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**rats, fires, and inner-city
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THE RELATIONSHIP OF SOLID WASTE STORAGE PRACTICES IN THE
INNER CITY TO THE INCIDENCE OF RAT INFESTATION
AND FIRES

by Robert M. Wolcott and Burnell W. Vincent*

Municipal solid waste occurs in such great volume and with such objectionable qualities that it would be considered a major problem in cities even if it were harmless to health and safety. But it often is not. Unless solid waste is managed properly in an urban environment, rats, flies, and other vectors will multiply by feeding on it. Improperly stored wastes invite fires and provide harborage for vermin. Poisonous or toxic substances, broken glass, and flammable solvents present daily threats to the lives of inner-city children.

While intuitively apparent, the relationship between solid waste and many of these problems is not well documented. There is, however, sufficient information to indicate the general extent of the relationship between solid waste and the incidence of rat infestation and fires in the inner city.

The Solid Waste-Fire Relationship

The storage of solid waste is afforded a relatively low priority in domestic space allocation. In crowded inner-city situations, provisions for storage are especially constrained, and all too frequently the solid waste storage areas and facilities are little more than open dumps. According to the District of Columbia fire department, solid waste has been the cause or major contributing factor in roughly 50 percent of the fires reported in Washington (Table 1). After-action reports filled out by the New York City firemen indicate that in both residential and commercial premises, solid waste was significantly contributory in 30 percent of the structural fires (Table 2) and 50 percent of all fires. Between 1970 and 1973, Cincinnati, Ohio, reduced

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by 50 percent the number of fires recorded as originating in solid waste.¹ The fire departments have attributed this reduction to measures taken as a result of a program of inspection and public education conducted by fire prevention specialists.²

TABLE 1
SOLID WASTE-RELATED FIRES IN
THE DISTRICT OF COLUMBIA*

Year	Total fires	Number	% SW-related
1969	10,925	5,288	48.4
1970	10,786	5,321	49.3
1971	10,403	5,139	49.4
1972	9,168	4,294	46.8
1973	9,705	4,850	50.0

*Annual reports. Washington, District of Columbia Fire Department, 1969 and following years.

During the Spring of 1973, the District of Columbia Fire Department surveyed 4,674 properties within an inner-city corridor and found fire hazards in 958 situations; two-thirds of the hazards concerned solid waste accumulations and storage.³ A major problem noted in the survey was the prevalence of abandoned buildings, many of which serve as promiscuous dumps. The buildings in many cases are beyond refurbishing and are in themselves "solid waste" requiring disposal. They are major fire hazards, and the fires that start in them are especially dangerous to fire fighters because of insecure steps, floors, and landings.

TABLE 2*
STRUCTURAL FIRES AND PERCENT RUBBISH-RELATED,
NYC, 1972+

Borough	Building type			
	Public	Commercial	Residential	Total
Manhattan				
Total	655	1581	10260	12496
Rub.Rel.	187	520	2934	3641
Percent	29	33	29	29
Bronx				
Total	322	910	9788	11020
Rub.Rel.	117	364	3396	3877
Percent	36	40	35	35
Richmond				
Total	87	224	825	1136
Rub.Rel.	9	36	157	222
Percent	10	25	19	20
Brooklyn				
Total	683	2209	11683	14575
Rub.Rel.	262	891	3388	4541
Percent	38	40	30	31
Queens				
Total	307	1207	4233	5757
Rub.Rel.	63	312	685	1060
Percent	21	26	16	18
New York City				
Total	2054	6131	36789	44974
Rub.Rel.	638	2143	10560	13341
Percent	31	35	29	30

*In reporting on the contributory role of rubbish in each fire, inspectors noted whether it was "significant," "not significant," or "unknown." The 6 percent of cases reported as unknown are excluded from this table.

+Annual statistics, New York, Fire Department of the City of New York.

Solid waste is flammable and therefore potentially hazardous. Yet its storage is typically a function of the availability of marginal and low-priority space. The inner city is, of its nature, poor in spatial resources. The high population density is accommodated by subdividing the dwelling units, but the space for refuse storage is seldom multiplied in proportion. Comparisons among the five boroughs of New York illustrate this point (Table 2). The population densities which exist in dwelling-unit structures in Staten Island and Queens are closer to the densities which the buildings were originally designed to accommodate. Under the conditions of superimposed densities in the older boroughs, one in three structural fires are caused or appreciably spread by stored solid waste, while the ratio is "only" one in five fires in Queens or Staten Island.

Table 3, which also applies to New York City, shows the total number of fires and the number of fires in three solid waste-related categories. The nonstructural rubbish fires in Table 3 and the structural, rubbish-related fires of Table 2 are additive, but vacant buildings in Table 3 are included in Table 2.

TABLE 3
NONSTRUCTURAL, RUBBISH-RELATED
FIRES, NEW YORK CITY, 1965-1972*

Year	Total fires	Nonstructural (number)	Rubbish fires (%)	Abandoned automobiles	Vacant or abandoned buildings
1965	85,592	25,148	29.3	---	2525
1966	90,290	28,178	31.2	---	3107
1967	91,161	30,821	33.8	---	3612
1968	127,826	51,350	40.1	---	6027
1969	126,204	47,006	27.3	---	6320
1970	127,249	48,669	38.2	---	6712
1971	125,306	45,669	36.4	---	6664
1972	119,297	40,740	34.1	---	5945

*Annual statistics. New York, Fire Department of the City of New York.

Each year, a million building fires occur in the United States, resulting in 12,000 deaths.⁴ Data on fire-caused injuries or amount of property loss are not available for inner-city areas; but according to the National Commission on Fire Protection and Control, fires cause \$3.7 billion in direct property losses each year for the nation as a whole. The total annual fire bill is \$12.4 billion, including a \$2.5 billion fire-fighting budget, \$1 billion for burn injury treatment, \$3.3 billion in productivity losses and \$1.9 billion for fire insurance costs. This figure does not include such costs as those for the oversizing of water mains by a factor of six or seven, or for fire design in buildings. Fires consume enormous amounts of clean water, and it is estimated that 37 million gallons of fuel are used each year in fighting urban fires. If one in three inner-city structural fires is of solid waste origin, and this seems a reasonable calculation based on the data from the District of Columbia and New York City fire departments, then it can be estimated that poor solid waste storage practices could conceivably be responsible for the loss of approximately \$500 million in personal property and as many as 3,500 lives annually.

The Solid Waste-Rat Relationship

The supportable population of rats is limited only by the availability of food, harborage, and water. The average female, during her first year of life, will raise four to seven litters of eight to 12 rats. Twenty of these ordinarily live to be weaned.⁶ The biological potential for reaching saturation levels is so great that poisoning, trapping, and other extermination measures seldom depress populations for more than six months in urban settings.⁷ Lack of adequate water supply is a limiting factor for rats only in the most arid climates. Availability of harborage is seldom a limiting factor in inner cities, unless it is conscientiously eliminated. Food, then, remains a primary determinant of the supportable population. One ounce of food (dry weight) and 1 ounce of water make up the rat's daily requirements.⁸

The primary inner-city locations of food supplies include solid waste storage and collection points, vacant lots and abandoned buildings with accumulated debris, sanitary sewers, and domestic and commercial food storage. Each of these supplies is much more readily available in the inner city. Three factors influencing the accessibility of solid waste are population densities, per capita generation increases, and a "trickle down" theory applicable to appliances and furniture. As noted in the discussion on fires, the population densities prevalent in inner-city situations are higher than original building design capacities. These high densities have been accommodated by subdivision of living quarters, with concomitant, increased burdens on such utility spaces as solid waste storage areas. Per capita solid waste generation rate increases, particularly since the 1950's, have compounded this situation.

The nature of inner-city wastes is influenced by the fact that low income consumers are typically the last users of furniture and appliances, that many of these items therefore end up abandoned, and that a disproportionately larger number of bulky items are available for rodent harborage.

Large metropolitan areas consistently report about 10 rat bites per 1,000,000 persons. Unreported bites are generally considered to occur at two to three times that rate.⁹ Typically, bites are incurred by the very young and the very old and are most likely to occur when the rat population is at saturation levels and food is the controlling factor.¹⁰ Of the estimated 45,000 cases of rat bite that occur each year in this country, approximately one-third are suffered by the 30 million inner-city Americans.¹¹

Destruction of food by rats has been roughly estimated to cost \$1 billion per year (a figure often quoted, but of obscure derivation) or between \$1 and \$10 per rat per year. The amount of rat-contaminated food we unknowingly consume, with concomitant disease exposure, is estimated to be much greater than the amounts destroyed.

Much of the damage is agricultural, of course, but there is also considerable damage to stored food supplies of inner-city residents. Rats are extremely agile and can gain entrance through openings as small as one-half inch wide. They can jump 4 feet horizontally, 3 feet up, and 50 feet down.⁶ They can gnaw through wood (in fact, they must do some gnawing each day in order to keep their teeth short enough to use). Thus it requires extremely rigorous application of control measures to prevent rat entry even in well maintained structures. Grain, cereal, and bread in paper or cardboard packaging are particularly attractive, and in rat infested areas it is not uncommon for families to experience damages amounting to \$1 to \$3 per week, or \$150 per year.¹² Restaurants and grocery stores are similarly plagued. In Cincinnati alone, the annual economic loss due to destruction of food was set at \$4 million following a rat population explosion in 1950, when the number of rats was estimated to be well over a million.¹³

Many of the diseases which have historically been transmitted to humans by rats and their parasites have been effectively controlled through medical technology.¹⁴ However, leptospirosis, rat bite fever, salmonellosis and murine typhus still occur, in the aggregate, at a rate of about 6,000 cases per year in the United States.¹³ Leptospiral infection may be considered an almost normal condition in the urban rat; most are carriers but suffer no observable ill effect from the disease. Rat bite fever and salmonellosis likewise are commonly harbored in rats, which are efficient vectors of both diseases because of their proximity to man and his food.¹⁵ Plague and murine typhus are also carried by rats, but the vectors are their ectoparasites-- mites, fleas, and lice. Some cases of dermatitis may also be attributed to the ectoparasites of rats.

Rat population estimates vary widely, but the literature commonly suggests that assuming one rat per person gives a fair indication of the rat population in the United States.¹⁶ For the 30 million Americans residing in the inner cities, however, there are an estimated 50 million rats.¹⁷ Ratios as high as 10 rats per person have been reported.¹³ Two indicators of infestation that seem more meaningful are the percentage of premises with active exterior rat signs and, citywide, the percentage of blocks with rat infestation.

Urban rats seem to prefer a commuting distance of less than 100 to 150 feet to food sources. This being so, reductions in local access to food or harborage will tend to cause migration from the immediate area. Older sewerage and combined storm-sanitary sewerage provide harborage, pathway, and food supply which will affect the impact of rat programs which rely on upgrading solid waste storage practices. Undoubtedly such unseen factors contribute to the wide variations in the effect that improvement of storage practices has on rat infestation levels (Table 4).

The Urban Rat Control Program, now administered by the Department of Health, Education, and Welfare's Community Environmental Management Activities in the Bureau of State Services, Center for Disease Control (CDC), does attempt, as part of its comprehensive rat program, to reduce food access by upgrading inner-city solid waste storage practices. Data from this program indicate that population suppression is generally associated with upgrading storage practices (Table 4), but that the relationship is not clear and simple. Besides garbage and sewage, rats are supported by domestic and commercial storage areas and by kitchens and food preparation areas. Still, improperly stored wastes seem to be the primary source of food for rats in the inner city. According to the U.S. Public Health Service Reports, an estimated 65 percent of the job of community rat control can be accomplished through improving solid waste storage practices.¹⁸

The HEW data were collected by CDC personnel from twenty locally directed, Federally aided projects. More than 4.3 million persons live in the target areas of the programs; 13,000 premises were surveyed. Annual program funding included about \$15 million in Federal grants plus \$5 million in local funds.¹⁹

The Washington, D.C., War on Rats Program, a CDC grantee, also surveyed 500 randomly selected blocks outside their target area in 1971; of these, 59 percent were found to be infected.²⁰ Of the 355 blocks found to have few or no sanitation problems, only 19 percent had rat infestations; of the 145 blocks that had a moderate or large number of sanitation problems, 88 percent had rat infestations.

TABLE 4
URBAN RAT CONTROL PROGRAM DATA

City	Premises with Active Exterior Rat Signs (%)				Premises with Unapproved Refuse Storage (%)			
	1969	1970	1971	1972	1969	1970	1971	1972
Atlanta	26	25	16	17	66	68	45	48
Baltimore	20	13	18	12	64	51	42	33
Buffalo	18	5	4	2	56	48	47	39
Charlotte	23	8	8	0.1	70	58	53	32
Chicago	11	13	13	13	88	93	87	87
Cleveland	41	22	25	31	67	55	62	55
Hoboken	5	2	6	0.7	44	42	32	44
Milwaukee	13	5	1	0.1	53	72	33	33
Nashville	22	12	14	12	58	44	31	30
Newark	19	12	14	6	63	65	75	57
New York	8	18	8	8	70	73	50	44
Norfolk	5	1	0.5	0.2	63	36	31	18
Philadelphia	19	4	3	4	67	31	39	34
Pittsburgh	11	7	5	4	56	78	76	79
Poughkeepsie	9	3	0.5	3	46	57	41	34
Rochester	30	12	7	11	59	55	53	63
St. Louis	19	14	4	13	62	61	47	55
Seattle	18	4	3	3	47	41	41	41
Trenton	1.3	0.6	0.5	0.6	64	47	33	28
Washington								
Pride Inc.	27	32	12	17	54	65	43	54
War on Rats	48	18	12	9	80	67	50	56

The percentage of residential blocks infested was triple the percentages of predominantly commercial or predominantly vacant blocks infested. In the 1971 survey, 72 percent of the blocks defined by the program as inner city were infested while only 22 percent of the remaining blocks were infested. The 1973 survey indicates that infestation of the inner-city blocks had been reduced to 42 percent. The administrators of the program say that they feel this reduction has been achieved principally through improved solid waste management practices and public education. The use of plastic bags was considered to be a major contribution to the program.²¹

In New York City, a rat control program initiated in 1969 has dramatically reduced the incidence of rat bites in five selected ghetto areas (Table 5).

TABLE 5
 REPORTED RAT BITES, SELECTED
 INNER-CITY AREAS OF NEW YORK CITY*

Year	Frequency
1968 - 69	401
1969 - 70	364
1970 - 71	301
1971 - 72	246
1972 - 73	186

*Department of Rodent Control, City of New York. Unpublished data.

The program included poisoning, sealing of potential harborage as well as improving refuse storage practices, and educating the public. The use of plastic bags has been encouraged and found to reduce accessibility. Four of the areas were provided five-day-a-week refuse collection; the director of the rat control program reports that this policy has been the crucial factor in dramatically reducing infestation.²²

The City of Milwaukee has installed a computerized system by which the field staff note the location of abandoned autos and appliances on survey sheets which are then fed into the computer. The information is passed on to the appropriate city agencies responsible for removing the items. This program has removed potential harborage and reduced rat infestations by up to 50 percent.¹³

Since upgrading of solid waste storage practices should have the concomitant effects of reduced rat infestation and reduced fire incidence, attempts were made to locate data for a particular area by relating fire department statistics with rat program efforts and vice

versa. Incompatible time intervals or geographic boundaries frustrated many attempts, but in Seattle's Eighth Census Tract, fire data are available for the period in which a rat control program was conducted (Table 6). The program was begun in late 1969, and, after an intensive "clean sweep" in early 1970, the area has been consistently maintained. The program includes removal of abandoned sheds, cleanup of vacant lots, block cleanup campaigns, etc. (The precipitous decline in the number of fires from 1969 to 1970 may have been exaggerated by a period of racial violence in Seattle in 1969; the summer of 1973 was a period of drought, contributing to the increase in nonstructural fires for that year.) No other inter-program correlations were readily available as of this writing, but the attempt would be worthwhile for any city interested in evaluating the potential to reduce both rat and fire problems. ²³

TABLE 6

THE INCIDENCE OF FIRE IN CENSUS TRACT 8, SEATTLE
DURING PERIOD OF RAT CONTROL PROGRAM

Year	Number of Structural Fires	Number of Non-structural Fires
1968	45	43
1969	62	49
1970	31	32
1971	31	19
1973	27	42

Conclusion

Among the benefits that improved solid waste storage can have in the inner cities are significant reductions in the high rates of rat infestation and fires. Some of the problems that often interfere with such improvement are quite difficult to solve since they are aspects of poverty, the economics of housing, or a lack of awareness among tenants and landlords. Concerted action by several of a city's departments on a three-point program is needed to achieve lasting effects: (1) improvements

in waste collection, including increased collection frequencies; (2) improved provisions for storage, whether by enforcement tactics or by municipally supplying the containers; (3) an active public education program with special measures for the special needs of the residents. In any case, as cities examine their range of problems in the course of program planning, the effects that poor waste storage may be causing in their inner-city areas clearly deserve consideration.

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