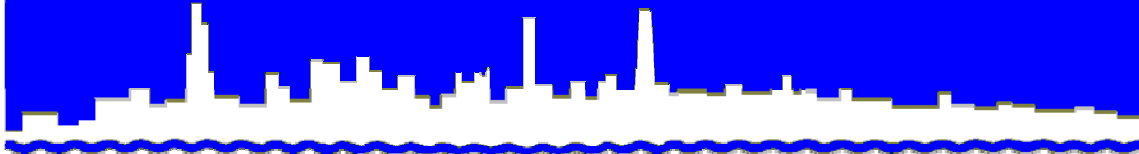


*Protecting Our Water Environment*



*Metropolitan Water Reclamation District of Greater Chicago*

***RESEARCH AND DEVELOPMENT  
DEPARTMENT***

*REPORT NO. 06-69*

*REPORT ON BIOSOLIDS CHARACTERISTICS FOR  
2005*

*November 2006*

REPORT ON BIOSOLIDS CHARACTERISTICS

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## INTRODUCTION

The Metropolitan Water Reclamation District of Greater Chicago (District) generates about 180,000 dry tons of biosolids annually through the operation of seven water reclamation plants (WRPs). Final biosolids products are generated at four of the District's WRPs: Calumet, John E. Egan, Hanover Park, and Stickney. The biosolids are produced through two main biosolids processing trains (BPTs), the high solids biosolids processing train (HSBPT) and low solids biosolids processing train (LSBPT).

In the HSBPT, anaerobically digested sludge is centrifuged to a solids content of 20 – 30 percent. At this stage, it meets the Class B pathogen criteria of the United States Environmental Protection Agency's (USEPA) Part 503 regulations for the land application of biosolids. The centrifuge cake biosolids are either land applied directly (Calumet, Egan, and Stickney WRPs) or are further processed by lagoon-aging followed by air-drying to approximately 65 percent solids (Calumet and Stickney WRPs).

In the LSBPT, the anaerobically-digested sludge is gravity thickened by lagoon-aging and then air-dried. The air-dried biosolids from both processing trains meet the Part 503 Class A pathogen criteria, the Part 503 vector attraction reduction requirements, and have a soil-like appearance and properties that allow them to be used as a soil conditioner.

Most of the District's biosolids are managed by land application through the following programs under permits issued by the Illinois Environmental Protection Agency (IEPA):

- Fischer Farm Land Application - The anaerobically digested liquid Class B biosolids from the Hanover Park WRP are applied to the Fischer Farm located on the plant grounds.
- Farmland Application - Class B centrifuge cake biosolids from the Calumet, Stickney, and John E. Egan WRPs are used to fertilize farmland in Cook and other nearby counties.
- Controlled Solids Distribution - Aged, air-dried Class A biosolids from the Stickney and Calumet WRPs are used in the Chicago Metropolitan area as a soil substitute or amendment for the construction of recreational fields, golf courses, etc., and in landscaping. The biosolids are also used as a fertilizer topdress for turfgrasses on these areas.
- Landfill Final and Daily Covers - Biosolids from the Stickney and Calumet WRPs are also used for landfill final and daily covers.

The District generates data on the characteristics of its biosolids through routine monitoring and reporting requirements of regulatory agencies and operating permits. Data on biosolids properties are also generated through scientific research or other studies that are designed specifically for evaluating biosolids characteristics not measured in the routine monitoring programs.

The purpose of this report is to provide information on the chemical characteristics of the District's biosolids to biosolids users.

## BIOSOLIDS CHEMICAL CHARACTERISTICS

### Biosolids Nutrients and Trace Metal Chemistry

The District conducts analysis of its biosolids as required by the USEPA's Part 503 biosolids land application regulations and by permits issued by the IEPA. The data reported here also include some parameters that are not required for Part 503 or IEPA monitoring compliance. Such datasets are primarily used to provide information to biosolids users, and for estimating agronomic and metal loading rates for the Class B biosolids farmland application program.

**Class B Centrifuge Cake Fertilizer Products.** A summary of the nutrient and trace metal data for centrifuge cake biosolids generated at the Calumet, John E. Egan, and Stickney WRPs in 2005 is presented in Tables 1, 2, and 3, respectively. These biosolids are used as fertilizer on farmland in Cook and other neighboring counties. They are Class B with respect to the Part 503 pathogen standards and can meet the vector attraction reduction requirements through incorporation into soil. These biosolids have higher nitrogen (N) content than Class A biosolids and are not as extensively stabilized. For this reason, they are primarily used as an agricultural fertilizer and application rates are typically computed to supply crop N requirements. Using data from Tables 1 through 3, the plant-available nitrogen (PAN) content of these biosolids is computed based on total Kjeldahl N (TKN) and ammonia N (NH<sub>3</sub>-N) according to the IEPA Part 391 rule as follows:

$$\text{PAN (lb N/ton)} = f \times \text{NH}_3\text{-N} + 0.2 \times \text{Organic N} \times 0.002 \quad [1]$$

where Organic N = (TKN – NH<sub>3</sub>-N).

$$\text{Biosolids rate (ton/ac)} = \text{crop N req. (lb/ac)} \times 1/\text{PAN (lb/ton)} \quad [2]$$

The factor of 0.2 represents the fraction of organic N that is available during the first year after application. The factor *f* represents the fraction of NH<sub>3</sub>-N that is plant available. The availability of NH<sub>3</sub>-N from biosolids is dependent on soil texture and the method of application and is estimated as follows:

- 100 percent – subsurface injection of liquid biosolids in non-sandy soils
- 80 percent – surface application followed by incorporation through disc or chisel plow
- 50 percent – surface or subsurface injection in sandy soils
- 25 percent – surface application without incorporation in heavy clay soils

TABLE 1. CHEMICAL COMPOSITION OF CENTRIFUGE CAKE BIOSOLIDS  
GENERATED AT THE CALUMET WRP IN 2005 AND APPLICABLE  
PART 503 EQ LIMITS

Constituent	Unit	Mean	Minimum	Maximum	503 Limit
pH		8.0	5.9	8.5	
TS	%	23.6	19.8	29.4	
TVS	%	53.8	42.7	60.1	
Volatile Acids	mg/kg	241	46	489	
TKN	"	39,889	17,624	51,775	
NH <sub>3</sub> -N	"	6,802	3,139	12,278	
Total P	"	23,895	11,454	32,563	
Ag	"	14	12	17	
Al	"	14,214	9,242	46,342	
As	"	6	<1	10	41
Ba	"	444	360	505	
Be	"	<0.05	<0.05	<0.05	
Ca	"	42,698	30,815	50,806	
Cd	"	3	2	4	39
Cr	"	74	57	93	
Cu	"	429	359	487	1,500
Fe	"	31,277	21,250	45,075	
Hg	"	1.1	0.30	3.3	17
K	"	2,952	1,455	4,691	
Mg	"	19,332	10,900	46,492	
Mn	"	896	583	1,455	
Mo	"	19	11	33	75
Na	"	1,041	826	1,442	
Ni	"	36	27	49	420
Pb	"	91	68	123	300
Sb	"	3	1	5	
Se	"	7	<1	15	100
Tl	"	<5	<5	<5	
Zn	"	952	795	1,101	2,800



TABLE 2. CHEMICAL COMPOSITION OF CENTRIFUGE CAKE BIOSOLIDS  
GENERATED AT THE JOHN E. EGAN WRP IN 2005 AND APPLICABLE  
PART 503 EQ LIMITS

Constituent	Unit	Mean	Minimum	Maximum	503 Limit
pH		8.1	7.7	8.5	
TS	%	23.2	20.1	26.5	
TVS	%	62.9	58.0	68.5	
Volatile Acids	mg/kg	1,217	240	3,996	
TKN	"	37,537	18,033	66,397	
NH <sub>3</sub> -N	"	4,617	2,710	7,728	
Total P	"	18,603	7,545	27,296	
Ag	"	38	13	50	
Al	"	10,292	8,391	12,695	
As	"	<1	<1	3	41
Ba	"	436	376	481	
Be	"	<0.05	<0.05	<0.05	
Ca	"	33,152	29,613	37,776	
Cd	"	4	3	4	39
Cr	"	160	131	179	
Cu	"	826	753	918	1,500
Fe	"	46,815	19,827	59,084	
Hg	"	1.4	0.23	2.5	17
K	"	2,135	1,173	5,577	
Mg	"	7,463	5,326	9,698	
Mn	"	847	622	966	
Mo	"	19	14	25	75
Na	"	852	106	5,061	
Ni	"	78	59	98	420
Pb	"	56	42	72	300
Sb	"	4	3	5	
Se	"	<1	<1	<1	100
Tl	"	ND	ND	ND	
Zn	"	946	784	1,145	2,800

ND=Not detectable.

TABLE 3. CHEMICAL COMPOSITION OF CENTRIFUGE CAKE BIOSOLIDS  
GENERATED AT THE STICKNEY WRP IN 2005 AND APPLICABLE  
PART 503 EQ LIMITS

Constituent	Unit	Mean	Minimum	Maximum	503 Limit
pH		7.8	7.4	8.2	
TS	%	25.5	22.8	29.3	
TVS	%	53.5	47.7	58.0	
TKN	mg/kg	11,757	5,574	24,601	
NH <sub>3</sub> -N	"	1,348	804	2,066	
Total P	"	5,448	3,534	11,468	
Ag	"	14	12	17	
Al	"	19,382	13,936	25,000	
Ba	"	444	361	506	
As	"	5	<1	7	41
Ca	"	33,012	27,608	39,108	
Cd	"	4	1	5	39
Cr	"	198	133	266	
Cu	"	394	311	485	1,500
Fe	"	15,054	11,763	17,609	
Hg	"	0.98	0.32	1.6	17
K	"	2,955	1,159	5,570	
Mg	"	14,672	12,357	17,377	
Mn	"	452	334	650	
Mo	"	15	9	23	75
Na	"	1,094	631	2,196	
Ni	"	50	32	90	420
Pb	"	128	92	161	300
Sb	"	3	1	5	
Se	"	<1	<1	<1	100
V	"	70	21	145	
Zn	"	852	654	1,080	2,800

The total P content of biosolids is relatively high, but only a small fraction is readily plant available. Land application of biosolids based on N content usually results in excessive application of P, which can contaminate surface waters through runoff. Land application rates based on P content are being adopted in several U.S. states to reduce P runoff. The IEPA Part 391 rule recommends that after five years of biosolids application, soil test P shall be monitored and biosolids application terminated if this value exceeds 400 lb/ac in sandy soils and 800 lb/ac in non-sandy soils.

**Class A Soil Amendment Products.** Data for Class A lagoon-aged, air-dried biosolids from the Calumet and Stickney WRPs are presented in Tables 4 and 5, respectively.

The John E. Egan WRP does not produce lagoon-aged, air-dried biosolids. All lagoon-aged, air-dried District biosolids that are land applied meet the Part 503 Exceptional Quality (EQ) criteria. These biosolids comply with the Class A pathogen and vector attraction reduction standards and the concentration of trace metals are much lower than the Part 503 EQ limits.

The air-dried biosolids are distinctly different from centrifuge cake in that they contain lower concentrations of volatile solids, TKN, and  $\text{NH}_3\text{-N}$ . These lower concentrations are mainly due to the loss of volatile solids and  $\text{NH}_3\text{-N}$  by volatilization during the lagoon-aging and air-drying processes. This renders the biosolids a less odorous product, which can be used at higher than fertilizer rates.

This product is best utilized as a fertilizer for top-dressing or preparing seedbeds for turf establishment on golf courses. It may also be used for the construction of athletic fields, for the establishment of prairie grasses and ornamental plants along highways, and in the establishment and rejuvenation of parks and gardens. As a nutrient source for turf, biosolids are typically applied as a ¼-inch layer (approximately 20 dry tons/ac) on the established turf. This application rate typically supplies approximately 200 lbs PAN/ac, 400 lbs/ac  $\text{P}_2\text{O}_5$ , (only about 50 percent of this total  $\text{P}_2\text{O}_5$  is plant available), and 60 lbs/ac  $\text{K}_2\text{O}$ . All air-dried biosolids utilized as soil amendment or fertilizer are analyzed immediately before distribution for parameters listed in Tables 4 and 5 and the analytical data can be used to estimate PAN content according to the following equation.

$$\text{PAN (lb N/ton)} = 0.25 \times \text{NH}_3\text{-N} + \text{NO}_3\text{-N} + 0.2 \times \text{Organic N} \times 0.002 \quad [3]$$

where Organic N = (TKN –  $\text{NH}_3\text{-N}$ ).

The factor 0.25 represents the fraction of  $\text{NH}_3\text{-N}$  that is plant available from surface-applied biosolids, and 0.2 represents the fraction of organic N that is available during the first year after application.

As a soil conditioner, the biosolids are typically blended with bulk soil or in-place soil at a rate of 1 part biosolids to 3 parts soil by volume. However, this rate might be adjusted depending on specific project needs.

TABLE 4. CHEMICAL COMPOSITION OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE CALUMET WRP IN 2005 AND APPLICABLE  
PART 503 EQ LIMITS

Constituent	Unit	Mean	Minimum	Maximum	503 Limit
pH		6.7	5.8	7.6	
TS	%	74.9	62.4	92.2	
TVS	%	40.7	22.7	45.7	
Volatile Acids	mg/dry kg	168	47	1,539	
Total Kjeldahl N	"	27,572	9,021	45,140	
NH <sub>3</sub> -N	"	2,019	162	4,215	
NO <sub>2</sub> +NO <sub>3</sub> -N	"	1,059	29	2,044	
Total P	"	23,180	9,908	46,481	
Ag	"	21	14	29	
Al	"	18,494	10,936	25,905	
As	"	7	1	11	41
Ba	"	476	321	575	
Be	"	<0.05	<0.05	0.15	
Ca	"	51,476	47,251	60,834	
Cd	"	8	5	12	39
Cr	"	171	82	620	
Cu	"	398	219	459	1,500
Fe	"	29,283	23,989	38,129	
Hg	"	1.1	0.09	2.3	17
K	"	3,866	1,653	6,929	
Mg	"	16,786	13,206	27,649	
Mn	"	768	577	1,025	
Mo	"	14	9	18	75
Na	"	733	143	1,156	
Ni	"	36	30	42	420
Pb	"	136	95	167	300
Sb	"	3	<0.9	4	
Se	"	11	3	25	100
Tl	"	ND	ND	ND	
Zn	"	1,282	765	1,586	2,800

TABLE 5. CHEMICAL COMPOSITION OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005 AND APPLICABLE PART 503 EQ LIMITS

Constituent	Unit	Mean	Minimum	Maximum	503 Limit
pH		6.7	6.1	7.8	
TS	%	71.7	54.0	92.5	
TVS	%	38.9	31.5	47.0	
Volatile Acids	mg/kg	414	149	1,160	
TKN	"	11,395	4,202	25,493	
NH <sub>3</sub> -N	"	1,400	95	7,371	
NO <sub>2</sub> +NO <sub>3</sub> -N	"	761	46	1,651	
Total P	"	10,695	5,097	18,368	
Al	"	19,861	13,875	25,793	
As	"	7	5	11	41
Ca	"	42,877	35,129	49,935	
Cd	"	7	4	14	39
Cr	"	310	233	451	
Cu	"	482	421	551	1,500
Fe	"	19,521	16,836	21,541	
Hg	"	1.0	0.64	1.3	17
K	"	3,087	1,764	5,285	
Mg	"	18,734	14,868	23,236	
Mn	"	587	513	697	
Mo	"	19	14	22	75
Na	"	961	368	1,369	
Ni	"	62	56	71	420
Pb	"	178	149	208	300
Se	"	<1	<1	<1	100
Zn	"	1,139	988	1,354	2,800

## **Biosolids Toxicity Characteristic Leaching Procedure (TCLP) Analyses**

The TCLP analyses of biosolids are required in order to satisfy the requirements of the USEPA's Part 261 rule where biosolids are used as landfill daily cover. The analyses include total and TCLP-extractable concentrations of biosolids constituents. The TCLP data generated for lagoon-aged, air-dried biosolids from the Calumet, John E. Egan, and Stickney WRPs are presented in Tables 6, 7, and 8, respectively. The data show that, in the TCLP extracts, most of the organic compounds are undetectable and the concentrations of the metals are much lower than the Part 261 regulatory limits. The District biosolids have always passed the TCLP test and are thereby classified by the USEPA and IEPA as non-hazardous and suitable for use as daily landfill cover.

## **Tiered Approach to Corrective Action Objectives (TACO)**

The TACO Standards were promulgated in 1997 as a voluntary program under Title 35, Illinois Administrative Code Part 742 to establish standards for the cleanup of contaminated sites in Illinois. The program was designed primarily to address the “how clean is clean” problem experienced in the implementation of other brownfield cleanup programs, such as the Site Remediation Program and the Leaking Underground Storage Tanks Program. For brownfields that meet the TACO cleanup objectives in the respective programs, the state issues a “No Further Remediation” letter. Objectives were developed for intended future land uses, specifically residential or commercial/industrial. The most stringent objectives were developed for sites anticipated for residential redevelopment. The default objectives are risk-based and include the following human exposure routes: soil ingestion, dust inhalation, and leachability to potable groundwater. Because the TACO standards are based on a cancer risk level of one in one million with many worst-case assumptions built into the risk pathways, the default for Tier I residential property is extremely conservative.

The objectives of the TACO program are not directly applicable to biosolids. However, in 2000, the District began to evaluate its biosolids by considering instances in which the TACO standards may be applicable to biosolids use in the remediation of brownfields. The TACO analyses for twelve biosolids samples, six from the Calumet and six from the Stickney WRPs, and the corresponding TACO Tier 1 residential objectives are presented in Tables 9 and 10, respectively. Extract concentrations (Tables 9 and 10) are used to evaluate the objectives for soil exposure through ingestion and dust inhalation for organic compounds and inorganic parameters, and the groundwater route for organic compounds. The data indicate that biosolids meet most Tier 1 residential objectives.

The data presented for the twelve biosolids samples (Tables 9 and 10) depict all concentrations of organic and inorganic compounds measured by the TACO analysis. Most of the organic compounds are undetectable, and the concentrations of most of the detectable compounds are lower than the TACO Tier 1 residential limits. The concentrations of all inorganic parameters are also much lower than the TACO limits.

TABLE 6. TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE CALUMET WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
Flash Point, Open Cup	>200°F	<140°F
Paint Filter Test	NFL2	
pH, 10 Percent Solution	5.9	2.1-12.4
Total Solids	56 %	NL <sup>3</sup>
----- Total Concentration (mg/dry kg) -----		
<u>Inorganics</u>		
Extractable Organic Halogens	<31.0 mg/kg	NL
Cyanide - Reactive	5.5 mg/kg	NL
Sulfide - Reactive	<8.6 mg/kg	NL
Ag	15	NL
As	6.6	NL
Ba	310	NL
Cd	5.7	NL
Cr	72	NL
Hg	0.56	NL
Pb	120	NL
Se	8.1	NL
----- TCLP <sup>4</sup> Extract (mg/L) -----		
Ag	<0.005	5
As	<0.100	5
Ba	<1.000	100
Cd	<0.050	1
Cr	<0.010	5
Hg	<0.002	0.2
Pb	<0.005	5
Se	<0.100	1

TABLE 6 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE CALUMET WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics</u>		
Phenols	0.84	NL
Total PCB	0.570	NL
Chlordane	<0.0010	0.03
Endrin	<0.0005	0.02
Heptachlor	<0.0005	0.008
Heptachlor Epoxide	<0.0005	0.008
Lindane	<0.0005	0.4
Methoxychlor	<0.0025	10
Toxaphene	<0.0050	0.5
2,4-D	<0.1000	10
2,4,5-TP	<0.0100	1
Benzene	<0.0250	0.5
Carbon Tetrachloride	<0.0250	0.5
Chlorobenzene	<0.0250	100
Chloroform	<0.1000	6
2-Butanone (methyl ethyl ketone)	<0.0250	200
Tetrachloroethylene	<0.0250	0.7
Trichloroethylene	<0.0250	0.5
Vinyl Chloride	<0.0250	0.2
1,4-Dichlorobenzene	<0.1000	7.5
1,2-Dichloroethane	<0.0250	0.5
1,1-Dichloroethylene	<0.0250	0.7
o-Cresol	<0.1000	200
m,p-Cresols	<0.1000	200
Hexachlorobenzene	<0.1000	0.13
Hexachlorobutadiene	<0.1000	0.5
Hexachloroethane	<0.1000	3



TABLE 6 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE CALUMET WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics (Continued)</u>		
Nitrobenzene	<0.1000	2
Pentachlorophenol	<0.5000	100
Pyridine	<0.2000	5
2,4-Dinitrotoluene	<0.1000	0.13
2,4,5-Trichlorophenol	<0.5000	400
2,4,6-Trichlorophenol	<0.1000	2

<sup>1</sup>All analyses were performed using EPA Method SW-846 and Standard Methods.

<sup>2</sup>NFL = No Free Liquid.

<sup>3</sup>NL = No limit specified.

<sup>4</sup>TCLP = Toxicity Characteristics Leaching Procedure.

TABLE 7. TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
 GENERATED AT THE JOHN E. EGAN WRP IN 2005 AND THE APPLICABLE PART 261  
 REGULATORY LIMITS

Parameter	Value	Regulatory Limit
Flash Point, Open Cup	>200°F	<140°F
Paint Filter Test	NFL <sup>2</sup>	
pH, 10 Percent Solution	8.6	2.1-12.4
Total Solids	80 %	NL <sup>3</sup>
----- Total Concentration (mg/dry kg) -----		
<u>Inorganics</u>		
Extractable Organic Halogens	<210 mg/kg	NL
Cyanide - Reactive	3.9 mg/kg	NL
Sulfide - Reactive	<48 mg/kg	NL
Ag	56	NL
As	<4.7	NL
Ba	420	NL
Cd	2.0	NL
Cr	140	NL
Hg	1.20	NL
Pb	49.0	NL
Se	6.6	NL
----- TCLP <sup>4</sup> Extract (mg/L) -----		
Ag	<0.050	5
As	<0.100	5
Ba	<1.000	100
Cd	<0.050	1
Cr	<0.050	5
Hg	<0.002	0.2
Pb	<0.050	5
Se	<0.100	1

TABLE 7 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE JOHN E. EGAN WRP IN 2005 AND THE APPLICABLE PART 261 REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics</u>		
Phenols	20.0	NL
Total PCB	<0.800	NL
Chlordane	<0.0010	0.03
Endrin	<0.0005	0.02
Heptachlor	<0.0005	0.008
Heptachlor Epoxide	<0.0005	0.008
Lindane	<0.0005	0.4
Methoxychlor	<0.0010	10
Toxaphene	<0.0050	0.5
2,4-D	<0.1000	10
2,4,5-TP	<0.0100	1
Benzene	<0.0250	0.5
Carbon Tetrachloride	<0.0250	0.5
Chlorobenzene	<0.0250	100
Chloroform	<0.0250	6
2-Butanone (methyl ethyl ketone)	<0.0250	200
Tetrachloroethylene	<0.0250	0.7
Trichloroethylene	<0.0250	0.5
Vinyl Chloride	<0.0250	0.2
1,4-Dichlorobenzene	<0.1000	7.5
1,2-Dichloroethane	<0.0250	0.5
1,1-Dichloroethylene	<0.0250	0.7
o-Cresol	<0.1000	200
m,p-Cresols	<0.1000	200
Hexachlorobenzene	<0.1000	0.13
Hexachlorobutadiene	<0.1000	0.5

TABLE 7 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE JOHN E. EGAN WRP IN 2005 AND THE APPLICABLE PART 261 REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics (Continued)</u>		
Hexachloroethane	<0.1000	3
Nitrobenzene	<0.1000	2
Pentachlorophenol	<0.5000	100
Pyridine	<0.2000	5
2,4-Dinitrotoluene	<0.1000	0.13
2,4,5-Trichlorophenol	<0.5000	400
2,4,6-Trichlorophenol	<0.1000	2

<sup>1</sup>All analyses were performed using EPA Method SW-846 and Standard Methods.

<sup>2</sup>NFL = No Free Liquid.

<sup>3</sup>NL = No limit specified.

<sup>4</sup>TCLP = Toxicity Characteristics Leaching Procedure.

TABLE 8. TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE STICKNEY WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
Flash Point, Open Cup	>200°F	<140°F
Paint Filter Test	NFL <sup>2</sup>	
pH, 10 Percent Solution	6.6	2.1-12.4
Total Solids	53 %	NL <sup>3</sup>
----- Total Concentration (mg/dry kg) -----		
<u>Inorganics</u>		
Extractable Organic Halogens	<33.0 mg/kg	NL
Cyanide - Reactive	3.6 mg/kg	NL
Sulfide - Reactive	<8.1 mg/kg	NL
Ag	18	NL
As	6.4	NL
Ba	210	NL
Cd	4.9	NL
Cr	190	NL
Hg	0.63	NL
Pb	100	NL
Se	2.7	NL
----- TCLP <sup>4</sup> Extract (mg/L) -----		
Ag	<0.005	5
As	<0.100	5
Ba	<1.000	100
Cd	<0.050	1
Cr	<0.010	5
Hg	<0.002	0.2
Pb	<0.005	5
Se	<0.100	1

TABLE 8 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE STICKNEY WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics</u>		
Phenols	1.30	NL
Total PCB	<0.567	NL
Chlordane	<0.0010	0.03
Endrin	<0.0005	0.02
Heptachlor	<0.0005	0.008
Heptachlor Epoxide	<0.0005	0.008
Lindane	<0.0005	0.4
Methoxychlor	<0.0025	10
Toxaphene	<0.0050	0.5
2,4-D	<0.1000	10
2,4,5-TP	<0.0100	1
Benzene	<0.0250	0.5
Carbon Tetrachloride	<0.0250	0.5
Chlorobenzene	<0.0250	100
Chloroform	<0.1000	6
2-Butanone (methyl ethyl ketone)	<0.0250	200
Tetrachloroethylene	<0.0250	0.7
Trichloroethylene	<0.0250	0.5
Vinyl Chloride	<0.0250	0.2
1,4-Dichlorobenzene	<0.1000	7.5
1,2-Dichloroethane	<0.0250	0.5
1,1-Dichloroethylene	<0.0250	0.7
o-Cresol	<0.1000	200
m,p-Cresols	<0.1000	200
Hexachlorobenzene	<0.1000	0.13

TABLE 8 (Continued). TCLP<sup>1</sup> ANALYSIS OF LAGOON-AGED, AIR-DRIED BIOSOLIDS  
GENERATED AT THE STICKNEY WRP IN 2005 AND THE APPLICABLE PART 261  
REGULATORY LIMITS

Parameter	Value	Regulatory Limit
----- TCLP Extract (mg/L) -----		
<u>Organics (Continued)</u>		
Hexachlorobutadiene	<0.1000	0.5
Hexachloroethane	<0.1000	3
Nitrobenzene	<0.1000	2
Pentachlorophenol	<0.5000	100
Pyridine	<0.2000	5
2,4-Dinitrotoluene	<0.1000	0.13
2,4,5-Trichlorophenol	<0.5000	400
2,4,6-Trichlorophenol	<0.1000	2

<sup>1</sup>All analyses were performed using EPA Method SW-846 and Standard Methods.

<sup>2</sup>NFL = No Free Liquid.

<sup>3</sup>NL = No limit specified.

<sup>4</sup>TCLP = Toxicity Characteristics Leaching Procedure.

TABLE 9. CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics</b>										
Dalapon	<0.89	<0.91	<0.91	<0.82	<0.81	<0.78	2,300	NA	0.85	8.5
2,4-D	<0.45	<0.45	<0.45	<0.41	<0.40	<0.39	780	NA	1.5	7.7
2,4,5-TP (Silvex)	<0.045	<0.045	<0.045	<0.041	<0.040	<0.039	630	NA	11	55
Dinoseb	<0.045	<0.045	<0.045	<0.041	<0.040	<0.039	78	NA	0.34	3.4
Picloram	<0.045	<0.045	<0.045	<0.041	<0.040	<0.039	5,500	NA	2	20
Aldicarb	<220	<220	<220	<200	<200	<190	78	NA	0.013	0.07
Carbofuran	<22	<22	<22	<20	<20	<19	390	NA	0.22	1.1
Endothall	<220	<220	<220	<200	<200	<190	1,600	NA	0.40	0.40
Pentachlorophenol	<0.045	<0.045	<0.045	<0.041	<0.040	<0.039	3	NA	0.03	0.14
Alpha-BHC	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	0.10	0.80	0.0005	0.003
Gamma-BHC (Lindane)	<0.23	<0.22	<0.11	<0.020	<0.020	<b>0.62</b>	0.50	NA	0.009	0.047
Aldrin	<0.23	<0.22	<0.11	<b>0.066</b>	<b>0.037</b>	<b>0.032</b>	0.04	3	0.50	2.5
Heptachlor	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	0.10	0.10	23	110
Heptachlor epoxide	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	0.07	5	0.70	3.3
Endosulfan I	<0.23	<0.22	<0.11	<b>0.035</b>	<0.020	<0.020	470	NA	18	90
Dieldrin	<0.23	<0.22	<0.11	<b>0.064</b>	<0.020	<b>0.042</b>	0.04	1	0.004	0.02
4,4'-DDE	<0.23	<0.22	<0.11	<0.020	<0.020	<b>0.036</b>	2	NA	54	270
Endrin	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	23	NA	1	5
Endosulfan II	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	470	NA	18	90
4,4'-DDD	<0.23	<0.22	<0.11	<0.015	<0.020	<0.020	3	NA	16	80
4,4'-DDT	<0.23	<0.22	<0.085	<0.020	<0.020	<b>0.025</b>	2	NA	32	160
Methoxychlor	<1.1	<1.1	<0.56	<0.034	<0.033	<0.033	390	NA	160	780
Alpha-Chlordane	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	0.50	20	10	48



TABLE 9 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
Gamma-Chlordane	<0.23	<0.22	<0.11	<0.020	<0.020	<0.020	0.50	20	10	48
Toxaphene	<2.2	<2.2	<1.1	<0.20	<0.20	<0.20	0.60	89	31	150
Atrazine	<22	<22	<11	<2.0	<2.0	<2.0	2,700	NA	0.066	0.33
Alachlor	<2.3	<2.2	<1.1	<b>0.36</b>	<b>0.39</b>	<b>0.31</b>	8	NA	0.04	0.20
Simazine	<8.9	<8.8	<0.85	<b>9.7</b>	<b>11</b>	<b>6.9</b>	390	NA	0.04	0.37
Aroclor 1016	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1221	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1232	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1242	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1248	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1254	<0.22	<0.22	<0.22	<0.20	<0.20	<0.20	NA	NA	NA	NA
Aroclor 1260 (PCBs)	<b>1.0</b>	<b>1.2</b>	<b>1.1</b>	<b>0.44</b>	<b>0.43</b>	<b>0.37</b>	1	1	1	1
Phenol	<11	<11	<11	<10	<9.9	<9.6	47,000	NA	100	100
Bis(2-chloroethyl)ether	<4.5	<4.5	<4.5	<4.0	<4.0	<3.9	0.60	0.20	0.0004	0.0004
1,4-Dichlorobenzene	<11	<11	<11	<10	<9.9	<9.6	NA	NA	2	11
1,2-Dichlorobenzene	<11	<11	<11	<10	<9.9	<9.6	7,000	560	17	43
2-Methylphenol (o-cresol)	<4.5	<4.5	<4.5	<4.0	<4.0	<3.9	3,900	NA	15	15
n-Nitroso-di-n-propylamine	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	0.09	NA	0.00005	0.00005
Hexachloroethane	<11	<11	<11	<10	<9.9	<9.6	78	NA	0.50	2.6
4-Methylphenol (m/p-cresol)	<4.5	<4.5	<4.5	<4.0	<4.0	<3.9	3,900	NA	15	15
2-Chlorophenol	<11	<11	<11	<10	<9.9	<9.6	390	53,000	4	4
Nitrobenzene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	39	92	0.10	0.10
1,2,4-Trichlorobenzene	<11	<11	<11	<10	<9.9	<9.6	780	3,200	5	53

TABLE 9 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
							Soil Exposure Route		Groundwater Exposure Route	
	1	2	3	4	5	6	Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
Benzoic acid	<45	<45	<45	<40	<40	<39	310,000	NA	400	400
Isophorone	<11	<11	<11	<10	<9.9	<9.6	15,600	4,600	8	8
2,4-Dimethylphenol	<22	<22	<22	<20	<20	<19	1,600	NA	9	9
Naphthalene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	3,100	NA	84	420
4-Chloroaniline	<45	<45	<45	<40	<40	<39	310	NA	0.70	0.70
2,4,6-Trichlorophenol	<11	<11	<11	<10	<9.9	<9.6	58	200	0.20	0.77
2,4,5-Trichlorophenol	<22	<22	<22	<20	<20	<19	7,800	NA	270	1,400
Hexachlorocyclopentadiene	<45	<45	<45	<40	<40	<39	550	10	400	2,200
2,6-Dinitrotoluene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	0.90	NA	0.0007	0.0067
2,4-Dinitrophenol	<45	<45	<45	<40	<40	<39	160	NA	0.20	0.20
2,4-Dinitrotoluene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	0.90	NA	0.0008	0.0008
Acenaphthene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	4,700	NA	570	2,900
Fluorene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	3,100	NA	560	2,800
Hexachlorobenzene	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	0.40	1	2	11
Diethyl phthalate	<4.5	<4.5	<4.5	<4.0	<4.0	<3.9	63,000	2,000	470	470
4-Chlorophenyl phenyl ether	<11	<11	<11	<10	<9.9	<9.6	NA	NA	NA	NA
n-Nitrosodiphenylamine	<2.2	<2.2	<2.2	<2.0	<2.0	<1.9	130	NA	1	5.6
Anthracene	<0.50	<2.2	<0.49	<0.42	<2.0	<1.9	23,000	NA	12,000	59,000
Carbazole	<11	<11	<11	<10	<9.9	<9.6	32	NA	0.60	2.8
Di-n-butyl phthalate	<11	<11	<11	<10	<9.9	<9.6	7,800	2,300	2,300	2,300
Fluoranthene	<b>7.5</b>	<b>5.5</b>	<b>5.6</b>	<b>3.9</b>	<b>3.0</b>	<b>3.7</b>	3,100	NA	4,300	21,000
Pyrene	<b>7.2</b>	<b>5.1</b>	<b>5.0</b>	<b>3.6</b>	<b>3.5</b>	<b>4.0</b>	2,300	NA	4,200	21,000
Butyl benzyl phthalate	<4.5	<4.5	<4.5	<4.0	<4.0	<3.9	16,000	930	930	930
Benzo(a)anthracene	<b>5.7</b>	<b>3.3</b>	<b>3.5</b>	1.6	1.4	1.6	0.90	NA	2	8

TABLE 9 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
Chrysene	<b>8.5</b>	<b>6.3</b>	<b>6.3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	88	NA	160	800
3,3-Dichlorobenzidine	11	11	11	10	9.9	9.6	1	NA	0.007	0.033
Bis(2-ethylhexyl) phthalate	<b>47</b>	<b>44</b>	<b>42</b>	<b>63</b>	54	60	46	31,000	3,600	31,000
Di-n-octyl phthalate	22	22	22	20	20	19	1,600	10,000	10,000	10,000
Benzo(b)fluoranthene	<b>6.1</b>	<b>4</b>	<b>5.5</b>	<b>2.5</b>	<b>2.3</b>	<b>2.1</b>	0.90	NA	5	25
Benzo(k)fluoranthene	11	<b>6.2</b>	<b>5.6</b>	<b>3.3</b>	<b>2.6</b>	<b>3.4</b>	9	NA	49	250
Benzo(a)pyrene	<b>7.3</b>	<b>4.9</b>	<b>4.7</b>	<b>2.3</b>	<b>2.0</b>	<b>2.2</b>	0.09	NA	8	82
Indeno(1,2,3-cd)pyrene	<b>5</b>	<b>4</b>	<b>4</b>	2	<b>2</b>	2	0.90	NA	14	69
Dibenzo(a,h)anthracene	2.0	2.2	2.2	0.8	<b>2.0</b>	1.9	0.09	NA	2	7.6
Vinyl chloride	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	0.30	0.03	0.01	0.07
1,1-Dichloroethene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	700	1,500	0.06	0.30
Carbon disulfide	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	7,800	720	32	160
Acetone	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	7,800	100,000	16	16
Methylene chloride	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	85	13	0.02	0.20
Trans-1,2-Dichloroethene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	1,600	3,100	0.70	3.4
1,1-Dichloroethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	7,800	1,300	23	110
Vinyl acetate	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	78,000	1,000	170	170
Cis-1,2-Dichloroethene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	780	1,200	0.40	1.1
Chloroform	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	100	0.30	0.60	2.9
1,1,1-Trichloroethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	NA	1,200	2	9.6
1,1-Dichloropropene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	NA	NA	NA	NA
Carbon tetrachloride	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	5	0.30	0.07	0.33
Benzene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	22			

TABLE 9 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
							Soil Exposure Route		Groundwater Exposure Route	
	1	2	3	4	5	6	Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
1,2-Dichloroethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	7	0.40	0.02	0.10
Trichloroethene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	58	5	0.06	0.30
Bromodichloromethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	10	3,000	0.60	0.60
Cis-1,3-Dichloropropene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	4	0.10	0.004	0.02
Toluene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	16,000	650	12	29
Trans-1,3-Dichloropropene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	4	0.10	0.004	0.02
1,1,2-Trichloroethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	310	1,800	0.02	0.30
Tetrachloroethene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	12	11	0.06	0.30
1,2-Dibromoethane (EDB)	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	0.0075	0.17	0.0004	0.004
Chlorobenzene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	1,600	130	1	6.5
1,1,1,2-Tetrachloroethane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	NA	NA	NA	NA
Ethylbenzene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	7,800	400	13	19
m&p-Xylenes	<0.013	<0.014	<0.014	<0.012	<0.012	<0.012	160,000	440	205	205
o-Xylene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	160,000	410	190	190
Styrene	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	16,000	1,500	4	18
Bromoform	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	81	53	0.80	0.80
1,2-Dibromo-3-chloropropane	<0.0067	<0.0068	<0.0068	<0.0062	<0.0060	<0.0059	0.46	11	0.002	0.002
n-Butyl alcohol (1-Butanol)	<0.54	<0.54	<0.54	<0.49	<0.48	<0.47	7,800	10,000	17	17
<b>Inorganics</b>										
CN	23	20	22	9.9	7.0	5.6	1,600	NA	0.20	0.60
Ag	24	21	20	11	10	9.4	390	NA	0.05	NA
Al	13,879	14,758	13,213	16,062	13,947	15,814	NA	NA	NA	NA
As	1.9	0.80	2.7	0.20	2.2	2.1	0.40	750	0.05	0.20
B	ND	ND	ND	ND	ND	ND	7,000	NA	2	2

TABLE 9 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	-----Total Concentration (mg/kg)-----						Soil Exposure Route		Groundwater Exposure Route	
	1	2	3	4	5	6	Ingestion	Inhalation	Class I	Class II
<b>Inorganics (Continued)</b>										
Ca	52,034	48,318	48,269	47,622	47,465	50,135	NA	NA	NA	NA
Cd	8.3	7.5	7.7	9.3	9.3	9.4	78	1,800	0.005	0.05
Co	4.2	5.5	5.6	4.2	5.6	5.4	4,700	NA	1	1
Cr	127	118	114	111	103	105	390	270	0.10	1
Cu	463	424	422	347	341	336	2,900	NA	0.65	0.65
Fe	30,098	28,155	26,850	34,206	33,864	34,692	NA	NA	5	5
Hg	1.85	1.00	1.05	0.87	1.04	1.18	23	10	0.002	0.01
K	2,616	3,072	2,553	4,186	3,487	4,132	NA	NA	NA	NA
Mg	16,708	16,164	15,203	16,393	16,432	18,112	NA	NA	NA	NA
Mn	816	758	760	965	970	970	3,700	69,000	0.15	10
Mo	16.5	16.3	15.5	13.6	13.1	13.7	NA	NA	NA	NA
Na	436	531	452	660	638	687	NA	NA	NA	NA
Ni	39	35	34	43	38	38	1,600	13,000	0.10	2
Pb	164	147	138	116	123	113	400	NA	0.0075	0.10
Se	10.5	7.8	7.3	<1.4	<1.4	<1.4	390	NA	0.05	0.05
V	24.4	24.9	20.9	86.1	84.4	83.5	550	NA	0.049	NA
Zn	1,582	1,456	1,438	964	978	968	23,000	NA	5	10

ND = Not determined.

NA = Not available.

For organics, values in bold indicate concentrations greater than reporting limits. Values preceded by "<" are method detection limits and are dependent on sample solids content.

TABLE 10. CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics</b>										
Dalapon	<1.1	<1.3	<1.0	<0.88	<0.87	<0.86	2,300	NA	0.85	8.5
2,4-D	<0.56	<0.63	<0.52	<0.44	<0.43	<0.43	780	NA	1.5	7.7
2,4,5-TP (Silvex)	<0.056	<0.063	<0.052	<0.044	<0.043	<0.043	630	NA	11	55
Dinoseb	<0.056	<0.063	<0.052	<0.044	<0.043	<0.043	78	NA	0.34	3.4
Picloram	<0.056	<0.063	<0.052	<0.044	<0.043	<0.043	5,500	NA	2	20
Aldicarb	<280	<310	<260	<220	<210	<210	78	NA	0.013	0.07
Carbofuran	<28	<31	<26	<22	<21	<21	390	NA	0.22	1.1
Endothall	<280	<310	<260	<220	<210	<210	1,600	NA	0.40	0.40
Pentachlorophenol	<0.056	<0.063	<0.052	<0.044	<0.043	<0.043	3	NA	0.03	0.14
Alpha-BHC	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	0.10	0.80	0.0005	0.003
Gamma-BHC (Lindane)	<b>0.066</b>	0.048	<0.026	<0.022	<0.021	<0.021	0.50	NA	0.009	0.047
Aldrin	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	0.04	3	0.50	2.5
Heptachlor	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	0.10	0.10	23	110
Heptachlor epoxide	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	0.07	5	0.70	3.3
Endosulfan I	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	470	NA	18	90
Dieldrin	<0.028	0.033	<0.026	<0.022	<0.021	<0.021	0.04	1	0.004	0.02
4,4'-DDE	<b>0.068</b>	0.047	<b>0.095</b>	<b>0.073</b>	<b>0.070</b>	<b>0.052</b>	2	NA	54	270
Endrin	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	23	NA	1	5
Endosulfan II	<0.028	<0.031	<0.026	<0.022	<0.021	<0.021	470	NA	18	90
4,4'-DDD	<0.028	<0.023	<b>0.035</b>	<b>0.025</b>	<b>0.032</b>	<b>0.022</b>	3	NA	16	80
4,4'-DDT	<0.019	<0.031	<0.026	<0.022	<0.021	<0.021	2	NA	32	160
Methoxychlor	<0.030	<0.15	<0.029	<0.11	<0.10	<0.10	390	NA	160	780
Alpha-Chlordane	<0.028	<0.031	<b>0.032</b>	<b>0.024</b>	<0.021	<0.021	0.50	20	10	48
Gamma-Chlordane	<b>0.10</b>	<0.031	<0.026	<b>0.026</b>	<0.021	<0.021	0.50	20	10	48

TABLE 10 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
Toxaphene	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	0.60	89	31	150
Atrazine	<2.7	<3.1	<2.6	<2.2	<2.1	<2.1	2,700	NA	0.066	0.33
Alachlor	<0.28	<0.31	<0.26	<0.22	<0.21	<0.21	8	NA	0.04	0.20
Simazine	<0.51	<b>1.4</b>	<1.0	<b>1.6</b>	<b>10</b>	<b>5.0</b>	390	NA	0.04	0.37
Aroclor 1016	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1221	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1232	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1242	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1248	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1254	<0.27	<0.31	<0.26	<0.22	<0.21	<0.21	NA	NA	NA	NA
Aroclor 1260 (PCBs)	<b>0.52</b>	<b>0.45</b>	<b>0.72</b>	<b>0.57</b>	<b>0.61</b>	<b>0.38</b>	1	1	1	1
Phenol	<14	<16	<13	<11	<11	<11	47,000	NA	100	100
Bis(2-chloroethyl)ether	<5.7	<6.3	<5.2	<4.4	<4.3	<4.3	0.60	0.20	0.0004	0.0004
1,4-Dichlorobenzene	<14	<16	<13	<11	<11	<11	NA	NA	2	11
1,2-Dichlorobenzene	<14	<16	<13	<11	<11	<11	7,000	560	17	43
2-Methylphenol (o-cresol)	<5.7	<6.3	<5.2	<4.4	<4.3	<4.3	3,900	NA	15	15
n-Nitroso-di-n-propylamine	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	0.09	NA	0.00005	0.00005
Hexachloroethane	<14	<16	<13	<11	<11	<11	78	NA	0.50	2.6
4-Methylphenol (m/p-cresol)	<5.7	<6.3	<5.2	<4.4	<17	<4.3	3,900	NA	15	15
2-Chlorophenol	<14	<16	<13	<11	<11	<11	390	53,000	4	4
Nitrobenzene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	39	92	0.10	0.10
1,2,4-Trichlorobenzene	<14	<16	<13	<11	<11	<11	780	3,200	5	53
Benzoic acid	<57	<63	<52	<44	<43	<43	310,000	NA	400	400
Isophorone	<14	<16	<13	<11	<11	<11	15,600	4,600	8	8

TABLE 10 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
2,4-Dimethylphenol	<28	<31	<26	<22	<21	<21	1,600	NA	9	9
Naphthalene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	3,100	NA	84	420
4-Chloroaniline	<57	<63	<52	<44	<43	<43	310	NA	0.70	0.70
2,4,6-Trichlorophenol	<14	<16	<13	<11	<11	<11	58	200	0.20	0.77
2,4,5-Trichlorophenol	<28	<31	<26	<22	<21	<21	7,800	NA	270	1,400
Hexachlorocyclopentadiene	<57	<63	<52	<44	<43	<43	550	10	400	2,200
2,6-Dinitrotoluene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	0.90	NA	0.0007	0.0067
2,4-Dinitrophenol	<57	<63	<52	<44	<43	<43	160	NA	0.20	0.20
2,4-Dinitrotoluene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	0.90	NA	0.0008	0.0008
Acenaphthene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	4,700	NA	570	2,900
Fluorene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	3,100	NA	560	2,800
Hexachlorobenzene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	0.40	1	2	11
Diethyl phthalate	<5.7	<6.3	<5.2	<4.4	<4.3	<4.3	63,000	2,000	470	470
4-Chlorophenyl phenyl ether	<14	<16	<13	<11	<11	<11	NA	NA	NA	NA
n-Nitrosodiphenylamine	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	130	NA	1	5.6
Anthracene	<2.8	<3.1	<2.6	<2.2	<2.1	<2.1	23,000	NA	12,000	59,000
Carbazole	<14	<16	<13	<11	<11	<11	32	NA	0.60	2.8
Di-n-butyl phthalate	<14	<16	<13	<11	<11	<11	7,800	2,300	2,300	2,300
Fluoranthene	<b>4.0</b>	<b>5.5</b>	<2.5	<1.7	<b>2.6</b>	<b>3.0</b>	3,100	NA	4,300	21,000
Pyrene	<b>4.2</b>	<b>6.0</b>	2.8	<2.2	<b>2.5</b>	<b>2.8</b>	2,300	NA	4,200	21,000
Butyl benzyl phthalate	<5.7	<6.3	<5.2	<4.4	<4.3	<4.3	16,000	930	930	930
Benzo(a)anthracene	1.6	2.2	1.2	0.66	0.79	0.9	0.90	NA	2	8
Chrysene	2.5	<b>3.5</b>	2.0	1.3	1.5	1.7	88	NA	160	800
3,3-Dichlorobenzidine	14	16	13	11	11	11	1	NA	0.007	0.033
Bis(2-ethylhexyl)phthalate	<b>54</b>	<b>81</b>	<b>37</b>	<b>26</b>	<b>47</b>	<b>53</b>	46	31,000	3,600	31,000



TABLE 10 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
							Ingestion	Inhalation	Class I	Class II
-----Total Concentration (mg/kg)-----										
<b>Organics (Continued)</b>										
Di-n-octyl phthalate	28	31	26	22	21	21	1,600	10,000	10,000	10,000
Benzo(b)fluoranthene	2	2.6	1.7	1.2	1.1	1.4	0.90	NA	5	25
Benzo(k)fluoranthene	2.8	<b>4.3</b>	2.6	1.7	1.8	1.7	9	NA	49	250
Benzo(a)pyrene	2.0	2.8	1.6	1.1	1.1	2.1	0.09	NA	8	82
Indeno(1,2,3-cd)pyrene	2	2	2	1	1	1	0.90	NA	14	69
Dibenzo(a,h)anthracene	0.8	1.0	2.6	2.2	2.1	2.1	0.09	NA	2	7.6
Vinyl chloride	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	0.30	0.03	0.01	0.07
1,1-Dichloroethene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	700	1,500	0.06	0.30
Carbon disulfide	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	7,800	720	32	160
Acetone	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0047	7,800	100,000	16	16
Methylene chloride	<0.0085	<0.0094	<0.0079	<b>0.010</b>	<b>0.19</b>	<b>0.17</b>	85	13	0.02	0.20
Trans-1,2-Dichloroethene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	1,600	3,100	0.70	3.4
1,1-Dichloroethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	7,800	1,300	23	110
Vinyl acetate	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	78,000	1,000	170	170
Cis-1,2-Dichloroethene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	780	1,200	0.40	1.1
Chloroform	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	100	0.30	0.60	2.9
1,1,1-Trichloroethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	NA	1,200	2	9.6
1,1-Dichloropropene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	NA	NA	NA	NA
Carbon tetrachloride	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	5	0.30	0.07	0.33
Benzene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	22	0.80	0.03	0.17
1,2-Dichloroethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	7	0.40	0.02	0.10
Trichloroethene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	58	5	0.06	0.30
Bromodichloromethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	10	3,000	0.60	0.60
Cis-1,3-Dichloropropene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	4	0.10	0.004	0.02

TABLE 10 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids						TACO Tier 1 Residential Objectives			
	Total Concentration (mg/kg)						Soil Exposure Route		Groundwater Exposure Route	
	1	2	3	4	5	6	Ingestion	Inhalation	Class I	Class II
<b>Organics (Continued)</b>										
Toluene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	16,000	650	12	29
Trans-1,3-Dichloropropene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	4	0.10	0.004	0.02
1,1,2-Trichloroethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	310	1,800	0.02	0.30
Tetrachloroethene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	12	11	0.06	0.30
1,2-Dibromoethane (EDB)	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	0.0075	0.17	0.0004	0.004
Chlorobenzene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	1,600	130	1	6.5
1,1,1,2-Tetrachloroethane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	NA	NA	NA	NA
Ethylbenzene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	7,800	400	13	19
m&p-Xylenes	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	160,000	440	205	205
o-Xylene	<0.017	<0.019	<0.016	<0.013	<0.013	<0.013	160,000	410	190	190
Styrene	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	16,000	1,500	4	18
Bromoform	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	81	53	0.80	0.80
1,2-Dibromo-3-chloropropane	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	0.46	11	0.002	0.002
n-Butyl alcohol (1-Butanol)	<0.0085	<0.0094	<0.0079	<0.0066	<0.0065	<0.0065	7,800	10,000	17	17

TABLE 10 (Continued). CONCENTRATIONS OF ORGANIC COMPOUNDS AND INORGANIC SPECIES IN SIX SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE STICKNEY WRP IN 2005, AND THEIR CORRESPONDING TACO TIER I RESIDENTIAL OBJECTIVES FOR THE SOIL AND GROUNDWATER EXPOSURE ROUTES

Compound/Element	Biosolids Sample						TACO Tier 1 Residential Objectives			
	1	2	3	4	5	6	Soil Exposure Route		Groundwater Exposure Route	
	-----Total Concentration (mg/kg)-----						Ingestion	Inhalation	Class I	Class II
<b>Inorganics</b>										
CN	<0.68	<0.75	<0.63	<0.52	<0.52	<0.52	1,600	NA	0.20	0.60
Ag	13.0	18.0	9.4	11.0	11.0	8.4	390	NA	0.05	NA
Al	21.9	20.7	35.7	33.7	13.2	29.0	NA	NA	NA	NA
As	23,804	23,066	22,335	23,964	19,111	22,660	0.40	750	0.05	0.20
B	6.6	4.4	3.1	0.0	3.0	1.9	7,000	NA	2	2
Ca	37,332	36,926	44,453	43,888	67,863	43,884	NA	NA	NA	NA
Cd	4.7	4.5	6.0	6.1	4.8	6.4	78	1,800	0.005	0.05
Co	7.2	6.4	9.5	9.4	5.4	6.4	4,700	NA	1	1
Cr	245	243	349	357	265	326	390	270	0.10	1
Cu	474	473	508	458	359	468	2,900	NA	0.65	0.65
Fe	17,354	16,986	20,141	22,119	14,671	18,154	NA	NA	5	5
Hg	1.09	1.20	1.37	1.67	1.38	0.79	23	10	0.002	0.01
K	5,113	4,955	3,300	4,642	4,342	4,839	NA	NA	NA	NA
Mg	17,528	17,228	20,890	19,638	37,582	21,228	NA	NA	NA	NA
Mn	532	519	638	618	521	643	3,700	69,000	0.15	10
Mo	18.9	18.5	14.9	17.2	14.2	19.6	NA	NA	NA	NA
Na	1,846	1,752	443	578	955	1,201	NA	NA	NA	NA
Ni	71	69	60	54	54	67	1,600	13,000	0.10	2
Pb	136	134	223	221	113	144	400	NA	0.0075	0.10
Se	2.7	0.8	1.0	0.0	2.9	2.2	390	NA	0.05	0.05
V	20.4	18.1	20.3	34.6	17.6	20.7	550	NA	0.049	NA
Zn	962	931	1,292	1,323	771	982	23,000	NA	5	10

NA = Not available.

For organics, values in bold print indicate concentrations greater than reporting limits. Values preceded by "<" are method detection limits and are dependent on sample solids content.

## **Topsoil Properties of Biosolids**

A portion of the lagoon-aged, air-dried biosolids from the Stickney and Calumet WRPs is used as a soil amendment or conditioner to improve the topsoil characteristics of poor-quality or degraded soils. Information in this section may be helpful in planning the use of biosolids as a soil conditioner. The District has conducted studies of biosolids physical properties. Included in these studies were particle size analysis, particle density, bulk density, porosity, moisture/suction relationship, water repellency (hydrophobicity), and saturated hydraulic conductivity (permeability). The results of these studies show that biosolids have physical properties similar to silt loam soils. Results are available in Research and Development Department reports (Nos. 03-8 and 03-10).

Biosolids used as a soil conditioner or amendment also have a significant inherent fertilizer value, which can be determined from the information presented in this section. In 2000, the District conducted a study to determine the chemical characteristics of its lagoon-aged, air-dried biosolids that are important in assessing their suitability as topsoil for establishing vegetation. The results from this study ([Table 11](#)) show that biosolids contain organic carbon and are a good source of macro- and micro-nutrients, and additional N is released from organic matter over time. As a soil conditioner, the high organic matter content of biosolids improves soil physical properties, such as moisture retention in sandy soils and improved internal drainage in heavy clays.

The electrical conductivity (a measure of soluble salt content) tends to be higher than the suitability range for some sensitive plant species. Biosolids users should be aware of this and should consult with soil science professionals in the Biosolids Utilization and Soil Science Section when planning the use of biosolids as a soil conditioner. These inquiries may be initiated by contacting Dr. Thomas Granato at 708-588-4059 or Dr. Albert Cox at 708-588-4063.

TABLE 11. TOPSOIL CHEMICAL PROPERTIES OF SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET AND STICKNEY WRPs IN 2000

Analysis	Units	Minimum	Maximum	Mean
Cation Exchange Capacity	cmol/kg	56.1	84.4	73.4
EC <sup>1</sup>	dS/m	2.31	8.29	4.54
pH <sup>1</sup>		5.94	7.18	6.58
Organic Carbon	%	8.4	14.6	11.9
Bray P1 Extractable P <sup>2</sup>	mg/kg	252	523	407
Total Kjeldahl-N	mg/kg	13,655	28,228	20,554
<u>1 M KCl-Extractable</u>				
NH <sub>3</sub> -N	mg/kg	28	3,547	1,776
NO <sub>3</sub> -N	"	134	458	144
<u>1 M NH<sub>4</sub>OAc Exchangeable Bases</u>				
Ca	mg/kg	3,691	8,417	5,649
K	"	366	980	787
Mg	"	862	1,969	1,528
Na	"	81	573	320
<u>DTPA-Extractable</u>				
Cd	mg/kg	3.2	8.6	4.8
Cr	"	0.0	0.6	0.1
Cu	"	6.7	126	50.5
Fe	"	4.9	275	114
Mn	"	27	131	65
Ni	"	5.1	23.0	14.0
Pb	"	11	36	17
Zn	"	150	1,049	485
Hot Water Extractable B	mg/kg	4.56	7.14	5.83
<u>0.1 M HCl-Extractable</u>				
Cd	mg/kg	0.08	0.41	0.24
Cr	"	0.27	1.73	0.80
Cu	"	1.3	5.1	2.4
Fe	"	35.6	120	67.5
Mn	"	8.4	13.9	11.0
Ni	"	0.40	1.08	0.66
Pb	"	0.06	0.84	0.32
Zn	"	20	42	31

TABLE 11 (Continued). TOPSOIL CHEMICAL PROPERTIES OF SAMPLES OF LAGOON-AGED, AIR-DRIED BIOSOLIDS GENERATED AT THE CALUMET AND STICKNEY WRPs IN 2000

Analysis	Units	Minimum	Maximum	Mean
<u>Saturation Paste Extractable</u>				
Saturation moisture	%	118	217	159
Alkalinity (as CaCO <sub>3</sub> )	mg/L	300	2,745	1,527
B	"	0.31	0.51	0.38
Cl	"	15	2,865	895
PO <sub>4</sub> -P	"	1.6	6.3	3.7

<sup>1</sup> Electrical conductivity (EC) and pH in 1:2 ratio of air-dried biosolids:water.

<sup>2</sup> Standard soil test method used in Illinois to determine plant-available P content of soils.