REPORT TO
SOUTH ESSEX SEWERAGE BOARD
SALEM, MASSACHUSETTS
UPON
PRELIMINARY STUDIES ON
DISPOSAL OF GREASE, GRIT, AND ASH

April 5, 1974
Mr. Howard S. Willard, Chairman  
South Essex Sewerage Board  
50 Fort Avenue  
Salem, Massachusetts 01970  

Dear Mr. Willard:

We have completed our preliminary studies to identify potential sites and methods for the disposal of solid wastes resulting from the present and future wastewater treatment operations of the South Essex Sewerage District.

Present solid wastes consist of grease and grit that are removed from the Peabody and Salem Grease and Grit Chambers.

Future wastes will consist of incinerator ash and residue from the new primary treatment facility now under construction and scheduled to be placed in operation in 1976. Grease and grit from Peabody will be trucked to the new treatment facility, processed and converted to ash. The Salem chamber will be discontinued.

Our interim report previously submitted identified several potential sites in Peabody and Salem for the disposal of untreated grease and grit. We have continued our studies for potential sites for incinerator ash disposal in all the member municipalities.

Our earlier work has been incorporated into this report so that all our studies are contained in this one report.

Respectfully submitted,

Metcalf & Eddy, Inc.

John G. Chalas  
Vice President
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ACKNOWLEDGMENTS

We wish to express our appreciation for the cooperation and assistance of Mr. Clifton R. Grinnell, District Engineer, Mr. Raymond Bouchard, and the many other members of the engineering departments of Beverly, Danvers, Marblehead, Peabody, and Salem.

The studies were undertaken by Mr. Norman W. F. Higgins, Project Manager, Mr. Rex O. Smith, Hydrogeologist, and other members of our staff under the direction of Mr. John Podger, Senior Vice President.
CHAPTER 1
INTRODUCTION

Background

The only solid waste presently generated from wastewater flows within the District is grease and grit from collection chambers in Salem and Peabody. This grease and grit is presently disposed of in an open pit at the Peabody sanitary landfill.

Construction of a primary wastewater treatment plant in Salem is scheduled for completion in 1976 and this plant will include a sludge incinerator. When the new plant is placed in operation, solids from the Peabody grease and grit collection chamber will be trucked to the plant and mixed with grease, grit, scum, sludge, and screenings generated at the new plant prior to reduction in volume by incineration. The existing grease and grit chamber in Salem will then be demolished.

Purpose and Scope

The present method of disposal of grease and grit is of great concern to the City Health Officer of Peabody because:

1. The disposal area is unfenced and thus presents a real danger to children who may gain access to the landfill site.
2. Complaints of odors are common during the hot summer months.
3. Transportation of the wastes in open trucks gives rise to complaints of odors and slopping of wastes on the highway.
The Regional Sanitary Engineers in the Northeast Region of the Massachusetts Department of Public Health have raised additional objections regarding the instability of the material, and the possibility of groundwater contamination.

As a result of these shortcomings of the present disposal method, the District is under pressure to improve the present disposal practices or to find an alternative disposal location. Thus, the purpose of this study is twofold:

1. To investigate and recommend an acceptable method and location for the short-term disposal of grease and grit from the collection chambers in Peabody and Salem.

2. To investigate and recommend an acceptable method and location for the long-term disposal of ash from the sludge incinerator.

The scope of the work includes:

1. A determination of the quantity and characteristics of the grease and grit chamber wastes from records maintained by the District, and by sampling and analysis of the wastes.

2. A determination of the quantity and characteristics of the incinerator ash based upon experience in similar installations elsewhere.

3. The consideration of various alternative methods for the short-term disposal of grease and grit.
4. The identification of possible disposal areas for grease, grit, and incinerator ash from a study of topographical, geological and land-use plans, and aerial photographs; and from the discussions of these areas with appropriate officials.

5. Field inspection of potentially acceptable sites and identification of the extent of field investigations necessary to obtain preliminary approval of the Massachusetts Department of Public Health for use of the selected sites for short-term and long-term disposal purposes.
CHAPTER 2

GREASE, GRIT, AND ASH QUANTITIES

Records of quantities of grease and grit removed from the chambers in Peabody and Salem have been maintained by the District. The records covering the period from 1963 through 1972 are shown in Table 2-1.

TABLE 2-1. GREASE AND GRIT QUANTITIES

<table>
<thead>
<tr>
<th>Year</th>
<th>Grease quantities, cf</th>
<th>Grit quantities, cf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peabody</td>
<td>Salem</td>
</tr>
<tr>
<td>1963</td>
<td>73,150</td>
<td>34,800</td>
</tr>
<tr>
<td>1964</td>
<td>42,000</td>
<td>24,350</td>
</tr>
<tr>
<td>1965</td>
<td>43,600</td>
<td>12,600</td>
</tr>
<tr>
<td>1966</td>
<td>76,800</td>
<td>25,400</td>
</tr>
<tr>
<td>1967</td>
<td>80,000</td>
<td>26,250</td>
</tr>
<tr>
<td>1968</td>
<td>(2)</td>
<td>31,500</td>
</tr>
<tr>
<td>1969</td>
<td>85,920</td>
<td>20,700</td>
</tr>
<tr>
<td>1970</td>
<td>35,400</td>
<td>14,520</td>
</tr>
<tr>
<td>1971</td>
<td>47,900</td>
<td>21,400</td>
</tr>
<tr>
<td>1972</td>
<td>21,300(3)</td>
<td>25,900</td>
</tr>
<tr>
<td>Average</td>
<td>60,000</td>
<td>23,700</td>
</tr>
</tbody>
</table>

1. Quantities as removed from chambers, including water.
2. Values not available.
3. Low values, resulting from a fire at the Peabody chamber, were ignored in the determination of average values.

The quantities are estimated only, based upon the number of trips required during cleaning operations using trucks of known capacity.
Although the quantities of grease removed from the Peabody chamber in 1970 and 1971 are significantly below those of previous years, there is insufficient information available to determine if this trend will continue. The average values of grease and grit shown in Table 2-1 have, therefore, been used in subsequent computations of land area requirements for disposal.

Land area requirements for the disposal of incinerator residue used later in this report are based upon quantities derived during the design of the wastewater treatment facilities. These indicate that 49 cubic yards per day of material, with a bulk density of approximately 37 pounds per cubic foot, will be produced initially, and that this figure will increase to the design figure of 55 cubic yards per day by 1990.
CHAPTER 3

GREASE AND GRIT SAMPLE ANALYSES

Samples of grease and grit were obtained from the Peabody chamber during cleaning operations in April 1973. These samples were analyzed in our laboratory with the following results:

<table>
<thead>
<tr>
<th></th>
<th>Grease</th>
<th>Grit</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Total Solids - TS</td>
<td>69.1</td>
<td>34.3</td>
</tr>
<tr>
<td>Total Volatile Solids - TVS as percent of TS</td>
<td>92.4</td>
<td>56.3</td>
</tr>
<tr>
<td>Chromium as received</td>
<td>mg/kg</td>
<td>660</td>
</tr>
<tr>
<td>Total chlorides as received</td>
<td>mg/kg</td>
<td>307</td>
</tr>
<tr>
<td>Fuel value - dry basis</td>
<td>Btu/lb</td>
<td>16,800</td>
</tr>
<tr>
<td>Density</td>
<td>lb/cf</td>
<td>54.8</td>
</tr>
</tbody>
</table>

In order to determine if any increase in total solids could be expected to result from dewatering on open sand beds, separate samples of grease and grit, 6 inches thick, were placed on 6-inch beds of sand and allowed to drain.

After one week, the sample of grease showed no evidence of draining and the test was abandoned.

The test of the grit sample was continued for three weeks and the solids content determined at the end of each week with the following results:

<table>
<thead>
<tr>
<th>Total solids of grit sample % wt.</th>
<th>As received</th>
<th>After 1 week</th>
<th>After 2 weeks</th>
<th>After 3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grind chips</td>
<td>34.3</td>
<td>38.0</td>
<td>40.1</td>
<td>41.8</td>
</tr>
</tbody>
</table>

3-1
These results indicate that a small reduction in moisture content of the grit could be expected if the material is dried on sand beds before disposal. A further reduction in moisture content could also be expected as a result of evaporation although this was not shown in our laboratory experiments.

Analyses of the filtrate from the one week and three weeks drainage test were conducted to determine the potential for groundwater contamination if the material is disposed of directly to a landfill operation. This was thought to be particularly important in view of the high concentration of chromium in the sample as received. The results of these analyses are shown below:

<table>
<thead>
<tr>
<th>Filtrate from drainage tests</th>
<th>After 1 week draining</th>
<th>After 3 week draining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dissolved solids</td>
<td>13,500</td>
<td>7,860</td>
</tr>
<tr>
<td>COD</td>
<td>28,000</td>
<td>16,000</td>
</tr>
<tr>
<td>BOD</td>
<td>23,000</td>
<td></td>
</tr>
<tr>
<td>Lead as Pb</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td>Zinc as Zn</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Chromium as Cr</td>
<td>150</td>
<td>87</td>
</tr>
<tr>
<td>Silver as Ag</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Mercury as Hg</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Copper as Cu</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Iron as Fe</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Note: All measurements are in mg/L.
The results confirm the possible need for some form of pretreatment before landfilling, or the adoption of special disposal methods, to reduce the potential for groundwater contamination by the chromium in the filtrate.

A further experiment was conducted to determine if chromium concentrations could be reduced by washing the grit prior to disposal in the landfill. A sample of grit was placed on a 6-inch bed of sand and allowed to drain. After one week the grit was flooded and allowed to drain and the filtrate analyzed for chromium. The sample was flooded a second time and the filtrate again analyzed for chromium. These analyses indicate concentrations of chromium of only 0.1 mg/L (milligrams per liter) and 0.2 mg/L, respectively.

The results of this experiment suggest that the chromium is fixed in an insoluble form within the grit and consequently would not be removed by subsequent leaching action of infiltration water. The test does not show if the chromium would be released as the organic fraction of the grit is slowly degraded. However, if this proves to be the case, the potential for groundwater contamination would be minimal, provided normal precautions were observed to limit the production of leachate during landfill operations.
CHAPTER 4
GREASE AND GRIT PHYSICAL CHARACTERISTICS

Consideration was given to the physical characteristics of the grease and grit as removed from the collection chamber from the point of view of transportation to the disposal site, and the method of disposal.

Grease

The grease forms as a thick blanket on top of the liquid in the chamber. It is removed from the chamber as a thick, gelatinous substance with a strong odor of kerosine. The hydrocarbon content of a sample of grease was found to be 7 percent weight on a dry basis. The remaining 93 percent is thought to be animal fats.

One of the major difficulties of disposing of the grease on land stems from the difficulty in stabilizing the material. This is exemplified by observation of old disposal areas to the northwest of Route 107 in Salem, where disposal beds of a mixture of grease and grit deposited many years ago are still soft and gelatinous beneath a top crust of only a few inches.

Experiments carried out using sand as a stabilizing material indicated that, when mixed with sand in the ratio of grease:sand = 1:3, the mixture was still very mobile. It was concluded, therefore, that disposal of grease by mixing on land with sand or soil would not be feasible.
A further experiment was carried out using crushed rock, with a voids ratio of approximately 40 percent, as the stabilizing material. In this case, a stable fill was achieved when sufficient grease was added to just fill the voids between the crushed rock.

**Grit**

The low velocities of flow in the grit chambers permit large quantities of organic matter to settle out with the grit to form a sludge blanket on the bottom of the chamber. Anaerobic conditions prevail in the sludge with the result that obnoxious odors are released when the sludge is excavated. These odors have been the cause of numerous complaints from residents adjacent to the disposal area, and along the route taken by the disposal trucks.

From an examination of this material, it seems unlikely that this problem would be alleviated by more frequent cleaning of the grit chamber.
As stated earlier, completion of the new wastewater treat-
ment facility is not expected until 1976. It is not possible,
therefore, to obtain samples of incinerator residue for examina-
tion. However, samples were obtained from an incinerator at the
wastewater treatment facility in Hartford, Connecticut, similar
to the one planned for the District. Although the compositions
of the residues from these two incinerators are not expected to
be identical, it is felt that their characteristics will be
sufficiently similar for a decision to be made on the disposal
of residue from the District on the basis of results obtained
from experiments on residue from the incinerator in Hartford.

The residue from Hartford is rust colored, and granular in
texture, although it breaks down very easily to form a fine
powder.

A sample of the residue was analyzed for the presence of
heavy metals since these may prove to be a potential source of
contamination if landfill is selected as the disposal method.
A sample was also thoroughly mixed with water and filtered, and
the filtrate subsequently analyzed for heavy metals. The results
of these analyses are shown below:
Concentrations of metal residues as received, Filtrate, mg/kg, mg/L

<table>
<thead>
<tr>
<th></th>
<th>Residue as received, mg/kg</th>
<th>Filtrate, mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead as Pb</td>
<td>790</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Zinc as Zn</td>
<td>800</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Chromium as Cr</td>
<td>200</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Silver as Ag</td>
<td>130</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Nickel as Ni</td>
<td>66</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Copper as Cu</td>
<td>880</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Iron as Fe</td>
<td>12,000</td>
<td>&lt;5</td>
</tr>
</tbody>
</table>

These results illustrate that although the concentrations of metals in the residue are considerable, they occur generally in insoluble form, and, even after vigorous mixing with water, concentrations in the washwater are comparatively small.

The bulk density of the residue as discharged from the Hartford incinerator is 33 pounds per cubic foot. However, the material is readily compacted, the maximum density then depending upon the moisture content. Laboratory compaction tests at various moisture contents indicate a maximum density of 87 pounds per cubic foot and an optimum moisture content of 22 percent.

A further laboratory experiment was carried out to determine the probable effects upon groundwater resulting from the disposal of the ash in a sanitary landfill. A sample of ash was compacted at approximately the optimum moisture content, and water, corresponding to one inch of rain, added. The filtrate from the sample was collected and analyzed. This procedure was repeated twice. Results of analysis are presented below.
<table>
<thead>
<tr>
<th>Concentration of metal, mg/L</th>
<th>Filtrate 1</th>
<th>Filtrate 2</th>
<th>Filtrate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead as Pb</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Zinc as Zn</td>
<td>0.05</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Chromium as Cr</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Silver as Ag</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Nickel as Ni</td>
<td>0.3</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Copper as Cu</td>
<td>0.4</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Iron as Fe</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

These experiments were carried out by adding water directly to the compacted residue. Since one of the major objectives of sanitary landfilling is to minimize the quantity of water coming into contact with the fill material, it appears that the adoption of this method of disposal for incinerator ash should result in little potential for groundwater contamination.
CHAPTER 6

POSSIBLE METHODS OF DISPOSAL OF GREASE AND GRIT

The various alternative methods considered for the disposal of grease and grit from the collection chambers in Salem and Peabody are based upon the understanding that the grease and grit can be removed from the chambers either separately or together, depending upon the disposal method adopted.

Three broad categories of disposal methods were considered:

1. Disposal of grease alone,
2. Disposal of grit alone, and
3. Combined disposal of grease and grit,

and these are discussed in detail in the following sections.

Disposal of Grease Alone

The results of tests and analyses of grease samples reported earlier in the report limit the disposal of grease to three alternative methods.

Land Disposal. The disposal of grease stabilized with crushed rock in pits with impervious earth cover appears to be a feasible alternative. Because of the nature of the material, it is most likely that the bottom and sides of the pits would be sealed and thus contamination of the groundwater would not be a problem.

Based upon the average quantities of grease presented in Table 2-1, 7,800 cubic yards of rock would be required annually. The total combined volume of grease and crushed rock to be
disposed of annually from Peabody and Salem would then be 3.5 and 1.35 acre-feet, respectively.

The areas of land required would depend upon the depths of the fill, which in turn depend upon the topography of the selected site, and the depths to bedrock and groundwater.

Storage in Lagoons. As an alternative to the permanent disposal on land, consideration was given to storage in lagoons and subsequent reexcavation and transportation to the treatment facilities after their completion in 1976. The approximate total land area requirements for separate lagooning of grease generated in Salem and Peabody, and for combined storage, with depths of 1, 2, and 3 feet are shown in Table 6-1.

The areas shown allow sufficient space for a separate lagoon for each emptying operation and for access to the lagoons for reexcavation. A buffer strip has also been included.

<table>
<thead>
<tr>
<th>Depth of grease, ft</th>
<th>Land area, acres</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salem</td>
<td>Peabody</td>
<td>Combined</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>10</td>
<td>13-1/2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>1-1/2</td>
<td>3</td>
<td>4-1/2</td>
</tr>
</tbody>
</table>

To minimize transportation costs, first consideration should be given to sites as close as possible to the incinerator for combined disposal, and for the separate disposal of grease.
from Salem. For the separate disposal of grease from Peabody, the site should, if possible, be located between the Peabody collection chamber and the incinerator.

**Incineration.** The combined disposal of grease from Salem and Peabody using a package incinerator similar to the Tumbleburner manufactured by Raymond/Bartlett-Snow was also considered. However, because of the high capital cost (approximately $200,000) and long (eight- to nine-month) delivery and installation period relative to an operating period which would be less than three years, this alternative was not pursued. Further consideration should only be given if the other two alternative disposal methods prove to be impractical.

The solid-waste incinerator in Salem is one of the many throughout the state which are unable to meet current air pollution control emission standards. The city is actively investigating alternative means of disposal of solid waste outside the city, and it is expected that the incinerator will close down before the new sludge incinerator at the Salem wastewater treatment plant is in operation. Thus, if the short-term disposal of grease and grit to the solid waste incinerator was considered, it is likely that another short-term disposal method would still be required covering the period from shutdown of the solid-waste incinerator to commissioning of the new sludge incinerator.

Even if shutdown of the solid waste incinerator could be postponed until after the sludge incinerator is commissioned, the
cost and time involved in providing the necessary modifications
to adapt the incinerator would undoubtedly preclude its use in
the short term.

For these reasons, no further consideration was given to
this method of disposal.

Disposal of Grit Alone

Preliminary discussions with the Massachusetts Department
of Public Health indicate that state approval for the disposal of
grit by sanitary landfill would probably be given, but that
approval may be subject to obtaining a reduction in chromium con­
centration by some form of pretreatment. Laboratory experiments
indicate that, although the moisture content of the grit may be
reduced by dewatering on drying beds, the chromium in equilibrium
with the grit would not be removed.

Any site would be acceptable provided it met Health Depart­
ment Regulations governing the development of sanitary landfills.
The method of development, however, would depend upon the depths
to bedrock and water table, and the proximity of surface and
groundwater resources. Where the potential for contamination of
these resources existed, consideration would be given to sealing
the landfill site, and to the collection and satisfactory disposal
of any leachate generated.

Combined Disposal of Grease and Grit

The methods of disposal of grease and grit together are
limited by the characteristics of the grease. As a result, the
only two feasible methods of disposal are those considered earlier for grease alone.

If land disposal is the adopted method, then 20,400 cubic yards of crushed rock would be required annually and the total combined volume of rock, grease, and grit to be disposed of annually from Peabody and Salem would be 10.4 and 2.25 acre-feet, respectively.

If, however, it is decided to store the grease and grit for subsequent disposal to the treatment facilities, the approximate land area requirements, on the same basis as for grease alone, are shown in Table 6-2.

<table>
<thead>
<tr>
<th>Depth of grease and grit, ft</th>
<th>Land area, acres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salem</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

TABLE 6-2. LAND AREA REQUIREMENTS FOR LAGOON STORAGE
CHAPTER 7

POSSIBLE METHODS OF DISPOSAL OF INCINERATOR RESIDUE

From tests conducted on samples of similar material from Hartford, it is expected that the incinerator residue will be inert, and that elements that could result in problems of groundwater contamination will be present in an insoluble form. The material appears, therefore, to be ideally suitable for some form of land disposal.

On the assumption that 85 percent of the laboratory maximum density can be achieved in the field, approximately 66 acre-feet of land area would be required for disposal of residue resulting from the incineration of wastes from primary treatment facilities through the year 1990.

Disposal could be affected either in one site for the entire period, or by filling and reclaiming smaller areas of land within the District. Consideration may also be given to the use of the residue as a structural fill either alone or with the addition of cement. If this course of action is considered, further compaction and strength tests should be conducted on the residue from the District's new incinerator.
CHAPTER 8
IDENTIFICATION OF POSSIBLE DISPOSAL SITES

In the preliminary investigations to identify possible solid waste disposal sites, the following general conditions were applied:

1. Sites for the disposal of grease and grit would be located within Salem or Peabody.

2. Sites for the disposal of incinerator ash could be located within any of the member towns of the South Essex Sewerage District.

3. Searches would be confined principally to areas zoned for industrial development.

With these conditions in mind, studies were made of topographical and surficial geological maps, aerial photographs, and land-use and zoning plans to identify potential disposal sites for further more detailed evaluation.

For the purposes of this investigation, the following field criteria were considered in assessing the suitability or otherwise of potential disposal sites:

1. Topography - steepness of slopes, presence of gullies, presence or absence of trees, and degree of existing screening of the site from highways and dwellings.

2. Man-made features - the existence of dwellings or industries close to the site, and the distance of the site from paved highways and ease of access.

8-1
3. Soil and geology - type of soil material exposed at or near the site, bedrock outcrops, boulders on the ground surface, and the availability of suitable cover material on site.

4. Groundwater - depth to the groundwater table, the existence of nearby water wells, and the estimated direction of groundwater movement.

5. Surface water - existence of streams, ponds, or swamps on site, and the distance to any nearby surface water bodies, especially where these are water supply sources.

The locations of all sites investigated are shown on Figure 1.

Plans of sites recommended for further investigation are included at the back of the report. These plans show the lot lines and areas of the parcels of land under consideration, and the names of the present owners.

Disposal Sites for Grease and Grit

The results of the search for disposal sites for grease and grit are described below.

Potential Sites in Salem. Six areas of industrially zoned land exist within the city. However, because of the density of existing development, or because of the close proximity of residential development, five of these areas were eliminated as unsuitable for disposal purposes. The sixth area lies to the east and west of Swampscott Road in the western side of the city.
Site S1. High-rise apartments are under construction in the northern section of the area to the west of Swampscott Road and south of Highland Avenue. Further construction is planned for the rest of Site S1. Extensive rock outcrops and swamps and surface drainage-ways flowing to Thompson's Meadow within the conservation area make the remainder of the area to the east of Swampscott Road unacceptable for disposal of grease and grit.

Site S2 along the western side of Swampscott Road contains the city incinerator, and disposal area for incinerator residue. This disposal area appears to be the cause of the obvious gross pollution of Forest River which flows along Swampscott Road and into Thompson's Meadow.

Site S2 also contains private dwellings, numerous outcrops of bedrock, swamps, and other surface drainageways tributary to Forest River. Because the potential for further pollution of surface and groundwater resources is great, and because bedrock is probably at shallow depths over most of the area, development for successful disposal of grease and grit would be difficult and costly. Site S2 should only be considered further, therefore, if other more favorable sites are not available.
Site S3 is a triangular-shaped parcel of 13.4 acres owned by the city at the end of Clark Avenue and about 0.4 miles east of Highland Avenue. Land slopes are steep to moderate with some gullies. The site is wooded with some open spaces. Access can be gained to the site via Clark Avenue. There are no dwellings near the site boundaries, and the only industry nearby is an auto-wrecking lot about 100 feet from the southeastern corner.

The soil underlying the site appears to be glacial till comprising of clay, sand, gravel, cobbles and boulders. There are numerous large boulders scattered on the ground surface, and numerous large outcrops of granitic bedrock. The surface of the bedrock is probably at very shallow depth beneath most of the site, which indicates that insufficient cover material for a sanitary landfill operation would be available on site.

No springs or swamps were observed, but the groundwater table is probably at shallow depth in the eastern part of the site. A brook crosses the northern tip of the site, then parallels the northeastern site boundary. The land surface of the site slopes downward steeply toward the brook.

Because of the outcropping and shallow bedrock, lack of cover material, probably shallow groundwater table and danger of pollution of the adjoining brook,
consideration should again be given to this site only if a more suitable site is not available.

Potential Sites in Peabody. The areas of land zoned for industrial development within the city lie generally between Route 128 and the South Reading Branch of the Boston and Maine Railroad to the west of Summit Street, and between Route 1 and Route 128 to the south of Forest Street.

Site P1 shown on Figure 1 contains numerous private dwellings and industries, several streams and a swamp. From a superficial inspection, it appears that the site is unsuitable for disposal purposes.

Site P2. The southern section of Site P2, which lies to the north of Route 128 and east of Farm Avenue, contains private dwellings and a watercourse and is, again, probably unsuitable for disposal of grease and grit. The northern section of the site comprises three parcels of land with a total area of approximately 41 acres. The area is extensively wooded and may be suitable for solid waste disposal. Detailed subsurface investigations would be necessary to confirm this conclusion.

Site P3 comprises two parcels of city-owned land with a total area of 58 acres, and lies to the north of Route 128 and west of Forest Avenue. Access to the site is gained from Forest Street and Forest Avenue to the east, and Dearborn Road to the west.
The city's sanitary landfill operation is located in the northern part of the site. The southern part of the site is a large, abandoned gravel borrow pit. The whole area is well screened by trees. There are bedrock outcrops in the northern part of the site, but none were observed in the southern part. The soil underlying the borrow pit and exposed in the banks in the southern part is composed mostly of glacial deposits of silt, sand, gravel, cobbles and boulders. A small stream flows along the northeastern side of the site and there are indications that the groundwater table may be shallow here. Another stream flows from the center of the site southward to Route 128. The water in this stream is colored, forms colored foam and apparently is polluted, possibly by the refuse deposited upgradient. The stream empties into a swamp at the base of the Route 128 embankment. Several swamps and areas of cattails indicate a shallow water table beneath parts of this southern gravel borrow area.

There is a large volume available in this abandoned gravel borrow area for a sanitary landfill operation, and there appears to be a large quantity of cover material left on site. However, in order to properly assess the suitability of the site, subsurface exploration by excavating test pits and making test borings
would be necessary to determine the position of the water table, depth to bedrock, and quantity and composition of overburden soil.

Site P4 is bounded on the south by Dearborn Road and lies about 0.45 miles east of Route 1 and 0.2 miles north of Route 128. The area is relatively flat, covered with grass, and screened by trees on three sides. There is one shallow gully along the southeastern side, but there is no evidence of streams, swamps, or shallow water table conditions. There are no outcrops of bedrock visible and only few boulders. From a superficial inspection, it would appear that soil overburden comprises a heterogeneous mixture of clay, silt, sand and gravel.

There are no occupied dwellings nearby and so the area is potentially suitable for disposal of grease and grit. Detailed subsurface investigations would be necessary to confirm this conclusion.

Disposal Sites for Incinerator Ash

The identification of possible sites for the disposal of incinerator ash has been made on the assumption that this material will be similar to that presently produced at the incinerator in Hartford, Connecticut, mentioned earlier in the report. It has also been assumed that the ash will be disposed of by conventional sanitary landfilling methods. It is on these bases that permission
of the appropriate regulatory agency will be sought for the use of a specific site for land disposal.

The assumed characteristics of the ash can be confirmed and, if necessary, the disposal method can be varied in the light of proven characteristics, after the new incinerator is in operation. Alternative disposal methods, such as use in structural foundation work and land reclamation, may also prove to be feasible.

Potential Sites in Beverly. Five possible sites were identified from topographic and land-use plans and aerial photographs. The potential of each site for use as a sanitary landfill is described in the following paragraphs.

**Site Bl** covers an area of approximately 16 acres bordered on the south side by Route 128 and on the southeast by Pine Knoll Drive. The site contains many large, fractured outcrops of bedrock with little, if any, on-site cover material, and with swampy areas to the east. The site is considered unsuitable for ash disposal.

**Site B2** lies to the south of the Beverly-Wenham line and is bounded on the west by Beverly Airport and on the south by Airport Road. The site, which covers an area of approximately 70 acres, is low, flat, and heavily wooded. The central part of the area is swampy and is probably flooded during the season when the groundwater table is highest, and drains to Wenham Lake which is a water supply source.
Industrial development is taking place along Airport Road which is the only access to the site. This site also appears to be unsuitable for ash disposal. Site B3 lies between Dodge Street to the south and the Beverly-Wenham line to the north. Covering an area of approximately 33 acres, the site is flat with an elevation above that of the surrounding areas, and is presently cultivated as a tree farm and cornfields. Use of this site for ash disposal would raise the ground surface elevation further above that of surrounding areas. Because of the close proximity of existing dwellings, this would be aesthetically unacceptable. For this reason, further investigation of Site B3 should only be considered if other recommended sites prove to be unsuitable.

Site B4 covers an area of approximately 275 acres bounded by Branch, Wood, and Common Lanes and Greenwood Avenue, and is an area of residential development. The site is very hilly with steep slopes and with large outcrops of fractured bedrock visible over the greater part of the area, with the result that cover material appears to be sparse. Swamps and ponds occur in the southeastern part of the site. The area is considered unsuitable for ash disposal purposes.
Site B5 is the present sanitary landfill adjacent to Brimbal Avenue and immediately south of Route 128. The remaining useful life of the site for disposal of solid waste is estimated to be no more than four years. Although this should be a sufficient period of time to enable the city to establish an alternative solid waste disposal system, disposal of ash to this site should only be considered as a stop-gap measure in the event that a permanent site is not immediately available.

Potential Sites in Danvers. Six sites, including the existing sanitary landfill, were inspected, and, of these, two sites are recommended for more detailed investigation. Descriptions of all sites are contained in the following paragraphs.

Site D1 straddles the Danvers-Peabody town line and is owned by The Ventron Corporation which intends to use the area for plant expansion.

Site D2 is an area of approximately 37 acres lying to the north of Andover Street and bordered on the east by Garden Street. The area is zoned for industrial development but is flanked on two sides by private dwellings.

The site is flat with a brook flowing along the northeastern boundary, and with swamps in the northwest. These indicate the possible presence
of a shallow groundwater table. Soil exposed in open excavations on site shows a high percentage of sand and gravel. Because of probably adverse groundwater conditions, and because it is located close to established dwellings, the site appears to be unsuitable for the disposal of incinerator ash.

**Site D3** lies to the west of Andover Street and south of Buxton Lane and covers an area of approximately 34 acres. There are existing dwellings along Buxton Lane, and the site is flanked by the Goodale and Sons of Jacob cemeteries to the west. The site is hilly and land slopes are steep. This, together with numerous outcrops of bedrock, indicates that bedrock is probably at a shallow depth over much of the site.

The area is densely wooded and slopes towards a marshy area in the south. This marsh drains towards the Ipswich River which is a water supply source. The site appears to be unsuitable for development as an ash disposal area.

**Site D4** is a privately owned rectangular area of approximately 40 acres along the Peabody city line in the extreme southwest of Danvers. It lies between Norris Brook to the northwest and the
sanitary landfill in the southeast. The Town Forest forms the northwestern boundary.
Topography varies from moderately steep to gently sloping with some gullies. The site is thickly wooded with the exception of the strip running east west along the New England Power Company easement. A dirt road runs along this easement with access from the sanitary landfill. The site is well screened on all sides with the exception of the one overlooking the landfill, and there are no dwellings in the immediate vicinity.
The overburden consists of silt, sand, and gravel with very few boulders and outcrops of bedrock apparent. The depth to bedrock is probably no greater than four feet on the hilltop but greater depths of overburden could be anticipated in the lower areas.
There is no evidence of a shallow groundwater table, although there are two small ponds in local depressions which may possibly have resulted from snowmelt.
Surface water appears to drain eastward towards the stream that flows past the sanitary landfill to Crane Brook.
The northwestern part of the site slopes steeply downward to Norris Brook which is a tributary of the Ipswich River.
Site D4 appears to be ideally suitable for disposal of incinerator ash provided precautions are taken to prevent the movement of ash or leachate towards Norris Brook.

Site D5 comprises an area of approximately 66 acres which lies to the north of West Street between Dayton Street and the Ipswich River. The 40 acres forming the northern part of the site are part of the Danvers State Hospital property. This area is grass covered and slopes gently towards the river in the west. There is evidence that bedrock and the groundwater table do not occur at shallow depth in the eastern part of this subarea. There is further evidence of an abundance of suitable cover material.

The subarea to the west along the river is low and swampy and would require filling before landfilling operations commenced. Material for this could probably be obtained from the eastern side of the land parcel.

This subarea is screened from the north, west, and south, and appears to be suitable for ash disposal purposes. There are only two dwellings near the site, in the southeastern corner, and the nearest hospital buildings are approximately 0.2 miles to the north.
Access along Dayton Street is good.
The southern part of the site is privately owned, is partly wooded and shows evidence of shallow bedrock and a shallower groundwater table than in the northern subarea.
The subarea is screened on the east, west, and north and there are dwellings along the eastern boundary.
Although still potentially suitable for ash disposal, the southern subarea is inferior to the subarea to the north.
Because the Ipswich River is a source of water supply, special provisions would be required in the development and operation of Site D5 to protect the river from any possible contamination.
Site D6 is the existing sanitary landfill with access from Route 1 via East Coast Road.
The rolling topography of the site has now been largely filled with solid waste, with the exception of the swampy area to the east which drains towards Crane Brook, and a large depression in the center of the fill area which apparently has been left unfilled on instructions of the State Department of Public Health.
It is necessary to import all cover material for the present operation.
Leachate contamination of surface water ponds and marshland to the east of the site is already occurring. It is unlikely that permission to extend filling operations into this area could be obtained.

Even assuming that landfilling continues in the central depression, the useful life of the site is extremely limited. The Town of Danvers is actively investigating alternative solid waste disposal methods, but will require the use of this present site until an alternative method is available.

The use of this site for interim disposal purposes should only be considered if an alternative method of disposal of solid waste is adopted.

Potential Sites in Marblehead. Two potential sites were identified and visited in Marblehead. Of these only one is possibly suitable for ash disposal.

Site M1 is town-owned land presently used for the disposal of residue from the solid waste incinerator, and for the disposal of other wastes which are not incinerated. The town is presently investigating alternative solid waste disposal methods. Until a satisfactory alternative is adopted, however, it would be unwise to permit landfilling of other materials in the remaining volume.

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The use of Site M1 for the disposal of incinerator ash from the wastewater treatment facility is not recommended at this time.

Site M2 is an old gravel borrow area along the Forest River, west of Lafayette Street and northwest of Star of the Sea cemetery. The site comprises two parcels of land separated by a Marblehead Town Water Department easement. The parcel of 16 acres north of the easement is the area under consideration.

The area has been excavated to a depth of over 40 feet at its deepest point and could be expected to provide capacity in excess of the 66 acre-feet quoted earlier in the report as being the required landfill capacity for incinerator ash through the year 1990.

Ponds of water exist in two low areas of the site and these would require filling to four feet above the groundwater table before landfilling of ash commenced. It is expected that material for the purpose could be excavated from within the site. There appears to be ample cover material on site, but this should be confirmed by subsurface investigations.

There are dwellings along Lafayette Street to the north, and along Leggs Hill Road to the southwest,
but these are well screened from the disposal site. The cemetery to the east is also screened from the site.

Access to the site could be obtained from Old Salem Road and via the water easement or from Lafayette Street. The two parcels of land, the water easement, and an area of salt marsh, totaling approximately 26 acres, were acquired by the town in March 1973 as a conservation area. However, because of the precipitous nature of the sides of the excavation, the area could present a real hazard to anyone wishing to use the area. Furthermore, unlawful dumping of refuse is presently occurring to a limited extent. This practice will no doubt continue, and may expand. Filling of the area with incinerator ash and subsequent landscaping would, therefore, convert what may otherwise be an eyesore into an aesthetically pleasing recreational parkland, and would undoubtedly enhance the value of abutting properties.

Potential Sites in Peabody. Of the sites described earlier for the disposal of grease and grit, Sites P2 and P3 appear to be ideally suitable for the disposal of incinerator ash. The use of ash at Site P1 in reclaiming land for industrial purposes is also a possibility. However, approval of the Department of Natural Resources would probably be required.
and this could only be obtained after the composition and characteristics of the ash are known.

Potential Sites in Salem. Only site S3 appears to offer any potential for the disposal of ash within Salem, although the use of this material for fill in worked-out areas of the Lynn Sand and Stone Company property at the southern end of Swampscott Road may be a feasible alternative. This alternative was not explored with the company.

The approximate haul distances from the proposed incinerator at the new primary treatment plant in Salem to the potential ash disposal sites are shown in Table 8-1.

<table>
<thead>
<tr>
<th>Site</th>
<th>Municipality</th>
<th>Round-trip haul distance, miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-2</td>
<td>Marblehead</td>
<td>11.1</td>
</tr>
<tr>
<td>P-3 (North-SLF)</td>
<td>Peabody</td>
<td>14.3</td>
</tr>
<tr>
<td>D-4 &amp; D-6 (SLF)</td>
<td>Danvers</td>
<td>16.3</td>
</tr>
<tr>
<td>P-3 (South)</td>
<td>Peabody</td>
<td>14.3</td>
</tr>
<tr>
<td>D-5</td>
<td>Danvers</td>
<td>17.0</td>
</tr>
<tr>
<td>P-2</td>
<td>Peabody</td>
<td>14.3</td>
</tr>
<tr>
<td>S-3</td>
<td>Salem</td>
<td>8.4</td>
</tr>
<tr>
<td>P-4</td>
<td>Peabody</td>
<td>16.8</td>
</tr>
</tbody>
</table>
CHAPTER 9
CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. An average of approximately 3,100 cubic yards of grease and 5,100 cubic yards of grit are disposed of annually.

2. Approximately 72 percent of the grease and 88.5 percent of the grit is removed from the chambers in Peabody. Thus, Peabody contributes approximately 82 percent of the total quantity of grease and grit.

3. The volumes of solids could be reduced by further dewatering prior to removal from the chambers.

4. The present method of disposal of grease and grit is of concern to responsible officials in Peabody because of:
   a. Odors emanating from trucks conveying the materials to the disposal area and from the disposal site itself.
   b. Slopping of the contents of the open trucks during transportation.
   c. Potential danger of the disposal area.

5. Additional objections to the present disposal method have been raised by the Regional Sanitary Engineer of the Massachusetts Department of Public Health with regard to:
a. The instability of the material at the disposal area.

b. The possibility of groundwater contamination.

6. Ash from the District's new incinerator should present no problems of disposal by conventional sanitary land-fill methods.

7. By consolidating the incinerator ash at optimum moisture content, it may be feasible to dispose of the material usefully as structural fill, in cement slurry, or in mass concrete work.

8. The following sites have been identified as potential sites for the disposal of grease and grit as removed from the existing chambers.
   Peabody, P3 (present disposal area)
   Peabody, P2
   Peabody, P4
   Salem, S3

9. The following sites have been identified as potential sites for the disposal of incinerator ash.
   Beverly, B5
   Peabody, P2, P3, P4
   Danvers, D4, D5, D6
   Salem, S3
   Marblehead, M2
Recommendations

At the present grease and grit disposal area (P3), we recommend that the District:

1. Consolidate the area by the addition of single size crushed rock.

2. Cover the consolidated area with compacted soil to prevent the emanation of odors.

3. Authorize Metcalf & Eddy to execute a program of groundwater sampling and analysis in the vicinity of the existing grease and grit disposal area.

4. If the analyses confirm the absence of groundwater contamination, negotiate with the City of Peabody for the continued use of the disposal site, possibly on a user-fee basis, and provide a fence around the immediate disposal area.

5. If the analyses indicate that contamination of the groundwater by the grease and grit is occurring, authorize Metcalf & Eddy to undertake further studies to determine if the contamination can be prevented. If this is not possible, pursue subsurface investigations at the other potential sites identified. The following order should be observed in investigating these sites:
   a. Peabody Site P-3 - Southern section.
   b. Peabody Site P-2 - Northern section.
   c. Peabody Site P-4.
   d. Salem Site S-3.
We further recommend that the District:

6. Arrange for further dewatering of the grease and grit in the future before removal from the collection chambers by modifying removal methods.

7. Arrange for the use of covered trucks to convey the material to the disposal site.

8. Carry out discussions with appropriate municipal officials for the possible use of any of the sites identified for ash disposal. If preliminary approval is obtained, authorize Metcalf & Eddy to carry out further studies and subsurface investigations to develop a definitive operational plan for submittal to the Local and State Department of Public Health for approval. The following sites should be studied in detail.

<table>
<thead>
<tr>
<th>Site</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. M-2</td>
<td>Marblehead</td>
</tr>
<tr>
<td>b. P-3 (North)</td>
<td>Peabody</td>
</tr>
<tr>
<td>c. D-4</td>
<td>Danvers</td>
</tr>
<tr>
<td>d. P-3 (South)</td>
<td>Peabody</td>
</tr>
<tr>
<td>e. D-6</td>
<td>Danvers</td>
</tr>
<tr>
<td>f. P-2</td>
<td>Peabody</td>
</tr>
<tr>
<td>g. S-3</td>
<td>Salem</td>
</tr>
</tbody>
</table>

Respectfully submitted,

METCALF & EDDY, INC.

John Podger
Senior Vice President

Registered Professional Engineer
Massachusetts License No. 19130
APPENDIX
FIG. 5 PEABODY SITES P-2, P-3, & P-4