reduced the quantity of waste 49% hydrofluoric acid by 4.8 gallons per day and wastewater to the B/690 F/HM Wastewater Treatment Facility by 1 gallon per minute.

FSI Tool Replacement - This pollution prevention project minimized chemical usage by utilizing a 50 wafer capacity tool in the Back End of Line (BEOL) process area. This allowed the tool to be run at or near capacity. This project was implemented in May 1998 and reduced the quantity of waste dilute hydrofluoric acid by 900 gal/year and wastewater to the B/690 F/HM Wastewater Treatment Facility by 1 gallon per minute.

Eliminate 7:1 Buffered Hydrofluoric Acid - This pollution prevention project involved replacing 7:1 buffered hydrofluoric acid (BHF) with an existing 40:1 BHF for the oxide etch process. This project was completed in May 1999 and reduced hydrofluoric acid waste by 2,351 gallons per year.

Shutdown of FSI Tool - This pollution prevention project involved shutting down an FSI tool that was utilized to strip films from monitor or test wafers by moving the process into another existing tool (SCP tank tool). This project was implemented in June 1998 and reduced hydrofluoric acid waste by 2,574 gallons per year and wastewater to the B/690 F/HM Wastewater Treatment Facility by 8 gallons per minute.

Crack Stop Etch Process Elimination - This pollution prevention project involved the elimination of the crack stop etch process. The crack stop etch process was no longer required due to ongoing process improvements. This project was completed in May 1999 and eliminated 3,600 gallons per year of hydrogen peroxide waste which was discharged to the B/690 F/HM Wastewater Treatment Facility. In addition, wastewater flow to the B/690 F/HM Wastewater Treatment Facility was reduced by 140 gallons per day.

Chromic/Phosphoric Acid Elimination - This pollution prevention project involved replacing chromic/phosphoric acid in a metal cleaning process with a very dilute mixture of sulfuric acid and hydrogen peroxide. This project was completed in May 1999 and reduced the use of chromic/phosphoric acid by approximately 2,400 gallons per year. In fact, implementation of this project has eliminated chromic/phosphoric acid from the ASTC. In addition, wastewater flow to the B/690 F/HM Wastewater Treatment Facility was reduced by 140 gallons per day.

Backside Etch Elimination - This pollution prevention project involved the elimination of a backside etch step in the semiconductor process. In this process, 49% hydrofluoric acid was utilized to strip unwanted oxide and nitride films from the back of wafers. The mixture of 49% hydrofluoric acid and nitric acid which was utilized for other applications was also eliminated. This project was implemented in May 1999. This project reduced the quantity of 49% hydrofluoric acid waste by 700 gallons per year. In addition, wastewater flow to the B/690 F/HM Wastewater Treatment Facility was reduced by 15 gallons per day.

This XL project is a natural extension of the pollution prevention efforts already undertaken at the East Fishkill facility. This project is consistent with EPA's Project XL guidance document entitled, "Project XL: Best Practices for Proposal Development." On page 13 of that document Section D, Innovation or Pollution Prevention states the following...

> "…EPA strongly encourages proposals which include strategies promoting pollution prevention and new technologies that improve environmental protection. Project themes EPA is particularly interested in include:
>
> - *approaches that encourage source reduction and recycling of hazardous waste or materials produced or used during manufacturing or commercial operations."*

The essence of this F006 recycling project speaks for itself in this regard as it proposes to utilize a hazardous waste as an ingredient in the manufacture of cement. In addition, the recycling of the F006 sludge into cement achieves a higher position on EPA's hierarchy of waste management options, moving from ultimate disposal to a recycling scenario.

3.5.2 New Pollution Prevention Initiatives Related to the Current XL Project

As stated earlier, IBM generates a total of approximately 825 tons of F006 sludge annually from a combination of two separate F/HM wastewater treatment facility operations. Initially, the sludge from the B/690 F/HM Wastewater Treatment Facility process serving the West Complex, which generates approximately 300 tons annually, will be utilized as part of this F006 recycling process.

If this initial Project XL Proposal is approved and successfully implemented, IBM will consider undertaking additional waste minimization measures in order to facilitate the reuse of the sludge generated at its B/386 F/HM Wastewater Treatment Facility as well. Among other elements, these waste minimization measures could include evaluating, designing and installing pretreatment equipment on specific manufacturing processes in order to make the approximately 500 tons of sludge generated annually at the B/386 F/HM Wastewater Treatment Facility more amenable for the recycling project (should the regulatory flexibility be eventually transferred beyond this project).

3.6 Transferability

The experience and data gained from this particular project may be useful to EPA and the NYSDEC in assessing whether broader regulatory relief for this type of recycling practice is feasible in New York State and across the United States. The eventual transferability of this project will depend on the data that it generates with regard to the effectiveness and safety of using this type of sludge as an ingredient in the manufacture of cement. Such data could be useful in supporting any future EPA regulatory initiatives regarding the recycling of F006 to make cement products. We do not expect, however, that the project will generate substantial amounts of data on the wide variety of other F006 waste streams that could potentially be used to make cement; such additional data would be required before EPA would be in a position to develop a national rulemaking for this particular recycling scenario.

In an October 7, 1998, study entitled, "Metal Finishing F006 Benchmarking Study," prepared by EPA's Office of Solid Waste (OSW), the amount of F006 sludge generated in the United States each year was estimated to range from 360,000 to 500,000 tons of dry weight equivalent. We recognize that F006 sludge quality across the country will vary significantly depending on the manufacturing sector generating the waste. In fact, some portion of this waste stream may prove to be inappropriate for any current recycling technology. However, even assuming that a fairly significant volume of this national waste stream may be more amenable to other forms of recycling such as metal recovery, the recycling into cement of even a small portion of this total volume of sludge could represent a contribution to achieving superior environmental performance.

3.7 Feasibility

IBM has in the past and continues to demonstrate a long-standing commitment to pollution prevention, waste minimization and recycling. This is very clearly demonstrated by the fact that IBM East Fishkill had designed and implemented a similar F006 sludge recycling project from 1988 to 1991. During that timeframe, IBM recognized the value of its F006 sludge and pursued a recycling project using the material as an ingredient in the manufacture of cement. As part of the project development undertaken to support the initiation of that recycling program, IBM undertook and completed a pilot study to successfully demonstrate the technical feasibility of the project. After demonstrating its technical feasibility, IBM implemented the project on a full-scale basis. In short, the technical feasibility of a recycling program such as this is not based on simply an engineering evaluation and analysis on paper, but a proven, demonstrated, long-term operation as both a pilot project and full-scale program for an approximate 3-year time frame.

IBM is fully committed to the merits of this XL project, and will continue to support its development and implementation.

3.8 Evaluation, Monitoring and Accountability

Within the limits of this pilot project, regulatory flexibility would supercede the UCD requirements that would ordinarily apply and thus overcome the barriers to recycling of IBM's sludge. These barriers are a direct consequence of the UCD requirements. Given such flexibility, there must be a commensurate level of accountability, monitoring and evaluation for this pilot project.

With regard to the issue of accountability, the IBM East Fishkill facility is a hazardous waste generator and a permitted storage facility. As such, IBM agrees to conduct inspections, analyze the sludge, and generally meet the RCRA management standards that would otherwise not be applicable to the sludge subject to this XL project (i.e., sludge that is proposed for exclusion from the definition of solid waste, which is discussed more fully in Section 4.0). IBM will extend its accountability to this project and implement the voluntary commitments discussed below.

Commitments

As part of this project, IBM understands that monitoring the chemical quality of the sludge being transported to the cement kiln for recycling is an important component of managing this recycling project as a successful aspect of the facility's overall pollution prevention/waste minimization program. As such, IBM will commit to undertaking a sludge sampling and laboratory analysis program for appropriate chemical constituents. The program is designed around specific chemical constituents identified by EPA as the "basis for listing" as well as the Land Disposal Restriction treatment standards and will be sampled by IBM personnel and analyzed at an Environmental Laboratory Approval Program (ELAP) laboratory. As of August 2000, IBM has collected and analyzed a total of three sludge samples and submitted the data to the USEPA and NYSDEC in support of this sludge recycling proposal. Those data are included in this FPA on Table 2-11. Going forward, IBM will collect and analyze an additional sludge sample every three months (one during each quarter) until a total of 12 sludge samples have been collected and analyzed in support of this project. Thus, nine more samples will be collected and analyzed at three month intervals. As is discussed below, the frequency of sampling and analysis will change to every six months after this initial period of proposal development and project implementation.

The Quality Assurance/Quality Control Plan summary provided on Table 3-1 and outlined below identifies the specific components of the sludge sampling and analysis program. These include:

- the list of specific chemical constituents of concern;
- the method of analysis;
- the sample collection protocol;
- the frequency of sample collection and analysis;
- holding times and preservation methods; and
- the rationale for the selection of each chemical species.

Table 3-1

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

QUALITY ASSURANCE/QUALITY CONTROL PLAN SUMMARY
F006 SLUDGE SAMPLE COLLECTION AND ANALYSIS FOR PROJECT XL

Constituent of Concern	Method of Analysis			Sample Collection Protocol	Frequency**	Preservation Method	Holding Time***	Rationale
	Method	TCLP*	Total					
Cadmium	ICP, Method 6010 or A.A.-Direct Aspiration Method 7130, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR****	Regulated hazardous constituent per land disposal restrictions, basis for listing of F006 sludge, and utilized in the manufacturing process
Chromium	ICP, Method 6010 or A.A.-Direct Aspiration Method 7190, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR	Regulated hazardous constituent per land disposal restrictions, and utilized in the manufacturing process
Cyanide (total)	Total and Amendable Cyanide Method 9012, SW-846	No	Yes	Grab/Composite	Quarterly	Cool to 4°C	14 days from VTSR	Regulated hazardous constituent per land disposal restrictions, and utilized in the manufacturing process

*If performing TCLP, samples must first undergo extraction by USEPA SW-846 Method 1311.
** Quarterly sample collection and analysis until such time as 12 sample events have occurred. At that time, sample collection and analysis will occur at a 6-month frequency provided that no modification to the manufacturing process has occurred.
***Holding times are based upon NYSDEC 10/95 ASP QA/QC requirements.
****VTSR - Validated Time of Sample Receipt.

Table 3-1 (continued)

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

QUALITY ASSURANCE/QUALITY CONTROL PLAN SUMMARY
F006 SLUDGE SAMPLE COLLECTION AND ANALYSIS FOR PROJECT XL

Constituent of Concern	Method of Analysis			Sample Collection Protocol	Frequency**	Preservation Method	Holding Time***	Rationale
	Method	TCLP*	Total					
Cyanide (amenable)	Total and Amendable Cyanide Method 9012, SW-846	No	Yes	Grab/Composite	Quarterly	Cool to 4°C	14 days from VTSR****	Regulated hazardous constituent per land disposal restrictions, and utilized in the manufacturing process
Lead	ICP, Method 6010 or A.A.-Furnace Technique Method 7421, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR	Regulated hazardous constituent per land disposal restrictions, and utilized in the manufacturing process
Nickel	ICP, Method 6010 or A.A.-Direct Aspiration Method 7520, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR	Regulated hazardous constituent per land disposal restrictions, basis for listing of F006 sludge, and utilized in the manufacturing process
Silver	ICP, Method 6010 or A.A.-Direct Aspiration Method 7760, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR	Regulated hazardous constituent per land disposal restrictions, and utilized in the manufacturing process

*If performing TCLP, samples must first undergo extraction by USEPA SW-846 Method 1311.

** Quarterly sample collection and analysis until such time as 12 sample events have occurred. At that time, sample collection and analysis will occur at a 6-month frequency provided that no modification to the manufacturing process has occurred.

***Holding times are based upon NYSDEC 10/95 ASP QA/QC requirements.

****VTSR - Validated Time of Sample Receipt.

Table 3-1 (continued)

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

QUALITY ASSURANCE/QUALITY CONTROL PLAN SUMMARY
F006 SLUDGE SAMPLE COLLECTION AND ANALYSIS FOR PROJECT XL

Constituent of Concern	Method of Analysis			Sample Collection Protocol	Frequency**	Preservation Method	Holding Time***	Rationale
	Method	TCLP*	Total					
Hexavalent Chromium	Colorimetric, Method 7196, SW-846	No	Yes	Grab/Composite	Quarterly	Cool to 4°C	24 hours from VTSR****	Basis for listing of F006 sludge, and utilized in the manufacturing process
Cyanide (complexed)	Total and Amendable Cyanide Method 9012, SW-846	No	Yes	Grab/Composite	Quarterly	Cool to 4°C	14 days from VTSR	Basis for listing of F006 sludge, and utilized in the manufacturing process
Arsenic	ICP, Method 6010 or A.A.-Furnace Technique, Method 7060, SW-846	Yes	Yes	Grab/Composite	Quarterly	Cool to 4°C	6 months from VTSR	Specifically requested by USEPA and utilized in the manufacturing process
Fluoride	Lachat Method 10-109-12-2-A	No	Yes	Grab/Composite	Quarterly	Cool to 4°C	28 days from VTSR	Specifically requested by USEPA and utilized in the manufacturing process

*If performing TCLP, samples must first undergo extraction by USEPA SW-846 Method 1311.

** Quarterly sample collection and analysis until such time as 12 sample events have occurred. At that time, sample collection and analysis will occur at a 6-month frequency provided that no modification to the manufacturing process has occurred.

***Holding times are based upon NYSDEC 10/95 ASP QA/QC requirements.

****VTSR - Validated Time of Sample Receipt.

IBM also agrees to provide an analysis of fluoride concentrations in the 9 remaining sludge samples. This will enable EPA to further expand its data collection efforts regarding the composition of various F006 waste streams.

Subsequent to this initial proposal development and project implementation period (in which a total of twelve samples will be collected and analyzed at three-month intervals), the sampling program will then require that the sludge be sampled and analyzed by IBM every six months, provided significant changes to the manufacturing process operations affecting the chemical makeup of the sludge are not implemented at the facility. In that eventuality, the conditional exclusion of the sludge from the solid waste definition would cease immediately, and it could not be resumed until after the three-month schedule for sampling and analysis is reinstated and two sample analyses have been demonstrated to meet the criteria given in Table 3-1. The reinstated three-month frequency would remain in effect for twelve sampling/analysis events, as in the initial proposal development and project implementation period.

In addition to the ongoing monitoring of sludge quality as presented and discussed above that will be incorporated into the rule developed to implement this project, IBM East Fishkill commits to assure the continued proper storage of the sludge at the IBM facility, the proper transportation of the material from the IBM East Fishkill facility in accordance with appropriate Department of Transportation requirements, and to provide its sludge only to cement kilns that agree to the proper storage, handling and utilization of the sludge at the kiln. Specific components of the overall sludge management strategy include:

Management of Sludge at the East Fishkill Facility

- In general, the sludge will continue to be managed under the XL project at the East Fishkill facility as if the material were still being regulated as a RCRA waste.
- The sludge will be stored in 25 cubic yard roll-off containers housed inside sludge container loading bays located in Building 690. The sludge will not be labeled as a RCRA waste.

- While no longer subject to RCRA regulations, IBM intends to continue to conduct RCRA-type inspections of this area on a regular basis.

- Sludge samples required as part of this FPA will be collected from the sludge dumpsters at this location.

- The "pickup" of the sludge by the transporter will be undertaken in a manner consistent with the current operation utilizing appropriate Department of Transportation requirements.

Transportation of Sludge from IBM East Fishkill to the Cement Kiln

- At this time, the sludge would not be excluded from being a solid waste for the purposes of NYSDEC's solid waste regulatory program until it arrives at the cement kiln. As a result, the transporter would require a Part 364 permit from NYSDEC to transport industrial/commercial solid waste. However, it is worthy to note that based on the NYSDEC's review of the Beneficial Use Determination petition to be submitted by IBM East Fishkill, the Department may allow the sludge to cease being a solid waste prior to its being transported to the cement kiln in accordance with the criteria found at 6 NYCRR Part 360-1.15(d)(3).

- A bill of lading, instead of a hazardous waste manifest and LDR notification will be utilized to track the movement of volume(s) and weight(s) of sludge from the IBM East Fishkill to the selected cement kiln.

- The sludge will be transported from IBM East Fishkill to the cement kiln in compliance with applicable Department of Transportation requirements.

Management of Sludge at the Cement Kiln

- Sludge will not be placed and/or stored/staged directly on the land prior to placement within the kiln.

- Sludge being temporarily stored/staged prior to placement in the kiln will be protected from precipitation events thereby eliminating any storm water runoff from the storage area.

- Sludge being temporarily stored/staged prior to placement in the kiln will be protected from dispersion/fugitive emissions by wind.

- IBM and the cement kiln will track and keep records with respect to volume and weight of sludge being transported from the IBM East Fishkill to the cement kiln.

- The cement kiln will not "specutively accumulate" the sludge as defined at 40 CFR 261.1; that is, it will be prohibited from stockpiling several sludge shipments for processing.

- The cement kiln will provide IBM with a certification that the sludge delivered to the kiln (from the IBM East Fishkill facility) was utilized as an ingredient in the manufacture of cement in accordance with the contract specifications. Cement manufactured utilizing IBM sludge as an ingredient will meet generally accepted cement industry standards.

- IBM will prepare and submit to the US Environmental Protection Agency Region 2 and the New York State Department of Environmental Conservation an annual report providing a summary of transportation and reuse activities associated with this XL project.

Tracking, Reporting and Evaluation

IBM will commit to continue to track and make available to the U.S. Environmental Protection Agency Region 2 and the New York State Department of Environmental Conservation-Albany analytical data regarding the quality of sludge earmarked for recycling on an ongoing basis as such data are generated (i.e., every three months or every six months), unless specific circumstances relative to this project dictated by regulatory agencies require otherwise. In addition, an annual report will be prepared by IBM which will include a summary of results of the sludge sampling and analytical program outlined in Section 3.8 – Evaluation, Monitoring and Accountability. Furthermore, information regarding sludge quantities generated, transported and utilized in the manufacture of cement will also be included.

3.9 Shifting of Risk Burden

The parties to this Agreement believe this F006 Sludge Recycling Project XL involves no transfer of risk. Inherent to the concept of legitimate recycling, the hazardous waste will contain no significant increase in hazardous constituents relative to the raw materials that would otherwise be used, so there is no expected increase in risk in the product produced. Prior to being recycled, the sludge will be transported and stored in a manner protective of public health and the environment. The management standards for transport and storage of the sludge in a manner protective of public health and the environment (including storage at the cement kiln) are presented in Section 3.8 – Evaluation, Monitoring and Accountability. Also, since the cement kiln where the sludge will be processed is already in existence, there are no siting issues such that additional unjust or disproportionate environmental impacts are foreseen. Since the facilities are already in existence, are currently properly permitted and are in compliance with such permits, and are located in either industrial or a heavy commercially zoned area, no foreseeable unjust or disproportionate environmental impacts are apparent.

4.0 DESCRIPTION OF THE REQUESTED FLEXIBILITY AND THE IMPLEMENTING MECHANISMS

This section describes the nature of the regulatory flexibility to be obtained through this project. It summarizes the legal authorities that are relevant to or impacted by the project, and it describes the manner in which the regulatory flexibility will be implemented.

4.1 Requested Flexibility

As discussed earlier, IBM has identified a portion of the total volume of wastewater treatment sludge generated at their facility that can be used as a substitute for ingredients normally used to produce cement. However, because this sludge is specifically listed as a hazardous waste (because a portion of the wastewaters from which this sludge is precipitated comes from electroplating operations, as opposed to exhibiting a characteristic of hazardous waste), and because this sludge will be used to produce a product (cement) typically used on the land, the sludge being recycled into cement would be subject to RCRA regulatory controls. These requirements include:

- the need for a storage permit if the sludge will be stored at the cement manufacturer prior to recycling;
- the requirement to use a hazardous waste manifest (and therefore a hazardous waste transporter); and
- the requirement to demonstrate that the cement product complies with LDR treatment standards in order to prevent the waste-derived product from being subject to regulation under RCRA (although the cement would legally be a hazardous waste).

In addition, the processing of F006 sludge by a cement kiln could compromise the regulatory status of the cement kiln dust (CKD). Under the current regulations, CKD is exempt from regulation as a hazardous waste under certain conditions. NYSDEC, however, currently regulates CKD as an “industrial commercial solid waste” under 6 NYCRR Part 360.

IBM maintains that such actual and potential RCRA regulatory controls are strong disincentives for a cement company to recycle any material that is a regulated hazardous waste. Moreover, it is IBM's position that the RCRA regulations preclude the recycling of its sludge as an ingredient in cement. In particular, a storage permit may be required, and the typical cement manufacturer would be unwilling to undertake the time, resources, expense, and product impacts (i.e., the cement product would legally be a hazardous waste, though not subject to regulation) of acquiring the permit and otherwise complying with the RCRA Subtitle C requirements.

Therefore, IBM is seeking a waiver of RCRA requirements to allow its proposed recycling scenario to be realized and tested outside of RCRA regulatory oversight. A site-specific conditional exclusion from the definition of solid waste is the regulatory mechanism preferred by the Parties to the FPA for providing the regulatory flexibility needed for this project. The effect of this flexibility would be to exclude IBM's sludge entirely from RCRA jurisdiction if it meets certain conditions that EPA and NYSDEC will put in place to ensure that human health and the environment are being protected under the terms of this project. Assuming the conditions are met, such an exclusion would apply at the point the sludge is generated and continue through the production, marketing, and use of the cement product made from the sludge.

4.1.1 The Current Regulatory Framework

In the current RCRA regulatory framework, the definition of solid waste (and thus, RCRA jurisdiction) is embodied in RCRA Section 1004(27) and 40 CFR Part 261.2. Pursuant to the federal rule, the definition is structured such that, in determining whether a recycled material meets the definition of solid waste and may therefore be subject to RCRA regulations, one must know both the type of material (e.g., whether it is a spent material, a sludge, etc.) and how the material will be recycled (e.g., reclamation, burning for energy recovery, use constituting disposal, etc.). As a listed waste (F006) being used in a manner constituting disposal (i.e., wastewater treatment sludge from electroplating operations being used to produce cement), the sludge would continue to meet the definition of solid waste (and thus, hazardous waste). EPA exerts RCRA jurisdiction over hazardous waste that are recycled to make products used on the land because such placement on the land has environmental impacts that are similar to those associated with disposal in a landfill. In addition, EPA has historically noted that products typically used on the land (e.g., fertilizer, asphalt, aggregate, cement, etc.) tend to have relatively lower economic value than other commercial products and very rarely have product specifications that address the potential presence and release of hazardous constituents not normally found in such products.

Consequently, while EPA does not prohibit the use of such sludges in the production of cement, such a recycling scenario would be subject to RCRA Subtitle C management standards and the cement kiln would likely require a RCRA permit. Further, the cement product produced from a hazardous waste (referred to as a hazardous waste-derived product) would be required to meet the Land Disposal Restrictions treatment standards, which are standards (e.g., numeric concentration levels for specific hazardous constituents) that must be met before a hazardous waste may be disposed of in a hazardous waste landfill. The cement product itself, assuming it meets the applicable treatment standards, would be exempt from any further requirements, including those pertaining to storage, transportation, labeling and use pursuant to 40 CFR 266.20(b). Legally, however, the cement product would still be a hazardous waste.

4.2 Legal Implementing Mechanisms

The legal implementing mechanism for this XL project will be a site-specific rule which will provide a conditional exclusion from the definition of a solid waste for the wastewater treatment sludge generated in IBM's West Complex, pursuant to 40 CFR 260.20. This temporary conditional exclusion will be set forth in 40 CFR 261.4(a) ("Materials which are not solid wastes."). The exclusion is "temporary" because this XL project will only be in place for five years after the effective date of the final rule allowing for the implementation of the XL project. The conditions for this site-specific exclusion reflect the fact that this is a pilot project designed to test the regulatory flexibility being provided. These conditions (discussed more fully in Sections 3.8, 5.1 and 5.3) include:

- The periodic monitoring of constituent concentrations to ensure that the sludge being recycled remains consistent with the sludge evaluated in developing this XL project.

- Various management standards such as "no land placement of the sludge," "protection against wind dispersal," "protection against precipitation runoff," and "no speculative accumulation." These standards are intended to ensure that the sludge is actually recycled rather than inadvertently released to the environment, and bolster the argument the sludge is being managed as a valued commodity rather than a waste-like material.

- Tracking, to ensure that the sludge is recycled.

- Data collection and reporting. Inherent to this pilot project is the need to gather sufficient data to assess the success of the pilot project. Such data will include the monitoring of constituent concentrations in the sludge, the volume of sludge recycled, and an accounting of the reduction in analogous raw materials used or the increase in cement production resulting from the recycling of the sludge. In addition, data will be collected to enable EPA to begin the process of evaluating whether the regulatory flexibility should be expanded to the national level and how such flexibility should be designed to both ensure protection of human health and the environment while encouraging the environmentally sound recycling of this waste stream. Before the regulatory flexibility can be expanded nationally, however, additional data that are beyond the scope of this project must be considered. The data from this project should prove useful in identifying the additional data that will be necessary.

The effect the proposed recycling would have on the cement product and the cement kiln dust, which are related issues, will be an important consideration in evaluating the results of this XL project. Testing of the cement and CKD will be considered during the process of selecting a cement company for participation in this project. Existing data from IBM's trial run for recycling its sludge, reported in February 1989, are expected to be useful in assessing whether recycling IBM's sludge has a measurable effect on the cement or the CKD, given its relatively small contribution to the total raw mix that is fed to a cement kiln. The parties to this agreement anticipate that the threat to human health and the environment will not be increased by the cement product and the cement kiln dust which will result from this project.

To implement the terms of this XL project, EPA will propose a site-specific rule incorporating the terms of the project, including those explained in this Section and Sections 3.8, 5.1 and 5.3 of this FPA. Subject to comments received during the public notice process, EPA will either promulgate the rule in final form, modify the rule as necessary to address comments (if significant changes are necessary, re-propose the rule to allow for further public notice and comment), or decide not to go final with a rule implementing the proposed regulatory modification. EPA expects to promulgate a final rule. The proposed and final rules will be published in the Federal Register. The new federal regulation will be set forth in 40 CFR 261.4(a).

Similarly, NYSDEC intends to propose and (subject to public comment) promulgate a state regulation that is equivalent to the federal regulation. This state regulation will be set forth in 6 NYCRR Part 371.1(e)(1). The proposed and final rules will be published in the State Register.

Although the site-specific rule has not been formally proposed as of this writing, it is anticipated that the language of the rule will be similar to that which follows. It must be pointed out; however, that the provisions of the proposed rule may differ significantly from those which follow in scope as well as detail. Therefore, the following may only be considered to be an example of what the proposed rule, which would modify 40 CFR 261.4(a), might look like:

(a) (*number to be assigned in the future*) Dewatered wastewater treatment sludges (EPA Hazardous Waste No. F006) generated in the West Complex of the International Business Machines Corporation's (IBM) East Fishkill Facility, in Hopewell Junction, New York, provided that each of the following conditions are met:

(1) The sludge is recycled as an ingredient in the manufacture of cement by a qualifying cement production facility.

(2) The sludge is not stored on the land, and protective measures are taken to ensure against wind dispersal and precipitation runoff.

(3) The sludge is not accumulated speculatively as defined at 40 CFR 261.1.

(4) Once every three months during *a period of initial proposal development and project implementation*, a shipment of the sludge undergoes a constituent analysis by IBM that demonstrates that the sludge has a composition similar to that of the typical raw mix for cement. Specifically, the sludge must not have levels of constituents of concern (see Table 3-1) that are significantly higher than those in raw material. (Specific criteria for the constituents of concern will be included in the proposed rule. If these criteria are exceeded, the regulatory flexibility will not apply, and the sludge must be managed as a hazardous waste subject to all

applicable requirements of RCRA Subtitle C.) *Subsequent to this period of initial proposal development and project implementation*, a shipment of the sludge will undergo constituent analysis every six months or sooner if significant changes which affect the chemical makeup of the sludge are implemented in the manufacturing operations at the facility.

(5) An accounting is made of the volumes of sludge that are recycled, with an assessment of how much less raw materials are used to produce the same volume of cement product, or how much more cement is produced attributable to the volume of sludge that is processed.

(6) IBM submits reports to EPA presenting the data as they are generated (either four or two times per year) as well as summarized in an annual report. For example, when IBM is conducting its calendar year quarterly sample collection and analysis during the earlier phase of project implementation, it will submit three quarterly reports with the fourth quarterly report also serving as the annual summary report. Likewise, during later stages of the project when IBM is collecting and analyzing samples on a semi-annual calendar year basis, it will submit a report addressing the analytical results of sludge sampled during the first half of the calendar year and a second report addressing the analytical results of sludge sampled during the second half of the calendar year. The second report will serve as both the report addressing the second half of the year as well as the annual summary report. The annual reports will be made publicly available.

During the five-year term of the XL project, IBM will submit data, as discussed more fully in Sections 3.8, 5.1 and 5.3 of this Agreement, that will determine the appropriateness of continuing to exclude its sludge from the definition of a solid waste or expanding the number of waste streams that may be recycled.

The Signatories to this document believe the flexibility that will be provided by this rule-making is appropriate for this XL project because it is intended to encourage the recycling of IBM's wastewater treatment sludge (West Complex) while protecting human health and the environment.

5.0 DISCUSSION OF INTENTIONS AND COMMITMENTS FOR IMPLEMENTING THE PROJECT

5.1 IBM's Intentions and Commitments

As discussed more fully within other sections of this FPA, IBM intends to:

- Assure that the goals and objectives of the FPA and final rule making are achieved by incorporating pertinent terms and conditions into the contract with both the transporter and the cement kiln. In addition, IBM will undertake and complete laboratory analysis of the F006 sludge designated for recycling and continue to meet, in general, the management standards and other regulatory obligations that would apply absent the regulatory flexibility proposed for this project.

- Track and make available to the U.S. Environmental Protection Agency Region 2 and the New York State Department of Environmental Conservation-Albany analytical data regarding the quality of sludge earmarked for recycling in accordance with the provisions of Section 3.8 – Evaluation, Monitoring and Accountability.

- Conduct inspections of the on-site IBM sludge storage facilities as outlined in Section 3.8 – Evaluation, Monitoring and Accountability.

5.2 EPA's and NYSDEC's Intentions and Commitments

- EPA intends to propose and issue (subject to applicable procedures and review of public comments) a site-specific rule, amending 40 CFR Part 261.4(a) that applies specifically to the IBM East Fishkill facility. The site-specific rule will also provide for withdrawal or termination and a post-Project compliance period consistent with this FPA. The standards and reporting requirements set forth in this FPA will be implemented in the site-specific rule.

- The State of New York intends to propose and issue (subject to applicable procedures and review of public comments) a rule under 6 NYCRR Part 371.1(e)(1). This specific rule will be published in the State Register as a proposed rule and will be subject to notice and comment. Depending on the comments received during the notice and comment period, NYSDEC will either promulgate the rule in final form, modify the rule subject to public notice and comment as necessary or decide not to go final with a rule implementing the proposed regulatory modification.

  However, to facilitate the implementation of this project in advance of a final and effective state rule, NYSDEC may initiate implementation of this project through the adoption of an "Enforcement Directive" (ED). NYSDEC may initiate an ED and implement the project after EPA has an effective date of the federal site-specific rule for the IBM East Fishkill facility (see Section 5.5).

5.3 Proposed Schedule and Milestones

Figure 5-1 provides a schedule of recent past and ongoing activities related to this project, as well as the identification of preliminary milestones associated with likely future activities which are envisioned to occur in support of this project. The schedule will be modified as appropriate when new information is available.

5.4 Periodic Review by the Parties to the Agreement

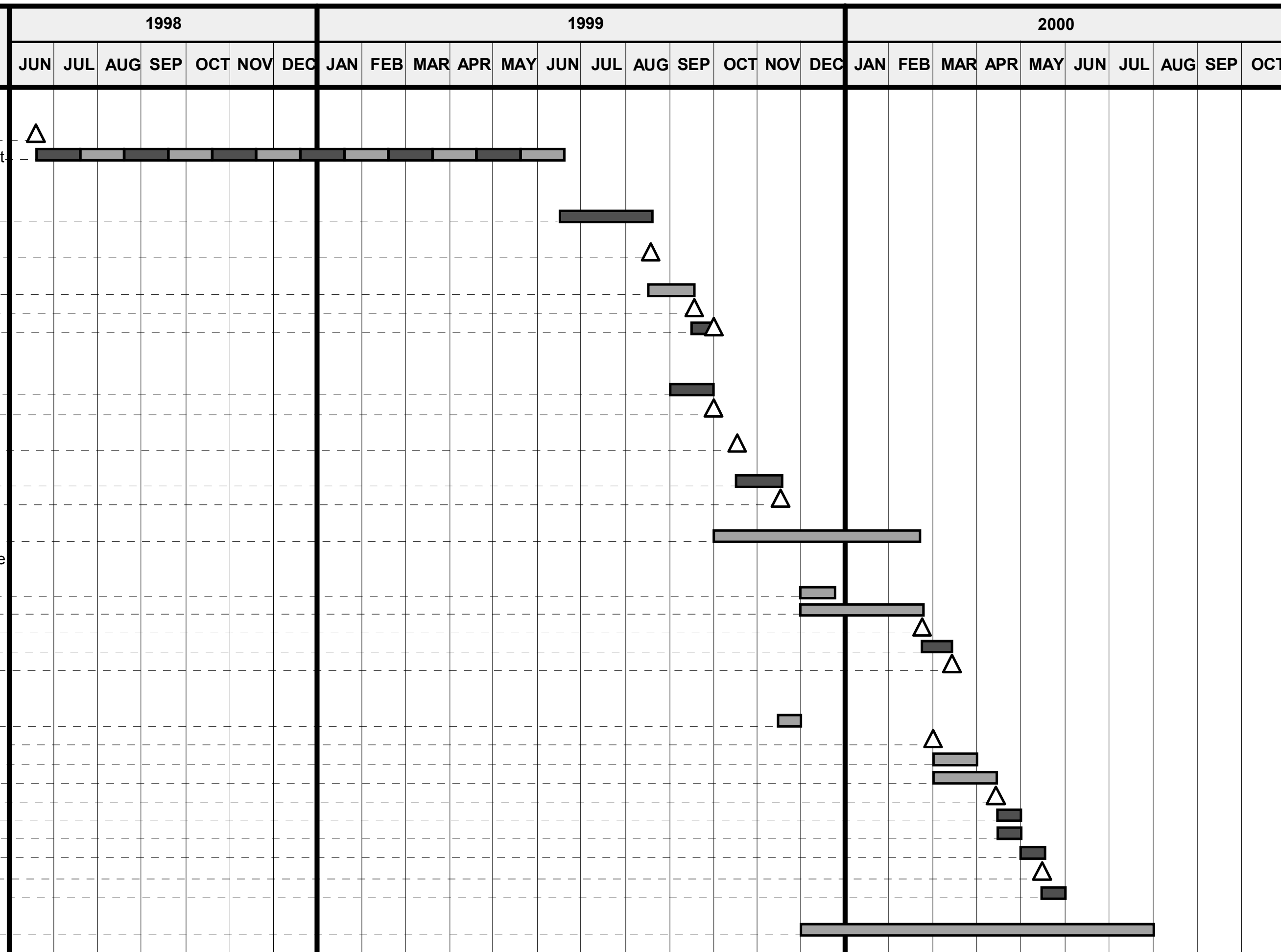
The Parties to this Agreement will hold periodic performance review conferences to assess their progress in implementing the IBM East Fishkill F006 Sludge Recycling Project XL. No later than thirty (30) days following a periodic performance review conference, IBM will provide a summary of the minutes of that conference to all Direct Participant Stakeholders. Any additional comments of participating stakeholders will be reported to EPA.

5.5 Duration of the Project

This Agreement will remain in effect for 5 years, unless the Project ends at an earlier date, as provided under Section 8.0, Section 11.0 or Section 9.0. The implementing mechanism(s) will contain "sunset" provisions ending authorization for this Project 5 years after the effective date of the final rule. They will also address withdrawal or termination conditions and procedures (as described in Section 11.0). This Project will not extend past the agreed upon date, unless all parties agree to an amendment to the Project term (as provided in Section 8.0).

International Business Machines Corporation
East Fishkill Facility
F006 Sludge Recycling Project

PROJECT ACTIVITIES



I. PROJECT INITIATION

- Initial Letter to USEPA - Region 2 Requesting Meeting to Present Project Concept
- Correspondence and Meetings with USEPA Advancing F006 Sludge Recycling Project

II. PREPROPOSAL INFORMATION DOCUMENT (PID)

- Preparation of PID
- Submission of PID to USEPA - Region 2 and New York State Department of Environmental Conservation (NYSDEC)
- Review of PID by USEPA - Region 2, Office of Reinvention Programs, Office of Solid Waste and NYSDEC
- Receipt of Technical Comments from USEPA - Region 2
- Respond to Technical Comments from USEPA - Region 2

III. PROJECT XL PROPOSAL DOCUMENT

- Preparation of Project XL Proposal
- Submission of Project XL Proposal to USEPA Region 2
- Receipt of Interim Technical Comments and Request for Supplemental Information from USEPA - Region 2
- IBM Responds to Interim Technical Comments and Request for Supplemental Information from USEPA - Region 2
- Receipt of Technical Comments from NYSDEC
- "Informal" Review of Project XL Proposal by USEPA Region 2, Office of Reinvention Programs, Office of Solid Waste and NYSDEC
- USEPA Region 2 Conducts Sampling and Analysis Program of Cement Kiln Aggregate Material
  - *Obtain Samples of Aggregate from Cement Kilns*
  - *Aggregate Sample Analysis*
  - *Receipt of Laboratory Analysis of Aggregate Samples*
  - *Evaluation/Assessment of IBM Sludge vs. Aggregate Data*
  - *Submission of Evaluation/Assessment to USEPA Region 2*
- "Formal" Review of Project XL Proposal by USEPA Region 2, Office of Reinvention Programs, Office of Solid Waste and NYSDEC
  - *USEPA - Region 2 Contacts Applicable HQ Offices and NYSDEC*
  - *USEPA - HQ Offices Identify Point of Contact*
  - *USEPA - HQ Offices Convenes Project XL Proposal Review Committee*
  - *Project XL Proposal Review Committee Completes Review of IBM Proposal*
- USEPA - Region 2 Sends Formal Coordinated HQ Comments to IBM
- Conference Call to Resolve any Questions or Issues
- IBM Responds to Formal Coordinated HQ Comments
- Conference Call to Resolve any Remaining Questions or Issues
- Formal Acceptance of Project XL Proposal by USEPA
- Notification of Project Stakeholders of Intent to Pursue the Project
- Development of Mechanism for Implementing Project (i.e. rule-making or modified delisting)

LEGEND

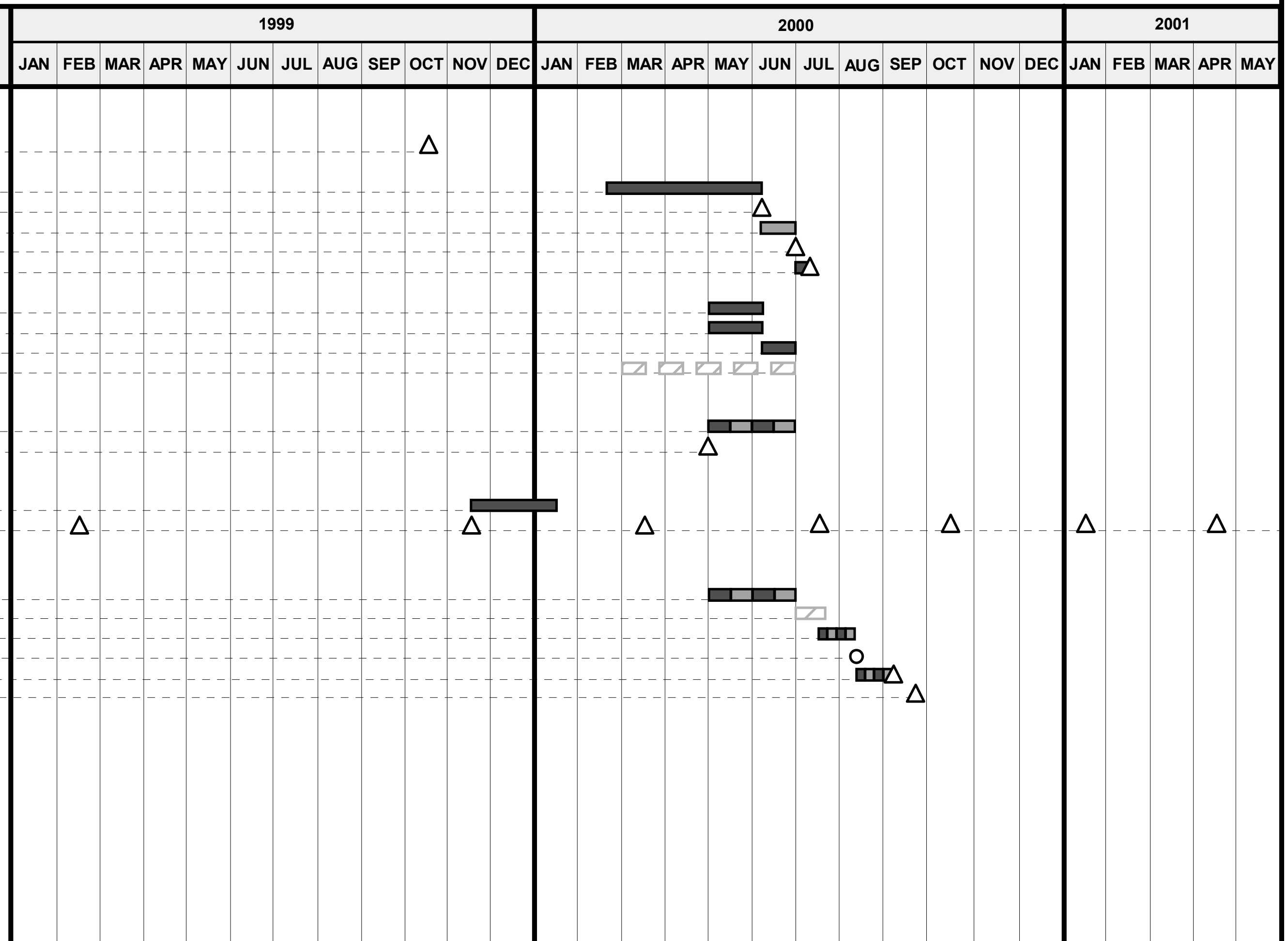
- IBM Activity
- USEPA / NYSDEC Activity
- Project Milestones
- Stakeholder Activity
- Technical Meetings/Conference Calls
- Cement Kiln/Transporter Activity

PROJECT SCHEDULE

FIGURE 5-1

International Business Machines Corporation
East Fishkill Facility
F006 Sludge Recycling Project

PROJECT ACTIVITIES



IV. PROJECT DEVELOPMENT

- Receipt of Project XL Guidance and Example Stakeholder Outreach Plans
- Stakeholder Outreach Plan (SOP)
  - *Preparation of SOP and Development of Ground Rules*
  - *Submission of SOP to USEPA Region 2 and NYSDEC*
  - *Review by USEPA Region 2, Office of Reinvention Programs and NYSDEC*
  - *Receipt of Technical Comments from USEPA - Region 2 and NYSDEC*
  - *Respond to Technical Comments from USEPA - Region 2 and NYSDEC*
- Initial Notification and Outreach
  - *Develop Project Fact Sheet*
  - *Identification of Contacts*
  - *Internal Notifications*
- Informal Stakeholder Meetings/Discussions
- Notification Follow-up
  - *Identification of Stakeholders as Direct Participants, Commentors or Members of General Public*
  - *Informational Meeting*
- Technical Activity
  - *Coordination with Portland Cement Association for Technical Information/Research*
  - *Ongoing Analytical Testing of IBM Sludge*

V. FINAL PROJECT AGREEMENT (FPA)

- Preparation of Draft FPA
- Stakeholder Review/Comment
- Modifications to Draft FPA Based on Stakeholder Input
- Meeting with Stakeholders to Resolve Remaining Items
- Preparation of Final FPA/Publication in Federal Register
- Approval of Final FPA

LEGEND

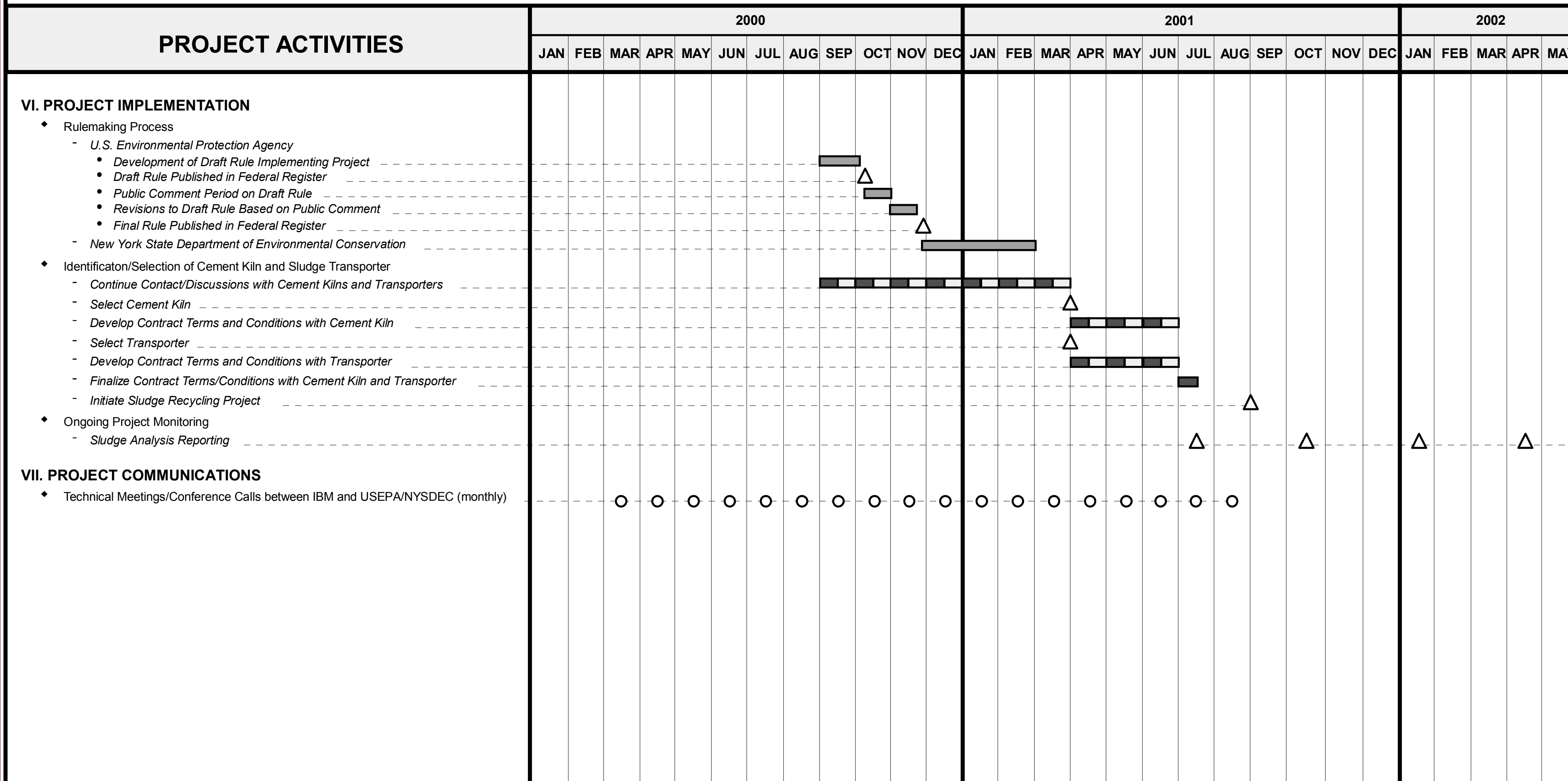
- IBM Activity
- USEPA / NYSDEC Activity
- Project Milestones
- Stakeholder Activity
- Technical Meetings/Conference Calls
- Cement Kiln/Transporter Activity

PROJECT SCHEDULE

FIGURE 5-1

IBM

International Business Machines Corporation
East Fishkill Facility
F006 Sludge Recycling Project



LEGEND
- IBM Activity
- USEPA / NYSDEC Activity
- Project Milestones
- Stakeholder Activity
- Technical Meetings/Conference Calls
- Cement Kiln/Transporter Activity

PROJECT SCHEDULE

FIGURE 5-1

6.0 LEGAL BASIS FOR THE PROJECT

6.1 Authority to Enter into the Agreement

By signing this Agreement, the EPA, NYSDEC and IBM acknowledge and agree that they have the respective authorities, discretion, and resources to enter into this Agreement and to implement all applicable provisions of this Project, as described in this Agreement.

6.2 Legal Effect of the Agreement

This Agreement states the intentions of the Parties with respect to the IBM East Fishkill F006 Sludge Recycling Project XL. The Parties have stated their intentions seriously and in good faith, and expect to carry out their stated intentions.

This Agreement does not create or modify legal rights or obligations, is not a contract or a regulatory action, such as a permit or a rule, and is not legally binding or enforceable against any Party. Rather, it expresses the plans and intentions of the Parties without making those plans and intentions binding requirements. This applies to the provisions of this Agreement that concern procedural as well as substantive matters. While both parties fully intend to adhere to these provisions, they are not legally obligated to do so.

EPA intends to publish for public comment the specific legal mechanisms necessary to implement the IBM Project. Any rules, permit modifications, policy changes or other legal mechanisms that implement the IBM East Fishkill F006 Sludge Recycling Project will be effective and enforceable as provided under applicable law.

This Agreement is not a “final agency action” by EPA, because it does not create or modify legal rights or obligations and is not legally enforceable. Nothing any Party does or does not do that deviates from a provision of this Agreement, or that is alleged to deviate from a provision of this Agreement, can serve as the sole basis for any claim for damages, compensation or other relief against any Party.

6.3 Other Laws or Regulations that May Apply

Except as provided in the legal implementing mechanism for the IBM Project, the Parties do not intend that this Final Project Agreement will modify any other existing or future laws or regulations**.**

6.4 Retention of Rights to Other Legal Remedies

Except as expressly provided in the legal implementing mechanism described in Section 4.2, nothing in this Agreement affects or limits IBM's, EPA's, NYSDEC's or any other signatory's legal rights. These rights include legal, equitable, civil, criminal or administrative claims or other relief regarding the enforcement of present or future applicable federal and state laws, rules, regulations or permits with respect to the facility.

Although IBM does not intend to challenge agency actions implementing the East Fishkill F006 Sludge Recycling Project (including any rule amendments or adoptions, permit actions, or other action) that are consistent with this Agreement, IBM reserves any right it may have to appeal or otherwise challenge any EPA, NYSDEC or local action to implement the Project. With regard to the legal implementing mechanisms, nothing in this Agreement is intended to limit IBM's rights to administrative or judicial appeal or review of those legal mechanisms, in accordance with the applicable procedures for such review.

7.0 UNAVOIDABLE DELAY DURING PROJECT IMPLEMENTATION

"Unavoidable delay" (for purposes of this Agreement) means any event beyond the control of any Party that causes delays or prevents the implementation of the Project described in this Agreement, despite the Parties' reasonable efforts to put their intentions into effect. An unavoidable delay can include, but not be limited to:

- temporary suspension of operation at the cement kiln due to regularly scheduled or unplanned maintenance or repair/overhaul activities
- significant economic considerations
- fire
- acts of war

When any event occurs that may delay or prevent the implementation of this Project, whether or not it is avoidable, the Party to this Agreement who knows about it will immediately provide notice to the remaining Parties. Within ten (10) days after that initial notice, the Party should confirm the event in writing. The confirming notice should include: 1) the reason for the delay; 2) the anticipated duration; 3) all actions taken to prevent or minimize the delay; and 4) why the delay was considered unavoidable, accompanied by appropriate documentation.

If the Parties agree that the delay is unavoidable, relevant parts of the Project schedule (see Section 5.3) will be extended to cover the time period lost due to the delay. If they agree, they will also document their agreement in a written amendment to this Agreement. If the Parties do not agree, then they will follow the provisions for Dispute Resolution outlined below.

This section applies only to provisions of this Agreement that are not implemented by legal implementing mechanisms. Legal mechanisms, such as permit provisions or rules, will be subject to modification or enforcement as provided under applicable law.

8.0 AMENDMENTS OR MODIFICATIONS TO THE AGREEMENT

This Project is designed to test new approaches to environmental protection and there is a degree of uncertainty regarding the environmental benefits and costs associated with activities to be undertaken in this Project. Therefore, it may be appropriate to amend this Agreement at some point during its duration.

This Final Project Agreement may be amended by mutual agreement of all parties at any time during the duration of the Project. The parties recognize that amendments to this Agreement may also necessitate modification of legal implementation mechanisms or may require development of new implementation mechanisms. If the Agreement is amended, the EPA, IBM and NYSDEC expect to work together with other regulatory bodies and stakeholders to identify and pursue any necessary modifications or additions to the implementation mechanisms in accordance with applicable procedures. If the parties agree to make a substantial amendment to this Agreement, the general public will receive notice of the amendment and be given an opportunity to participate in the process, as appropriate. Any significant modifications to the FPA will be subject to notice and public comment in the Federal Register. Any significant modifications to the project-specific rule will be subject to notice and public comment in the Federal Register and New York State Register.

In determining whether to amend the Agreement, the parties will evaluate whether the proposed amendment meets Project XL acceptance criteria and any other relevant considerations agreed on by the parties. All parties to the Agreement will meet within ninety (90) days following submission of any amendment proposal (or within a shorter or longer period if all parties agree) to discuss evaluation of the proposed amendment. If all parties support the proposed amendment, the parties will (after appropriate stakeholder involvement, if any) amend the Agreement.

9.0 TRANSFER OF PROJECT BENEFITS AND RESPONSIBILITIES TO A NEW OWNER

The parties expect that the implementing mechanisms will allow for a transfer of IBM's benefits and responsibilities under the Project to any future owner or operator upon request of IBM and the new owner or operator, provided that the following conditions are met:

A. IBM will provide written notice of any such proposed transfer to the EPA and NYSDEC at least ninety (90) days before the effective date of the transfer. The notice is expected to include identification of the proposed new owner or operator, a description of its financial and technical capability to assume the obligations associated with the Project, and a statement of the new owner or operator's intention to take over the responsibilities in the XL Project of the existing owner or operator.

B. Within forty-five (45) days of receipt of the written notice, the parties expect that EPA and NYSDEC, in consultation with interested stakeholders will determine whether: 1) the new owner or operator has demonstrated adequate capability to meet EPA's requirements for carrying out the XL Project; 2) is willing to take over IBM's responsibilities in the XL Project; and 3) is otherwise an appropriate Project XL partner. Other relevant factors, including the new owner or operator's record of compliance with Federal, State and local environmental requirements, may be considered as well.

It will be necessary to modify the Agreement to reflect the new owner and it may also be necessary for EPA and NYSDEC to amend appropriate rules, permits, or other implementing mechanisms (subject to applicable public notice and comment) to transfer the legal rights and obligations of IBM under this Project to the proposed new owner or operator.

10.0 PROCESS FOR RESOLVING DISPUTES

Any dispute which arises under or with respect to this Agreement will be subject to informal negotiations between the parties to the Agreement. The period of informal negotiations will not exceed twenty (20) calendar days from the time the dispute is first documented, unless that period is extended by a written agreement of the parties to the dispute. The dispute will be considered documented when one party sends a written Notice of Dispute to the other parties.

If the parties cannot resolve a dispute through informal negotiations, the parties may invoke non-binding mediation by describing the dispute with a proposal for resolution in a letter to the Regional Administrator for EPA Region 2 and the Commissioner of NYSDEC. The Regional Administrator or the Commissioner, as appropriate, will serve as the non-binding mediator and may request an informal mediation meeting to attempt to resolve the dispute. The Regional Administrator or the Commissioner will then issue a written opinion that will be non-binding and does not constitute a final EPA action. If this effort is not successful, the parties still have the option to terminate or withdraw from the Agreement, as set forth in Section 11.0 of this FPA.

11.0 WITHDRAWAL FROM OR TERMINATION OF THE AGREEMENT

11.1 Expectations

Although this Agreement is not legally binding and any party may withdraw from the Agreement at any time, it is the desire of the parties that it should remain in effect through the expected duration of five years, and be implemented as fully as practical unless one of the following conditions occurs:

1. Failure by any party to (a) comply with the provisions of the enforceable implementing mechanisms for this Project, or (b) act in accordance with the provisions of this Agreement. The assessment of the failure will take its nature and duration into account.
2. Failure of any party to disclose material facts during development of the Agreement.
3. Failure of the Project to provide superior environmental performance consistent with the provisions of this Agreement.
4. Enactment or promulgation of any environmental, health or safety law or regulation after execution of the Agreement, which renders the Project legally, technically or economically impracticable.
5. Decision by an agency to reject the transfer of the Project to a new owner or operator of the facility.

In addition, EPA and NYSDEC do not intend to withdraw from the Agreement if IBM does not act in accordance with this Agreement or its implementation mechanisms, unless the actions constitute a substantial failure to act consistently with intentions expressed in this Agreement and its implementing mechanisms. The decision to withdraw will, of course, take the failure's nature and duration into account.

IBM will be given notice and a reasonable opportunity to remedy any "substantial failure" before EPA's withdrawal. If there is a disagreement between the parties over whether a "substantial failure" exists, the parties will use the dispute resolution mechanism identified in Section 10.0 of this Agreement. EPA and the State of New York retain their discretion to use existing enforcement authorities, including withdrawal or termination of this Project, as appropriate. IBM retains any existing rights or abilities to defend themselves against any enforcement actions, in accordance with applicable procedures.

11.2 Procedures

The parties agree that the following procedures will be used to withdraw from or terminate the Project before expiration of the Project term. They also agree that the implementing mechanism(s) will provide for withdrawal or termination consistent with these procedures.

1. Any party that wants to terminate or withdraw from the Project is expected to provide written notice to the other parties at least sixty (60) days before the withdrawal or termination.

2. If requested by any party during the sixty (60) day period noted above, the dispute resolution proceedings described in this Agreement may be initiated to resolve any dispute relating to the intended withdrawal or termination. If, following any dispute resolution or informal discussion, a party still desires to withdraw or terminate, that party will provide written notice of final withdrawal or termination to the other parties.

3. The procedures described in this Section apply only to the decision to withdraw or terminate participation in this Agreement. Procedures to be used in modifying or rescinding any legal implementing mechanisms will be governed by the terms of those legal mechanisms and applicable law. It may be necessary to invoke the implementing mechanism's provisions that end authorization for the Project (called "sunset provisions") in the event of withdrawal or termination.

12.0 COMPLIANCE AFTER THE PROJECT IS OVER

The parties intend that there be an orderly return to compliance upon completion, withdrawal from, or termination of the Project, as follows:

A. Orderly Return to Compliance with Otherwise Applicable Regulations, if the Project Term is Completed

If, after an evaluation, the Project is terminated because the term has ended, IBM will return to compliance with all applicable requirements by the end of the Project term, unless the Project is amended or modified in accordance with Section 8.0 of this Agreement (Amendments or Modifications). IBM is expected to anticipate and plan for all activities to return to compliance sufficiently in advance of the end of the Project term. IBM may request a meeting with EPA and NYSDEC to discuss the timing and nature of any actions that IBM will be required to take. The parties should meet within thirty days of receipt of IBM's written request for such a discussion. At and following such a meeting, the parties should discuss in reasonable, good faith, which of the requirements deferred under this Project will apply after termination of the Project.

B. Orderly Return to Compliance with Otherwise Applicable Regulations in the Event of Early Withdrawal or Termination

In the event of a withdrawal or termination not based on the end of the Project term and where IBM has made efforts in good faith, the parties to the Agreement will determine an interim compliance period to provide sufficient time for IBM to return to compliance with any regulations deferred under the Project. The interim compliance period will extend from the date on which EPA, NYSDEC, or IBM provides written notice of final withdrawal or termination of the Project, in accordance with Section 11.0 of this Project Agreement. By the end of the interim compliance period, IBM will comply with the applicable deferred standards set forth in 40 CFR Part 261.4(a) and in 6 NYCRR Part 371.1(e)(1). During the interim compliance period, EPA may issue an order, permit, or other legally enforceable mechanism establishing a schedule for IBM to return to compliance with otherwise applicable regulations as soon as practicable. This schedule cannot extend beyond six months from the date of withdrawal or termination. IBM intends to be in compliance with all applicable Federal, State, and local requirements as soon as is practicable, as will be set forth in the new schedule.

13.0 SIGNATORIES AND EFFECTIVE DATE

We, the undersigned, pledge our support for the continued success of the IBM East Fishkill F006 Sludge Recycling Project XL and the furtherance of an effective partnership between the US Environmental Protection Agency, the New York State Department of Environmental Conservation and the International Business Machines Corporation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

____
Jeanne M. Fox
Regional Administrator, EPA Region 2

Date: ___________________

INTERNATIONAL BUSINESS MACHINES CORPORATION

____
Eric C. Schneider
Director-MHV Interconnect Products and
IBM East Fishkill Senior Location Executive

Date:____________________

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

____
John P. Cahill
Commissioner, New York State Department of Environmental Conservation

Date:____________________

APPENDIX A

CEMENT PLANT FEEDSTOCK SAMPLE RESULTS

IBM

International Business Machines Corporation

East Fishkill Facility
1580 Route 52
Hopewell Junction, NY 12533-6531
914 / 894-2121

March 8, 2000

George C. Meyer, P.E.
Chief, RCRA Compliance Branch
Division of Enforcement and Compliance Assistance
United States Environmental Protection Agency
Region 2
290 Broadway
New York, NY 10007-1866

Re: International Business Machines Corporation
East Fishkill Facility
Project XL F006 Sludge Recycling Project
Cement Plant Feedstock Sample Results

Dear Mr. Meyer:

The purpose of this letter is to provide you with a comparison of the analytical results for the International Business Machines Corporation (IBM) East Fishkill Facility's F006 sludge with that of the cement feedstock which was forwarded to IBM by your office. In addition, we offer our interpretation of the comparison with regard to the proposed F006 Sludge Recycling Project.

In December 1999 the U.S. Environmental Protection Agency (EPA) collected samples of cement feedstock material at five different cement manufacturing plants located in the northeast. Samples were collected and analyzed at the EPA analytical laboratory located in Edison, New Jersey, for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs) and metals. Based on our review of the data package, it appears that the samples were composited from three feedstock locations at each plant with the exception of VOCs analyses where the individual grab samples were analyzed. The analytical results of the samples are summarized on Tables 1 through 4 provided as Attachment 1. The last one or two columns on each table presents analytical results of IBM sludge samples collected on February 8 and November 1, 1999, from the Building 690 fluoride/heavy metal waste treatment facility for comparison purposes.

As shown on Table 1, VOCs were not detected above the detection limit in any cement feedstock sample. Low concentrations of methylene chloride, toluene, m-xylene and p-xylene and o-xylene were detected in the IBM sludge sample. However, it is important to note that the samples analyzed by EPA were run at a higher detection level than those analyzed by IBM (708 to 1080 ug/kg versus

2.5 ug/kg). For this reason, it is not possible to determine whether the low concentrations of the above listed compounds detected in the IBM sludge sample are present in the cement feedstock samples because the high detection limit misses detecting low concentrations.

As shown on Table 2, SVOCs were not detected above the detection limit in any cement feedstock sample or the IBM sludge sample.

As shown on Table 3, pesticides and PCBs were not detected above the detection limit in any cement feedstock sample. The IBM sludge sample was not analyzed for these compounds. The reason for this is that during the early discussion phases of this project, IBM and EPA agreed that since these compounds are not utilized in the manufacturing process operations at the East Fishkill facility, it would not be necessary to continue laboratory analysis of these constituents.

As shown on Table 4, a number of metal constituents were detected in both the cement feedstock samples as well as the IBM sludge samples. Table 5 presents a statistical summary of the analytical results of the cement feedstock samples and compares it to the IBM sludge samples.

Based upon a review of Table 5, the following can be concluded:

- Arsenic was detected at a concentration of 2.2 mg/kg in the IBM sludge sample collected on February 8, 1999, which is below the maximum value (11 mg/kg), the mean (4.1 mg/kg) and the upper limit of the 95% confidence interval (14 mg/kg) for the cement feedstock samples. The IBM sludge sample collected on November 1, 1999, was not analyzed for arsenic since it is not a listed constituent of F006 sludge.

- Beryllium was detected at a concentration of 0.21 mg/kg in the IBM sludge sample collected on February 8, 1999, which is below the maximum value (0.55 mg/kg), the mean (0.23 mg/kg) and the upper limit of the 95% confidence interval (0.85 mg/kg) for the cement feedstock samples. The IBM sludge sample collected on November 1, 1999, was not analyzed for beryllium since it is not a listed constituent of F006 sludge.

- Cadmium was detected at a concentration of 0.77 mg/kg in the IBM sludge sample collected on February 8, 1999, which is above the maximum value (0.65 mg/kg) and the mean (0.46 mg/kg) but below the upper limit of the 95% confidence interval (0.96 mg/kg) for the cement feedstock samples. Cadmium was detected at a concentration of 0.26 mg/kg in the IBM sludge sample collected on November 1, 1999, which is below the maximum value, mean and upper limit of the 95% confidence interval for the cement feedstock samples.

- Chromium was detected at a concentration of 20.0 mg/kg in the IBM sludge sample collected on February 8, 1999, which is above the mean (18 mg/kg) but below the maximum value (29 mg/kg) and the upper limit of the 95% confidence interval (41 mg/kg) for the cement feedstock samples. Cadmium was detected at a concentration of 9.8 mg/kg in the IBM sludge sample collected on November 1, 1999, which is below the maximum value, mean and upper limit of the 95% confidence interval for the cement feedstock samples.

- Lead was detected at a concentration of 16.8 mg/kg in the IBM sludge sample collected on February 8, 1999, which is above the maximum value (6.3 mg/kg), the mean (3.0 mg/kg) and the upper limit of the 95% confidence interval (8.3 mg/kg) for the cement feedstock samples. Lead was detected at a concentration of 1.9 mg/kg in the IBM sludge sample collected on November 1, 1999, which is below the maximum value, mean and upper limit of the 95% confidence interval for the cement feedstock samples.

- Mercury was not detected above the detection limit in the IBM sludge sample collected on February 8, 1999. The IBM sludge sample collected on November 1, 1999, was not analyzed for mercury since it is not a listed constituent of F006 sludge.

- Nickel was detected at a concentration of 8.0 mg/kg in the IBM sludge sample collected on February 8, 1999, which is below the maximum value (42 mg/kg), the mean (19 mg/kg) and the upper limit of the 95% confidence interval (54 mg/kg) for the cement feedstock samples. Nickel was detected at a concentration of 8.3 mg/kg in the IBM sludge sample collected on November 1, 1999, which is also below the maximum value, mean and upper limit of the 95% confidence interval for the cement feedstock samples.

- Silver was detected at a concentration of 1.4 mg/kg in the IBM sludge sample collected on February 8, 1999, which is above the mean (0.51 mg/kg) but below the maximum value (1.6 mg/kg) and the upper limit of the 95% confidence interval (2.0 mg/kg) for the cement feedstock samples. Silver was detected at a concentration of 0.12 mg/kg in the IBM sludge sample collected on November 1, 1999, which is below the maximum value, mean and upper limit of the 95% confidence interval for the cement feedstock samples.

- Cyanide was not detected above the detection limit in the IBM sludge samples collected on February 8, 1999, and November 1, 2000, or in the EPA cement feedstock samples.

In summary, the concentrations of cadmium, chromium, lead and silver detected in the February 8, 1999, sludge sample exceeded the mean concentration of the cement feedstock samples. However, the concentrations of these four constituents detected in the November 1, 1999, sludge sample were below the mean concentration of the cement feedstock samples. As a result, based upon comparison of the IBM sludge and cement feedstock sample results, it is evident that the composition of the two are very similar and that addition of the IBM sludge to the cement feedstock will not have a measurable effect on the composition of the feedstock, cement or cement kiln dust.

Please contact me at (914) 892-1629 if you have any questions or require further information.

Sincerely,

Salvatore J. Tranchina, P.E., Manager
Environmental Engineering and Operations

SJT/RMW/MRHt/cmc
Attachment
cc: W. Muszynski (EPA – Region 2)
P. Flax (EPA – Region 2)
L. Nadler (NYSDEC – Albany)
N. Ayengar (IBM)
R. Walka (WFC)
♦1506\SJT03020GCM.DOC(R02)

ATTACHMENT 1

ANALYTICAL RESULTS

TABLE 1
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS

	CEMENT PLANT FEEDSTOCK						IBM SLUDGE
CEMENT COMPANY	Glen Falls			Blue Circle			NA
SAMPLE IDENTIFICATION	GRAB #1	GRAB #2	GRAB #3	GRAB #1	GRAB #2	GRAB #3	CA-F Grab
DATE OF COLLECTION	12/22/99	12/22/99	12/22/99	12/21/99	12/21/99	12/21/99	2/08/99
UNITS	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Chloromethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Bromomethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Vinyl Chloride	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Chloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Methylene Chloride	955 U	975 U	942 U	778 U	708 U	808 U	3.6
Acetone	955 U	975 U	942 U	778 U	708 U	808 U	N/A
Carbon Disulfide	955 U	975 U	942 U	778 U	708 U	808 U	N/A
1,1-Dichloroethene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,1-Dichloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Chloroform	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,2-Dichloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
2-Butanone	955 U	975 U	942 U	778 U	708 U	808 U	N/A
1,1,1-Trichloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Carbon Tetrachloride	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Bromodichloromethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,2-Dichloropropane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,3-Z-Dichloropropene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Trichloroethene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Dibromochloromethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,1,2-Trichloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Benzene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,3-E-Dichloropropene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Bromoform	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
4-Methyl-2-pentanone	955 U	975 U	942 U	778 U	708 U	808 U	N/A
2-Hexanone	955 U	975 U	942 U	778 U	708 U	808 U	N/A
Tetrachloroethene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
1,1,2,2-Tetrachloroethane	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Toluene	955 U	975 U	942 U	778 U	708 U	808 U	1.6 J
Chlorobenzene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Ethylbenzene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
Styrene	955 U	975 U	942 U	778 U	708 U	808 U	2.5 U
m + p-Xylene	955 U	975 U	942 U	778 U	708 U	808 U	4.2
o-Xylene	955 U	975 U	942 U	778 U	708 U	808 U	2.1 J
VOA Total Xylenes Solid	955 U	975 U	942 U	778 U	708 U	808 U	N/A

Qualifiers:
U: Compound analyzed for but not detected.
J: Compound found at a concentration below the detection limit.

Notes:
N/A : Compound not analyzed for.

TABLE 1 (continued)
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS

	CEMENT PLANT FEEDSTOCK						IBM SLUDGE
CEMENT COMPANY	Hercules			St. Lawrence			NA
SAMPLE IDENTIFICATION	GRAB #1	GRAB #2	GRAB #3	GRAB #1	GRAB #2	GRAB #3	CA-F Grab
DATE OF COLLECTION	12/03/99	12/03/99	12/03/99	12/21/99	12/21/99	12/21/99	2/08/99
UNITS	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Chloromethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Bromomethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Vinyl Chloride	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Chloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Methylene Chloride	954 U	937 U	997 U	841 U	900 U	870 U	3.6
Acetone	954 U	937 U	997 U	841 U	900 U	870 U	N/A
Carbon Disulfide	954 U	937 U	997 U	841 U	900 U	870 U	N/A
1,1-Dichloroethene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,1-Dichloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Chloroform	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,2-Dichloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
2-Butanone	954 U	937 U	997 U	841 U	900 U	870 U	N/A
1,1,1-Trichloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Carbon Tetrachloride	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Bromodichloromethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,2-Dichloropropane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,3-Z-Dichloropropene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Trichloroethene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Dibromochloromethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,1,2-Trichloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Benzene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,3-E-Dichloropropene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Bromoform	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
4-Methyl-2-pentanone	954 U	937 U	997 U	841 U	900 U	870 U	N/A
2-Hexanone	954 U	937 U	997 U	841 U	900 U	870 U	N/A
Tetrachloroethene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
1,1,2,2-Tetrachloroethane	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Toluene	954 U	937 U	997 U	841 U	900 U	870 U	1.6 J
Chlorobenzene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Ethylbenzene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
Styrene	954 U	937 U	997 U	841 U	900 U	870 U	2.5 U
m + p-Xylene	954 U	937 U	997 U	841 U	900 U	870 U	4.2
o-Xylene	954 U	937 U	997 U	841 U	900 U	870 U	2.1 J
VOA Total Xylenes Solid	954 U	937 U	997 U	841 U	900 U	870 U	N/A

Qualifiers:
U: Compound analyzed for but not detected.
J: Compound found at a concentration below the detection limit.

Notes:
N/A : Compound not analyzed for.

TABLE 1 (continued)
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS

	CEMENT PLANT FEEDSTOCK						IBM SLUDGE	
CEMENT COMPANY	Keystone						NA	
SAMPLE IDENTIFICATION	GRAB #1		GRAB #2		GRAB #3		CA-F Grab	
DATE OF COLLECTION	12/03/99		12/03/99		12/03/99		2/08/99	
UNITS	(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
Chloromethane	1070	U	1080	U	980	U	2.5	U
Bromomethane	1070	U	1080	U	980	U	2.5	U
Vinyl Chloride	1070	U	1080	U	980	U	2.5	U
Chloroethane	1070	U	1080	U	980	U	2.5	U
Methylene Chloride	1070	U	1080	U	980	U	3.6	
Acetone	1070	U	1080	U	980	U	N/A	
Carbon Disulfide	1070	U	1080	U	980	U	N/A	
1,1-Dichloroethene	1070	U	1080	U	980	U	2.5	U
1,1-Dichloroethane	1070	U	1080	U	980	U	2.5	U
Chloroform	1070	U	1080	U	980	U	2.5	U
1,2-Dichloroethane	1070	U	1080	U	980	U	2.5	U
2-Butanone	1070	U	1080	U	980	U	N/A	
1,1,1-Trichloroethane	1070	U	1080	U	980	U	2.5	U
Carbon Tetrachloride	1070	U	1080	U	980	U	2.5	U
Bromodichloromethane	1070	U	1080	U	980	U	2.5	U
1,2-Dichloropropane	1070	U	1080	U	980	U	2.5	U
1,3-Z-Dichloropropene	1070	U	1080	U	980	U	2.5	U
Trichloroethene	1070	U	1080	U	980	U	2.5	U
Dibromochloromethane	1070	U	1080	U	980	U	2.5	U
1,1,2-Trichloroethane	1070	U	1080	U	980	U	2.5	U
Benzene	1070	U	1080	U	980	U	2.5	U
1,3-E-Dichloropropene	1070	U	1080	U	980	U	2.5	U
Bromoform	1070	U	1080	U	980	U	2.5	U
4-Methyl-2-pentanone	1070	U	1080	U	980	U	N/A	
2-Hexanone	1070	U	1080	U	980	U	N/A	
Tetrachloroethene	1070	U	1080	U	980	U	2.5	U
1,1,2,2-Tetrachloroethane	1070	U	1080	U	980	U	2.5	U
Toluene	1070	U	1080	U	980	U	1.6	J
Chlorobenzene	1070	U	1080	U	980	U	2.5	U
Ethylbenzene	1070	U	1080	U	980	U	2.5	U
Styrene	1070	U	1080	U	980	U	2.5	U
m + p-Xylene	1070	U	1080	U	980	U	4.2	
o-Xylene	1070	U	1080	U	980	U	2.1	J
VOA Total Xylenes Solid	1070	U	1080	U	980	U	N/A	

Qualifiers:
U: Compound analyzed for but not detected.
J: Compound found at a concentration below the detection limit.

Notes:
N/A : Compound not analyzed for.

TABLE 2
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

	CEMENT PLANT FEEDSTOCK										IBM SLUDGE	
CEMENT COMPANY	Glens Falls		Blue Circle		Hercules		St. Lawrence		Keystone		NA	
SAMPLE IDENTIFICATION	Composite		Composite		Composite		Composite		Composite		CA-F Grab	
DATE OF COLLECTION	12/22/99		12/21/99		12/03/99		12/21/99		12/03/99		2/08/99	
UNITS	(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
Phenol	500	U	355	U	473	U	337	U	366	U	930	U
bis(2-Chloroethyl)ether	500	U	355	U	473	U	337	U	366	U	930	U
2-Chlorophenol	500	U	355	U	473	U	337	U	366	U	930	U
1,3-Dichlorobenzene	500	U	355	U	473	U	337	U	366	U	930	U
1,4-Dichlorobenzene	500	U	355	U	473	U	337	U	366	U	930	U
1,2-Dichlorobenzene	500	U	355	U	473	U	337	U	366	U	930	U
2-Methylphenol	500	U	355	U	473	U	337	U	366	U	930	U
bis(2-Chloroisopropyl)ether	500	U	355	U	473	U	337	U	366	U	930	U
4-Methylphenol	500	U	355	U	473	U	337	U	366	U	930	U
N-Nitroso-di-n-propylamine	500	U	355	U	473	U	337	U	366	U	930	U
Hexachloroethane	500	U	355	U	473	U	337	U	366	U	930	U
Nitrobenzene	500	U	355	U	473	U	337	U	366	U	930	U
Isophorone	500	U	355	U	473	U	337	U	366	U	930	U
2-Nitrophenol	500	U	355	U	473	U	337	U	366	U	930	U
2,4-Dimethylphenol	500	U	355	U	473	U	337	U	366	U	930	U
bis(2-Chloroethoxy)methane	500	U	355	U	473	U	337	U	366	U	930	U
2,4-Dichlorophenol	500	U	355	U	473	U	337	U	366	U	930	U
1,2,4-Trichlorobenzene	500	U	355	U	473	U	337	U	366	U	930	U
Naphthalene	500	U	355	U	473	U	337	U	366	U	930	U
4-Chloroaniline	500	U	355	U	473	U	337	U	366	U	930	U
Hexachlorobutadiene	500	U	355	U	473	U	337	U	366	U	930	U
4-Chloro-3-methylphenol	500	U	355	U	473	U	337	U	366	U	930	U
2-Methylnaphthalene	500	U	355	U	473	U	337	U	366	U	930	U
Hexachlorocyclopentadiene	500	U	355	U	473	U	337	U	366	U	930	U
2,4,6-Trichlorophenol	500	U	355	U	473	U	337	U	366	U	930	U
2,4,5-Trichlorophenol	500	U	355	U	473	U	337	U	366	U	930	U
2-Chloronaphthalene	500	U	355	U	473	U	337	U	366	U	930	U
2-Nitroaniline	500	U	355	U	473	U	337	U	366	U	2300	U
Dimethylphthalate	500	U	355	U	473	U	337	U	366	U	930	U
Acenaphthylene	500	U	355	U	473	U	337	U	366	U	930	U
2,6-Dinitrotoluene	500	U	355	U	473	U	337	U	366	U	930	U
3-Nitroaniline	500	U	355	U	473	U	337	U	366	U	2300	U
Acenaphthene	500	U	355	U	473	U	337	U	366	U	930	U
2,4-Dinitrophenol	3000	U	2130	U	2840	U	2030	U	366	U	2300	U
4-Nitrophenol	500	U	355	U	473	U	337	U	366	U	2300	U

TABLE 2 (continued)
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
SEMIVOLATILE ORGANIC COMPOUNDS

	CEMENT PLANT FEEDSTOCK										IBM SLUDGE	
CEMENT COMPANY	Glens Falls		Blue Circle		Hercules		St. Lawrence		Keystone		NA	
SAMPLE IDENTIFICATION	Composite		Composite		Composite		Composite		Composite		CA-F Grab	
DATE OF COLLECTION	12/22/99		12/21/99		12/03/99		12/21/99		12/03/99		2/08/99	
UNITS	(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)		(ug/kg)	
Dibenzofuran	500	U	355	U	473	U	337	U	366	U	930	U
2,4-Dinitrotoluene	500	U	355	U	473	U	337	U	366	U	930	U
Fluorene	500	U	355	U	473	U	337	U	366	U	930	U
4-Nitroaniline	500	U	355	U	473	U	337	U	366	U	2300	U
4,6-Dinitro-2-methylphenol	3000	U	2130	U	2840	U	2030	U	366	U	2300	U
N-Nitrosodiphenylamine	500	U	355	U	473	U	337	U	366	U	930	U
4-Bromophenyl-phenylether	500	U	355	U	473	U	337	U	366	U	930	U
Hexachlorobenzene	500	U	355	U	473	U	337	U	366	U	930	U
Pentachlorophenol	500	U	355	U	473	U	337	U	366	U	2300	U
Phenanthrene	500	U	355	U	473	U	337	U	366	U	930	U
Anthracene	500	U	355	U	473	U	337	U	366	U	930	U
Di-n-butylphthalate	500	U	355	U	473	U	337	U	366	U	930	U
Fluoranthene	500	U	355	U	473	U	337	U	366	U	930	U
Pyrene	500	U	355	U	473	U	337	U	366	U	930	U
Butylbenzylphthalate	500	U	355	U	473	U	337	U	366	U	930	U
Benzo(a)anthracene	500	U	355	U	473	U	337	U	366	U	930	U
Chrysene	500	U	355	U	473	U	337	U	366	U	930	U
bis(2-Ethylhexyl)phthalate	500	U	355	U	473	U	337	U	366	U	140	J
Di-n-octylphthalate	500	U	355	U	473	U	337	U	366	U	930	U
Benzo(b)fluoranthene	500	U	355	U	473	U	337	U	366	U	930	U
Benzo(k)fluoranthene	500	U	355	U	473	U	337	U	366	U	930	U
Benzo(a)pyrene	500	U	355	U	473	U	337	U	366	U	930	U
Indeno(1,2,3-cd)pyrene	500	U	355	U	473	U	337	U	366	U	930	U
Dibenzo(a,h)anthracene	500	U	355	U	473	U	337	U	366	U	930	U
Benzo(g,h,i)perylene	500	U	355	U	473	U	337	U	366	U	930	U
Benzyl Alcohol	500	U	355	U	473	U	337	U	366	U	930	U
Benzoic Acid	1000	U	710	U	2840	U	675	U	366	U	N/A	
Diethylphthalate	500	U	355	U	473	U	337	U	366	U	930	U
4-Chlorophenyl-phenylether	500	U	355	U	473	U	337	U	366	U	930	U
Diazene,Diphenyl	500	U	355	U	473	U	337	U	366	U	N/A	

Qualifiers:
U: Compound analyzed for but not detected.
J: Compound found at a concentration below the detection limit.

Notes:
N/A : Compound not analyzed for.

TABLE 3
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
PESTICIDES AND PCBs

	CEMENT PLANT FEEDSTOCK					**IBM SLUDGE**
CEMENT COMPANY	Glens Falls	Blue Circle	Hercules	St. Lawrence	Keystone	NA
SAMPLE IDENTIFICATION	Composite	Composite	Composite	Composite	Composite	CA-F Grab
DATE OF COLLECTION	12/22/99	12/21/99	12/03/99	12/21/99	12/03/99	2/08/99
UNITS	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
PESTICIDES						
alpha-BHC	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
beta-BHC	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
delta-BHC	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
gamma-BHC (Lindane)	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
Heptachlor	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
Aldrin	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
Heptachlor Epoxide	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
Endosulfan I	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
Dieldrin	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
4,4'-DDE	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Endrin	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Endosulfan II	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
4,4'-DDD	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Endosulfan Sulfate	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
4,4'-DDT	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Methoxychlor	2.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Endrin Ketone	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
Endrin Aldehyde	0.5 U	0.35 U	0.47 U	0.33 U	0.36 U	N/A
alpha-Chlordane	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
gamma-Chlordane	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
T-Chlordane	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Toxaphene	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Hexachlorobenzene	0.25 U	0.17 U	0.23 U	0.16 U	0.18 U	N/A
PCBs						
Aroclor-1016	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1221	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1232	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1242	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1248	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1254	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1260	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A
Aroclor-1262	6.25 U	4.44 U	5.94 U	4.19 U	4.56 U	N/A

Qualifiers:
U: Compound analyzed for but not detected.

Notes:
N/A : Compound not analyzed for.

TABLE 4
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
INORGANIC CONSTITUENTS AND CYANIDE

	CEMENT PLANT FEEDSTOCK					IBM SLUDGE	
CEMENT COMPANY	Glens Falls	Blue Circle	Hercules	St. Lawrence	Keystone	NA	
SAMPLE IDENTIFICATION	Composite	Composite	Composite	Composite	Composite	CA-F COMP	B/690 HAZ FL
DATE OF COLLECTION	12/22/99	12/21/99	12/03/99	12/21/99	12/03/99	2/08/99	11/01/99
UNITS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	9680	4820	2890	8990	4220	N/A	N/A
Antimony	1.00 U	1.00 U	2.01	1.91	1.00 U	N/A	N/A
Arsenic	1.59	10.81	2.14	4.43	1.45	2.2 B	N/A
Barium	423	52.55	17.40	37.52	9.65	N/A	N/A
Beryllium	0.55	0.45	0.10 U	0.10 U	0.10 U	0.21 B	N/A
Cadmium	0.50 U	0.62	0.65	0.55	0.50 U	0.77 B	0.26
Calcium	245200	259100	264200	247400	254100	N/A	N/A
Chromium	11.30	12.21	26.90	29.01	9.77	20.0	9.80
Cobalt	3.15	3.03	3.93	2.09	3.11	N/A	N/A
Copper	5.18	9.15	52.11	8.70	9.51	N/A	N/A
Iron	6990	14200	14300	12200	9000	N/A	N/A
Lead	4.09	3.00 U	6.27	3.00 U	3.00 U	16.8	1.91
Magnesium	8800	5150	12500	12400	9200	N/A	N/A
Manganese	265	200	849	144	403	N/A	N/A
Mercury	3.15	0.1 U	0.91	0.1 U	0.1 U	0.25 U	N/A
Nickel	7.88	7.81	41.7	16.20	21.50	8.0	8.33
Potassium	4820	1710	858	1700	513	N/A	N/A
Selenium	0.64	1.00 U	0.54	1.00 U	1.00 U	N/A	N/A
Silver	0.50 U	0.50 U	1.56	0.50 U	0.50 U	1.4 B	0.12
Sodium	121	133	22.00	62.23	100 U	N/A	N/A
Thallium	16.7	1.00 U	14.60	1.00 U	1.00 U	N/A	N/A
Vanadium	9.90	24.32	7.42	12.90	2.84	N/A	N/A
Zinc	17.60	24.12	77.91	28.51	18.20	N/A	N/A
Cyanide	1.43	1.27	1.0 U	2.24	0.66 U	2.5 U	0.39 U

Qualifiers:
U: Compound analyzed for but not detected.
B: Compound detected at a concentration below the CRDL, but greater than the IDL.

Notes:
N/A: Constituent not analyzed for.

TABLE 5
INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL - PROJECT XL
CEMENT PLANT FEEDSTOCK SAMPLING ANALYTICAL RESULTS
INORGANIC CONSTITUENTS AND CYANIDE
STATISTICAL ANALYSIS

			CEMENT PLANT FEEDSTOCK						IBM Sludge	
		Number of	Range			Standard	95% Confidence Interval			
Analyte	Units	Samples	Min	Max	Mean	Deviation	Lower Limit	Upper Limit	2/08/99	11/01/99
Aluminum	mg/kg	5	2890	9,680	6,120	2,707	ND	13,635	N/A	N/A
Antimony	mg/kg	5	ND	2.0	1.1	0.72	ND	3.1	N/A	N/A
Arsenic	mg/kg	5	1.5	11	4.1	3.5	ND	14	2.2	N/A
Barium	mg/kg	5	9.7	423	108	158	ND	547	N/A	N/A
Beryllium	mg/kg	5	ND	0.55	0.23	0.22	ND	0.85	0.21	N/A
Cadmium	mg/kg	5	ND	0.65	0.46	0.18	ND	0.96	0.77	0.26
Calcium	mg/kg	5	245,200	264,200	254,000	7,086	234,329	273,671	N/A	N/A
Chromium	mg/kg	5	9.8	29	18	8.3	ND	41	20.0	9.80
Cobalt	mg/kg	5	2.1	3.9	3.1	0.58	1.4	4.7	N/A	N/A
Copper	mg/kg	5	5.2	52	17	18	ND	66	N/A	N/A
Iron	mg/kg	5	6,990	14,300	11,338	2,901	3,285	19,391	N/A	N/A
Lead	mg/kg	5	ND	6.3	3.0	1.9	ND	8.3	16.8	1.91
Magnesium	mg/kg	5	5,150	12,500	9,610	2,715	2,074	17,146	N/A	N/A
Manganese	mg/kg	5	144	849	372	254	ND	1,076	N/A	N/A
Mercury	mg/kg	5	ND	3.2	0.84	1.2	ND	4.2	ND	N/A
Nickel	mg/kg	5	7.8	42	19	12	ND	54	8.0	8.33
Potassium	mg/kg	5	513	4,820	1920	1524	ND	6,150	N/A	N/A
Selenium	mg/kg	5	ND	1	0.54	0.05	0.39	0.69	N/A	N/A
Silver	mg/kg	5	ND	1.6	0.51	0.52	ND	2.0	1.4	0.12
Sodium	mg/kg	5	ND	133	78	43	ND	196	N/A	N/A
Thallium	mg/kg	5	ND	17	6.6	7.5	ND	27	N/A	N/A
Vanadium	mg/kg	5	2.8	24	11	7.2	ND	32	N/A	N/A
Zinc	mg/kg	5	18	78	33	23	ND	96	N/A	N/A
Cyanide	mg/kg	5	ND	2.2	1.1	0.72	ND	3.1	ND	ND

Notes:
Statistical summary assumes values less than the IDL to be equal to half the IDL. Therefore, 0.5 x IDL was substituted for all "U" values.
ND: Not detected.

US EPA ARCHIVE DOCUMENT

APPENDIX B

"DISCUSSION OF THE INFLUENCE OF FLUORIDE ON CEMENT KILN OPERATION"

DISCUSSION of the INFLUENCE of FLUORIDE on CEMENT KILN OPERATION

{This brief report serves as an addendum to the report submitted to IBM in August 1986 titled "Initial Evaluation of the Conversion of Fluoride Sludge to Portland Cement". It does not alter the conclusions drawn in that report.}

A question has been raised regarding the possible influences on kiln operation of the fluoride in the sludge generated by IBM. Specifically - would the fluoride tend to concentrate in the kiln dust? Most of the dust is a waste which is landfilled, but some is sold as a lime substitute in agriculture. Thus excess fluoride in the dust could contaminate ground water. Could fluoride effect the operation of the kiln in other ways? As indicated in the original report, fluoride does not appear to pose any problems; the reasoning behind that conclusion is presented here.

Kiln Processes

The raw materials for cement production are fed to the kiln in the form of a slurry composed of water and powdered rock. This mix is slowly heated as it moves down the kiln and volatile compounds are driven from it. The volatiles are carried back through the cold end of the kiln by the combustion gases. First water leaves as steam. At about 1500F the limestone breaks down and carbon dioxide gas is driven off. In the burning zone of the kiln the boiling temperatures are reached for a number of common solid materials. Several sodium and potassium compounds in particular are driven into gaseous form by temperatures of 2500F to 2700F. One result is that the clinker produced by the kiln tends to be deficient in any compound or element that is volatile below 2700F.

The combustion gases carry volatile compounds back through the cold end of the kiln. Water and CO_2 will be carried out in gaseous form, but most of the other compounds condense to form solids prior to leaving the kiln. The condensation process occurs predominantly on the surface of dust particles. Small dust particles have a high ratio of surface area to volume and thus collect proportionately more volatile compounds than larger particles. So the dust being carried through and out of the kiln has a composition that depends on the the size of the particles. The larger dust particles have a composition similar to that of the kiln feed material. The smaller particles, especially those smaller than 10 microns, will be enriched in those compounds which are volatile in the hotter regions of the kiln.

Dust in the kiln originates primarily from mechanical agitation of the load as is slides through the kiln. The larger particles tend to settle back into the load while the smaller particles are carried out of the kiln by the flue gas. Cement kilns emit large amounts of dust (hundreds of tons per day) and so they are equipped with very good dust collectors. Electrostatic precipitators used on most cement kilns are multistage devices in which the largest particles tend to be collected in the first chamber and the smallest in the last chamber. The plant design takes advantage of this phenomenon by returning the catch of the first several chambers to the kiln and only discarding (wasting) the catch of the last chamber. This procedure has the desired effect of reducing the amount of alkali in the cement; of course it increases the amount of alkali and volatile compounds in the wasted dust. So dust which is land filled tends to contain relatively high amounts of potassium sodium compounds; might fluoride also be concentrated in the dust?

Fluoride in the Kiln Dust

The amount of fluoride in the wasted kiln dust will depend on how much is in the raw feed and on the volatility of the fluoride compounds. The dust composition will be that of the kiln feed plus whatever compounds are enriched by condensation processes in the kiln. The initial report showed that the amount of fluoride contributed to the kiln feed by the sludge would be small relative to existing average levels (average on a national basis because data specific to the Hudson Valley was not available). So there are two areas of concern regarding fluoride: Are fluoride levels in the Hudson Valley kilns much higher than average? and, Will processes in the kiln tend to enrich fluoride in the waste dust? Only the second question is answered here.

Fluoride will be enriched in the kiln dust if it exists in the kiln as a compound that is volatile at temperatures below 2700F. The melting and boiling points (in degrees F) of a number of compounds are listed below (Lange's Handbook of Chemistry).

Compound	Melting	Boiling
Calcium fluoride CaF_2	2584	4550
Calcium chloride $CaCl_2$	1422	3524
Potasium fluoride KF	1576	2762
Potasium chloride KCl	1312	2619
Potasium sulfate K_2SO_4	1953	3038
Sodium fluoride NaF	1825	3249
Sodium chloride NaCl	1474	2669
Sodium sulfate Na_2SO_4	1623	
Calcium oxide CaO	5300	6300
Silicon dioxide SiO_2	3133	4046

This shows that calcium fluoride probably does melt in the burning zone, but it does not boil and its vapor pressure is probably low. Thus we would not expect it to be enriched in the waste dust. The data also shows why alkali compounds tend to be enriched in the kiln waste dust - burning zone temperatures exceed or approach the boiling temperatures of several of them.

It is conceivable that chemical processes in the kiln could convert some of the calcium fluoride to potassium fluoride which could be enriched in the kiln dust. This appears to be unlikley. One respected kiln process consultant has stated that calcium fluoride does not convert to volatile species. Lea (Ref. 4 of the report) describes the use of 1 to 3% "calcium fluoride, or ... various fluoride wastes ... to facilitate clinkering". Apparently it forms eutectic compounds which help to reduce burning temperature. He goes on to discuss the chemistry of fluoride in cement. The fluoride does combine with the cement minerals in several forms - which suggests that formation of volatile species is not to be expected. In short we do not expect fluoride to be concentrated in the kiln dust or that the addition of small amounts of calcium fluoride to the kiln feed will substantially change the chemistry of the waste kiln dust.

Fluoride Effects on Kiln Operation

Addition of the IBM sludge to the feed of a typical kiln is expected to raise the fluoride content of the feed by about 0.03%; the average kiln dust concentration (probably close to that the feed content) is 0.13%. We noted above that the addition of 1-3% fluoride is known to facilitate clinker formation; it is not clear that the 0.03% contribution of the IBM sludge will be a sufficient quantity to have any measurable impact. Fluoride also changes the mineral forms in the cement with both beneficial and detrimental effects on cement properties as discussed by Lea (page 156). The net effect on the cement depends on site specific factors, but here again it is doubtful that IBM will generate enough fluoride to have a noticable effect.

Fluoride, in sufficient quantities, reacts with and degrades the refractory lining of the kiln. Under normal operating conditions, the inner surface of the kiln will be coated with a 2-4" layer of clinker. It is up to the operators to keep this layer from becomming too thick or from pealing off completely. The compounds in the IBM sludge will probably not have a significant influence on this coating. However, given the normal variability of kiln operation, it may prove impossible to determine whether or not the sludge has any effect. At a minimum it is likely to require several months of observation, operating alternately with and without the sludge.

Summary

A technical analysis shows that the addition of calcium fluoride to the kiln feed should result in a proportional increase in the amount of fluoride in the waste dust from the kiln. There is no basis to expect fluoride to be concentrated in the dust and changes in the dust are expected to be very small. Fluoride addition to the feed in amounts of 0.5 to 1.0% or more are known to influence the operation of the kiln and the properties of the cement. Whether these influences are beneficial or detrimental depends on site specific factors. Since IBM's contribution of fluoride to the kiln feed will be an order of magnitude less than the amounts which are known to effect the kiln, it is unlikely that the fluoride will have a noticable effect on cement plant operations.