NYC DEPARTMENT OF ENVIRONMENTAL PROTECTION
The Impact of Food Waste Disposers in Combined Sewer Areas of New York City

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EXECUTIVE SUMMARY

Domestic in-sink food waste disposers (FWDs) have been banned in New York City since the 1970s in areas served by combined sewer systems. The intent of the ban was to limit the direct discharge of raw organic wastes into water bodies surrounding the City during wet weather and to prevent possible deterioration of the City's sewer system. Since that time, a number of cities have allowed the introduction of FWDs and some have mandated their use. There have been no reported significant adverse effects attributed to the use of FWDs and the plumbing industry and others have repeatedly requested that the City discontinue the current ban. In response to the public's interest in FWDs, the Mayor requested that the City Council reconsider the ban. On September 22, 1995, Mayor Giuliani signed Local Law 74 authorizing the Department of Environmental Protection to conduct a 21- month pilot program to study the potential effects of permitting the use of FWDs in combined sewer areas.

The goals of the pilot study, as enumerated in Local Law 74, are to analyze and evaluate:

- the impact of grease and food solids on the operation of combined sewers;
- the impact on water consumption;
- the impact on the nutrient content of raw effluent;
- the impact of increased pollutant loadings to receiving waters, including increases in Biochemical Oxygen Demand (BOD) and suspended solids;
- the impact on wastewater treatment processes and sludge management;
- the impact on the City's ability to comply with applicable statutes, rules, permits, and orders;
- the impact on solid waste management; and
- any other impacts on the environment, public health and safety, and the cost of operating the water and sewer system.[1]

To accomplish the goals of Local Law 74, DEP, in conjunction with the plumbing industry, representatives of FWD manufacturers and their consultants, and the Department of Sanitation, conducted a comprehensive analysis of the issue categories listed in Local Law 74. The Department has considered the results of the analysis and recommends that the ban on the introduction of FWDs in combined sewer areas of the City be lifted. A discussion of the Department's recommendedon and a summary of the analyses for each impact area follows:

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[1] Local Law 74, p. 3.

Recommendation

As stated above, the Department has concluded that the prohibition on the introduction of FWDs in combined sewer areas should be lifted. Although impact analysis to the year 2035 may give rise to concern in the out-years, the analysis assumes an extreme worst case scenario that is speculative in nature and not likely to materialize. For example, a maximum FWD penetration rate of 1 percent of households per year usage is predicted by the industry and used in the following analyses. Under this assumption, by 2035, over one-third of the households in the City would have voluntarily chosen to incur the expense of purchasing and installing a unit in their homes. The cost of purchasing and installing these appliances -- $300 to $500 -- argues against a one percent installation rate being sustained for nearly forty years. Furthermore, FWDs have been permitted since 1971 in areas of the City served by storm and sanitary sewers, yet saturation rates appear well below 25 percent, according to reports from industry representatives. However, the penetration rate of 1 percent per year of households is consistent with what industry has used as a maximum. In the absence of published evidence that the maximum would never be reached, the 1 percent per year is used here to project worst-case future impacts.

In addition, there are many other uncertainties involved in projecting so long into the future. Only the infrastructure improvement programs currently planned can be factored into the analyses. There may be other changes to the wastewater treatment systems needed in the future, if, for example, standards for water quality become progressively more stringent in coming decades. Plans for such improvements are not likely to be significantly changed by the increases in pollutants noted due to the introduction of FWDs.

The results of our analyses raise a cautionary flag at very high penetration rates. We believe it is prudent to monitor the introduction of FWDs to insure that the worst case analyses do not materialize. To that end, DEP will track FWD installation using information provided pursuant to the existing Department of Building permitting requirements for the installation of plumbing appliances, including FWDs. DEP will monitor the number and location of units installed and investigate the affected drainage basins as installation rates indicate a need. In the unlikely event that problems begin to materialize, the Department will immediately inform the City Council and recommend corrective action. That action may take the form of suspending installation approvals of FWDs either in affected areas or city-wide, adjusting water billing structures to insure that users of the FWDs are assessed for the cost of corrective actions, or other mitigative measures.

Below is a summary of our pilot study and each impact analysis:

Pilot Study Sites

Three pilot locations were chosen for the study. Each location included a study group with FWD units installed and a control group without FWDs. The selected study locations were as follows:

- Parkway Village, Queens
  A garden apartment complex bordered by Union Turnpike, Grand Central Parkway, Main Street and Parsons Boulevard.
  - Pilot study area. Thirteen buildings numbered sixty-three to seventy-five along Grand Central Parkway. Population of 211 people. 34 FWDs were installed within 79 apartments.
  - Control area. Eight buildings numbered one through nine, excluding building eight, along Union Turnpike. Population of 127 people. (One apartment out of 49 had a FWD installed by mistake).

- Bay Ridge Towers, Brooklyn
  Two high-rise towers on 65th Street between 2nd and 4th Avenues.
  - Study area: 350 65th Street. A high rise tower between 3rd and 4th Avenues. 121 FWDs installed within 392 apartments, serving 695 people.
  - Control area: 260 65th Street. A high rise tower between 2nd and 3rd Avenues. 420 apartments with a population of 781 people.

- Low-Rise Apartment Buildings along E. 85th Street, Manhattan
  Four- and five-story, pre-1947 walk-up apartments and one postwar elevator building between 1st and 2nd Avenues on the Upper East Side of Manhattan. A total of 88 FWDs were installed in three buildings.
  - Study area buildings:
    - 326 E. 85th Street. A walk-up apartment with 11 FWDs installed in 17 apartments; population of 20 people.
    - 328 E. 85th Street. A walk-up apartment with 13 FWDs installed in 20 apartments; population of 27 people.
    - 344 E. 85th Street: A building with 64 FWDs installed in 65 apartments; population of 87 people.
  - Control area: 333-339 E. 85th Street: A group of five, four- story walk-up apartment buildings with 66 people.

SAMPLING RESULTS

Sampling Parameters

The key parameters sampled included TSS (total suspended solids), BOD and BOD(F) (biochemical oxygen demand and its filtrate), COD (chemical oxygen demand), and nutrients including NO_2 (nitrite), NO_3 (nitrate), NH_3 (ammonia), TKN (Total Kjeldahl Nitrogen), PO_4 (orthophosphate), TP (Total Phosphorous), and Settleable Solids.

The sampling results with and without FWDs are presented in Table ES-1,a-c. To provide a basis for analysis of future impacts, projections of future loadings were made for the

years 2000, 2005, 2010, 2025, 2035 (Table ES-2). For purposes of this study, it was assumed that disposers would be installed at a rate of one percent per year based on the total number of households in the City. DEP considers the near-term analysis years -- 2000 and 2005 -- to be a more reasonable time frame upon which impacts can be measured. Beyond that time horizon, impacts are considered speculative.

It should be noted that the data indicate a much greater increase in levels of certain pollutants at the Brooklyn site when compared with the Queens and Manhattan data which are similar. This discrepancy may be due to the presence of a large sinkhole in the street bed of 65th Street. It is possible that soil and sand infiltrated the sewer from the sinkhole and contaminated the data. Therefore, two sampling averages were used in the analyses; one with Brooklyn data and one without. Based on previous measurements of typical New York City sewage, DEP considers the Brooklyn data to lie outside the "normal" range, especially for levels of settleable and total suspended solids. Although these data are included in the report in the interest of completeness, caution should be exercised in interpreting results with the Brooklyn data. The impact conclusions that follow are predicated on DEP's belief that the Queens and Manhattan data are more representative of what can be expected if FWDs are introduced Citywide.

Table ES-1a. Average Pollutant Concentrations at Control Locations

Parameter	Queens (lbs/capita/day)	Brooklyn (lbs/capita/day)	Manhattan (lbs/capita/day)	Average	
				Brooklyn, Manhattan, Queens	Without Brooklyn
TSS	0.0721	0.0815	0.0587	0.0707	0.0654
BOD	0.0695	0.0700	0.0469	0.0621	0.0582
BOD (F)	0.0369	0.0412	0.0253	0.0345	0.0311
COD	0.1980	0.2268	0.1363	0.1870	0.1672
pH					
NO2	0.0000	0.0000	0.0000	0.0000	0.0000
NO3	0.0003	0.0001	0.0002	0.0002	0.0002
NH3	0.0129	0.0108	0.0053	0.0097	0.0091
TKN	0.0190	0.0202	0.0205	0.0199	0.0197
PO4	0.0016	0.0011	0.0014	0.0014	0.0015
TP	0.0036	0.0023	0.0020	0.0026	0.0028
Settleable Solids	0.0010	0.0037	0.0058	0.0035	0.0034
Initial O&G (Grab)	0.0081	0.0218	0.0113	0.0137	0.0097

Comp O&G	0.0130	0.0107	0.0102	0.0113	0.0116
Final O&G (Grab)	0.0078	0.0081	0.0074	0.0078	0.0076
Initial TPH (Grab)	0.0009	0.0051	0.0009	0.0023	0.0009
Comp TPH	0.0024	0.0027	0.0013	0.0022	0.0019
Final TPH (Grab)	0.0012	0.0049	0.0009	0.0023	0.0011

Table ES-1b. Average of Study Group Adjusted for 100% Food Waste Disposer Saturation

Parameter	100% FWDs Queens FWD Pop 49.4%	100% FWDs Brooklyn FWD Pop 34.1%	100% FWDs Manhattan		
				Complete Average	W/O Brooklyn Average
TSS	0.1197	0.3408	0.1048	0.1884	0.1122
BOD	0.1211	0.2402	0.1397	0.1670	0.1304
BOD (F)	0.0492	0.0963	0.0582	0.0679	0.0537
COD	0.2807	0.5897	0.2553	0.3752	0.2680
pH					
NO2	0.0000	0.0000	0.0001	0.0000	0.0000
NO3	0.0002	0.0001	0.0002	0.0002	0.0002
NH3	0.0172	0.0172	0.0088	0.0144	0.0130
TKN	0.0287	0.0390	0.0333	0.0337	0.0310
PO4	0.0018	0.0028	0.0024	0.0024	0.0021
TP	0.0045	0.0050	0.0032	0.0042	0.0039
Settleable Solids	0.0088	0.0300	0.0095	0.0161	0.0092
Initial O&G (Grab)	0.0037	0.0157	0.0035	0.0076	0.0036
Comp O&G	0.0178	0.0211	0.0171	0.0187	0.0174
Final O&G (Grab)	0.0114	0.0454	0.0083	0.0217	0.0098
Initial TPH (Grab)	0.0003	-0.0000	0.0006	0.0003	0.0004
Comp TPH	0.0025	0.0106	0.0013	0.0048	0.0019
Final TPH (Grab)	0.0007	0.0005	0.0011	0.0008	0.0009

Table ES-1c. Differences Between Study and Control Groups

Parameter	Queens	Brooklyn	Manhattan	Complete Average	W/O Brooklyn Average
TSS	0.048	0.2593	0.046	0.1177	0.0468
BOD	0.052	0.1703	0.093	0.1049	0.0722
BOD (F)	0.012	0.0551	0.033	0.0334	0.0226
COD	0.083	0.3629	0.119	0.1882	0.1008
pH					
NO2	-0.000	-0.0000	0.0000	0.0000	0.0000
NO3	-0.000	0.0000	0.0000	-0.0000	-0.0000
NH3	0.004	0.0065	0.0035	0.0047	0.0039
TKN	0.010	0.0188	0.0128	0.0138	0.0112
PO4	0.000	0.0018	0.0010	0.0010	0.0006
TP	0.001	0.0027	0.0012	0.0016	0.0011
Settleable Solids	0.008	0.0263	0.0037	0.0126	0.0057
Initial O&G (Grab)	-0.004	-0.0060	-0.0079	-0.0061	-0.0062
Comp O&G	0.005	0.0104	0.0069	0.0074	0.0059
Final O&G (Grab)	0.004	0.0373	0.0009	0.0139	0.0023
Initial TPH (Grab)	-0.001	-0.0051	-0.0003	-0.0020	-0.0005
Comp TPH	0.000	0.0079	-0.0000	0.0026	-0.0000
Final TPH (Grab)	-0.001	-0.0043	0.0002	-0.0016	-0.0002

Table ES-2. City-wide Projections
(Influent Pounds Increase Per Day Based on Manhattan and Queens Sampled Data Only)

Year	Population To NYC WPCPs	% Saturation (1% per year)	Population With FWDs	TSS	BOD	BOD Filtrate
2000	7,454,300	3	223,629	10,476	16,137	5,053
2005	7,498,600	8	599,888	28,103	43,287	13,555
2010	7,610,400	13	989,352	46,347	71,389	22,356
2025	8,018,000	28	2,245,040	105,172	161,997	50,730
2035	8,087,300	38	3,073,174	143,967	221,753	69,443

Year	COD	NH_3 (ammonia)	TKN	PO_4 (ortho-ph)	Total Phosphorous	Settleable Solids	Oil & Grease
2000	22,550	867	2,514	139	237	1,284	1,314
2005	60,489	2,326	6,743	373	636	3,445	3,525
2010	99,761	3,836	11,121	615	1,049	5,681	5,813
2025	226,377	8,704	25,237	1,394	2,381	12,891	13,191
2035	309,882	11,915	34,546	1,909	3,260	17,646	18,056

The detailed analyses conducted since Local Law 74 took effect, follows.

IMPACT EVALUATION

Sewer System

The introduction of FWD units may cause increases in suspended solids and oil and grease in the sewer system. According to values in the literature, this increase is about 20 percent per capita for domestic wastewater.[2] As a result, there may be an increase in maintenance costs incurred by the City. The following table shows the projected increase in maintenance expense as a result of introducing FWD units at a saturation rate of 1 percent beginning in 1997. This table also shows the estimated dollar cost from the impact of suspended solid deposits and its effect on the sewer cleaning program, sewer back-up (SBU) complaints, and grease removal. To put these figures in perspective, DEP currently spends about $0.5 million for routine contractual cleaning and $6,850,000 responding to SBU complaints.

Table ES-3. Maintenance Cost Increases due to Food Waste Disposers, 2000 - 2035.

Year	% Sat 1% per Yr.	% Impact Sat x 20%	% $ Increase in Sewer Cleaning Expense *	$ Inc in SBU & Grease Cleaning Expense *	Total $ Expense
2000	3	0.60%	3,000	42,000	45,000
2005	8	1.60	8,000	110,000	118,000
2010	13	2.60	13,000	178,000	191,000
2025	28	5.60	28,000	383,000	411,000
2035	38	7.60	38,000	521,000	559,000

* - Based on 1997 Fixed Dollars

[2] Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse (New York: McGraw-Hill, Inc., Third ed.): 166.

A videotape survey was also conducted as part of the pilot study. Videotaping was conducted before FWDs were installed, during the study and at the study's completion. No noticeable deposits of suspended material were observed in the videotapes at the end of the relatively brief study period.

Based on the analysis, potential future maintenance costs, even if worst case projections prove true, would be considered de minimis, therefore, no potential significant adverse impacts on the City's sewer system are expected if food waste disposers are permitted in combined sewer areas.

Water Consumption

The incremental increase in water demand due to the introduction of FWDs for the analysis years 2000, 2005, 2010, 2025, and 2035 was projected. The projections were based on a reasonable estimate of an additional per capita water demand of 1 gallon per capita per day with FWDs. This figure fell roughly between the high and low measurements of water demand obtained for the study. Industry estimates of water demand are somewhat lower.

Using the above assumptions, the additional water demand with FWDs would be approximately 3 million gallons per day by 2035, even under worst case assumptions. This represents a minor incremental increase when compared against the system's 1.3 billion gallon average annual daily water demand. Therefore, no potential significant impacts on the City's water supply system is expected if food waste disposers are permitted city-wide.

Table ES-4. City-wide Water Demand from Food Waste Disposers

Year	NYC Population Projection	Per cent Saturation (1%/apt/yr)	Population with FWDs	Water demand from FWDs (In million gallons per day)
2000	7,454,300	3%	223,629	0.22
2005	7,498,600	8	599,888	0.60
2010	7,610,400	13	989,352	0.99
2025	8,018,000	28	2,245,040	2.24
2035	8,087,300	38	3,073,174	3.07

Wastewater Treatment and Biosolids Handling

The analysis of potential impacts on the City's ability to treat wastewater and dispose of

sewage biosolids considered the potential additional capital and operating costs that might be incurred from additional food waste loadings in the waste stream. These costs can be attributed to the need for additional aeration capacity to treat the BOD, additional sludge digesters and dewatering facilities to handle solids, and additional nitrogen control measures. Costs for nitrogen control measures are potentially the most variable because they are dependent on future regulatory control scenarios. Tables ES-5 and ES-6 detail the additional costs DEP forecasts would be incurred to handle additional FWD loadings. The costs presented are cumulative and are in constant 1996 dollars.

The results show that in the decade after city-wide introduction of FWDs, increases in costs would be relatively small; approximately $4.1 million in 2005 (based on Queens and Manhattan data) for the most expensive nitrogen control measure. Measured against the estimated 1.525 billion dollar cost of maintaining the City's water and sewer infrastructure, this represents a de minimis impact.

Table ES-5. Annual Operating and Capital Costs for Wastewater Treatment and Biosolids Handling Using Different Nitrogen Control Technologies
(Based on Average Queens and Manhattan Sampling Data)

Scenario 1 - Increased Aeration

Year	Operating Cost	Capital Cost
2000	$578,600	$700,900
2005	2,400,000	1,800,000
2010	2,500,000	3,100,000
2025	5,700,000	17,400,000
2035	7,800,000	28,800,000

Scenario 2 - Fixed Media Nitrogen Removal

Year	Operating Cost	Capital Cost
2000	$578,600	$2,400,000
2005	2,400,000	6,100,000
2010	2,500,000	10,200,000
2025	5,700,000	33,300,000
2035	7,800,000	50,600,000

Scenario 3 - Biofilters

Year	Operating Cost	Capital Cost
2000	$1,500,000	$17,700,000
2005	4,800,000	50,140,000
2010	6,300,000	79,400,000
2025	14,600,000	165,700,000
2035	19,800,000	218,800,000

Table ES-6. Annual Operating and Capital Costs for Wastewater Treatment and Biosolids Handling Using Different Nitrogen Control Technologies
(Based on Average of Brooklyn, Queens and Manhattan Sampling Data)

Scenario 1 - Increased Aeration

Year	Operating Cost	Capital Cost
2000	$1,300,000	$2,500,000
2005	3,500,000	6,500,000
2010	5,700,000	12,700,000
2025	13,000,000	54,900,000
2035	17,900,000	83,600,000

Scenario 2 - Fixed Media Nitrogen Removal

Year	Operating Cost	Capital Cost
2000	$1,300,000	$4,200,000
2005	3,500,000	11,200,000
2010	5,700,000	20,300,000
2025	13,000,000	72,200,000
2035	17,900,000	107,200,000

Scenario 3 - Biofilters

Year	Operating Cost	Capital Cost
2000	$2,400,000	$23,223,000

2005	6,300,000	63,400,000
2010	10,400,000	100,703,000
2025	23,600,000	229,500,000
2035	32,200,000	305,900,000

The additional treatment plant costs due to FWDs were based on an assumed 3 gallons per capita per day (gcpd) flow rate. Since the water consumption analysis showed that an average flow per capita would be about 1 gcpd flow, a reconciliation of costs due to the additional flow was performed. Additional costs associated with flow would primarily be due to additional pumping requirements and chlorination. Table 7 shows the projected difference in costs that can be expected. These costs can be subtracted from Tables 5 and 6 for any scenario to obtain the projected costs assuming a 1 gallon per capita water consumption rate.

Table ES-7. Costs Resulting from Assuming Three Gallons per Capita per Day Flow
(in dollars)

Cost Item/Year	2000	2005	2010	2025	2035
Pumping Cost	$3,947	$10,586	$17,451	$41,785	$57,215
Chlorination Cost	4,982	$13,373	22,127	49,973	68,339
Total	**$8,928**	**$23,959**	**$39,577**	**$91,758**	**$125,554**

Impact on Water Rates

An estimate of the potential impact of the need for additional sewage treatment capacity on water and sewer rates was also performed. Minor incremental costs due to increased sewer maintenance were also identified, but are too small to affect the water rates. Similarly, increases in revenue from additional water demand generated by FWDs is too small to measure.

Increased sewage treatment and biosolids (sludge) handling resulted in near-term increases in the average annual household bill of $3.70 for the average owner-occupied dwelling and $3.15 for the average apartment building unit, if the most stringent nitrogen removal scenario were adopted. These impacts are also considered minor (less than 1 percent over projected water rates) and would not result in any potential displacement of residents. If a lesser amount of nitrogen removal is required, these costs would go down. Projections of water rates beyond 2005 are not presented because they are considered speculative.

Water Quality

Open Waters

Water quality modeling projected an increase in biochemical oxygen demand (BOD) due to FWDs resulting in a 0.01 milligram per liter decrease in dissolved oxygen (DO) in New York Harbor by 2005 (based on Queens and Manhattan sampling data). This increase is considered de minimis. Although larger decreases would occur using Brooklyn data and an escalation in DO deficits in out years is projected under worst case conditions, DEP considers these impacts to be highly speculative.

Tributaries

Analysis of tributary waters was conducted by estimating the impacts in a tributary with currently planned improvements, the Flushing Bay drainage basin. Installation of FWDs in this area is predicted to increase BOD and TSS loadings in the total CSO stream by 5.0 percent for BOD and TSS by 2.0 percent over baseline loads, using the Queens and Manhattan data set. Water quality modeling showed greatest effects to be near large CSO outfalls at the mouth of, and in, Flushing Creek with worst case loadings assumed. The percent of time that DO concentrations would be below the "never-less-than" 4.0 mg/L DO standard would increase by approximately 1.5 percent over baseline conditions in and around the immediate proximity of Flushing Creek. For lesser sanitary loads (similar to scenarios that omit Brooklyn loadings) the expected DO decrease would be a fraction of this.

In 1995 the NY Harbor Survey recorded average DO (at a single site) in Flushing Bay to be 7.7 mg/L (surface) and 5.3 mg/L (bottom), with a minimum DO of 3.5 mg/L. Summertime percent non-compliance with the NYS DEC never-less-than 4.0 mg/L DO standard was 50 percent. In this context, the above increases are considered de minimis. Effects in the later years would be expected to be more severe, but are considered speculative.

Solid Waste

The Department of Sanitation (DOS) recognizes the potential for kitchen waste disposals to make a positive impact on New York City residential waste management. Using the DEP projections of Total Suspended Solids, DOS estimated the effect of the diverted waste on its operating costs. The amount of food waste diverted is approximately 3 percent of the DOS total household refuse collection. If it is assumed that 38 percent of the City's households are equipped with kitchen waste disposals in the year 2035, and that the average equipped household places 50% of the targeted food wastes into disposals (this rate is comparable to the current capture rate for recyclables), the Department would save $4 million in solid waste export costs at current disposal rates.