FINAL REPORT

SOLID WASTE MANAGEMENT STUDY

PREPARED FOR

THE CITY AND BOROUGH OF JUNEAU
155 SOUTH SEWARD STREET
JUNEAU, ALASKA 99801

NOVEMBER 1983

ENGINEERING-SCIENCE

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Mr. Steve Gilbertson, Planner
Planning Department
The City and Borough of Juneau
155 South Seward Street
Juneau, Alaska 99801

Subject: Solid Waste Management Study for the City and Borough of Juneau, Alaska - Final Report

Dear Mr. Gilbertson:

This letter transmits 60 copies of the final report of the Solid Waste Management Study for the CBJ in accordance with our agreement dated 23 March 1983. This final report reflects comments received on the draft report by the Department of Environmental Conservation, the U.S. Fish and Wildlife Service, the State Department of Fish and Game, the CBJ Utility, and the Planning Commission and staff.

It has been a privilege to evaluate the potential alternatives for solid waste and sludge management, and resource recovery for the CBJ. We look forward to a continued working relationship with the City and Borough on these important environmental matters.

Very truly yours,

Chip Clements
Project Manager

Gordon S. Magnuson
Senior Vice President

CC/GSM/elj

Enclosures

ACKNOWLEDGEMENTS

The Engineering-Science team would like to acknowledge the following persons for their valuable contributions of time and effort. Without their assitance, this study could not have been completed.

- Mr. Steve Gilbertson - CBJ Planning Department, (Project Manager)

- Mr. Shorty Tonsgard - Channel Sanitation
  Ms. Jean Tonsgard
  Mr. Dennis Sheridan

- Mr. Dick Stokes - Department of Environmental Conservation

- Mr. Jim Beeson - CBJ Utility Department
  Mr. Don Shira
  Mr. Sid Weldon

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EXECUTIVE SUMMARY

BACKGROUND

The City and Borough of Juneau (CBJ) faces two pressing problems that stimulated this broad-scope solid waste/sludge management study. The first involves a near term shortage of landfill capacity, the second, a serious problem with sewage treatment plant sludge disposal. In contrast to these concerns, recycling and energy recovery from waste could offer potential benefits to the community. Thus, the CBJ decided to fund this initial project to make recommendations on future solid waste, sludge, and resource recovery systems. Based on these results, the CBJ can proceed with development and implementation of recommended options.

PROJECT SCOPE

This project represents a preliminary evaluation of solid waste, sludge, and resource recovery alternatives for the CBJ. Key tasks included:

- Evaluate solid waste disposal options including improvements and expansion of the existing landfill, and preliminary evaluations of new landfill and incineration sites.
- Assess the feasibility of alternative recycling programs including their costs, benefits, and impacts on solid waste disposal.
- Determine the feasibility of methane gas recovery from the existing landfill, and steam and electricity generation from waste-to-energy facilities.

- Evaluate sewage sludge disposal alternatives both prior to and after completion of the new Mendenhall Wastewater Treatment Plant.

- Discuss funding options for recommended solid waste/sludge management systems.

The project was completed during an eight month period beginning in the spring of 1983.

SOLID WASTE ALTERNATIVES

This section summarizes the results of the analysis of alternatives for solid waste management within the CBJ. Recommendations for action are presented.

The CBJ generates approximately 51 tons per day (TPD) of solid waste, or 4.6 lbs per person per day. This waste is presently collected by Channel Sanitation and disposed in their landfill in the Lemon Creek area. Six alternatives to the existing landfill operation were evaluated:

- Modifications to the existing landfill
- Development of a new landfill
- Incineration
- Waste-to-energy
- Co-combustion (refuse and sewage sludge)
- Methane recovery from the landfill

Modification of the Existing Landfill

There are no good sites for landfills within the CBJ. Of the sites evaluated, the existing landfill is the best for land-based solid waste disposal. It is located in an industrial area and has not demonstrated any severe environmental impacts. Although there are aesthetic problems with this operation, and its location is certainly not ideal, the operation is generally accepted by the community and can continue without the uproar that developing a new site is likely to create. Thus it seems prudent to investigate means of optimizing the use of this site.

Several alternatives were analyzed to extend the life of the landfill. In the consultants opinion, the best option is to construct an additional lift of 10 feet on top of the existing landfill grade, thus providing an additional 10 years of operating life. This program could be further enhanced by baling the refuse prior to burying in the landfill. Moderate density baling could extend landfill life an estimated 20 to 30 percent at an additional cost of approximately $12-$15 per ton. Other key advantages of baling include: litter and odor control, reduction of leachate, and savings in quantity of cover soil required. The capital cost for the baling facility would be about $900,000.

Costs for landfill disposal have risen sharply in recent years. The current fee at the landfill is $50 per ton for general garbage. Fees for wood, metal, tires and other bulky items are higher.

Development of a New Landfill

A preliminary survey showed that there are very few new sites within the CBJ that are feasible as future landfills. None of the sites investigated are ideal. All would require expensive leachate control systems, groundwater monitoring, and careful operations to protect ground and surface water resources.

The best site for a future landfill is located along the southeast side of Lemon Creek above the existing gravel pit. The City owns about 30 acres of land that is to be mined for gravel to a depth of about 40 feet. Once a portion of the gravel is removed, staged development of the landfill could begin. A preliminary estimate for construction of the landfill is $1.4 million,equipment cost would be another $1.2 million. Development could be accomplished in three or four phases to reduce upfront costs and to allow concommitant refuse disposal and gravel extraction. Total annual costs for the new secure landfill operation would range from $38 to $44 per ton in 1985, depending on the availability of construction grant funds from the DEC.

This would also be a good site for a future waste-to-energy plant generating steam and/or electricity for use at the nearby State Correctional Center.

The next best new landfill site is the city land behind the State Correctional Center. Access to this site via the new haul road on the east side of Lemon Creek and a new bridge across the river would minimize the impacts of landfill bound traffic on residential areas below the prison.

Incineration

Incineration is an attractive alternative in many areas of Southeast Alaska because good sites for landfills are so difficult to find. This is also the case in Juneau. One good site for incineration would be at the Channel Sanitation landfill. This area is zoned industrial, the landfill is already there, and ashes from the process could be buried with the refuse on-site. The primary disadvantage of small scale incineration (50 TPD in Juneau) is cost. A reliable, stoker-fired incinerator with a 20 year life would cost $12 million to construct, including air pollution control equipment. Total annual costs would be $111 per ton in 1985, or $77 per ton with a 50 percent DEC grant.

Waste-to-Energy

Refuse burns with about half the heating value of coal. This heat energy can be used to produce steam and/or electricity for industrial use. Revenue from sale of this energy can be used to defray a portion of the cost of the system.

Three types of waste-to-energy facilities were evaluated for the CBJ:

- A regional facility burning all the refuse and generating steam for sale to the hospital or state correctional center (the plant could generate much more steam than it could sell)
- A regional facility burning all the refuse and generating electricity for sale to AEL&P.
- Small modular facilities sized to burn only the amount of waste needed to meet the steam demand at the hospital and prison.

On a life-cycle cost basis, the regional waste-to-energy facility generating steam is superior to the other two options. However, it is slightly more expensive than incineration without energy recovery and much more expensive than landfilling.

The following factors contribute to the high cost of waste-to-energy facilities in Juneau:

- A high capital cost of $12 million
- Labor costs are high for small size facilities, particularly so in Alaska
- There are no large steam users in Juneau that can use more than about 20 percent of the steam from a regional waste-to- energy plant, and which have an appropriate location nearby for the burning facility.

A waste-to-energy plant selling steam to the hospital would cost $115 per ton in 1985, or $83 per ton with a DEC grant. If all the steam could be sold, the latter cost would drop to $62 per ton and the waste-to-energy facility would be superior to landfilling on a life cycle basis.

Co-combustion

Co-combustion is the burning of refuse with sewage sludge. Such systems are now operational in Stamford, Connecticut; Glen Cove, New York; and several cities in Europe. The City of Sitka, Alaska has just awarded a contract for construction of a 25 TPD co-combustion facility to burn sludge and refuse and provide steam to a local college.

In Juneau, the dewatered sludge from the new Mendenhall Wastewater Treatment Plant could be burned directly with refuse without having to be further dried. However, this highly treated sludge is valuable as a soil amendment, particularly in a region with poor soils. One of the main disadvantages of co-combustion in Juneau is that it seems wasteful to burn this useful product. Because there are no appropriate large steam users in the CBJ, it is not cost effective to generate steam with the waste heat from the co-combustion process.

A co-combustion plant for Juneau, would cost $14 million with total annual costs of $113 per ton in 1985. This cost would drop to about $78 per ton with a DEC grant.

Methane Gas Recovery

Many cities in the U.S. are now extracting gas from old landfills. The gas, caused by biological decomposion of refuse, is about 50 percent methane and can be used for a variety of purposes. Gas extraction has been attractive at certain landfills because a modest capital investment resulted in large revenues from the sale of the recovered gas.

Methane gas recovery from the Channel Sanitation landfill in Juneau is economically marginal. This is due to the small volume of refuse in the fill and the shallow 10 to 20 feet depths to which it is buried over most of the site. Very preliminary estimates show that enough gas may be able to be recovered to provide about 150 kilowatts of electrical generating capacity, or about 1 million kilowatt hours per year. This equates to an annual revenue of $60,000 at $0.06 per kilowatt hour. Under certain scenarios, AEL&P predicts rapidly increasing power costs which would benefit a gas recovery progam directly.

The gas extraction system and power generating equipment would cost about $500,000. Annual O&M costs cannot be estimated at this time.

Certain preliminary tests can be performed at the landfill to determine the quantity and quality of gas that can be recovered. These are discussed below under short term options.

Cost Summary

Table 1.1 summarizes the projected costs for the present landfill operation and these alternatives for solid waste management. Figures 1.1 and 1.2 graphically depict this information. Grant assisted incineration is competitive with existing landfilling. Waste-to-energy is more expensive only because all the steam cannot be sold. If it could, a grant supported, steam generating waste-to-energy plant would be the best overall option for solid waste disposal. On the other hand, waste-to-energy for power generation is not cost effective. A new landfill, though low in cost, carries the highest environmental risks.

As shown in the figures, the availability of construction grant money is very important for the capital intensive incineration and waste-to-energy projects. Another crucial variable is the yearly

TABLE 1.1

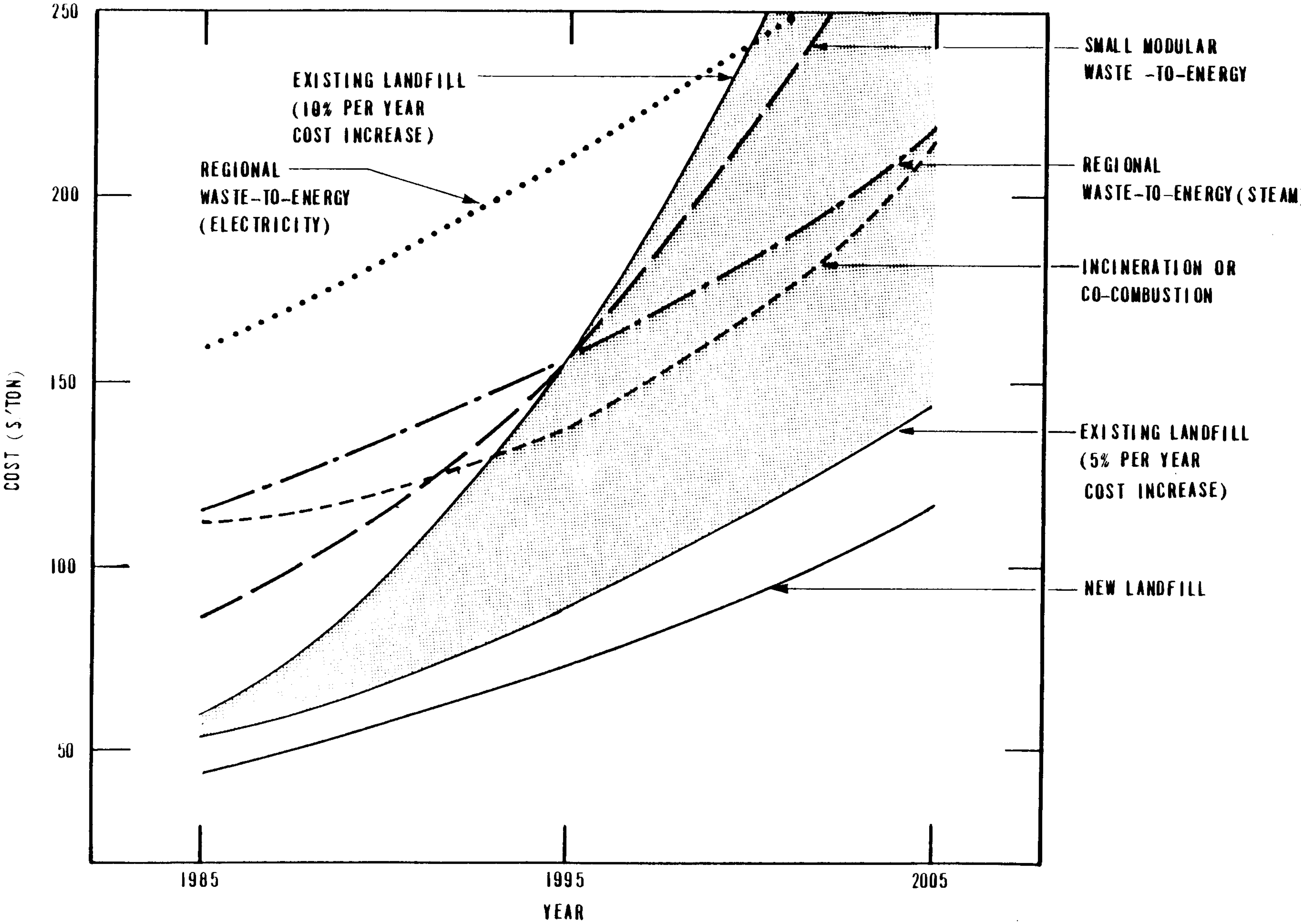
COST COMPARISON OF SOLID WASTE ALTERNATIVES

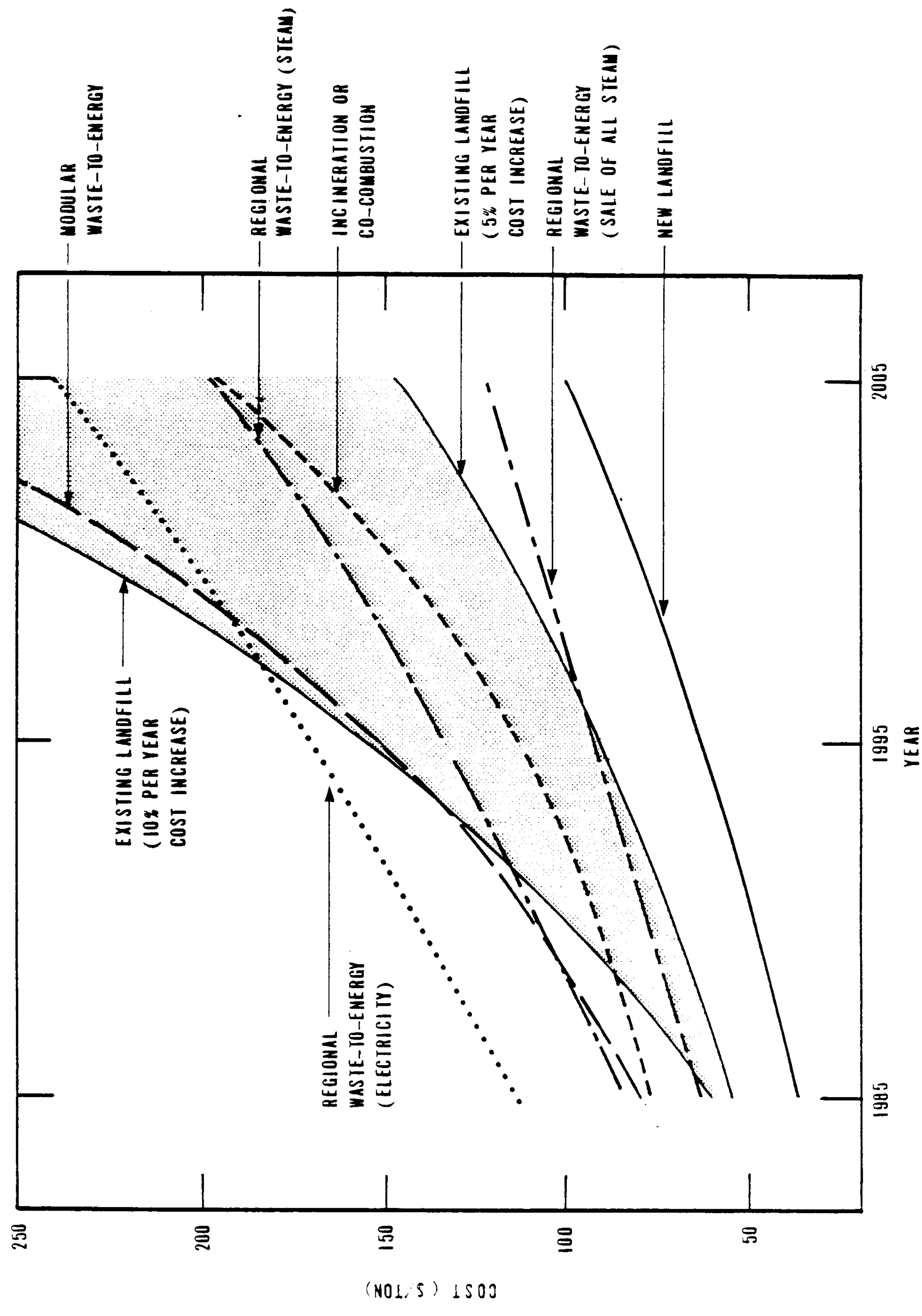
Alternative	Cost ($/Ton) 1985	1995	2005
1. Existing Landfill			
5% per year cost increase	55	90	146
10% per year cost increase	60	157	407
2. New Landfill[a]			
No grant	44	72	117
50% grant	38	61	99
3. Incineration			
No grant	111	139	215
50% grant	77	111	191
4. Waste-to-Energy (Regional)			
Steam Generation			
No grant	115	159	216
50% grant	83	134	195
50% grant, all steam sold	62	95	127
Power Generation			
No grant	157	211	269
50% grant	110	173	237
5. Waste-to-Energy (Modular)			
No grant	88	158	315
50% grant	80	151	309
6. Co-Combustion (No Energy Recovery)			
No grant	113	138	209
50% grant	78	110	186

a City operated, 5 percent per year cost increase

inflation of landfilling costs. At an increase of 5 percent per year, landfilling is the least expensive alternative. However, at a 10 percent per year cost increase several other options are more favorable.

LIFE CYCLE COST COMPARISONS OF SOLID WASTE ALTERNATIVES (NO GRANTS)





LIFE CYCLE COST COMPARISONS OF SOLID WASTE ALTERNATIVES
(WITH 50% GRANTS)

Recommended actions to be taken by the CBJ pertaining to solid waste are as follows.

Short Term Actions (Solid Waste)

1. Extend Life of Existing Landfill

   - Stockpile cover material and construct a new lift of approximately 10 feet on top of the existing landfill grade when existing capacity has been depleted.

   - Conduct a test program of the use of "Sanifoam" as an interim cover material.

   - Depending on the decision to develop a new landfill or a waste-to-energy facility, and scheduling for that project, the CBJ could opt to further extend the life of the existing landfill by baling. An increased life of 20 to 30 percent would result at an additional cost of about $12 to $15 per ton.

   - Test the feasibility of deep excavation and filling by monitoring tests conducted by Channel Sanitation this winter on the rate of water infiltration into existing pits.

2. Consider Development of Waste-to-Energy Plant

   - Review the potential for siting a facility within one mile of downtown Juneau and the steam demands of the largest buildings. A project to service large downtown steam users is very attractive economically.

   - Consider implementing a waste-to-energy project generating steam for the hospital or State Correctional Center, even at a high cost, due to the environmental benefits such a system has over the existing and future landfills.

3. Test for Feasibility of Methane Gas Recovery

   - Conduct landfill borings and methane gas extraction tests to determine quantities and extent of refuse, volumes and quality of methane gas, and sustainable extraction rates.

- Perform engineering cost analysis. The total testing program and engineering analysis would cost $50,000 to $75,000.

- Design methane gas recovery system, if proven economically feasible, with gas to be used as fuel in a reciprocating engine to generate power for sale to AEL&P.

4. <u>Plan for Development of New Landfill</u>

   - Designate 40 acre city-owned parcel behind existing gravel pit on Lemon Creek as a future landfill site.

   - Obtain legal access to the site.

   - Through planning process, ensure compatible future land uses surrounding the site.

   - Develop an excavation plan compatable with ultimate landfill use.

   - Begin excavation and export of gravel from site.

<u>Long Term Actions (Solid Waste)</u>

1. <u>Close Channel Sanitation Landfill</u>

   - Consider the ultimate use of the landfill for various recreational uses including athletic fields, playgrounds, and a golf course.

   - Prepare a closure plan consistent with the ultimate use of the site.

   - Provide a cap over the landfill surface to reduce rainfall infiltration.

   - Grade the surface to provide adequate runoff after allowing for settling.

   - Provide finished grade and top soil for recreational use.

2. <u>Construct and Operate Lemon Creek Landfill or Waste-to-Energy Plant</u>

   - Prepare design and specifications
   - Prepare construction bid documents
   - Select construction contractor

* Construct facility
* Begin operation

SLUDGE DISPOSAL ALTERNATIVES

This section summarizes the results of the analysis of alternatives for disposal of sewage treatment plant (STP) sludge within the CBJ. Short and long-term recommendations are presented.

Currently, the two main STP's in the CBJ produce about 12 TPD of sludge, eight TPD that has been dewatered to a cake with 17 percent solids at the Mendenhall STP, and four TPD of liquid sludge with only 2-3 percent solids at the Juneau-Douglas STP.

Disposal of these sludges is a serious, pressing problem. The dewatered Mendenhall STP sludge is trucked to a land disposal site on the Gastineau Channel about 1/4 mile south of the Juneau-Douglas STP. This site will be full as of August 1984. Until recently, the Juneau-Douglas STP sludge has been mixed with mine tailings and soil and piled up on the adjacent mining property. The mining company has since terminated this arrangement and no acceptable disposal method is readily available.

The CBJ has recently approved the design and construction of a new Mendenhall STP. If it performs as specified, this plant will produce a stable, sterilized sludge with a solids content of 30 percent when it goes into operation in late 1985. Therefore, sludge treatment and disposal alternatives put into practice in 1983 must be compatable with the changes in the nature and quantity of sludge to be produced after 1985.

With these constraints, a long list of potential sludge disposal techniques including composting, pasteurization, forest application, lagooning, land burial, codisposal, incineration, and co-combustion was reduced to those discussed below.

Juneau-Douglas STP Sludge

One option for disposing of the Juneau-Douglas STP sludge is to truck it to Mendenhall for processing and ultimate disposal. This will require the purchase of a new vacuum truck, one part-time driver to haul one load every two or three days, and the construction of sludge storage and feed equipment at the Mendenhall STP. Capital costs for this system including a truck and new facilities construction are estimated at about $150,000. Total annual costs would be approximately $70,000.

Alternatively, the Juneau-Douglas sludge could be dewatered on-site to a sufficient dryness to allow disposal to land either at the existing sludge disposal site or a new site. In fact, the CBJ Utility Department is planning to purchase and install a belt filter press, smaller but similar to the equipment at the Mendenhall plant. Capital costs for this type of system are approximately $130,000, and total annual costs about $50,000 to $60,000. These costs are highly sensitive to labor requirements.

Once the new Mendall STP is operational in 1985, wet Juneau-Douglas sludge, could be hauled to the Mendenhall STP. There it could be highly treated with the Mendenhall plant sludge for ultimate use as cover soil at the landfill or as a general soil amendment. Unfortunately, the new sludge treatment process at Mendenhall will not be able to treat belt filter pressed sludge from the Juneau-Douglas plant. Thus the preferred long range alternative would be continued operation of the belt filter press and burial at a disposal site. The benefit of advanced treatment afforded by hauling wet sludge to the Mendenhall STP for further treatment would be lost but overall costs would be lower.

Mendenhall STP Sludge

The best near-term (prior to 1985) alternatives for disposal of the dewatered Mendenhall STP sludge are continued use of the existing dedicated land burial site, and disposal in a separate secure area at the Channel Sanitation landfill.

The best long-term (after 1985) alternative for sludge disposal is stockpiling at the landfill and use as cover material, or possibly for sale to local residents as a soil conditioner. If indeed the processed sludge could be marketed as a soil amendment, the CBJ may even be able to obtain bids for the purchase of the sludge, eliminate hauling costs, and realize a net revenue from sludge disposal.

Short-Term Actions - Present to 1985 (Sludge)

1. Purchase a new vacuum tank truck for hauling wet sludge. This vehicle is needed for hauling the Auke Bay sludge even if dewatering equipment is installed at the Juneau-Douglas STP and the truck isn't needed there. The existing vehicle is badly in need of replacement.

2. Construct the necessary facilities and begin hauling wet Juneau-Douglas sludge to the Mendenhall STP in the new tank truck; or, purchase the proposed belt filter press, construct the necessary facilities, dewater on-site at the Juneau-Douglas STP, and haul direct to disposal.

3. Immediately begin to negotiate a contract for the future interim disposal of dewatered sludge at the Channel Sanitation landfill.

4. Utilize the remaining capacity of the existing sludge disposal site (approximately nine months capacity remains).

5. Once the existing sludge disposal site is full, begin disposal at a separate secure site within the Channel Sanitation land-fill.

6. As a precautionary measure, prepare the design of a dedicated, totally contained sludge disposal area of one to two acres at the proposed new landfill site at Lemon Creek. Begin excava-ting gravel as soon as possible so that, if need be, the site can be developed and ready when the existing sludge disposal site is depleted.

Long-Term Actions - After 1986 (Sludge)

1. Haul the highly treated, sterilized sludge from the Mendenhall plant to the landfill where it can be stockpiled and:

   - Sold or given away to local residents as a soil conditioner
   - Blended with sand and used as interim and final cover
   - Mixed and buried with the refuse

2. After closure of the Channel Sanitation landfill, haul to the new Lemon Creek landfill and continue the same program.

3. If the belt filter press system is working well at the Juneau-Douglas STP, continue the programs and haul the dewatered sludge to the landfill for disposal. This small amount of dewatered sludge (about one cubic yard per day) could be mixed directly in with the refuse.

4. If problems develop with the belt filter press operation at the Juneau-Douglas STP, or disposal of the dewatered sludge, revert to hauling wet sludge from the digester to the new Mendenhall STP for advanced treatment. Consider installation of a thickening centrifuge system at the Juneau-Douglas STP only if grants are available to cover most of the high capital cost.

RECYCLING

The opportunities for recycling in Juneau are severely limited by the high cost of transporting materials to the nearest market in Seattle. Conventional types of recycling programs, such as collecting metals, newspaper, and glass, are just not feasible.

Five types of recycling may be feasible and bear further investigation:

° specialty recycling center
° computer paper recycling
° corrugated paper (cardboard) recycling
° abandoned car reclamation
° materials salvage yard

Recycling high value materials can be successful in Juneau as evidenced by the ongoing JAWS program. Key materials recycled by JAWS are aluminum cans and scrap, copper, brass, and batteries. Another recycling center near downtown Juneay could be successful without adversely affecting the JAWS program.

Recycling computer paper from the large office buildings in Juneau also appears feasible. Many such office paper recovery programs are operating throughout the U.S. With a computer paper salvage value of

$150 per ton in Seattle, a well coordinated program with support from building workers may be profitable. Unfortunately, the increasing use of laser printing computer paper threatens program revenues because of its questionable market value.

Increased corrugated cardboard recycling is possible in Juneau. By utilizing existing balers at large food stores or developing a cooperative, centralized baling facility, small stores could also participate in baling and shipping cardboard on barge back-hauls to Seattle. However, the economic incentive for small cardboard generators is not very strong.

Abandoned car disposal is a major problem in the CBJ with approximately 1,500 cars per year being dumped throughout the community. The landfill fee of $0.05/lb ($100 to $200 per car) for old cars discourages the use of the landfill for disposal. A city supported program to collect abandoned cars, crush them, and ultimately ship them to Seattle for recycling would cost about $75 per vehicle at present market prices. Two potential sites for processing and storing the cars are the old sludge disposal site near the Mendenhall River, and the present Rock Dump sludge disposal site that will be full by the end of next summer. The latter is particularly appealing because its location on the Gastineau Channel allows easy barge access.

Short-Term Actions (Recycling)

1. Contact the State Procurement Office and determine the present and future quantities of laser printing computer paper being purchased for use in State offices. If large quantities are used, computer paper recycling would be ill advised at present. If, on the other hand only small quantities are found, then the CBJ could establish a trial computer paper recycling program at the State Office Building or other large office facility.

2. The CBJ in conjunction with DEC should encourage local stores to install corrugated balers or join in cooperative ventures with those stores already recycling. Large waste paper dealers in Seattle could be contacted for information and possibly favorable financing for balers.

3. Initiate a city supported abandoned car salvage operation. Designate the old sludge disposal area or the Rock Dump as a future abandoned car processing/storage site on the City's General Plan. The CBJ could manage the program or bids could be received from interested parties.

4. Discuss with Channel Sanitation, the possibility of designating a small area at the entrance to the landfill for salvage and sale of reusable materials. The program could be operated by Channel Sanitation, a non-profit recycling group such as JAWS, or any interested group.

Long-Term Actions (Recycling)

Continue programs developed under short-term actions.

FUNDING OPTIONS

Theoretically there are four funding programs that could provide monies for solid waste, sludge, and resource recovery projects in Juneau. These are:

- ADEC Formula Grants (Alaska Department of Conservation)
- Special Legislative Appropriation (Alaska State Legislature)
- EDA Grants (Department of Commerce, Economic Development Administration)
- EPA Clean Water Grants (U.S. Environmental Protection Agency)

ADEC Formula Grants

ADEC can provide authorization for funding up to 50 percent of most municipal solid waste and sludge disposal construction projects. If the project involves resource recovery, that portion of the facility is eligible for up to 60 percent funding. These monies apply only toward construction costs, not operation and maintenance.

At present there are no monies available in this program. Thus even if certified by ADEC, a project has no guarantee that it will receive funds at the present time.

Special Legislative Appropriation

Another grant source commonly utilized in Alaska, especially in recent years, is that of special legislative appropriation. Every year a certain number of projects are earmarked by the state legislature for special funding. Special legislation can fund any percentage of a project.

EDA Grants

A third remote possibility for grant funding is through the Department of Commerce, Economic Development Administration. The EDA grants have very specific requirements regarding unemployment statistics in the area to be benefited and regarding the creation of long-term jobs. Qualifying for an EDA grant requires special legislative appropriation at the Federal level. The EDA grant can be used to match ADEC grants for up to 100 percent funding.

EPA Clean Water Act Grants

Through the $2.4 billion per year Clean Water Grants program, the USEPA can provide 75 percent funding of the construction of conventional wastewater treatment plants and attendant sludge treatment/disposal facilities. In addition, funding up to 85 percent has been provided for such projects when designated as "innovative" or "alternative" (I/A) technology. Monies are dispersed to states according to a priority list of needed projects.

Projects involving the productive land use of sludge are classified as innovative by EPA and are eligible for 85 percent funding of capital costs (vehicles, land, sludge spreading equipment, etc.). In Juneau, this could include both use of the treated sludge for cover material at the landfill, or sale of the sludge to local residents as soil amendment.

Short-Term Actions (Funding)

1. Apply to ADEC for funding of construction costs associated with selected solid waste and sludge disposal projects.

2. Pursue special legislative appropriations and EDA grants as additional funding avenues for solid waste and sludge facilities construction.

Long-Term Actions (Funding)

Once the new Mendenhall STP is constructed, apply to EPA for funding of equipment needed to process and haul sludge from the Juneau-Douglas STP to the Mendenhall STP, and for trucks needed to haul the highly treated sludge to the landfill for use as cover soil.

SECTION 2

SOLID WASTE MANAGEMENT

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Alternatives for solid waste management are evaluated in this section including description of the existing collection/disposal system, characterization of the waste, and evaluation of disposal options.

EXISTING SYSTEM

Refuse collection service is provided on a voluntary basis to the entire CBJ by the Channel Sanitation Company. They collect residential, commercial, and tour ship waste using two 20 and two 25 cu yd rear loader compaction vehicles. Weekly residential service (three can limit) costs $15.32 per month for city residents and $15.02 per month for those outside city limits.

The existing landfill serving the CBJ is owned and operated by Channel Sanitation. The current tipping fee is $50 per ton for general garbage, $70 per ton for wood, $100 per ton for junk cars and metal, and $110 per ton for tires.

The site, located in a gravelly tidelands area, is reaching capacity and Channel Sanitation has recently constructed a final dike, thereby extending the operating life of the site by approximately five years. Local environmental agencies have stated that approval of subsequent expansions of the landfill is very unlikely. Thus, a new landfill site will be required within a few years.

WASTE QUANTITY AND COMPOSITION

Quantity

Approximately 40 to 70 TPD of solid waste is generated in the CBJ depending on the day and season. During 1982, an average of 51 TPD (7 day per week basis) was received at the landfill, corresponding to an overall per capita generation of 5.6 lbs per day. Table 2.1 summarizes

TABLE 2.1

MONTHLY REFUSE QUANTITIES AND FEES RECEIVED AT THE CHANNEL SANITATION LANDFILL[a] (1982)

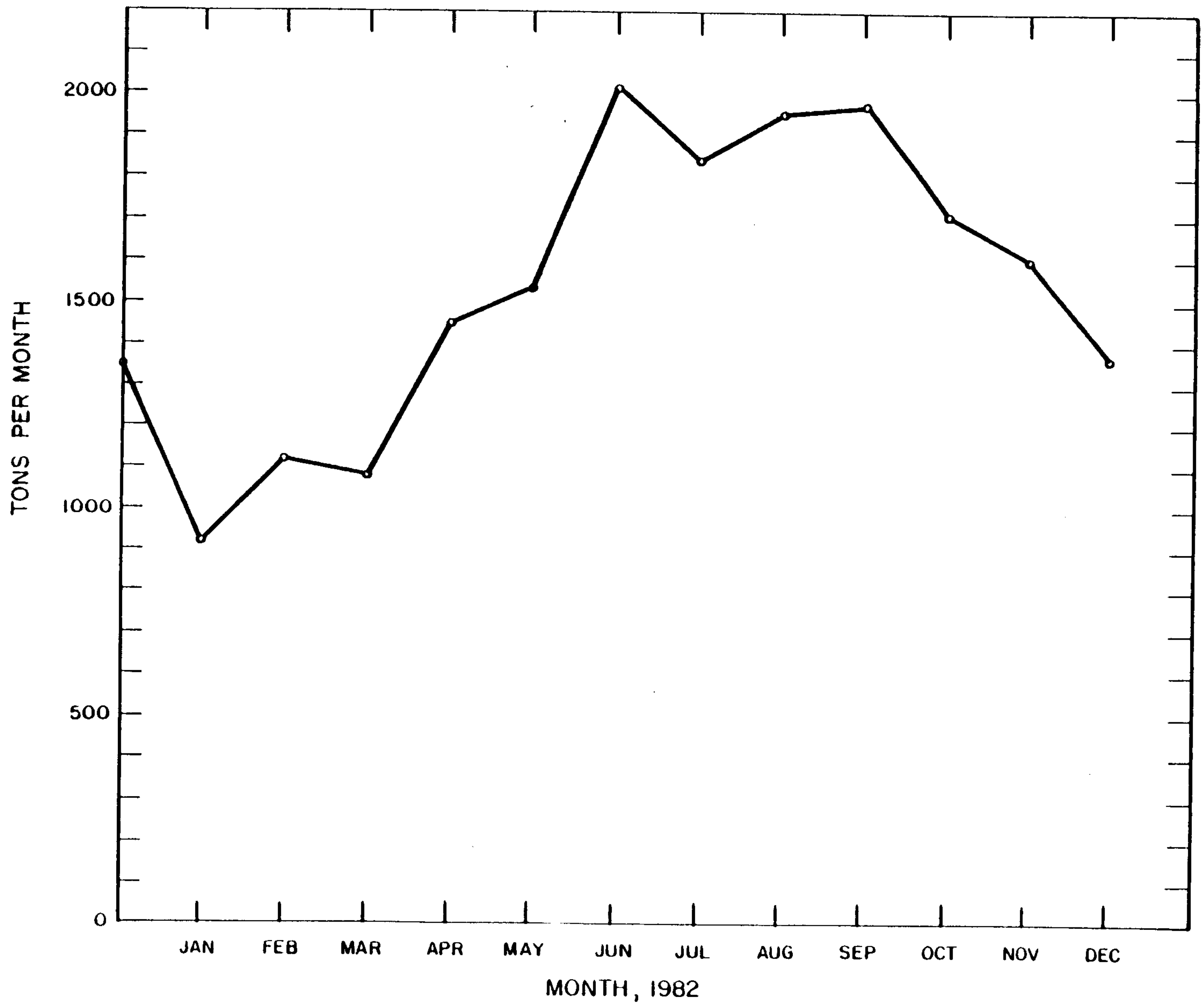
Month	Tons		Fees	
	Per Month	Per Day (avg.)	$/Month	$/Ton (avg.)
January	913	29	37,471	41
February	1,123	40	47,793	43
March	1,082	35	48,855	45
April	1,459	49	61,693	42
May	1,533	49	67,108	44
June	2,014	67	87,959	44
July	1,844	59	78,505	43
August	1,952	63	82,187	42
September	1,977	66	84,662	43
October	1,709	55	72,517	42
November	1,607	54	73,432	43
December	1,378	44	58,089	42
TOTAL	18,591	51	$800,271	$43/Ton

a All data provided by Channel Sanitation

monthly refuse quantities received at the landfill and the corresponding fees collected. Figure 2.1 displays the variation in monthly tonnage throughout the year. The increase in the summer months is due largely to the influx of tourists with over 100,000 visiting annually between June and October.

FIGURE 2.1

SOLID WASTE RECEIVED AT THE CHANNEL SANITATION LANDFILL (1982)



DATA OBTAINED FROM CHANNEL SANITATION RECORDS

Table 2.2 shows projected waste generation in Juneau for the next 20 years. These figures reflect both a constant per capita generation rate over that period, and an increasing per capita generation rate of 1.5 percent per year.

TABLE 2.2

PROJECTED SOLID WASTE GENERATION
IN JUNEAU

Year	Estimated Population	Estimated Waste Generation (TPD) (a)	(b)
1982	22,000	51	51
1987	25,300	58	62
1992	28,400	65	75
1997	31,400	72	90
2002	34,400	79	106

a Based on 4.6 lbs/person/day in 1982. No increase in per capita generation is included.
b Based on 4.6 lbs/person/day in 1982. 1.5 percent increase in per capita generation per year is included.

Composition

Waste composition in Juneau is skewed towards the residential and commercial categories as there is no industrial activity in the area. It was beyond the scope of this project to perform a waste characterization study. Table 2.3 displays estimated composition based on past work in Juneau.

There is no data on amounts of hazardous wastes entering the landfill. In a non-industrial community there should be little hazardous waste requiring disposal. However, there is no doubt that small quantities of household and commercial chemicals, paints, pesticides, and other products with trace amounts of hazardous constituents are being thrown out in the garbage and buried in the landfill.

TABLE 2.3

ESTIMATED SOLID WASTE COMPOSITION IN JUNEAU

	Composition (percent by weight)	
Catagory	Systech Results[a]	ES Estimates
Food	15	15
Paper	46	46
Plastic	4	6
Rubber	1	1
Textiles	3	3
Wood	1	1
Metals	12	12
Glass	17	15
Garden	0	0
Inert	1	1
	100	100

Estimated Moisture Content: 30 percent[b]
Estimated Heating Value: 4,500 Btu/lb

a 1973 Systech Corporation sampling data
b Although much of the waste appears to be stored in plastic bags or containers with lids, the very wet climate in Juneau will result in a higher moisture content than is typical in drier regions of the U.S.

ALTERNATIVES

This section presents the basic options for disposing of solid waste in the CBJ. Alternatives to be discussed are:

- Modifications to the existing landfill
- Development of a new landfill
- Incineration
- Waste-to-Energy
- Co-combustion (refuse and sewage sludge)
- Methane recovery from the landfill

Modifications to the Existing Landfill

As discussed in more detail later in this section, there are no ideal landfill sites within the CBJ. The existing landfill is one of the best sites available and therefore alternatives for extending its life are important. At present fill rates, the Channel Sanitation staff estimates that their landfill has approximately five years of capacity left. Several options were evaluated for expanding the capacity and life of the landfill. These included:

- Extending the boundaries of the site out to the highway
- Excavating and filling at depth below water level
- Excavating, pumping and lining
- Placing an additional lift on top of existing fill
- Baling the refuse prior to burial

An assessment of each of these alternatives follows.

<u>Extending Site Boundaries</u>

One option to increase the life of the Channel Sanitation landfill is to extend the boundary to the highway. This would add many acres to the site and provide years of extra capacity, and also open up additional gravel reserves under the wetlands.

However, this plan has several serious disadvantages. First, Hilgre Sand and Gravel owns two large parcels of land lying essentially between the landfill and the highway and is unlikely to sell as they are involved in a long term operation. Secondly, expansion to the east is not feasible because that land is publicly owned and not available. Third, extending the site to the highway will have a severe visual affect. Even with a high berm, the site will not only be plainly visible from the road but will be very close to the road rather than a few hundred yards away as is presently the case. Thus all motorists traveling between downtown Juneau and the airport or Mendenhall Valley will see a close-up view of the landfill or a massive berm.

Another disadvantage of this option is that extending the fill to the road would reduce the horizontal distance between the fill and the state game refuge across the highway. Theoretically, leachate from the landfill should be cleansed as it migrates with the tide through the soil towards the Gastineau Channel. Heavy metal ions are adsorbed by molecular attraction to the fine clay particles in the soil. Decreasing the distance the leachate travels to reach the state game refuge increases the possibility of contamination.

Because of these spatial and environmental considerations, it is the consultants opinion that extending the landfill boundaries to the highway should not be considered.

Excavating and Filling Below Water Level

Another alternative for expanding the landfill is to go deeper. By dredging down to roughly a 40 foot depth, Channel Sanitation could not only increase the capacity of the site but recover additional gravel reserves that would otherwise be buried under refuse. Old refuse is undoubtedly buried below water level in parts of the landfill. Deeper burial of refuse should not increase leachate production because the flooded areas will become devoid of oxygen which actually reduces leachate generation. Leachate that is produced should move with the hydraulic gradient towards the Channel and would not pose a threat to drinking water supplies.

Excavation would leave a deep hole filled with a combination of salt water from the channel and fresh water from Lemon Creek. Refuse could be dumped directly into the water with floating debris contained by a boom. Once the refuse level rose above the water surface then operations could continue as at present. This type of operation is rare but has been carried out in wetlands around San Francisco Bay.

The major drawbacks to this plan are primarily operational and aesthetic. For such a small site with one equipment operator it would be difficult to properly control the operation so that the dumping pit did not become an eyesore with floating debris and mud. Operating around a deep pit full of water could also pose safety problems. In addition, this disposal method would preclude the possible codisposal of sludge with refuse at this site.

Due to these concerns, the consultant does not recommend deeper excavation and filling with refuse as a means of extending landfill capacity. However, old tree stumps, limbs, and trimmings could be used to backfill water-filled excavations at the landfill. Once backfilled above the water line, these areas can receive refuse. In fact, the operator is currently doing this at the Channel Sanitation landfill.

Excavating, Pumping, and Lining

Another alternative, preferred by Channel Sanitation, is deep excavation followed by pump out of the intruding water and lining with impermeable materials (clay and/or plastic membrane).

A similar program has been successfully performed at the Mountain View landfill near San Francisco Bay since 1970. The Mountain View landfill is located behind some salt evaporation ponds about 1.5 miles from the Bay itself. In order to extend the life of the site, they have excavated down 20 to 25 feet below water level. Unlike Juneau however, the groundwater at Mountain View consists of small isolated brackish aquifers and some perched water in sand lenses. This is in marked contrast to the situation at Channel Sanitation where the ocean tide extends several feet up the existing berm. In order to keep the excavation dry, Mountain View personnel dig a deep ditch around the excavation (below the main excavation depth), drain collected water to a sump, and pump it out with one or two 6-inch pumps. When the excavation is complete, the ditches are backfilled with gravel and the entire bottom and sides of the pit are lined with 5 feet of clay. The pumps keep operating until the excavation is nearly full of refuse. Appendix C shows a rough diagram of the cell construction process. Attempts to go as deep as 30 to 35 feet failed due to rapid water infiltration.

The major problem with this approach at the landfill in Juneau is hydraulic pressure causing water to either break through the clay liner or seep under the plastic liner and cause it to float. The potential for rapid infiltration is much greater in Juneau than at Mountain View. With 40 to 60 feet of head, depending on the tide, it would seem very difficult to keep the seawater from intruding back into the hole. Indeed it may be difficult to maintain pit sidewalls at such a depth due to the instability of wet unconsolidated substrata in the area. However, Channel Sanitation has been able to dredge to 25 to 30 foot depths for gravel excavation during the past year. Another problem may be lack of good clay material to provide a sufficient liner for the bottom and sides of the hole. The local glacial till clay is difficult to handle being very mucky when wet and hardening like concrete when dry.

If a means can be developed to mitigate these problems, for example by going to a shallower depth (20 feet) or installing a trench drainage system, then it may be cost effective to pursue it. The advantages would be increased site capacity, retrieval of valuable deep gravel, and leachate control. The landfill surface over this area would have to be covered with a similar liner as used on the bottom to prevent the "bathtub effect" caused by rainfall penetrating, filling, and overflowing the contained area.

Mr. Tonsgard of Channel Sanitation would like to test pump this winter to gauge the rate of infiltration back into the hole. Many answers regarding the feasibility of this approach may be supplied after these tests.

Placing An Additional Lift on Top of the Fill

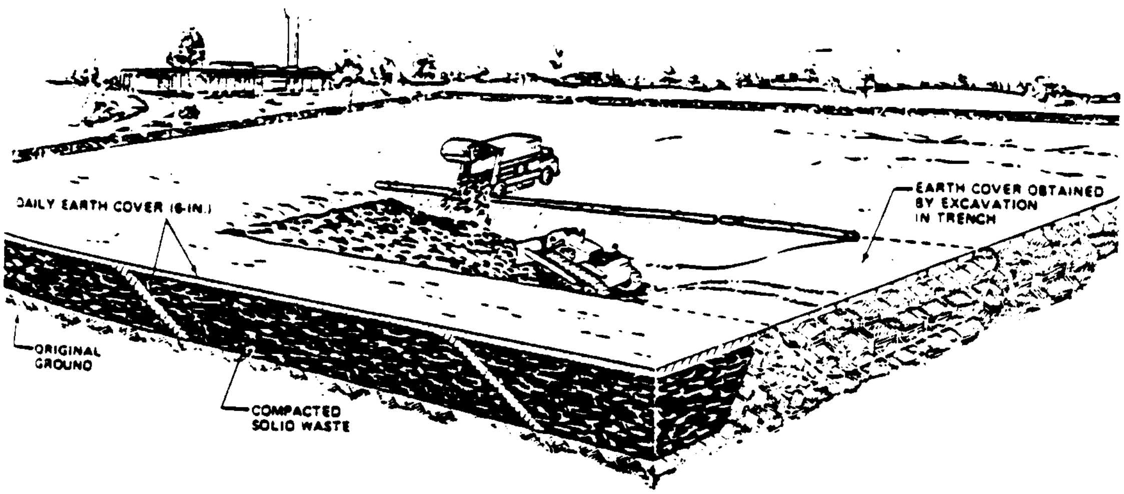
Of the options for expanding the landfill, placing an additional lift on the existing fill appears to be the best choice. There are several reasons why this alternative is promising.

First, an additional lift could provide years of capacity. Assuming a usable area of 30 acres at the existing site and a 10-foot lift height, roughly 500,000 cu yds of refuse could be deposited. At an in-place density of 900 lbs per cu yd, this equates to 225,000 tons of refuse or about 10 years of capacity at 60 TPD (the generation rate in the late 1980's).

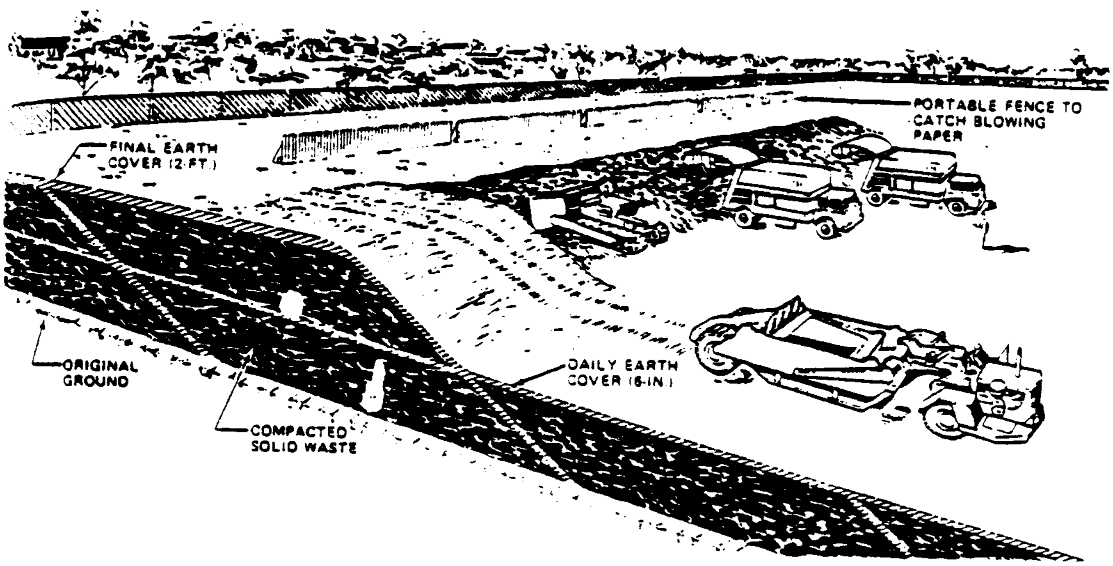
Secondly, no additional land would be required, no direct destruction of valuable habitats would occur, no problems of trying to operate below water levels would result, and only a DEC Solid Waste Management Permit would be required for continued operation.

Thirdly, while developing the new lift, the site could be operated as a normal sanitary landfill with daily cells, optimal compaction, and periodic cover. This should help greatly to reduce unsightliness, blowing litter, and the sporadic problems of vectors and odor. Figure 2.2 depicts the two basic methods of landfilling. The trench method is

BASIC METHODS OF LANDFILLING



TRENCH METHOD OF LANDFILLING. The waste collection truck deposits its load into the trench where the bulldozer spreads and compacts it. At the end of the day the dragline excavates soil from the future trench; this soil is used as the daily cover material. Trenches can also be excavated with a front-end loader, bulldozer, or scraper.



AREA METHOD OF LANDFILLING. The bulldozer spreads and compacts solid wastes. The scraper (foreground) is used to haul the cover material at the end of the days operations. Note the portable fence that catches any blowing debris. This is used with any landfill method.

Source : Reference 1

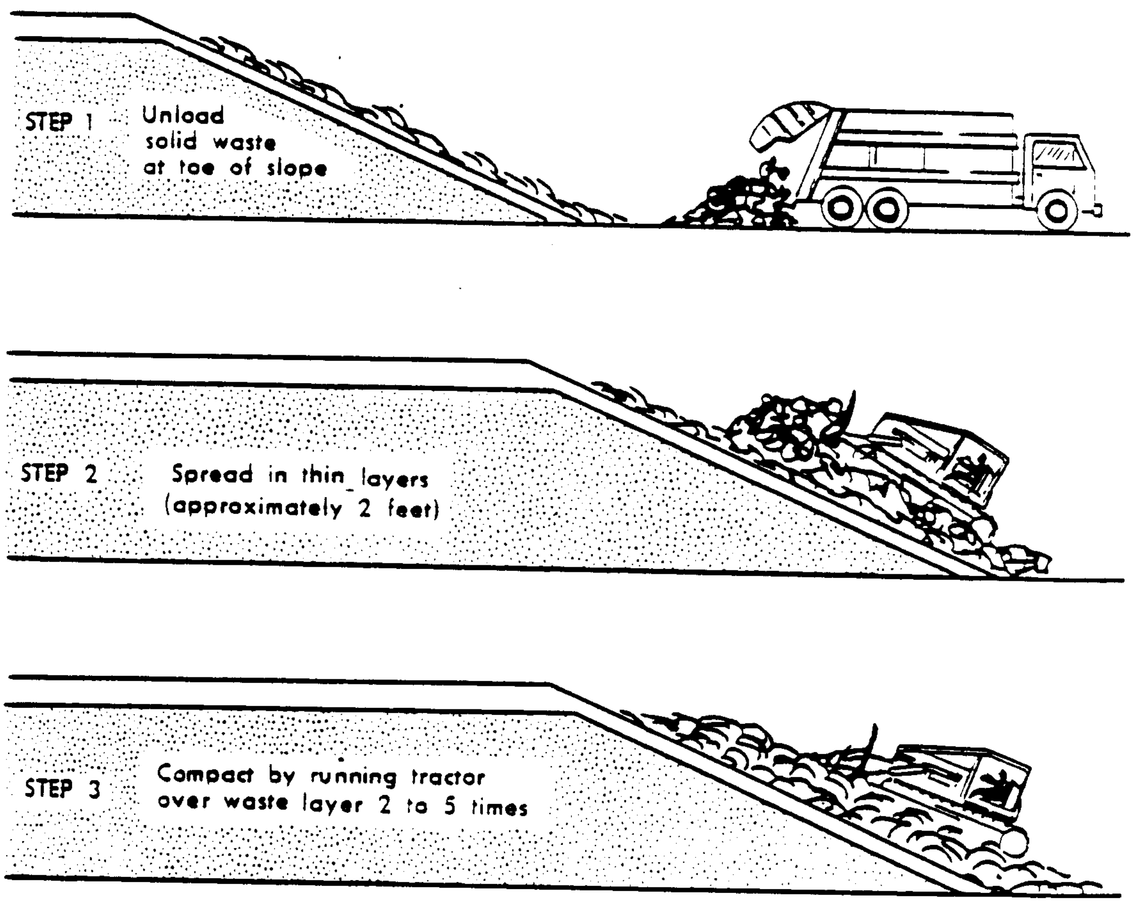
similar to the existing Channel Sanitation operation; the area method is the one that should be used to develop the additional lift. For a small site such as Channel Sanitation's, daily cover may not be necessary and cover frequency should be determined by the DEC. Figure 2.3 shows proper landfill operating procedures to obtain optimal compaction and best utilization of equipment. The new compactor recently purchased by Channel Sanitation should aid in obtaining high densities in the landfill cells.

By limiting the final height of the lift to approximately 10 feet, and planting trees and shrubs along the outer berms, visual impacts can be minimized. Highly treated sludge from the new Mendenhall STP could be used as a soil amendment to enhance revegetation.

The major problem with this plan may be a shortage of cover soil. Under current operations, there is a surplus of soil from the excavated trenches used for depositing the refuse. Since fill material is expensive and in short supply in Juneau, the importing of soil for cover should be avoided. In order to develop a sufficient supply of cover soil on site and to reduce the need for cover the following steps could be taken.

- Immediately begin to stockpile excavated material not suitable for processing and sale as gravel.
- Bring in and store soil overburden from construction projects throughout the CBJ that is suitable for landfill cover. The CBJ may want to save overburden from their Lemon Creek gravel excavation for future use at the proposed landfill on that site.
- Set aside one or more borrow areas (approximately 2 acres), with little commercial value for gravel excavation, to be used solely for excavating cover material.
- Maintain a small working face (see Figure 2.2) and cover less frequently (i.e. on a weekly basis rather than daily).
- Purchase a 30 mil hypalon plastic liner, large enough to cover the exposed face and use it to temporarily cover the exposed area at the end of the day during extended periods of rain. Sheets in

BASIC OPERATING PROCEDURES



Cushioning and bridging can be reduced and greater volume reduction achieved if the waste is spread in layers less than 2 ft. deep and is then compacted by a tracked, rubber-tired, steel-wheeled vehicle that passes over it 2 to 5 times. The equipment operator should try to develop the working surface on a slope between 20 and 30 degrees.

Source: Reference 2

widths of up to 100 feet are available. This will conserve a great deal of cover soil and prevent rainfall from percolating through exposed refuse and generating leachate. Costs for such a liner would be roughly $0.30/sq ft including shipping to Juneau. The required sheet of about 4,000 sq ft would cost $1,200.

- Once the new Mendenhall wastewater treatment plant is operation (1985), stockpile the treated, dewatered sewage sludge at the landfill for use as cover material. This organic, humus-like material could be mixed with poorer sandy soils at the landfill to create larger volumes of cover material. The CBJ may elect however, to stockpile this resource for future use at the proposed Lemon Creek site.

- Test the use of "Sanifoam" as an interim cover material. This chemical polymer foam, developed in southern California, is being used on several landfills throughout the U.S. (Appleton, Wisconsin; Joliet, Illinois; West Palm Beach, Florida; and others) and is being tested at the landfill in Anchorage. The chemical, applied by hand over the exposed refuse at the end of the day or week, sets up quickly similar to styrofoam. The foam layer controls odor, litter, and vectors, reduces rainfall infiltration, and most importantly reduces the need for soil cover material. Although the polymer structure of Sanifoam is stable and very slow to degrade, the foam lacks physical strength and breaks up readily into small, compressed pieces that fall into voids in the refuse. Under saturated conditions, several water soluble constitutents of the foam could be extracted and seep into the soil and water beneath the waste. However, chemical analysis of these extracts has shown them to be harmless compounds. Equipment costs are very low, $4,000 plus an enclosed pickup truck and small compressor. Daily cover with sanifoam would cost roughly $40,000 to $50,000 per year, and weekly cover about $15,000 to $20,000 per year in Juneau.

The final grade should be covered with at least two feet of well compacted earth, enhanced with treated sludge from the new Mendenhall STP, and sloped at 2 percent for drainage control. The soil at the site is suitable for this purpose as the clay content provides a low permeability lower horizon, while treated sewage sludge mixed with sand could provide a fertile top surface for vegetation.

It should not be necessary to purchase a scraper for hauling and spreading the cover material. Channel Sanitation should be able to excavate, haul, and apply the cover soil with their existing equipment (crane with dragline, dump trucks, and compactor).

Baling Refuse Prior to Burial

Another alternative to increase the life of a landfill is to bale the refuse prior to burial. Higher densities result which serve to extend existing capacity. A high density baling system used at a few landfills in the U.S. is probably too expensive and simply too big for a 50 TPD landfill. However, a smaller, moderate density baler such as that used at the Homer, Alaska landfill and several other locations in the lower 48 states may be cost effective for use in Juneau.

The main advantages of baling refuse are:

- Increased in-place density resulting in extended landfill life
- Reduction of vectors
- Reduction of leachate as bales are less susceptible to rainfall infiltration
- Reduced settling of the finished landfill surface
- Increased stability and load bearing capacity of the fill material
- Reduced need for cover material

The main disadvantages are:

- Increased capital and O&M costs
- Problems with system maintenance in such a remote area

In order to accurately estimate costs and performance for small baling systems, information was obtained from six similar existing operations at the following locations:

- Homer, Alaska
- Kittitas County, Washington
- Whitman County, Washington
- Monroe County, New York

* Scottsborough, Alabama
* Gillette, Wyoming

Table 2.4 summarizes the estimated costs of a baling system at the landfill in Juneau. These costs are based on the actual costs experienced in constructing and operating the six facilities surveyed. As shown baling would cost about $15 per ton ($12 per ton with a DEC grant).

The baling facility would consist of a 3,000 to 4,000 sq ft pre-fab building on a concrete slab, a baler with feed conveyor, and support accessories. This system should be capable of producing a one ton bale with a density of approximately 1,200 lbs/cu yd. Channel Sanitations new compactor vehicle can be expected to achieve densities of about 900 to 1,000 lbs/cu yd. Thus, a baling operation of this type could provide a 20 to 30 percent increase in refuse density and a corresponding increase in operating life of the Channel Sanitation landfill.

Development of a New Landfill

One alternative for future solid waste disposal in Juneau is the development of a new landfill. Basic criteria for a site in Juneau are:

* Location - should be central to main waste generation areas
* Capacity - should provide for 20 years of disposal or roughly one million cu yds in-place
* Soils - should have sufficient quantity of good quality soil for cover
* Land use - should be compatible with existing and future land uses
* Cost - should be developable at a reasonable cost
* Ownership - preferrably land owned by the city

The mountainous terrain, lack of good quality soil, high precipitation rates, and shallow groundwater greatly constrains the areas within the CBJ that could be appropriate for sanitary landfilling. Initially, five sites were selected by the ES team and CBJ planning personnel. These sites are listed in Table 2.5. Figure 2.4 shows the locations of the five sites and the existing Channel Sanitation landfill.

TABLE 2.4

COSTS FOR REFUSE
BALING AT THE CHANNEL
SANITATION LANDFILL
(50 TPD)

Cost Factor	Cost: Capital ($1,000)	Cost: Annual ($1,000/Yr)
Capital		
Baler (including conveyors)	300	57[a]
Shipping	20	
Installation	30	
Building and facilities	450	60[b]
Vehicles (skid loader, fork lift, flatbed) truck, wheel loader)	175	31[c]
Subtotal	975	148
Operation and Maintenance		
Labor (1.5 men)		75
Power		15
Maintenance		15
Vehicle O&M		10
Miscellaneous		20
Subtotal	-	$315
TOTAL	$975	$283
TOTAL COST PER TON (No Grant):		$ 15
TOTAL COST PER TON (50% Grant):		$ 12

a 10 years, 12% interest, $30,000 salvage value
b 20 years, 12% interest, no salvage value
c 10 years, 12% interest, no salvage value

After preliminary review with CBJ personnel, two of the five sites were eliminated from further consideration. The site at Sheep Creek was rejected primarily because it is a prime area for future recreational development and because an access road to the site would be very expensive.

The site in the Montana Creek area of the West Mendenhall Valley was also rejected at an early stage primarily because the Mendenhall

LOCATIONS OF CANDIDATE LANDFILL SITES
AND EXISTING CHANNEL SANITATION LANDFILL

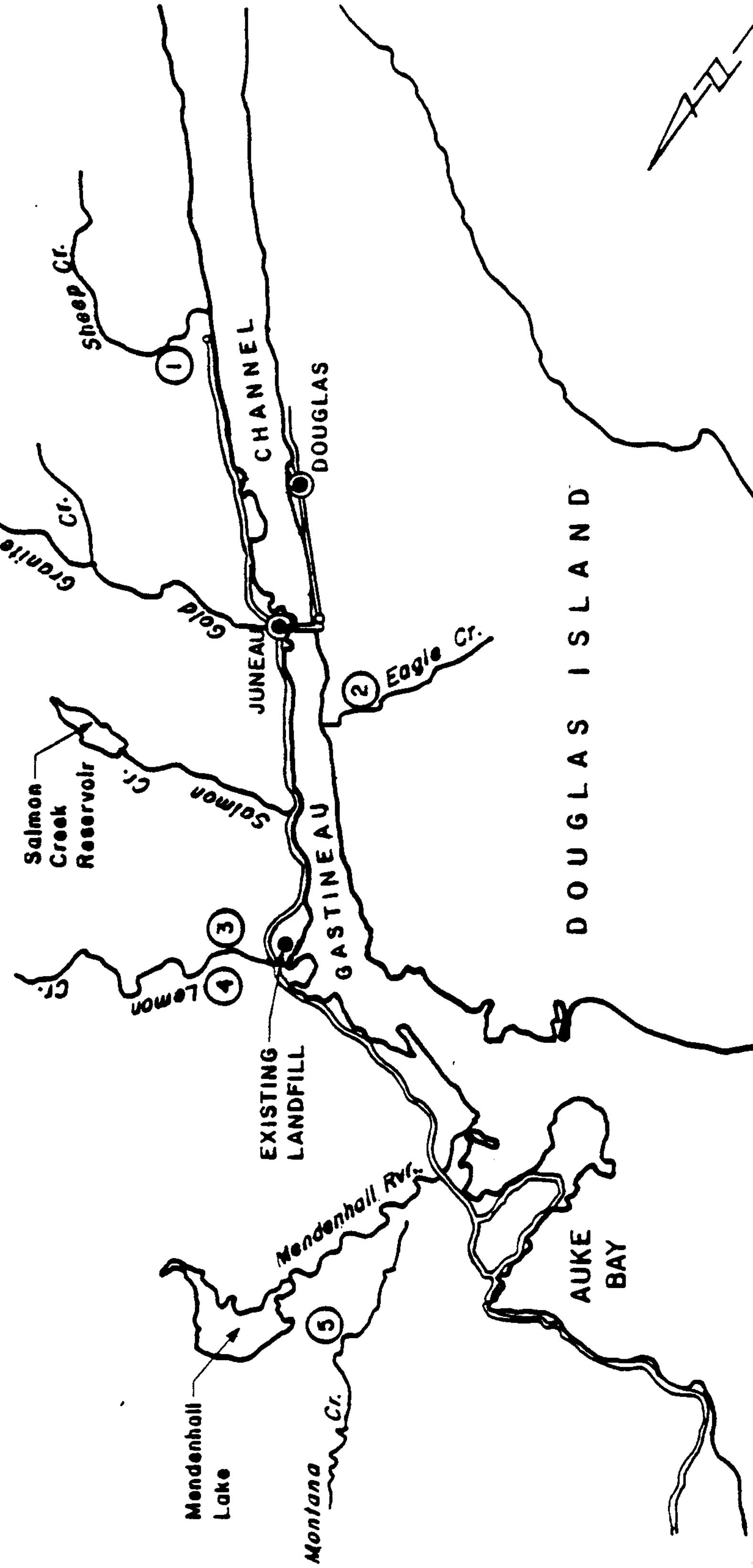


TABLE 2.5

CANDIDATE LANDFILL SITES IN JUNEAU

Site Number	Location
1	Sheep Creek area ° 6 miles south of downtown Juneau ° On bench above AEL&P substation
2	Eagle Creek area ° 2.5 miles west of downtown Juneau on Douglas Island ° Above and behind existing gravel pit at Eagle Creek
3	Lemon Creek (south side of creek) ° 6.5 miles north of downtown Juneau ° Above existing sand and gravel operation
4	State Correctional Center ° 7 miles north of downtown Juneau ° Above State Correctional Center
5	Montana Creek area ° 16 miles north of downtown Juneau in the West Mendenhall Valley

Valley is the primary residential area in the CBJ. Even though no housing currently exists in the area of the proposed landfill site, all landfill traffic would have to travel the length of the valley through residential neighborhoods. Eventually, low density rural housing is planned for the area. High water table conditions are also a constraint at this site.

During review of the Draft Report, the Herbert-Eagle mine area was mentioned as a possible landfill site. After careful review, this site has also been rejected primarily because of strong comments from the U.S. Fish and Wildlife Service and the State DEC that a landfill would severely impact the areas pristine nature and recreational uses. Very long, difficult access during the winter (over 30 miles one way from Juneau) increased liter, and higher costs are also negative points for this site. In addition the land was not selected by the CBJ.

The remaining three sites all survived the initial screening process and were further evaluated as discussed in the next section.

Evaluation of Three Candidate Landfill Sites

Table 2.6 shows a landfill siting matrix and a comparison of the three candidate landfill sites. The existing Channel Sanitation landfill is also included in the matrix for comparison.

As shown in Table 2.6, the existing landfill is the best site for future landfilling, in spite of the fact that it has long been and continues to be a source of contention for a portion of the community. Complaints include its dominating appearance from Juneau's main arterial highway, its odor, and its presence in what was once a highly productive wetland.

However, one must realize that there are no good sites for landfills within the entire Juneau area; that it is a matter of selecting the least damaging, least offensive site. In this light, continuing the Channel Sanitation landfill operation has several advantages over developing a new site in any of the alternative locations:

- In spite of aesthetic problems, the people of Juneau basically accept the present site and operation.
- The neighboring sand and gravel extraction operation has heavily imacted the area, and would have totally destroyed the immediate wetlands even if the landfill was not present.
- In the most critical environmental area of concern, ground and surface water contamination, the existing site is located in a less sensitive saltwater tidal zone compared to fresh water zones for proposed new sites.

TABLE 2.6

LANDFILL SITE RATING MATRIX[a]

Parameter	Possible Points	Site Location: Eagle Creek	Lemon Creek	State Correctional Center (SCC)	Expanded Existing Landfill
Location and Access					
Distance from waste generation points	5	2	5	5	5
Proximity to residential areas	5	3	4	2	4
Access to site	4	2	4	3	4
Subtotal	14	7	13	10	13
Land Use					
Existing land use	5	3	4	3	5
Surrounding land use	4	3	3	3	4
Impairment/enhancement of ultimate land use	3	2	3	2	2
Utility hook-up (water, power, and sewer)	2	1	1	1	2
Subtotal	14	9	11	9	13
Physical Features					
Capacity	5	4	4	4	4
Cover soil availability/quality	5	2	3	3	2
Drainage	3	1	2	2	3
Topography	3	2	3	3	3
Subtotal	16	9	12	12	12
Environmental Impacts					
Noise	1	1	1	1	1
Dust	1	1	1	1	1
Odors	3	2	2	1	2
Litter	2	1	1	1	1
Vectors	1	1	1	1	1
Flora	3	2	3	2	3
Fauna	3	2	3	2	3
Visual	3	3	3	3	2
Archeological/paleontological	2	2	2	2	2
Groundwater and surface water degradation	5	1	1	1	4
Subtotal	24	16	18	15	20

TABLE 2.6 (Continued)

Parameter	Possible Points	Site Location: Eagle Creek	Lemon Creek	State Correctional Center (SCC)	Expanded Existing Landfill
Costs					
Site development cost	4	1	2	2	4
Site operation cost	5	2	2	2	4
Hauling cost	5	3	5	5	5
Subtotal	14	6	9	9	13
TOTAL	82	47	63	55	71

a For each parameter a higher score is more positive for landfill development.

- Legal and permitting procedures are simplified.
- No new neighbors will be outraged, no new siting problems developed.

In terms of the new candidate sites, the Lemon Creek parcel scored the highest, followed by the State Correctional Center site and the Eagle Creek land on Douglas Island.

Short assessments highlighting the scoring in each category follow.

Location and Access. The Lemon Creek and SCC sites are optimally located in the Lemon Creek area about midway between downtown Juneau and the Mendenhall Valley. The Eagle Creek site is convenient for downtown Juneau but is very inconvenient for the Mendenhall Valley and areas further northwest along the Channel.

The Lemon Creek and SCC sites are removed from residential areas. The Eagle Creek land is remote from all but a few houses along the road. Access to the Lemon Creek site would be easy and direct along an existing industrial haul route, while the other sites would require more extensive new access roads.

Land Use. The three candidate sites ranked similarly in land use issues. The Lemon Creek site has a slight advantage in that the adjacent area has already been impacted by a large gravel operation and the site itself has extensive gravel reserves that the CBJ would like to develop prior to landfilling. Land around the other sites is generally zoned for rural conservation.

Physical Features. The Lemon Creek and SCC sites are similar in this category, while the Eagle Creek site had the lowest score. The SCC land has large capacity, a good supply of suitable cover soil, straight forward drainage control, and mild topography. The Lemon Creek site is similar but smaller in capacity. Problems with cover soil quality and drainage exist at Eagle Creek. The area is dotted with muskeg showing poorly draining soils and is directly in the drainage flow off the ridge behind.

Environmental Impacts. All three sites are acceptable in most areas of environmental impact. However, a major environmental concern at all three areas is the potential for groundwater and surface water degradation from leachate. The existing site, located in a tidal saltwater zone, is not in as sensitive a location in this regard. All the leachate produced mingles with the groundwater which is a combination of salt water from the Channel and fresh water from Lemon Creek. No groundwater monitoring has been performed but there should be little danger of the leachate polluting Lemon Creek as the hydraulic gradient in the area runs from the terminus of the creek toward the channel. Although the most recent sampling by DEC indicated the presence of leachate in small stagnant ponds at the landfill, the water flowing out Lemon Creek near the landfill was not found to be seriously impacted. The high tidal fluctuations tend to flush the soil zone under the landfill and dilute the leachate as it moves toward the sea. Leachate, typically very high in mineral salts and organic matter, would have serious impact on fresh water but little effect on salt water. This is the consultants opinion. No monitoring data exists in Juneau to refute or corroborate the impact of the present operation on the wetlands ecosystem.

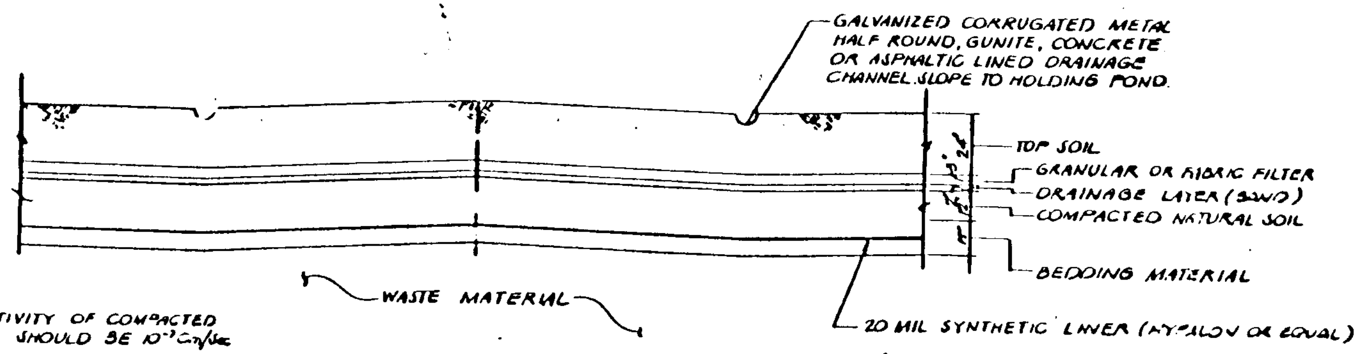
Unfortunately, the three candidate sites are located in fresh water drainage areas and leachate from the sites could have a very deleterious effect on local streams. The Eagle Creek site is in a particularly sensitive location since the general groundwater flow appears to move down from the ridge, under the site, and into the channel. Downstream from the site, several homes along the highway get their water from wells.

The other two sites are also situated in a sensitive water area along Lemon Creek, a natural salmon stream vigorously protected by DEC and The State Department of Fish and Game. The Lemon Creek site is particularly close to the creek in an area of sandy/gravelly soils and is upgradient of some existing water wells. The SCC site is up on a bench above the creek and is drained by a smaller stream flowing to the southwest.

Leachate would have to be very carefully collected and controlled at either of the three sites. This will probably involve placing a compacted clay or plastic liner under the site, and installing a leachate collection system and groundwater monitoring wells. The collected leachate would be transported by pipeline to the nearest interceptor sewer. Figure 2.5 shows cross sections of a secure landfill with required liner and leachate collection system. In order to prevent a "bath tub" effect where the site slowly fills with rain water and ultimately overflows, the final cover for the site must be just as impermeable as the bottom liner. Thus a clay and/or plastic liner to cap the site will be required. Figure 2.6 shows a typical leachate monitoring well. At least 3 such wells would have to be placed downgradient between the Lemon Creek landfill and the stream. Obviously, this type of site preparation and ongoing operation will be expensive and will make what was previously a small, simple landfill operation into a much more complex endeavor.

Groundwater and surface water degradation is the primary impact that would have to be mitigated before any of these sites could be developed. Failure to control leachate could lead to severe damage of nearby stream ecosystems.

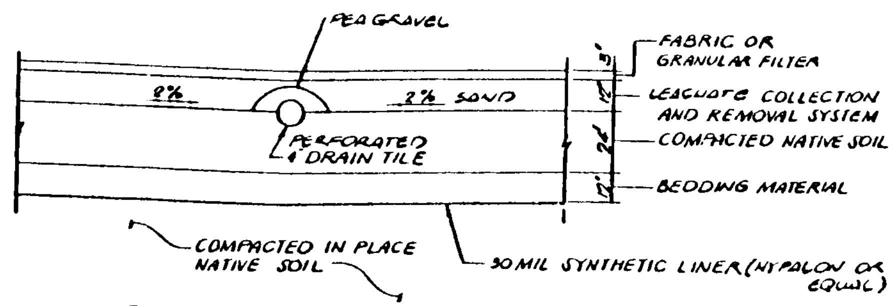
CROSS SECTION OF A SECURE LANDFILL



NOTES

1. HYDRAULIC CONDUCTIVITY OF COMPACTED NATURAL SOIL LAYER SHOULD BE 10^{-7} Cm/Sec OR LESS.
2. BEDDING MATERIAL NO COARSER THAN SAND

(1) FINAL CAP DETAIL
NOT TO SCALE

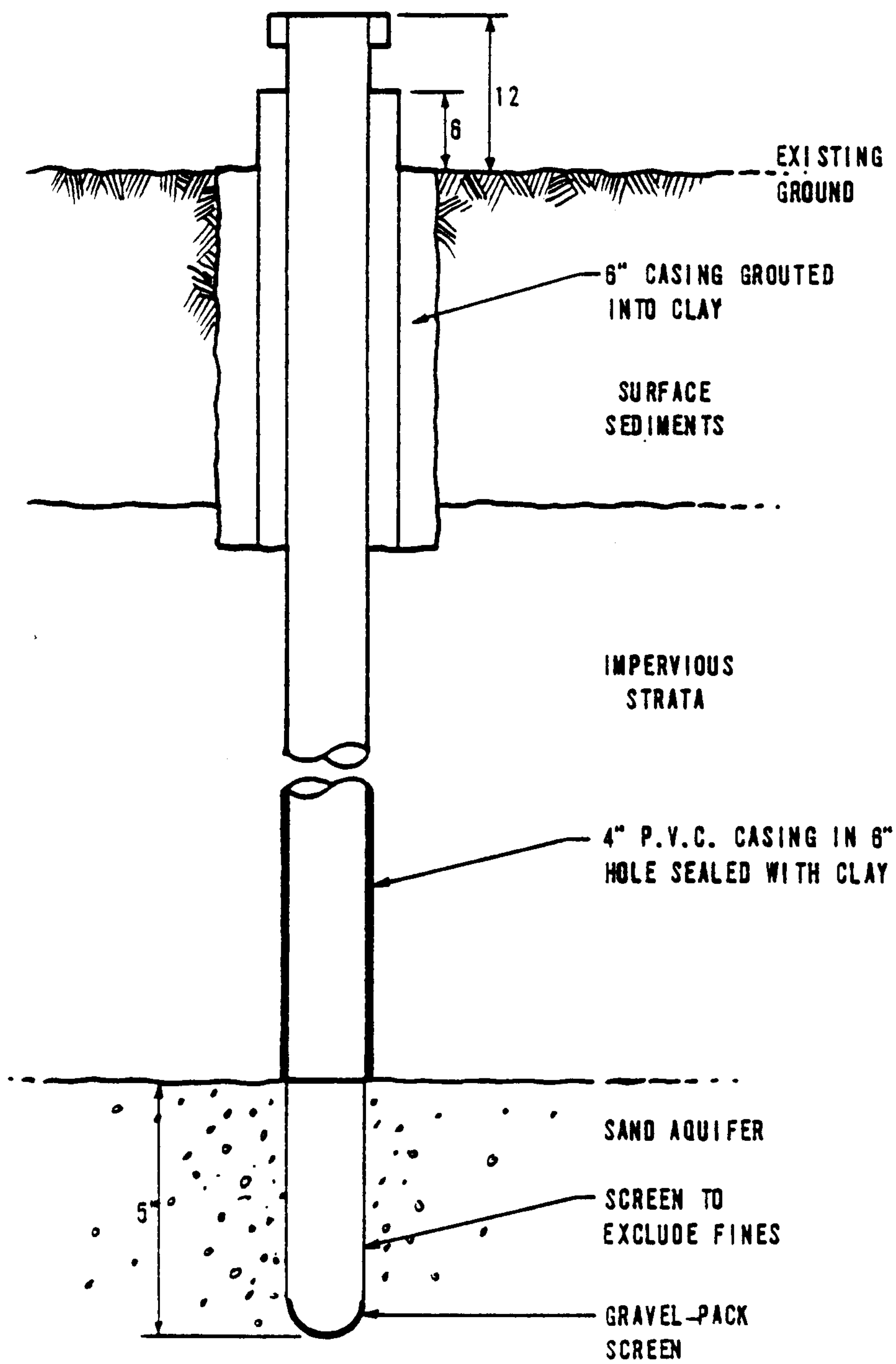


(2) BOTTOM LINER DETAIL
NOT TO SCALE

NOTES

1. SLOPE LINER AT 2% TO DRAIN
2. 4" DIA DRAIN PIPES AT 90 FT ON CENTER SLOPE AT 2% TO HOLDING POND
3. MATERIAL FOR LEACHATE COLLECTION AND REMOVAL LAYER TO HAVE HYDRAULIC CONDUCTIVITY GREATER THAN 10^{-3} Cm/Sec.
4. COMPACT NATIVE SOIL TO A HYDRAULIC CONDUCTIVITY OF 10^{-7} Cm/Sec.

TYPICAL WELL FOR LEACHATE MONITORING



Costs. All three sites would be expensive to develop due to the requirements for a bottom liner, the difficulty in handling the local glacial till clay, leachate control, and monitoring. Table 2.7 shows general estimated costs for developing the Lemon Creek site into a secure sanitary landfill. As shown, approximately $2.6 million would be required. This cost could be reduced to $1.9 million by a DEC grant, if monies were available.

Table 2.8 summarizes estimated annual costs for a new landfill at Lemon Creek. Total costs would range from $38 per ton with a 50 percent DEC construction grant, to $44 per ton with no grant monies.

Hauling costs would be minimized by locating a new landfill at either site in the Lemon Creek area. Hauling to Eagle Creek would increase transportation costs for Channel Disposal, reduce the time available for collection, and result in increased refuse collection rates.

Conclusions. There are no ideal sites for a new sanitary landfill in the CBJ. As shown in Table 2.6, the existing landfill rates higher overall than any new site.

When a new landfill is required, the best site is Lemon Creek, with the SCC site as first alternate. Advance planning will be necessary such that excavation for gravel would begin prior to the commencement of landfilling. In this way, valuable gravel would not have to be buried under refuse and the site could be developed to maximum capacity as a landfill.

The Lemon Creek site is well located and matched with adjacent land uses. Direct access along an existing construction road would be available. As previously mentioned, protection of groundwater and surface water resources would be the primary concern at this site. The site appears to have capacity for at least 1 million cy yds or about 20 years of operating life.

Preliminary design considerations include:

° Drainage - construct swales or half round channels to divert surface runoff around the site.

TABLE 2.7

ESTIMATED CAPITAL COSTS FOR A NEW LANDFILL AT LEMON CREEK (20 ACRES)

Cost Factor	Capital Cost[a] ($1,000)
Land Purchase	0[b]
Equipment (Dozen, Scraper, Grader, Miscellaneous)	1,180
Construction	
Access Road	70
Bottom Liner Installation	
° Subsurface Preparation	60
° 30 mil PVC liner (purchase, shipping, installation)	300
° Bedding Material (over liner)	80
° Native Soil Layer	80
Leachate Collection System	
° Piping and Sand Layer	110
° Storage, Pumping, Sewer Connections	110
Monitoring System	
° Engineering	20
° 3 Wells	30
Appurtenances	
° Fencing, Gates, etc.	50
° Scales and Office	100
Miscellaneous	
° Engineering Design	70
° EIR and Permits	50
° Legal	20
° Contingencies	250
SUBTOTAL CONSTRUCTION	$1,400
TOTAL COST (No Grant)	$2,580
TOTAL COST (50% Grant)	$1,880

a Assume site already excavated and rough graded due to planned gravel removal.

b Already owned by CBJ

TABLE 2.8

ESTIMATED ANNUAL COSTS FOR A NEW LANDFILL AT LEMON CREEK (56 TPD-1985)

Cost Factor	Annual Cost ($1,000)
Capital Costs (annualized)	
° Site Development ($1,400,000)	187[a]
° Rolling Equipment (Dozer, Scraper, Grader, Miscellaneous)	178[b]
° Site Closure ($410,000)	55[a]
Labor	
° Administration	50
° Scale Attendants (1.5)	35
° Clerical (1.5)	35
° Foreman/Lead Operator (1)	60
° Equipment Operator (1)	50
Equipment O&M	
° Scales	1
° Dozer	15
° Scraper	15
° Compactor	15
Leachate System O&M	50
Groundwater and Stream Monitoring	50
Miscellaneous	100
TOTAL COST	$896
TOTAL COST PER TON (No Grant)	$44
TOTAL COST PER TON (50% Grant)[c]	$38

a 20 years, 12%
b 10 years, 12% 15% salvage value
c Assuming grant covers site development and closure costs

° Buffer Zone - maintain an undisturbed buffer zone of at least 200 yards between the landfill and the newest commercial or residential establishments.

- Slopes - cut side slopes at 1:1 to preserve fill capacity and still minimize danger of side wall collapse.
- Depth - excavate so as to maintain at least a few feet of soil above the water table.
- Overburden - store all soil overburden on site for future use as cover soil.
- Leachate Control - construct and install bottom liner system, leachate collection system, and monitoring wells.

<u>Incineration</u>

This section provides an analysis of the feasibility of incineration for disposal of solid waste in the CBJ. A comparison of the costs of incineration vs. landfilling is also presented.

<u>Introduction</u>. The estimated quantity of refuse to be disposed in an incinerator in Juneau is 391 tons per week in 1985 and 588 tons per week in 2005. Based on these figures the optimum burning capacity of the incinerator should be 5 tons per hour. At this capacity, the refuse in 1985 can be burned operating the facility 16 hours per day, five days per week. In the year 2005 the facility will be operated 24 hours per day, five days per week.

Air regulations require that emissions of particulate matter from the incinerator not exceed 0.08 grains per cubic foot of exhaust gas corrected to 12 percent CO_2 and standard conditions. In order to achieve this, the exhaust gases must be cooled to 500°F and passed through an electrostatic precipitator or baghouse. Control of these particulate emissions is important because the Lemon Creek Valley, most likely site for incineration, already displays significant air quality degradation during the winter primarily from wood smoke. A limit of 0.08 grains is easily met with available controls. In fact, the emissions would probably be much lower. No visible plume is emitted from these facilities.

The two technologies most appropriate for burning the quantity of refuse generated in Juneau are:

- Mass-burning, stoker-fired, refractory wall furnaces
- Mass-burning, controlled-air furnaces

Mass-burning stoker-fired furnaces have a higher initial capital cost than controlled air furnaces, but have a longer life and have significantly less operating and maintenance problems.

One of the best sites for incineration is the existing landfill, a commercial/industrial area already heavily impacted by industry. Ash could be disposed directly on-site with other noncombustibles.

Economic Analysis. A 5 ton per hour capacity stoker-fired mass-burning incinerator will cost $12,000,000 to construct including the air pollution control equipment. The total annual cost of operating the facility in the years 1985, 1995, and 2005 are shown in Table 2.9. Refuse incineration would be eligible for a 50 percent capital cost grant from the DEC. This is reflected in a significant drop in costs, especially in the early years of the project as shown in the table.

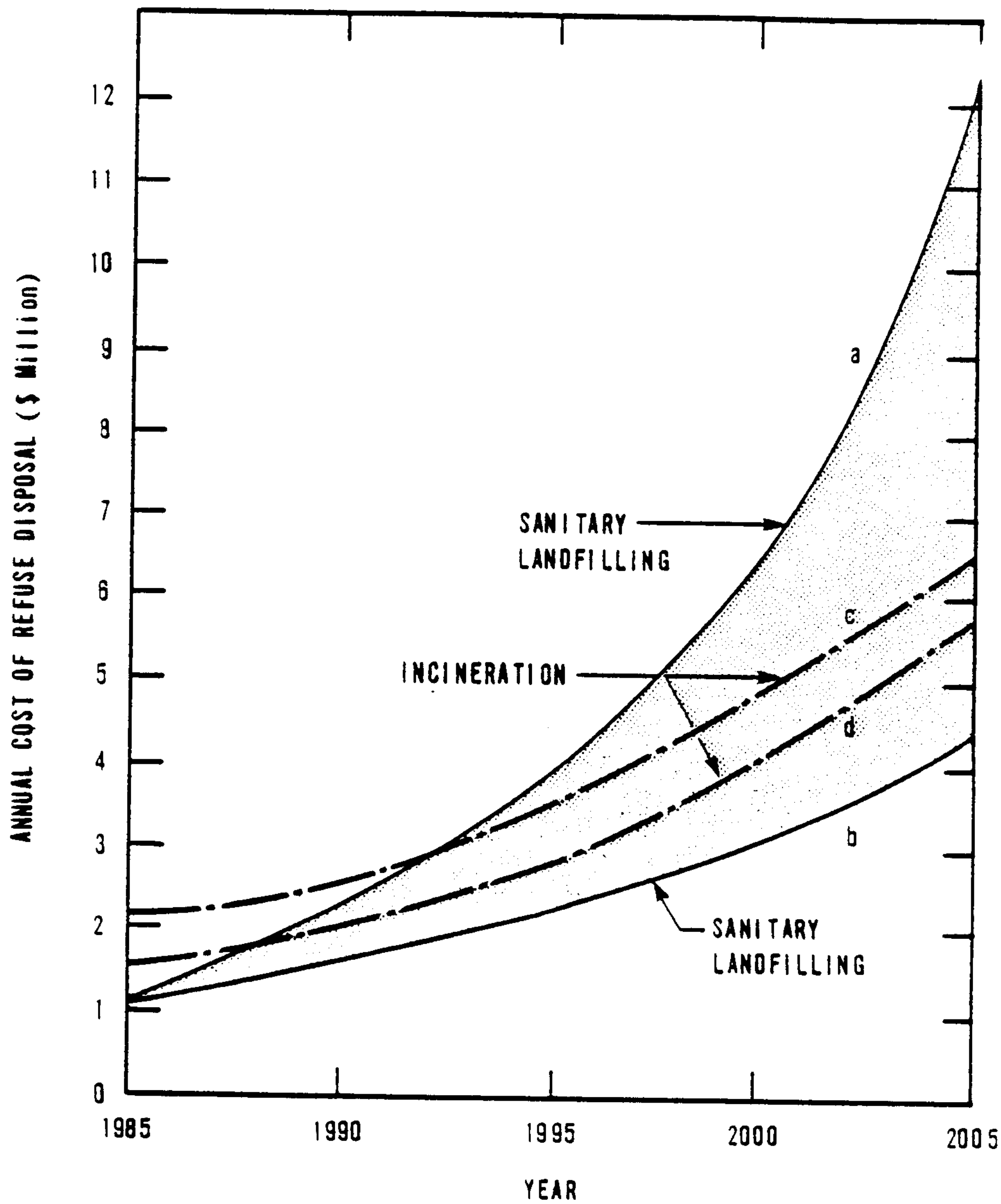
TABLE 2.9

COSTS OF SOLID WASTE
INCINERATION IN JUNEAU

Cost Category	Cost ($1,000) 1985	1995	2005
Debt Service	1,314	1,314	1,314
Labor	440	1,093	2,666
Miscellaneous	320	691	1,491
Residue Disposal	150	404	1,045
TOTAL COST	2,224	3,502	6,516
NET COST PER TON (No Grant)	$111	$139	$215
NET COST PER TON (50% Grant)	$ 77	$111	$191

Figure 2.7 shows the life cycle cost of disposing of Juneau refuse by incineration versus continuing the existing landfill operation. Costs at the Channel Sanitation landfill are projected to increase at between 5 and 10 percent per year as represented in the figure by the

LIFE CYCLE COMPARISON OF THE ANNUAL COST OF INCINERATION VERSUS LANDFILLING



LEGEND

a - 10% COST INCREASE PER YEAR
b - 5% COST INCREASE PER YEAR (50% GRANT)
c - INCINERATION (NO GRANT)
d - INCINERATION (50% GRANT)

shaded area. As can be seen in the figure, without grant money incineration is generally more expensive over the first 10 years and less expensive over the last 10 years than landfilling. However, with a 50 percent grant from DEC incineration is cost competetive with the existing landfill operation in Juneau.

Waste-to-Energy

The following subsections discuss the technologies, markets, and costs for the best waste-to-energy alternatives for Juneau. These alternatives include regional facilities burning all of the CBJ's solid waste and generating steam or electricity, and small modular plants providing steam for individual customers.

Technologies

In the past two decades there has been a proliferation of energy recovery technologies, some of which turned out to be technical and/or financial failures. The three systems that have emerged with varying degrees of success are as follows:

- Mass Burning in Stoker-Fired Furnaces
- Refuse-Derived Fuel Combustion
- Modular Controlled Air Combustion

Other systems such as the Union Carbide "PUROX" pyrolysis system, the Monsanto "LANDGUARD" pyrolysis system, the Carborundum "TORRAX" system, the Combustion Equipment "ECO FUEL TWO" system and many others, have not survived beyond a single pilot plant or full scale project.

Mass Burning in Stoker Fired Furnaces. Mass burning of unprepared refuse in stoker fired furnaces has been practiced in Europe for several decades and is the most advanced and reliable technology. There are over 100 of these type plants in Europe and other parts of the world. In the United States plants using this technology are in operation in Saugus, Massachusetts; Chicago, Illinois; Harrisburg, Pennsylvania; Glen Cove, New York; Harrisonburg, Virginia; Hampton, Virginia; Braintree, Massachusetts; Oceanside, New York; Gallatin, Tennessee; and Nashville, Tennessee.

In a plant designed for mass burning, unprepared refuse is charged directly into an incinerator furnace; and the heat generated by the combustion process is recovered in convection or radiation boilers in the form of steam.

Only oversized wastes such as brush, trees, discarded furniture, large crates, etc., must be preprocessed to reduce their size so that they can be charged into the incinerator furnace.

Latest developments in mass burning technology include efficient stokers designed specifically for refuse burning; combustion control systems yielding uniform temperatures throughout the combustion process; and improved combustion efficiency of the furnaces using optimum distribution of combustion air.

Figure 2.8 shows the cross section of a mass burning resource recovery plant at Norfolk Naval Base, Virginia.

Refuse-Derived Fuel Combustion. This technology has been used primarily in the United States, and to date has had a poor performance record overall. A list of RDF plants and their status is shown in Table 2.10. In spite of this poor record, RDF plants are presently being planned for Hartford, Connecticut and Haverhill, Massachusetts.

RDF technology involves two steps; the first step is the fuel preparation and the second is the actual burning of the RDF. Fuel preparation can range from simple shredding, as practiced in Albany, New York, to sophisticated systems involving flailing, trommeling, shredding, ferrous metal separation, nonferrous metal separation, glass separation, air classification, wet process separation, and pelletization. While many of the more sophisticated processes are of questionable value, it has been demonstrated that initial flailing and trommeling, prior to shredding, are of real value in the preparation of RDF.

The burning of RDF is usually accomplished in spreader stoker boilers. The use of stoker-fired boilers and suspension fired-boilers for burning RDF has not been successful.

CROSS SECTION OF A MASS BURNING WASTE-TO-ENERGY PLANT

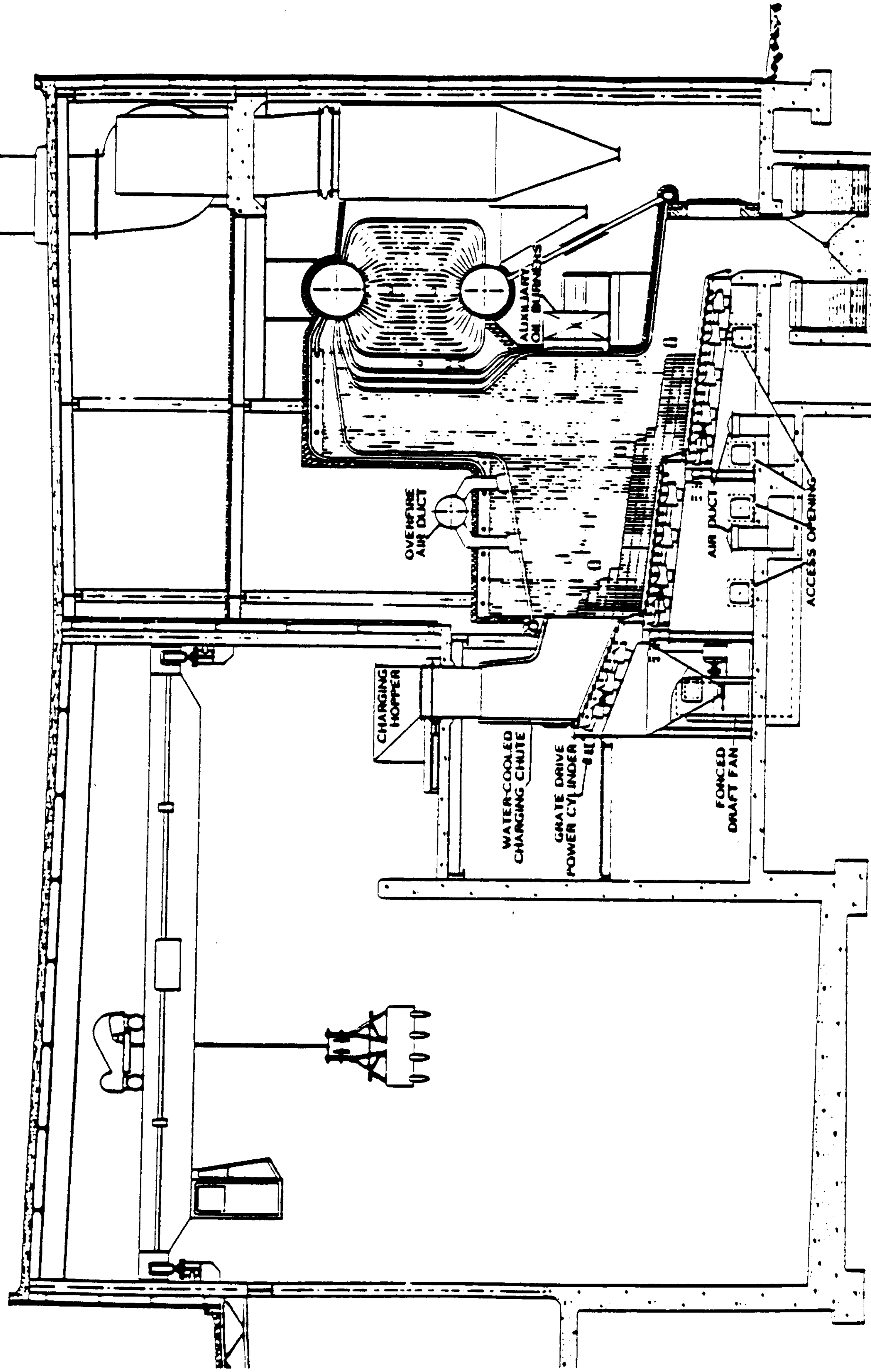


TABLE 2.10

STATUS OF RDF PLANTS

Location	Capacity (TPD)	Status
Bridgeport, CT	1,800	Closed
Dade Co., FL	3,000	Operational
Chicago, IL	1,000	Closed
Ames, IA	200	Operational
East Bridgewater, MA	300	Closed
Albany, NY	750	Operational with problems
Hempstead, NY	2,000	Closed
Niagara Falls, NY	2,200	Operating at 1,000 TPD
Akron, OH	1,000	Shut down for modifications
Milwaukee, WI	1,600	Closed
Madison, WI	250	Operating at partial capacity

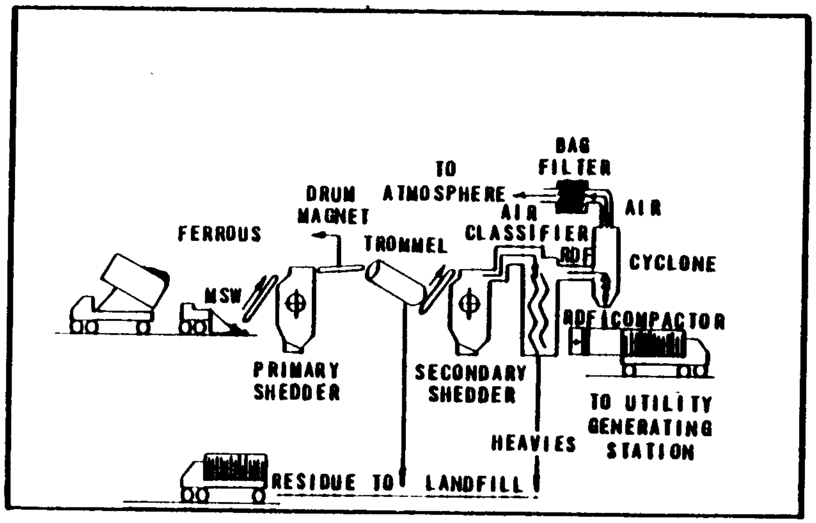
RDF plants are usually plagued with two main operational problems. The first problem involves explosions and fires caused by the accidental introduction of explosive and flammable materials into the shredders. The second problem involves feeding the RDF into the spreader stoker boiler. At the Albany plant, modifications to the feed system have been underway for 18 months, and the feed system is still not completely successful. Figures 2.9 and 2.10 show examples of RDF systems.

Modular Controlled Air Furnaces. There are over 20 modular controlled air furnace plants in operation in the United States, and many more are under construction or planned. The major advantage of modular controlled air plants over mass burning stoker-fired plants and RDF plants is their lower initial capital cost. Modular plants can be constructed from 50 to 70 percent of the initial capital cost of other type plants. However, on a 20 year life cycle basis, modular plants have higher capital costs than stoker-fired plants. This is mainly due

FIGURE 2.9

TYPICAL RDF SYSTEM

MADISON-RDF PRODUCTION SYSTEM



AKRON-RDF PRODUCTION SYSTEM

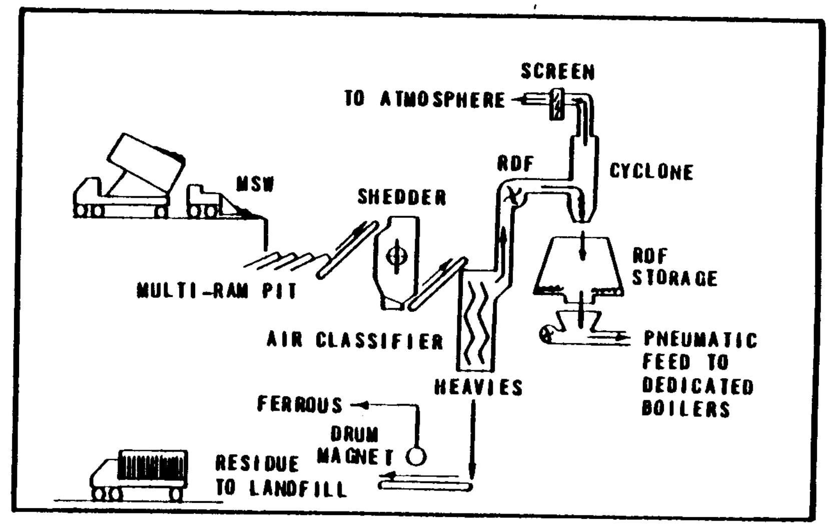
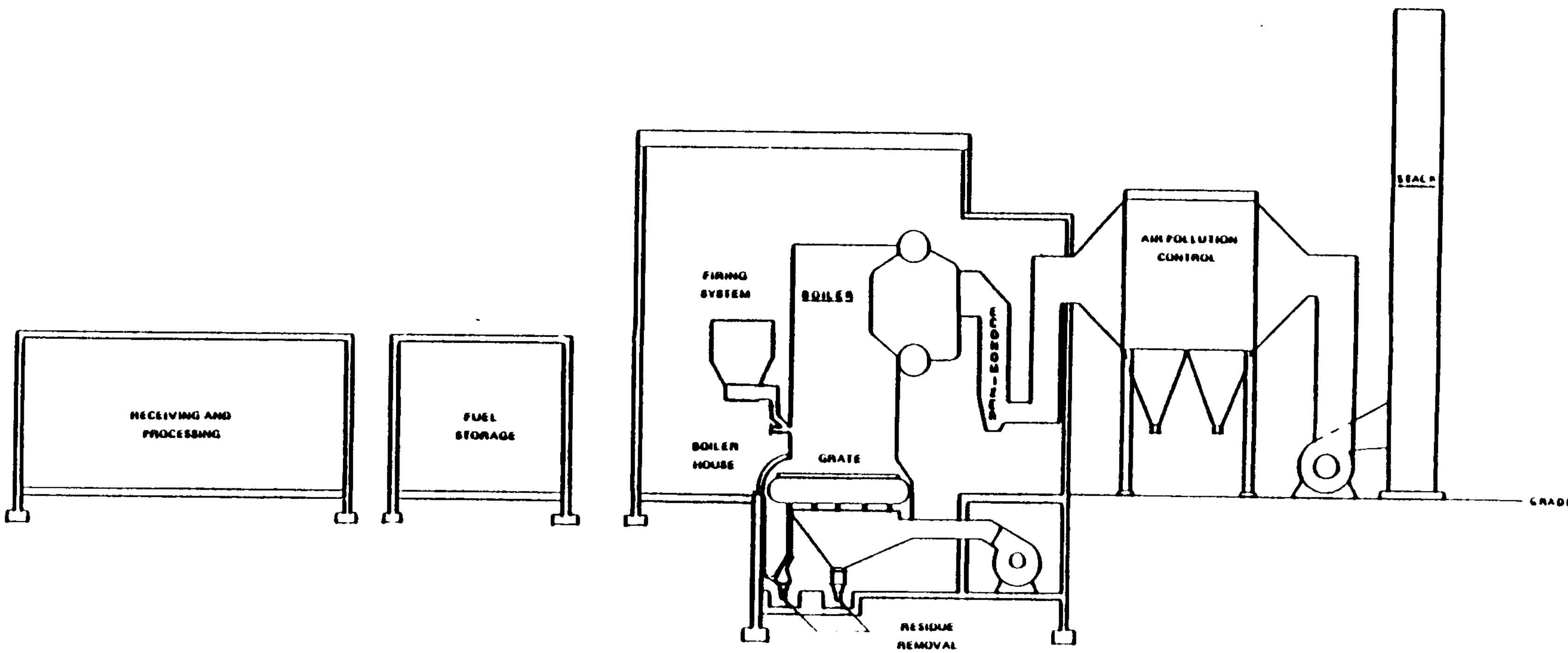


FIGURE 2.10

SCHEMATIC ELEVATION VIEW
SPREADER STOKER BOILER PLANT



ELEVATION

to the short life of major components of the modular systems. The other main drawbacks of modular controlled air plants are: (1) they are limited in capacity to about 240 tons per day (not a problem in Juneau); (2) they are usually suitable for producing low pressure steam only; and (3) they often have serious operational problems. Problems with modular controlled air plants at a number of Army installations have caused the Corps of Engineers to use a more expensive stoker fired mass burning furnace at their latest installation at Tooele Army Depot, Utah.

Figure 2.11 shows a typical modular controlled air furnace.

Conclusion. Based on the past operating history of RDF facilities and modular controlled air furnaces, it appears prudent to consider only mass burning stoker-fired furnaces in planning a Juneau energy recovery plant.

Energy Markets

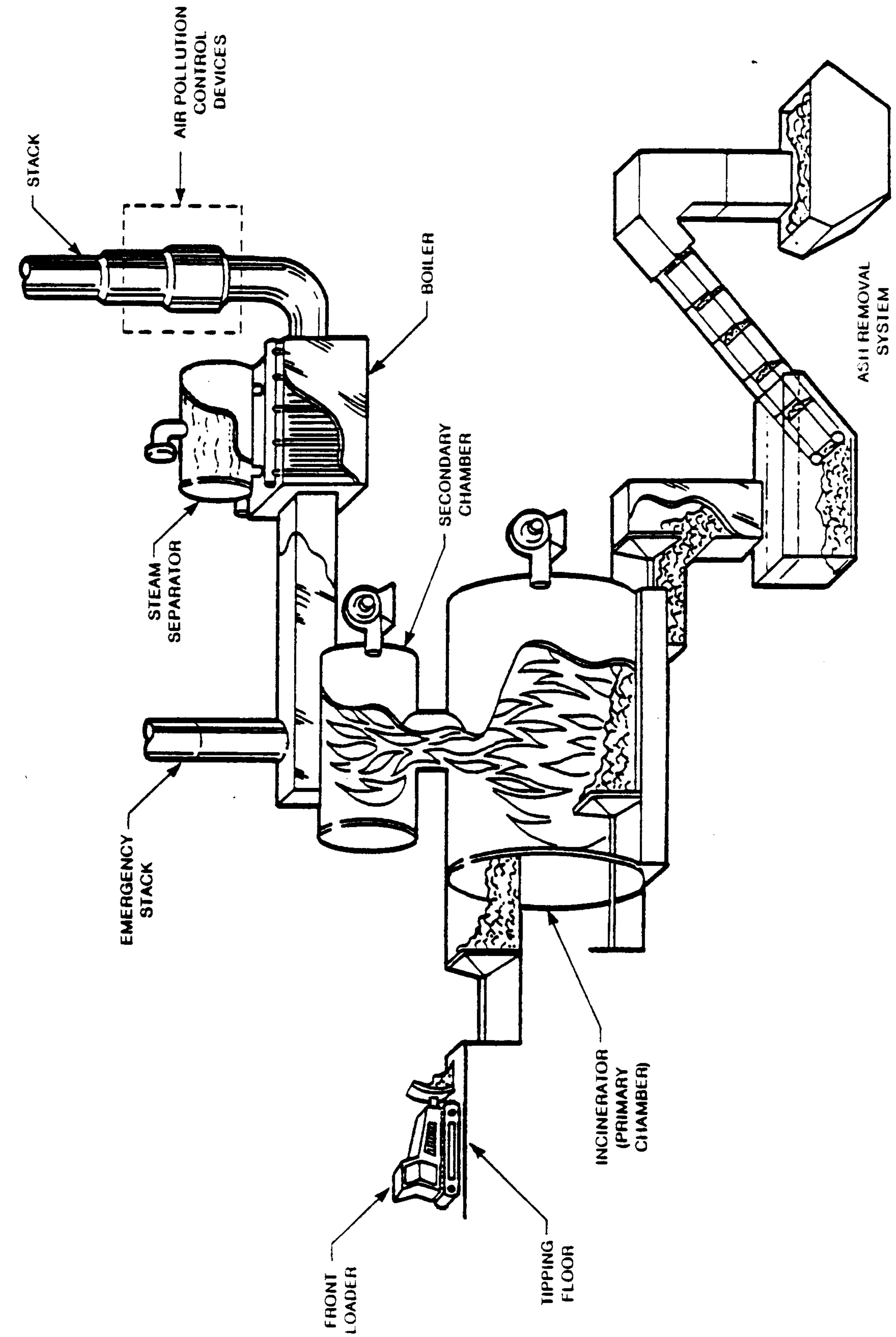
Waste-to-energy plants can generate steam and/or electricity for sale to industrial customers and utilities. For smaller size facilities, less than 200 tons per day (TPD), it is advantageous economically to market steam rather than electricity.

The annual fuel costs of the identified potential steam markets in Juneau are as follows:

School Complex	$197,000
Hospital	$144,000
Correctional Center	$112,000

From these figures, the greatest saving in fuel cost would result from locating an energy recovery plant near the school complex. However, it would be very difficult to locate a waste-to-energy facility at the school complex because of limited space, adjacent residential areas, and generally congested nature of the area. The same holds true for large steam users in downtown Juneau. CBJ Planning staff advised against locating a waste-to-energy plant downtown. Thus, the following engineering evaluations are based on siting the facility by the hospital. The total cost would also be very similar for siting the plant near

TYPICAL FEATURES OF MODULAR MASS-BURNING FACILITY



the State Correctional Center and using a portion of the steam at that facility.

The market for electricity in Juneau is difficult to predict because of the impact a new hydro project could have on electric rates. Table 2.11 below shows one set of predicted costs for a scenario where no new hydropower is developed and no moratorium on electrically heated homes occurs.

TABLE 2.11

AEL&P PREDICTED POWER RATES
(Worst Case Scenario)

Year	¢/kwh
1983	0.060
1984	0.082
1985	0.091
1986	0.101
1987	0.109
1988	0.116
1989	0.120
1990	0.125

This represents an average increase of 11 percent per year. AEL&P managers feel that more realistically, at least one new hydropower facility will be constructed, stabilizing prices at 8¢/kwh for a few years, with perhaps a five percent per year increase thereafter. It is very difficult to forecast revenues for a waste-to-energy plant with a 20 year life on these divergent predictions.

Costs For Waste-to-Energy

This subsection provides capital, O&M and life-cycle costs for the three selected waste-to-energy systems most appropriate for the CBJ.

Regional Facility (Producing Steam). A resource recovery plant to burn all of Juneau's solid waste and provide steam to one of the markets identified above should have a capacity of 4 tons per hour and operate 24 hours per day, 7 days per week.

A 4 ton per hour capacity, stoker-fired, mass burning resource recovery plant will cost $12,000,000 to construct. The total annual costs and fuel savings for operating the facility in the years 1985, 1995, and 2005 are shown in Table 2.12. Also shown is the significant effect on costs of a 50 percent grant from DEC for the capital portion of the facility. Because the waste-to-energy plant can produce much more steam than it can sell (limited steam market) it is actually more expensive overall to recover energy than to simply incinerate the waste.

TABLE 2.12

COSTS OF MASS-BURNING
WITH ENERGY RECOVERY IN JUNEAU
(Steam Used by Hospital)[a]

Cost Category	Cost ($1,000) 1985	1995	2005
Cost			
Debt Service	1,314	1,314	1,314
Labor	704	1,987	3,281
Miscellaneous	360	728	1,678
Residue Disposal	150	404	1,045
TOTAL COST	2,528	4,433	7,318
Revenue			
Savings in Fuel	169	364	696
NET COST	2,359	4,069	6,622
NET COST PER TON (No Grant)	$115	$159	$216
NET COST PER TON (50% Grant)	$83	$134	$195
NET COST PER TON (50% Grant and all steam sold)	$62	$ 95	$129

a Facility could also be located near the State Correctional Center; however, revenues would be lower and net costs slightly higher.

If however, all the steam that the facility could produce could be sold at market prices, over $800,000 in revenue would be generated in 1985. The bottom line of Table 2.12 shows the great positive impact sale of all the steam could have on net project costs. Under this scenario, waste-to-energy is much more favorable than incineration and over the long term, more favorable than landfilling. Unfortunately, some of the largest potential steam customers are located in downtown Juneau. There are no feasible sites for a waste-to-energy plant within a reasonable distance of the downtown area, and even if there were it would be extremely difficult politically and socially to implement such a project in that area. Figure 2.12 graphically compares the costs for a regional waste-to-energy facility vs. those for landfilling.

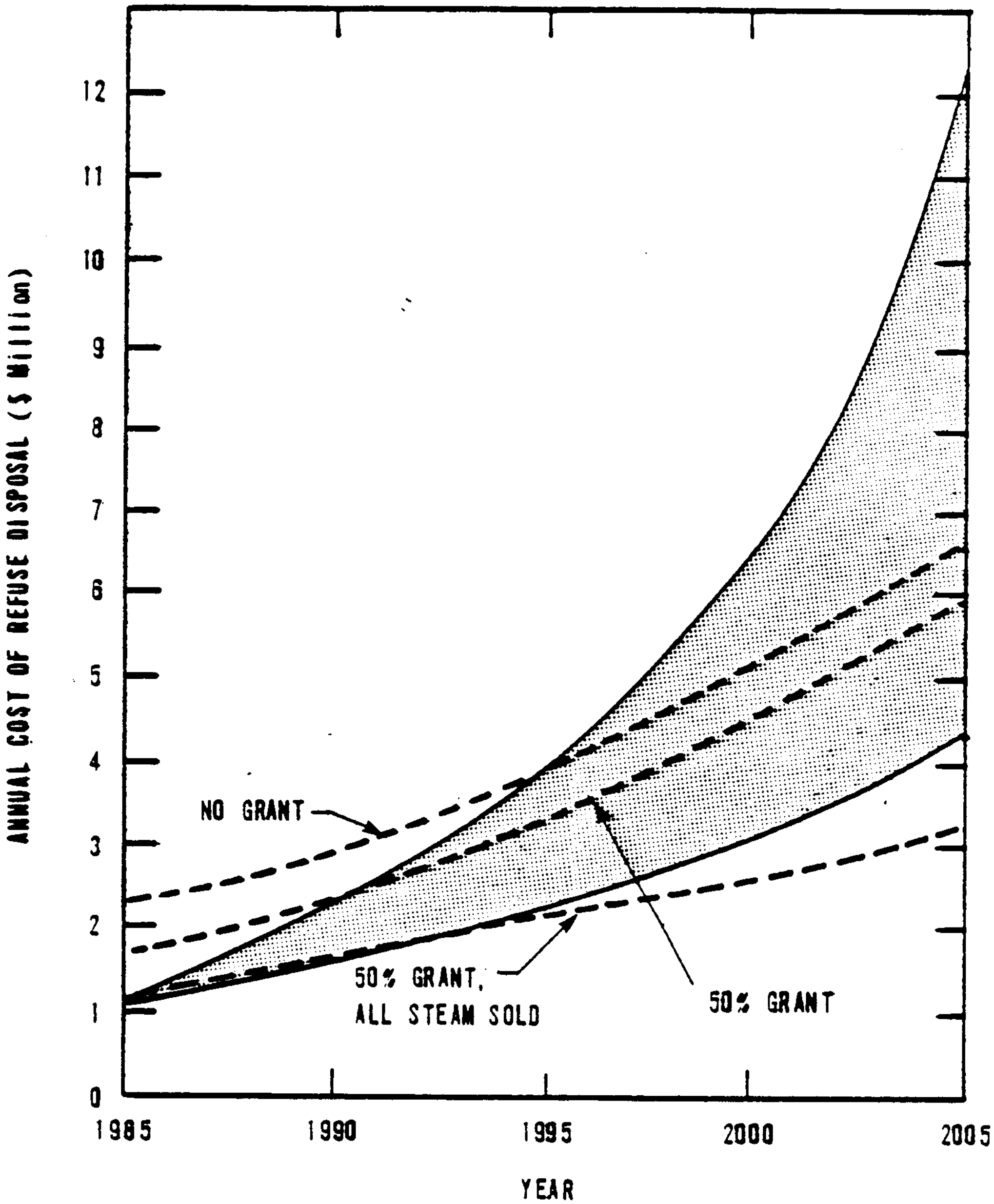
Regional Facility (Producing Electricity). The potential for generating electricity at the waste-to-energy plant for use at the hospital, school complex, State Correctional Center, and for sale to AEL&P was also evaluated. The economics for power generation are not favorable unless significant increases in electricity costs eventuate. For the size facility appropriate for Juneau, the additional costs to produce electricity outweigh the revenues that can be gained by selling the power at existing power costs of about 6¢/kwh.

Estimated annual costs for a $15 million electricity producing waste-to-energy facility for Juneau are shown in Table 2.13. Comparing these costs with those for incineration (Table 2.9) and waste-to-energy with steam production (Table 2.12), one can see the diseconomies of electricity generation. The capital and O&M costs far outweigh power revenues even assuming a high eight percent per year energy value inflation. Figure 2.13 compares the costs of regional electricity generating waste-to-energy facilities versus landfilling.

Small Modular Facility. An alternate to constructing a regional resource recovery plant and utilizing only a portion of the available steam at the school complex, hospital, or prison is to construct a smaller plant sized to meet the energy needs of the user. The hospital will be used in the following analysis.

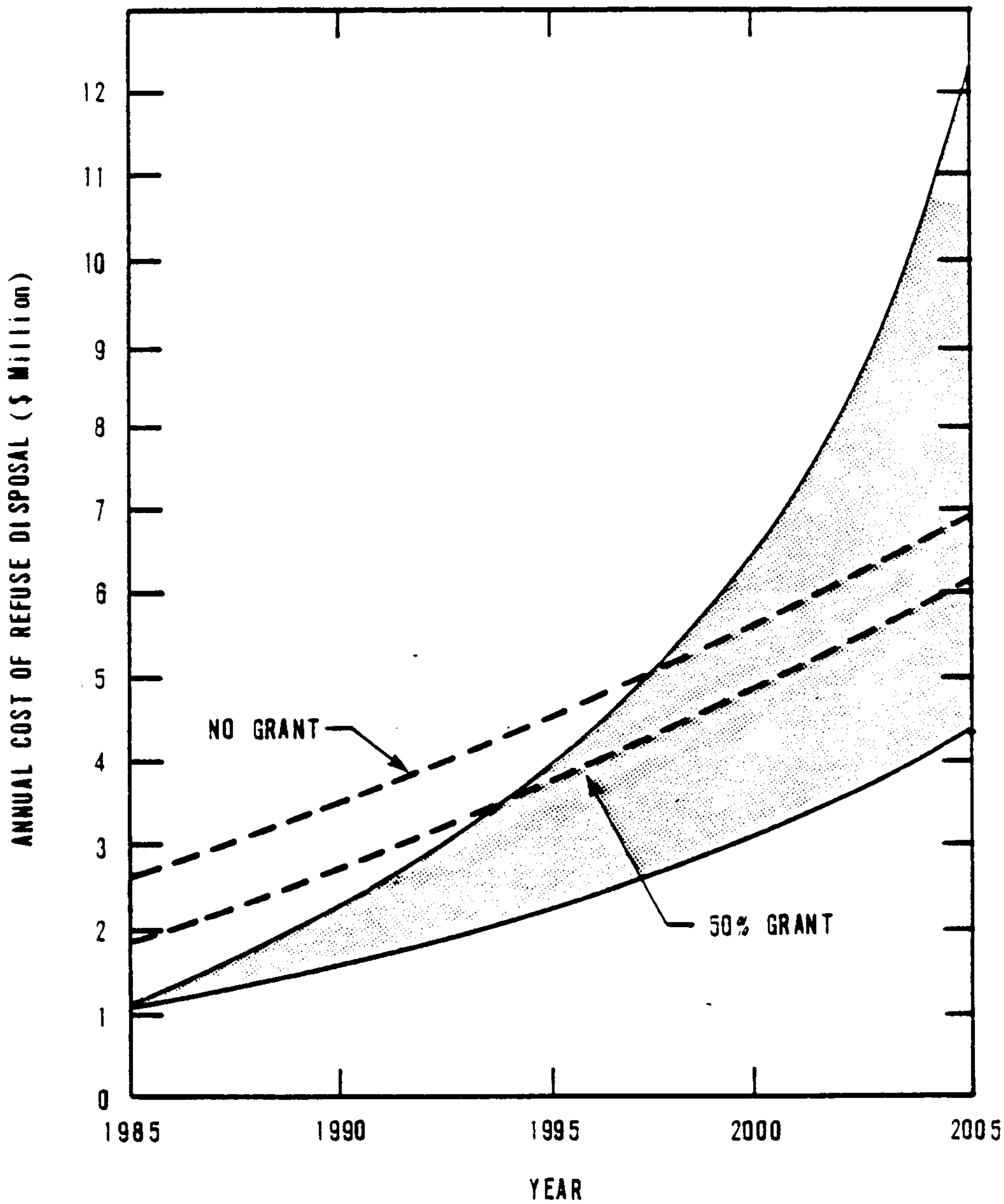
The maximum heat demand of the hospital is approximately 93×10^6 BTU/day. This could be supplied by a small modular controlled air unit burning one ton per hour of refuse. A plant of this size does not require sophisticated air pollution control equipment.

LIFE CYCLE COMPARISON OF THE ANNUAL COST OF A REGIONAL WASTE-TO-ENERGY FACILITY (STEAM) VERSUS LANDFILLING



SANITARY LANDFILLING (5-10% PER YEAR COST INCREASE); SHADED AREA

LIFE CYCLE COMPARISON OF THE ANNUAL COST OF A REGIONAL WASTE-TO-ENERGY FACILITY (ELECTRICITY) VERSUS LANDFILLING



SANITARY LANDFILLING (5-10% PER YEAR COST INCREASE): SHADED AREA

TABLE 2.13

COSTS OF MASS-BURNING
WITH ENERGY RECOVERY IN JUNEAU
(Sale of Electricity to AEL&P)

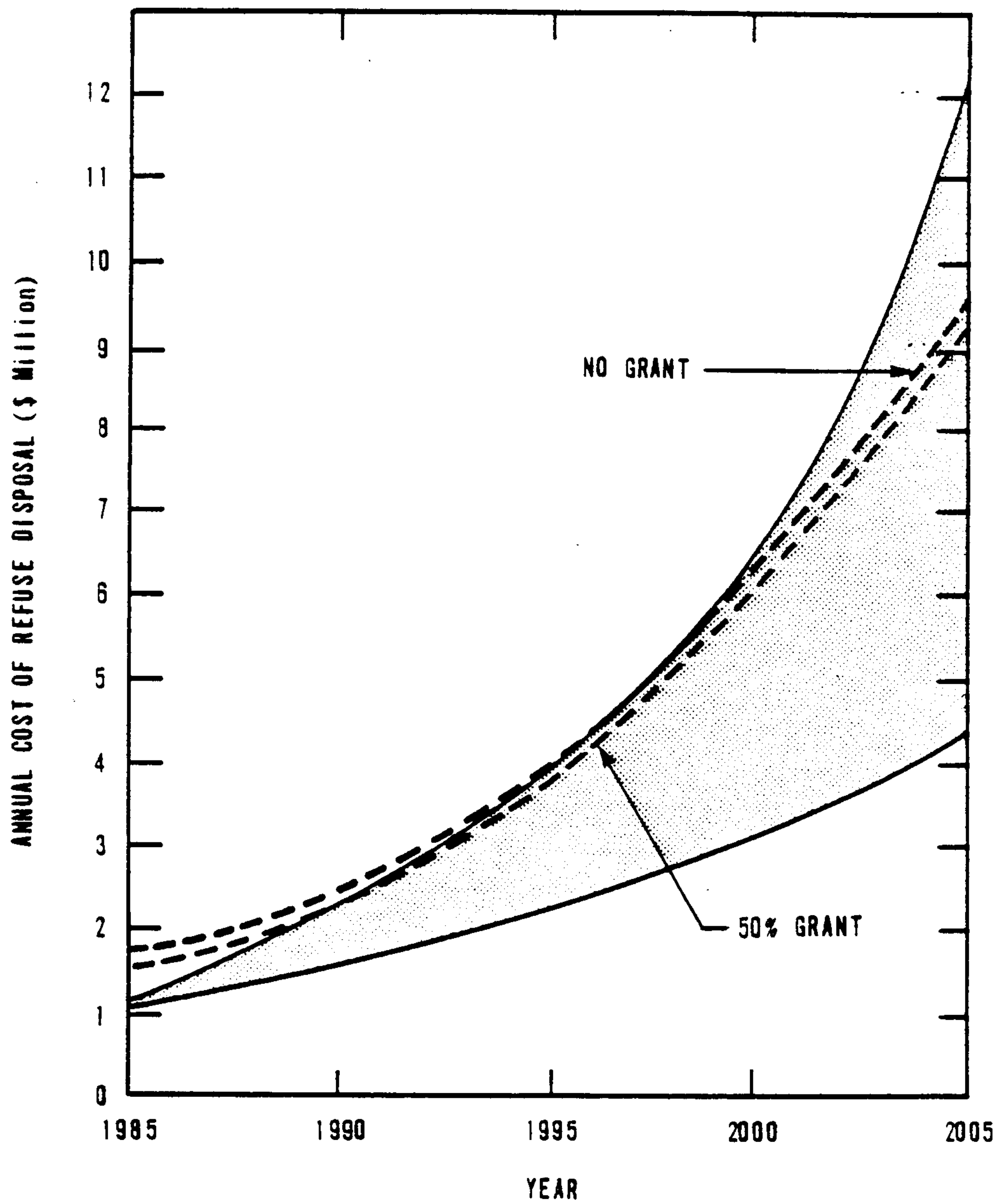
Cost Category	Cost ($1,000) 1985	1995	2005
Cost			
Debt Service	1,643	1,643	1,643
Labor	880	2,499	4,071
Miscellaneous	450	885	2,095
Residue Disposal	150	389	1,009
TOTAL COST	3,123	5,416	8,818
Revenue			
Sale of Electricity[a]	390	842	818
NET COST	2,733	4,574	7,000
NET COST PER TON (No Grant)	$157	$211	$269
NET COST PER TON (50% Grant)	$110	$173	$237

a Assumes sale of power to AEL&P at 75% of the average retail rate. This is probably optimistic. AEL&P's proposed rate schedule for payments to small power producers is pending approval by the State PUC.

A one ton per hour modular controlled air system will cost $2.2 million to construct. The total annual costs and fuel savings in the years 1985, 1995, and 2005 are shown in Table 2.14.

Figure 2.14 shows the life cycle cost of disposing of Juneau refuse by modular incineration with energy recovery versus landfilling. As can be seen, small modular units providing energy for specific users are not competitive economically. These small units are labor intensive and the high labor costs in Alaska are a real disadvantage in this application. In addition, they don't impact the total waste stream, only a portion of it. The bulk of the solid waste would still require landfill disposal.

LIFE CYCLE COMPARISON OF THE
ANNUAL COST OF SMALL MODULAR WASTE TO ENERGY FACILITY
VERSUS LANDFILLING



SANITARY LANDFILLING (5-10% PER YEAR COST INCREASE) : SHADED AREA

TABLE 2.14

COST FOR MODULAR
INCINERATION WITH ENERGY RECOVERY
(Steam Used by the Hospital)

Cost Category	Cost ($1,000) 1985	1995	2005
Cost			
Debt Service	343	343	343
Labor	440	950	2,050
Miscellaneous	320	691	1,491
Residue Disposal (Ash plus remaining refuse)	864	2,419	6,464
TOTAL COST	1,967	4,403	10,348
Revenue			
Savings in Fuel	169	364	696
NET COST	1,798	4,039	9,652
NET COST PER TON (No Grant)	$88	$158	$315
NET COST PER TON (50% Grant)	$80	$151	$309

Co-combustion

Co-combustion of dryed sludge and refuse has been practiced for years in a number of plants in Europe and in one plant in Stamford, Connecticut. Co-combustion of dewatered sludge and refuse has also been practiced in Europe, and is now being practiced at Glen Cove, New York.

Co-combustion of dewatered sludge and refuse is preferred over dryed sludge and refuse for it eliminates the capital and operating costs involved in sludge drying. Co-combustion of dewatered sludge and refuse is limited, however, to situations where the quantity of dewatered sludge is no more than 12 percent of the weight of refuse to be co-burned with the sludge.

The new Mendenhall wastewater treatment plant to be completed in 1985 will produce 3 to 4 tons per day of 30 percent solids sludge, including sludge from the Juneau Douglas plant that has been processed at the Mendenhall facility. This amounts to less than 10 percent of the quantity of refuse to be co-burned with the sludge. Hence, predrying of sludge is not required at Juneau.

The estimated high heat value of the sludge/refuse mixture in 1985 is calculated as follows:

Refuse: 56 TPD x 4,500 BTU/lb x 2,000	= 504×10^6 BTU
Sludge: 4 TPD x 5,000 BTU/lb x 0.30 x 2,000	= 12×10^6 BTU
Total	516×10^6 BTU

$$\frac{516 \times 10^6 \text{ BTU}}{2,000 \times 60} = 4,300 \text{ BTU/lb}$$

The estimated quantity of sludge and refuse to be disposed at Juneau is 420 tons per week in 1985, and 640 tons per week in the year 2005. Based on these figures the optimum burning capacity of the co-combustion facility should be 6 tons per hour. The facility will operate 5 days per week. In 1985 the plant will operate 16 hours per day and in the year 2005 the plant will operate 24 hours per day.

Two feasible co-combustion sites in Juneau are the existing Channel Sanitation landfill and the proposed future landfill site on the east side of Lemon Creek. One advantage of the latter site is that heat generated by the combustion process could be used to generate steam for use at the nearby State Correctional Center.

Economic Analysis

A 6 ton per hour capacity stoker-fired mass-burning co-combustion plant will cost $14,000,000 to construct. The total annual costs of operating the facility in the years 1985, 1995, and 2005 are shown in Table 2.15.

An analysis of the feasibility of recovering energy from the co-combustion facility to provide steam for heating at the prison was conducted. The analysis revealed that the additional costs for labor to

TABLE 2.15

COST FOR CO-COMBUSTION
(6 Tons per Hour)

Cost Category	Cost ($1,000) 1985	1995	2005
Debt Service	1,533	1,533	1,533
Labor	440	1,093	2,666
Miscellaneous	340	734	1,584
Residue Disposal	172	464	1,202
TOTAL COST	2,485	3,824	6,985
NET COST PER TON (No Grant)	$113	$138	$209
NET COST PER TON (50% Grant)	$78	$110	$186
NET COST PER TON (92.5% Grant)	$49	$87	$167

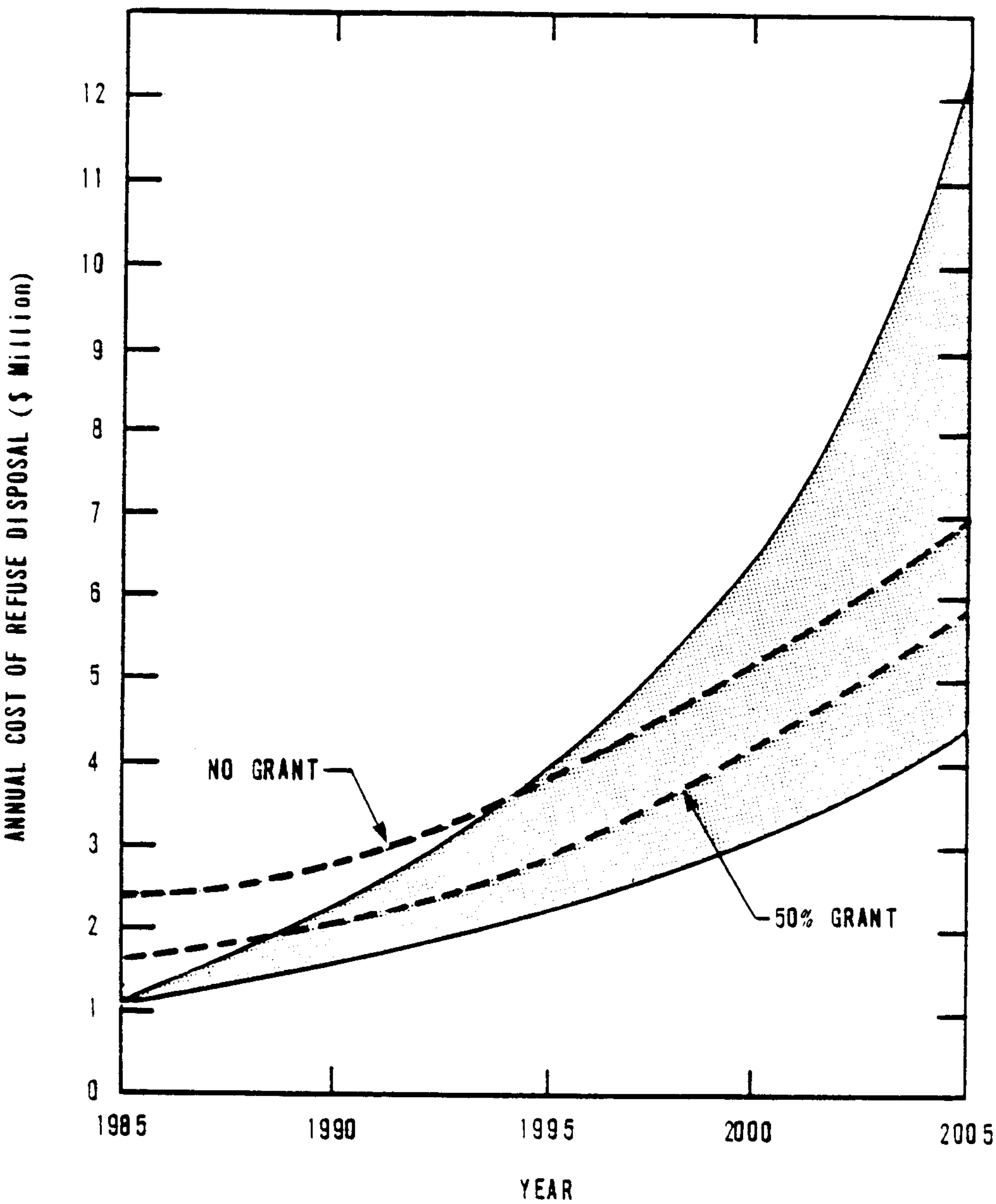
operate the boiler plant plus the additional equipment costs for boilers and steam transmission line were greater than the energy savings. At this time, co-combustion without energy recovery is more economical. However, in designing the co-combustion plant it would be prudent to plan for the addition of boilers if future conditions should favor energy recovery.

Figure 2.15 shows the life cycle cost of disposal of Juneau sludge and refuse by co-combustion versus landfilling.

Methane Gas Recovery

Many cities in the U.S. are now developing gas extraction systems at their old landfills. The landfill gas (LFG), caused by biological decomposition of the organic matter in the refuse, is about 50 percent methane with the remainder mostly CO_2. The captured gas can be used for a variety of purposes, the most popular of which is the generation of electricity. Other uses include space heating, sale to industry as low or medium Btu gas, or sale to the local gas company after gas scrubbing. LFG recovery projects have been attractive at certain sites, especially deep, large capacity landfills that are closed. The attraction lies in the relatively low capital cost of the equipment compared to high

LIFE CYCLE COMPARISON OF THE ANNUAL COST OF CO-COMBUSTION VERSUS LANDFILLING OF SLUDGE AND REFUSE



SANITARY LANDFILLING (5-10% PER YEAR COST INCREASE); SHADED AREA potential revenues. An auxilliary benefit of gas recovery systems is that they mitigate odor and safety problems that often result when LFG migrates off-site.

Figure 2.16 displays a typical LFG well field and piping plan. Gas is pulled out of the fill under a vacuum and through the piping system to the power generating facility. At the Channel Sanitation landfill, the nearby location of the AEL&P auxilliary diesel power generation provides easy access to the power grid.

Figure 2.17 shows a schematic diagram of a typical LFG power generation system. The gas from the well field is filtered to remove moisture, and metered into a reciprocating engine that powers a generator to produce the electricity. These engines are designed to be able to burn a "dirty" gas without creating maintenance problems. With this system no sophisticated gas scrubbing for removal of CO_2 and trace contaminants is requi1red.

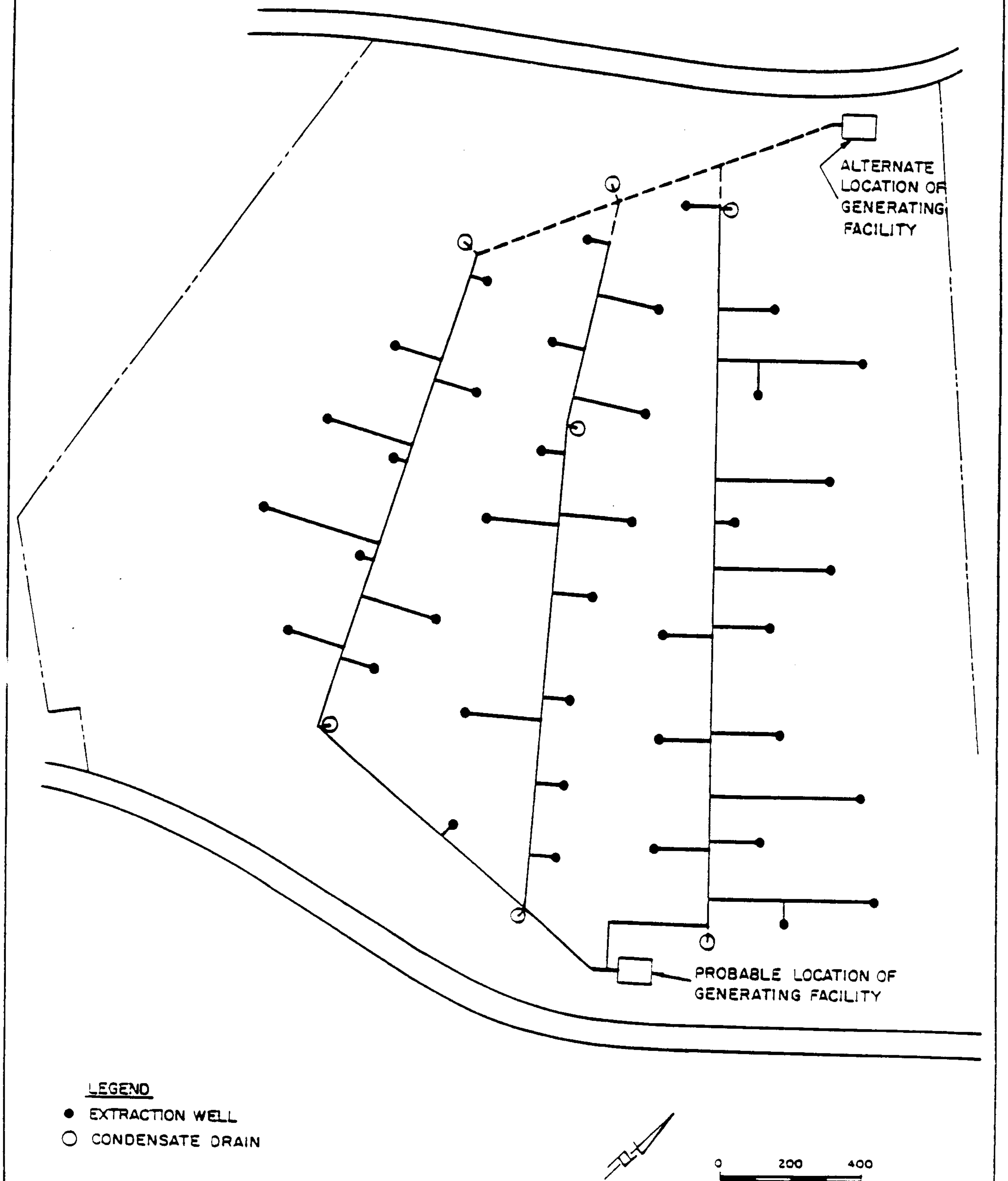
Although very successful in other parts of the country, prospects for economically feasible recovery and utilization of landfill gas (LFG) at the Channel Sanitation landfill may be marginal at best. Optimum conditions would be required as follows:

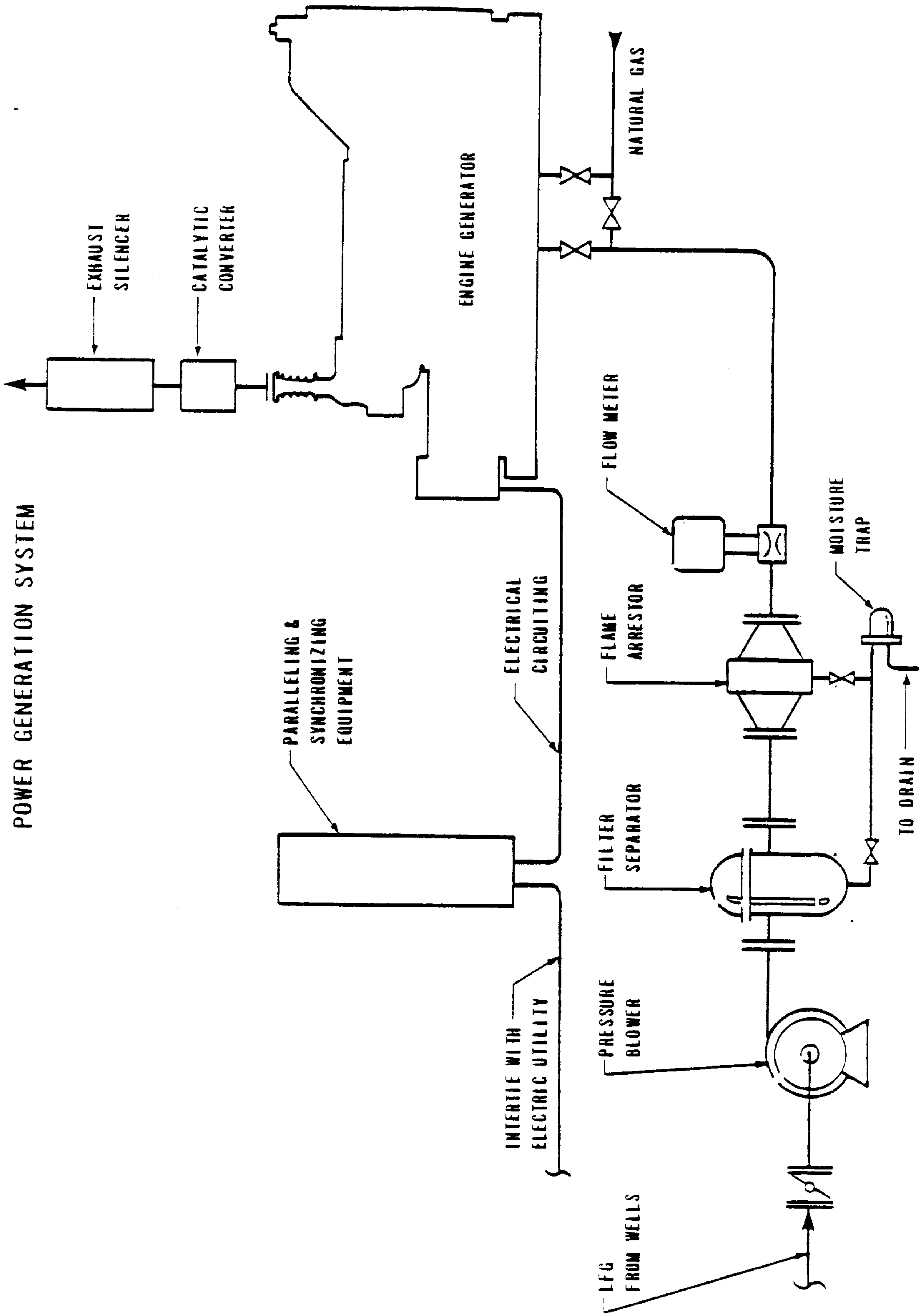
- ° The LFG is recoverable in adequate quantities and concentrations
- ° The LFG is utilized in a local engine generator set
- ° Environmental constraints do not result in imposition of an intolerable economic burden

Based on reported quantities of solid wastes deposited since 1960, there may be a total of 300,000 tons in place (See Table 2.16). If the deeper portions of the fill contain 200,000 tons, the electrical generating capacity could be of the order of magnitude of 150 kilowatts and produce about 1,000,000 kilowatt hours per year, if operating 300 days per year. At an average price of $0.06 per kilowatt hour in Juneau this would have a gross value of $60,000 per year.

A first level estimate of capital costs to capture this gas and convert it to power would be approximately $500,000. Assuming a DEC grant of 60 percent (50 percent plus 10 percent for energy recovery), a 15 year life, and 12 percent interest, the amortized capital cost would

WELL FIELD AND PIPING PLAN





POWER GENERATION SYSTEM

TABLE 2.16

QUANTITIES OF SOLID WASTE
AT CHANNEL SANITATION LANDFILL

Year	Population	Annual Tonnage[a]
1960	9,745	8,000
1961	10,100 (est.)	8,300
1962	10,500 (est.)	8,600
1963	11,000 (est.)	9,000
1964	11,400 (est.)	9,400
1965	11,900 (est.)	9,800
1966	12,300 (est.)	10,100
1967	12,700	10,400
1968	12,953	10,600
1969	13,297	10,900
1970	13,556	11,100
1971	14,463	11,900
1972	15,260	12,500
1973	15,831	13,000
1974	17,428	14,300
1975	18,310	15,000
1976	18,760	15,400
1977	18,886	15,500
1978	19,500	16,000
1979	19,510 (est.)	16,000
1980	19,528	16,000
1981	20,500 (est.)	16,800
1982	22,000	18,000
1983	23,000 (est.)	18,900
	TOTAL TONS IN LANDFILL	305,500

a Calculated @ 4.6 lbs/person/day, based on 1982 population and tonnage

be $44,000. Operating and maintenance costs would raise the total annual cost to approximately $100,000. Thus it appears that unless power costs rise to about $0.10 per kilowatt hour, LFG recovery will not be economically feasible. Under some scenarios predicted by AEL&P, no Crater Lake hydro project and no moratoriums on electrically heated homes, costs for electricity in Juneau will rise to 10¢/kwh in 1986 And to 12¢/kwh in 1989. If this happened, LFG recovery would soon be feasible economically. However, AEL&P management anticipates that at least one new hydro project will be on-line by the late 1980's, which may stabilize costs in the 8¢/kwh range.

Because of the unique circumstances which are known and the lack of test data no recommendation is offered at this time. Prior to any major expenditure in this area, soil borings and an extraction test in the landfill should be performed. Once gas quantities, quality, and extraction rates are known, a refined cost/benefit analysis can be performed.

SECTION 3

SLUDGE MANAGEMENT

SECTION 3

SLUDGE MANAGEMENT

INTRODUCTION

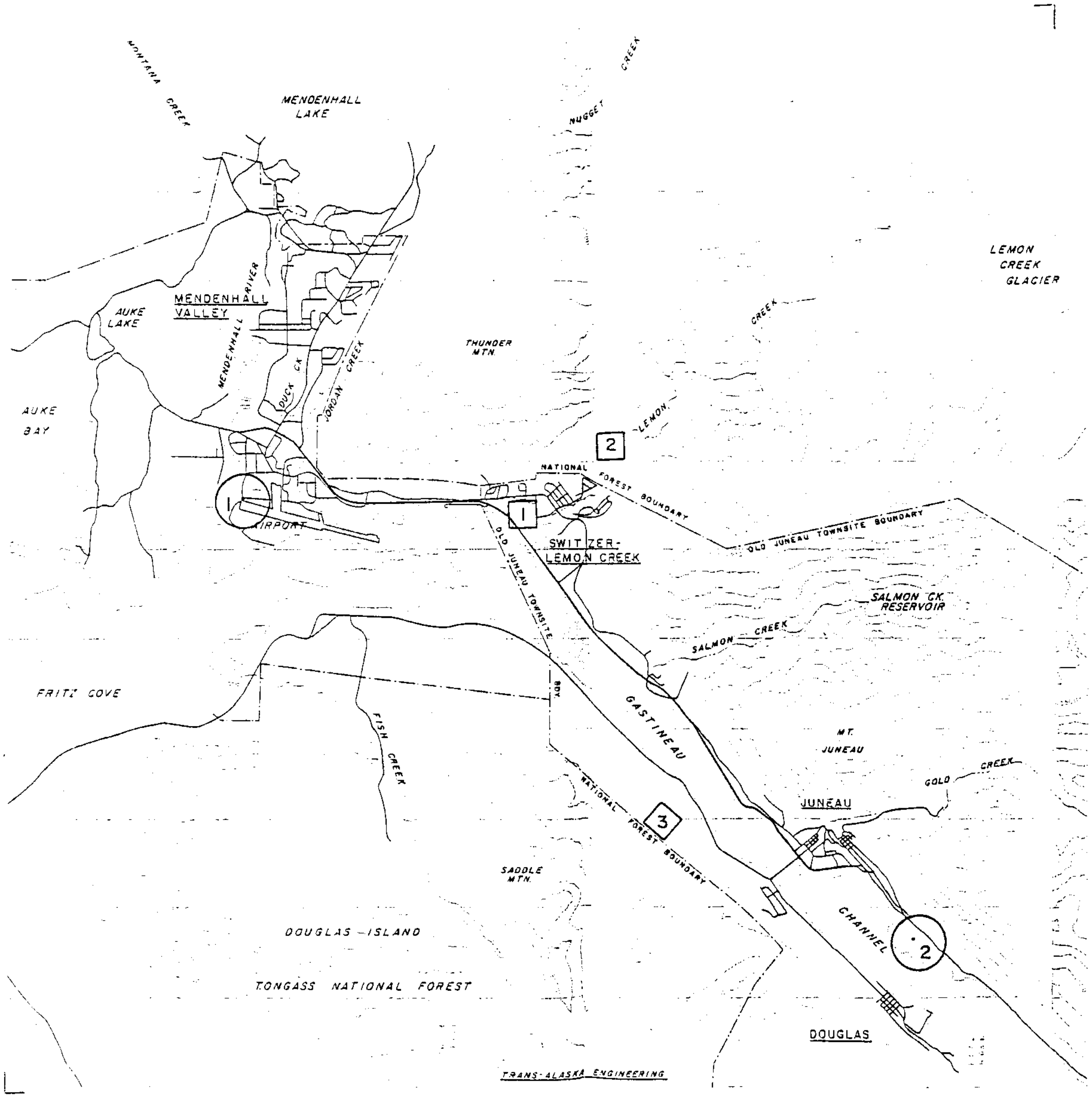
This section discusses the best means of disposing of 12 tons per day of sludge from Juneau's Mendenhall and Juneau-Douglas sewage treatment plants (STP's). The sludge picture is complicated somewhat by the ongoing development of a new sophistacted treatment plant at Mendenhall. The design calls for a very high level of sludge treatment resulting in a sludge that is completely stabilized and dewatered to 30 percent. That new treatment system, however, is not expected to be operational until late 1985. Thus, the primary thrust of this section is to develop a sludge management plan that will handle the sludge as is currently being produced for the next two years. In addition, alternatives are discussed to provide for disposal of the highly treated sludge commencing in 1985.

DESCRIPTION OF SLUDGE IN JUNEAU

Existing Juneau Sludge

Juneau has two major sources of domestic sewage sludge: the Mendenhall and the Juneau-Douglas STP's. A third (and much smaller) STP, Auke Bay, transfers its raw sludge to the Mendenhall plant for processing. Figure 3.1, Location Map, illustrates approximate plant locations.

The three plants process a total of 3.8 million gallons of sewage per day. The sludge currently being disposed amounts to about 12 tons per day (TPD). Eight TPD that has been dewatered to 17 percent solids at the Mendenhall STP, and four TPD of liquid sludge (about 1,000 gallons per day) with only two to three percent solids at the Juneau-Douglas STP. At present, the Mendenhall STP sludge is being disposed in



LEGEND

- (1) MENDENHALL SEWAGE TREATMENT PLANT
- (2) JUNEAU-DOUGLAS SEWAGE TREAT. PLANT
- [1] EXIST. LANDFILL DISPOSAL SITE
- [2] LEMON CREEK / STATE CORRECTIONAL CENTER DISPOSAL SITE
- [3] EAGLE CREEK DISPOSAL SITE

N

1" = 1.2 Mi.

LOCATION MAP

a dedicated disposal site approximately 1/4 mile south of the Juneau-Douglas plant. This site has less than one year of life remaining. The Juneau-Douglas STP sludge is accumulating in ponds and within the treatment processes while a disposal plan is developed.

Waste activated sludge is aerobically digested at both treatment plants. Figure 3.2 illustrates the differences in treatment between the two plants. The major difference is that mechanical dewatering is practiced at the Mendenhall plant which results in an 80 percent volume reduction in the sludge leaving the plant.

Chemically, the Juneau sludge probably contains somewhat less than the "typical" heavy metal contaminants. Heavy metal concentration is important in determining the amount of sludge that can be applied to land at a disposal site. Here the word "typical" must be used with caution in that it is very difficult to compare one sludge with another. However, Juneau does not have any major sources of industrial pollution contributing to its wastewater stream, and the few chemical analyses of Juneau's sludge indicate no excessive metal pollutants.

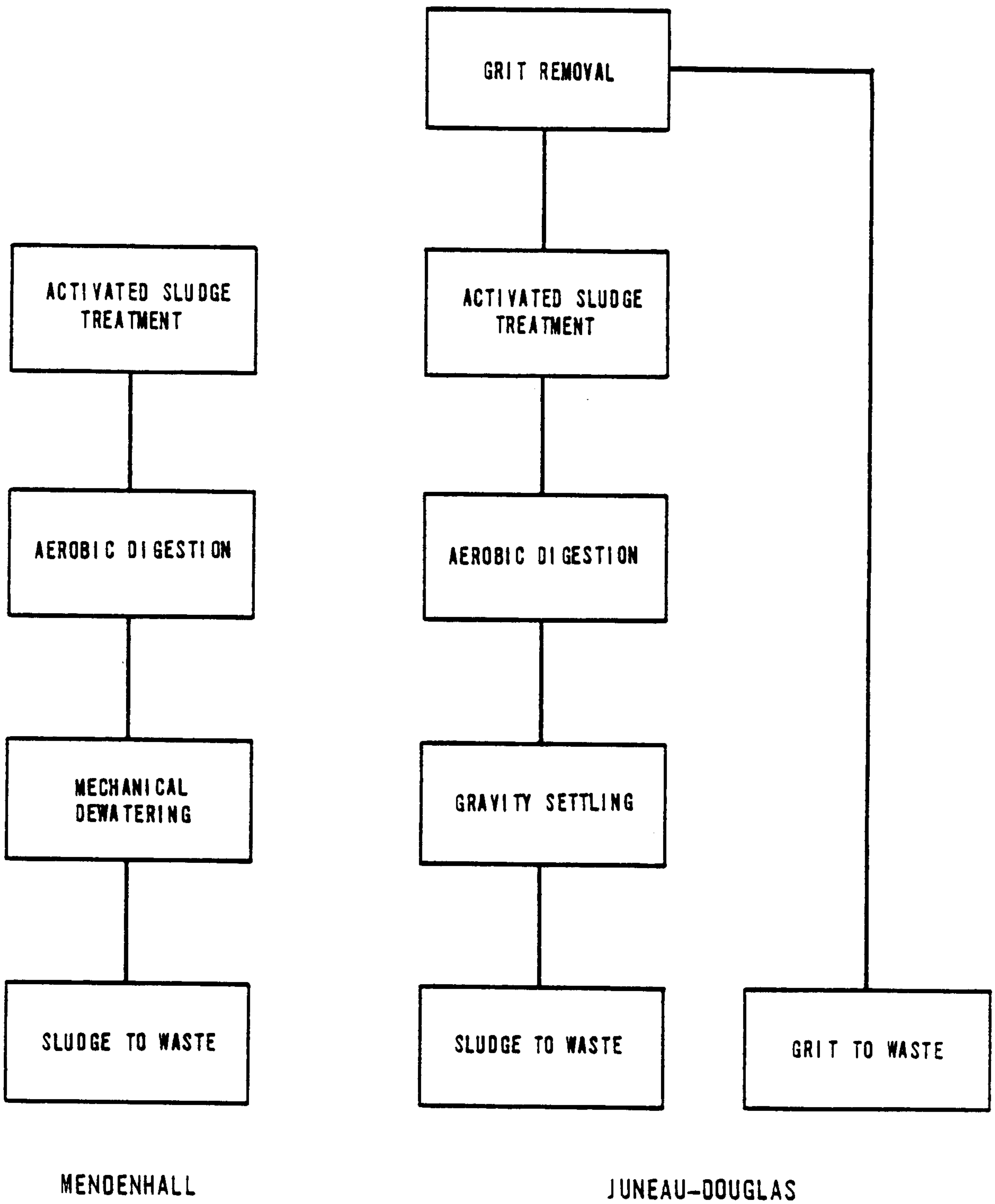
Future Juneau Sludge

Future increases in sludge production can be estimated to be proportional to population growth, assuming that the general nature of the community does not change (i.e., no major industrialization, etc.). The distribution in sludge production between the three STP's is not likely to vary considerably.

The downtown city area currently served by the Juneau-Douglas STP is already developed to near saturation. Little raw land remains to be developed. The Mendenhall Valley, on the other hand, contains area for residential expansion. The impacts of any population increase in the Juneau area in the near future will largely be absorbed by the Mendenhall and Auke Bay STP's. Significant additional loading on the Juneau-Douglas STP is not expected to occur until additional sewage collection facilities are developed on Douglas Island.

It should further be noted that population growth, even in the non-sewered areas, does contribute to increases in sludge production at the sewage treatment plants due to the treatment of septic tank pumpings

SLUDGE TREATMENT CURRENTLY USED IN JUNEAU



(septage). Currently, most septage in Juneau is treated at the Mendenhall plant.

Table 3.1 summarizes current Juneau sludge production data. Table 3.2 illustrates projected sludge quantities.

TABLE 3.1

CURRENT SLUDGE QUANTITIES IN JUNEAU

	Major Treatment Plants	
	Juneau-Douglas	Mendenhall
Population	10,000	12,000
Domestic W.W. Flow		
Sewage	1.0 MGD	1.4 MGD
Inflow	0.9 MGD	0.2 MGD
Total	1.9 MGD	1.6 MGD
Wastewater Solids	300 lbs/day	1800 lbs/day
Sludge Process	Aerobic digestion + Gravity Setting	Aerobic digestion + Filter Press
Treated Sludge		
Solids Concentration	2-3 percent	17 percent
Volume	5.6 cy/day	9.1 cy/day (including grit)
Total Weight	4.3 ton/day	8.0 ton/day
Weight if JD Dewatered @ MH Plant	0.7 ton/day	-
Grit		
Volume	7 cu ft/day	included with sludge
Weight	1,050 lbs/day	-

Proposed New Sludge Treatment Facilities

The CBJ is currently planning to implement an innovative new sludge treatment process commencing in late 1985 as part of the new Mendenhall treatment plant. The process will involve centrifuging, heat treatment, and anaerobic digestion followed by filter press dewatering. Grit and limed screened solids would be processed separately and disposed in the landfill. Final waste sludge concentration is planned to be as high as

TABLE 3.2

PROJECTED SLUDGE QUANTITIES IN JUNEAU

Year	Estimated Population	Projected Sludge Quantities[a] (TPD)
1983	22,000	8.7
1985[b]	24,000	9.6
1985[c]	24,000	5.4
1987	25,300	5.7
1992	28,400	6.4
1997	31,400	7.1
2002	34,400	7.8

a Based on existing sludge production. No increase in per capita production is included. Assumes Juneau-Douglas sludge is dewatered at the Mendenhall plant prior to disposal.

b Before new sludge treatment facility construction.

c After new sludge treatment facility construction.

30 percent solids. The sludge would be sterile and usable as a soil amendment.

This new process will also be able to receive and treat either wet or centrifuged sludge from the Juneau-Douglas STP.

SLUDGE DISPOSAL REGULATIONS

State

State authority for regulating disposal of sludge is vested in the Alaska Department of Environmental Conservation (ADEC). Regulations, as currently written, are somewhat unclear and at times the subject of emotional controversy. The controversy involves whether sludge is to be administered under wastewater or solid waste regulations. ADEC's position usually is that solid waste regulations apply. However, some State municipalities have argued successfully that sludge disposal falls under the State's wastewater regulations. Since the CBJ has accepted responsibility for disposal of both solid waste and wastewater, the controversy probably is not important here.

Sludge disposed as solid waste is administered under Alaska Administrative Code 18 AAC 60. Those regulations require that the person or authority responsible must obtain a solid waste disposal permit prior to disposing of any sludge. The disposal practice may be required by permit to conform to operating standards similar to that of a sanitary landfill including placement of daily cover. Elsewhere in the State, the cover requirements are sometimes loosely enforced when daily cover is not practical. Considering that the CBJ is a major municipality with the financial means to provide for proper disposal it is assumed that the State regulations will be strictly administered. State regulations and permit requirements are generally patterned after regulations and guidelines developed by EPA.

Federal

Federal authority for regulating land application of sludge is vested in the EPA by the joint authority of the Resource Conservation and Recovery Act of 1976 (RCRA) and the Clean Water Act of 1977 (CWA). Under that authority, EPA writes regulations and guidelines. Responsibility for enforcement is delegated to ADEC.

Major federal restrictions disallow the following:

- ° sites located where the land will be flooded
- ° runoff of sludge pollutants into surface waters
- ° contamination of drinking water source
- ° nuisance odors beyond the site boundary
- ° limited public access depending on
  - the degree of treatment
  - application procedures
  - the remoteness of the site
  - the ownership of the site
- ° fences may be required
- ° treatment by a "process to significantly reduce pathogens" prior to land application.

If there is to be a direct contact between the sludge and the edible portion of a crop, then either an 18-month period must elapse between the sludge application and growth of such crops, or the sludge must be subjected to further disinfection treatment prior to application. Further disinfection processes may include composting, heat drying, heat treatment, thermophilic aerobic digestion, pasteurization, and irradiation. (Cadmium and PCB application and minimum soil pH are regulated for soils used for sludge application which produce food chain crops).

In rare cases, a specific sludge may be so high in contaminants that it would be classified as a hazardous waste. If a specific sludge is found to be hazardous waste, it is excluded from any of the land application options discussed in this report, and must be disposed of at a hazardous waste facility. The CBJ sludge is not classified as a hazardous waste.

TREATMENT AND DISPOSAL OPTIONS

Overview

The recent CBJ decision to implement an advanced sludge treatment system by late 1985 considerably limits the treatment and disposal options that should be considered at this time. Capital intensive projects which are not compatible with the new treatment system are not feasible. For example, pasteurization, composting, and lagoon treatment of sludge all require major capital investments for treatment that would be used for only two years. This is not cost effective.

The fact that the proposed treatment system produces a highly dewatered sludge virtually eliminates the possibility of forest application as a disposal method. Forest application involves the use of sprayers to spread liquid sludge above ground in a forest setting. Sludge currently being produced at the Mendenhall plant and sludge planned to be produced under the new system are both too dry to allow use of a spray applicator.

Agricultural utilization of the sludge over the next two years is similarly not viable. Agricultural utilization would require some major capital investment at this time in order to precondition the sludge to the point that it could be feasibly spread under agricultural conditions. Since that capital investment for sludge treatment is planned for the Mendenhall plant in 1985, it would not be wise to duplicate the effort now.

Ocean disposal may also be discounted. At best, establishing an ocean disposal system would involve a lengthy permit process. Since the decision has already been made for a major capital investment for facilities that provide a high level of sludge treatment and a dry sludge cake, an ocean disposal option would not be compatible with that proposed system.

Table 3.3 lists the feasible sludge treatment/disposal options for each of the two main treatment plants in Juneau. Each alternative is discussed below.

Juneau-Douglas STP Sludge

The Juneau-Douglas plant sludge is not dewatered, has a solids concentration of only two to three percent, and is very difficult to dispose of in this state. The previous disposal method, consisting of mixing the wet sludge from the lagoons with mine tailings and stockpiling the mixture on the adjacent mining property, has been terminated. The lagoons are filling with sludge and a critical disposal problem has developed.

Two options are available for the next two years until the new Mendenhall STP is constructed, both requiring relatively short lead times: truck the wet Juneau-Douglas sludge to the Mendenhall plant for dewatering and disposal with the Mendenhall sludge; or dewater the Juneau-Douglas sludge on-site and haul it directly to a land disposal site. Although the CBJ Utility Department has decided to proceed with the latter alternative, both are discussed below. In this way, the CBJ will have information on direct hauling if for some reason the belt filter press option is not carried through. Also, the utility may need to go back to direct hauling of wet sludge to the Mendenhall plant when the new sludge treatment system begins operating there. The new system will not be able to treat belt pressed sludge.

Sanitation landfill, or at a new dedicated sludge disposal site in the Lemon Creek area. It should be understood that the Mendenhall digester is grossly overloaded. Thus the Juneau-Douglas sludge would have to be stored in a new separate tank at the Mendenhall STP. The belt filter press has the capacity to dewater the additional activated sludge.

The following components would be required for this system:

- A new vacuum tank truck (approximately 3,000 gallon capacity)
- A new heated garage at the Juneau-Douglas plant for the truck
- A part-time employee to drive the truck
- A new sludge storage/blending/feed facility at the Mendenhall plant

The Juneau-Douglas STP is generating about 1,000 gallons per day of sludge. Therefore once every three days the truck would pull sludge from the digester or one of the lagoons and haul it to the Mendenhall STP. There, the sludge would be unloaded into a 6,000 gallon concrete storage tank. The sludge would be pumped out of the tank, blended with the Mendenhall sludge, dosed with polymer and fed through the filter press. Alternatively, the two sludges could be fed to the filter press separately.

The question of sludge compatability and the potential input on polymer performance and dewatering has been raised. In the consultant's opinion, this is not a major problem. Both plants produce similar waste activated sludge that is aerobically digested. Although variations in dewatering performance are bound to occur with the different sludges and blends of the sludges, certain polymers should work adequately for all. Testing of polymers should be performed to isolate the best for this application.

It should be clearly understood that the recommendation to dewater the Juneau-Douglas sludge at the Mendenhall plant involves additional manpower and operating cost. At the 1983 sludge production level, approximately 6 man months per year will be utilized in the transfer of sludge from one plant to the other. In addition, another one man month per year would be required for operation of the dewatering facility. One very essential requirement in addition to the purchase of the pumper truck is the construction of a small heated garage for housing the truck. Sludge pumper trucks are not usually designed for winter operation. Past attempts at transferring sludge during the winter in Juneau have proven the need for a heated garage. One additional feature that should be considered is a modification of the new pumper truck which would allow hot water from the engine cooling system to be circulated through a heat exchanger around the operating valves of the pumper truck.

Table 3.4 summarizes the estimated costs for this program. As shown, total capital costs are estimated at $150,000 and the annual cost at $70,000. Grant funds may be available to cover some of the capital costs.

TABLE 3.4

COSTS FOR HAULING AND TREATING JUNEAU-DOUGLAS SLUDGE AT THE MENDENHALL STP

Cost Factor	Cost	
	Capital ($)	Annual ($/yr)
3,000 gallon vacuum tank truck	70,000	14,000[a]
Facilities		
Heated storage garage at Juneau-Douglas plant	30,000	4,000[b]
Sludge storage/blending/feed facilities at Mendenhall plant	50,000	7,000[b]
Labor (7 man-months per year)		30,000
O&M (vehicle and facilities)		15,000
Total Cost	150,000	70,000

a 7 years, 12% interest, 10% salvage value
b 20 years, 12% interest, no salvage value.

<u>Dewater Juneau-Douglas Sludge On-Site (1983-1985)</u>

An alternative to hauling wet sludge to Mendenhall is to dewater the Juneau-Douglas sludge on-site and haul the dewatered sludge directly to a land disposal site. There are several advantages to this approach, namely the reduction in hauling and the close proximity of the existing sludge disposal site only 1/4 mile away. Disadvantages include: 1) the capital and O&M cost for the dewatering facility; 2) the fact that once the existing disposal site closes in about nine months, the sludge will have to be trucked much further to the Channel Sanitation landfill, or to a new dedicated site in the Lemon Creek area; and 3) the inability of the new Mendenhall STP to handle belt filter pressed sludge from the Juneau-Douglas plant. This process would have to be abandoned in favor of a centrifuge system or hauling of the liquid sludge if the Mendenhall facility is to be used.

The CBJ Utilities Department is planning to purchase and install a mobile, trailer mounted belt press for use at the Juneau-Douglas plant. The portable press, manufactured by Parkson of Ft. Lauderdale, Florida, can process 6 gpm and produce a dewatered sludge of 17 to 18 percent solids. The unit is expected to be on-line by February or March, 1984 and will cost roughly $50,000. Sludge samples have been tested by the manufacturer to gauge dewatering performance. Relatively inexpensive, small, batch fed plate and frame type presses are also appropriate in this application. Table 3.5 presents estimated costs for dewatering the Juneau-Douglas sludge with a new belt filter press and hauling it to the existing disposal site. As shown, capital costs are approximately $130,000. Labor is the most critical item, representing roughly one half of the total annual cost of $56,000.

TABLE 3.5

ESTIMATED COSTS FOR BELT PRESS DEWATERING AT THE JUNEAU-DOUGLAS PLANT

Cost Factor	Cost	
	Capital ($)	Annual ($/yr)
Facilities	40,000	5,000[a]
Equipment		
Filter Press	50,000	8,000[b]
Sludge pre-conditioning	5,000	1,000[b]
Truck	25,000	5,000[c]
Installation and shipping	10,000	2,000[b]
Labor		
1 part time laborer (operate press and drive truck)	-	25,000
Operation and Maintenance	-	10,000
Total Cost	130,000	56,000

a 20 years, 12% interest, no salvage value
b 10 years, 12% interest, 10% salvage value
c 7 years, 12% interest, 10% salvage value

As previously mentioned, belt pressed sludge from the Juneau-Douglas STP will not be compatible with the new Mendenhall sludge treatment process. Therefore, three choices exit for long-term treatment/disposal of the Juneau-Douglas sludge:

- Haul wet sludge to Mendenhall STP for advanced treatment
- Dewater on-site and haul to disposal site.
- Thicken sludge (centrifuge) and haul to Mendenhall STP for advanced treatment.

Each of these is discussed briefly below.

Haul Wet Sludge to Mendenhall STP (1986-)

This option was discussed previously in this section.

Dewater On-Site and Haul to Disposal Site (1986-)

This option was also discussed previously. It is probably the simplest long-range option, particularly since the Utility is planning to install a belt filter press in the next few months and this would just be a continuation of that program. The small amount of dewatered sludge could be buried with refuse at the Channel Sanitation landfill or the future landfill in Lemon Creek. However, this alternative does not take advantage of the high level sludge treatment at the Mendenhall plant that could render the Juneau-Douglas STP sludge fit for use as a soil amendment.

Thicken Sludge (Centrifuge) and Haul to Mendenhall STP (1986-)

For a capital cost of about $600,000 a thickening centrifuge process could be installed at the Juneau-Douglas STP. This would thicken the sludge from two to three present solids to four to seven percent and cut in half the volume of sludge that would have to be hauled to Mendenhall for advanced treatment.

The key to the economics of hauling wet sludge vs. centrifuged sludge may be the availability of grant money. If a very large portion of the capital cost of the centrifuge system could be covered by grants, then centrifuging may be attractive. Without this funding, direct haul of wet sludge to the Mendhall STP, or continued belt filter press dewatering and burial are much less expensive.

Mendenhall STP Sludge

Once the new sludge treatment system is implemented at the Mendenhall plant as planned in late 1985, sludge disposal should not be a serious problem. The planned sludge treatment, consisting of centrifuges, heat treatment units, anaerobic digesters, and belt press filters, will produce a sludge that is sterile and highly dewatered. The treated sludge can be used for commercial agriculture, on domestic landscaping as a soil amendment, or at the landfill as interim and final cover material. Provisions should be made for covering the sludge as it is stockpiled at the landfill or other sites for later use. The CBJ may want to begin stockpiling this material under cover at the proposed Lemon Creek landfill site for future use.

Prior to start-up of the new treatment plant in late 1985, the four most feasible options for disposal of the Mendenhall STP dewatered sludge are:

- Dewater and haul to existing disposal site
- Dewater and haul to Channel Sanitation landfill
- Dewater and haul to new sludge disposal site
- Dewater and incinerate

Each of these is discussed briefly below.

Dewater and Haul to Existing Disposal Site (1983-1985)

The existing sludge disposal site, called the Rock Dump, is an old landfill. Capacity remains for burial of dewatered sludge at that site until approximately August 1984. Continued use does not appear to present any overriding environmental problems. The operation is presently accepted by the public and is well removed from residential areas.

Dewater and Haul to Channel Sanitation Landfill (1983-1985)

Once the existing Rock Dump site is filled, the dewatered sludge could be buried at the Channel Sanitation landfill. This can normally be accomplished in one of two ways:

- within the landfill, but in a separate sludge-only designated area

° within a common disposal cell with municipal solid waste

Since the sludge at the Mendenhall plant receives very little digestion, co-burial with refuse should not be considered for health reasons. Therefore a separate sludge-only disposal area would have to be used.

This area should encompass rougly one acre, for approximately one years sludge disposal. The area should be secured by a perimeter fence and locking gate to keep the public out, and should preferably be located in an isolated area of the landfill. The sludge should be covered daily with soil or a chemical foam such as Sanifoam.

Since the landfill is almost totally covered with refuse, the sludge will have to be buried in trenches dug directly into the refuse. The trenches will be more difficult to excavate and cannot be as deep or closely spaced as they could be in native soil. However one advantage is that the refuse will tend to act as a sponge to soak up free moisture in the sludge.

It is anticipated that this disposal method would be required for roughly one to two years, until the new Mendenhall plant is operational. The highly treated sludge from that process would no longer be buried but stockpiled at the landfill, blended with soil and sand, and used for final cover or other beneficial uses.

Dewater and Haul to New Sludge Disposal Site (1983-1985)

If Channel Sanitation will not take the sludge, then a new dedicated land disposal site will have to be created to take the sludge until the new treatment plant comes on line in 1985. Two of the best locations for this operation are the sites selected as potential future landfills at Lemon Creek and above the State Correctional Center.

Unlike disposal at the Channel Sanitation landfill, sludge disposal at one of the locations would require a fully contained system with a plastic membrane liner and a monitoring well system. Leachate collected from the system would have to be discharged to the sewer system. An area of approximately one acre out of a total of 30 to 40 acres, would be needed for one years disposal. Sludge could be deposited in bermed cells with one months capacity. The active cell could be covered daily with a movable membrane liner or a thin layer of Sanifoam or dirt to control odors. Full cells would be covered with approximately 18 inches of soil. Figure 2.5 and 2.6 in Section 2 show details of a typical bottom liner and a monitoring well.

Due to the complexity, cost, and environmental concerns of this alternative, it is not as advantageous as using the Channel Sanitation landfill for this purpose. However, should Channel Sanitation refuse to take the sludge or charge an exorbitant fee, the CBJ may be forced to develop a new dedicated sludge disposal site.

It would seem prudent for the CBJ to contract in the near future, for the design of a dewatered sludge disposal area at the proposed Lemon Creek landfill site. In this way, the CBJ will have an alternative that can be implemented quickly in case an agreement cannot be reached with Channel Sanitation to take the sludge, or in case problems develop with the disposal of sludge at that site.

Dewater and Incinerate

Incineration of sludge is a common practice where other options are not feasible or are very expensive. Incineration of sludge is energy intensive. Approximately 2,500 BTU's of fuel per pound will be needed to burn Juneau's sludge. That equates to 27 million BTU's per day or approximately 200 gallons of fuel per day.

Incineration of sludge in Juneau is simply not cost effective. The cost of fuel plus the cost of one operator exceeds the total cost of the land disposal systems. Incineration would become feasible only if land disposal sites are not available and there was no way to dispose, recycle, or sell the highly treated, sterilized sludge.

The co-combustion of sludge with refuse is more feasible then straight sludge incineration. Co-combustion is discussed in Section 2, Solid Waste Management. The primary long-term disadvantage of co-combustion in Juneau is that the highly treated sludge produced by the new Mendenhall STP is useful as a soil amendment, for a region that is very soil poor. It would be wasteful to burn this resource.

SECTION 4

RECYCLING

SECTION 4

RECYCLING

This section describes existing materials recycling in the CBJ and the potential for expanded recycling programs.

EXISTING PROGRAMS IN JUNEAU

There is only one formal recycling program within the CBJ. This is operated by the group called "JAWS" and consists of a buy-back center located near the existing sanitary landfill. Developed by local teen-agers, the JAWS program has been very successful in gaining public support. This has included a $10,000 grant from the Department of Environmental Conservation (DEC), a $3,000 grant from SOHIO, the donation of two shipping containers and drayage costs from the Foss Alaska Shipping Line (FAL), and the donation of the land for the present operation by a local citizen.

Material is purchased from or donated by residents who bring it to the site. In addition, drop off boxes for donated materials are located at various sites in the community. When the shipping containers are full, FAL hauls them to the barge and the material is shipped to Seattle markets. Revenue from donated materials (materials not purchased by JAWS) go to support the Marie Drake School sports programs.

Table 4.1 summarizes the materials recycled by JAWS during 1982. The totals actually represent only 9 or 10 months of full scale operation. Prior to that, the JAWS program did not have a permanent site and recycling was sporadic. As shown in the table approximately 126,000 lbs was recycled in 1982.

TABLE 4.1

MATERIALS RECYCLED BY JAWS
(1982 Totals)[a]

Material	Amount Recycled (lbs)
Aluminum Cans	50,729
Aluminum Scrap	42,590
Lead	457
Copper	15,966
Radiators	1,976
Batteries	9,234
Iron Scrap	774
Brass	2,768
Faucets, Electric Motors	1,817
Magnesium	140
Stainless Steel	76
Bronze	20
TOTAL	126,547 lbs.

a Represents only 9 to 10 months of full scale operation

Prices paid by JAWS for the key materials are:

- 15¢/lb for aluminum
- 15 to 40¢/lb for copper depending on quality
- 25¢/lb for brass

MARKETS

The primary constraint to recycling in Juneau is the cost of shipping materials to the nearest markets in Seattle over 1,000 miles away. The cost for containerized barge transportation of recyclable material from Juneau to Seattle is presently $2.97 per 100 wt or $59.40 per ton. The charge for hauling the container from the recycling center to the barge (a service now donated by FAL) totals $120 per container.

Depending on the weight of material, this could add $10 to $50 per ton to the overall transportation cost.

Table 4.2 lists current market prices in Seattle. As can be seen by comparing the transportation costs with market prices, the only materials worth recycling in Juneau are high value commodities that can be shipped and sold in Seattle, and materials that can be salvaged and reused directly in Juneau. These include:

- Aluminum cans
- Aluminum scrap
- Copper
- Brass
- Bronze
- Computer paper and cards
- Miscellaneous items such as batteries and radiators
- Reusable items (old furniture; demolition and construction materials such as lumber, metal, wire; household goods and fixtures; pipe; doors; etc.)

TABLE 4.2

TYPICAL SECONDARY MATERIALS PRICES IN SEATTLE (SPRING 1983)

Material	Price ($/ton)
Newspaper	50-62
Glass (color sorted)	40
Computer Paper and Cards	150
Corrugated (cardboard)	50
White Paper	70-90
Colored Paper	30-50
Aluminum Cans	600-700
Aluminum Scrap (clean)	400-500
Copper	1,000
Brass	600-800
Beer Bottles (refillable)	60-80¢/case of 24
Tin and Bi-Metal Cans	(no market)

The conventional recyclers fare of newspaper, glass, and bi-metal cans are much too low in value to be considered for recycling in Juneau.

ALTERNATIVE RECYCLING PROGRAMS

Due to the severe local market constraints, the list of possible recycling alternatives for Juneau is short:

- specialty recycling center
- commercial paper recycling
- corrugated paper (cardboard) recycling
- abandoned car reclamation
- materials salvage yard

Each of these is briefly discussed below.

Specialty Recycling Center

It appears that the growing CBJ community could support at least one other specialty recycling center, perhaps located near the downtown area to capture materials in that area and in Douglas. Although some competition with JAWS may result, it is more likely that the existence of two conveniently located recycling centers would result in the capture of more material than at present.

Due to the shipping costs, it is unlikely that any recycling effort is going to be a large money maker. However, another small buy-back operation similar to JAWS could be successful. The program should concentrate on high value items for the Seattle scrap market, and materials that can be reused in Juneau (lumber, metal pipe and fixtures, doors, etc.)

Commercial Paper Recycling

With the high level of government activity in Juneau, the potential exists for recovering and recycling regular, ink-printed computer paper and computer cards from the several large office complexes downtown. The overall economics of such a program appear favorable with shipping costs at $60 per ton (loaded in a container at the dock) and the value of computer paper and cards at $150 in Seattle.

Hundreds of similiar programs are being successfully conducted in the "lower 48". The logistics of an operation in a large Juneau office building could be as follows:

- Waste computer paper and cards would be stacked back in the boxes they are delivered in.
- During building clean-up, custodians would deliver these boxes to a central storage area where they would stack the boxes on pallets. Alternatively, a designated employee could collect the boxes of paper and deliver them to the central storage area.
- Full pallets would be banded for stability.
- When a full load of 8 to 10 pallets had accumulated, they would be loaded in a FAL shipping container for transport to Seattle.

Several trouble spots that may have to be addressed include:

- Contamination: It is very important that employees know the proper type of computer paper for recycling. NCR paper and paper with carbon are not acceptable, and if found will severly reduce the value of a load of recyclable paper. Unfortunately, the DEC reports that most of the waste computer paper generated in the CBJ is now the new laser printing type. The burned-on letters are a contaminant in the repulping/bleaching processes and most U.S. paper mills will not accept it. Some foreign mills will buy it if it represents less than 5 percent in a bale of regular computer paper. Large paper recyclers in Seattle will try to market this paper only in large quantities (i.e. 20 tons in a shipping container) and even then the value is questionable. Most U.S. mills will remain hesitant to accept this paper until a new process is developed to break down and/or remove the burned letters.

- Limited Storage: Some buildings have limited storage capacity and may not be able to accommodate 8 to 10 pallets of recycled paper. Use of nearby warehouse space or donation of a FAL container at the dock for storage are possible alternatives.

- <u>Program Responsibility</u>: It is important to designate a key employee as program manager. This person can then be a focus for publicity, logistics of collection, interfacing with FAL and Seattle markets, and answering questions on a day-to-day basis.

Such a program could be administered by the CBJ, the State, or a private concern. In most instances, private industry has taken the lead on such projects. If competition for the paper is a question, the CBJ or the State may be required to put the paper up for bid. This is common in other similar programs throughout the country.

The success of such programs depends to a large extent on the enthusiasm and commitment of the key people involved. For this reason, it may be advantageous to locate individuals in the community and the larger office buldings who are interested in this type of project. The people at JAWS and Ms. Cara Zuckerman, litter control/recycling specialist in DEC's Southeastern office, would be good initial contacts.

The State attempted a trial white paper and computer paper recycling programs at the State Office Building in Juneau a few years ago. Paper was separated by office workers, moved to the loading ramp by the janitors, and picked up by Channel Sanitation for recycling. The program never really got off the ground and was terminated after three months. However, even with this initial failure, the CBJ should examine the possiblity of re-establishing a computer paper recycling program.

Before any computer paper recycling program is initiated, the paper purchaser for the State buildings should be contacted to verify the increasing use of laser printed computer paper. If use of this paper is ubiquitous in the State office then its recycling is ill advised at this time because of the above mentioned marketing problems.

<u>Corrugated Paper (Cardboard) Recycling</u>

Although cardboard boxes are a low value commodity, the availability of barge back-haul space on barges servicing food stores in Juneau makes recycling feasible. This is substantiated by DEC's claim that most of the food stores in Juneau already bale and return their cardboard boxes to Seattle in this manner.

Smaller stores (liquor, hardware, furniture, etc.) generate many boxes that could be recycled if they could be baled. This could be accomplished via agreements to use existing food store balers or by a cooperative effort to purchase and install a new centralized baler for use by a consortium of stores.

Three economic problems will probably arise:

- Transportation of loose boxes to the baler is time consuming and expensive, and is a cost that the present recycling stores eliminate by locating the baler on-site.
- Lack of back-haul space on food store servicing barges would economically kill any new corrugated recycling program.
- It may be difficult to determine who should pay what proportion of total costs for a cooperative, centralized system.

Certainly, the CBJ should encourage any large store not presently recycling to closely examine the benefits being realized by similar stores in baling and recycling their boxes. The monetary incentive may be there. It may be more difficult to convince smaller store owners, who must bear additional costs in transporting boxes to a baler, that corrugated recycling is worth the effort.

Abandoned Car Reclamation

Abandoned car disposal is a problem in the CBJ. Table 4.3 summarizes the yearly growth in numbers of motor vehicles in Juneau from 1970 to 1981. An increase of over 150 percent occurred during that period. Assuming a conservative 10 year life per vehicle, then about 10 percent of the total will be abandoned each year. This equates to roughly 1,500 cars in 1983.

Channel Sanitation accepted abandoned cars for free at their landfill until this year. Cars were crushed by the landfill compactor, stockpiled, and barged to Seattle for processing. The Channel Sanitation barge could haul approximately 1,500 cars that had been crushed in this manner. Channel Sanitation has stopped the reclamation program due to falling prices in Seattle (from $65/ton in 1981 to $43 in early 1983) and the additional environmental and aesthetic requirements they would

TABLE 4.3

NUMBERS OF MOTOR VEHICLES IN THE CBJ

Year	Number of Vehicles[a]
1970	5,634
1971	6,154
1972	6,604
1983	7,369
1974	8,210
1975	7,585
1976	8,678
1977	8,347
1978	8,118
1979	11,089
1980	12,678
1981	14,391

a From CBJ Planning Department data

have had to provide for the car storage area. Channel Sanitation presently charges 5¢/lb for abandoned vehicles, which is reflected in a total cost of $100 to $200 per vehicle. This change from free disposal to a charge of $100-200 is likely to result in illegal roadside dumping of junk cars.

The CBJ Planning Department has conducted a brief study of the problem. Key findings of their work are as follows:

- Abandoned car disposal is a growing problem in Juneau with no present solution.
- Most residents will not pay $100-200 to dispose of their old cars at the landfill.
- The optimal solution would be to provide an abandoned car staging area on waterfront property, however the costs are prohibitive. (One exception is the old Rock Dump, now used for sludge burial.

It could be used for car reclamation beginning in September 1984.)

- It was recommended that the CBJ provide a site for abandoned car storage and contract the operation to private enterprise.
- One possible site is the former sludge disposal area (10 acres) owned by the CBJ west of the airport and the Mendenhall River.

Table 4.4 summarizes the estimated costs and revenues of an abandoned car reclamation program in Juneau. The costs are based on the assumption that 1,500 cars will be processed per year, and that a large barge (286 ft. by 80 ft.) would make one trip every two years with 3,000 cars. The costs include tow truck service to pick up the cars and all costs of the operation except land purchase. The present price for scrap cars in Seattle is $53/ton (November, 1983).

As shown in the table, a net cost of approximately $75 per vehicle would be incurred. Including a profit of 30 percent before taxes for a private operation would increase the cost to roughly $100 per vehicle. Because the operation is relatively low in capital costs, a 50 percent grant from DEC would lower overall costs only about $16 per vehicle. Should prices rebound to the 1981 levels of $65 per ton, costs for the operation in Juneau would drop to $61 per vehicle or $79 per vehicle with a 30 percent profit (no grant money). According to car recyclers in Seattle the market is unlikely to rebound to this level until the world economy improves. Currently, the Japanese have stopped buying U.S. salvaged cars, and the rest of the foreign and domestic markets are weak.

Materials Salvage Yard

One other type of recycling program that may be feasible is the salvage of reusable materials. This may be particularly beneficial in a city like Juneau where the high population turnover results in many discarded but still useful goods, and where unavoidable shipping costs result in high prices for new merchandise.

TABLE 4.4

ESTIMATED COSTS FOR ABANDONED CAR RECLAMATION
(1,500 Cars)

Category	Cost Capital ($1,000)	Cost Annual ($1,000/Yr)
Costs		
° Site Costs		
- Land purchase (5 acres @ $40,000/acre)	200	
- Improvements	50	
- Miscellaneous	10	
Subtotal	$260	7[a]
° Equipment (Used)		
- Scales	20	
- Tow truck (1)	15	
- Mobile car crusher	100	
- Loader	120	
Subtotal	255	41[b]
° Operation		
- Fuel and maintenance		25
- Labor (1 operator, 1/2 clerical)		50
- Administration and Overhead		20
Subtotal		95
° Transport and Shipping		
- Haul from remote crushing site to yard ($10/car)[d]		8
- Haul to Barge ($10/car)		15
- Shipping (0.5 trips)[c]		38
Subtotal		61
TOTAL ANNUAL COST		204
REVENUE		
° 1,500 vehicles (1.15 tons/vehicle @ $53/ton)		$91
NET ANNUAL COST		$113
NET COST PER VEHICLE		$75
NET COST PER VEHICLE (50% Grant)		$59

a Excluding cost of land purchase
b Calculated at 10 year life, 12% interest, 10% salvage
c If empty back haul available, cost will be 50 percent less
d Not all cars will be crushed at a remote site

This type of recycling has worked successfuly in several communities in the lower 48, most notably near Berkeley, California. A local recycling group called Urban Ore, has established a salvaged materials yard near one of the areas landfills. As residents approach the landfill with loads of waste, they are enticed to stop off at the salvage yard to donate or sell reusable items. These include: furniture, plumbing fuxtures, pipe, wire, toys and especially used lumber. Urban Ore workers sort, clean, perform minor repairs, and price the material. Residents can purchase items from a neatly sorted salvage area on their way home from the landfill. It is best to locate the salvage yard at or near the landfill so it is convenient for residents to drop off or buy the materials. Channel Sanitation, JAWS, or some other recycling group or business should consider establishing a material salvage yard to reduce waste volumes at the landfill, gain a moderate revenue, create jobs, and provide a service to the residents of the CBJ.

Further information on the unique program in Berkeley can be obtained by contacting Urban Ore, Inc., 1325 Sixth Street, Berkeley, California 94710.

SECTION 5

FUNDING ALTERNATIVES

SECTION 5

FUNDING ALTERNATIVES

Grants for construction of solid waste facilities are potentially available from three sources. These grants in combination could theoretically provide for funding of up to 100 percent of the construction costs of a solid waste project. However, any grant funding beyond 60 percent of the capital cost of a project must be through special State or Federal legislation under programs currently available.

ADEC FORMULA GRANTS

Alaska Department of Environmental Conservation (ADEC) can provide authorization for funding up to 50 percent of most municipal solid waste construction projects. If the project involves resource recovery, the resource recovery portion of the project can be funded up to 60 percent of the capital cost. Although these grants can be processed and authorized in-house at ADEC without special legislative authorization of a specific project, the monies authorized for construction by ADEC must be authorized through State legislation. At this time, no monies are authorized for disbursement. In other words, ADEC may certify that a solid waste project is eligible for grant funding up to 50 or possibly 60 percent of the capital cost, but monies are not currently available for funding such projects.

SPECIAL LEGISLATIVE APPROPRIATION

Another grant source commonly utilized in Alaska, especially in recent years, is that of special legislative appropriation. Every year a certain number of projects are earmarked by the State legislature for special funding. Special legislation can fund any percentage of a project. On some recent projects, the special legislation has made 50 percent of the project capital cost available as a match to the ADEC grants. In other words, State money matches State money for a total 100 percent grant. An example of the 100 percent State grant was the recent planned construction of a septage treatment facility in Wasilla. Another example was construction of a solid waste baling facility in Homer. In that case, certain surplus revenues had been allocated to municipalities on a per capita basis. The Kenai Peninsula Borough elected to utilize a portion of those monies to match the 50 percent ADEC grant for construction of the solid waste baler.

The City of Sitka is presently in the process of securing a 50 percent grant through this type of a special state legislative appropriation for their new co-combustion, waste-to-energy project.

EDA GRANTS

A third remote possibility for grant funding is through the Department of Commerce, Economic Development Administration. That agency is currently considering funding up to 60 percent of a solid waste facility on Kodiak Island. The EDA grants have very specific requirements regarding unemployment statistics in the area to be benefited and regarding the creation of long term jobs. Qualifying for an EDA grant requires special legislative appropriation at the Federal level. The EDA grant can be used to match ADEC grants for up to 100 percent funding.

EPA CLEAN WATER ACT GRANT

One other alternative for funding of projects involving sludge disposal is the EPA Clean Water Act Grant program. Two sludge disposal alternatives being considered in Juneau may be eligible for EPA funding, use of the sludge as cover soil or a soil amendment, and co-combustion.

Projects involving the productive land use of sludge are classified as innovative by EPA and are eligible for 85 percent funding of capital costs (vehicles, land, sludge spreading equipment, etc.). In Juneau, this could include both use of the treated sludge for cover material at the landfill, or sale of the sludge to local residents as soil amendment.

The co-combustion of sludge with refuse would also be eligible for 85 percent EPA funding. However, under EPA's Multiple Purpose Policy, only the sludge portion of the project is eligible. Thus in Juneau if 50 TPD of refuse is to be burned with 5 TPD of sludge, only 10 percent of the incineration system would be eligible.

In October, 1984 the Clean Water Grant program will reduce it's funding to 55 percent for conventional systems, and 75 percent for I/A projects. Therefore it is advantageous to move quickly toward preliminary design and grant eligibility of these projects.

APPENDIX A

POTENTIAL LANDFILL SITE SOIL EVALUATIONS

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POTENTIAL LANDFILL SITE
SOIL EVALUATIONS

The following information was developed from researching existing reports and related data, personal knowledge of the areas investigated and a brief field visit and overflight. No subsurface exploration or sampling has been conducted on the sites to date. Assumptions or conclusions reached in this report were done so without the benefit of the subsurface reconnaissance necessary to affirm geologic conditions, and therefore should be considered preliminary in nature.

In all, four potential landfill sites are discussed in this soils report: Eagle Creek, Lemon Creek, State Correctional Center, and the existing Channel Sanitation landfill. Although several others were investigated during the study process, (including Sheep Creek and Mountain Creek sites) they were turned down as potential sites for a variety of reasons including location, drainage or groundwater conditions, access, etc.

Of the four sites finally selected for consideration, three of these are within the Lemon Creek drainage with the fourth across Gastineau Channel on Douglas Island. Sites are number to coincide with the numbers given in Section 2 of the report.

Existing Landfill

The existing landfill is located near the outer or seaward boundary of the Lemon Creek alluvial fan (see Figure A.1). The area is subject to tidal influences from the adjacent Gastineau Channel and exhibits characteristics of both alluvial fan and estuarine depositional influences. Typically the area has a low relief topography. Access is provided from the nearby Lemon Creek Road which at one time was the main arterial between the airport and Juneau proper. This was replaced several years ago by construction of the airport freeway seaward of the proposed site. This has somewhat isolated the area from Gastineau Channel, although tidal influence continues through culverts and the Lemon Creek bridge.

Present use of the landfill occurs above high water or ground water levels. This consists of excavating shallow cells isolated by embankments around the perimeter, backfill of the solid waste and an overlayment of fine grained soils to shed moisture. The end result is a land surface several feet above the surrounding natural terrain.

Gravel deposits occur beneath the landfill which in some adjacent areas have been mined, below tidal or groundwater levels. Environmental restrictions on the present operation would however, require either backfilling gravel excavations with soils to a point above groundwater influence or leaving the gravel resource in place.

Surficial deposits in the area have been affected somewhat by isostatic rebound or gradual upward movement of the land surface. Thus, some fine grained intertidal soils have been elevated above the present tide levels. These intertidal soils are from 5 to 7 feet thick gradually increasing in depth seaward. These consist generally of soft to moderately stiff cohesive silts and sandy silts with little to no gravels.

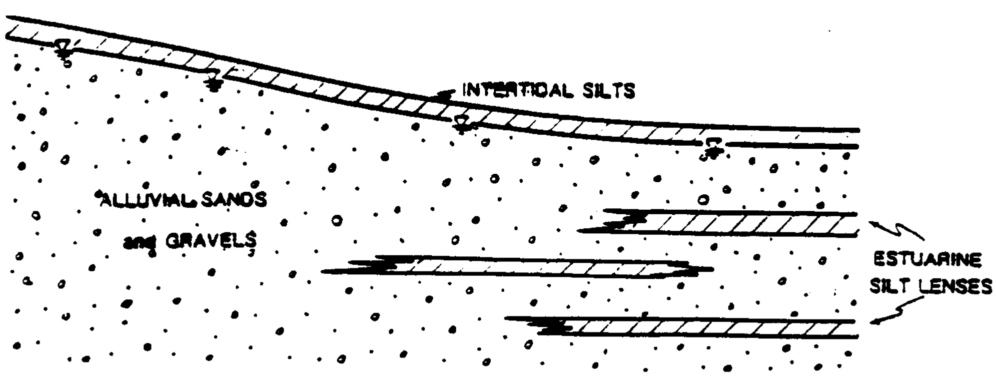


FIGURE A.1 GENERALIZED SOIL CONDITIONS AT THE EXISTING LANDFILL

The underlying alluvial fan deposits consist of sands, gravelly sands and sandy gravels. It is suspected that lenses of estuarine silt and sandy silt are interfingered with the gravels particularly at the outer or seaward end of the fan deposits.

Groundwater conditions are influenced by the fresh waters from nearby Lemon Creek and saline waters from Gastineau Channel. The granular alluvial deposits are highly permeable and will generally be saturated throughout this area.

Proposed Site No. 2 - Eagle Creek

Site No. 2 is situated on Douglas Island in the vicinity of Eagle Creek, approximately 1-1/2 miles northwest of the Juneau Douglas Bridge (see Figure A.1). The site consists of an elongate bench trending parallel to Gastineau Channel and some 500 feet or more in elevation. An existing borrow or gravel pit is located downslope and adjacent to Eagle Creek. At the present time no surface access is available to the site. Vegetation consists primarily of muskeg and small spruce indicative of poor drainage conditions. This area is a part of the Eagle Creek Drainage System.

The bench along this area was created by glacier scouring of the bedrock followed or accompanied by deposition of glacial fill materials. Typically, the makeup of the till will consist of compact gravelly sandy silts and clays. Normally this type of deposit is tight, exhibiting poor permeability characteristics. Some reworking of the till may have occurred as a result of stream action associated with the Eagle Creek tributaries. If so, some cleaner sandy gravel lenses or deposits could be intermixed with or possibly overly the till.

The surface muskeg deposits probably consist of a blanket layer of moist to saturated poorly drained organics grading to organic silts at depth.

Bedrock in the area is probably shallow and consists of steeply dipping and highly fractured meta-sediments similar to those described previously.

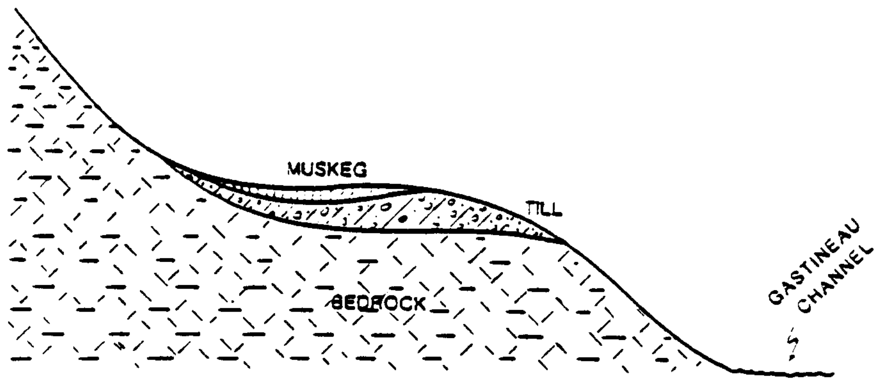


FIGURE A.2 GENERALIZED SOIL CONDITIONS AT SITE NO. 2

Groundwater throughout the area probably rests on the tight or impermeable till and is directly connected to the surface drainage. Moisture is supplied both from the Eagle Creek drainage and as runoff from adjacent mountain slopes.

Proposed Site No. 3 - Lemon Creek

Site No. 3 is located along the south side of Lemon Creek at the distal or upper end of the Lemon Creek delta and approximately 1/2 mile upstream from the existing landfill (see Figure A.1). A trailer park, supposedly in the process of being closed down, occupies a portion of the area under consideration. An existing borrow pit is also located in this area immediately to the south of the trailer park and abutting the steep hillside. Exposures along the borrow area outbanks and previous gravel exploration in the area provide a good indication of subsurface conditions.

Granular subsurface soils within the stream valley consist of clean well graded sands to gravelly sands and sandy gravels with occasional cobble and boulder sized materials. Density of the materials probably varies from loose to medium dense. These deposits have excellent permeability and, we suspect, a relatively moderate to low soils moisture content above groundwater level. Based on the previously mentioned borings and exposures, the gravel deposits appear to be fairly extensive in depth and probably extend at least below the present elevation of Lemon Creek.

The toe and lower slopes of the adjacent steep hillsides which border to the west are mantled with colluvial deposits resulting from gradual weathering and erosion of the steep hillside and are probably intermixed with remnants of higher stream or alluvial bench deposits. This deposit is probably wedge shaped in cross section gradually thinning toward the present stream valley. The colluvial soils will generally consist of silts and sandy gravelly silts with varying amounts of generally angular cobble and boulder sized fragments. Moisture contents

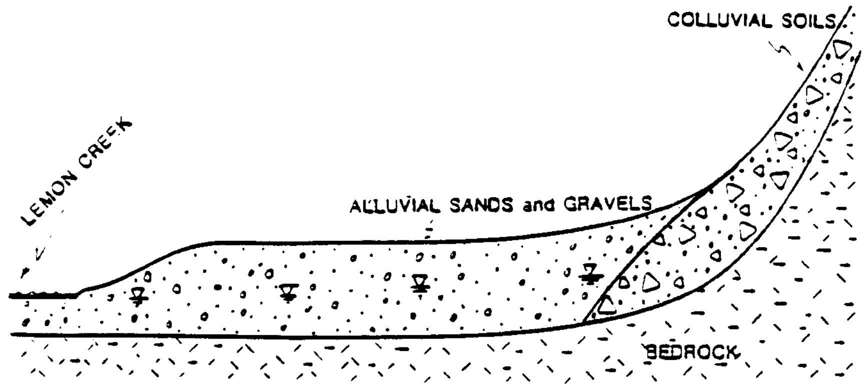


FIGURE A.3 GENERALIZED SOIL CONDITIONS AT SITE NO. 3

probably vary from moderate to high with the soils having generally poor permeability characteristics.

The colluvial deposits and alluvial gravels are underlain at varying depths by a highly folded and fractured, meta-sedimentary bedrock. Actual bedrock outcrops occur higher on the slopes.

Groundwater elevations will undoubtedly vary throughout the area dependent somewhat on localized drainage conditions, the possible occurrence of fine grained impermeable deposits and other factors. In general, it is assumed that groundwater will be encountered at the elevation of Lemon Creek with a gradual upward trend laterally toward the hillside. Use of the area would probably require some type of drainage control along the hillside to prevent an influx of both surface runoff and groundwater.

Proposed Site No. 4 - State Correctional Center

The proposed Site No. 4 is located on a high bench along the northern side of Lemon Creek and behind the State prison facility (see Figure A.1). The site is accessible from a rough cut trail or road leading up a steep embankment from the prison road system. A few acres have been previously cleared and apparently some timber cutting has taken place. The area is fairly level with a gentle slope to the south. No streams appear to cross the area with the exception of a small drainage along the western edge at the base of a steep southwest trending mountain slope.

The surficial deposits are composed of remnant delta or high stream bench alluvial materials laid down by Lemon Creek and later abandoned as the creek became incised in its present location. The upper few feet contain silty sandy gravelly deposits of a poorly developed residual soil. Underlying these we would expect to encounter fairly clean and well drained sands and sandy gravels typical of this type of stream deposition. Gravelly materials are also exposed along the narrow roadway cut leading up to the site, giving the impression of an extremely thick deposit. It is suspected, however, that the gravel deposits although possibly several tens of feet thick are underlain by a bedrock remnant erroded and leveled off by Lemon Creek, but not incised as it is further to the south. However, confirmation of the subsurface profiles and geology in this area would require test drilling.

Bedrock in the area is undoubtedly similar to Site No. 3, consisting of greenstone and greenshist interbedded with black and gray slaty phillite and graywacke meta sediments. Although masked by the alluvial materials, we would expect the bedrock to be steeply dipping and highly fractured.

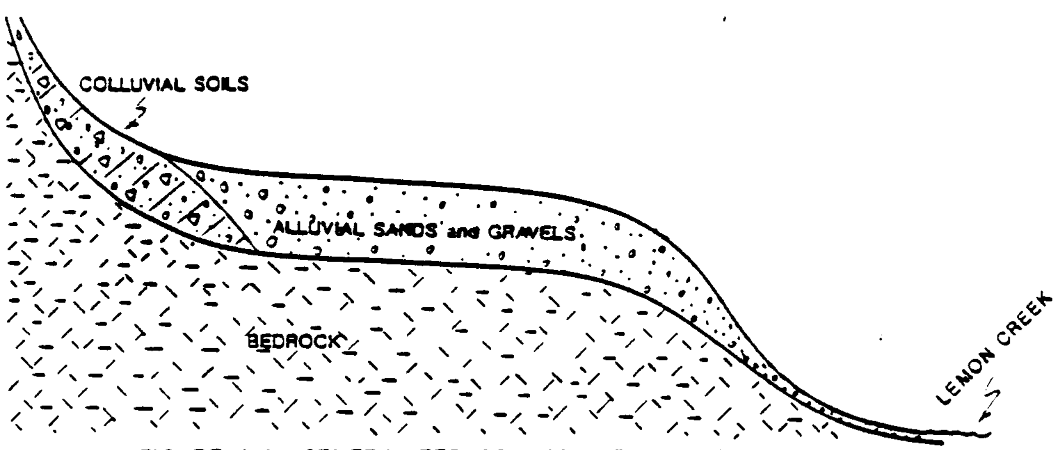


FIGURE A.4 GENERALIZED SOIL CONDITIONS AT SITE NO. 4

Unless fine grained sediments occur within the alluvial gravels, we would expect that the groundwater occurs fairly deep throughout the area at or near the alluvial-bedrock contact. Along the western edge, a potentially higher bedrock profile probably results in a shallower groundwater condition.

Conclusions

The existing landfill site appears to offer good opportunities for expanding the present operation. It has the advantage of general although possibly grudging acceptance by the populace since it has been in operation for a number of years. It also provides good access from Juneau and environs. One major drawback is the limit placed on the depth of solid waste backfill by the high groundwater level. If the underlying gravels could be mined and backfilled with solid waste below groundwater, a greater economy of operation could be achieved through offsetting dump costs by the sale of gravels. Through proper engineering and construction of isolating dikes and pumping, it is believed the solid waste backfill could be emplaced in a relatively dry condition. However, when dewatering is stopped, the surrounding permeable soils will allow saturation to quickly occur. This rapid infiltration could possibly be stopped or greatly retarded by placement of a thick clay liner along the bottom and sides of the excavation prior to filling with refuse.

Site No. 3 contains significant quantities of excellent gravel materials which will be mined in the near future. It also has good access to the Juneau road system. Although backfilling with solid waste would seem to be advantageous, the proximity to Lemon Creek (an anadramous fish stream) and potential for a hydrologic connection through the gravel soils could curtail the use of this site as a landfill area unless effective drainage control and leachate collection systems are constructed.

Mining and sale of Site No. 4 appears to offer good potential. Existing gravel reserves which may be extensive could help offset landfill development and operational expenses. Drainage or contamination of groundwater does not appear to be a problem, although this and the extent of gravels would need to be confirmed through an extensive subsurface exploration program. Near-surface residual soils could possibly be used to provide a moisture shedding surface barrier. Access to the site, although presently rough, could easily be improved. Visibility of the site is also limited by topography and forrest cover.

Site No. 2 has several disadvantages including a lack of available access, poor drainage conditions and probably generally poor soils. Concern of contamination of Eagle Creek is an added problem. Use of the site could probably require continual and expensive drainage control and mantenance.

In closing, we would again point to the preliminary nature of this study and suggest that a detailed subsurface exploration program precede any site selection.

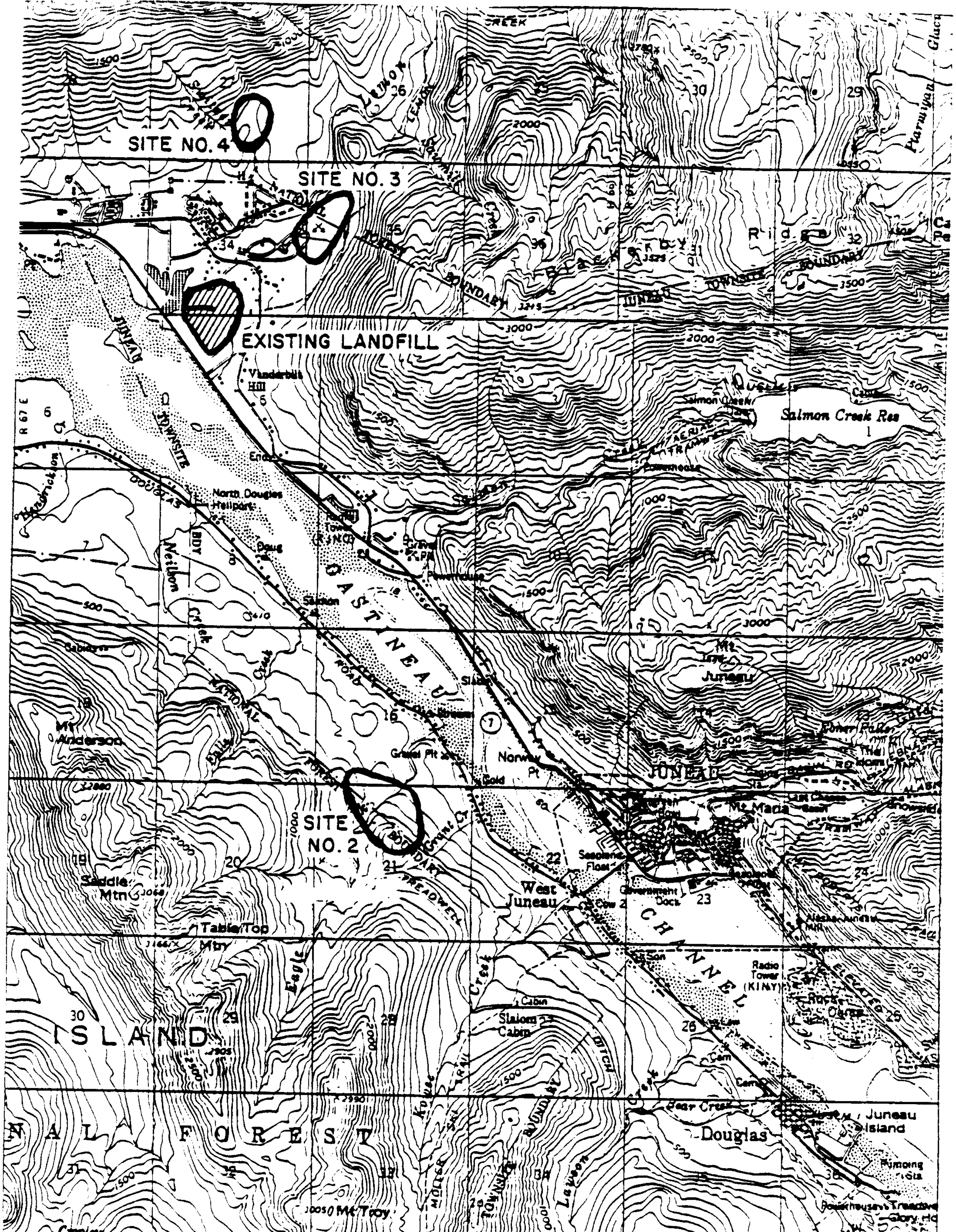


FIGURE A.1 APPROXIMATE SITE LOCATIONS.

APPENDIX B

ENERGY USAGE AT THE BARTLETT MEMORIAL HOSPITAL, STATE CORRECTIONAL CENTER, AND SCHOOL COMPLEX

TABLE B.1

FUEL USAGE AT THE BARTLETT MEMORIAL HOSPITAL

Month	Fuel Oil (Gallons)	Cost ($)
March 1982	13,439	14,837
April	15,435	16,624
May	10,478	11,096
June	9,880	10,463
July	5,465	5,779
August	8,222	8,694
September	9,723	10,283
October	9,299	9,869
November	13,763	14,223
December	12,601	13,515
January 1983	14,669	15,732
February	11,751	12,605
TOTAL	134,725 gal/yr	$143,720/yr
Monthly Average	11,227 gal/mo	$ 11,977/mo

TABLE B.2

ELECTRICITY USAGE AT THE BARTLETT MEMORIAL HOSPITAL

Month	Electricity (KWH/Mo)	Cost ($)
March 1982	96,000	5,755
April	84,800	6,886
May	124,900	8,066
June	103,700	7,244
July	114,000	6,984
August	92,700	5,779
September	126,300	7,619
October	98,700	6,135
November	118,500	7,329
December	137,300	7,899
January 1983	140,900	8,335
February	94,300	6,185
TOTAL	1,332,100 KWH/yr	$84,216/yr
Monthly Average	111,008 KWH/mo	$ 7,018/mo.

TABLE B.3

FUEL USAGE AT THE
STATE CORRECTIONAL CENTER/JUNEAU

Month	Fuel Oil (Gallons)	Cost
March 1982	6,713	$ 7,412
April	7,885	8,565
May	5,429	5,750
June	5,421	5,741
July	5,245	5,555
August	3,910	4,141
September	3,887	4,155
October	5,266	4,989
November	8,509	9,111
December	9,746	10,516
January 1983	9,971	10,801
February	6,386	6,891
TOTAL	78,372 gal/yr	$83,628/yr
	6,531 gal/mo (average)	$ 6,969/mo
Anticipated use after completion of new construction	102,200 gallons/yr 8,520 gallons/mo (average)	

TABLE B.4

ELECTRICITY USAGE AT THE
STATE CORRECTIONAL CENTER/JUNEAU

Month	Electricity (KWH/Mo)	Cost ($)
April 1982	76,700	$ 5,959
May	93,600	6,010
June	80,400	5,555
July	96,100	5,617
August	76,900	4,581
September	97,500	5,737
October	82,600	4,941
November	101,800	6,024
December	110,700	5,417
January 1983	115,700	6,207
February	72,700	4,345
March	96,700	4,239
TOTAL FOR YEAR	1,105,400 KWH/yr	$64,632/yr
Monthly Average	92,117 KWH/mo	$ 5,386/mo
Anticipated Use after completion of new construction	1,446,100 KWH/yr	
	120,507 KWH/mo	

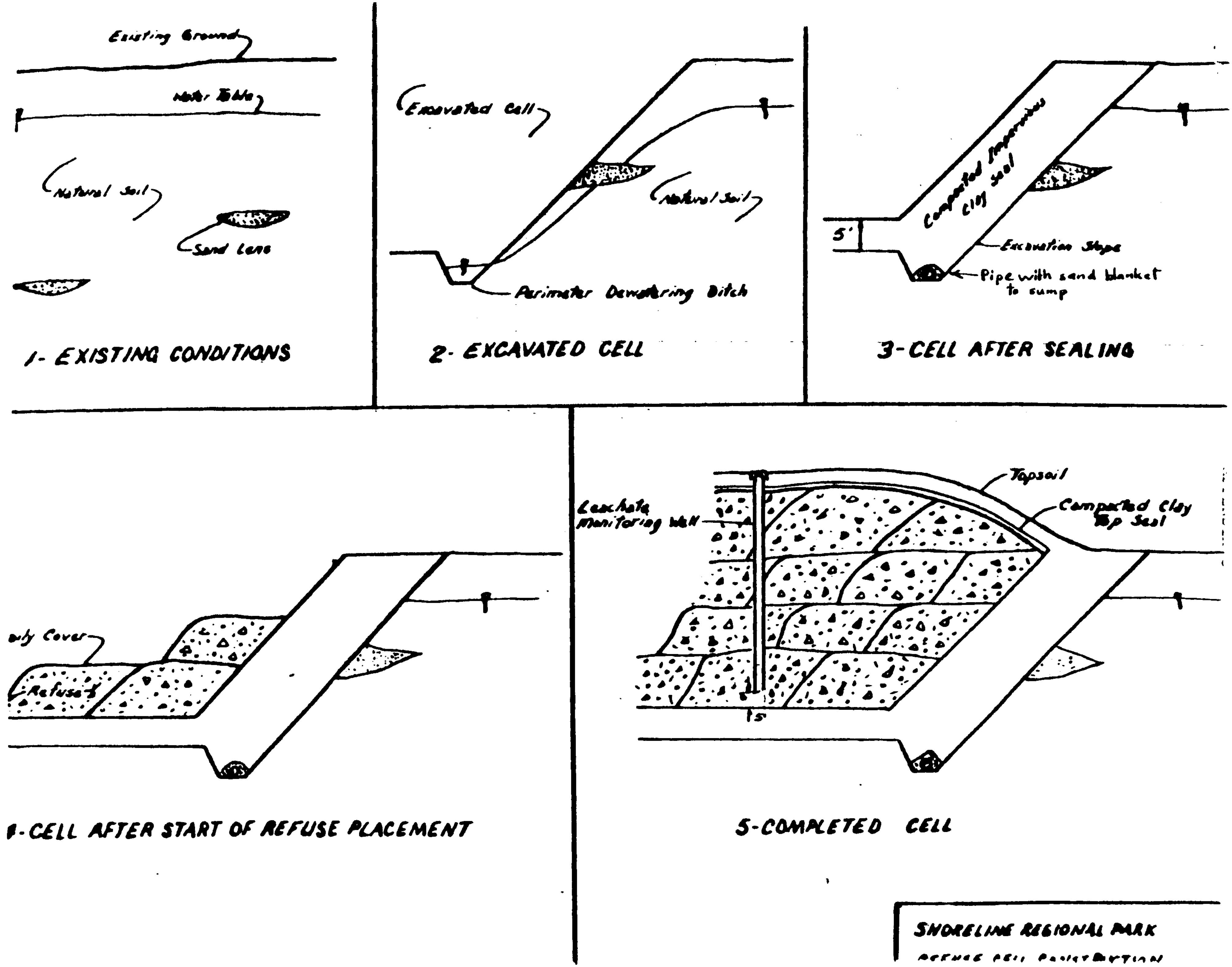
TABLE B.5

FUEL USAGE AT JUNEAU SCHOOL COMPLEX

Month	Gallons of Fuel Oil				
	Swimming Pool	Harbor View School	Marie Drake Jr. H.S.	Juneau/Douglas High School	Total Complex
July 1979	2,920	0	0	1,797	4,717
August	2,420	0	0	1,787	4,207
September	3,445	1,100	0	786	5,331
October	4,115	3,587	3,755	6,373	17,830
November	4,231	3,529	2,302	6,692	16,754
December	6,019	3,700	2,182	7,823	19,724
January 1980	4,601	8,629	4,213	12,133	29,576
February	5,604	3,531	2,089	7,988	19,212
March	5,097	4,975	2,776	6,368	19,216
April	5,139	3,928	3,426	7,191	19,684
May	4,567	3,316	3,227	4,767	15,877
June	3,214	396	1,220	2,542	7,372
TOTAL	51,372	36,691	25,190	66,247	179,500

APPENDIX C

TYPICAL REFUSE CELL CONSTRUCTION, MOUNTAIN VIEW, CALIFORNIA LANDFILL



Existing Ground
Water Table
Natural Soil
Sand Lens
1- EXISTING CONDITIONS
Excavated Cell
Natural Soil
Perimeter Dewatering Ditch
2- EXCAVATED CELL
Compacted Impervious Clay Seal
5'
Excavation Slope
Pipe with sand blanket to sump
3-CELL AFTER SEALING
Daily Cover
Refuse
4-CELL AFTER START OF REFUSE PLACEMENT
Topsoil
Compacted Clay Top Seal
Leachate Monitoring Well
5'
5-COMPLETED CELL
SHORELINE REGIONAL PARK