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Volume Reduction of Refuse

Seminar Proceedings

**Solid Waste Management
Report EPS-3-EC-76-9**

**Environmental Conservation Directorate
May 1976**

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VOLUME REDUCTION OF REFUSE
Seminar Proceedings

Sponsored by
Environment Canada
and
Newfoundland Department of Provincial
Affairs and Environment

Held
February 17, 1976
St. John's, Newfoundland

ABSTRACT

A one-day seminar was held on February 17, 1976 in St. John's, Newfoundland. Jointly sponsored by the Newfoundland Department of Provincial Affairs and Environment and Environment Canada, the seminar dealt with an important aspect of solid waste management known as volume reduction. The two principal methods of volume reduction, compaction and shredding, were discussed by speakers chosen for their many years of experience in their respective fields.

RÉSUMÉ

Le 17 février 1976 un séminaire s'est tenu à Saint-Jean, Terre-Neuve, parrainé conjointement par le ministère terre-neuvien des Affaires provinciales et Environnement Canada; ce séminaire a porté sur un important aspect de la gestion des déchets solides, la réduction du volume des déchets. Des participants choisis pour leur longue expérience ont traité des deux principales méthodes appliquées à la réduction des volumes, c'est-à-dire le compactage et le déchiquetage.

FOREWORD

At the request of the Newfoundland Department of Provincial Affairs and Environment, a seminar was held in St. John's where two speakers presented papers on the volume reduction of refuse.

Jointly sponsored by the Provincial Government and Environment Canada, the seminar addressed itself to refuse compaction and shredding.

Each of the speakers has many years of experience as a working professional in daily contact with his subject.

Environment Canada is pleased to have had the cooperation of these two individuals in making available their experience to a national audience by means of this publication.

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VOLUME REDUCTION OF REFUSE

Seminar Proceedings

CHAIRMAN'S OPENING REMARKS

Mr. L.P. Fedoruk
Chief, Federal Activities and Solid Waste Division
Atlantic Region, Environmental Protection Service
Environment Canada
Halifax, Nova Scotia

Good morning gentlemen. My name is Lawrence Fedoruk and I will be acting as your Chairman today. It is a seminar that was requested by your Department of Environment and it is a seminar on solid waste reduction so that we have some means of reducing volumes so that we can finally dispose of them. The two topics today are Solid Waste Baling and Solid Waste Pulverization. Before we get into the talks, Mr. Cyril Downey, Assistant Deputy Minister of the Environment would like to say a few words.

WELCOMING ADDRESS

Mr. Cyril J. Downey
Assistant Deputy Minister (Environment)
Newfoundland Department of Provincial Affairs
and Environment
St. John's, Newfoundland

Thank you Lawrence. First of all, I would like to bring you greetings from the Minister and Deputy Minister, both of whom are out of the Province at the moment. They will be back this morning we hope and the Minister says he is going to get around today if he gets in. They have great concern for this matter of waste disposal. As you know we had quite a hectic time of it, of late, getting our fingers burnt with the Ruby Line Affair, and we had quite a tumultuous time over in the Conception Bay Center area. Other areas are of equal concern but seem to be straightening themselves out very well. Areas that Roger Saunders has been active in on the West coast seem to be settling down nicely, around the Deer

Lake area. Others with Roger Pottle and the boys up in the Port Rexton area are coming along and there is really satisfactory activity taking place there. It is very gratifying to the Minister and Deputy Minister and myself.

We all have changing opinions, I guess, about waste disposal. The thing that is fairly evident to all of us is that we are in a transient period with our thinking, with our type of waste, and it behooves us to find a more satisfactory way to take care of it. We know that Councils have a mandate to look after the waste for their various communities; they have this responsibility. We in Environment have a responsibility and mandate that makes it necessary for us to encourage and to do all we can to help out in this area that is so important environmentally.

The means of taking care of waste are not all that satisfactory in this energy conscious period.

People are turning more to the burning of waste to generate fuel from it. That in itself is a most wasteful way to handle it. We have all been made aware of that. The economic times are not conducive to salvage too well.

We've had the experience with trying to put together metals, papers and this type of thing and it's not quite satisfactory. I think it is important to realize that these things are not satisfactory. We had an excellent example of an ingenious approach to this thing a little while ago. You probably saw it as well as I did. Out in Hawaii, their present method of taking care of old cars is fascinating. This probably would not be acceptable to our Environment Canada people, but they have found that by taking cars and dumping them out in the sea at different strategic locations that they are developing strains of fish habitat and various protective areas that are conducive to growing bigger and better fish and more species that didn't live in that habitat before. This is an interesting approach.

In regard to newspapers, it is kind of futile to think of recycling newsprint, when at the same time we've got to find a way of handling it. It's shocking to take 50-60 years to grow a tree, consume it over a period of a few months, use it for something that takes about five to ten minutes of our day and then discard it on the scrap heap or burn it. There has got to be a better means of utilizing this valuable fibre. It's up to engineers, biologists, all of us, communities, universities, to come up with something better than we are doing on this.

The seminar that we are having here today is an approach, at least it is going to conserve some space, when anybody reduces something, especially waste. It means that it takes less area in which to store it. Today, space is getting to be an expensive item. So that I think we are all going to look forward with a great deal of interest to what these learned gentlemen or experienced people have to tell us about, at least a step in the handling of waste and that is, it's reduction.

We are pleased to have a little part in this from the environment point of view. We appreciate what Environment Canada has done to pull this program together and to make it possible for us. I appreciate the efforts of our own chaps, Carl Strong and the boys in getting the arrangements made. So with that, welcome to you.

Some of you had a hard time with the weather yesterday, getting here, I know and I'm sure we will have a nice little seminar throughout the day. Lawrence - thank you very much.

CHAIRMAN'S REMARKS

Mr. L.P. Fedoruk

Thank you very much Mr. Downey. Our first speaker this morning is Mr. Morris Waxman. He is the President of I. Waxman and Sons Limited in Hamilton, Ontario and has been an active recycler for 30 years. In 1957, he experimented with recovering materials from household refuse before the term 'recycling' became fashionable. Mr. Waxman began baling refuse in 1965 and became associated with a commercial-scale baling operation in 1970. I think Mr. Waxman should have some valuable information for everyone here. Mr. Waxman.

REFUSE COMPACTION AND BALING

*Mr. Morris Waxman
President*

*I. Waxman and Sons Ltd.
Hamilton, Ontario*

Before I get into my prepared talk, I would like to thank Bob MacKenzie for inviting me to Newfoundland. It is the first time I, as a native-born Canadian, have been to the eastern part of Canada and I would like to thank him for that opportunity. I would also like to thank him for just having me here this morning and I hope that whatever I have to say will either leave you with something to think about or something to ask about.

But I'll tell you really how I feel this morning. I feel like the fellow that was introduced at a large gathering one day something like this: 'Mr. Jones, a very distinguished gentlemen, of the community has over the past several years accumulated millions of dollars by discovering oil in Texas'. When Mr. Jones came to the rostrum to address the gathering, and thank the man that introduced him he said there was just one slight problem with his introduction. He said 'it wasn't Texas, it was Kentucky; it wasn't oil; it was coal, he didn't make several million dollars, they lost ten million; it wasn't him, it was his brother'. The reason I'm telling you that is because when Bob first called me he asked me if I would speak on the high compression baling of solid waste and I started to write something on that. About ten days later I got this official piece of paper in the mail and there are the headings that he wanted me to talk about - I think there's probably 30 of them there and they go from compactor trucks, transfer vehicles, stationary compactors, transfer stations, compaction by vehicles and landfill, high pressure compaction plants - I've only read you the first little bunch there. So what I have done is I had included a little bit about all of these items and the examples I am giving you are examples that we ourselves have run into in our own business. Then I have taken the latter half of the paper and have it exclusively on the high compression baling of solid waste.

The compaction of solid waste takes many forms and uses, and varies as far from you or I pushing an extra bag of household garbage into a garbage can at our home, to the production of high compression bales weighing from 2000 lbs. to 6000 lbs.

The equipment you could consider in this category of compaction of baling, also varies from the at home compactor, installed in your kitchen, various types and sizes of stationary compactors, compactor trucks of various sizes, and then to high compression baling on a production line for complete municipalities.

Each of these particular pieces of equipment were devised and *should* be tailored to a particular problem and use.

For example, any particular plant, commercial building or industry that has refuse or solid waste to dispose of, may have a pick up once a week. Now this could be satisfactory for this particular situation. But there may be problems where certain plants need service once a day, or certain parts of any plant, commercial building or industry may need service daily or by the hour.

Now, these factors come into play. What is the accessibility to the refuse produced? What is the traffic like in the immediate area of the plant or building to be serviced? And what is the truck time for final disposal before the truck can return for more service to the plant or building?

If any or all of the above are problems, you now have a perfect situation for compaction equipment to do a job it can do best. The compaction equipment can be sized to the problems I have just mentioned.

Let us take this set of circumstances; a plant produces 40 cubic yards of solid waste per day. The vehicle servicing this plant has to be in the plant once every day without fail, or you now have a greater problem, even to the point that production in one particular area might have to stop. Most stationary compactor manufacturers produce a machine that will give approximately 4 to 1 compaction. Using this figure as a guideline the service vehicle would make 1 trip to the 4 it previously made, saving the refuse company 3 trips to the landfill site and the plant has reduced its traffic in plant by 4 to 1 which I am sure has also resulted in a direct saving in disposal cost to the customer.

Aside from reducing a given problem by 4 to 1, you have also reduced the fuel consumption by 4 to 1 for the vehicle, which to say the least is very important.

Most if not all reasons for using compaction in industry, or commercial buildings is to reduce the volume, and save money, but some supposed knowledgeable people, who tell customers what to use, have some far-out reasons for the particular type of equipment they recommend to a customer.

A case in point: approx. 5 months ago, the manager in our refuse dept., had to look into why we were having trouble servicing a compaction unit at a new shopping plaza. Let me say now, that we did not have anything to do with the selection of this equipment. The equipment was new, and was on the site; what the customer required was service by one of our front-end loader trucks only.

Through several conversations with the architect of the plaza, who also chose this equipment, we found out the reasons for his choice. It was 'aesthetics', what had looked good, out at the back of the store. These were some of the problems,

- 1) the packer unit was too small
- 2) the container would not fit the truck that had to service this unit
- 3) he wanted only one container out at the back of the store.
- 4) an extra container had to be used in any event and

5) this is most important;

the people from the store had to disconnect the full container and replace it with the second empty container, the reasons-one container could not handle the amount of refuse for one full day.

What should have been put there, is a compactor that would have handled the largest piece or carton they had to dispose of. The compactor unit and controls could have been placed inside the building, so that no personnel would have to go outside, to dispose of the refuse. The compaction container would have been outside, and of the proper size not to require a maximum number of trips, and allowing the store to have storage all day, instead of loose refuse outside the store and around the container.

I am quite sure that what is obvious to you right now, is that someone goofed. Putting together a proper package for a customer is most times, and I can say all the time, quite simple, if given all the facts to work with.

I don't really know whether the architect can be blamed, he wanted to maintain the "aesthetics" of the building, and the surroundings and that's fine. But the customer had a disposal problem! If the architect would have consulted someone that is actually doing this type of work daily; by that I mean people who are in the refuse disposal business, people who use a variety of pieces of equipment, from various manufacturers, he would have found a proper installation, that looked every bit as good and maybe better.

Private haulers are really not tied to any particular manufacturer, and usually pick from all to suit the job, both for efficiency and service.

What I am trying to tell you, is that architects and designers put together multi-million dollar buildings, plants, and shopping plazas and forget, that somehow the garbage has to be disposed of, and more important it has to be removed from the plant efficiently.

I would conclude to this point and time if there are any experts in the handling of solid waste for commercial and industrial refuse, it would be your local refuse hauler; and why these people are not consulted more often, is something that I cannot fully understand.

The architect, the designer, and the engineer are professional people, and so are the people in the refuse business.

Another example of how compaction with innovation was used to save time, labour and money;

A plant, because of the nature of the products produced, and type of equipment and machinery needed to produce the products, is housed in a multi-storey building.

On the fourth floor of this particular plant, part of the solid waste that has to be removed, was approx. 55 fiber drums per shift.

The method they were using was,

- 1) the drums are first put on wooden pallets
- 2) by fork lift they are brought down the elevator to the first floor
- 3) after being left on the first floor, the fork lift goes back up the elevator to the fourth floor for more productive work

- 4) a fork lift from the first floor, now has to take the pallet, loaded with drums, outside, and leaves the pallet and drums beside the refuse bin
- 5) someone else has to unload the pallet by hand and place the drums into a 40 yd. container.

There is a considerable amount of labour, in man-time and fork lift-time, consumed in unloading a pallet when you consider that there are only 4 drums per pallet.

This is how compaction turned a materials handling problem into a time saving, labour saving, and disposal cost saving solution.

The fiber drums are 19", 21" and 22" in diameter and 27", 33" and 38" high, made of a very strong and heavy fiber, with a galvanized steel ring at the top and bottom of the drum for extra strength.

Before I carry on, I would like to inform you, that these drums could not be re-used and had no salvage value.

What was used and modified for this particular application, was one of the smallest commercial apartment type packers. The framework at the ram face end, where the packing container is normally attached, was lengthened to accept the longest fiber drums. This was done by extending the framework with 3" x 3" angle iron forming a rectangle 24" x 22" x 46" long, with a 3/4 inch thick steel plate 24" x 22" at the opposite end of the ram. This rectangular space allows the fiber drum to sit in this frame and by pushing one button, the ram is activated and reduces a drum that was approx. 27" long to a 5" pancake.

The time and money was saved this way: the packing unit was installed on the fourth floor, with the plate end of the packing unit through the outside plant wall. A metal chute was attached to the outside wall of the plant, and had an opening to accept the largest diameter drum after it was compressed. The bottom of the chute was 12" from the top of a 6 yd. front end loader container. The 6 yd. container, held more of the compressed drums than are produced in an 8 hr. shift. No one now had to pack drums on a pallet, use a fork truck and elevator to come down to the first floor, have another fork truck take the drums outside, and then have someone unload them. Instead the drum, where it is emptied, is put in the chamber of the compactor, the man presses a button, the drum is compacted at the chute end, and when the ram retracts automatically releasing the pressure, the drum falls down the chute into the 6 yd. container. Time saved, money saved and compaction used.

Some of the specifications for this type of compaction unit would be;

The Motor: 3 H.P. - 1800 R.P.M.
 550 volt 3 phase 60 cycle (standard)
 5 amp service would be required
 or 230 volt single phase 60 cycle
 would require 30 amp service.

Couplings: in this case Nylicon gear type requiring no lubrication

Pump: 3 gpm at 1200 P.S.I. and 1800 RPM 2000 P.S.I. rated

Relief Valve set at 1200 P.S.I. - 2000 P.S.I. rated

Directional Valve: standard 1/8" size industrial type
4 gpm capacity at 3000 P.S.I.

Cylinder: 3 1/2" dia. bore x 38" stroke with threaded gland for
easy packing replacement.

Hoses: To meet S.A.E. 100 R 2 specifications 5000 P.S.I. rated

Ram Size: 22" x 24"

Ram Area: 3.67 square feet

Ram Force 12000 lbs.

Ram Pressure 330 lbs. per sq. ft.

Charging opening when being used conventionally 22" wide x 28" long

Electrical 115 volt circuitry, Industrial full voltage motor starter

Controls: with automatic reset overload relays. Solid state timing
relay. Heavy duty push buttons and limit switches.

The cost of this unit or one similar, by this or other manufacturers is approx. \$3,200.00. The floor space in the plant for this particular installation was 100" x 50".

The complete installation with the outside chute was \$4,000.00. The saving in labour to the plant for handling, I don't have, but the saving in disposal cost was 300 percent.

Similar savings were made by a local 500 bed hospital that had one pick-up of a 40 yd. container per day; when a 1 1/2 yd. compaction unit was installed with a 40 yd. compaction container, they have 1 pick-up per week.

A food market that had a pick-up every day and a half to two days, now has a pick-up every two weeks.

And similar savings were made in heavy industry.

Any size stationary compactor can be installed, with the compaction unit inside or outside the plant or building, and the refuse can be loaded into the machine by hand, by conveyor, by a chute, or by containers that fit to a dumping mechanism, fitted to the stationary packer.

Specifications for this type of unit would be

Capacity	1.5 cu. yd.
Length	117"
Width	69"
Height	57"
Compaction Force	50,000 lbs.
Jog Force	@ 2000 P.S.I. 56,000 lbs.
Cycle Time	35 seconds
Motor	1 - 15 HP
Cylinder bore	6" x 3" rod
Pump, single fixed	

displacement	13 1/2 gpm
Ram Face	30" x 60"
Ram Stroke	47"
Working Pressure	1800 P.S.I.
Jog Pressure	2000 P.S.I.
Penetration	5"
Electrical requirements	Can be 208/220/440 or 550 volt 60 cycle 3 phase power supply.
Rated capacity	86 cu. yds. per hr. @ 80%
Weight	8500 lbs.

Cost of this unit would be approximately \$7,000. Delivery and installation, which is usually done by the manufacturer would be about \$900.00. The customer would have to supply suitable electrical service for hook up, and a cement pad for final installation of the compaction unit. This normally costs approx. \$900.00. And finally, to complete the unit a 40 yd. compaction container, which hooks up to the unit and receives the refuse, could cost \$4,500.00.

The total, \$13,300.00 is a lot of money, which is what this installation would cost. But with any problem that has a solution, the monies spent must pay off; and with compaction and some of the examples I already gave you, 300% is not a bad return.

Stationary compaction units usually range in capacity size, from 1/2 cu. yd. to 11 cu. yds.

The range normally used in apartment buildings would go to a 1 cu. yd.

Most shopping plazas and commercial buildings up to 3 cu. yd., with industry and special types of waste or volume, to approx. 7 cu. yd. compaction units. Some of the questions you should get answers to, before investing in compaction are:

- 1) Will the hopper and charging box handle the largest piece of refuse to be disposed of?
- 2) Will the hopper or charge box be big enough to hold the refuse, for the method of feeding that you choose?
- 3) Is the compaction force sufficient to handle wooden pallets, drums, or heavy cardboard containers, if occasionally you have these items?
- 4) Is the electric motor large enough to do the job?
- 5) Is the hydraulic system and push cylinder sufficient for the ram head?
- 6) Does the ram head penetrate far enough into the compaction container?
- 7) Is the compaction cycle fast enough to accommodate the amount of refuse you have?
- 8) Is the compaction force sufficient to give you the compaction ratio you want?
- 9) Are the electric motor and the hydraulics accesible for maintenance?
- 10) Is the compaction container built strong enough so that it won't buckle or bend?
- 11) Very important! are the couplings for hooking the compaction container to the compactor heavy enough so they will not detach?
- 12) Will the compactor unit fit the space allotted?
- 13) Is there enough space for the compaction container?

- 14) Is there lots of room for the truck to service the compaction container?
- 15) Make sure spare parts are readily available and
- 16) Depending on the size compaction container used, check the legal gross weight a vehicle can carry.

The largest compaction units are normally installed in what is referred to as a transfer station.

Municipalities have installed transfer stations, or have had them installed and operated, by private industry for these two main reasons

- 1) to eliminate a costly long distance haul for the collection vehicles and
- 2) to get more production from the collection vehicle and the work crew that goes to make up this unit.

An actual example of how a transfer station installation paid off - A city in the State of Michigan had a 25 mile haul to their landfill site. They were using 15 yd. packer collection vehicles with a 3 man crew. They made 60 trips per day to the landfill site. After the transfer station was installed, they have 15 transfer-trailer trips per day, and only one man going to the landfill site, the driver of the unit.

You can see with this ratio of truck traffic, the savings in fuel, maintenance to the trucks and the cost of tires, greater efficiency and savings in labour will pay for the transfer station; the actual number of years it would take will depend on the number of tons of refuse handled.

The transfer station itself is made up of the transfer packer, the transfer trailer and a building.

For maximum efficiency of a transfer station the location, if possible, should be central to the greatest volume of garbage picked up. This will give the packer or open type truck, whichever is being used to make curbside pick up, short distance to travel, to dump his load and return to the city streets for another load. Collection units are designed for collection and *not* long distance travel.

This type of set-up, if possible, gives maximum efficiency to the city truck and workcrew, and the transfer/trailer can complete the haul to a landfill site.

The transfer compaction trailer can self-eject the load at the landfill site and return for another.

The building that houses the transfer station is usually a split level or two storey.

At ground level you have the storage area where the vehicles back into the building and discharge the load of refuse and you have the opening to your compaction hopper.

You can feed the stationary compactor by direct hopper feed. This means the collection vehicles dump directly into the receiving hopper, positioned atop the stationary packer. Where large volume and tonnage are involved, collection vehicles can dump onto the concrete floor of the building and the refuse is pushed into the hopper, with a front end loader.

Some transfer stations use the push pit method. The pit is part of, and below the tipping floor. The depth below the floor, and the width are usually 10 ft. wide and 10 ft. high, and the length, at least 40 ft., to allow 4 trucks to dump their load in the push pit at one time. When the pit is full the

operator, by activating the hydraulic mechanism, can move the material directly into the hopper feeding the stationary packer. Although this is a smooth, clean operation it has its drawbacks; while the operator is moving the refuse to the hopper, no trucks can dump into the push pit. So this limits this type of feed to a moderate tonnage operation. Another method of feed to a stationary compactor is by conveyor belt; for refuse, most conveyor belts are made from steel construction, installed in a pit. This would allow the trucks to dump directly on the conveyor, feeding the hopper continuously. Also, with this arrangement you can install reversing mechanism and feed two stationary compactors at each end of the conveyor.

The transfer trailer which is as important as the transfer packer should be well constructed and reinforced with heavy duty tandem suspension and springs, and a proper landing gear to maintain the transfer trailer while it is being loaded.

Some specifications from one Canadian manufacturer for 65 and 75 yd. compaction trailers. The floor of the body is constructed of 7 gauge Stelcaloy steel reinforced.

The walls and the top are 12 gauge High Tensile Steel reinforced.

The ejection ram is 10 gauge High Tensile Steel reinforced.

The trailer construction has suspension and axles, 40,000 lb. suspension spring and torque arms.

Two 20,000 lb. oil lubricating axles.

Landing gear, two speed retractable rollers 120,000 lbs. capacity diagonal bracing

Weight 26,000 lbs.

Overall Length 38'

Overall Height 13'6"

Overall Width 8'

The telescoping cylinder for discharging the load is 5 stage 8 1/2" to 4 1/2" diameter with 85,000 lb. thrust.

The cost of a transfer trailer is approx. \$35,000.00, so you can see why this piece of equipment should be well built and well maintained.

The heart of the system, the transfer packer, should be designed to handle the present tonnage and, most important, anticipated future tonnage. The construction should be heavy enough to accept white goods and furniture if that is what you collect.

The coupling from the packer to the transfer trailer should be fool proof so that they can not unhook during the loading cycle; the packing blade and wear parts should be made from Manganese or other wear resistant plate.

The cost of a transfer packer is approximately \$35,000.00.

Some general specs on a Transfer packer

Length 27'8"

Width 8'10"

The Charging Box opening is 120" x 74" with a depth of 50 1/2"

The Packing Blade is made of 1/2" Manganese plate with 20" of penetration.

Full cycle approx. 45 seconds displacing 11.7 cu. yds. of loose

refuse.

The Packing Cylinder is 10" diameter with 150" of stroke and 106,029 lbs. of thrust

Operating Pressure 1,400 P.S.I. with Relief Valve at 1,800 P.S.I.

The Power Unit is self contained with one 50 HP Motor

The Grabs have 100,000 P.S.I. Yield Strength with hard Rubber Bumper Pads.

I have given you two costs, one is the trailer and the other the transfer packer; although this is the main part of any transfer system, other items are involved: the building, tractors to haul the trailers, front end loaders to move the loose refuse to the hopper, the hopper and a building to house the operation.

Two actual examples of cost;

- 1) The Windsor Ont. Transfer station. The capacity design was for 600 tons per day. Utilization at present is approx. 375 tons per day. Capital cost in 1973 dollars \$1,070,700.00 and I am not sure this includes the mobile equipment.
- 2) The Bermondsey Transfer Station, Toronto, Ont. The capacity design was 1,000 tons per day. At present I believe they are utilizing the capacity. Capital cost, excluding mobile equipment: \$2,300,000.00 in 1973 dollars. This transfer station is using 10 Tractors and 13 Transfer Trailers, and what they paid for these would have to be added to the capital cost.

Transfer stations can save money on the hauling of loose refuse, because you have taken loose refuse, that weighs approx. 150 lbs. to the cu. yd., and in a 75 cu. yd. transfer trailer you could haul 40,000 lbs. which is a good conservative load. This would give you approximately 535 lbs. to the cu. yd. or 20 lbs. per cu. ft.

I would like to make an observation: when the transfer trailer arrives at the landfill site and ejects the compressed load, what you have when the bulldozer hits this load to spread it, is loose garbage again. So the money saved is in hauling.

Another group of compaction equipment is truck mounted. These include rear loading and side loading compaction units, normally used and seen on city streets for the collection of municipal garbage. This type of vehicle has a driver and 1 or 2 men to dump out the garbage cans and throw the garbage bags into the rear or side compaction unit.

A side compaction unit is just that. As the truck goes along the curb, the garbage is thrown into the side opening of the packer: the refuse from several homes can be placed inside this side opening, before the driver will activate the packing blade, compressing this amount of refuse in the packer. The packing blade will then return and the vehicle will continue on down the street, and the men will continue till the compactor is full. Some side loading compactor units can be loaded from both sides of the truck, and some models have attachments for self unloading containers.

The rear compaction unit does the same service except that the loading area at the rear of the truck is usually much lower and larger allowing 2 men to easily place a complete sofa or range into the opening, for compaction into the vehicle.

Depending on the volume of refuse the number of streets and homes to be serviced, the condition of travel on a collection route, would determine the type and size of compaction unit you would choose, and the size could range from 14 to 31 cu. yds. of compaction space.

The collection and hauling of solid waste is the costliest aspect of refuse management and was the most neglected for many years. I would guess that of the cost of disposing of refuse, 70 to 80% of the monies spent would be for collection and hauling.

Therefore, with more effective packer bodies, automotive collection vehicles and improved transfer stations and baling plants, this cost will continue to come down.

There is one more compaction unit that is doing a tremendous service, although it is mainly used by private haulers for the collection of commercial and industrial waste, and that is the front end loader.

The front end loader is operated by one man, the driver of the vehicle. All controls are in the cab of the truck, and are conveniently placed for easy use.

A set of arms extending from behind and coming up and over the cab, have extending steel forks.

These arms and attached forks are so designed that in travel they don't hinder the opening of the cab doors, or the vision of the driver.

In use, the truck will drive up to a container, extend the forks, drive ahead, so that the forks go into the openings provided on the container. The operator will then engage a lever, and the arms will rotate over the cab and dump the contents of the container into the packer. When completed the operator will reverse the operation and the arms will rotate forward, putting the container back on the ground, disengaging the forks and go to the location of another container.

The front end loader truck and one man, the operator, can service as many as 80 front end loader containers per day which will be located in many places and over a large area of the city.

Front end loader container capacities are 1 to 6 cu. yds. of loose refuse. This range of sizes gives flexibility and good service to small and medium size business and industry.

The front end loader is manufactured in models ranging from 25 to 40 cu. yds. of compacted refuse, and the arms and forks with a lifting capacity of 4,000, 6,000 and 8,000 lbs. for lifting and dumping containers.

A front end, rear end or side loader is an expensive piece of equipment, and so is the vehicle you are going to mount it on, therefore it is most important that the truck chassis chosen has the proper size engine and transmission and that the front and rear axles are sufficient and even maybe more to handle the gross weight you want to carry.

An actual example: a 34 yd. front end loader mounted on a chassis including P.T.O. and hook up was \$21,300.00. The chassis has a 250 Cummings engine, automatic transmission - 20,000 lbs. front axle suspension and 44,000 lbs tandem rear suspension and cost \$31,000.00. This totals \$52,300.00 for one unit, so you can see the importance of choosing the proper components.

In checking the 1975 Sanitation Industry Year Book and 1975 Annual listing of National Solid Wastes Management Association - Rated Commercial and Industrial Stationary Compactors, I counted 69 manufacturers who produce either all, or some of the equipment I have described.

And really to do justice to each one of these pieces of equipment, the stationary compactor, the transfer station, the rear and side and front end loader, should be the topic of separate papers.

I would now like to describe for you, with the aid of a film, what I believe to be a realistic answer to a 1976 problem, of solid waste disposal with 1976 technology, the high compression baling of solid waste. What I will outline is a transfer baling plant that can compress into high density bales, on a continuous basis, residential, commercial and industrial waste. With the ability to recycle paper and metals, when economics and markets are there, and without further capital outlay use these same balers for baling the extracted metal and paper products, for direct shipment.

Also this transfer baling plant is different, because the end product will arrive at the landfill site, compacted, and not loose, eliminating expensive compaction equipment at the landfill site.

This method of handling solid waste is economical to handle and transfer with the least amount of noise and pollution, and would be the best product for trucking or rail hauling and most important land filling.

Most arguments against proposed landfill operations which I have read in various newspapers, and as put forward by local groups and individuals, are eliminated with this process.

The complete plant, when finished and landscaped, will look like any modern plant building and would have no outward appearance that would make it look out of place.

Included in a plant to produce 1000 tons of baled refuse per day on one shift, or 2000 tons per day on two shifts would be

Item 1 Two 2,300 ton capacity hydraulic compaction presses designed to produce 48" x 48" x 48" bales of refuse in a continuous operation.

The vertical down acting type press and compaction chamber includes: main cylinder and upper platen, moving platen with welded steel compaction ram, compaction chamber with replaceable wear plates, ejector cylinder and gates with locking cylinders, pullback cylinder and overhead prefill tank and valve. The press incorporates the latest designs stemming from advancements in metallurgy, manufacturing procedures and the hydraulic industry. Special features include: a specially designed submerged prefill valve to assure rapid cycling, and unilaterally adjustable guideways to maintain additional guidance on the compaction ram, thereby distributing the load in off-center conditions and also increases ram and packing life.

Item 2 Two strapping machines. This equipment has been developed jointly by R.S.I. and Stanley Strapping Systems, Inc. It utilizes 20,000 pounds of compression force (to reduce the rebound characteristics of the bales) with automatic strap feeders and a hand strapping tool to bind the stack of bales together. This equipment has undergone extensive tests and has proven reliable under the most severe operating conditions. By utilizing this equipment, it is estimated that the life of the landfill site will be increased by as much as 15 percent.

- Item 3 Two charging devices. The twelve cubic yard capacity chamber incorporates a vertical closure compaction ram and a horizontal charging compaction ram. Overall pre-compaction ratio achieved in the chamber alone is approx. 6:1 assuring that the high pressure chamber is charged with a 2000 - 2400 pound load. The chamber is constructed of heavy abrasion resistant plate with welded structural reinforcing, machined and precision fit for proper clearances with the rams. The hydraulic cylinders are specially constructed mill duty type with packings and seals designed for easy in place service. The force capabilities of the rams are sufficient to compact or crush any oversized articles such as refrigerators, washing machines, furniture, etc., encountered in municipal refuse.
- Item 4 Two charging conveyors. This conveyor is designed to convey municipal and commercial refuse at the rate of 12,000 cubic feet per minute. The normal operation cycle will have a 60 second period with the conveyor run time in each cycle approximately 20 seconds. The conveyor may be loaded at a maximum average of 70 pounds per square foot. The special leakproof construction of this conveyor requires that it need not be cleaned underneath more often than 5,000 ton intervals.
- The conveyor is 7'0" wide by approx. 65'0" long horizontal and inclined centers, constructed essentially as follows: Z bar steel slat conveyors with Z shaped pans formed from 3/8" plate bolted between strands of 9" pitch steel strap roller chain. The chain rides on a 20 pound rail which is supported by wide flange beams, on the carrying run and angle track on the return. Approx. 40'0" will be horizontal and the final 25'0" inclined at 30 degree angle. The conveyor will be mounted in a structural steel frame. The head shaft will be approx. 4-15/16" diameter, will operate in pillow block bearings and will be driven by a 30HP, 1800/1900 RPM reversing motor coupled to a reducer with guarded precision chain transmission. The tail shaft of approx. 2-7/16" diameter, will operate in anti-friction bearing, in screw take up frames.
- Item 5 All necessary handling equipment for the loading of bales on to flat bed trailers, and bale stacking and transfer equipment.
- Final details of this equipment depends upon site location and building design. The equipment consists basically of an automated - transfer table, stacking table or elevator and push-off device to deliver a stack of one, two or three bales to the bale strapping machine, and finally to a suitable location on the shipping dock or directly on to a flat bed trailer. This equipment is fully automated within the press cycle.
- Item 6 Glass enclosed press operator control station. Final design here again to be concluded with the building design. Station includes all push button controls for both fully automatic cycling and manual operation, and also features special control relay override push buttons on each function for easy maintenance operation.
- Item 7 Hydraulic Power Unit. This unit contains all the pumps, motors, valves, manifolds, filters, electrical controls and reservoir necessary to power the press and equipment through a fully automated cycle in 60 seconds. The system features are:
- a) Variable volume pumps (approx. 600 HP) with electro-hydraulic controls for the high pressure rams. This provides a smooth non shock operation to the rams and provides automatic unloading at the end of each stroke.

- b) Lower pressure fixed volume pumps (approx. 300 HP) for all auxiliary functions.
- c) High volume supercharging pump (approx. 450 GPM) with 20 micron filter tank and high capacity heat exchanger to assure that all the oil is filtered and cooled prior to going into the pumps and valves.
- d) Separate pilot pressure system with 10 micron filtration to provide smooth operation of the controls.
- e) Reservoir with approx. 4,000 gallon capacity designed to trap all sludge and foreign matter. This Hydraulic Power Unit has the capability of producing 4,400,000 lbs. of force to the high pressure ram in the main compaction chamber. With the ram face being 4 ft. square, this would give 2,000 lbs. pressure to each square inch of the ram face.

Item 8 In a separate suitable location on the property automatic ticket printing truck scales for weighing and recording all necessary data on refuse trucks as they are received.

Item 9 Scale houses with floor area for scale console and washroom facilities.

Item 10 All front end bucket type loader. These would be rubber-tired loaders with 4 yd. buckets, for moving the solid waste to the conveyors.

Item 11 Two air compressors with air receiver, dryer and electrical control equipment. This equipment would mainly be used for air operated tools in maintenance.

Item 12 Large portable steam generator for cleaning building and equipment.

Item 13 Suitable accommodation for the personnel required to operate the plant, such as washrooms, locker area and offices.

The cost of this plant on a turn key basis including a 45,000 square foot building, as calculated in 1975 dollars, would be 4 and a half million dollars and the personnel required to run this complete operation is

First Shift		Second Shift
Office Manager	(1)	
Clerk	(1)	
Scale Man	(2)	(2)
Supervisor	(1)	(1)
Front End		
Operator	(1)	(1)
Floorman	(1)	
Press Operator	(2)	(2)
Strapping Machine		
Operator	(2)	(2)
Fork Lift		
Operator	(2)	(2)
Clean Up Man	(1)	(1)
Maintenance	(1)	(1)

Utility Man

(1)

(1)

for a total of sixteen people and 13 for the second shift for a total of 29 people.

The operation would proceed as follows: A truck full of refuse would pass over the scale for gross weighing, from there the truck would follow a designated roadway to the transfer holding building, having enough area and height to make a turn, and then backing into the building to discharge his load. He would then proceed by designated roadway to the outgoing scale for tare weighing.

The refuse would then be moved onto a conveyor which feeds the baling press. The refuse will then be moved on the conveyor to the charging chamber of the baling press, and then automatic operation of the baling press will produce a dense compact bale of refuse. When this has been completed the bale then goes to the strapping area, and two steel bands are put around the bale. From there the bale is placed on the flat bed trailer. This operation continues until the flat bed trailer is loaded and then this trailer is moved from the building, and another trailer is put in its place continuing the operation.

What I have just described is a plant that has the capacity to produce 2000 tons of baled refuse per day.

The bale of solid waste is now complete and the trailer is loaded.

In transit, this truck and trailer load of baled refuse will look like any load of commercial freight, when travelling on the highway or a city street, and while in transit will not give off any odour or pollution.

Baled solid waste is the most economical way to transfer solid waste from Location A to Location B with the least amount of traffic, no smell and no pollution. Specifically 60 truck loads of bales, as the one truck you will see in the film, would be the equivalent of 2,000 tons of refuse. Now if you compare this with the fact that there are literally hundreds of trucks per day leaving the core of a city to deposit loads of refuse at a landfill site, you can now understand why this method is economical, will cut down on traffic to a suitable landfill site, will cut down on noise, and eliminate road pollution. Another plus here is with fewer trucks to do this work, there will be a great saving in fuel consumption.

We have to this point brought the loose refuse to the baling plant. We have produced a bale and we have transported this bale. Not to minimize the importance of the points already made, this method of baled refuse has its most important advantages at the landfill site.

In the film you will see the unloading of a truck load of bales.

Each bale weighs approx. 4,000 lbs. and has an average density of 65 lbs. per cubic foot.

At the landfill site the bales will be deposited in a precise manner, much like a brick mason laying bricks; then at the end of each day a layer of clean dirt fill will cover the bales leaving a clean neat compact stable site, a true sanitary landfill site.

At the landfill site there will be:-

- 1) No blowing paper and other bits of scrap and refuse to pollute the air and the countryside. Two ton bales are very hard to blow around.

- 2) No messy conditions in rainy weather to permit polluted water to drain off onto adjacent land and into the streams and rivers. Because the bales are tightly compressed the water will run off the bale not through it as in loose refuse.
- 3) No room for breeding places for rats and other disease carrying animals and pests. For reasons I cannot explain, rats and other animals do not like compressed bales of garbage. With bales that I had produced at our Hamilton plant, we put scraps of meat, bread and sugar, on and around the bales: when I inspected the bales the following morning, the scraps of meat, the bread, and the sugar were gone. This was done for 2 weeks, creating what I thought would be a habit for the rats or other animals. I inspected the bales every day, for that 2 week period, and although the goodies were gone every morning, there was not one sign of any animal scratching or gnawing or trying to pry something from a bale. The bales were inspected regularly for the following 3 months and still no signs of rats or other animals. My plant has approx. 600 ft. of shoreline on the Hamilton Bay. Two of the bales were inside a warehouse, and 10 bales were left outside. I am not going to comment on the rats situation around the Hamilton Harbour but I think the bales were in the right place for this experiment.
- 4) The bales as mentioned before will be placed in contact with each other so there will be no voids or crevices.
- 5) No odour, because the odour is left behind during the compaction operation. Here again, I cannot give you a precise answer, but after the bale is produced, the smell is gone. Part of the answer maybe the lack of oxygen because of compression. And because of this high compression the juices are squeezed out of the bale. Included in this plant is treatment for the juices whereby the liquid goes into the local sewer system, and the solids are returned and go into the next bale.
- 6) No fires because the solid compacted bales are so tightly packed that it is virtually impossible for a bale to support combustion.
- 7) No explosions because again, the tightly packed bales have been drained and practically nothing left to cause generation of methane gas. If some gas is generated, it will be so slight that it will just dissipate. Here again, I conducted an experiment on the bales I produced. First we drilled a hole three quarters of the way into the bale. Then we drilled approx. 50 small holes into a 3/8" piece of stainless steel tubing. The piece of tubing was put into the bale with all the holes inside the bale. The piece of tubing protruding from the bale was sealed. After 3 months the seal was taken off the tube and was tested for explosive gases. None was found. This was done seven years ago and we still have these bales. I am not an engineer now, and certainly was not then. I say this because I have with me a report dated July 1, 1973 by Anylcon. Inc. of Boston, Mass. for the landfill site you will see in the film. I don't understand this 10 page report, and therefore cannot explain it to you; however, what I do understand is the heading: *Purpose of Test*. To survey North Carver Sanitary Landfill Area for flammable gases, and I understand the conclusion which reads as follows: The entire sanitary landfill area was exceptionally clean and free of debris. No obnoxious odours, flies or rodents were evidenced. There were no explosive concentrations of flammable gases found. The trace quantities of flammable gas found were not abnormal and could be found in any marsh or area where decomposing organic matter was present.

To carry on, there would be no possibility of scavenger operations, that is there will be no way for people or animals to try to pick through the refuse, in an attempt to salvage something, leaving behind a mess.

Another very significant point is that using this system of landfilling with bales, you can extend the life of any site by 30 to 50%, which means that a site that was going to be used for 20 years would now last 26 to 30 years or more. With landfill sites hard to find, and the further distance you would have to travel, I don't know how you could put a monetary value on this extended time.

I have already given you the cost of a 2000 ton per day plant which is 4.5 million dollars and the number of people to completely operate this plant is 29 people for 2 shifts.

Assuming the landfill site is 30 miles or less round trip, the cost for baling, hauling, and landfilling would be approx. \$10.00 per ton.

To come up with an exact figure and to properly work out the cost for this type of plant, the hauling and the land filling, you would need to know where the plant was going to be located; and included in this would be

- a) the general condition of the soil, bearing loads, and drainage conditions
- b) are there proper road conditions for the traffic to and from the plant?
- c) are all the utilities provided such as water, electric, phone, and sewage and of a proper size.
- d) rail location to the plant if you intend to haul by rail and building codes, rules and regulatory laws pertaining to this type of plant should be known.

The landfilling operation

- a) the haul distance from the baler plant
- b) engineering survey to determine usable amount of land available.
- c) availability of cover material.
- d) the Provincial and local rules and regulations that govern the operation of a landfill site.
- e) and final use of completed sanitary landfill.

The type of solid waste to be processed and the amount such as:

- a) Tons per day of municipal waste.
- b) Tons per day of commercial waste.
- c) Tons per day of private collectors which would include commercial and industrial waste.

The compaction system will handle all materials as received except:

- a) Building demolition such as concrete, rubble, extra large timbers and steel beams
- b) tree trunks and stumps
- c) Hazardous and dangerous chemicals and explosives such as drums of flammable materials - radioactive wastes and pathological wastes.

I have tried in this paper to give you some idea of what compaction will and can do to solve solid waste problems: I am sure that I have left many question unanswered, and you will probably ask

them: before you see the film I would like to close with an editorial published in the December 1975 edition, of Solid Waste Management and Refuse Removal, titled, "Blue Sky or the Facts?"

The Office of Solid Wastes Management Programs of the Environmental Protection Agency may not have performed a service to the thousands of public officials who recently attended the APWA convention in New Orleans, by showing a movie claimed to have been made in 1974. Called "The Big Pickup", the half-hour colour film is an excellent explanation - to the layman - of what's involved in the \$7 billion U.S. refuse industry. And there's its very drawback at a professional show such as this. We all know - and solid wastes pros are frequently irritated by - the facile "solution" to this country's wastes problems. Use automated systems to pick up the refuse. Burn it, pollution-free, to produce boundless "free" energy. Recycle used materials and shut down our ore mines or put away our logging saws.

The public may like to believe these handy myths, but the pros know better. Every solution has its drawbacks, every situation, its trade-offs. Trouble is, not all the public works managers who came to New Orleans were solid wastes pros, and many of them may have been misled by the EPA film.

Issued and ostensibly made in 1974, the work betrays its age when it shows a service station with signs advertising gasoline at 30¢ and 33¢ for high test. We all know it's been longer than that since we found driving such a bargain. In a more serious vein, to those involved in this field, it demonstrates what it calls "revolutionary" new methods and equipment to handle the major cost component of any refuse system: collection.

Some of these systems are still in use, albeit in very few locations. But at least one - prominently featured in the movie - was abandoned after extensive hoopla by the manufacturer. Like so many seemingly great ideas, it had been tried, tested, and found wanting in the harsh daylight of reality.

No mention was made in the film, nor did any EPA official comment before or after its showing, that this method had been found to be non-viable, or that the other systems shown might have limited applications. Nor did the film suggest that, in cities with street parking problems, the neat curbside installations shown might not work as well as they were demonstrated to do here.

Misleading the general public into a belief that the ultimate solution is just around the corner is unfortunate enough. But to try to persuade public works officials - with the power to spend millions of their city's dollars - that these largely unproved methods of collection are the answer to their own problems, could cause plenty of headaches in the future.

EPA: we need some aspirin. How about a little more "truth in advertising?" How about some healthy skepticism?"

QUESTION PERIOD: REFUSE COMPACTION & BALING

Comment: (Mr. Waxman) Before you get into your questions, I think it is only fair to myself - I'm over 21 and I will take all the beating you want to give me - but I am not an engineer. I produce none of the equipment that we were talking about or that you have seen.

My main business, in Hamilton, is I. Waxman & Sons Ltd. I am the president of the Company. We are the largest single supplier of prepared scrap steel to the Steel Company of Canada in Canada.

We are also in the refuse hauling business, that is commercial and industrial refuse. I have spent a considerable amount of time, my own time and my own money, in the last twenty years or more, in going through the United States and Canada looking at, probably, every conceivable type of gimmick or proposal or process that there is for the handling of solid waste.

Regarding the baling plant that I have just shown you or the transfer station, what I am prepared to do to any municipality is to come in, if you have a problem, tell you what we think you should do with it; not only are we prepared to tell you what we think you should do with it but I am prepared to put my money where my mouth is and by that I meant we will put the plant up; we will operate the plant; we will operate the landfill site at a fixed cost to a municipality. Now, that is what I do.

I may not be able to answer all your technical questions on each and every one of those pieces of equipment. Some of those pieces of equipment we use ourselves and, naturally, I don't personally use them.

So you ask your questions and I will do the best I can to answer them.

Question: (Mr. T.P. Hynes, Dept of Provincial Affairs & Environment, Deer Lake) What would be the smallest sized community that you could foresee this being feasible for?

Answer: (Mr. Waxman) Another manufacturer produces a baler for 57,000 tons per year. So that's probably a city of less than 50,000 people.

Question: (Mr. Carl Strong, Dept of Provincial Affairs & Environment, St. John's) I would suggest that part of the answer to that question could relate to just what other alternatives are available to the municipality and how costly landfill would be to the community. In Newfoundland a lot of our areas just don't have the terrain suitable for landfilling and the high volume of fill that is required to cover in a simple sanitary landfill operation.

Answer: (Mr. Waxman) Well, I don't know. You've told me something and you've asked a question. The cheapest way to get rid of solid waste is to landfill it, without doing anything to it and if you have the land and if you have the cover you might be able to still get away with that particular situation.

With bales you don't have to cover the bales at all. The only thing is, I don't know what the rules and regulations are in this province. I know what they are in Ontario - we have to cover them. So, therefore any proposals that we would make in the province of Ontario would have to cover the bales.

So if you say that you don't have areas for landfill sites in this province, you may have a worked out quarry, a worked out mine, some land that is not suitable for anything else, then baled waste is easier to monitor, it is easier to put into a landfill site. Make yourself a ski run and that may be one way to get rid of your waste in this province.

Question: (Mr. Strong) Earlier in your talk, you indicated, I thought you said 15% extension to the life of the sanitary landfill but later you mentioned 30 to 50. So the first 15 I take it, was 50%?

Answer: (Mr. Waxman) No. What I mentioned was that there was, because of the strapping - which incidently you really do not have to do; the bale will stay together without strapping - but with the strapping you take up the expansion in the bale. Because of the nature of what is in the bale the bale will expand after it comes out of the compaction chamber and I said that with banding the bale you would have a saving at the landfill site of approximately 15% in the bale size itself.

Now I said using baled refuse, because of the density of baled refuse, which is about 65 pounds per cubic foot, you could, from using other methods extend the landfill site by anywhere from 30 to 50%. In other words if you were putting it in there loose I would say that the landfill site would last at least 50% longer by using bales.

Question: (Mr. Alfred Sullivan, Town of Goulds) I wonder if you could give us any comparative figures on waste disposal - landfill versus incinerator. I can't escape making this comment on the landfill that Mr. Strong made in reference to land in this particular area. For instance, from my experience, my little knowledge I have about land conditions, if I know of an area such as was shown there, in my estimation a landfill, I would go to every means I know of to get at it, to claim it and sell it for something other than a landfill.

Do you have any figures or could you give us - you have mentioned that you were not an engineer - Do you have knowledge of the various classifications of soil?

I see in your film, that the pictures were taken on a very calm day. I can just see the branches in the trees moving and you show the small quantities that you have to cover. I could visualize that 90% of the days you dump in Newfoundland you wouldn't have to fill that in because in an hour it would be gone with the wind. Could you give us an idea of the type of soil in the film and comparative figures on landfill versus incineration?

Answer: (Mr. Waxman) Well to answer question No. 1. I really can't tell you what kind of soil that was. That was the first time that I'd ever been on that site. They were near a quarry if I can remember correctly. It was originally used for a landfill site for the municipality of Carver and because these people came in and gave Carver a deal,

whereby they could still bring their refuse in there and they would look after it for nothing, they allowed them to put a bale fill site in there. It wasn't agricultural land if that's what you're asking, not to my knowledge.

No. 2 - the cost of baling as compared to incineration. Here again I'm not an expert. I would say that if you were talking about 1,000 tons a day or 2,000 tons a day, the cost of baling would be very cheap, compared to the cost of incineration. Just what that cost would be is something I don't want to answer. I have my own ideas, but I will tell you that first of all the cost of building an incinerator, to handle 1,000 tons a day would probably cost you in the neighbourhood of 20 million dollars and the cost of building that baling plant to handle 2,000 tons a day 4 1/2 million dollars. So if you take those two costs alone, the cost of amortizing the money is going to be astronomical. So I don't know whether that answers your question, but that is as far as I want to go.

Question: (unidentified) How long will it take for the baled garbage to decay? How long to the deterioration point?

Answer: (Mr. Waxman) I can't tell you. I don't know. All I know is that I think I made bales in Canada long before they were made in the United States. Although the E.P.A. has produced quite a book, I've never read it and it has to do with baling and rail hauling. But the bales that I have at my own plant, that we made experimentally some 7 years ago are decomposing or decaying or deteriorating very nicely and they are going into earth. We have left them exactly where we put them and they've stayed in the same place for all that time and they just seem to be going into earth. They are on top of the ground, we've left them for the elements because putting them in the ground sort of protects them. I want to see what the water, the rain, the snow, the sun, the wind, did to the bale. Now I am not a scientist, this is for my own information, but there have been extensive studies done by scientists, on baled refuse in the United States.

Question: (Dr. John Evans, Memorial University, St. John's) How would you handle liquid waste? Oils and agricultural wastes are a problem in local dumps and how would you handle car wrecks?

Answer: (Mr. Waxman) Liquid waste is a problem onto itself and I'm no expert on liquid waste, so I'm not going to attempt to answer your question. It sure is something that I don't think I'd want to put in any landfill site. I'll say that much.

As far as car wrecks are concerned, I don't know what your problem is. I don't know anybody that owns more land in the province of Newfoundland than the Provincial Government. You probably have a provincial police department, a roads department and a works department.

So why you don't get yourself a piece of land somewhere between a lot of trees that nobody can see and when the highway department isn't busy, or they go by and they see an old wreck, tag it, then get your legal department in the province to say how long it should sit there, before you move it and it belongs to you. Once it has been that length of time, pick the darn thing up and tow it to this particular depot.

Now when you get enough of them there I may come down from Ontario and buy them off you and send them back. But you're not going to get rid of one or two cars. Now that happens to be my field and you don't have to throw them away and you don't put them into a landfill site. The provincial government should find a spot and put them away, and it won't cost you any money to get rid of them.

Question: (Mr. C.G. Riche, City Engineer's Dept, St. John's) I am from the city council. My job is superintendent of sanitation department, concerning taking garbage and the operation of Robin Hood Bay. If you have some money we'll sell you 5,000 motor cars down at Robin Hood Bay. They're yours for the taking. We had that problem licked. Approximately one year ago, this company came in and started picking up those scrapped cars. It was also my responsibility to see that the scrap cars were picked up off the street, for those people who were just leaving them there. It is quite interesting to hear the way you talk about it.

I would like you to come down to Robin Hood Bay and see our operation. We have everything down there - oil from filling stations, septic tank liquids. We take 200 tons of garbage a day out of the city - city garbage not commercial - and we got a pretty good operation. The only thing we got a problem with is the soil, the cover. I bet you 50 bucks if you went down to bury garbage now you wouldn't know were to put it, it is so good an operation.

Answer: (Mr. Waxman) You are probably running a very, very good operation but as I said before and I'm going to say it again, metal is not paper. Metal won't go away on you, there is a time and a place for everything. The province owns more land than anybody I know of, so why don't the areas get together, find a spot to put these cars and forget that you have them, just keep putting them there. Their time will come.

Now if you want to create a problem find a place to dump them; you just told me you don't have a place to dump them. So if you want to create a bigger problem, look for a place to dump the cars.

Question: (Mr. John Warren, Town of Stephenville) Most communities in Newfoundland are between 500 and 10,000 persons in size and each of them has its own specific problem. As I see the majority of the problems, no community is big enough to handle its own operation properly. Is there a manufacturer of a portable baler and if so what would be its approximate cost?

Answer: (Mr. Waxman) I have with me in my book a list of all the people that manufacture balers and I'm prepared to give it to you. But I don't know of anybody that produces what you're looking for. I just don't know, I haven't heard of one. But if you want this list of names I'll be very happy to give it to you.

Comment: (Mr. Warren) I would like to have that list later. I've seen similar operations to the ones you've discussed in England. I've seen these operations and really, it was an unfair question possibly. Inasmuch as I've seen some of these units operating in England and I wondered, if there are any in Canada?

Answer: (Mr. Waxman) I don't really know.

Question: (Mr. Roger Saunders, Dept. of Provincial Affairs & Environment, Deer Lake) I can see your system working and I think it is a fantastic system. The only way that I can see it work properly in Newfoundland, would be if all councils got together in the area and got themselves involved in the system. But I can not see the system working with the council of say Stephenville or Deer Lake which has a population of probably 5,000. However, I do see the day when possibly all councils would get together and help to locate one particular site which will handle such a system as that and I'm sure that most Environment Officers and government would go along with that.

Answer: (Mr. Waxman) Let me answer your question this way. I did not come down here to sell anybody anything. And I came here to give you some of the information that I have. If its of value, fine; if it is not, we've spent a very nice morning.

But I will give you some information free - regardless of what system you use-and that is the more municipalities you bring into a system, the more volume you have by having a greater amount of population, regardless of how you get that population together, is going to give you a cheaper product when you're finished, whether you truck it, or whether you bale it, whether you shred it, or whether you burn it. I don't care what you do to it. But the more municipalities you can get together to form a region, and if you don't like the word "region" use some other word, but the more people you can get together or the more municipalities you can get together to get a bigger tonnage for whatever decision you make, will be cheaper because of the volume.

Question: (Mr. A.J. Rendell, Town of Labrador City) You mentioned the smallest baling plant was around 50,000 tons a year. Have you any idea what the capital cost would be of that and how many people it would take to operate it?

Answer: (Mr. Waxman) I hate to go into capital cost. I just happen to have this brochure with me and I'll be very happy to give it to you. What I've done throughout the paper is to say that I do not manufacture anything and I'm not here selling for anybody. I really don't want to mention any manufacturer's name. I'll be very happy to lend you this after we are through and you can copy the manufacturer's name down and take any capital cost figures that are in here, then I'll show you why they don't work though because it is a good sales pitch.

Question: (Mr. Hynes) You mentioned before that if we could gather enough cars together in one place to just forget them till we had enough you would come down and buy them. How many cars are we talking about and what kind of price?

Answer: (Mr. Waxman) That would all depend as to what the price of scrap is at the time you are talking. 5,000 cars would be enough at certain times. At certain times it wouldn't. Now I'm talking from economics.

There is another lesson I want to give everybody here and I want to tell you this, that whatever you're doing, if it doesn't pay and somebody can't make a buck

at it, it is not going to get done and you might as well get that through your head. It's just not going to work. The government can only give you so much money, and I'm sick and tired of paying 60% of taxes.

Question: (Mr. Hynes) If you did buy 5,000 cars what would you do bring in a compactor?

Answer: (Mr. Waxman) Don't worry about what I'll do, you just have them there when I want them.

Question: (Mr. Strong) To tie in with what Roger Saunders has said and the feelings of the Stephenville and Labrador City representatives, I'm sure that the province doesn't anticipate that any more than the largest communities in Newfoundland would ever consider a full scale transfer station or baling plants.

I would like to point out something that came to light earlier this morning, and that could be used by the smaller municipalities here. I remember a couple of years ago, attending a solid waste Seminar in Halifax and a tape was shown of the system put to use in Muskoka, which is a summer cottage area in Ontario which utilises the front end loader collection from widely separated containers which is now being investigated by Prince Edward Island and New Brunswick Environment for the smaller communities to use as a collection system for household waste.

Answer: (Mr. Waxman) I would say it is probably the cheapest way that you can service that type of area if it is a cottage area. The containers can be made to look attractive if they're going to be stationed somewhere. It's suprising what paint will do and the containers can be made with a lock and a key so that only those who are using them have the key. The truck driver would have a key so that when he goes to dump them, he can open the container. It's a good system for that type of use where you've got a long distance to travel and not too much refuse. The containers as I said before, were anywhere from 1 to 6 and even up to 8 cubic yards, depending on the type of refuse that's going into it. As long as the arms on the front end loader are sufficient to handle the weight that is in the container.

Comment: (Mr. Waxman) If there are no more questions, I'm just going to take one minute and show you what I do in my basement for my hobby.

This is garbage that came from the Hamilton dump and using a particular type of filler, that I've found produced by one of the largest chemical companies in the North American Continent I made that block. How that block was made in a Pyrex glass pan, that my wife had in the kitchen, that she, of course, immediately threw away after she found out what I did with it. It was made only with the force of putting the material into the Pyrex pan and I put a piece of wood on top, and found a 20 or 25 pound weight and left it there for a couple of days; I screwed 2 screws into this thing. I've had this for a couple of years.

With refinement, to me this is the type or recycling that should be done with garbage. You're only going to use so much as a fuel fraction - if we ever get to use it as fuel fraction. But in doing something like this, even in an area like this as I understand, which was news to me, that you don't have all the building material in

this area that you should have, that a lot of the wood comes in. I've had it tested and if it was made under pressure it would be fire proof, because of the chemical we found to bind it. I think it would make a good wall board of some kind.

These are two other samples - these samples are made from garbage without the metal - and here again they were made in my basement by myself. This is a piece that has a finish on it, that I put on.

One day we were laying some hydro cables in our plant to a piece of equipment and I thought "what a place to put garbage." So really, when you put a pipe under ground for a hydro line it's more for a guide than anything else. So I produced a piece of pipe out of garbage and it won't break; that's all garbage. What I used was a beer bottle for the mold and the outside of the mold was a peanut butter jar. Here again, I just compressed the garbage into the peanut butter jar with the beer bottle around it, to produce this. I left it near an oil furnace overnight to harden it. Then I had to break the bottle to get it out. But to me, this is recycling. And some day this is going to take place.

Here's what I consider fuel. I made this myself in my basement. There it is in block form, and what is the method I use? Don't ask me. I'm not going to tell you.

The last one took me three years of research, but included in these samples, which were made in Europe for me, is every conceivable piece of wood I could find in the Hamilton dump which included lumber from the Steel Company, from Dominion Foundries, from old radio crates, old radio boxes, (the cabinet of the radio), plywoods, wood off the side of a house, branches from trees - you name it, I could go on all day. I took two men with me, two of our labourers and a truck. We went up one day and we picked out this lumber, but this was of course, after we had spent 3 years in research and doing some work with some engineers in Ontario and some consultants. The only place we could produce the samples was in Europe. There was nobody over here that could do it. There is a piece of particle board that's new, made from virgin lumber, and there is a piece of particle board made from garbage. Really, the only difference is the colour, and after doing tests on a piece of particle board, the exact thickness that this is, this was found to be superior. You might say to yourself, "well, if you've done all this and if you are who you say you are how come you're not doing it?" And that would be a real good question. I have a real good answer for you. It's already cost me thousands of dollars to get this far. Until I get something going where I'm making money from garbage, I'm not putting any more money into it.

Question: (unidentified) How close to a watershed area could one of those baling landfills be placed without interfering with the watershed?

Answer: (Mr. Waxman) I think, that you would have to abide by the rules and regulations as laid down in your Province, whether you use bales, raw garbage or anything else. The only thing I'm going to tell you is - here again I'm no scientist and I'm no engineer - so although I have reams and reams of answers for the question you just

asked, and I'll look it up for you and I'll let you read the answer, because people have done research on this particular matter. You can't put bales in open water and expect God to forget that it's garbage. It's still garbage. The only thing is it's more controllable and the fact that you've taken the juices out of it, has made it less prone to produce leachate and made it less prone to methane gas generation. But if you take that bale and put it in the water, all you've done is you've brought the process back to stage one. You know, it's garbage again. Now, we've gone to the trouble of taking all the juices out of it, we've taken the trouble of compacting it and taken the oxygen out of it and what you want to do, is put it back. So you've caused a problem, that's what you've done by putting it in the water. Now, how close can you get it to the water? I'd say you can get within a fraction of the water, as long as you don't let the water run through the bale. That's the only way I can answer your question.

Question: (Mr. Sean O'Rafferty, Proctor & Redfern, St. John's) I've enjoyed your talk, because I've been at the plant and it's just about everything you said. I have to agree with you. There is only one question I have and that is you've used a phrase in the last couple of moments and you've used it once during your talk. I'd like to ask what you mean by it? You said that "we have squeezed the juices out of it." Are you just using that as a phrase or do you have some notion of squeezing moisture out of the contents that you're putting in?

Answer: (Mr. Waxman) Well let me answer your question as truthfully as I can. If you've been there you saw the sump working at the bottom of the baler and whatever is in the bale, whether it is juice or orange juice, tomato juice, water, moisture, whatever it is, that I consider "juice".

Question: (Mr. O'Rafferty) Yeah, this is before it gets to the landfill site at all?

Answer: (Mr. Waxman) Right!

Question: (Mr. O'Rafferty) And it is in the compression process?

Answer: (Mr. Waxman) Right! In the compression process. Whatever moisture I'm referring to, that moisture is "juice".

Comment: (Mr. O'Rafferty) I also might be able to answer that gentleman's question about the landfill. To my eyes that was a sandy loam, the kind of material that is not often found around here, but wouldn't be too far off some of the materials that are. It was a loam and, incidentally, that location, if I remember rightly, was on the shores of a lake.

Answer: (Mr. Waxman) That location, if I remember rightly, was close to a small, very small lake, but very close to the ocean and within 50 feet of a road.

Question: (Mr. Evans) You say this is a way of solving transportation problems? It seems to me that in the St. John's area we could have only one compaction site. In order for the thing to work, you're going to have to cover the whole municipal area which covers quite a vast area. So you will have to have garbage trucks coming from St.

Phillips and all around the bays coming into this compaction area. I don't see how you solve your transportation problem.

Answer:

(Mr. Waxman) You've got me at a very bad disadvantage by the fact that I've never been here before. As I said when I started I really don't know the terrain. I don't know the area you're talking about and I'm not trying to side-step your question. I want to tell you that although I believe in baling very strongly neither baling nor transfer stations nor incineration, nor grinding by itself is an answer to every problem you're going to come up with. So what you have to do is find out what you have and then do the best you can with what you have. Now, what we've got as I read to you in that editorial, and I have a briefcase full of facts, is plants that have been put up, that were supposed to have been the answer to every problem we have. But really we're finding out that before we can find the problems we want to solve, we first have to solve problems caused by the plants. They are bigger problems than the problems we wanted to solve. So what you have to do is find out what you have and take a look and go out and look at what's working. Now, try and solve your problem.

It's like the man who was 80 years old and never got a driver's licence because he didn't want to own a car till he could buy the best car made. Now you know when that's going to happen-never! He is going to die without driving. So what you have to do is if you want to own an automobile, use your judgement and buy what you consider to be the best one today, because nobody knows what is going to happen tomorrow. And your problem is *right now*.

The solid waste problem is *now*, it's not tomorrow. And I'll tell you another thing, you're with the University, your problem is not recycling, your problem is not banning the can, your problem is not producing fuel, your problem is not producing steam, your problem is not collecting paper, your problem is the disposal in the right way of the solid waste produced every day by the population of wherever you live. That's what your problem is.

Comment: (Several in audience) Hear! Hear!

Comment: (Mr. O'Rafferty) Mr. Waxman, I would like to add one other word. In that location in Boston, and correct me if I am wrong but I believe that at the time that plant was instituted two local incinerators were abandoned.

Answer: (Mr. Waxman) That's right.

Comment: (Mr. Riche) What you are saying is the best way to dispose of our garbage is to cover...

Answer: (Mr. Waxman) No, I'm saying that the best way to dispose of garbage in your particular area, is what your particular problem is. Now to ask me to answer something that you've probably studied for five or ten years in three seconds is not fair. I don't know your problem nor did I come down here to sell anybody a baling plant, nor did I come down here to have anybody buy a packer truck, nor did I come to have anybody buy a transfer station or whatever I showed you. I'll be very happy to sit down with you if you will take the time to tell me what your problem is with

whatever knowledge I have. I'll do the best I can to help you o.k? But to ask me if the answer to your problem, here now, is a landfill site where you cover garbage - I don't know. But I'm saying this - if you have the land area, if you have the fill and you are abiding by the law of the province, that's probably the cheapest way you are going to get rid of garbage. How long they will let you do it - I don't know.

Comment: (Mr. Riche) That's the way everybody has to look at it - the cheapest way.

Answer: (Mr. Waxman) Yeah., but that's been the problem...

Question: (unidentified) I know an area in the city here, not too far away from here where they dump garbage, then they fill it, loose garbage then they fill it. Now, they've got beautiful homes on it. If you use bales you're not going to be able to put anything on it except maybe a playground...

Answer: (Mr. Waxman) No. Bales haven't been around that long. There have been studies done and I know of one bale fill-site that already has had built on it, a one storey commercial type building. Part of it was for storage and part of it was some industry. I'm not going to stand here and tell you that you're going to be able to build on bales. But I'll tell you this - you'll build on bales a lot quicker than you will on raw garbage because you've already compacted it. Many times, the density of the bale is greater than the density of the land you're putting it into.

Comment: (unidentified) Did you know that the owners of those homes have brought numerous lawsuits against the contractor because their homes are sinking 4 or 5 feet into the dump site?

Answer: (Mr. Waxman) I had nothing to do with it!

CHAIRMAN'S REMARKS

Mr. L.P. Fedoruk

This morning we had Morris Waxman talking on compaction. Listening to the questions that were generated at the end I'd like to emphasize that what we are trying to give you today is two methods in the handling of solid waste. For any of your particular problems, the first thing you have to do is define the problem. The methods that are being discussed today may or may not fit your situation. It depends on what your problem definition is. So this is the theme that these are two methods. There are several other methods that will probably be given in future seminars, incineration happens to be one of them. The gentlemen that are speaking today are not familiar with your own particular problems so only in the general sense can they answer your questions.

This afternoon, Bob Dilke is going to be talking on Solid Waste Pulverization. Now, this is another method, like compaction, in doing something to your solid waste to reduce the volume or to put it in such condition that you can handle it easier. Now Bob, is the Chief Sanitary Engineer for the City of Edmonton. He joined the city in 1951 and has been involved in the solid waste problems of that city since that time. In 1970, he was instrumental in the construction of a refuse pulverization plant which is an important element in the overall refuse transfer concept being promoted by the city.

SOLID WASTE SHREDDING

*Mr. R.C. Dilke
Chief Sanitary Engineer
City of Edmonton
Edmonton, Alberta*

Volume reduction is only one part of a total solid waste system. No proper evaluation can be made of the utility of including volume reduction into a solid waste system without examining all of the system's parts and their interrelation. As with other systems, the problem must be defined before a practical solution can be found.

Unfortunately there is no universal solid waste system which can be transplanted from one community, region or metropolis, to another. Each system has its own unique problems and restrictions whether they are topographical, political, social, economic or whatever.

The minimum number of components to any solid waste system are:

1. Collection
2. Transportation
3. Disposal

Most formal solid waste systems include a fourth component, processing. A broad definition of processing might include, sorting prior to collection, compression of waste into a collection vehicle, grinding, composting incineration, pyrolysis, recycling valuable constituents, baling or any other action

over and above the three basic requirements. At this time no matter how sophisticated the system, there is always a worthless residue which must be disposed of to the land.

The number and kind of restrictions which may be imposed on the designer of a system are too numerous to attempt to define here. Each system is unique, requires different regulations and economic restraints. The designer's problem usually becomes that of designing the most efficient and economical system which can satisfy the imposed restrictions.

It is very important that each part of a system is designed to complement the other parts.

The separate optimization of each part of a system rarely results in the optimization of the total system. Usually a number of trade-offs are required to optimize the total system.

A simplified example of the pitfalls of optimizing only one portion of a system can be shown in the case of incineration.

A hypothetical large city finds that it can no longer obtain landfills and must incinerate to reduce the volume of waste generated. The city produces 900 tons of waste per day. A study is made which determines that burning costs for a 300 ton per day incinerator are \$8.00 per ton but a 900 ton per day incinerator burns waste for \$6.50 per ton. Therefore a 900 ton per day incinerator is built on an available site near the city centre. No further investigation is done and an economical solution is assumed to have been reached.

Investigation into the waste collection system would have revealed that the cost of collection and haul of waste to the central 900 tons per day incinerator was \$30.00 per ton while the cost of collection and shorter haul of waste to three 300 tons per day decentralized incinerators appropriately placed was only \$24.00 per ton.

Incineration had saved \$1.50 per ton, collection had lost \$6.00 per ton for a total system loss of \$4.50 per ton.

This sounds ridiculous but a similar situation exists in some large cities. (Paris, London)

On the other hand a central heating/cooling system may be feasible only in the central core of the city which would produce a revenue of \$6.00 per ton thereby turning a net saving of \$1.50 per ton to the central incinerator system.

Grinding or shredding of solid waste is in a similar position to incineration or any other processing option. Its costs and benefits to the total solid waste system must be determined if an economical system is to result.

GRINDING APPLICATIONS

In my opinion there are only two applications which may warrant grinding:

1. As a processing step in resource recovery and,
2. as a process to reduce landfill costs and nuisance.

Grinding for Resource Recovery

It is generally accepted that if large scale resource recovery is to be attempted, it must be preceded by grinding or shredding. In this case volume reduction due to grinding is not an issue. Of

course the removal of material for recycling may substantially reduce the amount of material left for disposal.

In most cases this type of recycling system cannot be economically supported by the dollar value of the materials recovered. This is mainly because viable stable markets for the materials recovered are usually not available. In some cases such an operation can be supported by benefits to other parts of the solid waste system which do not relate directly to the value of the recovered material.

For example; the cost of separating combustibles from a waste stream to be used for a fuel supplement in a nearby coal fired boiler may be less than hauling all of the material to landfill 40 miles away from the source. Landfill space may also be very expensive, almost non-existent or politically unacceptable.

Under this kind of circumstance resource recovery may be the lowest cost alternative for the whole system.

Shredding prior to Landfilling

There is little doubt that a landfill operation is easier and less costly with shredded waste than with raw waste however, the costs of shredding will probably outweigh the landfilling advantages if shredding is done only to facilitate landfilling.

Advantages of Shredded Waste Landfills

1. It is easier to move, shape and obtain a higher initial compaction with shredded waste.

The homogeneous nature of shredded waste substantially reduces machine time requirements for placement. Edmonton's experience indicates that machine time may be reduced to less than half that required for raw waste. Although initial compaction may be higher for shredded wastes our experience in Edmonton suggests that, when fill depths exceed 25 to 30 feet, there may not be much difference in the densities obtained for raw as opposed to shredded waste. The type of waste, season, moisture content and size of grind also affect the densities obtained.

The most definitive tests for determining compacted densities were done in Madison, Wisconsin. The final report of the Madison experiments should still be available from:

The Heil Co.

Milwaukee, Wisconsin 53201

or from the U.S. Environmental Protection Agency, Office of Solid Waste Management Programs.

I won't attempt to reproduce Madison's report here but the results of one of their compaction tests is of interest in volume reduction.

Two similar cells were compacted equally, one contained unprocessed waste and attained a wet weight compaction of 1119 lb/cu. yd. A second cell, shredded refuse, under the same compaction attained a wet weight density of 1425 lb/cu. yd. A third cell of shredded refuse was given 60% of the compaction and attained a wet weight

density of 1278 lb/cu. yd. These figures show considerable volume saving for shredded waste.

2. Due to the homogeneous nature of shredded refuse much less earth is required to produce a clean cover. When earth cover is generated within the landfill site this means less earth moving cost. When earth cover is hauled in to the landfill from elsewhere a saving in both earth haul and landfill space is realized.

In the case where only final cover, and not daily cover is required an additional saving in earth cover costs would be realized.

3. Properly compacted shredded waste can support heavy traffic loads in wet weather providing roadway grades are not steep. For anyone who has attempted to run a sanitary landfill in wet weather this advantage is obvious.
4. In Edmonton we have spread three to four feet of uncompacted shredded waste over areas to be used for winter earth borrow. This effectively insulates the borrow areas and permits earth moving for cover during cold winter periods.
5. Shredded waste produces much less blowing paper on the landfill and reduces nuisance value and clean-up costs.
6. Shredded waste is less attractive to birds especially when it is compacted. We don't have rats in Edmonton but Madison's tests indicate that rats are hard pressed to survive in shredded landfills.
7. The relatively homogeneous nature of shredded waste facilitates further processing such as resource recovery.

There is only one major disadvantage to producing shredded waste and that is the cost of doing so. In most cases the dollar savings produced by shredding waste for landfill only, are insufficient to pay for the cost of shredding. Special local conditions such as very high land costs for landfill space or very high cost of earth cover may offset shredding costs.

Some of the major factors which contribute to the cost of shredding are discussed below:

1. In Edmonton we have just completed a plant with a maximum annual capacity of 60,000 tons of domestic waste on one shift. Built in 1975 this plant will cost close to \$1,400,000 not including land. The plant has two unloading areas, two shredder feed conveyor systems and two shredders rated at 20 tons per hour which deliver shredded waste onto one 6 foot outloading belt conveyor.

One large shredder would have reduced the costs but reliability is a big factor in our system.

2. Shredding plants must be designed for peak daily demands unless partial bypassing straight to the landfill is acceptable. Storage for more than 2 or three hours in the plant can produce fires and odor.
3. Where packers are used for collection a high peak hourly demand occurs because they usually all arrive at the plant to unload at similar times.

Meeting high hourly demands again raises the plant cost. These demands can be overcome in three ways:

- (a) Design a plant large enough to meet hourly demands.
- (b) Design collection schedules or equipment to reduce hourly peaks by staggered starting times, or using smaller vehicles which make more trips, or a combination of both.
- (c) Supply a dumping floor at the plant as a surge pile from which waste is fed to the grinders by a front end loader or equivalent.

Obviously any combination of these may be used:

- (a) may greatly increase the plant cost
- (b) if feasible, may cost very little but may not have enough influence to completely eliminate hourly peaks.
- (c) increases the plant cost and adds the cost of a machine and operator to the operation cost.

- 4. Prior to building a shredding station it must be decided how much of the total waste stream and what categories of waste are to be shredded. This decision will greatly affect the type, size and cost of the plant. This decision may also have repercussions on the collection system, be it municipal or private or a combination of both.

Many materials in the waste stream are both difficult to shred or grind and difficult to place in a landfill, so that the nice neat concept of a landfill operated only with homogeneous shredded material has no basis in reality. Even when domestic waste only is to be processed parts of this waste will probably bypass the shredding plant for economic reasons. Materials such as white goods, car parts and large lumber are difficult and costly to break. Lumber is not difficult to break up but it is bulky and will not feed into the smaller grinders which are adequate for other household waste. Heavy metal, stones, rubble, white goods, reinforcing rod can all cause damage, even to very large and rugged shredding or grinding machines. A reliable method must be devised so that these materials will bypass the shredding plant.

- 5. Shredding is a rugged job and even the heaviest machines are subject to extended downtime due to breakdown or maintenance. It is obviously expensive to supply two complete process lines for reliability. In designing our new Edmonton plant we have compromised on this issue. Each of the two shredders will supply half of the intended capacity on one shift. In the event of a lengthy repair on one machine we can double shift the remaining machine. This would require part of the collection crew to be changed to night shift during the period of breakdown.
- 6. Shredding plants are not portable therefore, after shredding, the waste must be reloaded and transported to the area being landfilled. This costs extra money since unprocessed waste is delivered to the point of landfilling ready for placement.

The fact that shredded material must be reloaded can be turned into a considerable advantage when the landfill or disposal point is a considerable distance from the

waste generation area. The shredding plant can then accrue most of the cost benefits of a transfer station.

7. It costs more to produce fine shredded waste than coarse shredded waste. As the shredded size decreases, throughput decreases while machine wear and power requirements increase. Therefore the shredded size should be no finer than required for the purpose intended.

For straight landfilling a material that is quite coarse will suffice however when the combustible portion is to be used as fuel a finer grind is usually required.

The Edmonton System

I will attempt to outline the Edmonton system which we have proposed and partially constructed, not because it can be transplanted elsewhere but because some of the problems that faced us may be similar to those facing others and some of Edmonton's solutions may be useful to others.

I have brought a few copies of a report that was prepared for Edmonton City Council in January 1974. This report outlines the system planned and shows the relative costs involved.

In Edmonton we have been fortunate in obtaining landfills and our cost of landfilling is low. Shredding was not undertaken primarily to reduce landfill cost but is used in conjunction with transfer stations.

We could have used transfer stations without shredders, and these would have been less expensive however when the program began in 1968 we were of the opinion that resource recovery was coming and that shredding would be the first step in resource recovery. With this mind we have incorporated shredders into our transfer stations. The savings realized by the transfer operation are able to more than offset the additional shredding costs. As fuel costs increase, the possibility of using the combustible portion of waste for fuel is coming closer. If it had not been for the fact that Edmonton's power plants operate on natural gas, and not coal, we would probably have been burning solid waste now. Edmonton's next power plant will be fueled with coal and hopefully some solid waste.

We are currently planning a pilot ferrous metal recovery project. Markets for this material may be available but are not assured.

Recently Edmonton investigated the economics of burning shredded or raw solid wastes in conjunction with natural gas fired power boilers but this so far is not economical for us. Waste heat recovery is currently being investigated.

In 1969 the concept of transfer stations with shredders was accepted by City Council and approval was obtained to build one transfer station. The station was completed in late 1970 and after some run-in problems the plant has run satisfactorily up-to-date.

Figure 1 shows the schematic layout of our first shredding plant.

Waste is dumped from collection vehicles into a receiving hopper approximately 30 feet long and 10 feet deep. The bottom of the hopper is formed by a 5 foot wide steel plate conveyor with 4 inch steel angle flights at 2 feet centres.

The hopper bottom conveyor is reversible and has variable speed drive. This conveyor delivers in line to another steel plate conveyor which rises at an angle of 37 degrees. This second variable speed conveyor delivers the waste up into the shredder. The 37 degree angle tends to even out the feed to the shredder, because large clumps tend to break up and roll back down the conveyor, thus reducing surge loads on the shredder.

The shredder feed system is probably the most difficult and most important part of the plant. We have had to make a number of alterations to the feed end of our hopper to prevent the waste from bridging the conveyor. The angle on the inclined conveyor is also important. Two plants which I have seen, have fed the shredder with a horizontal conveyor. Both of these plants had considerable difficulty in regulating the feed to the shredder, which leads to the inability to develop full capacity of the shredder.

Our shredder is the vertical type. I'll explain more about it later. The shredded waste is ejected horizontally from the bottom of the shredder into a chute which directs it onto the outloading 42" belt conveyor. This belt conveyor rises at 20° to about 13 feet from the floor then travels level for approximately 50 feet. A belt unloader, or tripper, is fitted on the level portion of the belt. The tripper has a horizontal travel of about 45'. It picks up the belt and dumps the shredded waste onto a short cross feed belt which is part of the tripper. The cross feed belt is reversible and can convey the shredded waste to either side of the belt into 45 feet long open topped transfer trailers parked on both sides of the elevated conveyor. The tripper travels back and forth for the full length of the trailers so that they can be evenly filled, one at a time. When one trailer is filled it is taken to the landfill and another parked in its place. This system provides an empty trailer at all times which means that the shredder can run continuously. The net carrying capacity of the trailers is 19.5 tons on 72000 lb/tons however the average annual load carried is approximately 15 tons. During wet periods when the waste contains a lot of grass cuttings care must be taken not to overload. This load variation does not create any problem because the lighter densities occur during the winter when the rate of waste generation is lowest.

Figure 2 gives a plan view of the station layout.

Figure 3 gives a plan view of our new station. This station is essentially the same as the first station except that two shredders and two in-feed conveyor systems are used. The two shredders discharge onto a common 6 foot wide outfeed conveyor which uses the same tripper arrangement to load the transfer trailers. The width of the in-feed conveyors has been increased from 5 feet to 6 feet. The loading hoppers are shallower and have a vertical rear face. These latter changes were made to decrease the problem of bridging caused mostly by Christmas trees and loads of brush cuttings.

We have used the same shredders in both stations. They have a nominal capacity of 20 tons per hour and a peak capacity of over 40 tons per hour.

In 1975 our single shredder station produced 31,000 tons, shredding 7 hours per day. This is an average of over 20 tons per hour in spite of the fact that the station was not operating for 18 days, in 1975. This downtime was due to repairs and maintenance.

Figure 4 shows a cross section of the shredders which we are using.

The first shredder was designed and supplied by Eidal Corporation, New Mexico. The second two shredders were purchased from Pangbourn Division of Carborundum, Hagerstown, Maryland. Pangbourn purchased Eidal's patents.

One of the main features of this shredder is that the shaft is cantilevered from the base of the machine therefore no top shaft bearing is required. This allows a clear 6 feet diameter opening for the waste to enter, thereby reducing feeding problems.

The total machine weighs 20 tons. The rotor and belt driven flywheel weigh a total of 13,750 lbs. and rotate at the relatively low speed of 390 R.P.M. The rotational inertia including drive parts is high at 70,000 lb. feet².

The flywheel is driven with 16 belts, 8 from each of the two 200 horsepower motors. Because of the high rotational inertia the motors rarely draw full power even with peak throughput. The normal operating current draw ranges from 50% to 70% full load.

The system is interlocked electrically so that the outfeed conveyor must be started before the shredder can start and the shredder must be started before the in-feed conveyor can start. The shredder is fitted with a current sensing device which has two set points. The high set point shuts down the in-feed conveyor before a motor overload occurs. The shredder continues to run and as it clears the heavy load, the current drops. When the current reaches the low set point the in-feed conveyor restarts.

The operator works in a cubicle from which he can see the hopper and the in-feed conveyor and also the loading of the transfer trailers. The tripper can travel back and forth automatically between stops to load the trailers, or can be manually controlled by the operator. Manual control is usually required when trailers are being topped up.

The operator's cubicle is heated and cooled by a separate air supply and is slightly pressurized to prevent dust entry. The remainder of the plant is heated by a hot water type boiler using anti-freeze instead of water. During operation in cold weather only the operator's cubicle is heated. Since the traffic doors are open most of the time the rest of the building is not heated unless the plant is shut down for repairs or maintenance. The whole building is usually heated at night to facilitate clean up and for storage of vehicles.

Staff

The plant has a complement of three men, one operator foreman and two laborers, on a single 8 hour shift. The shift time is arranged to start one hour before collection trucks arrive. The staff spends the first hour each day performing routine maintenance, equipment inspection and clean up. During the next seven hours while the plant is shredding, the foreman is primarily engaged operating the plant. The two laborers perform a variety of tasks such as, keeping the dumping area clean, cleaning up spillage from conveyors, assisting in topping up trailers if required, assisting drivers of transfer vehicles to cover transfer trailers with nylon nets, removing visible heavy metal from the in-feed conveyors and any other maintenance tasks which can be done during operation. This staff also performs the majority of all of the heavy maintenance or repairs required to the plant during shut downs, with assistance from whatever trades people may be required.

Heavy wear portions of the machine are hard surfaced periodically. Some of this is done piecemeal in the first morning hour by hired welders. The majority is done off shift or when the plant is shut down for some other reason.

Spare Parts

Most of the parts we carry are interchangeable on the three machines we now have. The major ones are:

1. The outer shell of the machine complete with liners.
2. A spare rotor with shredding wheels.
3. The large shaft bearings.
4. Two types of replaceable wear plates.

The outer shell is not really required since with a small amount of hard facing the liners have lasted for years. We happen to have a second shell because the first machine supplied had no access door in the shell to service the shredding wheels. We ordered a new shell with a door which greatly decreases the time required to service the wheels.

The rotor requires hard facing about once per year. Sometimes this may take three or four days. This would require a plant shut down, therefore we carry a spare rotor which can be changed off shift in less than 8 hours.

The large shaft bearings are not always available on short notice so we carry spares to avoid shutdown during a long delivery. We have had only one bearing failure during five years. This one failed after three years because of a greasing problem. We recently replaced the other bearing during an overhaul simply to be on the safe side. During the same overhaul, inspection of the main shaft disclosed several fatigue cracks. A new shaft was built locally within 36 hours to replace it. This did not result in any additional downtime.

Two replaceable wear plates are used on the breaker bar at the top of the rotor and on the two sweeper arms on the bottom of the rotor. These are hard faced and exchanged approximately once per month. Occasionally these plates become warped or too worn and require replacement.

Design Considerations

1. The shredder feed system is the most important part of the plant and presents most of the problems. The ability of the plant to produce optimum capacity depends almost fully upon a trouble free feed system. Some of our findings are as follows:
 - (a) The wider the shredder feed opening the easier it is to feed. We feel that the minimum feed opening should be 5' wide by 4' or more.
 - (b) Do not attempt to reduce the cross section or width of the waste flow once it is established on the conveyor.
 - (c) When feeding out of a waste hopper conveyor width should not be less than 5 feet. If the extra cost of feeding with a front end loader is considered necessary a narrower conveyor may be satisfactory.
 - (d) Our double conveyor system, which is 5 feet wide in our first station, has proven to be very beneficial in controlling hopper bridging. Our new station has 6 feet wide feed conveyors of the same design. We expect that considerably less bridging will occur on the 6 foot belts. Experience with the new station will determine whether or not the more expensive double conveyor system is required for the 6 foot wide conveyor. Our third transfer station may not require double feed conveyors.

- (e) The feed hopper for our first station was sloped at 45 degrees on all sides. This caused some bridging from front to back and bridging at the opening to the inclined conveyor.
- (f) A slope of 35 degrees on the inclined portion of the feed conveyor appears to be optimal for uniform feeding to the shredder.
- (g) There should be enough clear opening at the top of the shredder to allow the longest expected material to fall clear into the shredder from the feed conveyor. This prevents feed jams at the top of the shredder (see Figure 5). We have found that 6 feet clear will handle almost all domestic waste.
- (h) All surfaces over which the waste slides must be free from projections contra to the flow. Even the edge of a 1/4" plate can produce a stoppage.
- (i) It is difficult to reduce spillage from the underside of the feed conveyor where it enters the shredder opening. Careful design can reduce this but provision should be made to collect spillage from this source in order to reduce clean up requirements. Spillage will occur at various places. Good design to reduce spillage will pay off in clean up costs and in plant appearance. If we had been more aware of this problem when we designed our first station we would probably only need a two man crew instead of three.

Shredders - Vertical Shaft

Edmonton has experience with only one type of shredder therefore we are not qualified to recommend a particular machine. We have, however, visited other installations and have formed some opinions on the merits and shortcomings of different types of machines.

The Pangbourn machine is the only machine that I know of that uses sprocket type wheels for shredding rather than swing hammers. Relative to its capacity the Pangbourn machine has a large feed opening, a high rotational inertia and a low speed. We feel that lower speeds reduce wear. Small tires and mattresses will pass through the machine. Most swing hammer machines can be fouled by the wires in these articles. The wire winds around the rotor and ties back the hammers. When this happens the machine plugs up and has to be opened, cleaned out and the wires cut off before shredding can resume.

Our information indicates that care is required to balance most swing hammer machines. When swing hammers are hard faced or changed we have been told that the hammers must all be weighed and placed appropriately on the rotor to balance the rotor, to avoid serious vibration. We attribute this to the generally higher speeds used for swing hammers. Our machine has given no balance problems to date. We also infer that higher speeds increase wear rates.

We know of two available types of vertical shaft shredders. Pangbourn produces 20 and 40 ton models and Heil produces 20 and 40 ton per hour models. The Heil machines use swing hammers, the Pangbourne machines do not. The 40 ton Pangbourn and both Heil models require a top shaft bearing. While this is good for the shaft, the top bearing arrangement limits the size of the opening into the machine for waste. This makes the feed system more critical.

These vertical machines have the advantage of less headroom requirement because they discharge horizontally from the bottom. A simple discharge chute arrangement can be used to direct

shredded material onto a belt conveyor. The chute absorbs the impact of the heavier pieces discharged and prevents damage to the belt.

It is quite important that the vertical distance between the input to the shredder and the output from the shredder be kept to a minimum. This will govern the overall height of the installation. When conveyors are used they become longer as the input-output distance increases. The building will also become higher and larger.

Our output belt conveyor travels at 300 feet per minute. The inclined part of this conveyor rises at an angle of 20 degrees, which we think is close to the maximum for plain belts. At a slope of 20 degrees the belt conveyor will have to be almost three feet longer for each additional foot of rise.

In our opinion the Pangbourn machine is more rugged. It can be fed passenger tires, bicycles, open ended oil drums, passenger car wheels, small pipe and small thin cast iron articles. Larger articles rarely cause damage but the machine must be stopped to remove them. The machine was severely damaged once when a heavy truck axle dropped through into the sweeper area (Figure 4).

The Heil machines have an excellent feature which rejects heavy articles before they reach the shredding part of the machine. Figure 6.

The size of product is regulated in the Heil by hammer placement and by the distance between the hammers and the outer conical shell. (Figure 6).

The Pangbourn machine product size is regulated to some extent by the distance between the shredding wheels and the outer conical shell but in addition has a segmental annular ring which regulates the opening through which the material falls before it is ejected. (Figure 4).

Horizontal Shaft Machines

Horizontal shaft machines are available in a large number of shapes and sizes. There are a number of different design variations but to my knowledge all of these machines use swing hammers. Hammer designs vary widely in size and shape. Most of these machines were designed for other purposes long before shredding municipal solid waste was considered advantageous. In recent years the manufacturers of these machines have adapted them to solid waste. In general very little adaptation was required. The long developmental period for these machines has resulted in excellent rugged designs capable of breaking up almost anything.

The horizontal shaft machine Figure 7 has two main advantages when used for solid wastes.

1. It has a large horizontal feed opening and;
2. very large capacities are available if required.

These machines also have some disadvantages:

1. Shredded size is regulated by the size of openings in a heavy grate at the bottom of the machine. This grate occasionally becomes plugged.
2. Heavy articles are often projected at high velocity back at the feed opening. Heavy steel plate is required to resist them. A method of preventing this material from leaving the opening is required.

3. Heavy articles are often projected out of the bottom grate. An additional steel plate or steel vibrating conveyor is required under the machine to absorb these shocks prior to loading onto a cheaper faster belt conveyor.
4. The total headroom requirement may be several feet more than for vertical shaft machines.
5. Horizontal machines usually have very heavy hammers. We understand that regular balancing is usually required.

We have fitted a 3/4" water line into the top of our shredder hood. A small amount of added water appears to assist shredding, decreases dust and may help to prevent fires and explosions.

We have had a few very minor explosions in our machine and no fires.

Heavy explosions seem to be rare however most designers include a large sized free opening from the shredderhood to relieve the force of explosions.

Reloading Shredded Waste

There may be a few cases where moveable conveyor belts can be used to deliver shredded waste from the shredder to the fill area. These are few, so in most cases the shredded waste must be reloaded and hauled to the disposal point.

In our opinion the least complex system is the best because it will result in fewer stoppages.

The shredder should definitely not have to be shut down during any phase of the normal loading operation. The system which we developed in Edmonton has proven to be very reliable. The open topped trailers used have adequate capacity for long hauls and are inexpensive and relatively light weight, allowing high net load weights when required. They are not however, self unloading. The load is pulled out by the landfill tractor. This has produced no problems to date. When we have more shredders in operation we are considering the use of mobile trailer dumpers similar to those in successful use by San Francisco.

A different system is used in Madison and Great Falls.

A conveyor belt delivers the shredded waste from the machine into a large hopper which is mounted above a stationary compactor. The stationary compactor forces the waste into a 60 to 75 cubic yard transfer trailer of the type available from several manufacturers. These trailers have the advantage of being self unloading by means of a hydraulically operated push plate. The weight of the unloading system and the heavy construction required to resist packing forces, increases the weight of this type of trailer to from 24,000 to 26,000 lbs. Our trailer weighs only 16,500 lbs. Unless highway load limits are higher than 76,000 lbs. the heavier packer filled trailer cannot carry any larger payload than the open type.

Our opinion is that the Madison - Great Falls system is more expensive and complex than warranted unless higher than usual wheel loads are acceptable.

A simpler loading system which uses a belt conveyor to dump directly into a trailer or truck may be quite sufficient for small installations.

The simplest system available is for the shredder to discharge directly into the haul vehicle. This loading system can be quite inexpensive if the plant can be built on a steep hillside, but on level ground the deep ramps required may be a prohibitive expense.

Plant Location

I wish to stress the point that if at all possible the plant should be placed as near as possible to the centre of the waste generation area. This is beneficial even if the disposal point is close by when the plant is built. This placement may greatly reduce the haul distance of the collection vehicles. Any reduction in collection haul results in collection savings. The shredding plant then becomes a transfer station and gives the total system much more flexibility. This means that the collection system becomes independent of the final disposal point and that if long hauls exist or occur in the future they can be accomplished in a very efficient way on large transfer vehicles.

In most cities the cost of collection is around 80% of the total solid waste budget, 50% or more of the total collection hours may be spent hauling waste to the disposal point. This haul time is essentially non productive and expensive, especially when 3 or 4 man collection crews are used. Obviously any reduction in collection haul time means that collection crews and vehicles have more time for collection which is the only productive portion of their work. For example;

Assuming that collection is made by 20 yard packers with a 2 man crew. One man driving an 80 cubic yard transfer vehicle can haul as much waste as 4 packer trucks and 8 crewmen. The difference in cost is obvious.

In Edmonton, where the majority of our crews are only one man crews, this saving not only finances our shredding transfer stations but also produces a net saving of from \$4 to \$7 per ton of waste as well.

The transfer concept itself is certainly not applicable in many places but if a shredding plant is built for any reason it must also be considered as a transfer station which may be able to produce large benefits to the existing or future total system.

General Remarks

Dust has not been a severe problem in Edmonton however, fluff from shredding cloth and paper finds its way around the plant. An air cleaning system may be necessary in some plants.

In designing the interior of our plant we have attempted to eliminate places where dust and fluff can collect such as roof trusses, ledges and piping. The walls are plastic coated and almost all areas can be hosed down.

Noise levels may exceed 100 D.B. near the shredder. The control cubicle is double glazed and partially sound proofed. Noise levels outside our concrete block building are negligible. Ear protection should be used by personnel if they are subject to long exposure to the noise near the shredder. Both ear protection and dust masks are used by our personnel when required.

The average load in our collection vehicles has a density of 235 lb/cu. yd. The average density in the newly loaded transfer vehicle is 320 lb/cy. yd. so the volume reduction from collection vehicle to transfer trailer is approximately 35%. During the trip to the landfill the waste compacts about 25% more in the trailer.

I have included some information with this paper which should be of interest but does not relate to shredding. We have recently completed a small landfill and during its operation we collected some useful information.

All waste entering the site was weighed and listed under 10 categories. Prior to starting operation, during operation and after completion, volumes were measured using aerial photography methods. This method of measuring volumes is not expensive and is accurate to less than 5%. A lot of earth was hauled into the site for disposal at no cost to us. The additional earth requirements were generated within the landfill area.

In the handout along with the diagrams there is a list of shutdown times and causes, an annual cost for running the station in 1975 and breakdown of transfer vs. direct haul costs for our Edmonton Shredding Transfer Station.

You might want to do a quick job on some of these figures here. These are the compaction data that I was telling you about. Before we started the landfill at all, in December 1972, we flew the area, got the volume of the gravel pit and set a datum level for volume calculations. We flew it again on February 14, August 16, January 5, and so on down the line. On the final flight there was a total tonnage of 1,355,900 put in and the volume that was used was 1,404,000 cubic yards an overall compaction density of 1903 pounds per cubic yard. Now, of course that is high.

You see on the bottom here a listing of the different ways we categorized it when we weighed it in. The city runs the only landfills in town, so all the waste that goes to landfill, including some of the areas around Edmonton, goes into this landfill. Now the contract refers to the 2 small collection contracts we have which handle about 30% of the domestic refuse. Adding that to the city's pick up gives you 134,000 pounds. The household is stuff that is delivered by people themselves to the landfill. The commercial is the same business Mr. Waxman is in; that is collection by private, commercial, industrial whatever. Rubble-that's building debris. Manure-we have a large packing plant industry in Edmonton and that's the manure we get from part of that. Liquids, and these are all tons, are 84,000 tons, dirt 204,000 tons and grindings 48,000 tons. Now that's over the total life of a landfill. Plywood chips-we have a big planing mill that was not burning its chips, and brought them to landfill, so we have a thousand tons of those.

In 1974 we landfilled 1,034,000 tons. Now, that can't necessarily be related to some other people's figures because it's the only landfill in town. A lot of dirt and rubble and everything else go there which would not normally go to others.

Down time for 1974 was 28 1/2 days and the reasons are given. In 1975 it was down for 18 working days. We're reducing that gradually by various means.

In the cost breakdown of the West transfer station you can use these figures whichever way you like. The maintenance on our station-that's a 1975 cost is 88¢ a ton approximately. This was a little heavier year for the cost of maintenance and, we're not counting down time in that by the way. It gives you the cost to the station, the building, and the charges against it.

On the last page it shows you with our trucks that we haul directly to the landfill average haul from the city of Edmonton to our major landfill, is 12.8 miles one way. Our cost for that haul, not the collection, but haul, would be \$832,500. For the transfer system, to operate the station costs \$131,000 and to haul ground refuse costs \$62,400 for a total cost of arriving at the same destination

with the waste shredded, of \$610,800. The savings for the transfer system are \$221,700 annually. That works out for that transfer station, because it's a little further away than some of the others, to be a savings of 7 dollars a ton approximately. So you can see why we have a transfer operation and why, if you consider grinding, make sure you consider it as a transfer station along with it. I can give some more statistics. The weighted average haul distance from the city to the landfill is 10.8 miles. From the transfer area, the one we are talking about here, is 12.8 miles, so it is more than the average. That's why the saving is a little higher. The transfer area to the landfill is 12.8 miles average haul but from the areas that go into the transfer station the weighted average mile haul is only 3.3 miles. Now those collection vehicles are then traveling 3.3 miles for every trip instead of 12.8. That's where the money is for transfer stations. I'm not trying to sell transfer stations per se but if you do grind, then for Heaven's sake transfer. Call it a transfer station even if you don't really transfer because some time in the future when the landfill moves on you, the whole collection system can stay intact, as it was, and you'll have a cheap way of getting all your waste out to the landfill.

Thank you. That's about all I have for now.

COST SAVINGS FOR TRANSFER STATION

Amount transferred 31700 tons

HAUL DIRECT TO LANDFILL

Collect 31700 tons @ \$8.60/Ton	272,600
Haul average 12.8 miles @ \$1.38/Ton-mile	559,900
	<hr/>
	832,500

TRANSFER SYSTEM

Collect 31700 tons @ \$8.60/Ton	272,600
Haul average 3.3 miles @ \$1.38/Ton-mile	144,400
Operate station (including capital)	131,400
Haul ground refuse (including capital)	62,400
	<hr/>
	610,800

Saving for transfer system

\$221,700 =
\$7.00/Ton

Average Haul Distances (tonnage weighted, one way)

Entire City to landfill	10.8 miles
Transfer area to landfill	12.8 miles
Transfer area to station	3.3 miles

COST BREAKDOWN OF WEST TRANSFER STATION

STATION:

General (Power, Utilities and Maintenance material)	13,600
Operation (all labour and direct labour overheads)	37,500
Building maintenance (cleanup and repair)	11,200
Welding (hardsurfacing wheels, breaker, sweeper while operating)	4,900
Repair parts	4,300
Replace grinder wheels and shell (including all hardsurfacing, to prepare shell, rotor and wheels and cost of wheels)	9,000
Non routine repair (conveyor, shaft and bearings, sweeper, including parts and labour)	9,700
Scale repair	800
	<hr/>
	91,000

HAUL:

Labour and direct labour overhead	26,300
All other costs including diesel, oil, routine maintenance or tractors and trailers, parts, garage overhead charges	18,500
	<hr/>
	44,800

CAPITAL:

Station:	Building (excluding land)	
	\$240,200 @ 8% for 20 years	24,500
	Equipment \$106,800 @ 8% for 10 years	15,900
		<hr/>
	347,000 *	40,400
	*Estimated 1975 replacement cost \$800,000	
	2 tractors and 5 trailers \$108,000 @ 8% for 8 years less \$13,000 salvage	17,600

1975 Production	31,689 tons		
1975 Cost/Ton	Transfer	131,400/31,689 =	\$4.15/Ton
	Haul	62,400/31,689 =	\$1.97/Ton
			<hr/>
	Total		\$6.12/Ton
	Maintenance on Station equipment		\$0.88/Ton

STATION DOWNTIME FOR 1974 & 1975

1974	DAYS	CAUSE
	4 1/2	Pans on inclined conveyor bent.
	2	Exchange rotor (c/w new wheels) and outer shell.
	2	Pans on horizontal conveyor.
	7 1/2	Inclined conveyor tailshaft sprocket.
	12 1/2	Motor shafts & bearings for both motors.
	<hr/>	
	28.5	

1975	DAYS	
	1/2	Replace coupling on belt conveyor.
	1/2	Replace conveyor link.
	1/2	Electrical in loadout conveyor.
	5	Complete change over and repair belt pulley.
	1	Replace broken loadout track.
	9	Change top and bottom main bearings and replace shaft. weld grinders.
	1 1/2	Sweeper plate broken.
	<hr/>	
	18	

VOLUME AND TONNAGE COMPUTATIONS - FRONTIER FARMS

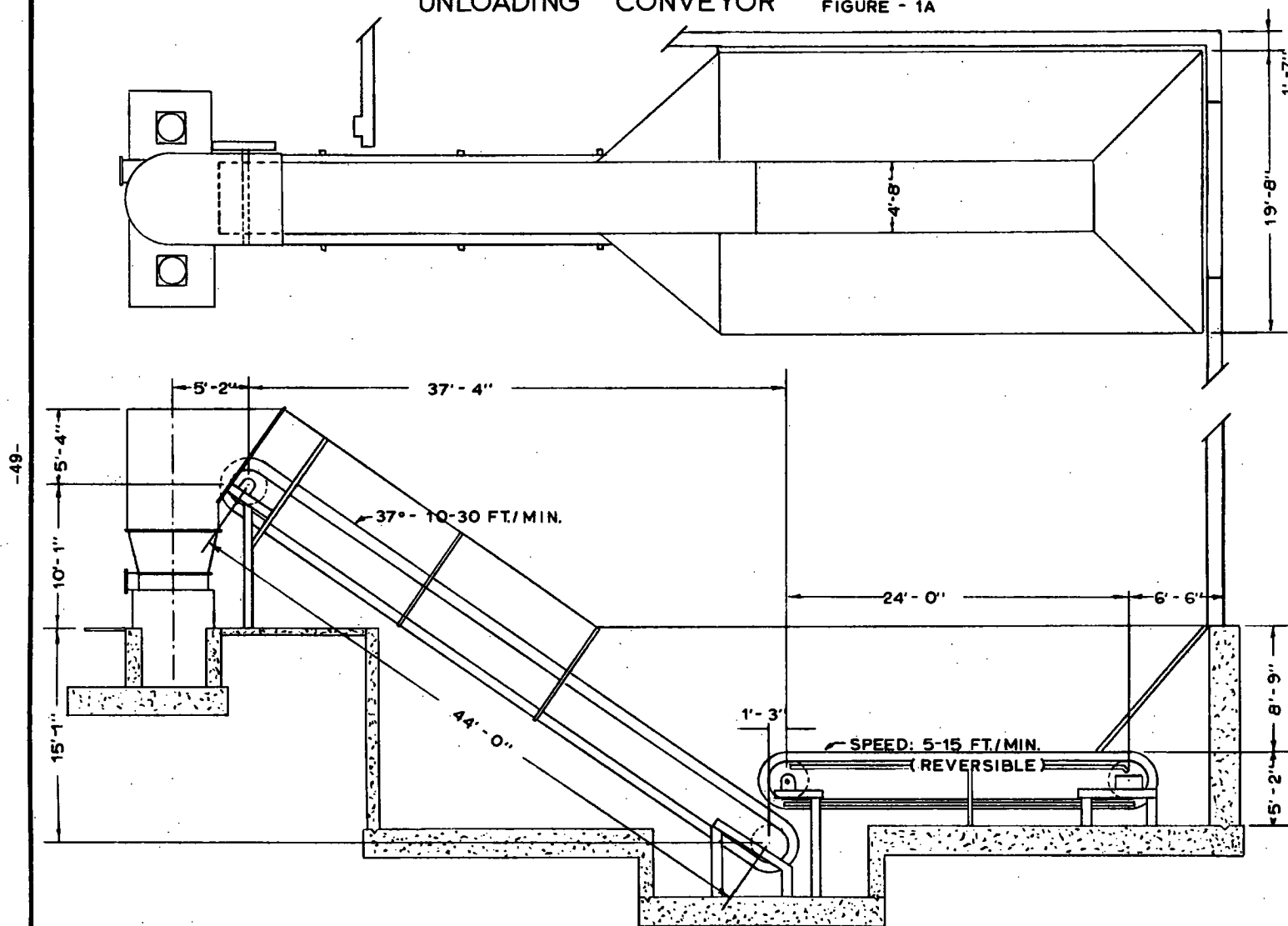
COMPACTION DATA

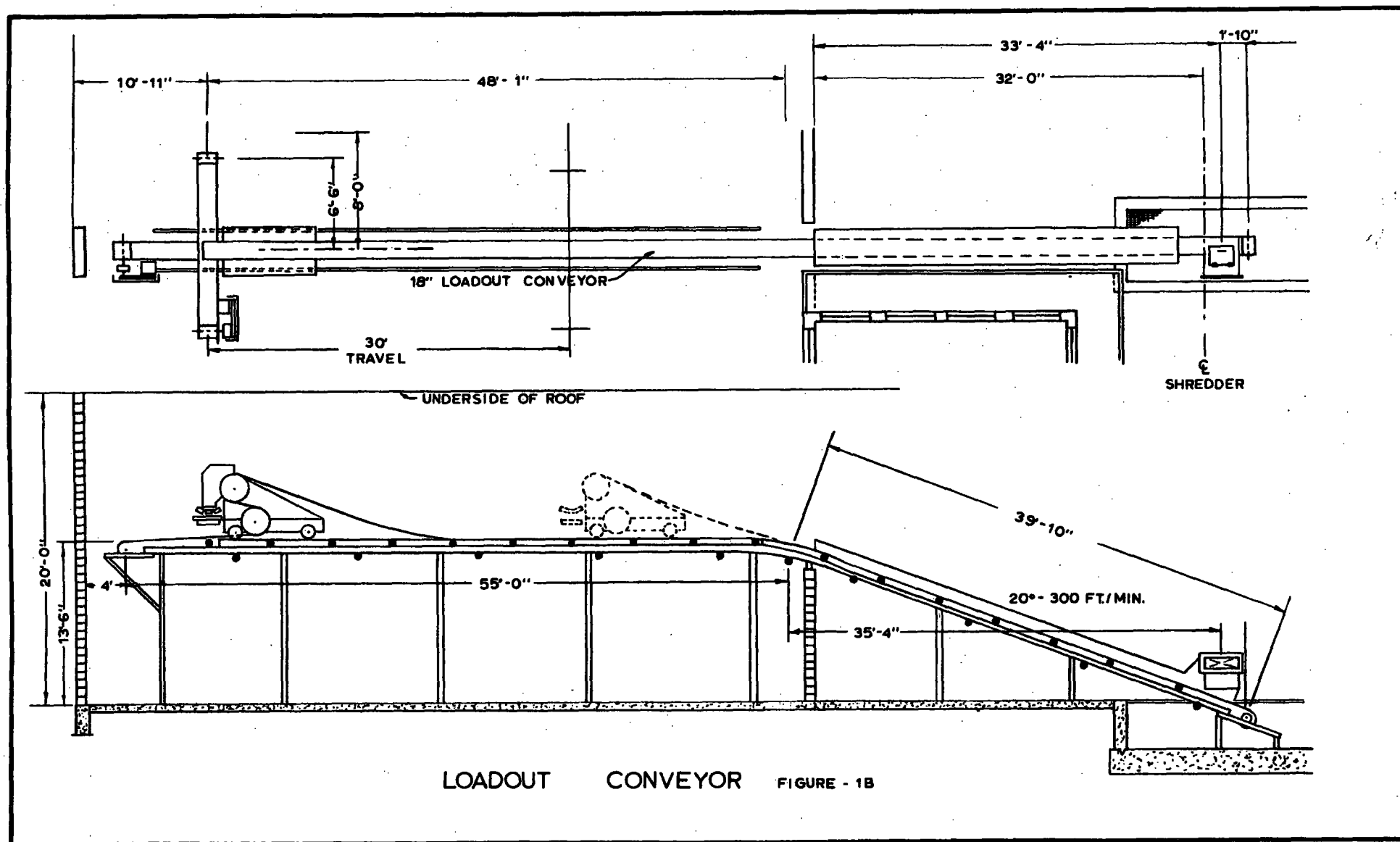
DATE	TONNAGE	VOLUME	COMPACTION
December 1972	-	-	-
February 14, 1973	55,713 Tons	116,322 Cubic Yards	958 Pounds/Cubic Yards
August 16, 1973	291,936	367,580	1,588
January 5, 1974	479,484	560,801	1,710
June 21, 1974	681,635	826,906	1,649
February 18, 1975	1,003,038	1,105,481	1,815
September 19, 1975 (Final)	1,355,992.9	1,404,589	1,930

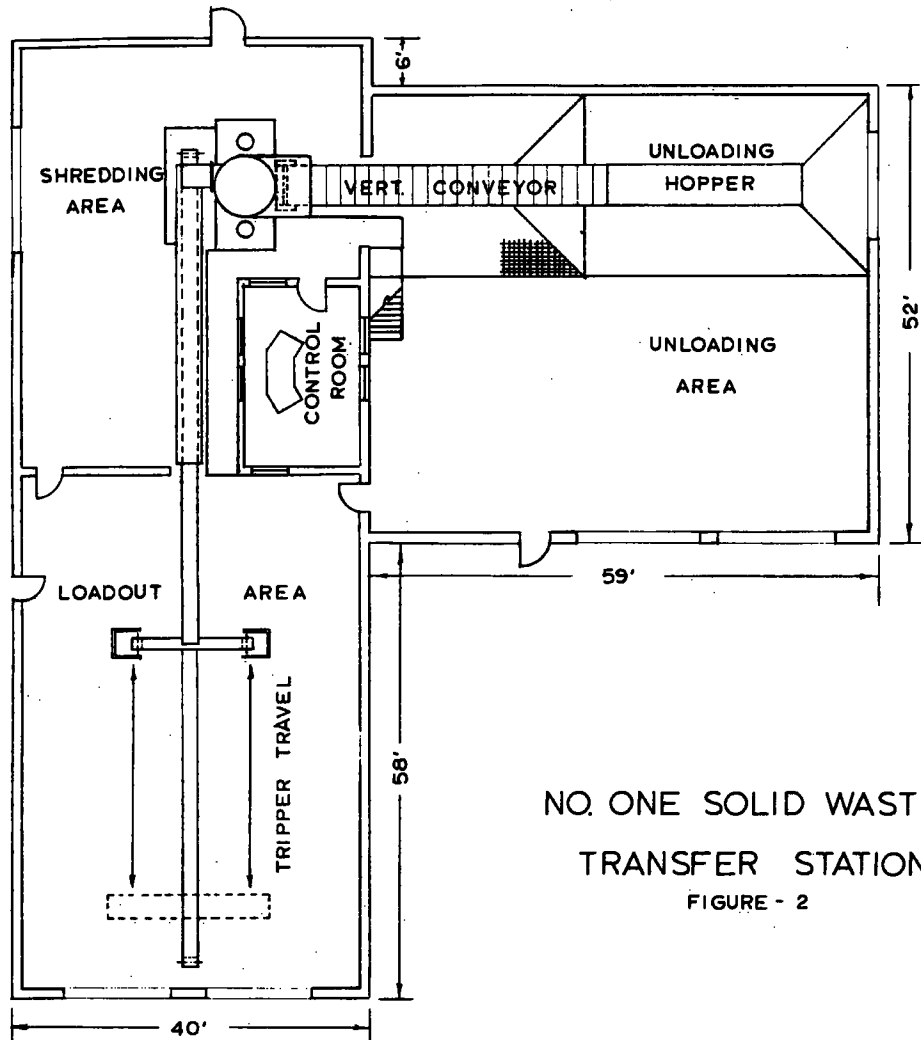
BREAKDOWN OF FINAL TONNAGE

Components (Tons)									Total
Contract	Household	Commercial	Rubble	Manure	Liquids	Dirt	Grindings	Plywood Chips	Tonnage
134,648.3	108,049.6	402,101.8	305,984.3	66,846.2	84,786.5	204,509.9	48,049.2	1,017.1	1,355,992.9

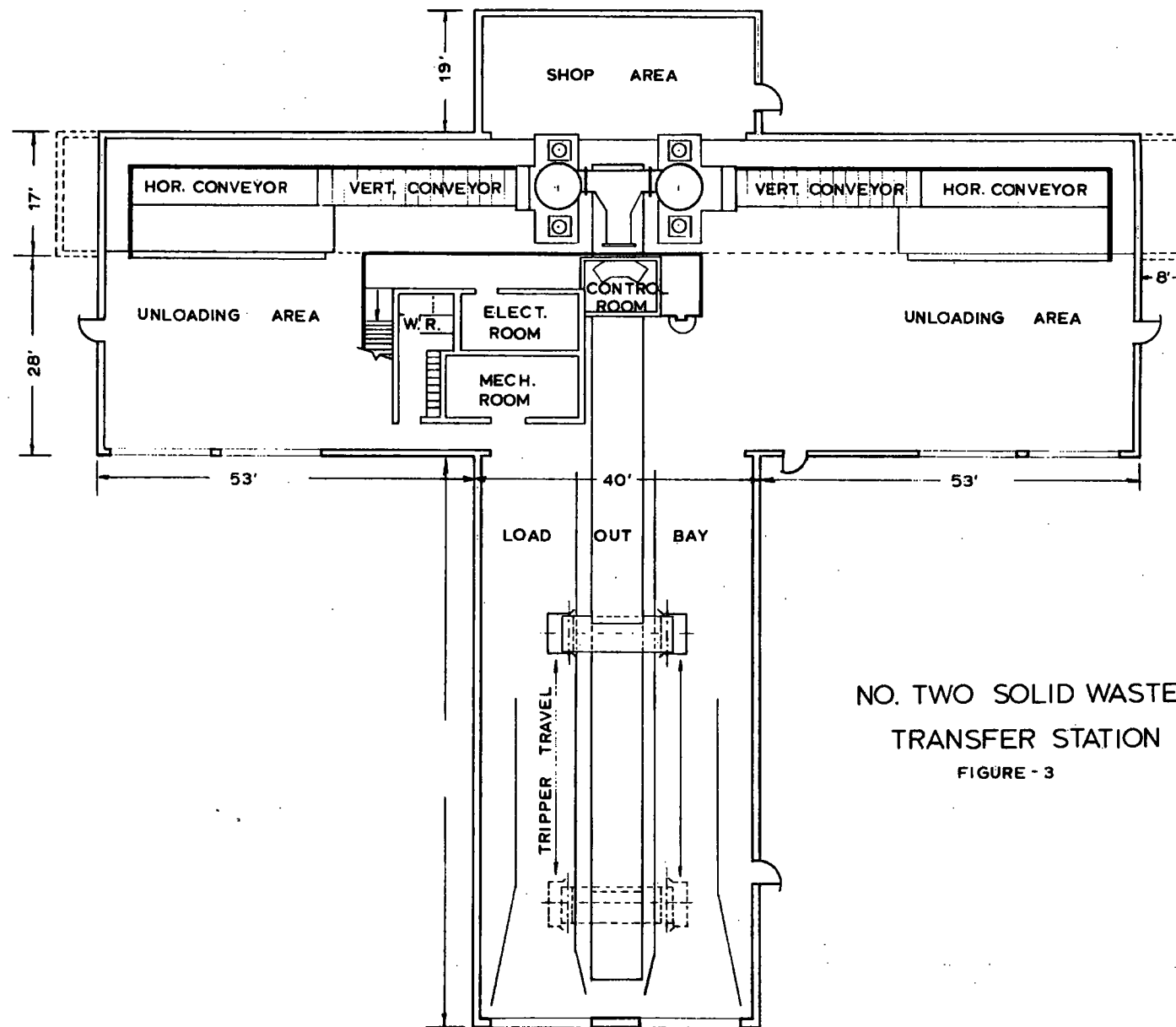
UNLOADING CONVEYOR FIGURE - 1A





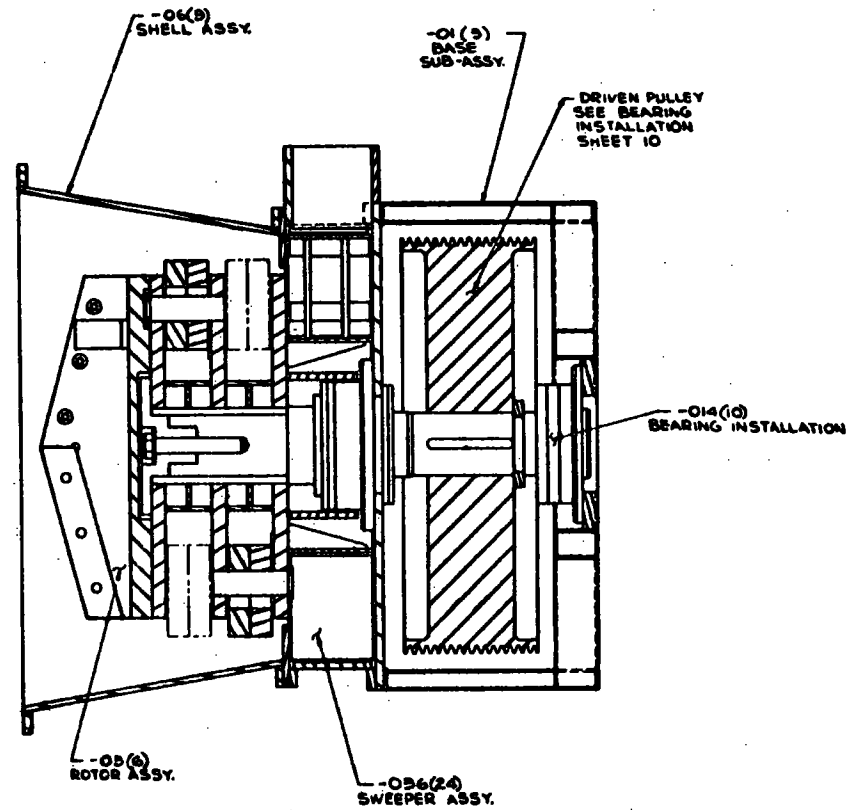
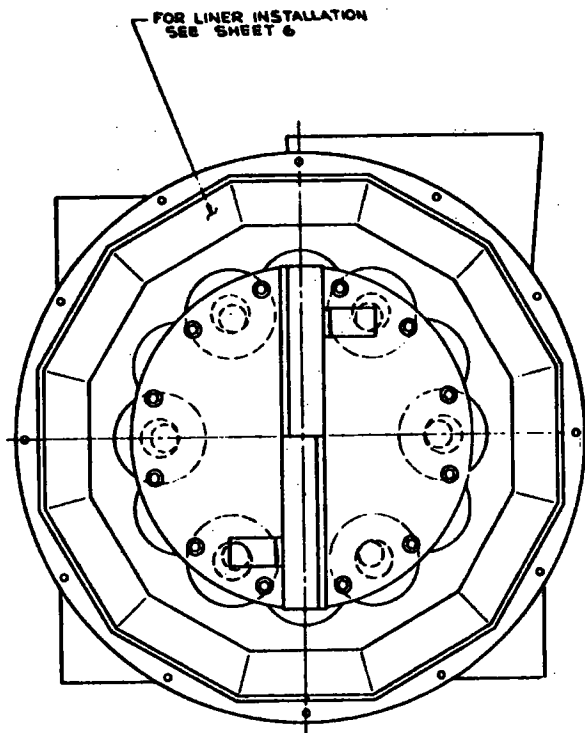


NO. ONE SOLID WASTE
TRANSFER STATION
FIGURE - 2



NO. TWO SOLID WASTE
TRANSFER STATION

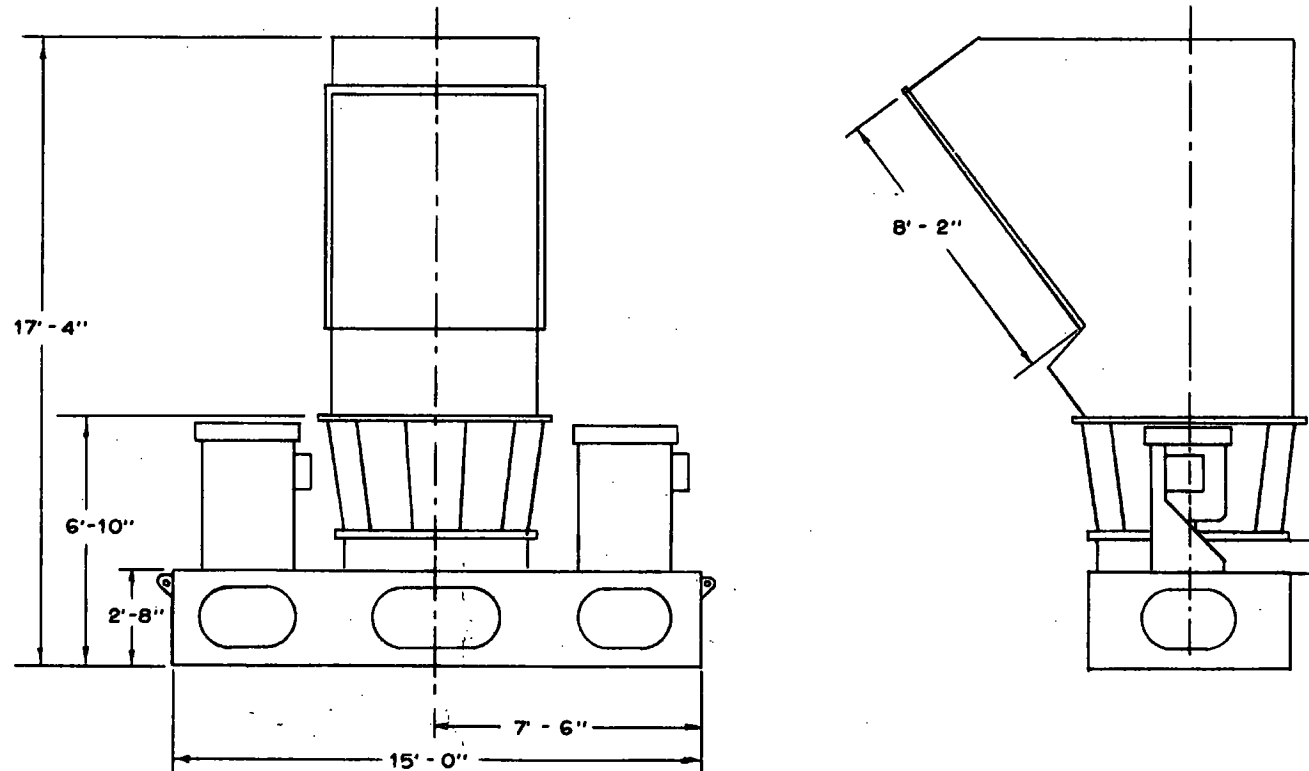
FIGURE - 3



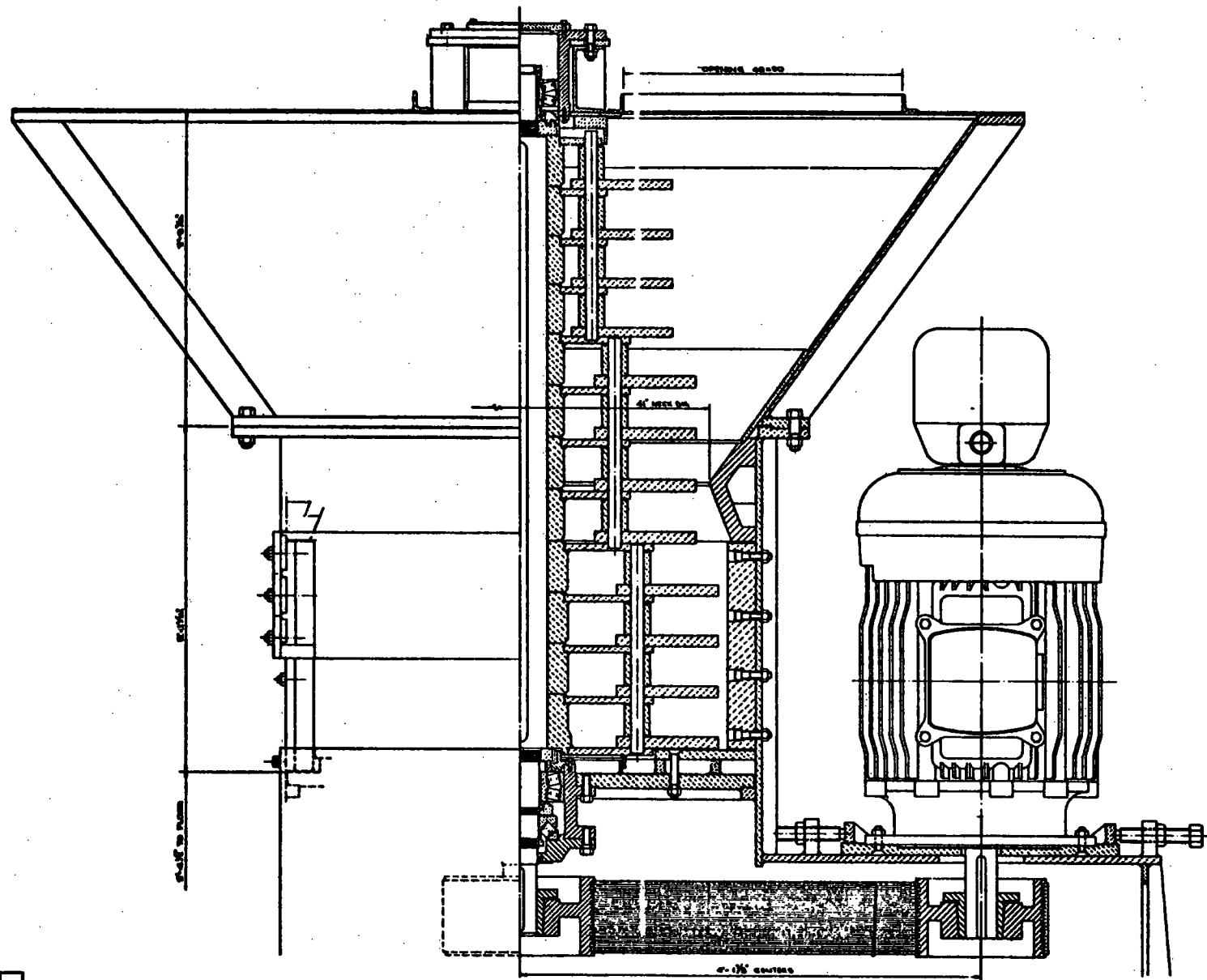
SINGLE ROTOR SHREDDER
GENERAL ASSEMBLY SECTION
74111-00

FIGURE - 4

GENERAL ASSEMBLY FIGURE - 5

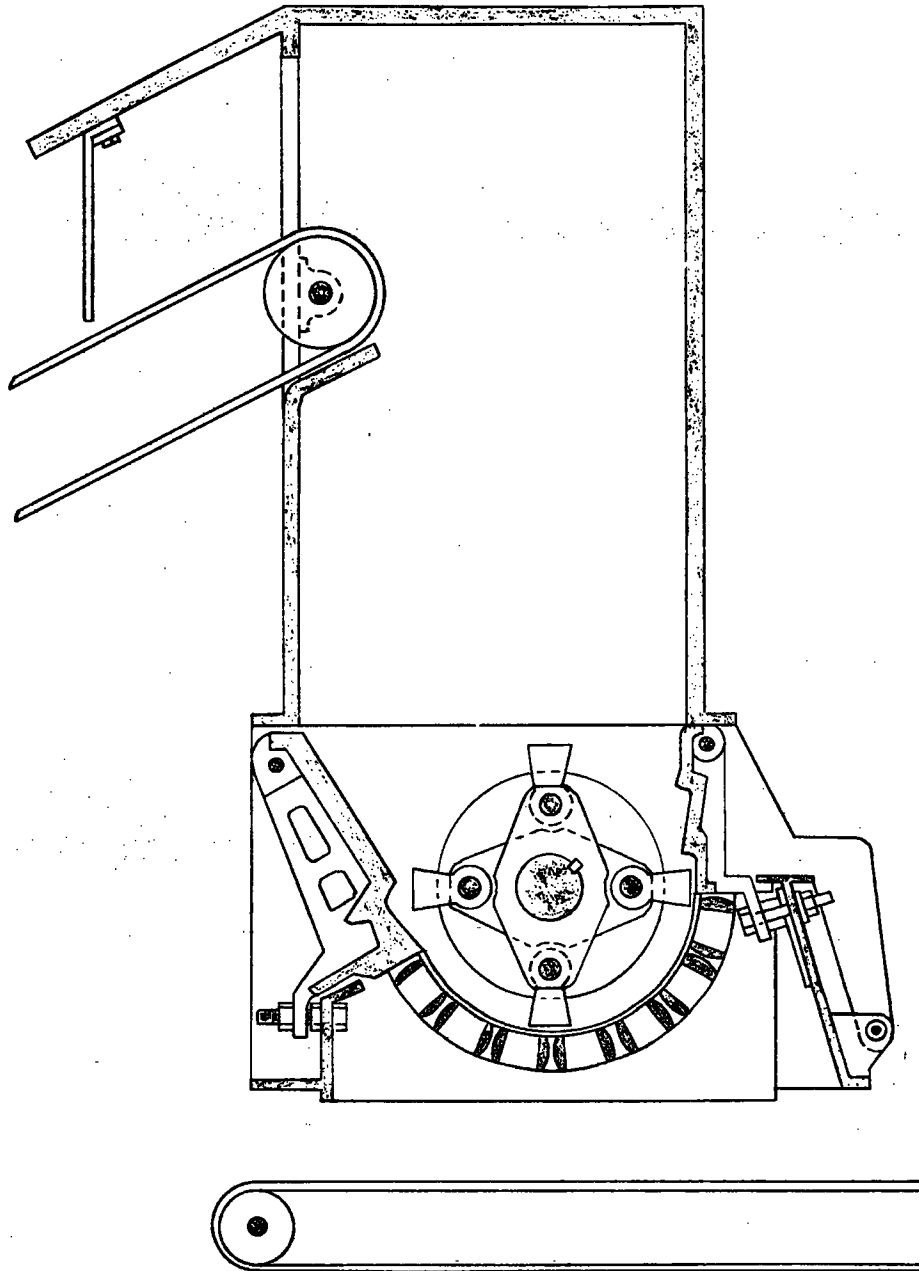


752E36



HEIL 42" DIA. PULVERIZER

FIGURE-6



HORIZONTAL REFUSE SHREDDER FIGURE - 7

QUESTION PERIOD: SOLID WASTE SHREDDING

- Question: (Mr. Riche) Do the people separate one article from the other?
- Answer: (Mr. Dilke) No.
- Question: (Mr. Riche) If a fellow had a couple of spare tires would they go out with the regular garbage?
- Answer: (Mr. Dilke) Yes.
- Question: (Mr. Riche) Like bed springs, washers, driers?
- Answer: (Mr. Dilke) Yes. Theoretically, we don't pick that stuff up, but in fact, we do. We're in the garbage business, so we collect everything we can collect. What we do is to avoid the peak periods. When we're in a peak period we won't pick up the rough stuff. We will leave it till the next week. If it is not something that's going to be objectionable like Christmas trees. We don't pick them all up on the day after Christmas.
- Comment: (Mr. Riche) We don't either.
- Comment: (Mr. Dilke) We spread them over a little while. They are one hell of a thing to handle.
- Comment: (Mr. Riche) We pick them up on a slack day when there's no garbage.
- Answer: (Mr. Dilke) Well, we don't have those kinds of days exactly. When things settle down a bit we take so much a day or something like that. Our system is a weekly system, we collect in certain areas on specified days of the week.
- Comment: (Mr. Riche) Well I didn't see any car parts, washers, driers. In your pictures it's just ordinary household garbage.
- Answer: (Mr. Dilke) Oh well, we don't take those things to the transfer station. But they find their way in. We've had truck axles, transmissions... The collectors claim they never knew it was in there, but I find it hard to believe that the guy picked up a 40 pound axle and threw it in the truck without knowing it was there.
- Question: (Mr. O'Rafferty) I'd just like to make a comment about some of the figures on the last page where you say. "Cost savings for transfer station". It is the question of what exactly is meant by "saving"?
- Answer: (Mr. Dilke) It's the saving over and above the cost if we didn't go to the transfer station and hauled directly with the collection vehicle.
- Question: (Mr. O'Rafferty) O.K. Just bear with me for a moment. You have a cost for direct haul to the landfill of \$832,000. Now in your transfer station, if you took out the cost to operate the station at \$131,400--it doesn't give the proportion of operating a transfer station and the cost of grinding.

Answer: (Mr. Dilke) No it doesn't.

Question: (Mr. O'Rafferty) If you took that \$131,400 out-it was all for grinding-and added it to \$221,000, you'd have a saving of \$350,000.

Answer: (Mr. Dilke) No, that's not only for grinding; that's the whole station.

Question: (Mr. O'Rafferty) What proportion of that would be for grinding?

Answer: (Mr. Dilke) I don't have that figure, I don't think.

Question: (Mr. O'Rafferty) What I'm trying to get at is-you are making substantial savings in the transfer system because of the savings on your collection system and I could not agree with you more - but what I'm trying to sort of zero in on is the basic reason for grinding. Is it because you would not be able to use a transfer system, at the locations you're using them, without grinding?

Answer: (Mr. Dilke) No. I mentioned earlier in my paper that grinding per se was not our point in making these transfer stations. Grinding was added because we felt it might help our landfills. We also have a problem around the landfills with blowing papers and the traffic and all the rest of it. Transfer stations help eliminate traffic, but if you grind it also helps eliminate a lot of that blowing stuff. There are other ways to do it; this is one way we figure might be worthwhile. Grinding, per se was not what we were in the business for. We did it that way. We decided we could do it in bulk and it would be cheaper. There is no question about it. I think I said it in the first statement, that it would be cheaper to do it in a bulk transfer system. I don't think there is any question about that. The total cost of operating the grinding station is \$4.15 a ton. Now, I don't have the figure of what it would cost if we did not grind, and that is what you're after.

Question: (Mr. O'Rafferty) \$4.15 a ton, at 32,000 tons is about 125,000 dollars and that would only leave \$6,000 to operate the transfer station.

Question: (Mr. Dilke) I don't quite follow you?

Question: (Mr. O'Rafferty) \$4.15 a ton by 32,000 tons is roughly 125,000 dollars and your item "to operate transfer station" is \$131,000?

Answer: (Mr. Dilke) I'm afraid somebody made this up for me and I can't tell you what was in there and what's different about those two figures. I think the total justifies one way or the other, but he may have put those figures down in the wrong order. Certainly, I haven't a figure for just grinding.

Question: (Mr. O'Rafferty) Could I ask my question perhaps in a slightly different way?

Answer: (Mr. Dilke) O.K.

Question: (Mr. O'Rafferty) Would you think that in the location where you now have a transfer station or anticipate having a transfer station it would make any difference from an aesthetic point of view or from a neighbourboard point of view if you transferred in bulk rather than grind?

Answer: (Mr. Dilke) No.

Question: (unidentified) For what purpose would that land be used after it is reclaimed?

Answer: (Mr. Dilke) Park purpose basically.

Question: (unidentified) Could it be reclaimed for agricultural, say, in ten or fifteen years?

Answer: (Mr. Dilke) Agriculture is doubtful. With our rainfall picture, the general higher ambient temperature that's in the landfill will cause the snow to melt off and evaporate early in the spring. I think the older landfill would have cooled down a bit; there is no real problem in growing. We have grass and weeds growing beautifully on the landfill. We have two completed landfills, three actually, but one is just recently completed. One makes up about 60 acres of park land that's used for a golf course, a three par course.

Question: (unidentified) It is essentially open space, right?

Answer: (Mr. Dilke) Yes.

Question: (Mr. Strong) In your breakdown of final tonnage I think you mentioned that a portion of this was coming from neighbouring areas?

Answer: (Mr. Dilke) Yes.

Question: (Mr. Strong) Would they be unincorporated areas outside the city or small townships?

Answer: (Mr. Dilke) No, the main one here, is called Sherwood Park, which is actually part of the county; it isn't an incorporated town.

Question: (Mr. Strong) Do they have a local government of some sort?

Answer: (Mr. Dilke) No, they don't. All they have is representation in the county; they are a bedroom community.

Question: (Mr. Strong) Do individual householders bring this in?

Answer: (Mr. Dilke) No, its brought in by their own collection system. We have an arrangement whereby they pay us a fee for that. But they are a total of about 20 to 25 thousand people.

Question: (Mr. Strong) Do you have any information on the collection system? How do they finance it? Who do you bill?

Answer: (Mr. Dilke) We bill the county for Sherwood Park which is the bigger one, and we bill the town of St. Albert directly.

Question: (Mr. Strong) The county-so they have some sort of government?

Answer: (Mr. Dilke) It's a county system about 5 miles out of Edmonton. They are a little irate at the moment because they think they don't have proper representation, which I guess they don't.

- Question: **(Mr. O'Rafferty)** The question of the location of your transfer station relevant to existing development - Are these located in industrial areas?
- Answer: **(Mr. Dilke)** Light Industrial.
- Question: **(Mr. O'Rafferty)** Light Industrial. And there are plants, for example, light industrial plants, on the site next door?
- Answer: **(Mr. Dilke)** Yes.
- Question: **(Mr O'Rafferty)** Were they any trouble at all?
- Answer: **(Mr. Dilke)** The new one, the double one, is beside the City of Edmonton power station and a lumber yard.
- Question: **(Mr. O'Rafferty)** My next question relates to your landfill operation at the present time. What's the closest residential zoning that you have to those areas?
- Answer: **(Mr. Dilke)** At the moment neither of the ones used are in the city. We have a small private one, which would take 68 thousand tons a year minimum and its just out in the north west corner of the city. The other two are outside the east boundary of the city and there are no residences nearby.
- Question: **(Mr. O'Rafferty)** Is it a mile?
- Answer: **(Mr. Dilke)** A quarter mile is the closest to our large one, but there are only about 4 residences in the whole area.
- Question: **(Mr. O'Rafferty)** So within half a mile, you would have significant residences?
- Answer: **(Mr. Dilke)** No. These are just sort-of country houses, farm houses. There are two farm houses and three people that live out there.
- Question: **(Mr. O'Rafferty)** I'm just trying to find out how far it is from any significant housing development?
- Answer: **(Mr. Dilke)** It's approximately 4 miles from any significant housing development.
- Question: **(unidentified)** When you were establishing the landfill site did you establish a buffer zone?
- Answer: **(Mr. Dilke)** There is a 15 hundred foot radius in our provincial regulations. We must be 1,500 feet away from the nearest place where you make up food and this sort of thing. That is, in fact, just a regulation. You would probably have to be a great deal further than that, or just outside that, where, I guess you could establish a landfill there. Provincial governments are notorious fence-sitters. I may be insulting some of them here. The regulations are there but quite often they would rather not enforce them against public opinion. I don't really blame them for that.
- Question: **(unidentified)** How close would you allow a housing development to come to your landfill?

Answer: (Mr. Dilke) We are not in the city, so we don't really have a handle on that.

Question: (unidentified) Under conditions of normal expansion?

Answer: (Mr. Dilke) The last one we had in the city, they were within about 800 feet of part of the landfill. And hollering like hell. The landfill was there first and then they moved in with the houses. Actually we were improving their property by 50 or 60% in price. They apparently did not want to wait the couple of years it took to finish it off.

Question: (Mr. Riche) Do you have a problem with rats?

Answer: (Mr. Dilke) We don't have any rats in Edmonton.

Comment: (Mr. Riche) You don't?

Answer: (Mr. Dilke) They have a border patrol in Alberta. There are some. We occasionally get a half dozen or a dozen rats in town and somebody detects them. They've got a system going all the time. They've managed to hold them at the Saskatchewan border, more or less. We have a lot of open land they've got to cross. I guess they don't like that.

CLOSING REMARKS

Mr. L.P. Fedoruk

Thank you very much Bob, we have pretty well concluded the seminar. I would like to thank our two speakers for coming to speak. Bob came a long way and he was a little concerned this morning that he had to stay up until 4 o'clock in the morning before he got sleepy enough to go to bed. Thanks very much gentlemen. I would like to say about Morris' talk that it was refreshing to have someone present a paper who was not associated with government or the scientific community. He's a down to earth guy who is in the business and he's doing it for profit. He knows what can and cannot be done that's going to make money. It was refreshing to see he had some answers, he didn't have all the answers, but I liked his approach. I think in future seminars we should have more people that are associated with particular topics who are not necessarily within government or within the academic-scientific community.

I would also like to thank the people who worked behind the scenes. I was only the chairman, so I flew in last night. The fellows that did most of the work are Bob MacKenzie, Carl Strong, and Roger Pottle.

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